

# The Society of Thoracic Surgeons of Thailand



## First National Congenital Cardiac Surgical Database Report

Demonstrating

***“Practice of congenital cardiac surgery in Thailand:  
Analysis of performance and outcome”***

2014

Pantpis Sakornpant  
Vichao Kojaranjit



The Society of Thoracic Surgeons of Thailand gratefully acknowledge the assistance of database registry and analysis team for:

- Data validation
- Data merging and aggregation
- Data analysis
- Report design and presentation
- Publishing this report

This document is proprietary information that is protected by copyright. All rights reserved. No part of this document may be photocopied, stored in a retrieval system, transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the permission of the publishers and without prior written consent from **The Society of Thoracic Surgeons of Thailand**, 11th. Floor, Royal Golden Jubilee Building, 2 Soi Soonvijai, Petchburi Road, Bangkok, Huaykwang, Bangkok, 10310 Thailand.

January 2014

ISBN 978-616-91988-0-2

*Published by*

**The Society of Thoracic Surgeons of Thailand**

11th. Floor, Royal Golden Jubilee Building, 2 Soi Soonvijai, Petchburi Road,  
Bangkapi, Huaykwang, Bangkok, 10310 Thailand  
Phone/Fax +66 2318 2711

*Printed & bound by*

**Bangkok Medical Publisher**

3/3 Sukhumvit 49, Sukhumvit Road,  
Klongtan Nua, Wadhana, Bangkok 10110, Thailand  
Phone/Fax +66 2258 7954

*Printing kindly supported by*

Edwards Lifesciences (Thailand) Limited

 Edwards Lifesciences



# Introduction



## Why do we need congenital cardiac surgery database in Thailand?

Information on congenital heart surgery in our country is less known. Though in practice, we have operated on congenital heart in patients from birth to adults since the beginning of cardiac surgery in this country yet there have had only numbers of operation recorded rather than having information regarding our practice of congenital heart surgery. We need to know what we are doing; we require information regarding not only numbers of operation but our performance and outcome at each age level including complexity of problems.

It is known that many congenital heart diseases of the same diagnosis require more than a single operative procedure; moreover patients with the same diagnosis could have different types of procedures at different ages and also different procedure at the different hospitals or surgeons. Obviously, the outcome of this practice is oblivious.

The severity of the congenital heart disease at the time of operation for similar diagnosis may be different; for example the larger institutes may get sicker patients more than the smaller hospitals therefore they could have higher mortality. In congenital heart surgery, it is not right to compare the quality of hospitals only by measuring operative mortality because some patients could survive 30-day mortality but die later therefore in-hospital mortality which expresses the status at discharge is preferred. Again, using only in-hospital mortality as the only tool for comparison of quality of care and management in congenital heart surgery is not enough because patients with congenital heart disease have different preoperative risk conditions, specific risk of pathology and technical difficulty of operative procedures. Comparison of quality of surgical management must be based on case-mix of population with adjusted risk.

For all reasons stated above we require reliable statement and information provided by hospitals in Thailand. Reliable information with valid analysis can give details of our performance. Without it, we do not know where we are and how can we improve ourselves. Information could be obtained by having database registry from most hospitals practicing congenital heart surgery. The database registry must be able to provide information regarding outcome on workload, preoperative and postoperative risk factors. Quality of database information with quality analysis can provide information on quality of care and management of congenital heart disease in this country. Comparison of quality of surgery among hospitals could be done from case-mix with adjusted risk.

Why case-mix? Certainly, quality assessment of congenital cardiac surgery of any hospital is difficult to attain to any standard because some referral hospitals receive higher risk than smaller hospitals therefore they tend to have higher morbidity and mortality than the smaller ones. One way of practice for outcome assessment is to analyze on case-mix by assessment of all risk category levels and risk score level. At present, there are 3 popular approaches for analysis namely **Aristotle Basic Complexity (ABC)** [O'Brien SM, Jacobs JP, Clarke DR et al. Accuracy of the Aristotle Basic Complexity Score for classifying the mortality and morbidity potential of congenital heart surgery operation. *Ann Thorac Surg* 2007;84:2027-37], **Risk Adjustment for Congenital Heart Surgery (RACHS-1)** [Al-Radi OO, Harrell FE, Caldarone CA et al. Case complexity scores in congenital heart surgery: A comparative study of the Aristotle Basic Complexity Score and the Risk Adjustment in Congenital Heart Surgery. *J Thorac Surg* 2007; 133:865-74] and **combined Society of Thoracic Surgeons and European Association for Cardio-Thoracic Surgeons (STS-EACTS)** [O'Brien SM, Clarke DR, Jacobs JP et al. An empirically based tool for analyzing mortality associated with congenital heart surgery. *J Thorac Surg* 2009; 138:1139-53]

Analysis of congenital cardiac surgical database in Thailand is made according to the STS-EACTS approach; quality of information is maintained valid, transparent and accountable. Finally, the quality of report must be reliable and informative comparable to international standard.



Here is our practice of congenital cardiac surgery based in our surgical database in Thailand between year 2006 and 2011 which includes 26 hospitals, the database for analysis is comprised of 13,099 patients. Here is the report of our performance:

- The quality of performance is reported by outcome of the cardiac procedures rather than by diagnosis.
- Analysis is seen by workload and patient characteristics. The end-point of outcome is the in-hospital mortality, morbidity, postoperative length of stay, the trend of outcome over time and late survival.
- Analysis is based according to mortality and morbidity categories which are very useful for case-mix in all hospitals but attention is also given to some particular age group. Late survival is expressed in each group of patients and mortality categories.
- Quality of database analysis is expressed by disclosure of missing data which are not included in analysis.

Finally for comparison, quality of surgery of congenital heart disease of each institution is expressed as funnel plots of in-hospital mortality for all mortality categories of data with volume of surgery. The real name of each institution is disclosed only as a code letter so that the identity of each hospital is kept secret.

### **Pantpis Sakornpant**

Past President

Chairman of database registry and analysis



## Congenital Cardiac Surgical Database Report

Thailand cardiac surgical database registration for both adult and congenital commenced in January 2006 and has continued since that time and still continually growing.

This book is the first report of congenital cardiac surgical database registry of Society of Thoracic Surgeons of Thailand with comprehensive analysis covering six calendar years between 2006 and 2011. The registry of congenital cardiac surgical database is voluntarily participated by 26 hospitals with data validity of 13,361 patient records. Each patient's record has informed consent by patient parents prior to registry. Each participating hospital manages its own team of database collection and delivery. The database registry is sent via internet to the Society server, all data are checked for validity before analysis.

The database collection uses the minimum dataset STS Collection Forum Version 2.30 for congenital cardiac surgery ([The Society of Thoracic Surgeons Congenital Cardiac Surgery Database](#)). We have great concern pertaining to different diagnosis of the same disease because of multiple procedures at different stages; questions for diagnosis from participating hospitals have been raised from time to time. The other concern is about a single patient can have many lesions either related or unrelated to the first diagnosis.

Quality of surgery depends on outcome, but surgery for congenital heart disease has complexity related to risk of pathology requiring multiple procedures in patients; the in-hospital mortality cannot be assessed in congenital heart surgery the same way like assessment in adult cardiac surgery. Complexity of congenital heart surgery can be approached on potential for mortality, potential for morbidity and technical difficulty of the procedure. One of these approaches, is based on using Aristotle Basic Complexity Score (ABC score) ([O'Brien SM, Jacobs JP, Clarke DR et al. Accuracy of the Aristotle Basic Complexity Score for Classifying the Mortality and Morbidity Potential of Congenital Heart Surgery Operations. Ann Thorac Surg 2007; 84: 2027-37](#)). Though it is useful for discriminating between low-risk and high-risk, but this determination of technical difficulty, though being performed by international experts, is considered too subjective; moreover, some congenital heart diseases carrying small number of disease occurrence but with high mortality cannot be precisely analysed by small sample sizes.

Other approach is known as Risk Adjustment in Congenital Heart Registry (RACHS-1) ([Al-Radi OO, Harrell FE, Caldarone CA J Thorac Cardiovasc Surg 2007; 133: 865-74](#)) this was also proposed as analysis tool comparing in-hospital mortality and length of stay with ABC score and claimed to be more discriminating. This predictive power is still too early to be conclusive.

Another concept is by STS-EACTS ([O'Brien SM, Clark DR, Jacobs JP et al An empirically based tool for analyzing mortality associated with congenital heart surgery. J Thorac Cardiovasc Surg 2009; 138: 1139-53](#)). This concept emphasized that in predicting for outcome, a constant factor for outcome should be established regardless of the hospital where the patient receives the operative procedure, the risk of in-hospital mortality by procedures must be identified and risk must be categorized according to group procedures by proposing STS-EACTS score and risk category concepts for analysis.

Because of complexity related to risk of pathology, multiple procedures in one diagnosis and some congenital anomalies having small numbers of occurrence but with a very high mortality, it is impossible to use logistic regression such as in analysis of adult cardiac surgery. Bayesian models are used in STS-EACTS approach for analysis in order to prevent errors arising from a small number of disease occurrences.

Analysis of outcomes of congenital cardiac surgery is still unsettled.

We use STS-EACTS approach for analysis and report in this book. We think that the risk modules can be compared among institutions even with the presence of different case mix.



Based on complexity and intent to decrease percentage of missing data, the in-hospital mortality is preferred to the operative mortality for analysis. In-hospital mortality signifies the status of death at discharge which could be more or less than 30-day mortality; therefore the number of in-hospital mortality is higher than the operative mortality. Based on risk variables, procedures and case-mix, the STS-EACTS analytic method is used for analysis in this book. The records of patients with the ductal operation performed as a primary procedure and the body weight less than 2.5 kilograms are excluded for analysis.

Therefore a total of 13,099 patients are considered valid for analysis in this book. In congenital heart surgery, a single diagnosis could undergo several operative procedures at one time and different operation at other time or at different age. Based on this complexity, operative procedure not diagnosis is taken for analysis. Though we have made analysis of patients with single and multiple procedures, we express more details in outcome of major procedure which could be more than one procedure which we make only brief notes; this is to avoid confusion of the readers therefore we put additional information for multiple and isolated procedures in appendices.

Before analysis, a validation sample of 2,852 was obtained from 2 hospitals for validation; the C-score for STS-EACTS scores as predictor of operative mortality was 0.789 and for STS-EACTS categories as predictor of operative mortality was 0.767. The C-score for STS-EACTS scores as predictor of in-hospital mortality was 0.79 and for STS-EACTS categories as predictor of in-hospital mortality was 0.766.

We use analysis of morbidity as advocated by Jacobs et al [Jacobs ML, O'Brien SM, Jacobs JP Mavroudis C, Lacour-Gayet F, Pasquali SK, Welke K, Pizarro C, Tsai F and Clarke DR J. *Thorac Cardiovasc Surg* 2013; 145:1046-57]

Here is information of congenital cardiac surgical database report:

- For information, age levels are classified into 6 group levels, namely newborn meaning age from birth to one month, infant meaning age from 31 to 365 days, pre-school age meaning >1-3 years, school age meaning >3-10 years, grown-up meaning >10-15 years and adult meaning >15 years.
- Workload and risks at various age levels with population characteristics including preoperative conditions and outcome.
- Operative characteristics including mortality category and score as risks of outcome.
- Display of in-hospital mortality as observed, estimated and adjusted risk.
- Identification of risk of in-hospital mortality by key and group procedures.
- Identification of risk of in-hospital morbidity by key and group procedures.
- Quality of our performance by risk-adjusted mortality category with volume number of experience displayed by funnel plot.
- Late survival after hospital discharge.

We are grateful for participation by surgeons and their colleagues from 26 institutions.

We must express thank to Bureau of Policy and Strategy, the Ministry of Public Health which supplies information regarding late death or survival using the national identification (13 digit identification). Without workforce of participation and contribution, this "First National Congenital Cardiac Surgical Database Report" by the Society of Thoracic Surgeons of Thailand cannot be accomplished. This book is aimed to serve as the standard of reference for monitoring performance of surgical management of congenital heart disease in Thailand and anywhere in the world. This is the first book of congenital cardiac surgical database report with comprehensive analysis in Asia if not in the world. There must be some aspect which is not seen in the report; certainly improvement can be seen in the subsequent edition, yet this book can be used for study to improve outcome of surgical management in congenital heart disease furthermore it is also useful as a



guideline for creating a database registry and analysis not only in congenital heart surgery but also for other discipline of Medicine and Surgery.

Finally, on behalf of the Society of Thoracic Surgeons of Thailand, I would like to express my sincere thanks to all participants, contributors, supporters and Miss Nongchana Klangasuk, M. Phil (Imperial College, London U.) who has allowed us to use her teaching quarter, fully equipped with computer appliances for our work and analysis.

*"An eagle cannot fly without support from the wind under the wings"*

### **Pantpis Sakornpant**

Past President of STST

Chairman of Database Registry and Analysis





## Introduction to limitation of data analysis

We are concern about some missing data which have affected analysis:

1. 5.8% missing data of discharge date which could affect the unusually high postoperative length of stay in some part of analysis.
2. 3.9% loss of in-hospital mortality and 1.1 % of missing data on primary procedures.
3. Though not so significant in percentage of missing data, we have seen loss of data in height and weight.

The patient status after discharge was given in June 2012 by Bureau of Policy and Strategy, the Ministry of Public Health. This could give wrong impression that the survival time is short though in reality the survival is much longer. In chapter of survival, we provide information that the cumulative death becomes stable without any change then the survival curve is a straight line.

Another missing data of extubation time is high so that we better omit the intubation interval in order to prevent confusion.

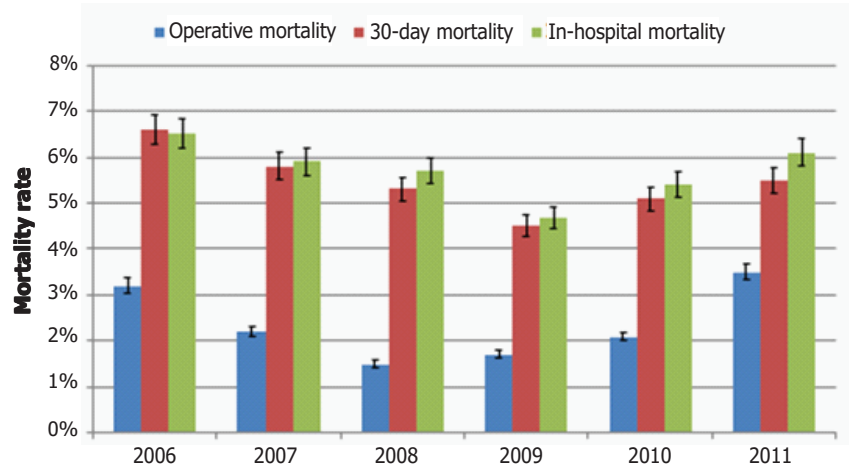
There is however a limitation on using Bayesian approach for calculation of small data with small events e.g. in data with small number of events and the observed mortality is 100% but the Bayesian random effect could only give estimated mortality of 95%. The observed mortality will be the same as Bayesian when the number of events is significant.

Because the date expression from excel file is in the form of date/month/year can give problems of calculation and analysis we therefore have to reduce error by separation of date/month/year into each new column. STS Data Registry format does not provide the types of preoperative arrhythmia for selection; therefore we cannot have information of arrhythmia type related to adult congenital heart surgery.

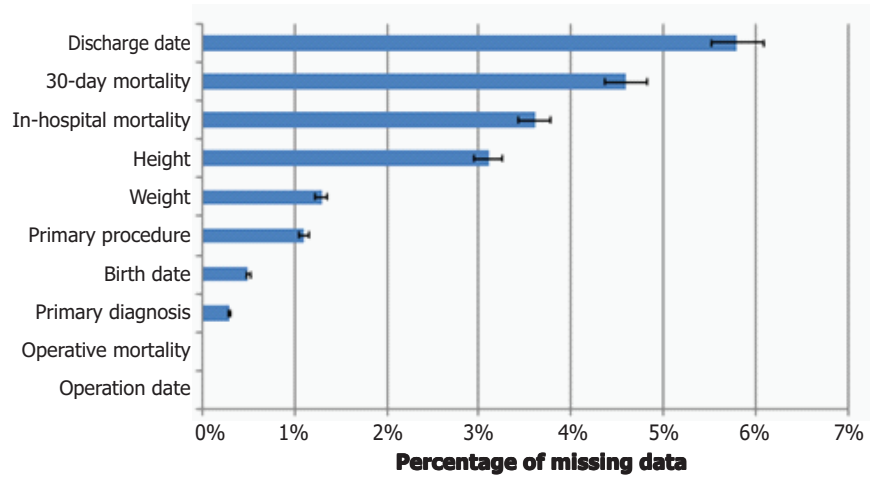
One patient in any age group may have more than one procedure in operation. In order to avoid confusion we use only the term "procedure" which is meant single procedure or more than one procedure; one can see additional information of isolated and multiple procedures and outcome in the appendices.



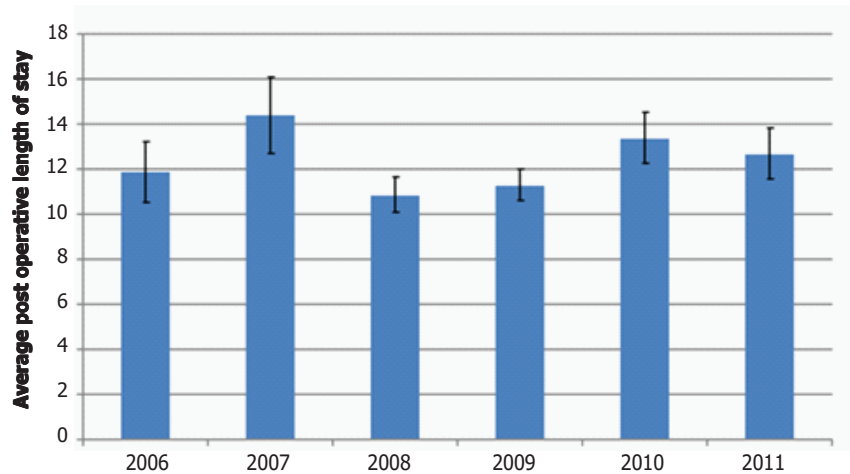
Mortality rate: calendar year 2006-2011



Missing data from database registry (n=13,099)



Average post operative length of stay: calendar year 2006-2011





## Summary

This is the summary of Congenital Heart Surgery Database Report: measuring performance, risk and outcome

- This report contains data of practice of congenital heart surgery between calendar year 2006 and 2011 from 26 hospitals in Thailand; they are major hospitals performing most numbers of cardiac surgeries in the country.
- The numbers of valid data obtained from 26 hospitals prior to analysis are 13,361. Using the concepts of STS-EACTS score and STS-EACTS categories, patients weighing less than or equal to 2500 grams undergoing patent ductus arteriosus ligation as their primary procedure are not included in the calculation and analysis for morbidity and mortality. Therefore 13,099 patient records are considered for analysis.
- In congenital heart surgery, operative procedure is preferred to name diagnosis of disease for risk analysis of mortality and morbidity outcome because one diagnosis could have more than a single procedure; also one diagnosis could have different procedures at different ages. The outcome of performance is demonstrated by in-hospital mortality, complication, postoperative length of stay, time trends and late survival.

## Database overview and workload

The workload of hospitals is classified into 3 groups according to the numbers of operation registered; this reflects the volume size of only congenital heart surgery and does not necessarily mean the total volume of cardiac surgery with adult cardiac surgery included.

- Group 1: each hospital having registered data of congenital operation more than 500 patient records. There are 10 hospitals with a total number of 10,835 patient records. This group having congenital heart surgery performed at all age level.
- Group 2: each hospital having registered data of congenital operation >100-500 patient records. There are 6 hospitals with a total number of 1,406 patient records; this group has congenital heart surgery performed at all age level.
- Group 3: each hospital having registered data of congenital operation <100 patient records. There are 10 hospitals with a total number of 250 patient records. This group has no congenital heart surgery performed in newborn.

## Workload by age group

- The most common age of congenital heart surgery is at school age level 3-10 year (25%) followed by the adult age level >15 year 22%. Of all age level for surgery, 6% are newborn and 19% are infant.

## Estimated risk of congenital heart surgery

- The in-hospital mortality of the newborn (23%) is almost twice of infant (12%). After one year of age, the in-hospital mortality declines and becomes 2% or less after 10 years of age and in adult >15 years.
- Overall the time trend shows improvement of in-hospital mortality; only the newborn still carries very high mortality and longer postoperative length of stay which require improvement.
- Newborn is the group of already highest risk with high in-hospital mortality. In order to save more lives and to reduce postoperative length of stay, a team of high experience is necessary. The operation and management must be carried out by expertise in a specialized unit of any hospital; the cost is necessarily high.

## Preoperative risk

- Preoperative risk is present in 14% in all age groups.
- The patients with preoperative risk have the mean postoperative length of stay 22 days comparing to



- 10 days in those 86% of patients without preoperative risk.
- The in-hospital mortality rate in all patients with preoperative risk is 19% comparing to those without having mortality rate of 4%.
  - The preoperative risk of mechanical ventilatory support, though present in 5% of all patients, is the most common preoperative risk which carries 31% of in-hospital mortality rate.
  - The preoperative risks of shock and renal failure requiring dialysis, each has in-hospital mortality rate of 50%.
  - In all age groups, the higher is the mortality category the more is the number of patients with preoperative risk. In patients with same mortality category, those with preoperative risk have higher in-hospital mortality rate than those without.
  - Preoperative risks are present in newborn, infant and preschool children at 37%, 27% and 10% but beyond these age groups the preoperative risks are less than 10% of population.
  - The in-hospital mortality rate in each age group with preoperative risk is several times higher than mortality rate in the similar age group without preoperative risk.
  - Number and type of preoperative risk vary according to age group.
  - More than 20% of newborn are on mechanical ventilatory support before operation; the leading preoperative risks in newborn are ventilatory support, acidosis and shock; the percentage of preoperative risk in infancy (27%) is less than in newborn (37%) yet acidosis, pulmonary hypertensive crisis and shock seem to be more prevalent than newborn.
  - In newborn without preoperative risk the in-hospital mortality rate is 18% but with preoperative risk the in-hospital mortality rate is 31%.
  - In infant without preoperative risk the in-hospital mortality rate is 6% but with preoperative risk the mortality rate is 25%.
  - Among > 1 to 10 years of age, most patients have less numbers of preoperative risks than the younger age but they have higher percentage of pulmonary hypertensive crisis as the leading preoperative risk factors.
  - The older children and adult with congenital heart disease seem to have pulmonary hypertension; some of the grown-up even come for operation with preoperative risk of ventilatory support, arrhythmia and heart block.
  - Different pictures among patients of younger age, grown-up and adult probably reflect some patients with particular preoperative risk dying during newborn and infancy leaving those alive growing-up with residual heart lesion. This explains why we have increasing problem of pulmonary hypertension or myocardial problem with arrhythmia and heart block in grown-up children and adult.
  - There are 2,916 patients of adult congenital heart surgery (>15 years) comprising of 34% of male with in-hospital mortality rate of 3% and 66% of female with in-hospital mortality rate of 0.1%. Most of male patients are in higher mortality category than female.

### **Mortality risk and procedures**

- In all age group with 5 mortality categories, there are 177 procedures in 12482 operations with observed mortality rate of 6%; the most numbers of procedure performed are in mortality category 1 having VSD repair with patch which has observed mortality rate of 2%. The most often procedures apart from VSD repair are for example ASD repair with patch, modified Blalock-Taussig shunt, primary closure of VSD, primary closure of ASD, TOF repair(ventriculotomy and transanular patch)
- The highest observed mortality rate of 100% are in mortality category 5 e.g. corrected TGA repair, valvuloplasty of truncal valve, aortic root replacement with homograft, Konno procedure and Ross-Konno procedure
- In newborn with 5 mortality categories, there are 88 procedures in 684 operations with in-hospital mortality of 23%. Modified Blalock-Taussig shunt, arterial switch operation, surgical PDA closure, TAPVC repair and PA banding are the most 5 often procedures performed with the observed mortality rate of 13, 26, 11, 46 and 15 per cents respectively. Only PDA closure surgical is in mortality category



- 1 otherwise the others are in mortality category 2,3,3 and 4; the high in-hospital mortality in newborn is due to high mortality category patients with high preoperative risk.
- In infant with 5 mortality categories, there are 127 operative procedures in 269 operations with in-hospital mortality of 12% ; the most often 5 procedures are PDA surgical closure, VSD patch repair, modified Blalock-Taussig shunt, PA banding and PDA device closure with the observed mortality rate of 5, 6, 6 19 and 5 per cents respectively. PA banding and modified Blalock-Taussig shunt are in mortal category 2 and 3 otherwise the other three are in mortality category 1.
  - In preschool children with 5 mortality categories, there are 123 operative procedures in 2322 operations with in-hospital mortality of 5%; the most 6 often procedures are VSD patch repair, PDA surgical closure, modified Blalock-Taussig shunt, VSD primary closure, TOF repair (ventriculotomy transannular patch) and bidirectional cavopulmonary anastomosis with the observed mortality rate of 2, 1, 1, 1, 9 and 8 per cents respectively. Most often performed procedures are in category1 except bidirectional cavopulmonary anastomosis and modified Blalock-Taussig shunt which are in mortality category 2 and 3.
  - In school age children with 5 mortality categories, there are 145 operative procedures in 2172 operations with in-hospital mortality of 4%; the most often 7 procedures are VSD patch repair, ASD patch repair, TOF repair (ventriculotomy and transannular patch), VSD repair primary closure, PDA closure surgical, TOF repair non-ventriculotomy and ASD repair primary closure. These are in mortality category 1 with mortality rate of less than 1% except TOF non-ventriculotomy with mortality rate of 7%.
  - In grown-up children with 5 mortality categories, there are 126 procedures in 1121 operations with in-hospital mortality of 2%; the most often operative procedure performed is VSD patch repair followed by VSD primary closure, ASD repair patch, ASD repair primary closure and PDA repair surgical closure. All most common procedures are in mortality category 1 with no observed mortality except VSD repair patch with almost 2% of in-hospital mortality.
  - In adult with all mortality categories, there are 120 operative procedures in 2830 operations with in-hospital mortality of 2%; the most often 7 procedures are ASD repair patch, ASD repair primary closure, VSD repair patch, PDA closure surgical, VSD repair primary closure, ASD repair partial closure and TOF repair (ventriculotomy, annular patch). All most common procedures are in mortality category 1 and mortality score 0.1. The group of VSD and ASD repair has mortality less than 1 or 2% except TOF repair with 4% mortality.

### Remarks on adjusted risk of mortality

STS-EACTS have proposed the mortality categories and mortality score as tools for case-mix adjustment for comparing outcomes of performance of hospitals in congenital heart surgery. According to STS-EACTS, there are 5 mortality categories ranging from category 1 to 5 and mortality scores ranging from 0.1 to 5.0.

### Morbidity risk and procedures

**In all age groups** with 5 morbidity categories, there are 177 procedures in 12631 operations with morbidity of 22%. Most morbidity is in morbidity category 1 with highest morbidity in mediastinal procedure (16%), ASD with primary closure (15%) and congenitally corrected TGA repair with VSD closure (15%). In morbidity category 2, the highest morbidity is Rastelli operation (30%). In morbidity category 3, the highest morbidity is Fontan, TCPC with external conduit (48%). In morbidity category 4, the highest morbidity is congenitally corrected TGA repair with atrial switch and ASO (78%). In morbidity category 5, all procedures in this category have highest morbidity (100%) such as truncal valve valvuloplasty, aortic root replacement with or without using homograft and others.

**In newborn** with 5 morbidity categories, there are 90 procedures in 718 operations with morbidity of 48%. Most morbidity is in morbidity category 2; among the highest morbidity category 2 are TOF repair, tricuspid valve surgery, pulmonic valve replacement and others.



**In infant** with 5 morbidity categories, there are 127 procedures in 2355 operations with morbidity of 35%. Most morbidity is in morbidity category 2; among the highest morbidity category 2 are coronary artery bypass, coronary artery procedure, Glenn operation and others.

**In preschool children** with 5 morbidity categories, there are 123 procedures in 2351 operations with morbidity of 20%. Most morbidity is in morbidity category 2. Among the highest morbidity category 2 are pectus repair, tricuspid valvuloplasty and others.

**In school age children** with 5 morbidity categories, there are 145 procedures in 3214 operations with 20% morbidity. Most morbidity is in morbidity category 2. Among the highest morbidity category 2 are pulmonic valve replacement, AVSD repair and AVR.

**In grown-up children** with 5 morbidity categories, there are 126 procedures in 1139 operations with morbidity of 17%. Most morbidity is in morbidity category 2. The highest morbidity in category 2 is AVR with bioprosthesis.

**In adult** with 5 morbidity categories, there are 121 procedures in 2842 operations with 12% morbidity. Most morbidity is in morbidity category 2. Among the highest morbidity category 2 are unifocalization of MAPCAs and cardiac tumour resection.

### Adult congenital heart surgery

Adult congenital heart surgery is 22% of all congenital heart surgery in Thailand. The median age of operation is 34 years (IQR 23-46) with 34% of male gender. 79% of operations are performed isolated; 95% of operations are performed without previous operation signifying that most of patients in adult congenital heart surgery are not related to surgery performed in early life. Adult congenital heart surgery in Thailand is performed by adult cardiac surgeon in 25 hospitals in the fourth decade of life. There are not many complex lesions in adult congenital heart surgery; most patients with complexity lesions probably die earlier with or without surgery. Our patients operated in the fourth decade of life could have untoward preoperative risk because surgery is not performed earlier in childhood therefore risks related to particular lesion remain. Example is seen in our adult patients with VSD repair having the median age of 25 years having preoperative arrhythmia of 5% and pulmonary hypertensive crisis of 5%; these preoperative risk possibly lead to incidence of 2% postoperative arrhythmia and 2% of low cardiac output and 1% of pulmonary hypertension. In spite of preoperative risk and postoperative complication the in-hospital mortality is 1% but it is interesting to learn late follow-up in adult congenital heart surgery what will become of these patients; [we had an usual experience of performing heart-lung transplantation in a woman of 43 of age with symptomatic pulmonary hypertension after successful repair of secundum ASD at the age of 18 in some other hospital, the lung pathology revealed plexiform type of pulmonary hypertension.] In this book we also present preoperative arrhythmia of ASD repair with the median age of repair of 39 years with preoperative arrhythmia of 2% and pulmonary hypertensive crisis of 4%, though having the in-hospital mortality of 1% yet the postoperative arrhythmia is 4% and 2% with low cardiac output.

TOF repair represent 15% of congenital heart surgery in adult, the median age of repair is 26 years and the in-hospital mortality rate is 6% while mortality of school age children is 3% [our personal experience having a 19 year-old unrepaired TOF patients waiting for heart-lung transplantation with arrhythmia and heart failure but died while waiting for donor].

Limitation of our database registry is lacking type of arrhythmia declared [this is also there is no type of arrhythmia given in STS Registry Format].

### Funnel plot

Efficiency of performance can be estimated by funnel plot for in-hospital mortality by using STS-EACTS mortality category as adjusted risk. Not only individual hospital can be reviewed for performance but also individual can be reviewed. In our analysis, funnel plot showing hospital performance by age risk and in-hospital mortality is also illustrated.

A to Z codes representing hospital names in our book to avoid disclosure of hospital names are used. There



is a straight line representing database of average mortality baseline of all hospitals. Y-axis shows risk-adjusted in-hospital mortality while X-axis shows number of operations in STS-EACTS mortality category or number of operations in age related group.

If any hospital, representing by A to Z code, residing within the funnel plot near the baseline is considered good performance and outcome while the hospital code touching the 95% CI interval that hospital should be advised to improve performance; while the hospital code touching 100% CI that hospital should be advised to stop operations until proof of safety performance is shown.

### Survival

Late survival after discharge is plot with variable risks of gender and multiple procedures for all age groups.

**Overall late survival** in 11621 patients at 6th year is 94.2%. There is no gender difference, no single, double or triple procedure difference.

**Late survival in newborn** in 531 patients at 6th year is 95.3%. Survival of female at 6th year is 96.8% which is better than male at 6th year of 94.4%. There is no difference between single and triple procedure.

**Late survival in infant** in 2015 patients at 6th years is 94.9% Survival of male at 6th year is 95.6% which is better than female at 6th year of 94.1%. Late survival is poorer in isolated procedure at 6th year of 94.3% than in triple and double procedure of 95.5% and 96.3% respectively.

**Late survival in preschool children** in 2192 patients at 6th year is 93.6%, the survival in male of 94% is better than female of 93.2%. Late survival in triple procedure of 97.1% is better than isolated procedure of 93.2% and double procedure of 93.5%. This is evidence that most patients in triple procedure are in mortality category 1.

**Late survival in school age children** in 3030 patients at 6th year is 93.7%, the survival in male of 94.6% is better than female of 92.8%. Late survival in triple procedure of 91.2% is less than isolated procedure of 93.7% and double procedure of 94.7%.

**Late survival in grown-up children** in 1080 patients at 6th year is 94.8%, there is no gender difference. The isolated procedure has the poorest survival of 94.2% comparing to double procedure of 96.2% and triple procedure of 98.1%.

**Late survival in adult** in 2764 patients at 6th year is 94.4%, the late survival in female of 94.2% is poorer than male of 95.0%. The late survival in triple procedure of 92.3% is poorer than isolated procedure of 94.6% and double procedure of 94.2%.

### Payer

Universal Health Coverage takes care 87% of congenital heart surgery up to 15 years of age and 77% in adult congenital heart surgery.

The trend of newborn surgery supported by Universal Health Coverage shows increasing percentage from 9% in 2006 to 84% in 2011 with the highest peak of 89% in 2008.

By Universal Health Coverage, the newborn in hospital mortality is 23% with the workload of 82% while Self Payment having the similar in-hospital mortality with the workload of 8% and Civil Service having the workload of 4% has the in-hospital mortality of 39%.

Under Civil Service payment, the postoperative length of stay is 34 days. Under Universal Health Coverage, the postoperative length of stay is 23 days while under Self Payment the postoperative length of stay is 17 days.



## Preface

**Since** the first Patent Ductus Arteriosus ligation performed in 1953, Cardiac surgery in Thailand had continued to make progress and expanded to serve the whole region of Thailand. Over the past 2 decades the number of cardiac surgery in Thailand had increased steadily due to increasing numbers of the trained cardiac surgeons and cardiac centers. Currently over 13,000 cardiac surgeries are performed yearly.

In the medical practice there is no doubt that the data and statistics had played a significant role in our daily practice. The result and the predicting factors we obtained from the database will definitely improve and change our practice. Without data, it is just another opinion. We have long depended on the data of the western country which do not totally reflect the reality in our own population.

I am pleased to see that the database registry and analysis committee have succeeded in obtaining the Thai Congenital Cardiac Surgery Database for the first time in history. I believe this will open up a new horizon for the management of congenital cardiac surgery in Thailand with our own database.

The database covered 6 years period from 2006-2011, with participation of 26 cardiac centers in the country, with validated data of 13,099 patients. Analysis based on the performances, workloads, risk factors and long term survival were included. Participation of the Bureau of Policy and Strategy, the Ministry of Public health ensured the accuracy of the survival and late death through the National identification. This makes the database reliable and referable resources for the congenital cardiac surgery in Thailand. Without participation and cooperation of the 26 cardiac centers which tirelessly supplied the validated data, and all other participating parties, we will not have the product of hard work that you are holding in your hand right now.

Finally, I want to thank the database registry and analysis committee Dr. Pantpis Sakornpant and Dr. Vichao Kojaranjit for their tremendous efforts and the wonderful results they have achieved with this report.

**Weerachai Nawarawong M.D. FACS**

President of the Society of Thoracic Surgeons of Thailand





## Acknowledgements

### Names of all past presidents

Chin Buranadham  
Pantpis Sakornpant  
Chawalit Ongcharit  
Teera Limsila  
Prinya Sakiyalak  
Yothin Kurowat  
Somboon Boonkasem  
Naronk Rodwarna  
Chalit Cheanvechai  
Kittipan V. Arom  
Pradistchai Chaiseri  
Supreecha Tanamai  
Cherdchai Tontisirin  
Pansak Laksanabunsong  
Weerachai Nawarawong

### Year of position

1986-1989  
1989-1990  
1990-1992  
1992-1994  
1994-1996  
1996-1998  
1998-2000  
2000-2002  
2002-2004  
2004-2006  
2006-2008  
2008-2010  
2010-2011  
2011-2012  
2012-2014

## Committee for Cardiac Surgical Database Registry

*Chairman:* Pantpis Sakornpant  
*Vice-chairman:* Kittipan V. Arom  
*Member:* Apirak Chetpaophan  
Attapoom Susuppaus  
Chaiwut Yottasurodom  
Nopadol Penkitti  
Patchara Ongcharit  
Piya Samankatiwat  
Samphant Pornvilawan  
Sompop Prathanee  
Suthep Taksinachanekit  
Vichao Kojaranjit  
Weerachai Nawarawong

## Database Registry and Analysis

*Chairman:* Pantpis Sakornpant  
*Assistant:* Vichao Kojaranjit  
*Statistician:* Somjai Puttakitukpol, DNS  
Wanlop Jaidee, Ph.D



## Committee for printing and publishing

*Chairman:*

*Vice-chairman:*

*Member:*

Sompop Prathanee  
Vichao Kojaranjit  
Attapoom Susuppaus  
Boonton Khorprasert  
Chaithat Ragrachagarn  
Chaiwut Yottasurodom  
Chareonkiat Rergkhang  
Damri Sethachinda  
Kanok Suvarnakich  
Kriengchai Prasongsukarn  
Nakhon Boonmee  
Opart Satthapud  
Pattanasak Lertpradit  
Santichai Karnnaowakul  
Sitthiphorn Simabowonsut  
Suthep Taksinachanekit  
Thitipong Tepsuwan  
Vichai Benjacholamas

## Name of other supporters

Nongchana Klangsuk, MPhil.  
Edwards Lifesciences (Thailand) Limited  
All patients who provided consent for data registry



## Current hospital representatives

Bangpakok 9 International Hospital	Vichai Benjacholamas
Bhumibol Adulyadej Hospital	Wichai Rungfasangaroon Nakhon Boonmee
Buddhachinaraj Hospital	Amnuaypon Kridanchalee Sittichok Vachirasrisirikul Jessada Methrujanant
Bumrungrad International Hospital	Samphant Pornvilawan
Central Chest Institute of Thailand	Taweesak Chotivatanapong Choosak Kasemsan Chaiwit Yottasurodom
Chiangrai Prachanukroh Hospital	Kwanjai Tossiri Chanawit Sitthisombat
King Chulalongkorn Memorial Hospital	Vichai Benjacholamas Jule Namchaisiri
Lampang Hospital	Nuttapon Arayawudhikul Boonsap Sakboon
Maharaj Nakorn Chiang Mai Hospital	Weerachai Nawarawong Surin Woragidpoonpol Suphachai Chuaratanaphong
Maharat Nakhon Ratchasima Hospital	Damri Sethachinda Vorapot Vittayakritsirikul
Naresuan University Hospital	Jarun Sayasathid
Phramongkutklao Hospital	Worasin Ketanond Teerachat Silarat
Phrapokklao Hospital	Sitthiphorn Simabowonsut
Police General Hospital	Paiboon Jeamanukoolkit
Queen Sirikit National Institute of Child Health	Vichao Kojaranjit Sonthakit Leelahanon
Queen Sirikit Heart Center of the Northeast	Chusak Kuptanond Sompop Prathanee
Rajavithi Hospital	Perapat Mokarapong Attapoom Susuppaus
Ramathibodi Hospital	Sukasom Attanawanich Piya Samankatiwat
Sappasitthiprasong Hospital	Chaithat Ragrachagarn Teerapol Kohtien
Siriraj Hospital	Somchai Sriyoschati Thawon Subtaweessin Wanchai Wongkornrat
Songklanagarind Hospital	Charoenkiat Rergkliang Teera Simapattanapong



The Society of Thoracic Surgeons of Thailand  
First National Congenital Cardiac Surgical Database Report

Srinagarindra Hospital

Chusak Kuptanond  
Sompop Prathanee

Suratthani Hospital

Boonton Khorprasert  
Paradorn Jetwana

Thammasat University Hospital

Opart Satthapud  
Chaisit Srisomboon

Vajira Hospital

Kanok Suvarnakich  
Zarina Sadad

Yala Hospital

Somchai Waikittipong



## Contents

Why do we need congenital cardiac surgery database in Thailand?	4
Congenital Cardiac Surgical Database Report	6
Introduction to limitation of data analysis	9
Summary	11
Preface	16
Acknowledgement	17
Names of all past presidents	17
Committee for Cardiac Surgical Database Registry	17
Database registry and analysis	17
Committee for printing and publishing	18
Name of other supporters	18
Current hospital representatives	19
<b>Chapter 1 Validation</b>	<b>25</b>
About STS-EACTS	26
Validation of data for analysis	26
Validation of hospital A patient records	27
Validation of hospital B patient records	31
Validation of morbidity	35
Conclusion of validity	38
<b>Chapter 2 Workload</b>	<b>39</b>
Workload and age distribution of patients in congenital heart surgery	40
Mortality risk of congenital heart surgery in newborn and calendar year	44
Mortality risk of congenital heart surgery in infant and calendar year	47
Mortality risk of congenital heart surgery in pre-school patients and calendar year	50
Mortality risk of congenital heart surgery in school age and calendar year	53
Mortality risk of congenital heart surgery in grown-up patients and calendar year	56
Mortality risk of congenital heart surgery in adult and calendar year	59
Workload of hospitals	62
Workload and mortality category	66
Overview of Workload by age group and gender	69
In-hospital mortality by age, gender and mortality category	72
<b>Chapter 3 Preoperative risk</b>	<b>79</b>
Overall preoperative risk factors	80
Preoperative risk and mortality category	83
Types of preoperative risk and age	87
<b>Chapter 4 Mortality category risk and procedures</b>	<b>91</b>
Mortality category and procedures of all age groups	93
Table 1.1 - 1.5 Frequency of procedure and mortality risk in all age group for mortality category 1 - 5	94
Mortality category and procedures in newborn	109
Table 2.1 - 2.5 Frequency of procedure and mortality risk in newborn for mortality category 1 - 5	110



Mortality category and procedures in infant	114
Table 3.1 - 3.5 Frequency of procedure and mortality risk in infant for mortality category 1 - 5	115
Mortality category and procedures in preschool children	120
Table 4.1 - 4.5 Frequency of procedure and mortality risk in preschool children for mortality category 1 - 5	121
Mortality category and procedures in school age children	126
Table 5.1 - 5.5 Frequency of procedure and mortality risk in school age children for mortality category 1 - 5	127
Mortality category and procedures in grown-up children	132
Table 6.1 - 6.5 Frequency of procedure and mortality risk in grown-up children for mortality category 1 - 5	133
Mortality category and procedures in adult	138
Table 7.1 - 7.4 Frequency of procedure and mortality risk in adult for mortality category 1 - 4	139
<b>Chapter 5 Postoperative complications</b>	<b>145</b>
Overall postoperative complications	146
Newborn with most common postoperative complications and in-hospital mortality	154
Infants with most common postoperative complications and in-hospital mortality	156
Pre school patients with most common postoperative complications and in-hospital mortality	158
School age patients with most common postoperative complications and in-hospital mortality	160
Grown-up patients with most common postoperative complications and in-hospital mortality	162
Adult with most common postoperative complications and in-hospital mortality	164
<b>Chapter 6 Morbidity category risk and procedures</b>	<b>167</b>
Morbidity category and procedures of all age groups	169
Table 1.1 - 1.5 Frequency of procedure and morbidity risk in all age group for morbidity category 1 - 5	170
Morbidity risk in newborn	185
Table 2.1 - 2.5 Frequency of procedure and morbidity risk in newborn for morbidity category 1 - 5	186
Morbidity risk in infant	190
Table 3.1 - 3.5 Frequency of procedure and morbidity risk in infant for morbidity category 1 - 5	191
Morbidity risk in preschool children	197
Table 4.1 - 4.4 Frequency of procedure and morbidity risk in preschool children for morbidity category 1 - 4	198
Morbidity risk in school age children	203
Table 5.1 - 5.5 Frequency of procedure and morbidity risk in school age children for morbidity category 1 - 5	204
Morbidity risk in grown-up children	210
Table 6.1 - 6.5 Frequency of procedure and morbidity risk in grown-up children for morbidity category 1 - 5	211
Morbidity risk in adult	216
Table 7.1 - 7.4 Frequency of procedure and morbidity risk in adult for morbidity category 1 - 4	217



<b>Chapter 7</b>	<b>Funnel plot measuring performance of hospital for in-hospital mortality</b>	<b>223</b>
	Estimation of in-hospital mortality by risk of mortality category	224
	Monitoring of performance for outcome	224
	Funnel plot measuring performance of hospitals by mortality category for in-hospital mortality	226
	Funnel plot showing performance of hospitals by age risk and in-hospital mortality	229
<b>Chapter 8</b>	<b>Adult congenital heart surgery</b>	<b>233</b>
	Performance and outcomes of adult congenital heart surgery	234
	Table 1 Adult patient operative characteristics	236
	Congenital heart surgery in adult	242
	Common adult congenital heart disease, procedure and gender	246
<b>Chapter 9</b>	<b>Late survival</b>	<b>251</b>
<b>Chapter 10</b>	<b>Payer</b>	<b>273</b>
	Workload of payers and mortality category	274
<b>Appendices</b>		<b>291</b>
	The Society of Thoracic Surgeons Congenital Cardiac Surgery Database Data Collection Form Version 2.30	292
	Datasets	300
	Predicted mortality calculation	302
	Funnel plot	303
	Additional information on morbidity category risk of isolated and multiple procedures	304
	Additional information on mortality category risk of isolated and multiple procedures	375
	Abbreviation	445
	Definition	447
	In-hospital mortality and age group of each hospital	449
	Workload, in-hospital mortality and mortality category risk	451







# Chapter 1



## About STS-EACTS

**STS-EACTS** is recognized widely that it is good for case-mix adjustment to measure outcomes, comparing performance and it can be used for quality improvement of institutions participating in database registry. [O'Brien SM, Clark DR, Jacobs JP et al An empirically based tool for analyzing mortality associated with congenital heart surgery Thorac Cardiovasc Surg 2009; 138: 1139-53; Jacobs ML, O'Brien SM Jacobs PO et al An empirically based tool for analyzing morbidity associated with operations for congenital heart disease J Thorac Cardiovasc Surg 2013;145:1046-57]

1. Using Bayesian model to estimate procedure-specific relative risk of in-hospital mortality and morbidity. Bayesian method is good with small sample size.
2. Convert these procedure specific mortality and morbidity estimates into a scale ranging from 0.1 to 5.0 called STS-EACTS mortality scores and morbidity scores
3. Grouping procedures with similar estimated risk into STS-EACTS mortality category and morbidity category ranging 1 to 5 mortality categories and morbidity categories. These will be used for comparing case-mix in various institutions.

### Validation of data for analysis

Since we decided to select STS-EACTS analytical approach for our data analysis, **we have to begin with validation of our data to see if there is any correlation of our observed mortality with the STS-EACTS mortality category and mortality score; to see any correlation of our observed morbidity with the STS-EACTS morbidity category and morbidity score.** Here are the steps of validation:

1. Whole data from Hospital A of 1,884 patients with 94 operative procedures were selected for comparison of in-hospital mortality category with the total numbers of 12,482 patients in database registry with 175 procedures excluding the missing data of 617 (4.7%) patients.

In-hospital mortality was estimated using Bayesian random effects model between the whole data of hospital A and whole data of all 26 hospitals.

Estimated mortality rate by mortality category in validating hospital A with z-test for binomial difference.

2. Plot bar graph between proposed and observed procedure risk comparing mortality rate between 2 graphs of hospital i.e. all hospitals and hospital A according to mortality category with 95% CI and p-value. Create graph expressing estimated mortality and procedures with mortality rate in ascending order; compare graphic presentation between all hospitals and hospital A.



### Validation of hospital A patient records (94 procedures / 1,884 cases)

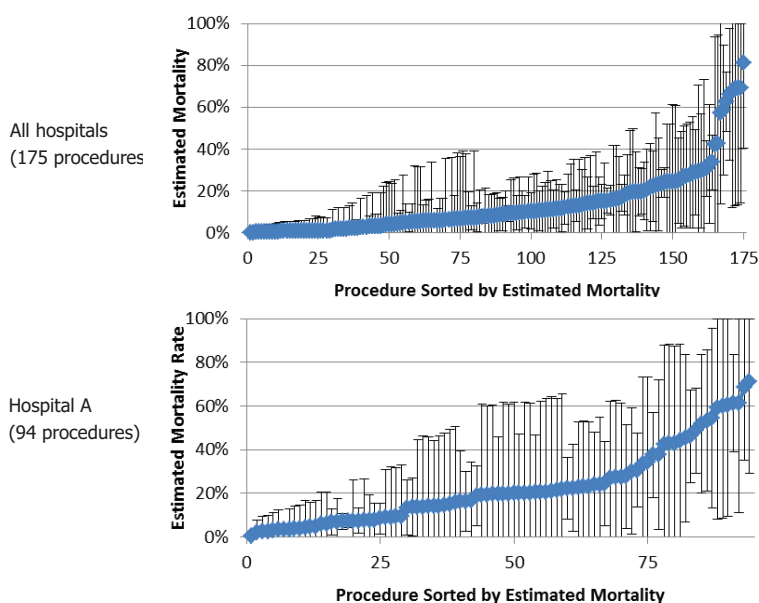
In-hospital mortality in hospital A by mortality category

Mortality category	No. procedure	No. patients	No. death	Mortality rate	95% CI	
					Lower	Upper
1	13	606	12	1.98%	0.00%	3.09%
2	16	829	55	6.63%	4.94%	8.33%
3	13	112	13	11.61%	5.67%	17.54%
4	35	239	56	23.43%	18.06%	28.80%
5	17	98	57	58.16%	48.40%	67.93%
Total	94	1,884	193	10.24%	8.87%	11.61%

In-hospital mortality in all hospitals by mortality category

Mortality category	No. procedure	No. patients	No. death	Mortality rate	95% CI	
					Lower	Upper
1	56	7,726	128	1.7%	1.4%	1.9%
2	54	3,013	217	7.2%	6.3%	8.1%
3	29	1,061	164	15.5%	13.3%	17.6%
4	27	617	159	25.8%	22.3%	29.2%
5	9	65	44	67.7%	56.3%	79.1%
Total	175	12,482	712	5.7%	5.3%	6.1%
Missing		617 (4.7%)				

Comparison between proposed and observed procedure risk





The above graph illustrated estimated mortality by procedures in ascending order by estimated mortality rate.

The estimated mortality rate will be used to calculate mortality score and mortality category using the receiver operating characteristic curve (ROC) or C-index.

Thus, we can compare c-index of mortality score and c-index of mortality category between Hospital A and all hospitals using DeLong and colleagues method.

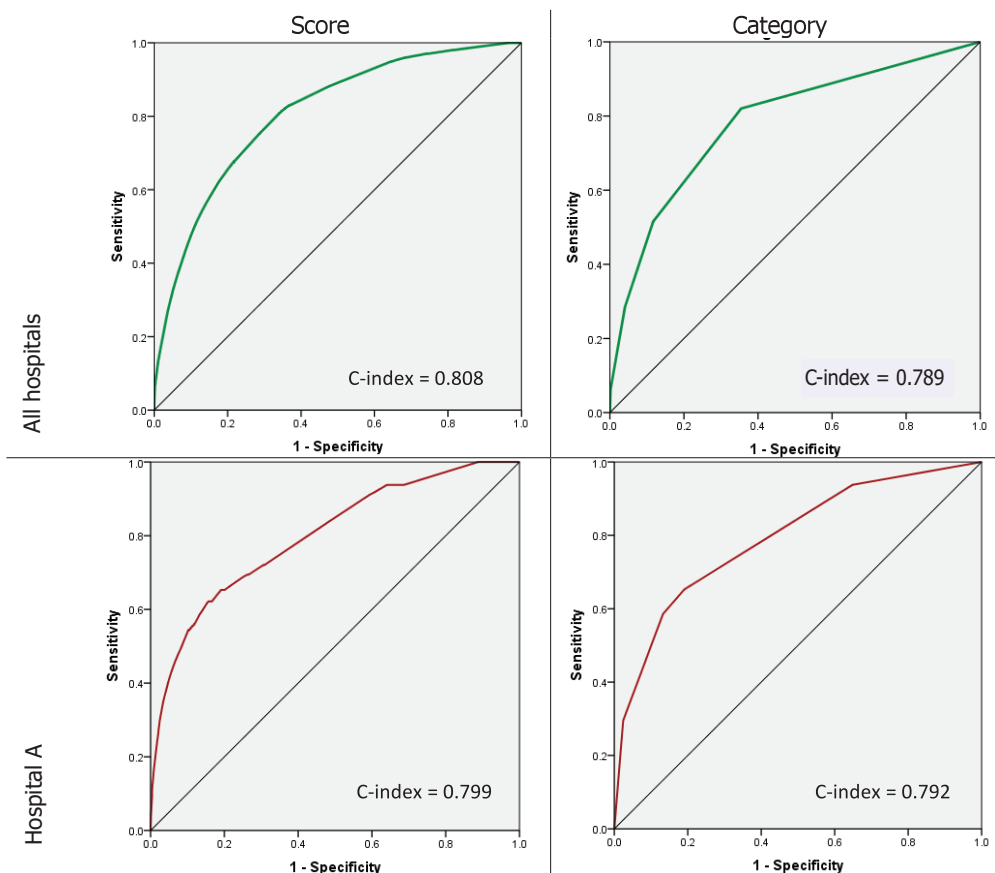
The c-index of hospitals A mortality scores with 94 procedures is 0.799 and the C-index of mortality category is 0.792.

The correlation between observed mortality and estimated mortality of Hospital A to 94 procedures is  $R^2=0.8698$ .

Regarding in-hospital mortality to mortality category level of 26 hospitals with 12,482 patients, all mortality category levels are expressed in each level of 175 procedures which give  $R^2=0.9678$ .

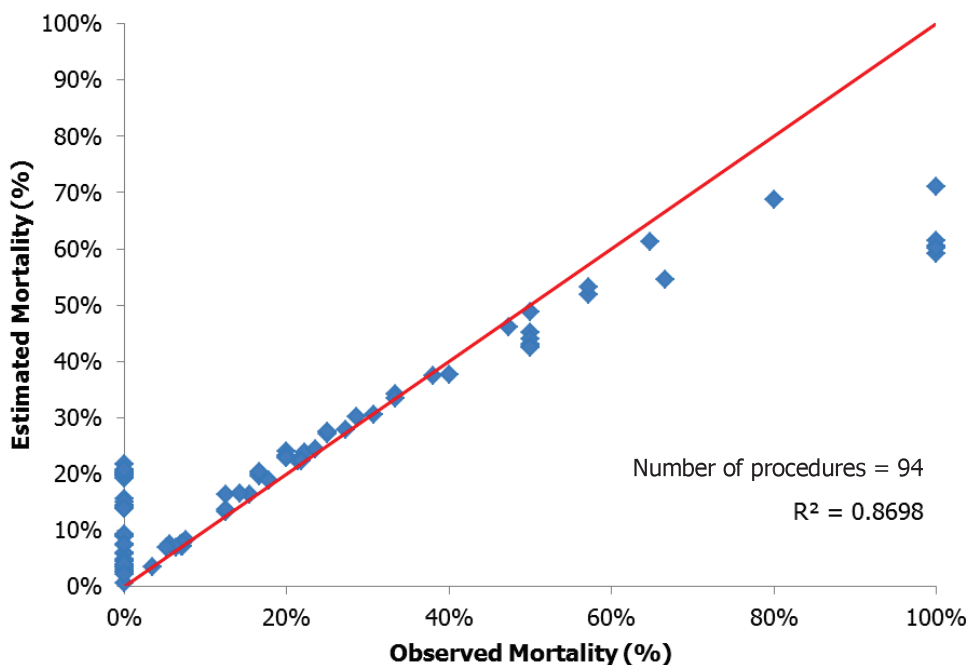
The c-index of all hospitals mortality scores with 175 procedures is 0.808 and the C-index of mortality category is 0.789.

Comparison between proposed and observed ROC curve for STS-EACTS score and category

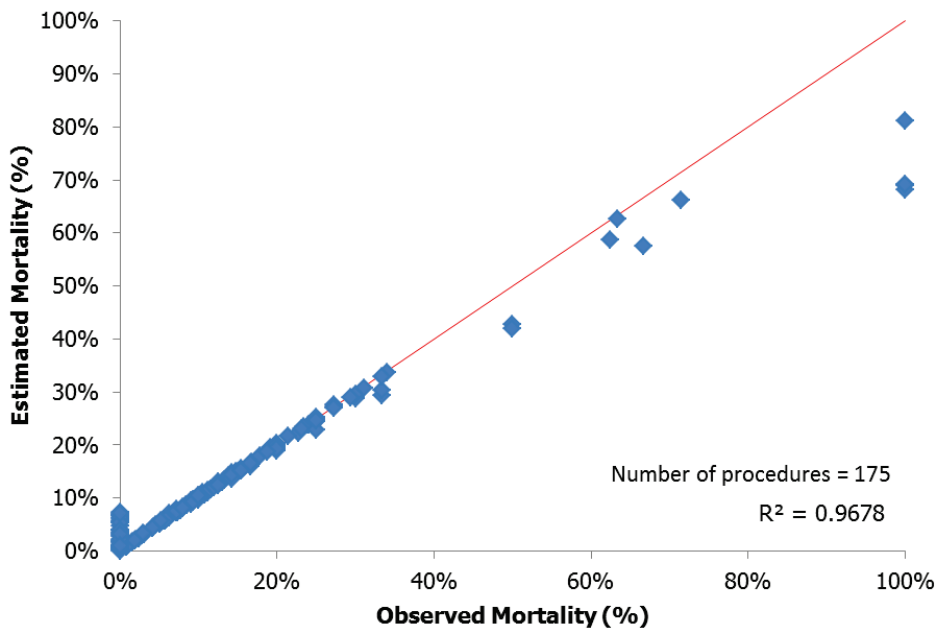




Correlation between observed and estimated in-hospital mortality in hospital A

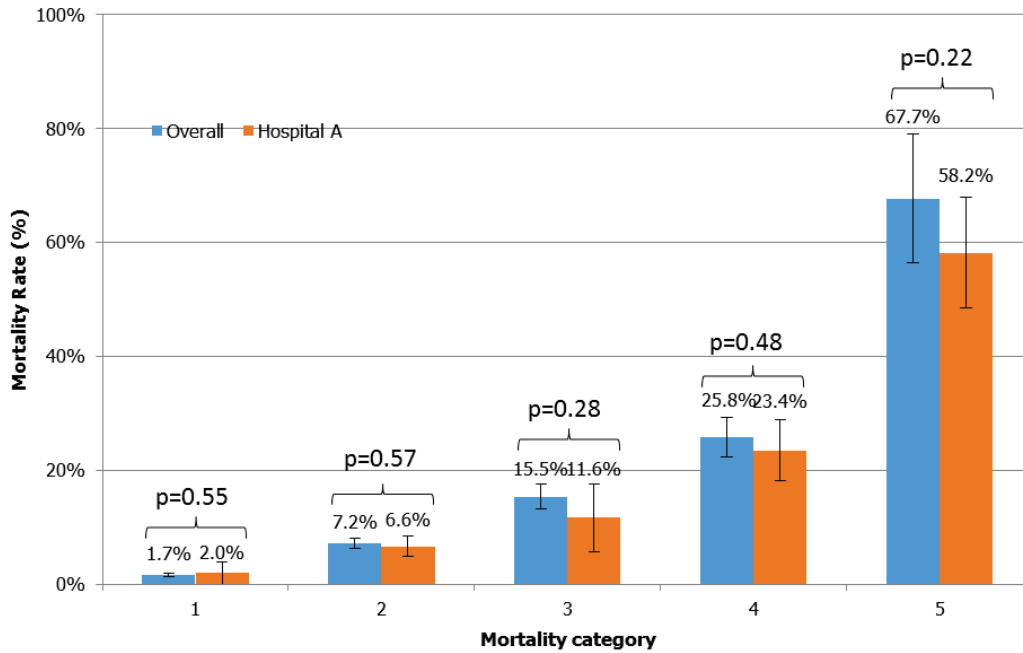


Correlation between observed and estimated in-hospital mortality in all hospitals





Comparison of in-hospital mortality between hospital A and all hospitals by mortality category



Statistical comparison

Method of comparison	All hospitals	Hospital A	p-value
STS-EACTS score (c-index)	0.808	0.799	0.635
STS-EACTS category (c-index)	0.789	0.792	0.664
Observed mortality & Estimated mortality (R <sup>2</sup> )	0.968	0.870	<0.001
Mortality score & observed mortality (R <sup>2</sup> )	0.999	0.998	0.720



## Validation of hospital B patient records (142 procedures / 1,659 cases)

In-hospital mortality in hospital B by mortality category

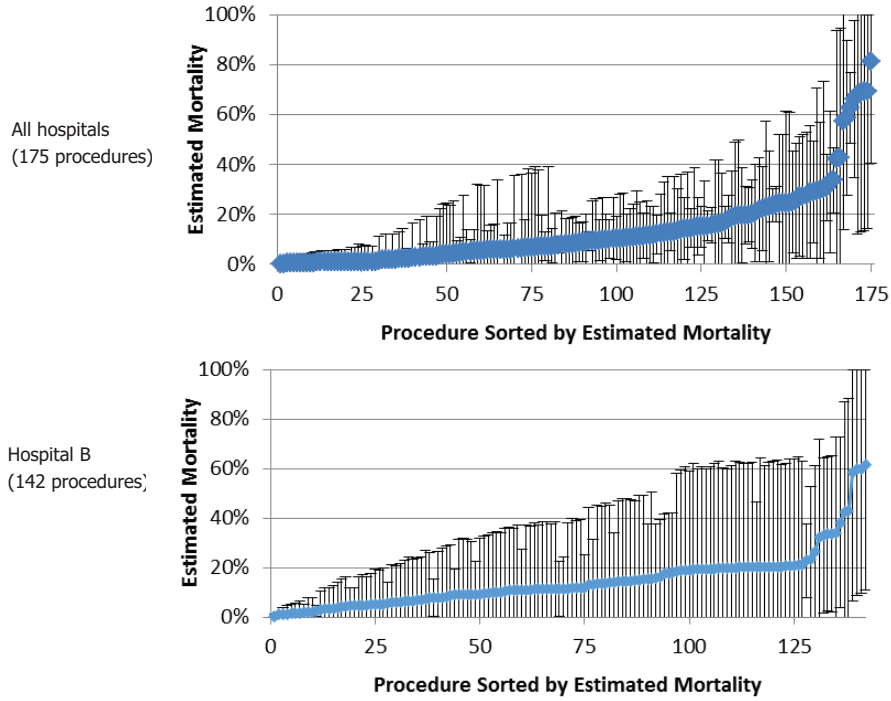
Mortality category	No. procedure	No. patients	No. death	Mortality rate	95% CI	
					Lower	Upper
1	16	963	7	0.73%	0.00%	1.26%
2	29	319	8	2.51%	0.79%	4.22%
3	43	219	11	5.02%	2.13%	7.92%
4	43	124	16	12.90%	7.00%	18.80%
5	11	34	15	44.12%	27.43%	60.81%
Total	142	1,659	57	3.44%	2.56%	4.31%

In-hospital mortality in all hospitals by mortality category

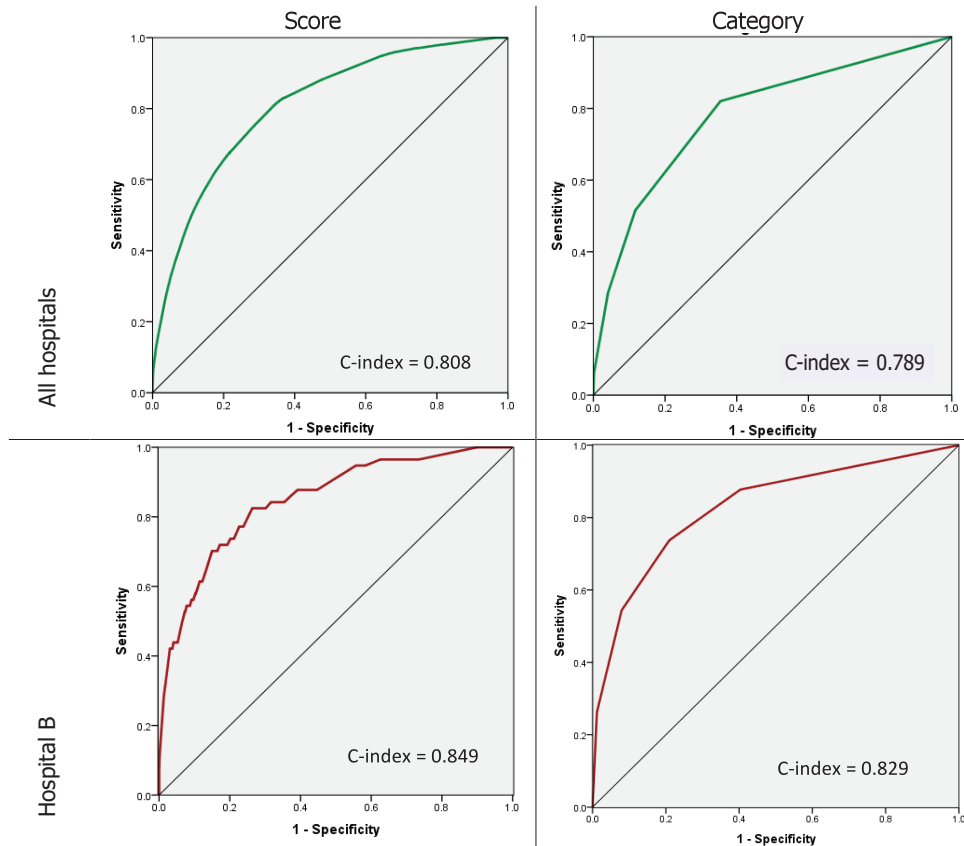
Mortality category	No. procedure	No. patients	No. death	Mortality rate	95% CI	
					Lower	Upper
1	56	7,726	128	1.7%	1.4%	1.9%
2	54	3,013	217	7.2%	6.3%	8.1%
3	29	1,061	164	15.5%	13.3%	17.6%
4	27	617	159	25.8%	22.3%	29.2%
5	9	65	44	67.7%	56.3%	79.1%
Total	175	12,482	712	5.7%	5.3%	6.1%
Missing		617 (4.7%)				



### Comparison between proposed and observed procedure risk



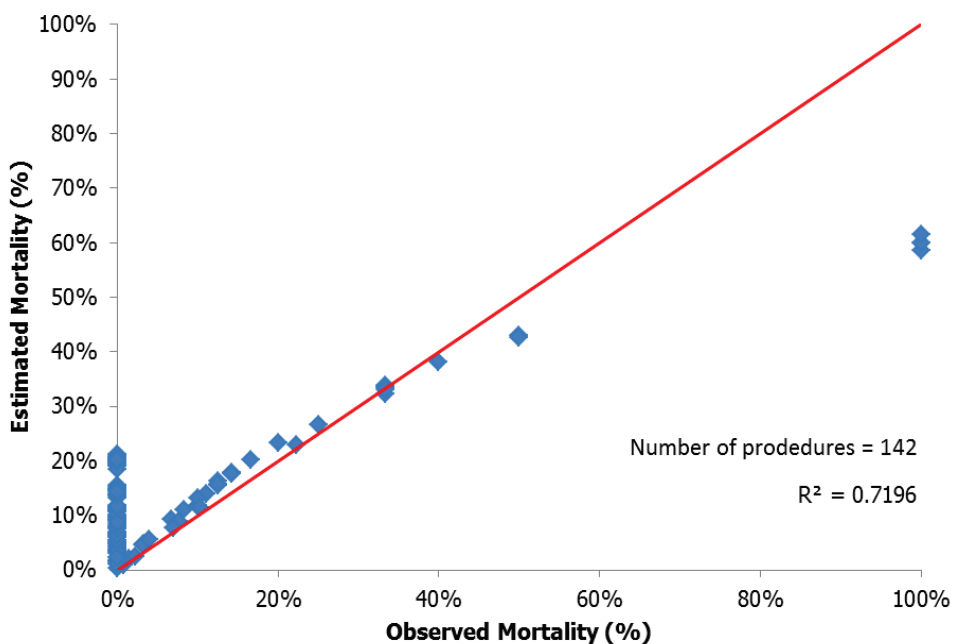
### Comparison between proposed and observed ROC curve for STS-EACTS score and category



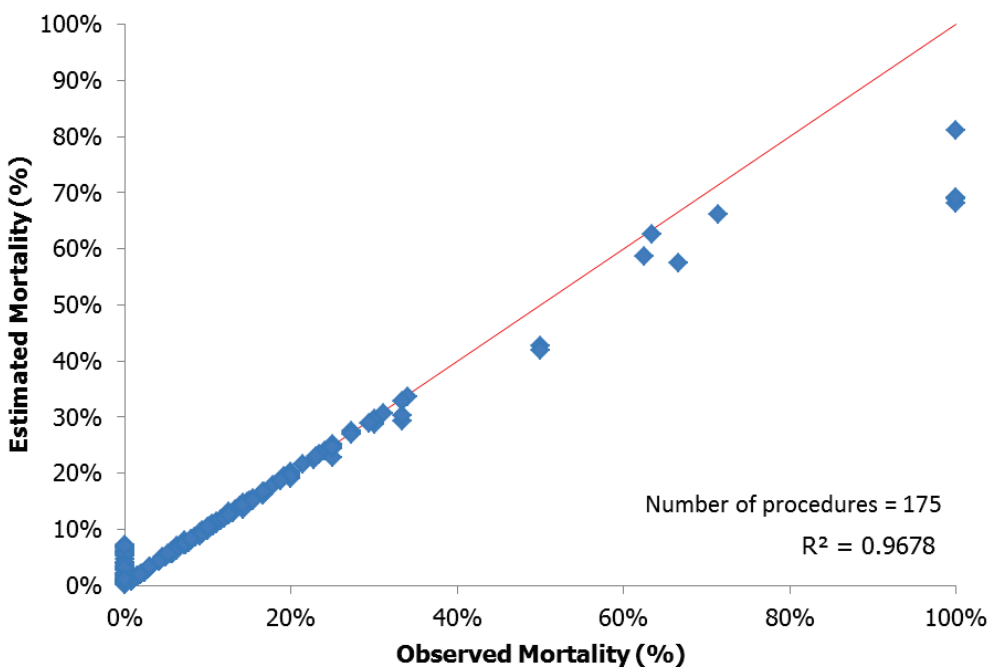




Correlation between observed and estimated in-hospital mortality in hospital B



Correlation between observed and estimated in-hospital mortality in all hospitals

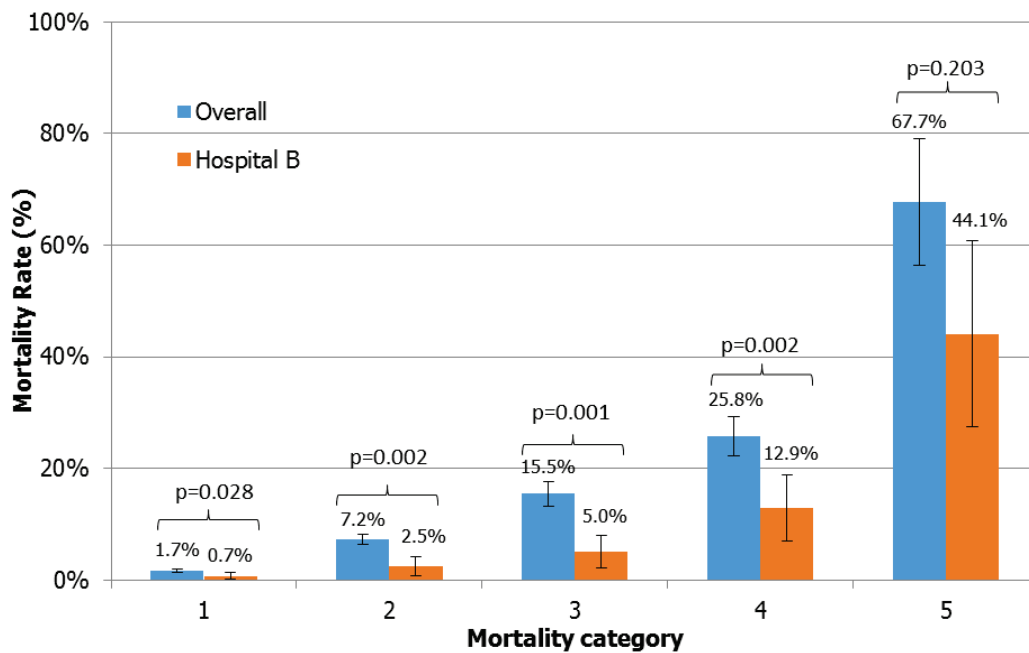




A comparison of in-hospital mortality between Hospital B with 142 procedures against all hospitals with 175 procedures and also against the Hospital A with 94 procedures has not shown any statistical difference as shown below.

It should be informed here that for all hospitals, the selected procedure must be performed for comparison not less than 40 cases in that procedure; and for Hospital A, the selected procedure for comparison must not be less than 20 cases in that procedure.

Comparison of in-hospital mortality between hospital B and all hospital by mortality category



Statistical comparison

Method of comparison	All hospital	Hospital B	p-value
STS-EACTS score (c-index)	0.808	0.849	0.152
STS-EACTS score (c-index)	0.789	0.829	0.174
Observed mortality & Estimated mortality (R <sup>2</sup> )	0.968	0.720	<0.001
Mortality score & observed mortality (R <sup>2</sup> )	0.999	0.984	0.700



## Validation of morbidity

Morbidity analysis is based on morbidity scores and categories [Jacobs ML, O'Brien SM, Jacobs JP Mavroudis C, Lacour-Gayet F, Pasquali SK, Welke K, Pizarro C, Tsai F and Clarke DR J Thorac Cardiovasc Surg 2013; 145:1046-57]

Table 1 Summary of morbidity categories (n=12,613 missing 3.7%)

Mortality categories	No. procedure	No. patients	No. of complication	Morbidity rate %	95% CI	
					Lower	Upper
1	52	3,126	311	9.9	8.9	11.0
2	55	7,034	1,476	21.0	20.0	21.9
3	36	1,511	519	34.3	32.0	36.7
4	27	930	496	53.3	50.1	56.5
5	7	12	12	100.0	100.0	100.0
Overall	177	12,613	2814	22.3	21.6	23.0

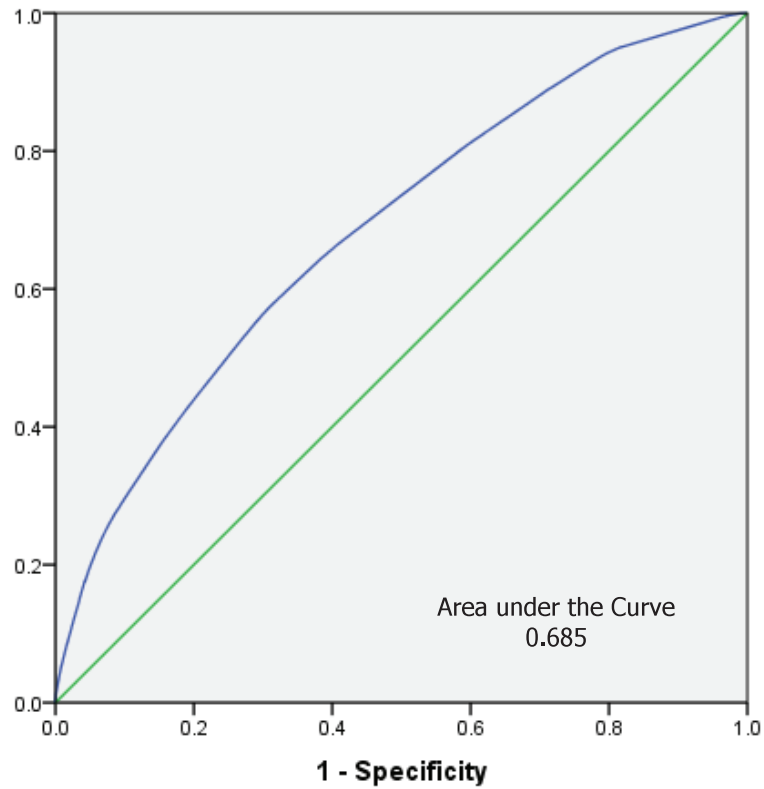
Table 2 Most common complications by procedure with mortality rate (n=12,763 missing 2.6%)

Most common complication* description	No. of event	Mortality n (%)	Rank correlation with all complication
Pneumonia	405	38 (9.4%)	0.484
Other postoperative complication	337	58 (17.6%)	0.407
Postoperative septicemia	311	103 (33.2%)	0.390
Postoperative respiratory insufficiency requiring reintubation	208	56 (26.9%)	0.302
Postoperative respiratory insufficiency requiring mechanical ventilatory support >7 days	177	16 (9.1%)	0.452
Pleural effusion requiring drainage	150	4 (2.7%)	0.284
Postoperative acidosis	146	46 (31.7%)	0.341
Postoperative low cardiac output	143	62 (43.4%)	0.384
Postoperative arrhythmia	122	12 (9.9%)	0.295
Pneumothorax	103	7 (7.0%)	0.220
Bleeding requiring reoperation	100	18 (18.4%)	0.212
Acute renal failure requiring temporary dialysis	92	49 (53.8%)	0.258
Postoperative pulmonary hypertension crisis (PA pressure > systemic pressure)	90	36 (40.0%)	0.253
All complication	2,829	717 (5.7%)	-

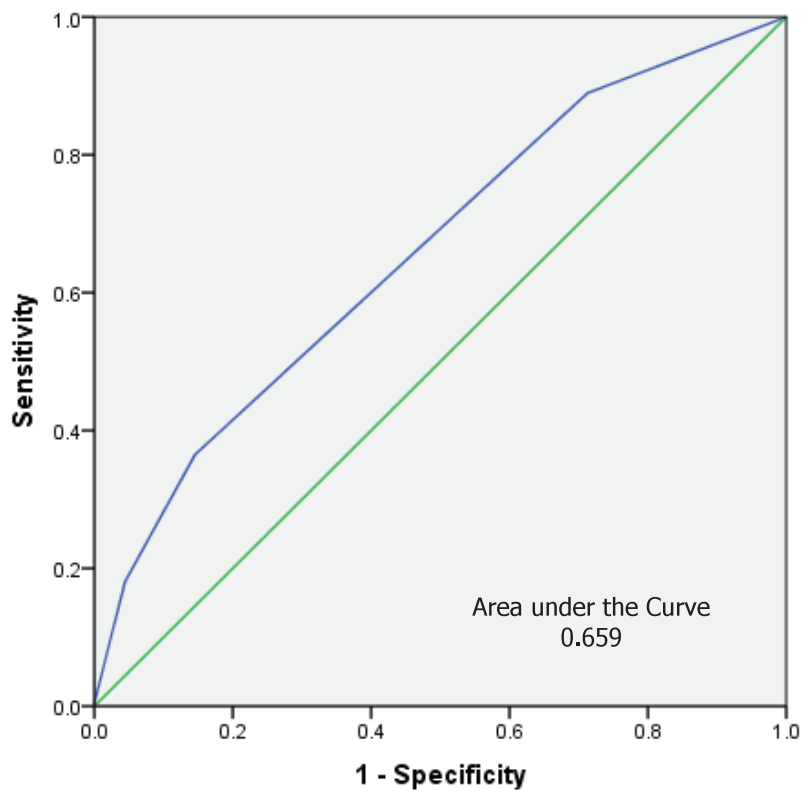
\*Most common complications were selected by morbidity rate > 0.7%



**Figure 1** Receiver operating characteristic (ROC) curves for the STS morbidity score with all complication

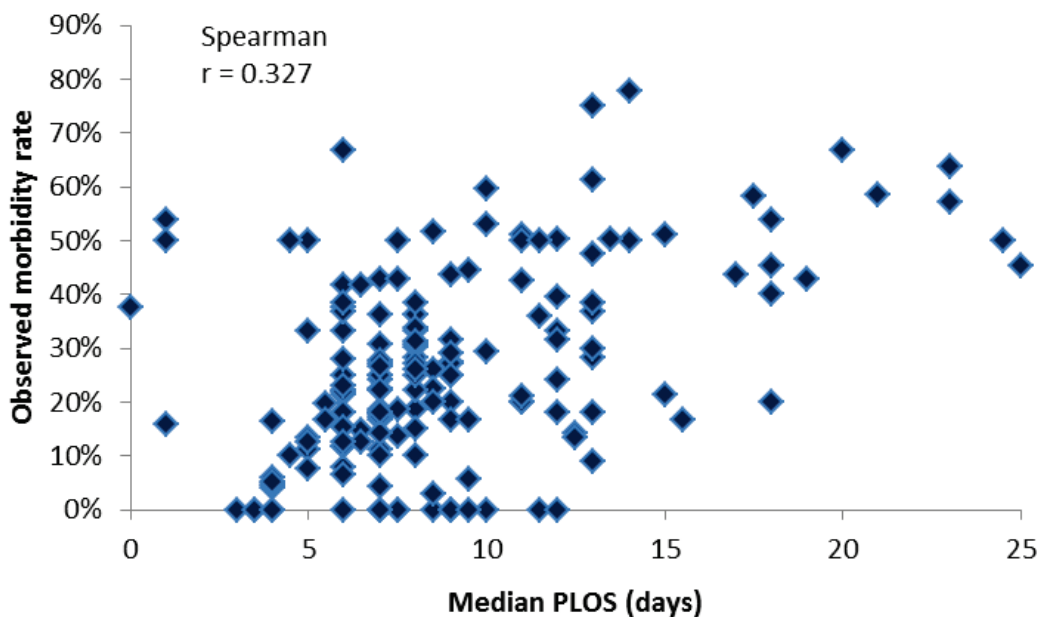


**Figure 2** Receiver operating characteristic (ROC) curves for the STS morbidity category with all complication

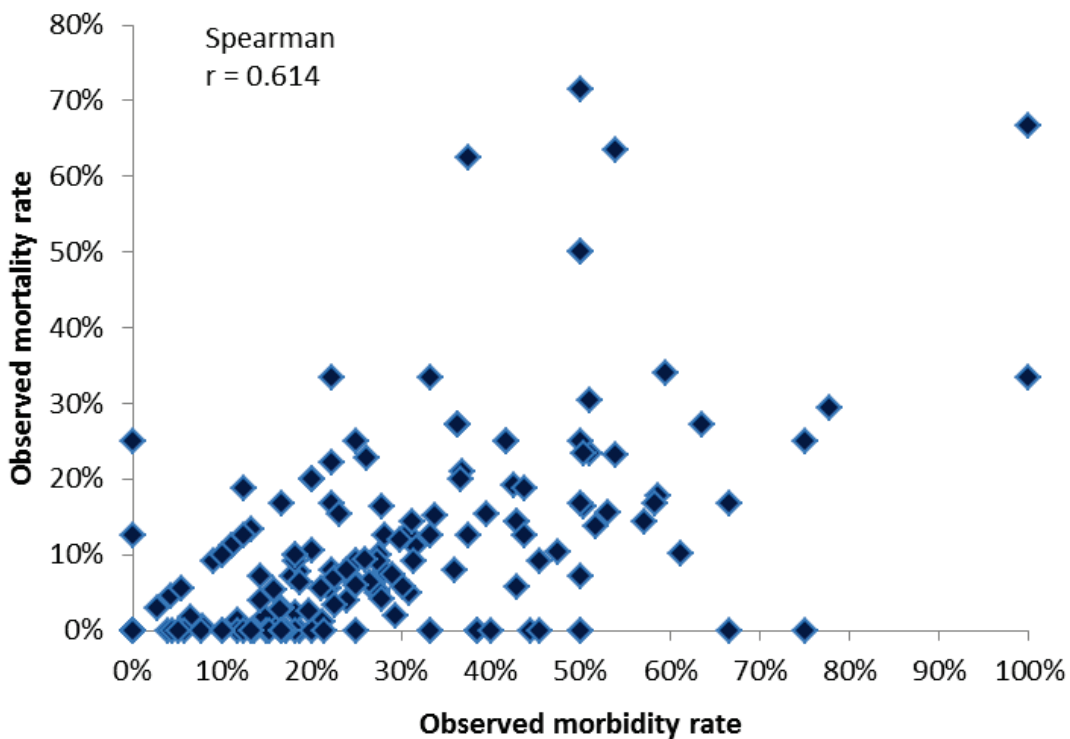




**Figure 3** Median PLOS (days) and observed morbidity rate (%) of 177 procedures (diamond dot)



**Figure 4** Observed morbidity rate and observed mortality rate of 177 procedures (diamond dot)





**Remarks:** It is noticeable that there is only fair relationship between observed mortality and morbidity rate; this is due to the fact that some morbidity can happen without mortality and there is also much morbidity. The ROC of morbidity score and category with all complications are about .7 which is fair therefore we can only say that the morbidity category and score can be used for analysis in this book.

### **Conclusion of validity**

Our data have shown that there is correlation of observed mortality with the STS-EACTS mortality category and mortality score; there is also correlation of observed morbidity with the STS-EACTS morbidity category and morbidity score. We, therefore, can use STS-EACTS analytical approach for our data analysis and compare case-mix in various institutions.



## Chapter 2



## Database overview

### Workload and age distribution of patients in congenital heart surgery

- Of all ages in congenital heart surgery, 25% are operated during school age (3-10 years), 6% in newborn and 22% in adult > 15 year.
- The postoperative length of stay in newborn is the longest (23 days) which has not been improved by year trend.
- The in-hospital mortality rate of newborn is the highest (23%) of all age group while of adult is the lowest (2%).
- Postoperative length of stay in newborn and infant is longer than those after 1 year of age and in adult (9 days).

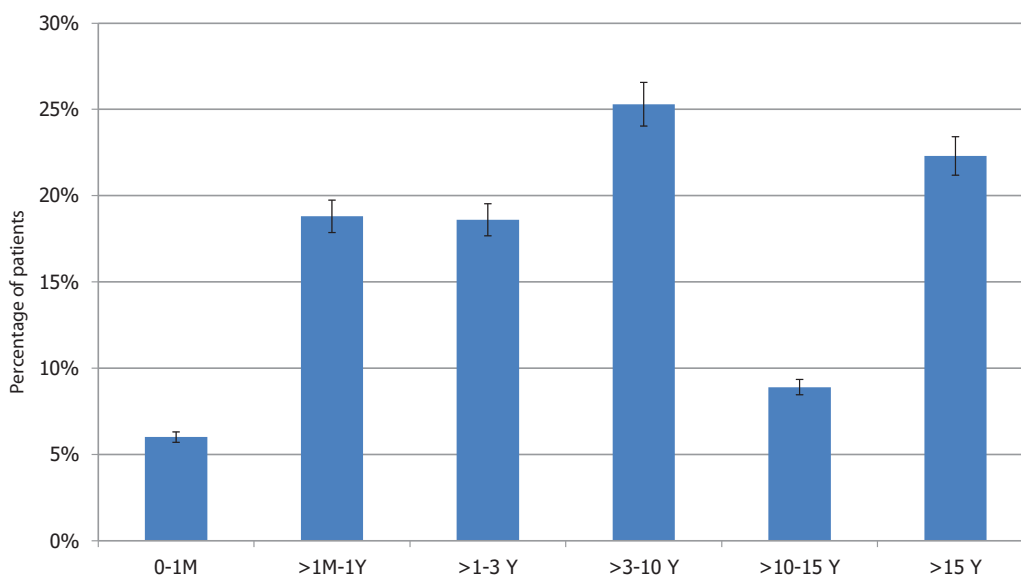
Workload of patients by age in 26 hospitals (n = 13,081)

Age	n	Percentage
Newborn (0-30 day)	783	6.0%
Infant (31-365 day)	2,463	18.8%
Pre school (>1-3 year)	2,434	18.6%
School age (>3-10 year)	3,316	25.3%
Grown up (>10-15 year)	1,169	8.9%
Adult (>15 year)	2,916	22.3%
Total	13,081	100.0%
Missing	18 (0.1%)	





Workload of patients by age in 26 hospitals (n = 13,081)

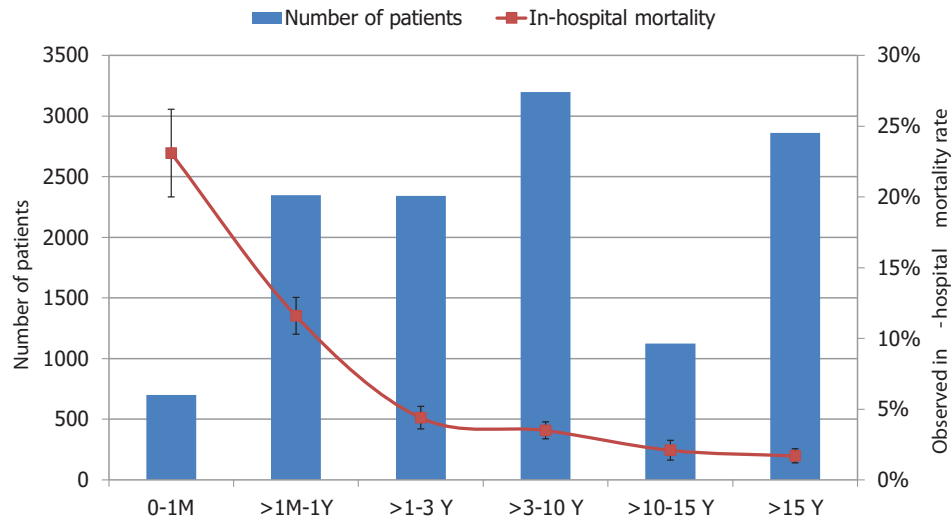


Patients by age and observed in-hospital mortality in 26 hospitals (n=12,574)

Age	All	Alive	In-hospital Mortality	95%CI
Newborn	5.6%	76.9%	23.1%	20.0-26.4
	701	539	162	
Infant	18.7%	88.4%	11.6%	10.3-12.9
	2,346	2,075	271	
Pre school	18.6%	95.6%	4.4%	3.6-5.4
	2,341	2,237	104	
School age	25.4%	96.5%	3.5%	2.9-4.2
	3,199	3,086	113	
Grown up	8.9%	97.9%	2.1%	1.4-3.2
	1,125	1,101	24	
Adult	22.8%	98.3%	1.7%	1.2-2.2
	2,862	2,814	48	
Total	100.0%	94.3%	5.7%	5.3-6.2
	12,574	11,852	722	
Missing	4.0% (525)			



Patients by age and observed in-hospital mortality in 26 hospitals (n = 12,574)

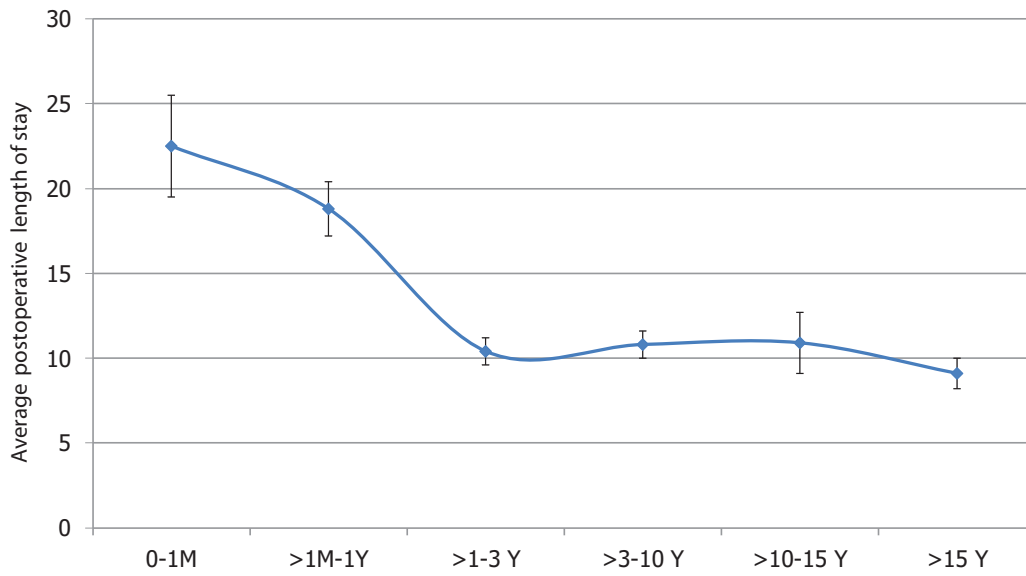


Patients by age and postoperative length of stay in 26 hospitals (n=12,329)

Age	n	Mean	SD	95%CI
Newborn	662	22.5	39.1	19.5-25.5
Infant	2,277	18.8	40.6	17.2-20.5
Pre school	2,271	10.4	19.4	9.6-11.2
School age	3,160	10.8	23.8	10.0-11.6
Grown up	1,119	10.9	30.0	9.1-12.6
Adult	2,840	9.1	23.5	8.2-10.0
Total	12,329	12.4	28.8	11.9-13.0
Missing	5.9% (770)			



Patients by age and postoperative length of stay in 26 hospitals (n = 12,329)





### Mortality risk of congenital heart surgery in newborn (0-30 day, n = 783) and calendar year

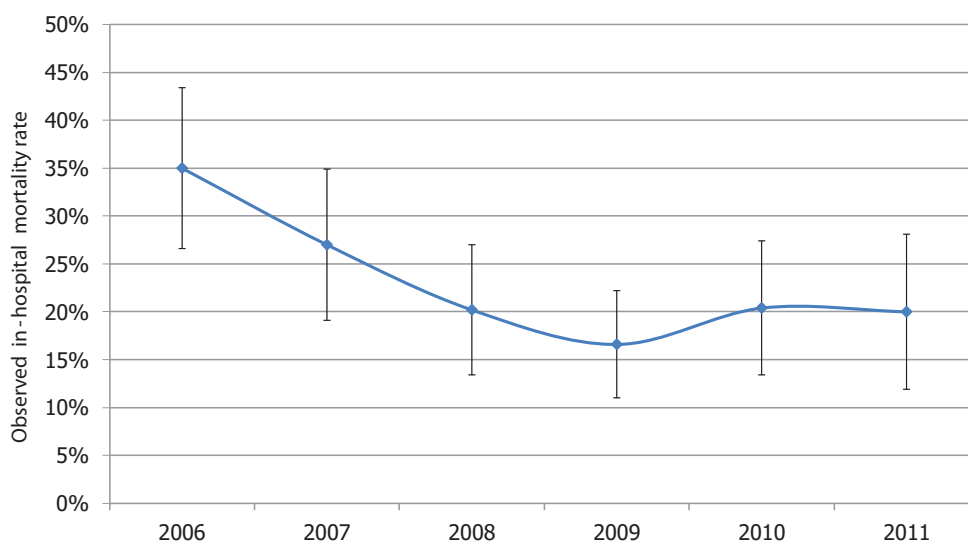
- Observed mortality of newborn has been decreasing overtime from 35% in 2006 to 20% in 2011.
- Postoperative length of stay in newborn has not decreased overtime.
- Newborn is the group of already highest risk with high in-hospital mortality. In order to save more lives and to reduce postoperative length of stay, a team of high experience is necessary. The operation and management must be carried out by expertise in a specialized unit of any hospital; the cost is necessarily high.

Newborn patients (0-30 day), observed in-hospital mortality and calendar year (n=701)

Year	All	Dead	95%CI
2006	17.5%	35.0%	26.6-44.1
	123	43	
2007	16.4%	27.0%	19.1-36.0
	115	31	
2008	17.0%	20.2%	13.4-28.5
	119	24	
2009	21.5%	16.6%	11.0-23.5
	151	25	
2010	16.1%	20.4%	13.4-29.0
	113	23	
2011	11.4%	20.0%	11.9-30.4
	80	16	
Missing	10.5%(82)		



Newborn patients (0-30 day), observed in-hospital mortality rate and calendar year (n = 701)

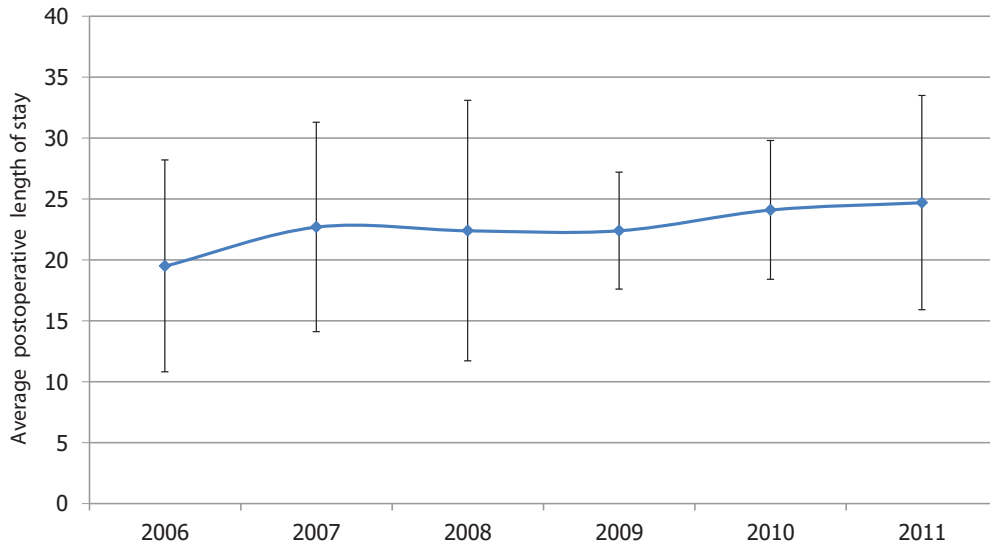


Newborn patients (0-30 day), postoperative length of stay in 26 hospitals and calendar year (n=662)

Year	n	Mean	SD	95%CI
2006	117	19.5	47.0	10.8-28.1
2007	111	22.7	45.9	14.1-31.4
2008	105	22.4	41.9	11.7-30.9
2009	151	22.4	30.1	17.6-27.2
2010	99	24.1	28.7	18.4-29.8
2011	79	24.7	39.3	15.9-33.5
Total	662	22.5	39.1	19.5-25.5
Missing	15.5%(121)			



Newborn patients (0-30 day), postoperative length of stay  
in 26 hospitals and calendar year (n = 662)





## Mortality risk of congenital heart surgery in infants (31-365 day, n = 2,463) and calendar year

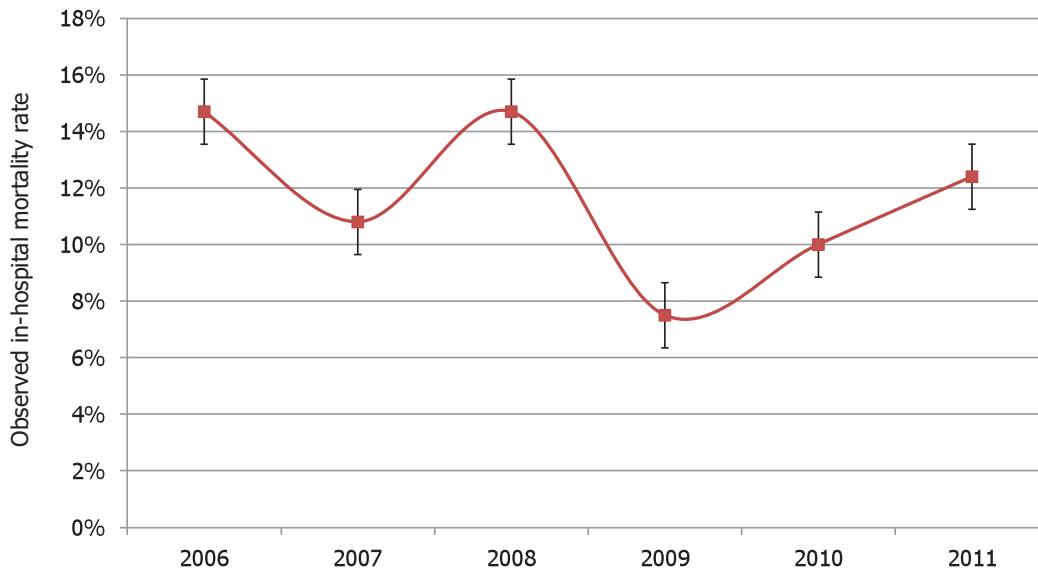
- Over time, the in-hospital mortality has decreased but there is a tendency of an increase in the last two years which could be due to more high risk of patients for operation.
- The postoperative length of stay is generally less than 3 weeks though having come down over time it also has a tendency of increasing in the last two years.
- There is evidence that in the last two years more patients with high category risk are operated.

Overview of infant patients (31-365 day), observed in-hospital mortality and calendar year (n=2,346)

Year	All	Dead	95%CI
2006	17.7%	14.7%	11.4-18.5
	415	61	
2007	18.9%	10.8%	8.1-14.1
	443	48	
2008	16.5%	14.7%	11.3-18.6
	388	57	
2009	18.3%	7.5%	5.2-10.4
	429	32	
2010	17.5%	10.0%	7.3-13.3
	412	41	
2011	11.0%	12.4%	8.6-17.0
	259	32	
Missing	4.8%(117)		



Infant (31-365 day), observed in-hospital mortality rate and calendar year (n = 2,346)



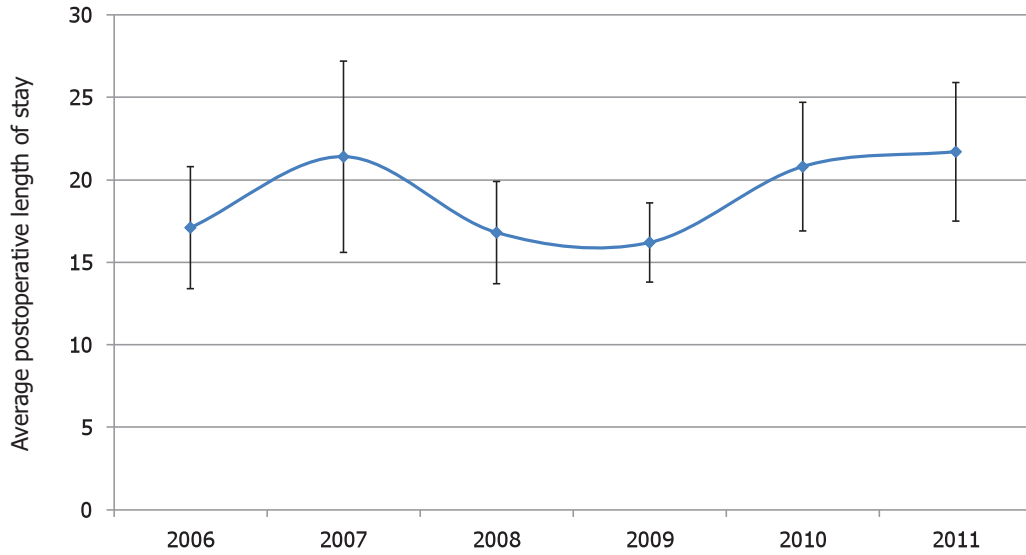
Infant patients (31-365 day), postoperative length of stay in 26 hospitals and calendar year (n=2,277)

Year	n	Mean	SD	95%CI
2006	408	17.1	38.4	13.4-20.8
2007	444	21.4	62.1	15.6-27.2
2008	368	16.8	30.0	13.7-20.0
2009	423	16.2	24.7	13.8-18.5
2010	382	20.8	38.5	16.9-24.7
2011	252	21.7	33.9	17.5-26.0
Total	2,277	18.8	40.6	17.2-20.5
Missing	7.6%(186)			





Infant (31-365 day), postoperative length of stay in  
26 hospitals and calendar year (n = 2,277)





## Mortality risk of congenital heart surgery in pre-school patients (1-3 year) (n = 2,434) and calendar year

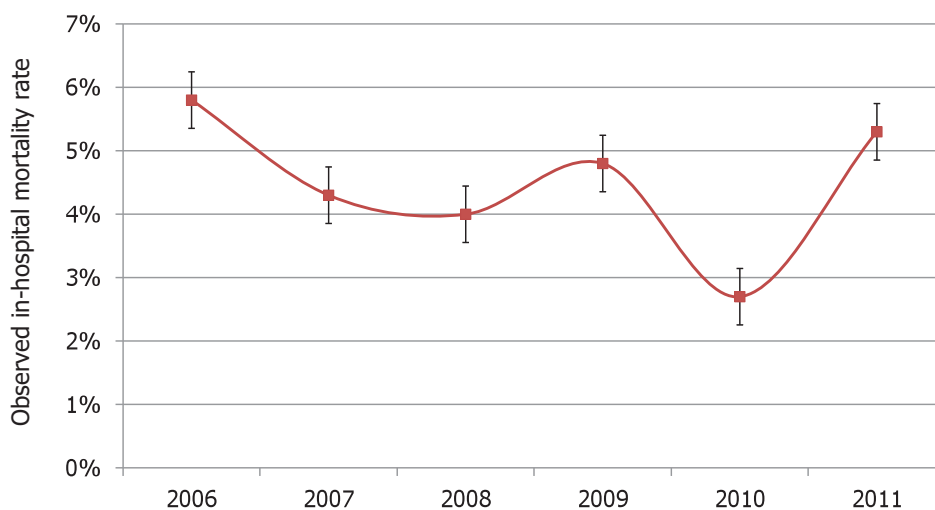
- The postoperative length of stay is around 10 days and it has decreased over time except the last two years when it rebounded to 11 days.
- The in-hospital mortality rate has come down overtime from 6% in 2006 to 5% in 2011.

Overview of pre-school patients (>1-3 year),  
observed in-hospital mortality and calendar year (n=2,341)

Year	All	Dead	95%CI
2006	18.3%	5.8%	3.8-8.5
	430	25	
2007	20.1%	4.3%	2.6-6.5
	470	20	
2008	19.4%	4.0%	2.4-6.2
	453	18	
2009	16.0%	4.8%	2.9-7.5
	374	18	
2010	15.8%	2.7%	1.3-4.9
	370	10	
2011	10.4%	5.3%	2.9-8.9
	244	13	
Missing	3.8%(93)		



Pre-school patients (>1-3 year), in-hospital mortality rate and calendar year (n = 2,340)

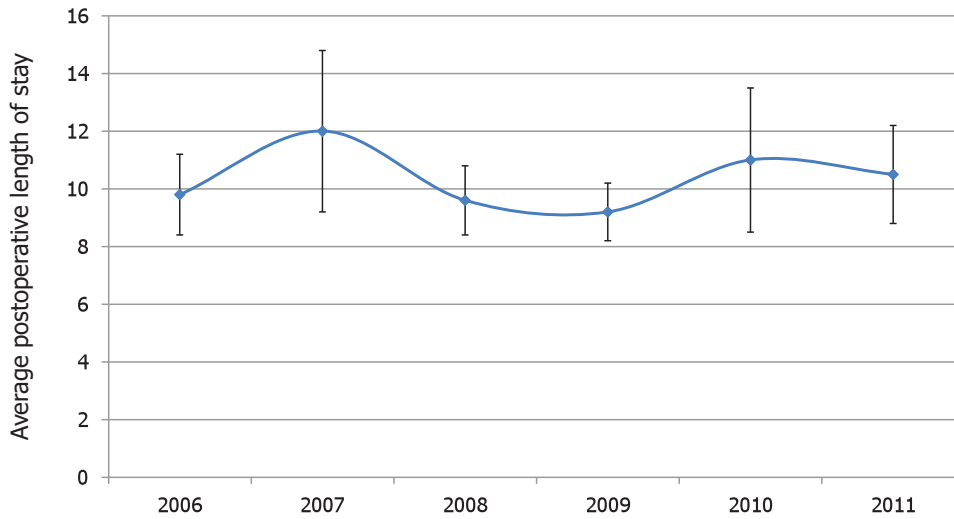


Pre-school patients (>1-3 year), postoperative length of stay in 26 hospitals (n=2,271)

Year	n	Mean	SD	95%CI
2006	431	9.8	15.0	8.4-11.2
2007	472	12.0	30.0	9.2-14.7
2008	427	9.6	12.2	8.4-10.7
2009	375	9.2	10.2	8.2-10.3
2010	339	11.0	23.7	8.5-13.5
2011	227	10.5	13.4	8.8-12.2
Total	2,271	10.4	19.4	9.6-11.2
Missing	6.7%(163)			



Pre-school patients (>1-3 year), postoperative length of stay  
in 26 hospitals and calendar year (n = 2,271)





### Mortality risk of congenital heart surgery in school age (>3-10 year, n = 3,316) and calendar year

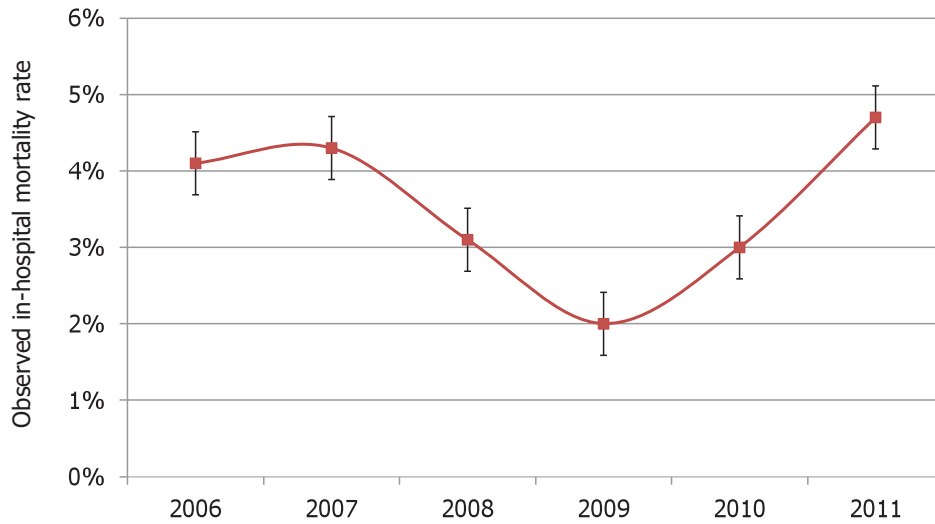
- The observed in-hospital mortality has come down from 4% in the early year to 3% except the latest year which was 5%. There is database evidence that there are more patients with high risk in the latest year.
- The postoperative length of stay has been from 10 to 12 days over time.

Overview of school age patients (>3-10 year),  
 observed in-hospital mortality and calendar year (n=3,199)

Year	All	Dead	95%CI
2006	18.9%	4.1%	2.7-6.0
	606	25	
2007	19.6%	4.3%	2.9-6.2
	628	27	
2008	20.2%	3.1%	1.9-4.7
	645	20	
2009	15.4%	2.0%	1.0-3.7
	494	10	
2010	14.6%	3.0%	1.6-5.0
	468	14	
2011	11.2%	4.7%	2.8-7.5
	358	17	
Missing	3.5%(117)		



School age patients (>3-10 year), observed in-hospital mortality rate and calendar year (n =3,199)

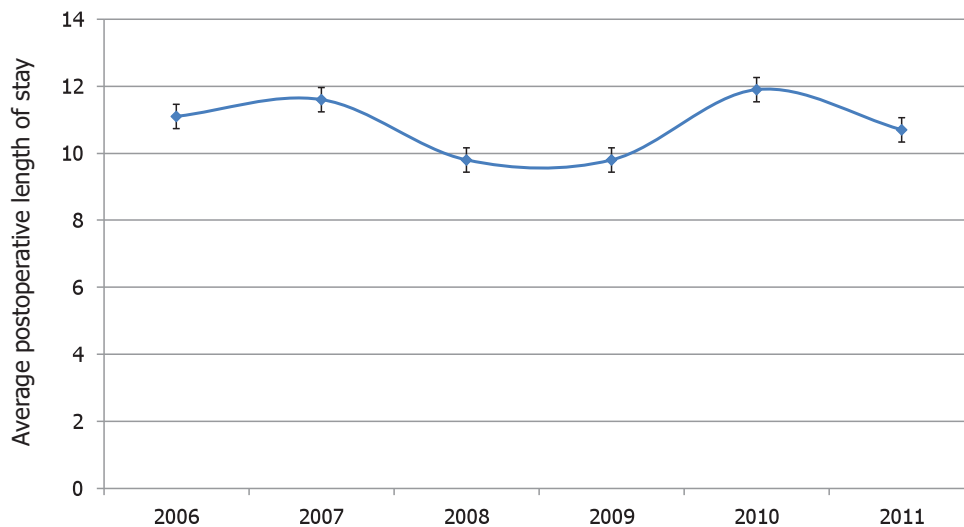


School age patients (>3-10 year), postoperative length of stay in 26 hospitals (n=3,160)

Year	n	Mean	SD	95%CI
2006	609	11.1	34.7	8.3-13.9
2007	633	11.6	31.3	9.2-14.0
2008	637	9.8	15.7	8.6-11.0
2009	497	9.8	12.5	8.7-10.9
2010	435	11.9	17.9	10.2-13.6
2011	349	10.7	13.5	9.3-12.1
Total	3,160	10.8	23.8	10.0-11.6
Missing	4.7% (156)			



School age patients (>3-10 year), postoperative length of stay  
in 26 hospitals (n =3,160)





## Mortality risk of congenital heart surgery in grown-up patients (>10-15 year, n = 1,169) and calendar year

- In general, the in-hospital mortality has not decreased but rather increasing from 1% in 2006 to 3% in the latest year.
- The postoperative length of stay has been decreasing from 13 days in 2006 to 10 days in 2011 over time.

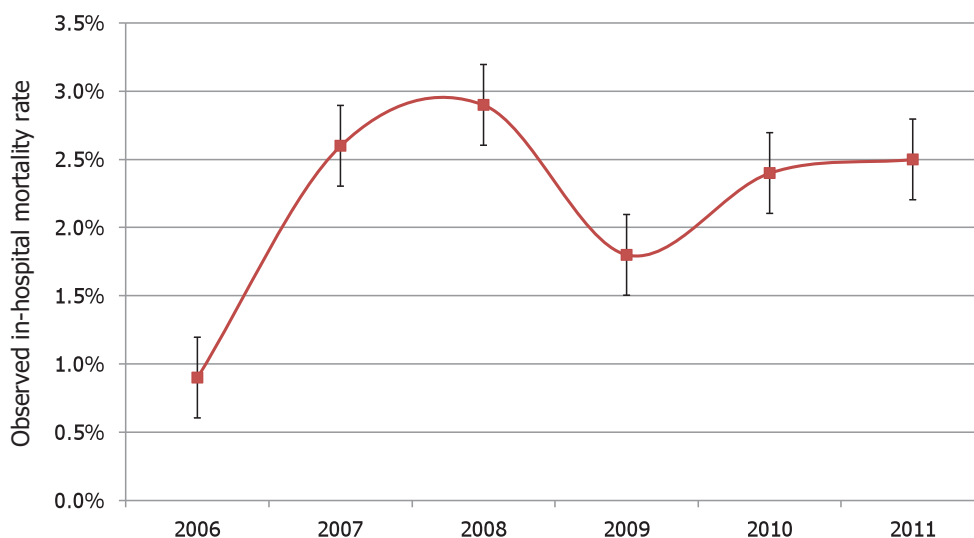
Overview of grown-up patients (>10-15 year),  
observed in-hospital mortality and calendar year (n=1,125)

Year	All	Dead	95%CI
2006	20.6%	0.9%	0.1-3.1
	232	2	
2007	20.6%	2.6%	0.9-5.5
	232	6	
2008	18.7%	2.9%	1.1-6.1
	210	6	
2009	14.8%	1.8%	0.4-5.2
	166	3	
2010	14.6%	2.4%	0.7-6.1
	164	4	
2011	10.8%	2.5%	0.5-7.1
	121	3	
Missing	3.8%(44)		





Grown-up patients (>10-15 year), observed in-hospital mortality rate and calendar year (n = 1,125)

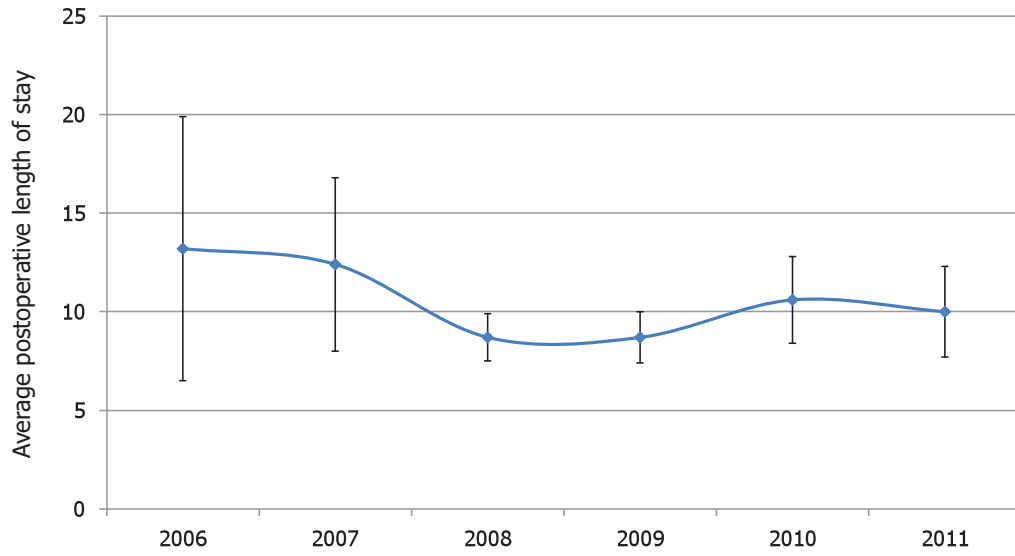


Grown-up patients (>10-15 year), postoperative length length of stay in 26 hospitals (n=1,119)

Year	n	Mean	SD	95%CI
2006	234	13.2	52.4	6.5-20.0
2007	235	12.4	34.7	8.0-16.9
2008	207	8.7	8.8	7.5-9.9
2009	164	8.7	8.2	7.4-10.0
2010	159	10.6	14.5	8.4-12.9
2011	120	10.0	12.8	7.7-12.3
Total	1,119	10.8	30.0	9.1-12.6
Missing	4.3%(50)			



Grown-up patients (>10-15 year), postoperative length of stay  
in 26 hospitals and calendar year (n = 1,119)





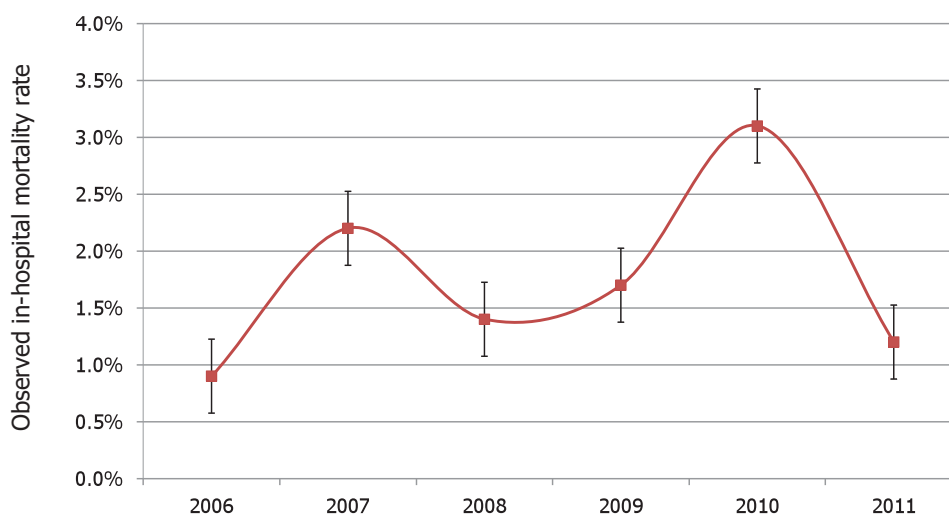
## Mortality risk of congenital heart surgery in adult (>15 year, n = 2,916) and calendar year

- In general, the in-hospital mortality has been around 1% to 3% overtime.
- The postoperative length of stay has not significantly decreased overtime.

Overview of adult patients (>15 year), observed In-hospital mortality  
 and calendar year (n=2,862)

Year	All	Dead	95%CI
2006	23.5%	0.9%	0.3-1.9
	673	6	
2007	18.9%	2.2%	1.2-3.8
	541	12	
2008	17.8%	1.4%	0.6-2.8
	510	7	
2009	14.8%	1.7%	0.7-3.4
	424	7	
2010	13.6%	3.1%	1.6-5.3
	390	12	
2011	11.3%	1.2%	0.3-3.1
	324	4	
Missing	1.9%(54)		

Adult patients (>15 year), observed in-hospital mortality rate  
 and calendar year (n = 2,862)

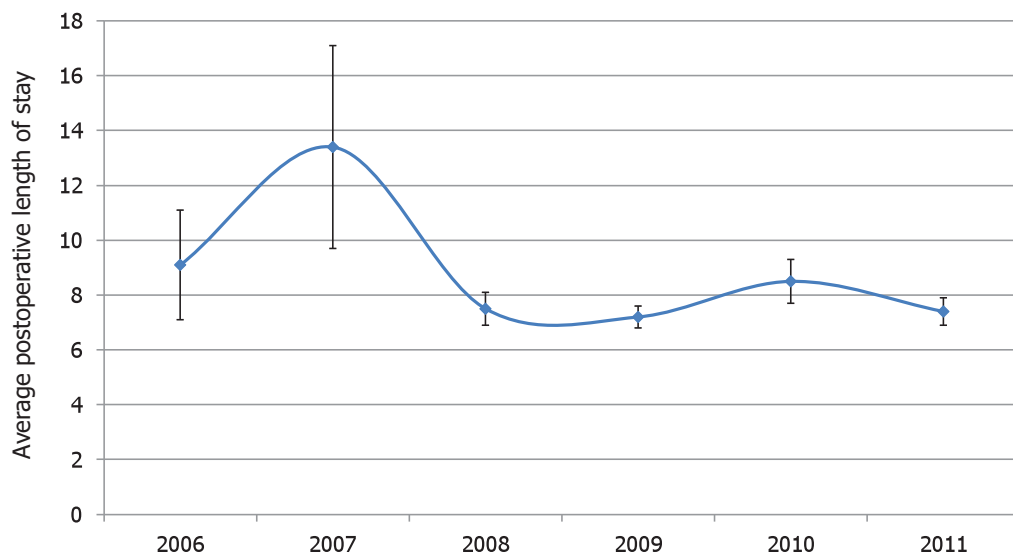




Adult patients (>15 year), postoperative length of stay  
in 26 hospitals and calendar year (n=2,840)

Year	n	Mean	SD	95%CI
2006	670	9.1	26.1	7.1-11.1
2007	543	13.4	43.5	9.7-17.0
2008	499	7.5	7.3	6.9-8.2
2009	422	7.2	5.1	6.8-7.7
2010	387	8.5	8.0	7.7-9.3
2011	319	7.4	4.3	6.9-7.9
Total	2,840	9.1	23.5	8.2-10.0
Missing	2.6%(76)			

Adult patients (>15 year), postoperative length of stay  
in 26 hospitals and calendar year (n = 2,840)

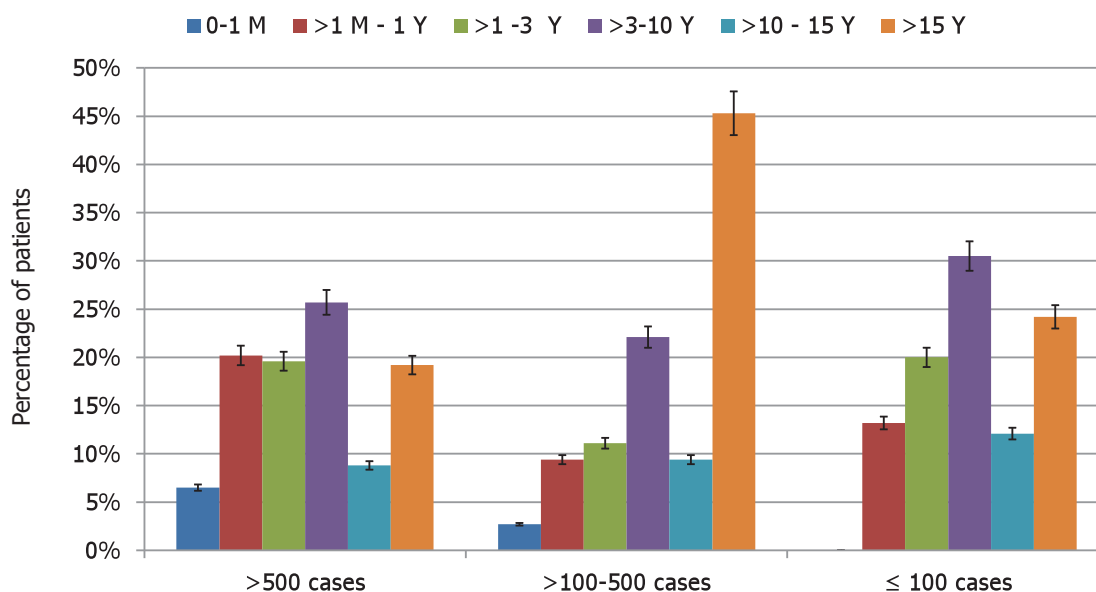




Volume Workload and volume of age group (n=13,081)

Age	>500 Cases	>100-500 cases	≤ 100 cases	Total
Newborn	6.5%	2.7%	0.0%	6.0%
	742	41	0	783
Infant	20.2%	9.4%	13.2%	18.8%
	2,296	142	25	2,463
Pre school	19.6%	11.1%	20.0%	18.6%
	2,229	167	38	2,434
School age	25.7%	22.1%	30.5%	25.3%
	2,925	333	58	3,316
Grown up	8.8%	9.4%	12.1%	8.9%
	1,005	141	23	1,169
Adult	19.2%	45.3%	24.2%	22.3%
	2,187	683	46	2,916
Total	100.0%	100.0%	100.0%	100.0%
	11,384	1,507	190	13,081
Missing	0.1%(16)	0.1%(2)	0	0.1%(18)

Percentage of patients by volume workload and age group (n = 13,081)



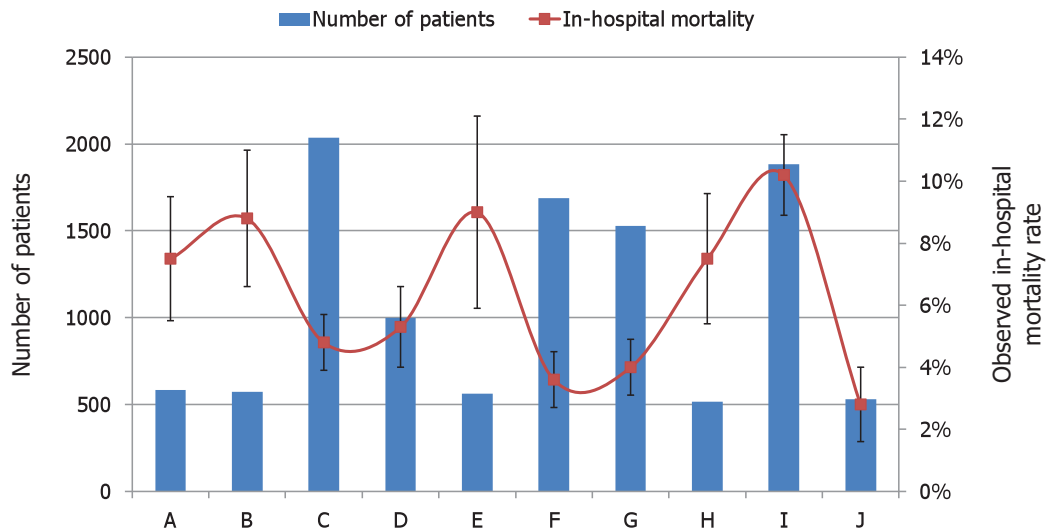


## Workload of hospitals

### Group 1 > 500 cases; 10 hospitals

Number of patients, observed in-hospital mortality among 10 hospitals (>500 cases) (n= 10,900)

Hospital	All	Alive	Mortality	95%CI
A	5.4%	92.5%	7.5%	5.5-10.0
	584	540	44	
B	5.2%	91.2%	8.8%	6.6-11.4
	571	521	50	
C	18.7%	95.2%	4.8%	3.9-5.8
	2,036	1,938	98	
D	9.2%	94.7%	5.3%	4.0-6.9
	1,000	947	53	
E	5.2%	92.0%	9.0%	5.9-10.5
	563	518	45	
F	15.5%	96.4%	3.6%	2.7-4.5
	1,689	1,629	60	
G	14.0%	96.0%	4.0%	3.1-5.1
	1,527	1,466	61	
H	4.7%	92.5%	7.5%	5.4-10.2
	517	478	39	
I	17.3%	89.8%	10.2%	8.9-11.7
	1,884	1,691	193	
J	4.9%	97.2%	2.8%	1.6-4.6
	529	514	15	
Total	100%	94.0%	6.0%	5.6-6.5
	10,900	10,242	658	
Missing	4.4%(500)			



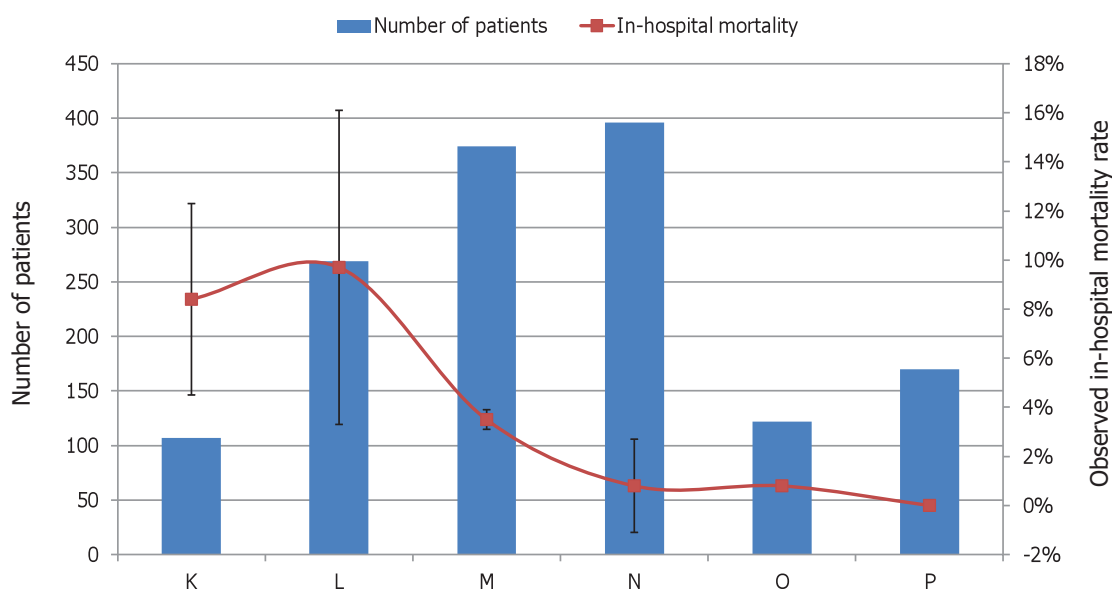


**Group 2 >100-500 cases; 6 hospitals**

Number of patients, observed in-hospital mortality rate among 6 hospitals (>100-500 cases) (n= 1,438)

Hospital	All	Alive	Mortality	95%CI
K	7.4%	91.6%	8.4%	3.9-15.4
	107	98	9	
L	18.7%	90.3%	9.7%	6.4-13.8
	269	243	26	
M	26.0%	98.7%	1.3%	0.4-3.1
	374	369	5	
N	27.5%	96.5%	3.5%	1.9-5.9
	396	382	14	
O	8.5%	99.2%	0.8%	0.02-4.5
	122	121	1	
P	11.8%	100%	0%	-
	170	170	0	
Total	100%	96.2%	3.8%	2.9-4.9
	1,438	1,383	55	
Missing	0.4%(6)			

Number of patients, observed in-hospital mortality rate among 6 hospitals (>100 - 500 cases) (n = 1,438)





**Group 3 ≤ 100 cases; 10 hospitals**

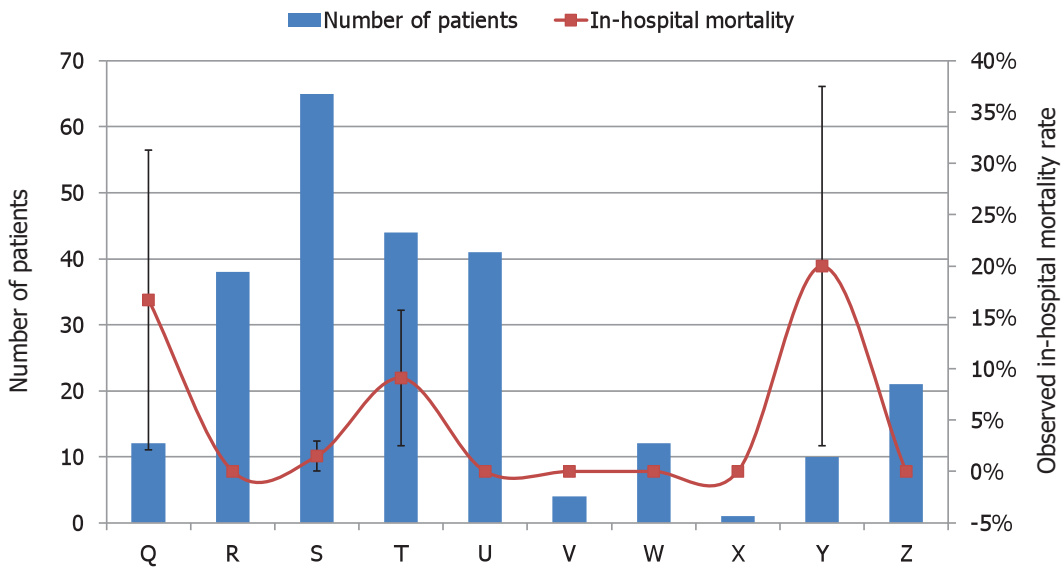
Number of patients, observed in-hospital mortality among  
 10 hospitals (≤100 cases) (n= 248)

Hospital	All	Alive	Mortality	95%CI
Q	4.8%	83.3%	16.7%	2.1-48.4
	12	10	2	
R	15.3%	100.0%	0.0%	0
	38	38	0	
S	26.2%	98.5%	1.5%	0.04-8.3
	65	64	1	
T	17.7%	90.9%	9.1%	2.5-21.7
	44	40	4	
U	16.5%	100.0%	0%	0
	41	41	0	
V	1.6%	100.0%	0%	0
	4	4	0	
W	4.8%	100.0%	0%	0
	12	12	0	
X	0.4%	100.0%	0%	0
	1	1	0	
Y	4.0%	80.0%	20.0%	2.5-55.6
	10	8	2	
Z	8.5%	100.0%	0%	0
	21	21	0	
Total	100%	96.4%	3.6%	1.7-6.8
	248	239	9	
Missing	2.7%(7)			





Number of patients, observed in-hospital mortality rate  
 among 10 hospitals ( $\leq 100$  cases) (n = 248)





## Workload and mortality category n = 12,957

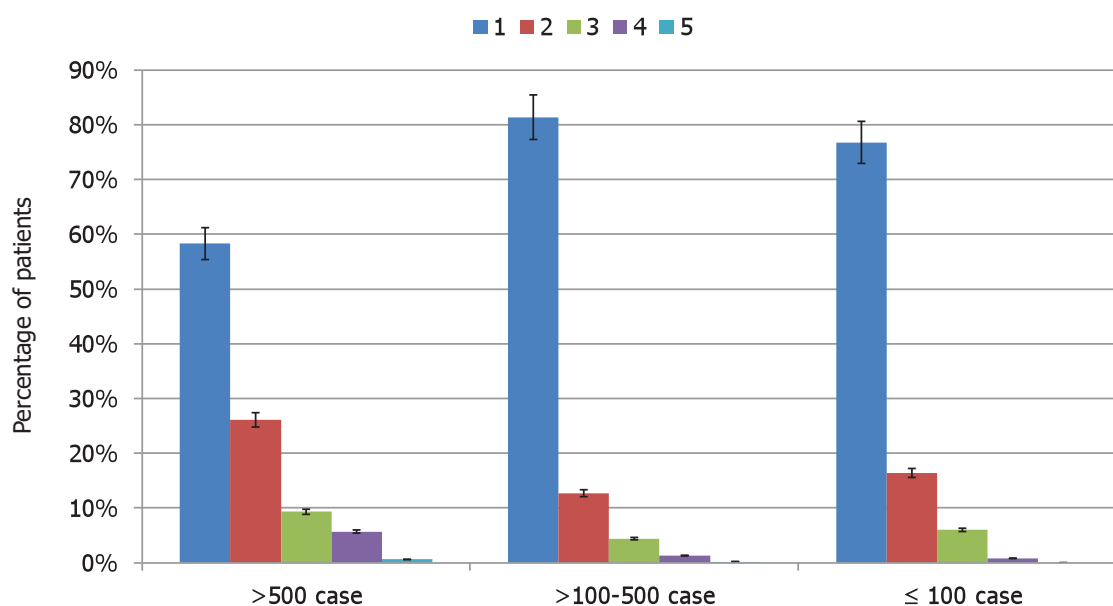
- Most of operated patients (61%) are in category 1.
- 25% are in category 2.
- 8% are in category 3.
- 5% are in category 4.
- Less than 1% is in category 5.
- The large hospital with more data registry has more patients of each corresponding category than the smaller hospital.
- In-hospital mortality of category 1 is 1%; there is small difference of in-hospital mortality among groups of hospitals.
- In-hospital mortality of category 2 is 4%; there is wide variety of in-hospital mortality among groups of hospitals.
- In-hospital mortality of category 3 is 10%; there is wide variety of in-hospital mortality among groups of hospitals.
- In-hospital mortality of category 4 is 16%; there is wide variety of in-hospital mortality among groups of hospitals.
- In-hospital mortality of category 5 is 46%; there is wide variety of in-hospital mortality among groups of hospitals.



Number of patients by mortality category among three hospital groups (n=12,957)

Mortality category	>500 cases	>100-500 cases	≤ 100 cases	Total
1	58.3%	81.4%	76.8%	61.1%
	6,587	1,144	192	7,923
2	26.1%	12.7%	16.4%	24.5%
	2,949	179	41	3,169
3	9.3%	4.4%	6.0%	8.7%
	1,055	62	15	1,132
4	5.7%	1.3%	0.8%	5.1%
	644	18	2	664
5	0.6%	0.2%	0.0%	0.5%
	66	3	0	69
Total	100.0%	100.0%	100.0%	100.0%
	11,301	1,406	250	12,957
Missing	1.1%(142)			

Number of patients, by mortality category among three hospital groups (n = 12,957)





Number of observed in-hospital mortality by mortality category among three hospital groups (n=12,957)

Mortality category	>500 cases		>100-500 cases		≤100 cases		Total	
	All	Dead	All	Dead	All	Dead	All	Dead
1	77.2%	1.0%	91.6%	0.4%	88.7%	0.6%	79.0%	0.9%
	8,724	84	1,347	6	165	1	10,236	91
2	13.7%	4.3%	5.6%	2.4%	7.0%	0.0%	12.7%	4.1%
	1,548	66	83	2	13	0	1,644	68
3	6.0%	10.0%	2.0%	3.4%	3.2%	0.0%	5.5%	9.6%
	681	68	29	1	6	0	716	69
4	2.7%	15.7%	0.5%	0.0%	1.1%	50.0%	2.4%	15.5%
	300	47	8	0	2	1	310	48
5	0.4%	46.9%	0.2%	33.3%	-	-	0.4%	46.2%
	49	23	3	1	-	-	52	24
Total	100.0%	2.5%	100.0%	0.7%	100.0%	1.1%	100.0%	2.3%
	11,302	288	1,470	10	186	2	12,958	300
Missing	1.1%(141)							



## Overview of workload by age group and gender

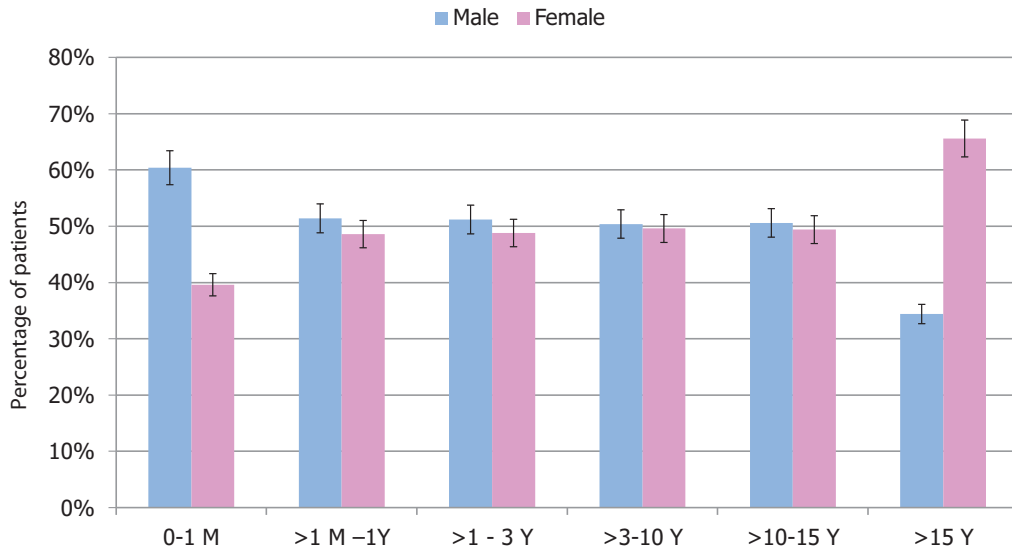
- The number of congenital heart surgery in children is slightly more in male than in female but is almost equal in group >3-15 year, but beyond 15 years of age, the number of female operated is more than male.
- The in-hospital mortality rate is slightly higher in male than female except in the age group of >1-3 year and > 10-15 year which have similar mortality rate.
- The postoperative length of stay is longer in male than in female except in the newborn.
- In newborn the postoperative length of stay is about one month, the older is the age the shorter is the postoperative length of stay.
- The postoperative length of stay in >15 year old men and women are 11 and 8 days respectively.

Age group and gender (n = 13,081)

Age	Male	Female	Total
Newborn	60.4%	39.6%	100%
	473	310	783
Infant	51.4%	48.6%	100%
	1,266	1,197	2,463
Pre school	51.2%	48.8%	100.0%
	1,247	1,187	2,434
School age	50.4%	49.6%	100.0%
	1,671	1,645	3,316
Grown up	50.6%	49.4%	100.0%
	592	577	1,169
Adult	34.4%	65.6%	100.0%
	1,002	1,914	2,916
Total	47.8%	52.2%	100.00%
	6,251	6,830	13,081
Missing	0.1% (9)	0.1% (9)	



Age group and gender (n = 13,081)

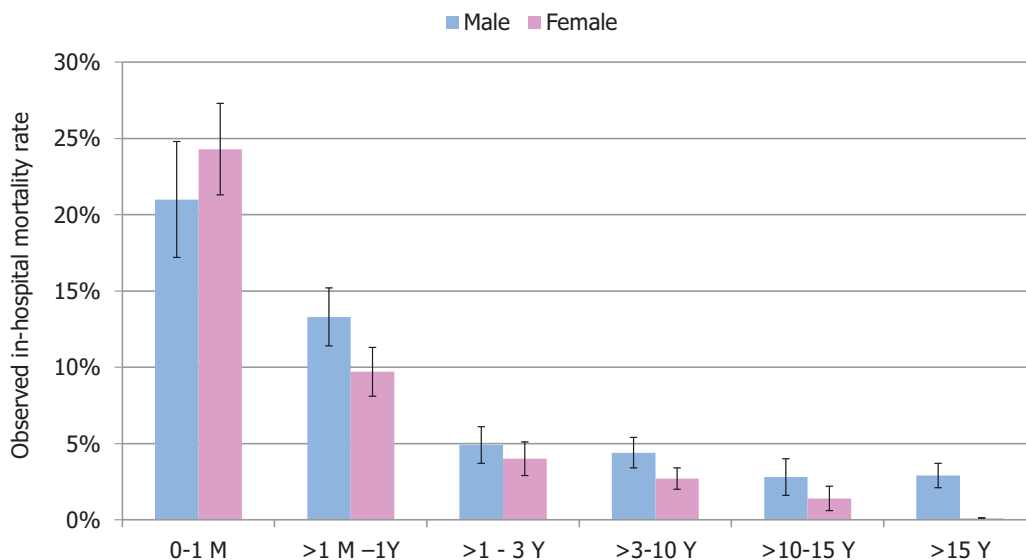


Age group and gender by in-hospital mortality (n = 12,574)

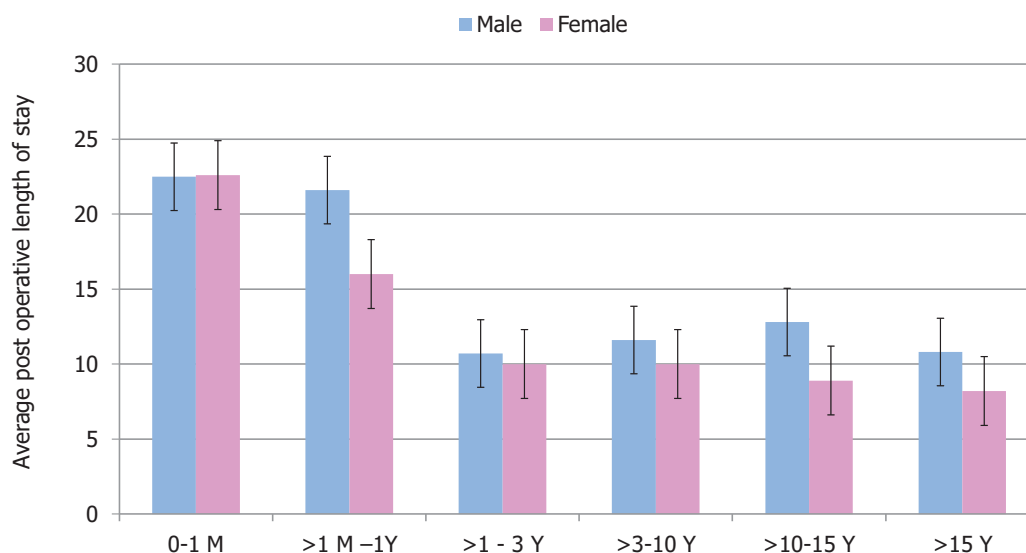
Age	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
Newborn	7.1%	21.0%	17.2-25.2	4.2%	26.3%	21.3-32.0
	424	89		277	73	
Infant	20.1%	13.3%	11.4-15.4	17.3%	9.7%	8.1-11.6
	1,203	160		1,143	111	
Pre school	19.9%	4.9%	3.7-6.2	17.4%	4.0%	2.9-5.3
	1,192	58		1,149	46	
School age	26.9%	4.4%	3.4-5.5	24.1%	2.7%	2.0-3.6
	1,608	70		1,591	43	
Grown up	9.5%	2.8%	1.6-4.5	8.4%	1.4%	0.6-2.8
	569	16		556	8	
Adult	16.4%	3.0%	2.1-4.3	28.5%	0.1%	0.06-1.6
	981	29		1,881	19	
Total	100.0%	7.1%	6.4-7.7	100.0%	4.5%	4.1-5.0
	5,977	422		6,597	300	
Missing	4.5% (283)			3.5% (242)		



In-hospital mortality by age group and gender (n = 12,574)



Age group and gender by average postoperative length of stay (n = 12,574)





## **In-hospital mortality by age, gender and mortality category**

- In newborn with mortality category 1, female gender has more in-hospital mortality (10%) than male (7%).
- In newborn with mortality category 2, female gender has less in-hospital mortality (15%) than male(16%).
- In newborn with mortality category 3, female gender has more in-hospital mortality (30%) than male (23%).
- In newborn with mortality category 4, female gender has more in-hospital mortality (42%) than male (33%).
- In newborn with mortality category 5, female gender has more in-hospital mortality (60%) than male (50%).
- In infant with mortality category 1, female gender has lesser in-hospital mortality (5%) than male (6%).
- In infant with mortality category 2, female gender has lesser in-hospital mortality (10%) than male (14%).
- In infant with mortality category 3, female gender has lesser in-hospital mortality (18%) than male (26%).
- In infant with mortality category 4, female gender has more in-hospital mortality (26%) than male(23%).
- In infant with mortality category 5, female gender has more in-hospital mortality (89%) than male (71%).
- In pre-school age with nearly all mortality categories, male has more in-hospital mortality than female except in mortality category 3 and 5 which both sexes having same mortality.
- In school age with nearly all mortality categories, male has more in-hospital mortality than female except in mortality category 1 which male has less in-hospital mortality than female.
- In grown up patients with nearly all mortality categories, male has more in-hospital mortality than female except in mortality category 1 which male has less in-hospital mortality than female.
- In adult with all mortality categories, male has more in-hospital mortality than female.

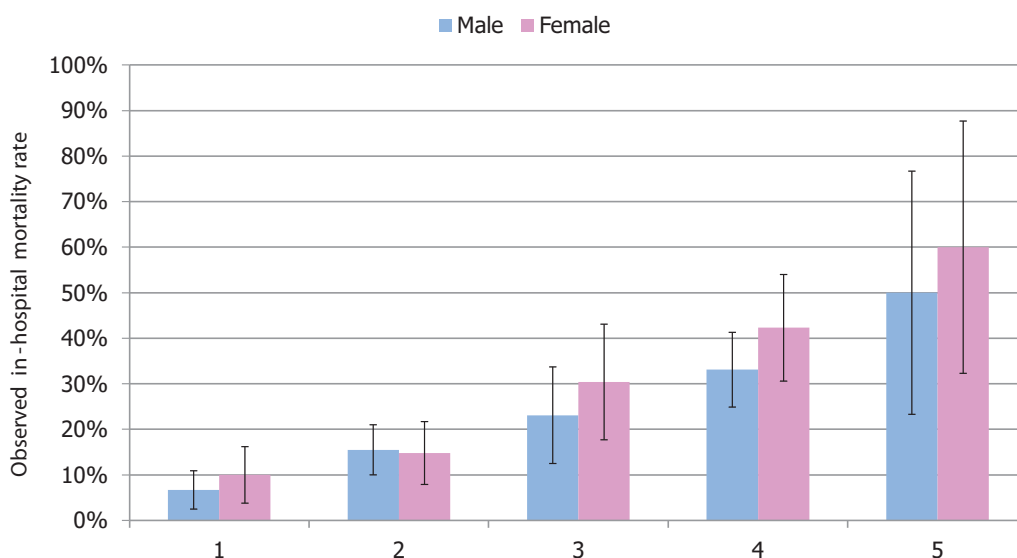




In-hospital mortality of newborn by gender and mortality category (n = 694)

Mortality Category	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
1	21.1%	6.7%	2.5-14.1	22.0%	10.0%	3.8-20.5
	89	6		60	6	
2	33.7%	15.5%	10.0-22.5	29.7%	14.8%	7.9-24.4
	142	22		81	12	
3	12.4%	23.1%	12.5-36.8	16.8%	30.4%	17.7-45.8
	52	12		46	14	
4	29.5%	33.1%	24.9-42.1	26.0%	42.3%	30.6-54.6
	124	41		71	30	
5	3.3%	50.0%	23.3-8.0	5.5%	60.0%	32.3-83.7
	14	7		15	9	
Total	100.0%	20.9%	17.1-25.1	100.0%	26.0%	20.9-31.6
	421	88		273	71	
Missing	11.0% (52)			11.9% (37)		

In-hospital mortality of newborn by gender and mortality category (n = 694)

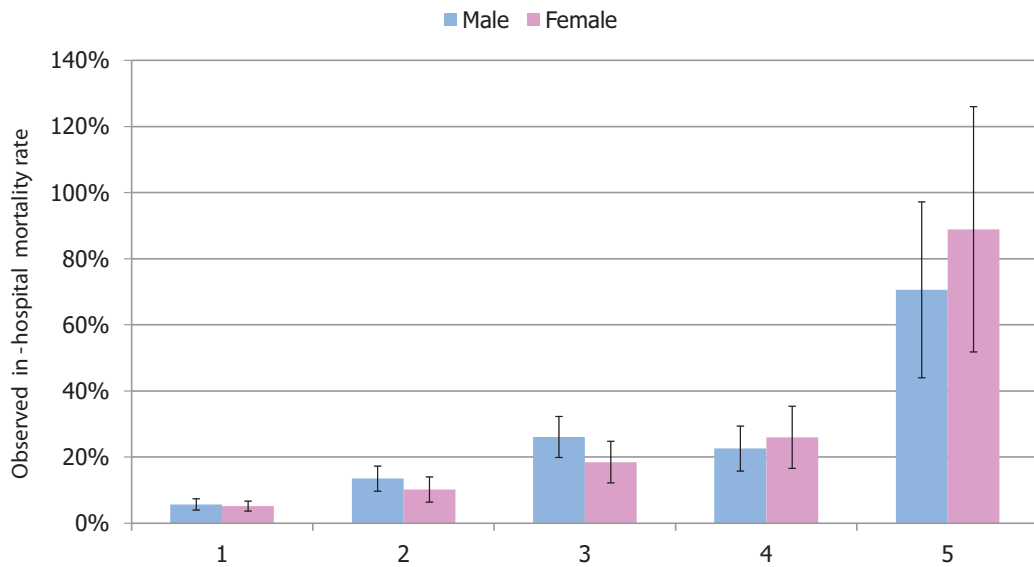




Infant: In-hospital mortality by gender and mortality category (n = 2,331)

Mortality Category	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
1	50.2%	5.7%	4.0-7.8	62.8%	5.2%	3.7-7.1
	600	34		713	37	
2	22.2%	13.5%	9.7-18.2	18.1%	10.2%	6.4-15.2
	266	36		206	21	
3	15.1%	26.1%	19.9-33.2	11.5%	18.5%	12.2-26.2
	180	47		130	24	
4	11.1%	22.6%	15.8-30.6	6.8%	26.0%	16.6-37.2
	133	30		77	20	
5	1.4%	70.6%	44.0-89.7	0.8%	88.9%	51.8-99.7
	17	12		9	8	
Total	100.0%	13.3%	11.4-15.4	100.0%	9.7%	8.0-11.6
	1,196	159		1,135	110	
Missing	5.5% (70)			5.2% (62)		

In-hospital mortality of infant by gender and mortality category (n = 2,331)

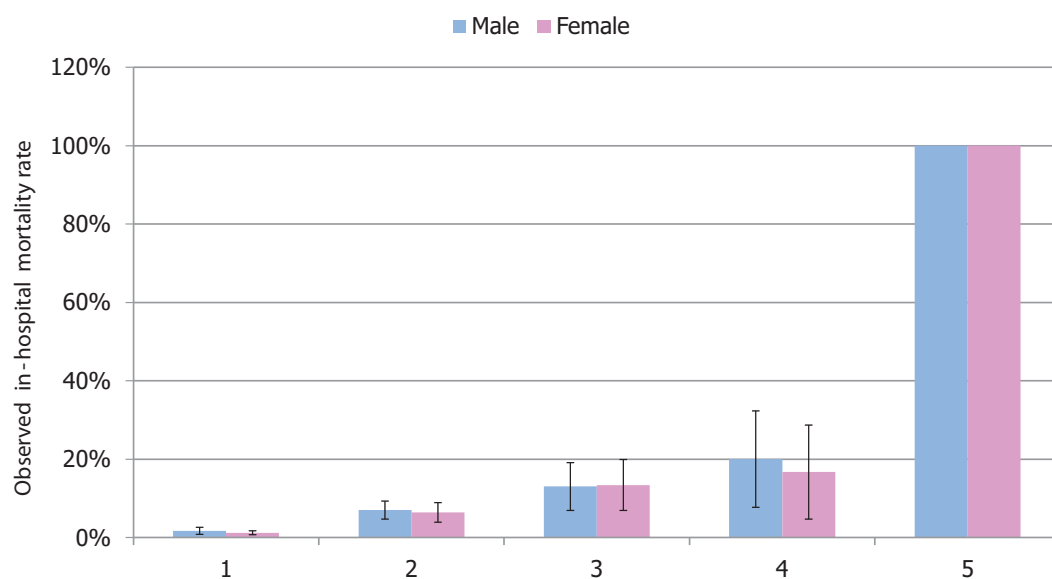




Pre school patients: in-hospital mortality by gender and mortality category (n = 2,322)

Mortality Category	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
1	55.8%	1.7%	0.8-3.0	64.2%	1.2%	0.7-2.3
	662	11		729	9	
2	33.9%	7.0%	4.7-9.9	26.2%	6.4%	3.9-9.8
	402	28		297	19	
3	7.8%	13.0%	6.9-21.7	7.2%	13.4%	6.9-22.7
	92	12		82	11	
4	2.5%	20.0%	7.7-38.6	2.1%	16.7%	4.7-37.4
	30	6		24	4	
5	0.1%	100.0%	-	0.3%	100.0%	-
	1	1		3	3	
Total	100.0%	4.9%	3.7-6.3	100.0%	4.1%	3.0-5.4
	1,187	58		1,135	46	
Missing	5.0% (62)			4.4% (52)		

Pre school patients: in-hospital mortality by gender and mortality category (n = 2,322)

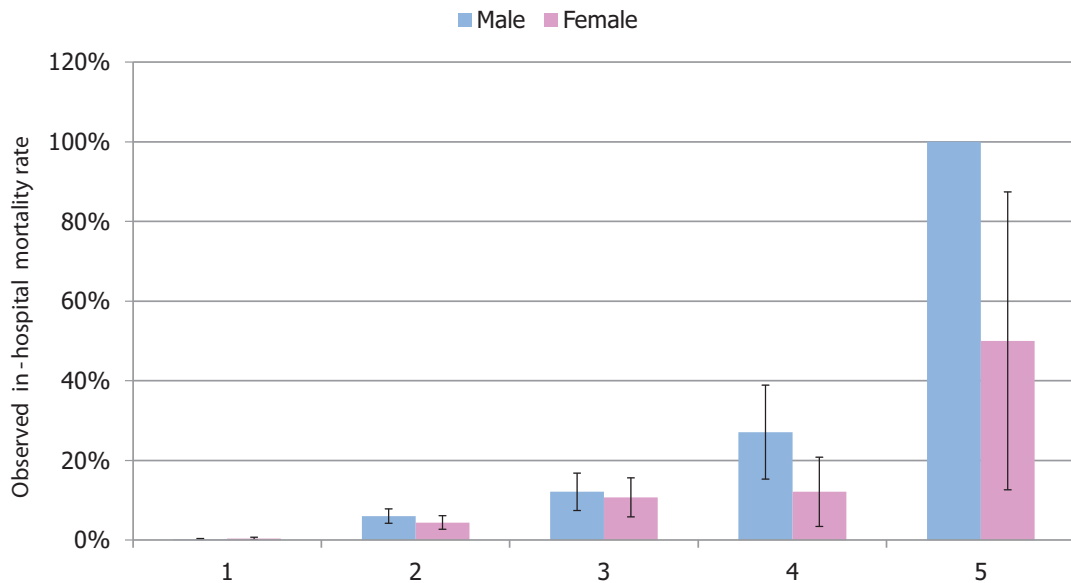




School age patients: in-hospital mortality by gender and mortality category (n = 3,172)

Mortality Category	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
1	51.9%	0.2%	0.03-0.9	61.4%	0.4%	0.1-1.1
	828	2		968	4	
2	35.2%	6.0%	4.2-8.4	28.6%	4.4%	2.7-6.8
	562	34		451	20	
3	9.8%	12.1%	7.4-18.3	7.7%	10.7%	5.8-17.5
	157	19		122	13	
4	9.8%	27.1%	15.3-41.8	2.1%	12.1%	3.4-28.2
	48	13		33	4	
5	0.1%	100.0%	-	0.1%	50.0%	12.6-98.7
	1	1		2	1	
Total	100.0%	4.3%	3.4-5.4	100.0%	2.7%	1.9-3.6
	1,596	69		1,576	42	
Missing	4.5% (75)			4.2% (69)		

School age patients: in-hospital mortality by gender and mortality category (n = 3,172)

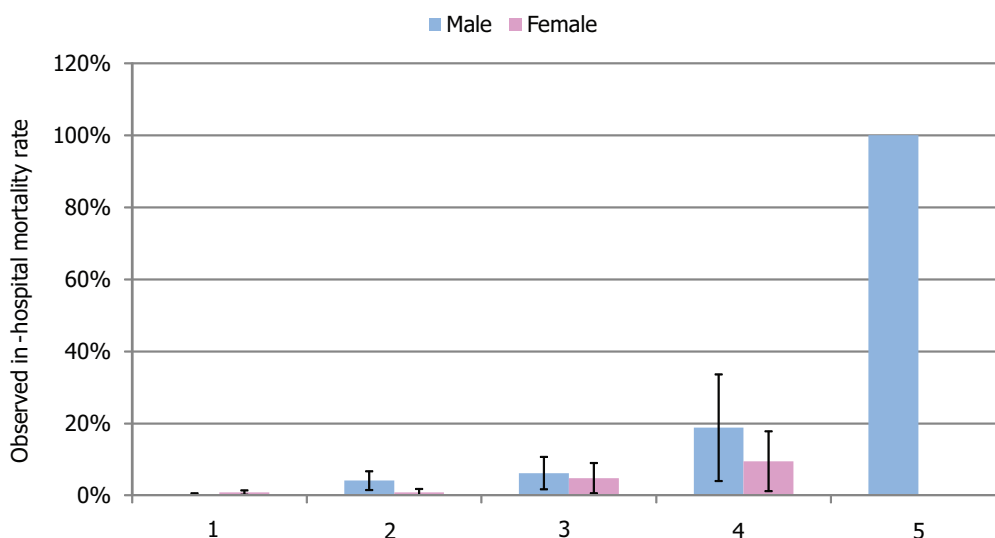




Grown up patients: in-hospital mortality by gender and mortality category (n = 1,121)

Mortality Category	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
1	59.6%	0.3%	0.008-1.6	68.53%	0.8%	0.2-2.3
	337	1		381	3	
2	55.7%	4.1%	1.5-8.8	20.0%	0.9%	0.002-4.9
	145	6		111	1	
3	11.5%	6.2%	1.7-15.0	20.0%	4.8%	0.6-16.2
	65	4		42	2	
4	2.8%	18.8%	4.0-45.6	7.6%	9.5%	1.2-30.4
	16	3		21	2	
5	0.4%	100.0%	-	0.2%	0.0%	-
	2	2		1	0	
Total	100.0%	2.8%	1.6-4.6	100.0%	1.4%	0.6-2.8
	565	16		556	8	
Missing	4.6% (27)			3.6% (21)		

Grown up patients: in-hospital mortality by gender and mortality category (n = 1,121)

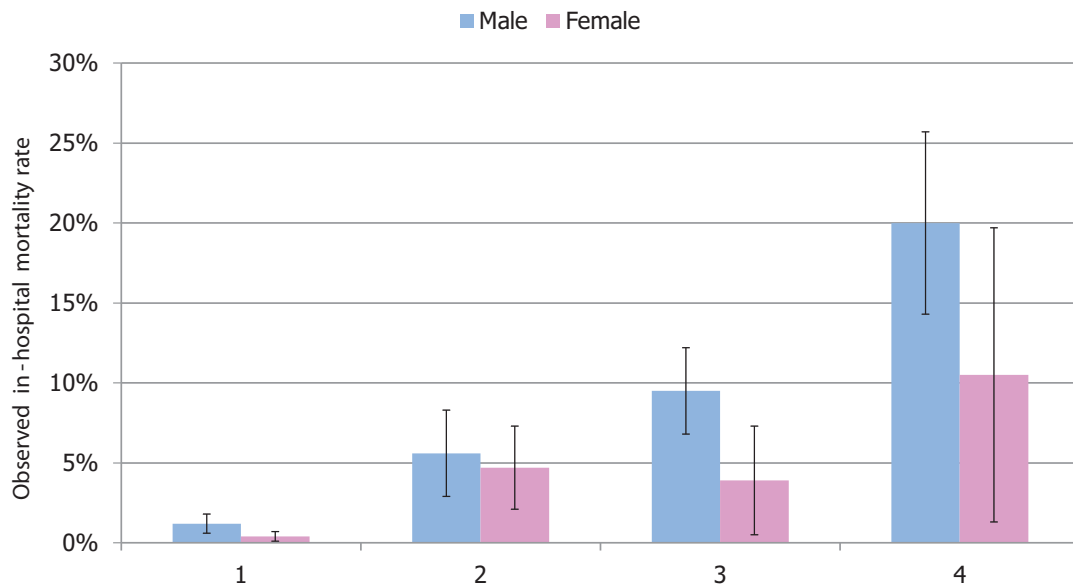




Adult patients: in-hospital mortality by gender and mortality category (n = 2,830)

Mortality Category	Male		95% CI	Female		95% CI
	All	Dead		All	Dead	
1	75.4%	1.2%	0.6-2.3	87.1%	0.4%	0.1-0.8
	732	9		1,619	6	
2	18.2%	5.6%	2.7-10.1	9.1%	4.7%	2.1-9.1
	177	10		170	8	
3	4.3%	9.5%	2.7-22.6	2.7%	3.9%	0.5-13.5
	42	4		51	2	
4	2.1%	20.0%	5.7-43.7	1.0%	10.5%	1.3-33.1
	20	4		19	2	
Total	100.0%	2.8%	1.8-4.0	100.0%	1.0%	0.6-1.5
	971	27		1,859	18	
Missing	3.1% (31)			2.9% (55)		

Adult patients: in-hospital mortality by gender and mortality category (n = 2,830)





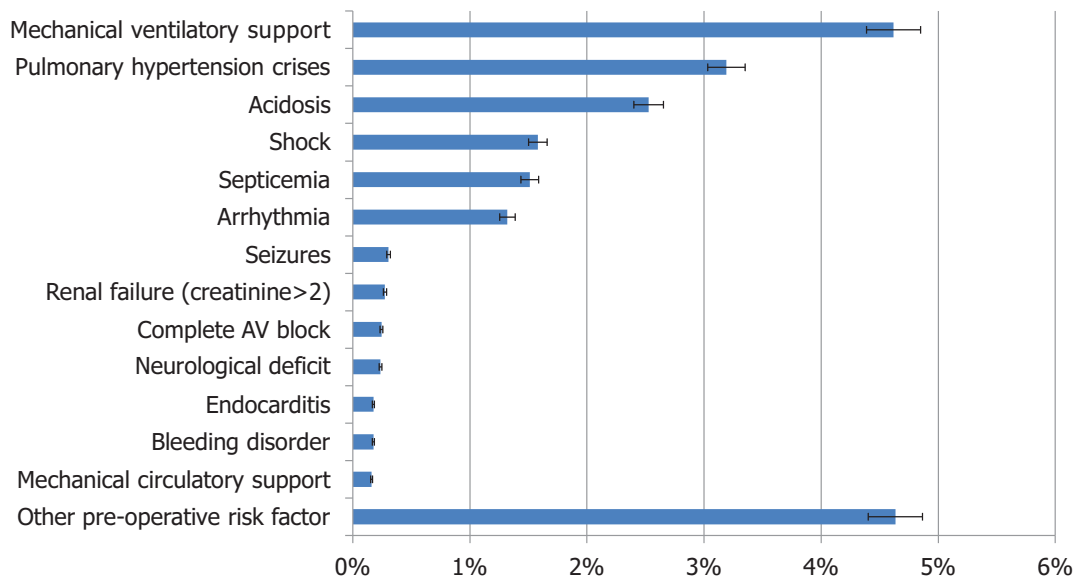
# Chapter 3



### Overall preoperative risk factors

- The incidence of preoperative risk factors is almost 14% of all patients.
- The incidence of mechanical ventilatory support of all patients before operation is almost 5%; this is the most common pre operative risk factors, with this risk the in-hospital mortality rate is about 31%.
- With preoperative risk, the mean postoperative length of stay is 22 days comparing to 10 days of those without.
- The preoperative risk factors with shock or renal failure requiring dialysis have similar in-hospital mortality of 50%.
- Patients with renal failure with creatinine >2.0 mg and patients with acidosis, both have similar in-hospital mortality rate of 39%.
- Mechanical circulatory support and bleeding disorder are not common (0.25%) but each has similar mortality rate of 35%.
- The higher is the mortality category the higher is the in-hospital mortality; with presence of preoperative risk the in-hospital mortality is more dominant.

Most common preoperative risk factors in 26 hospitals (n = 12,934)







Preoperative risk factors and postoperative length of stay in 26 hospitals (n = 12,299)

Preoperative risk factors	Percentage Number	Mean S.D.	95% CI
No	86.3%	11.0	10.5-11.5
	10,619	27.0	
Yes	13.7%	21.5	19.7-23.3
	1,680	36.9	
Missing	6.7% (880)		

Preoperative risk factors and observed in-hospital mortality in 26 hospitals (n = 12,549)

Preoperative risk factors	Percentage Number	In-hospital mortality	95% CI
No	86.2%	3.6%	3.2-3.9
	10,816	386	
Yes	13.8%	18.8%	17.0-20.7
	1,733	326	
Missing	4.2% (550)		

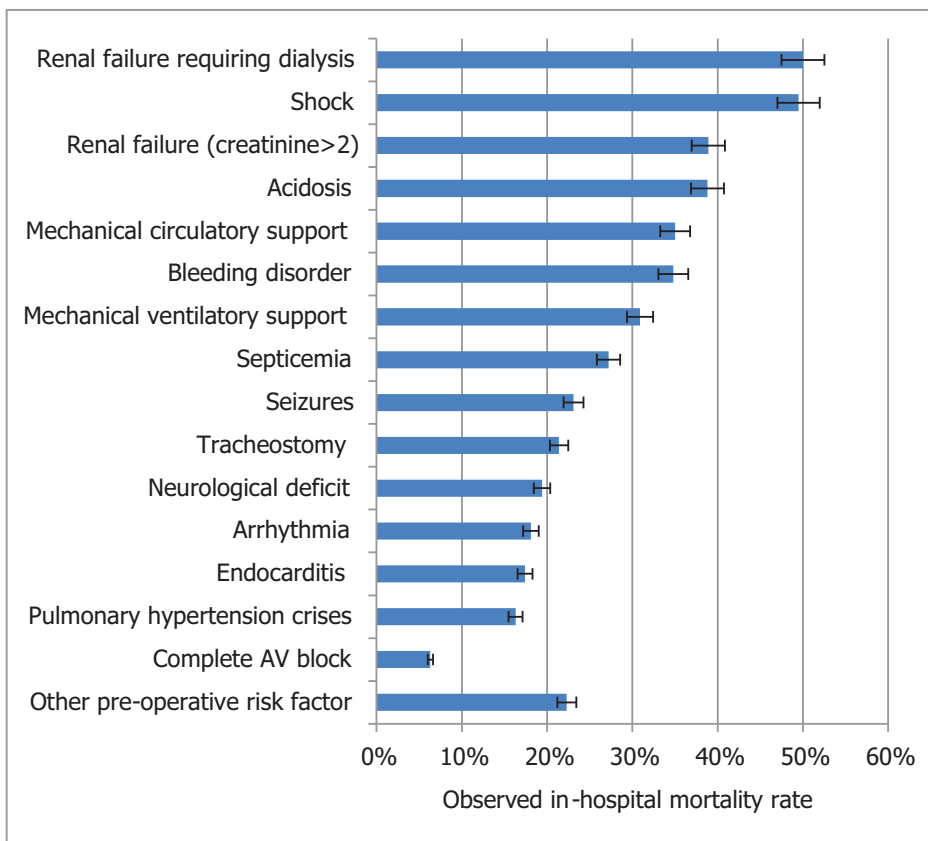


Preoperative risk factors and in-hospital mortality  
in 26 hospitals (n= 12,549)

Type of Preoperative risk	Percentage Number	In-hospital mortality	95%CI
Mechanical ventilatory support	4.7%	30.9%	27.2-34.8
	595	184	
Pulmonary hypertensive crisis	3.0%	16.3%	12.7-20.4
	381	62	
Acidosis	2.6%	38.8%	33.5-44.4
	327	127	
Shock	1.6%	49.5%	42.5-56.6
	204	101	
Septicemia	1.6%	27.2%	21.1-34.0
	195	53	
Arrhythmia	1.4%	18.1%	12.7-24.7
	171	31	
Seizures	0.3%	23.1%	11.1-39.3
	39	9	
Renal failure (creatinine >2)	0.3%	38.9%	23.1-56.5
	36	14	
Complete AV block	0.3%	6.3%	0.8-20.8
	32	2	
Neurological deficit	0.2%	19.4%	7.5-37.5
	31	6	
Bleeding disorder	0.2%	34.8%	16.4-57.3
	23	8	
Endocarditis	0.2%	17.4%	5.0-38.8
	23	4	
Mechanical circulatory support	0.2%	35.0%	15.3-59.2
	20	7	
Tracheostomy	0.1%	21.4%	4.7-50.8
	14	3	
Renal failure requiring dialysis	0.1%	50.0%	15.7-84.3
	8	4	
Other preoperative risk factor	4.7%	22.3%	19.0-25.9
	592	132	



Pre-operative risk factors and in-hospital mortality (n = 12,549)



**Preoperative risk and mortality category**

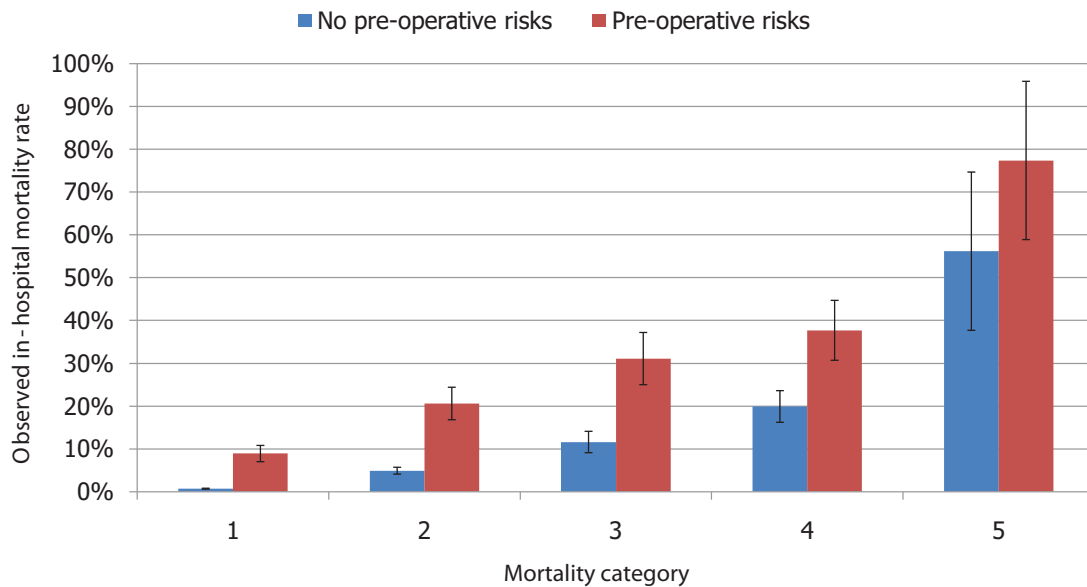
- With preoperative risk, the higher is the mortality category risk the higher is the number of preoperative risk together with the in-hospital mortality.
- Preoperative risk is present in the younger age than the older age; preoperative risk in newborn is 37%.
- In all age groups, presence of preoperative risk have more in-hospital mortality than those without, in addition the younger age has higher in-hospital mortality than the older age. For instance the in-hospital mortality of newborn, infant and small children is 31%, 25% and 16% respectively.



Preoperative risks, mortality category and in-hospital mortality (n = 12,447)

Mortality category	Preoperative risks					
	No			Yes		
	Percentage Number	In-hospital mortality	95% CI	Percentage Number	In-hospital mortality	95% CI
1	88.7%	0.7%	0.6-1.0	11.3%	8.9%	7.0-10.9
	6,842	51		870	77	
2	85.8%	4.9%	4.1-5.8	14.2%	20.0%	16.8-24.7
	2,576	126		428	88	
3	79.9%	11.6%	9.5-14.0	20.1%	31.1%	25.0-37.8
	845	98		212	66	
4	70.0%	19.9%	16.2-24.0	30.0%	37.7%	30.7-45.2
	428	85		183	69	
5	50.8%	56.2%	37.7-73.6	49.2%	77.4%	58.9-90.4
	32	18		31	24	
Missing	5.0% (652)					

Preoperative risks, mortality category and in-hospital mortality (n = 12,447)

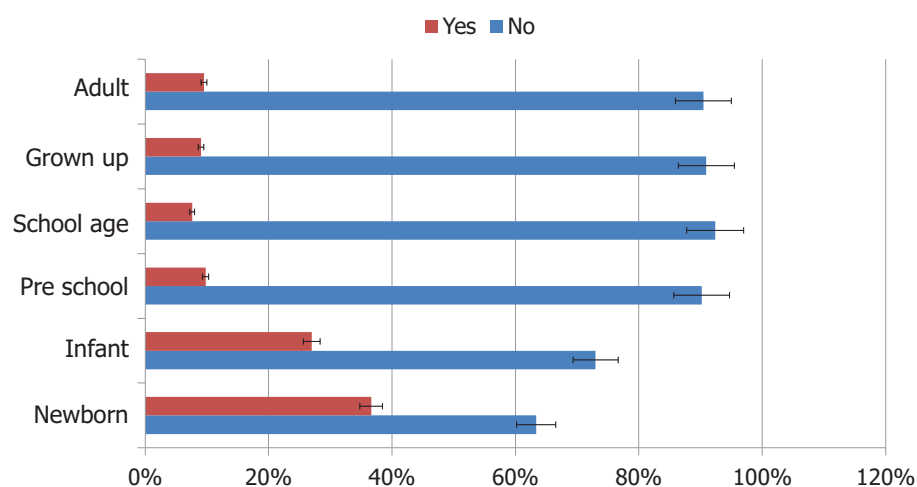




Preoperative risks and age group (n = 12,916)

Age	Preoperative risks		All
	No	Yes	
Newborn	63.4%	36.6%	100%
	481	278	759
Infant	73.0%	27.0%	100%
	1,766	653	2,419
Pre school	90.2%	9.8%	100.0%
	2,173	236	2,409
School age	92.4%	7.6%	100.0%
	3,032	250	3,282
Grown up	90.9%	9.1%	100.0%
	1,045	104	1,149
Adult	90.5%	9.5%	100.0%
	2,622	276	2,898
Missing	1.4% (183)		

Preoperative risks and age group (n = 12,916)

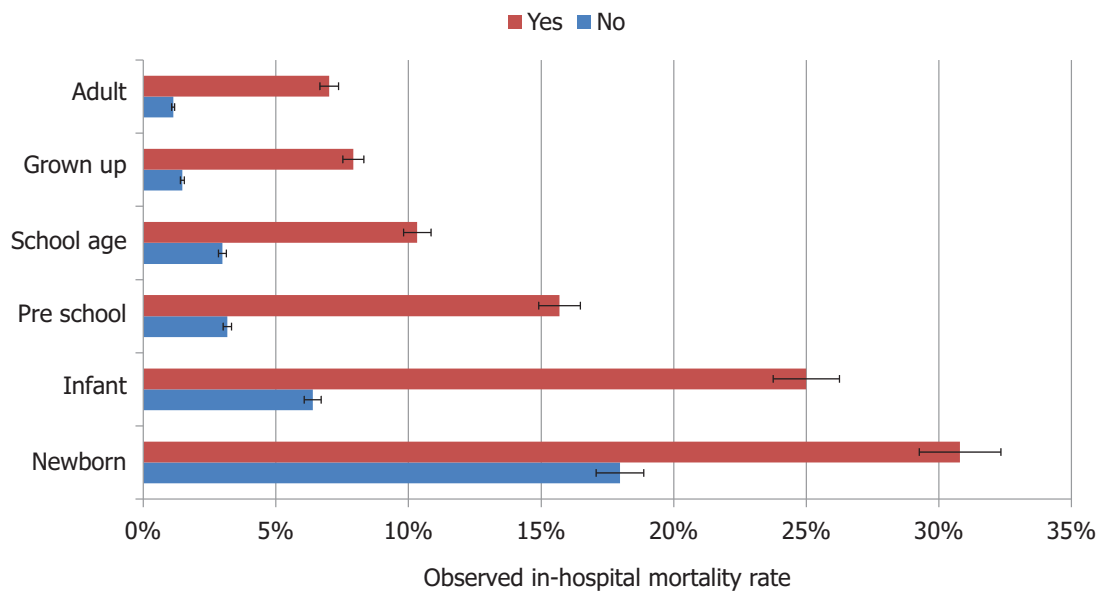




Preoperative risks, age group and in-hospital mortality (n = 12,537)

Age	Observed in-hospital mortality rate	
	Without risk	With risk
Newborn	18.0%	30.8 %
Infant	6.4%	25.0%
Pre school	3.2%	15.7%
School age	3.0%	10.3%
Grown up	1.5%	7.9%
Adult	1.1%	7.0 %
All	3.6%	18.8%
Missing	4.3% (562)	

Preoperative risks, age group and in-hospital mortality (n = 12,537)

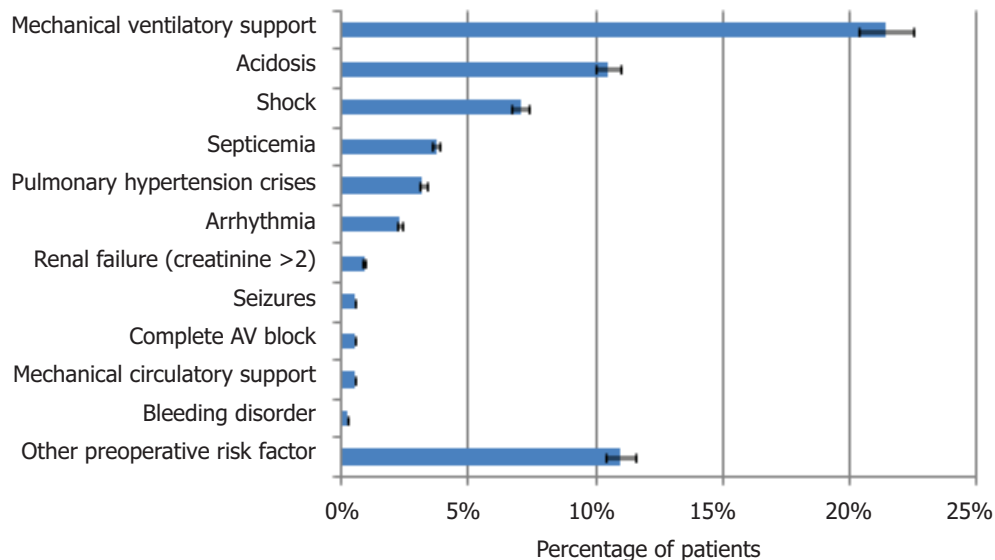




### Types of preoperative risk and age

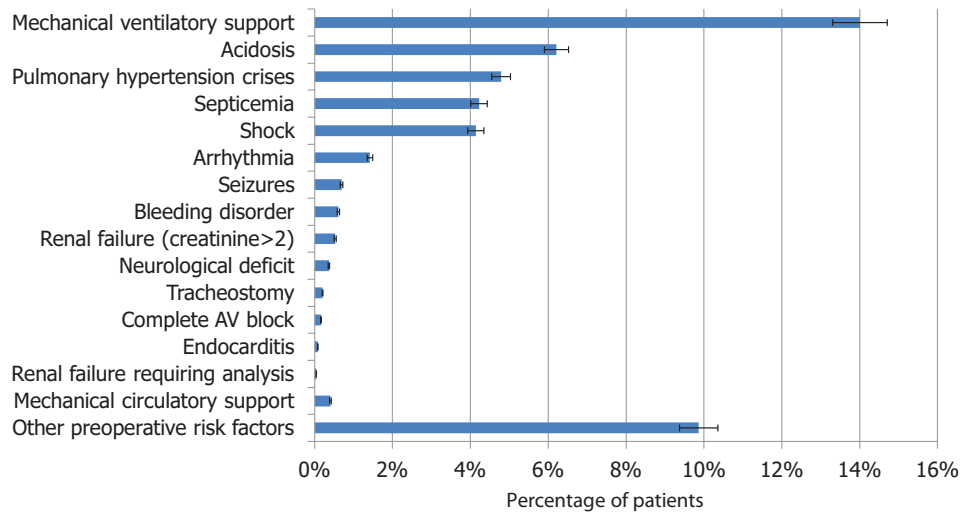
- Preoperative risk varies according to age group.
- More than 20% of newborn are on mechanical ventilatory support before operation; the leading preoperative risks in newborn are ventilatory support, acidosis and shock; while the percentage of preoperative risk in infancy is less than newborn yet acidosis, pulmonary hypertensive crisis, septicemia and shock seem to be more prevalent than newborn.
- Among > 1 to 10 years of age, most patients have less numbers of preoperative risk than the younger age but they have higher percentage of pulmonary hypertensive crisis as the leading preoperative risk factors.
- The older children and adult with congenital heart disease seem to have pulmonary hypertension; some of the grown-up even come for operation with preoperative risk of ventilatory support, arrhythmia and heart block; different picture between patients in younger age and grown-up or adult probably reflects some children with particular preoperative risk die during newborn and infancy leaving the remaining grown-up alive with residual heart lesion. This explains why we have increasing problem of pulmonary hypertension or myocardial problem with arrhythmia and heart block in grown-up children and adult.

Preoperative risk factors in newborn patients (0-1 month) (n = 783)

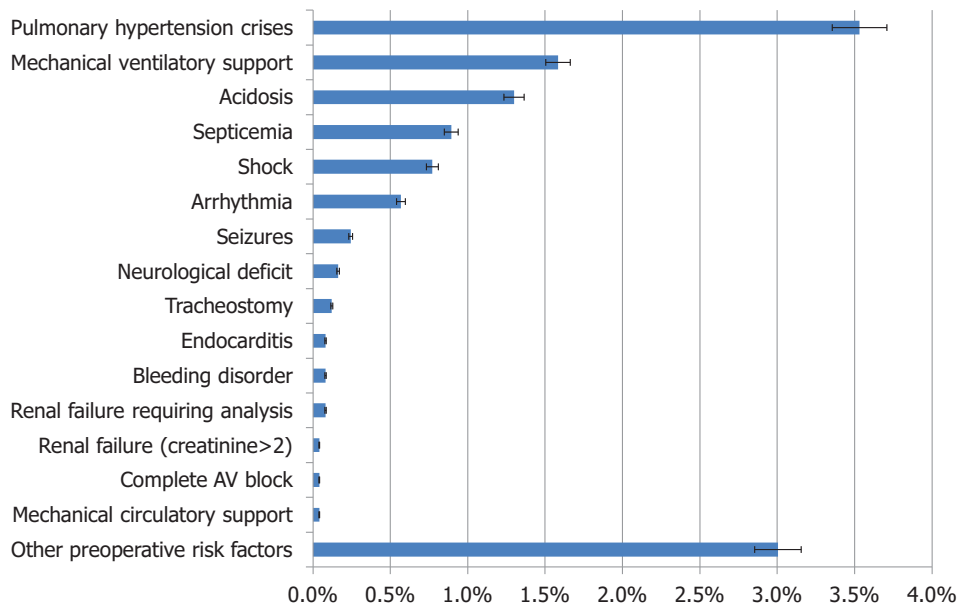




Most common preoperative risk factors in infant patients (>1 month - 1 Year) (n = 2,463)



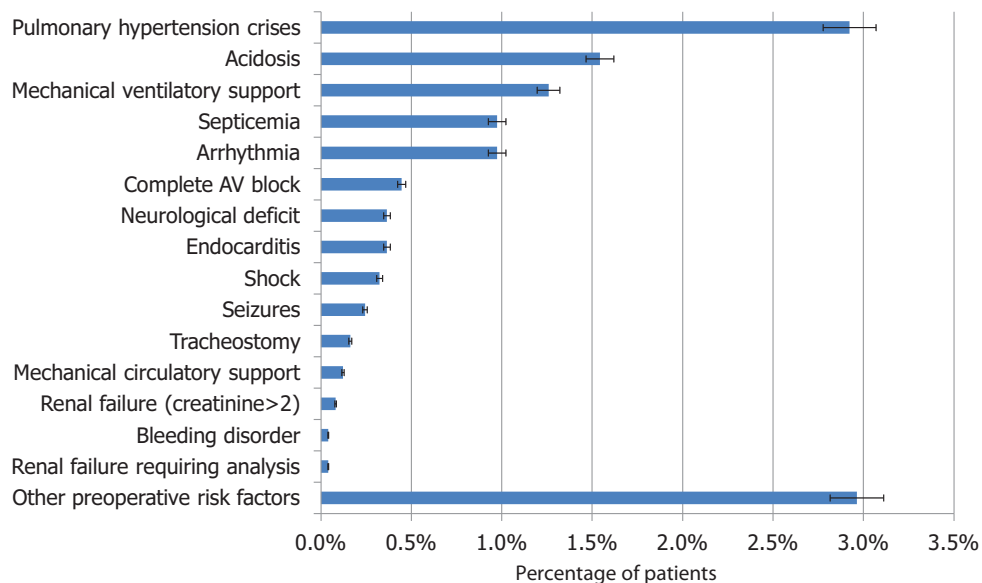
Most common preoperative risk factors in pre school patients (>1 - 3 Year) (n = 2,434)



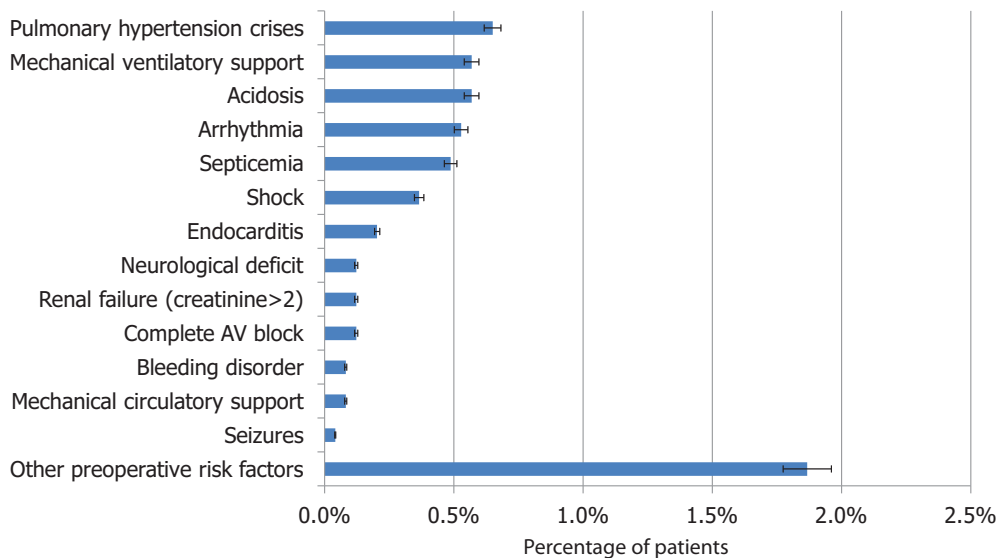




Most common preoperative risk factors in school age patients (>3 - 10 Year) (n = 3,316)

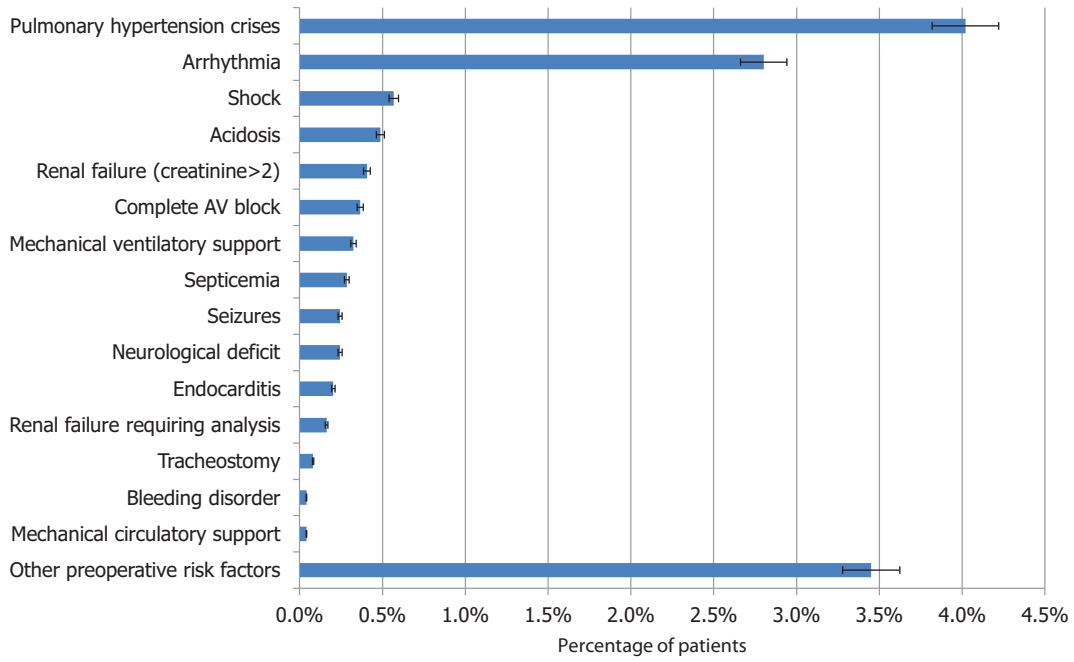


Most common preoperative risk factors in grown up patients (>10 - 15 Year) (n = 1,169)





Most common preoperative risk factors in adult patients (>15 Year) (n = 2,916)





# Chapter 4





## Mortality category and procedures of all age groups

- There are 177 procedures of 12,482 operations in 5 mortality categories with 6% in-hospital mortality.
- Most operations are in mortality category 1; the most common procedures in category 1 are VSD repair with patch, ASD repair with patch, PDA surgical closure, VSD repair with primary closure, ASD repair with primary closure and TOF repair with ventriculotomy and non-transanular patch. Their in-hospital mortality are 2%, 1%, 3%, 1%, 1% and 6% respectively.
- In mortality category 2, the most common procedures are Modified Blalock-Taussig shunt, TOF repair by non ventriculotomy and Bidirectional cavopulmonary anastomosis; all with the in-hospital mortality of 6%, 8% and 9% respectively.
- In mortality category 3 of all ages, the most common procedures are TAPVC repair, PA banding, Complete CAVSD repair, DORV with intraventricular tunnel repair and Central shunt; all with the in-hospital mortality of 23%, 15%, 16%, 16% and 14% respectively.
- In mortality category 4 of all ages, the most common procedures are Arterial switch operation, Aortic arch repair, Interrupted aortic arch repair and Congenitally corrected TGA repair, atrial switch and ASO (double switch); all with in-hospital mortality rate of 23%, 34%, 30% and 29% respectively.
- In mortality category 5 of all ages, the most common procedures are Norwood procedure, HLHS biventricular repair, and Damus-Kaye-Stensel procedure; all with in-hospital mortality of 63% 63% and 71% respectively.



**Table 1.1**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No.with mortality		%	95% CI	
					Lower	Upper
VSD repair, patch	2,021	48	2.4%	2.4%	1.7%	3.1%
ASD repair, patch	1,506	9	0.6%	0.6%	0.2%	1.0%
PDA closure, surgical	1,267	35	2.8%	2.8%	1.8%	3.7%
VSD repair, primary closure	721	8	1.1%	1.1%	0.4%	1.9%
ASD repair, primary closure	644	6	0.9%	0.9%	0.2%	1.7%
TOF repair, ventriculotomy, transanular patch	550	32	5.8%	5.8%	4.0%	7.7%
PDA closure, device	233	6	2.6%	2.6%	0.5%	4.8%
ASD partial closure	122	2	1.6%	1.7%	0.0%	4.0%
PDA closure, NOS	111	0	0.0%	0.1%	0.0%	0.6%
Valvuloplasty, tricuspid	89	5	5.6%	5.5%	0.8%	10.3%
TOF repair, ventriculotomy, nontransanular patch	80	4	5.0%	5.1%	0.4%	9.8%
PFO, primary closure	78	1	1.3%	1.4%	0.0%	4.0%
Valvuloplasty, mitral	77	3	3.9%	4.1%	0.0%	8.4%
Valvuloplasty, pulmonic	75	4	5.3%	5.5%	0.3%	10.7%
Coarctation repair, end to end	72	3	4.2%	4.3%	0.0%	9.0%
Esophageal procedure	68	4	5.9%	5.9%	0.6%	11.1%
PAPVC repair	61	1	1.6%	1.7%	0.0%	5.0%
AVC (AVSD) repair, partial (incomplete) (PAVSD)	50	2	4.0%	4.3%	0.0%	9.8%
Coarctation repair, end to end, extended	50	1	2.0%	2.2%	0.0%	6.2%
Pacemaker implantation, permanent	39	0	0.0%	0.3%	0.0%	1.7%
VSD, multiple, repair	35	1	2.9%	3.2%	0.0%	8.9%
Aortic stenosis, subvalvar, repair	35	0	0.0%	0.3%	0.0%	2.3%
Organ procurement	35	1	2.9%	3.4%	0.0%	9.5%
Valve surgery, other, tricuspid	31	1	3.2%	3.4%	0.0%	9.5%
Sinus of Valsalva, aneurysm repair	30	0	0.0%	0.3%	0.0%	2.3%
Coronary artery fistula ligation	25	0	0.0%	0.4%	0.0%	2.9%
Cardiac procedure, other	25	0	0.0%	0.5%	0.0%	3.2%
VSD repair, NOS	22	1	4.5%	5.0%	0.0%	13.9%
PA, reconstruction (plasty), NOS	22	0	0.0%	0.4%	0.0%	3.1%
Occlusion MAPCA(s)	20	1	5.0%	5.5%	0.0%	15.1%
Valve surgery, other, mitral	20	0	0.0%	0.5%	0.0%	3.3%
Mediastinal procedure	19	1	5.3%	5.6%	0.0%	16.3%
ASD repair, NOS	17	0	0.0%	0.7%	0.0%	4.7%
DCRV repair	17	0	0.0%	0.5%	0.0%	3.3%
AVC (AVSD) repair, intermediated (transitional)	16	0	0.0%	0.6%	0.0%	3.6%



Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
32	0.2	7.0	5.0	10.0
8	0.1	6.0	5.0	8.0
5	0.2	4.0	3.0	8.0
30	0.2	6.0	5.0	8.0
7	0.1	6.0	4.0	7.0
79	0.4	8.0	6.0	11.0
rare	0.2	5.5	4.0	8.0
10	0.2	6.5	5.0	8.0
rare	0.1	4.0	3.0	6.0
57	0.4	6.0	4.0	9.3
62	0.4	7.0	6.0	10.8
6	0.2	6.0	5.0	7.0
76	0.3	7.0	5.0	10.0
26	0.4	7.0	4.0	11.8
24	0.3	7.0	5.0	14.3
rare	0.4	9.0	6.0	17.5
27	0.2	6.0	5.0	9.0
31	0.3	7.0	5.0	10.0
24	0.2	10.0	6.0	14.0
2	0.1	4.0	3.0	17.0
113	0.3	7.0	5.0	9.3
42	0.1	7.0	6.0	8.3
rare	0.3	8.5	5.8	13.8
rare	0.3	8.5	4.0	14.3
61	0.1	7.0	4.0	10.0
17	0.1	4.0	4.0	9.0
rare	0.1	5.0	2.0	11.5
rare	0.4	7.0	4.0	7.0
rare	0.1	7.5	6.0	8.8
51	0.4	9.0	5.0	18.0
76	0.1	8.0	5.0	13.0
rare	0.4	1.0	0.0	13.0
rare	0.1	6.0	5.0	8.0
48	0.1	4.0	3.3	6.0
33	0.1	7.0	5.3	10.5



**Table 1.1**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No.with mortality		%	95% CI	
					Lower	Upper
Aortic stenosis, supraaortic, repair	15	0	0.0%	0.6%	0.0%	4.2%
Coarctation repair, interposition graft	15	0	0.0%	0.7%	0.0%	4.8%
Lung biopsy	14	0	0.0%	0.7%	0.0%	4.8%
Valve excision, pulmonary (without replacement)	13	0	0.0%	0.8%	0.0%	6.0%
Fontan, other	13	0	0.0%	0.8%	0.0%	5.2%
Congenitally corrected TGA repair, VSD closure	13	0	0.0%	0.7%	0.0%	4.6%
Coarctation repair, subclavian flap	12	0	0.0%	0.7%	0.0%	4.8%
Cardiac tumor resection	12	0	0.0%	0.9%	0.0%	6.4%
Pleural drainage procedure	12	0	0.0%	0.8%	0.0%	5.4%
Pulmonary artery origin from ascending aorta (hemitruncus) repair	11	0	0.0%	1.0%	0.0%	6.6%
Ligation, thoracic duct	11	0	0.0%	1.0%	0.0%	7.5%
Peripheral vascular procedure, other	10	0	0.0%	1.1%	0.0%	7.6%
ASD repair, device	9	0	0.0%	1.3%	0.0%	8.1%
Congenitally corrected TGA repair, other	9	0	0.0%	1.2%	0.0%	8.1%
Pericardial procedure, other	8	0	0.0%	1.3%	0.0%	8.1%
VATS (video-assisted thoracoscopic surgery)	8	0	0.0%	1.3%	0.0%	8.9%
Pectus repair	6	0	0.0%	1.6%	0.0%	11.2%
Valve replacement, aortic (AVR), bioprosthetic	5	0	0.0%	1.9%	0.0%	12.7%
Shunt, systemic to pulmonary, NOS	5	0	0.0%	1.8%	0.0%	11.7%
Bronchoscopy	5	0	0.0%	1.9%	0.0%	12.1%
Valve closure, semilunar	4	0	0.0%	2.0%	0.0%	14.0%
Arrhythmia surgery-atrial, surgical ablation	4	0	0.0%	2.2%	0.0%	14.3%
PAPVC, scimitar, repair	3	0	0.0%	3.0%	0.0%	19.4%
Aortic dissection repair	3	0	0.0%	3.2%	0.0%	19.2%
Shunt, ligation and takedown	3	0	0.0%	3.4%	0.0%	20.2%
Thoracotomy, other	3	0	0.0%	2.7%	0.0%	17.1%
VSD, repair, device	2	0	0.0%	4.6%	0.0%	27.9%
VSD creation/enlargement	2	0	0.0%	4.6%	0.0%	28.7%
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	2	0	0.0%	4.0%	0.0%	25.0%
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	2	0	0.0%	4.9%	0.0%	30.2%
ICD (AICD) implantation	2	0	0.0%	4.1%	0.0%	25.2%
Aneurysm ventricular, left, repair	2	0	0.0%	4.4%	0.0%	25.9%
Mediastinal exploration	2	0	0.0%	4.6%	0.0%	28.0%





Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
64	0.1	7.5	6.0	9.8
49	0.1	5.0	4.0	6.0
rare	0.1	15.0	7.5	26.8
rare	0.1	6.0	4.5	10.5
rare	0.1	13.0	7.5	18.5
106	0.1	6.0	5.0	10.0
23	0.1	8.0	6.0	16.5
88	0.1	15.5	9.3	19.0
rare	0.1	9.5	6.3	14.0
89	0.1	12.0	6.0	23.3
rare	0.1	25.0	15.0	42.0
rare	0.2	8.0	2.8	19.5
rare	0.2	12.0	5.0	21.5
rare	0.2	9.5	6.3	24.0
rare	0.2	6.5	3.8	14.5
rare	0.2	4.0	3.3	4.0
rare	0.2	5.5	5.0	8.0
55	0.2	11.0	5.0	23.5
rare	0.2	7.0	5.0	18.5
rare	0.2	18.0	6.5	49.5
rare	0.2	11.0	-	-
84	0.2	13.0	5.5	23.5
91	0.2	9.0	-	-
128	0.3	20.0	-	-
11	0.3	8.0	-	-
rare	0.2	7.0	-	-
rare	0.3	6.0	-	-
83	0.3	10.0	-	-
70	0.3	8.5	-	-
133	0.3	3.5	-	-
14	0.3	11.5	-	-
107	0.3	9.5	-	-
rare	0.3	24.5	-	-



**Table 1.2**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No. with mortality		%	95% CI	
					Lower	Upper
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	880	55	6.3%	6.3%	4.7%	7.9%
TOF repair, non ventriculotomy	234	18	7.7%	7.8%	4.3%	11.3%
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	215	20	9.3%	9.4%	5.5%	13.4%
TOF repair, NOS	84	6	7.1%	7.2%	1.6%	12.9%
Pulmonary atresia-VSD (including TOF, PA), repair	78	10	12.8%	12.9%	5.4%	20.4%
Rastelli	67	8	11.9%	12.3%	4.8%	19.7%
Lung procedure, other	55	4	7.3%	7.4%	0.7%	14.1%
TOF repair, RV-PA conduit	50	5	10.0%	10.1%	1.7%	18.4%
Fontan, TCPC, external conduit, nonfenestrated	49	5	10.2%	10.1%	2.0%	18.3%
Pericardial drainage procedure	45	5	11.1%	11.5%	1.9%	21.1%
Unifocalization MAPCA(s)	44	4	9.1%	9.2%	0.7%	17.8%
Valve replacement, pulmonic (PVR)	44	4	9.1%	9.5%	1.0%	18.0%
Fontan, TCPC, external conduit, NOS	39	4	10.3%	10.4%	0.8%	19.9%
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	35	2	5.7%	6.0%	0.0%	13.8%
Pericardectomy	33	3	9.1%	9.4%	0.0%	18.9%
Pulmonary Venous Stenosis, repair	32	4	12.5%	12.4%	1.4%	23.4%
Valve replacement, mitral (MVR)	32	4	12.5%	12.6%	1.4%	23.8%
Mitral stenosis, supra-valvar mitral ring, repair	29	2	6.9%	7.3%	0.0%	16.5%
ASD creation/enlargement	26	2	7.7%	7.9%	0.0%	17.6%
Ventricular septal fenestration	25	2	8.0%	8.3%	0.0%	18.6%
AP window repair	25	2	8.0%	8.5%	0.0%	19.2%
Cardiotomy, other	25	2	8.0%	8.3%	0.0%	19.4%
Fontan, atrio-pulmonary connection	22	2	9.1%	9.3%	0.0%	20.7%
TOF, AVC (AVSD), repair	19	2	10.5%	11.0%	0.0%	24.4%
TOF, absent pulmonary valve, repair	18	2	11.1%	11.2%	0.0%	25.3%
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	18	1	5.6%	6.1%	0.0%	16.5%
Ligation, pulmonary artery	18	1	5.6%	6.1%	0.0%	16.5%
AVC (AVSD) repair, NOS	16	1	6.3%	6.9%	0.0%	19.2%
Valvuloplasty, aortic	16	1	6.3%	7.1%	0.0%	19.0%
Shunt, systemic to pulmonary, other	16	2	12.5%	13.4%	0.0%	29.1%
Fontan, NOS	14	1	7.1%	7.5%	0.0%	20.3%



Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
39	0.4	7.0	5.0	13.0
81	0.5	8.0	6.0	11.0
43	0.6	8.0	6.0	12.0
rare	0.5	7.0	5.0	11.0
92	0.8	8.0	6.0	13.0
125	0.7	13.0	8.0	20.3
rare	0.5	9.0	6.0	19.0
80	0.6	9.0	7.0	13.0
97	0.6	13.0	7.5	26.5
1	0.7	5.0	3.0	7.5
116	0.6	7.0	5.0	11.0
44	0.6	8.0	5.0	13.0
rare	0.6	13.0	8.0	21.0
63	0.4	7.5	6.0	12.3
20	0.6	12.0	8.0	17.0
117	0.7	8.0	6.0	11.0
69	0.7	13.0	7.0	22.0
74	0.5	7.0	6.0	10.8
9	0.5	8.0	5.3	10.8
45	0.5	6.0	4.8	8.3
35	0.5	11.5	5.3	23.5
rare	0.5	12.0	5.5	23.8
94	0.6	13.0	7.0	30.3
122	0.7	9.0	6.0	12.0
109	0.7	9.0	5.8	14.8
41	0.4	11.0	7.0	32.0
rare	0.4	9.5	3.3	19.5
rare	0.5	9.0	4.0	21.3
72	0.5	7.5	7.0	18.5
rare	0.8	17.0	6.0	35.0
rare	0.5	12.5	7.8	40.0



**Table 1.2**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No. with mortality		%	95% CI	
					Lower	Upper
Palliation, other	14	1	7.1%	7.9%	0.0%	21.7%
Valve closure, tricuspid (exclusion, univentricular approach)	11	1	9.1%	10.1%	0.0%	26.8%
Vascular ring repair	11	1	9.1%	9.5%	0.0%	26.2%
PA debanding	11	1	9.1%	10.3%	0.0%	27.8%
1 1/2 ventricular repair	10	1	10.0%	10.5%	0.0%	28.1%
Coronary artery procedure, other	10	1	10.0%	10.9%	0.0%	28.4%
Pulmonary embolectomy	10	1	10.0%	10.8%	0.0%	29.0%
Conduit, reoperation	9	1	11.1%	11.6%	0.0%	31.0%
Atrial septal fenestration	8	1	12.5%	13.0%	0.0%	34.5%
Coarctation repair, other	8	1	12.5%	13.6%	0.0%	35.7%
Aortic root replacement, mechanical	1	0	0.0%	8.2%	0.0%	44.5%
Other annular enlargement procedure	1	0	0.0%	7.7%	0.0%	42.6%
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	7.3%	0.0%	39.3%
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	8.5%	0.0%	45.6%
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	8.2%	0.0%	44.2%
ASD creation, balloon septostomy (BAS) (Rashkind)	1	0	0.0%	10.1%	0.0%	50.8%
ASD creation, blade septostomy	1	0	0.0%	7.6%	0.0%	42.0%
Minimally invasive procedure	1	0	0.0%	7.9%	0.0%	43.2%
Delayed sternal closure	1	0	0.0%	7.7%	0.0%	41.9%



Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
rare	0.5	11.5	4.8	26.5
36	0.6	6.0	5.0	9.0
19	0.6	18.0	6.0	31.0
29	0.6	13.0	6.5	22.5
58	0.6	6.0	4.0	7.5
17	0.7	7.0	5.5	21.0
rare	0.7	4.5	4.0	18.8
77	0.7	7.0	5.0	18.0
12	0.8	6.0	4.3	7.8
112	0.8	7.5	3.5	14.8
111	0.5	45.0	-	-
142	0.5	9.0	-	-
99	0.5	9.0	-	-
rare	0.5	6.0	-	-
15	0.5	7.0	-	-
12	0.6	12.0	-	-
rare	0.5	3.0	-	-
rare	0.5	4.0	-	-
rare	0.5	246.0	-	-



**Table 1.3**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No. with mortality		%	95% CI	
					Lower	Upper
TAPVC repair	146	34	23.3%	23.1%	16.3%	30.0%
PA banding (PAB)	143	22	15.4%	15.3%	9.5%	21.1%
AVC(AVSD) repair, complete CAVSD	134	22	16.4%	16.5%	10.1%	22.9%
DORV, intraventricular tunnel repair	97	15	15.5%	15.6%	8.4%	22.8%
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	77	11	14.3%	14.4%	6.8%	22.0%
DORV repair, NOS	73	11	15.1%	15.3%	7.0%	23.6%
RVOT procedure	61	10	16.4%	16.5%	7.4%	25.5%
Arterial switch operation (ASO) and VSD repair	56	10	17.9%	17.8%	8.4%	27.2%
Truncus arteriosus repair	47	9	19.1%	19.3%	8.4%	30.1%
Fontan, TCPC, lateral tunnel, fenestrated	30	6	20.0%	20.2%	5.8%	34.6%
Coarctation repair, patch aortoplasty	29	4	13.8%	13.9%	1.4%	26.4%
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	22	5	22.7%	22.5%	5.7%	39.3%
Cor triatriatum repair	19	4	21.1%	21.4%	3.8%	39.0%
Valve surgery, other pulmonic	18	3	16.7%	17.1%	0.9%	33.2%
Valve replacement, tricuspid (TVR)	16	3	18.8%	18.6%	0.0%	37.9%
Thoracic and/or mediastinal procedure, other	16	3	18.8%	19.6%	0.5%	38.6%
Valve replacement, aortic (AVR), mechanical	15	3	20.0%	20.4%	0.4%	40.5%
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	15	2	13.3%	13.9%	0.0%	30.8%
Pulmonary artery sling repair	13	3	23.1%	23.0%	0.7%	45.3%
Sternotomy wound drainage	13	2	15.4%	16.1%	0.0%	34.8%
Hemifontan	12	2	16.7%	17.8%	0.0%	38.5%
PA, reconstruction (plasty), branch, central	9	2	22.2%	23.1%	0.0%	49.3%
Pacemaker procedure	8	1	12.5%	13.8%	0.0%	36.5%
Conduit, placement, LV to PA	7	1	14.3%	15.9%	0.0%	41.4%
Valve replacement, aortic (AVR), NOS	7	1	14.3%	15.5%	0.0%	40.3%
Tracheal procedure	7	1	14.3%	15.5%	0.0%	40.1%
Valve excision, tricuspid (without replacement)	6	1	16.7%	17.5%	0.0%	44.3%
Congenitally corrected TGA repair, atrial switch and Rastelli	6	1	16.7%	18.2%	0.0%	47.2%
Mustard	6	1	16.7%	17.2%	0.0%	44.5%
Senning	5	1	20.0%	20.6%	0.0%	52.2%
Atrial baffle procedure, NOS	5	1	20.0%	21.7%	0.0%	54.8%



Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
104	1.3	11.0	6.0	24.3
21	0.9	12.0	6.5	28.0
87	0.9	12.0	7.0	18.0
132	0.9	10.0	7.0	15.0
47	0.8	8.0	5.0	16.3
rare	0.9	8.0	7.0	11.8
40	0.9	6.0	4.0	9.0
138	1.0	21.0	12.5	29.0
134	1.1	11.0	7.3	23.0
101	1.1	13.0	8.3	21.5
22	0.8	8.5	6.3	12.0
137	1.3	8.5	2.8	16.5
60	1.2	6.0	5.0	10.0
rare	1.0	7.0	5.0	17.5
65	1.1	9.0	6.0	14.5
rare	1.1	6.0	2.0	39.8
52	1.1	11.0	8.0	16.0
rare	0.8	12.5	6.8	18.5
105	1.3	18.0	7.0	44.5
rare	0.9	6.0	4.0	33.3
78	1.0	17.5	10.0	28.5
68	1.3	8.0	3.0	9.0
3	0.8	5.0	3.0	7.3
73	0.9	7.0	6.0	9.0
0	0.9	19.0	8.0	31.0
rare	0.9	23.0	5.0	50.0
13	1.0	6.0	4.3	13.5
139	1.0	14.0	3.8	25.3
100	1.0	9.0	8.0	23.5
108	1.2	18.0	10.5	27.0
67	1.2	8.5	2.5	11.5



**Table 1.4**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No. with mortality		%	95% CI	
					Lower	Upper
Arterial switch operation (ASO)	145	34	23.4%	23.5%	16.6%	30.3%
Aortic arch repair	47	16	34.0%	34.2%	20.6%	47.8%
Interrupted aortic arch repair	46	14	30.4%	30.3%	17.3%	43.3%
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	17	5	29.4%	29.9%	9.2%	50.6%
Anomalous systemic venous connection repair	12	3	25.0%	25.0%	1.4%	48.5%
Anomalous origin of coronary artery repair	12	3	25.0%	24.9%	1.1%	48.7%
Valve replacement, truncal	11	3	27.3%	28.1%	2.6%	53.6%
PA, reconstruction (plasty), main (trunk)	11	3	27.3%	28.2%	2.8%	53.6%
Conduit, placement, RV to PA	11	3	27.3%	27.4%	2.4%	52.3%
Valve surgery, other, aortic	11	3	27.3%	27.3%	2.4%	52.3%
Coronary artery bypass	9	3	33.3%	34.0%	5.7%	62.3%
Fontan, atrio-ventricular connection	8	2	25.0%	26.4%	0.0%	55.4%
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	4	1	25.0%	25.7%	0.0%	63.0%
Aneurysm, pulmonary artery, repair	4	1	25.0%	26.8%	0.0%	64.9%
Pleural procedure, other	4	1	25.0%	25.3%	0.0%	63.8%
ASD, common atrium (single atrium), septation	3	1	33.3%	31.5%	0.0%	75.0%
Aortic root replacement, NOS	3	1	33.3%	34.3%	0.0%	80.5%
Pulmonary AV fistula repair/occlusion	2	1	50.0%	49.5%	0.0%	100.0%





Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
130	1.3	13.5	8.8	21.0
82	1.9	10.0	5.0	25.5
118	1.7	15.0	4.0	24.0
148	1.6	14.0	7.5	24.5
54	1.4	6.0	5.0	10.0
119	1.4	6.5	1.8	7.8
46	1.5	23.0	2.0	34.0
25	1.5	8.0	5.0	16.0
66	1.5	8.0	6.0	15.0
rare	1.5	7.0	2.0	8.0
98	1.8	7.0	5.0	16.5
0	1.5	7.0	2.5	10.5
135	1.4	5.0	1.3	11.8
53	1.5	3.5	0.8	12.3
rare	1.4	56.0	28.5	122.5
18	1.7	5.0	-	-
rare	1.9	40.0	-	-
rare	2.6	7.5	-	-



**Table 1.5**  
**Frequency of procedure and mortality risk in all age group (n=12,482 missing 4.7%)**  
**Mortality category 5**

Procedure name	No. of operations		Observed mortality	Bayesian estimated mortality risk		
	All operations	No. with mortality		%	95% CI	
					Lower	Upper
Norwood procedure	41	26	63.4%	63.9%	49.3%	78.5%
HLHS biventricular repair	8	5	62.5%	62.3%	31.4%	93.2%
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	7	5	71.4%	70.5%	38.3%	100.0%
Intraaortic balloon pump (IABP) insertion	3	2	66.7%	65.8%	20.9%	100.0%
Congenitally corrected TGA repair, NOS	2	2	100.0%	95.2%	71.8%	100.0%
Coarctation repair, NOS	2	1	50.0%	51.6%	0.0%	100.0%
Valvuloplasty, truncal valve	1	1	100.0%	92.6%	58.8%	100.0%
Aortic root replacement, homograft	1	1	100.0%	91.3%	53.6%	100.0%
Konno procedure	1	1	100.0%	90.8%	51.3%	100.0%
Ross-Konno procedure	1	1	100.0%	91.5%	55.5%	100.0%
<b>Total (177 procedures)</b>	<b>12,482</b>	<b>712</b>	<b>5.7%</b>			



Procedure risk		Post operative length of stay		
Difficulty ranking	Mortality score	Median	IQR	
			Q1	Q3
147	3.4	1.0	0.0	21.5
145	3.3	0.0	0.0	5.3
114	3.7	1.0	0.3	42.3
rare	3.5	8.0	-	-
rare	5.0	6.5	-	-
rare	2.8	4.5	-	-
59	4.9	5.0	-	-
121	4.8	7.0	-	-
131	4.8	5.0	-	-
146	4.8	10.0	-	-





## Mortality category and procedures in newborn

- There are 88 procedures of 684 patients in 5 mortality categories with 23% in-hospital mortality.
- Most operations are in mortality category 1; the most common procedures in category 1 are PDA surgical closure, Coarctation repair by end to end extended, VSD repair with patch, Pulmonic valvuloplasty and Coarctation repair by end to end; all with the in-hospital mortality of 11%, 8%, no mortality, 9% and no mortality respectively.
- In mortality category 2, the most common procedures are PA banding, Central aorto-pulmonary shunt and pulmonary atresia-VSD (including TOF, PA); all with the in-hospital mortality of 15%, 13% and 40% respectively.
- In mortality category 3 of newborn, the most common procedures are Modified Blalock-Taussig shunt, TAPVC repair and Arterial switch operation with VSD repair; all with in-hospital mortality of 13%, 46% and 27% respectively.
- In mortality category 4 of newborn, the most common procedures are Arterial switch operation, Interrupted aortic arch repair, Aortic arch repair and Congenitally corrected TGA with double switch; all with in-hospital mortality of 26%, 35%, 44% and 20% respectively.
- In mortality category 5 of newborn, the most common procedures are Norwood procedure and HLHS biventricular repair; these two with in-hospital mortality of 52% and 67%.



**Table 2.1**  
**Frequency of procedure and mortality risk in newborn (n=684 missing 11.4%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PDA closure, surgical	56	6	10.7%	2.6%	18.8%	5	0.2
Coarctation repair, end to end, extended	13	1	7.7%	0.0%	22.2%	24	0.2
VSD repair, patch	12	0	0.0%	0.0%	0.0%	32	0.2
Valvuloplasty, pulmonic	11	1	9.1%	0.0%	26.1%	26	0.4
Coarctation repair, end to end	11	0	0.0%	0.0%	0.0%	24	0.3
PDA closure, device	8	1	12.5%	0.0%	35.4%	rare	0.2
ASD repair, patch	5	0	0.0%	0.0%	0.0%	8	0.1
VSD repair, primary closure	5	2	40.0%	0.0%	82.9%	30	0.2
ASD repair, primary closure	4	1	25.0%	0.0%	67.4%	7	0.1
PDA closure, NOS	4	0	0.0%	0.0%	0.0%	rare	0.1
Shunt, systemic to pulmonary, other	3	1	33.3%	0.0%	86.7%	rare	0.2
Organ procurement	3	1	33.3%	0.0%	86.7%	rare	0.3
PFO, primary closure	2	0	0.0%	0.0%	0.0%	6	0.2
Pulmonary artery origin from ascending aorta (hemitruncus) repair	2	0	0.0%	0.0%	0.0%	89	0.1
Occlusion MAPCA(s)	2	1	50.0%	0.0%	100.0%	51	0.4
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
Valve excision, pulmonary (without replacement)	2	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, subclavian flap	2	0	0.0%	0.0%	0.0%	23	0.1
Lung procedure, other	2	1	50.0%	0.0%	100.0%	rare	0.2
Pacemaker procedure	2	1	50.0%	0.0%	100.0%	3	0.3
Bronchoscopy	2	0	0.0%	0.0%	0.0%	rare	0.2
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	113	0.3
TOF repair, ventriculotomy, transanular patch	1	0	0.0%	0.0%	0.0%	79	0.4
Valve surgery, other, tricuspid	1	1	100.0%	100.0%	100.0%	rare	0.3
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	70	0.3
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	17	0.1
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	0.1
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
Esophageal procedure	1	0	0.0%	0.0%	0.0%	rare	0.4
Mediastinal exploration	1	0	0.0%	0.0%	0.0%	rare	0.3
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Cardiac procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2



**Table 2.2**  
**Frequency of procedure and mortality risk in newborn (n=684 missing 11.4%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA banding (PAB)	27	4	14.8%	1.4%	28.2%	21	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	16	2	12.5%	0.0%	28.7%	47	0.8
Pulmonary atresia-VSD (including TOF, PA), repair	5	2	40.0%	0.0%	82.9%	92	0.8
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	4	0	0.0%	0.0%	0.0%	43	0.4
Coarctation repair, other	3	0	0.0%	0.0%	0.0%	112	0.8
ASD creation/enlargement	2	0	0.0%	0.0%	0.0%	9	0.5
AP window repair	2	0	0.0%	0.0%	0.0%	35	0.5
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
Fontan, TCPC, external conduit, NOS	2	1	50.0%	0.0%	100.0%	rare	0.6
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	2	1	50.0%	0.0%	100.0%	114	0.6
Pulmonary Venous Stenosis, repair	1	1	100.0%	100.0%	100.0%	117	0.7
TOF repair, non ventriculotomy	1	1	100.0%	100.0%	100.0%	81	0.5
TOF repair, RV-PA conduit	1	0	0.0%	0.0%	0.0%	80	0.6
Valve closure, tricuspid (exclusion, univentricular approach)	1	0	0.0%	0.0%	0.0%	36	0.6
Valve replacement, pulmonic (PVR)	1	1	100.0%	100.0%	100.0%	44	0.6
Valvuloplasty, aortic	1	0	0.0%	0.0%	0.0%	72	0.5
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Vascular ring repair	1	0	0.0%	0.0%	0.0%	19	0.6
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	14	0.5
ASD creation, balloon septostomy (BAS)(Rashkind)	1	0	0.0%	0.0%	0.0%	12	0.5



**Table 2.3**  
**Frequency of procedure and mortality risk in newborn (n=684 missing 11.4%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	179	24	13.4%	8.4%	18.4%	39	0.8
TAPVC repair	41	19	46.3%	31.1%	61.6%	104	1.3
Arterial switch operation (ASO) and VSD repair	15	4	26.7%	4.3%	49.0%	138	1.0
RVOT procedure	10	5	50.0%	19.0%	81.0%	40	0.9
Truncus arteriosus repair	6	3	50.0%	10.0%	90.0%	134	1.1
Coarctation repair, patch aortoplasty	6	1	16.7%	0.0%	46.5%	22	0.8
Valve surgery, other pulmonic	3	2	66.7%	13.3%	100.0%	rare	1.0
Pacemaker implantation, permanent	3	0	0.0%	0.0%	0.0%	2	0.8
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	2	1	50.0%	0.0%	100.0%	137	1.3
AVC(AVSD) repair, complete CAVSD	1	1	100.0%	100.0%	100.0%	87	0.9
Cor triatriatum repair	1	1	100.0%	100.0%	100.0%	60	1.2
Valve excision, tricuspid (without replacement)	1	0	0.0%	0.0%	0.0%	13	1.0
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	1.0
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	rare	0.8
DORV repair, NOS	1	1	100.0%	100.0%	100.0%	rare	0.9
Pulmonary artery sling repair	1	0	0.0%	0.0%	0.0%	105	1.3
Aneurysm, pulmonary artery, repair	1	1	100.0%	100.0%	100.0%	53	1.2
Sternotomy wound drainage	1	1	100.0%	100.0%	100.0%	rare	0.9





**Table 2.4**  
**Frequency of procedure and mortality risk in newborn (n=684 missing 11.4%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Arterial switch operation (ASO)	87	23	26.4%	17.2%	35.7%	130	1.3
Interrupted aortic arch repair	23	8	34.8%	15.3%	54.2%	118	1.7
Aortic arch repair	16	7	43.8%	19.4%	68.1%	82	1.9
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	10	2	20.0%	0.0%	44.8%	148	1.6
PA, reconstruction (plasty), main (trunk)	5	3	60.0%	17.1%	100.0%	25	1.5
Pulmonary AV fistula repair/occlusion	3	1	33.3%	0.0%	86.7%	rare	2.6
Valve replacement, truncal	1	1	100.0%	100.0%	100.0%	46	1.5
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	54	1.4
Valve surgery, other, aortic	1	1	100.0%	100.0%	100.0%	rare	1.5
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	0	1.5

**Table 2.5**  
**Frequency of procedure and mortality risk in newborn (n=684 missing 11.4%)**  
**Mortality category 5**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	23	12	52.2%	31.8%	72.6%	147	3.4
HLHS biventricular repair	3	2	66.7%	13.3%	100.0%	145	3.3
PA debanding	2	1	50.0%	0.0%	100.0%	29	3.7
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	rare	5.0
Coarctation repair, NOS	1	1	100.0%	100.0%	100.0%	rare	2.8
<b>Total (88 procedures)</b>	<b>684</b>	<b>159</b>	<b>22.9%</b>	<b>19.8%</b>	<b>26.0%</b>		



### **Mortality category and procedures in infant**

- There are 127 procedures of 2331 patients in all 5 mortality categories with 12% in-hospital mortality.
- Most operations are in mortality category 1; the most common procedures in category 1 are PDA with surgical closure, VSD with patch repair, VSD with primary closure and PDA with device closure; all with the in-hospital mortality of 5%, 6%, 4% and 5% respectively.
- In mortality category 2, the most common procedures are PA banding, Bidirectional cavopulmonary anastomosis, Central shunt and AP window repair; all with the in-hospital mortality of 19%, 26%, 44% and no mortality.
- In mortality category 3 of infant, the most common procedures are Modified Blalock-Taussig shunt, TAPVC repair, complete CAVSD repair, Arterial switch operation with VSD closure; all with the in-hospital mortality of 9%, 16%, 24%, and 16%.
- In mortality category 4, the most common procedures are Arterial switch operation, Aortic arch repair, Interrupted aortic arch repair; all with the in-hospital mortality of 15%, 41%, and 30%.
- In mortality category 5, the most common procedures are Norwood procedure and HLHS with biventricular repair; both sharing the same in-hospital mortality of 75%.



**Table 3.1**  
**Frequency of procedure and mortality risk in infant (n=2,331 missing 5.4%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PDA closure, surgical	510	26	5.1%	3.2%	7.0%	5	0.2
VSD repair, patch	419	27	6.4%	4.1%	8.8%	32	0.2
VSD repair, primary closure	78	3	3.8%	0.0%	8.1%	30	0.2
PDA closure, device	78	4	5.1%	0.2%	10.0%	rare	0.2
PDA closure, NOS	32	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, end to end	31	3	9.7%	0.0%	20.1%	24	0.3
Coarctation repair, end to end, extended	24	0	0.0%	0.0%	0.0%	24	0.2
ASD repair, patch	22	2	9.1%	0.0%	21.1%	8	0.1
Lung procedure, other	16	2	12.5%	0.0%	28.7%	rare	0.2
TOF repair, ventriculotomy, transanular patch	15	1	6.7%	0.0%	19.3%	79	0.4
Esophageal procedure	12	1	8.3%	0.0%	24.0%	rare	0.4
PFO, primary closure	11	1	9.1%	0.0%	26.1%	6	0.2
ASD, repair, primary closure	11	2	18.2%	0.0%	41.0%	7	0.1
ASD partial closure	11	1	9.1%	0.0%	26.1%	10	0.2
AVC (AVSD) repair, partial (incomplete) (PAVSD)	7	0	0.0%	0.0%	0.0%	31	0.3
Coarctation repair, subclavian flap	7	0	0.0%	0.0%	0.0%	23	0.1
Tracheal procedure	6	1	16.7%	0.0%	46.5%	rare	0.1
Organ procurement	6	0	0.0%	0.0%	0.0%	rare	0.3
AVC (AVSD) repair, intermediated (transitional)	5	0	0.0%	0.0%	0.0%	33	0.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	5	0	0.0%	0.0%	0.0%	89	0.1
Valvuloplasty, pulmonic	5	2	40.0%	0.0%	82.9%	26	0.4
Shunt, systemic to pulmonary, other	5	0	0.0%	0.0%	0.0%	rare	0.2
Mediastinal procedure	5	0	0.0%	0.0%	0.0%	rare	0.4
PAPVC repair	4	1	25.0%	0.0%	67.4%	27	0.2
TOF repair, ventriculotomy, nontransanular patch	4	0	0.0%	0.0%	0.0%	62	0.4
Occlusion MAPCA(s)	4	0	0.0%	0.0%	0.0%	51	0.4
Valvuloplasty, tricuspid	4	0	0.0%	0.0%	0.0%	57	0.4
PA, reconstruction (plasty), NOS	4	0	0.0%	0.0%	0.0%	rare	0.1
Pleural drainage procedure	4	0	0.0%	0.0%	0.0%	rare	0.1
Pulmonary embolectomy	3	0	0.0%	0.0%	0.0%	34	0.1
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	113	0.3
VSD repair, NOS	3	1	33.3%	0.0%	86.7%	rare	0.4
Valvuloplasty, mitral	3	2	66.7%	13.3%	100.0%	76	0.3
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	17	0.1



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Palliation, other	3	0	0.0%	0.0%	0.0%	rare	0.3
Bronchoscopy	3	0	0.0%	0.0%	0.0%	rare	0.2
ASD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
Valve surgery, other, tricuspid	2	0	0.0%	0.0%	0.0%	rare	0.3
DCRV repair	2	0	0.0%	0.0%	0.0%	48	0.1
Atrial baffle procedure, NOS	2	1	50.0%	0.0%	100.0%	67	0.1
Ligation, thoracic duct	2	0	0.0%	0.0%	0.0%	rare	0.1
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.1
Peripheral vascular procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.2
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	83	0.3
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.2
Aortic stenosis, subvalvar, repair	1	0	0.0%	0.0%	0.0%	42	0.1
Aortic stenosis, supra-valvar, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Valve surgery, other, mitral	1	0	0.0%	0.0%	0.0%	76	0.1
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	0.1
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	3	0.3
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2



**Table 3.2**  
**Frequency of procedure and mortality risk in infant (n=2,331 missing 5.4%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA banding (PAB)	90	17	18.9%	10.8%	27.0%	21	0.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	31	8	25.8%	10.4%	41.2%	43	0.4
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	16	7	43.8%	19.4%	68.1%	47	0.8
AP window repair	13	0	0.0%	0.0%	0.0%	35	0.5
TOF repair, non ventriculotomy	13	2	15.4%	0.0%	35.0%	81	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	7	3	42.9%	6.2%	79.5%	92	0.8
Vascular ring repair	6	1	16.7%	0.0%	46.5%	19	0.6
Pulmonary Venous Stenosis, repair	5	0	0.0%	0.0%	0.0%	117	0.7
Rastelli	5	4	80.0%	44.9%	100.0%	125	0.7
ASD creation/enlargement	4	2	50.0%	1.0%	99.0%	9	0.5
Coarctation repair, other	4	1	25.0%	0.0%	67.4%	112	0.8
Lung biopsy	4	0	0.0%	0.0%	0.0%	rare	0.5
AVC (AVSD) repair, NOS	3	1	33.3%	0.0%	86.7%	rare	0.5
TOF repair, RV-PA conduit	3	1	33.3%	0.0%	86.7%	80	0.6
TOF repair, NOS	3	0	0.0%	0.0%	0.0%	rare	0.5
Fontan, atrio-pulmonary connection	3	0	0.0%	0.0%	0.0%	94	0.6
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	3	2	66.7%	13.3%	100.0%	114	0.6
Cardiotomy, other	3	0	0.0%	0.0%	0.0%	rare	0.5
Ventricular septal fenestration	2	1	50.0%	0.0%	100.0%	45	0.5
Unifocalization MAPCA(s)	2	0	0.0%	0.0%	0.0%	116	0.6
Mitral stenosis, supra-avalvular mitral ring, repair	2	1	50.0%	0.0%	100.0%	74	0.5
Pericardectomy	2	1	50.0%	0.0%	100.0%	20	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	rare	0.5
Coronary artery procedure, other	2	1	50.0%	0.0%	100.0%	17	0.7
Atrial septal fenestration	1	1	100.0%	100.0%	100.0%	12	0.8
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	122	0.7
Valve closure, tricuspid (exclusion, univentricular approach)	1	1	100.0%	100.0%	100.0%	36	0.6
1 1/2 ventricular repair	1	1	100.0%	100.0%	100.0%	58	0.6
Conduit, reoperation	1	0	0.0%	0.0%	0.0%	77	0.7
Valvuloplasty, aortic	1	1	100.0%	100.0%	100.0%	72	0.5
Pericardial drainage procedure	1	1	100.0%	100.0%	100.0%	1	0.7
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	1	100.0%	100.0%	100.0%	41	0.4



**Table 3.3**  
**Frequency of procedure and mortality risk in infant (n=2,331 missing 5.4%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	281	25	8.9%	5.6%	12.2%	39	0.8
TAPVC repair	70	11	15.7%	7.2%	24.2%	104	1.3
AVC(AVSD) repair, complete CAVSD	45	11	24.4%	11.9%	37.0%	87	0.9
Arterial switch operation (ASO) and VSD repair	38	6	15.8%	4.2%	27.4%	138	1.0
Truncus arteriosus repair	27	6	22.2%	6.5%	37.9%	134	1.1
DORV, intraventricular tunnel repair	20	4	20.0%	2.5%	37.5%	132	0.9
Coarctation repair, patch aortoplasty	18	3	16.7%	0.0%	33.9%	22	0.8
DORV repair, NOS	8	1	12.5%	0.0%	35.4%	rare	0.9
Pulmonary artery sling repair	8	2	25.0%	0.0%	55.0%	105	1.3
RVOT procedure	7	3	42.9%	6.2%	79.5%	40	0.9
PA, reconstruction (plasty), branch, central	5	1	20.0%	0.0%	55.1%	68	1.3
Pacemaker implantation, permanent	5	0	0.0%	0.0%	0.0%	2	0.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	5	0	0.0%	0.0%	0.0%	63	1.0
Cor triatriatum repair	4	2	50.0%	1.0%	99.0%	60	1.2
Thoracic and/or mediastinal procedure, other	4	1	25.0%	0.0%	67.4%	rare	1.1
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	0	0.0%	0.0%	0.0%	137	1.3
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	rare	1.0
Sternotomy wound drainage	2	1	50.0%	0.0%	100.0%	rare	0.9
Fontan, TCPC, lateral tunnel, fenestrated	1	0	0.0%	0.0%	0.0%	101	1.1
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	1.0



**Table 3.4**  
**Frequency of procedure and mortality risk in infant (n=2,331 missing 5.4%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Arterial switch operation (ASO)	47	7	14.9%	4.7%	25.1%	130	1.3
Aortic arch repair	22	9	40.9%	20.4%	61.5%	82	1.9
Interrupted aortic arch repair	20	6	30.0%	9.9%	50.1%	118	1.7
Valve replacement, truncal	7	1	14.3%	0.0%	40.2%	46	1.5
Anomalous origin of coronary artery repair	6	3	50.0%	10.0%	90.0%	119	1.4
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	5	3	60.0%	17.1%	100.0%	148	1.6
Pulmonary AV fistula repair/occlusion	4	0	0.0%	0.0%	0.0%	rare	2.6
Pleural procedure, other	3	0	0.0%	0.0%	0.0%	rare	1.4
Anomalous systemic venous connection repair	2	1	50.0%	0.0%	100.0%	54	1.4
Coronary artery bypass	2	1	50.0%	0.0%	100.0%	98	1.8
ASD, common atrium (single atrium), septation	1	1	100.0%	100.0%	100.0%	18	1.7
Fontan, atrio-ventricular connection	1	1	100.0%	100.0%	100.0%	0	1.5
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	1.4
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	107	1.5

**Table 3.5**  
**Frequency of procedure and mortality risk in infant (n=2,331 missing 5.4%)**  
**Mortality category 5**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	16	12	75.0%	53.8%	96.2%	147	3.4
HLHS biventricular repair	4	3	75.0%	32.6%	100.0%	145	3.3
PA debanding	4	0	0.0%	0.0%	0.0%	29	3.7
Valvuloplasty, truncal valve	1	1	100.0%	100.0%	100.0%	59	4.9
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	rare	5.0
Coarctation repair, NOS	1	0	0.0%	0.0%	0.0%	rare	2.8
Intraaortic balloon pump (IABP) insertion	1	1	100.0%	100.0%	100.0%	rare	3.5
<b>Total (127 procedures)</b>	<b>2331</b>	<b>269</b>	<b>11.5%</b>	<b>10.2%</b>	<b>12.8%</b>		



## Mortality category and procedures in preschool children

- There are 123 procedures in 2322 patients of all 5 mortality categories with 5% mortality.
- Most operations are in category 1; most of the common procedures are VSD repair with patch, PDA with surgical closure, VSD with primary closure, TOF repair with ventriculotomy and transanular patch, ASD repair with patch; all with the in-hospital mortality of 2%, 1%, 1%, 9% and 2% respectively.
- In mortality category 2 of preschool children, the most common procedures are Bidirectional cavopulmonary anastomosis, TOF repair with non-ventriculotomy, TOF repair (not otherwise stated) and PA banding; all with in-hospital mortality of 8%, 12%, 12% and no mortality respectively.
- In mortality category 3 of preschool children, most common procedures are Modified Blalock-Taussig shunt, Complete AVSD repair, DORV with intraventricular tunnel repair and TAPVC repair and Bilateral bidirectional cavopulmonary anastomosis; all with in-hospital mortality of 1%, 10%, 23%, 15% and 11% respectively.
- In mortality category 4 of preschool children, most common procedures are Anomalous systemic venous connection repair, Arterial switch operation and Aortic arch repair; all with in-hospital mortality of 25%, 67% and no mortality.
- In mortality category 5 of preschool children, there are only two Norwood patients with 100% mortality.





**Table 4.1**  
**Frequency of procedure and mortality risk in preschool children (n=2,322 missing 4.6%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	597	12	2.0%	0.9%	3.1%	32	0.2
PDA closure, surgical	302	3	1.0%	0.0%	2.1%	5	0.2
VSD repair, primary closure	160	1	0.6%	0.0%	1.8%	30	0.2
TOF repair, ventriculotomy, transanular patch	129	12	9.3%	4.3%	14.3%	79	0.4
ASD repair, patch	67	1	1.5%	0.0%	4.4%	8	0.1
PDA closure, device	50	1	2.0%	0.0%	5.9%	rare	0.2
ASD repair, primary closure	34	0	0.0%	0.0%	0.0%	7	0.1
PDA closure, NOS	30	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, end to end	15	0	0.0%	0.0%	0.0%	24	0.3
AVC (AVSD) repair, partial (incomplete) (PAVSD)	14	0	0.0%	0.0%	0.0%	31	0.3
TOF repair, ventriculotomy, non transanular patch	14	1	7.1%	0.0%	20.6%	62	0.4
Lung procedure, other	14	0	0.0%	0.0%	0.0%	rare	0.2
Esophageal procedure	13	0	0.0%	0.0%	0.0%	rare	0.4
Valvuloplasty, pulmonic	11	1	9.1%	0.0%	26.1%	26	0.4
ASD partial closure	9	1	11.1%	0.0%	31.6%	10	0.2
VSD, multiple, repair	8	0	0.0%	0.0%	0.0%	113	0.3
PAPVC repair	8	0	0.0%	0.0%	0.0%	27	0.2
Aortic stenosis, subvalvar, repair	8	0	0.0%	0.0%	0.0%	42	0.1
PFO, primary closure	6	0	0.0%	0.0%	0.0%	6	0.2
Valvuloplasty, mitral	6	0	0.0%	0.0%	0.0%	76	0.3
Coarctation repair, end to end, extended	6	0	0.0%	0.0%	0.0%	24	0.2
Mediastinal procedure	6	0	0.0%	0.0%	0.0%	rare	0.4
Pulmonary embolectomy	5	0	0.0%	0.0%	0.0%	34	0.1
AVC (AVSD) repair, intermediated (transitional)	5	0	0.0%	0.0%	0.0%	33	0.1
Occlusion MAPCA(s)	5	0	0.0%	0.0%	0.0%	51	0.4
Valve surgery, other, mitral	5	0	0.0%	0.0%	0.0%	76	0.1
Organ procurement	5	0	0.0%	0.0%	0.0%	rare	0.3
Cardiac procedure, other	4	0	0.0%	0.0%	0.0%	rare	0.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	3	0	0.0%	0.0%	0.0%	89	0.1
Valvuloplasty, tricuspid	3	2	66.7%	13.3%	100.0%	57	0.4
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	rare	0.1
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	rare	0.2
Fontan, other	3	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, subclavian flap	3	0	0.0%	0.0%	0.0%	23	0.1



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.4
Valve surgery, other, tricuspid	2	0	0.0%	0.0%	0.0%	rare	0.3
Aortic stenosis, supravalvar, repair	2	0	0.0%	0.0%	0.0%	64	0.1
Shunt, systemic to pulmonary, other	2	1	50.0%	0.0%	100.0%	rare	0.2
Shunt, systemic to pulmonary, NOS	2	0	0.0%	0.0%	0.0%	rare	0.3
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	rare	0.1
ASD repair, device	1	0	0.0%	0.0%	0.0%	rare	0.2
ASD repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.1
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.2
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	17	0.1
Palliation, other	1	0	0.0%	0.0%	0.0%	rare	0.3
Ligation, thoracic duct	1	0	0.0%	0.0%	0.0%	rare	0.1
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2



**Table 4.2**  
**Frequency of procedure and mortality risk in preschool children (n=2,322 missing 4.6%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	112	9	8.0%	3.0%	13.1%	43	0.4
TOF repair, non ventriculotomy	52	6	11.5%	2.9%	20.2%	81	0.5
TOF repair, NOS	17	2	11.8%	0.0%	27.1%	rare	0.5
PA banding (PAB)	17	0	0.0%	0.0%	0.0%	21	0.6
TOF repair, RV-PA conduit	13	1	7.7%	0.0%	22.2%	80	0.6
AP window repair	8	2	25.0%	0.0%	55.0%	35	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	8	1	12.5%	0.0%	35.4%	92	0.8
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	8	0	0.0%	0.0%	0.0%	47	0.8
AVC (AVSD) repair, NOS	7	0	0.0%	0.0%	0.0%	rare	0.5
Pulmonary Venous Stenosis, repair	7	2	28.6%	0.0%	62.0%	117	0.7
Unifocalization MAPCA(s)	6	2	33.3%	0.0%	71.1%	116	0.6
Lung biopsy	6	0	0.0%	0.0%	0.0%	rare	0.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	5	0	0.0%	0.0%	0.0%	41	0.4
ASD creation/enlargement	4	0	0.0%	0.0%	0.0%	9	0.5
Ventricular septal fenestration	4	0	0.0%	0.0%	0.0%	45	0.5
Fontan, TCPC, external conduit, nonfenestrated	4	1	25.0%	0.0%	67.4%	97	0.6
TOF, AVC (AVSD), repair	3	1	33.3%	0.0%	86.7%	122	0.7
TOF, absent pulmonary valve, repair	3	1	33.3%	0.0%	86.7%	109	0.7
Valve replacement, mitral (MVR)	3	1	33.3%	0.0%	86.7%	69	0.7
Rastelli	3	0	0.0%	0.0%	0.0%	125	0.7
Vascular ring repair	3	0	0.0%	0.0%	0.0%	19	0.6
Cardiotomy, other	3	1	33.3%	0.0%	86.7%	rare	0.5
Atrial septal fenestration	2	0	0.0%	0.0%	0.0%	12	0.8
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	36	0.6
Valve replacement, pulmonic (PVR)	2	0	0.0%	0.0%	0.0%	44	0.6
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	1	0.7
Fontan, TCPC, external conduit, NOS	2	1	50.0%	0.0%	100.0%	rare	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	rare	0.5
Damus-KayooStansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	2	2	100.0%	100.0%	100.0%	114	0.6
Hemifontan	2	0	0.0%	0.0%	0.0%	78	0.5
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	58	0.6
Mitral stenosis, supra-valvar mitral ring, repair	1	1	100.0%	100.0%	100.0%	74	0.5
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	94	0.6
Coarctation repair, other	1	0	0.0%	0.0%	0.0%	112	0.8
ASD creation, blade septostomy	1	0	0.0%	0.0%	0.0%	rare	0.4
Minimally invasive procedure	1	0	0.0%	0.0%	0.0%	rare	0.5



**Table 4.3**  
**Frequency of procedure and mortality risk in preschool children (n=2,322 missing 4.6%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	219	2	0.9%	0.0%	2.2%	39	0.8
AVC(AVSD) repair, complete CAUSD	60	6	10.0%	2.4%	17.6%	87	0.9
DORV, intraventricular tunnel repair	22	5	22.7%	5.2%	40.2%	132	0.9
TAPVC repair	20	3	15.0%	0.0%	30.6%	104	1.3
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	18	2	11.1%	0.0%	25.6%	63	1.0
DORV repair, NOS	13	2	15.4%	0.0%	35.0%	rare	0.9
Cor triatriatum repair	8	1	12.5%	0.0%	35.4%	60	1.2
Truncus arteriosus repair	7	0	0.0%	0.0%	0.0%	134	1.1
RVOT procedure	4	1	25.0%	0.0%	67.4%	40	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	0	0.0%	0.0%	0.0%	rare	0.8
Coarctation repair, patch aortoplasty	4	0	0.0%	0.0%	0.0%	22	0.8
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	2	0.8
Mustard	3	1	33.3%	0.0%	86.7%	100	1.0
Pulmonary artery sling repair	3	0	0.0%	0.0%	0.0%	105	1.3
Valve excision, tricuspid (without replacement)	2	1	50.0%	0.0%	100.0%	13	1.0
Arterial switch operation (ASO) and VSD repair	2	0	0.0%	0.0%	0.0%	138	1.0
Senning	2	1	50.0%	0.0%	100.0%	108	1.2
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	rare	0.9
Thoracic and/or mediastinal procedure, other	2	1	50.0%	0.0%	100.0%	rare	1.1
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	1	0	0.0%	0.0%	0.0%	137	1.3
Valve replacement, tricuspid (TVR)	1	1	100.0%	100.0%	100.0%	65	1.1
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	rare	1.0
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	73	0.9
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	139	1.0
Pectus repair	1	0	0.0%	0.0%	0.0%	rare	0.9
Shunt, ligation and takedown	1	0	0.0%	0.0%	0.0%	11	0.9
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	1.2



**Table 4.4**  
**Frequency of procedure and mortality risk in preschool children (n=2,322 missing 4.6%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Anomalous systemic venous connection repair	4	1	25.0%	0.0%	67.4%	54	1.4
Arterial switch operation (ASO)	3	2	66.7%	13.3%	100.0%	130	1.3
Aortic arch repair	3	0	0.0%	0.0%	0.0%	82	1.9
Fontan, atrio-ventricular connection	2	0	0.0%	0.0%	0.0%	0	1.5
Anomalous origin of coronary artery repair	2	0	0.0%	0.0%	0.0%	119	1.4
Interrupted aortic arch repair	2	0	0.0%	0.0%	0.0%	118	1.7
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	18	1.7
Conduit, placement, RV to PA	1	1	100.0%	100.0%	100.0%	66	1.5
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	1.4

**Table 4.5**  
**Frequency of procedure and mortality risk in preschool children (n=2,322 missing 4.6%)**  
**Mortality category 5**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	2	2	100.0%	100.0%	100.0%	147	3.4
<b>Total (123 procedures)</b>	<b>2322</b>	<b>104</b>	<b>4.5%</b>	<b>3.6%</b>	<b>5.3%</b>		



## Mortality category and procedures in school aged children

- There are 145 procedures in 3172 patients of 5 mortality categories with 4% mortality.
- Most of patients in school aged children are in mortality category 1.
- In mortality category 1, the most common procedures are VSD repair with patch, ASD repair with patch, TOF repair with ventriculotomy and transanular patch, VSD repair with primary closure, PDA with surgical closure and ASD repair with primary closure; all with mortality of < than 1%, no mortality, 6%, 1%, no mortality and 1%.
- In mortality category 2, the most common procedures are TOF repair with non ventriculotomy, Bidirectional cavopulmonary anastomosis, Rastelli, TOF repair (not otherwise stated method) and Pulmonary atresia with VSD repair; all with in-hospital mortality of 7%, 4%, 7%, 5% and 8% respectively.
- In mortality category 3 of school aged children, the most common procedures are Modified Blalock-Taussig shunt, DORV with intraventricular tunnel repair, DORV with nothing otherwise specified and Complete AVSD repair; all with in-hospital mortality of 3%, 14%, 17% and 18%.
- In mortality category 4 of school aged children, the most common procedures are Valve surgery with other and aortic, Arterial switch operation, Main PA reconstruction and RV-PA conduit placement; all with in-hospital mortality of 17%, 33%, 0% and 25%.
- In mortality category 5 of school aged children, there are 3 procedures, namely PA banding, IABP insertion and Homograft aortic root replacement with in-hospital mortality of 0%, 50% and 100% respectively.



**Table 5.1**  
**Frequency of procedure and mortality risk in school aged children (n=3,172 missing 4.3%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	520	1	0.2%	0.0%	0.6%	32	0.2
ASD repair, patch	328	0	0.0%	0.0%	0.0%	8	0.1
TOF repair, ventriculotomy, transanular patch	292	16	5.5%	2.9%	8.1%	79	0.4
VSD repair, primary closure	236	2	0.8%	0.0%	2.0%	30	0.2
PDA closure, surgical	204	0	0.0%	0.0%	0.0%	5	0.2
ASD, repair, primary closure	124	1	0.8%	0.0%	2.4%	7	0.1
PDA closure, device	52	0	0.0%	0.0%	0.0%	rare	0.2
TOF repair, ventriculotomy, nontransanular patch	29	1	3.4%	0.0%	10.1%	62	0.4
PDA closure, NOS	27	0	0.0%	0.0%	0.0%	rare	0.1
PAPVC repair	25	0	0.0%	0.0%	0.0%	27	0.2
Valvuloplasty, mitral	20	0	0.0%	0.0%	0.0%	76	0.3
PFO, primary closure	18	0	0.0%	0.0%	0.0%	6	0.2
ASD partial closure	18	0	0.0%	0.0%	0.0%	10	0.2
Esophageal procedure	17	2	11.8%	0.0%	27.1%	rare	0.4
Aortic stenosis, subvalvar, repair	16	0	0.0%	0.0%	0.0%	42	0.1
Valvuloplasty, pulmonic	14	0	0.0%	0.0%	0.0%	26	0.4
VSD, multiple, repair	13	1	7.7%	0.0%	22.2%	113	0.3
Valvuloplasty, tricuspid	13	2	15.4%	0.0%	35.0%	57	0.4
Lung procedure, other	13	0	0.0%	0.0%	0.0%	rare	0.2
AVC (AVSD) repair, partial (incomplete) (PAVSD)	12	1	8.3%	0.0%	24.0%	31	0.3
VSD repair, NOS	10	0	0.0%	0.0%	0.0%	rare	0.4
Coarctation repair, end to end	10	0	0.0%	0.0%	0.0%	24	0.3
Cardiac procedure, other	9	0	0.0%	0.0%	0.0%	rare	0.1
Valve surgery, other, mitral	8	0	0.0%	0.0%	0.0%	76	0.1
Organ procurement	8	0	0.0%	0.0%	0.0%	rare	0.3
DCRV repair	7	0	0.0%	0.0%	0.0%	48	0.1
Valve excision, pulmonary (without replacement)	7	0	0.0%	0.0%	0.0%	rare	0.1
Occlusion MAPCA(s)	6	0	0.0%	0.0%	0.0%	51	0.4
Valve surgery, other, tricuspid	6	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), NOS	6	0	0.0%	0.0%	0.0%	rare	0.1
Fontan, other	6	0	0.0%	0.0%	0.0%	rare	0.1
Coronary artery fistula ligation	6	0	0.0%	0.0%	0.0%	17	0.1
ASD repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.1
Aortic stenosis, supra-valvar, repair	5	0	0.0%	0.0%	0.0%	64	0.1
Congenitally corrected TGA repair, other	5	0	0.0%	0.0%	0.0%	rare	0.2



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Coarctation repair, end to end, extended	5	0	0.0%	0.0%	0.0%	24	0.2
Palliation, other	5	1	20.0%	0.0%	55.1%	rare	0.3
AVC (AVSD) repair, intermediated (transitional)	4	0	0.0%	0.0%	0.0%	33	0.1
Peripheral vascular procedure, other	4	0	0.0%	0.0%	0.0%	rare	0.2
Pulmonary embolectomy	3	1	33.3%	0.0%	86.7%	34	0.1
ASD repair, device	3	0	0.0%	0.0%	0.0%	rare	0.2
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	rare	0.2
Congenitally corrected TGA repair, VSD closure	3	0	0.0%	0.0%	0.0%	106	0.1
Pacemaker procedure	3	0	0.0%	0.0%	0.0%	3	0.3
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	rare	0.1
Ligation, thoracic duct	3	0	0.0%	0.0%	0.0%	rare	0.1
Valve closure, semilunar	2	0	0.0%	0.0%	0.0%	rare	0.2
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Atrial baffle procedure, NOS	2	0	0.0%	0.0%	0.0%	67	0.1
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
VSD repair, device	1	0	0.0%	0.0%	0.0%	rare	0.3
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	89	0.1
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	70	0.3
Sinus of Valsalva, aneurysm repair	1	0	0.0%	0.0%	0.0%	61	0.1
Coarctation repair, interposition graft	1	0	0.0%	0.0%	0.0%	49	0.1
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	0.0%	0.0%	15	0.2
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
Mediastinal exploration	1	0	0.0%	0.0%	0.0%	rare	0.3





**Table 5.2**  
**Frequency of procedure and mortality risk in school aged children (n=3,172 missing 4.3%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, non ventriculotomy	127	9	7.1%	2.6%	11.5%	81	0.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	56	2	3.6%	0.0%	8.4%	43	0.4
Rastelli	44	3	6.8%	0.0%	14.3%	125	0.7
TOF repair, NOS	42	2	4.8%	0.0%	11.2%	rare	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	36	3	8.3%	0.0%	17.4%	92	0.8
Fontan, TCPC, external conduit, nonfenestrated	34	3	8.8%	0.0%	18.4%	97	0.6
Fontan, TCPC, external conduit, NOS	31	2	6.5%	0.0%	15.1%	rare	0.6
TOF repair, RV-PA conduit	24	2	8.3%	0.0%	19.4%	80	0.6
Unifocalization MAPCA(s)	21	1	4.8%	0.0%	13.9%	116	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	21	1	4.8%	0.0%	13.9%	47	0.8
TOF, AVC (AVSD), repair	12	1	8.3%	0.0%	24.0%	122	0.7
TOF, absent pulmonary valve, repair	10	0	0.0%	0.0%	0.0%	109	0.7
Fontan, atrio-pulmonary connection	10	2	20.0%	0.0%	44.8%	94	0.6
Cardiotomy, other	10	0	0.0%	0.0%	0.0%	rare	0.5
Valve replacement, mitral (MVR)	9	1	11.1%	0.0%	31.6%	69	0.7
Valve replacement, pulmonic (PVR)	8	2	25.0%	0.0%	55.0%	44	0.6
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	8	0	0.0%	0.0%	0.0%	41	0.4
Valvuloplasty, aortic	7	0	0.0%	0.0%	0.0%	72	0.5
Mitral stenosis, supra-valvar mitral ring, repair	7	0	0.0%	0.0%	0.0%	74	0.5
Fontan, NOS	7	1	14.3%	0.0%	40.2%	rare	0.5
1 1/2 ventricular repair	6	0	0.0%	0.0%	0.0%	58	0.6
Hemifontan	6	2	33.3%	0.0%	71.1%	78	0.5
Cardiac tumor resection	6	0	0.0%	0.0%	0.0%	88	0.7
Ventricular septal fenestration	5	0	0.0%	0.0%	0.0%	45	0.5
Pulmonary Venous Stenosis, repair	5	1	20.0%	0.0%	55.1%	117	0.7
Pericardectomy	5	1	20.0%	0.0%	55.1%	20	0.6
Coronary artery procedure, other	5	0	0.0%	0.0%	0.0%	17	0.7
AVC (AVSD) repair, NOS	4	0	0.0%	0.0%	0.0%	rare	0.5
Lung biopsy	4	0	0.0%	0.0%	0.0%	rare	0.5
PA banding (PAB)	4	0	0.0%	0.0%	0.0%	21	0.6
ASD creation/enlargement	3	0	0.0%	0.0%	0.0%	9	0.5
Valve closure, tricuspid (exclusion, univentricular approach)	3	0	0.0%	0.0%	0.0%	36	0.6
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	77	0.7
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	12	0.8
AP window repair	1	0	0.0%	0.0%	0.0%	35	0.5
Pericardial drainage procedure	1	0	0.0%	0.0%	0.0%	1	0.7
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	0.0%	0.0%	99	0.5
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Vascular ring repair	1	0	0.0%	0.0%	0.0%	19	0.6
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	14	0.5
Delayed sternal closure	1	0	0.0%	0.0%	0.0%	rare	0.5



**Table 5.3**  
**Frequency of procedure and mortality risk in school aged children (n=3,172 missing 4.3%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	160	4	2.5%	0.1%	4.9%	39	0.8
DORV, intraventricular tunnel repair	37	5	13.5%	2.5%	24.5%	132	0.9
DORV repair, NOS	35	6	17.1%	4.7%	29.6%	rare	0.9
AVC(AVSD) repair, complete CAVSD	22	4	18.2%	2.1%	34.3%	87	0.9
RVOT procedure	20	1	5.0%	0.0%	14.6%	40	0.9
Fontan, TCPC, lateral tunnel, fenestrated	17	4	23.5%	3.4%	43.7%	101	1.1
Pacemaker implantation, permanent	16	0	0.0%	0.0%	0.0%	2	0.8
TAPVC repair	10	1	10.0%	0.0%	28.6%	104	1.3
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	8	2	25.0%	0.0%	55.0%	137	1.3
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	8	0	0.0%	0.0%	0.0%	63	1.0
Truncus arteriosus repair	5	0	0.0%	0.0%	0.0%	134	1.1
Thoracic and/or mediastinal procedure, other	5	0	0.0%	0.0%	0.0%	rare	1.1
Valve replacement, aortic (AVR), mechanical	4	2	50.0%	1.0%	99.0%	52	1.1
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	1	25.0%	0.0%	67.4%	rare	0.8
Pectus repair	4	0	0.0%	0.0%	0.0%	rare	0.9
Valve replacement, tricuspid (TVR)	3	0	0.0%	0.0%	0.0%	65	1.1
PA, reconstruction (plasty), branch, central	3	0	0.0%	0.0%	0.0%	68	1.3
Valve surgery, other pulmonic	3	0	0.0%	0.0%	0.0%	rare	1.0
Valve replacement, aortic (AVR)	3	1	33.3%	0.0%	86.7%	0	0.9
Senning	3	0	0.0%	0.0%	0.0%	108	1.2
Sternotomy wound drainage	3	0	0.0%	0.0%	0.0%	rare	0.9
Cor triatriatum repair	2	0	0.0%	0.0%	0.0%	60	1.2
Conduit, placement, LV to PA	2	0	0.0%	0.0%	0.0%	73	0.9
Congenitally corrected TGA repair, atrial switch and Rastelli	2	0	0.0%	0.0%	0.0%	139	1.0
Mustard	2	0	0.0%	0.0%	0.0%	100	1.0
Pulmonary artery sling repair	1	1	100.0%	100.0%	100.0%	105	1.3
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	1.2



**Table 5.4**  
**Frequency of procedure and mortality risk in school aged children (n=3,172 missing 4.3%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valve surgery, other, aortic	6	1	16.7%	0.0%	46.5%	rare	1.5
Arterial switch operation (ASO)	6	2	33.3%	0.0%	71.1%	130	1.3
PA, reconstruction (plasty), main (trunk)	5	0	0.0%	0.0%	0.0%	25	1.5
Conduit, placement, RV to PA	4	1	25.0%	0.0%	67.4%	66	1.5
Valve replacement, truncal	3	1	33.3%	0.0%	86.7%	46	1.5
Aortic root replacement	3	1	33.3%	0.0%	86.7%	rare	1.9
Fontan, atrio-ventricular connection	3	1	33.3%	0.0%	86.7%	0	1.5
Aortic arch repair	3	0	0.0%	0.0%	0.0%	82	1.9
Coronary artery bypass	2	0	0.0%	0.0%	0.0%	98	1.8
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	18	1.7
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	0	0.0%	0.0%	0.0%	148	1.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	135	1.4
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	119	1.4
Interrupted aortic arch repair	1	0	0.0%	0.0%	0.0%	118	1.7
Pulmonary AV fistula repair/occlusion	1	0	0.0%	0.0%	0.0%	rare	2.6
Pleural procedure, other	1	1	100.0%	100.0%	100.0%	rare	1.4

**Table 5.5**  
**Frequency of procedure and mortality risk in school aged children (n=3,172 missing 4.3%)**  
**Mortality category 5**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA debanding	4	0	0.0%	0.0%	0.0%	29	3.7
Intraaortic balloon pump (IABP) insertion	2	1	50.0%	0.0%	100.0%	rare	3.5
Aortic root replacement, homograft	1	1	100.0%	100.0%	100.0%	121	4.8
<b>Total (145 procedures)</b>	<b>3172</b>	<b>111</b>	<b>3.5%</b>	<b>2.9%</b>	<b>4.1%</b>		



## Mortality and procedures of grown-up children

- There are 126 procedures in 1121 grown-up patients of all mortality categories with in-hospital mortality of 2%.
- Most patients are in category 1; the most common procedures are VSD repair with patch, VSD repair with primary closure, ASD repair with patch, ASD repair with primary closure, PDA with surgical closure and TOF repair with ventriculotomy and transannular patch; all with in-hospital mortality of 2% for VSD repair with patch but 0% for the remaining.
- In mortality category 2, the most common procedures are TOF repair with non-ventriculotomy, Central Ao-PA shunt, Pulmonary atresia-VSD repair and Unifocalization of MAPCA's; all with in-hospital mortality of 0%, 8%, 8% and 0%.
- In mortality category 3, the most common procedures are Modified Blalock-Taussig shunt, DORV with intraventricular tunnel repair and Fontan TCPC with fenestrated lateral tunnel; all with in-hospital mortality of 0%, 0% and 13%.
- In mortality category 4, the most common procedures are Aortic valve surgery other and Coronary artery bypass with in-hospital mortality of 33% and 0% respectively.
- In mortality category 5, there are only 4 procedures namely Konno procedure and Ross-Konno procedure which both have 100% in-hospital mortality while HLHS biventricular repair and PA debanding have 0% in-hospital mortality. Because the numbers are too small, this could be interpreted as it could happen by chance.



**Table 6.1**  
**Frequency of procedure and mortality risk in grown-up children (n=1,121 missing 4.1%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	195	3	1.5%	0.0%	3.3%	32	0.2
VSD repair, primary closure	119	0	0.0%	0.0%	0.0%	30	0.2
ASD repair, patch	116	0	0.0%	0.0%	0.0%	8	0.1
ASD repair, primary closure	68	0	0.0%	0.0%	0.0%	7	0.1
PDA closure, surgical	51	0	0.0%	0.0%	0.0%	5	0.2
TOF repair, ventriculotomy, transanular patch	43	0	0.0%	0.0%	0.0%	79	0.4
Esophageal procedure	23	1	4.3%	0.0%	12.7%	rare	0.4
Valvuloplasty, mitral	19	1	5.3%	0.0%	15.3%	76	0.3
PDA closure, device	17	0	0.0%	0.0%	0.0%	rare	0.2
TOF repair, ventriculotomy, nontransanular patch	14	0	0.0%	0.0%	0.0%	62	0.4
PFO, primary closure	11	0	0.0%	0.0%	0.0%	6	0.2
Valvuloplasty, pulmonic	9	0	0.0%	0.0%	0.0%	26	0.4
PDA closure, NOS	9	0	0.0%	0.0%	0.0%	rare	0.1
ASD partial closure	8	0	0.0%	0.0%	0.0%	10	0.2
Aortic stenosis, subvalvar, repair	8	0	0.0%	0.0%	0.0%	42	0.1
Lung procedure, other	8	1	12.5%	0.0%	35.4%	rare	0.2
AVC (AVSD) repair, partial (incomplete) (PAVSD)	7	1	14.3%	0.0%	40.2%	31	0.3
PAPVC repair	7	0	0.0%	0.0%	0.0%	27	0.2
Pulmonary embolectomy	7	0	0.0%	0.0%	0.0%	34	0.1
Cardiac procedure, other	7	0	0.0%	0.0%	0.0%	rare	0.1
Organ procurement	7	0	0.0%	0.0%	0.0%	rare	0.3
Aortic stenosis, supravalvar, repair	6	0	0.0%	0.0%	0.0%	64	0.1
Valvuloplasty, tricuspid	5	0	0.0%	0.0%	0.0%	57	0.4
Ligation, thoracic duct	5	0	0.0%	0.0%	0.0%	rare	0.1
DCRV repair	4	0	0.0%	0.0%	0.0%	48	0.1
Mediastinal procedure	4	1	25.0%	0.0%	67.4%	rare	0.4
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	113	0.3
Occlusion MAPCA(s)	3	0	0.0%	0.0%	0.0%	51	0.4
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	rare	0.1
Sinus of valsalva, aneurysm repair	3	0	0.0%	0.0%	0.0%	61	0.1
Congenitally corrected TGA repair, VSD closure	3	0	0.0%	0.0%	0.0%	106	0.1
Coarctation repair, end to end	3	0	0.0%	0.0%	0.0%	24	0.3
Coarctation repair, interposition graft	3	0	0.0%	0.0%	0.0%	49	0.1
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	rare	0.1
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.4



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Coarctation repair, end to end, extended	2	0	0.0%	0.0%	0.0%	24	0.2
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Palliation, other	2	0	0.0%	0.0%	0.0%	rare	0.3
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	33	0.1
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	rare	0.3
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	rare	0.1
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	0.2
Valve replacement, aortic (AVR), bioprosthetic	1	0	0.0%	0.0%	0.0%	55	0.2
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	133	0.3
Pericardial procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Tracheal procedure	1	0	0.0%	0.0%	0.0%	rare	0.1
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	3	0.3
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
VATS (video-assisted thoracoscopic surgery)	1	0	0.0%	0.0%	0.0%	rare	0.2
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2



**Table 6.2**  
**Frequency of procedure and mortality risk in grown-up children (n=1,121 missing 4.1%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, non ventriculotomy	25	0	0.0%	0.0%	0.0%	81	0.5
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	13	1	7.7%	0.0%	22.2%	47	0.8
Pulmonary atresia-VSD (including TOF, PA), repair	12	1	8.3%	0.0%	24.0%	92	0.8
Unifocalization MAPCA(s)	11	0	0.0%	0.0%	0.0%	116	0.6
Valve replacement, pulmonic (PVR)	10	0	0.0%	0.0%	0.0%	44	0.6
Valve replacement, mitral (MVR)	9	0	0.0%	0.0%	0.0%	69	0.7
Rastelli	8	1	12.5%	0.0%	35.4%	125	0.7
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	8	0	0.0%	0.0%	0.0%	43	0.4
Mitral stenosis, supravalvar mitral ring, repair	7	0	0.0%	0.0%	0.0%	74	0.5
Pericardial drainage procedure	4	1	25.0%	0.0%	67.4%	1	0.7
Pericardectomy	4	0	0.0%	0.0%	0.0%	20	0.6
Fontan, TCPC, external conduit, nonfenestrated	4	1	25.0%	0.0%	67.4%	97	0.6
Hemifontan	4	0	0.0%	0.0%	0.0%	78	0.5
Cardiotomy, other	4	0	0.0%	0.0%	0.0%	rare	0.5
Coronary artery procedure, other	3	0	0.0%	0.0%	0.0%	17	0.7
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	3	0	0.0%	0.0%	0.0%	41	0.4
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	88	0.7
Ventricular septal fenestration	2	0	0.0%	0.0%	0.0%	45	0.5
TOF repair, RV-PA conduit	2	0	0.0%	0.0%	0.0%	80	0.6
TOF, absent pulmonary valve, repair	2	0	0.0%	0.0%	0.0%	109	0.7
TOF repair, NOS	2	1	50.0%	0.0%	100.0%	rare	0.5
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	36	0.6
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	77	0.7
Valvuloplasty, aortic	2	0	0.0%	0.0%	0.0%	72	0.5
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	rare	0.5
PA banding (PAB)	2	0	0.0%	0.0%	0.0%	21	0.6
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Pulmonary Venous Stenosis, repair	1	0	0.0%	0.0%	0.0%	117	0.7
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	122	0.7
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	58	0.6
Fontan, TCPC, external conduit, NOS	1	0	0.0%	0.0%	0.0%	rare	0.6



**Table 6.3**  
**Frequency of procedure and mortality risk in grown-up children (n=1,121 missing 4.1%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	25	0	0.0%	0.0%	0.0%	39	0.8
DORV, intraventricular tunnel repair	9	0	0.0%	0.0%	0.0%	132	0.9
Fontan, TCPC, lateral tunnel, fenestrated	8	1	12.5%	0.0%	35.4%	101	1.1
DORV repair, NOS	8	0	0.0%	0.0%	0.0%	rare	0.9
Pacemaker implantation, permanent	8	0	0.0%	0.0%	0.0%	2	0.8
RVOT procedure	7	0	0.0%	0.0%	0.0%	40	0.9
Valve replacement, aortic (AVR), mechanical	6	1	16.7%	0.0%	46.5%	52	1.1
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	5	1	20.0%	0.0%	55.1%	137	1.3
Valve surgery, other pulmonic	5	0	0.0%	0.0%	0.0%	rare	1.0
Valve replacement, tricuspid (TVR)	4	1	25.0%	0.0%	67.4%	65	1.1
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	0	0.0%	0.0%	0.0%	rare	0.8
Thoracic and/or mediastinal procedure, other	4	1	25.0%	0.0%	67.4%	rare	1.1
AVC(AVSD) repair, complete CAVSD	3	0	0.0%	0.0%	0.0%	87	0.9
Conduit, placement, LV to PA	3	1	33.3%	0.0%	86.7%	73	0.9
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	3	0	0.0%	0.0%	0.0%	63	1.0
Sternotomy wound drainage	3	0	0.0%	0.0%	0.0%	rare	0.9
Truncus arteriosus repair	2	0	0.0%	0.0%	0.0%	134	1.1
TAPVC repair	2	0	0.0%	0.0%	0.0%	104	1.3
Valve replacement, aortic (AVR)	2	0	0.0%	0.0%	0.0%	0	0.9
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	60	1.2
PA, reconstruction (plasty), branch, central	1	1	100.0%	100.0%	100.0%	68	1.3
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	1.0
Arterial switch operation (ASO) and VSD repair	1	0	0.0%	0.0%	0.0%	138	1.0
Mustard	1	0	0.0%	0.0%	0.0%	100	1.0
Coarctation repair, patch aortoplasty	1	0	0.0%	0.0%	0.0%	22	0.8
Pectus repair	1	0	0.0%	0.0%	0.0%	rare	0.9





**Table 6.4**  
**Frequency of procedure and mortality risk in grown-up children (n=1,121 missing 4.1%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valve surgery, other, aortic	3	1	33.3%	0.0%	86.7%	rare	1.5
Coronary artery bypass	3	0	0.0%	0.0%	0.0%	98	1.8
Aortic arch repair	2	0	0.0%	0.0%	0.0%	82	1.9
Anomalous origin of coronary artery repair	2	0	0.0%	0.0%	0.0%	119	1.4
Pulmonary AV fistula repair/occlusion	2	0	0.0%	0.0%	0.0%	rare	2.6
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	54	1.4
PA, reconstruction (plasty), main (trunk)	1	0	0.0%	0.0%	0.0%	25	1.5
Conduit, placement, RV to PA	1	0	0.0%	0.0%	0.0%	66	1.5
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	0	1.5
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	0	0.0%	0.0%	0.0%	148	1.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	1.4
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	107	1.5

**Table 6.5**  
**Frequency of procedure and mortality risk in grown-up children (n=1,121 missing 4.1%)**  
**Mortality category 5**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Konno procedure	1	1	100.0%	100.0%	100.0%	131	4.8
Ross-Konno procedure	1	1	100.0%	100.0%	100.0%	146	4.8
HLHS biventricular repair	1	0	0.0%	0.0%	0.0%	145	3.3
PA debanding	1	0	0.0%	0.0%	0.0%	29	3.7
<b>Total (126 procedures)</b>	<b>1121</b>	<b>24</b>	<b>2.1%</b>	<b>1.3%</b>	<b>3.0%</b>		



## Mortality category and procedures in adult

- There are 120 procedures in 2830 patients of adult congenital heart surgery of 5 mortality categories with 2% of in-hospital mortality. Most operations are in mortality category 1.
- The most common procedures of adult mortality category 1 are ASD repair with patch, ASD repair with primary closure, VSD repair with patch, PDA with surgical closure and VSD repair with primary closure; all with in-hospital mortality of 1%, 1%, 2%, 0% and 0%.
- In mortality category 2, the most common procedures are Pericardial drainage, Pulmonic valve replacement, TOF repair with not otherwise stated procedure, Pericardectomy and TOF repair with non ventriculotomy; all with in-hospital mortality of 8%, 4%, 5%, 5% and 0%.
- In mortality category 3 of adult congenital, the most common procedures are Modified Blalock-Taussig shunt, RVOT procedure, DORV with intraventricular tunnel repair and Tricuspid valve replacement; all with in-hospital mortality of 0%, 0%, 11% and 13%.
- In mortality category 4 of adult congenital, the most common procedures are RV-PA conduit placement and Anomalous systemic venous connection repair; these two with in-hospital mortality of 20% and 0%.
- In mortality category 5, there is none.



**Table 7.1**  
**Frequency of procedure and mortality risk in adult (n=2,830 missing 2.9%)**  
**Mortality category 1**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
ASD repair, patch	966	6	0.6%	0.1%	1.1%	8	0.1
ASD repair, primary closure	402	2	0.5%	0.0%	1.2%	7	0.1
VSD repair, patch	277	5	1.8%	0.2%	3.4%	32	0.2
PDA closure, surgical	143	0	0.0%	0.0%	0.0%	5	0.2
VSD repair, primary closure	123	0	0.0%	0.0%	0.0%	30	0.2
ASD partial closure	75	0	0.0%	0.0%	0.0%	10	0.2
TOF repair, ventriculotomy, transanular patch	70	3	4.3%	0.0%	9.0%	79	0.4
Valvuloplasty, tricuspid	64	1	1.6%	0.0%	4.6%	57	0.4
PFO, primary closure	30	0	0.0%	0.0%	0.0%	6	0.2
Valvuloplasty, mitral	29	0	0.0%	0.0%	0.0%	76	0.3
PDA closure, device	27	0	0.0%	0.0%	0.0%	rare	0.2
Sinus of valsalva, aneurysm repair	26	0	0.0%	0.0%	0.0%	61	0.1
Valvuloplasty, pulmonic	24	0	0.0%	0.0%	0.0%	26	0.4
TOF repair, ventriculotomy, nontransanular patch	19	2	10.5%	0.0%	24.3%	62	0.4
Valve surgery, other, tricuspid	19	0	0.0%	0.0%	0.0%	rare	0.3
PAPVC repair	17	0	0.0%	0.0%	0.0%	27	0.2
Coronary artery fistula ligation	14	0	0.0%	0.0%	0.0%	17	0.1
Coarctation repair, interposition graft	11	0	0.0%	0.0%	0.0%	49	0.1
AVC (AVSD) repair, partial (incomplete) (PAVSD)	10	0	0.0%	0.0%	0.0%	31	0.3
ASD repair, NOS	9	0	0.0%	0.0%	0.0%	rare	0.1
PDA closure, NOS	9	0	0.0%	0.0%	0.0%	rare	0.1
VSD, multiple, repair	7	0	0.0%	0.0%	0.0%	113	0.3
VATS (video-assisted thoracoscopic surgery)	7	0	0.0%	0.0%	0.0%	rare	0.2
Valve surgery, other, mitral	6	0	0.0%	0.0%	0.0%	76	0.1
ASD repair, device	5	0	0.0%	0.0%	0.0%	rare	0.2
VSD repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.4
Organ procurement	5	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), NOS	4	0	0.0%	0.0%	0.0%	rare	0.1
DCRV repair	4	0	0.0%	0.0%	0.0%	48	0.1
Valve replacement, aortic (AVR), bioprosthetic	4	0	0.0%	0.0%	0.0%	55	0.2
Congenitally corrected TGA repair, VSD closure	4	0	0.0%	0.0%	0.0%	106	0.1
Valve excision, pulmonary (without replacement)	3	0	0.0%	0.0%	0.0%	rare	0.1



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Palliation, other	3	0	0.0%	0.0%	0.0%	rare	0.3
Aortic stenosis, subvalvar, repair	2	0	0.0%	0.0%	0.0%	42	0.1
Fontan, other	2	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, end to end	2	0	0.0%	0.0%	0.0%	24	0.3
Lung procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Esophageal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.1
VSD, repair, device	1	0	0.0%	0.0%	0.0%	rare	0.3
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	83	0.3
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	33	0.1
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.2
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	0.2
Aortic stenosis, supra-valvar, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	133	0.3
Pericardial procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	0.1
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	3	0.3
Atrial baffle procedure, NOS	1	0	0.0%	0.0%	0.0%	67	0.1
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2



**Table 7.2**  
**Frequency of procedure and mortality risk in adult (n=2,830 missing 2.9%)**  
**Mortality category 2**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Pericardial drainage procedure	37	3	8.1%	0.0%	16.9%	1	0.7
Valve replacement, pulmonic (PVR)	23	1	4.3%	0.0%	12.7%	44	0.6
TOF repair, NOS	20	1	5.0%	0.0%	14.6%	rare	0.5
Pericardectomy	20	1	5.0%	0.0%	14.6%	20	0.6
TOF repair, non ventriculotomy	16	0	0.0%	0.0%	0.0%	81	0.5
ASD creation/enlargement	13	0	0.0%	0.0%	0.0%	9	0.5
Pulmonary Venous Stenosis, repair	13	0	0.0%	0.0%	0.0%	117	0.7
Ventricular septal fenestration	12	1	8.3%	0.0%	24.0%	45	0.5
Mitral stenosis, supravalvar mitral ring, repair	12	0	0.0%	0.0%	0.0%	74	0.5
Valve replacement, mitral (MVR)	11	2	18.2%	0.0%	41.0%	69	0.7
Pulmonary atresia-VSD (including TOF, PA), repair	10	0	0.0%	0.0%	0.0%	92	0.8
Fontan, TCPC, external conduit, nonfenestrated	7	0	0.0%	0.0%	0.0%	97	0.6
Rastelli	7	0	0.0%	0.0%	0.0%	125	0.7
TOF repair, RV-PA conduit	6	1	16.7%	0.0%	46.5%	80	0.6
Valvuloplasty, aortic	5	0	0.0%	0.0%	0.0%	72	0.5
Cardiotomy, other	5	1	20.0%	0.0%	55.1%	rare	0.5
Atrial septal fenestration	4	0	0.0%	0.0%	0.0%	12	0.8
Unifocalization MAPCA(s)	4	1	25.0%	0.0%	67.4%	116	0.6
Conduit, reoperation	4	1	25.0%	0.0%	67.4%	77	0.7
Fontan, atrio-pulmonary connection	4	0	0.0%	0.0%	0.0%	94	0.6
Arrhythmia surgery-atrial, surgical ablation	4	0	0.0%	0.0%	0.0%	84	0.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	4	1	25.0%	0.0%	67.4%	43	0.4
TOF, absent pulmonary valve, repair	3	1	33.3%	0.0%	86.7%	109	0.7
Fontan, TCPC, external conduit, NOS	3	0	0.0%	0.0%	0.0%	rare	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3	0	0.0%	0.0%	0.0%	47	0.8
PA banding (PAB)	3	1	33.3%	0.0%	86.7%	21	0.6
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	88	0.7
TOF, AVC (AVSD), repair	2	0	0.0%	0.0%	0.0%	122	0.7
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	36	0.6
Ligation, pulmonary artery	2	1	50.0%	0.0%	100.0%	rare	0.4
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
AP window repair	1	0	0.0%	0.0%	0.0%	35	0.5
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	58	0.6
Aortic root replacement, mechanical	1	0	0.0%	0.0%	0.0%	111	0.5
Other annular enlargement procedure	1	0	0.0%	0.0%	0.0%	142	0.5
Fontan, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	0	0.0%	0.0%	0.0%	41	0.4



**Table 7.3**  
**Frequency of procedure and mortality risk in adult (n=2,830 missing 2.9%)**  
**Mortality category 3**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	15	0	0.0%	0.0%	0.0%	39	0.8
RVOT procedure	13	0	0.0%	0.0%	0.0%	40	0.9
DORV, intraventricular tunnel repair	9	1	11.1%	0.0%	31.6%	132	0.9
Valve replacement, tricuspid (TVR)	8	1	12.5%	0.0%	35.4%	65	1.1
DORV repair, NOS	8	1	12.5%	0.0%	35.4%	rare	0.9
Valve replacement, aortic (AVR), mechanical	5	0	0.0%	0.0%	0.0%	52	1.1
Valve surgery, other pulmonic	4	0	0.0%	0.0%	0.0%	rare	1.0
Fontan, TCPC, lateral tunnel, fenestrated	4	1	25.0%	0.0%	67.4%	101	1.1
AVC(AVSD) repair, complete CAVSD	3	0	0.0%	0.0%	0.0%	87	0.9
TAPVC repair	3	0	0.0%	0.0%	0.0%	104	1.3
Cor triatriatum repair	3	0	0.0%	0.0%	0.0%	60	1.2
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	1	33.3%	0.0%	86.7%	137	1.3
Valve excision, tricuspid (without replacement)	3	0	0.0%	0.0	0.0%	13	1.0
Pacemaker implantation, permanent	3	0	0.0%	0.0%	0.0%	2	0.8
Valve replacement, aortic (AVR)	2	0	0.0%	0.0%	0.0%	0	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	2	1	50.0%	0.0%	100.0%	rare	0.8
Shunt, ligation and takedown	2	0	0.0%	0.0%	0.0%	11	0.9
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	rare	0.9
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	73	0.9
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	63	1.0
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	1.2
Thoracic and/or mediastinal procedure, other	1	0	0.0%	0.0%	0.0%	rare	1.1



**Table 7.4**  
**Frequency of procedure and mortality risk in adult (n=2,830 missing 2.9%)**  
**Mortality category 4**

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Conduit, placement, RV to PA	5	1	20.0%	0.0%	55.1%	66	1.5
Anomalous systemic venous connection repair	4	0	0.0%	0.0%	0.0%	54	1.4
Coronary artery bypass	2	2	100.0%	100.0%	100.0%	98	1.8
Valve surgery, other, aortic	1	0	0.0%	0.0%	0.0%	rare	1.5
Arterial switch operation (ASO)	1	0	0.0%	0.0%	0.0%	130	1.3
Aortic arch repair	1	0	0.0%	0.0%	0.0%	82	1.9
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	119	1.4
<b>Total (120 procedures)</b>	<b>2830</b>	<b>45</b>	<b>1.6%</b>	<b>1.1%</b>	<b>2.1%</b>		







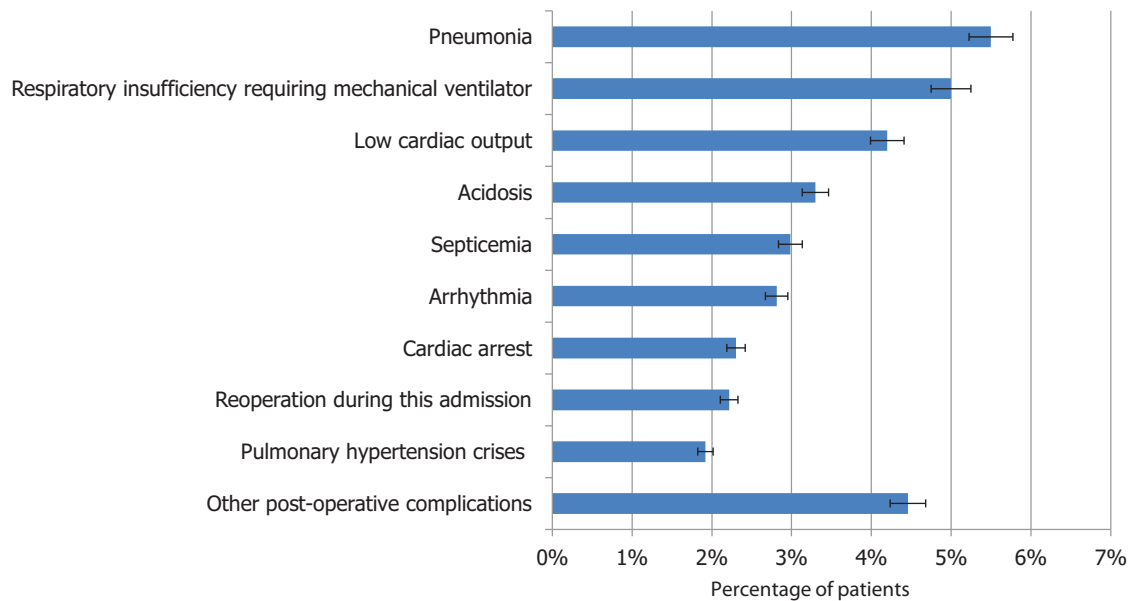
# Chapter 5



## Overall postoperative complications

- Pneumonia and respiratory insufficiency requiring mechanical ventilatory support > 7 days are the two most common complications.
- The overall complications occurs in 22% of population; in this population, the in-hospital mortality is 21% and the mean postoperative length of stay is 21 days.
- Of all complications, cardiac arrest, mechanical circulatory support, systemic vein obstruction, acute renal failure requiring temporary dialysis and sternum being left opened carry high in-hospital mortality rate at 75%, 66%, 63%, 59% and 59% in successive order.
- The higher is the mortality category, the higher is the number of postoperative complication also with very high percentage of in-hospital mortality.

Most common postoperative complications in 26 hospitals (n=12,763)





Postoperative complication and in-hospital mortality in 26 hospitals (n=12,567)

Postoperative complications	Percentage Number	In-hospital mortality	95% CI
No	77.7% 9,767	1.2% 121	1.0-1.5
Yes	22.3% 2,800	21.3% 596	19.9-22.8
Missing	4.1% (532)		

Postoperative complication and postoperative length of stay in 26 hospitals (n=12,567)

Postoperative complications	Percentage Number	Mean S.D.	95% CI
No	77.7% 9,572	10.1 26.8	9.5-10.6
Yes	22.3% 2,748	20.8 33.4	19.5-22.0
Missing	5.9% (779)		



Postoperative complication and in-hospital mortality in 26 hospitals (n= 12,574)

Type of complications	Percentage Number	In-hospital mortality	95%CI
Pneumonia	5.6%	17.6%	14.8-20.6
	700	123	
Respiratory insufficiency requiring mechanical ventilatory support >7 days	5.1%	23.5%	20.3-27.0
	638	150	
Low cardiac output	4.2%	48.7%	44.4-53.0
	534	260	
Acidosis	3.3%	44.9%	4.0-49.8
	419	188	
Septicemia	3.0%	36.8%	32.0-41.9
	380	140	
Arrhythmia	2.8%	23.3%	19.0-28.1
	356	83	
Cardiac arrest	2.3%	74.7%	69.3-79.5
	292	218	
Reoperation during this admission	2.2%	31.2%	25.7-37.0
	276	86	
Pulmonary hypertensive crisis	1.9%	38.8%	32.6-45.2
	245	95	
Pleural effusion requiring drainage	1.9%	10.2%	6.7-14.8
	235	24	
Respiratory insufficiency requiring reintubation	1.7%	26.9%	21.0-33.5
	208	56	
Acute renal failure requiring temporary dialysis	1.4%	59.4%	51.9-66.7
	180	107	
Pneumothorax	1.2%	10.2%	5.8-16.3
	147	15	
Bleeding requiring reoperation	1.0%	26.0%	18.5-34.7
	123	32	
Mechanical circulatory support	0.8%	66.0%	56.1-75.0
	106	70	
Chylothorax	0.6%	6.5%	2.1-14.5
	77	5	

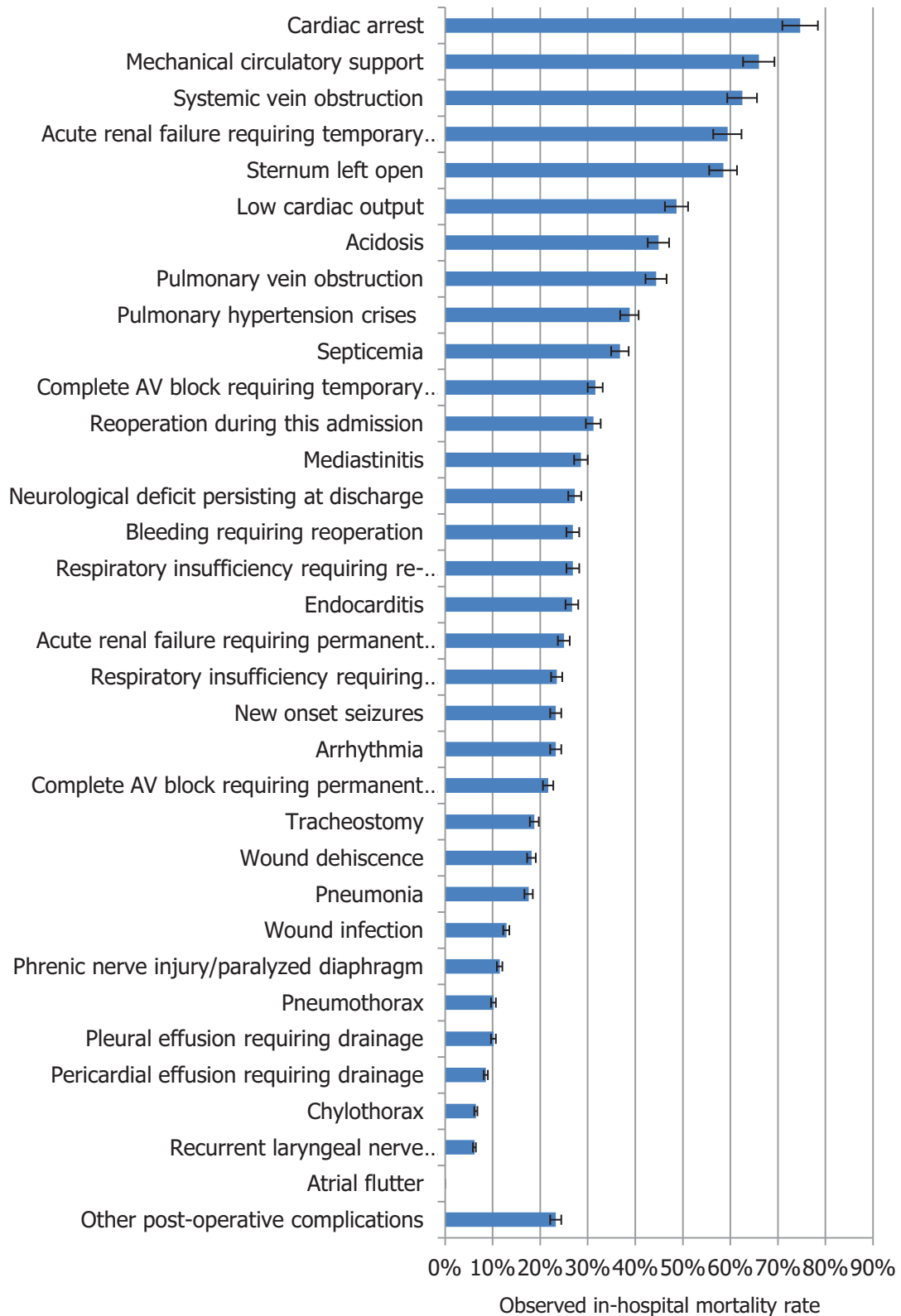


Postoperative complication and in-hospital mortality in 26 hospitals (n= 12,574)

Type of complications	Percentage Number	In-hospital mortality	95%CI
Complete AV block requiring temporary pacemaker	0.6% 76	31.6% 24	21.4-43.3
New onset seizures	0.6% 73	23.3% 17	14.2-34.6
Pericardial effusion requiring drainage	0.6% 70	8.6% 6	3.2-17.7
Tracheostomy	0.5% 69	18.8% 13	11.7-33.2
Wound infection	0.5% 62	12.9% 8	5.7-23.9
Neurological deficit persisting at discharge	0.3% 44	27.3% 12	15.0-42.8
Sternum left open	0.3% 41	58.5% 24	42.1-73.7
Phrenic nerve injury/paralyzed diaphragm	0.2% 26	11.5% 3	2.4-30.2
Complete AV block requiring permanent pacemaker	0.2% 23	21.7% 5	7.5-43.7
Recurrent laryngeal nerve injury/paralyzed vocal cord	0.1% 16	6.2% 1	0.1-30.2
Endocarditis	0.1% 15	26.7% 4	7.8-55.1
Mediastinitis	0.1% 14	28.6% 4	8.4-58.1
Wound dehiscence	0.1% 11	18.2% 2	2.3-51.8
Atrial flutter	0.1% 10	0.0% 0	0
Pulmonary vein obstruction	0.1% 9	44.4% 4	13.7-78.8
Systemic vein obstruction	0.1% 8	62.5% 5	24.5-91.5
Acute renal failure requiring permanent dialysis	0.0% 4	25.0% 1	0.6-80.6
Other postoperative complication	4.4% 559	23.3% 130	19.8-27.0



Postoperative complications and in-hospital mortality (n=12,574)

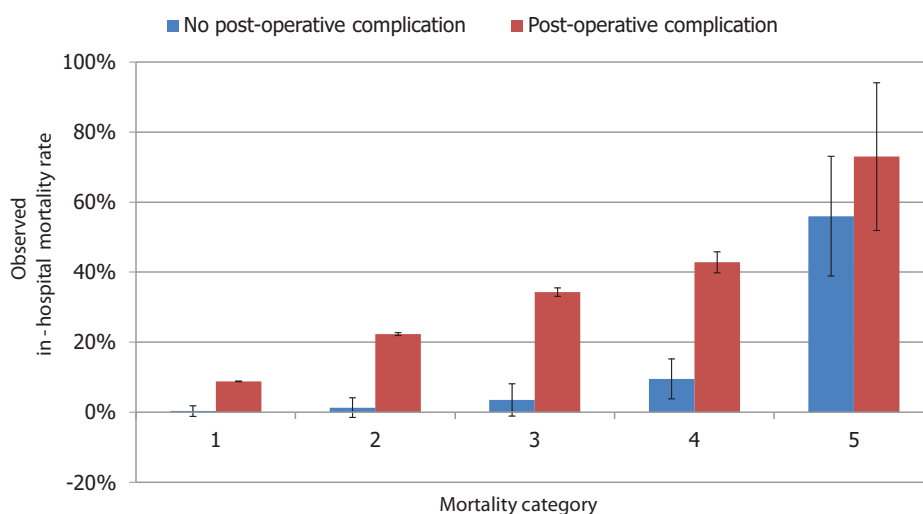




Postoperative complication, mortality category and in-hospital mortality (n=12,464)

Mortality category	Postoperative complication					
	No			Yes		
	Percentage Number	In-hospital mortality	95% CI	Percentage Number	In-hospital mortality	95% CI
1	84.5% 6,517	0.3% 21	0.2-0.5	15.5% 1,199	8.8% 106	7.3-10.6
2	72.0% 2,167	1.3% 29	0.9-1.9	28.0% 844	22.3% 188	19.5-25.2
3	61.2% 648	3.5% 23	2.3-5.3	38.8% 411	34.3% 141	29.7-39.1
4	51.5% 317	9.5% 30	6.5-13.2	48.5% 299	42.8% 128	37.1-48.6
5	40.3% 25	56.0% 14	34.9-75.6	59.7% 37	73.0% 27	55.9-86.2
Missing	4.8% (635)					

Postoperative complication, mortality category and in-hospital mortality (n=12,464)

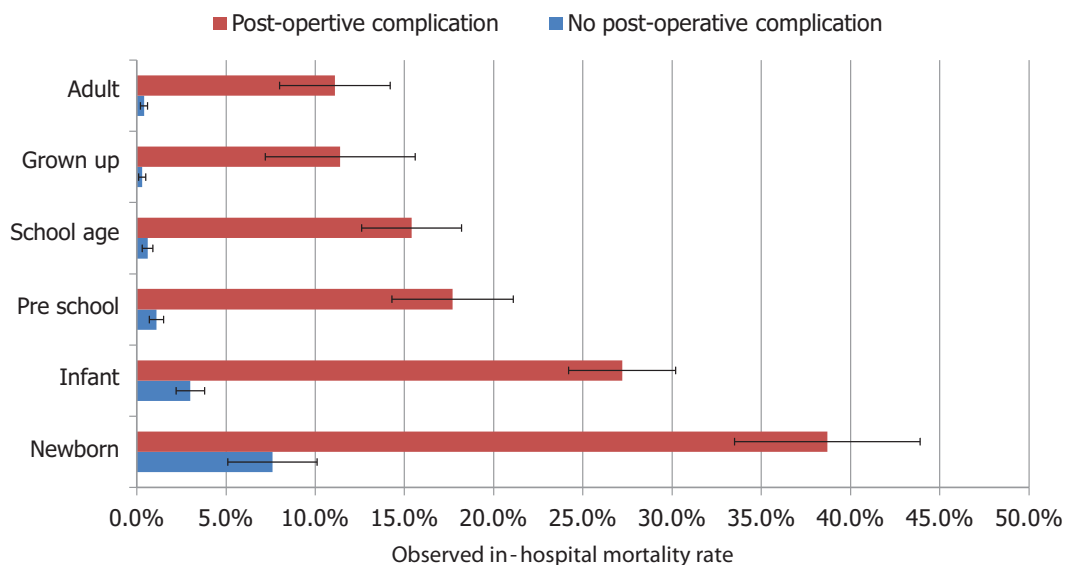




Postoperative complication and age group (n=12,751)

Age	Postoperative complication				All
	No		Yes		
	Percentage Number	95% CI	Percentage Number	95% CI	
Newborn	52.3%	48.6-56.0	47.7%	44.0-51.4	100.0%
	382		348		730
Infant	65.1%	63.2-67.1	34.9%	32.9-36.8	100.0%
	1,546		827		2,373
Pre school	80.1%	78.4-81.6	19.9%	18.3-21.6	100.0%
	1,902		474		2,376
School age	80.2%	78.8-81.6	19.8%	18.4-21.2	100.0%
	2,606		642		3,248
Grown up	83.3%	81.0-85.4	16.7%	14.6-19.0	100.0%
	952		191		1,143
Adult	88.1%	86.9-89.3	11.9%	10.7-13.1	100.0%
	2,538		343		2,881
Missing	2.7% (348)				

Postoperative complication and age group (n=12,751)



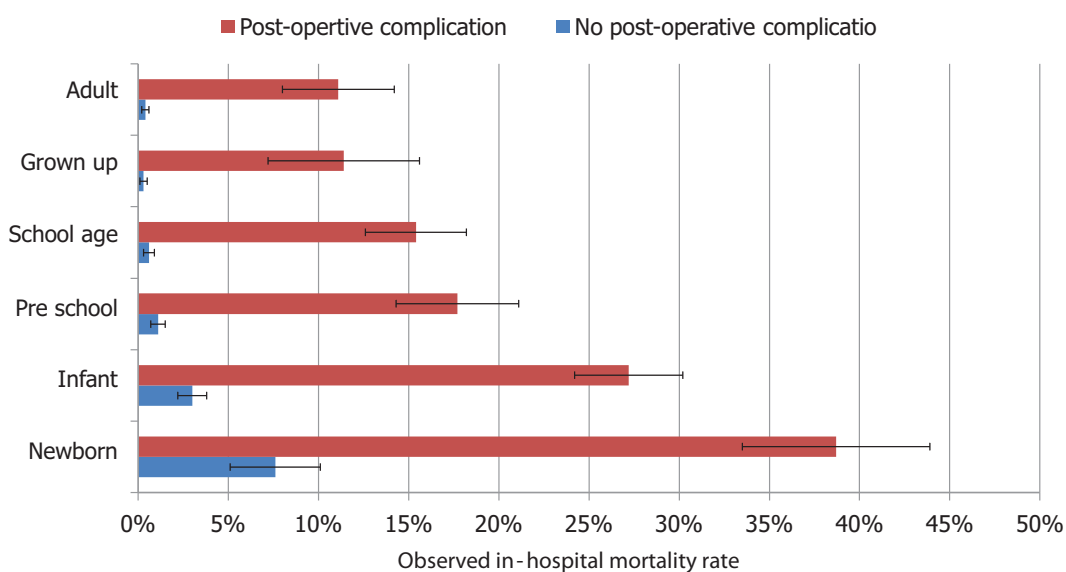




Postoperative complication, age group and observed in-hospital mortality (n=12,555)

Age	Postoperative complication			
	No		Yes	
	Observed in-hospital mortality	95% CI	Observed in-hospital mortality	95% CI
Newborn	7.6%	5.1-10.8	38.7%	33.5-44.1
Infant	3.0%	2.2-3.9	27.2%	24.2-30.4
Pre school	1.1%	0.7-1.7	17.7%	14.3-21.4
School age	0.6%	0.3-1.0	15.4%	12.6-18.4
Grown up	0.3%	0.1-0.9	11.4%	7.2-16.8
Adult	0.4%	0.2-0.7	11.1%	8.0-14.9
Missing	4.2% (544)			

Postoperative complication, age group and observed in-hospital mortality (n=12,555)

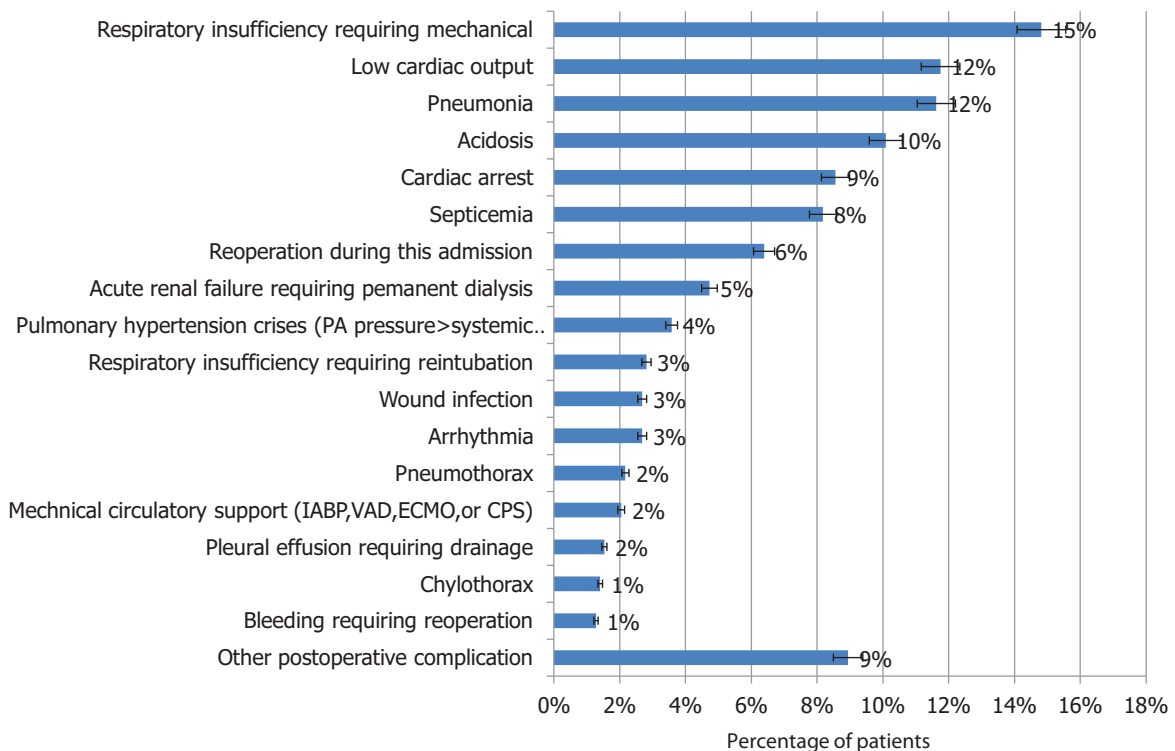




## Newborn with most common postoperative complications and in-hospital mortality

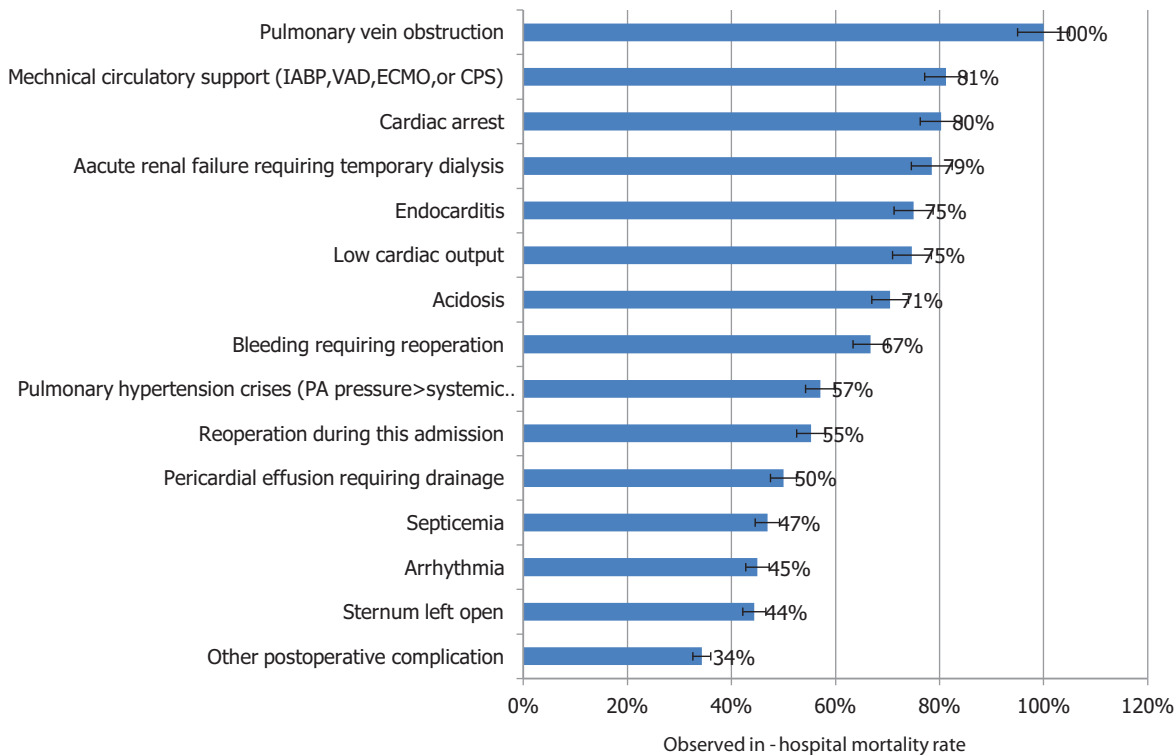
- In newborn, most 10 common postoperative complications are respiratory insufficiency requiring mechanical ventilatory support > 7 days, low cardiac output, pneumonia, acidosis, cardiac arrest, septicemia, reoperation, acute renal failure requiring permanent dialysis, pulmonary hypertensive crisis and respiratory insufficiency requiring reintubation in successive order.
- Most mortality is found in pulmonary vein obstruction (100%), mechanical circulatory support (81%), cardiac arrest (80%), acute renal failure requiring temporary dialysis (79%), endocarditis (75%) and low cardiac output (75%).

Most common postoperative complication in newborn patients (0-1 month) (n=783)





Postoperative complication, observed in-hospital mortality  
 in newborn patients (0-1 month) (n=697)

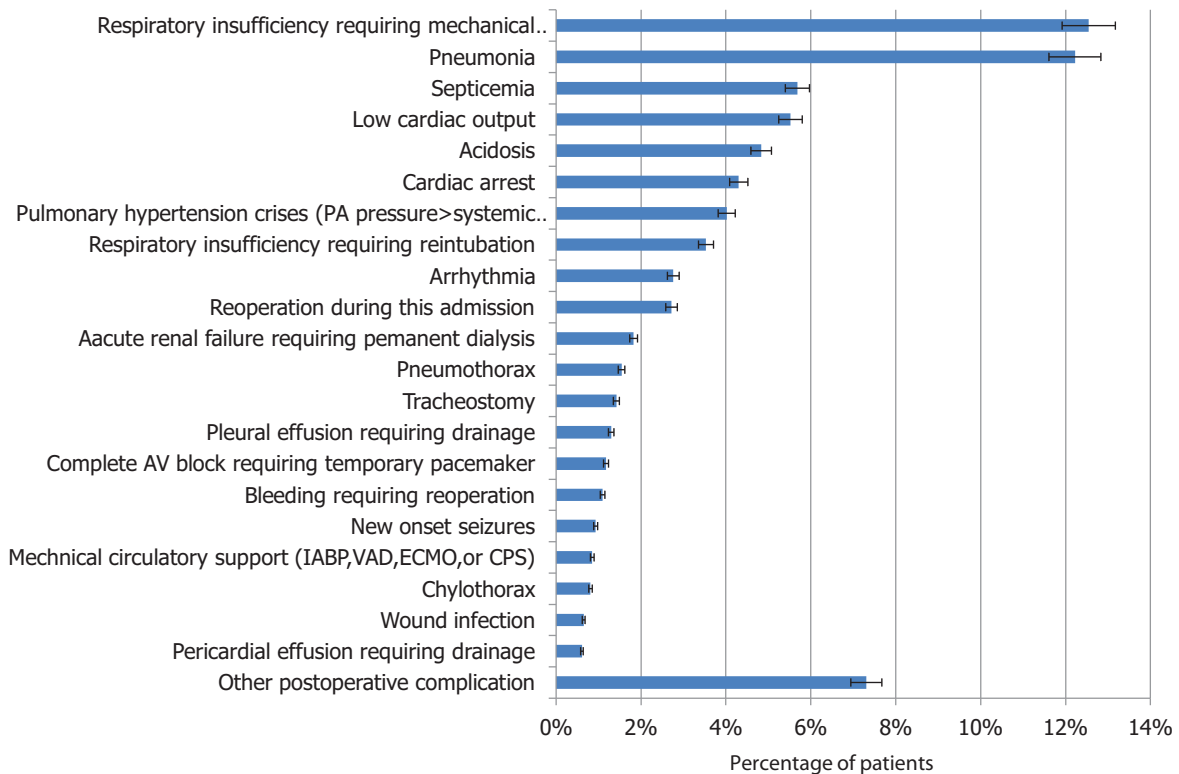




## Infant with most common postoperative complications and in-hospital mortality

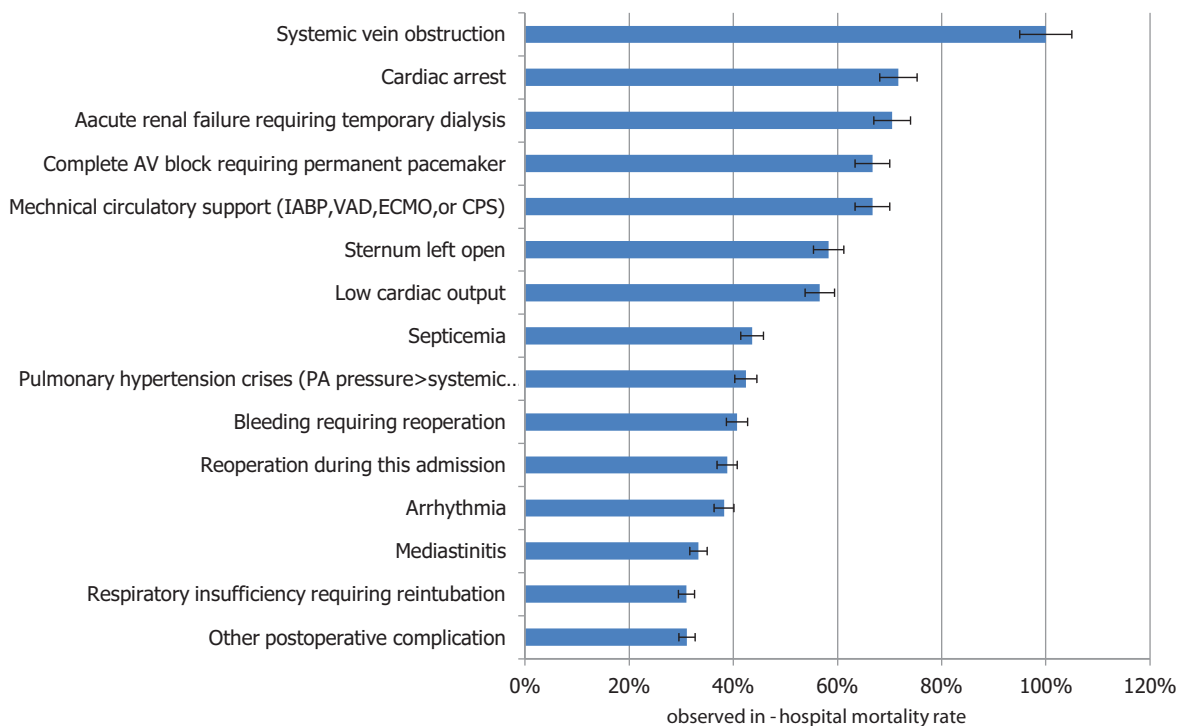
- Ten most common postoperative complications are respiratory insufficiency requiring mechanical ventilatory support > 7 days, pneumonia, septicaemia, low cardiac output, acidosis, cardiac arrest, pulmonary hypertensive crisis, pulmonary insufficiency requiring reintubation, arrhythmia and reoperation during this admission.
- In infant, ten most common in-hospital mortality are systemic vein obstruction, cardiac arrest, acute renal failure requiring temporary dialysis, complete AV block requiring permanent pacemaker, mechanical circulatory support, sternum left open, low cardiac output, septicaemia, pulmonary hypertensive crisis and bleeding requiring reoperation.

Most common postoperative complication in infant patients (>1 month-1 Year) (n=2,463)





Postoperative complication, observed in-hospital mortality  
 in infant patients (> 1 month-1 Year) (n=2,342)

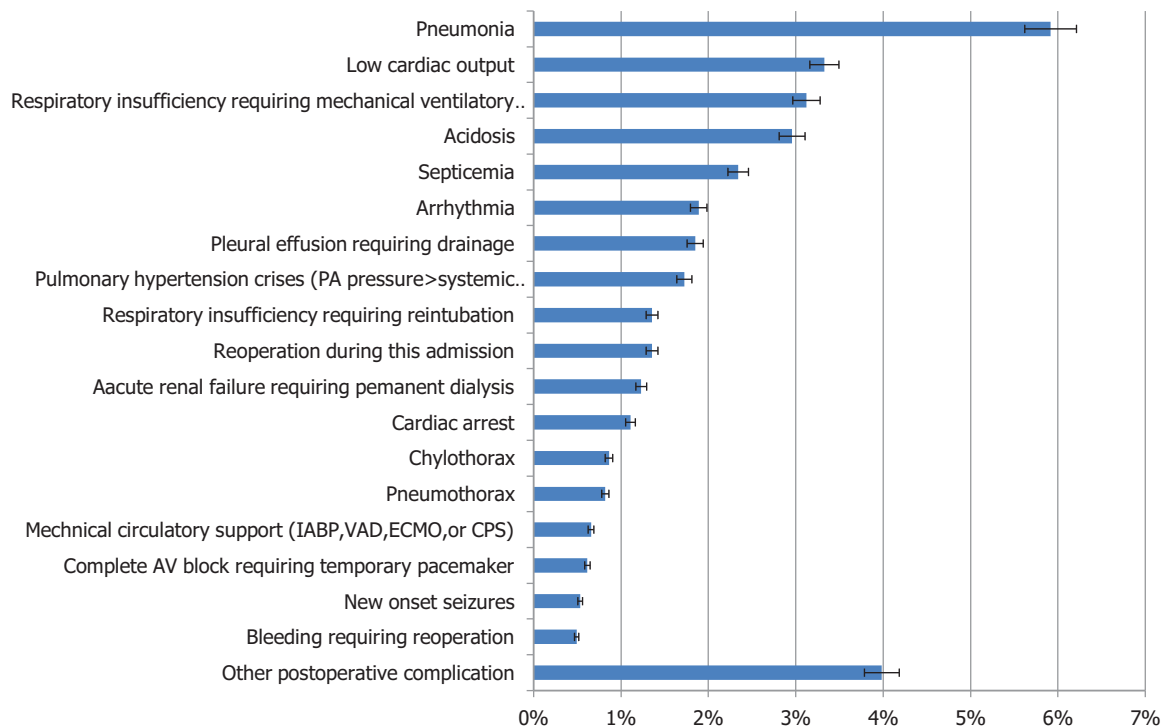




## Pre school patients with most common postoperative complications and in-hospital mortality

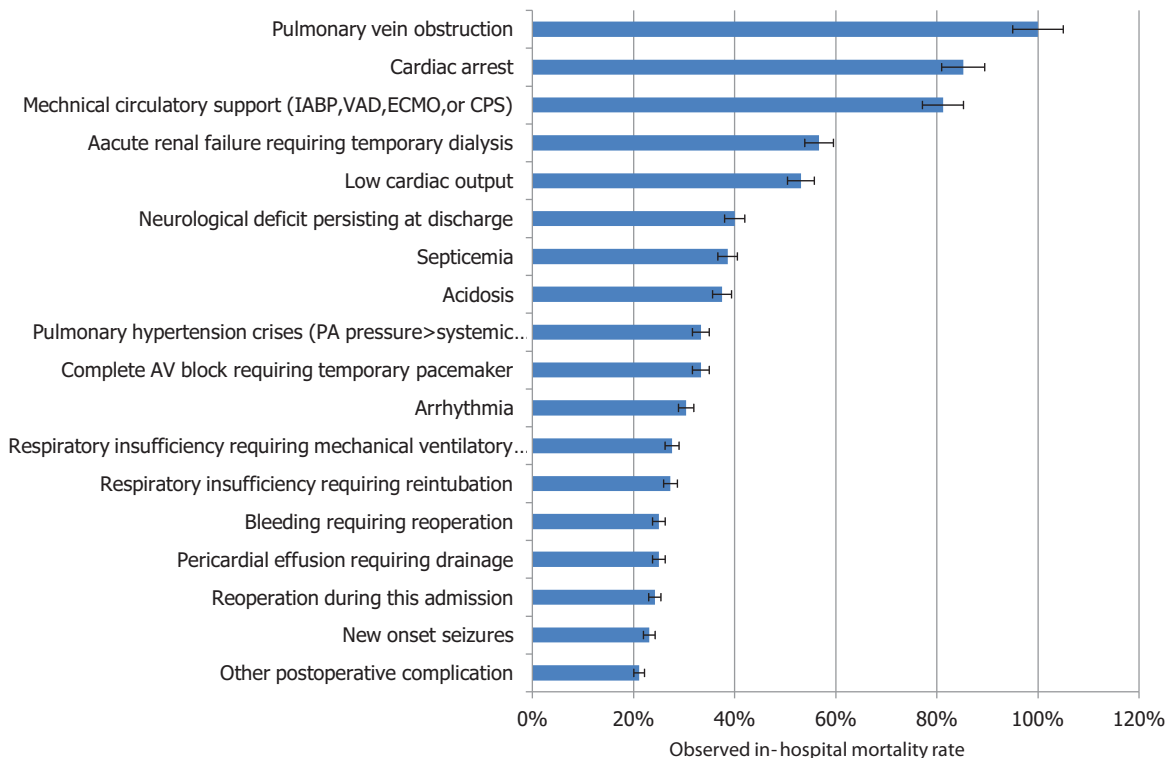
- Ten most common complication in pre school children are pneumonia, low cardiac output, respiratory insufficiency requiring mechanical ventilatory support > 7 days, acidosis, septicaemia, arrhythmia, pleural effusion requiring drainage, pulmonary hypertensive crisis, respiratory insufficiency requiring reintubation and reoperation during this admission.
- Ten most common in-hospital mortality are pulmonary vein obstruction, cardiac arrest, mechanical circulatory support, acute renal failure requiring temporary dialysis, low cardiac output, neurological deficit persisting at discharge, septicaemia, acidosis, pulmonary hypertensive crisis and complete AV block requiring temporary pacemaker.

Most common postoperative complication in pre school patients (>1-3 Year) (n=2,434)





Postoperative complication, observed in-hospital mortality  
 in pre school patients (>1-3 Year) (n=2,341)

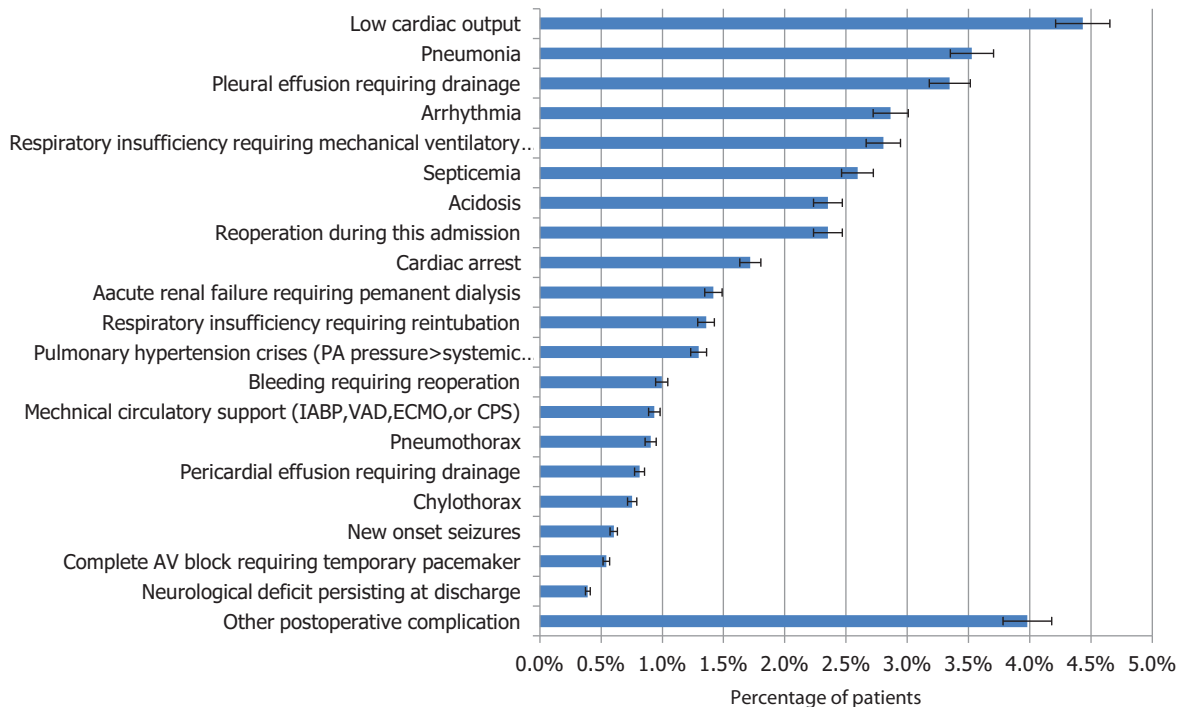




## School age patients with most common postoperative complications and in-hospital mortality

- Ten most common postoperative complications in school age children are low cardiac output, pneumonia, pleural effusion requiring drainage, arrhythmia, respiratory insufficiency requiring mechanical ventilatory support > 7 days, septicaemia, acidosis, reoperation during this admission, cardiac arrest and acute renal failure requiring permanent dialysis.
- Ten most common in-hospital mortality in school age children are pulmonary vein obstruction, cardiac arrest, mechanical circulatory support, acute renal failure requiring temporary dialysis, low cardiac output, neurological deficit persisting at discharge, septicaemia, acidosis, pulmonary hypertensive crisis and complete AV block requiring temporary pacemaker.

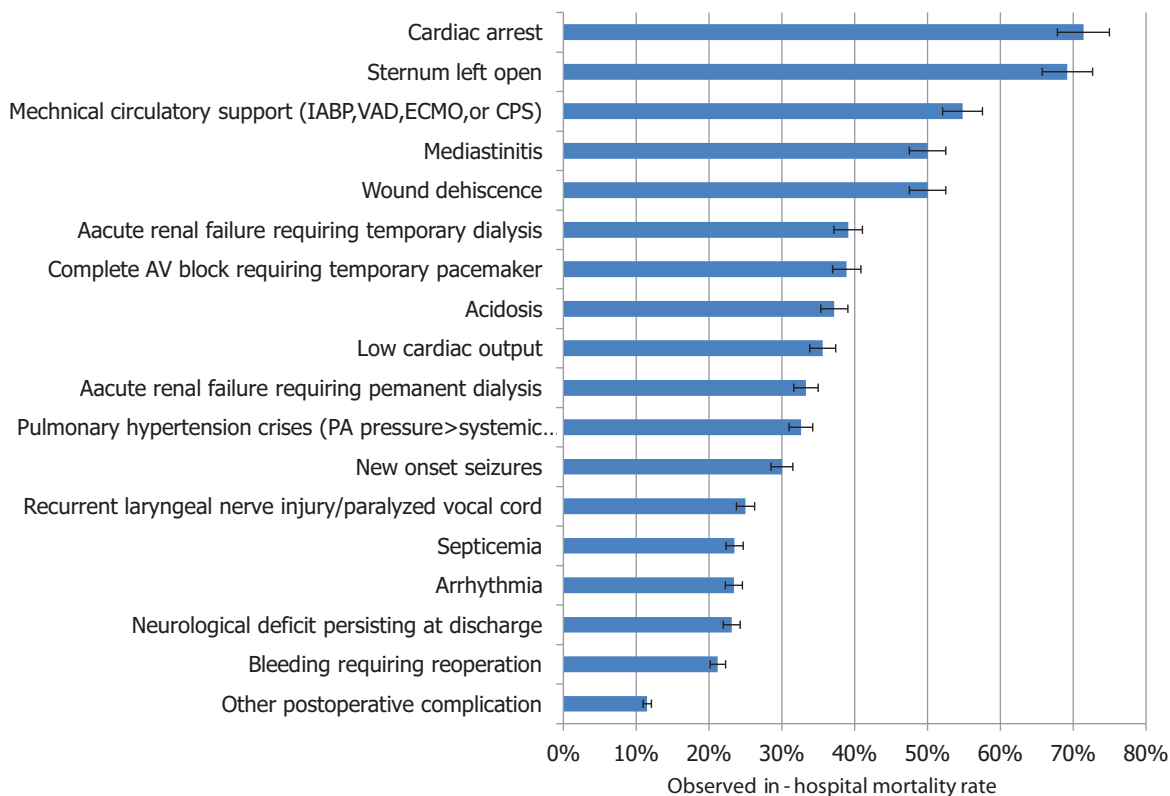
Most common postoperative complication in school age patients (>3-10 Years) (n=3,316)







Postoperative complication, observed in-hospital mortality in school age patients (>3-10 Year) (n=3,198)

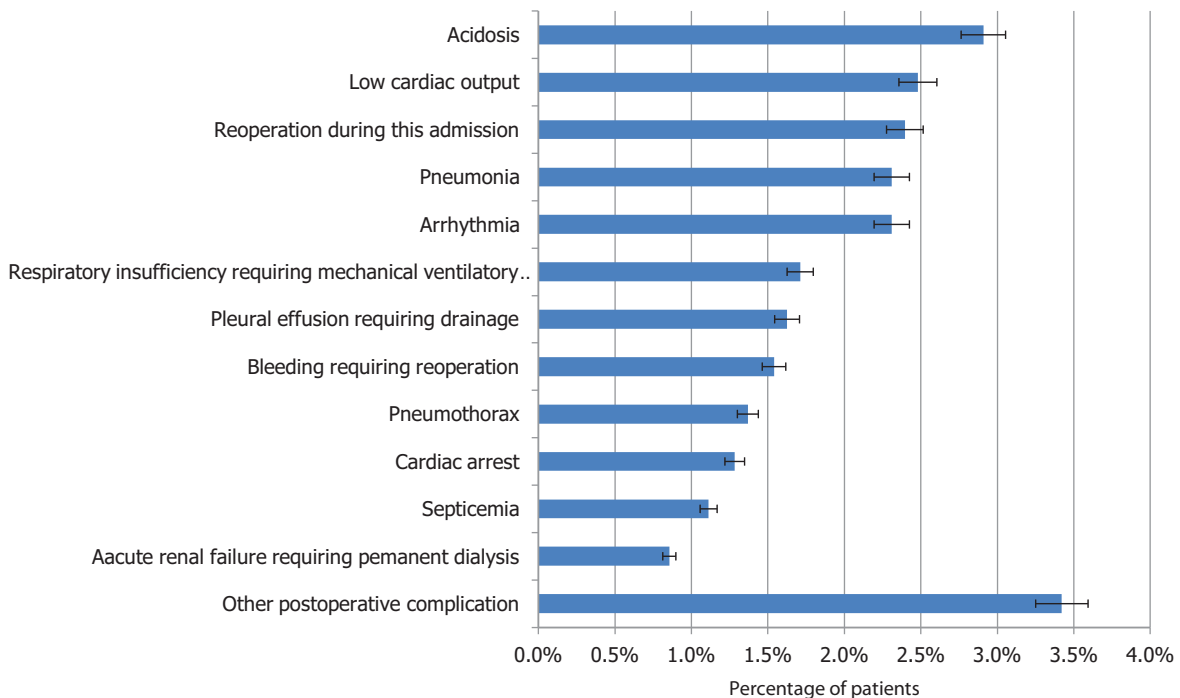




## Grown up patients with most common postoperative complications and in-hospital mortality

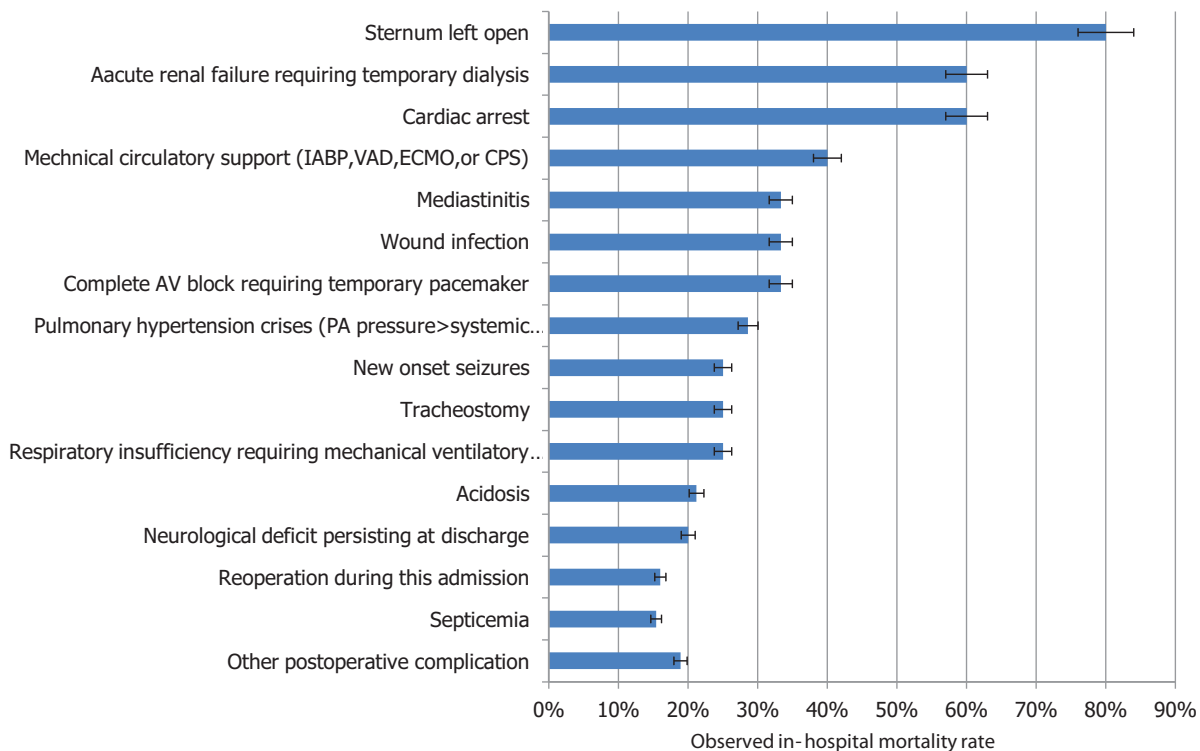
- Ten most common postoperative complications are acidosis, low cardiac output, reoperation during this admission, pneumonia, arrhythmia, respiratory insufficiency requiring mechanical ventilatory support > 7 days, pleural effusion requiring drainage, bleeding requiring reoperation, pneumothorax and cardiac arrest.
- Ten most common in-hospital mortality in grown up children are sternum left open, acute renal failure requiring temporary dialysis, cardiac arrest, mechanical circulatory support, mediastinitis, wound infection, complete AV block requiring temporary pacemaker, pulmonary hypertensive crisis, new onset seizures and tracheostomy.

Most common postoperative complication in grown up patients (> 10-15 Year) (n=1,169)





Postoperative complication, observed in-hospital mortality  
 in grown up patients (>10-15 Year) (n=1,123)

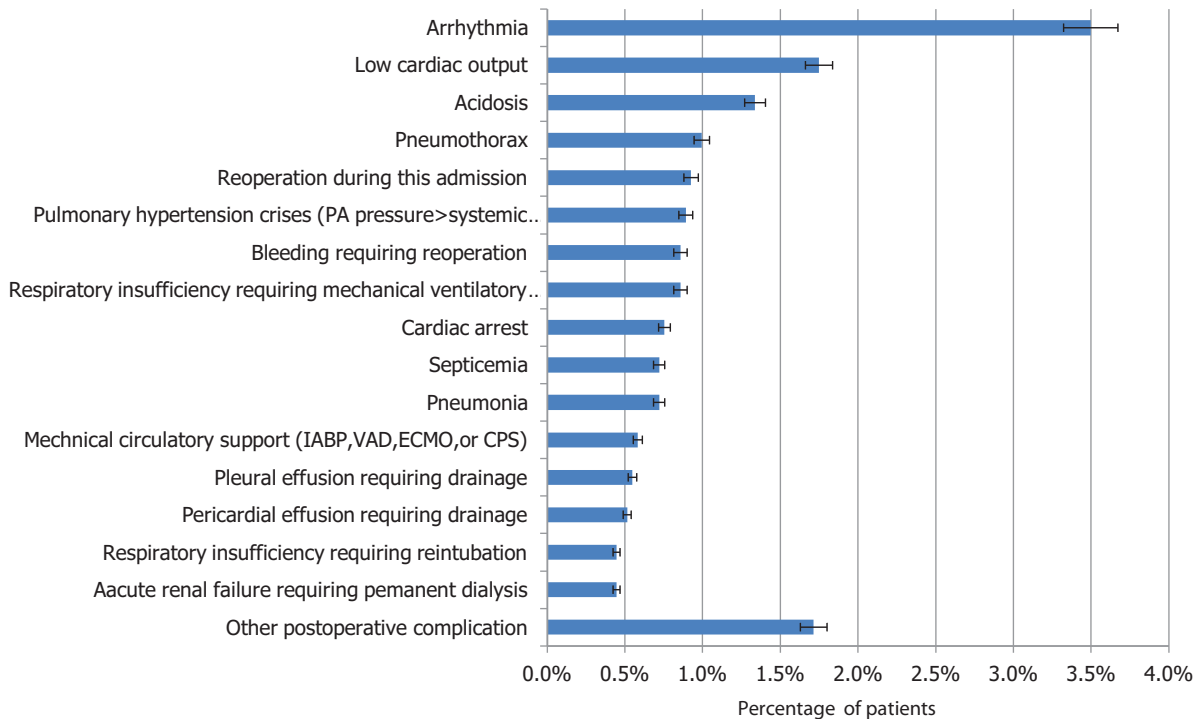




## Adult patients with most common postoperative complications and in-hospital mortality

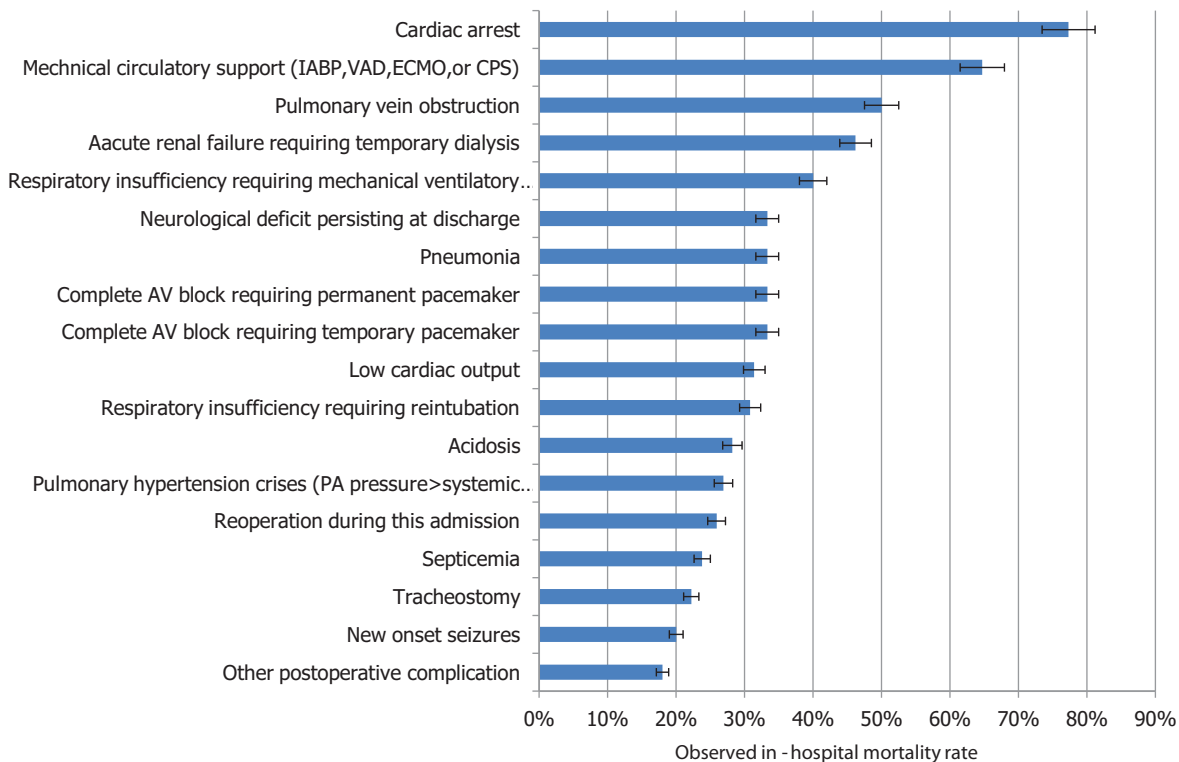
- Ten most common postoperative complications in adult are arrhythmia, low cardiac output, acidosis, pneumothorax, reoperation during this admission, pulmonary hypertensive crisis, bleeding requiring reoperation, respiratory insufficiency requiring mechanical ventilatory support > 7 days, cardiac arrest and septicaemia.
- Ten most common in-hospital mortality in adult patients are cardiac arrest, mechanical circulatory support, pulmonary vein obstruction, acute renal failure requiring temporary dialysis, respiratory insufficiency requiring reintubation, neurological deficit persisting at discharge, pneumonia, complete AV block requiring temporary pacemaker and low cardiac output.

Most common postoperative complication in adult patients (>15 Year) (n=2,916)





Postoperative complication, observed in-hospital mortality in adult patients (>15 Year) (n=2,854)







# Chapter 6







## Morbidity category and procedures of all ages

- There are 177 procedures of 12631 operations of all ages in 5 morbidity categories with 22% morbidity.
- Most operations are in morbidity category 1; the procedures with highest morbidity in category 1 expressed in percentage are Mediastinal procedure (16%), Congenitally corrected TGA repair with VSD closure (15%), Mitral valve surgery and other (15%), ASD repair with primary closure (15%), and ASD with partial closure.
- In morbidity category 2, the highest percentage of morbidity are Rastelli (30%), Coarctation repair with end to end, extended (29%), Lung procedure (29%), TOF repair with non ventriculotomy (28%) and Mitral valve replacement (28%).
- In morbidity category 3, the procedures with highest morbidity are Fontan TCPC with external conduit, NOS (48%), Vascular ring repair (46%), Thoracic duct ligation (46%) and Congenitally corrected TGA repair with other (44%), Tricuspid valve replacement (44%) and Shunt with systemic to pulmonary artery, other (44%).
- In morbidity category 4, the procedures with highest morbidity are Congenitally corrected TGA repair, atrial switch with ASO (double switch) (78%), Atrial surgical ablation for atrial arrhythmia (75%), Pleural procedure (75%), Tricuspid valve excision without replacement (67%) and Aortic dissection repair (67%).
- In morbidity category 5, the procedures with highest morbidity are Aortic root replacement (100%), IABP insertion (100%) and Congenitally corrected TGA repair, NOS (100%).
- The higher is the morbidity category the higher is the percentage of morbidity.

### Remarks

- Postoperative length of stay in morbidity category must be interpreted carefully because complexity of score with high difficulty ranking can have long postoperative stay unless the patients die not so long stay after operation.



**Table 1.1**  
**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
Mediastinal procedure	19	3	15.8%	16.2%	0.0%	32.8%
ASD repair, primary closure	648	100	15.4%	15.5%	12.7%	18.2%
Congenitally corrected TGA repair, VSD closure	13	2	15.4%	15.7%	0.0%	34.9%
Valve surgery, other, mitral	20	3	15.0%	15.7%	0.0%	31.6%
ASD partial closure	122	18	14.8%	14.8%	8.6%	20.9%
Valvuloplasty, mitral	77	11	14.3%	14.4%	6.7%	22.1%
Fontan, NOS	14	2	14.3%	15.1%	0.0%	34.1%
PA, reconstruction (plasty), NOS	22	3	13.6%	14.0%	0.0%	28.3%
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	15	2	13.3%	14.0%	0.0%	30.3%
Coarctation repair, interposition graft	15	2	13.3%	13.7%	0.0%	30.3%
Pericardial procedure, other	8	1	12.5%	13.4%	0.0%	35.4%
Pacemaker procedure	8	1	12.5%	13.7%	0.0%	36.2%
Thoracic and/or mediastinal procedure, other	16	2	12.5%	13.1%	0.0%	29.9%
PFO, primary closure	85	10	11.8%	11.7%	5.0%	18.5%
ASD repair, NOS	17	2	11.8%	12.0%	0.0%	26.8%
Conduit, reoperation	9	1	11.1%	12.1%	0.0%	32.1%
Pericardial drainage procedure	45	5	11.1%	11.3%	2.0%	20.6%
Sinus of Valsalva, aneurysm repair	30	3	10.0%	10.3%	0.0%	20.9%
Pulmonary AV fistula repair/occlusion	10	1	10.0%	10.6%	0.0%	28.5%
Peripheral vascular procedure, other	10	1	10.0%	10.3%	0.0%	27.5%
PA debanding	11	1	9.1%	9.7%	0.0%	25.7%
ASD repair, patch	1518	120	7.9%	7.9%	6.6%	9.3%
Cardiac procedure, other	26	2	7.7%	8.0%	0.0%	18.3%
PAPVC repair	62	4	6.5%	6.4%	0.7%	12.0%
DCRV repair	17	1	5.9%	6.2%	0.0%	17.3%
Pulmonary embolectomy	18	1	5.6%	6.0%	0.0%	16.8%
Pacemaker implantation, permanent	39	2	5.1%	5.2%	0.0%	11.9%
PDA closure, NOS	111	5	4.5%	4.5%	0.8%	8.2%
VSD repair, NOS	23	1	4.3%	4.8%	0.0%	13.7%
Coronary artery fistula ligation	25	1	4.0%	4.2%	0.0%	12.0%
Organ procurement	35	1	2.9%	3.1%	0.0%	8.7%
VSD creation/enlargement	2	0	0.0%	4.0%	0.0%	25.1%
PAPVC, scimitar, repair	3	0	0.0%	2.8%	0.0%	18.4%
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	2	0	0.0%	5.4%	0.0%	29.7%
Aortic root replacement, mechanical	1	0	0.0%	8.4%	0.0%	45.5%
Other annular enlargement procedure	1	0	0.0%	9.5%	0.0%	49.5%



Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
rare	0.9	1.0	0.0	13.0
7	0.8	6.0	4.0	7.0
106	0.9	6.0	5.0	10.0
76	0.9	8.0	5.0	13.0
10	0.8	6.5	5.0	8.0
76	0.8	7.0	5.0	10.0
rare	0.8	12.5	7.8	40.0
rare	0.8	7.5	6.0	8.8
rare	0.8	12.5	6.8	18.5
49	0.8	5.0	4.0	6.0
rare	0.7	6.5	3.8	14.5
3	0.8	5.0	3.0	7.3
rare	0.7	6.0	2.0	39.8
6	0.7	6.0	5.0	7.0
rare	0.7	6.0	5.0	8.0
77	0.7	7.0	5.0	18.0
1	0.6	5.0	3.0	7.5
61	0.6	7.0	4.0	10.0
rare	0.6	4.5	4.0	18.8
rare	0.6	8.0	2.8	19.5
29	0.6	13.0	6.5	22.5
8	0.5	6.0	5.0	8.0
rare	0.5	5.0	2.0	11.5
27	0.4	6.0	5.0	9.0
48	0.4	4.0	3.3	6.0
34	0.4	9.5	3.3	19.5
2	0.3	4.0	3.0	17.0
rare	0.3	4.0	3.0	6.0
rare	0.3	7.0	4.0	7.0
17	0.3	4.0	4.0	9.0
rare	0.2	8.5	5.8	13.8
83	0.3	10.0	-	-
91	0.2	9.0	-	-
70	0.3	8.5	-	-
111	0.5	45.0	-	-
142	0.6	9.0	-	-



**Table 1.1 (cont.)**

**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**

**Morbidity category 1**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
Aortic stenosis, supraaortic, repair	14	0	0.0%	0.7%	0.0%	4.7%
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	2	0	0.0%	4.7%	0.0%	28.2%
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	8.3%	0.0%	44.6%
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	7.8%	0.0%	43.5%
Coarctation repair, other	8	0	0.0%	1.3%	0.0%	8.7%
ICD (AICD) implantation	2	0	0.0%	4.8%	0.0%	29.7%
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	8.3%	0.0%	45.3%
ASD creation, balloon septostomy (BAS) (Rashkind)	1	0	0.0%	9.0%	0.0%	47.0%
ASD creation, blade septostomy	1	0	0.0%	8.8%	0.0%	45.8%
Shunt, systemic to pulmonary, NOS	5	0	0.0%	2.0%	0.0%	12.7%
Aneurysm ventricular, left, repair	2	0	0.0%	4.3%	0.0%	27.0%
Aneurysm, pulmonary artery, repair	4	0	0.0%	2.3%	0.0%	16.1%
VATS (video-assisted thoracoscopic surgery)	8	0	0.0%	1.3%	0.0%	8.8%
Minimally invasive procedure	1	0	0.0%	8.7%	0.0%	45.4%
Delayed sternal closure	1	0	0.0%	9.4%	0.0%	48.5%
Thoracotomy, other	3	0	0.0%	3.0%	0.0%	18.2%



Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
64	0.1	7.5	6.0	9.8
133	0.3	3.5	-	-
99	0.5	9.0	-	-
rare	0.5	6.0	-	-
112	0.1	7.5	3.5	14.8
14	0.3	11.5	-	-
15	0.5	7.0	-	-
12	0.5	12.0	-	-
rare	0.5	3.0	-	-
rare	0.2	7.0	5.0	18.5
107	0.3	9.5	-	-
53	0.2	3.5	0.8	12.3
rare	0.1	4.0	3.3	4.0
rare	0.5	4.0	-	-
rare	0.5	246.0	-	-
rare	0.2	7.0	-	-



**Table 1.2**  
**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
Rastelli	67	20	29.9%	30.0%	19.2%	40.8%
Coarctation repair, end to end, extended	51	15	29.4%	29.6%	16.9%	42.3%
Lung procedure, other	55	16	29.1%	29.1%	17.5%	40.7%
TOF repair, non ventriculotomy	238	67	28.2%	28.2%	22.4%	34.0%
Valve replacement, mitral (MVR)	32	9	28.1%	28.2%	13.0%	43.4%
RVOT procedure	61	17	27.9%	28.0%	17.1%	38.9%
Coarctation repair, end to end	72	20	27.8%	27.9%	17.5%	38.2%
TOF repair, RV-PA conduit	51	14	27.5%	27.5%	15.7%	39.3%
Occlusion MAPCA(s)	22	6	27.3%	27.6%	8.9%	46.4%
Valvuloplasty, pulmonic	77	21	27.3%	27.3%	17.6%	37.0%
Valve replacement, pulmonic (PVR)	44	12	27.3%	27.1%	14.6%	39.5%
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	896	238	26.6%	26.6%	23.7%	29.5%
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	23	6	26.1%	26.5%	8.8%	44.2%
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	216	56	25.9%	26.0%	19.9%	32.2%
AVC (AVSD) repair, NOS	16	4	25.0%	24.9%	4.0%	45.9%
Unifocalization MAPCA(s)	44	11	25.0%	25.3%	12.5%	38.1%
Valve closure, tricuspid (exclusion, univentricular approach)	12	3	25.0%	25.4%	2.0%	48.8%
Fontan, atrio-ventricular connection	8	2	25.0%	25.4%	0.0%	53.3%
Shunt, ligation and takedown	4	1	25.0%	26.2%	0.0%	63.2%
Esophageal procedure	68	17	25.0%	25.3%	15.3%	35.2%
AVC (AVSD) repair, partial (incomplete) (PAVSD)	50	12	24.0%	24.2%	12.5%	36.0%
Cardiotomy, other	25	6	24.0%	24.6%	8.3%	40.9%
Sternotomy wound drainage	13	3	23.1%	23.8%	1.3%	46.3%
Valve surgery, other, tricuspid	31	7	22.6%	22.4%	8.2%	36.7%
Mitral stenosis, supra-valvar mitral ring, repair	31	7	22.6%	22.8%	8.2%	37.3%
Ventricular septal fenestration	27	6	22.2%	22.5%	6.6%	38.3%
PA, reconstruction (plasty), branch, central	9	2	22.2%	23.2%	0.0%	49.4%
Valve surgery, other pulmonic	18	4	22.2%	22.3%	3.8%	40.8%
Coronary artery bypass	9	2	22.2%	23.6%	0.0%	50.1%
Valvuloplasty, tricuspid	87	19	21.8%	21.7%	13.3%	30.1%
Lung biopsy	14	3	21.4%	21.9%	1.1%	42.7%
VSD repair, primary closure	725	154	21.2%	21.2%	18.3%	24.2%
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	19	4	21.1%	21.5%	3.6%	39.5%



Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
125	1.6	13.0	8.0	20.3
24	1.6	10.0	6.0	14.0
rare	1.5	9.0	6.0	19.0
81	1.5	8.0	6.0	11.0
69	1.5	13.0	7.0	22.0
40	1.5	6.0	4.0	9.0
24	1.5	7.0	5.0	14.3
80	1.5	9.0	7.0	13.0
51	1.5	9.0	5.0	18.0
26	1.4	7.0	4.0	11.8
44	1.4	8.0	5.0	13.0
39	1.4	7.0	5.0	13.0
137	1.4	8.5	2.8	16.5
43	1.4	8.0	6.0	12.0
rare	1.3	9.0	4.0	21.3
116	1.3	7.0	5.0	11.0
36	1.4	6.0	5.0	9.0
0	1.4	7.0	2.5	10.5
11	1.4	8.0	-	-
rare	1.3	9.0	6.0	17.5
31	1.3	7.0	5.0	10.0
rare	1.3	12.0	5.5	23.8
rare	1.3	6.0	4.0	33.3
rare	1.2	8.5	4.0	14.3
74	1.2	7.0	6.0	10.8
45	1.2	6.0	4.8	8.3
68	1.2	8.0	3.0	9.0
rare	1.2	7.0	5.0	17.5
98	1.3	7.0	5.0	16.5
57	1.2	6.0	4.0	9.3
rare	1.2	15.0	7.5	26.8
30	1.1	6.0	5.0	8.0
41	1.2	11.0	7.0	32.0



**Table 1.2 (cont.)**  
**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
TOF, AVC (AVSD), repair	20	4	20.0%	20.5%	3.6%	37.5%
Valve replacement, aortic (AVR), mechanical	15	3	20.0%	21.0%	1.0%	40.9%
Valve replacement, aortic (AVR), bioprosthetic	5	1	20.0%	20.8%	0.0%	52.7%
Senning	5	1	20.0%	21.7%	0.0%	54.8%
Atrial baffle procedure, NOS	5	1	20.0%	20.9%	0.0%	53.4%
PDA closure, device	234	46	19.7%	19.5%	14.5%	24.6%
AVC (AVSD) repair, intermediated (transitional)	16	3	18.8%	19.3%	1.4%	37.2%
Valvuloplasty, aortic	16	3	18.8%	19.1%	0.0%	38.4%
ASD creation/enlargement	27	5	18.5%	18.8%	4.4%	33.2%
Pulmonary artery origin from ascending aorta (hemitruncus) repair	11	2	18.2%	18.8%	0.0%	40.7%
1 1/2 ventricular repair	11	2	18.2%	18.1%	0.0%	39.1%
Fontan, atrio-pulmonary connection	22	4	18.2%	18.2%	2.9%	33.6%
Coronary artery procedure, other	11	2	18.2%	19.1%	0.0%	41.6%
VSD repair, patch	2047	371	18.1%	18.1%	16.5%	19.8%
TOF repair, NOS	84	15	17.9%	18.0%	9.7%	26.3%
Aortic stenosis, subvalvar, repair	35	6	17.1%	17.0%	4.5%	29.4%
VSD, multiple, repair	36	6	16.7%	16.7%	4.6%	28.9%
Mustard	6	1	16.7%	17.5%	0.0%	45.9%
Pectus repair	6	1	16.7%	17.7%	0.0%	45.4%
Cardiac tumor resection	12	2	16.7%	17.8%	0.0%	38.2%
Pleural drainage procedure	12	2	16.7%	17.3%	0.0%	38.2%
PDA closure, surgical	1283	211	16.4%	16.5%	14.4%	18.5%





Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
122	1.1	9.0	6.0	12.0
52	1.1	11.0	8.0	16.0
55	1.1	11.0	5.0	23.5
108	1.2	18.0	10.5	27.0
67	1.1	8.5	2.5	11.5
rare	1.1	5.5	4.0	8.0
33	1.0	7.0	5.3	10.5
72	1.0	7.5	7.0	18.5
9	1.0	8.0	5.3	10.8
89	1.0	12.0	6.0	23.3
58	1.0	6.0	4.0	7.5
94	1.0	13.0	7.0	30.3
17	1.0	7.0	5.5	21.0
32	1.0	7.0	5.0	10.0
rare	1.0	7.0	5.0	11.0
42	0.9	7.0	6.0	8.3
113	0.9	7.0	5.0	9.3
100	1.0	9.0	8.0	23.5
rare	1.0	5.5	5.0	8.0
88	1.0	15.5	9.3	19.0
rare	0.9	9.5	6.3	14.0
5	0.9	4.0	3.0	8.0



**Table 1.3**  
**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
Fontan, TCPC, external conduit, NOS	40	19	47.5%	47.2%	31.6%	62.7%
Vascular ring repair	11	5	45.5%	45.6%	17.2%	74.0%
Ligation, thoracic duct	11	5	45.5%	45.4%	16.8%	74.0%
Congenitally corrected TGA repair, other	9	4	44.4%	44.8%	14.0%	75.6%
Valve replacement, tricuspid (TVR)	16	7	43.8%	43.7%	20.1%	67.3%
Shunt, systemic to pulmonary, other	16	7	43.8%	44.1%	20.1%	68.1%
Conduit, placement, LV to PA	7	3	42.9%	42.5%	8.4%	76.6%
Valve replacement, aortic (AVR)	7	3	42.9%	43.3%	9.8%	76.7%
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	35	15	42.9%	42.9%	26.7%	59.1%
Truncus arteriosus repair	47	20	42.6%	42.9%	28.9%	56.8%
Anomalous systemic venous connection repair	12	5	41.7%	41.5%	14.3%	68.7%
Anomalous origin of coronary artery repair	12	5	41.7%	41.5%	14.8%	68.1%
Bronchoscopy	5	2	40.0%	40.8%	2.3%	79.4%
PA banding (PAB)	144	57	39.6%	39.4%	31.5%	47.3%
Valve excision, pulmonary (without replacement)	13	5	38.5%	38.5%	12.3%	64.8%
Fontan, other	13	5	38.5%	38.0%	13.1%	62.9%
Coarctation repair, subclavian flap	13	5	38.5%	38.5%	13.4%	63.6%
Atrial septal fenestration	8	3	37.5%	37.8%	6.4%	69.2%
HLHS biventricular repair	8	3	37.5%	37.6%	7.3%	67.9%
Cor triatriatum repair	19	7	36.8%	36.7%	15.3%	58.1%
Fontan, TCPC, lateral tunnel, fenestrated	30	11	36.7%	36.9%	19.8%	54.0%
PA, reconstruction (plasty), main (trunk)	11	4	36.4%	36.8%	9.1%	64.6%
Conduit, placement, RV to PA	11	4	36.4%	36.5%	9.7%	63.3%
Valve surgery, other, aortic	11	4	36.4%	36.6%	10.3%	62.8%
AP window repair	25	9	36.0%	35.6%	17.3%	53.8%
DORV repair, NOS	74	25	33.8%	33.7%	22.9%	44.5%
ASD, repair, device	9	3	33.3%	33.3%	4.2%	62.3%
ASD, common atrium (single atrium), septation	3	1	33.3%	34.1%	0.0%	78.1%
VSD, repair, device	3	1	33.3%	34.0%	0.0%	80.9%
Pulmonary Venous Stenosis, repair	33	11	33.3%	33.4%	18.0%	48.9%
TOF, absent pulmonary valve, repair	19	6	31.6%	31.8%	11.3%	52.3%
Pericardectomy	35	11	31.4%	31.6%	17.2%	46.0%
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	80	25	31.3%	31.4%	21.1%	41.7%
TOF repair, ventriculotomy, nontransanular patch	81	25	30.9%	31.0%	21.0%	41.1%
Pulmonary atresia-VSD (including TOF, PA), repair	78	24	30.8%	30.8%	20.7%	40.9%
TOF repair, ventriculotomy, transanular patch	562	170	30.2%	30.3%	26.7%	33.9%



Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
rare	2.5	13.0	8.0	21.0
19	2.4	18.0	6.0	31.0
rare	2.4	25.0	15.0	42.0
rare	2.3	9.5	6.3	24.0
65	2.3	9.0	6.0	14.5
rare	2.3	17.0	6.0	35.0
73	2.2	7.0	6.0	9.0
0	2.3	19.0	8.0	31.0
63	2.2	7.5	6.0	12.3
134	2.2	11.0	7.3	23.0
54	2.2	6.0	5.0	10.0
119	2.2	6.5	1.8	7.8
rare	2.1	18.0	6.5	49.5
21	2.1	12.0	6.5	28.0
rare	2.0	6.0	4.5	10.5
rare	2.0	13.0	7.5	18.5
23	2.0	8.0	6.0	16.5
12	2.0	6.0	4.3	7.8
145	2.0	0.0	0.0	5.3
60	1.9	6.0	5.0	10.0
101	1.9	13.0	8.3	21.5
25	1.9	8.0	5.0	16.0
66	1.9	8.0	6.0	15.0
rare	1.9	7.0	2.0	8.0
35	1.9	11.5	5.3	23.5
rare	1.8	8.0	7.0	11.8
rare	1.8	12.0	5.0	21.5
18	1.8	5.0	-	-
rare	1.8	6.0	-	-
117	1.8	8.0	6.0	11.0
109	1.7	9.0	5.8	14.8
20	1.7	12.0	8.0	17.0
47	1.7	8.0	5.0	16.3
62	1.6	7.0	6.0	10.8
92	1.6	8.0	6.0	13.0
79	1.6	8.0	6.0	11.0



**Table 1.4**  
**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	18	14	77.8%	77.3%	58.8%	95.8%
Arrhythmia surgery-atrial, surgical ablation	4	3	75.0%	73.5%	35.1%	100.0%
Pleural procedure, other	4	3	75.0%	73.8%	36.5%	100.0%
Valve excision, tricuspid (without replacement)	6	4	66.7%	66.4%	31.9%	100.0%
Aortic dissection repair	3	2	66.7%	65.9%	19.8%	100.0%
Valve replacement, truncal	11	7	63.6%	62.8%	35.7%	89.8%
Fontan, TCPC, external conduit, nonfenestrated	49	30	61.2%	61.0%	47.9%	74.1%
Aortic arch repair	47	28	59.6%	59.5%	45.4%	73.6%
Arterial switch operation (ASO) and VSD repair	58	34	58.6%	58.2%	45.5%	70.9%
Hemifontan	12	7	58.3%	58.3%	31.5%	85.0%
Tracheal procedure	7	4	57.1%	56.8%	23.5%	90.1%
Norwood procedure	39	21	53.8%	53.7%	38.2%	69.2%
Pulmonary artery sling repair	13	7	53.8%	53.7%	27.7%	79.7%
DORV, intraventricular tunnel repair	98	52	53.1%	53.3%	43.6%	63.0%
Coarctation repair, patch aortoplasty	29	15	51.7%	51.2%	33.9%	68.5%
Interrupted aortic arch repair	47	24	51.1%	51.1%	36.8%	65.4%
TAPVC repair	147	75	51.0%	50.9%	43.0%	58.9%
AVC(AVSD) repair, complete CAVSD	137	69	50.4%	50.3%	41.7%	58.9%
Arterial switch operation (ASO)	151	76	50.3%	50.4%	42.8%	57.9%
Valve closure, semilunar	4	2	50.0%	49.4%	7.4%	91.4%
Congenitally corrected TGA repair, atrial switch and Rastelli	6	3	50.0%	50.0%	13.3%	86.7%
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	4	2	50.0%	50.3%	6.9%	93.7%
Coarctation repair, NOS	2	1	50.0%	49.3%	0.0%	100.0%
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	8	4	50.0%	49.9%	17.9%	82.0%
Palliation, other	14	7	50.0%	49.6%	24.6%	74.5%
Ligation, pulmonary artery	2	1	50.0%	49.8%	0.0%	100.0%
Mediastinal exploration	2	1	50.0%	50.7%	0.0%	100.0%



Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
148	4.0	14.0	7.5	24.5
84	3.8	13.0	5.5	23.5
rare	3.8	56.0	28.5	122.5
13	3.4	6.0	4.3	13.5
128	3.4	20.0	-	-
46	3.2	23.0	2.0	34.0
97	3.2	13.0	7.5	26.5
82	3.1	10.0	5.0	25.5
138	3.0	21.0	12.5	29.0
78	3.0	17.5	10.0	28.5
rare	2.9	23.0	5.0	50.0
147	2.8	1.0	0.0	21.5
105	2.8	18.0	7.0	44.5
132	2.8	10.0	7.0	15.0
22	2.7	8.5	6.3	12.0
118	2.7	15.0	4.0	24.0
104	2.6	11.0	6.0	24.3
87	2.6	12.0	7.0	18.0
130	2.6	13.5	8.8	21.0
rare	2.6	11.0	-	-
139	2.6	14.0	3.8	25.3
135	2.6	5.0	1.3	11.8
rare	2.6	4.5	-	-
114	2.6	1.0	0.3	42.3
rare	2.6	11.5	4.8	26.5
rare	2.6	7.5	-	-
rare	2.6	24.5	-	-



**Table 1.5**  
**Frequency of procedure and morbidity risk in all age group (n=12,631 missing 3.6%)**  
**Morbidity category 5**

Procedure name	No. of operations		Observed morbidity	Bayesian estimated morbidity risk		
	All operations	No. with morbidity		%	95% CI	
					Lower	Upper
Valvuloplasty, truncal valve	1	1	100.0%	90.1%	49.6%	100.0%
Aortic root replacement	3	3	100.0%	97.3%	82.4%	100.0%
Aortic root replacement, homograft	1	1	100.0%	90.4%	51.8%	100.0%
Konno procedure	1	1	100.0%	92.4%	58.5%	100.0%
Ross-Konno procedure	1	1	100.0%	92.2%	56.5%	100.0%
Congenitally corrected TGA repair, NOS	2	2	100.0%	95.5%	71.5%	100.0%
Intraaortic balloon pump (IABP) insertion	3	3	100.0%	97.3%	84.0%	100.0%
<b>Total (177 procedures)</b>	<b>12,631</b>	<b>2,815</b>	<b>22.3%</b>			



Procedure risk		Post operative length of stay		
Difficulty ranking	Morbidity score	Median	IQR	
			Q1	Q3
59	4.6	5.0	-	-
rare	5.0	40.0	-	-
121	4.6	7.0	-	-
131	4.8	5.0	-	-
146	4.7	10.0	-	-
rare	4.9	6.5	-	-
rare	5.0	8.0	-	-







## Morbidity risk in newborn

- There are 90 procedures of 718 operations in newborn of all morbidity categories with 48% morbidity.
- Most morbidities are in morbidity category 1 and 2
- In newborn with morbidity category 1, the number of procedures with events are so low that the observed morbidity could be happened by chance.
- In newborn with morbidity category 2, the procedures with high morbidity rate are RVOT procedure (90%), Pulmonic valvuloplasty (64%), and VSD repair with primary closure (60%).
- In newborn with morbidity category 3, the procedures with high morbidity rate are AP window repair (100%) and Truncus arteriosus repair (83%).
- In newborn with morbidity category 4, the procedures with high morbidity rate are Congenitally corrected TGA repair, atrial switch and ASO (double switch) (80%), TAPVC repair (71%) and Aortic arch repair (69%).
- In newborn with morbidity category 5, there is only one procedure: Congenitally corrected TGA repair, NOS (100%).



**Table 2.1**  
**Frequency of procedure and morbidity risk in newborn (n=718 missing 8.3%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Peripheral vascular procedure, other	1	1	100.0%	100.0%	100.0%	0.6
ASD repair, primary closure	4	2	50.0%	1.0%	99.0%	0.8
PFO, primary closure	2	1	50.0%	0.0%	100.0%	0.7
Pacemaker procedure	2	1	50.0%	0.0%	100.0%	0.8
PA debanding	2	1	50.0%	0.0%	100.0%	0.6
Pacemaker implantation, permanent	3	1	33.3%	0.0%	86.7%	0.3
Pulmonary AV fistula repair/occlusion	3	1	33.3%	0.0%	86.7%	0.6
Organ procurement	3	1	33.3%	0.0%	86.7%	0.2
ASD repair, patch	5	0	0.0%	0.0%	0.0%	0.5
PDA closure, NOS	4	0	0.0%	0.0%	0.0%	0.3
Coarctation repair, other	3	0	0.0%	0.0%	0.0%	0.1
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	0.8
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	0.3
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	0.8
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	0.3
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	0.3
ASD creation, balloon septostomy (BAS) (Rashkind)	1	0	0.0%	0.0%	0.0%	0.5
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	0.2
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2
Cardiac procedure, other	1	0	0.0%	0.0%	0.0%	0.5



**Table 2.2**  
**Frequency of procedure and morbidity risk in newborn (n=718 missing 8.3%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, NOS	1	1	100.0%	100.0%	100.0%	1.0
Valve surgery, other, tricuspid	1	1	100.0%	100.0%	100.0%	1.2
Valve replacement, pulmonic (PVR)	1	1	100.0%	100.0%	100.0%	1.4
Sternotomy wound drainage	1	1	100.0%	100.0%	100.0%	1.3
RVOT procedure	10	9	90.0%	71.4%	100.0%	1.5
Valve surgery, other pulmonic	3	2	66.7%	13.3%	100.0%	1.2
Valvuloplasty, pulmonic	11	7	63.6%	35.2%	92.1%	1.4
VSD repair, primary closure	5	3	60.0%	17.1%	100.0%	1.1
Coarctation repair, end to end, extended	13	7	53.8%	26.7%	80.9%	1.6
PDA closure, device	8	4	50.0%	15.4%	84.6%	1.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	2	1	50.0%	0.0%	100.0%	1.0
TOF repair, non ventriculotomy	2	1	50.0%	0.0%	100.0%	1.5
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	2	1	50.0%	0.0%	100.0%	1.4
Lung procedure, other	2	1	50.0%	0.0%	100.0%	1.5
Coarctation repair, end to end	11	5	45.5%	16.0%	74.9%	1.5
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	188	75	39.9%	32.9%	46.9%	1.4
PDA closure, surgical	58	23	39.7%	27.1%	52.2%	0.9
ASD creation/enlargement	3	1	33.3%	0.0%	86.7%	1.0
Occlusion MAPCA(s)	3	1	33.3%	0.0%	86.7%	1.5
VSD repair, patch	13	4	30.8%	5.7%	55.9%	1.0
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	4	0	0.0%	0.0%	0.0%	1.4
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	1.0
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	0.9
TOF repair, RV-PA conduit	1	0	0.0%	0.0%	0.0%	1.5
Unifocalization MAPCA(s)	1	0	0.0%	0.0%	0.0%	1.3
Valve closure, tricuspid (exclusion, univentricular approach)	1	0	0.0%	0.0%	0.0%	1.4
Valvuloplasty, aortic	1	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	1.4
Esophageal procedure	1	0	0.0%	0.0%	0.0%	1.3



**Table 2.3**  
**Frequency of procedure and morbidity risk in newborn (n=718 missing 8.3%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
AP window repair	2	2	100.0%	100.0%	100.0%	1.9
Cor triatriatum repair	1	1	100.0%	100.0%	100.0%	1.9
Pulmonary Venous Stenosis, repair	1	1	100.0%	100.0%	100.0%	1.8
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	2.2
Valve surgery, other, aortic	1	1	100.0%	100.0%	100.0%	1.9
Vascular ring repair	1	1	100.0%	100.0%	100.0%	2.4
Truncus arteriosus repair	6	5	83.3%	53.5%	100.0%	2.2
HLHS biventricular repair	3	2	66.7%	13.3%	100.0%	2.0
Shunt, systemic to pulmonary, other	3	2	66.7%	13.3%	100.0%	2.3
Pulmonary atresia-VSD (including TOF, PA), repair	5	3	60.0%	17.1%	100.0%	1.6
PA, reconstruction (plasty), main (trunk)	5	3	60.0%	17.1%	100.0%	1.9
Valve excision, pulmonary (without replacement)	2	1	50.0%	0.0%	100.0%	2.0
Fontan, TCPC, external conduit, NOS	2	1	50.0%	0.0%	100.0%	2.5
Coarctation repair, subclavian flap	2	1	50.0%	0.0%	100.0%	2.0
Bronchoscopy	2	1	50.0%	0.0%	100.0%	2.1
PA banding (PAB)	28	13	46.4%	28.0%	64.9%	2.1
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	16	7	43.8%	19.4%	68.1%	1.7
TOF repair, ventriculotomy, transanular patch	1	0	0.0%	0.0%	0.0%	1.6
Pericardectomy	1	0	0.0%	0.0%	0.0%	1.7
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	2.3
DORV repair, NOS	1	0	0.0%	0.0%	0.0%	1.8



**Table 2.4**  
**Frequency of procedure and morbidity risk in newborn (n=718 missing 8.3%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
AVC(AVSD) repair, complete CAVSD	2	2	100.0%	100.0%	100.0%	2.6
Valve replacement, truncal	1	1	100.0%	100.0%	100.0%	3.2
Valve excision, tricuspid (without replacement)	1	1	100.0%	100.0%	100.0%	3.4
Coarctation repair, NOS	1	1	100.0%	100.0%	100.0%	2.6
Pulmonary artery sling repair	1	1	100.0%	100.0%	100.0%	2.8
Mediastinal exploration	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	10	8	80.0%	55.2%	100.0%	4.0
TAPVC repair	41	29	70.7%	56.8%	84.7%	2.6
Aortic arch repair	16	11	68.8%	46.0%	91.5%	3.1
Arterial switch operation (ASO) and VSD repair	15	10	66.7%	42.8%	90.5%	3.0
Arterial switch operation (ASO)	92	52	56.5%	46.4%	66.7%	2.6
Norwood procedure	22	11	50.0%	29.1%	70.9%	2.8
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	2	1	50.0%	0.0%	100.0%	2.6
Interrupted aortic arch repair	24	11	45.8%	25.9%	65.8%	2.7
Coarctation repair, patch aortoplasty	6	2	33.3%	0.0%	71.1%	2.7
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	2.6
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	3.4

**Table 2.5**  
**Frequency of procedure and morbidity risk in newborn (n=718 missing 8.3%)**  
**Morbidity category 5**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	4.9
<b>Total (90 procedures)</b>	<b>718</b>	<b>347</b>	<b>48.3%</b>	<b>44.7%</b>	<b>52.0%</b>	



## Morbidity risk in infant

- In infants, there are 2355 operations with 127 procedures of all morbidity categories with 35% morbidity.
- Most morbidities in infants are in morbidity category 2.
- The highest morbidity in infant with morbidity category 1 are Pericardial drainage procedure (100%), ASD repair with primary closure (55%), Double chamber right ventricle repair (50%), ASD with partial closure (46%) and Mediastinal procedure (40%).
- The highest morbidity in infant with morbidity category 2 are Coronary artery bypass, Coronary artery procedure with other approach, Unidirectional cavopulmonary anastomosis, Tricuspid valve closure for exclusion of univentricular approach, Aortic valvuloplasty and Fontan Atrio-ventricular connection.
- The highest morbidity in infant with morbidity category 3 are Cor triatriatum repair, Anomalous systemic venous connection repair, ASD with common atrium (single) septation, Atrial septal fenestration, Fontan - TCPC with fenestrated lateral tunnel, Fontan - other and Congenitally corrected TGA repair - other.
- The highest morbidity in infants with morbidity category 4 are Pleural procedure - other, Congenitally corrected TGA repair with atrial switch and Rastelli, Congenitally corrected TGA repair with VSD closure and LV to PA conduit and Aortic dissection repair.
- The highest morbidity in infants with morbidity category 5 are Truncal valvuloplasty, Congenitally corrected TGA repair, NOS and Intraaortic balloon pump insertion.



**Table 3.1**  
**Frequency of procedure and morbidity risk in infant (n=2,355 missing 4.4%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Pericardial drainage procedure	1	1	100.0%	100.0%	100.0%	0.6
ASD, repair, primary closure	11	6	54.5%	25.1%	84.0%	0.8
DCRV repair	2	1	50.0%	0.0%	100.0%	0.4
ASD partial closure	11	5	45.5%	16.0%	74.9%	0.8
Mediastinal procedure	5	2	40.0%	0.0%	82.9%	0.9
VSD repair, NOS	3	1	33.3%	0.0%	86.7%	0.3
Valvuloplasty, mitral	3	1	33.3%	0.0%	86.7%	0.8
ASD repair, patch	22	6	27.3%	8.7%	45.9%	0.5
PA, reconstruction (plasty), NOS	4	1	25.0%	0.0%	67.4%	0.8
PFO, primary closure	11	2	18.2%	0.0%	41.0%	0.7
PDA closure, NOS	32	2	6.3%	0.0%	14.6%	0.3
Organ procurement	6	0	0.0%	0.0%	0.0%	0.2
Pacemaker implantation, permanent	5	0	0.0%	0.0%	0.0%	0.3
PAPVC repair	4	0	0.0%	0.0%	0.0%	0.4
Coarctation repair, other	4	0	0.0%	0.0%	0.0%	0.1
PA debanding	4	0	0.0%	0.0%	0.0%	0.6
Pulmonary AV fistula repair/occlusion	4	0	0.0%	0.0%	0.0%	0.6
Thoracic and/or mediastinal procedure, other	4	0	0.0%	0.0%	0.0%	0.7
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	0.3
Pulmonary embolectomy	3	0	0.0%	0.0%	0.0%	0.4
ASD repair, NOS	2	0	0.0%	0.0%	0.0%	0.7
Fontan, NOS	2	0	0.0%	0.0%	0.0%	0.8
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	0.5
Peripheral vascular procedure, other	2	0	0.0%	0.0%	0.0%	0.6
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	0.3
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
Conduit, reoperation	1	0	0.0%	0.0%	0.0%	0.7
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Valve surgery, other, mitral	1	0	0.0%	0.0%	0.0%	0.9
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	0.9
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	0.8
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	0.3
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2



**Table 3.2**  
**Frequency of procedure and morbidity risk in infant (n=2,355 missing 4.4%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Coronary artery bypass	2	2	100.0%	100.0%	100.0%	1.3
Coronary artery procedure, other	2	2	100.0%	100.0%	100.0%	1.0
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	2	100.0%	100.0%	100.0%	1.2
Valve closure, tricuspid (exclusion, univentricular approach)	1	1	100.0%	100.0%	100.0%	1.4
Valvuloplasty, aortic	1	1	100.0%	100.0%	100.0%	1.0
Fontan, atrio-ventricular connection	1	1	100.0%	100.0%	100.0%	1.4
Fontan, atrio-pulmonary connection	3	2	66.7%	13.3%	100.0%	1.0
Rastelli	5	3	60.0%	17.1%	100.0%	1.6
Esophageal procedure	12	7	58.3%	30.4%	86.2%	1.3
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	31	17	54.8%	37.3%	72.4%	1.4
Lung procedure, other	16	8	50.0%	25.5%	74.5%	1.5
ASD creation/enlargement	4	2	50.0%	1.0%	99.0%	1.0
Occlusion MAPCA(s)	4	2	50.0%	1.0%	99.0%	1.5
Valvuloplasty, tricuspid	4	2	50.0%	1.0%	99.0%	1.2
Pleural drainage procedure	4	2	50.0%	1.0%	99.0%	0.9
Ventricular septal fenestration	2	1	50.0%	0.0%	100.0%	1.2
Valve surgery, other, tricuspid	2	1	50.0%	0.0%	100.0%	1.2
1 1/2 ventricular repair	2	1	50.0%	0.0%	100.0%	1.0
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	1.2
Mitral stenosis, supra-valvar mitral ring, repair	2	1	50.0%	0.0%	100.0%	1.2
Atrial baffle procedure, NOS	2	1	50.0%	0.0%	100.0%	1.1
RVOT procedure	7	3	42.9%	6.2%	79.5%	1.5
Coarctation repair, end to end	30	12	40.0%	22.5%	57.5%	1.5
AVC (AVSD) repair, intermediated (transitional)	5	2	40.0%	0.0%	82.9%	1.0
Valvuloplasty, pulmonic	5	2	40.0%	0.0%	82.9%	1.4
VSD repair, primary closure	78	30	38.5%	27.7%	49.3%	1.1
VSD repair, patch	424	147	34.7%	30.1%	39.2%	1.0
AVC (AVSD) repair, NOS	3	1	33.3%	0.0%	86.7%	1.3
TOF repair, RV-PA conduit	3	1	33.3%	0.0%	86.7%	1.5
TOF repair, NOS	3	1	33.3%	0.0%	86.7%	1.0
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	284	85	29.9%	24.6%	35.3%	1.4
AVC (AVSD) repair, partial (incomplete) (PAVSD)	7	2	28.6%	0.0%	62.0%	1.3
PDA closure, device	78	21	26.9%	17.1%	36.8%	1.1
VSD, multiple, repair	4	1	25.0%	0.0%	67.4%	0.9





Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	4	1	25.0%	0.0%	67.4%	1.4
Lung biopsy	4	1	25.0%	0.0%	67.4%	1.2
PDA closure, surgical	516	124	24.0%	20.3%	27.7%	0.9
Coarctation repair, end to end, extended	25	5	20.0%	4.3%	35.7%	1.6
Pulmonary artery origin from ascending aorta (hemitruncus) repair	5	1	20.0%	0.0%	55.1%	1.0
PA, reconstruction (plasty), branch, central	5	1	20.0%	0.0%	55.1%	1.2
TOF repair, non ventriculotomy	13	2	15.4%	0.0%	35.0%	1.5
Cardiotomy, other	3	0	0.0%	0.0%	0.0%	1.3
Unifocalization MAPCA(s)	2	0	0.0%	0.0%	0.0%	1.3
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	1.3
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	1.1
Aortic stenosis, subvalvar, repair	1	0	0.0%	0.0%	0.0%	0.9



**Table 3.3**  
**Frequency of procedure and morbidity risk in infant (n=2,355 missing 4.4%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Cor triatriatum repair	4	4	100.0%	100.0%	100.0%	1.9
Anomalous systemic venous connection repair	2	2	100.0%	100.0%	100.0%	2.2
ASD, common atrium (single atrium), septation	1	1	100.0%	100.0%	100.0%	1.8
Atrial septal fenestration	1	1	100.0%	100.0%	100.0%	2.0
Fontan, TCPC, lateral tunnel, fenestrated	1	1	100.0%	100.0%	100.0%	1.9
Fontan, other	1	1	100.0%	100.0%	100.0%	2.0
Congenitally corrected TGA repair, other	1	1	100.0%	100.0%	100.0%	2.3
TOF repair, ventriculotomy, nontransanular patch	4	3	75.0%	32.6%	100.0%	1.6
Pulmonary atresia-VSD (including TOF, PA), repair	7	5	71.4%	38.0%	100.0%	1.6
Shunt, systemic to pulmonary, other	5	3	60.0%	17.1%	100.0%	2.3
Vascular ring repair	6	3	50.0%	10.0%	90.0%	2.4
Pericardectomy	2	1	50.0%	0.0%	100.0%	1.7
Ligation, thoracic duct	2	1	50.0%	0.0%	100.0%	2.4
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	17	8	47.1%	23.3%	70.8%	1.7
PA banding (PAB)	90	39	43.3%	33.1%	53.6%	2.1
Pulmonary Venous Stenosis, repair	5	2	40.0%	0.0%	82.9%	1.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	5	2	40.0%	0.0%	82.9%	2.2
Coarctation repair, subclavian flap	8	3	37.5%	4.0%	71.0%	2.0
Truncus arteriosus repair	27	10	37.0%	18.8%	55.3%	2.2
Anomalous origin of coronary artery repair	6	2	33.3%	0.0%	71.1%	2.2
Bronchoscopy	3	1	33.3%	0.0%	86.7%	2.1
AP window repair	13	4	30.8%	5.7%	55.9%	1.9
TOF repair, ventriculotomy, transanular patch	15	4	26.7%	4.3%	49.0%	1.6
HLHS biventricular repair	4	1	25.0%	0.0%	67.4%	2.0
DORV repair, NOS	8	1	12.5%	0.0%	35.4%	1.8



**Table 3.4**  
**Frequency of procedure and morbidity risk in infant (n=2,355 missing 4.4%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Pleural procedure, other	3	3	100.0%	100.0%	100.0%	3.8
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	2.6
Aortic dissection repair	1	1	100.0%	100.0%	100.0%	3.4
Aortic arch repair	22	16	72.7%	54.1%	91.3%	3.1
Valve replacement, truncal	7	5	71.4%	38.0%	100.0%	3.2
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	6	4	66.7%	28.9%	100.0%	4.0
Tracheal procedure	6	4	66.7%	28.9%	100.0%	2.9
Coarctation repair, patch aortoplasty	18	11	61.1%	38.6%	83.6%	2.7
DORV, intraventricular tunnel repair	20	12	60.0%	38.5%	81.5%	2.8
Norwood procedure	15	9	60.0%	35.2%	84.8%	2.8
Arterial switch operation (ASO) and VSD repair	40	22	55.0%	39.6%	70.4%	3.0
Interrupted aortic arch repair	20	11	55.0%	33.2%	76.8%	2.7
AVC(AVSD) repair, complete CAVSD	45	24	53.3%	38.8%	67.9%	2.6
TAPVC repair	70	37	52.9%	41.2%	64.6%	2.6
Pulmonary artery sling repair	8	4	50.0%	15.4%	84.6%	2.8
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	4	2	50.0%	1.0%	99.0%	2.6
Arterial switch operation (ASO)	48	20	41.7%	27.7%	55.6%	2.6
Palliation, other	3	1	33.3%	0.0%	86.7%	2.6
Coarctation repair, NOS	1	0	0.0%	0.0%	0.0%	2.6



**Table 3.5**  
**Frequency of procedure and morbidity risk in infant (n=2,355 missing 4.4%)**  
**Morbidity category 5**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valvuloplasty, truncal valve	1	1	100.0%	100.0%	100.0%	4.6
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	4.9
Intraaortic balloon pump (IABP) insertion	1	1	100.0%	100.0%	100.0%	5.0
<b>Total (127 procedures)</b>	<b>2,355</b>	<b>826</b>	<b>35.1%</b>	<b>33.1%</b>	<b>37.0%</b>	



## Morbidity risk in preschool children

- There are 123 procedures in 2351 operations with 20% morbidity in all morbidity categories of preschool children. Most preschool children are in morbidity category 2.
- The highest morbidity in preschool children with morbidity category 1 are Mitral valve surgery and other (40%), Mitral valvuloplasty (17%) and ASD with partial closure (11%).
- The highest morbidity in preschool children with morbidity category 2 are Pectus repair (100%), Tricuspid valvuloplasty (67%) and TOF with AVSD repair (50%).
- The highest morbidity in preschool children with morbidity category 3 are Fontan TCPC with external conduit, NOS (100%), Anomalous origin of coronary artery repair (100%), ASD repair with device (100%), TVR (100%), Congenitally corrected TGA repair with other (100%) and others.
- The highest morbidity of preschool children in morbidity category 4 are Congenitally corrected TGA with atrial switch and Rastelli (100%), Arterial switch operation (67%), Tricuspid valve excision without replacement (50%), Norwood procedure (50%), Arterial switch operation with VSD repair (50%) and others.
- There is no patient in morbidity category 5



**Table 4.1**  
**Frequency of procedure and morbidity risk in preschool children (n=2,351 missing 3.4%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed Morbidity risk			Procedure risk
	All operations	No.with Morbidity	%	95% CI		Morbidity score
				Lower	Upper	
Valve surgery, other, mitral	5	2	40.0%	0.0%	82.9%	0.9
Valvuloplasty, mitral	6	1	16.7%	0.0%	46.5%	0.8
ASD partial closure	9	1	11.1%	0.0%	31.6%	0.8
ASD repair, patch	68	4	5.9%	0.3%	11.5%	0.5
ASD repair, primary closure	34	2	5.9%	0.0%	13.8%	0.8
PDA closure, NOS	30	0	0.0%	0.0%	0.0%	0.3
PAPVC repair	8	0	0.0%	0.0%	0.0%	0.4
PFO, primary closure	7	0	0.0%	0.0%	0.0%	0.7
Mediastinal procedure	6	0	0.0%	0.0%	0.0%	0.9
Pulmonary embolectomy	5	0	0.0%	0.0%	0.0%	0.4
Cardiac procedure, other	5	0	0.0%	0.0%	0.0%	0.5
Organ procurement	5	0	0.0%	0.0%	0.0%	0.2
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	0	0.0%	0.0%	0.0%	0.8
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	0.3
VSD repair, NOS	3	0	0.0%	0.0%	0.0%	0.3
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	0.8
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	0.7
Aortic stenosis, supraaortic, repair	2	0	0.0%	0.0%	0.0%	0.1
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	0.8
Shunt, systemic to pulmonary, NOS	2	0	0.0%	0.0%	0.0%	0.2
Thoracic and/or mediastinal procedure, other	2	0	0.0%	0.0%	0.0%	0.7
ASD repair, NOS	1	0	0.0%	0.0%	0.0%	0.7
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	0.9
Coarctation repair, other	1	0	0.0%	0.0%	0.0%	0.1
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	0.3
ASD creation, blade septostomy	1	0	0.0%	0.0%	0.0%	0.5
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Minimally invasive procedure	1	0	0.0%	0.0%	0.0%	0.5
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	0.6



**Table 4.2**  
**Frequency of procedure and morbidity risk in preschool children (n=2,351 missing 3.4%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed Morbidity risk			Procedure risk
	All operations	No.with Morbidity	%	95% CI		Morbidity score
				Lower	Upper	
Pectus repair	1	1	100.0%	100.0%	100.0%	1.0
Valvuloplasty, tricuspid	3	2	66.7%	13.3%	100.0%	1.2
Unifocalization MAPCA(s)	6	3	50.0%	10.0%	90.0%	1.3
TOF, AVC (AVSD), repair	4	2	50.0%	1.0%	99.0%	1.1
Valve surgery, other, tricuspid	2	1	50.0%	0.0%	100.0%	1.2
Valve replacement, pulmonic (PVR)	2	1	50.0%	0.0%	100.0%	1.4
Senning	2	1	50.0%	0.0%	100.0%	1.2
Shunt, ligation and takedown	2	1	50.0%	0.0%	100.0%	1.4
Sternotomy wound drainage	2	1	50.0%	0.0%	100.0%	1.3
Valvuloplasty, pulmonic	12	5	41.7%	13.8%	69.6%	1.4
Aortic stenosis, subvalvar, repair	8	3	37.5%	4.0%	71.0%	0.9
Valve closure, tricuspid (exclusion, univentricular approach)	3	1	33.3%	0.0%	86.7%	1.4
Valve replacement, mitral (MVR)	3	1	33.3%	0.0%	86.7%	1.5
Mustard	3	1	33.3%	0.0%	86.7%	1.0
Cardiotomy, other	3	1	33.3%	0.0%	86.7%	1.3
TOF repair, non ventriculotomy	52	16	30.8%	18.2%	43.3%	1.5
TOF repair, RV-PA conduit	13	4	30.8%	5.7%	55.9%	1.5
VSD repair, primary closure	161	43	26.7%	19.9%	33.5%	1.1
ASD creation/enlargement	4	1	25.0%	0.0%	67.4%	1.0
RVOT procedure	4	1	25.0%	0.0%	67.4%	1.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	112	26	23.2%	15.4%	31.0%	1.4
Esophageal procedure	13	3	23.1%	0.2%	46.0%	1.3
AVC (AVSD) repair, partial (incomplete) (PAVSD)	14	3	21.4%	0.0%	42.9%	1.3
AVC (AVSD) repair, intermediated (transitional)	5	1	20.0%	0.0%	55.1%	1.0
Occlusion MAPCA(s)	5	1	20.0%	0.0%	55.1%	1.5
VSD repair, patch	604	115	19.0%	15.9%	22.2%	1.0
TOF repair, NOS	17	3	17.6%	0.0%	35.8%	1.0
Coarctation repair, end to end, extended	6	1	16.7%	0.0%	46.5%	1.6
Lung biopsy	6	1	16.7%	0.0%	46.5%	1.2
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	220	34	15.5%	10.7%	20.2%	1.4
Lung procedure, other	14	2	14.3%	0.0%	32.6%	1.5
AVC (AVSD) repair, NOS	7	1	14.3%	0.0%	40.2%	1.3
Coarctation repair, end to end	15	2	13.3%	0.0%	30.5%	1.5



Procedure name	No. of operations		Observed Morbidity risk			Procedure risk
	All operations	No.with Morbidity	%	95% CI		Morbidity score
				Lower	Upper	
VSD, multiple, repair	8	1	12.5%	0.0%	35.4%	0.9
PDA closure, surgical	306	27	8.8%	5.6%	12.0%	0.9
PDA closure, device	51	4	7.8%	0.5%	15.2%	1.1
Ventricular septal fenestration	5	0	0.0%	0.0%	0.0%	1.2
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	5	0	0.0%	0.0%	0.0%	1.2
Pulmonary artery origin from ascending aorta (hemitruncus) repair	3	0	0.0%	0.0%	0.0%	1.0
Rastelli	3	0	0.0%	0.0%	0.0%	1.6
Mitral stenosis, supra-valvar mitral ring, repair	2	0	0.0%	0.0%	0.0%	1.2
Fontan, atrio-ventricular connection	2	0	0.0%	0.0%	0.0%	1.4
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	0.9
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	1	0	0.0%	0.0%	0.0%	1.4
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	1.2
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	1.0





**Table 4.3**  
**Frequency of procedure and morbidity risk in preschool children (n=2,351 missing 3.4%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed Morbidity risk			Procedure risk
	All operations	No.with Morbidity	%	95% CI		Morbidity score
				Lower	Upper	
Fontan, TCPC, external conduit, NOS	2	2	100.0%	100.0%	100.0%	2.5
Anomalous origin of coronary artery repair	2	2	100.0%	100.0%	100.0%	2.2
ASD, repair, device	1	1	100.0%	100.0%	100.0%	1.8
Valve replacement, tricuspid (TVR)	1	1	100.0%	100.0%	100.0%	2.3
Congenitally corrected TGA repair, other	1	1	100.0%	100.0%	100.0%	2.3
Fontan, other	3	2	66.7%	13.3%	100.0%	2.0
Atrial septal fenestration	2	1	50.0%	0.0%	100.0%	2.0
Shunt, systemic to pulmonary, other	2	1	50.0%	0.0%	100.0%	2.3
TOF repair, ventriculotomy, nontransanular patch	14	6	42.9%	16.9%	68.8%	1.6
Truncus arteriosus repair	7	3	42.9%	6.2%	79.5%	2.2
AP window repair	8	3	37.5%	4.0%	71.0%	1.9
TOF repair, ventriculotomy, transanular patch	131	44	33.6%	25.5%	41.7%	1.6
Coarctation repair, subclavian flap	3	1	33.3%	0.0%	86.7%	2.0
Vascular ring repair	3	1	33.3%	0.0%	86.7%	2.4
Pulmonary Venous Stenosis, repair	7	2	28.6%	0.0%	62.0%	1.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	18	5	27.8%	7.1%	48.5%	2.2
Pulmonary atresia-VSD (including TOF, PA), repair	8	2	25.0%	0.0%	55.0%	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	8	2	25.0%	0.0%	55.0%	1.7
Anomalous systemic venous connection repair	4	1	25.0%	0.0%	67.4%	2.2
DORV repair, NOS	13	3	23.1%	0.2%	46.0%	1.8
PA banding (PAB)	17	3	17.6%	0.0%	35.8%	2.1
Cor triatriatum repair	8	1	12.5%	0.0%	35.4%	1.9
TOF, absent pulmonary valve, repair	3	0	0.0%	0.0%	0.0%	1.7
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	1.8
Conduit, placement, RV to PA	1	0	0.0%	0.0%	0.0%	1.9
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	2.2
Pericardectomy	1	0	0.0%	0.0%	0.0%	1.7
Ligation, thoracic duct	1	0	0.0%	0.0%	0.0%	2.4



**Table 4.4**  
**Frequency of procedure and morbidity risk in preschool children (n=2,351 missing 3.4%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed Morbidity risk			Procedure risk
	All operations	No.with Morbidity	%	95% CI		Morbidity score
				Lower	Upper	
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	2.6
Arterial switch operation (ASO)	3	2	66.7%	13.3%	100.0%	2.6
Valve excision, tricuspid (without replacement)	2	1	50.0%	0.0%	100.0%	3.4
Norwood procedure	2	1	50.0%	0.0%	100.0%	2.8
Arterial switch operation (ASO) and VSD repair	2	1	50.0%	0.0%	100.0%	3.0
Interrupted aortic arch repair	2	1	50.0%	0.0%	100.0%	2.7
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	2	1	50.0%	0.0%	100.0%	2.6
Hemifontan	2	1	50.0%	0.0%	100.0%	3.0
DORV, intraventricular tunnel repair	23	11	47.8%	27.4%	68.2%	2.8
AVC(AVSD) repair, complete CAVSD	61	28	45.9%	33.4%	58.4%	2.6
TAPVC repair	21	7	33.3%	13.2%	53.5%	2.6
Aortic arch repair	3	1	33.3%	0.0%	86.7%	3.1
Pulmonary artery sling repair	3	1	33.3%	0.0%	86.7%	2.8
Fontan, TCPC, external conduit, nonfenestrated	4	1	25.0%	0.0%	67.4%	3.2
Coarctation repair, patch aortoplasty	4	1	25.0%	0.0%	67.4%	2.7
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	2.6
Palliation, other	1	0	0.0%	0.0%	0.0%	2.6
<b>Total (123 procedures)</b>	<b>2,351</b>	<b>472</b>	<b>20.1%</b>	<b>18.5%</b>	<b>21.7%</b>	



## Morbidity risk in school age children

- In school aged children, there are 145 procedures in 3214 operations with 20% morbidity in all morbidity categories.
- Most school age children are in morbidity category 2.
- In morbidity category 1, the highest morbidity are Coarctation repair with interposition graft (100%) and Congenitally corrected TGA repair with VSD closure.
- In morbidity category 2, the highest morbidity are Pulmonic valve replacement (50%), AVSD repair, NOS (50%) and Mechanical aortic valve replacement (50%).
- In morbidity category 3, the highest morbidity are Tricuspid valve replacement (67%), Aortic valve replacement (67%) and Thoracic duct ligation (67%).
- In school age children with morbidity category 4, the highest morbidity are Semilunar valve closure (100%), Congenitally corrected TGA repair, atrial switch with ASO (double switch) (100%), Congenitally corrected TGA repair with VSD closure and LV to PA conduit (100%) and Interrupted aortic arch repair (100%).
- In school age children with morbidity category 5, the highest morbidity are Aortic root replacement (100%), IABP insertion (100%) and Aortic root replacement with homograft (100%).



**Table 5.1**  
**Frequency of procedure and morbidity risk in school aged children (n=3,214 missing 3.0%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Coarctation repair, interposition graft	1	1	100.0%	100.0%	100.0%	0.8
Congenitally corrected TGA repair, VSD closure	3	2	66.7%	13.3%	100.0%	0.9
PA, reconstruction (plasty), NOS	6	2	33.3%	0.0%	71.1%	0.8
Pulmonary embolectomy	3	1	33.3%	0.0%	86.7%	0.4
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	1	25.0%	0.0%	67.4%	0.8
Cardiac procedure, other	9	2	22.2%	0.0%	49.4%	0.5
ASD partial closure	19	4	21.1%	2.7%	39.4%	0.8
PFO, primary closure	21	4	19.0%	2.3%	35.8%	0.7
ASD repair, primary closure	125	22	17.6%	10.9%	24.3%	0.8
Valvuloplasty, mitral	20	3	15.0%	0.0%	30.6%	0.8
Fontan, NOS	7	1	14.3%	0.0%	40.2%	0.8
PAPVC repair	25	3	12.0%	0.0%	24.7%	0.4
ASD, repair, patch	333	22	6.6%	3.9%	9.3%	0.5
PDA closure, NOS	27	0	0.0%	0.0%	0.0%	0.3
Pacemaker implantation, permanent	16	0	0.0%	0.0%	0.0%	0.3
VSD repair, NOS	10	0	0.0%	0.0%	0.0%	0.3
Valve surgery, other, mitral	8	0	0.0%	0.0%	0.0%	0.9
Organ procurement	8	0	0.0%	0.0%	0.0%	0.2
DCRV repair	7	0	0.0%	0.0%	0.0%	0.4
Coronary artery fistula ligation	6	0	0.0%	0.0%	0.0%	0.3
ASD repair, NOS	5	0	0.0%	0.0%	0.0%	0.7
Aortic stenosis, supraaortic, repair	5	0	0.0%	0.0%	0.0%	0.1
Thoracic and/or mediastinal procedure, other	5	0	0.0%	0.0%	0.0%	0.7
PA debanding	4	0	0.0%	0.0%	0.0%	0.6
Peripheral vascular procedure, other	4	0	0.0%	0.0%	0.0%	0.6
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	0.7
Pacemaker procedure	3	0	0.0%	0.0%	0.0%	0.8
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	0.7
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	0.9
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	0.3
Sinus of valsalva, aneurysm repair	1	0	0.0%	0.0%	0.0%	0.6
Pericardial drainage procedure	1	0	0.0%	0.0%	0.0%	0.6
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	0.0%	0.0%	0.5
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	0.0%	0.0%	0.5
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	0.3



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	0.0%	0.0%	0.5
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	0.2
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Pulmonary AV fistula repair/occlusion	1	0	0.0%	0.0%	0.0%	0.6
Delayed sternal closure	1	0	0.0%	0.0%	0.0%	0.5



**Table 5.2**  
**Frequency of procedure and morbidity risk in school aged children (n=3,214 missing 3.0%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valve replacement, pulmonic (PVR)	8	4	50.0%	15.4%	84.6%	1.4
AVC (AVSD) repair, NOS	4	2	50.0%	1.0%	99.0%	1.3
Valve replacement, aortic (AVR), mechanical	4	2	50.0%	1.0%	99.0%	1.1
Valvuloplasty, tricuspid	13	6	46.2%	19.1%	73.3%	1.2
Valve replacement, mitral (MVR)	9	3	33.3%	2.5%	64.1%	1.5
Occlusion MAPCA(s)	6	2	33.3%	0.0%	71.1%	1.5
Valve surgery, other, tricuspid	6	2	33.3%	0.0%	71.1%	1.2
Valve closure, tricuspid (exclusion, univentricular approach)	3	1	33.3%	0.0%	86.7%	1.4
PA, reconstruction (plasty), branch, central	3	1	33.3%	0.0%	86.7%	1.2
Valve surgery, other pulmonic	3	1	33.3%	0.0%	86.7%	1.2
Fontan, atrio-ventricular connection	3	1	33.3%	0.0%	86.7%	1.4
TOF repair, non ventriculotomy	129	41	31.8%	23.7%	39.8%	1.5
VSD, multiple, repair	13	4	30.8%	5.7%	55.9%	0.9
Rastelli	44	13	29.5%	16.1%	43.0%	1.6
Valvuloplasty, aortic	7	2	28.6%	0.0%	62.0%	1.0
PDA closure, device	52	13	25.0%	13.2%	36.8%	1.1
TOF repair, RV-PA conduit	24	6	25.0%	7.7%	42.3%	1.5
AVC (AVSD) repair, partial (incomplete) (PAVSD)	12	3	25.0%	0.5%	49.5%	1.3
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	8	2	25.0%	0.0%	55.0%	1.4
Lung biopsy	4	1	25.0%	0.0%	67.4%	1.2
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	160	32	20.0%	13.8%	26.2%	1.4
Fontan, atrio-pulmonary connection	10	2	20.0%	0.0%	44.8%	1.0
Coarctation repair, end to end, extended	5	1	20.0%	0.0%	55.1%	1.6
Unifocalization MAPCA(s)	21	4	19.0%	2.3%	35.8%	1.3
Esophageal procedure	17	3	17.6%	0.0%	35.8%	1.3
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	57	10	17.5%	7.7%	27.4%	1.4
VSD repair, primary closure	237	40	16.9%	12.1%	21.6%	1.1
TOF repair, NOS	42	7	16.7%	5.4%	27.9%	1.0
TOF, AVC (AVSD), repair	12	2	16.7%	0.0%	37.8%	1.1
1 1/2 ventricular repair	6	1	16.7%	0.0%	46.5%	1.0
Lung procedure, other	13	2	15.4%	0.0%	35.0%	1.5
RVOT procedure	20	3	15.0%	0.0%	30.6%	1.5
Mitral stenosis, supra-valvar mitral ring, repair	7	1	14.3%	0.0%	40.2%	1.2



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	8	1	12.5%	0.0%	35.4%	1.2
VSD repair, patch	529	55	10.4%	7.8%	13.0%	1.0
Coarctation repair, end to end	10	1	10.0%	0.0%	28.6%	1.5
Cardiotomy, other	10	1	10.0%	0.0%	28.6%	1.3
PDA closure, surgical	206	16	7.8%	4.1%	11.4%	0.9
Valvuloplasty, pulmonic	14	1	7.1%	0.0%	20.6%	1.4
Aortic stenosis, subvalvar, repair	16	1	6.3%	0.0%	18.1%	0.9
Ventricular septal fenestration	6	0	0.0%	0.0%	0.0%	1.2
Cardiac tumor resection	6	0	0.0%	0.0%	0.0%	1.0
Coronary artery procedure, other	5	0	0.0%	0.0%	0.0%	1.0
AVC (AVSD) repair, intermediated (transitional)	4	0	0.0%	0.0%	0.0%	1.0
Pectus repair	4	0	0.0%	0.0%	0.0%	1.0
ASD creation/enlargement	3	0	0.0%	0.0%	0.0%	1.0
Senning	3	0	0.0%	0.0%	0.0%	1.2
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	0.9
Sternotomy wound drainage	3	0	0.0%	0.0%	0.0%	1.3
Mustard	2	0	0.0%	0.0%	0.0%	1.0
Coronary artery bypass	2	0	0.0%	0.0%	0.0%	1.3
Atrial baffle procedure, NOS	2	0	0.0%	0.0%	0.0%	1.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	1.0



**Table 5.3**  
**Frequency of procedure and morbidity risk in school aged children (n=3,214 missing 3.0%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valve replacement, tricuspid (TVR)	3	2	66.7%	13.3%	100.0%	2.3
Valve replacement, aortic (AVR)	3	2	66.7%	13.3%	100.0%	2.3
Ligation, thoracic duct	3	2	66.7%	13.3%	100.0%	2.4
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	8	4	50.0%	15.4%	84.6%	2.2
Pulmonary Venous Stenosis, repair	6	3	50.0%	10.0%	90.0%	1.8
Conduit, placement, RV to PA	4	2	50.0%	1.0%	99.0%	1.9
Conduit, placement, LV to PA	2	1	50.0%	0.0%	100.0%	2.2
Fontan, TCPC, external conduit, NOS	32	14	43.8%	26.6%	60.9%	2.5
Valve excision, pulmonary (without replacement)	7	3	42.9%	6.2%	79.5%	2.0
DORV repair, NOS	36	15	41.7%	25.6%	57.8%	1.8
Fontan, TCPC, lateral tunnel, fenestrated	17	7	41.2%	17.8%	64.6%	1.9
Truncus arteriosus repair	5	2	40.0%	0.0%	82.9%	2.2
Congenitally corrected TGA repair, other	5	2	40.0%	0.0%	82.9%	2.3
TOF, absent pulmonary valve, repair	11	4	36.4%	7.9%	64.8%	1.7
Valve surgery, other, aortic	6	2	33.3%	0.0%	71.1%	1.9
Pericardectomy	6	2	33.3%	0.0%	71.1%	1.7
Fontan, other	6	2	33.3%	0.0%	71.1%	2.0
ASD, repair, device	3	1	33.3%	0.0%	86.7%	1.8
TOF repair, ventriculotomy, transannular patch	301	100	33.2%	27.9%	38.5%	1.6
TOF repair, ventriculotomy, nontransannular patch	30	8	26.7%	10.8%	42.5%	1.6
Pulmonary atresia-VSD (including TOF, PA), repair	36	9	25.0%	10.9%	39.1%	1.6
PA, reconstruction (plasty), main (trunk)	5	1	20.0%	0.0%	55.1%	1.9
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	21	4	19.0%	2.3%	35.8%	1.7
PA banding (PAB)	4	0	0.0%	0.0%	0.0%	2.1
VSD repair, device	2	0	0.0%	0.0%	0.0%	1.8
Cor triatriatum repair	2	0	0.0%	0.0%	0.0%	1.9
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	2.3
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	1.8
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	2.0
AP window repair	1	0	0.0%	0.0%	0.0%	1.9
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	2.2
Vascular ring repair	1	0	0.0%	0.0%	0.0%	2.4





**Table 5.4**  
**Frequency of procedure and morbidity risk in school aged children (n=3,214 missing 3.0%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valve closure, semilunar	2	2	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	1	100.0%	100.0%	100.0%	4.0
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	2.6
Interrupted aortic arch repair	1	1	100.0%	100.0%	100.0%	2.7
Pulmonary artery sling repair	1	1	100.0%	100.0%	100.0%	2.8
Hemifontan	6	5	83.3%	53.5%	100.0%	3.0
Palliation, other	5	4	80.0%	44.9%	100.0%	2.6
Fontan, TCPC, external conduit, nonfenestrated	34	24	70.6%	55.3%	85.9%	3.2
DORV, intraventricular tunnel repair	37	21	56.8%	40.8%	72.7%	2.8
AVC(AVSD) repair, complete CAVSD	22	12	54.5%	33.7%	75.4%	2.6
Congenitally corrected TGA repair, atrial switch and Rastelli	2	1	50.0%	0.0%	100.0%	2.6
Arterial switch operation (ASO)	6	2	33.3%	0.0%	71.1%	2.6
Valve replacement, truncal	3	1	33.3%	0.0%	86.7%	3.2
TAPVC repair	10	2	20.0%	0.0%	44.8%	2.6
Aortic arch repair	3	0	0.0%	0.0%	0.0%	3.1
Pleural procedure, other	1	0	0.0%	0.0%	0.0%	3.8
Mediastinal exploration	1	0	0.0%	0.0%	0.0%	2.6

**Table 5.5**  
**Frequency of procedure and morbidity risk in school aged children (n=3,214 missing 3.0%)**  
**Morbidity category 5**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Aortic root replacement	3	3	100.0%	100.0%	100.0%	5.0
Intraaortic balloon pump (IABP) insertion	2	2	100.0%	100.0%	100.0%	5.0
Aortic root replacement, homograft	1	1	100.0%	100.0%	100.0%	4.6
<b>Total (145 procedures)</b>	<b>3,214</b>	<b>638</b>	<b>19.9%</b>	<b>18.5%</b>	<b>21.2%</b>	



## Morbidity risk in grown-up children

- In grown-up patients with all morbidity categories, there are 126 procedures in 1139 operations with 17% morbidity.
- Most patients are in morbidity category 2.
- In grown-up children with morbidity category 1, the highest morbidity is Pericardial procedure with other (100%).
- In morbidity category 2, the highest morbidity are AVR with bioprosthesis (100%) and Mitral stenosis with supra-avalvar mitral ring repair (57%).
- In morbidity category 3 of grown-up patients, the highest morbidity are Bilateral bidirectional cavopulmonary anastomosis (100%) and Fontan TCPC with external conduit, NOS (100%).
- In morbidity category 4 of grown-up children, the highest morbidity are Congenitally corrected TGA with atrial switch and ASO (double switch), Arterial switch operation with VSD repair and Coarctation repair with patch aortoplasty; each has morbidity of 100%.
- In morbidity category 5 of grown-up children, Konno procedure and Ross-Konno procedure share the same morbidity of 100%.



**Table 6.1**  
**Frequency of procedure and morbidity risk in grown-up children (n=1,139 missing 2.6%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Pericardial procedure, other	1	1	100.0%	100.0%	100.0%	0.7
Thoracic and/or mediastinal procedure, other	4	2	50.0%	1.0%	99.0%	0.7
Sinus of Valsalva, aneurysm repair	3	1	33.3%	0.0%	86.7%	0.6
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	1	25.0%	0.0%	67.4%	0.8
Mediastinal procedure	4	1	25.0%	0.0%	67.4%	0.9
Valvuloplasty, mitral	19	4	21.1%	2.7%	39.4%	0.8
ASD repair, primary closure	68	9	13.2%	5.2%	21.3%	0.8
Pacemaker implantation, permanent	8	1	12.5%	0.0%	35.4%	0.3
PDA closure, NOS	9	1	11.1%	0.0%	31.6%	0.3
ASD repair, patch	117	9	7.7%	2.9%	12.5%	0.5
PFO, primary closure	14	0	0.0%	0.0%	0.0%	0.7
ASD partial closure	8	0	0.0%	0.0%	0.0%	0.8
PAPVC repair	8	0	0.0%	0.0%	0.0%	0.4
Pulmonary embolectomy	7	0	0.0%	0.0%	0.0%	0.4
Cardiac procedure, other	7	0	0.0%	0.0%	0.0%	0.5
Organ procurement	7	0	0.0%	0.0%	0.0%	0.2
Aortic stenosis, supraaortic, repair	5	0	0.0%	0.0%	0.0%	0.1
DCRV repair	4	0	0.0%	0.0%	0.0%	0.4
Pericardial drainage procedure	4	0	0.0%	0.0%	0.0%	0.6
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	0.8
Congenitally corrected TGA repair, VSD closure	3	0	0.0%	0.0%	0.0%	0.9
Coarctation repair, interposition graft	3	0	0.0%	0.0%	0.0%	0.8
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	0.3
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	0.7
Fontan, NOS	2	0	0.0%	0.0%	0.0%	0.8
Pulmonary AV fistula repair/occlusion	2	0	0.0%	0.0%	0.0%	0.6
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	0.3
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	0.8
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	0.2
PA debanding	1	0	0.0%	0.0%	0.0%	0.6
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	0.3
VATS (video-assisted thoracoscopic surgery)	1	0	0.0%	0.0%	0.0%	0.1
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	0.6



**Table 6.2**  
**Frequency of procedure and morbidity risk in grown-up children (n=1,139 missing 2.6%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valve replacement, aortic (AVR), bioprosthetic	1	1	100.0%	100.0%	100.0%	1.1
Mitral stenosis, supra-valvar mitral ring, repair	7	4	57.1%	20.5%	93.8%	1.2
TOF repair, NOS	2	1	50.0%	0.0%	100.0%	1.0
Coarctation repair, end to end, extended	2	1	50.0%	0.0%	100.0%	1.6
Valve replacement, pulmonic (PVR)	10	4	40.0%	9.6%	70.4%	1.4
Lung procedure, other	8	3	37.5%	4.0%	71.0%	1.5
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	26	9	34.6%	16.3%	52.9%	1.4
TOF repair, RV-PA conduit	3	1	33.3%	0.0%	86.7%	1.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	3	1	33.3%	0.0%	86.7%	1.2
Sternotomy wound drainage	3	1	33.3%	0.0%	86.7%	1.3
Aortic stenosis, subvalvar, repair	8	2	25.0%	0.0%	55.0%	0.9
Rastelli	8	2	25.0%	0.0%	55.0%	1.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	8	2	25.0%	0.0%	55.0%	1.4
Cardiotomy, other	4	1	25.0%	0.0%	67.4%	1.3
Valvuloplasty, pulmonic	9	2	22.2%	0.0%	49.4%	1.4
Valve replacement, mitral (MVR)	9	2	22.2%	0.0%	49.4%	1.5
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	5	1	20.0%	0.0%	55.1%	1.4
VSD repair, primary closure	121	22	18.2%	11.3%	25.1%	1.1
Unifocalization MAPCA(s)	11	2	18.2%	0.0%	41.0%	1.3
Esophageal procedure	23	4	17.4%	1.9%	32.9%	1.3
Valve replacement, aortic (AVR), mechanical	6	1	16.7%	0.0%	46.5%	1.1
TOF repair, non ventriculotomy	26	4	15.4%	1.5%	29.3%	1.5
AVC (AVSD) repair, partial (incomplete) (PAVSD)	7	1	14.3%	0.0%	40.2%	1.3
PDA closure, device	17	2	11.8%	0.0%	27.1%	1.1
VSD repair, patch	199	20	10.1%	5.9%	14.2%	1.0
PDA closure, surgical	51	5	9.8%	1.6%	18.0%	0.9
RVOT procedure	7	0	0.0%	0.0%	0.0%	1.5
Valvuloplasty, tricuspid	5	0	0.0%	0.0%	0.0%	1.2
Valve surgery, other pulmonic	5	0	0.0%	0.0%	0.0%	1.2
Occlusion MAPCA(s)	4	0	0.0%	0.0%	0.0%	1.5
Coarctation repair, end to end	4	0	0.0%	0.0%	0.0%	1.5
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	0.9



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Coronary artery bypass	3	0	0.0%	0.0%	0.0%	1.3
Coronary artery procedure, other	3	0	0.0%	0.0%	0.0%	1.0
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	1.0
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	0.9
Ventricular septal fenestration	2	0	0.0%	0.0%	0.0%	1.2
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	1.4
Valvuloplasty, aortic	2	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	1.0
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	1.0
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	1.3
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	1.1
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	1.2
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
PA, reconstruction (plasty), branch, central	1	0	0.0%	0.0%	0.0%	1.2
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	1.4
Mustard	1	0	0.0%	0.0%	0.0%	1.0
Pectus repair	1	0	0.0%	0.0	0.0%	1.0



**Table 6.3**  
**Frequency of procedure and morbidity risk in grown-up children (n=1,139 missing 2.6%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	3	3	100.0%	100.0%	100.0%	2.2
Fontan, TCPC, external conduit, NOS	1	1	100.0%	100.0%	100.0%	2.5
Conduit, placement, LV to PA	3	2	66.7%	13.3%	100.0%	2.2
Pericardectomy	4	2	50.0%	1.0%	99.0%	1.7
TOF, absent pulmonary valve, repair	2	1	50.0%	0.0%	100.0%	1.7
Valve replacement, aortic (AVR)	2	1	50.0%	0.0%	100.0%	2.3
Anomalous origin of coronary artery repair	2	1	50.0%	0.0%	100.0%	2.2
Shunt, systemic to pulmonary, other	2	1	50.0%	0.0%	100.0%	2.3
PA banding (PAB)	2	1	50.0%	0.0%	100.0%	2.1
Ligation, thoracic duct	5	2	40.0%	0.0%	82.9%	2.4
Fontan, TCPC, lateral tunnel, fenestrated	8	3	37.5%	4.0%	71.0%	1.9
Pulmonary atresia-VSD (including TOF, PA), repair	12	4	33.3%	6.7%	60.0%	1.6
Valve surgery, other, aortic	3	1	33.3%	0.0%	86.7%	1.9
TOF repair, ventriculotomy, nontransanular patch	14	4	28.6%	4.9%	52.2%	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	15	4	26.7%	4.3%	49.0%	1.7
TOF repair, ventriculotomy, transanular patch	43	11	25.6%	12.5%	38.6%	1.6
DORV repair, NOS	8	2	25.0%	0.0%	55.0%	1.8
Valve replacement, tricuspid (TVR)	4	1	25.0%	0.0%	67.4%	2.3
Truncus arteriosus repair	2	0	0.0%	0.0%	0.0%	2.2
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	1.9
Pulmonary Venous Stenosis, repair	1	0	0.0%	0.0%	0.0%	1.8
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	2.2
PA, reconstruction (plasty), main (trunk)	1	0	0.0%	0.0%	0.0%	1.9
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	2.0
Conduit, placement, RV to PA	1	0	0.0%	0.0%	0.0%	1.9
HLHS biventricular repair	1	0	0.0%	0.0%	0.0%	2.0
Fontan, other	1	0	0.0%	0.0%	0.0%	2.0



**Table 6.4**  
**Frequency of procedure and morbidity risk in grown-up children (n=1,139 missing 2.6%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	1	100.0%	100.0%	100.0%	4.0
Arterial switch operation (ASO) and VSD repair	1	1	100.0%	100.0%	100.0%	3.0
Coarctation repair, patch aortoplasty	1	1	100.0%	100.0%	100.0%	2.7
Fontan, TCPC, external conduit, nonfenestrated	4	3	75.0%	32.6%	100.0%	3.2
AVC(AVSD) repair, complete CAVSD	4	2	50.0%	1.0%	99.0%	2.6
Palliation, other	2	1	50.0%	0.0%	100.0%	2.6
DORV, intraventricular tunnel repair	9	4	44.4%	12.0%	76.9%	2.8
Hemifontan	4	1	25.0%	0.0%	67.4%	3.0
TAPVC repair	2	0	0.0%	0.0%	0.0%	2.6
Aortic arch repair	2	0	0.0%	0.0%	0.0%	3.1
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	2.6
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	2.6
Tracheal procedure	1	0	0.0%	0.0%	0.0%	2.9

**Table 6.5**  
**Frequency of procedure and morbidity risk in grown-up children (n=1,139 missing 2.6%)**  
**Morbidity category 5**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Konno procedure	1	1	100.0%	100.0%	100.0%	4.8
Ross-Konno procedure	1	1	100.0%	100.0%	100.0%	4.7
<b>Total (126 procedures)</b>	<b>1,139</b>	<b>190</b>	<b>16.7%</b>	<b>14.5%</b>	<b>18.8%</b>	



## Morbidity risk in adult

- In adult, there are 121 procedures in 2842 operations with 12% morbidity in all morbidity categories.
- Most of adult patients have morbidity category 2.
- In morbidity category 1 of adult, the highest morbidity is Fontan, NOS (100%).
- In adult with morbidity category 2, the highest morbidity are Unifocalization of MAPCAs (67%) and Cardiac tumour resection (67%).
- In adult with morbidity category 3, the highest morbidity are VSD repair with device (100%) and Bilateral bidirectional cavopulmonary anastomosis (100%).
- In adult with morbidity category 4, the highest morbidity is Aortic dissection repair (100%).
- There is no morbidity category 5 in adult.





**Table 7.1**  
**Frequency of procedure and morbidity risk in adult (n=2,842 missing 2.5%)**  
**Morbidity category 1**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Fontan, NOS	1	1	100.0%	100.0%	100.0%	0.8
Conduit, reoperation	4	1	25.0%	0.0%	67.4%	0.7
ASD repair, NOS	9	2	22.2%	0.0%	49.4%	0.7
PDA closure, NOS	9	2	22.2%	0.0%	49.4%	0.3
Valve surgery, other, mitral	6	1	16.7%	0.0%	46.5%	0.9
ASD repair, primary closure	405	59	14.6%	11.1%	18.0%	0.8
ASD partial closure	74	8	10.8%	3.7%	17.9%	0.8
Pericardial drainage procedure	37	4	10.8%	0.8%	20.8%	0.6
PFO, primary closure	30	3	10.0%	0.0%	20.7%	0.7
Coarctation repair, interposition graft	11	1	9.1%	0.0%	26.1%	0.8
ASD repair, patch	971	79	8.1%	6.4%	9.9%	0.5
Sinus of Valsalva, aneurysm repair	26	2	7.7%	0.0%	17.9%	0.6
Coronary artery fistula ligation	14	1	7.1%	0.0%	20.6%	0.3
Valvuloplasty, mitral	29	2	6.9%	0.0%	16.1%	0.8
PAPVC repair	17	1	5.9%	0.0%	17.1%	0.4
VATS (video-assisted thoracoscopic surgery)	7	0	0.0%	0.0%	0.0%	0.1
VSD repair, NOS	5	0	0.0%	0.0%	0.0%	0.3
Organ procurement	5	0	0.0%	0.0%	0.0%	0.2
PA, reconstruction (plasty), NOS	4	0	0.0%	0.0%	0.0%	0.8
DCRV repair	4	0	0.0%	0.0%	0.0%	0.4
Congenitally corrected TGA repair, VSD closure	4	0	0.0%	0.0%	0.0%	0.9
Pacemaker implantation, permanent	3	0	0.0%	0.0%	0.0%	0.3
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	2	0	0.0%	0.0%	0.0%	0.8
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	0.9
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	0.5
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	0.3
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
Aortic root replacement, mechanical	1	0	0.0%	0.0%	0.0%	0.5
Other annular enlargement procedure	1	0	0.0%	0.0%	0.0%	0.6
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	0.3
Pericardial procedure, other	1	0	0.0%	0.0%	0.0%	0.7
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	0.8
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Thoracic and/or mediastinal procedure, other	1	0	0.0%	0.0%	0.0%	0.7
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	0.6



**Table 7.2**  
**Frequency of procedure and morbidity risk in adult (n=2,842 missing 2.5%)**  
**Morbidity category 2**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Unifocalization MAPCA(s)	3	2	66.7%	13.3%	100.0%	1.3
Cardiac tumor resection	3	2	66.7%	13.3%	100.0%	1.0
Cardiotomy, other	5	3	60.0%	17.1%	100.0%	1.3
Ventricular septal fenestration	12	5	41.7%	13.8%	69.6%	1.2
TOF repair, RV-PA conduit	6	2	33.3%	0.0%	71.1%	1.5
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	1	33.3%	0.0%	86.7%	1.4
AVC (AVSD) repair, partial (incomplete) (PAVSD)	10	3	30.0%	1.6%	58.4%	1.3
Rastelli	7	2	28.6%	0.0%	62.0%	1.6
Valve replacement, mitral (MVR)	11	3	27.3%	1.0%	53.6%	1.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	4	1	25.0%	0.0%	67.4%	1.4
TOF repair, non ventriculotomy	16	3	18.8%	0.0%	37.9%	1.5
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	17	3	17.6%	0.0%	35.8%	1.4
Valvuloplasty, tricuspid	62	9	14.5%	5.7%	23.3%	1.2
VSD repair, primary closure	123	16	13.0%	7.1%	19.0%	1.1
Valvuloplasty, pulmonic	25	3	12.0%	0.0%	24.7%	1.4
PDA closure, surgical	145	16	11.0%	5.9%	16.1%	0.9
VSD repair, patch	277	30	10.8%	7.2%	14.5%	1.0
TOF repair, NOS	19	2	10.5%	0.0%	24.3%	1.0
Valve surgery, other, tricuspid	19	2	10.5%	0.0%	24.3%	1.2
Valve replacement, pulmonic (PVR)	23	2	8.7%	0.0%	20.2%	1.4
ASD creation/enlargement	13	1	7.7%	0.0%	22.2%	1.0
RVOT procedure	13	1	7.7%	0.0%	22.2%	1.5
Mitral stenosis, supra-valvar mitral ring, repair	13	1	7.7%	0.0%	22.2%	1.2
PDA closure, device	27	2	7.4%	0.0%	17.3%	1.1
VSD, multiple, repair	7	0	0.0%	0.0%	0.0%	0.9
Valvuloplasty, aortic	5	0	0.0%	0.0%	0.0%	1.0
Valve replacement, aortic (AVR), mechanical	5	0	0.0%	0.0%	0.0%	1.1
Valve surgery, other pulmonic	4	0	0.0%	0.0%	0.0%	1.2
Valve replacement, aortic (AVR), bioprosthetic	4	0	0.0%	0.0%	0.0%	1.1
Fontan, atrio-pulmonary connection	4	0	0.0%	0.0%	0.0%	1.0
TOF, AVC (AVSD), repair	2	0	0.0%	0.0%	0.0%	1.1
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	1.4
Aortic stenosis, subvalvar, repair	2	0	0.0%	0.0%	0.0%	0.9



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Coarctation repair, end to end	2	0	0.0%	0.0%	0.0%	1.5
Coronary artery bypass	2	0	0.0%	0.0%	0.0%	1.3
Lung procedure, other	2	0	0.0%	0.0%	0.0%	1.5
Shunt, ligation and takedown	2	0	0.0%	0.0%	0.0%	1.4
Esophageal procedure	2	0	0.0%	0.0%	0.0%	1.3
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	1.3
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	1.0
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	1.3
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	1.0
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	0	0.0%	0.0%	0.0%	1.2
Atrial baffle procedure, NOS	1	0	0.0%	0.0%	0.0%	1.1



**Table 7.3**  
**Frequency of procedure and morbidity risk in adult (n=2,842 missing 2.5%)**  
**Morbidity category 3**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD, repair, device	1	1	100.0%	100.0%	100.0%	1.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	1	1	100.0%	100.0%	100.0%	2.2
DORV repair, NOS	8	4	50.0%	15.4%	84.6%	1.8
Conduit, placement, RV to PA	5	2	40.0%	0.0%	82.9%	1.9
Valve replacement, tricuspid (TVR)	8	3	37.5%	4.0%	71.0%	2.3
Cor triatriatum repair	3	1	33.3%	0.0%	86.7%	1.9
TOF, absent pulmonary valve, repair	3	1	33.3%	0.0%	86.7%	1.7
Valve excision, pulmonary (without replacement)	3	1	33.3%	0.0%	86.7%	2.0
Fontan, TCPC, external conduit, NOS	3	1	33.3%	0.0%	86.7%	2.5
PA banding (PAB)	3	1	33.3%	0.0%	86.7%	2.1
Pericardectomy	21	6	28.6%	9.2%	47.9%	1.7
Atrial septal fenestration	4	1	25.0%	0.0%	67.4%	2.0
Anomalous systemic venous connection repair	4	1	25.0%	0.0%	67.4%	2.2
Pulmonary Venous Stenosis, repair	13	3	23.1%	0.2%	46.0%	1.8
TOF repair, ventriculotomy, nontransanular patch	19	4	21.1%	2.7%	39.4%	1.6
ASD, repair, device	5	1	20.0%	0.0%	55.1%	1.8
TOF repair, ventriculotomy, transanular patch	71	11	15.5%	7.1%	23.9%	1.6
Pulmonary atresia-VSD (including TOF, PA), repair	10	1	10.0%	0.0%	28.6%	1.6
Fontan, TCPC, lateral tunnel, fenestrated	4	0	0.0%	0.0%	0.0%	1.9
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3	0	0.0%	0.0%	0.0%	1.7
Valve replacement, aortic (AVR)	2	0	0.0%	0.0%	0.0%	2.3
Fontan, other	2	0	0.0%	0.0%	0.0%	2.0
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	2.3
AP window repair	1	0	0.0%	0.0%	0.0%	1.9
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	2.2
Valve surgery, other, aortic	1	0	0.0%	0.0%	0.0%	1.9
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	2.3
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	2.2



**Table 7.4**  
**Frequency of procedure and morbidity risk in adult (n=2,842 missing 2.5%)**  
**Morbidity category 4**

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Aortic dissection repair	1	1	100.0%	100.0%	100.0%	3.4
Arrhythmia surgery-atrial, surgical ablation	4	3	75.0%	32.6%	100.0%	3.8
Valve excision, tricuspid (without replacement)	3	2	66.7%	13.3%	100.0%	3.4
Ligation, pulmonary artery	2	1	50.0%	0.0%	100.0%	2.6
DORV, intraventricular tunnel repair	9	4	44.4%	12.0%	76.9%	2.8
AVC(AVSD) repair, complete CAVSD	3	1	33.3%	0.0%	86.7%	2.6
Palliation, other	3	1	33.3%	0.0%	86.7%	2.6
Fontan, TCPC, external conduit, nonfenestrated	7	2	28.6%	0.0%	62.0%	3.2
TAPVC repair	3	0	0.0%	0.0%	0.0%	2.6
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	2.6
Arterial switch operation (ASO)	1	0	0.0%	0.0%	0.0%	2.6
Aortic arch repair	1	0	0.0%	0.0%	0.0%	3.1
<b>Total (121 procedures)</b>	<b>2,842</b>	<b>341</b>	<b>12.0%</b>	<b>10.8%</b>	<b>13.2%</b>	





# Chapter 7



## Estimation of in-hospital mortality by risk of mortality category

- The higher is the mortality category, the higher is the in-hospital mortality.
- Only in category 1-3, the bigger hospitals has significantly lower in-hospital mortality rate than the smaller hospitals though this is not clearly evident in category 4.
- The funnel plot of each mortality category is shown for all hospitals as expressed by hospital code A to Z with number of operation and in-hospital mortality. The average base-line mortality is shown, it should be advised that the hospital with confidence interval above 95% should be advised to improve their performance and the one with confidence interval above 99% interval should be advised to stop operation until it is proved that the particular hospital can perform operation with better outcome.

## Monitoring of performance for outcome

- Efficiency of performance of any hospitals can be estimated by funnel plot for in-hospital mortality by using STS-EACTS mortality category as adjusted risk.
- Not only individual hospital can be reviewed for performance but also individual surgeon can be reviewed.
- Funnel plot is used as a key performance indicator for improvement of outcome.

In-hospital mortality by mortality category (n=12482)

Mortality category	Number of procedure	Number of patients	Number of death	Mortality rate	95% CI	
1	56	7,726	128	1.7%	1.4%	1.9%
2	54	3,013	217	7.2%	6.3%	8.1%
3	29	1,061	164	15.5%	13.3%	17.6%
4	27	617	159	25.8%	22.3%	29.2%
5	9	65	44	67.7%	56.3%	79.1%
Total	175	12,482	712	5.7%	5.3%	6.1%
Missing	617 cases (4.7%)					





In-hospital mortality of hospital with  $\leq 100$  cases by mortality category (n=247)

Mortality category	Number of procedure	Number of patients	Number of death	Mortality rate	95% CI	
1	14	189	5	2.6%	0.4%	4.9%
2	11	41	3	7.3%	0.0%	15.3%
3	7	15	0	0.0%	-	-
4	2	2	1	50.0%	-	-
5	-	-	-	-	-	-
Total	34	247	9	3.6%	1.3%	6.0%
Missing	8 cases (3.1%)					

In-hospital mortality of hospital size with  $> 100-500$  cases by mortality category (n=1400)

Mortality category	Number of procedure	Number of patients	Number of death	Mortality rate	95% CI	
1	25	1138	12	1.1%	0.5%	1.6%
2	25	179	22	12.3%	7.5%	17.1%
3	10	62	13	21.0%	10.8%	31.1%
4	12	18	4	22.2%	3.0%	41.4%
5	1	3	3	100.0%	-	-
Total	73	1400	54	3.9%	2.8%	4.9%
Missing	44 cases (3.0%)					

In-hospital mortality of hospital with  $>500$  cases by mortality category (n=10,835)

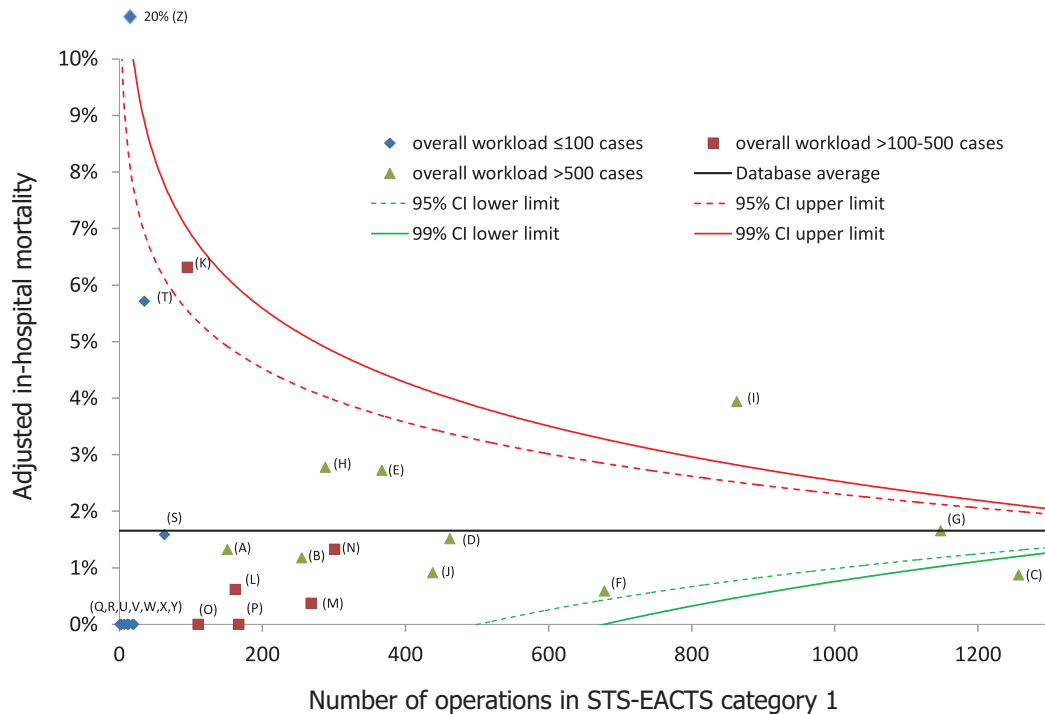
Mortality category	Number of procedure	Number of patients	Number of death	Mortality rate	95% CI	
1	56	6399	111	1.7%	1.4%	2.1%
2	53	2793	192	6.9%	5.9%	7.8%
3	29	984	151	15.3%	13.1%	17.6%
4	27	597	154	25.8%	22.3%	29.3%
5	9	62	41	66.1%	54.3%	77.9%
Total	174	10835	649	6.0%	5.5%	6.4%
Missing	99 cases (0.9%)					



### Funnel plot measuring performance of hospitals by mortality category for in-hospital mortality

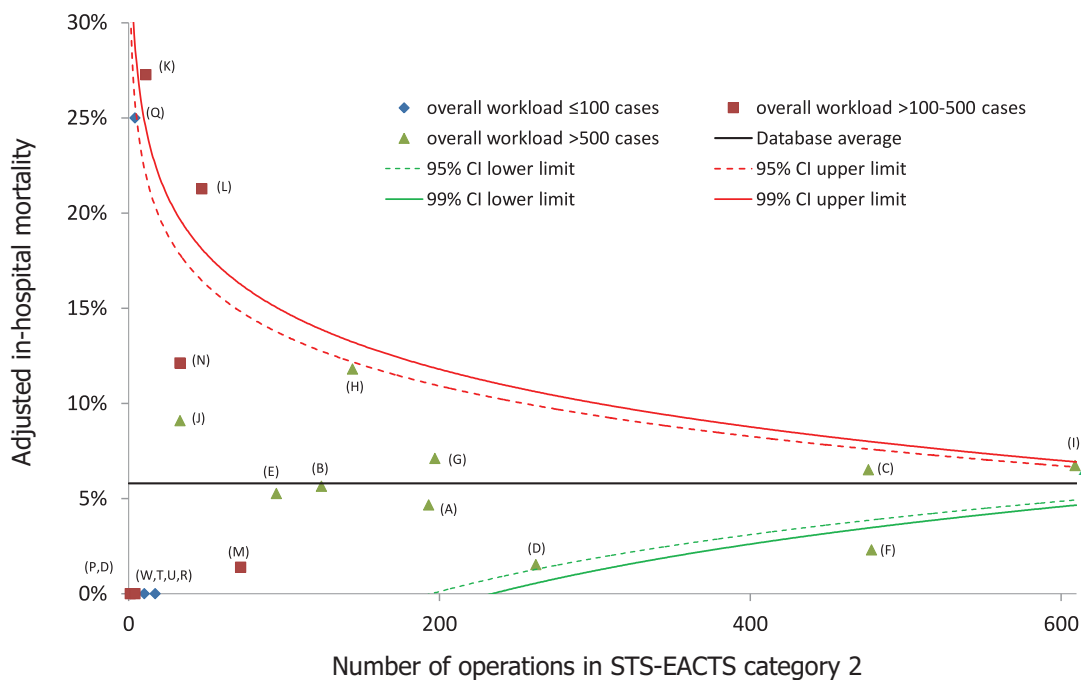
- In mortality category 1, Hospital Z and I must be notified to stop surgery until they have proof that their surgery is safe; Hospital K should be advised to improve its performance.
- In mortality category 2, Hospital K and L must be warned to stop surgery until they have proof that their surgery is safe; Hospital Q, H and I should be advised to improve their performance.
- In mortality category 3, Hospital L must be warned to stop surgery until they have proof that their surgery is safe; Hospital N should be advised to improve its performance.
- In mortality category 4, Hospital E, I and Q must be advised to stop surgery until they have proof that their surgery is safe; Hospital C should be advised to improve its performance.
- In mortality category 5, Hospital B and D must be notified to stop surgery until they have proof that their surgery is safe; Hospital M, L and C should be advised to improve their performance.

Funnel plot of adjusted in-hospital mortality risk of STS-EACTS category 1

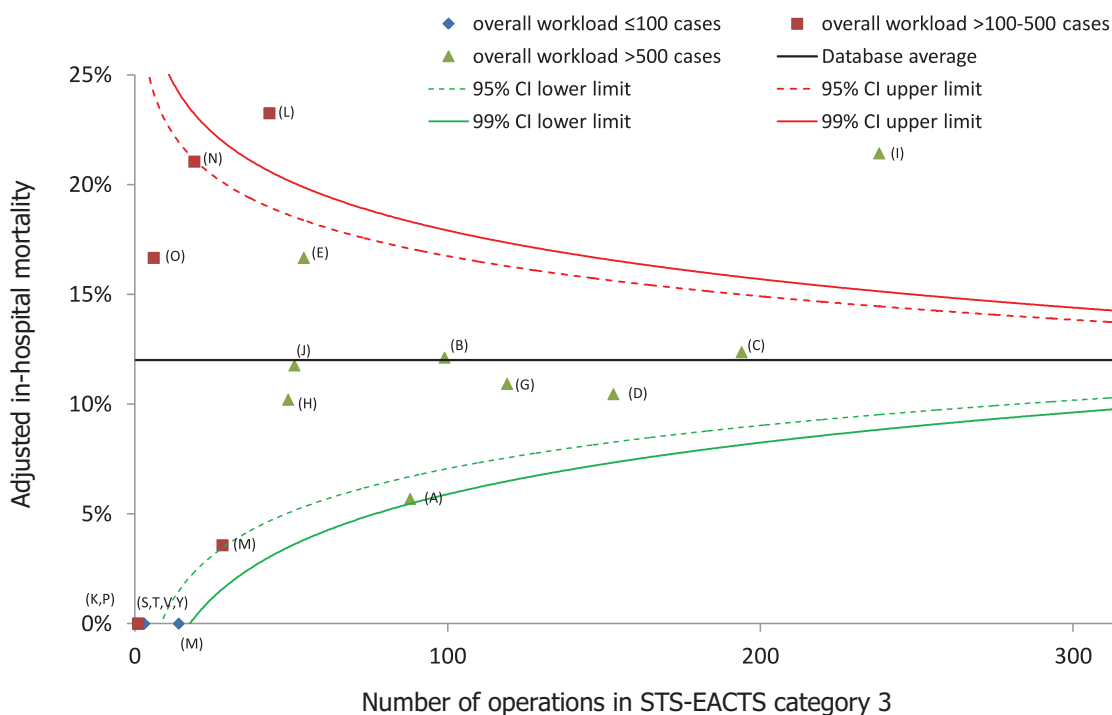




Funnel plot of adjusted in-hospital mortality risk of STS-EACTS category 2

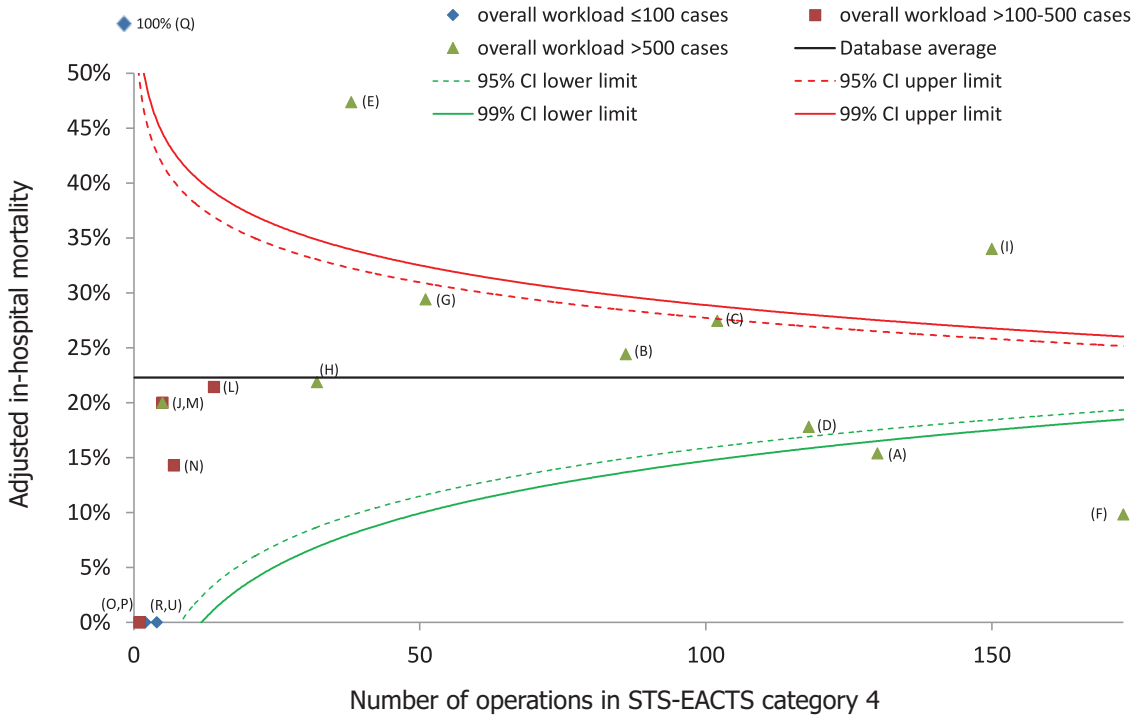


Funnel plot of adjusted in-hospital mortality risk of STS-EACTS category 3

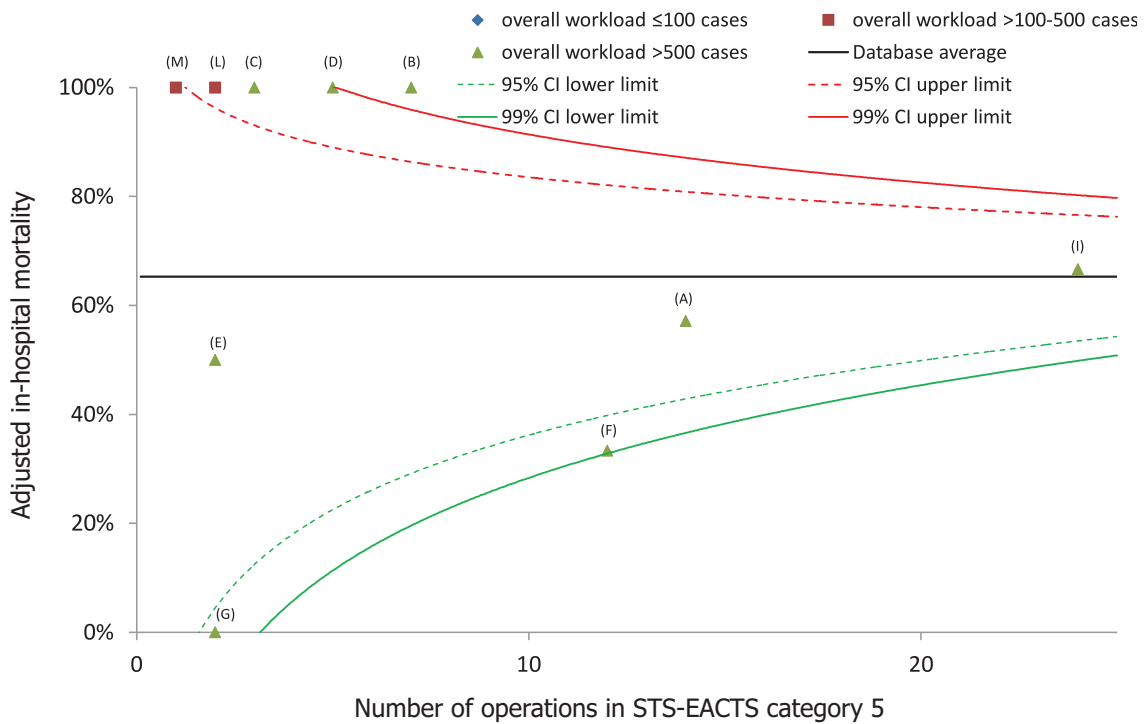




Funnel plot of adjusted in-hospital mortality risk of STS-EACTS category 4



Funnel plot of adjusted in-hospital mortality risk of STS-EACTS category 5



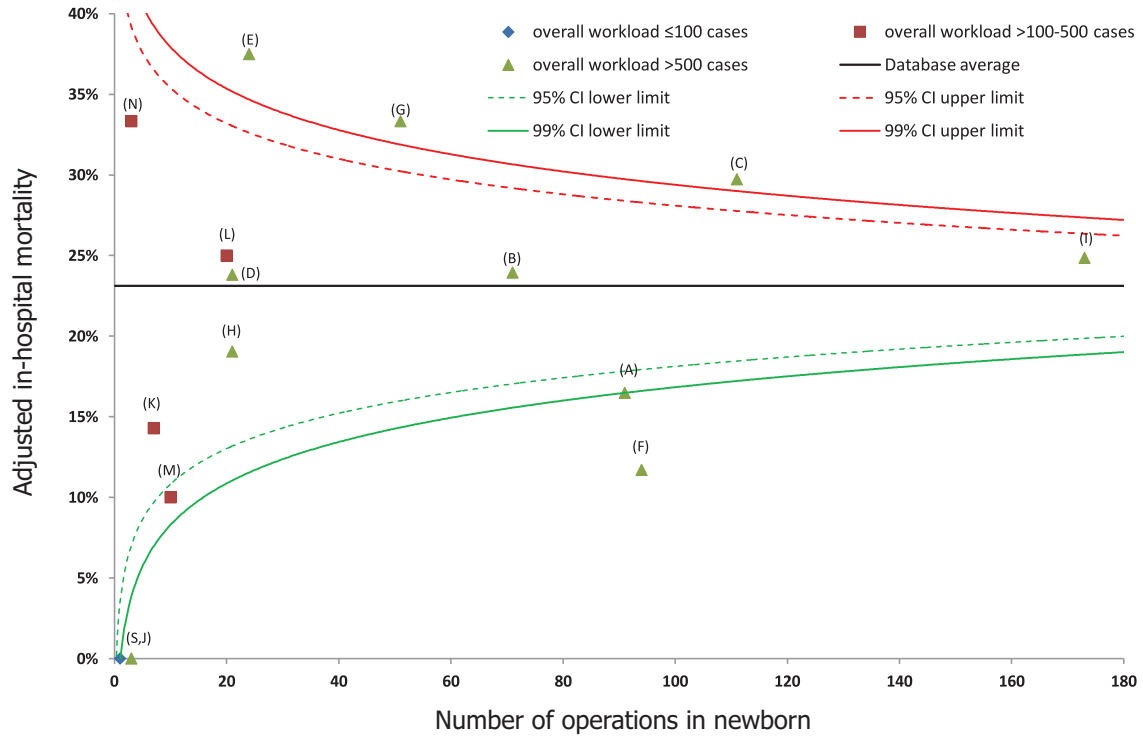


### **Funnel plot showing performance of hospitals by age risk and in-hospital mortality**

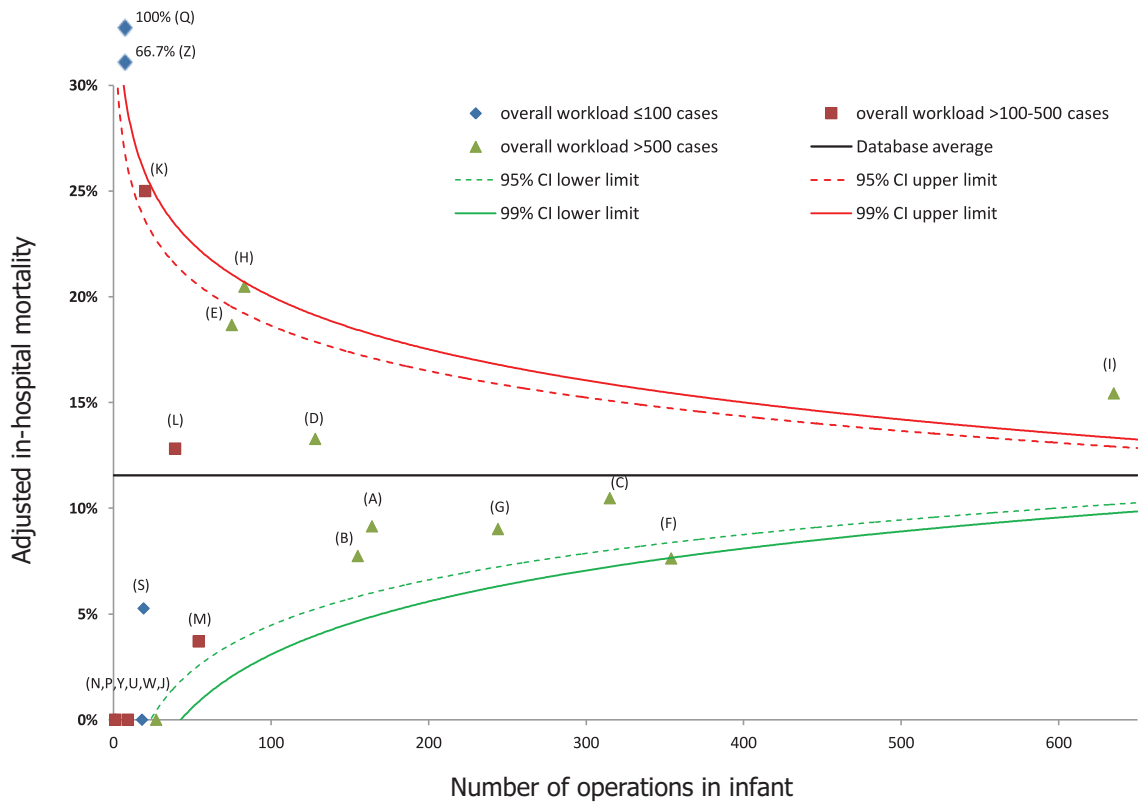
- In newborn, Hospital E, G and C must be notified to stop surgery because of high mortality until they have proof that their surgery is safe.
- In infant, Hospital Q, Z, K, H and I must be notified to stop surgery because of high mortality until they have proof that their surgery is safe; Hospital E should be advised to improve performance.
- In small children, Hospital L, T, I and O must be notified to stop surgery until they have proof that their surgery is safe.
- In school aged children, Hospital L must be notified to stop surgery until it has proof that their surgery is safe.
- In grown-up children, Hospital K, D and I must be notified to stop surgery until they have proof that their surgery is safe.
- In adult, Hospital B must be notified to stop surgery until it has proof that their surgery is safe.



Funnel plot of adjusted in-hospital mortality risk of newborn

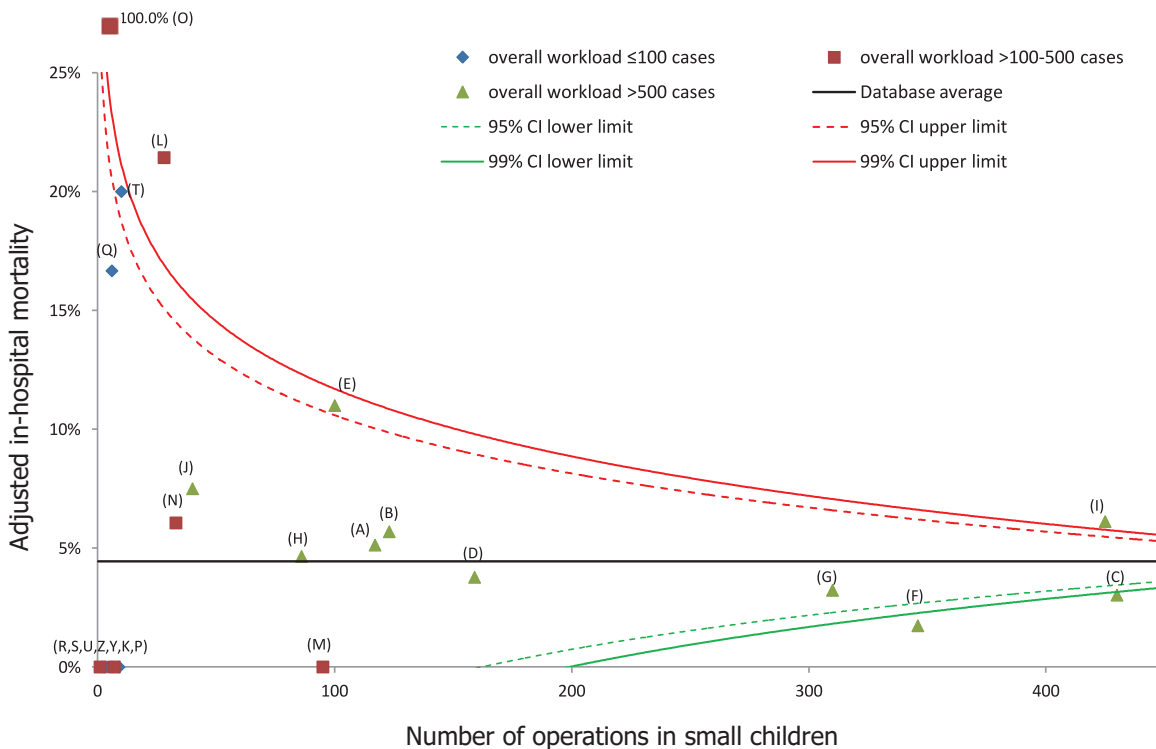


Funnel plot of adjusted in-hospital mortality risk of infant

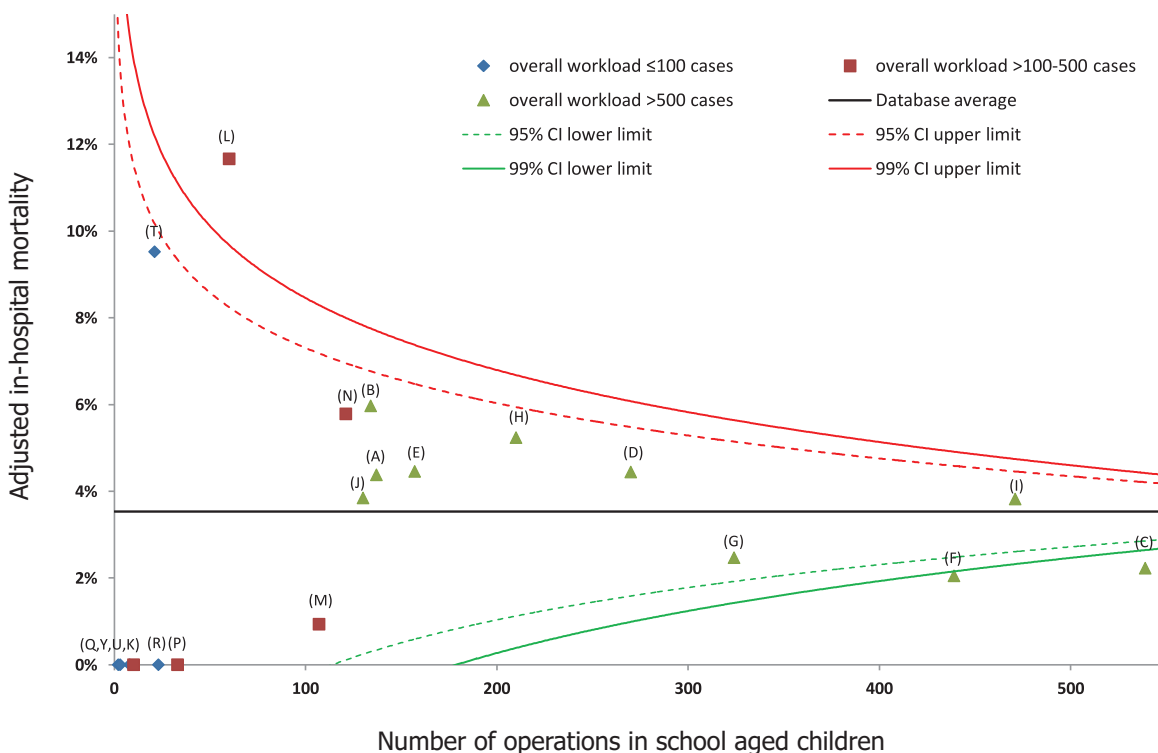




Funnel plot of adjusted in-hospital mortality risk of small children

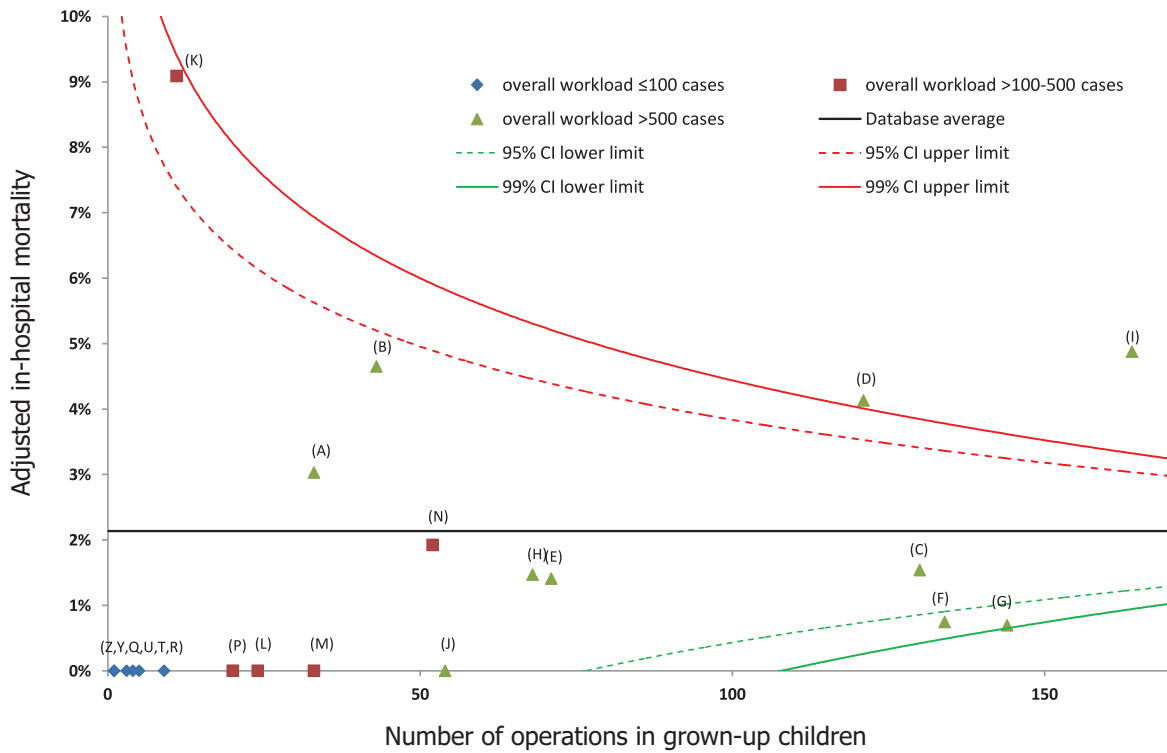


Funnel plot of adjusted in-hospital mortality risk of school aged children

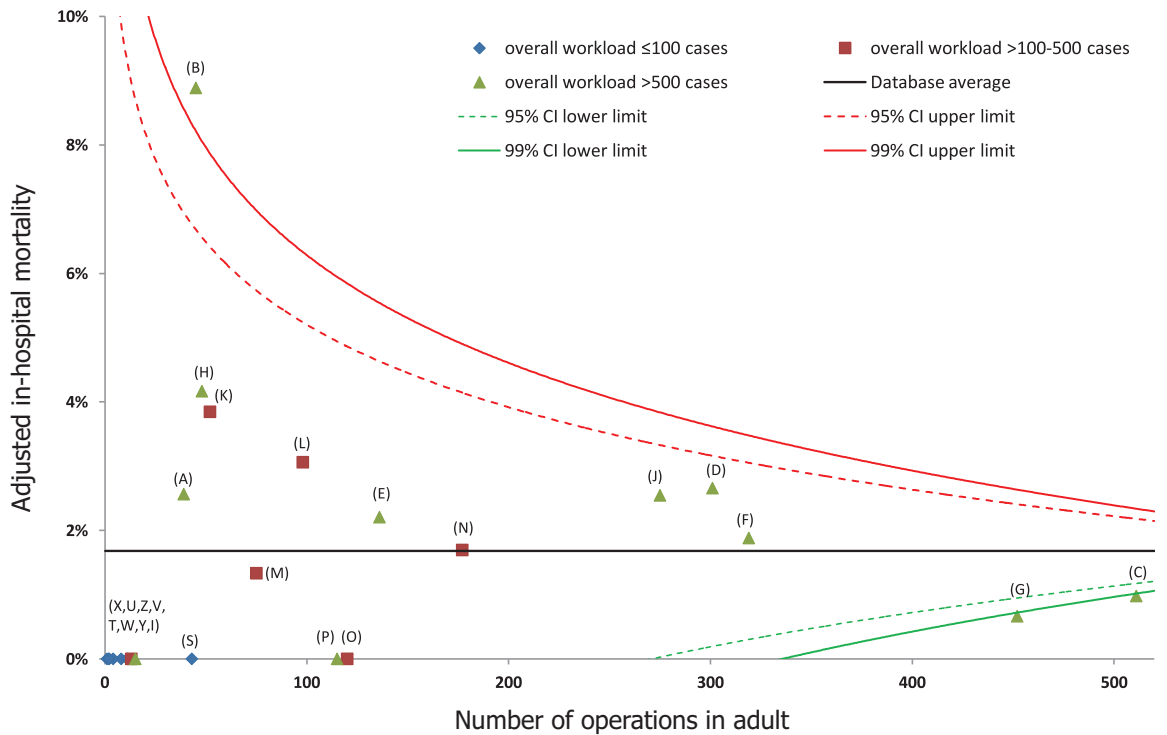




Funnel plot of adjusted in-hospital mortality risk of grown-up children



Funnel plot of adjusted in-hospital mortality risk of adult







# Chapter 8



## Adult congenital heart surgery

### Performance and outcomes of adult congenital heart surgery

In our database registry for congenital heart disease, there are 2873 numbers of congenital heart surgery in patients older than 15 years of age (regarded as adult) in between 2006 to 2011; unlike the report of adult age in the western countries which define the adult as age  $\geq 18$  years but in Thailand any person older than 15 years of age is adult and that person cannot be admitted in hospital children ward. In Thailand all congenital heart operations are performed by adult cardiac surgeons who can perform both adult and congenital heart surgery in 25 hospitals rather than by paediatric cardiac surgeons. The numbers of registry of congenital heart surgery exclude 165 patients with ASD and few others which have been registered in adult cardiac surgery. The congenital heart surgery in adult comprises of 22% of all congenital heart surgery of 13081 during the same period.

The patient characteristics, preoperative risks and outcome are illustrated in Table 1, the median age is 34 years (interquartile range 23-46) and 34 % are male gender. Most of the operation (78%) are performed isolated and without previous operation (96%). Regarding preoperative risk, the pulmonary hypertensive crisis and arrhythmia are 3% and 2% successively. Preoperative pulmonary hypertensive crisis is seen in RVOT procedure (8%), PAPVC repair (6%), modified Blalock-Taussig shunt (6%), ASD repair (4%), VSD repair (5%), pulmonic valve replacement (4%), and PDA closure (3%).

Preoperative arrhythmia is present most in pericardial drainage (16%) followed by pulmonic valve replacement (13%), modified Blalock-Taussig shunt (6%), VSD repair (5%), tricuspid valvuloplasty (5%) and pulmonic valvuloplasty (3%)

Overall, 83% of operations are STS-EACTS mortality category 1 and 13% are mortality category 2. The median CPB time is 46 minutes (interquartile range 30-75). The most common 5 operations are ASD repair (52%), VSD repair (15%), PDA closure (6%), TOF repair (5%) and tricuspid valvuloplasty (2%).

Overall in-hospital mortality rate is 1.6%; mitral valve replacement has the highest mortality of 18%. The mortality rate of TOF repair is 6%. The median postoperative length of stay is 6 days (interquartile range 4-8).

Overall postoperative arrhythmia is 4%; postoperative arrhythmia is most often in ventricular septal fenestration (17%), pulmonary venous stenosis repair (15%), AVSD repair (10%) and pulmonary valvuloplasty (8%). Postoperative low cardiac output is 9% after mitral valve replacement, 8% after ventricular septal fenestration and 8% after pulmonary venous stenosis repair. Postoperative acidosis is 8% after ventricular septal fenestration, 8% after pulmonary venous stenosis repair and 8% after repair of supra-mitral valve stenosis.

Though overall reoperation is less than 1%, reoperation for modified Blalock-Taussig shunt is 12%, reoperation for mitral valve replacement is 9% and reoperation for bleeding is frequent in Rastelli and RVOT procedure.

It is interesting to notes the detail study of the 3 most common open heart operation in adult namely ASD repair, VSD repair and TOF repair.

The number of ASD repair represents 52% of adult congenital heart surgery. The age at repair is 39 years of age (IQR 28-49); 25% are male, cardiac abnormality is present at 2%; 95% of operations are isolated and 99% of patients have no previous heart operation. Preoperative arrhythmia presents in 2% and pulmonary hypertensive crisis in 4%. The in-hospital mortality rate is less than 1% yet the postoperative complication with arrhythmia is present at 4% and other 2% having low cardiac output. Postoperative pulmonary hypertension is less than 1%.

The number of VSD repair represents 15% of adult congenital heart surgery. The age at repair is 25 years of age (IQR 19-35); 53% are male, cardiac abnormality is present at 2%, 60% of operations are isolated and 95% of patients have no previous operation. Preoperative arrhythmia presents in 5% and pulmonary hypertensive crisis



in 5%. The in-hospital mortality rate is 1% yet the postoperative complication with arrhythmia is present at 2% and also 2% with low cardiac output. Reoperation during this admission is 1% and less than 1% is for postoperative bleeding. Postoperative pulmonary hypertension is 15%.

The number of TOF repair represents 5% of adult congenital heart surgery. The age at repair is 26 years of age (IQR 20-34); 46% are male, cardiac abnormality is present at 4%, 72% of operations are isolated and 95% of patients have no previous operation. Regarding preoperative risk, each category of arrhythmia, renal impairment with creatinine > 2 mg and seizure, shares the incidence of 1%. The in-hospital mortality rate is 6% and postoperative length of stay is 7 days (IQR 6-11); the postoperative arrhythmia is present at 4% and low cardiac output at 2%. Reoperation during this admission is 4% and 1% is for bleeding. Furthermore respiratory insufficiency requiring mechanical ventilatory support > 7 days, cardiac arrest and pneumonia, each category has incidence of postoperative complication of 4%. The need for mechanical circulatory support such as IABP or ECMO or VAD is 1% sharing the same incidence of acute renal failure requiring dialysis.

PDA with surgical closure is 6% of adult congenital heart surgery. The age of repair is 29 years of age (IQR 23-40); 25% are male, cardiac abnormality is present at 2%, 89% are isolated operation and all patients have no previous operation. Regarding preoperative risk, arrhythmia is 2% and pulmonary hypertensive crisis 3%. All are performed without CPB. There is no operative mortality and the postoperative length of stay is 5 days. 3% have postoperative arrhythmia and 3% have pneumothorax.

#### Comment

The population of congenital heart surgery in adult has the median age at fourth decade of life; more than 95% never have previous heart operation, signifying that most of the patients having congenital heart surgery in adult are not related to surgery performed earlier year in life. Congenital heart surgery in adult is performed in Thailand mostly by adult cardiac surgeons. There are not many complex congenital heart operations in adult which could be attributed by complexity lesions which die earlier either with or without surgery. Even those with complex lesion without operation cannot live up to the fourth decade. In western countries adult congenital surgery is performed younger either in the third and fourth decade [J Thorac Cardiovasc Surg 2011; 142: 1090-7].

Our patients operated in the late second and third decade of life could have untoward preoperative risks because surgery is not performed earlier in childhood; therefore some congenital lesions with risks related to particular lesion remain. Example is seen in the group of patients with VSD repair having the median age of 25 years. This group has preoperative arrhythmia of 5% and pulmonary hypertensive crisis of 5% present before surgery; these may be risk related to unoperated VSD. The preoperative risks possibly lead to development of postoperative arrhythmia of 2%, of 2% with low cardiac output and 1% of pulmonary hypertension. In spite of preoperative risk and postoperative complication, the in-hospital mortality is 1%.

The other examples are seen in ASD repair and TOF repair. In ASD repair, the median age of repair is 39 years having the preoperative arrhythmia of 2%, pulmonary hypertensive crisis of 4%. Though the in-hospital mortality is less than 1% yet the postoperative complication with arrhythmia is 4% and 2% with low cardiac output.

TOF repair represent 5% of congenital heart disease in adult. The median age of repair is in the third decade (26 years); the in-hospital mortality rate is higher in adult (6%) than children of school age (3%).

Limitation of database registry is that no type of arrhythmia is declared and quality of life after surgery is not known even at late follow-up.



**Table 1** Adult patient operative characteristics

Patient characteristics	Overall		ASD, repair		VSD repair	
	n=2,873		n=1,502		n=416	
	n	%	n	%	n	%
Age*	33.8	(23-46)	38.7	(28-49)	25.2	(19-35)
Gender (male)	986	34.3%	371	24.7%	220	52.9%
Weight*	50	(44-58)	50	(44-58)	52	(45-59)
Cardiac abnormality	50	1.7%	20	1.3%	8	1.9%
Isolated procedure	2,253	78.4%	1407	94.2%	249	59.9%
No previous heart operation	2,746	95.6%	1486	98.9%	395	95.0%
<b>Pre-operative risks</b>						
Arrhythmia	69	2.4%	31	2.1%	22	5.3%
Pulmonary hypertensive crisis	99	3.4%	59	3.9%	19	4.6%
Shock	14	0.5%	4	0.3%	1	0.2%
Acidosis	12	0.4%	1	0.1%	1	0.2%
Renal failure, Creatinine > 2	10	0.3%	3	0.2%	1	0.2%
Septicemia	7	0.2%	3	0.2%	0	0.0%
Neurological deficit	6	0.2%	2	0.1%	1	0.2%
Seizure	6	0.2%	1	0.1%	1	0.2%
Other preoperative risks	85	3.0%	32	2.1%	9	2.2%
<b>Operative risks</b>						
STS-EACTS category 1	2375	82.7%	1502	100.0%	416	100.0%
STS-EACTS category 2	360	12.5%				
STS-EACTS category 3	98	3.4%				
STS-EACTS category 4	40	1.4%				
CPB time*	46	(30-75)	40	(30-53)	67	(46-93)
<b>Patient outcome</b>						
In-hospital mortality	45	1.6%	8	0.5%	5	1.2%
Postoperative length of stay*	6	(4-8)	6	(5-8)	6	(5-8)
<b>Postoperative complications</b>						
Arrhythmia	101	3.5%	53	3.5%	9	2.2%
Low cardiac output	49	1.7%	23	1.5%	8	1.9%
Acidosis	38	1.3%	18	1.2%	3	0.7%
Pneumothorax	29	1.0%	13	0.9%	2	0.5%
Reoperation during this admission	27	0.9%	3	0.2%	5	1.2%
Pulmonary hypertension	25	0.9%	11	0.7%	6	1.4%
Bleeding requiring reoperation	25	0.9%	5	0.3%	3	0.7%
Respiratory insufficiency requiring mechanical ventilator > 7 days	24	0.8%	5	0.3%	3	0.7%
Cardiac arrest	20	0.7%	6	0.4%	1	0.2%
Pneumonia	20	0.7%	10	0.7%	0	0.0%
Mechanical circulatory support (IABP,VAD,ECMO)	17	0.6%	5	0.3%	3	0.7%
Acute renal failure requiring temporary dialysis	13	0.5%	2	0.1%	2	0.5%
Respiratory insufficiency requiring reintubation	13	0.5%	1	0.1%	1	0.2%

\* = Median (Interquartile range)



PDA closure		TOF repair		Valvuloplasty-tircuspid		Pericardial drainage procedure		Valvuloplasty-mitral		Sinus of valsalva, aneurysm repair	
n=181		n=139		n=64		n=37		n=29		n=28	
n	%	n	%	n	%	n	%	n	%	n	%
29.4	(23-40)	26.4	(20-34)	48	(27-50)	52.5	(43-65)	40.8	(29-50)	33.0	(28-40)
46	25.4%	64	46.0%	17	26.6%	21	56.8%	11	37.9%	13	46.4%
49	(42-55)	47	(40-55)	50	(45-57)	51	(44-59)	47	(41-56)	53	(46-64)
4	2.2%	5	3.6%	1	1.6%	0	0.0%	0	0.0%	0	0.0%
161	89.0%	100	71.9%	4	6.3%	37	100.0%	4	13.8%	20	71.4%
181	100.0%	132	95.0%	62	96.9%	36	97.3%	29	100.0%	28	100.0%
3	1.7%	2	1.4%	3	4.7%	6	16.2%	1	3.4%	0	0.0%
6	3.3%	1	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1	0.6%	2	1.4%	0	0.0%	0	0.0%	0	0.0%	1	3.6%
1	0.6%	1	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	2	1.4%	0	0.0%	1	2.7%	0	0.0%	1	3.6%
0	0.0%	1	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0	2	1.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
5	2.8%	2	1.4%	3	4.7%	18	48.6%	0	0.0%	1	3.6%
181	100.0%	1	0.7%	51	79.7%	0	0.0%	25	86.2%	28	100.0%
		138	99.3%	0	0.0%	37	100.0%	4	13.8%		
				13	20.3%						
0	(0-33)	108	(79-144)	68	(46-98)	0		82	(58-98)	83.5	(58-110)
0	0.0%	8	5.8%	1	1.6%	3	8.1%	0	0.0%	0	0.0%
5	(3-7)	7	(6-11)	5	(4-8)	5	(3-8)	7	(5-9)	5.5	(4-9)
5	2.8%	6	4.3%	3	4.7%	1	2.7%	1	3.4%	1	3.6%
0	0.0%	3	2.2%	1	1.6%	1	2.7%	1	3.4%	0	0.0%
1	0.6%	5	3.6%	1	1.6%	0	0.0%	0	0.0%	0	0.0%
6	3.3%	2	1.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	6	4.3%	1	1.6%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	0.7%	1	1.6%	0	0.0%	0	0.0%	1	3.6%
0	0.0%	2	1.4%	2	3.1%	0	0.0%	0	0.0%	0	0.0%
1	0.6%	5	3.6%	2	3.1%	1	2.7%	0	0.0%	0	0.0%
0	0.0%	5	3.6%	1	1.6%	1	2.7%	0	0.0%	0	0.0%
0	0.0%	5	3.6%	2	3.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	2	1.4%	1	1.6%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	2	1.4%	1	1.6%	0	0.0%	0	0.0%	0	0.0%
1	0.6%	1	0.7%	1	1.6%	0	0.0%	0	0.0%	0	0.0%



Patient characteristics	Valvuloplasty-pulmonic		Valve replacement, pulmonic (PVR)		Pericadectomy	
	n=25		n=24		n=21	
	n	%	n	%	n	%
Age*	28.4	(23-43)	31.8	(21-41)	56	(46-62)
Gender (male)	9	36.0%	9	37.5%	18	85.7%
Weight*	51	(45-55)	49	(43-65)	60	(56-63)
Cardiac abnormality	1	1.7%	0	0.0%	0	0.0%
Isolated procedure	6	10.3%	17	70.8%	20	95.2%
No previous heart operation	24	41.4%	7	29.2%	21	100.0%
<b>Pre-operative risks</b>						
Arrhythmia	2	3.4%	3	12.5%	0	0.0%
Pulmonary hypertensive crisis	0	0.0%	1	4.2%	0	0.0%
Shock	0	0.0%	0	0.0%	0	0.0%
Acidosis	0	0.0%	0	0.0%	0	0.0%
Renal failure, Creatinine > 2	0	0.0%	0	0.0%	0	0.0%
Septicemia	1	1.7%	0	0.0%	0	0.0%
Neurological deficit	0	0.0%	0	0.0%	0	0.0%
Seizure	0	0.0%	0	0.0%	0	0.0%
Other preoperative risks	0	0.0%	0	0.0%	2	9.5%
<b>Operative risks</b>						
STS-EACTS category 1	10	40.0%	0	0.0%	0	0.0%
STS-EACTS category 2	15	60.0%	24	100.0%	21	100.0%
STS-EACTS category 3						
STS-EACTS category 4						
CPB time*	43	(27-82)	109	(69-142)	0	
<b>Patient outcome</b>						
In-hospital mortality	0	0.0%	1	4.2%	1	4.8%
Postoperative length of stay*	5	(4-10)	7.5	(5-10)	11	(7-14)
<b>Postoperative complications</b>						
Arrhythmia	2	8.0%	0	0.0%	1	4.8%
Low cardiac output	0	0.0%	0	0.0%	0	0.0%
Acidosis	1	4.0%	0	0.0%	1	4.8%
Pneumothorax	1	4.0%	0	0.0%	1	4.8%
Reoperation during this admission	0	0.0%	0	0.0%	0	0.0%
Pulmonary hypertension	0	0.0%	0	0.0%	1	4.8%
Bleeding requiring reoperation	0	0.0%	0	0.0%	0	0.0%
Respiratory insufficiency requiring mechanical ventilator > 7 days	0	0.0%	0	0.0%	0	0.0%
Cardiac arrest	0	0.0%	0	0.0%	0	0.0%
Pneumonia	0	0.0%	0	0.0%	0	0.0%
Mechanical circulatory support (IABP,VAD,ECMO)	0	0.0%	0	0.0%	0	0.0%
Acute renal failure requiring temporary dialysis	0	0.0%	0	0.0%	1	4.8%
Respiratory insufficiency requiring reintubation	0	0.0%	1	4.2%	1	4.8%



Valve other-tricuspid		PAPVC repair		Shunt, systemic to pulmonary, modified Blalock-Taussig shunt		ASD creation/enlargement		Coronary artery fistula ligation		Pulmonary venous stenosis, repair	
n=19		n=17		n=17		n=14		n=14		n=13	
n	%	n	%	n	%	n	%	n	%	n	%
51	(38-57)	33	(22-46)	17.6	(16-23)	34.3	(29-51)	45.0	(27-70)	30.3	(23-38)
7	36.8%	6	35.3%	9	52.9%	4	28.6%	6	42.9%	4	30.8%
49	(44-61)	47	(41-58)	40	(38-47)	55	(45-58)	60	(44-72)	47.5	(41-53)
0	0.0%	0	0.0%	0	0.0%	1	7.1%	0	0.0%	1	7.7%
0	0.0%	3	17.6%	16	94.1%	7	50.0%	11	78.6%	7	53.8%
18	94.7%	16	94.1%	15	88.2%	14	100.0%	14	100.0%	13	100.0%
0	0.0%	0	0.0%	1	5.9%	1	7.1%	0	0.0%	0	0.0%
0	0.0%	1	5.9%	1	5.9%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	1	5.9%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	5.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1	5.3%	0	0.0%	0	0.0%	1	7.1%	0	0.0%	0	0.0%
13	68.4%	17	100.0%	0	0.0%	2	14.3%	14	100.0%	4	30.8%
6	31.6%			17	100.0%	12	85.7%			9	69.2%
69	(49-100)	71	(47-90)	0		83	(39-77)	26	(0-72)	94	(59-131)
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
7	(4-10)	7	(5-10)	6	(5-9)	7	(5-9)	7	(4-13)	8	(6-13)
0	0.0%	1	5.9%	0	0.0%	0	0.0%	0	0.0%	2	15.4%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%
0	0.0%	1	5.9%	0	0.0%	0	0.0%	0	0.0%	1	7.7%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	2	11.8%	0	0.0%	1	7.1%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	1	5.9%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.1%	1	7.7%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.1%	0	0.0%



Patient characteristics	RVOT procedure		Mitral stenosis, supralvalvar mitral ring repair		Ventricular septal fenestration	
	n=13		n=13		n=12	
	n	%	n	%	n	%
Age*	24.8	(19-40)	19.1	(15-45)	24.4	(19-35)
Gender (male)	4	30.8%	5	38.5%	8	66.7%
Weight*	50	(44-54)	47	(43-54)	53	(46-63)
Cardiac abnormality	1	7.7%	0	0.0%	0	0.0%
Isolated procedure	5	38.5%	4	30.8%	8	66.7%
No previous heart operation	11	84.6%	13	100.0%	10	83.3%
<b>Pre-operative risks</b>						
Arrhythmia	1	7.7%	0	0.0%	0	0.0%
Pulmonary hypertensive crisis	1	7.7%	0	0.0%	0	0.0%
Shock	0	0.0%	0	0.0%	0	0.0%
Acidosis	0	0.0%	0	0.0%	0	0.0%
Renal failure, Creatinine > 2	0	0.0%	0	0.0%	0	0.0%
Septicemia	0	0.0%	0	0.0%	0	0.0%
Neurological deficit	0	0.0%	0	0.0%	0	0.0%
Seizure	0	0.0%	0	0.0%	0	0.0%
Other preoperative risks	0	0.0%	0	0.0%	1	8.3%
<b>Operative risks</b>						
STS-EACTS category 1	3	23.1%	6	46.2%	0	0.0%
STS-EACTS category 2	0	0.0%	7	53.8%	12	100.0%
STS-EACTS category 3	10	76.9%				
STS-EACTS category 4						
CPB time*	78	(65-95)	80	(58-90)	74.5	(56-127)
<b>Patient outcome</b>						
In-hospital mortality	0	0.0%	0	0.0%	1	8.3%
Postoperative length of stay*	8	(5-13)	6	(5-10)	6	(5-10)
<b>Postoperative complications</b>						
Arrhythmia	0	0.0%	0	0.0%	2	16.7%
Low cardiac output	0	0.0%	0	0.0%	1	8.3%
Acidosis	0	0.0%	1	7.7%	1	8.3%
Pneumothorax	0	0.0%	0	0.0%	0	0.0%
Reoperation during this admission	0	0.0%	0	0.0%	0	0.0%
Pulmonary hypertension	0	0.0%	0	0.0%	0	0.0%
Bleeding requiring reoperation	1	7.7%	0	0.0%	0	0.0%
Respiratory insufficiency requiring mechanical ventilator > 7 days	0	0.0%	0	0.0%	0	0.0%
Cardiac arrest	0	0.0%	0	0.0%	0	0.0%
Pneumonia	0	0.0%	0	0.0%	0	0.0%
Mechanical circulatory support (IABP,VAD,ECMO)	0	0.0%	0	0.0%	1	8.3%
Acute renal failure requiring temporary dialysis	0	0.0%	0	0.0%	0	0.0%
Respiratory insufficiency requiring reintubation	0	0.0%	0	0.0%	0	0.0%





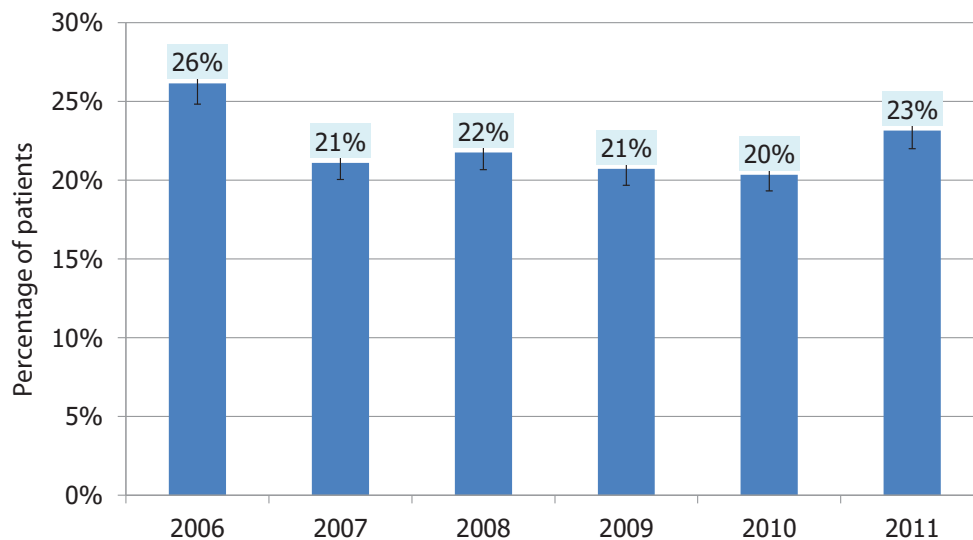
Pulmonary atresia-VSD (including TOF,PA), repair		Valve replacement, MVR		Coarctation repair, interposition graft		AVC (AVSD) repair, (PAVSD)		Rastelli	
n=12		n=11		n=11		n=10		n=10	
n	%	n	%	n	%	n	%	n	%
19.2	(17-20)	30.7	(17-47)	25.4	(17-28)	34.8	(27-49)	19.8	(17-23)
3	25.0%	7	63.6%	7	63.6%	0	0.0%	7	70.0%
45	(39-49)	48	(44-62)	58	(49-61)	47	(37-53)	42	(41-45)
0	0.0%	1	9.1%	0	0.0%	2	20.0%	0	0.0%
6	50.0%	3	27.3%	11	100.0%	2	20.0%	8	80.0%
10	83.3%	10	90.9%	10	90.9%	10	100.0%	6	60.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	1	9.1%	0	0.0%	0	0.0%
1	8.3%	4	36.4%	11	100.0%	10	100.0%	0	0.0%
0	0.0%	0	0.0%					0	0.0%
11	91.7%	7	63.6%					10	100.0%
159	(106-188)	89	(71-106)	0		98.5	(75-152)	172.5	(117-276)
0	0.0%	2	18.2%	0	0.0%	0	0.0%	0	0.0%
7	(5-10)	11	(7-26)	5	(4-6)	5	(5-7)	6	(6-21)
0	0.0%	0	0.0%	0	0.0%	1	10.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	10.0%
1	8.3%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	10.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
0	0.0%	1	9.1%	0	0.0%	1	10.0%	0	0.0%



## Congenital heart surgery in adult

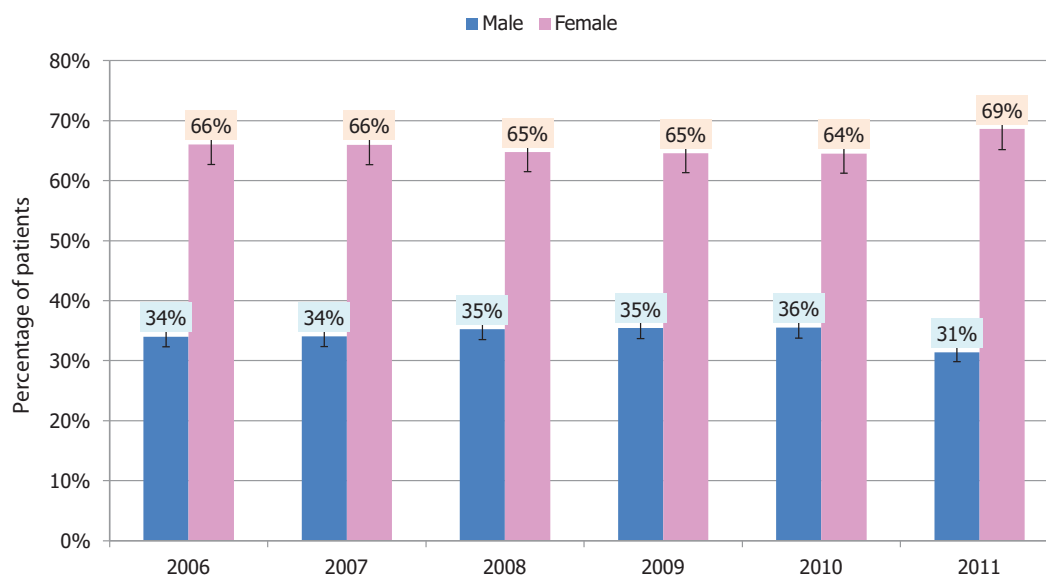
- In 2006 the percentage of adult congenital heart surgery is 26% but time trend later shows 22% of adult congenital heart surgery.
- The ratio of male to female operation is about 1:2.
- 95% of patients have no previous operation before adult surgery while 5% of patients have previous operation.
- 79% of patients have isolated-procedure operation while 15% having double-procedure operation and 6% triple-procedure operation.
- 83% of patients are in mortality category 1 and 12% in mortality category 2; in-hospital mortality rate is less than 1% in category 1 and 5% in category 2.
- 3% and 1% are in category 3 and 4 with in-hospital mortality of 7% and 15% respectively.
- In category 1 there is 75% of male and 87% of female; male has more mortality than female in all categories
- Median postoperative length of stay is 6 days; there is no relationship between number of procedure operation and postoperative length of stay.

Percentage of adult patients in each year (n=2,916) missing 0.1% (18)





Adult patients, gender and calendar year (n=2,916)



Multiple procedures and postoperative length of stay (n=2,806)

Number of procedure	n	Median	IQR
Single	78.7%	6.0	5.0-8.0
	2,207		
Double	15.4%	7.0	5.0-9.0
	433		
Triple	5.9%	6.0	4.0-9.0
	166		
Total	100.0%	6.0	4.0-8.0
	2,806		
Missing	2.6%(76)		



Previous heart operation and age (n=2,916)

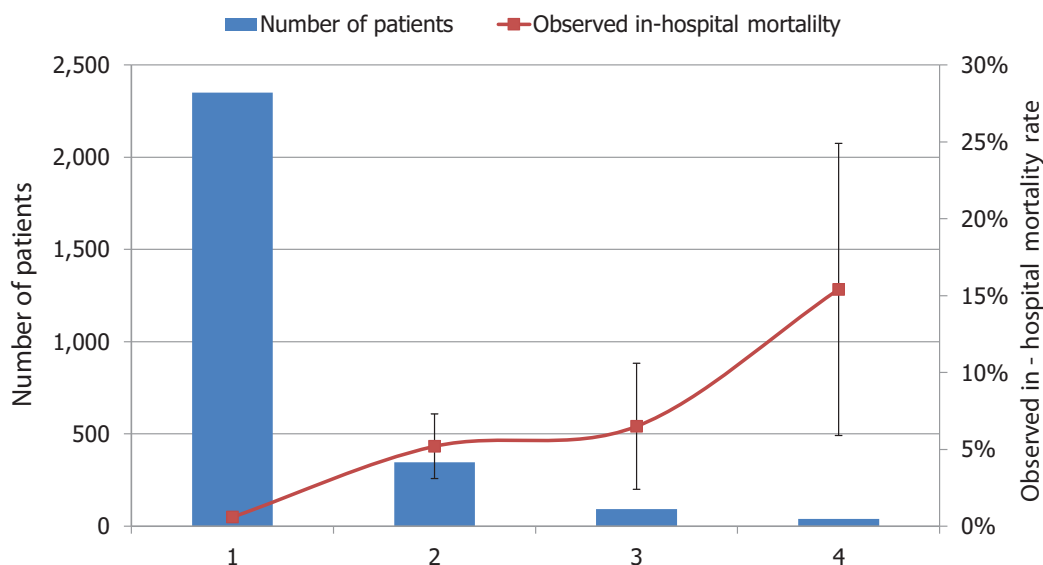
History of previous heart operation	n	Median	IQR	Min - Max
0	95.4% 2,782	34.2	23.5-46.6	15-90
1	3.7% 108	23.6	18.0-34.1	15-64
2	0.5% 16	21.8	16.8-21.8	15-63
3	0.2% 6	31.3	20.9-31.3	18-56
4	0.1% 4	22.9	17.1-22.9	18-29
Missing	0 (0.0%)			

Mortality category and observed in-hospital mortality (n=2,830)

Mortality category	All	Alive	Dead	95% CI
1	83.1% 2,351	99.4% 2,336	0.6% 15	0.4-1.1
2	12.3% 347	94.8% 329	5.2% 18	3.1-8.1
3	3.3% 93	93.5% 87	6.5% 6	2.4-13.5
4	1.4% 39	84.6% 33	15.4% 6	5.9-30.5
Total	100.0% 2,830	98.4% 2,785	1.6% 45	1.2-2.1
Missing	2.9% (86)			



Mortality category and observed in-hospital mortality (n=2,830)



Mortality category and gender (n=2,830)

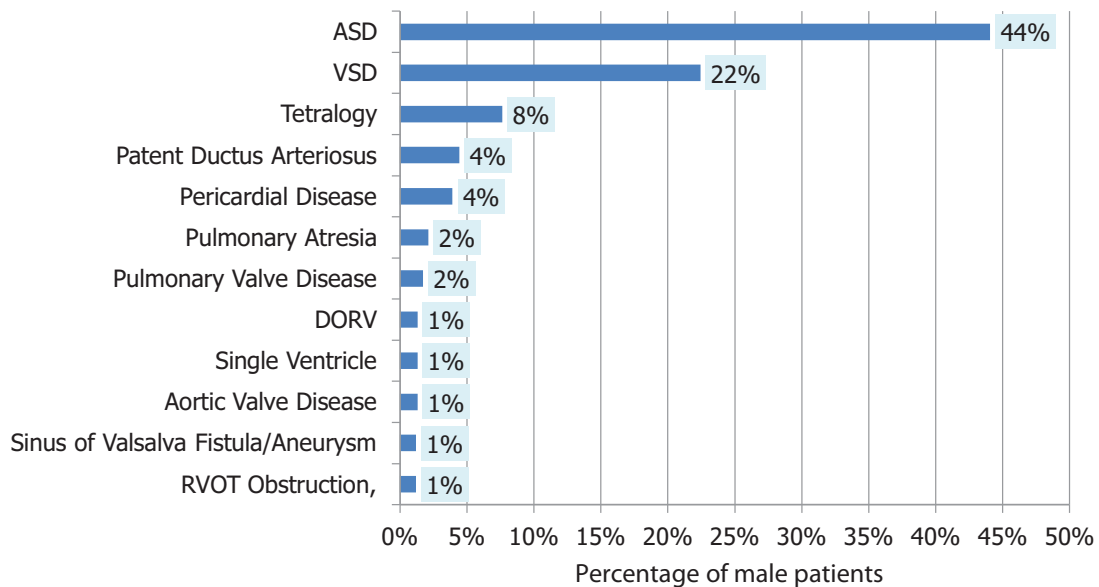
Mortality Category	Male		Female	
	All	Dead	All	Dead
1	75.4%	1.2%	87.1%	0.4%
	732	9	1,619	6
2	18.2%	5.6%	9.1%	4.7%
	177	10	170	8
3	4.3%	9.5%	2.7%	3.9%
	42	4	51	2
4	2.1%	20.0%	1.0%	10.5%
	20	4	19	2
Total	100.0%	2.8%	100.0%	1.0%
	971	27	1,859	18
Missing	2.9% (86)			



## Common adult congenital heart disease, procedure and gender

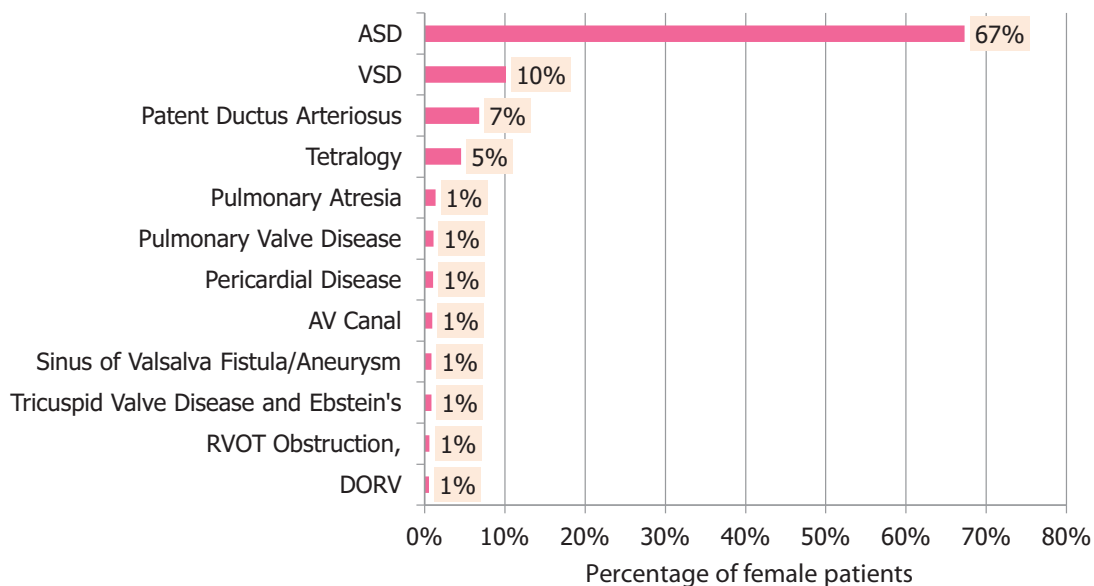
- In male, the common heart diseases are ASD, VSD, Tetralogy of Fallot, PDA and pericardial disease successively.
- In female, the common heart diseases are ASD, VSD, PDA, Tetralogy of Fallot and pulmonary atresia successively.
- In male, the most common procedure are ASD repair patch, VSD repair patch, ASD repair primary closure, VSD repair primary closure and TOF repair, ventriculotomy with transanular patch.
- In female, the most common procedures are ASD repair patch, ASD repair primary closure, VSD repair patch, PDA closure surgical and VSD repair primary closure.

Most common primary diagnosis of male adult (n=994)

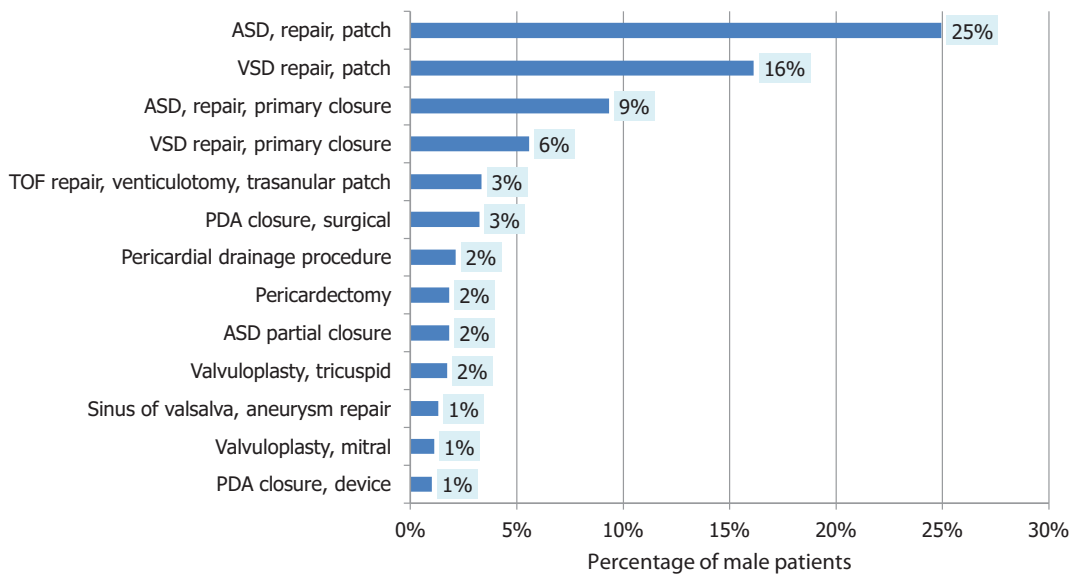




Most common primary diagnosis of female adult (n=1,910)

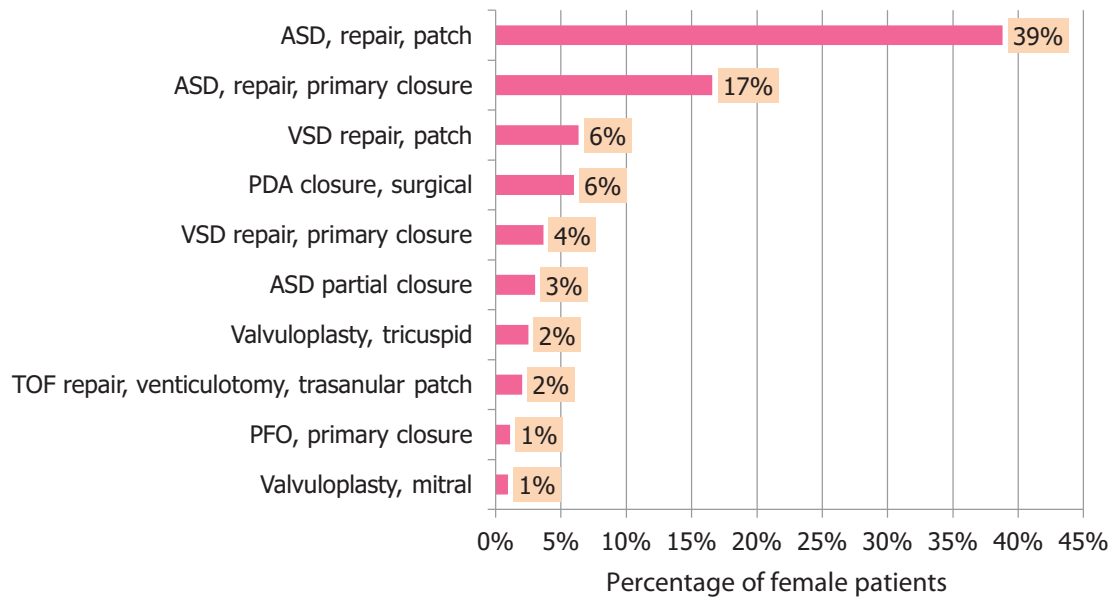


Most common primary procedure of male adult (n=986)





Most common primary procedure of female adult (n=1,887)







The 4 most frequent operations performed in adult congenital heart surgery

1	ASD repair	
	1 PFO, primary closure	30
	2 ASD, repair, primary closure	402
	3 ASD, repair, patch	966
	4 ASD, repair, device	5
	7 ASD partial closure	75
	9 ASD repair, NOS	9
2	VSD repair	
	10 VSD repair, primary closure	123
	11 VSD repair, patch	277
	12 VSD, repair, device	1
	13 VSD, multiple, repair	7
	16 VSD repair, NOS	5
3	TOF repair	
	35 TOF repair, non ventriculotomy	16
	36 TOF repair, ventriculotomy, nontransanular patch	19
	37 TOF repair, ventriculotomy, transanular patch	70
	38 TOF repair, RV-PA conduit	6
	39 TOF, AVC (AVSD), repair	2
	40 TOF, absent pulmonary valve, repair	3
	41 TOF repair, NOS	20
4	PDA closure	
	134 PDA closure, surgical	143
	135 PDA closure, device	27
	136 PDA closure, NOS	9





# Chapter 9



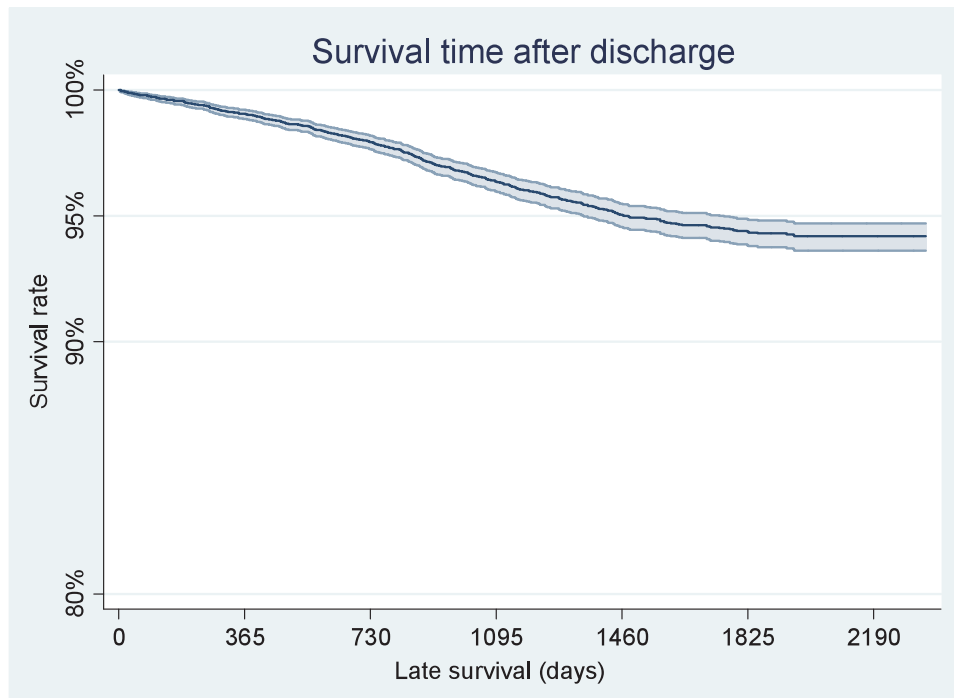
## Survival

Success is meant by long-term result after our performance, in this chapter we try to elaborate our result of performance apart from in-hospital mortality, morbidity, postoperative length of stay, trend and late result after discharge. The late outcome pertaining to alive and dead is obtained from National Public Registry through Bureau of Policy and Strategy, Ministry of Public Health using 13 digit people identification. The cut-off date for live or dead status is end of June 2012.

### Overall late survival (n=11,621 missing 2.0%)

(Total case = 11,864 are alive at discharge)

In all age levels after discharge, the cumulative failure has persisted throughout 6 years; however survival rate is 94.2% (95% CI: 93.6% - 94.7%) at 6 years.



Year after discharge	1	2	3	4	5	6
No. at risk	11,621	10,916	9,282	7,298	5,199	3,071
No. of censor	596	1,520	1,851	2,012	2,098	2,179
No. of dead	109	114	133	87	30	5
Cumulative failure rate	0.9%	2.1%	3.6%	4.9%	5.6%	5.8%

**Note:** Censor was the patient that alive at period between discharge date and the end of June 2012 and this time was shorter than year after discharge.

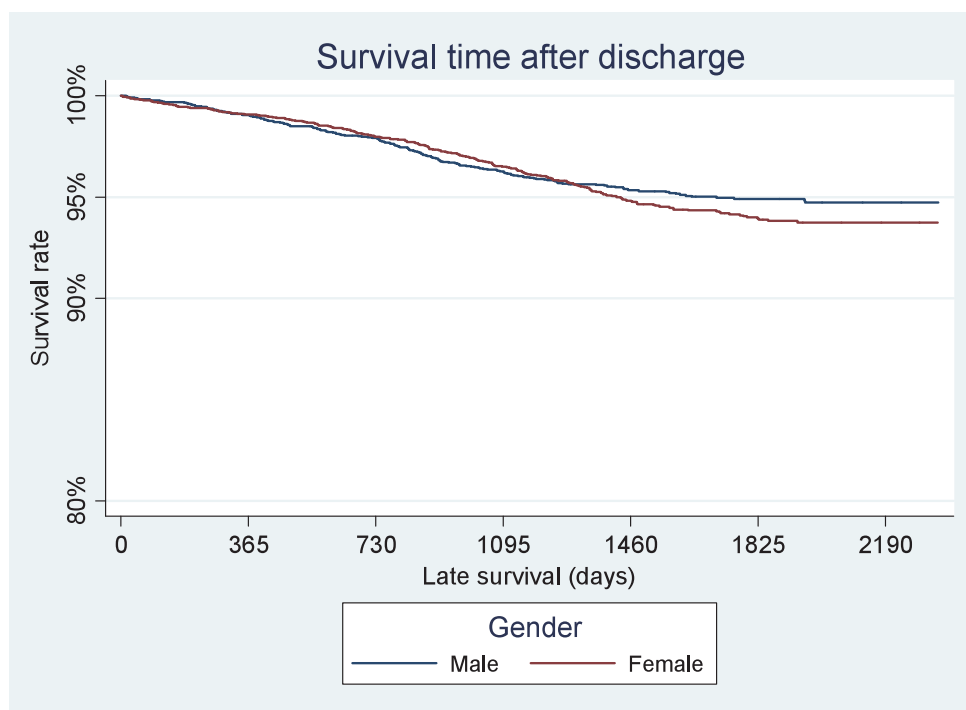
The cumulative failure rate was calculated over each patient and evaluated at indicated times.



### Overall late survival by gender (n=11,621 missing 2.0%)

(Total case = 11,864 are alive at discharge)

There is no gender difference in survival after hospital discharge except the latest 3 years when male survival is higher than female. The 6<sup>th</sup> year survival rate in male is 94.7% (95% CI: 93.9% - 95.4%) and female is 93.8% (95% CI: 92.9% - 94.5%).



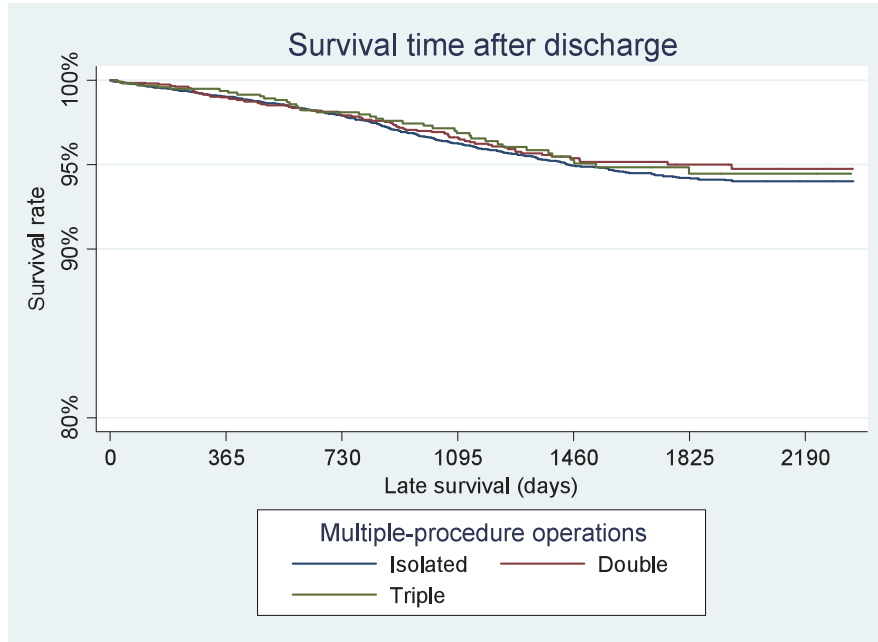
Year after discharge	1	2	3	4	5	6
<b>Male (n=5,471)</b>						
No. at risk	5,471	5,149	4,353	3,410	2,411	1,417
No. of censor	270	741	876	970	985	1,003
No. of dead	52	55	67	29	9	2
Cumulative failure rate	1.0%	2.1%	3.7%	4.7%	5.1%	5.3%
<b>Female (n=6,150)</b>						
No. at risk	6,150	5,767	4,929	3,888	2,788	1,654
No. of censor	326	779	975	1,042	1,113	1,651
No. of dead	57	59	66	58	21	3
Cumulative failure rate	0.9%	2.0%	3.5%	5.2%	6.1%	6.2%



### Overall late survival by multiple-procedure operations (n=11,531 missing 2.8%)

(Total case = 11,864 are alive at discharge)

There is no difference of late survival after discharge among single double and triple procedures, this phenomenon is probable due to all age-group analysis so that any difference is not easily seen. The 6<sup>th</sup> year survival rate of isolated is 94.0% (95% CI: 93.3% - 94.6%), double is 94.8% (95% CI: 93.4% - 95.9%), and triple is 94.5% (95% CI: 92.3% - 96.0%).



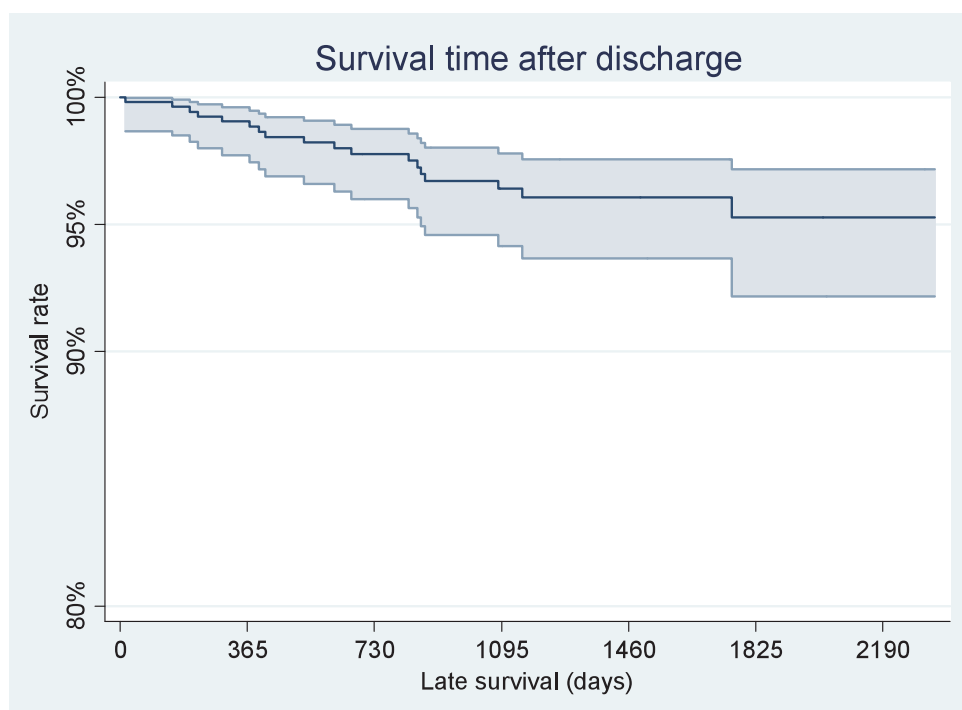
Year after discharge	1	2	3	4	5	6
<b>Isolated (n=8,436)</b>						
No. at risk	8,436	7,976	6,788	5,332	3,808	2,273
No. of censor	379	1,105	1,352	1,461	1,511	1,617
No. of dead	81	83	104	63	24	4
Cumulative failure rate	1.0%	2.1%	3.7%	5.1%	5.8%	6.0%
<b>Double (n=2,113)</b>						
No. at risk	2,113	1,975	1,662	1,288	902	537
No. of censor	117	293	355	371	362	536
No. of dead	21	20	19	15	3	1
Cumulative failure rate	1.0%	2.1%	3.4%	4.6%	5.0%	5.2%
<b>Triple (n=982)</b>						
No. at risk	982	908	782	637	457	240
No. of censor	68	115	136	171	214	240
No. of dead	6	11	9	9	3	0
Cumulative failure rate	0.6%	1.9%	3.2%	4.7%	5.6%	5.6%



### Late survival in newborn (n=531 missing 1.5%)

(Total case = 539 are alive at discharge)

In newborn, the in-hospital mortality is high but after hospital discharge there has been reducing number of death until no death at the last two years. However, the 6<sup>th</sup> year survival rate is 95.3% (95% CI: 92.2% - 97.2%).



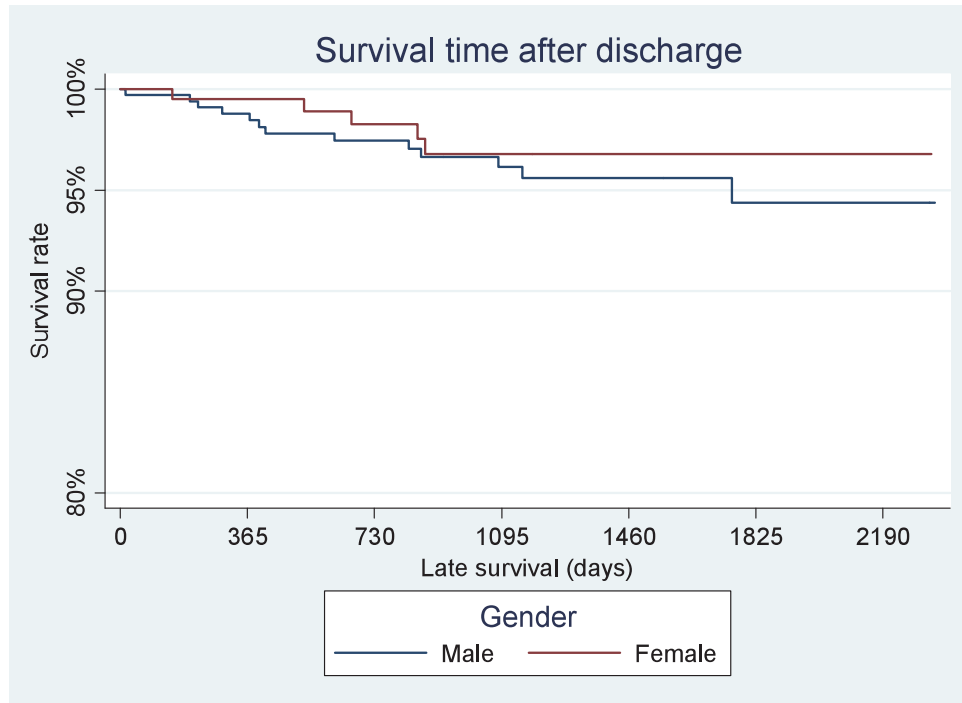
Year after discharge	1	2	3	4	5	6
No. at risk	531	492	410	298	186	104
No. of censor	34	76	107	111	81	72
No. of dead	5	6	5	1	1	0
Cumulative failure rate	1.0%	2.2%	3.6%	3.9%	4.7%	4.7%



### Late survival in newborn by gender (n=531 missing 1.5%)

(Total case = 539 are alive at discharge)

In newborn after hospital discharge, mortality of male is more than female. The 6<sup>th</sup> year survival rate in male is 94.4% (95% CI: 89.7% - 97.0%), and female is 96.8% (95% CI: 92.4% - 98.7%).



Year after discharge	1	2	3	4	5	6
<b>Male (n=330)</b>						
No. at risk	330	307	264	191	123	65
No. of censor	19	39	70	67	57	47
No. of dead	4	4	3	1	1	0
Cumulative failure rate	1.2%	2.6%	3.9%	4.4%	5.6%	5.6%
<b>Female (n=201)</b>						
No. at risk	201	186	147	108	64	40
No. of censor	14	37	37	44	24	40
No. of dead	1	2	2	0	0	0
Cumulative failure rate	0.5%	1.7%	3.2%	3.2%	3.2%	3.2%

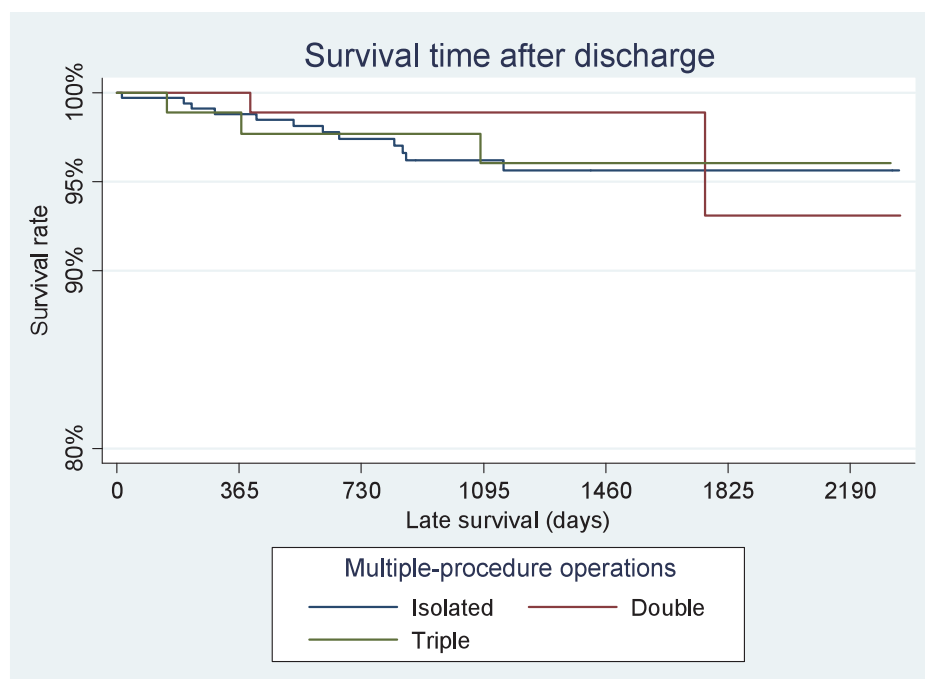




### Late survival in newborn by multiple-procedure operations (n=527 missing 2.2%)

(Total case = 539 are alive at discharge)

In newborn after discharge, there is no difference of late survival between isolated and triple procedure but by chance the double procedure having one death in the fifth year of follow-up. The 6<sup>th</sup> year survival rate of isolated is 95.7% (95% CI: 92.4% - 97.5%), double is 93.1% (95% CI: 67.9% - 98.7%), and triple is 96.0% (95% CI: 88.0% - 98.7%).



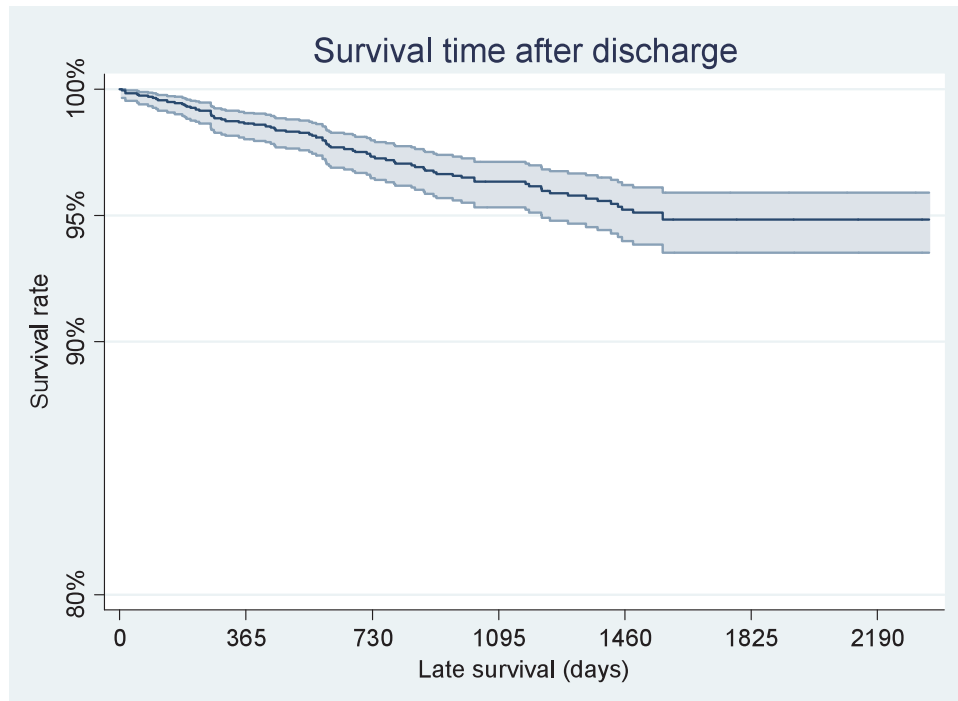
Year after discharge	1	2	3	4	5	6
<b>Isolated (n=336)</b>						
No. at risk	336	313	264	187	113	65
No. of censor	19	45	74	73	48	47
No. of dead	4	4	3	1	0	0
Cumulative failure rate	1.2%	2.6%	3.8%	4.4%	4.4%	4.4%
<b>Double (n=101)</b>						
No. at risk	101	93	72	52	31	17
No. of censor	8	20	20	21	13	17
No. of dead	0	1	0	0	1	0
Cumulative failure rate	0.0%	1.1%	1.1%	1.1%	6.9%	6.9%
<b>Triple (n=90)</b>						
No. at risk	90	84	72	58	43	23
No. of censor	5	11	13	15	20	23
No. of dead	1	1	1	0	0	0
Cumulative failure rate	1.1%	2.3%	4.0%	4.0%	4.0%	4.0%



### Late survival in infant (n=2,015 missing 2.9%)

(Total case = 2,075 are alive at discharge)

In infant after hospital discharge, there is continuing risk of death after discharge until the 6<sup>th</sup> year the survival rate is 94.9% (95% CI: 93.5% - 95.9%).



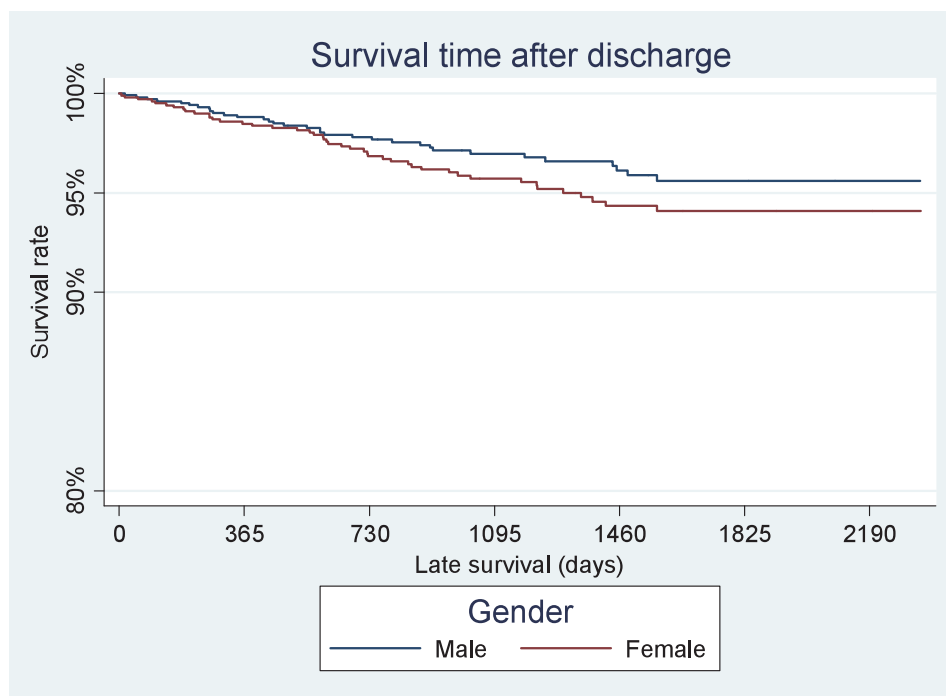
Year after discharge	1	2	3	4	5	6
No. at risk	2,015	1,886	1,563	1,168	809	483
No. of censor	102	300	381	348	323	340
No. of dead	27	23	14	11	3	0
Cumulative failure rate	1.4%	2.7%	3.7%	4.8%	5.2%	5.2%



### Late survival in infant by gender (n=2,015 missing 2.9%)

(Total case = 2,075 are alive at discharge)

In infant after hospital discharge, the in-hospital mortality in female is higher than male. The 6<sup>th</sup> year survival rate in male is 95.6% (95% CI: 93.7% - 96.9%), and female is 94.1% (95% CI: 92.1% - 95.6%).



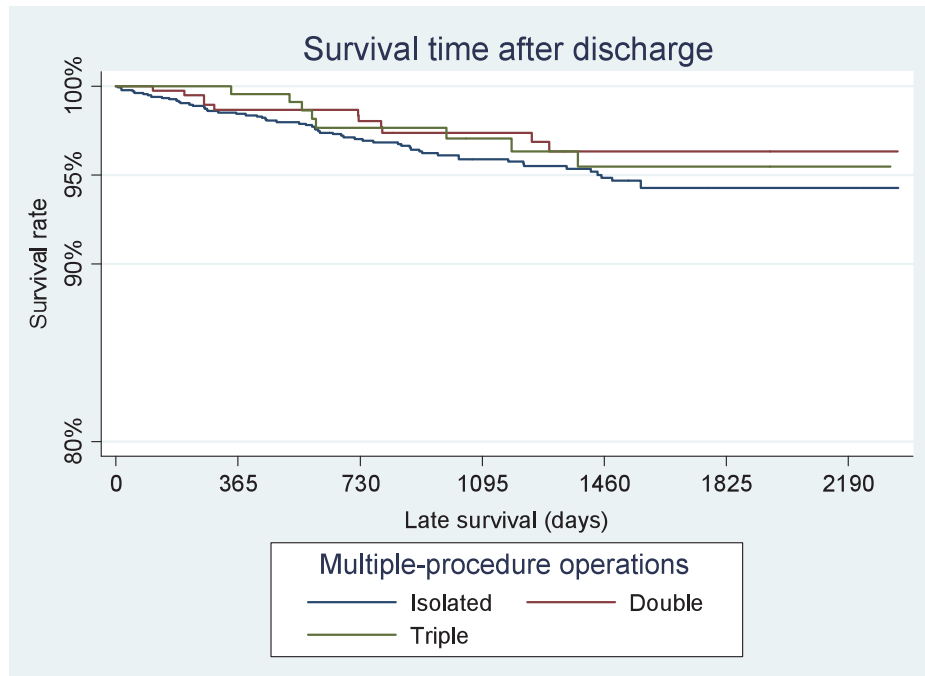
Year after discharge	1	2	3	4	5	6
<b>Male (n=1,017)</b>						
No. at risk	1,017	956	787	580	399	241
No. of censor	49	160	201	177	156	170
No. of dead	12	9	6	4	2	0
Cumulative failure rate	1.2%	2.2%	3.0%	3.9%	4.4%	4.4%
<b>Female (n=998)</b>						
No. at risk	998	931	777	591	411	242
No. of censor	52	140	178	173	168	242
No. of dead	15	14	8	7	1	0
Cumulative failure rate	1.5%	3.2%	4.3%	5.7%	5.9%	5.9%



### Late survival in infant by multiple-procedure operations (n=2,003 missing 3.5%)

(Total case = 2,075 are alive at discharge)

In infant after hospital discharge, late survival of isolated procedure group is lower than triple and double procedure. The 6<sup>th</sup> year survival rate of isolated is 94.3% (95% CI: 92.6% - 95.6%), double is 96.3% (95% CI: 93.3% - 98.0%), and triple is 95.5% (95% CI: 90.9% - 97.8%).



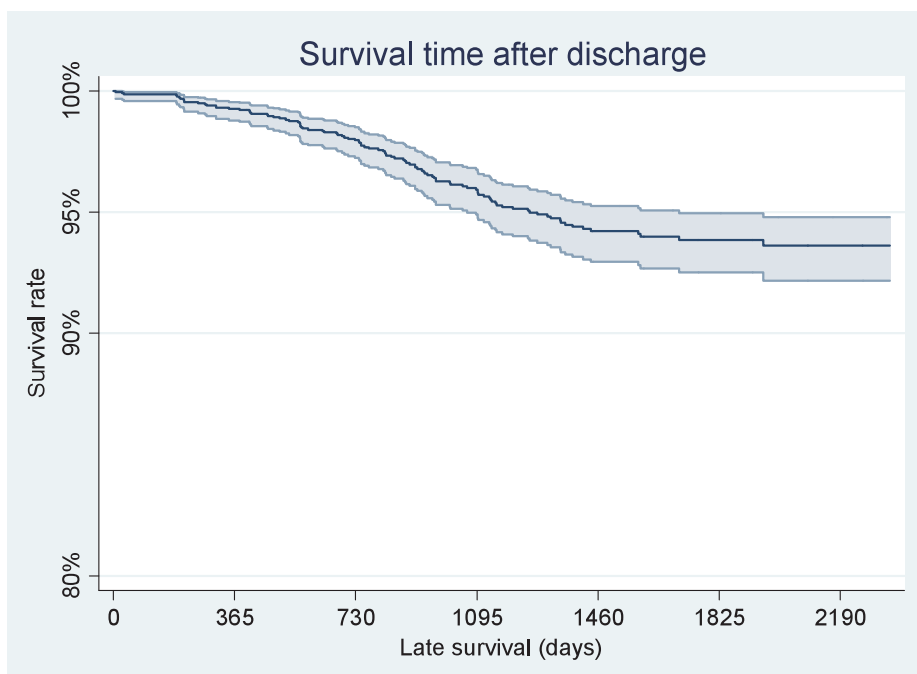
Year after discharge	1	2	3	4	5	6
<b>Isolated (n=1,364)</b>						
No. at risk	1,364	1,282	1,059	795	551	336
No. of censor	61	206	253	237	212	233
No. of dead	21	17	11	7	3	0
Cumulative failure rate	1.6%	3.0%	4.1%	5.2%	5.7%	5.7%
<b>Double (n=390)</b>						
No. at risk	390	365	303	224	148	83
No. of censor	20	60	77	74	65	83
No. of dead	5	2	2	2	0	0
Cumulative failure rate	1.3%	2.0%	2.6%	3.7%	3.7%	3.7%
<b>Triple (n=249)</b>						
No. at risk	249	231	194	143	105	61
No. of censor	17	33	50	36	44	61
No. of dead	1	4	1	2	0	0
Cumulative failure rate	0.4%	2.3%	3.0%	4.5%	4.5%	4.5%



### Late survival in preschool children (n=2,192 missing 2.0%)

(Total case = 2,237 are alive at discharge)

In preschool children after hospital discharge, the in-hospital mortality has been decreasing until 5<sup>th</sup> year at follow-up the survival is 93.6% (95% CI: 92.2% - 94.8%).



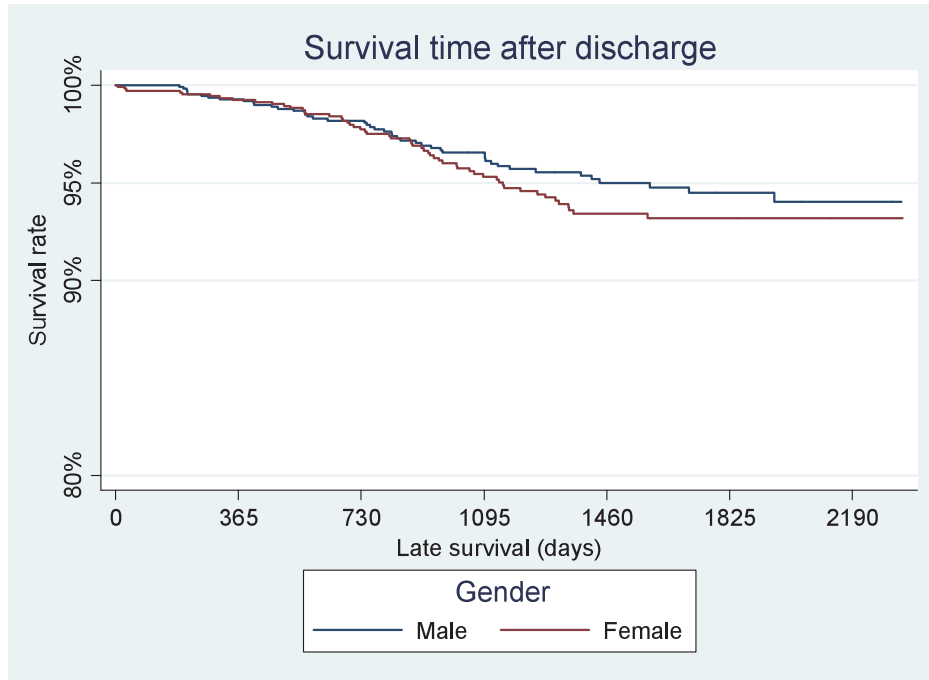
Year after discharge	1	2	3	4	5	6
No. at risk	2,192	2,075	1,759	1,364	992	541
No. of censor	101	291	362	350	448	387
No. of dead	16	25	33	22	3	0
Cumulative failure rate	0.7%	2.0%	4.1%	5.8%	6.2%	6.4%



### Late survival in preschool children by gender (n=2,192 missing 2.0%)

(Total case = 2,237 are alive at discharge)

Late survival in preschool children after discharge has shown that the female gender die more than male so that the after 5<sup>th</sup> years of follow up the survival rate in male is 94.0% (95% CI: 91.8% - 95.6%), and female is 93.2% (95% CI: 91.1% - 94.8%).



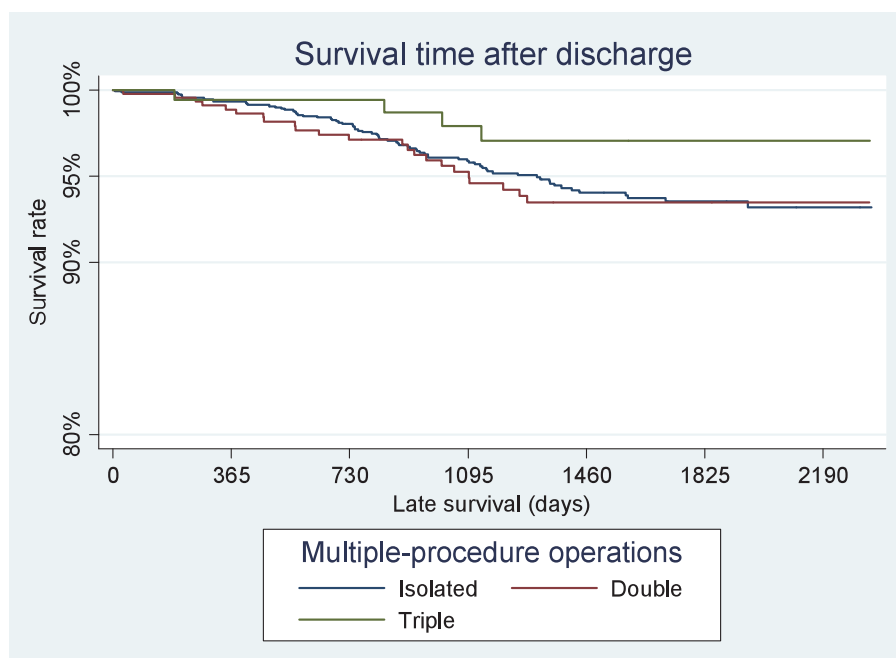
Year after discharge	1	2	3	4	5	6
<b>Male (n=1,116)</b>						
No. at risk	1,116	1,065	893	698	497	264
No. of censor	43	161	181	191	231	189
No. of dead	8	11	14	10	2	1
Cumulative failure rate	0.7%	1.8%	3.5%	5.0%	5.5%	6.0%
<b>Female (n=1,076)</b>						
No. at risk	1,076	1,011	867	668	495	279
No. of censor	57	130	180	161	215	279
No. of dead	8	14	19	12	1	0
Cumulative failure rate	0.8%	2.3%	4.7%	6.6%	6.8%	6.8%



## Late survival in preschool children by multiple-procedure operations (n=2,173 missing 2.9%)

(Total case = 2,237 are alive at discharge)

Late survival in preschool children after hospital discharge shows that the triple procedure has better survival than isolated and double procedures; this is explained by most patients in triple procedure are in mortality category 1 and the late survival is 97.1% (95% CI: 92.3% - 98.9%). However, the 6<sup>th</sup> year survival rate of isolated is 93.2% (95% CI: 91.3% - 94.7%), and double is 93.5% (95% CI: 90.3% - 95.7%).



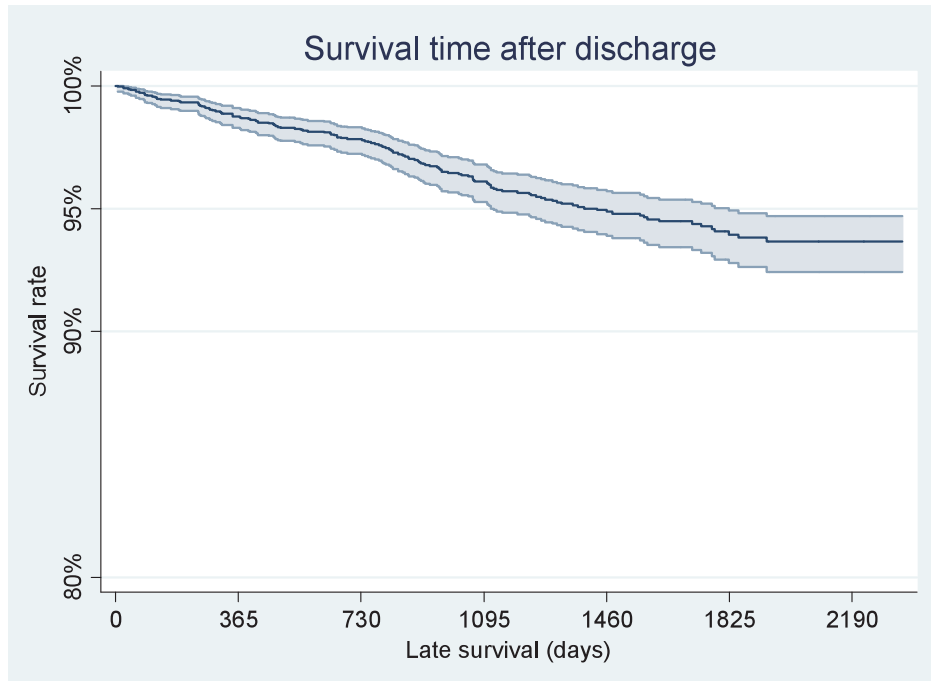
Year after discharge	1	2	3	4	5	6
<b>Isolated (n=1,542)</b>						
No. at risk	1,542	1,469	1,257	953	687	371
No. of censor	63	194	279	250	313	267
No. of dead	10	18	25	16	3	1
Cumulative failure rate	0.7%	2.0%	4.1%	6.0%	6.5%	6.8%
<b>Double (n=453)</b>						
No. at risk	453	431	353	281	207	116
No. of censor	17	71	66	69	91	116
No. of dead	5	7	6	5	0	0
Cumulative failure rate	1.1%	2.9%	4.8%	6.5%	6.5%	6.5%
<b>Triple (n=178)</b>						
No. at risk	178	164	140	121	91	50
No. of censor	13	24	17	29	41	50
No. of dead	1	0	2	1	0	0
Cumulative failure rate	0.6%	0.6%	2.1%	2.9%	2.9%	2.9%



### Late survival in school-age children (n=3,030 missing 1.8%)

(Total case = 3,086 are alive at discharge)

Late survival of school-age children after hospital discharge is 93.7% (95% CI: 92.4% - 94.7%).



Year after discharge	1	2	3	4	5	6
No. at risk	3,030	2,841	2,423	1,947	1,372	771
No. of censor	152	393	437	554	590	537
No. of dead	37	25	39	21	11	2
Cumulative failure rate	1.2%	2.2%	3.9%	5.1%	6.0%	6.3%

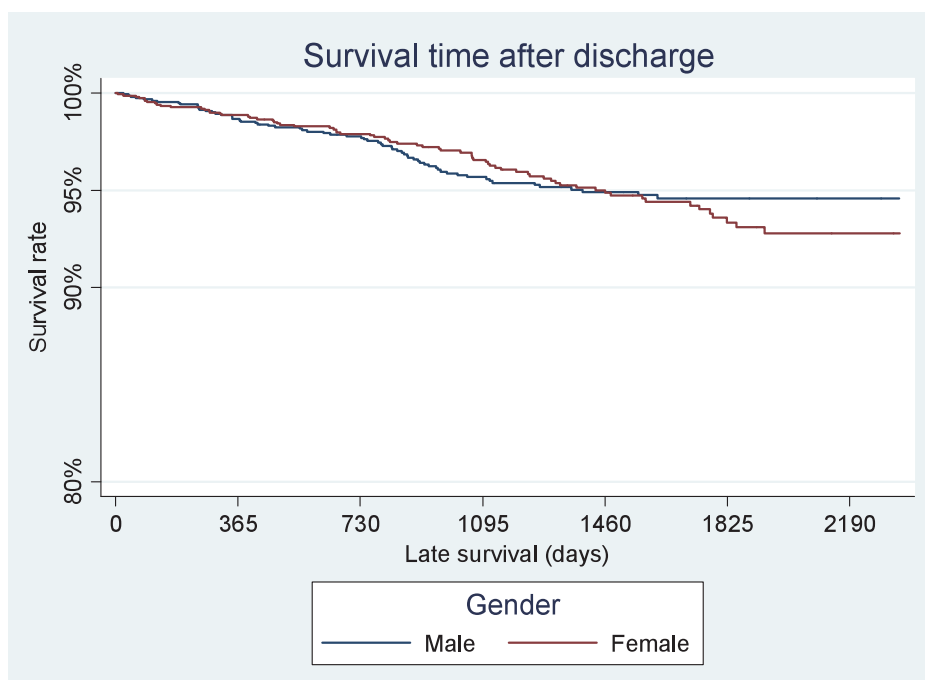




### Late survival in school-age children by gender (n=3,030 missing 1.8%)

(Total case = 3,086 are alive at discharge)

Late survival of school-age children after hospital discharge is less in female than male. The 6<sup>th</sup> year survival rate in male is 94.6% (95% CI: 93.1% - 95.8%), and female is 92.8% (95% CI: 90.7% - 94.4%).



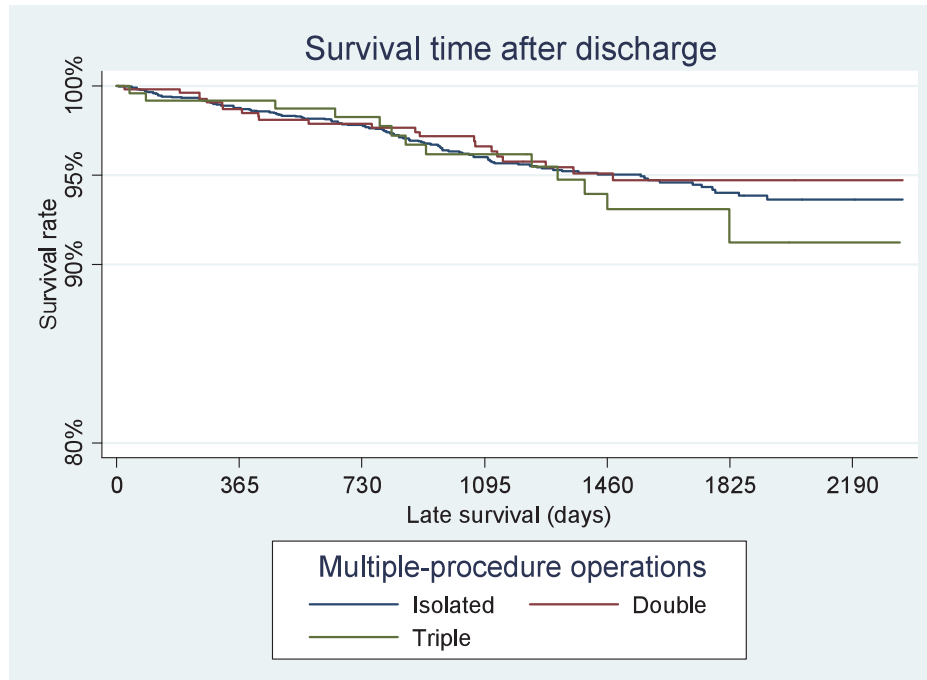
Year after discharge	1	2	3	4	5	6
<b>Male (n=1,523)</b>						
No. at risk	1,523	1,427	1,206	974	680	384
No. of censor	76	209	208	287	294	267
No. of dead	20	12	24	7	2	0
Cumulative failure rate	1.3%	2.2%	4.3%	5.1%	5.4%	5.4%
<b>Female (n=1,507)</b>						
No. at risk	1,507	1,416	1,217	973	692	387
No. of censor	74	186	229	267	296	385
No. of dead	17	13	15	14	9	2
Cumulative failure rate	1.1%	2.1%	3.5%	5.0%	6.7%	7.2%



### Late survival in school-age children by multiple-procedure operations (n=3,008 missing 2.5%)

(Total case = 3,086 are alive at discharge)

Late survival in school-age children by triple procedure is less than isolated and double procedures. The 6<sup>th</sup> year survival rate of isolated is 93.7% (95% CI: 92.2% - 94.9%), double is 94.7% (95% CI: 92.0% - 96.5%), and triple is 91.2% (95% CI: 84.2% - 95.2%).



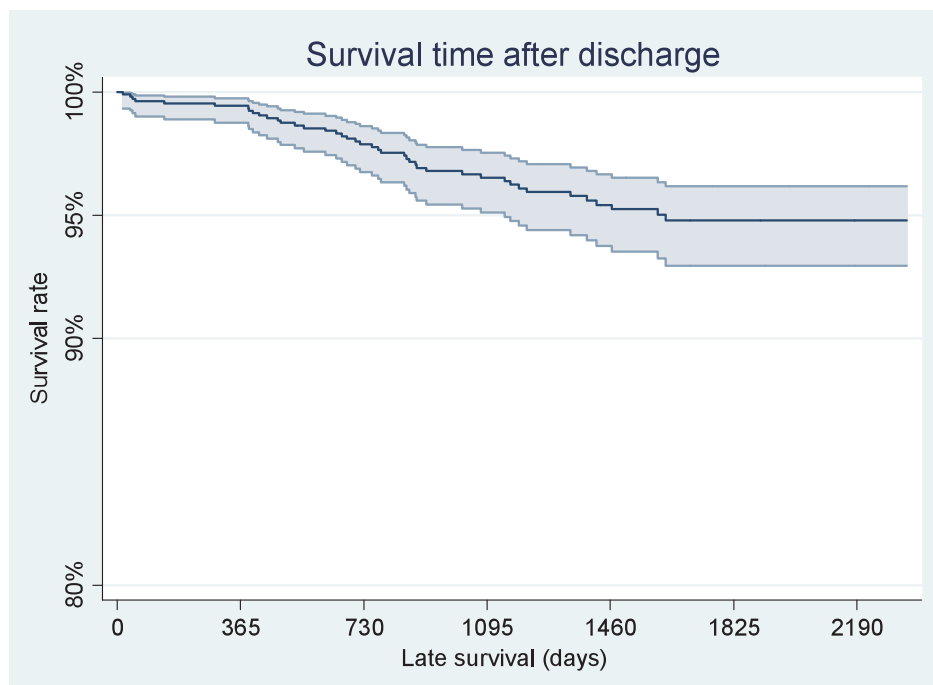
Year after discharge	1	2	3	4	5	6
<b>Isolated (n=2,213)</b>						
No. at risk	2,213	2,093	1,777	1,439	1,010	579
No. of censor	93	297	308	416	423	409
No. of dead	27	19	30	13	8	2
Cumulative failure rate	1.2%	2.2%	4.0%	5.0%	6.0%	6.4%
<b>Double (n=548)</b>						
No. at risk	548	511	441	344	249	143
No. of censor	30	66	92	90	105	143
No. of dead	7	4	5	5	1	0
Cumulative failure rate	1.3%	2.1%	3.4%	4.9%	5.3%	5.3%
<b>Triple (n=247)</b>						
No. at risk	247	227	197	160	110	50
No. of censor	18	28	33	47	58	50
No. of dead	2	2	4	3	2	0
Cumulative failure rate	0.8%	1.8%	3.8%	6.0%	8.8%	8.8%



### Late survival in grown-up children (n=1,080 missing 1.9%)

(Total case = 1,101 are alive at discharge)

Late survival after hospital discharge in grown-up children is similar to the overall survival that is 94.8% (95% CI: 93.0% - 96.2%) at 6<sup>th</sup> year.



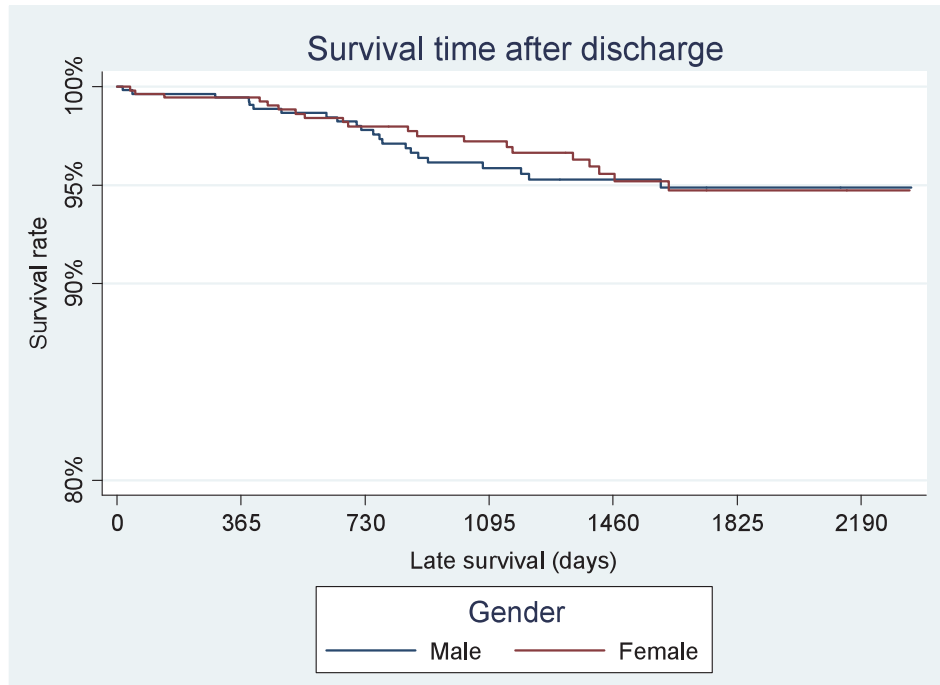
Year after discharge	1	2	3	4	5	6
No. at risk	1,080	1,032	879	705	525	318
No. of censor	42	138	163	173	204	211
No. of dead	6	15	11	7	3	0
Cumulative failure rate	0.6%	2.1%	3.5%	4.6%	5.2%	5.2%



### Late survival in grown-up children by gender (n=1,080 missing 1.9%)

(Total case = 1,101 are alive at discharge)

There is no gender difference in late survival after hospital discharge in grown-up children. The 6<sup>th</sup> year survival rate in male is 94.9% (95% CI: 92.2% - 96.6%), and female is 94.7% (95% CI: 91.8% - 96.6%).



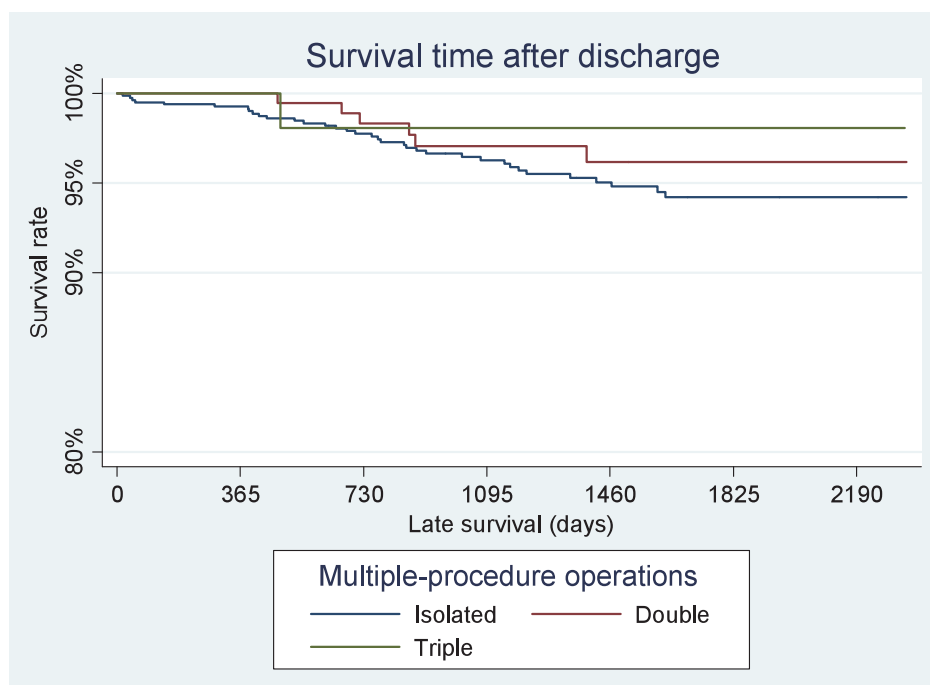
Year after discharge	1	2	3	4	5	6
<b>Male (n=546)</b>						
No. at risk	546	520	444	355	272	168
No. of censor	23	68	81	81	103	110
No. of dead	3	8	8	2	1	0
Cumulative failure rate	0.6%	2.2%	4.1%	4.7%	5.1%	5.1%
<b>Female (n=534)</b>						
No. at risk	534	513	436	351	254	151
No. of censor	18	70	82	92	101	151
No. of dead	3	7	3	5	2	0
Cumulative failure rate	0.6%	2.0%	2.8%	4.4%	5.3%	5.3%



### Late survival in grown-up children by multiple-procedure operations (n=1,076 missing 2.3%)

(Total case = 1,101 are alive at discharge)

Late survival after hospital discharge in grown-up children by multiple procedure operations shows that isolated procedure has poorest survival. The 6<sup>th</sup> year survival rate of isolated is 94.2% (95% CI: 91.9% - 95.9%), double is 96.2% (95% CI: 91.6% - 98.3%), and triple is 98.1% (95% CI: 87.1% - 99.7%).



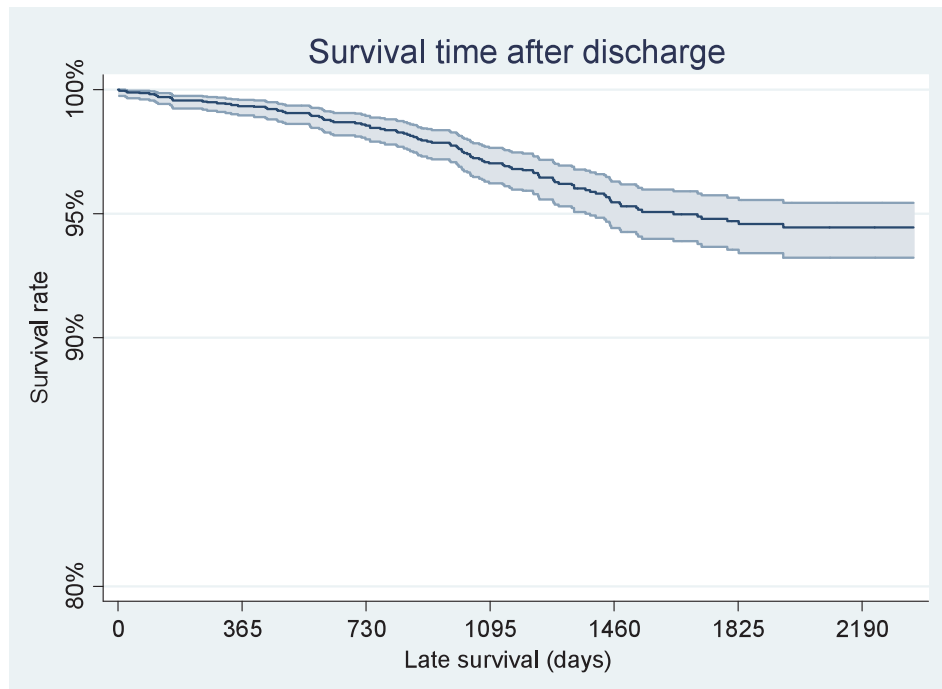
Year after discharge	1	2	3	4	5	6
<b>Isolated (n=815)</b>						
No. at risk	815	779	657	525	393	231
No. of censor	30	111	123	126	159	155
No. of dead	6	11	9	6	3	0
Cumulative failure rate	0.7%	2.3%	3.7%	5.0%	5.8%	5.8%
<b>Double (n=204)</b>						
No. at risk	204	198	173	141	104	70
No. of censor	6	22	30	36	34	70
No. of dead	0	3	2	1	0	0
Cumulative failure rate	0.0%	1.7%	2.9%	3.8%	3.8%	3.8%
<b>Triple (n=57)</b>						
No. at risk	57	55	50	40	30	18
No. of censor	2	4	10	10	12	18
No. of dead	0	1	0	0	0	0
Cumulative failure rate	0.0%	1.9%	1.9%	1.9%	1.9%	1.9%



### Late survival in adult (n=2,764 missing 1.8%)

(Total case = 2,814 are alive at discharge)

Late survival after hospital discharge in adult is similar to overall all age that is 94.4% (95% CI: 93.2% - 95.4%) at 6<sup>th</sup> year.



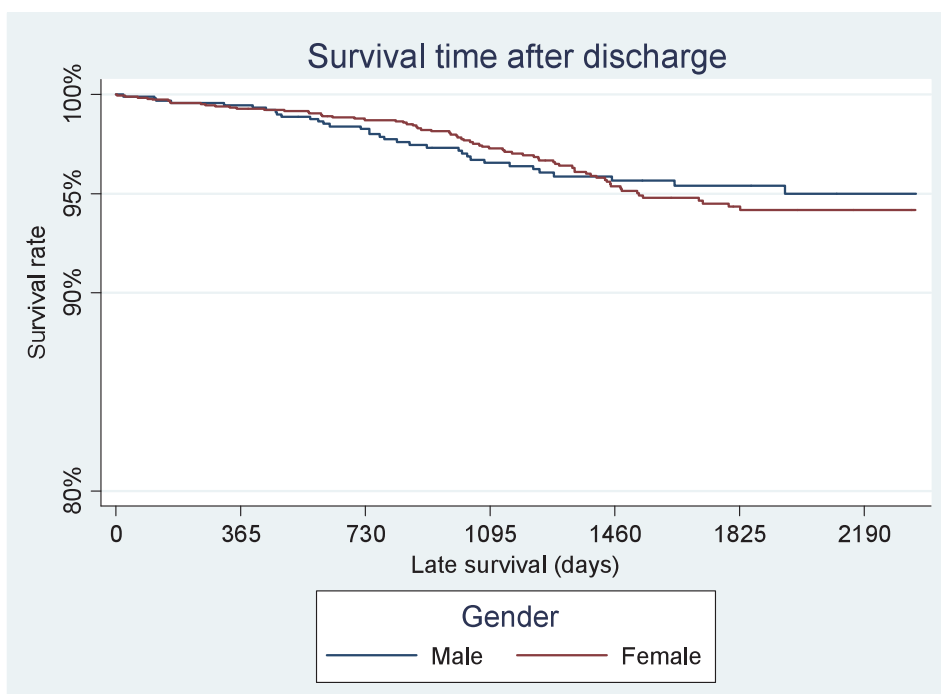
Year after discharge	1	2	3	4	5	6
No. at risk	2,764	2,584	2,242	1,814	1,315	857
No. of censor	162	323	397	474	449	631
No. of dead	18	19	31	25	9	2
Cumulative failure rate	0.7%	1.5%	3.0%	4.5%	5.3%	5.6%



### Late survival in adult by gender (n=2,764 missing 1.8%)

(Total case = 2,814 are alive at discharge)

Late survival after hospital discharge in adult showing early two years male gender dies more than female but dies less in the subsequent years. The 6<sup>th</sup> year survival rate in male is 95.0% (95% CI: 92.9% - 96.5%), and female is 94.2% (95% CI: 92.6% - 95.4%).



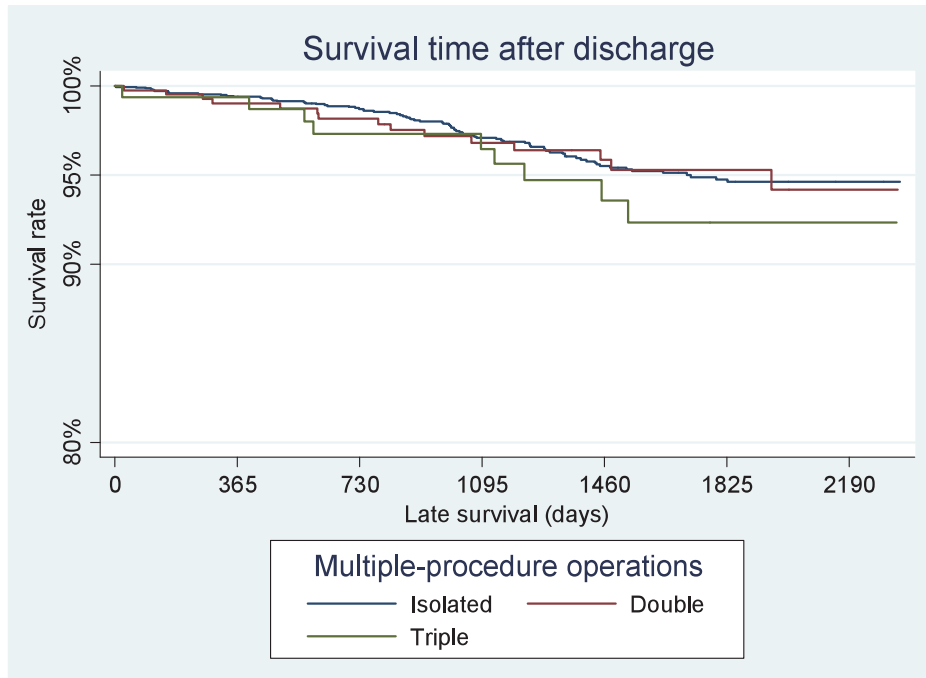
Year after discharge	1	2	3	4	5	6
<b>Male (n=936)</b>						
No. at risk	936	875	761	614	443	298
No. of censor	56	104	135	166	144	219
No. of dead	5	10	12	5	1	1
Cumulative failure rate	0.5%	1.7%	3.5%	4.4%	4.6%	5.0%
<b>Female (n=1,828)</b>						
No. at risk	1,828	1,710	1,482	1,201	872	560
No. of censor	105	219	262	309	304	559
No. of dead	13	9	19	20	8	1
Cumulative failure rate	0.7%	1.3%	2.7%	4.6%	5.7%	5.8%



### Late survival in adult by multiple-procedure operations (n=2,735 missing 2.8%)

(Total case = 2,814 are alive at discharge)

In adult, late survival after hospital discharge is poorer in multiple-procedure operations. The 6<sup>th</sup> year survival rate of isolated is 94.6% (95% CI: 93.3% - 95.7%), double is 94.2% (95% CI: 89.8% - 96.7%), and triple is 92.3% (95% CI: 85.5% - 96.0%).



Year after discharge	1	2	3	4	5	6
<b>Isolated (n=2,159)</b>						
No. at risk	2,159	2,036	1,770	1,436	1,056	694
No. of censor	110	253	308	360	355	505
No. of dead	13	13	26	20	7	1
Cumulative failure rate	0.6%	1.3%	2.9%	4.5%	5.3%	5.4%
<b>Double (n=417)</b>						
No. at risk	417	381	325	251	171	116
No. of censor	32	53	70	78	54	115
No. of dead	4	3	4	2	1	1
Cumulative failure rate	1.0%	1.8%	3.2%	4.2%	4.7%	5.8%
<b>Triple (n=159)</b>						
No. at risk	159	150	134	118	83	42
No. of censor	8	13	15	32	40	42
No. of dead	1	3	1	3	1	0
Cumulative failure rate	0.6%	2.7%	3.5%	6.4%	7.7%	7.7%





# Chapter 10



## Workload of payers and mortality category

- 83% of congenital heart surgery are paid by Universal Health Coverage Scheme, 5% by Civil Service, 4% by Self Payment, 3% by Social Security, 5% by Other sources and less than 1% by Private Insurance.
- Regarding type of payers and mortality risk, in mortality category 1, Private Insurance has 88%, Social Security 84%, Civil Service 63%, Other (62%), Universal Health Coverage 61% and Self Payment 50%.
- In mortality category 2, Universal Health Coverage, Self Payment, and Other share similar number of patients 25%, 25% and 24% while Social Security as only 12% of patients.
- In mortality category 3, Self Payment has 12%, Civil Service 9%, Universal health Coverage 9%, Other (7%), Private Insurance 6% and Social Security 3%.
- In mortality category 4, the leading percentage go to Self Payment (12%), Other (7%), Universal Health Coverage (5%), Civil Service (4%), Social Service (1%) and Private Insurance (none).
- In mortality category 5, less than 1% of workload is in each category.

Type of payment (n=13,099)

Type of payer	n	Percentage
Universal health coverage (UHC)	10,927	83.4
Social security (SS)	356	2.7
Civil servant (CS)	713	5.4
Self payment (SP)	481	3.7
Private insurance (PI)	17	0.1
Others	605	4.6
Total	13,099	100.0
Missing	0	



Workload by age and type of payer (n=13,081)

Age	UHC	SS	CS	SP	PI	Other	Total
Newborn	81.4%	0.1%	4.0%	9.3%		5.2%	6.0%
	637	1	31	73		41	783
Infant	85.9%	0.1%	3.9%	4.6%	0.1%	5.4%	18.8%
	2,116	3	95	113	3	133	2,463
Pre school	84.9%	0.1%	5.1%	4.2%	0.1%	5.5%	18.6%
	2,067	2	125	103	3	134	2,434
School age	85.8%	0.0%	5.4%	3.2%	0.1%	5.5%	25.3%
	2,845	1	179	105	2	184	3,316
Grown up	86.6%		5.1%	2.2%	-	6.1%	8.9%
	1,012		60	26		71	1,169
Adult	76.6%	11.9%	7.6%	2.1%	0.3%	1.4%	22.3%
	2,235	348	222	60	9	42	2,916
Total	83.4%	2.7%	5.4%	3.7%	0.1%	4.6%	100.00%
	10,912	355	712	480	17	605	13,081
Missing	0.1% (18)						

Type of payer and mortality category (n=12,957)

Mortality category	UHC	SS	CS	SP	PI	Other	Total
1	60.7%	83.9%	63.1%	50.1%	88.2%	61.9%	61.1%
	6,553	297	445	239	15	374	7,923
2	25.0%	11.6%	23.3%	24.7%	5.9%	23.5%	24.5%
	2,703	41	164	118	1	142	3,169
3	8.9%	3.1%	9.2%	12.2%	5.9%	6.5%	8.7%
	958	11	65	58	1	39	1,132
4	4.9%	1.4%	4.0%	12.4%	0.0%	7.3%	5.1%
	528	5	28	59	0	44	664
5	0.5%	0.0%	0.4%	0.6%	0.0%	0.8%	0.5%
	58	0	3	3	0	5	69
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	10,800	354	705	477	17	604	12,957
Missing	1.1% (142)						



Type of payer and in-hospital mortality (n=12,586)

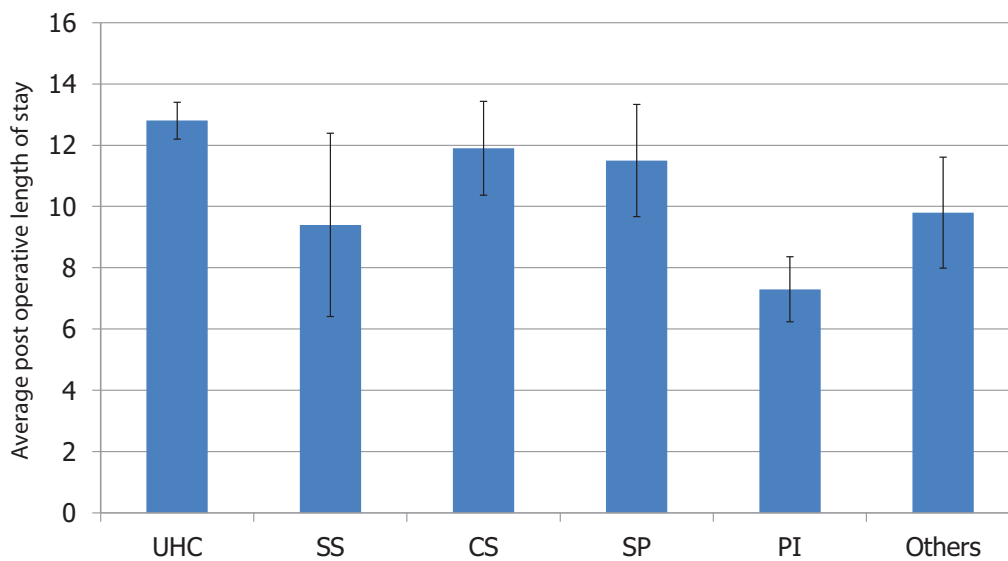
Type of payer	All	Alive	Dead	95% CI
Universal health coverage	83.5%	94.1%	5.9%	5.5-6.4
	10,509	9,888	621	
Social security	2.8%	98.9%	1.1%	0.3-2.9
	350	346	4	
Civil servant	5.3%	94.5%	5.5%	3.9-7.5
	672	635	37	
Self payment	3.5%	91.6%	8.4%	6.0-11.4
	441	404	37	
Private insurance	0.1%	100.0%	0.0%	-
	17	17	0	
Others	4.7%	96.1%	3.9%	2.5-5.7
	597	574	23	
Total	100.0%	94.3%	5.7%	5.3-6.2
	12,586	11,864	722	
Missing	3.9% (513)			

Type of payer and postoperative length of stay (n=12,338)

Type of payer	n	Mean	95% CI	SD
Universal health coverage	10,290	12.8	12.2-13.4	29.9
Social Security	347	9.4	6.4-12.4	28.2
Civil servant	652	11.9	10.4-13.3	19.2
Self payment	437	11.5	9.7-13.4	19.9
Private insurance	17	7.3	6.2-8.4	2.1
Others	595	9.8	8.0-11.5	21.9
Total	12,338	12.4	11.9-12.9	28.7
Missing	5.8% (761)			



Type of payer and postoperative length of stay (n=12,338)





## Workload of payers in newborn

- Regarding workload sharing, Universal Health Coverage takes care 87% of congenital heart surgery in children up to 15 years of age and 77% in adult congenital heart surgery.
- The trend of newborn surgery supported by Universal Health Coverage shows increasing percentage from 79% in 2006 to 84% in 2011, having the highest peak of 89% in 2008.
- The trend of Self Payment in newborn surgery is the second highest in 2006 (14%) with peak to 16% in 2007 decreasing to 7% in 2011.
- The trend of Civil Service in newborn surgery decreases from 5% in 2006 to nearly 5% in 2011.
- In newborn, the in-hospital mortality rate in Universal Health Coverage is 23% with the workload of 82% while Self Payment having the workload of 8% having similar mortality rate; Civil Service with the workload of 4% has the mortality rate of 39%.

Newborn patients (0-30 day): Type of payer and calendar year (n=782)

Year	UHC	CS	SP	Other
2006	78.7%	5.3%	14.0%	2.0%
	118	8	21	3
2007	78.8%	2.7%	16.4%	2.1%
	115	4	24	3
2008	89.8%	1.6%	5.5%	3.1%
	114	2	7	4
2009	78.4%	4.6%	7.8%	9.2%
	120	7	12	14
2010	81.2%	5.1%	2.6%	11.1%
	95	6	3	13
2011	84.3%	4.5%	6.7%	4.5%
	75	4	6	4
Total	81.4%	4.0%	9.3%	5.2%
	637	31	73	41
Missing	0			



Newborn patients (0-30 day): Type of payer and in-hospital mortality (n=700)

Type of payer	All	Alive	Dead	95% CI
Universal health coverage	82.1%	77.2%	22.8%	19.4-26.4
	575	444	131	
Civil servant	4.0%	60.7%	39.3%	21.5-59.4
	28	17	11	
Self payment	8.0%	76.8%	23.2%	13.0-36.4
	56	43	13	
Other	5.9%	82.9%	17.1%	7.2-32.1
	41	34	7	
Total	100.0%	76.9%	23.1%	20.0-26.4
	700	538	162	
Missing	10.5% (82)			

Newborn patients (0-30 day): Type of payer, mortality category and observed in-hospital mortality (n=693)

Mortality category	UHC		CS		SP		Other	
	All	Dead	All	Dead	All	Dead	All	Dead
1	22.4%	9.4%	14.3%	0.0%	14.3%	0.0%	22.0%	0.0%
	127	12	4	0	8	0	9	0
2	34.5%	15.8%	25.0%	28.6%	19.6%	9.1%	22.0%	0.0%
	196	31	7	2	11	1	9	0
3	13.6%	26.0%	35.7%	40.0%	10.7%	33.3%	12.2%	0.0%
	77	20	10	4	6	2	5	0
4	25.2%	37.1%	25.0%	71.4%	53.6%	30.0%	36.6%	26.7%
	143	53	7	5	30	9	15	4
5	4.4%	48.0%			1.8%	100.0%	7.3%	100.0%
	25	12			1	1	3	3
Total	100.0%	22.5%	100.0%	39.3%	100.0%	23.2%	100.0%	17.1%
	568	128	28	11	56	13	41	7
Missing	11.4% (89)							



## Type of payer and postoperative length of stay in newborn

- The mean stay is 23 days, while the longest is 34 days with the patients under Civil Servant.
- The shortest stay is 15 days with the patients under Other.
- The stay of patients under Universal health Coverage is 23 days and under Self payment 17 days.

Newborn patients (0-30 day): Type of payer and postoperative length of stay (n=661)

Type of payer	n	Mean	95% CI	SD
Universal health coverage	542	23.2	19.7-26.7	41.5
Civil servant	24	34.3	16.4-52.3	42.5
Self payment	54	16.9	12.0-21.8	18.1
Others	41	14.6	9.6-19.6	15.9
Total	662	22.5	19.5-25.5	39.1
Missing	15% (121)			





## Workload of payer in infants

- Universal Health Coverage is the main payer of infant surgery (86%) comparing to the other types of payers; Self Payment is 5% which is similar to Civil Servant. The in-hospital mortality rate of patients under Universal Health Coverage (12%) is similar to Civil Servant (12%); each has twice mortality rate of Self Payment (6%).
- Most of patient in all types of payer are in category 1 with descending numbers in subsequent categories respectively.
- Overall, infants have the mortality rate of 5% for mortality category 1, 12% for mortality category 2, 23% for mortality category 3, 24% for mortality category 4 and 77% for mortality category 5.

Infant patients (31-365 day): Type of payer and calendar year (n=2,457)

Year	UHC	CS	SP	Other
2006	87.8%	4.2%	6.4%	1.5%
	397	19	29	7
2007	86.5%	3.8%	5.3%	4.4%
	437	19	27	22
2008	87.4%	2.3%	4.5%	5.8%
	346	9	18	23
2009	81.7%	4.4%	3.5%	10.4%
	352	19	15	45
2010	88.1%	3.9%	2.9%	5.1%
	364	16	12	21
2011	84.6%	5.0%	4.6%	5.8%
	220	13	12	15
Total	100.0%	100.0%	100.0%	100.0%
	2,116	95	113	133
Missing	0			



Infant patients (31-365 day): Type of payer and in-hospital mortality (n=2,340)

Type of payer	All	Alive	Dead	95% CI
Universal health coverage	86.3%	87.9%	12.1%	10.7-13.6
	2,020	1,775	245	
Civil servant	3.6%	88.1%	11.9%	5.9-20.8
	84	74	10	
Self payment	4.4%	94.2%	5.8%	2.1-12.1
	104	98	6	
Others	5.6%	92.4%	7.6%	3.7-13.5
	132	122	10	
Total	100.0%	88.4%	11.6%	10.3-12.9
	2,340	2,063	271	
Missing	4.8% (117)			

Infant patients (31-365 day): Type of payer, mortality category and observed in-hospital mortality (n=2,325)

Mortality category	UHC		CS		SP		Other	
	All	Dead	All	Dead	All	Dead	All	Dead
1	56.1%	5.9%	55.4%	6.5%	53.4%	1.8%	62.1%	1.2%
	1,125	66	46	3	55	1	82	1
2	20.4%	13.4%	21.7%	0.0%	25.2%	0.0%	13.6%	11.1%
	409	55	18	0	26	0	18	2
3	13.9%	21.9%	10.8%	33.3%	9.7%	20.0%	9.1%	41.7%
	279	61	9	3	10	2	12	5
4	8.6%	26.2%	9.6%	25.0%	10.7%	18.2%	14.4%	5.3%
	172	45	8	2	11	2	19	1
5	1.1%	72.7%	2.4%	100.0%	1.0%	100.0%	0.8%	100.0%
	22	16	2	2	1	1	1	1
Total	100.0%	12.1%	100.0%	12.0%	100.0%	5.8%	100.0%	7.6%
	2,007	243	83	10	103	6	132	10
Missing	5.4% (132)							



## Workload of payer in pre school age

- Universal Health Coverage takes care 85% of pre school age with 5% mortality rate.
- Civil Servant takes care 5% of pre school age with 5% mortality rate, while Self Payment having 5% workload with 4% mortality rate.
- Most proportion of patients in all types of payer are patients of mortality category 1, less are patients of mortality category 2 and 3 but least are mortality category 4 and 5.

Pre school patients (>1-3 year): Type of payer and calendar year (n=2,429)

Year	UHC	CS	SP	Other
2006	87.1%	6.0%	4.4%	2.4%
	393	27	20	11
2007	86.6%	4.6%	4.8%	4.0%
	452	24	25	21
2008	86.3%	4.3%	3.9%	5.2%
	397	20	18	24
2009	83.4%	5.3%	3.4%	7.7%
	316	20	13	29
2010	82.0%	4.3%	5.4%	7.8%
	306	16	20	29
2011	81.5%	7.2%	2.8%	8.0%
	203	18	7	20
Total	84.9%	5.1%	4.2%	5.5%
	2,067	125	103	134
Missing	0			



Pre school patients (>1-3 year): Type of payer and in-hospital mortality (n=2,336)

Type of payer	All	Alive	Dead	95% CI
Universal health coverage	85.1%	95.5%	4.5%	3.7-5.5
	1,989	1,899	90	
Civil servant	5.1%	94.9%	5.1%	1.9-10.7
	118	112	6	
Self payment	4.2%	93.8%	6.2%	2.3-13.0
	97	91	6	
Other	5.6%	98.5%	1.5%	0.2-5.4
	132	130	2	
Total	100.0%	95.6%	4.5%	3.6-5.4
	2,336	2,237	104	
Missing	3.8% (93)			

Pre school patients (>1-3 year): Type of payer, mortality category and observed in-hospital mortality (n=2,317)

Mortality category	UHC		CS		SP		Other	
	All	Dead	All	Dead	All	Dead	All	Dead
1	60.0%	1.5%	53.8%	3.2%	61.9%	0.0%	62.9%	0.0%
	1,182	18	63	2	60	0	83	0
2	30.4%	6.8%	32.5%	5.3%	21.6%	14.3%	30.3%	2.5%
	599	41	38	2	21	3	40	1
3	7.3%	15.3%	11.1%	0.0%	12.4%	8.3%	3.0%	0.0%
	144	22	13	0	12	1	4	0
4	2.2%	14.0%	2.6%	66.7%	4.1%	50.0%	3.0%	0.0%
	43	6	3	2	4	2	4	0
5	0.2%	100.0%	0	0	0	0	3.0%	100.0%
	3	3	0	0	0	0	4	4
Total	100.0%	4.6%	100.0%	5.1%	100.0%	6.2%	100.0%	1.5%
	1,971	90	117	6	97	6	132	2
Missing	4.6% (112)							



## Workload of payer in School age, Grown up and Adult

- Similar patterns are workload of payers in school age and grown up.
- But in adult congenital heart surgery, most proportions of payer are Universal Health Coverage (77%) and Social Security (12%); the proportions of other payer are small.
- Most payers of adult congenital heart surgery, are mortality category 1 (83%), mortality category 2 (13%), mortality category 3 (3%), mortality category 4 (1%) and none in category 5.

School age patients (>3-10 year): Type of payer and calendar year (n=3,312)

Year	UHC	CS	SP	Other
2006	88.5%	6.0%	2.5%	3.1%
	576	39	16	20
2007	85.7%	6.0%	2.5%	5.8%
	576	40	17	39
2008	88.3%	4.4%	3.2%	4.1%
	580	29	21	27
2009	84.0%	4.8%	4.0%	7.2%
	421	24	20	36
2010	82.8%	5.5%	3.2%	8.1%
	390	26	15	38
2011	83.0%	5.8%	4.4%	6.6%
	302	21	16	24
Total	85.8%	5.4%	3.2%	5.5%
	2,845	179	105	184
Missing	0			



School age patients (>3-10 year): Type of payer and in-hospital mortality (n=3,196)

Type of payer	All	Alive	Dead	95% CI
Universal health coverage	85.8%	96.5%	3.5%	2.8-4.2
	2,745	2,649	96	
Civil servant	5.3%	95.9%	4.1%	1.7-8.3
	170	163	7	
Self payment	3.2%	92.1%	7.9%	3.5-15.0
	101	93	8	
Others	5.6%	98.9%	1.1%	0.1-4.0
	180	178	2	
Total	100.0%	96.5%	3.5%	2.9-4.2
	3,196	3,083	113	
Missing	3.5% (116)			

School age patients (>3-10 year): Type of payer, mortality category and in-hospital mortality (n=3,169)

Mortality category	UHC		CS		SP		Other	
	All	Dead	All	Dead	All	Dead	All	Dead
1	56.3%	0.3%	55.4%	1.1%	48.0%	0.0%	67.0%	0.8%
	1,532	4	93	1	48	0	120	1
2	32.1%	5.5%	32.7%	1.8%	37.0%	10.8%	26.3%	2.1%
	874	48	55	1	37	4	47	1
3	8.8%	10.4%	10.1%	29.4%	12.0%	16.7%	5.6%	0.0%
	240	25	17	5	12	2	10	0
4	2.7%	20.5%	1.8%	0.0%	3.0%	66.7%	1.1%	0.0%
	73	15	3	0	3	2	2	0
5	0.1%	66.7%	0	0	0	0	0	0
	3	2	0	0	0	0	0	0
Total	100.0%	4.6%	100.0%	5.1%	100.0%	6.2%	100.0%	1.5%
	2,722	90	168	6	100	6	179	2
Missing	4.3% (143)							



Grown up patients (10-15 year): Type of payer and calendar year (n=1,169)

Year	UHC	CS	SP	Other	Total
2006	88.7%	5.7%	2.0%	3.6%	21.1%
	219	14	5	9	247
2007	86.1%	6.7%	2.0%	5.2%	21.6%
	217	17	5	13	252
2008	87.9%	7.0%	1.4%	3.7%	18.3%
	188	15	3	8	214
2009	85.5%	3.6%	3.0%	7.8%	14.2%
	142	6	5	13	166
2010	85.6%	2.4%	1.8%	10.2%	14.3%
	143	4	3	17	167
2011	83.7%	3.3%	4.1%	8.9%	10.5%
	103	4	5	11	123
Total	86.6%	5.1%	2.2%	6.1%	100.0%
	1,012	60	26	71	1,169
Missing	0				

Grown up patients (10-15 year): Type of payer and in-hospital mortality (n=1,125)

Type of payer	All	Alive	Dead	95% CI
Universal health coverage	86.6%	97.8%	2.2%	1.3-3.3
	974	953	21	
Civil servant	5.1%	98.2%	1.8%	0.04-9.4
	57	56	1	
Self payment	2.0%	95.7%	4.3%	0.1-21.9
	23	22	1	
Others	6.3%	98.6%	1.4%	0.04-7.6
	71	70	1	
Total	100.0%	97.9%	2.1%	1.4-3.2
	1,125	1,101	24	
Missing	3.8% (44)			



Grown up patients (10-15 year): Type of payer, mortality category and in-hospital mortality (n=1,121)

Mortality category	UHC		CS		SP		Other	
	All	Dead	All	Dead	All	Dead	All	Dead
1	64.8%	0.5%	56.1%	0.0%	47.8%	0.0%	64.8%	2.2%
	629	3	32	0	11	0	46	1
2	22.2%	3.3%	28.1%	0.0%	17.4%	0.0%	29.6%	0.0%
	215	7	16	0	4	0	21	0
3	9.5%	6.5%	12.3%	0.0%	21.7%	0.0%	4.2%	0.0%
	92	6	7	0	5	0	3	0
4	3.3%	12.5%	3.5%	50.0%	8.7%	0.0%	1.4%	0.0%
	32	4	2	1	2	0	1	0
5	0.2%	50.0%	0	0	0	100.0%	0	0
	2	1	0	0	1	1	0	0
Total	100.0%	4.6%	100.0%	5.1%	100.0%	6.2%	100.0%	1.5%
	970	90	57	6	23	6	71	2
Missing	4.1% (48)							

Adult patients (>15 year): Type of payer and calendar year (n=2,907)

Year	UHC	CS	SP	Other	Total
2006	75.8%	13.3%	8.4%	1.4%	0.9%
	524	92	58	10	6
2007	76.8%	12.1%	8.6%	1.6%	0.7%
	431	68	48	9	4
2008	80.6%	8.9%	8.1%	1.6%	0.8%
	416	46	42	8	4
2009	74.6%	12.0%	6.6%	2.8%	4.0%
	318	51	28	12	17
2010	76.6%	12.4%	5.6%	2.3%	2.0%
	302	49	22	9	8
2011	74.4%	12.8%	7.3%	3.7%	0.9%
	244	42	24	12	3
Total	76.6%	11.9%	7.6%	2.1%	1.4%
	2,235	348	222	60	42
Missing	0				





Adult patients (>15 year): Type of payer and in-hospital mortality (n=2,862)

Type of payer	All	Alive	Dead	95% CI
Universal health coverage	76.7%	98.3%	1.7%	1.2-2.4
	2,196	2,158	38	
Social security	11.9%	98.8%	1.2%	0.3-3.0
	342	338	4	
Civil servant	7.5%	99.1%	0.9%	0.1-3.3
	215	213	2	
Self payment	2.1%	94.9%	5.1%	1.1-14.1
	59	56	3	
Others	1.4%	97.6%	2.4%	0.06-12.9
	41	40	1	
Total	100.0%	98.3%	1.7%	1.2-2.2
	2,853	2,805	48	
Missing	1.9% (54)			

Adult patients (>15 year): type of payer, mortality category and in-hospital mortality (n=2,821)

Mortality category	UHC		SS		CS		SP		Other	
	All	Dead	All	Dead	All	Dead	All	Dead	All	Dead
1	82.5%	0.7%	84.5%	0.3%	88.7%	0.0%	81.0%	2.1%	70.7%	0.0%
	1,789	13	288	1	189	0	47	1	29	0
2	12.8%	5.1%	11.4%	5.1%	8.9%	10.5%	12.1%	0.0%	12.2%	0.0%
	277	14	39	2	19	2	7	0	5	0
3	3.4%	6.8%	2.9%	0.0%	1.4%	0.0%	5.2%	33.3%	9.8%	0.0%
	73	5	10	0	3	0	3	1	4	0
4	1.3%	10.3%	1.2%	25.0%	0.9%	0.0%	1.7%	100.0%	7.3%	33.3%
	29	3	4	1	2	0	1	1	3	1
Total	100.0%	4.6%	100.0%	4.6%	100.0%	5.1%	100.0%	6.2%	100.0%	1.5%
	2,168	90	341	90	213	6	58	6	41	2
Missing	3.0% (86)									





# Appendices



The Society of Thoracic Surgeons  
Congenital Cardiac Surgery Database  
Data Collection Form  
Version 2.30

Data Collection Form

**ADMINISTRATIVE**

Participant ID:	Hospital Name:		
Operation ID:	SSN: - - - - -	MRN: - - - - -	Patient ID: (software generated)
Last Name:	First Name:	MI:	Country:
Address:	City:	State/Province:	Postal Code:
DOB: (mm/dd/yyyy) _/ _/ _	Age (in days):	Gender (check one): <input type="checkbox"/> M <input type="checkbox"/> F <input type="checkbox"/> Ambiguous	
Race (check one): <input type="checkbox"/> Caucasian <input type="checkbox"/> Black <input type="checkbox"/> Hispanic <input type="checkbox"/> Asian <input type="checkbox"/> Native American <input type="checkbox"/> Other			

**HOSPITALIZATION**

Admission date: (mm/dd/yyyy) _/ _/ _	Surgery date: (mm/dd/yyyy) _/ _/ _	Discharge date: (mm/dd/yyyy) _/ _/ _
Height (Cm):	Weight (Kg):	
Attending Cardiologist:	Attending Pediatrician/Physician:	
Clinic:	Clinic:	
Address:	Address:	
City:	State:	Zip:
	City:	State:
		Zip:

**Non-Cardiac Abnormalities**

None
Or check all that apply
<input type="checkbox"/> Asplenia
<input type="checkbox"/> Polysplenia
<input type="checkbox"/> Down syndrome
<input type="checkbox"/> Turner syndrome
<input type="checkbox"/> DiGeorge
<input type="checkbox"/> Williams-Beuren syndrome
<input type="checkbox"/> Alagille syndrome (intrahepatic biliary duct agenesis)
<input type="checkbox"/> 22q11 deletion
<input type="checkbox"/> Other chromosomal/syndromic abnormality
<input type="checkbox"/> Rubella
<input type="checkbox"/> Marfan syndrome
<input type="checkbox"/> Other noncardiac abnormality

**Pre-Operative Risk Factors**

None
Or check all that apply
<input type="checkbox"/> Preoperative mechanical circulatory support (IABP, VAD, ECMO, or CPS)
<input type="checkbox"/> Preoperative complete AV block
<input type="checkbox"/> Preoperative arrhythmia
<input type="checkbox"/> Preoperative shock
<input type="checkbox"/> Preoperative acidosis
<input type="checkbox"/> Preoperative pulmonary hypertension crises (PA pressure > systemic pressure)
<input type="checkbox"/> Preoperative mechanical ventilatory support
<input type="checkbox"/> Preoperative tracheostomy
<input type="checkbox"/> Preoperative renal failure (creatinine >2)
<input type="checkbox"/> Preoperative renal failure requiring dialysis
<input type="checkbox"/> Preoperative bleeding disorder
<input type="checkbox"/> Preoperative endocarditis
<input type="checkbox"/> Preoperative septicemia
<input type="checkbox"/> Preoperative neurological deficit
<input type="checkbox"/> Preoperative seizures
<input type="checkbox"/> Other preoperative risk factor

**DIAGNOSIS (see page 2 for list of diagnosis)**

Antenatal Diagnosis: <input type="checkbox"/> Yes <input type="checkbox"/> No
---

**INTRA-OPERATIVE AND PROCEDURE (see page 4 for list of procedures)**

Surgeon:	Resident:
Assistant surgeon:	Consultant Attending:
Is this operation a re-operation during this admission: <input type="checkbox"/> Yes <input type="checkbox"/> No (if yes →) <input type="checkbox"/> Planned <input type="checkbox"/> Unplanned	
Number of prior total cardi thoracic operations:	Number of prior open cardi thoracic operations:
Operation type: <input type="checkbox"/> CPB <input type="checkbox"/> No CPB, Cardiovascular <input type="checkbox"/> ECMO <input type="checkbox"/> Thoracic <input type="checkbox"/> Interventional Cardiology <input type="checkbox"/> Other	
Cross Clamp time (minutes):	CPB time (minutes):
	Circulatory Arrest time (minutes):

**POST-OPERATIVE DATA AND COMPLICATIONS (see page 7 for list of complications)**

Intubation date/time: (mm/dd/yyyy 00:00 – 23:59)	Extubation date/time: (mm/dd/yyyy 00:00 – 23:59)	Intubated and extubated in OR: <input type="checkbox"/> Yes <input type="checkbox"/> No
Reoperation after this operation during this admission: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Discharge Location: <input type="checkbox"/> Home <input type="checkbox"/> Acute Care Center <input type="checkbox"/> Chronic Care Center		
Mortality Discharge Status: <input type="checkbox"/> Alive <input type="checkbox"/> Dead		Status at 30 days after surgery: <input type="checkbox"/> Alive <input type="checkbox"/> Dead
(if dead →) Mortality Date: (mm/dd/yyyy) _/ _/ _		
Operative Mortality: <input type="checkbox"/> Yes <input type="checkbox"/> No		Mortality Assigned to this Operation: <input type="checkbox"/> Yes <input type="checkbox"/> No



DIAGNOSIS		
Check all diagnosis that apply. CIRCLE the ONE PRIMARY diagnosis for this operation.		
Septal Defects	ASD	PFO
		ASD, secundum
		ASD, sinus venosus
		ASD, coronary sinus
		ASD, common atrium (single atrium)
		ASD, NOS
	VSD	VSD, single
		VSD, multiple
		VSD, NOS
	AV Canal	AVC (AVSD), complete CAVSD
		AVC (AVSD), intermediate (transitional)
		AVC (AVSD), partial (incomplete) (PAVSD) (ASD, primum)
		AVC (AVSD), NOS
	AP Window	AP window (aortopulmonary window)
Pulmonary artery origin from ascending aorta (hemitruncus)		
Truncus Arteriosus	Truncus arteriosus	
	Truncal valve insufficiency	
Pulmonary Venous Anomalies	Partial Anomalous Pulm Venous	Partial anomalous pulmonary venous connection (PAPVC)
		Partial anomalous pulmonary venous connection (PAPVC), scimitar
	Total Anomalous Pulm Venous	Total anomalous pulmonary venous connection (TAPVC), type 1 (supracardiac)
		Total anomalous pulmonary venous connection (TAPVC), type 2 (cardiac)
		Total anomalous pulmonary venous connection (TAPVC), type 3 (infracardiac)
		Total anomalous pulmonary venous connection (TAPVC), type 4 (mixed)
Total anomalous pulmonary venous connection (TAPVC), NOS		
Cor Triatriatum	Cor triatriatum	
Pulmonary Venous Stenosis	Pulmonary venous stenosis	
Systemic Venous Anomalies	Anomalous Systemic Venous Connection	Systemic venous anomaly
		Systemic venous obstruction
Right Heart Lesions	Tetralogy	TOF
		TOF, AVC (AVSD)
		TOF, absent pulmonary valve
	Pulmonary Atresia	Pulmonary atresia
		Pulmonary atresia, IVS
		Pulmonary atresia, VSD (including TOF, PA)
		Pulmonary atresia, VSD-MAPCA (pseudotruncus)
		MAPCA(s) (major aortopulmonary collateral[s]) (without PA-VSD)
	Tricuspid Valve Disease and Ebstein's Anomaly	Ebstein's anomaly
		Tricuspid regurgitation, non-Ebstein's related
		Tricuspid stenosis
		Tricuspid regurgitation and tricuspid stenosis
		Tricuspid valve, other
	RVOT Obstruction, IVS Pulmonary Stenosis	Pulmonary stenosis, valvar
		Pulmonary artery stenosis (hypoplasia), main (trunk)
		Pulmonary artery stenosis, branch, central
		Pulmonary artery stenosis, branch, peripheral (beyond the hilar bifurcation)
		Pulmonary artery stenosis, NOS
		Pulmonary artery, discontinuous
		Pulmonary stenosis, NOS
		Pulmonary stenosis, subvalvar
		DCRV
	Pulmonary Valve Disease	Pulmonary valve, other
		Pulmonary insufficiency
		Pulmonary insufficiency and pulmonary stenosis
	Conduit failure	Conduit failure
	Left Heart Lesions	Aortic Valve Disease
Aortic stenosis, valvar		
Aortic stenosis, supra-valvar		
Aortic stenosis, NOS		
Aortic valve atresia		



Left Heart Lesions (continued)	Aortic Valve Disease (continued)	Aortic insufficiency
		Aortic insufficiency and aortic stenosis
		Aortic valve, other
	Sinus of Valsalva Fistula/Aneurysm	Sinus of Valsalva aneurysm
	LV to Aorta Tunnel	LV to aorta tunnel
	Mitral Valve Disease	Mitral stenosis, supraaortic mitral ring
		Mitral stenosis, valvar
		Mitral stenosis, subvalvar
		Mitral stenosis, subvalvar, parachute
		Mitral stenosis, NOS
		Mitral regurgitation and mitral stenosis
		Mitral regurgitation
	Mitral valve, other	
	Hypoplastic Left Heart Syndrome	Hypoplastic left heart syndrome (HLHS)
Cardiomyopathy	Cardiomyopathy	
	Cardiomyopathy, end stage congenital heart disease	
Pericardial Disease	Pericardial effusion	
	Pericarditis	
	Pericardial disease, other	
Single Ventricle	Single ventricle, DILV	
	Single ventricle, DIRV	
	Single ventricle, mitral atresia	
	Single ventricle, tricuspid atresia	
	Single ventricle, unbalanced AV canal	
	Single ventricle, heterotaxia syndrome	
	Single ventricle, other	
	Single ventricle, NOS	
Transposition of the Great Arteries	Congenitally Corrected TGA	Congenitally corrected TGA
	Transposition of the Great Arteries	TGA, IVS
		TGA, IVS-LVOTO
		TGA, VSD
		TGA, VSD-LVOTO
TGA, NOS		
DORV	DORV, VSD type	
	DORV, TOF type	
	DORV, TGA type	
	DORV, remote VSD (uncommitted VSD)	
	DORV, NOS	
DOLV	DOLV	
Thoracic Arteries and Veins	Coarctation of Aorta (all types)	Coarctation of aorta
		Aortic arch hypoplasia
	Coronary Artery Anomalies	Coronary artery anomaly, anomalous aortic origin
		Coronary artery anomaly, anomalous pulmonary origin (includes ALCAPA)
		Coronary artery anomaly, fistula
		Coronary artery anomaly, aneurysm
		Coronary artery anomaly, other
	Coronary artery anomaly, NOS	
	Interrupted Arch	Interrupted aortic arch
	Patent Ductus Arteriosus	Patent ductus arteriosus
Vascular rings and Slings	Vascular ring	
	Pulmonary artery sling	
Aortic Aneurysm	Aortic aneurysm (including pseudoaneurysm)	
Aortic Dissection	Aortic dissection	
Lung Disease	Lung Disease	Lung disease, benign
		Lung disease, malignant
	Pectus Excavatum, Carinatum	Pectus
	Tracheal Stenosis	Tracheal stenosis
Electrophysiologic		Arrhythmia
		Arrhythmia, heart block, acquired
		Arrhythmia, heart block, congenital



Electrophysiologic (continued)		Arrhythmia, heart block, NOS
		Arrhythmia, pacemaker, indication for replacement
Miscellaneous, Other		Atrial isomerism, left
		Atrial isomerism, right
		Aneurysm, ventricular, right
		Aneurysm, ventricular, left
		Aneurysm, pulmonary artery
		Aneurysm, other
		Hypoplastic RV
		Hypoplastic LV
		Mediastinitis
		Endocarditis
		Prosthetic valve failure
		Myocardial infarction
		Cardiac tumor
		Pulmonary AV fistula
		Pulmonary embolism
		Pulmonary vascular obstructive disease, NOS
		Pulmonary vascular obstructive disease (Eisenmenger's)
		Primary pulmonary hypertension
		Persistent fetal circulation
		Meconium aspiration
		Pleural disease, benign
		Pleural disease, malignant
		Pneumothorax
		Pleural effusion
		Chylothorax
		Empyema
		Esophageal disease, benign
		Esophageal disease, malignant
		Mediastinal disease, benign
		Mediastinal disease, malignant
		Mediastinal disease, NOS
		Diaphragm paralysis
		Diaphragm disease, other
		Cardiac, other
	Thoracic and/or mediastinal, other	
	Peripheral vascular, other	
	Normal heart	
	Miscellaneous, other	

### PROCEDURES

Check all procedures that apply. CIRCLE the ONE PRIMARY procedure for this operation.

Septal Defects	ASD	PFO, primary closure
		ASD repair, primary closure
		ASD repair, patch
		ASD repair, device
		ASD, common atrium (single atrium), septation
		ASD creation/enlargement
		ASD partial closure
		Atrial septal fenestration
		ASD repair, NOS
		VSD
	VSD repair, patch	
	VSD repair, device	
	VSD, multiple, repair	
	VSD creation/enlargement	
	Ventricular septal fenestration	
	VSD repair, NOS	
	AV Canal	AVC (AVSD) repair, complete (CAVSD)
		AVC (AVSD) repair, intermediate (transitional)
		AVC (AVSD) repair, partial (incomplete) (PAVSD)
		AVC (AVSD) repair, NOS
	AP Window	AP window repair
		Pulmonary artery origin from ascending aorta (hemitruncus) repair



The Society of Thoracic Surgeons of Thailand  
First National Congenital Cardiac Surgical Database Report

Data Collection Form

Septal Defects (continued)	Truncus Arteriosus	Truncus arteriosus repair
		Valvuloplasty, truncal valve
		Valve replacement, truncal
Pulmonary Venous Anomalies	Partial Anomalous Pulm Venous Conn	PAPVC repair
		PAPVC, scimitar, repair
	Total Anomalous Pulm Venous Conn	TAPVC repair
Cor Triatriatum		Cor triatriatum repair
Pulmonary Venous Stenosis		Pulmonary venous stenosis repair
Systemic Venous Anomalies	Anomalous Systemic Venous Connection	Atrial baffle procedure (non-Mustard, non-Senning)
		Atrial baffle procedure, NOS
		Anomalous systemic venous connection repair
		Systemic venous stenosis repair
Right Heart Lesions	Tetralogy of Fallot	TOF repair, no ventriculotomy
		TOF repair, ventriculotomy, nontransannular patch
		TOF repair, ventriculotomy, transannular patch
		TOF repair, RV-PA conduit
		TOF, AVC (AVSD), repair
		TOF, absent pulmonary valve, repair
		TOF repair, NOS
	Pulmonary Atresia	Pulmonary atresia-VSD (including TOF, PA), repair
		Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair
		Unifocalization MAPCA(s)
		Occlusion MAPCA(s)
	Tricuspid Valve Disease and Ebstein's Anomaly	Valvuloplasty, tricuspid
		Valve replacement, tricuspid (TVR)
		Valve closure, tricuspid (exclusion, univentricular approach)
		Valve excision, tricuspid (without replacement)
		Valve surgery, other, tricuspid
	RVOT Obstruction, IVS Pulmonary Stenosis	RVOT procedure
		1 1/2 ventricular repair
		PA, reconstruction (plasty), main (trunk)
		PA, reconstruction (plasty), branch, central
		PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)
		PA, reconstruction (plasty), NOS
		DCRV repair
	Pulmonary Valve Disease	Valvuloplasty, pulmonic
		Valve replacement, pulmonic (PVR)
		Valve excision, pulmonary (without replacement)
		Valve closure, semilunar
		Valve surgery, other, pulmonic
	Conduit Stenosis / Insufficiency	Conduit, reoperation
		Conduit, placement, RV to PA
		Conduit, placement, LV to PA
	Left Heart Lesions	Aortic Valve Disease
Valve replacement, aortic (AVR)		
Valve replacement, aortic (AVR), mechanical		
Valve replacement, aortic (AVR), bioprosthetic		
Valve replacement, aortic (AVR), homograft		
Aortic root replacement		
Aortic root replacement, mechanical		
Aortic root replacement, homograft		
Ross procedure		
Konno procedure		
Ross-Konno procedure		
Other annular enlargement procedure		
Aortic stenosis, subvalvar, repair		
Aortic stenosis, supra-valvar, repair		
Valve surgery, other, aortic		
Sinus of Valsalva Aneurysm		Sinus of Valsalva, aneurysm repair
LV to Aorta Tunnel		LV to aorta tunnel repair
Mitral Valve Disease		Valvuloplasty, mitral
		Mitral stenosis, supra-valvar mitral ring, repair
		Valve replacement, mitral (MVR)
		Valve surgery, other, mitral





Left Heart Lesions (continued)	Hypoplastic Left Heart	Norwood procedure
		HLHS biventricular repair
	Cardiomyopathy	Transplant, heart
		Transplant, heart and lung
		Partial left ventriculectomy (LV volume reduction surgery) (Batista)
	Constrictive Pericarditis	Pericardial drainage procedure
Pericardiectomy		
Pericardial procedure, other		
Single Ventricle		Fontan, atrio-pulmonary connection
		Fontan, atrio-ventricular connection
		Fontan, TCPC, lateral tunnel, fenestrated
		Fontan, TCPC, lateral tunnel, nonfenestrated
		Fontan, TCPC, lateral tunnel, NOS
		Fontan, TCPC, external conduit, fenestrated
		Fontan, TCPC, external conduit, nonfenestrated
		Fontan, TCPC, external conduit, NOS
		Fontan, other
		Fontan, NOS
Transposition of the Great Arteries	Congenitally Corrected TGA	Congenitally corrected TGA repair, atrial switch and ASO (double switch)
		Congenitally corrected TGA repair, atrial switch and Rastelli
		Congenitally corrected TGA repair, VSD closure
		Congenitally corrected TGA repair, VSD closure and LV to PA conduit
		Congenitally corrected TGA repair, other
	Congenitally corrected TGA repair, NOS	
	Transposition of the Great Arteries	Arterial switch operation (ASO)
		Arterial switch operation (ASO) and VSD repair
		Senning
		Mustard
Rastelli		
REV		
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)		
DORV		DORV, intraventricular tunnel repair
		DORV repair, NOS
DOLV		DOLV repair
Thoracic Arteries and Veins	Coarctation of Aorta	Coarctation repair, end to end
		Coarctation repair, end to end, extended
		Coarctation repair, subclavian flap
		Coarctation repair, patch aortoplasty
		Coarctation repair, interposition graft
		Coarctation repair, other
		Coarctation repair, NOS
		Aortic arch repair
	Coronary Artery Anomalies	Coronary artery fistula ligation
		Anomalous origin of coronary artery repair
		Coronary artery bypass
		Coronary artery procedure, other
	Interrupted Arch	Interrupted aortic arch repair
Patent Ductus Arteriosus	PDA closure, surgical	
	PDA closure, device	
	PDA closure, NOS	
Vascular Rings and Slings	Vascular ring repair	
	Pulmonary artery sling repair	
Aortic Aneurysm	Aortic aneurysm repair	
Aortic Dissection	Aortic dissection repair	
Lung Disease	Lung Disease	Lung biopsy
		Transplant, lung(s)
		Lung procedure, other
	Pectus Excavatum, Carinatum	Pectus repair
	Tracheal Stenosis	Tracheal procedure
Electrophysiologic		Pacemaker implantation, permanent
		Pacemaker procedure
		ICD (AICD) implantation
		ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure
		Arrhythmia surgery-atrial, surgical ablation
		Arrhythmia surgery-ventricular, surgical ablation
		Arrhythmia surgery, NOS



Interventional Cardiology Procedures		ASD creation, balloon septostomy (BAS) (Rashkind)
		ASD creation, blade septostomy
		Balloon dilation
		Stent placement
		Device closure
		RF ablation
Palliative Procedures		Coil embolization
		Shunt, systemic to pulmonary, modified Blalock-Taussig shunt (MBTS)
		Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)
		Shunt, systemic to pulmonary, other
		Shunt, systemic to pulmonary,NOS
		Shunt, ligation and takedown
		PA banding (PAB)
		PA debanding
		Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)
		Bidirectional cavopulmonary anastomosis (BDCPA) (bidirectional Glenn)
		Glenn (unidirectional cavopulmonary anastomosis) (unidirectional Glenn)
		Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn)
Miscellaneous Procedures		Hemifontan
		Palliation, other
		Aneurysm, ventricular, right, repair
		Aneurysm, ventricular, left, repair
		Aneurysm, pulmonary artery, repair
		Atrial baffle procedure, NOS
		Cardiac tumor resection
		Conduit placement, NOS
		Pulmonary AV fistula repair/occlusion
		Ligation, pulmonary artery
		Pulmonary embolectomy
		Pleural drainage procedure
		Pleural procedure, other
		Ligation, thoracic duct
		Decortication
		Esophageal procedure
		Mediastinal procedure
		Bronchoscopy
		Diaphragm plication
		Diaphragm procedure, other
		Intraaortic balloon pump (IABP) insertion
		ECMO procedure
		Right/left heart assist device procedure
		VATS (video-assisted thoracoscopic surgery)
		Minimally invasive procedure
		Bypass for noncardiac lesion
		Delayed sternal closure
		Mediastinal exploration
		Sternotomy wound drainage
		Thoracotomy, other
		Cardiotomy, other
		Cardiac procedure, other
		Thoracic and/or mediastinal procedure, other
		Peripheral vascular procedure, other
	Miscellaneous procedure, other	
	Organ procurement	
	Other procedure	

### COMPLICATIONS

		None
OR check all that apply:		
Operative		Reoperation during this admission (unplanned reoperation)
		Systemic vein obstruction
		Pulmonary vein obstruction
		Bleeding requiring reoperation
Renal		Sternum left open
		Acute renal failure requiring temporary dialysis
		Acute renal failure requiring permanent dialysis



Neurologic deficit persisting at discharge		Postoperative neurological deficit persisting at discharge
		Postoperative new onset seizures
Infection		Wound dehiscence
		Wound infection
		Postoperative septicemia
		Mediastinitis
		Postoperative endocarditis
Respiratory		Pneumothorax
		Pleural effusion requiring drainage
		Pneumonia
		Postoperative tracheostomy
		Phrenic nerve injury/paralyzed diaphragm
		Recurrent laryngeal nerve injury/paralyzed vocal cord
		Postoperative respiratory insufficiency requiring mechanical ventilatory support > 7 days
		Postoperative respiratory insufficiency requiring reintubation
Other		Postoperative cardiac arrest
		Postoperative mechanical circulatory support (IABP, VAD, ECMO, or CPS)
		Postoperative arrhythmia
		Postoperative complete AV block requiring temporary pacemaker
		Postoperative complete AV block requiring permanent pacemaker
		Postoperative low cardiac output
		Pericardial effusion requiring drainage
		Postoperative acidosis
		Postoperative pulmonary hypertension crises (PA pressure > systemic pressure)
		Chylothorax
		Other postoperative complication



## Datasets

### The STST National Congenital Cardiac Surgical Database

*The Society of Thoracic Surgeons of Thailand  
National Congenital Cardiac Surgical Database*

#### Patient identification & demographic

Hospital name	Patient name	
Consultant name-surname	Patient surname	
Surgeon name-surname	Patient gender	<input type="radio"/> 1. Male <input type="radio"/> 2. Female
Anesthetist name-surname	Date of birth	dd/mm/yyyy
Hospital number	Weight (kg.)	
Patient domicile	Height (cm.)	
Patient identification number		

#### Admission details

Date of admission	dd/mm/yyyy		
Date of operation	dd/mm/yyyy		
Payer	<input type="radio"/> 1. Universal health coverage	<input type="radio"/> 2. Social security	<input type="radio"/> 3. Civil servants
	<input type="radio"/> 4. Self payment	<input type="radio"/> 5. Others	<input type="radio"/> 6. Private

Previous operation

Previous open heart surgery

Category	<input type="radio"/> 1. CPB	<input type="radio"/> 2. No CPB, Cardiovascular	<input type="radio"/> 3. ECMO
	<input type="radio"/> 4. Thoracic	<input type="radio"/> 5. Interventional	<input type="radio"/> 6. Other

Diagnosis1&Procedure1

Group Diagnosis1

Diagnosis1

Group Procedure1

Procedure1

Diagnosis2&Procedure2

Group Diagnosis2

Diagnosis2

Group Procedure2

Procedure2

Diagnosis3&Procedure3

Group Diagnosis3

Diagnosis3

Group Procedure3

Procedure3

Complication

- |   |   |
|---|---|
| <input type="radio"/> No complication   | <input type="checkbox"/> pneumonia  |
| <input type="checkbox"/> reoperation during this admission                                      | <input type="checkbox"/> pneumothorax                                     |
| <input type="checkbox"/> post operative cardiac arrest  | <input type="checkbox"/> pleural effusion requiring drainage              |
| <input type="checkbox"/> post operative mechanical circulatory support (IABP, VAD, ECMO or CPS) | <input type="checkbox"/> chylothorax                                      |
| <input type="checkbox"/> post operative complete AV block requiring temporary pacemaker         | <input type="checkbox"/> acute renal failure requiring temporary dialysis |
| <input type="checkbox"/> post operative complete AV block requiring permanent pacemaker         | <input type="checkbox"/> acute renal failure requiring permanent dialysis |
| <input type="checkbox"/> post operative arrhythmia  | <input type="checkbox"/> bleeding requiring reoperation                   |
| <input type="checkbox"/> post operative low cardiac output                                      | <input type="checkbox"/> wound dehiscence                                 |
| <input type="checkbox"/> post operative acidosis  | <input type="checkbox"/> wound infection                                  |



- |   |  |
|---|--|
| <input type="checkbox"/> sternum left open  | <input type="checkbox"/> mediastinitis   |
| <input type="checkbox"/> pericardial effusion requiring drainage  | <input type="checkbox"/> post operative endocarditis                                 |
| <input type="checkbox"/> systemic vein obstruction  | <input type="checkbox"/> post operative septicemia                                   |
| <input type="checkbox"/> pulmonary vein obstruction   | <input type="checkbox"/> phrenic nerve injury/paralyzed diaphragm                    |
| <input type="checkbox"/> post operative pulmonary hypertension crisis (PA pressure > systemic pressure)             | <input type="checkbox"/> recurrent laryngeal nerve injury/paralyzed vocal cord       |
| <input type="checkbox"/> post operative respiratory insufficiency requiring mechanical ventilatory support > 7 days | <input type="checkbox"/> post operative neurological deficit persisting at discharge |
| <input type="checkbox"/> post operative tracheostomy  | <input type="checkbox"/> post operative new onset seizures                           |
| <input type="checkbox"/> other post operative complication  | <input type="checkbox"/> atrial flutter  |
| <input type="checkbox"/> post operative respiratory insufficiency requiring reintubation                            |  |

**Non-Cardiac Abnormalities**

- None**
- Asplenia
  
- Polysplenia
- Down syndrome
- Turner syndrome
- DiGeorge
- Williams-Beuren syndrome
  
- Alagille syndrome (intrahepatic biliary duct agenesis)
- 22q11 deletion
- Other chromosomal/syndromic abnormality
- Rubella
- Marfan syndrome
- Other noncardiac abnormality

**Pre-operative Risk Factor**

- None**
- Pre-operative mechanical circulatory support (IABP, VAD, ECMO or CPS)
- Pre-operative complete AV block
- Pre-operative arrhythmia
- Pre-operative shock
- Pre-operative acidosis
- Pre-operative pulmonary hypertension crises (PA pressure > systemic pressure)
- Pre-operative mechanical ventilatory support
  
- Pre-operative tracheostomy
- Pre-operative renal failure (creatinine > 2)
- Pre-operative renal failure requiring dialysis
- Pre-operative bleeding disorder
- Pre-operative endocarditis
- Pre-operative septicemia
- Pre-operative neurological deficit
- Pre-operative seizures
- Other pre-operative risk factor

X clamp time (minute)  
 Arrest time (minute)  
 CPB time (minute)  
 Intubation date  
 Extubation date  
 Intubated and extubated in OR  
 Mortality date  
 Discharge date  
 Patient status of 30 days operation date  
 Patient status at discharge

Operative mortality  Mortality   
 Reoperation

Time (Example 12:30)  
 Time (Example 12:30)  
 No  Yes  
 (Day/month/year Example 31/12/2548)  
 (Day/month/year Example 31/12/2548)  
 NA  Alive  Dead  
 NA  Alive  Dead



## Predicted mortality can be calculated using Risk adjusted by STS-EACTS category

Logistic predicted mortality is better than observed mortality alone. Each hospital can calculate logistic predicted mortality using this formula

$$\text{Logistic predicted mortality} = \frac{e^{(\beta_0 + \sum \beta_i X_i)}}{1 + e^{(\beta_0 + \sum \beta_i X_i)}}$$

Where:

- $e$  is the base for natural logarithms and is approximately 2.7182...
- $\beta_0$  is the constant of the logistic regression equation: -4.67751...
- $\beta_i$  is the coefficient of the variable  $X_i$  in the logistic regression equation obtained by STS-EACTS category of each operative procedure

1. For all patients in any hospital, one must check the particular procedure for mortality category number status from mortality category risk and procedures (Chapter 4) and replace the category number with  $\beta_i$  value in the above equation.

<b>STS-EACTS category</b>	$\beta_i$
Category 1	0
Category 2	1.415
Category 3	2.124
Category 4	2.457
Category 5	4.120

2. For any particular age group, the age group must be replaced with  $\beta_i$  value according to the particular group list down below.

<b>Age group</b>	$\beta_i$
Newborn	1.600
Infant	1.405
Preschool children	0.628
School age children	0.307
Grown-up children	0.182
Adult	0

$X_i$  is set to 1 if categorical risk factor is present and 0 if it is absent.

### For example,

Overall case of VSD repair with patch in STS-EACTS category 1,  $\beta_{cat1} = 0$  and  $X_i$  of  $\beta_{cat1} = 1$ , the predict mortality =  $\exp(-4.67751 + (0*1))...$

In newborn case of VSD repair with patch in STS-EACTS category 1,  $\beta_{cat1} = 0$  and  $\beta_{newborn} = 1.6$  the predicted mortality =  $\exp(-4.67751 + (0*1) + (1.6*1))...$

3. The predicted (adjusted mortality) mortality is then brought for comparison in Funnel plot using the numbers of procedures as X-axis and adjusted mortality as Y-axis.



## Funnel plot

Funnel plots [Light RJ and Pillemer DB: [The Science of Reviewing Research](#). Cambridge, Massachusetts. Harvard University Press.1984; ISBN 0-674 85431-4m, Egger MG et al: [Bias in meta-analysis detected by a simple, graphical test](#). BMJ 1997; 315:624-9 PMC 2127453/PubMed/11576817]

### How the Funnel plot is created in our book

- Preparation of data.
- Estimation of frequency of all cases with in-hospital mortality of each hospital of 26 hospitals according to 5 STS-EACTS mortality categories.
- Make scatter plots according to workload and in-hospital mortality for each STS-EACTS mortality category.
- Estimate database average of overall in-hospital mortality from all hospitals in-hospital mortality in individual category.
- Create a log-scale of lower and upper 95% CI and 99%CI.
- Number of operations is represented by x-axis and number of in-hospital mortality by y axis.
- For better reading, each hospital is given the A to Z code with various colours of dots; also the workload of operation is classified into 3 groups of number  $\leq 100$  cases,  $>100-500$  cases and  $>500$  cases. Use line graphs to represent 95% CI and 99%CI for both upper and lower limits.

### Interpretation

In common with confidence interval plots, funnel plots are drawn with the measure of performance of hospitals (in-hospital mortality) on the vertical axis and number of operations on individual category (STS-EACTS) in horizontal axis.

Any hospital with the performance (in-hospital mortality) touching or beyond 95%CI should be warned to improve the performance and with the performance touching or beyond 99%CI should be warned to stop the performance temporarily until it is demonstrated that further performance is safe.

Our funnel plot measures both performance and number of operation under the same severity and difficulty of operation (STS-EACTS category). Understanding our performance lead us to improve our outcomes, further it can be used to measure morbidity of individual hospital or individual surgeon.

A to Z codes, representing hospital names, are used in our book to avoid disclosure of hospital name; each hospital is informed about its own performance without any knowledge of other hospital code names.

Finally in our opinion, funnel plot measuring performance can be applied for use in any other countries successfully.



Table 8.1  
Frequency of isolated procedure and morbidity risk in all age group (n=9,106 missing 1.3%)  
Morbidity category 1

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	1418	103	7.3%	5.9%	8.6%	0.5
ASD repair, primary closure	601	86	14.3%	11.5%	17.1%	0.8
PDA closure, NOS	108	4	3.7%	0.1%	7.3%	0.3
ASD partial closure	94	13	13.8%	6.9%	20.8%	0.8
PFO, primary closure	45	4	8.9%	0.6%	17.2%	0.7
Pericardial drainage procedure	43	5	11.6%	2.0%	21.2%	0.6
Pacemaker implantation, permanent	35	1	2.9%	0.0%	8.4%	0.3
Organ procurement	32	1	3.1%	0.0%	9.2%	0.2
Cardiac procedure, other	26	2	7.7%	0.0%	17.9%	0.5
Sinus of Valsalva, aneurysm repair	22	1	4.5%	0.0%	13.2%	0.6
Coronary artery fistula ligation	22	1	4.5%	0.0%	13.2%	0.3
VSD repair, NOS	20	0	0.0%	0.0%	0.0%	0.3
Mediastinal procedure	19	3	15.8%	0.0%	32.2%	0.9
PAPVC repair	18	1	5.6%	0.0%	16.1%	0.4
Pulmonary embolectomy	18	1	5.6%	0.0%	16.1%	0.4
Valvuloplasty, mitral	16	2	12.5%	0.0%	28.7%	0.8
Thoracic and/or mediastinal procedure, other	16	2	12.5%	0.0%	28.7%	0.7
Coarctation repair, interposition graft	15	2	13.3%	0.0%	30.5%	0.8
ASD repair, NOS	12	1	8.3%	0.0%	24.0%	0.7
Fontan, NOS	12	2	16.7%	0.0%	37.8%	0.8
Aortic stenosis, supraaortic, repair	11	0	0.0%	0.0%	0.0%	0.1
Congenitally corrected TGA repair, VSD closure	11	1	9.1%	0.0%	26.1%	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	11	1	9.1%	0.0%	26.1%	0.8
Peripheral vascular procedure, other	10	1	10.0%	0.0%	28.6%	0.6
Conduit, reoperation	9	1	11.1%	0.0%	31.6%	0.7
PA, reconstruction (plasty), NOS	8	0	0.0%	0.0%	0.0%	0.8
Pericardial procedure, other	8	1	12.5%	0.0%	35.4%	0.7
Pacemaker procedure-	8	1	12.5%	0.0%	5.4%	0.8
Pulmonary AV fistula repair/occlusion	8	0	0.0%	0.0%	0.0%	0.6
DCRV repair	7	1	14.3%	0.0%	40.2%	0.4
Valve surgery, other, mitral	7	2	28.6%	0.0%	62.0%	0.9
PA debanding	7	0	0.0%	0.0%	0.0%	0.6
Coarctation repair, other	5	0	0.0%	0.0%	0.0%	0.1
Shunt, systemic to pulmonary, NOS	5	0	0.0%	0.0%	0.0%	0.2
Aneurysm, pulmonary artery, repair	3	0	0.0%	0.0%	0.0%	0.2
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	2	0	0.0%	0.0%	0.0%	0.3
ICD (AICD) implantation	2	0	0.0%	0.0%	0.0%	0.3





Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Thoracotomy, other	2	0	0.0%	0.0%	0.0%	0.2
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	0.3
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
Aortic root replacement, mechanical	1	0	0.0%	0.0%	0.0%	0.5
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	0.0%	0.0%	0.5
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	0.0%	0.0%	0.5
ASD creation, blade septostomy	1	0	0.0%	0.0%	0.0%	0.5
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	0.3
Minimally invasive procedure	1	0	0.0%	0.0%	0.0%	0.5
Delayed sternal closure	1	0	0.0%	0.0%	0.0%	0.5

Additional Information on morbidity category risk



Table 8.2  
Frequency of isolated procedure and morbidity risk in all age group (n=9,106 missing 1.3%)  
Morbidity category 2

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
PDA closure, surgical	1181	189	16.0%	13.9%	18.1%	0.9
VSD repair, patch	1167	150	12.9%	10.9%	14.8%	1.0
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	804	209	26.0%	23.0%	29.0%	1.4
VSD repair, primary closure	532	98	18.4%	15.1%	21.7%	1.1
PDA closure, device	206	34	16.5%	11.4%	21.6%	1.1
TOF repair, non ventriculotomy	158	49	31.0%	23.8%	38.2%	1.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	126	31	24.6%	17.1%	32.1%	1.4
TOF repair, NOS	67	11	16.4%	7.5%	25.3%	1.0
Esophageal procedure	65	15	23.1%	12.8%	33.3%	1.3
Lung procedure, other	48	13	27.1%	14.5%	39.7%	1.5
Coarctation repair, end to end	37	9	24.3%	10.5%	38.1%	1.5
TOF repair, RV-PA conduit	36	6	16.7%	4.5%	28.8%	1.5
Unifocalization MAPCA(s)	31	7	22.6%	7.9%	37.3%	1.3
Rastelli	28	6	21.4%	6.2%	36.6%	1.6
Valve replacement, pulmonic (PVR)	26	6	23.1%	6.9%	39.3%	1.4
AVC (AVSD) repair, partial (incomplete)(PAVSD)	25	5	20.0%	4.3%	35.7%	1.3
Aortic stenosis, subvalvar, repair	25	3	12.0%	0.0%	24.7%	0.9
Coarctation repair, end to end, extended	24	4	16.7%	1.8%	31.6%	1.6
RVOT procedure	23	3	13.0%	0.0%	26.8%	1.5
Valvuloplasty, pulmonic	22	6	27.3%	8.7%	45.9%	1.4
VSD, multiple, repair	20	2	10.0%	0.0%	23.1%	0.9
Ventricular septal fenestration	20	4	20.0%	2.5%	37.5%	1.2
Cardiotomy, other	20	5	25.0%	6.0%	44.0%	1.3
ASD creation/enlargement	15	3	20.0%	0.0%	40.2%	1.0
Mitral stenosis, supra-valvar mitral ring, repair	15	4	26.7%	4.3%	49.0%	1.2
Valve replacement, mitral (MVR)	15	5	33.3%	9.5%	57.2%	1.5
AVC (AVSD) repair, NOS	14	4	28.6%	4.9%	52.2%	1.3
Lung biopsy	14	3	21.4%	0.0%	42.9%	1.2
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	13	3	23.1%	0.2%	46.0%	1.4
Occlusion MAPCA(s)	13	3	23.1%	0.2%	46.0%	1.5
Fontan, atrio-pulmonary connection	13	3	23.1%	0.2%	46.0%	1.0
TOF, AVC (AVSD), repair	12	3	25.0%	0.5%	49.5%	1.1
Valvuloplasty, aortic	12	3	25.0%	0.5%-	49.5%	1.0
AVC (AVSD) repair , intermediated (transitional)	11	2	18.2%	0.0%	41.0%	1.0



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	11	3	27.3%	1.0%	53.6%	1.2
Sternotomy wound drainage	11	1	9.1%	0.0%	26.1%	1.3
Valvuloplasty, tricuspid	10	5	50.0%	19.0%	81.0%	1.2
Pleural drainage procedure	10	2	20.0%	0.0%	44.8%	0.9
Valve surgery, other pulmonic	9	2	22.2%	0.0%	49.4%	1.2
Valve replacement, aortic (AVR), mechanical	9	2	22.2%	0.0%	49.4%	1.1
Coronary artery bypass	8	1	12.5%	0.0%	35.4%	1.3
1 1/2 ventricular repair	7	2	28.6%	0.0%	62.0%	1.0
Coronary artery procedure, other	7	1	14.3%	0.0%	40.2%	1.0
Pulmonary artery origin from ascending aorta (hemitruncus) repair	6	2	33.3%	0.0%	71.1%	1.0
Pectus repair	6	1	16.7%	0.0%	46.5%	1.0
Cardiac tumor resection	6	0	0.0%	0.0%	0.0%	1.0
Valve closure, tricuspid (exclusion, univentricular approach)	5	1	20.0%	0.0%	55.1%	1.4
Atrial baffle procedure, NOS	5	1	20.0%	0.0%	55.1%	1.1
Valve surgery, other, tricuspid	3	1	33.3%	0.0%	86.7%	1.2
Fontan, atrio-ventricular connection	3	0	0.0%	0.0%	0.0%	1.4
Senning	3	0	0.0%	0.0%	0.0%	1.2
Mustard	3	0	0.0%	0.0%	0.0%	1.0
Shunt, ligation and takedown	3	1	33.3%	0.0%	86.7%	1.4
Valve replacement, aortic (AVR), bioprosthetic	2	0	0.0%	0.0%	0.0%	1.1
PA, reconstruction (plasty), branch, central	1	0	0.0%	0.0%	0.0%	1.2

Additional Information on morbidity category risk



Table 8.3  
Frequency of isolated procedure and morbidity risk in all age group (n=9,106 missing 1.3%)  
Morbidity category 3

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	382	119	31.2%	26.5%	35.8%	1.6
PA banding (PAB)	84	28	33.3%	23.3%	43.4%	2.1
TOF repair, ventriculotomy, nontransanular patch	58	15	25.9%	14.6%	37.1%	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	53	17	32.1%	19.5%	44.6%	1.7
Pulmonary atresia-VSD (including TOF, PA), repair	42	11	26.2%	12.9%	39.5%	1.6
DORV repair, NOS	41	11	26.8%	13.3%	40.4%	1.8
Fontan, TCPC, external conduit, NOS	32	14	43.8%	26.6%	60.9%	2.5
Pericardectomy	28	7	25.0%	9.0%	41.0%	1.7
Fontan, TCPC, lateral tunnel, fenestrated	23	8	34.8%	15.3%	54.2%	1.9
Truncus arteriosus repair	21	7	33.3%	13.2%	53.5%	2.2
Pulmonary Venous Stenosis, repair	18	7	38.9%	16.4%	61.4%	1.8
Bilateral bidirectional cavopulmonary anastomosis (BDCPA)(bilateral bidirectional Glenn)	18	9	50.0%	26.9%	73.1%	2.2
Shunt, systemic to pulmonary, other	13	5	38.5%	12.0%	64.9%	2.3
AP window repair	12	3	25.0%	0.5%	49.5%	1.9
Anomalous origin of coronary artery repair	12	5	41.7%	13.8%	69.6%	2.2
TOF, absent pulmonary valve, repair	11	4	36.4%	7.9%	64.8%	1.7
Ligation, thoracic duct	11	5	45.5%	16.0%	74.9%	2.4
Valve replacement, tricuspid (TVR)	10	5	50.0%	19.0%	81.0%	2.3
Fontan, other	10	4	40.0%	9.6%	70.4%	2.0
Coarctation repair, subclavian flap	9	4	44.4%	12.0%	76.9%	2.0
Conduit, placement, RV to PA	8	3	37.5%	4.0%	71.0%	1.9
Vascular ring repair	8	3	37.5%	4.0%	71.0%	2.4
ASD repair, device	7	2	28.6%	0.0%	62.0%	1.8
Conduit, placement, LV to PA	7	3	42.9%	6.2%	79.5%	2.2
Congenitally corrected TGA repair, other	7	2	28.6%	0.0%	62.0%	2.3
Valve excision, pulmonary (without replacement)	6	2	33.3%	0.0%	71.1%	2.0
Valve surgery, other, aortic	6	0	0.0%	0.0%	0.0%	1.9
Atrial septal fenestration	5	2	40.0%	0.0%	82.9%	2.0
Cor triatriatum repair	5	2	40.0%	0.0%	82.9%	1.9
PA, reconstruction (plasty), main (trunk)	5	2	40.0%	0.0%	82.9%	1.9
Valve replacement, aortic (AVR)	5	1	20.0%	0.0%	55.1%	2.3
Bronchoscopy	5	2	40.0%	0.0%	82.9%	2.1
Anomalous systemic venous connection repair	4	3	75.0%	32.6%	100.0%	2.2
HLHS biventricular repair	4	0	0.0%	0.0%	0.0%	2.0
ASD, common atrium (single atrium), septation	3	1	33.3%	0.0%	86.7%	1.8
VSD repair, device	3	1	33.3%	0.0%	86.7%	1.8



Table 8.4  
Frequency of isolated procedure and morbidity risk in all age group (n=9,106 missing 1.3%)  
Morbidity category 4

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
AVC(AVSD) repair, complete CAVSD	81	41	50.6%	39.7%	61.5%	2.6
Arterial switch operation (ASO)	71	35	49.3%	37.7%	60.9%	2.6
TAPVC repair	59	25	42.4%	29.8%	55.0%	2.6
DORV, intraventricular tunnel repair	47	21	44.7%	30.5%	58.9%	2.8
Fontan, TCPC, external conduit, nonfenestrated	34	18	52.9%	36.2%	69.7%	3.2
Norwood procedure	27	14	51.9%	33.0%	70.7%	2.8
Arterial switch operation (ASO) and VSD repair	27	15	55.6%	36.8%	74.3%	3.0
Interrupted aortic arch repair	11	3	27.3%	1.0%	53.6%	2.7
Aortic arch repair	10	3	30.0%	1.6%	58.4%	3.1
Hemifontan	9	4	44.4%	12.0%	76.9%	3.0
Palliation, other	9	4	44.4%	12.0%	76.9%	2.6
Tracheal procedure	6	3	50.0%	10.0%	90.0%	2.9
Congenitally corrected TGA repair, atrial switch and Rastelli	5	2	40.0%	0.0%	82.9%	2.6
Coarctation repair, patch aortoplasty	5	1	20.0%	0.0%	55.1%	2.7
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	4	3	75.0%	32.6%	100.0%	4.0
Pulmonary artery sling repair	4	1	25.0%	0.0%	67.4%	2.8
Valve replacement, truncal	3	1	33.3%	0.0%	86.7%	3.2
Valve closure, semilunar	3	1	33.3%	0.0%	86.7%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	3	1	33.3%	0.0%	86.7%	2.6
Damus-Kaye-Stansel procedure (DKS)(creation of AP anastomosis without arch reconstruction)	3	1	33.3%	0.0%	86.7%	2.6
Pleural procedure, other	3	2	66.7%	13.3%	100.0%	3.8
Mediastinal exploration	2	1	50.0%	0.0%	100.0%	2.6
Valve excision, tricuspid (without replacement)	1	1	100.0%	100.0%	100.0%	3.4
Aortic dissection repair	1	1	100.0%	100.0%	100.0%	3.4
Ligation, pulmonary artery	1	0	0.0%	0.0%	0.0%	2.6

Additional Information on morbidity category risk



Table 8.5

Frequency of isolated procedure and morbidity risk in all age group (n=9,106 missing 1.3%)  
 Morbidity category 5

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Intraaortic balloon pump (IABP) insertion	3	3	100.0%	100.0%	100.0%	5.0
Aortic root replacement	2	2	100.0%	100.0%	100.0%	5.0
Valvuloplasty, truncal valve	1	1	100.0%	100.0%	100.0%	4.6
Aortic root replacement, homograft	1	1	100.0%	100.0%	100.0%	4.6
Konno procedure	1	1	100.0%	100.0%	100.0%	4.8
Ross-Konno procedure	1	1	100.0%	100.0%	100.0%	4.7
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	4.9
<b>Total (170 procedures)</b>	<b>9106</b>	<b>1700</b>	<b>18.7%</b>	<b>17.9%</b>	<b>19.5%</b>	

Additional information on morbidity category risk



Table 9.1  
Frequency of isolated procedure and morbidity risk in newborn (n=434 missing 4.4%)  
Morbidity category 1

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	4	0	0.0%	0.0%	0.0%	0.5
PDA closure, NOS	4	0	0.0%	0.0%	0.0%	0.3
Organ procurement	3	1	33.3%	0.0%	86.7%	0.2
ASD repair, primary closure	2	0	0.0%	0.0%	0.0%	0.8
Coarctation repair, other	2	0	0.0%	0.0%	0.0%	0.1
Pacemaker implantation, permanent	2	0	0.0%	0.0%	0.0%	0.3
Pacemaker procedure	2	1	50.0%	0.0%	100.0%	0.8
Pulmonary AV fistula repair/occlusion	2	0	0.0%	0.0%	0.0%	0.6
PFO, primary closure	1	0	0.0%	0.0%	0.0%	0.7
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	0.9
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	0.3
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	0.3
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	0.2
PA debanding	1	0	0.0%	0.0%	0.0%	0.6
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2
Cardiac procedure, other	1	0	0.0%	0.0%	0.0%	0.5
Peripheral vascular procedure, other	1	1	100.0%	100.0%	100.0%	0.6

Additional Information on morbidity category risk



Table 9.2  
Frequency of isolated procedure and morbidity risk in newborn (n=434 missing 4.4%)  
Morbidity category 2

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	165	64	38.8%	31.4%	46.2%	1.4
PDA closure, surgical	50	20	40.0%	26.4%	53.6%	0.9
Coarctation repair, end to end	6	3	50.0%	10.0%	90.0%	1.5
VSD repair, patch	5	0	0.0%	0.0%	0.0%	1.0
Coarctation repair, end to end, extended	5	1	20.0%	0.0%	55.1%	1.6
PDA closure, device	5	2	40.0%	0.0%	82.9%	1.1
Valvuloplasty, pulmonic	4	2	50.0%	1.0%	99.0%	1.4
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	3	0	0.0%	0.0%	0.0%	1.4
ASD creation/enlargement	2	1	50.0%	0.0%	100.0%	1.0
VSD repair, primary closure	2	1	50.0%	0.0%	100.0%	1.1
TOF repair, non ventriculotomy	2	1	50.0%	0.0%	100.0%	1.5
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	2	1	50.0%	0.0%	100.0%	1.4
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	1.5
Lung procedure, other	2	1	50.0%	0.0%	100.0%	1.5
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	0.9
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	1	100.0%	100.0%	100.0%	1.0
TOF repair, NOS	1	1	100.0%	100.0%	100.0%	1.0
Unifocalization MAPCA(s)	1	0	0.0%	0.0%	0.0%	1.3
Valve surgery, other pulmonic	1	1	100.0%	100.0%	100.0%	1.2
Esophageal procedure	1	0	0.0%	0.0%	0.0%	1.3
Sternotomy wound drainage	1	1	100.0%	100.0%	100.0%	1.3





Table 9.3  
Frequency of isolated procedure and morbidity risk in newborn (n=434 missing 4.4%)  
Morbidity category 3

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
PA banding (PAB)	11	3	27.3%	1.0%	53.6%	2.1
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	9	6	66.7%	35.9%	97.5%	1.7
Pulmonary atresia-VSD (including TOF, PA), repair	3	2	66.7%	13.3%	100.0%	1.6
PA, reconstruction (plasty), main (trunk)	3	2	66.7%	13.3%	100.0%	1.9
Shunt, systemic to pulmonary, other	3	2	66.7%	13.3%	100.0%	2.3
Fontan, TCPC, external conduit, NOS	2	1	50.0%	0.0%	100.0%	2.5
Bronchoscopy	2	1	50.0%	0.0%	100.0%	2.1
Truncus arteriosus repair	1	0	0.0%	0.0%	0.0%	2.2
Pulmonary Venous Stenosis, repair	1	1	100.0%	100.0%	100.0%	1.8
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	2.2
TOF repair, ventriculotomy, transanular patch	1	0	0.0%	0.0%	0.0%	1.6
Valve excision, pulmonary (without replacement)	1	1	100.0%	100.0%	100.0%	2.0
Pericardectomy	1	0	0.0%	0.0%	0.0%	1.7
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	2.3
DORV repair, NOS	1	0	0.0%	0.0%	0.0%	1.8
Coarctation repair, subclavian flap	1	1	100.0%	100.0%	100.0%	2.0
Vascular ring repair	1	1	100.0%	100.0%	100.0%	2.4

Additional Information on morbidity category risk



Table 9.4

Frequency of isolated procedure and morbidity risk in newborn (n=434 missing 4.4%)  
Morbidity category 4

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Arterial switch operation (ASO)	46	27	58.7%	44.5%	72.9%	2.6
Norwood procedure	19	10	52.6%	30.2%	75.1%	2.8
TAPVC repair	13	9	69.2%	44.1%	94.3%	2.6
Arterial switch operation (ASO) and VSD repair	6	3	50.0%	10.0%	90.0%	3.0
Interrupted aortic arch repair	5	0	0.0%	0.0%	0.0%	2.7
Aortic arch repair	3	0	0.0%	0.0%	0.0%	3.1
AVC(AVSD) repair, complete CAVSD	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	1	100.0%	100.0%	100.0%	4.0
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	2.6
Damus-Kaye-Stansel procedure (DKS)(creation of AP anastomosis without arch reconstruction)	1	0	0.0%	0.0%	0.0%	2.6
Mediastinal exploration	1	1	100.0%	100.0%	100.0%	2.6

Table 9.5

Frequency of isolated procedure and morbidity risk in newborn (n=434 missing 4.4%)  
Morbidity category 5

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	4.9
<b>Total (68 procedures)</b>	<b>434</b>	<b>179</b>	<b>41.2%</b>	<b>36.6%</b>	<b>45.9%</b>	



Table 10.1  
Frequency of isolated procedure and morbidity risk in infant (n=1,558 missing 1.6%)  
Morbidity category 1

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
PDA closure, NOS	30	2	6.7%	0.0%	15.6%	0.3
ASD repair, patch	11	0	0.0%	0.0%	0.0%	0.5
Organ procurement	6	0	0.0%	0.0%	0.0%	0.2
ASD repair, primary closure	5	2	40.0%	0.0%	82.9%	0.8
ASD partial closure	5	3	60.0%	17.1%	100.0%	0.8
Mediastinal procedure	5	2	40.0%	0.0%	82.9%	0.9
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	0.3
Thoracic and/or mediastinal procedure, other	4	0	0.0%	0.0%	0.0%	0.7
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	0.3
PA debanding	3	0	0.0%	0.0%	0.0%	0.6
Pulmonary AV fistula repair/occlusion	3	0	0.0%	0.0%	0.0%	0.6
Pulmonary embolectomy	3	0	0.0%	0.0%	0.0%	0.4
PFO, primary closure	2	1	50.0%	0.0%	100.0%	0.7
ASD repair, NOS	2	0	0.0%	0.0%	0.0%	0.7
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	0.3
PAPVC repair	2	0	0.0%	0.0%	0.0%	0.4
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	0.8
DCRV repair	2	1	50.0%	0.0%	100.0%	0.4
Coarctation repair, other	2	0	0.0%	0.0%	0.0%	0.1
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	0.5
Peripheral vascular procedure, other	2	0	0.0%	0.0%	0.0%	0.6
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
Conduit, reoperation	1	0	0.0%	0.0%	0.0%	0.7
Valvuloplasty, mitral	1	0	0.0%	0.0%	0.0%	0.8
Pericardial drainage procedure	1	1	100.0%	100.0%	100.0%	0.6
Fontan, NOS	1	0	0.0%	0.0%	0.0%	0.8
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	0.9
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	0.8
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2

Additional Information on morbidity category risk



Table 10.2  
Frequency of isolated procedure and morbidity risk in infant (n=1,558 missing 1.6%)  
Morbidity category 2

Additional Information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
PDA closure, surgical	491	115	23.4%	19.7%	27.2%	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	253	74	29.2%	23.6%	34.9%	1.4
VSD repair, patch	181	43	23.8%	17.6%	30.0%	1.0
PDA closure, device	70	16	22.9%	13.0%	32.7%	1.1
VSD repair, primary closure	45	13	28.9%	15.6%	42.1%	1.1
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	19	12	63.2%	41.5%	84.8%	1.4
Lung procedure, other	14	6	42.9%	16.9%	68.8%	1.5
Coarctation repair, end to end, extended	13	2	15.4%	0.0%	35.0%	1.6
Esophageal procedure	12	7	58.3%	30.4%	86.2%	1.3
Coarctation repair, end to end	9	4	44.4%	12.0%	76.9%	1.5
TOF repair, non ventriculotomy	7	1	14.3%	0.0%	40.2%	1.5
AVC (AVSD) repair , intermediated (transitional)	4	1	25.0%	0.0%	67.4%	1.0
AVC (AVSD) repair, partial (incomplete) (PAVSD)	4	0	0.0%	0.0%	0.0%	1.3
RVOT procedure	4	1	25.0%	0.0%	67.4%	1.5
Lung biopsy	4	1	25.0%	0.0%	67.4%	1.2
AVC (AVSD) repair, NOS	3	1	33.3%	0.0%	86.7%	1.3
TOF repair, RV-PA conduit	3	1	33.3%	0.0%	86.7%	1.5
TOF repair, NOS	3	1	33.3%	0.0%	86.7%	1.0
Pleural drainage procedure	3	2	66.7%	13.3%	100.0%	0.9
Cardiotomy, other	3	0	0.0%	0.0%	0.0%	1.3
VSD, multiple, repair	2	0	0.0%	0.0%	0.0%	0.9
Ventricular septal fenestration	2	1	50.0%	0.0%	100.0%	1.2
Pulmonary artery origin from ascending aorta (hemitruncus) repair	2	1	50.0%	0.0%	100.0%	1.0
Unifocalization MAPCA(s)	2	0	0.0%	0.0%	0.0%	1.3
Occlusion MAPCA(s)	2	1	50.0%	0.0%	100.0%	1.5
Valvuloplasty, pulmonic	2	0	0.0%	0.0%	0.0%	1.4
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	1.2
Fontan, atrio-pulmonary connection	2	1	50.0%	0.0%	100.0%	1.0
Rastelli	2	1	50.0%	0.0%	100.0%	1.6
Atrial baffle procedure, NOS	2	1	50.0%	0.0%	100.0%	1.1
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	1.3
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	1.0



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	1.1
Valvuloplasty, tricuspid	1	1	100.0%	100.0%	100.0%	1.2
1 1/2 ventricular repair	1	1	100.0%	100.0%	100.0%	1.0
PA, reconstruction (plasty), branch, central	1	0	0.0%	0.0%	0.0%	1.2
Valvuloplasty, aortic	1	1	100.0%	100.0%	100.0%	1.0
Aortic stenosis, subvalvar, repair	1	0	0.0%	0.0%	0.0%	0.9
Mitral stenosis, supra-avalvar mitral ring, repair	1	0	0.0%	0.0%	0.0%	1.2
Coronary artery bypass	1	1	100.0%	100.0%	100.0%	1.3
Coronary artery procedure, other	1	1	100.0%	100.0%	100.0%	1.0
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	1	100.0%	100.0%	100.0%	1.2

Additional Information on morbidity category risk



Table 10.3  
Frequency of isolated procedure and morbidity risk in infant (n=1,558 missing 1.6%)  
Morbidity category 3

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
PA banding (PAB)	53	21	39.6%	26.5%	52.8%	2.1
Truncus arteriosus repair	14	5	35.7%	10.6%	60.8%	2.2
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	11	6	54.5%	25.1%	84.0%	1.7
TOF repair, ventriculotomy, transanular patch	10	2	20.0%	0.0%	44.8%	1.6
AP window repair	7	2	28.6%	0.0%	62.0%	1.9
Anomalous origin of coronary artery repair	6	2	33.3%	0.0%	71.1%	2.2
DORV repair, NOS	5	0	0.0%	0.0%	0.0%	1.8
Coarctation repair, subclavian flap	5	2	40.0%	0.0%	82.9%	2.0
Pulmonary atresia-VSD (including TOF, PA), repair	4	4	100.0%	100.0%	100.0%	1.6
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	4	1	25.0%	0.0%	67.4%	2.2
TOF repair, ventriculotomy, nontransanular patch	3	2	66.7%	13.3%	100.0%	1.6
HLHS biventricular repair	3	0	0.0%	0.0%	0.0%	2.0
Vascular ring repair	3	1	33.3%	0.0%	86.7%	2.4
Shunt, systemic to pulmonary, other	3	1	33.3%	0.0%	86.7%	2.3
Bronchoscopy	3	1	33.3%	0.0%	86.7%	2.1
Pulmonary Venous Stenosis, repair	2	1	50.0%	0.0%	100.0%	1.8
Ligation, thoracic duct	2	1	50.0%	0.0%	100.0%	2.4
ASD, common atrium (single atrium), septation	1	1	100.0%	100.0%	100.0%	1.8
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	2.2
Pericardectomy	1	0	0.0%	0.0%	0.0%	1.7
Fontan, other	1	1	100.0%	100.0%	100.0%	2.0



Table 10.4  
Frequency of isolated procedure and morbidity risk in infant (n=1,558 missing 1.6%)  
Morbidity category 4

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TAPVC repair	32	15	46.9%	29.6%	64.2%	2.6
AVC(AVSD) repair, complete CAVSD	20	11	55.0%	33.2%	76.8%	2.6
Arterial switch operation (ASO) and VSD repair	20	11	55.0%	33.2%	76.8%	3.0
Arterial switch operation (ASO)	19	7	36.8%	15.2%	58.5%	2.6
Norwood procedure	8	4	50.0%	15.4%	84.6%	2.8
DORV, intraventricular tunnel repair	6	3	50.0%	10.0%	90.0%	2.8
Tracheal procedure	5	3	60.0%	17.1%	100.0%	2.9
Interrupted aortic arch repair	4	2	50.0%	1.0%	99.0%	2.7
Coarctation repair, patch aortoplasty	3	1	33.3%	0.0%	86.7%	2.7
Aortic arch repair	3	3	100.0%	100.0%	100.0%	3.1
Pulmonary artery sling repair	3	1	33.3%	0.0%	86.7%	2.8
Pleural procedure, other	2	2	100.0%	100.0%	100.0%	3.8
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	0	0.0%	0.0%	0.0%	4.0
Damus-Kaye-Stansel procedure (DKS)(creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	2.6
Palliation, other	1	0	0.0%	0.0%	0.0%	2.6

Additional Information on morbidity category risk

Table 10.5  
Frequency of isolated procedure and morbidity risk in infant (n=1,558 missing 1.6%)  
Morbidity category 5

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valvuloplasty, truncal valve	1	1	100.0%	100.0%	100.0%	4.6
Intraaortic balloon pump (IABP) insertion	1	1	100.0%	100.0%	100.0%	5.0
<b>Total (109 procedures)</b>	<b>1558</b>	<b>447</b>	<b>28.7%</b>	<b>26.4%</b>	<b>30.9%</b>	



Table 11.1  
Frequency of isolated procedure and morbidity risk in preschool children (n=1,654 missing 0.8%)  
Morbidity category 1

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	60	3	5.0%	0.0%	10.5%	0.5
PDA closure, NOS	30	0	0.0%	0.0%	0.0%	0.3
ASD repair, primary closure	26	1	3.8%	0.0%	11.2%	0.8
Mediastinal procedure	6	0	0.0%	0.0%	0.0%	0.9
ASD partial closure	5	0	0.0%	0.0%	0.0%	0.8
Pulmonary embolectomy	5	0	0.0%	0.0%	0.0%	0.4
Cardiac procedure, other	5	0	0.0%	0.0%	0.0%	0.5
Organ procurement	5	0	0.0%	0.0%	0.0%	0.2
PAPVC repair	4	0	0.0%	0.0%	0.0%	0.4
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	0.3
VSD repair, NOS	3	0	0.0%	0.0%	0.0%	0.3
Valve surgery, other, mitral	3	2	66.7%	13.3%	100.0%	0.9
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	0.7
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	3	0	0.0%	0.0%	0.0%	0.8
PFO, primary closure	2	0	0.0%	0.0%	0.0%	0.7
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	0.8
Shunt, systemic to pulmonary, NOS	2	0	0.0%	0.0%	0.0%	0.2
Thoracic and/or mediastinal procedure, other	2	0	0.0%	0.0%	0.0%	0.7
PA, reconstruction (plasty), NOS	1	0	0.0%	0.0%	0.0%	0.8
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Valvuloplasty, mitral	1	0	0.0%	0.0%	0.0%	0.8
Coarctation repair, other	1	0	0.0%	0.0%	0.0%	0.1
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	0.3
ASD creation, blade septostomy	1	0	0.0%	0.0%	0.0%	0.5
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Minimally invasive procedure	1	0	0.0%	0.0%	0.0%	0.5
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	0.6





Table 11.2  
Frequency of isolated procedure and morbidity risk in preschool children (n=1,654 missing 0.8%)  
Morbidity category 2

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	340	45	13.2%	9.6%	16.8%	1.0
PDA closure, surgical	286	24	8.4%	5.2%	11.6%	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	211	33	15.6%	10.7%	20.5%	1.4
VSD repair, primary closure	116	30	25.9%	17.9%	33.8%	1.1
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	58	12	20.7%	10.3%	31.1%	1.4
PDA closure, device	4	4	8.2%	0.5%	15.8%	1.1
TOF repair, non ventriculotomy	37	14	37.8%	22.2%	53.5%	1.5
TOF repair, NOS	12	1	8.3%	0.0%	24.0%	1.0
Lung procedure, other	12	1	8.3%	0.0%	24.0%	1.5
Esophageal procedure	11	2	18.2%	0.0%	41.0%	1.3
TOF repair, RV-PA conduit	10	2	20.0%	0.0%	44.8%	1.5
Coarctation repair, end to end	9	1	11.1%	0.0%	31.6%	1.5
AVC (AVSD) repair, partial (incomplete)(PAVSD)	7	1	14.3%	0.0%	40.2%	1.3
Lung biopsy	6	1	16.7%	0.0%	46.5%	1.2
VSD, multiple, repair	5	1	20.0%	0.0%	55.1%	0.9
AVC (AVSD) repair, NOS	5	1	20.0%	0.0%	55.1%	1.3
Unifocalization MAPCA(s)	5	2	40.0%	0.0%	82.9%	1.3
Valvuloplasty, pulmonic	5	3	60.0%	17.1%	100.0%	1.4
Ventricular septal fenestration	4	0	0.0%	0.0%	0.0%	1.2
AVC (AVSD) repair , intermediated (transitional)	4	1	25.0%	0.0%	67.4%	1.0
ASD creation/enlargement	3	1	33.3%	0.0%	86.7%	1.0
Occlusion MAPCA(s)	3	0	0.0%	0.0%	0.0%	1.5
RVOT procedure	3	1	33.3%	0.0%	86.7%	1.5
Aortic stenosis, subvalvar, repair	3	0	0.0%	0.0%	0.0%	0.9
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	3	0	0.0%	0.0%	0.0%	1.2
Pulmonary artery origin from ascending aorta (hemitruncus) repair	2	0	0.0%	0.0%	0.0%	1.0
TOF, AVC (AVSD), repair	2	1	50.0%	0.0%	100.0%	1.1
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	1.4
Mitral stenosis, supra-valvar mitral ring, repair	2	0	0.0%	0.0%	0.0%	1.2
Valve replacement, mitral (MVR)	2	1	50.0%	0.0%	100.0%	1.5

Additional Information on morbidity category risk



Additional Information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	0.9
Cardiotomy, other	2	1	50.0%	0.0%	100.0%	1.3
Valvuloplasty, tricuspid	1	1	100.0%	100.0%	100.0%	1.2
Valve surgery, other, tricuspid	1	1	100.0%	100.0%	100.0%	1.2
Valve replacement, pulmonic (PVR)	1	1	100.0%	100.0%	100.0%	1.4
Senning	1	0	0.0%	0.0%	0.0%	1.2
Mustard	1	0	0.0%	0.0%	0.0%	1.0
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	1.6
Pectus repair	1	1	100.0%	100.0%	100.0%	1.0
Shunt, ligation and takedown	1	1	100.0%	100.0%	100.0%	1.4
Sternotomy wound drainage	1	0	0.0%	0.0%	0.0%	1.3



Table 11.3  
Frequency of isolated procedure and morbidity risk in preschool children (n=1,654 missing 0.8%)  
Morbidity category 3

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	74	27	36.5%	2.5%	47.5%	1.6
PA banding (PAB)	13	3	23.1%	0.2%	46.0%	2.1
TOF repair, ventriculotomy, nontransanular patch	11	4	36.4%	7.9%	64.8%	1.6
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	7	3	42.9%	6.2%	79.5%	2.2
DORV repair, NOS	5	1	20.0%	0.0%	55.1%	1.8
Pulmonary Venous Stenosis, repair	4	1	25.0%	0.0%	67.4%	1.8
AP window repair	3	1	33.3%	0.0%	86.7%	1.9
Truncus arteriosus repair	3	1	33.3%	0.0%	86.7%	2.2
TOF, absent pulmonary valve, repair	3	0	0.0%	0.0%	0.0%	1.7
Pulmonary atresia-VSD (including TOF, PA), repair	3	1	33.3%	0.0%	86.7%	1.6
Coarctation repair, subclavian flap	3	1	33.3%	0.0%	86.7%	2.0
Vascular ring repair	3	1	33.3%	0.0%	86.7%	2.4
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3	1	33.3%	0.0%	86.7%	1.7
Cor triatriatum repair	2	1	50.0%	0.0%	100.0%	1.9
Fontan, TCPC, external conduit, NOS	2	2	100.0%	100.0%	100.0%	2.5
Fontan, other	2	1	50.0%	0.0%	100.0%	2.0
Anomalous origin of coronary artery repair	2	2	100.0%	100.0%	100.0%	2.2
Shunt, systemic to pulmonary, other	2	1	50.0%	0.0%	100.0%	2.3
ASD repair, device	1	1	100.0%	100.0%	100.0%	1.8
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	1.8
Atrial septal fenestration	1	1	100.0%	100.0%	100.0%	2.0
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	2.2
Valve replacement, tricuspid (TVR)	1	1	100.0%	100.0%	100.0%	2.3
Conduit, placement, RV to PA	1	0	0.0%	0.0%	0.0%	1.9
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	2.2
Pericardectomy	1	0	0.0%	0.0%	0.0%	1.7
Congenitally corrected TGA repair, other	1	1	100.0%	100.0%	100.0%	2.3
Ligation, thoracic duct	1	0	0.0%	0.0%	0.0%	2.4

Additional Information on morbidity category risk



Table 11.4

Frequency of isolated procedure and morbidity risk in preschool children (n=1,654 missing 0.8%)

Morbidity category 4

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
AVC(AVSD) repair, complete CAVSD	45	20	44.4%	29.9%	59.0%	2.6
DORV, intraventricular tunnel repair	17	7	41.2%	17.8%	64.6%	2.8
TAPVC repair	10	1	10.0%	0.0%	28.6%	2.6
Fontan, TCPC, external conduit, nonfenestrated	3	0	0.0%	0.0%	0.0%	3.2
Coarctation repair, patch aortoplasty	2	0	0.0%	0.0%	0.0%	2.7
Hemifontan	2	1	50.0%	0.0%	100.0%	3.0
Valve excision, tricuspid (without replacement)	1	1	100.0%	100.0%	100.0%	3.4
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	2.6
Arterial switch operation (ASO)	1	0	0.0%	0.0%	0.0%	2.6
Aortic arch repair	1	0	0.0%	0.0%	0.0%	3.1
Interrupted aortic arch repair	1	0	0.0%	0.0%	0.0%	2.7
Pulmonary artery sling repair	1	0	0.0%	0.0%	0.0%	2.8
Damus-Kaye-Stansel procedure (DKS)(creation of AP anastomosis without arch reconstruction)	1	0	0.0%	0.0%	0.0%	2.6
Palliation, other	1	0	0.0%	0.0%	0.0%	2.6
<b>Total (112 procedures)</b>	<b>1654</b>	<b>282</b>	<b>17.0%</b>	<b>15.2%</b>	<b>18.9%</b>	



Table 12.1  
Frequency of isolated procedure and morbidity risk in school aged children (n=2,356 missing 1.3%)  
Morbidity category 1

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	311	22	7.1%	4.2%	9.9%	0.5
ASD repair, primary closure	115	18	15.7%	9.0%	22.3%	0.8
PDA closure, NOS	27	0	0.0%	0.0%	0.0%	0.3
ASD partial closure	15	3	20.0%	0.0%	40.2%	0.8
Pacemaker implantation, permanent	15	0	0.0%	0.0%	0.0%	0.3
PFO, primary closure	10	1	10.0%	0.0%	28.6%	0.7
Cardiac procedure, other	9	2	22.2%	0.0%	49.4%	0.5
VSD repair, NOS	8	0	0.0%	0.0%	0.0%	0.3
PAPVC repair	6	1	16.7%	0.0%	46.5%	0.4
Fontan, NOS	6	1	16.7%	0.0%	46.5%	0.8
Coronary artery fistula ligation	6	0	0.0%	0.0%	0.0%	0.3
Organ procurement	6	0	0.0%	0.0%	0.0%	0.2
Thoracic and/or mediastinal procedure, other	5	0	0.0%	0.0%	0.0%	0.7
Aortic stenosis, supra-valvar, repair	4	0	0.0%	0.0%	0.0%	0.1
Valve surgery, other, mitral	4	0	0.0%	0.0%	0.0%	0.9
Peripheral vascular procedure, other	4	0	0.0%	0.0%	0.0%	0.6
Valvuloplasty, mitral	3	0	0.0%	0.0%	0.0%	0.8
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	0.7
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	3	1	33.3%	0.0%	86.7%	0.8
Pacemaker procedure	3	0	0.0%	0.0%	0.0%	0.8
PA debanding	3	0	0.0%	0.0%	0.0%	0.6
Pulmonary embolectomy	3	1	33.3%	0.0%	86.7%	0.4
ASD repair, NOS	2	0	0.0%	0.0%	0.0%	0.7
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	0.8
DCRV repair	2	0	0.0%	0.0%	0.0%	0.4
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	0.7
Congenitally corrected TGA repair, VSD closure	2	1	50.0%	0.0%	100.0%	0.9
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	0.9
Sinus of Valsalva, aneurysm repair	1	0	0.0%	0.0%	0.0%	0.6
Pericardial drainage procedure	1	0	0.0%	0.0%	0.0%	0.6
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	0.0%	0.0%	0.5
Coarctation repair, interposition graft	1	1	100.0%	100.0%	100.0%	0.8
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	0.3
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	0.0%	0.0%	0.5
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	0.2
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Pulmonary AV fistula repair/occlusion	1	0	0.0%	0.0%	0.0%	0.6
Delayed sternal closure	1	0	0.0%	0.0%	0.0%	0.5

Additional Information on morbidity category risk



Table 12.2  
Frequency of isolated procedure and morbidity risk in school aged children (n=2,356 missing 1.3%)  
Morbidity category 2

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	351	35	10.0%	6.8%	13.1%	1.0
VSD repair, primary closure	192	29	15.1%	10.0%	20.2%	1.1
PDA closure, surgical	179	12	6.7%	3.0%	10.4%	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	139	29	20.9%	14.1%	27.6%	1.4
TOF repair, non ventriculotomy	75	28	37.3%	26.4%	48.3%	1.5
PDA closure, device	45	9	20.0%	8.3%	31.7%	1.1
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	38	6	15.8%	4.2%	27.4%	1.4
TOF repair, NOS	35	5	14.3%	2.7%	25.9%	1.0
Rastelli	17	3	17.6%	0.0%	35.8%	1.6
Esophageal procedure	16	2	12.5%	0.0%	28.7%	1.3
TOF repair, RV-PA conduit	14	1	7.1%	0.0%	20.6%	1.5
Unifocalization MAPCA(s)	14	3	21.4%	0.0%	42.9%	1.3
Aortic stenosis, subvalvar, repair	12	1	8.3%	0.0%	24.0%	0.9
Lung procedure, other	11	2	18.2%	0.0%	41.0%	1.5
Coarctation repair, end to end	9	1	11.1%	0.0%	31.6%	1.5
AVC (AVSD) repair, partial (incomplete) (PAVSD)	8	3	37.5%	4.0%	71.0%	1.3
TOF, AVC (AVSD), repair	8	2	25.0%	0.0%	55.0%	1.1
Fontan, atrio-pulmonary connection	8	2	25.0%	0.0%	55.0%	1.0
Cardiotomy, other	8	1	12.5%	0.0%	35.4%	1.3
VSD, multiple, repair	7	1	14.3%	0.0%	40.2%	0.9
RVOT procedure	7	1	14.3%	0.0%	40.2%	1.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	6	1	16.7%	0.0%	46.5%	1.2
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	5	1	20.0%	0.0%	55.1%	1.4
Valvuloplasty, tricuspid	5	3	60.0%	17.1%	100.0%	1.2
Valvuloplasty, aortic	5	2	40.0%	0.0%	82.9%	1.0
Valve replacement, mitral (MVR)	5	2	40.0%	0.0%	82.9%	1.5
Ventricular septal fenestration	4	0	0.0%	0.0%	0.0%	1.2
AVC (AVSD) repair, NOS	4	2	50.0%	1.0%	99.0%	1.3
Occlusion MAPCA(s)	4	2	50.0%	1.0%	99.0%	1.5
1 1/2 ventricular repair	4	1	25.0%	0.0%	67.4%	1.0
Valve replacement, pulmonic (PVR)	4	2	50.0%	1.0%	99.0%	1.4
Mitral stenosis, supra-valvar mitral ring, repair	4	1	25.0%	0.0%	67.4%	1.2



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Coarctation repair, end to end, extended	4	1	25.0%	0.0%	67.4%	1.6
Coronary artery procedure, other	4	0	0.0%	0.0%	0.0%	1.0
Lung biopsy	4	1	25.0%	0.0%	67.4%	1.2
Pectus repair	4	0	0.0%	0.0%	0.0%	1.0
Valve closure, tricuspid (exclusion, univentricular approach)	3	1	33.3%	0.0%	86.7%	1.4
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	1.0
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	0.9
Sternotomy wound drainage	3	0	0.0%	0.0%	0.0%	1.3
ASD creation/enlargement	2	0	0.0%	0.0%	0.0%	1.0
AVC (AVSD) repair , intermediated (transitional)	2	0	0.0%	0.0%	0.0%	1.0
Valve surgery, other, tricuspid	2	0	0.0%	0.0%	0.0%	1.2
Valvuloplasty, pulmonic	2	0	0.0%	0.0%	0.0%	1.4
Valve replacement, aortic (AVR), mechanical	2	1	50.0%	0.0%	100.0%	1.1
Fontan, atrio-ventricular connection	2	0	0.0%	0.0%	0.0%	1.4
Senning	2	0	0.0%	0.0%	0.0%	1.2
Mustard	2	0	0.0%	0.0%	0.0%	1.0
Coronary artery bypass	2	0	0.0%	0.0%	0.0%	1.3
Atrial baffle procedure, NOS	2	0	0.0%	0.0%	0.0%	1.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	1.0
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	1.2

Additional Information on morbidity category risk



Table 12.3  
Frequency of isolated procedure and morbidity risk in school aged children (n=2,356 missing 1.3%)  
Morbidity category 3

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	213	72	33.8%	27.5%	40.2%	1.6
Fontan, TCPC, external conduit, NOS	25	10	40.0%	20.8%	59.2%	2.5
TOF repair, ventriculotomy, nontransanular patch	22	6	27.3%	8.7%	45.9%	1.6
Pulmonary atresia-VSD (including TOF, PA), repair	22	3	13.6%	0.0%	28.0%	1.6
DORV repair, NOS	21	8	38.1%	17.3%	58.9%	1.8
Fontan, TCPC, lateral tunnel, fenestrated	14	5	35.7%	10.6%	60.8%	1.9
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	13	1	7.7%	0.0%	22.2%	1.7
TOF, absent pulmonary valve, repair	7	3	42.9%	6.2%	79.5%	1.7
Fontan, other	5	2	40.0%	0.0%	82.9%	2.0
Pulmonary Venous Stenosis, repair	4	3	75.0%	32.6%	100.0%	1.8
Valve surgery, other, aortic	4	0	0.0%	0.0%	0.0%	1.9
Congenitally corrected TGA repair, other	4	1	25.0%	0.0%	67.4%	2.3
PA banding (PAB)	4	0	0.0%	0.0%	0.0%	2.1
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	4	2	50.0%	1.0%	99.0%	2.2
ASD, repair, device	3	1	33.3%	0.0%	86.7%	1.8
Truncus arteriosus repair	3	1	33.3%	0.0%	86.7%	2.2
Valve excision, pulmonary (without replacement)	3	1	33.3%	0.0%	86.7%	2.0
Ligation, thoracic duct	3	2	66.7%	13.3%	100.0%	2.4
VSD repair, device	2	0	0.0%	0.0%	0.0%	1.8
PA, reconstruction (plasty), main (trunk)	2	0	0.0%	0.0%	0.0%	1.9
Conduit, placement, RV to PA	2	1	50.0%	0.0%	100.0%	1.9
Conduit, placement, LV to PA	2	1	50.0%	0.0%	100.0%	2.2
Valve replacement, aortic (AVR)	2	1	50.0%	0.0%	100.0%	2.3
Pericardectomy	2	0	0.0%	0.0%	0.0%	1.7
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	1.8
AP window repair	1	0	0.0%	0.0%	0.0%	1.9
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	1.9
Valve replacement, tricuspid (TVR)	1	1	100.0%	100.0%	100.0%	2.3
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	2.2
Vascular ring repair	1	0	0.0%	0.0%	0.0%	2.4
Shunt, systemic to pulmonary, other	1	0	0.0%	0.0%	0.0%	2.3





Table 12.4  
Frequency of isolated procedure and morbidity risk in school aged children (n=2,356 missing 1.3%)  
Morbidity category 4

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
Fontan, TCPC, external conduit, nonfenestrated	23	14	60.9%	40.9%	80.8%	3.2
DORV, intraventricular tunnel repair	15	10	66.7%	42.8%	90.5%	2.8
AVC(AVSD) repair, complete CAVSD	11	7	63.6%	35.2%	92.1%	2.6
Arterial switch operation (ASO)	4	1	25.0%	0.0%	67.4%	2.6
Hemifontan	4	3	75.0%	32.6%	100.0%	3.0
Valve replacement, truncal	3	1	33.3%	0.0%	86.7%	3.2
TAPVC repair	3	0	0.0%	0.0%	0.0%	2.6
Palliation, other	3	2	66.7%	13.3%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and Rastelli	2	1	50.0%	0.0%	100.0%	2.6
Valve closure, semilunar	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	1	100.0%	100.0%	100.0%	4.0
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	2.6
Interrupted aortic arch repair	1	1	100.0%	100.0%	100.0%	2.7
Pleural procedure, other	1	0	0.0%	0.0%	0.0%	3.8
Mediastinal exploration	1	0	0.0%	0.0%	0.0%	2.6

Additional Information on morbidity category risk



Table 12.5

Frequency of isolated procedure and morbidity risk in school aged children (n=2,356 missing 1.3%)

Morbidity category 5

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Aortic root replacement	2	2	100.0%	100.0%	100.0%	5.0
Intraaortic balloon pump (IABP) insertion	2	2	100.0%	100.0%	100.0%	5.0
Aortic root replacement, homograft	1	1	100.0%	100.0%	100.0%	4.6
<b>Total (139 procedures)</b>	<b>2356</b>	<b>422</b>	<b>17.9%</b>	<b>16.4%</b>	<b>19.5%</b>	

Additional information on morbidity category risk



Table 13.1  
Frequency of isolated procedure and morbidity risk in grown-up children (n=860 missing 1.4%)  
Morbidity category 1

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	113	7	6.2%	1.8%	10.6%	0.5
ASD repair, primary closure	65	9	13.8%	5.4%	22.2%	0.8
PFO, primary closure	9	0	0.0%	0.0%	0.0%	0.7
PDA closure, NOS	9	1	11.1%	0.0%	31.6%	0.3
Pacemaker implantation, permanent	8	1	12.5%	0.0%	35.4%	0.3
Valvuloplasty, mitral	7	2	28.6%	0.0%	62.0%	0.8
Pulmonary embolectomy	7	0	0.0%	0.0%	0.0%	0.4
Cardiac procedure, other	7	0	0.0%	0.0%	0.0%	0.5
Organ procurement	7	0	0.0%	0.0%	0.0%	0.2
ASD partial closure	5	0	0.0%	0.0%	0.0%	0.8
Aortic stenosis, supra-valvar, repair	5	0	0.0%	0.0%	0.0%	0.1
Mediastinal procedure	4	1	25.0%	0.0%	67.4%	0.9
Thoracic and/or mediastinal procedure, other	4	2	50.0%	1.0%	99.0%	0.7
PAPVC repair	3	0	0.0%	0.0%	0.0%	0.4
Congenitally corrected TGA repair, VSD closure	3	0	0.0%	0.0%	0.0%	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	3	0	0.0%	0.0%	0.0%	0.8
Coarctation repair, interposition graft	3	0	0.0%	0.0%	0.0%	0.8
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	0.3
DCRV repair	2	0	0.0%	0.0%	0.0%	0.4
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	0.7
Sinus of Valsalva, aneurysm repair	2	0	0.0%	0.0%	0.0%	0.6
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	0.8
Pulmonary AV fistula repair/occlusion	2	0	0.0%	0.0%	0.0%	0.6
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	0.3
Pericardial procedure, other	1	1	100.0%	100.0%	100.0%	0.7
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	0.8
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	0.2
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	0.3
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	0.6

Additional Information on morbidity category risk



Table 13.2

Frequency of isolated procedure and morbidity risk in grown-up children (n=860 missing 1.4%)  
Morbidity category 2

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	137	14	10.2%	5.1%	15.3%	1.0
VSD repair, primary closure	91	13	14.3%	7.1%	21.5%	1.1
PDA closure, surgical	44	4	9.1%	0.6%	17.6%	0.9
TOF repair, non ventriculotomy	23	2	8.7%	0.0%	20.2%	1.5
Esophageal procedure	23	4	17.4%	1.9%	32.9%	1.3
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	19	6	31.6%	10.7%	52.5%	1.4
PDA closure, device	13	1	7.7%	0.0%	22.2%	1.1
Unifocalization MAPCA(s)	8	1	12.5%	0.0%	35.4%	1.3
Lung procedure, other	8	3	37.5%	4.0%	71.0%	1.5
Aortic stenosis, subvalvar, repair	7	2	28.6%	0.0%	62.0%	0.9
Valve replacement, pulmonic (PVR)	5	2	40.0%	0.0%	82.9%	1.4
Valve replacement, mitral (MVR)	5	1	20.0%	0.0%	55.1%	1.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	5	0	0.0%	0.0%	0.0%	1.4
AVC (AVSD) repair, partial (incomplete) (PAVSD)	4	0	0.0%	0.0%	0.0%	1.3
RVOT procedure	4	0	0.0%	0.0%	0.0%	1.5
Valve replacement, aortic (AVR), mechanical	4	1	25.0%	0.0%	67.4%	1.1
Mitral stenosis, supra-valvar mitral ring, repair	4	2	50.0%	1.0%	99.0%	1.2
Rastelli	4	1	25.0%	0.0%	67.4%	1.6
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	0	0.0%	0.0%	0.0%	1.4
Coarctation repair, end to end	3	0	0.0%	0.0%	0.0%	1.5
Coronary artery bypass	3	0	0.0%	0.0%	0.0%	1.3
Cardiotomy, other	3	1	33.3%	0.0%	86.7%	1.3
VSD, multiple, repair	2	0	0.0%	0.0%	0.0%	0.9
Ventricular septal fenestration	2	0	0.0%	0.0%	0.0%	1.2
TOF repair, RV-PA conduit	2	0	0.0%	0.0%	0.0%	1.5
TOF repair, NOS	2	1	50.0%	0.0%	100.0%	1.0
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	1.5
Valvuloplasty, pulmonic	2	0	0.0%	0.0%	0.0%	1.4
Valve surgery, other pulmonic	2	0	0.0%	0.0%	0.0%	1.2
Valvuloplasty, aortic	2	0	0.0%	0.0%	0.0%	1.0
Coronary artery procedure, other	2	0	0.0%	0.0%	0.0%	1.0
Cardiac tumor resection	2	0	0.0%	0.0%	0.0%	1.0
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	0.9



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	1.3
AVC (AVSD) repair , intermediated (transitional)	1	0	0.0%	0.0%	0.0%	1.0
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	1.3
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	1.1
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	1.4
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	1.6
Pectus repair	1	0	0.0%	0.0%	0.0%	1.0
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	1	100.0%	100.0%	100.0%	1.2

Additional Information on morbidity category risk



Table 13.3

Frequency of isolated procedure and morbidity risk in grown-up children (n=860 missing 1.4%)

Morbidity category 3

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	33	9	27.3%	12.1%	42.5%	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	14	3	21.4%	0.0%	42.9%	1.7
TOF repair, ventriculotomy, nontransanular patch	10	2	20.0%	0.0%	44.8%	1.6
Pulmonary atresia-VSD (including TOF, PA), repair	5	1	20.0%	0.0%	55.1%	1.6
Fontan, TCPC, lateral tunnel, fenestrated	5	3	60.0%	17.1%	100.0%	1.9
Ligation, thoracic duct	5	2	40.0%	0.0%	82.9%	2.4
DORV repair, NOS	4	0	0.0%	0.0%	0.0%	1.8
Valve replacement, tricuspid (TVR)	3	1	33.3%	0.0%	86.7%	2.3
Conduit, placement, LV to PA	3	2	66.7%	13.3%	100.0%	2.2
Pericardectomy	3	2	66.7%	13.3%	100.0%	1.7
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	3	3	100.0%	100.0%	100.0%	2.2
Anomalous origin of coronary artery repair	2	1	50.0%	0.0%	100.0%	2.2
Shunt, systemic to pulmonary, other	2	1	50.0%	0.0%	100.0%	2.3
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	2.0
Valve replacement, aortic (AVR)	1	0	0.0%	0.0%	0.0%	2.3
Valve surgery, other, aortic	1	0	0.0%	0.0%	0.0%	1.9
HLHS biventricular repair	1	0	0.0%	0.0%	0.0%	2.0
Fontan, TCPC, external conduit, NOS	1	1	100.0%	100.0%	100.0%	2.5
Fontan, other	1	0	0.0%	0.0%	0.0%	2.0
PA banding (PAB)	1	0	0.0%	0.0%	0.0%	2.1



Table 13.4  
Frequency of isolated procedure and morbidity risk in grown-up children (n=860 missing 1.4%)  
Morbidity category 4

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
AVC(AVSD) repair, complete CAVSD	4	2	50.0%	1.0%	99.0%	2.6
Fontan, TCPC, external conduit, nonfenestrated	4	3	75.0%	32.6%	100.0%	3.2
DORV, intraventricular tunnel repair	4	0	0.0%	0.0%	0.0%	2.8
Hemifontan	3	0	0.0%	0.0%	0.0%	3.0
Aortic arch repair	2	0	0.0%	0.0%	0.0%	3.1
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	2.6
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	1	100.0%	100.0%	100.0%	4.0
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	2.6
Arterial switch operation (ASO) and VSD repair	1	1	100.0%	100.0%	100.0%	3.0
Tracheal procedure	1	0	0.0%	0.0%	0.0%	2.9
Palliation, other	1	1	100.0%	100.0%	100.0%	2.6

Additional Information on morbidity category risk

Table 13.5  
Frequency of isolated procedure and morbidity risk in grown-up children (n=860 missing 1.4%)  
Morbidity category 5

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Konno procedure	1	1	100.0%	100.0%	100.0%	4.8
Ross-Konno procedure	1	1	100.0%	100.0%	100.0%	4.7
<b>Total (107 procedures)</b>	<b>860</b>	<b>125</b>	<b>14.5%</b>	<b>12.2%</b>	<b>16.9%</b>	



Table 14.1  
Frequency of isolated procedure and morbidity risk in adult (n=2,235 missing 0.8%)  
Morbidity category 1

Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	918	71	7.7%	6.0%	9.5%	0.5
ASD repair, primary closure	387	56	14.5%	11.0%	18.0%	0.8
ASD partial closure	63	7	11.1%	3.4%	18.9%	0.8
Pericardial drainage procedure	37	4	10.8%	0.8%	20.8%	0.6
PFO, primary closure	21	2	9.5%	0.0%	22.1%	0.7
Sinus of Valsalva, aneurysm repair	19	1	5.3%	0.0%	15.3%	0.6
Coarctation repair, interposition graft	11	1	9.1%	0.0%	26.1%	0.8
Coronary artery fistula ligation	11	1	9.1%	0.0%	26.1%	0.3
ASD repair, NOS	8	1	12.5%	0.0%	35.4%	0.7
PDA closure, NOS	8	1	12.5%	0.0%	35.4%	0.3
VSD repair, NOS	5	0	0.0%	0.0%	0.0%	0.3
Conduit, reoperation	4	1	25.0%	0.0%	67.4%	0.7
Valvuloplasty, mitral	4	0	0.0%	0.0%	0.0%	0.8
Congenitally corrected TGA repair, VSD closure	4	0	0.0%	0.0%	0.0%	0.9
Organ procurement	4	0	0.0%	0.0%	0.0%	0.2
PAPVC repair	3	0	0.0%	0.0%	0.0%	0.4
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	0.8
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	2	0	0.0%	0.0%	0.0%	0.8
Pacemaker implantation, permanent	2	0	0.0%	0.0%	0.0%	0.3
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	0.9
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	0.5
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	0.3
DCRV repair	1	0	0.0%	0.0%	0.0%	0.4
Aortic root replacement, mechanical	1	0	0.0%	0.0%	0.0%	0.5
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	0.3
Pericardial procedure, other	1	0	0.0%	0.0%	0.0%	0.7
Fontan, NOS	1	1	100.0%	100.0%	100.0%	0.8
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	0.8
Thoracic and/or mediastinal procedure, other	1	0	0.0%	0.0%	0.0%	0.7
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	0.6





Table 14.2  
Frequency of isolated procedure and morbidity risk in adult (n=2,235 missing 0.8%)  
Morbidity category 2

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	153	13	8.5%	4.1%	12.9%	1.0
PDA closure, surgical	130	14	10.8%	5.4%	16.1%	0.9
VSD repair, primary closure	86	12	14.0%	6.6%	21.3%	1.1
PDA closure, device	23	2	8.7%	0.0%	20.2%	1.1
Valve replacement, pulmonic (PVR)	16	1	6.3%	0.0%	18.1%	1.4
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	16	3	18.8%	0.0%	37.9%	1.4
TOF repair, non ventriculotomy	14	3	21.4%	0.0%	42.9%	1.5
TOF repair, NOS	14	2	14.3%	0.0%	32.6%	1.0
Ventricular septal fenestration	8	3	37.5%	4.0%	71.0%	1.2
ASD creation/enlargement	7	1	14.3%	0.0%	40.2%	1.0
TOF repair, RV-PA conduit	6	2	33.3%	0.0%	71.1%	1.5
Valvuloplasty, pulmonic	6	0	0.0%	0.0%	0.0%	1.4
RVOT procedure	5	0	0.0%	0.0%	0.0%	1.5
Rastelli	5	1	20.0%	0.0%	55.1%	1.6
Valvuloplasty, aortic	4	0	0.0%	0.0%	0.0%	1.0
Mitral stenosis, supra-valvar mitral ring, repair	4	1	25.0%	0.0%	67.4%	1.2
Cardiotomy, other	4	2	50.0%	1.0%	99.0%	1.3
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	0.9
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	1	33.3%	0.0%	86.7%	1.4
Valvuloplasty, tricuspid	3	0	0.0%	0.0%	0.0%	1.2
Valve surgery, other pulmonic	3	0	0.0%	0.0%	0.0%	1.2
Valve replacement, aortic (AVR), mechanical	3	0	0.0%	0.0%	0.0%	1.1
Valve replacement, mitral (MVR)	3	1	33.3%	0.0%	86.7%	1.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	3	1	33.3%	0.0%	86.7%	1.4
AVC (AVSD) repair, partial (incomplete) (PAVSD)	2	1	50.0%	0.0%	100.0%	1.3
Valve replacement, aortic (AVR), bioprosthetic	2	0	0.0%	0.0%	0.0%	1.1
Aortic stenosis, subvalvar, repair	2	0	0.0%	0.0%	0.0%	0.9
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	1.0
Coronary artery bypass	2	0	0.0%	0.0%	0.0%	1.3
Shunt, ligation and takedown	2	0	0.0%	0.0%	0.0%	1.4
Esophageal procedure	2	0	0.0%	0.0%	0.0%	1.3
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	1.3

Additional Information on morbidity category risk



Additional information on morbidity category risk

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	1.3
Unifocalization MAPCA(s)	1	1	100.0%	100.0%	100.0%	1.3
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	1.5
Lung procedure, other	1	0	0.0%	0.0%	0.0%	1.5
Atrial baffle procedure, NOS	1	0	0.0%	0.0%	0.0%	1.1
Cardiac tumor resection	1	0	0.0%	0.0%	0.0%	1.0



Table 14.3  
Frequency of isolated procedure and morbidity risk in adult (n=2,235 missing 0.8%)  
Morbidity category 3

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	51	9	17.6%	7.2%	28.1%	1.6
Pericardectomy	20	5	25.0%	6.0%	44.0%	1.7
TOF repair, ventriculotomy, nontransanular patch	12	1	8.3%	0.0%	24.0%	1.6
Pulmonary Venous Stenosis, repair	7	1	14.3%	0.0%	40.2%	1.8
Pulmonary atresia-VSD (including TOF, PA), repair	5	0	0.0%	0.0%	0.0%	1.6
Valve replacement, tricuspid (TVR)	5	2	40.0%	0.0%	82.9%	2.3
Conduit, placement, RV to PA	5	2	40.0%	0.0%	82.9%	1.9
DORV repair, NOS	5	2	40.0%	0.0%	82.9%	1.8
Atrial septal fenestration	4	1	25.0%	0.0%	67.4%	2.0
Fontan, TCPC, lateral tunnel, fenestrated	4	0	0.0%	0.0%	0.0%	1.9
ASD, repair, device	3	0	0.0%	0.0%	0.0%	1.8
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3	0	0.0%	0.0%	0.0%	1.7
Cor triatriatum repair	2	1	50.0%	0.0%	100.0%	1.9
Valve replacement, aortic (AVR)	2	0	0.0%	0.0%	0.0%	2.3
Fontan, TCPC, external conduit, NOS	2	0	0.0%	0.0%	0.0%	2.5
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	2.3
PA banding (PAB)	2	1	50.0%	0.0%	100.0%	2.1
VSD, repair, device	1	1	100.0%	100.0%	100.0%	1.8
AP window repair	1	0	0.0%	0.0%	0.0%	1.9
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	2.2
TOF, absent pulmonary valve, repair	1	1	100.0%	100.0%	100.0%	1.7
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	2.0
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	2.2
Valve surgery, other, aortic	1	0	0.0%	0.0%	0.0%	1.9
Fontan, other	1	0	0.0%	0.0%	0.0%	2.0
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	2.3
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	2.2

Additional Information on morbidity category risk



Table 14.4

Frequency of isolated procedure and morbidity risk in adult (n=2,235 missing 0.8%)  
 Morbidity category 4

Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
DORV, intraventricular tunnel repair	5	1	20.0%	0.0%	55.1%	2.8
Fontan, TCPC, external conduit, nonfenestrated	4	1	25.0%	0.0%	67.4%	3.2
Palliation, other	3	1	33.3%	0.0%	86.7%	2.6
TAPVC repair	1	0	0.0%	0.0%	0.0%	2.6
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	2.6
Arterial switch operation (ASO)	1	0	0.0%	0.0%	0.0%	2.6
Aortic arch repair	1	0	0.0%	0.0%	0.0%	3.1
Aortic dissection repair	1	1	100.0%	100.0%	100.0%	3.4
Ligation, pulmonary artery	1	0	0.0%	0.0%	0.0%	2.6
<b>Total (106 procedures)</b>	<b>2,235</b>	<b>244</b>	<b>10.9%</b>	<b>9.6%</b>	<b>12.2%</b>	

Additional information on morbidity category risk



Table 15.1  
Frequency of multiple procedure and morbidity risk in all age group (n=3,526 missing 5.4%)  
Morbidity category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	100	17	17.0%	9.6%	24.4%	0.5
Valvuloplasty, mitral	61	9	14.8%	5.9%	23.7%	0.8
ASD repair, primary closure	47	14	29.8%	16.7%	42.9%	0.8
PAPVC repair	44	3	6.8%	0.0%	14.3%	0.4
PFO, primary closure	40	6	15.0%	3.9%	26.1%	0.7
ASD partial closure	28	5	17.9%	3.7%	32.0%	0.8
PA, reconstruction (plasty), NOS	14	3	21.4%	0.0%	42.9%	0.8
Valve surgery, other, mitral	13	1	7.7%	0.0%	22.2%	0.9
DCRV repair	10	0	0.0%	0.0%	0.0%	0.4
Sinus of Valsalva, aneurysm repair	8	2	25.0%	0.0%	55.0%	0.6
VATS (video-assisted thoracoscopic surgery)	8	0	0.0%	0.0%	0.0%	0.1
ASD repair, NOS	5	1	20.0%	0.0%	55.1%	0.7
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	1	25.0%	0.0%	67.4%	0.8
Pacemaker implantation, permanent	4	1	25.0%	0.0%	67.4%	0.3
PA debanding	4	1	25.0%	0.0%	67.4%	0.6
VSD repair, NOS	3	1	33.3%	0.0%	86.7%	0.3
Aortic stenosis, supra-valvar, repair	3	0	0.0%	0.0%	0.0%	0.1
Coarctation repair, other	3	0	0.0%	0.0%	0.0%	0.1
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	0.3
PDA closure, NOS	3	1	33.3%	0.0%	86.7%	0.3
Organ procurement	3	0	0.0%	0.0%	0.0%	0.2
PAPVC, scimitar, repair	2	0	0.0%	0.0%	0.0%	0.2
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	2	0	0.0%	0.0%	0.0%	0.3
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	0.8
Congenitally corrected TGA repair, VSD closure	2	1	50.0%	0.0%	100.0%	0.9
Pulmonary AV fistula repair/occlusion	2	1	50.0%	0.0%	100.0%	0.6
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	0.3
Other annular enlargement procedure	1	0	0.0%	0.0%	0.0%	0.6
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	0.0%	0.0%	0.5
ASD creation, balloon septostomy (BAS)(Rashkind)	1	0	0.0%	0.0%	0.0%	0.5
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	0.3
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2

Additional Information on morbidity category risk



Table 15.2  
Frequency of multiple procedure and morbidity risk in all age group (n=3,526 missing 5.4%)  
Morbidity category 2

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	880	221	25.1%	22.2%	28.0%	1.0
VSD repair, primary closure	193	56	29.0%	22.6%	35.4%	1.1
PDA closure, surgical	102	22	21.6%	13.6%	29.6%	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	92	29	31.5%	22.0%	41.0%	1.4
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	90	25	27.8%	18.5%	37.0%	1.4
TOF repair, non ventriculotomy	80	18	22.5%	13.3%	31.7%	1.5
Valvuloplasty, tricuspid	77	14	18.2%	9.6%	26.8%	1.2
Valvuloplasty, pulmonic	55	15	27.3%	15.5%	39.0%	1.4
Rastelli	39	14	35.9%	20.8%	51.0%	1.6
RVOT procedure	38	14	36.8%	21.5%	52.2%	1.5
Coarctation repair, end to end	35	11	31.4%	16.0%	46.8%	1.5
Valve surgery, other, tricuspid	28	6	21.4%	6.2%	36.6%	1.2
PDA closure, device	28	12	42.9%	24.5%	61.2%	1.1
Coarctation repair, end to end, extended	27	11	40.7%	22.2%	59.3%	1.6
AVC (AVSD) repair, partial (incomplete) (PAVSD)	25	7	28.0%	10.4%	45.6%	1.3
Valve replacement, pulmonic (PVR)	18	6	33.3%	11.6%	55.1%	1.4
TOF repair, NOS	17	4	23.5%	3.4%	43.7%	1.0
Valve replacement, mitral (MVR)	17	4	23.5%	3.4%	43.7%	1.5
VSD, multiple, repair	16	4	25.0%	3.8%	46.2%	0.9
Mitral stenosis, supra-valvar mitral ring, repair	16	3	18.8%	0.0%	37.9%	1.2
TOF repair, RV-PA conduit	15	8	53.3%	28.1%	78.6%	1.5
Unifocalization MAPCA(s)	13	4	30.8%	5.7%	55.9%	1.3
ASD creation/enlargement	12	2	16.7%	0.0%	37.8%	1.0
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	10	3	30.0%	1.6%	58.4%	1.4
Aortic stenosis, subvalvar, repair	10	3	30.0%	1.6%	58.4%	0.9
Occlusion MAPCA(s)	9	3	33.3%	2.5%	64.1%	1.5
Valve surgery, other pulmonic	9	2	22.2%	0.0%	49.4%	1.2
Fontan, atrio-pulmonary connection	9	1	11.1%	0.0%	31.6%	1.0
TOF, AVC (AVSD), repair	8	1	12.5%	0.0%	35.4%	1.1
PA, reconstruction (plasty), branch, central	8	2	25.0%	0.0%	55.0%	1.2
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	8	1	12.5%	0.0%	35.4%	1.2
Ventricular septal fenestration	7	2	28.6%	0.0%	62.0%	1.2
Valve closure, tricuspid (exclusion, univentricular approach)	7	2	28.6%	0.0%	62.0%	1.4



Procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Lung procedure, other	7	3	42.9%	6.2%	79.5%	1.5
Valve replacement, aortic (AVR), mechanical	6	1	16.7%	0.0%	46.5%	1.1
Cardiac tumor resection	6	2	33.3%	0.0%	71.1%	1.0
AVC (AVSD) repair, intermediated (transitional)	5	1	20.0%	0.0%	55.1%	1.0
Pulmonary artery origin from ascending aorta (hemitruncus) repair	5	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-ventricular connection	5	2	40.0%	0.0%	82.9%	1.4
Cardiotomy, other	5	1	20.0%	0.0%	55.1%	1.3
1 1/2 ventricular repair	4	0	0.0%	0.0%	0.0%	1.0
Valvuloplasty, aortic	4	0	0.0%	0.0%	0.0%	1.0
Coronary artery procedure, other	4	1	25.0%	0.0%	67.4%	1.0
Valve replacement, aortic (AVR), bioprosthetic	3	1	33.3%	0.0%	86.7%	1.1
Mustard	3	1	33.3%	0.0%	86.7%	1.0
Esophageal procedure	3	2	66.7%	13.3%	100.0%	1.3
AVC (AVSD) repair, NOS	2	0	0.0%	0.0%	0.0%	1.3
Senning	2	1	50.0%	0.0%	100.0%	1.2
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	0.9
Sternotomy wound drainage	2	2	100.0%	100.0%	100.0%	1.3
Coronary artery bypass	1	1	100.0%	100.0%	100.0%	1.3
Shunt, ligation and takedown	1	0	0.0%	0.0%	0.0%	1.4

Additional Information on morbidity category risk



Table 15.3  
Frequency of multiple procedure and morbidity risk in all age group (n=3,526 missing 5.4%)  
Morbidity category 3

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	180	51	28.3%	21.8%	34.9%	1.6
PA banding (PAB)	60	29	48.3%	35.7%	61.0%	2.1
Pulmonary atresia-VSD (including TOF, PA), repair	36	13	36.1%	20.4%	51.8%	1.6
DORV repair, NOS	33	14	42.4%	25.6%	59.3%	1.8
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	27	8	29.6%	12.4%	46.9%	1.7
Truncus arteriosus repair	26	13	50.0%	30.8%	69.2%	2.2
TOF repair, ventriculotomy, nontransanular patch	23	10	43.5%	23.2%	63.7%	1.6
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	17	6	35.3%	12.6%	58.0%	2.2
Pulmonary Venous Stenosis, repair	15	4	26.7%	4.3%	49.0%	1.8
Cor triatriatum repair	14	5	35.7%	10.6%	60.8%	1.9
AP window repair	13	6	46.2%	19.1%	73.3%	1.9
Anomalous systemic venous connection repair	8	2	25.0%	0.0%	55.0%	2.2
TOF, absent pulmonary valve, repair	8	2	25.0%	0.0%	55.0%	1.7
Fontan, TCPC, external conduit, NOS	8	5	62.5%	29.0%	96.0%	2.5
Valve excision, pulmonary (without replacement)	7	3	42.9%	6.2%	79.5%	2.0
Pericardectomy	7	4	57.1%	20.5%	93.8%	1.7
Fontan, TCPC, lateral tunnel, fenestrated	7	3	42.9%	6.2%	79.5%	1.9
Valve replacement, tricuspid (TVR)	6	2	33.3%	0.0%	71.1%	2.3
PA, reconstruction (plasty), main (trunk)	6	2	33.3%	0.0%	71.1%	1.9
Valve surgery, other, aortic	5	4	80.0%	44.9%	100.0%	1.9
HLHS biventricular repair	4	3	75.0%	32.6%	100.0%	2.0
Coarctation repair, subclavian flap	4	1	25.0%	0.0%	67.4%	2.0
Atrial septal fenestration	3	1	33.3%	0.0%	86.7%	2.0
Conduit, placement, RV to PA	3	1	33.3%	0.0%	86.7%	1.9
Fontan, other	3	1	33.3%	0.0%	86.7%	2.0
Vascular ring repair	3	2	66.7%	13.3%	100.0%	2.4
Shunt, systemic to pulmonary, other	3	2	66.7%	13.3%	100.0%	2.3
ASD, repair, device	2	1	50.0%	0.0%	100.0%	1.8
Valve replacement, aortic (AVR)	2	2	100.0%	100.0%	100.0%	2.3
Congenitally corrected TGA repair, other	2	2	100.0%	100.0%	100.0%	2.3





Table 15.4  
Frequency of multiple procedure and morbidity risk in all age group (n=3,526 missing 5.4%)  
Morbidity category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
TAPVC repair	88	50	56.8%	46.5%	67.2%	2.6
Arterial switch operation (ASO)	80	41	51.3%	40.3%	62.2%	2.6
AVC(AVSD) repair, complete CAVSD	56	28	50.0%	36.9%	63.1%	2.6
DORV, intraventricular tunnel repair	51	31	60.8%	47.4%	74.2%	2.8
Aortic arch repair	37	25	67.6%	52.5%	82.7%	3.1
Interrupted aortic arch repair	36	21	58.3%	42.2%	74.4%	2.7
Arterial switch operation (ASO) and VSD repair	31	19	61.3%	44.1%	78.4%	3.0
Coarctation repair, patch aortoplasty	24	14	58.3%	38.6%	78.1%	2.7
Fontan, TCPC, external conduit, nonfenestrated	15	12	80.0%	59.8%	100.0%	3.2
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	14	11	78.6%	57.1%	100.0%	4.0
Norwood procedure	12	7	58.3%	30.4%	86.2%	2.8
Pulmonary artery sling repair	9	6	66.7%	35.9%	97.5%	2.8
Valve replacement, truncal	8	6	75.0%	45.0%	100.0%	3.2
Valve excision, tricuspid (without replacement)	5	3	60.0%	17.1%	100.0%	3.4
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	5	3	60.0%	17.1%	100.0%	2.6
Palliation, other	5	3	60.0%	17.1%	100.0%	2.6
Arrhythmia surgery-atrial, surgical ablation	4	3	75.0%	32.6%	100.0%	3.8
Hemifontan	3	3	100.0%	100.0%	100.0%	3.0
Coarctation repair, NOS	2	1	50.0%	0.0%	100.0%	2.6
Aortic dissection repair	2	1	50.0%	0.0%	100.0%	3.4
Valve closure, semilunar	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	2.6
Tracheal procedure	1	1	100.0%	100.0%	100.0%	2.9
Ligation, pulmonary artery	1	1	100.0%	100.0%	100.0%	2.6
Pleural procedure, other	1	1	100.0%	100.0%	100.0%	3.8

Additional Information on morbidity category risk



Table 15.5  
Frequency of multiple procedure and morbidity risk in all age group (n=3,526 missing 5.4%)  
Morbidity category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Aortic root replacement	1	1	100.0%	100.0%	100.0%	5.0
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	4.9
<b>Total (145 procedures)</b>	<b>3526</b>	<b>1115</b>	<b>31.6%</b>	<b>30.1%</b>	<b>33.2%</b>	

Additional information on morbidity category risk



**Table 16.1**  
 Frequency of multiple procedure and morbidity risk in newborn (n=284 missing 10.4%)  
 Morbidity category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, primary closure	2	2	100.0%	100.0%	100.0%	0.8
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	0.8
PFO, primary closure	1	1	100.0%	100.0%	100.0%	0.7
ASD repair, patch	1	0	0.0%	0.0%	0.0%	0.5
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	0.3
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	0.8
Coarctation repair, other	1	0	0.0%	0.0%	0.0%	0.1
Pacemaker implantation, permanent	1	1	100.0%	100.0%	100.0%	0.3
ASD creation, balloon septostomy (BAS) (Rashkind)	1	0	0.0%	0.0%	0.0%	0.5
PA debanding	1	1	100.0%	100.0%	100.0%	0.6
Pulmonary AV fistula repair/occlusion	1	1	100.0%	100.0%	100.0%	0.6

Additional Information on morbidity category risk



Table 16.2  
Frequency of multiple procedure and morbidity risk in newborn (n=284 missing 10.4%)  
Morbidity category 2

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	23	11	47.8%	27.4%	68.2%	1.4
RVOT procedure	10	9	90.0%	71.4%	100.0%	1.5
VSD repair, patch	8	4	50.0%	15.4%	84.6%	1.0
Coarctation repair, end to end, extended	8	6	75.0%	45.0%	100.0%	1.6
PDA closure, surgical	8	3	37.5%	4.0%	71.0%	0.9
Valvuloplasty, pulmonic	7	5	71.4%	38.0%	100.0%	1.4
Coarctation repair, end to end	5	2	40.0%	0.0%	82.9%	1.5
VSD repair, primary closure	3	2	66.7%	13.3%	100.0%	1.1
PDA closure, device	3	2	66.7%	13.3%	100.0%	1.1
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	1.2
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	1.0
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	1.0
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	1.0
TOF repair, RV-PA conduit	1	0	0.0%	0.0%	0.0%	1.5
Occlusion MAPCA(s)	1	1	100.0%	100.0%	100.0%	1.5
Valve closure, tricuspid (exclusion, univentricular approach)	1	0	0.0%	0.0%	0.0%	1.4
Valve surgery, other, tricuspid	1	1	100.0%	100.0%	100.0%	1.2
Valve replacement, pulmonic (PVR)	1	1	100.0%	100.0%	100.0%	1.4
Valvuloplasty, aortic	1	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	1.4
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	1.4



**Table 16.3**  
Frequency of multiple procedure and morbidity risk in newborn (n=284 missing 10.4%)  
Morbidity category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
PA banding (PAB)	17	10	58.8%	35.4%	82.2%	2.1
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	7	1	14.3%	0.0%	40.2%	1.7
Truncus arteriosus repair	5	5	100.0%	100.0%	100.0%	2.2
HLHS biventricular repair	3	2	66.7%	13.3%	100.0%	2.0
AP window repair	2	2	100.0%	100.0%	100.0%	1.9
Pulmonary atresia-VSD (including TOF, PA), repair	2	1	50.0%	0.0%	100.0%	1.6
PA, reconstruction (plasty), main (trunk)	2	1	50.0%	0.0%	100.0%	1.9
Cortriatriatum repair	1	1	100.0%	100.0%	100.0%	1.9
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	2.0
Valve surgery, other, aortic	1	1	100.0%	100.0%	100.0%	1.9
Coarctation repair, subclavian flap	1	0	0.0%	0.0%	0.0%	2.0

Additional Information on morbidity category risk



Table 16.4  
Frequency of multiple procedure and morbidity risk in newborn (n=284 missing 10.4%)  
Morbidity category 4

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Arterial switch operation (ASO)	46	25	54.3%	40.0%	68.7%	2.6
TAPVC repair	28	20	71.4%	54.7%	88.2%	2.6
Interrupted aortic arch repair	19	11	57.9%	35.7%	80.1%	2.7
Aortic arch repair	13	11	84.6%	65.0%	100.0%	3.1
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	9	7	77.8%	50.6%	100.0%	4.0
Arterial switch operation (ASO) and VSD repair	9	7	77.8%	50.6%	100.0%	3.0
Coarctation repair, patch aortoplasty	6	2	33.3%	0.0%	71.1%	2.7
Norwood procedure	3	1	33.3%	0.0%	86.7%	2.8
AVC(AVSD) repair, complete CAUSD	1	1	100.0%	100.0%	100.0%	2.6
Valve replacement, truncal	1	1	100.0%	100.0%	100.0%	3.2
Valve excision, tricuspid (without replacement)	1	1	100.0%	100.0%	100.0%	3.4
Coarctation repair, NOS	1	1	100.0%	100.0%	100.0%	2.6
Pulmonary artery sling repair	1	1	100.0%	100.0%	100.0%	2.8
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	3.4
Damus-Kaye-Stansel procedure (DKS (creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	2.6
<b>Total (58 procedures)</b>	<b>284</b>	<b>168</b>	<b>59.2%</b>	<b>53.4%</b>	<b>64.9%</b>	



Table 17.1  
Frequency of multiple procedure and morbidity risk in infant (n=797 missing 7.3%)  
Morbidity category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	11	6	54.5%	25.1%	84.0%	0.5
PFO, primary closure	9	1	11.1%	0.0%	31.6%	0.7
ASD repair, primary closure	6	4	66.7%	28.9%	100.0%	0.8
ASD partial closure	6	2	33.3%	0.0%	71.1%	0.8
PAPVC repair	2	0	0.0%	0.0%	0.0%	0.4
PA, reconstruction (plasty), NOS	2	1	50.0%	0.0%	100.0%	0.8
Valvuloplasty, mitral	2	1	50.0%	0.0%	100.0%	0.8
Coarctation repair, other	2	0	0.0%	0.0%	0.0%	0.1
PDA closure, NOS	2	0	0.0%	0.0%	0.0%	0.3
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	0.3
VSD repair, NOS	1	1	100.0%	100.0%	100.0%	0.3
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Valve surgery, other, mitral	1	0	0.0%	0.0%	0.0%	0.9
Fontan, NOS	1	0	0.0%	0.0%	0.0%	0.8
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	0.3
PA debanding	1	0	0.0%	0.0%	0.0%	0.6
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	0.3
Pulmonary AV fistula repair/occlusion	1	0	0.0%	0.0%	0.0%	0.6

Additional Information on morbidity category risk



Table 17.2  
Frequency of multiple procedure and morbidity risk in infant (n=797 missing 7.3%)  
Morbidity category 2

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	243	104	42.8%	36.6%	49.0%	1.0
VSD repair, primary closure	33	17	51.5%	34.5%	68.6%	1.1
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	31	11	35.5%	18.6%	52.3%	1.4
PDA closure, surgical	25	9	36.0%	17.2%	54.8%	0.9
Coarctation repair, end to end	21	8	38.1%	17.3%	58.9%	1.5
Coarctation repair, end to end, extended	12	3	25.0%	0.5%	49.5%	1.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	12	5	41.7%	13.8%	69.6%	1.4
PDA closure, device	8	5	62.5%	29.0%	96.0%	1.1
TOF repair, non ventriculotomy	6	1	16.7%	0.0%	46.5%	1.5
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	4	1	25.0%	0.0%	67.4%	1.4
PA, reconstruction (plasty), branch, central	4	1	25.0%	0.0%	67.4%	1.2
ASD creation/enlargement	3	2	66.7%	13.3%	100.0%	1.0
AVC (AVSD) repair, partial (incomplete)(PAVSD)	3	2	66.7%	13.3%	100.0%	1.3
Pulmonary artery origin from ascending aorta (hemitruncus) repair	3	0	0.0%	0.0%	0.0%	1.0
Valvuloplasty, tricuspid	3	1	33.3%	0.0%	86.7%	1.2
RVOT procedure	3	2	66.7%	13.3%	100.0%	1.5
Valvuloplasty, pulmonic	3	2	66.7%	13.3%	100.0%	1.4
Rastelli	3	2	66.7%	13.3%	100.0%	1.6
VSD, multiple, repair	2	1	50.0%	0.0%	100.0%	0.9
Occlusion MAPCA(s)	2	1	50.0%	0.0%	100.0%	1.5
Valve surgery, other, tricuspid	2	1	50.0%	0.0%	100.0%	1.2
Lung procedure, other	2	2	100.0%	100.0%	100.0%	1.5
AVC (AVSD) repair, intermediated (transitional)	1	1	100.0%	100.0%	100.0%	1.0
Valve closure, tricuspid (exclusion, univentricular approach)	1	1	100.0%	100.0%	100.0%	1.4
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
Mitral stenosis, supra-avalvular mitral ring, repair	1	1	100.0%	100.0%	100.0%	1.2
Fontan, atrio-pulmonary connection	1	1	100.0%	100.0%	100.0%	1.0
Fontan, atrio-ventricular connection	1	1	100.0%	100.0%	100.0%	1.4
Coronary artery bypass	1	1	100.0%	100.0%	100.0%	1.3
Coronary artery procedure, other	1	1	100.0%	100.0%	100.0%	1.0
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	1	100.0%	100.0%	100.0%	1.2
Pleural drainage procedure	1	0	0.0%	0.0%	0.0%	0.9





Table 17.3  
Frequency of multiple procedure and morbidity risk in infant (n=797 missing 7.3%)  
Morbidity category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
PA banding (PAB)	37	18	48.6%	32.5%	64.8%	2.1
Truncus arteriosus repair	13	5	38.5%	12.0%	64.9%	2.2
AP window repair	6	2	33.3%	0.0%	71.1%	1.9
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	6	2	33.3%	0.0%	71.1%	1.7
TOF repair, ventriculotomy, transanular patch	5	2	40.0%	0.0%	82.9%	1.6
Cor triatriatum repair	4	4	100.0%	100.0%	100.0%	1.9
Pulmonary Venous Stenosis, repair	3	1	33.3%	0.0%	86.7%	1.8
Pulmonary atresia-VSD (including TOF, PA), repair	3	1	33.3%	0.0%	86.7%	1.6
DORV repair, NOS	3	1	33.3%	0.0%	86.7%	1.8
Coarctation repair, subclavian flap	3	1	33.3%	0.0%	86.7%	2.0
Vascular ring repair	3	2	66.7%	13.3%	100.0%	2.4
Shunt, systemic to pulmonary, other	2	2	100.0%	100.0%	100.0%	2.3
Atrial septal fenestration	1	1	100.0%	100.0%	100.0%	2.0
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	2.2
TOF repair, ventriculotomy, nontransanular patch	1	1	100.0%	100.0%	100.0%	1.6
HLHS biventricular repair	1	1	100.0%	100.0%	100.0%	2.0
Pericardectomy	1	1	100.0%	100.0%	100.0%	1.7
Fontan, TCPC, lateral tunnel, fenestrated	1	1	100.0%	100.0%	100.0%	1.9
Congenitally corrected TGA repair, other	1	1	100.0%	100.0%	100.0%	2.3
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	1	1	100.0%	100.0%	100.0%	2.2

Additional Information on morbidity category risk



Table 17.4  
Frequency of multiple procedure and morbidity risk in infant (n=797 missing 7.3%)  
Morbidity category 4

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
TAPVC repair	38	22	57.9%	42.2%	73.6%	2.6
Arterial switch operation (ASO)	29	13	44.8%	26.7%	62.9%	2.6
AVC(AVSD) repair, complete CAVD	25	13	52.0%	32.4%	71.6%	2.6
Arterial switch operation (ASO) and VSD repair	20	11	55.0%	33.2%	76.8%	3.0
Aortic arch repair	19	13	68.4%	47.5%	89.3%	3.1
Interrupted aortic arch repair	16	9	56.3%	31.9%	80.6%	2.7
Coarctation repair, patch aortoplasty	15	10	66.7%	42.8%	90.5%	2.7
DORV, intraventricular tunnel repair	14	9	64.3%	39.2%	89.4%	2.8
Valve replacement, truncal	7	5	71.4%	38.0%	100.0%	3.2
Norwood procedure	7	5	71.4%	38.0%	100.0%	2.8
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	5	4	80.0%	44.9%	100.0%	4.0
Pulmonary artery sling repair	5	3	60.0%	17.1%	100.0%	2.8
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	3	1	33.3%	0.0%	86.7%	2.6
Palliation, other	2	1	50.0%	0.0%	100.0%	2.6
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	2.6
Coarctation repair, NOS	1	0	0.0%	0.0%	0.0%	2.6
Aortic dissection repair	1	1	100.0%	100.0%	100.0%	3.4
Tracheal procedure	1	1	100.0%	100.0%	100.0%	2.9
Pleural procedure, other	1	1	100.0%	100.0%	100.0%	3.8



Table 17.5  
 Frequency of multiple procedure and morbidity risk in infant (n=797 missing 7.3%)  
 Morbidity category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	4.9
<b>Total (92 procedures)</b>	<b>797</b>	<b>379</b>	<b>47.6%</b>	<b>44.1%</b>	<b>51.0%</b>	

Additional Information on morbidity category risk



Table 18.1  
 Frequency of multiple procedure and morbidity risk in preschool children (n=697 missing 5.7%)  
 Morbidity category 1

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, primary closure	8	1	12.5%	0.0%	35.4%	0.8
ASD repair, patch	8	1	12.5%	0.0%	35.4%	0.5
PFO, primary closure	5	0	0.0%	0.0%	0.0%	0.7
Valvuloplasty, mitral	5	1	20.0%	0.0%	55.1%	0.8
ASD partial closure	4	1	25.0%	0.0%	67.4%	0.8
PAPVC repair	4	0	0.0%	0.0%	0.0%	0.4
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	0.8
Valve surgery, other, mitral	2	0	0.0%	0.0%	0.0%	0.9
ASD repair, NOS	1	0	0.0%	0.0%	0.0%	0.7
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	0.8



Table 18.2  
Frequency of multiple procedure and morbidity risk in preschool children (n=697 missing 5.7%)  
Morbidity category 2

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	264	70	26.5%	21.2%	31.8%	1.0
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	54	14	25.9%	14.2%	37.6%	1.4
VSD repair, primary closure	45	13	28.9%	15.6%	42.1%	1.1
PDA closure, surgical	20	3	15.0%	0.0%	30.6%	0.9
TOF repair, non ventriculotomy	15	2	13.3%	0.0%	30.5%	1.5
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	9	1	11.1%	0.0%	31.6%	1.4
AVC (AVSD) repair, partial (incomplete)(PAVSD)	7	2	28.6%	0.0%	62.0%	1.3
Valvuloplasty, pulmonic	7	2	28.6%	0.0%	62.0%	1.4
Coarctation repair, end to end	6	1	16.7%	0.0%	46.5%	1.5
TOF repair, NOS	5	2	40.0%	0.0%	82.9%	1.0
Aortic stenosis, subvalvar, repair	5	3	60.0%	17.1%	100.0%	0.9
Coarctation repair, end to end, extended	5	1	20.0%	0.0%	55.1%	1.6
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	0.9
TOF repair, RV-PA conduit	3	2	66.7%	13.3%	100.0%	1.5
Rastelli	3	0	0.0%	0.0%	0.0%	1.6
AVC (AVSD) repair, NOS	2	0	0.0%	0.0%	0.0%	1.3
TOF, AVC (AVSD), repair	2	1	50.0%	0.0%	100.0%	1.1
Occlusion MAPCA(s)	2	1	50.0%	0.0%	100.0%	1.5
Valvuloplasty, tricuspid	2	1	50.0%	0.0%	100.0%	1.2
Fontan, atrio-ventricular connection	2	0	0.0%	0.0%	0.0%	1.4
Mustard	2	1	50.0%	0.0%	100.0%	1.0
PDA closure, device	2	0	0.0%	0.0%	0.0%	1.1
Lung procedure, other	2	1	50.0%	0.0%	100.0%	1.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	0	0.0%	0.0%	0.0%	1.2
Esophageal procedure	2	1	50.0%	0.0%	100.0%	1.3
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	1.0
Ventricular septal fenestration	1	0	0.0%	0.0%	0.0%	1.2
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	1.0
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	1.0
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	1	0	0.0%	0.0%	0.0%	1.4
Unifocalization MAPCA(s)	1	1	100.0%	100.0%	100.0%	1.3
Valve closure, tricuspid (exclusion, univentricular approach)	1	1	100.0%	100.0%	100.0%	1.4

Additional Information on morbidity category risk



Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	1.2
RVOT procedure	1	0	0.0%	0.0%	0.0%	1.5
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	1.0
Valve replacement, pulmonic (PVR)	1	0	0.0%	0.0%	0.0%	1.4
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	1.2
Valve replacement, mitral (MVR)	1	0	0.0%	0.0%	0.0%	1.5
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	1.0
Senning	1	1	100.0%	100.0%	100.0%	1.2
Shunt, ligation and takedown	1	0	0.0%	0.0%	0.0%	1.4
Sternotomy wound drainage	1	1	100.0%	100.0%	100.0%	1.3
Cardiotomy, other	1	0	0.0%	0.0%	0.0%	1.3



Table 18.3  
 Frequency of multiple procedure and morbidity risk in preschool children (n=697 missing 5.7%)  
 Morbidity category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	57	17	29.8%	17.9%	41.7%	1.6
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn)	11	2	18.2%	0.0%	41.0%	2.2
DORV repair, NOS	8	2	25.0%	0.0%	55.0%	1.8
Cor triatriatum repair	6	0	0.0%	0.0%	0.0%	1.9
AP window repair	5	2	40.0%	0.0%	82.9%	1.9
Pulmonary atresia-VSD (including TOF, PA), repair	5	1	20.0%	0.0%	55.1%	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	5	1	20.0%	0.0%	55.1%	1.7
Truncus arteriosus repair	4	2	50.0%	1.0%	99.0%	2.2
PA banding (PAB)	4	0	0.0%	0.0%	0.0%	2.1
Pulmonary Venous Stenosis, repair	3	1	33.3%	0.0%	86.7%	1.8
Anomalous systemic venous connection repair	3	1	33.3%	0.0%	86.7%	2.2
TOF repair, ventriculotomy, nontransanular patch	3	2	66.7%	13.3%	100.0%	1.6
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	2.0
Fontan, other	1	1	100.0%	100.0%	100.0%	2.0

Additional Information on morbidity category risk



Table 18.4  
Frequency of multiple procedure and morbidity risk in preschool children (n=697 missing 5.7%)  
Morbidity category 4

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
AVC(AVSD) repair, complete CAVSD	16	8	50.0%	25.5%	74.5%	2.6
TAPVC repair	11	6	54.5%	25.1%	84.0%	2.6
DORV, intraventricular tunnel repair	6	4	66.7%	28.9%	100.0%	2.8
Norwood procedure	2	1	50.0%	0.0%	100.0%	2.8
Arterial switch operation (ASO)	2	2	100.0%	100.0%	100.0%	2.6
Arterial switch operation (ASO) and VSD repair	2	1	50.0%	0.0%	100.0%	3.0
Coarctation repair, patch aortoplasty	2	1	50.0%	0.0%	100.0%	2.7
Aortic arch repair	2	1	50.0%	0.0%	100.0%	3.1
Pulmonary artery sling repair	2	1	50.0%	0.0%	100.0%	2.8
Valve excision, tricuspid (without replacement)	1	0	0.0%	0.0%	0.0%	3.4
Fontan, TCPC, external conduit, nonfenestrated	1	1	100.0%	100.0%	100.0%	3.2
Interrupted aortic arch repair	1	1	100.0%	100.0%	100.0%	2.7
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	2.6
<b>Total (83 procedures)</b>	<b>697</b>	<b>190</b>	<b>27.3%</b>	<b>24.0%</b>	<b>30.6%</b>	





Table 19.1  
Frequency of multiple procedure and morbidity risk in school aged children (n=858 missing 4.1%)  
Morbidity category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	22	0	0.0%	0.0%	0.0%	0.5
PAPVC repair	19	2	10.5%	0.0%	24.3%	0.4
Valvuloplasty, mitral	17	3	17.6%	0.0%	35.8%	0.8
PFO, primary closure	11	3	27.3%	1.0%	53.6%	0.7
ASD repair, primary closure	10	4	40.0%	9.6%	70.4%	0.8
DCRV repair	5	0	0.0%	0.0%	0.0%	0.4
ASD partial closure	4	1	25.0%	0.0%	67.4%	0.8
PA, reconstruction (plasty), NOS	4	2	50.0%	1.0%	99.0%	0.8
Valve surgery, other, mitral	4	0	0.0%	0.0%	0.0%	0.9
ASD repair, NOS	3	0	0.0%	0.0%	0.0%	0.7
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	0.3
Organ procurement	2	0	0.0%	0.0%	0.0%	0.2
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	0.3
Aortic stenosis, supra-aortic, repair	1	0	0.0%	0.0%	0.0%	0.1
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	0.0%	0.0%	0.5
Fontan, NOS	1	0	0.0%	0.0%	0.0%	0.8
Congenitally corrected TGA repair, VSD closure	1	1	100.0%	100.0%	100.0%	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	0.8
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	0.3
PA debanding	1	0	0.0%	0.0%	0.0%	0.6

Additional Information on morbidity category risk



Table 19.2  
Frequency of multiple procedure and morbidity risk in school aged children (n=858 missing 4.1%)  
Morbidity category 2

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	178	20	11.2%	6.6%	15.9%	1.0
TOF repair, non ventriculotomy	54	13	24.1%	12.7%	35.5%	1.5
VSD repair, primary closure	45	11	24.4%	11.9%	37.0%	1.1
Rastelli	27	10	37.0%	18.8%	55.3%	1.6
PDA closure, surgical	27	4	14.8%	1.4%	28.2%	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	21	3	14.3%	0.0%	29.3%	1.4
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	19	4	21.1%	2.7%	39.4%	1.4
RVOT procedure	13	2	15.4%	0.0%	35.0%	1.5
Valvuloplasty, pulmonic	12	1	8.3%	0.0%	24.0%	1.4
TOF repair, RV-PA conduit	10	5	50.0%	19.0%	81.0%	1.5
Valvuloplasty, tricuspid	8	3	37.5%	4.0%	71.0%	1.2
TOF repair, NOS	7	2	28.6%	0.0%	62.0%	1.0
Unifocalization MAPCA(s)	7	1	14.3%	0.0%	40.2%	1.3
PDA closure, device	7	4	57.1%	20.5%	93.8%	1.1
VSD, multiple, repair	6	3	50.0%	10.0%	90.0%	0.9
AVC (AVSD) repair, partial (incomplete)(PAVSD)	4	0	0.0%	0.0%	0.0%	1.3
TOF, AVC (AVSD), repair	4	0	0.0%	0.0%	0.0%	1.1
Valve surgery, other, tricuspid	4	2	50.0%	1.0%	99.0%	1.2
Valve replacement, pulmonic (PVR)	4	2	50.0%	1.0%	99.0%	1.4
Aortic stenosis, subvalvar, repair	4	0	0.0%	0.0%	0.0%	0.9
Valve replacement, mitral (MVR)	4	1	25.0%	0.0%	67.4%	1.5
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	1	33.3%	0.0%	86.7%	1.4
PA, reconstruction (plasty), branch, central	3	1	33.3%	0.0%	86.7%	1.2
Mitral stenosis, supra-valvar mitral ring, repair	3	0	0.0%	0.0%	0.0%	1.2
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	1.0
Ventricular septal fenestration	2	0	0.0%	0.0%	0.0%	1.2
AVC (AVSD) repair, intermediated (transitional)	2	0	0.0%	0.0%	0.0%	1.0
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	1.5
1 1/2 ventricular repair	2	0	0.0%	0.0%	0.0%	1.0
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	1.2
Valvuloplasty, aortic	2	0	0.0%	0.0%	0.0%	1.0
Valve replacement, aortic (AVR), mechanical	2	1	50.0%	0.0%	100.0%	1.1
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	1.0



1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
Lung procedure, other	2	0	0.0%	0.0%	0.0%	1.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	0	0.0%	0.0%	0.0%	1.2
Cardiotomy, other	2	0	0.0%	0.0%	0.0%	1.3
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	1.0
Fontan, atrio-ventricular connection	1	1	100.0%	100.0%	100.0%	1.4
Senning	1	0	0.0%	0.0%	0.0%	1.2
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	1.5
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	1.6
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	1.0
Esophageal procedure	1	1	100.0%	100.0%	100.0%	1.3

Additional Information on morbidity category risk



Table 19.3

Frequency of multiple procedure and morbidity risk in school aged children (n=858 missing 4.1%)  
Morbidity category 3

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transannular patch	88	28	31.8%	22.1%	41.5%	1.6
DORV repair, NOS	15	7	46.7%	21.4%	71.9%	1.8
Pulmonary atresia-VSD (including TOF, PA), repair	14	6	42.9%	16.9%	68.8%	1.6
TOF repair, ventriculotomy, nontransannular patch	8	2	25.0%	0.0%	55.0%	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	8	3	37.5%	4.0%	71.0%	1.7
Fontan, TCPC, external conduit, NOS	7	4	57.1%	20.5%	93.8%	2.5
TOF, absent pulmonary valve, repair	4	1	25.0%	0.0%	67.4%	1.7
Valve excision, pulmonary (without replacement)	4	2	50.0%	1.0%	99.0%	2.0
Pericardectomy	4	2	50.0%	1.0%	99.0%	1.7
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn)	4	2	50.0%	1.0%	99.0%	2.2
PA, reconstruction (plasty), main (trunk)	3	1	33.3%	0.0%	86.7%	1.9
Fontan, TCPC, lateral tunnel, fenestrated	3	2	66.7%	13.3%	100.0%	1.9
Truncus arteriosus repair	2	1	50.0%	0.0%	100.0%	2.2
Pulmonary Venous Stenosis, repair	2	0	0.0%	0.0%	0.0%	1.8
Valve replacement, tricuspid (TVR)	2	1	50.0%	0.0%	100.0%	2.3
Conduit, placement, RV to PA	2	1	50.0%	0.0%	100.0%	1.9
Valve surgery, other, aortic	2	2	100.0%	100.0%	100.0%	1.9
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	2.0
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	1.9
Valve replacement, aortic (AVR)	1	1	100.0%	100.0%	100.0%	2.3
Fontan, other	1	0	0.0%	0.0%	0.0%	2.0
Congenitally corrected TGA repair, other	1	1	100.0%	100.0%	100.0%	2.3
Shunt, systemic to pulmonary, other	1	0	0.0%	0.0%	0.0%	2.3



Table 19.4

Frequency of multiple procedure and morbidity risk in school aged children (n=858 missing 4.1%)  
Morbidity category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
DORV, intraventricular tunnel repair	22	11	50.0%	29.1%	70.9%	2.8
AVC(AVSD) repair, complete CAVSD	11	5	45.5%	16.0%	74.9%	2.6
Fontan, TCPC, external conduit, nonfenestrated	11	10	90.9%	73.9%	100.0%	3.2
TAPVC repair	7	2	28.6%	0.0%	62.0%	2.6
Aortic arch repair	3	0	0.0%	0.0%	0.0%	3.1
Arterial switch operation (ASO)	2	1	50.0%	0.0%	100.0%	2.6
Hemifontan	2	2	100.0%	100.0%	100.0%	3.0
Palliation, other	2	2	100.0%	100.0%	100.0%	2.6
Valve closure, semilunar	1	1	100.0%	100.0%	100.0%	2.6
Pulmonary artery sling repair	1	1	100.0%	100.0%	100.0%	2.8

Additional Information on morbidity category risk

Table 19.5

Frequency of multiple procedure and morbidity risk in school aged children (n=858 missing 4.1%)  
Morbidity category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Aortic root replacement	1	1	100.0%	100.0%	100.0%	5.0
<b>Total (98 procedures)</b>	<b>858</b>	<b>216</b>	<b>25.2%</b>	<b>22.3%</b>	<b>28.1%</b>	



Table 20.1  
Frequency of multiple procedure and morbidity risk in grown-up children (n=279 missing 3.8%)  
Morbidity category 1

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Valvuloplasty, mitral	12	2	16.7%	0.0%	37.8%	0.8
PFO, primary closure	5	0	0.0%	0.0%	0.0%	0.7
PAPVC repair	5	0	0.0%	0.0%	0.0%	0.4
ASD, repair, patch	4	2	50.0%	1.0%	99.0%	0.5
ASD, repair, primary closure	3	0	0.0%	0.0%	0.0%	0.8
ASD partial closure	3	0	0.0%	0.0%	0.0%	0.8
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	0.8
DCRV repair	2	0	0.0%	0.0%	0.0%	0.4
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	0.6
Sinus of Valsalva, aneurysm repair	1	1	100.0%	100.0%	100.0%	0.6
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	1	100.0%	100.0%	100.0%	0.8
PA debanding	1	0	0.0%	0.0%	0.0%	0.6
VATS (video-assisted thoracoscopic surgery)	1	0	0.0%	0.0%	0.0%	0.1
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	0.2



Table 20.2  
Frequency of multiple procedure and morbidity risk in grown-up children (n=279 missing 3.8%)  
Morbidity category 2

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	62	6	9.7%	2.3%	17.0%	1.0
VSD repair, primary closure	30	9	30.0%	13.6%	46.4%	1.1
Valvuloplasty, pulmonic	7	2	28.6%	0.0%	62.0%	1.4
PDA closure, surgical	7	1	14.3%	0.0%	40.2%	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	7	3	42.9%	6.2%	79.5%	1.4
Valvuloplasty, tricuspid	5	0	0.0%	0.0%	0.0%	1.2
Valve replacement, pulmonic (PVR)	5	2	40.0%	0.0%	82.9%	1.4
Valve replacement, mitral (MVR)	4	1	25.0%	0.0%	67.4%	1.5
Rastelli	4	1	25.0%	0.0%	67.4%	1.6
PDA closure, device	4	1	25.0%	0.0%	67.4%	1.1
AVC (AVSD) repair, partial (incomplete) (PAVSD)	3	1	33.3%	0.0%	86.7%	1.3
TOF repair, non ventriculotomy	3	2	66.7%	13.3%	100.0%	1.5
Unifocalization MAPCA(s)	3	1	33.3%	0.0%	86.7%	1.3
RVOT procedure	3	0	0.0%	0.0%	0.0%	1.5
Valve surgery, other pulmonic	3	0	0.0%	0.0%	0.0%	1.2
Mitral stenosis, supra-valvar mitral ring, repair	3	2	66.7%	13.3%	100.0%	1.2
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	3	2	66.7%	13.3%	100.0%	1.4
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	2	1	50.0%	0.0%	100.0%	1.4
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	1.5
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	1.4
Valve replacement, aortic (AVR), mechanical	2	0	0.0%	0.0%	0.0%	1.1
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	0	0.0%	0.0%	0.0%	1.2
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	0.9
TOF repair, RV-PA conduit	1	1	100.0%	100.0%	100.0%	1.5
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	1.2
PA, reconstruction (plasty), branch, central	1	0	0.0%	0.0%	0.0%	1.2
Valve replacement, aortic (AVR), bioprosthetic	1	1	100.0%	100.0%	100.0%	1.1
Aortic stenosis, subvalvar, repair	1	0	0.0%	0.0%	0.0%	0.9
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	1.0
Mustard	1	0	0.0%	0.0%	0.0%	1.0
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	1.5

Additional Information on morbidity category risk



Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
Coarctation repair, end to end, extended	1	1	100.0%	100.0%	100.0%	1.6
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	1.0
Cardiac tumor resection	1	0	0.0%	0.0%	0.0%	1.0
Pleural drainage procedure	1	0	0.0%	0.0%	0.0%	0.9
Sternotomy wound drainage	1	1	100.0%	100.0%	100.0%	1.3
Cardiotomy, other	1	0	0.0%	0.0%	0.0%	1.3





Table 20.3  
Frequency of multiple procedure and morbidity risk in grown-up children (n=279 missing 3.8%)  
Morbidity category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	10	2	20.0%	0.0%	44.8%	1.6
Pulmonary atresia-VSD (including TOF, PA), repair	7	3	42.9%	6.2%	79.5%	1.6
TOF repair, ventriculotomy, nontransanular patch	4	2	50.0%	1.0%	99.0%	1.6
DORV repair, NOS	4	2	50.0%	1.0%	99.0%	1.8
Fontan, TCPC, lateral tunnel, fenestrated	3	0	0.0%	0.0%	0.0%	1.9
Truncus arteriosus repair	2	0	0.0%	0.0%	0.0%	2.2
TOF, absent pulmonary valve, repair	2	1	50.0%	0.0%	100.0%	1.7
Valve surgery, other, aortic	2	1	50.0%	0.0%	100.0%	1.9
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	1.9
Pulmonary Venous Stenosis, repair	1	0	0.0%	0.0%	0.0%	1.8
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	2.2
Valve replacement, tricuspid (TVR)	1	0	0.0%	0.0%	0.0%	2.3
PA, reconstruction (plasty), main (trunk)	1	0	0.0%	0.0%	0.0%	1.9
Conduit, placement, RV to PA	1	0	0.0%	0.0%	0.0%	1.9
Valve replacement, aortic (AVR)	1	1	100.0%	100.0%	100.0%	2.3
Pericardectomy	1	0	0.0%	0.0%	0.0%	1.7
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	1	1	100.0%	100.0%	100.0%	1.7
PA banding (PAB)	1	1	100.0%	100.0%	100.0%	2.1

Additional Information on morbidity category risk



Table 20.4  
 Frequency of multiple procedure and morbidity risk in grown-up children (n=279 missing 3.8%)  
 Morbidity category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
DORV, intraventricular tunnel repair	5	4	80.0%	44.9%	100.0%	2.8
TAPVC repair	2	0	0.0%	0.0%	0.0%	2.6
Coarctation repair, patch aortoplasty	1	1	100.0%	100.0%	100.0%	2.7
Hemifontan	1	1	100.0%	100.0%	100.0%	3.0
Palliation, other	1	0	0.0%	0.0%	0.0%	2.6
<b>Total (74 procedures)</b>	<b>279</b>	<b>65</b>	<b>23.3%</b>	<b>18.3%</b>	<b>28.3%</b>	

Additional information on morbidity category risk



Table 21.1  
 Frequency of multiple procedure and morbidity risk in adult (n=607 missing 2.1%)  
 Morbidity category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
ASD repair, patch	53	8	15.1%	5.5%	24.7%	0.5
Valvuloplasty, mitral	25	2	8.0%	0.0%	18.6%	0.8
ASD, repair, primary closure	18	3	16.7%	0.0%	33.9%	0.8
PAPVC repair	14	1	7.1%	0.0%	20.6%	0.4
ASD partial closure	11	1	9.1%	0.0%	26.1%	0.8
PFO, primary closure	9	1	11.1%	0.0%	31.6%	0.7
Sinus of Valsalva, aneurysm repair	7	1	14.3%	0.0%	40.2%	0.6
VATS (video-assisted thoracoscopic surgery)	7	0	0.0%	0.0%	0.0%	0.1
Valve surgery, other, mitral	6	1	16.7%	0.0%	46.5%	0.9
DCRV repair	3	0	0.0%	0.0%	0.0%	0.4
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	0.3
ASD repair, NOS	1	1	100.0%	100.0%	100.0%	0.7
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	0.2
PA, reconstruction (plasty), NOS	1	0	0.0%	0.0%	0.0%	0.8
Other annular enlargement procedure	1	0	0.0%	0.0%	0.0%	0.6
PDA closure, NOS	1	1	100.0%	100.0%	100.0%	0.3
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	0.3
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	0.2
Organ procurement	1	0	0.0%	0.0%	0.0%	0.2

Additional Information on morbidity category risk



Table 21.2  
Frequency of multiple procedure and morbidity risk in adult (n=607 missing 2.1%)  
Morbidity category 2

Additional information on morbidity category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
VSD repair, patch	124	17	13.7%	7.7%	19.8%	1.0
Valvuloplasty, tricuspid	59	9	15.3%	6.1%	24.4%	1.2
VSD repair, primary closure	37	4	10.8%	0.8%	20.8%	1.1
Valve surgery, other, tricuspid	19	2	10.5%	0.0%	24.3%	1.2
Valvuloplasty, pulmonic	19	3	15.8%	0.0%	32.2%	1.4
PDA closure, surgical	15	2	13.3%	0.0%	30.5%	0.9
Mitral stenosis, supra-valvar mitral ring, repair	9	0	0.0%	0.0%	0.0%	1.2
AVC (AVSD) repair, partial (incomplete) (PAVSD)	8	2	25.0%	0.0%	55.0%	1.3
RVOT procedure	8	1	12.5%	0.0%	35.4%	1.5
Valve replacement, mitral (MVR)	8	2	25.0%	0.0%	55.0%	1.5
Valve replacement, pulmonic (PVR)	7	1	14.3%	0.0%	40.2%	1.4
ASD creation/enlargement	6	0	0.0%	0.0%	0.0%	1.0
TOF repair, NOS	5	0	0.0%	0.0%	0.0%	1.0
VSD, multiple, repair	4	0	0.0%	0.0%	0.0%	0.9
Ventricular septal fenestration	4	2	50.0%	1.0%	99.0%	1.2
PDA closure, device	4	0	0.0%	0.0%	0.0%	1.1
TOF repair, non ventriculotomy	2	0	0.0%	0.0%	0.0%	1.5
TOF, AVC (AVSD), repair	2	0	0.0%	0.0%	0.0%	1.1
Unifocalization MAPCA(s)	2	1	50.0%	0.0%	100.0%	1.3
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	1.4
Valve replacement, aortic (AVR), mechanical	2	0	0.0%	0.0%	0.0%	1.1
Valve replacement, aortic (AVR), bioprosthetic	2	0	0.0%	0.0%	0.0%	1.1
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	1.0
Rastelli	2	1	50.0%	0.0%	100.0%	1.6
Cardiac tumor resection	2	2	100.0%	100.0%	100.0%	1.0
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	1.0
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	1.2
Valvuloplasty, aortic	1	0	0.0%	0.0%	0.0%	1.0
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	1.5
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	1.0
Lung procedure, other	1	0	0.0%	0.0%	0.0%	1.5
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	1	0	0.0%	0.0%	0.0%	1.4
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	1.4
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	0	0.0%	0.0%	0.0%	1.2
Cardiotomy, other	1	1	100.0%	100.0%	100.0%	1.3



Table 21.3  
Frequency of multiple procedure and morbidity risk in adult (n=607 missing 2.1%)  
Morbidity category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No.with Morbidity	%	95% CI		
				Lower	Upper	
TOF repair, ventriculotomy, transanular patch	20	2	10.0%	0.0%	23.1%	1.6
TOF repair, ventriculotomy, nontransanular patch	7	3	42.9%	6.2%	79.5%	1.6
Pulmonary Venous Stenosis, repair	6	2	33.3%	0.0%	71.1%	1.8
Pulmonary atresia-VSD (including TOF, PA), repair	5	1	20.0%	0.0%	55.1%	1.6
Anomalous systemic venous connection repair	3	0	0.0%	0.0%	0.0%	2.2
Valve replacement, tricuspid (TVR)	3	1	33.3%	0.0%	86.7%	2.3
DORV repair, NOS	3	2	66.7%	13.3%	100.0%	1.8
ASD, repair, device	2	1	50.0%	0.0%	100.0%	1.8
TOF, absent pulmonary valve, repair	2	0	0.0%	0.0%	0.0%	1.7
Valve excision, pulmonary (without replacement)	2	1	50.0%	0.0%	100.0%	2.0
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	1.9
Pericardectomy	1	1	100.0%	100.0%	100.0%	1.7
Fontan, TCPC, external conduit, NOS	1	1	100.0%	100.0%	100.0%	2.5
Fontan, other	1	0	0.0%	0.0%	0.0%	2.0
PA banding (PAB)	1	0	0.0%	0.0%	0.0%	2.1
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	1	1	100.0%	100.0%	100.0%	2.2

Additional Information on morbidity category risk



Table 21.4  
 Frequency of multiple procedure and morbidity risk in adult (n=607 missing 2.1%)  
 Morbidity category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Morbidity risk			Morbidity score
	All operations	No. with Morbidity	%	95% CI		
				Lower	Upper	
DORV, intraventricular tunnel repair	4	3	75.0%	32.6%	100.0%	2.8
Arrhythmia surgery-atrial, surgical ablation	4	3	75.0%	32.6%	100.0%	3.8
AVC(AVSD) repair, complete CAVSD	3	1	33.3%	0.0%	86.7%	2.6
Valve excision, tricuspid (without replacement)	3	2	66.7%	13.3%	100.0%	3.4
Fontan, TCPC, external conduit, nonfenestrated	3	1	33.3%	0.0%	86.7%	3.2
TAPVC repair	2	0	0.0%	0.0%	0.0%	2.6
Ligation, pulmonary artery	1	1	100.0%	100.0%	100.0%	2.6
<b>Total (77 procedures)</b>	<b>607</b>	<b>97</b>	<b>16.0%</b>	<b>13.1%</b>	<b>18.9%</b>	

Additional information on morbidity category risk



Table 8.1  
Frequency of isolated procedure and mortality risk in all age group (n=9,002 missing 2.5%)  
Mortality category 1

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
ASD repair, patch	1,407	3	0.2%	0.0%	0.5%	8	0.5
PDA closure, NOS	108	0	0.0%	0.0%	0.0%	rare	0.3
ASD partial closure	94	0	0.0%	0.0%	0.0%	10	0.8
Pericardial drainage procedure	43	5	11.6%	2.0%	21.2%	1	0.6
PFO, primary closure	40	1	2.5%	0.0%	7.3%	6	0.8
Pacemaker implantation, permanent	35	0	0.0%	0.0%	0.0%	2	0.4
Organ procurement	32	1	3.1%	0.0	9.2%	rare	0.2
Cardiac procedure, other	25	0	0.0%	0.0%	0.0%	rare	0.5
Sinus of Valsalva, aneurysm repair	22	0	0.0%	0.0%	0.0%	61	0.6
Coronary artery fistula ligation	22	0	0.0%	0.0%	0.0%	17	0.3
VSD repair, NOS	19	0	0.0%	0.0%	0.0%	rare	0.3
Pulmonary embolectomy	18	1	5.6%	0.0%	16.1%	34	0.4
PAPVC repair	17	0	0.0%	0.0%	0.0%	27	0.4
Thoracic and/or mediastinal procedure, other	16	3	18.8%	0.0%	37.9%	rare	0.7
Coarctation repair, interposition graft	15	0	0.0%	0.0%	0.0%	49	0.8
ASD creation/enlargement	14	0	0.0%	0.0%	0.0%	9	0.9
ASD repair, NOS	12	0	0.0%	0.0%	0.0%	rare	0.7
Aortic stenosis, supravalvar, repair	12	0	0.0%	0.0%	0.0%	64	0.1
Fontan, NOS	12	0	0.0%	0.0%	0.0%	rare	0.8
Congenitally corrected TGA repair, VSD closure	11	0	0.0%	0.0%	0.0%	106	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	11	2	18.2%	0.0%	41.0%	rare	0.8
Peripheral vascular procedure, other	10	0	0.0%	0.0%	0.0%	rare	0.6
Conduit, reoperation	9	1	11.1%	0.0%	31.6%	77	0.7
PA, reconstruction (plasty), NOS	8	0	0.0%	0.0%	0.0%	rare	0.9
Pericardial procedure, other	8	0	0.0%	0.0%	0.0%	rare	0.7
Pacemaker procedure	8	1	12.5%	0.0%	35.4%	3	0.7
Pulmonary AV fistula repair/occlusion	8	0	0.0%	0.0%	0.0%	rare	0.6
DCRV repair	7	0	0.0%	0.0%	0.0%	48	0.5
PA debanding	7	0	0.0%	0.0%	0.0%	29	0.5
Coarctation repair, other	5	0	0.0%	0.0%	0.0%	112	0.1
Shunt, systemic to pulmonary, NOS	5	0	0.0%	0.0%	0.0%	rare	0.1
Aneurysm, pulmonary artery, repair	3	1	33.3%	0.0%	86.7%	53	0.1
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	2	0	0.0%	0.0%	0.0%	133	0.2
ICD (AICD) implantation	2	0	0.0%	0.0%	0.0%	14	0.2
Thoracotomy, other	2	0	0.0%	0.0%	0.0%	rare	0.2

Additional Information on mortality category risk



Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	83	0.2
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.3
Aortic root replacement, mechanical	1	0	0.0%	0.0%	0.0%	111	0.3
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	0.0%	0.0%	99	0.3
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	0.0%	0.0%	15	0.3
ASD creation, blade septostomy	1	0	0.0%	0.0%	0.0%	rare	0.3
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	107	0.2
Ligation, pulmonary artery	1	0	0.0%	0.0%	0.0%	rare	0.3
Minimally invasive procedure	1	0	0.0%	0.0%	0.0%	rare	0.3
Delayed sternal closure	1	0	0.0%	0.0%	0.0%	rare	0.3





Table 8.2  
Frequency of isolated procedure and mortality risk in all age group (n=9,002 missing 2.5%)  
Mortality category 2

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PDA closure, surgical	1167	31	2.7%	1.7%	3.6%	5	0.9
VSD repair, patch	1154	13	1.1%	0.5%	1.7%	32	1.0
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	795	43	5.4%	3.8%	7.0%	39	1.4
ASD repair, primary closure	597	3	0.5%	0.0%	1.1%	7	0.9
VSD repair, primary closure	528	1	0.2%	0.0%	0.6%	30	1.2
PDA closure, device	205	2	1.0%	0.0%	2.3%	rare	1.0
TOF repair, non ventriculotomy	154	13	8.4%	4.1%	12.8%	81	1.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	125	14	11.2%	5.7%	16.7%	43	1.4
TOF repair, NOS	67	4	6.0%	0.3%	11.6%	rare	1.0
Esophageal procedure	65	4	6.2%	0.3%	12.0%	rare	1.4
Lung procedure, other	48	3	6.3%	0.0%	13.1%	rare	1.6
Coarctation repair, end to end	36	1	2.8%	0.0%	8.1%	24	1.5
TOF repair, RV-PA conduit	35	4	11.4%	0.9%	22.0%	80	1.5
Unifocalization MAPCA(s)	31	2	6.5%	0.0%	15.1%	116	1.4
Rastelli	28	2	7.1%	0.0%	16.7%	125	1.6
Valve replacement, pulmonic (PVR)	26	2	7.7%	0.0%	17.9%	44	1.5
Pericardectomy	26	1	3.8%	0.0%	11.2%	20	1.6
AVC (AVSD) repair, partial (incomplete)(PAVSD)	25	1	4.0%	0.0%	11.7%	31	1.4
Aortic stenosis, subvalvar, repair	25	0	0.0%	0.0%	0.0%	42	1.0
Coarctation repair, end to end, extended	24	0	0.0%	0.0%	0.0%	24	1.6
VSD, multiple, repair	20	1	5.0%	0.0%	14.6%	113	0.9
Cardiotomy, other	20	2	10.0%	0.0%	23.1%	rare	1.3
Ventricular septal fenestration	19	2	10.5%	0.0%	24.3%	45	1.2
Mediastinal procedure	19	1	5.3%	0.0%	15.3%	rare	0.9
Valvuloplasty, mitral	16	2	12.5%	0.0%	28.7%	76	1.3
Valve replacement, mitral (MVR)	15	2	13.3%	0.0%	30.5%	69	1.5
AVC (AVSD) repair, NOS	14	1	7.1%	0.0%	20.6%	rare	1.4
Lung biopsy	14	0	0.0%	0.0%	0.0%	rare	1.2
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	13	3	23.1%	0.2%	46.0%	137	1.4
Mitral stenosis, supra-avalvar mitral ring, repair	13	1	7.7%	0.0%	22.2%	74	1.5
Fontan, atrio-pulmonary connection	13	2	15.4%	0.0%	35.0%	94	1.0
TOF, AVC (AVSD), repair	12	1	8.3%	0.0%	24.0%	122	1.1

Additional information on mortality category risk



Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valvuloplasty, aortic	12	1	8.3%	0.0%	24.0%	72	1.0
AVC (AVSD) repair, intermediated (transitional)	11	0	0.0%	0.0%	0.0%	33	1.1
Occlusion MAPCA(s)	11	0	0.0%	0.0%	0.0%	51	1.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	11	1	9.1%	0.0%	26.1%	41	1.2
Sternotomy wound drainage	11	2	18.2%	0.0%	41.0%	rare	1.3
Pleural drainage procedure	10	0	0.0%	0.0%	0.0%	rare	1.0
Valve surgery, other pulmonic	9	2	22.2%	0.0%	49.4%	rare	1.2
Valve replacement, aortic (AVR), mechanical	9	2	22.2%	0.0%	49.4%	52	1.1
Coronary artery bypass	8	3	37.5%	4.0%	71.0%	98	1.2
1 1/2 ventricular repair	7	1	14.3%	0.0%	40.2%	58	1.0
Valve surgery, other, mitral	7	0	0.0%	0.0%	0.0%	76	1.5
Coronary artery procedure, other	7	1	14.3%	0.0%	40.2%	17	1.0
Pulmonary artery origin from ascending aorta (hemitruncus) repair	6	0	0.0%	0.0%	0.0%	89	1.0
Pectus repair	6	0	0.0%	0.0%	0.0%	rare	1.0
Cardiac tumor resection	6	0	0.0%	0.0%	0.0%	88	0.9
Atrial baffle procedure, NOS	5	1	20.0%	0.0%	55.1%	67	1.1
Valve closure, tricuspid (exclusion, univentricular approach)	4	0	0.0%	0.0%	0.0%	36	1.5
Fontan, atrio-ventricular connection	3	0	0.0%	0.0%	0.0%	0	1.4
Senning	3	0	0.0%	0.0%	0.0%	108	1.1
Mustard	3	0	0.0%	0.0%	0.0%	100	1.0
Valve replacement, aortic (AVR), bioprosthetic	2	0	0.0%	0.0%	0.0%	55	1.1
Shunt, ligation and takedown	2	0	0.0%	0.0%	0.0%	11	1.3
PA, reconstruction (plasty), branch, central	1	0	0.0%	0.0%	0.0%	68	1.3



Table 8.3  
Frequency of isolated procedure and mortality risk in all age group (n=9,002 missing 2.5%)  
Mortality category 3

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, ventriculotomy, transanular patch	372	23	6.2%	3.7%	8.6%	79	1.6
PA banding (PAB)	83	12	14.5%	6.9%	22.0%	21	2.1
TOF repair, ventriculotomy, nontransanular patch	57	3	5.3%	0.0%	11.1%	62	1.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	50	8	16.0%	5.8%	26.2%	47	1.7
Pulmonary atresia-VSD (including TOF, PA), repair	42	4	9.5%	0.6%	18.4%	92	1.7
DORV repair, NOS	40	6	15.0%	3.9%	26.1%	rare	1.8
RVOT procedure	23	2	8.7%	0.0%	20.2%	40	1.7
Fontan, TCPC, lateral tunnel, fenestrated	23	5	21.7%	4.9%	38.6%	101	1.9
Truncus arteriosus repair	21	2	9.5%	0.0%	22.1%	134	2.2
Valvuloplasty, pulmonic	21	2	9.5%	0.0%	22.1%	26	1.8
Pulmonary Venous Stenosis, repair	18	2	11.1%	0.0%	25.6%	117	2.0
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	18	1	5.6%	0.0%	16.1%	63	2.2
Shunt, systemic to pulmonary, other	13	2	15.4%	0.0%	35.0%	rare	2.3
AP window repair	12	0	0.0%	0.0%	0.0%	35	1.9
Anomalous origin of coronary artery repair	12	3	25.0%	0.5%	49.5%	119	2.2
Valvuloplasty, tricuspid	11	2	18.2%	0.0%	41.0%	57	1.8
Ligation, thoracic duct	11	0	0.0%	0.0%	0.0%	rare	2.4
TOF, absent pulmonary valve, repair	10	2	20.0%	0.0%	44.8%	109	1.7
Valve replacement, tricuspid (TVR)	10	3	30.0%	1.6%	58.4%	65	2.4
Fontan, other	10	0	0.0%	0.0%	0.0%	rare	2.0
Conduit, placement, RV to PA	8	3	37.5%	4.0%	71.0%	66	1.9
Coarctation repair, subclavian flap	8	0	0.0%	0.0%	0.0%	23	2.0
Vascular ring repair	8	0	0.0%	0.0%	0.0%	19	2.4
ASD repair, device	7	0	0.0%	0.0%	0.0%	rare	1.8
Conduit, placement, LV to PA	7	1	14.3%	0.0%	40.2%	73	2.3
Congenitally corrected TGA repair, other	7	0	0.0%	0.0%	0.0%	rare	2.3
Valve excision, pulmonary (without replacement)	6	0	0.0%	0.0%	0.0%	rare	2.1
Valve surgery, other, aortic	6	0	0.0%	0.0%	0.0%	rare	1.9
Atrial septal fenestration	5	0	0.0%	0.0%	0.0%	12	2.0
Cor triatriatum repair	5	1	20.0%	0.0%	55.1%	60	2.3

Additional Information on mortality category risk



Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA, reconstruction (plasty), main (trunk)	5	2	40.0%	0.0%	82.9%	25	2.2
Valve replacement, aortic (AVR)	5	1	20.0%	0.0%	55.1%	0	2.2
Bronchoscopy	5	0	0.0%	0.0%	0.0%	rare	2.1
HLHS biventricular repair	4	2	50.0%	1.0%	99.0%	145	1.9
ASD, common atrium (single atrium), septation	3	1	33.3%	0.0%	86.7%	18	1.8
Valve surgery, other, tricuspid	3	0	0.0%	0.0%	0.0%	rare	1.9
VSD repair, device	2	0	0.0%	0.0%	0.0%	rare	1.8
Valve excision, tricuspid (without replacement)	1	1	100.0%	100.0%	100.0%	13	2.5



Table 8.4  
Frequency of isolated procedure and mortality risk in all age group (n=9,002 missing 2.5%)  
Mortality category 4

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
AVC (AVSD) repair, complete CAVSD	79	14	17.7%	9.3%	26.1%	87	2.6
Arterial switch operation (ASO)	70	17	24.3%	14.2%	34.3%	130	2.6
TAPVC repair	59	13	22.0%	11.5%	32.6%	104	2.7
DORV, intraventricular tunnel repair	46	6	13.0%	3.3%	22.8%	132	2.8
Fontan, TCPC, external conduit, nonfenestrated	34	2	5.9%	0.0%	13.8%	97	3.2
Fontan, TCPC, external conduit, NOS	31	3	9.7%	0.0%	20.1%	rare	2.5
Norwood procedure	28	16	57.1%	38.8%	75.5%	147	2.8
Arterial switch operation (ASO) and VSD repair	27	7	25.9%	9.4%	42.5%	138	3.1
Interrupted aortic arch repair	11	2	18.2%	0.0%	41.0%	118	2.6
Aortic arch repair	10	0	0.0%	0.0%	0.0%	82	3.1
Hemifontan	9	1	11.1%	0.0%	31.6%	78	3.0
Palliation, other	9	0	0.0%	0.0%	0.0%	rare	2.6
Tracheal procedure	6	0	0.0%	0.0%	0.0%	rare	3.0
Congenitally corrected TGA repair, atrial switch and Rastelli	5	1	20.0%	0.0%	55.1%	139	2.6
Coarctation repair, patch aortoplasty	5	0	0.0%	0.0%	0.0%	22	2.7
Anomalous systemic venous connection repair	4	2	50.0%	1.0%	99.0%	54	2.6
Pulmonary artery sling repair	4	0	0.0%	0.0%	0.0%	105	2.8
Valve replacement, truncal	3	1	33.3%	0.0%	86.7%	46	3.3
Valve closure, semilunar	3	0	0.0%	0.0%	0.0%	rare	2.6
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	3	0	0.0%	0.0%	0.0%	148	4.0
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	3	1	33.3%	0.0%	86.7%	135	2.6
Damus-Kaye-Stansel procedure (DKS (creation of AP anastomosis without arch reconstruction)	3	2	66.7%	13.3%	100.0%	114	2.6
Pleural procedure, other	3	1	33.3%	0.0%	86.7%	rare	3.8
Mediastinal exploration	2	0	0.0%	0.0%	0.0%	rare	2.5
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	3.4

Additional Information on mortality category risk



Table 8.5

Frequency of isolated procedure and mortality risk in all age group (n=9,002 missing 2.5%)  
 Mortality category 5

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Intraaortic balloon pump (IABP) insertion	3	2	66.7%	13.3%	100.0%	rare	5.0
Aortic root replacement	2	1	50.0%	0.0%	100.0%	rare	5.0
Valvuloplasty, truncal valve	1	1	100.0%	100.0%	100.0%	59	4.7
Aortic root replacement, homograft	1	1	100.0%	100.0%	100.0%	121	4.7
Konno procedure	1	1	100.0%	100.0%	100.0%	131	4.7
Ross-Konno procedure	1	1	100.0%	100.0%	100.0%	146	4.7
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	rare	4.9
<b>Total (170 procedures)</b>	<b>9,002</b>	<b>386</b>	<b>4.3%</b>	<b>3.9%</b>	<b>4.7%</b>		

Additional information on mortality category risk



Table 9.1  
Frequency of isolated procedure and mortality risk in newborn (n=421 missing 7.3%)  
Mortality category 1

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PDA closure, surgical	48	5	10.4%	1.8%	19.1%	5	0.2
Coarctation repair, end to end	6	0	0.0%	0.0%	0.0%	24	0.3
VSD repair, patch	5	0	0.0%	0.0%	0.0%	32	0.2
Coarctation repair, end to end, extended	5	0	0.0%	0.0%	0.0%	24	0.2
PDA closure, device	5	0	0.0%	0.0%	0.0%	rare	0.2
ASD repair, patch	4	0	0.0%	0.0%	0.0%	8	0.1
Valvuloplasty, pulmonic	4	1	25.0%	0.0%	67.4%	26	0.4
PDA closure, NOS	4	0	0.0%	0.0%	0.0%	rare	0.1
Shunt, systemic to pulmonary, other	3	1	33.3%	0.0%	86.7%	rare	0.2
Organ procurement	3	1	33.3%	0.0%	86.7%	rare	0.3
ASD repair, primary closure	2	0	0.0%	0.0%	0.0%	7	0.1
VSD repair, primary closure	2	1	50.0%	0.0%	100.0%	30	0.2
Lung procedure, other	2	1	50.0%	0.0%	100.0%	rare	0.2
Pacemaker procedure	2	1	50.0%	0.0%	100.0%	3	0.3
Bronchoscopy	2	0	0.0%	0.0%	0.0%	rare	0.2
PFO, primary closure	1	0	0.0%	0.0%	0.0%	6	0.2
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	113	0.3
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	89	0.1
TOF repair, ventriculotomy, transanular patch	1	0	0.0%	0.0%	0.0%	79	0.4
Occlusion MAPCA(s)	1	0	0.0%	0.0%	0.0%	51	0.4
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	rare	0.1
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, subclavian flap	1	0	0.0%	0.0%	0.0%	23	0.1
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	17	0.1
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
Esophageal procedure	1	0	0.0%	0.0%	0.0%	rare	0.4
Mediastinal exploration	1	0	0.0%	0.0%	0.0%	rare	0.3
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Cardiac procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2

Additional Information on mortality category risk



Table 9.2  
 Frequency of isolated procedure and mortality risk in newborn (n=421 missing 7.3%)  
 Mortality category 2

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA banding (PAB)	10	1	10.0%	0.0%	28.6%	21	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	9	2	22.2%	0.0%	49.4%	47	0.8
Pulmonary atresia-VSD (including TOF, PA), repair	3	1	33.3%	0.0%	86.7%	92	0.8
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	3	0	0.0%	0.0%	0.0%	43	0.4
Fontan, TCPC, external conduit, NOS	2	1	50.0%	0.0%	100.0%	rare	0.6
Coarctation repair, other	2	0	0.0%	0.0%	0.0%	112	0.8
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	9	0.5
Pulmonary Venous Stenosis, repair	1	1	100.0%	100.0%	100.0%	117	0.7
TOF repair, non ventriculotomy	1	1	100.0%	100.0%	100.0%	81	0.5
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Vascular ring repair	1	0	0.0%	0.0%	0.0%	19	0.6
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	14	0.5
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	1	0	0.0%	0.0%	0.0%	114	0.6





Table 9.3  
 Frequency of isolated procedure and mortality risk in newborn (n=421 missing 7.3%)  
 Mortality category 3

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	160	20	12.5%	7.4%	17.6%	39	0.8
TAPVC repair	14	7	50.0%	23.8%	76.2%	104	1.3
Arterial switch operation (ASO) and VSD repair	6	2	33.3%	0.0%	71.1%	138	1.0
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	2	1	50.0%	0.0%	100.0%	137	1.3
Pacemaker implantation, permanent	2	0	0.0%	0.0%	0.0%	2	0.8
AVC(AVSD) repair, complete CAVSD	1	1	100.0%	100.0%	100.0%	87	0.9
Truncus arteriosus repair	1	0	0.0%	0.0%	0.0%	134	1.1
Valve surgery, other pulmonic	1	1	100.0%	100.0%	100.0%	rare	1.0
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	1.0
DORV repair, NOS	1	1	100.0%	100.0%	100.0%	rare	0.9
Aneurysm, pulmonary artery, repair	1	1	100.0%	100.0%	100.0%	53	1.2
Sternotomy wound drainage	1	1	100.0%	100.0%	100.0%	rare	0.9

Additional Information on mortality category risk



Table 9.4  
Frequency of isolated procedure and mortality risk in newborn (n=421 missing 7.3%)  
Mortality category 4

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Arterial switch operation (ASO)	45	13	28.9%	15.6%	42.1%	130	1.3
Interrupted aortic arch repair	5	2	40.0%	0.0%	82.9%	118	1.7
PA, reconstruction (plasty), main (trunk)	3	2	66.7%	13.3%	100.0%	25	1.5
Aortic arch repair	3	0	0.0%	0.0%	0.0%	82	1.9
Pulmonary AV fistula repair/occlusion	2	0	0.0%	0.0%	0.0%	rare	2.6
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	54	1.4
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	0	0.0%	0.0%	0.0%	148	1.6

Table 9.5  
Frequency of isolated procedure and mortality risk in newborn (n=421 missing 7.3%)  
Mortality category 5

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	19	10	52.6%	30.2%	75.1%	147	3.4
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	rare	5.0
PA debanding	1	0	0.0%	0.0%	0.0%	29	3.7
<b>Total (66 procedures)</b>	<b>421</b>	<b>82</b>	<b>19.5%</b>	<b>15.7%</b>	<b>23.3%</b>		



Table 10.1  
Frequency of isolated procedure and mortality risk in infant (n=1,547 missing 2.3%)  
Mortality category 1

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PDA closure, surgical	486	24	4.9%	3.0%	6.9%	5	0.2
VSD repair, patch	179	7	3.9%	1.1%	6.8%	32	0.2
PDA closure, device	70	2	2.9%	0.0%	6.8%	rare	0.2
VSD repair, primary closure	45	0	0.0%	0.0%	0.0%	30	0.2
PDA closure, NOS	30	0	0.0%	0.0%	0.0%	rare	0.1
Lung procedure, other	14	1	7.1%	0.0%	20.6%	rare	0.2
Coarctation repair, end to end, extended	13	0	0.0%	0.0%	0.0%	24	0.2
Esophageal procedure	12	1	8.3%	0.0%	24.0%	rare	0.4
ASD, repair, patch	11	0	0.0%	0.0%	0.0%	8	0.1
TOF repair, ventriculotomy, transanular patch	10	1	10.0%	0.0%	28.6%	79	0.4
Coarctation repair, end to end	9	1	11.1%	0.0%	31.6%	24	0.3
Organ procurement	6	0	0.0%	0.0%	0.0%	rare	0.3
ASD repair, primary closure	5	0	0.0%	0.0%	0.0%	7	0.1
ASD partial closure	5	0	0.0%	0.0%	0.0%	10	0.2
Tracheal procedure	5	0	0.0%	0.0%	0.0%	rare	0.1
Mediastinal procedure	5	0	0.0%	0.0%	0.0%	rare	0.4
AVC (AVSD) repair, intermediated (transitional)	4	0	0.0%	0.0%	0.0%	33	0.1
AVC (AVSD) repair, partial (incomplete)(PAVSD)	4	0	0.0%	0.0%	0.0%	31	0.3
Coarctation repair, subclavian flap	4	0	0.0%	0.0%	0.0%	23	0.1
Pulmonary embolectomy	3	0	0.0%	0.0%	0.0%	34	0.1
TOF repair, ventriculotomy, nontransanular patch	3	0	0.0%	0.0%	0.0%	62	0.4
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	17	0.1
Shunt, systemic to pulmonary, other	3	0	0.0%	0.0%	0.0%	rare	0.2
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	rare	0.1
Bronchoscopy	3	0	0.0%	0.0%	0.0%	rare	0.2
PFO, primary closure	2	1	50.0%	0.0%	100.0%	6	0.2
ASD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
VSD, multiple, repair	2	0	0.0%	0.0%	0.0%	113	0.3
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.4
Pulmonary artery origin from ascending aorta (hemitruncus) repair	2	0	0.0%	0.0%	0.0%	89	0.1
PAPVC repair	2	0	0.0%	0.0%	0.0%	27	0.2
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	51	0.4
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	rare	0.1

Additional Information on mortality category risk



Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
DCRV repair	2	0	0.0%	0.0%	0.0%	48	0.1
Valvuloplasty, pulmonic	2	0	0.0%	0.0%	0.0%	26	0.4
Atrial baffle procedure, NOS	2	1	50.0%	0.0%	100.0%	67	0.1
Ligation, thoracic duct	2	0	0.0%	0.0%	0.0%	rare	0.1
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.1
Peripheral vascular procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.2
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.2
Valvuloplasty, tricuspid	1	0	0.0%	0.0%	0.0%	57	0.4
Aortic stenosis, subvalvar, repair	1	0	0.0%	0.0%	0.0%	42	0.1
Valvuloplasty, mitral	1	1	100.0%	100.0%	100.0%	76	0.3
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	3	0.3
Palliation, other	1	0	0.0%	0.0%	0.0%	rare	0.3
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2



Table 10.2  
Frequency of isolated procedure and mortality risk in infant (n=1,547 missing 2.3%)  
Mortality category 2

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA banding (PAB)	53	10	18.9%	8.3%	29.4%	21	0.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	19	6	31.6%	10.7%	52.5%	43	0.4
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	10	6	60.0%	29.6%	90.4%	47	0.8
AP window repair	7	0	0.0%	0.0%	0.0%	35	0.5
TOF repair, non ventriculotomy	7	1	14.3%	0.0%	40.2%	81	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	4	2	50.0%	1.0%	99.0%	92	0.8
Lung biopsy	4	0	0.0%	0.0%	0.0%	rare	0.5
AVC (AVSD) repair, NOS	3	1	33.3%	0.0%	86.7%	rare	0.5
TOF repair, RV-PA conduit	3	1	33.3%	0.0%	86.7%	80	0.6
TOF repair, NOS	3	0	0.0%	0.0%	0.0%	rare	0.5
Vascular ring repair	3	0	0.0%	0.0%	0.0%	19	0.6
Cardiotomy, other	3	0	0.0%	0.0%	0.0%	rare	0.5
Ventricular septal fenestration	2	1	50.0%	0.0%	100.0%	45	0.5
Pulmonary Venous Stenosis, repair	2	0	0.0%	0.0%	0.0%	117	0.7
Unifocalization MAPCA(s)	2	0	0.0%	0.0%	0.0%	116	0.6
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
Rastelli	2	1	50.0%	0.0%	100.0%	125	0.7
Coarctation repair, other	2	0	0.0%	0.0%	0.0%	112	0.8
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	9	0.5
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	122	0.7
1 1/2 ventricular repair	1	1	100.0%	100.0%	100.0%	58	0.6
Conduit, reoperation	1	0	0.0%	0.0%	0.0%	77	0.7
Valvuloplasty, aortic	1	1	100.0%	100.0%	100.0%	72	0.5
Mitral stenosis, supra-valvar mitral ring, repair	1	0	0.0%	0.0%	0.0%	74	0.5
Pericardial drainage procedure	1	1	100.0%	100.0%	100.0%	1	0.7
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Fontan, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Coronary artery procedure, other	1	1	100.0%	100.0%	100.0%	17	0.7
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	114	0.6
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	1	100.0%	100.0%	100.0%	41	0.4

Additional Information on mortality category risk



Table 10.3  
Frequency of isolated procedure and mortality risk in infant (n=1,547 missing 2.3%)  
Mortality category 3

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	251	18	7.2%	4.0%	10.4%	39	0.8
TAPVC repair	32	6	18.8%	5.2%	32.3%	104	1.3
AVC(AVSD) repair, complete CAUSD	20	7	35.0%	14.1%	55.9%	87	0.9
Arterial switch operation (ASO)and VSD repair	20	5	25.0%	6.0%	44.0%	138	1.0
Truncus arteriosus repair	14	2	14.3%	0.0%	32.6%	134	1.1
DORV, intraventricular tunnel repair	6	0	0.0%	0.0%	0.0%	132	0.9
DORV repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.9
RVOT procedure	4	1	25.0%	0.0%	67.4%	40	0.9
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	2	0.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	4	0	0.0%	0.0%	0.0%	63	1.0
Thoracic and/or mediastinal procedure, other	4	1	25.0%	0.0%	67.4%	rare	1.1
Coarctation repair, patch aortoplasty	3	0	0.0%	0.0%	0.0%	22	0.8
Pulmonary artery sling repair	3	0	0.0%	0.0%	0.0%	105	1.3
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	rare	1.0
Sternotomy wound drainage	2	1	50.0%	0.0%	100.0%	rare	0.9
PA, reconstruction (plasty), branch, central	1	0	0.0%	0.0%	0.0%	68	1.3



Table 10.4  
Frequency of isolated procedure and mortality risk in infant (n=1,547 missing 2.3%)  
Mortality category 4

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Arterial switch operation (ASO)	19	2	10.5%	0.0%	24.3%	130	1.3
Anomalous origin of coronary artery repair	6	3	50.0%	10.0%	90.0%	119	1.4
Interrupted aortic arch repair	4	0	0.0%	0.0%	0.0%	118	1.7
Aortic arch repair	3	0	0.0%	0.0%	0.0%	82	1.9
Pulmonary AV fistula repair/occlusion	3	0	0.0%	0.0%	0.0%	rare	2.6
Pleural procedure, other	2	0	0.0%	0.0%	0.0%	rare	1.4
ASD, common atrium (single atrium), septation	1	1	100.0%	100.0%	100.0%	18	1.7
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	54	1.4
Coronary artery bypass	1	1	100.0%	100.0%	100.0%	98	1.8

Additional Information on mortality category risk

Table 10.5  
Frequency of isolated procedure and mortality risk in infant (n=1,547 missing 2.3%)  
Mortality category 5

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	9	6	66.7%	35.9%	97.5%	147	3.4
HLHS biventricular repair	3	2	66.7%	13.3%	100.0%	145	3.3
PA debanding	3	0	0.0%	0.0%	0.0%	29	3.7
Valvuloplasty, truncal valve	1	1	100.0%	100.0%	100.0%	59	4.9
Intraaortic balloon pump (IABP) insertion	1	1	100.0%	100.0%	100.0%	rare	3.5
<b>Total (108 procedures)</b>	<b>1,547</b>	<b>134</b>	<b>8.7%</b>	<b>7.3%</b>	<b>10.1%</b>		



Table 11.1

Frequency of isolated procedure and mortality risk in preschool children (n=1,635 missing 2.2%)

Mortality category 1

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	337	4	1.2%	0.0%	2.3%	32	0.2
PDA closure, surgical	282	2	0.7%	0.0%	1.7%	5	0.2
VSD repair, primary closure	115	0	0.0%	0.0%	0.0%	30	0.2
TOF repair, ventriculotomy, transannular patch	73	7	9.6%	2.8%	16.3%	79	0.4
ASD repair, patch	59	0	0.0%	0.0%	0.0%	8	0.1
PDA closure, device	48	0	0.0%	0.0%	0.0%	rare	0.2
PDA closure, NOS	30	0	0.0%	0.0%	0.0%	rare	0.1
ASD repair, primary closure	26	0	0.0%	0.0%	0.0%	7	0.1
Lung procedure, other	12	0	0.0%	0.0%	0.0%	rare	0.2
TOF repair, ventriculotomy, nontransannular patch	11	1	9.1%	0.0%	26.1%	62	0.4
Esophageal procedure	11	0	0.0%	0.0%	0.0%	rare	0.4
Coarctation repair, end to end	9	0	0.0%	0.0%	0.0%	24	0.3
AVC (AVSD) repair, partial (incomplete)(PAVSD)	7	0	0.0%	0.0%	0.0%	31	0.3
Mediastinal procedure	6	0	0.0%	0.0%	0.0%	rare	0.4
Pulmonary embolectomy	5	0	0.0%	0.0%	0.0%	34	0.1
ASD partial closure	5	0	0.0%	0.0%	0.0%	10	0.2
VSD, multiple, repair	5	0	0.0%	0.0%	0.0%	113	0.3
Valvuloplasty, pulmonic	5	1	20.0%	0.0%	55.1%	26	0.4
Organ procurement	5	0	0.0%	0.0%	0.0%	rare	0.3
AVC (AVSD) repair, intermediated (transitional)	4	0	0.0%	0.0%	0.0%	33	0.1
PAPVC repair	4	0	0.0%	0.0%	0.0%	27	0.2
Cardiac procedure, other	4	0	0.0%	0.0%	0.0%	rare	0.1
Occlusion MAPCA(s)	3	0	0.0%	0.0%	0.0%	51	0.4
Aortic stenosis, subvalvar, repair	3	0	0.0%	0.0%	0.0%	42	0.1
Valve surgery, other, mitral	3	0	0.0%	0.0%	0.0%	76	0.1
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, subclavian flap	3	0	0.0%	0.0%	0.0%	23	0.1
PFO, primary closure	2	0	0.0%	0.0%	0.0%	6	0.2
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.4
Pulmonary artery origin from ascending aorta (hemitruncus) repair	2	0	0.0%	0.0%	0.0%	89	0.1
Fontan, other	2	0	0.0%	0.0%	0.0%	rare	0.1
Shunt, systemic to pulmonary, other	2	1	50.0%	0.0%	100.0%	rare	0.2





Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, NOS	2	0	0.0%	0.0%	0.0%	rare	0.3
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	rare	0.1
ASD, repair, device	1	0	0.0%	0.0%	0.0%	rare	0.2
Valvuloplasty, tricuspid	1	1	100.0%	100.0%	100.0%	57	0.4
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), NOS	1	0	0.0%	0.0%	0.0%	rare	0.1
Aortic stenosis, supra-valvar, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Valvuloplasty, mitral	1	0	0.0%	0.0%	0.0%	76	0.3
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	24	0.2
Coronary artery fistula ligation	1	0	0.0%	0.0%	0.0%	17	0.1
Palliation, other	1	0	0.0%	0.0%	0.0%	rare	0.3
Ligation, thoracic duct	1	0	0.0%	0.0%	0.0%	rare	0.1
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2

Additional Information on mortality category risk



Table 11.2

Frequency of isolated procedure and mortality risk in preschool children (n=1,635 missing 2.2%)  
Mortality category 2

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	58	6	10.3%	2.5%	18.2%	43	0.4
TOF repair, non ventriculotomy	37	4	10.8%	0.8%	20.8%	81	0.5
PA banding (PAB)	13	0	0.0%	0.0%	0.0%	21	0.6
TOF repair, NOS	12	0	0.0%	0.0%	0.0%	rare	0.5
TOF repair, RV-PA conduit	10	1	10.0%	0.0%	28.6%	80	0.6
Lung biopsy	6	0	0.0%	0.0%	0.0%	rare	0.5
AVC (AVSD) repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.5
Unifocalization MAPCA(s)	5	1	20.0%	0.0%	55.1%	116	0.6
Ventricular septal fenestration	4	0	0.0%	0.0%	0.0%	45	0.5
Pulmonary Venous Stenosis, repair	4	0	0.0%	0.0%	0.0%	117	0.7
ASD creation/enlargement	3	0	0.0%	0.0%	0.0%	9	0.5
AP window repair	3	0	0.0%	0.0%	0.0%	35	0.5
TOF, absent pulmonary valve, repair	3	1	33.3%	0.0%	86.7%	109	0.7
Pulmonary atresia-VSD (including TOF, PA), repair	3	0	0.0%	0.0%	0.0%	92	0.8
Fontan, TCPC, external conduit, nonfenestrated	3	0	0.0%	0.0%	0.0%	97	0.6
Vascular ring repair	3	0	0.0%	0.0%	0.0%	19	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3	0	0.0%	0.0%	0.0%	47	0.8
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	3	0	0.0%	0.0%	0.0%	41	0.4
TOF, AVC (AVSD), repair	2	0	0.0%	0.0%	0.0%	122	0.7
Valve replacement, mitral (MVR)	2	1	50.0%	0.0%	100.0%	69	0.7
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	1	0.7
Fontan, TCPC, external conduit, NOS	2	1	50.0%	0.0%	100.0%	rare	0.6
Fontan, NOS	2	0	0.0%	0.0%	0.0%	rare	0.5
Hemifontan	2	0	0.0%	0.0%	0.0%	78	0.5
Cardiotomy, other	2	1	50.0%	0.0%	100.0%	rare	0.5
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	12	0.8
Valve closure, tricuspid (exclusion, univentricular approach)	1	0	0.0%	0.0%	0.0%	36	0.6
Valve replacement, pulmonic (PVR)	1	0	0.0%	0.0%	0.0%	44	0.6
Mitral stenosis, supraaortic mitral ring, repair	1	1	100.0%	100.0%	100.0%	74	0.5
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Coarctation repair, other	1	0	0.0%	0.0%	0.0%	112	0.8
ASD creation, blade septostomy	1	0	0.0%	0.0%	0.0%	rare	0.4
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	114	0.6
Minimally invasive procedure	1	0	0.0%	0.0%	0.0%	rare	0.5

Additional Information on mortality category risk



Table 11.3  
Frequency of isolated procedure and mortality risk in preschool children (n=1,635 missing 2.2%)  
Mortality category 3

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	211	2	0.9%	0.0%	2.3%	39	0.8
AVC(AVSD) repair, complete CAVSD	44	3	6.8%	0.0%	14.3%	87	0.9
DORV, intraventricular tunnel repair	16	4	25.0%	3.8%	46.2%	132	0.9
TAPVC repair	9	0	0.0%	0.0%	0.0%	104	1.3
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn)	7	1	14.3%	0.0%	40.2%	63	1.0
DORV repair, NOS	5	2	40.0%	0.0%	82.9%	rare	0.9
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	2	0.8
Truncus arteriosus repair	3	0	0.0%	0.0%	0.0%	134	1.1
RVOT procedure	3	1	33.3%	0.0%	86.7%	40	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	3	0	0.0%	0.0%	0.0%	rare	0.8
Cor triatriatum repair	2	1	50.0%	0.0%	100.0%	60	1.2
Coarctation repair, patch aortoplasty	2	0	0.0%	0.0%	0.0%	22	0.8
Thoracic and/or mediastinal procedure, other	2	1	50.0%	0.0%	100.0%	rare	1.1
Valve replacement, tricuspid (TVR)	1	1	100.0%	100.0%	100.0%	65	1.1
Valve excision, tricuspid (without replacement)	1	1	100.0%	100.0%	100.0%	13	1.0
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	73	0.9
Congenitally corrected TGA repair, atrial switch and Rastelli	1	1	100.0%	100.0%	100.0%	139	1.0
Senning	1	0	0.0%	0.0%	0.0%	108	1.2
Mustard	1	0	0.0%	0.0%	0.0%	100	1.0
Pulmonary artery sling repair	1	0	0.0%	0.0%	0.0%	105	1.3
Pectus repair	1	0	0.0%	0.0%	0.0%	rare	0.9
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	1.2
Sternotomy wound drainage	1	0	0.0%	0.0%	0.0%	rare	0.9



Table 11.4  
 Frequency of isolated procedure and mortality risk in preschool children (n=1,635 missing 2.2%)  
 Mortality category 4

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Anomalous origin of coronary artery repair	2	0	0.0%	0.0%	0.0%	119	1.4
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	18	1.7
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	54	1.4
Conduit, placement, RV to PA	1	1	100.0%	100.0%	100.0%	66	1.5
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	1.4
Arterial switch operation (ASO)	1	1	100.0%	100.0%	100.0%	130	1.3
Aortic arch repair	1	0	0.0%	0.0%	0.0%	82	1.9
Interrupted aortic arch repair	1	0	0.0%	0.0%	0.0%	118	1.7
<b>Total (111 procedures)</b>	<b>1,635</b>	<b>56</b>	<b>3.4%</b>	<b>2.5%</b>	<b>4.3%</b>		

Additional Information on mortality category risk



Table 12.1  
Frequency of isolated procedure and mortality risk in school aged children (n=2,318 missing 2.9%)  
Mortality category 1

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	345	1	0.3%	0.0%	0.9%	32	0.2
ASD repair, patch	306	0	0.0%	0.0%	0.0%	8	0.1
TOF repair, ventriculotomy, transannular patch	204	12	5.9%	2.7%	9.1%	79	0.4
VSD repair, primary closure	191	0	0.0%	0.0%	0.0%	30	0.2
PDA closure, surgical	177	0	0.0%	0.0%	0.0%	5	0.2
ASD, repair, primary closure	114	1	0.9%	0.0%	2.6%	7	0.1
PDA closure, device	45	0	0.0%	0.0%	0.0%	rare	0.2
PDA closure, NOS	27	0	0.0%	0.0%	0.0%	rare	0.1
TOF repair, ventriculotomy, nontransannular patch	21	1	4.8%	0.0%	13.9%	62	0.4
Esophageal procedure	16	2	12.5%	0.0%	28.7%	rare	0.4
ASD partial closure	14	0	0.0%	0.0%	0.0%	10	0.2
Aortic stenosis, subvalvar, repair	12	0	0.0%	0.0%	0.0%	42	0.1
Lung procedure, other	11	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, end to end	9	0	0.0%	0.0%	0.0%	24	0.3
Cardiac procedure, other	9	0	0.0%	0.0%	0.0%	rare	0.1
VSD repair, NOS	8	0	0.0%	0.0%	0.0%	rare	0.4
AVC (AVSD) repair, partial (incomplete)(PAVSD)	8	1	12.5%	0.0%	35.4%	31	0.3
PFO, primary closure	7	0	0.0%	0.0%	0.0%	6	0.2
VSD, multiple, repair	7	1	14.3%	0.0%	40.2%	113	0.3
PAPVC repair	6	0	0.0%	0.0%	0.0%	27	0.2
Coronary artery fistula ligation	6	0	0.0%	0.0%	0.0%	17	0.1
Organ procurement	6	0	0.0%	0.0%	0.0%	rare	0.3
Valvuloplasty, tricuspid	5	1	20.0%	0.0%	55.1%	57	0.4
Fontan, other	5	0	0.0%	0.0%	0.0%	rare	0.1
Occlusion MAPCA(s)	4	0	0.0%	0.0%	0.0%	51	0.4
Aortic stenosis, supra-valvar, repair	4	0	0.0%	0.0%	0.0%	64	0.1
Valve surgery, other, mitral	4	0	0.0%	0.0%	0.0%	76	0.1
Congenitally corrected TGA repair, other	4	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, end to end, extended	4	0	0.0%	0.0%	0.0%	24	0.2
Peripheral vascular procedure, other	4	0	0.0%	0.0%	0.0%	rare	0.2
ASD, repair, device	3	0	0.0%	0.0%	0.0%	rare	0.2
Valve excision, pulmonary (without replacement)	3	0	0.0%	0.0%	0.0%	rare	0.1



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valvuloplasty, mitral	3	0	0.0%	0.0%	0.0%	76	0.3
Pericardial procedure, other	3	0	0.0%	0.0%	0.0%	rare	0.2
Pacemaker procedure	3	0	0.0%	0.0%	0.0%	3	0.3
Palliation, other	3	0	0.0%	0.0%	0.0%	rare	0.3
Pulmonary embolectomy	3	1	33.3%	0.0%	86.7%	34	0.1
Pleural drainage procedure	3	0	0.0%	0.0%	0.0%	rare	0.1
Ligation, thoracic duct	3	0	0.0%	0.0%	0.0%	rare	0.1
ASD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
AVC (AVSD) repair, intermediated (transitional)	2	0	0.0%	0.0%	0.0%	33	0.1
Valve surgery, other, tricuspid	2	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
DCRV repair	2	0	0.0	0.0%	0.0%	48	0.1
Valvuloplasty, pulmonic	2	0	0.0%	0.0%	0.0%	26	0.4
Congenitally corrected TGA repair, VSD closure	2	0	0.0%	0.0%	0.0%	106	0.1
Atrial baffle procedure, NOS	2	0	0.0%	0.0%	0.0%	67	0.1
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
VSD, repair, device	1	0	0.0%	0.0%	0.0%	rare	0.3
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	89	0.1
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	0.2
Sinus of Valsalva, aneurysm repair	1	0	0.0%	0.0%	0.0%	61	0.1
Coarctation repair, interposition graft	1	0	0.0%	0.0%	0.0%	49	0.1
ICD (AICD) ([automatic] implantable cardioverter defibrillator) procedure	1	0	0.0%	0.0%	0.0%	15	0.2
Shunt, systemic to pulmonary, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
Mediastinal exploration	1	0	0.0%	0.0%	0.0%	rare	0.3

Additional Information on mortality category risk



Table 12.2

Frequency of isolated procedure and mortality risk in school aged children (n=2,318 missing 2.9%)

Mortality category 2

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, non ventriculotomy	73	7	9.6%	2.8%	16.3%	8	0.5
Bidirectional cavopulmonary anastomosis (BDCPA) (bidirectional Glenn)	37	1	2.7%	0.0%	7.9%	43	0.4
TOF repair, NOS	35	2	5.7%	0.0%	13.4%	rare	0.5
Fontan, TCPC, external conduit, NOS	24	1	4.2%	0.0%	12.2%	rare	0.6
Fontan, TCPC, external conduit, nonfenestrated	23	1	4.3%	0.0%	12.7%	97	0.6
Pulmonary atresia-VSD (including TOF, PA), repair	22	1	4.5%	0.0%	13.2%	92	0.8
Rastelli	17	0	0.0%	0.0%	0.0%	125	0.7
TOF repair, RV-PA conduit	14	1	7.1%	0.0%	20.6%	80	0.6
Unifocalization MAPCA(s)	14	1	7.1%	0.0%	20.6%	116	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	13	0	0.0%	0.0%	0.0%	47	0.8
TOF, AVC (AVSD), repair	8	1	12.5%	0.0%	35.4%	122	0.7
Fontan, atrio-pulmonary connection	8	2	25.0%	0.0%	55.0%	94	0.6
Cardiotomy, other	8	0	0.0%	0.0%	0.0%	rare	0.5
TOF, absent pulmonary valve, repair	6	0	0.0%	0.0%	0.0%	109	0.7
Fontan, NOS	6	0	0.0%	0.0%	0.0%	rare	0.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	6	0	0.0%	0.0%	0.0%	41	0.4
Valvuloplasty, aortic	5	0	0.0%	0.0%	0.0%	72	0.5
Valve replacement, mitral (MVR)	5	0	0.0%	0.0%	0.0%	69	0.7
AVC (AVSD) repair, NOS	4	0	0.0%	0.0%	0.0%	rare	0.5
Pulmonary Venous Stenosis, repair	4	1	25.0%	0.0%	67.4%	117	0.7
1 1/2 ventricular repair	4	0	0.0%	0.0%	0.0%	58	0.6
Valve replacement, pulmonic (PVR)	4	1	25.0%	0.0%	67.4%	44	0.6
Mitral stenosis, supra-valvar mitral ring, repair	4	0	0.0%	0.0%	0.0%	74	0.5
Coronary artery procedure, other	4	0	0.0%	0.0%	0.0%	17	0.7
Lung biopsy	4	0	0.0%	0.0%	0.0%	rare	0.5
PA banding (PAB)	4	0	0.0%	0.0%	0.0%	21	0.6
Hemifontan	4	1	25.0%	0.0%	67.4%	78	0.5
Ventricular septal fenestration	3	0	0.0%	0.0%	0.0%	45	0.5
Valve closure, tricuspid (exclusion, univentricular approach)	3	0	0.0%	0.0%	0.0%	36	0.6





Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	88	0.7
ASD creation/enlargement	2	0	0.0%	0.0%	0.0%	9	0.5
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	77	0.7
AP window repair	1	0	0.0%	0.0%	0.0%	35	0.5
Pericardial drainage procedure	1	0	0.0%	0.0%	0.0%	1	0.7
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Fontan, TCPC, lateral tunnel, nonfenestrated	1	0	0.0%	0.0%	0.0%	99	0.5
Vascular ring repair	1	0	0.0%	0.0%	0.0%	19	0.6
ICD (AICD) implantation	1	0	0.0%	0.0%	0.0%	14	0.5
Delayed sternal closure	1	0	0.0%	0.0%	0.0%	rare	0.5

Additional Information on mortality category risk



Table 12.3

Frequency of isolated procedure and mortality risk in school aged children (n=2,318 missing 2.9%)

Mortality category 3

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	139	3	2.2%	0.0%	4.6%	39	0.8
DORV repair, NOS	20	3	15.0%	0.0%	30.6%	rare	0.9
DORV, intraventricular tunnel repair	15	2	13.3%	0.0%	30.5%	132	0.9
Pacemaker implantation, permanent	15	0	0.0%	0.0%	0.0%	2	0.8
Fontan, TCPC, lateral tunnel, fenestrated	14	3	21.4%	0.0%	42.9%	101	1.1
AVC(AVSD) repair, complete CAVSD	11	3	27.3%	1.0%	53.6%	87	0.9
RVOT procedure	7	0	0.0%	0.0%	0.0%	40	0.9
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	5	1	20.0%	0.0%	55.1%	137	1.3
Thoracic and/or mediastinal procedure, other	5	0	0.0%	0.0%	0.0%	rare	1.1
Pectus repair	4	0	0.0%	0.0%	0.0%	rare	0.9
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	4	0	0.0%	0.0%	0.0%	63	1.0
Truncus arteriosus repair	3	0	0.0%	0.0%	0.0%	134	1.1
TAPVC repair	3	0	0.0%	0.0%	0.0%	104	1.3
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	3	1	33.3%	0.0%	86.7%	rare	0.8
Sternotomy wound drainage	3	0	0.0%	0.0%	0.0%	rare	0.9
Conduit, placement, LV to PA	2	0	0.0%	0.0%	0.0%	73	0.9
Valve replacement, aortic (AVR)	2	1	50.0%	0.0%	100.0%	0	0.9
Valve replacement, aortic (AVR), mechanical	2	1	50.0%	0.0%	100.0%	52	1.1
Congenitally corrected TGA repair, atrial switch and Rastelli	2	0	0.0%	0.0%	.0%	139	1.0
Senning	2	0	0.0%	0.0%	0.0%	108	1.2
Mustard	2	0	0.0%	0.0%	0.0%	100	1.0
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	60	1.2
Valve replacement, tricuspid (TVR)	1	0	0.0%	0.0%	0.0%	65	1.1
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	rare	1.0
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	1.2



Table 12.4  
Frequency of isolated procedure and mortality risk in school aged children (n=2,318 missing 2.9%)  
Mortality category 4

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valve surgery, other, aortic	4	0	0.0%	0.0%	0.0%	rare	1.5
Arterial switch operation (ASO)	4	1	25.0%	0.0%	67.4%	130	1.3
Valve replacement, truncal	3	1	33.3%	0.0%	86.7%	46	1.5
PA, reconstruction (plasty), main (trunk)	2	0	0.0%	0.0%	0.0%	25	1.5
Conduit, placement, RV to PA	2	1	50.0%	0.0%	100.0%	66	1.5
Aortic root replacement	2	1	50.0%	0.0%	100.0%	rare	1.9
Fontan, atrio-ventricular connection	2	0	0.0%	0.0%	0.0%	0	1.5
Coronary artery bypass	2	0	0.0%	0.0%	0.0%	98	1.8
ASD, common atrium (single atrium), septation	1	0	0.0%	0.0%	0.0%	18	1.7
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	0	0.0%	0.0%	0.0%	148	1.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	1	100.0%	100.0%	100.0%	135	1.4
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	119	1.4
Interrupted aortic arch repair	1	0	0.0%	0.0%	0.0%	118	1.7
Pulmonary AV fistula repair/occlusion	1	0	0.0%	0.0%	0.0%	rare	2.6
Pleural procedure, other	1	1	100.0%	100.0%	100.0%	rare	1.4

Additional Information on mortality category risk

Table 12.5  
Frequency of isolated procedure and mortality risk in school aged children (n=2,318 missing 2.9%)  
Mortality category 5

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA debanding	3	0	0.0%	0.0%	0.0%	29	3.7
Intraaortic balloon pump (IABP) insertion	2	1	50.0%	0.0%	100.0%	rare	3.5
Aortic root replacement, homograft	1	1	100.0%	100.0%	100.0%	121	4.8
<b>Total (139 procedures)</b>	<b>2,318</b>	<b>68</b>	<b>2.9%</b>	<b>2.2%</b>	<b>3.6%</b>		



Table 13.1  
Frequency of isolated procedure and mortality risk in grown-up children (n=846 missing 3.0%)  
Mortality category 1

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	135	1	0.7%	0.0%	2.2%	32	0.2
ASD repair, patch	112	0	0.0%	0.0%	0.0%	8	0.1
VSD repair, primary closure	89	0	0.0%	0.0%	0.0%	30	0.2
ASD repair, primary closure	65	0	0.0%	0.0%	0.0%	7	0.1
PDA closure, surgical	44	0	0.0%	0.0%	0.0%	5	0.2
TOF repair, ventriculotomy, transanular patch	33	0	0.0%	0.0%	0.0%	79	0.4
Esophageal procedure	23	1	4.3%	0.0%	12.7%	rare	0.4
PDA closure, device	13	0	0.0%	0.0%	0.0%	rare	0.2
TOF repair, ventriculotomy, nontransanular patch	10	0	0.0%	0.0%	0.0%	62	0.4
PDA closure, NOS	9	0	0.0%	0.0%	0.0%	rare	0.1
Lung procedure, other	8	1	12.5%	0.0%	35.4%	rare	0.2
PFO, primary closure	7	0	0.0%	0.0%	0.0%	6	0.2
Aortic stenosis, subvalvar, repair	7	0	0.0%	0.0%	0.0%	42	0.1
Valvuloplasty, mitral	7	1	14.3%	0.0%	40.2%	76	0.3
Pulmonary embolectomy	7	0	0.0%	0.0%	0.0%	34	0.1
Cardiac procedure, other	7	0	0.0%	0.0%	0.0%	rare	0.1
Organ procurement	7	0	0.0%	0.0%	0.0%	rare	0.3
Aortic stenosis, supra-valvar, repair	6	0	0.0%	0.0%	0.0%	64	0.1
ASD partial closure	5	0	0.0%	0.0%	0.0%	10	0.2
Ligation, thoracic duct	5	0	0.0%	0.0%	0.0%	rare	0.1
AVC (AVSD) repair, partial (incomplete) (PAVSD)	4	0	0.0%	0.0%	0.0%	31	0.3
Mediastinal procedure	4	1	25.0%	0.0%	67.4%	rare	0.4
Congenitally corrected TGA repair, VSD closure	3	0	0.0%	0.0%	0.0%	106	0.1
Coarctation repair, interposition graft	3	0	0.0%	0.0%	0.0%	49	0.1
VSD, multiple, repair	2	0	0.0%	0.0%	0.0%	113	0.3
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.4
PAPVC repair	2	0	0.0%	0.0%	0.0%	27	0.2
DCRV repair	2	0	0.0%	0.0%	0.0%	48	0.1
Valvuloplasty, pulmonic	2	0	0.0%	0.0%	0.0%	26	0.4
Sinus of Valsalva, aneurysm repair	2	0	0.0%	0.0%	0.0%	61	0.1
Coarctation repair, end to end	2	0	0.0%	0.0%	0.0%	24	0.3
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	rare	0.1
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	33	0.1



Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Occlusion MAPCA(s)	1	0	0.0%	0.0%	0.0%	51	0.4
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	rare	0.1
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	0.2
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	133	0.3
Pericardial procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	24	0.2
Tracheal procedure	1	0	0.0%	0.0%	0.0%	rare	0.1
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	3	0.3
Shunt, systemic to pulmonary, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
Palliation, other	1	0	0.0%	0.0%	0.0%	rare	0.3
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2

Additional Information on mortality category risk



Table 13.2  
Frequency of isolated procedure and mortality risk in grown-up children (n=846 missing 3.0%)  
Mortality category 2

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, non ventriculotomy	22	0	0.0%	0.0%	0.0%	81	0.5
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	12	0	0.0%	0.0%	0.0%	47	0.8
Unifocalization MAPCA(s)	8	0	0.0%	0.0%	0.0%	116	0.6
Pulmonary atresia-VSD (including TOF, PA), repair	5	0	0.0%	0.0%	0.0%	92	0.8
Valve replacement, pulmonic (PVR)	5	0	0.0%	0.0%	0.0%	44	0.6
Valve replacement, mitral (MVR)	5	0	0.0%	0.0%	0.0%	69	0.7
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	5	0	0.0%	0.0%	0.0%	43	0.4
Mitral stenosis, supravalvar mitral ring, repair	4	0	0.0%	0.0%	0.0%	74	0.5
Fontan, TCPC, external conduit, nonfenestrated	4	1	25.0%	0.0%	67.4%	97	0.6
Rastelli	4	1	25.0%	0.0%	67.4%	125	0.7
Pericardectomy	3	0	0.0%	0.0%	0.0%	20	0.6
Hemifontan	3	0	0.0%	0.0%	0.0%	78	0.5
Cardiotomy, other	3	0	0.0%	0.0%	0.0%	rare	0.5
Ventricular septal fenestration	2	0	0.0%	0.0%	0.0%	45	0.5
TOF repair, NOS	2	1	50.0%	0.0%	100.0%	rare	0.5
Conduit, reoperation	2	0	0.0%	0.0%	0.0%	77	0.7
Valvuloplasty, aortic	2	0	0.0%	0.0%	0.0%	72	0.5
Pericardial drainage procedure	2	1	50.0%	0.0%	100.0%	1	0.7
Fontan, NOS	2	0	0.0%	0.0%	0.0%	rare	0.5
Coronary artery procedure, other	2	0	0.0%	0.0%	0.0%	17	0.7
Cardiac tumor resection	2	0	0.0%	0.0%	0.0%	88	0.7
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
TOF repair, RV-PA conduit	1	0	0.0%	0.0%	0.0%	80	0.6
TOF, AVC (AVSD), repair	1	0	0.0%	0.0%	0.0%	122	0.7
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	58	0.6
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	94	0.6
Fontan, TCPC, external conduit, NOS	1	0	0.0%	0.0%	0.0%	rare	0.6
PA banding (PAB)	1	0	0.0%	0.0%	0.0%	21	0.6
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	0	0.0%	0.0%	0.0%	41	0.4



Table 13.3  
Frequency of isolated procedure and mortality risk in grown-up children (n=846 missing 3.0%)  
Mortality category 3

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	19	0	0.0%	0.0%	0.0%	39	0.8
Pacemaker implantation, permanent	8	0	0.0%	0.0%	0.0%	2	0.8
Fontan, TCPC, lateral tunnel, fenestrated	5	1	20.0%	0.0%	55.1%	101	1.1
RVOT procedure	4	0	0.0%	0.0%	0.0%	40	0.9
Valve replacement, aortic (AVR), mechanical	4	1	25.0%	0.0%	67.4%	52	1.1
DORV, intraventricular tunnel repair	4	0	0.0%	0.0%	0.0%	132	0.9
DORV repair, NOS	4	0	0.0%	0.0%	0.0%	rare	0.9
Thoracic and/or mediastinal procedure, other	4	1	25.0%	0.0%	67.4%	rare	1.1
AVC (AVSD) repair, complete CAVSD	3	0	0.0%	0.0%	0.0%	87	0.9
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	0	0.0%	0.0%	0.0%	137	1.3
Valve replacement, tricuspid (TVR)	3	1	33.3%	0.0%	86.7%	65	1.1
Conduit, placement, LV to PA	3	1	33.3%	0.0%	86.7%	73	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	3	0	0.0%	0.0%	0.0%	rare	0.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	3	0	0.0%	0.0%	0.0%	63	1.0
Valve surgery, other pulmonic	2	0	0.0%	0.0%	0.0%	rare	1.0
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	rare	0.9
Valve replacement, aortic (AVR)	1	0	0.0%	0.0%	0.0%	0	0.9
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	1.0
Arterial switch operation (ASO) and VSD repair	1	0	0.0%	0.0%	0.0%	138	1.0
Pectus repair	1	0	0.0%	0.0%	0.0%	rare	0.9

Additional Information on mortality category risk



Table 13.4

Frequency of isolated procedure and mortality risk in grown-up children (n=846 missing 3.0%)

Mortality category 4

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Coronary artery bypass	3	0	0.0%	0.0%	0.0%	98	1.8
Aortic arch repair	2	0	0.0%	0.0%	0.0%	82	1.9
Anomalous origin of coronary artery repair	2	0	0.0%	0.0%	0.0%	119	1.4
Pulmonary AV fistula repair/occlusion	2	0	0.0%	0.0%	0.0%	rare	2.6
Valve surgery, other, aortic	1	0	0.0%	0.0%	0.0%	rare	1.5
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	0	1.5
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	1	0	0.0%	0.0%	0.0%	148	1.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	1.4
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	107	1.5

Table 13.5

Frequency of isolated procedure and mortality risk in grown-up children (n=846 missing 3.0%)

Mortality category 5

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Konno procedure	1	1	100.0%	100.0%	100.0%	131	4.8
Ross-Konno procedure	1	1	100.0%	100.0%	100.0%	146	4.8
HLHS biventricular repair	1	0	0.0%	0.0%	0.0%	145	3.3
<b>Total (107 procedures)</b>	<b>846</b>	<b>16</b>	<b>1.9%</b>	<b>1.0%</b>	<b>2.8%</b>		





Table 14.1  
Frequency of isolated procedure and mortality risk in adult (n=2,226 missing 1.2%)  
Mortality category 1

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
ASD repair, patch	914	3	0.3%	0.0%	0.7%	8	0.1
ASD repair, primary closure	384	2	0.5%	0.0%	1.2%	7	0.1
VSD repair, patch	153	0	0.0%	0.0%	0.0%	32	0.2
PDA closure, surgical	129	0	0.0%	0.0%	0.0%	5	0.2
VSD repair, primary closure	86	0	0.0%	0.0%	0.0%	30	0.2
ASD partial closure	64	0	0.0%	0.0%	0.0%	10	0.2
TOF repair, ventriculotomy, transannular patch	51	3	5.9%	0.0%	12.3%	79	0.4
PDA closure, device	23	0	0.0%	0.0%	0.0%	rare	0.2
PFO, primary closure	21	0	0.0%	0.0%	0.0%	6	0.2
Sinus of Valsalva, aneurysm repair	19	0	0.0%	0.0%	0.0%	61	0.1
TOF repair, ventriculotomy, nontransannular patch	12	1	8.3%	0.0%	24.0%	62	0.4
Coarctation repair, interposition graft	11	0	0.0%	0.0%	0.0%	49	0.1
Coronary artery fistula ligation	11	0	0.0%	0.0%	0.0%	17	0.1
ASD repair, NOS	8	0	0.0%	0.0%	0.0%	rare	0.1
PDA closure, NOS	8	0	0.0%	0.0%	0.0%	rare	0.1
VSD repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.4
Valvuloplasty, pulmonic	5	0	0.0%	0.0%	0.0%	26	0.4
Valvuloplasty, tricuspid	4	0	0.0%	0.0%	0.0%	57	0.4
Valvuloplasty, mitral	4	0	0.0%	0.0%	0.0%	76	0.3
Congenitally corrected TGA repair, VSD closure	4	0	0.0%	0.0%	0.0%	106	0.1
Organ procurement	4	0	0.0%	0.0%	0.0%	rare	0.3
ASD, repair, device	3	0	0.0%	0.0%	0.0%	rare	0.2
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	113	0.3
PAPVC repair	3	0	0.0%	0.0%	0.0%	27	0.2
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	rare	0.1
Palliation, other	3	0	0.0%	0.0%	0.0%	rare	0.3
AVC (AVSD) repair, partial (incomplete)(PAVSD)	2	0	0.0%	0.0%	0.0%	31	0.3
Valve replacement, aortic (AVR), bioprosthetic	2	0	0.0%	0.0%	0.0%	55	0.2
Aortic stenosis, subvalvar, repair	2	0	0.0%	0.0%	0.0%	42	0.1
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Esophageal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
Mediastinal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
Cardiac procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.1
VSD, repair, device	1	0	0.0%	0.0%	0.0%	rare	0.3

Additional Information on mortality category risk



Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	83	0.3
DCRV repair	1	0	0.0%	0.0%	0.0%	48	0.1
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	rare	0.1
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	0.2
Aortic stenosis, supra-valvar, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Partial left ventriculectomy (LV volume reduction surgery)(Batista)	1	0	0.0%	0.0%	0.0%	133	0.3
Pericardial procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	24	0.3
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	0.1
Lung procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Pacemaker procedure	1	0	0.0%	0.0%	0.0%	3	0.3
Atrial baffle procedure, NOS	1	0	0.0%	0.0%	0.0%	67	0.1
Peripheral vascular procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2



Table 14.2  
Frequency of isolated procedure and mortality risk in adult (n=2,226 missing 1.2%)  
Mortality category 2

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Pericardial drainage procedure	37	3	8.1%	0.0%	16.9%	1	0.7
Pericardectomy	19	1	5.3%	0.0%	15.3%	20	0.6
Valve replacement, pulmonic (PVR)	16	1	6.3%	0.0%	18.1%	44	0.6
TOF repair, NOS	15	1	6.7%	0.0%	19.3%	rare	0.5
TOF repair, non ventriculotomy	14	0	0.0%	0.0%	0.0%	81	0.5
Ventricular septal fenestration	8	1	12.5%	0.0%	35.4%	45	0.5
ASD creation/enlargement	7	0	0.0%	0.0%	0.0%	9	0.5
Pulmonary Venous Stenosis, repair	7	0	0.0%	0.0%	0.0%	117	0.7
TOF repair, RV-PA conduit	6	1	16.7%	0.0%	46.5%	80	0.6
Pulmonary atresia-VSD (including TOF, PA), repair	5	0	0.0%	0.0%	0.0%	92	0.8
Rastelli	5	0	0.0%	0.0%	0.0%	125	0.7
Atrial septal fenestration	4	0	0.0%	0.0%	0.0%	12	0.8
Conduit, reoperation	4	1	25.0%	0.0%	67.4%	77	0.7
Valvuloplasty, aortic	4	0	0.0%	0.0%	0.0%	72	0.5
Fontan, TCPC, external conduit, nonfenestrated	4	0	0.0%	0.0%	0.0%	97	0.6
Cardiotomy, other	4	1	25.0%	0.0%	67.4%	rare	0.5
Mitral stenosis, supra-valvar mitral ring, repair	3	0	0.0%	0.0%	0.0%	74	0.5
Valve replacement, mitral (MVR)	3	1	33.3%	0.0%	86.7%	69	0.7
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3	0	0.0%	0.0%	0.0%	47	0.8
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	3	1	33.3%	0.0%	86.7%	43	0.4
Unifocalization MAPCA(s)	2	0	0.0%	0.0%	0.0%	116	0.6
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
Fontan, TCPC, external conduit, NOS	2	0	0.0%	0.0%	0.0%	rare	0.6
PA banding (PAB)	2	1	50.0%	0.0%	100.0%	21	0.6
AVC (AVSD) repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
AP window repair	1	0	0.0%	0.0%	0.0%	35	0.5
TOF, absent pulmonary valve, repair	1	1	100.0%	100.0%	100.0%	109	0.7
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	58	0.6
Aortic root replacement, mechanical	1	0	0.0%	0.0%	0.0%	111	0.5
Fontan, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Cardiac tumor resection	1	0	0.0%	0.0%	0.0%	88	0.7
Ligation, pulmonary artery	1	0	0.0%	0.0%	0.0%	rare	0.4

Additional Information on mortality category risk



Table 14.3  
Frequency of isolated procedure and mortality risk in adult (n=2,226 missing 1.2%)  
Mortality category 3

Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	14	0	0.0%	0.0%	0.0%	39	0.8
Valve replacement, tricuspid (TVR)	5	1	20.0%	0.0%	55.1%	65	1.1
RVOT procedure	5	0	0.0%	0.0%	0.0%	40	0.9
DORV, intraventricular tunnel repair	5	0	0.0%	0.0%	0.0%	132	0.9
DORV repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.9
Fontan, TCPC, lateral tunnel, fenestrated	4	1	25.0%	0.0%	67.4%	101	1.1
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	1	33.3%	0.0%	86.7%	137	1.3
Valve surgery, other pulmonic	3	0	0.0%	0.0%	0.0%	rare	1.0
Valve replacement, aortic (AVR), mechanical	3	0	0.0%	0.0%	0.0%	52	1.1
Cor triatriatum repair	2	0	0.0%	0.0%	0.0%	60	1.2
Valve replacement, aortic (AVR)	2	0	0.0%	0.0%	0.0%	0	0.9
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	2	1	50.0%	0.0%	100.0%	rare	0.8
Pacemaker implantation, permanent	2	0	0.0%	0.0%	0.0%	2	0.8
Shunt, ligation and takedown	2	0	0.0%	0.0%	0.0%	11	0.9
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	rare	0.9
TAPVC repair	1	0	0.0%	0.0%	0.0%	104	1.3
Conduit, placement, LV to PA	1	0	0.0%	0.0%	0.0%	73	0.9
Thoracic and/or mediastinal procedure, other	1	0	0.0%	0.0%	0.0%	rare	1.1



Table 14.4  
 Frequency of isolated procedure and mortality risk in adult (n=2,226 missing 1.2%)  
 Mortality category 4

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Conduit, placement, RV to PA	5	1	20.0%	0.0%	55.1%	66	1.5
Coronary artery bypass	2	2	100.0%	100.0%	100.0%	98	1.8
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	54	1.4
Valve surgery, other, aortic	1	0	0.0%	0.0%	0.0%	rare	1.5
Arterial switch operation (ASO)	1	0	0.0%	0.0%	0.0%	130	1.3
Aortic arch repair	1	0	0.0%	0.0%	0.0%	82	1.9
Anomalous origin of coronary artery repair	1	0	0.0%	0.0%	0.0%	119	1.4
<b>Total (106 procedures)</b>	<b>2,226</b>	<b>30</b>	<b>1.3%</b>	<b>0.9%</b>	<b>1.8%</b>		

Additional Information on mortality category risk



Table 15.1  
Frequency of multiple procedure and mortality risk in all age group (n=3,480 missing 6.7%)  
Mortality category 1

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
ASD repair, patch	99	6	6.1%	1.4%	10.8%	8	0.5
PAPVC repair	44	1	2.3%	0.0%	6.7%	27	0.4
PFO, primary closure	38	0	0.0%	0.0%	0.0%	6	0.8
ASD partial closure	28	2	7.1%	0.0%	16.7%	10	0.8
PA, reconstruction (plasty), NOS	14	0	0.0%	0.0%	0.0%	rare	0.9
ASD creation/enlargement	12	2	16.7%	0.0%	37.8%	9	0.9
DCRV repair	10	0	0.0%	0.0%	0.0%	48	0.5
VATS (video-assisted thoracoscopic surgery)	8	0	0.0%	0.0%	0.0%	rare	0.1
Sinus of Valsalva, aneurysm repair	8	0	0.0%	0.0%	0.0%	61	0.6
ASD repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.7
Arrhythmia surgery-atrial, surgical ablation	4	0	0.0%	0.0%	0.0%	84	0.1
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	4	0	0.0%	0.0%	0.0%	rare	0.8
Pacemaker implantation, permanent	4	0	0.0%	0.0%	0.0%	2	0.4
PA debanding	4	1	25.0%	0.0%	67.4%	29	0.5
VSD repair, NOS	3	1	33.3%	0.0%	86.7%	rare	0.3
Aortic stenosis, supra-valvar, repair	3	0	0.0%	0.0%	0.0%	64	0.1
Coarctation repair, other	3	1	33.3%	0.0%	86.7%	112	0.1
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	17	0.3
PDA closure, NOS	3	0	0.0%	0.0%	0.0%	rare	0.3
Organ procurement	3	0	0.0%	0.0%	0.0%	rare	0.2
PAPVC, scimitar, repair	2	0	0.0%	0.0%	0.0%	91	0.3
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	2	0	0.0%	0.0%	0.0%	70	0.2
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	1	0.6
Fontan, NOS	2	1	50.0%	0.0%	100.0%	rare	0.8
Congenitally corrected TGA repair, VSD closure	2	0	0.0%	0.0%	0.0%	106	0.9
Pulmonary AV fistula repair/occlusion	2	1	50.0%	0.0%	100.0%	rare	0.6
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	83	0.2
Other annular enlargement procedure	1	0	0.0%	0.0%	0.0%	142	0.3
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	0.0%	0.0%	rare	0.3
ASD creation, balloon septostomy (BAS) (Rashkind)	1	0	0.0%	0.0%	0.0%	12	0.3
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	107	0.2
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	0.1
Ligation, pulmonary artery	1	1	100.0%	100.0%	100.0%	rare	0.3
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2



Table 15.2  
Frequency of multiple procedure and mortality risk in all age group (n=3,480 missing 6.7%)  
Mortality category 2

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	867	35	4.0%	2.7%	5.3%	32	1.0
VSD repair, primary closure	193	7	3.6%	1.0%	6.3%	30	1.2
PDA closure, surgical	100	4	4.0%	0.2%	7.8%	5	0.9
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	90	6	6.7%	1.5%	11.8%	43	1.4
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	85	12	14.1%	6.7%	21.5%	39	1.4
TOF repair, non ventriculotomy	80	5	6.3%	0.9%	11.6%	81	1.5
Valvuloplasty, mitral	61	1	1.6%	0.0%	4.8%	76	1.3
ASD, repair, primary closure	47	3	6.4%	0.0%	13.4%	7	0.9
Rastelli	39	6	15.4%	4.1%	26.7%	125	1.6
Coarctation repair, end to end	36	2	5.6%	0.0%	13.0%	24	1.5
PDA closure, device	28	4	14.3%	1.3%	27.2%	rare	1.0
Coarctation repair, end to end, extended	26	1	3.8%	0.0%	11.2%	24	1.6
AVC (AVSD) repair, partial (incomplete)(PAVSD)	25	1	4.0%	0.0%	11.7%	31	1.4
Valve replacement, pulmonic (PVR)	18	2	11.1%	0.0%	25.6%	44	1.5
TOF repair, NOS	17	2	11.8%	0.0%	27.1%	rare	1.0
Valve replacement, mitral (MVR)	17	2	11.8%	0.0%	27.1%	69	1.5
Mitral stenosis, supra-valvar mitral ring, repair	16	1	6.3%	0.0%	18.1%	74	1.5
VSD, multiple, repair	15	0	0.0%	0.0%	0.0%	113	0.9
TOF repair, RV-PA conduit	15	1	6.7%	0.0%	19.3%	80	1.5
Unifocalization MAPCA(s)	13	2	15.4%	0.0%	35.0%	116	1.4
Valve surgery, other, mitral	13	0	0.0%	0.0%	0.0%	76	1.5
Aortic stenosis, subvalvar, repair	10	0	0.0%	0.0%	0.0%	42	1.0
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	9	2	22.2%	0.0%	49.4%	137	1.4
Occlusion MAPCA(s)	9	1	11.1%	0.0%	31.6%	51	1.5
Valve surgery, other pulmonic	9	1	11.1%	0.0%	31.6%	rare	1.2
Fontan, atrio-pulmonary connection	9	0	0.0%	0.0%	0.0%	94	1.0
PA, reconstruction (plasty), branch, central	8	2	25.0%	0.0%	55.0%	68	1.3
TOF, AVC (AVSD), repair	7	1	14.3%	0.0%	40.2%	122	1.1
Valve closure, tricuspid (exclusion, univentricular approach)	7	1	14.3%	0.0%	40.2%	36	1.5
Pericardectomy	7	2	28.6%	0.0%	62.0%	20	1.6
Lung procedure, other	7	1	14.3%	0.0%	40.2%	rare	1.6
Glenn (unidirectional cavopulmonary anastomosis) (unidirectional Glenn)	7	0	0.0%	0.0%	0.0%	41	1.2

Additional Information on mortality category risk



Additional information on mortality category risk

Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Ventricular septal fenestration	6	0	0.0%	0.0%	0.0%	45	1.2
Valve replacement, aortic (AVR), mechanical	6	1	16.7%	0.0%	46.5%	52	1.1
Cardiac tumor resection	6	0	0.0%	0.0%	0.0%	88	0.9
AVC (AVSD) repair, intermediated (transitional)	5	0	0.0%	0.0%	0.0%	33	1.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	5	0	0.0%	0.0%	0.0%	89	1.0
Fontan, atrio-ventricular connection	5	2	40.0%	0.0%	82.9%	0	1.4
Cardiotomy, other	5	0	0.0%	0.0%	0.0%	rare	1.3
Valvuloplasty, aortic	4	0	0.0%	0.0%	0.0%	72	1.0
1 1/2 ventricular repair	3	0	0.0%	0.0%	0.0%	58	1.0
Valve replacement, aortic (AVR), bioprosthetic	3	0	0.0%	0.0%	0.0%	55	1.1
Mustard	3	1	33.3%	0.0%	86.7%	100	1.0
Coronary artery procedure, other	3	0	0.0%	0.0%	0.0%	17	1.0
Esophageal procedure	3	0	0.0%	0.0%	0.0%	rare	1.4
AVC (AVSD) repair, NOS	2	0	0.0%	0.0%	0.0%	rare	1.4
Senning	2	1	50.0%	0.0%	100.0%	108	1.1
Pleural drainage procedure	2	0	0.0%	0.0%	0.0%	rare	1.0
Sternotomy wound drainage	2	0	0.0%	0.0%	0.0%	rare	1.3
Coronary artery bypass	1	0	0.0%	0.0%	0.0%	98	1.2





Table 15.3  
Frequency of multiple procedure and mortality risk in all age group (n=3,480 missing 6.7%)  
Mortality category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, ventriculotomy, transannular patch	178	9	5.1%	1.8%	8.3%	79	1.6
Valvuloplasty, tricuspid	78	3	3.8%	0.0%	8.1%	57	1.8
PA banding (PAB)	60	10	16.7%	7.2%	26.1%	21	2.1
Valvuloplasty, pulmonic	54	2	3.7%	0.0%	8.7%	26	1.8
RVOT procedure	38	8	21.1%	8.1%	34.0%	40	1.7
Pulmonary atresia-VSD (including TOF, PA), repair	36	6	16.7%	4.5%	28.8%	92	1.7
DORV repair, NOS	33	5	15.2%	2.9%	27.4%	rare	1.8
Valve surgery, other, tricuspid	28	1	3.6%	0.0%	10.4%	rare	1.9
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	27	3	11.1%	0.0%	23.0%	47	1.7
Truncus arteriosus repair	26	7	26.9%	9.9%	44.0%	134	2.2
TOF repair, ventriculotomy, nontransannular patch	23	1	4.3%	0.0%	12.7%	62	1.6
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	17	1	5.9%	0.0%	17.1%	63	2.2
Cor triatriatum repair	14	3	21.4%	0.0%	42.9%	60	2.3
Pulmonary Venous Stenosis, repair	14	2	14.3%	0.0%	32.6%	117	2.0
AP window repair	13	2	15.4%	0.0%	35.0%	35	1.9
TOF, absent pulmonary valve, repair	8	0	0.0%	0.0%	0.0%	109	1.7
Valve excision, pulmonary (without replacement)	7	0	0.0%	0.0%	0.0%	rare	2.1
Fontan, TCPC, lateral tunnel, fenestrated	7	1	14.3%	0.0%	40.2%	101	1.9
Valve replacement, tricuspid (TVR)	6	0	0.0%	0.0%	0.0%	65	2.4
PA, reconstruction (plasty), main (trunk)	6	1	16.7%	0.0%	46.5%	25	2.2
Valve excision, tricuspid (without replacement)	5	0	0.0%	0.0%	0.0%	13	2.5
Valve surgery, other, aortic	5	3	60.0%	17.1%	100.0%	rare	1.9
HLHS biventricular repair	4	3	75.0%	32.6%	100.0%	145	1.9
Coarctation repair, subclavian flap	4	0	0.0%	0.0%	0.0%	23	2.0
Atrial septal fenestration	3	1	33.3%	0.0%	86.7%	12	2.0
Conduit, placement, RV to PA	3	0	0.0%	0.0%	0.0%	66	1.9
Fontan, other	3	0	0.0%	0.0%	0.0%	rare	2.0
Vascular ring repair	3	1	33.3%	0.0%	86.7%	19	2.4
Shunt, systemic to pulmonary, other	3	0	0.0%	0.0%	0.0%	rare	2.3
ASD, repair, device	2	0	0.0%	0.0%	0.0%	rare	1.8
Valve replacement, aortic (AVR)	2	0	0.0%	0.0%	0.0%	0	2.2
Congenitally corrected TGA repair, other	2	0	0.0%	0.0%	0.0%	rare	2.3

Additional Information on mortality category risk



Table 15.4  
Frequency of multiple procedure and mortality risk in all age group (n=3,480 missing 6.7%)  
Mortality category 4

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TAPVC repair	87	21	24.1%	15.1%	33.1%	104	2.7
Arterial switch operation (ASO)	75	17	22.7%	13.2%	32.1%	130	2.6
AVC(AVSD) repair, complete CAVSD	55	8	14.5%	5.2%	23.9%	87	2.6
DORV, intraventricular tunnel repair	51	9	17.6%	7.2%	28.1%	132	2.8
Aortic arch repair	37	16	43.2%	27.3%	59.2%	82	3.1
Interrupted aortic arch repair	35	12	34.3%	18.6%	50.0%	118	2.6
Arterial switch operation (ASO) and VSD repair	29	3	10.3%	0.0%	21.4%	138	3.1
Coarctation repair, patch aortoplasty	24	4	16.7%	1.8%	31.6%	22	2.7
Fontan, TCPC, external conduit, nonfenestrated	15	3	20.0%	0.0%	40.2%	97	3.2
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	4	5	35.7%	10.6%	60.8%	148	4.0
Norwood procedure	13	10	76.9%	54.0%	99.8%	147	2.8
Pulmonary artery sling repair	9	3	33.3%	2.5%	64.1%	105	2.8
Valve replacement, truncal	8	2	25.0%	0.0%	55.0%	46	3.3
Anomalous systemic venous connection repair	8	1	12.5%	0.0%	35.4%	54	2.6
Fontan, TCPC, external conduit, NOS	8	1	12.5%	0.0%	35.4%	rare	2.5
Palliation, other	5	1	20.0%	0.0%	55.1%	rare	2.6
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	4	3	75.0%	32.6%	100.0%	114	2.6
Hemifontan	3	1	33.3%	0.0%	86.7%	78	3.0
Coarctation repair, NOS	2	1	50.0%	0.0%	100.0%	rare	2.6
Aortic dissection repair	2	0	0.0%	0.0%	0.0%	128	3.4
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	2.6
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	2.6
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	2.6
Tracheal procedure	1	1	100.0%	100.0%	100.0%	rare	3.0
Pleural procedure, other	1	0	0.0%	0.0%	0.0%	rare	3.8



Table 15.5  
 Frequency of multiple procedure and mortality risk in all age group (n=3,480 missing 6.7%)  
 Mortality category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Aortic root replacement	1	0	0.0%	0.0%	0.0%	rare	5.0
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	rare	4.9
<b>Total (144 procedures)</b>	<b>3,480</b>	<b>326</b>	<b>9.4%</b>	<b>8.4%</b>	<b>10.3%</b>		

Additional Information on mortality category risk



Table 16.1  
 Frequency of multiple procedure and mortality risk in newborn (n=273 missing 13.9%)  
 Mortality category 1

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Coarctation repair, end to end, extended	8	1	12.5%	0.0%	35.4%	24	0.2
PDA closure, surgical	8	1	12.5%	0.0%	35.4%	5	0.2
VSD repair, patch	7	0	0.0%	0.0%	0.0%	32	0.2
Valvuloplasty, pulmonic	7	0	0.0%	0.0%	0.0%	26	0.4
Coarctation repair, end to end	5	0	0.0%	0.0%	0.0%	24	0.3
VSD repair, primary closure	3	1	33.3%	0.0%	86.7%	30	0.2
PDA closure, device	3	1	33.3%	0.0%	86.7%	rare	0.2
ASD, repair, primary closure	2	1	50.0%	0.0%	100.0%	7	0.1
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
PFO, primary closure	1	0	0.0%	0.0%	0.0%	6	0.2
ASD repair, patch	1	0	0.0%	0.0%	0.0%	8	0.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	89	0.1
Occlusion MAPCA(s)	1	1	100.0%	100.0%	100.0%	51	0.4
Valve surgery, other, tricuspid	1	1	100.0%	100.0%	100.0%	rare	0.3
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	70	0.3
Valve excision, pulmonary (without replacement)	1	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, subclavian flap	1	0	0.0%	0.0%	0.0%	23	0.1
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	0.1



Table 16.2  
Frequency of multiple procedure and mortality risk in newborn (n=273 missing 13.9%)  
Mortality category 2

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA banding (PAB)	17	3	17.6%	0.0%	35.8%	21	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	7	0	0.0%	0.0%	0.0%	47	0.8
AP window repair	2	0	0.0%	0.0%	0.0%	35	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	2	1	50.0%	0.0%	100.0%	92	0.8
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	9	0.5
TOF repair, RV-PA conduit	1	0	0.0%	0.0%	0.0%	80	0.6
Valve closure, tricuspid (exclusion, univentricular approach)	1	0	0.0%	0.0%	0.0%	36	0.6
Valve replacement, pulmonic (PVR)	1	1	100.0%	100.0%	100.0%	44	0.6
Valvuloplasty, aortic	1	0	0.0%	0.0%	0.0%	72	0.5
Coarctation repair, other	1	0	0.0%	0.0%	0.0%	112	0.8
ASD creation, balloon septostomy (BAS)(Rashkind)	1	0	0.0%	0.0%	0.0%	12	0.5
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	114	0.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	43	0.4

Additional Information on mortality category risk



Table 16.3  
Frequency of multiple procedure and mortality risk in newborn (n=273 missing 13.9%)  
Mortality category 3

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TAPVC repair	27	12	44.4%	25.7%	63.2%	104	1.3
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	19	4	21.1%	2.7%	39.4%	39	0.8
RVOT procedure	10	5	50.0%	19.0%	81.0%	40	0.9
Arterial switch operation (ASO) and VSD repair	9	2	22.2%	0.0%	49.4%	138	1.0
Coarctation repair, patch aortoplasty	6	1	16.7%	0.0%	46.5%	22	0.8
Truncus arteriosus repair	5	3	60.0%	17.1%	100.0%	134	1.1
Valve surgery, other pulmonic	2	1	50.0%	0.0%	100.0%	rare	1.0
Cor triatriatum repair	1	1	100.0%	100.0%	100.0%	60	1.2
Valve excision, tricuspid (without replacement)	1	0	0.0%	0.0%	0.0%	13	1.0
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	rare	0.8
Pulmonary artery sling repair	1	0	0.0%	0.0%	0.0%	105	1.3
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	2	0.8



Table 16.4  
Frequency of multiple procedure and mortality risk in newborn (n=273 missing 13.9%)  
Mortality category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Arterial switch operation (ASO)	42	10	23.8%	10.9%	36.7%	130	1.3
Interrupted aortic arch repair	18	6	33.3%	11.6%	55.1%	118	1.7
Aortic arch repair	13	7	53.8%	26.7%	80.9%	82	1.9
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	9	2	22.2%	0.0%	49.4%	148	1.6
PA, reconstruction (plasty), main (trunk)	2	1	50.0%	0.0%	100.0%	25	1.5
Valve replacement, truncal	1	1	100.0%	100.0%	100.0%	46	1.5
Valve surgery, other, aortic	1	1	100.0%	100.0%	100.0%	rare	1.5
Fontan, atrio-ventricular connection	1	0	0.0%	0.0%	0.0%	0	1.5
Pulmonary AV fistula repair/occlusion	1	1	100.0%	100.0%	100.0%	rare	2.6

Additional Information on mortality category risk

Table 16.5  
Frequency of multiple procedure and mortality risk in newborn (n=273 missing 13.9%)  
Mortality category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	4	2	50.0%	1.0%	99.0%	147	3.4
HLHS biventricular repair	3	2	66.7%	13.3%	100.0%	145	3.3
Coarctation repair, NOS	1	1	100.0%	100.0%	100.0%	rare	2.8
PA debanding	1	1	100.0%	100.0%	100.0%	29	3.7
<b>Total (57 procedures)</b>	<b>273</b>	<b>77</b>	<b>28.2%</b>	<b>22.9%</b>	<b>33.5%</b>		



Table 17.1  
Frequency of multiple procedure and mortality risk in infant (n=784 missing 8.8%)  
Mortality category 1

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	240	20	8.3%	4.8%	11.8%	32	0.2
VSD repair, primary closure	33	3	9.1%	0.0%	18.9%	30	0.2
PDA closure, surgical	24	2	8.3%	0.0%	19.4%	5	0.2
Coarctation repair, end to end	22	2	9.1%	0.0%	21.1%	24	0.3
ASD, repair, patch	11	2	18.2%	0.0%	41.0%	8	0.1
Coarctation repair, end to end, extended	11	0	0.0%	0.0%	0.0%	24	0.2
PFO, primary closure	9	0	0.0%	0.0%	0.0%	6	0.2
PDA closure, device	8	2	25.0%	0.0%	55.0%	rare	0.2
ASD, repair, primary closure	6	2	33.3%	0.0%	71.1%	7	0.1
ASD partial closure	6	1	16.7%	0.0%	46.5%	10	0.2
TOF repair, ventriculotomy, transannular patch	5	0	0.0%	0.0%	0.0%	79	0.4
AVC (AVSD) repair, partial (incomplete)(PAVSD)	3	0	0.0%	0.0%	0.0%	31	0.3
Pulmonary artery origin from ascending aorta (hemitruncus) repair	3	0	0.0%	0.0%	0.0%	89	0.1
Valvuloplasty, tricuspid	3	0	0.0%	0.0%	0.0%	57	0.4
Valvuloplasty, pulmonic	3	2	66.7%	13.3%	100.0%	26	0.4
Coarctation repair, subclavian flap	3	0	0.0%	0.0%	0.0%	23	0.1
PAPVC repair	2	1	50.0%	0.0%	100.0%	27	0.2
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	51	0.4
Valve surgery, other, tricuspid	2	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
Valvuloplasty, mitral	2	1	50.0%	0.0%	100.0%	76	0.3
PDA closure, NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
Lung procedure, other	2	1	50.0%	0.0%	100.0%	rare	0.2
Shunt, systemic to pulmonary, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Palliation, other	2	0	0.0%	0.0%	0.0%	rare	0.3
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	113	0.3
VSD creation/enlargement	1	0	0.0%	0.0%	0.0%	83	0.3
VSD repair, NOS	1	1	100.0%	100.0%	100.0%	rare	0.4
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	33	0.1
TOF repair, ventriculotomy, nontransannular patch	1	0	0%	0%	0%	62	0.4
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Valve surgery, other, mitral	1	0	0.0%	0.0%	0.0%	76	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Aortic dissection repair	1	0	0.0%	0.0%	0.0%	128	0.1
Tracheal procedure	1	1	100.0%	100.0%	100.0%	rare	0.1
Pleural drainage procedure	1	0	0.0%	0.0%	0.0%	rare	0.1





Table 17.2  
Frequency of multiple procedure and mortality risk in infant (n=784 missing 8.8%)  
Mortality category 2

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA banding (PAB)	37	7	18.9%	6.3%	31.5%	21	0.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	12	2	16.7%	0.0%	37.8%	43	0.4
AP window repair	6	0	0.0%	0.0%	0.0%	35	0.5
TOF repair, non ventriculotomy	6	1	16.7%	0.0%	46.5%	81	0.5
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	6	1	16.7%	0.0%	46.5%	47	0.8
ASD creation/enlargement	3	2	66.7%	13.3%	100.0%	9	0.5
Pulmonary Venous Stenosis, repair	3	0	0.0%	0.0%	0.0%	117	0.7
Pulmonary atresia-VSD (including TOF, PA), repair	3	1	33.3%	0.0%	86.7%	92	0.8
Rastelli	3	3	100.0%	100.0%	100.0%	125	0.7
Vascular ring repair	3	1	33.3%	0.0%	86.7%	19	0.6
Coarctation repair, other	2	1	50.0%	0.0%	100.0%	112	0.8
Damus-Kaye-Stansel procedure (DKS) (creation of AP anastomosis without arch reconstruction)	2	1	50.0%	0.0%	100.0%	114	0.6
Atrial septal fenestration	1	1	100.0%	100.0%	100.0%	12	0.8
Valve closure, tricuspid (exclusion, univentricular approach)	1	1	100.0%	100.0%	100.0%	36	0.6
Mitral stenosis, supra-valvar mitral ring, repair	1	1	100.0%	100.0%	100.0%	74	0.5
Pericardectomy	1	1	100.0%	100.0%	100.0%	20	0.6
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	94	0.6
Fontan, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	17	0.7

Additional information on mortality category risk



Table 17.3  
Frequency of multiple procedure and mortality risk in infant (n=784 missing 8.8%)  
Mortality category 3

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TAPVC repair	38	5	13.2%	2.4%	23.9%	104	1.3
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	30	7	23.3%	8.2%	38.5%	39	0.8
AVC(AVSD) repair, complete CAVSD	25	4	16.0%	1.6%	30.4%	87	0.9
Arterial switch operation (ASO) and VSD repair	18	1	5.6%	0.0%	16.1%	138	1.0
Coarctation repair, patch aortoplasty	15	3	20.0%	0.0%	40.2%	22	0.8
DORV, intraventricular tunnel repair	14	4	28.6%	4.9%	52.2%	132	0.9
Truncus arteriosus repair	13	4	30.8%	5.7%	55.9%	134	1.1
Pulmonary artery sling repair	5	2	40.0%	0.0%	82.9%	105	1.3
Cor triatriatum repair	4	2	50.0%	1.0%	99.0%	60	1.2
PA, reconstruction (plasty), branch, central	4	1	25.0%	0.0%	67.4%	68	1.3
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	0	0.0%	0.0%	0.0%	137	1.3
RVOT procedure	3	2	66.7%	13.3%	100.0%	40	0.9
DORV repair, NOS	3	1	33.3%	0.0%	86.7%	rare	0.9
Fontan, TCPC, lateral tunnel, fenestrated	1	0	0.0%	0.0%	0.0%	101	1.1
Congenitally corrected TGA repair, atrial switch and Rastelli	1	0	0.0%	0.0%	0.0%	139	1.0
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	2	0.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	63	1.0



Table 17.4  
Frequency of multiple procedure and mortality risk in infant (n=784 missing 8.8%)  
Mortality category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Arterial switch operation (ASO)	28	5	17.9%	3.7%	32.0%	130	1.3
Aortic arch repair	19	9	47.4%	24.9%	69.8%	82	1.9
Interrupted aortic arch repair	16	6	37.5%	13.8%	61.2%	118	1.7
Valve replacement, truncal	7	1	14.3%	0.0%	40.2%	46	1.5
Congenitally corrected TGA repair, atrial switch and ASO (double switch)	5	3	60.0%	17.1%	100.0%	148	1.6
Anomalous systemic venous connection repair	1	1	100.0%	100.0%	100.0%	54	1.4
Fontan, atrio-ventricular connection	1	1	100.0%	100.0%	100.0%	0	1.5
Congenitally corrected TGA repair, VSD closure and LV to PA conduit	1	0	0.0%	0.0%	0.0%	135	1.4
Coronary artery bypass	1	0	0.0%	0.0%	0.0%	98	1.8
Aneurysm ventricular, left, repair	1	0	0.0%	0.0%	0.0%	107	1.5
Pulmonary AV fistula repair/occlusion	1	0	0.0%	0.0%	0.0%	rare	2.6
Pleural procedure, other	1	0	0.0%	0.0%	0.0%	rare	1.4

Additional information on mortality category risk

Table 17.5  
Frequency of multiple procedure and mortality risk in infant (n=784 missing 8.8%)  
Mortality category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	7	6	85.7%	59.8%	100.0%	147	3.4
HLHS biventricular repair	1	1	100.0%	100.0%	100.0%	145	3.3
Congenitally corrected TGA repair, NOS	1	1	100.0%	100.0%	100.0%	rare	5.0
Coarctation repair, NOS	1	0	0.0%	0.0%	0.0%	rare	2.8
PA debanding	1	0	0.0%	0.0%	0.0%	29	3.7
<b>Total (89 procedures)</b>	<b>784</b>	<b>135</b>	<b>17.2%</b>	<b>14.6%</b>	<b>19.9%</b>		



Table 18.1  
Frequency of multiple procedure and mortality risk in preschool children (n=687 missing 7.0%)  
Mortality category 1

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	260	8	3.1%	1.0%	5.2%	32	0.2
TOF repair, ventriculotomy, transanular patch	56	5	8.9%	1.5%	16.4%	79	0.4
VSD repair, primary closure	45	1	2.2%	0.0%	6.5%	30	0.2
PDA closure, surgical	20	1	5.0%	0.0%	14.6%	5	0.2
ASD, repair, primary closure	8	0	0.0%	0.0%	0.0%	7	0.1
ASD, repair, patch	8	1	12.5%	0.0%	35.4%	8	0.1
AVC (AVSD) repair, partial (incomplete)(PAVSD)	7	0	0.0%	0.0%	0.0%	31	0.3
Valvuloplasty, pulmonic	6	0	0.0%	0.0%	0.0%	26	0.4
Coarctation repair, end to end	6	0	0.0%	0.0%	0.0%	24	0.3
Aortic stenosis, subvalvar, repair	5	0	0.0%	0.0%	0.0%	42	0.1
Valvuloplasty, mitral	5	0	0.0%	0.0%	0.0%	76	0.3
Coarctation repair, end to end, extended	5	0	0.0%	0.0%	0.0%	24	0.2
PFO, primary closure	4	0	0.0%	0.0%	0.0%	6	0.2
ASD partial closure	4	1	25.0%	0.0%	67.4%	10	0.2
PAPVC repair	4	0	0.0%	0.0%	0.0%	27	0.2
VSD, multiple, repair	3	0	0.0%	0.0%	0.0%	113	0.3
TOF repair, ventriculotomy, nontransanular patch	3	0	0.0%	0.0%	0.0%	62	0.4
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	51	0.4
Valvuloplasty, tricuspid	2	1	50.0%	0.0%	100.0%	57	0.4
PA, reconstruction (plasty), NOS	2	0	0.0%	0.0%	0.0%	rare	0.1
Valve surgery, other, mitral	2	0	0.0%	0.0%	0.0%	76	0.1
PDA closure, device	2	1	50.0%	0.0%	100.0%	rare	0.2
Lung procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Esophageal procedure	2	0	0.0%	0.0%	0.0%	rare	0.4
ASD repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.1
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	33	0.1
Pulmonary artery origin from ascending aorta (hemitruncus) repair	1	0	0.0%	0.0%	0.0%	89	0.1
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.2
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	rare	0.3
Aortic stenosis, supravalvar, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1



Table 18.2  
Frequency of multiple procedure and mortality risk in preschool children (n=687 missing 7.0%)  
Mortality category 2

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	54	3	5.6%	0.0%	11.7%	43	0.4
TOF repair, non ventriculotomy	15	2	13.3%	0.0%	30.5%	81	0.5
AP window repair	5	2	40.0%	0.0%	82.9%	35	0.5
TOF repair, NOS	5	2	40.0%	0.0%	82.9%	rare	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	5	1	20.0%	0.0%	55.1%	92	0.8
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	5	0	0.0%	0.0%	0.0%	47	0.8
PA banding (PAB)	4	0	0.0%	0.0%	0.0%	21	0.6
Pulmonary Venous Stenosis, repair	3	2	66.7%	13.3%	100.0%	117	0.7
TOF repair, RV-PA conduit	3	0	0.0%	0.0%	0.0%	80	0.6
Rastelli	3	0	0.0%	0.0%	0.0%	125	0.7
AVC (AVSD) repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.5
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	0	0.0%	0.0%	0.0%	41	0.4
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	9	0.5
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	12	0.8
TOF, AVC (AVSD), repair	1	1	100.0%	100.0%	100.0%	122	0.7
Unifocalization MAPCA(s)	1	1	100.0%	100.0%	100.0%	116	0.6
Valve closure, tricuspid (exclusion, univentricular approach)	1	0	0.0%	0.0%	0.0%	36	0.6
1 1/2 ventricular repair	1	0	0.0%	0.0%	0.0%	58	0.6
Valve replacement, pulmonic (PVR)	1	0	0.0%	0.0%	0.0%	44	0.6
Valve replacement, mitral (MVR)	1	0	0.0%	0.0%	0.0%	69	0.7
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	94	0.6
Fontan, TCPC, external conduit, nonfenestrated	1	1	100.0%	100.0%	100.0%	97	0.6
Damus-Kaye-Stansel procedure (DKS)(creation of AP anastomosis without arch reconstruction)	1	1	100.0%	100.0%	100.0%	114	0.6
Cardiotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.5

Additional Information on mortality category risk



Table 18.3  
Frequency of multiple procedure and mortality risk in preschool children (n=687 missing 7.0%)  
Mortality category 3

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
AVC(AVSD) repair, complete CAVSD	16	3	18.8%	0.0%	37.9%	87	0.9
TAPVC repair	11	3	27.3%	1.0%	53.6%	104	1.3
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	11	1	9.1%	0.0%	26.1%	63	1.0
DORV repair, NOS	8	0	0.0%	0.0%	0.0%	rare	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	8	0	0.0%	0.0%	0.0%	39	0.8
Cor triatriatum repair	6	0	0.0%	0.0%	0.0%	60	1.2
DORV, intraventricular tunnel repair	6	1	16.7%	0.0%	46.5%	132	0.9
Truncus arteriosus repair	4	0	0.0%	0.0%	0.0%	134	1.1
Arterial switch operation (ASO) and VSD repair	2	0	0.0%	0.0%	0.0%	138	1.0
Mustard	2	1	50.0%	0.0%	100.0%	100	1.0
Coarctation repair, patch aortoplasty	2	0	0.0%	0.0%	0.0%	22	0.8
Pulmonary artery sling repair	2	0	0.0%	0.0%	0.0%	105	1.3
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	1	0	0.0%	0.0%	0.0%	137	1.3
Valve excision, tricuspid (without replacement)	1	0	0.0%	0.0%	0.0%	13	1.0
RVOT procedure	1	0	0.0%	0.0%	0.0%	40	0.9
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	rare	1.0
Senning	1	1	100.0%	100.0%	100.0%	108	1.2
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	rare	0.8
Shunt, ligation and takedown	1	0	0.0%	0.0%	0.0%	11	0.9
Sternotomy wound drainage	1	0	0.0%	0.0%	0.0%	rare	0.9



Table 18.4  
 Frequency of multiple procedure and mortality risk in preschool children (n=687 missing 7.0%)  
 Mortality category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Anomalous systemic venous connection repair	3	0	0.0%	0.0%	0.0%	54	1.4
Fontan, atrio-ventricular connection	2	0	0.0%	0.0%	0.0%	0	1.5
Arterial switch operation (ASO)	2	1	50.0%	0.0%	100.0%	130	1.3
Aortic arch repair	2	0	0.0%	0.0%	0.0%	82	1.9
Interrupted aortic arch repair	1	0	0.0%	0.0%	0.0%	118	1.7

Additional Information on mortality category risk

Table 18.5  
 Frequency of multiple procedure and mortality risk in preschool children (n=687 missing 7.0%)  
 Mortality category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Norwood procedure	2	2	100.0%	100.0%	100.0%	147	3.4
<b>Total (82 procedures)</b>	<b>687</b>	<b>48</b>	<b>7.0%</b>	<b>5.1%</b>	<b>8.9%</b>		



Table 19.1  
Frequency of multiple procedure and mortality risk in school aged children (n=854 missing 4.7%)  
Mortality category 1

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	175	0	0.0%	0.0%	0.0%	32	0.2
TOF repair, ventriculotomy, transannular patch	88	4	4.5%	0.2%	8.9%	79	0.4
VSD repair, primary closure	45	2	4.4%	0.0%	10.5%	30	0.2
PDA closure, surgical	27	0	0.0%	0.0%	0.0%	5	0.2
ASD, repair, patch	22	0	0.0%	0.0%	0.0%	8	0.1
PAPVC repair	19	0	0.0%	0.0%	0.0%	27	0.2
Valvuloplasty, mitral	17	0	0.0%	0.0%	0.0%	76	0.3
Valvuloplasty, pulmonic	12	0	0.0%	0.0%	0.0%	26	0.4
PFO, primary closure	11	0	0.0%	0.0%	0.0%	6	0.2
ASD, repair, primary closure	10	0	0.0%	0.0%	0.0%	7	0.1
TOF repair, ventriculotomy, nontransannular patch	8	0	0.0%	0.0%	0.0%	62	0.4
Valvuloplasty, tricuspid	8	1	12.5%	0.0%	35.4%	57	0.4
PDA closure, device	7	0	0.0%	0.0%	0.0%	rare	0.2
VSD, multiple, repair	6	0	0.0%	0.0%	0.0%	113	0.3
DCRV repair	5	0	0.0%	0.0%	0.0%	48	0.1
ASD partial closure	4	0	0.0%	0.0%	0.0%	10	0.2
AVC (AVSD) repair, partial (incomplete)(PAVSD)	4	0	0.0%	0.0%	0.0%	31	0.3
Valve surgery, other, tricuspid	4	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), NOS	4	0	0.0%	0.0%	0.0%	rare	0.1
Valve excision, pulmonary (without replacement)	4	0	0.0%	0.0%	0.0%	rare	0.1
Aortic stenosis, subvalvar, repair	4	0	0.0%	0.0%	0.0%	42	0.1
Valve surgery, other, mitral	4	0	0.0%	0.0%	0.0%	76	0.1
ASD repair, NOS	3	0	0.0%	0.0%	0.0%	rare	0.1
VSD repair, NOS	2	0	0.0%	0.0%	0.0%	rare	0.4
AVC (AVSD) repair, intermediated (transitional)	2	0	0.0%	0.0%	0.0%	33	0.1
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	51	0.4
Lung procedure, other	2	0	0.0%	0.0%	0.0%	rare	0.2
Palliation, other	2	1	50.0%	0.0%	100.0%	rare	0.3
Organ procurement	2	0	0.0%	0.0%	0.0%	rare	0.3
PA, reconstruction (plasty), branch, peripheral (at or beyond the hilar bifurcation)	1	0	0.0%	0.0%	0.0%	70	0.3





Procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valve closure, semilunar	1	0	0.0%	0.0%	0.0%	rare	0.2
Aortic stenosis, supraaortic, repair	1	0	0.0%	0.0%	0.0%	64	0.1
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Congenitally corrected TGA repair, VSD closure	1	0	0.0%	0.0%	0.0%	106	0.1
Congenitally corrected TGA repair, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	24	0.3
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	24	0.2
Shunt, systemic to pulmonary, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Esophageal procedure	1	0	0.0%	0.0%	0.0%	rare	0.4

Additional Information on mortality category risk



Table 19.2  
Frequency of multiple procedure and mortality risk in school aged children (n=854 missing 4.7%)  
Mortality category 2

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
TOF repair, non ventriculotomy	54	2	3.7%	0.0%	8.7%	81	0.5
Rastelli	27	3	11.1%	0.0%	23.0%	125	0.7
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	19	1	5.3%	0.0%	15.3%	43	0.4
Pulmonary atresia-VSD (including TOF, PA), repair	14	2	14.3%	0.0%	32.6%	92	0.8
Fontan, TCPC, external conduit, nonfenestrated	11	2	18.2%	0.0%	41.0%	97	0.6
TOF repair, RV-PA conduit	10	1	10.0%	0.0%	28.6%	80	0.6
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	8	1	12.5%	0.0%	35.4%	47	0.8
TOF repair, NOS	7	0	0.0%	0.0%	0.0%	rare	0.5
Unifocalization MAPCA(s)	7	0	0.0%	0.0%	0.0%	116	0.6
Fontan, TCPC, external conduit, NOS	7	1	14.3%	0.0%	40.2%	rare	0.6
TOF, AVC (AVSD), repair	4	0	0.0%	0.0%	0.0%	122	0.7
TOF, absent pulmonary valve, repair	4	0	0.0%	0.0%	0.0%	109	0.7
Valve replacement, pulmonic (PVR)	4	1	25.0%	0.0%	67.4%	44	0.6
Valve replacement, mitral (MVR)	4	1	25.0%	0.0%	67.4%	69	0.7
Pericardectomy	4	1	25.0%	0.0%	67.4%	20	0.6
Mitral stenosis, supra-valvar mitral ring, repair	3	0	0.0%	0.0%	0.0%	74	0.5
Cardiac tumor resection	3	0	0.0%	0.0%	0.0%	88	0.7
Ventricular septal fenestration	2	0	0.0%	0.0%	0.0%	45	0.5
1 1/2 ventricular repair	2	0	0.0%	0.0%	0.0%	58	0.6
Valvuloplasty, aortic	2	0	0.0%	0.0%	0.0%	72	0.5
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	0	0.0%	0.0%	0.0%	41	0.4
Hemifontan	2	1	50.0%	0.0%	100.0%	78	0.5
Cardiotomy, other	2	0	0.0%	0.0%	0.0%	rare	0.5
ASD creation/enlargement	1	0	0.0%	0.0%	0.0%	9	0.5
Atrial septal fenestration	1	0	0.0%	0.0%	0.0%	12	0.8
Pulmonary Venous Stenosis, repair	1	0	0.0%	0.0%	0.0%	117	0.7
Fontan, TCPC, lateral tunnel, NOS	1	0	0.0%	0.0%	0.0%	rare	0.5
Fontan, NOS	1	1	100.0%	100.0%	100.0%	rare	0.5
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	17	0.7



Table 19.3  
Frequency of multiple procedure and mortality risk in school aged children (n=854 missing 4.7%)  
Mortality category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
DORV, intraventricular tunnel repair	22	3	13.6%	0.0%	28.0%	132	0.9
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	21	1	4.8%	0.0%	13.9%	39	0.8
DORV repair, NOS	15	3	20.0%	0.0%	40.2%	rare	0.9
RVOT procedure	13	1	7.7%	0.0%	22.2%	40	0.9
AVC(AVSD) repair, complete CAVSD	11	1	9.1%	0.0%	26.1%	87	0.9
TAPVC repair	7	1	14.3%	0.0%	40.2%	104	1.3
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA) (bilateral bidirectional Glenn)	4	0	0.0%	0.0%	0.0%	63	1.0
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	3	1	33.3%	0.0%	86.7%	137	1.3
PA, reconstruction (plasty), branch, central	3	0	0.0%	0.0%	0.0%	68	1.3
Fontan, TCPC, lateral tunnel, fenestrated	3	1	33.3%	0.0%	86.7%	101	1.1
Truncus arteriosus repair	2	0	0.0%	0.0%	0.0%	134	1.1
Valve replacement, tricuspid (TVR)	2	0	0.0%	0.0%	0.0%	65	1.1
Valve surgery, other pulmonic	2	0	0.0%	0.0%	0.0%	rare	1.0
Valve replacement, aortic (AVR), mechanical	2	1	50.0%	0.0%	100.0%	52	1.1
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	60	1.2
Valve replacement, aortic (AVR)	1	0	0.0%	0.0%	0.0%	0	0.9
Senning	1	0	0.0%	0.0%	0.0%	108	1.2
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	rare	0.8
Pulmonary artery sling repair	1	1	100.0%	100.0%	100.0%	105	1.3
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	2	0.8

Additional Information on mortality category risk



Table 19.4  
Frequency of multiple procedure and mortality risk in school aged children (n=854 missing 4.7%)  
Mortality category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA, reconstruction (plasty), main (trunk)	3	0	0.0%	0.0%	0.0%	25	1.5
Aortic arch repair	3	0	0.0%	0.0%	0.0%	82	1.9
Conduit, placement, RV to PA	2	0	0.0%	0.0%	0.0%	66	1.5
Valve surgery, other, aortic	2	1	50.0%	0.0%	100.0%	rare	1.5
Arterial switch operation (ASO)	2	1	50.0%	0.0%	100.0%	130	1.3
Aortic root replacement	1	0	0.0%	0.0%	0.0%	rare	1.9
Fontan, atrio-ventricular connection	1	1	100.0%	100.0%	100.0%	0	1.5

Table 19.5  
Frequency of multiple procedure and mortality risk in school aged children (n=854 missing 4.7%)  
Mortality category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA debanding	1	0	0.0%	0.0%	0.0%	29	3.7
<b>Total (97 procedures)</b>	<b>854</b>	<b>43</b>	<b>5.0%</b>	<b>3.6%</b>	<b>6.5%</b>		



Table 20.1  
Frequency of multiple procedure and mortality risk in grown-up children (n=275 missing 5.2%)  
Mortality category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	60	2	3.3%	0.0%	7.9%	32	0.2
VSD repair, primary closure	30	0	0.0%	0.0%	0.0%	30	0.2
Valvuloplasty, mitral	12	0	0.0%	0.0%	0.0%	76	0.3
TOF repair, ventriculotomy, transanular patch	10	0	0.0%	0.0%	0.0%	79	0.4
Valvuloplasty, pulmonic	7	0	0.0%	0.0%	0.0%	26	0.4
PDA closure, surgical	7	0	0.0%	0.0%	0.0%	5	0.2
PAPVC repair	5	0	0.0%	0.0%	0.0%	27	0.2
Valvuloplasty, tricuspid	5	0	0.0%	0.0%	0.0%	57	0.4
PFO, primary closure	4	0	0.0%	0.0%	0.0%	6	0.2
ASD, repair, patch	4	0	0.0%	0.0%	0.0%	8	0.1
TOF repair, ventriculotomy, nontransanular patch	4	0	0.0%	0.0%	0.0%	62	0.4
PDA closure, device	4	0	0.0%	0.0%	0.0%	rare	0.2
ASD, repair, primary closure	3	0	0.0%	0.0%	0.0%	7	0.1
ASD partial closure	3	0	0.0%	0.0%	0.0%	10	0.2
AVC (AVSD) repair, partial (incomplete (PAVSD))	3	1	33.3%	0.0%	86.7%	31	0.3
PA, reconstruction (plasty), NOS	3	0	0.0%	0.0%	0.0%	rare	0.1
Occlusion MAPCA(s)	2	0	0.0%	0.0%	0.0%	51	0.4
DCRV repair	2	0	0.0%	0.0%	0.0%	48	0.1
VSD, multiple, repair	1	0	0.0%	0.0%	0.0%	113	0.3
Valve surgery, other, tricuspid	1	0	0.0%	0.0%	0.0%	rare	0.3
Valve replacement, aortic (AVR), bioprosthetic	1	0	0.0%	0.0%	0.0%	55	0.2
Aortic stenosis, subvalvar, repair	1	0	0.0%	0.0%	0.0%	42	0.1
Sinus of valsalva, aneurysm repair	1	0	0.0%	0.0%	0.0%	61	0.1
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	24	0.3
Coarctation repair, end to end, extended	1	0	0.0%	0.0%	0.0%	24	0.2
Palliation, other	1	0	0.0%	0.0%	0.0%	rare	0.3
Pleural drainage procedure	1	0	0.0%	0.0%	0.0%	rare	0.1
VATS (video-assisted thoracoscopic surgery)	1	0	0.0%	0.0%	0.0%	rare	0.2
Thoracotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.2

Additional Information on mortality category risk



Table 20.2  
Frequency of multiple procedure and mortality risk in grown-up children (n=275 missing 5.2%)  
Mortality category 2

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Pulmonary atresia-VSD (including TOF, PA), repair	7	1	14.3%	0.0%	40.2%	92	0.8
Valve replacement, pulmonic (PVR)	5	0	0.0%	0.0%	0.0%	44	0.6
Valve replacement, mitral (MVR)	4	0	0.0%	0.0%	0.0%	69	0.7
Rastelli	4	0	0.0%	0.0%	0.0%	125	0.7
TOF repair, non ventriculotomy	3	0	0.0%	0.0%	0.0%	81	0.5
Unifocalization MAPCA(s)	3	0	0.0%	0.0%	0.0%	116	0.6
Mitral stenosis, supra-valvar mitral ring, repair	3	0	0.0%	0.0%	0.0%	74	0.5
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	3	0	0.0%	0.0%	0.0%	43	0.4
TOF, absent pulmonary valve, repair	2	0	0.0%	0.0%	0.0%	109	0.7
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	36	0.6
Pericardial drainage procedure	2	0	0.0%	0.0%	0.0%	1	0.7
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	2	0	0.0%	0.0%	0.0%	41	0.4
Pulmonary Venous Stenosis, repair	1	0	0.0%	0.0%	0.0%	117	0.7
TOF repair, RV-PA conduit	1	0	0.0%	0.0%	0.0%	80	0.6
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Fontan, atrio-pulmonary connection	1	0	0.0%	0.0%	0.0%	94	0.6
Coronary artery procedure, other	1	0	0.0%	0.0%	0.0%	17	0.7
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	1	1	100.0%	100.0%	100.0%	47	0.8
PA banding (PAB)	1	0	0.0%	0.0%	0.0%	21	0.6
Hemifontan	1	0	0.0%	0.0%	0.0%	78	0.5
Cardiac tumor resection	1	0	0.0%	0.0%	0.0%	88	0.7
Cardiotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.5



Table 20.3  
Frequency of multiple procedure and mortality risk in grown-up children (n=275 missing 5.2%)  
Mortality category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No. with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	6	0	0.0%	0.0%	0.0%	39	0.8
DORV, intraventricular tunnel repair	5	0	0.0%	0.0%	0.0%	132	0.9
DORV repair, NOS	4	0	0.0%	0.0%	0.0%	rare	0.9
RVOT procedure	3	0	0.0%	0.0%	0.0%	40	0.9
Valve surgery, other pulmonic	3	0	0.0%	0.0%	0.0%	rare	1.0
Fontan, TCPC, lateral tunnel, fenestrated	3	0	0.0%	0.0%	0.0%	101	1.1
Truncus arteriosus repair	2	0	0.0%	0.0%	0.0%	134	1.1
TAPVC repair	2	0	0.0%	0.0%	0.0%	104	1.3
Pulmonary atresia-VSD-MAPCA (pseudotruncus), repair	2	1	50.0%	0.0%	100.0%	137	1.3
Valve replacement, aortic (AVR) mechanical	2	0	0.0%	0.0%	0.0%	52	1.1
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	60	1.2
Valve replacement, tricuspid (TVR)	1	0	0.0%	0.0%	0.0%	65	1.1
PA, reconstruction (plasty), branch, central	1	1	100.0%	100.0%	100.0%	68	1.3
Valve replacement, aortic (AVR)	1	0	0.0%	0.0%	0.0%	0	0.9
Mustard	1	0	0.0%	0.0%	0.0%	100	1.0
TGA, other procedures (Nikaidoh, Kawashima, LV-PA conduit, other)	1	0	0.0%	0.0%	0.0%	rare	0.8
Coarctation repair, patch aortoplasty	1	0	0.0%	0.0%	0.0%	22	0.8
Sternotomy wound drainage	1	0	0.0%	0.0%	0.0%	rare	0.9

Additional Information on mortality category risk



Table 20.4  
Frequency of multiple procedure and mortality risk in grown-up children (n=275 missing 5.2%)  
Mortality category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Valve surgery, other, aortic	2	1	50.0%	0.0%	100.0%	rare	1.5
Anomalous systemic venous connection repair	1	0	0.0%	0.0%	0.0%	54	1.4
PA, reconstruction (plasty), main (trunk)	1	0	0.0%	0.0%	0.0%	25	1.5
Conduit, placement, RV to PA	1	0	0.0%	0.0%	0.0%	66	1.5

Additional information on mortality category risk

Table 20.5  
Frequency of multiple procedure and mortality risk in grown-up children (n=275 missing 5.2%)  
Mortality category 5

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
PA debanding	1	0	0.0%	0.0%	0.0%	29	3.7
<b>Total (74 procedures)</b>	<b>275</b>	<b>8</b>	<b>2.9%</b>	<b>0.9%</b>	<b>4.9%</b>		





Table 21.1  
Frequency of multiple procedure and mortality risk in adult (n=604 missing 2.6%)  
Mortality category 1

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
VSD repair, patch	124	5	4.0%	0.6%	7.5%	32	0.2
Valvuloplasty, tricuspid	60	1	1.7%	0.0%	4.9%	57	0.4
ASD, repair, patch	52	3	5.8%	0.0%	12.1%	8	0.1
VSD repair, primary closure	37	0	0.0%	0.0%	0.0%	30	0.2
Valvuloplasty, mitral	25	0	0.0%	0.0%	0.0%	76	0.3
TOF repair, ventriculotomy, transanular patch	19	0	0.0%	0.0%	0.0%	79	0.4
Valve surgery, other, tricuspid	19	0	0.0%	0.0%	0.0%	rare	0.3
Valvuloplasty, pulmonic	19	0	0.0%	0.0%	0.0%	26	0.4
ASD, repair, primary closure	18	0	0.0%	0.0%	0.0%	7	0.1
PAPVC repair	14	0	0.0%	0.0%	0.0%	27	0.2
PDA closure, surgical	14	0	0.0%	0.0%	0.0%	5	0.2
ASD partial closure	11	0	0.0%	0.0%	0.0%	10	0.2
PFO, primary closure	9	0	0.0%	0.0%	0.0%	6	0.2
AVC (AVSD) repair, partial (incomplete) (PAVSD)	8	0	0.0%	0.0%	0.0%	31	0.3
TOF repair, ventriculotomy, nontransanular patch	7	1	14.3%	0.0%	40.2%	62	0.4
Sinus of Valsalva, aneurysm repair	7	0	0.0%	0.0%	0.0%	61	0.1
VATS (video-assisted thoracoscopic surgery)	7	0	0.0%	0.0%	0.0%	rare	0.2
Valve surgery, other, mitral	6	0	0.0%	0.0%	0.0%	76	0.1
VSD, multiple, repair	4	0	0.0%	0.0%	0.0%	113	0.3
PDA closure, device	4	0	0.0%	0.0%	0.0%	rare	0.2
DCRV repair	3	0	0.0%	0.0%	0.0%	48	0.1
Coronary artery fistula ligation	3	0	0.0%	0.0%	0.0%	17	0.1
ASD, repair, device	2	0	0.0%	0.0%	0.0%	rare	0.2
Valve excision, pulmonary (without replacement)	2	0	0.0%	0.0%	0.0%	rare	0.1
Valve replacement, aortic (AVR), bioprosthetic	2	0	0.0%	0.0%	0.0%	55	0.2
ASD repair, NOS	1	0	0.0%	0.0%	0.0%	rare	0.1
AVC (AVSD) repair, intermediated (transitional)	1	0	0.0%	0.0%	0.0%	33	0.1
PAPVC, scimitar, repair	1	0	0.0%	0.0%	0.0%	91	0.2
PA, reconstruction (plasty), NOS	1	0	0.0%	0.0%	0.0%	rare	0.1
Fontan, other	1	0	0.0%	0.0%	0.0%	rare	0.1
Coarctation repair, end to end	1	0	0.0%	0.0%	0.0%	24	0.3
PDA closure, NOS	1	0	0.0%	0.0%	0.0%	rare	0.1
Lung procedure, other	1	0	0.0%	0.0%	0.0%	rare	0.2
Organ procurement	1	0	0.0%	0.0%	0.0%	rare	0.3

Additional Information on mortality category risk



Table 21.2  
Frequency of multiple procedure and mortality risk in adult (n=604 missing 2.6%)  
Mortality category 2

Additional information on mortality category risk

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Mitral stenosis, supra-valvar mitral ring, repair	9	0	0.0%	0.0%	0.0%	74	0.5
Valve replacement, mitral (MVR)	8	1	12.5%	0.0%	35.4%	69	0.7
Valve replacement, pulmonic (PVR)	7	0	0.0%	0.0%	0.0%	44	0.6
ASD creation/enlargement	6	0	0.0%	0.0%	0.0%	9	0.5
Pulmonary Venous Stenosis, repair	6	0	0.0%	0.0%	0.0%	117	0.7
TOF repair, NOS	5	0	0.0%	0.0%	0.0%	rare	0.5
Pulmonary atresia-VSD (including TOF, PA), repair	5	0	0.0%	0.0%	0.0%	92	0.8
Ventricular septal fenestration	4	0	0.0%	0.0%	0.0%	45	0.5
Arrhythmia surgery-atrial, surgical ablation	4	0	0.0%	0.0%	0.0%	84	0.6
Fontan, TCPC, external conduit, nonfenestrated	3	0	0.0%	0.0%	0.0%	97	0.6
TOF repair, non ventriculotomy	2	0	0.0%	0.0%	0.0%	81	0.5
TOF, AVC (AVSD), repair	2	0	0.0%	0.0%	0.0%	122	0.7
TOF, absent pulmonary valve, repair	2	0	0.0%	0.0%	0.0%	109	0.7
Unifocalization MAPCA(s)	2	1	50.0%	0.0%	100.0%	116	0.6
Valve closure, tricuspid (exclusion, univentricular approach)	2	0	0.0%	0.0%	0.0%	36	0.6
Fontan, atrio-pulmonary connection	2	0	0.0%	0.0%	0.0%	94	0.6
Rastelli	2	0	0.0%	0.0%	0.0%	125	0.7
Cardiac tumor resection	2	0	0.0%	0.0%	0.0%	88	0.7
Valvuloplasty, aortic	1	0	0.0%	0.0%	0.0%	72	0.5
Other annular enlargement procedure	1	0	0.0%	0.0%	0.0%	142	0.5
Pericardectomy	1	0	0.0%	0.0%	0.0%	20	0.6
Fontan, TCPC, external conduit, NOS	1	0	0.0%	0.0%	0.0%	rare	0.6
PA banding (PAB)	1	0	0.0%	0.0%	0.0%	21	0.6
Bidirectional cavopulmonary anastomosis (BDCPA)(bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	43	0.4
Glenn (unidirectional cavopulmonary anastomosis)(unidirectional Glenn)	1	0	0.0%	0.0%	0.0%	41	0.4
Ligation, pulmonary artery	1	1	100.0%	100.0%	100.0%	rare	0.4
Cardiotomy, other	1	0	0.0%	0.0%	0.0%	rare	0.5



Table 21.3  
Frequency of multiple procedure and mortality risk in adult (n=604 missing 2.6%)  
Mortality category 3

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
RVOT procedure	8	0	0.0%	0.0%	0.0%	40	0.9
DORV, intraventricular tunnel repair	4	1	25.0%	0.0%	67.4%	132	0.9
AVC(AVSD) repair, complete CAVSD	3	0	0.0%	0.0%	0.0%	87	0.9
Valve replacement, tricuspid (TVR)	3	0	0.0%	0.0%	0.0%	65	1.1
Valve excision, tricuspid (without replacement)	3	0	0.0%	0.0%	0.0%	13	1.0
DORV repair, NOS	3	1	33.3%	0.0%	86.7%	rare	0.9
TAPVC repair	2	0	0.0%	0.0%	0.0%	104	1.3
Valve replacement, aortic (AVR), mechanical	2	0	0.0%	0.0%	0.0%	52	1.1
Cor triatriatum repair	1	0	0.0%	0.0%	0.0%	60	1.2
Valve surgery, other pulmonic	1	0	0.0%	0.0%	0.0%	rare	1.0
Pacemaker implantation, permanent	1	0	0.0%	0.0%	0.0%	2	0.8
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt	1	0	0.0%	0.0%	0.0%	39	0.8
Bilateral bidirectional cavopulmonary anastomosis (BBDCPA)(bilateral bidirectional Glenn)	1	0	0.0%	0.0%	0.0%	63	1.0
Aneurysm, pulmonary artery, repair	1	0	0.0%	0.0%	0.0%	53	1.2

Additional Information on mortality category risk

Table 21.4  
Frequency of multiple procedure and mortality risk in adult (n=604 missing 2.6%)  
Mortality category 4

1 <sup>st</sup> procedure name	No. of operations		Observed Mortality risk			Procedure risk	
	All operations	No.with Mortality	%	95% CI		Difficulty ranking	Mortality score
				Lower	Upper		
Anomalous systemic venous connection repair	3	0	0.0%	0.0%	0.0%	54	1.4
<b>Total (76 procedures)</b>	<b>604</b>	<b>15</b>	<b>2.5%</b>	<b>1.2%</b>	<b>3.7%</b>		





## Abbreviation

List of Abbreviation	Meaning
AICD	Automatic implantable cardioverter defibrillator
ALCAPA	Anomalous left coronary artery from pulmonary artery
AP window	Aortopulmonary window
ASD	Atrial septal defect
AV	Aortic valve
AV fistula	Arteriovenous fistula
AVR	Aortic valve replacement
BMI	Body mass index
AVC	Atrioventricular canal
AVSD	Atrioventricular septal defect
BBDCPA	Bilateral bidirectional cavopulmonary anastomosis
BDCPA	Bidirectional cavopulmonary anastomosis
CAVSD	Complete atrioventricular septal defect
CCS	Canadian cardiovascular society
CI	Confidence interval
CPB	Cardiopulmonary bypass
CPS	Cardiopulmonary support
CS	Civil servant
CTD	Connective tissue disorder
DCRV	Double chamber right ventricle
DILV	Double inlet left ventricle
DIRV	Double inlet right ventricle
DM	Diabetes mellitus
DORV	Double outlet right ventricle
DOLV	Double outlet left ventricle
EACTS	European Association for Cardio-Thoracic Surgery
ECMO	Extracorporeal membrane oxygenation
EF	Ejection fraction
GI	Gastrointestinal
HLHS	Hypoplastic left heart syndrome
IABP	Intra-aortic balloon pump
ICD	Implantable cardioverter defibrillator
IQR	Interquartile range
IV	Intravenous
IVS	Intact ventricular septum
LV	Left ventricle



LVEF	Left ventricular ejection fraction
LVOTO	Left ventricular outflow tract obstruction
MAPCA	Major aortopulmonary collateral artery (arteriole)
MBTS	Modified Blalock-Taussig shunt
MI	Myocardial infarction
MV	Mitral valve
MVR	Mitral valve replacement
NA	Not available
NHSO	National Health Security Office
NOS	Not otherwise specified
NYHA	New York Heart Association
O:E ratio	Observed to expected ratio
PA	Pulmonary artery
	Pulmonary atresia
PAB	Pulmonary artery banding
PAPVC	Partial anomalous pulmonary venous connection
PAVSD	Partial form atrioventricular septal defect
PDA	Patent ductus arteriosus
PFO	Patent foramen ovale
PI	Private insurance
PLOS	Postoperative length of stay
ROC	Receiver operating characteristic
RV	Right ventricle
SCTS	Society for Cardiothoracic Surgery in Great Britain & Ireland
SD	Standard deviation
SE	Standard error
SP	Self payment
SS	Social security
STS	The Society of Thoracic Surgeons
STST	The Society of Thoracic Surgeons of Thailand
TA	Tricuspid atresia
TCPC	Total cavopulmonary connection
TGA	Transposition of great arteries
TV	Tricuspid valve
TVR	Tricuspid valve replacement
VAD	Ventricular assist device
VSD	Ventricular septal defect
UHC	Universal health coverage



## Definition

### Age group

Newborn	0 - 30 days
Infant	31 - 365 days
Preschool/small children	> 1 - 3 years
School age	> 3 - 10 years
Grown-up	> 10 - 15 years
Adult	> 15 years







### In-hospital mortality and age group of each hospital

Hospital Code	Newborn			Infant			Preschool		
	No.	Mortality	95%CI	No.	Mortality	95%CI	No.	Mortality	95%CI
A	91	16.5%	9.5-25.7	164	9.1%	5.2-14.6	117	5.1%	1.9-10.8
B	71	23.9%	14.6-35.5	155	7.7%	4.1-13.1	123	5.7%	2.3-11.4
C	111	29.7%	21.4-39.1	315	10.5%	7.3-14.4	430	3.0%	1.6-5.1
D	21	23.8%	8.2-47.2	128	13.3%	7.9-20.4	159	3.8%	1.4-8.0
E	24	37.5%	18.8-59.4	75	18.7%	10.6-29.3	100	11.0%	5.6-18.8
F	94	11.7%	6.0-20.0	354	7.6%	5.1-10.9	346	1.7%	0.6-3.7
G	51	33.3%	20.8-47.9	244	9.0%	5.7-13.3	310	3.2%	1.6-5.9
H	21	19.0%	5.4-41.9	83	20.5%	12.4-30.8	86	4.7%	1.3-11.5
I	173	24.9%	18.6-32.0	635	15.4%	12.7-18.5	425	6.1%	4.0-8.8
J	3	0.0%		27	0.0%		40	7.5%	1.6-20.4
K	7	14.3%	0.3-57.9	20	25.0%	8.7-49.1	7	0.0%	
L	20	25.0%	8.7-49.1	39	12.8%	4.3-27.4	28	21.4%	8.3-41.0
M	10	10.0%	0.3-44.5	54	3.7%	0.5-12.7	95	0.0%	
N	3	33.3%	0.8-90.6	9	0.0%		33	6.1%	0.07-20.2
O							1	100.0%	
P				1	0.0%		1	0.0%	
Q				1	100.0%		6	16.7%	0.4-64.1
R							6	0.0%	
S	1	0.0%		19	5.3%	0.1-26.0	2	0.0%	
T							10	20.0%	2.5-55.6
U				18	0.0%		9	0.0%	
V									
W				1	0.0%				
X									
Y				1	0.0%		3	0.0%	
Z				3	66.7%	9.4-99.2	4	0.0%	

In-hospital mortality and age group of each hospital



### In-hospital mortality and age group of each hospital

In-hospital mortality and age group of each hospital

Hospital Code	School age			Grown up			Adult		
	No.	Mortality	95%CI	No.	Mortality	95%CI	No.	Mortality	95%CI
A	137	4.4%	1.6-9.3	33	3.0%	0.07-15.8	39	2.6%	0.07-13.5
B	134	6.0%	2.6-11.4	43	4.7%	0.6-15.8	45	8.9%	2.5-21.2
C	539	2.2%	1.2-3.9	130	1.5%	0.2-5.4	511	1.0%	0.3-2.3
D	270	4.4%	2.3-7.6	121	4.1%	1.4-9.4	301	2.7%	1.2-5.2
E	157	4.5%	1.8-9.0	71	1.4%	0.04-7.6	136	2.2%	0.5-6.3
F	439	2.1%	0.9-3.9	134	0.7%	0.01-4.1	319	1.9%	0.7-4.0
G	324	2.5%	1.1-4.9	144	0.7%	0.02-3.8	452	0.7%	0.1-1.9
H	210	5.2%	2.6-9.2	68	1.5%	0.04-7.9	48	4.2%	0.5-14.3
I	471	3.8%	2.3-6.0	164	4.9%	2.1-9.4	15	0.0%	
J	130	3.8%	1.3-8.7	54	0.0%		275	2.5%	1.0-5.2
K	10	0.0%		11	9.1%	0.02-4.1	52	3.8%	0.5-13.2
L	60	11.7%	4.8-22.6	24	0.0%		98	3.1%	0.6-0.9
M	107	0.9%	0.02-5.1	33	0.0%		75	1.3%	0.03-7.2
N	121	5.8%	2.4-11.6	52	1.9%	0.05-10.3	177	1.7%	0.4-4.9
O							120	0.0%	
P	33	0.0%		20	0.0%		115	0.0%	
Q	2	0.0%		3	0.0%				
R	23	0.0%		9	0.0%				
S							43	0.0%	
T	21	9.5%	1.2-30.3	5	0.0%		8	0.0%	
U	8	0.0%		4	0.0%		2	0.0%	
V							4	0.0%	
W							11	0.0%	
X							1	0.0%	
Y	3	0.0%		1	0.0%		13	0.0%	
Z				1	0.0%		2	0.0%	



**Workload, in-hospital mortality and mortality category risks**

Hospital Code	Category 1		Category 2		Category 3		Category 4		Category 5		Total	
	Number Workload	Mortality	Number Workload	Mortality	Number Workload	Mortality	Number Workload	Mortality	Number Workload	Mortality	Number Workload	Mortality
A	182		200		84		96		14		576	
	31.6%	1.6%	34.7%	5.5%	14.6%	6.0%	16.7%	17.7%	2.4%	57.1%	100%	7.6%
B	289		140		62		74		6		571	
	50.6%	1.7%	24.5%	6.4%	10.9%	17.7%	13.0%	25.7%	1.1%	100.0%	100%	8.8%
C	1317		509		137		67		2		2032	
	64.8%	0.9%	25.0%	6.9%	6.7%	19.0%	3.3%	32.8%	0.1%	100.0%	100%	4.8%
D	512		288		128		68		4		1000	
	51.2%	1.4%	28.8%	4.5%	12.8%	10.9%	6.8%	22.1%	0.4%	100.0%	100%	5.3%
E	386		98		46		24		2		556	
	69.4%	2.6%	17.6%	8.2%	8.3%	26.1%	4.3%	50.0%	0.4%	50.0%	100%	7.7%
F	810		523		216		101		9		1659	
	48.8%	0.7%	31.5%	3.6%	13.0%	6.9%	6.1%	12.9%	0.5%	44.4%	100%	3.4%
G	1186		234		54		42		1		1517	
	78.2%	1.6%	15.4%	8.5%	3.6%	16.7%	2.8%	31.0%	0.1%	0.0%	100%	4.0%
H	311		144		41		17				513	
	60.6%	3.2%	28.1%	11.8%	8.0%	14.6%	3.3%	23.5%			100%	7.2%
I	955		590		212		103		24		1884	
	50.7%	3.7%	31.3%	8.6%	11.3%	25.0%	5.5%	36.9%	1.3%	66.7%	100%	10.2%
J	451		67		4		5				527	
	85.6%	0.9%	12.7%	13.4%	0.8%	0.0%	0.9%	20.0%			100%	2.7%
K	95		12								107	
	88.8%	6.3%	11.2%	25.0%							100%	8.4%
L	170		57		32		7		2		268	
	63.4%	0.6%	21.3%	22.8%	11.9%	25.0%	2.6%	28.6%	0.7%	100.0%	100%	9.7%
M	281		70		18		4		1		374	
	75.1%	0.4%	18.7%	1.4%	4.8%	5.6%	1.1%	25.0%	0.3%	100.0%	100%	1.3%
N	314		29		11		6				360	
	87.2%	1.3%	8.1%	13.8%	3.1%	36.4%	1.7%	16.7%			100%	3.6%
O	110		10		1						121	
	90.9%	0.0%	8.3%	10.0%	0.8%	0.0%					100%	0.8%
P	168		1				1				170	
	98.8%	0.0%	0.6%	0.0%			0.6%	0.0%			100%	0.0%
Q	7		4				1				12	
	58.3%	0%	33.3%	25.0%			8.3%	100.0%			100%	16.7%
R	21		15		2						38	
	55.3%	0%	39.5%	0.0%	5.3%	0.0%					100%	0.0%
S	63		1								64	
	98.4%	1.6%	1.6%	0.0%							100%	1.6%
T	37		5		2						44	
	84.1%	5.4%	11.4%	40.0%	4.5%	0.0%					100%	9.1%
U	15		15		10		1				41	
	36.6%	0.0%	36.6%	0.0%	24.4%	0.0%	2.4%	0.0%			100%	0.0%
V	3		1								4	
	75.0%	0.0%	25.0%	0.0%							100%	0.0%
W	12										12	
	100.0%	0.0%									100%	0.0%
X	1										1	
	100.0%	0.0%									100%	0.0%
Y	20				1						21	
	95.2%	0.0%			4.8%	0.0%					100%	0.0%
Z	10										10	
	100.0%	20.0%									100%	20.0%

Workload, In-hospital mortality and mortality category risks

