Canadian Agency for Drugs and Technologies in Health

RAPID RESPONSE REPORT:
SUMMARY WITH CRITICAL APPRAISAL

TITLE: Bariatric Surgical Procedures for Obese and Morbidly Obese Patients: A Review of Comparative Clinical and Cost-Effectiveness, and Guidelines

DATE: 24 April 2014

CONTEXT AND POLICY ISSUES

Obesity is defined as a body mass index (BMI) of ≥ 30 kg/m^2, and is further classified into class I (BMI 30.0 to 34.9 kg/m^2), class II (BMI 35.0 to 39.9 kg/m^2), and class III obesity (BMI ≥ 40.0 kg/m^2), with an increase in morbidity associated with increasing class of obesity.[1] As of 2011, 18.3% of adult Canadians were obese, which represented a 200% increase from 1985.[2] Among the 18.3%, 71.6% were categorized as having class I obesity, 19.7% had class II obesity, and 8.7% had class III obesity.[2]

Obesity is associated with considerable morbidity, including hypertension, dyslipidemia, type 2 diabetes, cardiovascular disease, cancer, and osteoarthritis.[3] Not surprisingly, the increased prevalence of comorbidities associated with obesity result in a reduction in life expectancy in those who are obese compared to individuals with a BMI of 18.5 to 24.9 kg/m^2.[3]

Bariatric surgery has been proven to be more effective than other measures such as medications and lifestyle interventions for weight loss.[4] There are a number of bariatric surgical procedures currently available, and the most commonly performed procedures are Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), and laparoscopic adjustable gastric banding (LAGB).[5] RYGB involves restricting the size of the stomach to create a much smaller gastric pouch, and attaching the pouch to the mid-jejunum, resulting in malabsorption of food.[6] SG involves removing the greater fundus and curvature of the stomach, creating a much smaller tube-like stomach, thereby restricting food intake.[6] LAGB uses a band that is encircled around the top of the stomach.[6] The band is connected to a subcutaneous port that can be used to inflate the band, increasing the restriction on the stomach.[6] Each procedure is associated with benefits and risks; therefore, the purpose of this review is to compare the clinical effectiveness, safety, and cost-effectiveness of the RYGB, SG, and LAGB procedures amongst one another in obese and morbidly obese patients. This report builds on a Rapid Response report completed in August 2013, which focused on the evidence for prioritizing patients for bariatric surgery.[7]

Disclaimer: The Rapid Response Service is an information service for those involved in planning and providing health care in Canada. Rapid responses are based on a limited literature search and are not comprehensive, systematic reviews. The intent is to provide a list of sources and a summary of the best evidence on the topic that CADTH could identify using all reasonable efforts within the time allowed. Rapid responses should be considered along with other types of information and health care considerations. The information included in this response is not intended to replace professional medical advice, nor should it be construed as a recommendation for or against the use of a particular health technology. Readers are also cautioned that a lack of good quality evidence does not necessarily mean a lack of effectiveness particularly in the case of new and emerging health technologies, for which little information can be found, but which may in future prove to be effective. While CADTH has taken care in the preparation of the report to ensure that its contents are accurate, complete and up to date, CADTH does not make any guarantee to that effect. CADTH is not liable for any loss or damages resulting from use of the information in the report.

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RESEARCH QUESTIONS

1. What is the comparative clinical effectiveness and safety of roux-en-y gastric bypass (RYGB), sleeve gastrectomy (SG), and laparoscopic adjustable gastric band (LAGB) for obese and morbidly obese patients?

2. What is the comparative cost-effectiveness of specific bariatric surgical interventions (RYGB, SG, and LAGB) for obese and morbidly obese patients?

3. What are the evidence-based guidelines regarding selection of a specific bariatric surgical intervention (RYGB, SG, and LAGB) for obese and morbidly obese patients?

KEY FINDINGS

Results consistently demonstrated that roux-en-y gastric bypass (RYGB) was associated with a greater weight reduction relative to laparoscopic adjustable gastric band (LAGB), but was also associated with a higher risk for procedural adverse events. sleeve gastrectomy (SG) appeared to be more effective than LAGB but less effective than RYGB for weight loss, and had a reduced risk for complications relative to RYGB and a higher risk for complications relative to LABG, but evidence was conflicting. Incremental cost-effectiveness ratios (ICERs) for RYGB and LAGB were reported in two cost studies, with RYGB dominating LAGB in one analysis, thought he generalizability of these findings to a Canadian context is unclear. No guidelines recommending specific surgical procedures were identified.

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2014, Issue3), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. Methodological filters were applied to limit retrieval to systematic reviews, randomized controlled trials and economic studies for questions 1 and 2. The guideline filter was applied to limit retrieval to guidelines question 3. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2009 and March 25, 2014.

Selection Criteria and Methods

One reviewer screened the titles and abstracts of the retrieved publications for relevancy, and evaluated the relevant full-text publications for the final article selection based on the criteria listed in Table 1.

Table 1: Selection Criteria

Population	Obese or morbidly obese patients
Intervention	Roux-en-y gastric bypass (RYGB), sleeve gastrectomy (SG), or laparoscopic adjustable gastric bad (LAGB)
Comparator	All questions: any of the three intervention procedures compared against each other

Outcomes	Question 1: weight loss, quality of life improvement, adverse events, reduction of obesity-related comorbidities Question 2: cost-effectiveness Question 3: guidelines specifying which procedure is recommended in general, for specific patients, or under specific circumstances
Study Designs	Health technology assessments, systematic review, meta-analyses, randomized controlled trials, economic analyses, and guidelines

Exclusion Criteria

Studies were excluded if they did not meet the selection criteria, if they were duplicate publications or included in a selected systematic review or meta-analysis, or were published prior to January 1, 2009.

Critical Appraisal of Individual Studies

Systematic reviews (SRs) and meta-analyses (MAs) were critically appraised using the AMSTAR instrument.[8] Randomized controlled trials (RCTs) were appraised using the Downs and Black checklist[9] and economic analyses were appraised using Drummond's Checklist.[10] The health technology assessment (HTA) was critically appraised using a combination of the AMSTAR instrument for the SR component.[8] Numeric scores were not calculated; instead, important methodological aspects of each study relating to validity of the study results were summarized.

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 438 publications were indentified in the initial literature search. After review of the titles, 47 articles were selected for full text review. A total of 21 relevant articles were identified in the grey literature search; as a result, 68 articles were assessed for inclusion in this report.

A total of 21 studies met the inclusion criteria for this review. There was one HTA,[11] ten MAs,[12-21] three SRs,[22-24] and five RCTs[25-29] included that addressed question 1. In terms of question 2, there were three studies included (the one HTA also included in question 1, and two additional economic analyses).[11,30,31] There were no guidelines identified that recommended a particular bariatric surgery technique over another. As a result, this review was unable to address question 3.

Appendix 1 provides the PRISMA flowchart for study selection in this report.

Summary of Study Characteristics

Details on clinical and safety study characteristics, economic study characteristics, critical appraisal, and study findings are located in Appendices 2 through 5, respectively.

Study Design

Among the studies included, there was one HTA,[11] ten MAs,[12-16,18-21,32] three SRs,[22-24] five RCTs,[25-29] and two economic analyses.[30,31] The number of included studies in the HTAs, MAs, and SRs ranged from 5 to 164, and the publication dates of the included studies was 1986 to 2013.[11-24] It must be noted that many of the studies reviewed in the HTA, MA, and SR overlapped, particularly some RCTs.[11-24] Of note, while the HTA included a SR assessing effectiveness of bariatric procedures, a SR evaluating the economic literature, and an economic analysis, the economic analysis was not applicable to this Rapid Report because it did not evaluate the costs associated with the different types of bariatric procedures, and instead combined costs.[11]

Country of Origin

The countries of origin included Canada,[11,22] China,[14-16,18,32] Finland,[25] France,[26] Israel,[28] Italy,[23,27] New Zealand,[19] South Korea,[12,13] Switzerland,[29] United Kingdom,[20,24] and the United States,[12,13,21] The economic analyses were from Portugal and the United States.[30,31]

Patient Population

The patient populations were adults with obesity, based on BMI, for all studies.[11-31] A number of studies used the definition of a BMI > 40 kg/m^2 or a BMI of > 35 kg/m^2 plus the presence of comorbidities (for example, cardiovascular disease, type 2 diabetes, or obstructive sleep apnea).[15,24,25,27-29] Two studies focused on people with obesity and type 2 diabetes,[21,28] and one study evaluated individuals 55 years of age and older.[20] Most studies reported a greater proportion of women than men, and baseline BMI ranged from 30.3 to 79.9 kg/m^2.[11-31]

Interventions and Comparators

Three types of bariatric surgeries were evaluated in this analysis: RYGB, LAGB, and SG. In terms of the number of studies evaluating each type of bariatric procedure, 17 evaluated RYGB,[11,13-16,18-21,23-29,33] 10 evaluated LAGB,[11,12,20,21,23,24,27,28,32,33] and 16 evaluated SG.[11-16,18,19,23-26,28,29,32,33] A total of five studies compared all three procedures,[11,12,22-24] ten studies compared RYGB and SG,[13-16,18,19,25,26,28,29] five studies compared RYGB and LAGB,[20,21,27,30,31] and one study compared SG to LAGB.[32]

Clinical Outcomes

In terms of clinical outcomes, all studies evaluated weight loss in some form, either by percent excess weight loss, reduction in BMI, reduction in weight, or percent excess BMI reduction, except one study that only looked at risk for anemia, iron deficiency, and vitamin B12 deficiency.[13] Percent excess weight loss is calculated by determining excess body weight (subtracting ideal body weight from total body weight at the time of surgery) and total weight loss after surgery, and dividing total weight loss by excess body weight. Other clinical outcomes evaluated included length of operation, length of hospital stay, complications associated with the procedure, need for reoperation, improvement and/or resolution in obesity-related complications, quality of life, and changes in nutrient levels.

Economic Outcomes

The economic analyses each used both cost-effectiveness analysis and cost-utility analysis to for comparing RYGB to LAGB.[30,31] The perspective of one of the analyses was the health care system, and the other was the societal perspective.[30,31] The economic analyses did not specify the assumptions for their analyses.[30,31] Both manuscripts conducted sensitivity analyses to test the robustness of their findings. Wang and colleagues used three different BMI trajectories, including having the BMI approach the same trajectory as a non-surgical patient five years after the surgery was completed, having BMI remain stable five years after the surgery was completed, and regaining 100% of the weight lost in the first 5 years of surgery, up to 15 years post-surgery.[30] They also varied BMI at baseline, age at baseline, sex, early complication rate, discount rate, and early mortality rate to conduct further sensitivity analyses.[30] Faria and colleagues conducted sensitivity analyses by varying BMI, age, and presence or absence of comorbidities at the time of surgery.[31] Lastly, one HTA included a systematic review on available studies assessing cost-effectiveness of RYGB, SG, and LAGB.[11]

Summary of Critical Appraisal

There was one HTA that included an effectiveness SR and an economic SR, 11 MAs, and 3 SRs that evaluated clinical and safety endpoints. In general, these manuscripts were found to be of moderate quality. A few studies had inadequate search strategies (for example, only searching two databases for relevant literature) to identify all relevant literature.[13,15,19-21,32] In addition, only two studies provided a list of excluded studies and the reason for exclusion.[11,24] Many studies reported using duplicate study selection.[12-14,16,21,22,24] Fewer studies reported duplicate data extraction.[12,18,21,22,24] Most studies reported assessing quality of the included studies, and all included MAs reported the statistical methods for combining study results to produce an overall effect size. However, three of the studies did not report the amount of heterogeneity associated with combining studies in their MAs.[12,19,20] Lastly, possibility of publication bias was assessed in seven of the 15 manuscripts, and authors concluded that it was unlikely that publication bias was present in their reviews.[14,15,18-21,32]

There were five RCTs that compared one form of bariatric surgery to another included in this report.[25-29] In general, the studies were of moderate quality. None of the studies were blinded, which would be expected for individuals undergoing the procedure and surgeons conducting the surgery, however, none of the studies had blinded outcome assessors or analysts.[25-29] Losses to follow up were reported in all of the studies, and some losses were substantial, particularly in the study conducted by Peterli and colleagues at three years follow-up.[25-29] The losses to follow up did not appear to differ between surgical groups, however.[25-29] Four of the studies did not use intention-to-treat analysis, thereby excluding losses to follow up from the study analyses.[25-27,29] The process of randomization was not documented in three of the studies.[25-27]

Two economic analyses compared cost-effectiveness and cost-utility of RYGB and LAGB.[30,31] The quality of each of these analyses was poor. While both studies had a clear objective and stated that costs were discounted at 3% per year, neither study reported assumptions of the analyses, and the only evaluated direct costs associated with each procedure.[30,31] In addition, the studies did not clearly state what items or costs associated with these items were included in the direct costs, therefore it was not possible to assess generalizability of costs included in each model.[30,31] Faria and colleagues stated that they used a societal perspective "of universal coverage for health care" to conduct their economic analyses, however, they do not specify what costs were included, and did not include indirect costs associated with bariatric procedures.[31]

Summary of Findings

What is the comparative clinical effectiveness and safety of specific bariatric surgical interventions (roux-en-y gastric bypass, sleeve gastrectomy, and laparoscopic adjustable gastric band) for obese and morbidly obese patients?

RYGB versus LAGB

Among the studies that compared RYGB with LAGB, it was consistently noted that RYGB was associated with a statistically significantly greater reduction in weight (measured by percent excess weight loss, percent excess BMI loss, reduction in BMI, or reduction in weight in kilograms) and improvement or resolution of obesity-related comorbidities including type 2 diabetes, dyslipidemia, obstructive sleep apnea, and hypertension.[11,12,20-24,27] In addition, reoperation was necessary in more people who received LAGB compared to those who received RYGB.[12,27] However, duration of surgery, risk for complications related to the procedure, and length of hospital stay were consistently higher in people who underwent RYGB compared to those who underwent LAGB.[11,12,23,24,27]

RYGB versus SG

A total of fourteen studies compared RYGB with SG.[11,13-16,18,19,22-26,28,29] Among these studies, most found that SG was less effective than RYGB for weight outcomes and improvement in obesity-related comorbidities, but were also less likely to have procedural complications relative to RYGB.[12,14-16,18,22-24,29] The only available studies assessing risk of nutrient deficiency were done in studies comparing RYGB to SG. In a study conducted by Kwon and colleagues, RYGB was associated with vitamin B12 deficiency compared to SG (odds ratio [OR]: 3.55; 95% confidence interval [CI]: 1.26 to 10.01).[13] Also, Vix and colleagues evaluated vitamin D and parathyroid hormones in people randomized to RYGB or SG, and found that RYGB was associated with significantly lower vitamin D and parathyroid hormone levels up to 12 months after surgery compared with SG.[26] These studies suggest a greater risk for nutrient deficiencies in patients who undergo RYGB compared to those who undergo SG. The need for reoperation was lower for SG compared with RYGB in four studies,.[12,14,18,23] but was not significantly different in two studies.[16,29]

LAGB versus SG

There were six studies that compared LAGB to SG.[11,12,22-24,32] The HTA from the Institute of Health Economics noted that clinical evidence was limited for SG, and did not make any direct comparisons with LAGB.[11] SG was associated with a greater reduction in BMI at 1 and 5 years relative to LAGB in a MA of RCTs and observational studies.[12] SG was also associated with a greater likelihood for remission of diabetes, hypertension, dyslipidemia, and sleep apnea in this MA.[12] Complications rates were similar between SG and LAGB, whereas reoperation was less likely in SG relative to LAGB.[12] Similar results were seen in terms of weight reduction and resolution of type 2 diabetes in a MA conducted by Wang and colleagues, where SG was associated with a greater reduction in weight at 6 and 12 months, but these comparisons were limited by high heterogeneity.[32] In a SR conducted by Sarkosh and colleagues, it was found that

LAGB was associated with a greater mean percent weight loss (66.8%) compared with SG (46.1%).[22]

Lastly, it must be noted that some studies concluded that, based on the differing benefit and risk profiles associated with each bariatric procedure, that assessment of the patient, preferences of the patient, and experience of the surgeon will influence the choice of type of procedure.[11,14,24]

What is the comparative cost-effectiveness of specific bariatric surgical interventions (roux-en-y gastric bypass, sleeve gastrectomy, and laparoscopic adjustable gastric band) for obese and morbidly obese patients?

Wang and colleagues conducted cost-effectiveness and cost-utility analyses to compare lifetime direct medical costs, quality-adjusted life years (QALYs), and the incremental cost effectiveness ratio (ICER) of RYGB compared to LABG.[30] They used a healthcare system perspective, and a reference case of a 53-year old female with a BMI of 44 kg/m^2 to conduct their analyses. They found the direct medical costs for RYGB ($169,074) to be comparable to LAGB ($164,313) with a standard BMI trajectory (BMI decreasing after surgery), and the QALYs for RYGB (13.4) to be higher than for LAGB (12.8), producing an ICER of $7,935 per QALY gained for RYGB compared to LAGB.[30] Sensitivity analyses varying the BMI trajectory (weight stable and maximum weight regain) produced similar results.[30]

Faria and colleagues also conducted cost-effectiveness and cost-utility analyses to compare lifetime costs and QALYs of RYGB compared to LAGB.[31] In contrast to the study by Wang et al, the lifetime costs of LAGB (41,056 euro) was consistently more than the lifetime costs of RYGB (29,254 euro), although it was unclear as to what costs were driving the difference.[30,31] However, similarly to the previous economic analyses, RYGB was consistently associated with greater QALYs (16.36) relative to LAGB (15.09).[31] These analyses were robust over a number of sensitivity analyses, including those with type 2 diabetes, and varying levels of BMI.[31] The study authors concluded that RYGB was dominant as it was consistently associated with greater QALYs and lower costs relative to LABG across sensitivity analyses.[31]

Lastly, in the one HTA included in this review there were no direct economic comparisons identified in the cost-effectiveness literature review.[11]

Limitations

There are a number of limitations that must be noted when considering the information reported in this review. A number of pooled comparisons within the MAs were associated with significant heterogeneity, and therefore results must be interpreted with caution. In addition, some of the MAs/SRs did not assess the possibility of publication bias, and as a result, studies may be missing from these reviews, which could impact the conclusions drawn in each review. Some studies within this review had conflicting conclusions. In addition, many of the studies included in the HTA, MAs, and SRs overlapped, which may overemphasize the conclusions drawn from the overlapping studies. Lastly, the included economic analyses were of poor quality and lacked important information regarding costs, limiting the generalizability and applicability of the results. Also, there was no economic information available for SG.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

Results consistently demonstrated that RYGB was associated with a greater weight reduction relative to LAGB, but was also associated with a higher risk for procedural adverse events and a longer duration of hospitalization after the procedure. The evidence of effectiveness and safety for SG suggested that it is less effective than RYGB for weight loss but associated with a reduced risk for complications, and more effective for weight loss compared to LAGB, but also more likely to result in complications, but evidence was conflicting. The economic analyses included in this Rapid Response report suffered from serious limitations and lacked information to evaluate the generalizability of the results to the Canadian population, limiting the conclusions that can be drawn from these studies. Lastly, no guidelines were identified that recommended one bariatric procedure over another.

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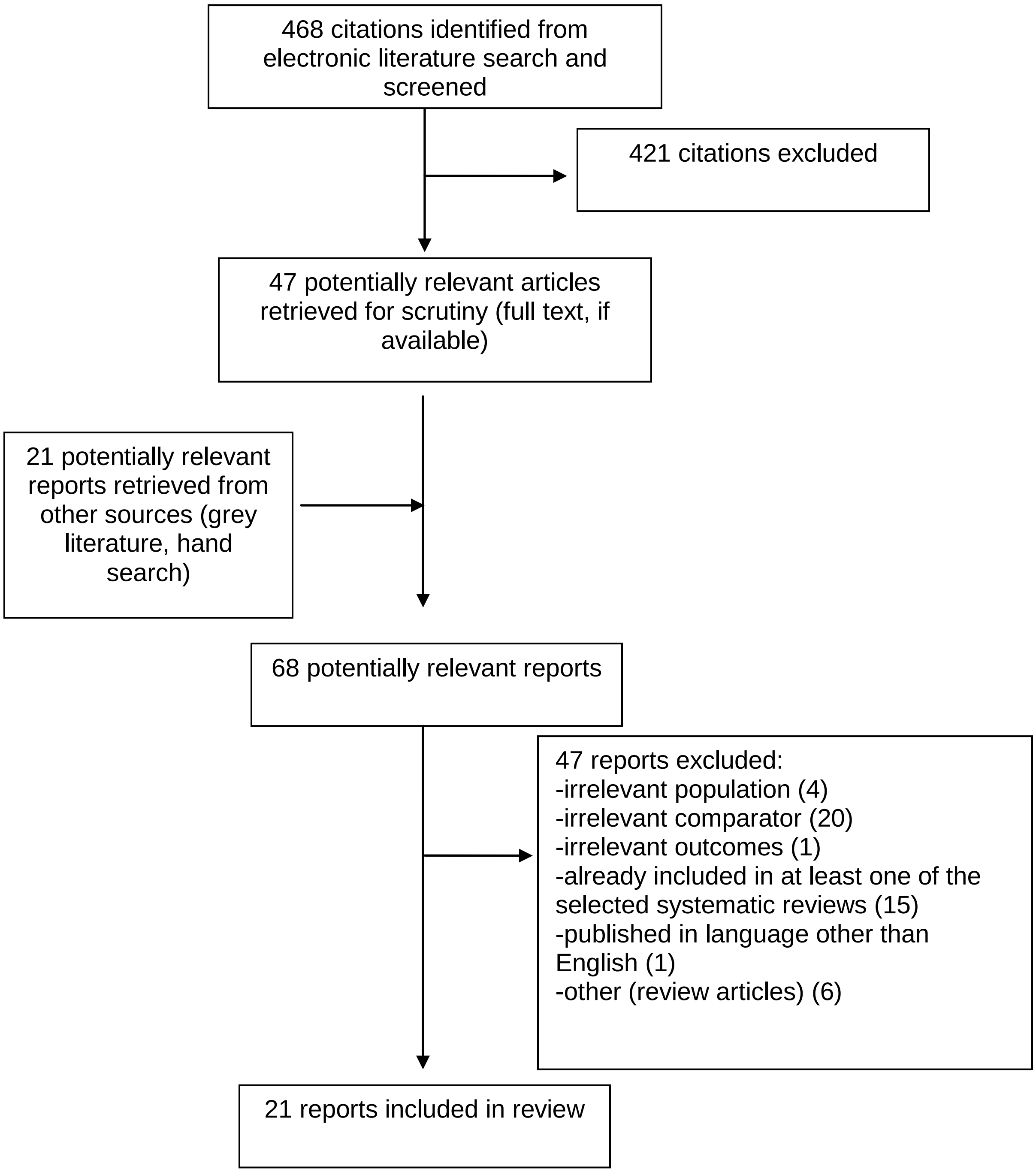
APPENDIX 1: Selection of Included Studies



APPENDIX 2: Characteristics of the Individual Included Studies

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
Health Technology Assessments					
Institute of Health Economics, 2012, Canada[11]	HTA Clinical component: years of included studies: 2003 – 2010 Economic component: years of included studies: 2002 – 2010	Clinical component: included 14 SR/HTA, 6 of which addressed bariatric surgery Economic component: included 29 studies, 11 of which addressed bariatric surgery		RYGB SG LAGB	Hospital length of stay Reoperations and revisions Gastrointestinal disturbances Surgical complications Weight loss Comorbidities Health-related quality of life Mortality
Meta-Analyses					
Chang, 2014, South Korea and United States[12]	MA Years of included studies: 2003 – 2012 73 studies had a length of follow-up of < 2 years, and 91 had a follow up of 2 or more years	Studies of individuals > 18 years that evaluated bariatric surgery 164 studies included (37 RCTs and 127 observational studies) Mean age: 44.56 years Mean BMI: 45.62 kg/m^2 78.87% female		SG (n not reported) LAGB (n not reported) RYGB (n not reported)	Weight outcomes: change in BMI, yearly change in BMI, yearly % excess weight loss Comorbidities outcomes: type 2 diabetes remission, hypertension remission, dyslipidemia remission, sleep apnea remission, cardiovascular disease remission

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
					Surgical risk outcomes: ≤ 30 day mortality, > 30 day mortality, complications, reoperations
Kwon, 2014, South Korea and United States[13]	MA Years of included studies: 2008 – 2013 Follow up ranged from 3 to 60 months	Included 9 studies (4 RCTs, 5 observational studies) Baseline mean age ranged from 30.6 – 48.3 years Baseline mean BMI ranged from 37.0 – 48.6 kg/m^2 Baseline proportion of females ranged from 57.8% to 100%	SG n = 398	RYGB n = 706	Anemia Iron deficiency Vitamin B12 deficiency
Li, 2014, China[14]	MA Years of included studies: 2008 – 2013 Follow-up ranged from 12 to 60 months	Included 32 studies (6 RCTs, 26 observational studies) with at least 12 months follow up	RYGB n = 3,874	SG n = 2,652	Percent excess weight loss Resolution of obesity-related comorbidities Postoperative complications Reoperation
Li, 2013, China[15]	MA Years of included studies: 2008 – 2012 Length of follow-up not	Included 16 studies (3 RCTs, 13 observational studies Baseline mean age ranged from 32.68 – 53 years	RYGB n = 1,592	SG n = 1,166	Resolution of type 2 diabetes Resolution of hypertension Percent excess weight loss

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
	reported	Baseline mean BMI ranged from 37.9 – 51.6 kg/m^2 Baseline proportion of females ranged from 26.1% to 93.8%			
Li, 2013, China[16]	MA Years of included studies: 2011, 2012 Follow-up ranged from 1 to 36 months	Included 5 RCTs Baseline mean age ranged from 18 – 67 years Baseline mean BMI ranged from 30.3 – < 50 kg/m^2	RYGB n = 196	SG n = 200	Remission of type 2 diabetes Percent excess weight loss Reoperation rate Complications Triglycerides LDL
Wang, 2013, China[32]	MA Years of included studies: 2005 – 2012 Length of follow-up not reported	Included 11 observational studies Baseline mean age ranged from 33 – 49.6 years Baseline mean BMI ranged from 37.5 – 54.3 kg/m^2 Baseline proportion of females ranged from 26.1% to 90%	SG n = 388	LAGB n = 616	Percent excess weight loss at 6 and 12 months Improvement in type 2 diabetes at 6 and 12 months
Yang, 2013, China[18]	MA Years of included studies: 2008 – 2012	Included 8 studies (6 RCTs, 2 observational studies) Baseline age	RYGB n = 143	SG n = 141	Adverse events Change in BMI Change in fasting plasma

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
	Follow-up ranged from 3 to 24 months	ranged from 30 – 60 years Baseline BMI ranged from 31.5 – 54.1 kg/m^2 Baseline proportion of females was 74%			glucose Change in A1C Change in triglycerides Change in total cholesterol Change in LDL Change in HDL
Yip, 2013, New Zealand[19]	MA Years of included studies: 2007 – 2012 Follow-up ranged from 1 to 36 months	Included 33 studies (3 RCTs, 30 observational studies) Studies included individuals > 18 years who has type 2 diabetes Baseline mean BMI was 43.66 kg/m^2 Baseline proportion of females was 67%	RYGB n = 998	SG n = 179	Remission of type 2 diabetes Percent excess BMI loss
Lynch, 2012, United Kingdom[20]	MA Years of included studies: 2001 – 2011 Length of follow-up not reported	Included 18 studies of patients ≥ 55 years old (only 6 studies included in the meta-analysis, and all studies were observational) Baseline mean age ranged from 58.6 – 60 years Baseline mean	RYGB n = 663	LAGB n = 543	Percent excess weight loss Mortality within 30 days Improvement or cure of comorbidities, including diabetes (all types), hypertension, lipid abnormalities,

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
		BMI ranged from 42.3 – 50.2 kg/m² Baseline proportion of females ranged from 62% to 85%			obstructive sleep apnea, and joint disease
Garb, 2009, United States[21]	MA Years of included studies: 2003 – 2007 Follow-up ranged from 11 to 91 months	Included 28 studies (6 RCTs, 22 observational studies) Studies included individuals > 18 years who has type 2 diabetes Baseline mean BMI was 43.66 kg/m² Baseline proportion of females was 67%	RYBG n = 5,518	LAGB n = 1,529	Percent excess weight loss at 1, 2 and > 3 years
Systematic Reviews					
Sarkhosh, 2013, Canada[22]	SR Years of included studies: 1986 – 2011 Follow-up ranged from 4 to 156 months	Included 69 studies (3 RCTs, 11 controlled trails, and 55 case series) Baseline mean age ranged from 30.4 – 68 years Baseline mean BMI ranged from 32.7 – 79.9 kg/m² Baseline proportion of females ranged from 0% to 98%		RYGB n = 5,430 SG n = 543 LAGB n = 4,095	Resolution or improvement of obstructive sleep apnea Percent excess weight loss
Trastulli, 2013, Italy[23]	SR	Included 15 RCTs	SG n = 795	RYGB n = 246	Mortality

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
	Years of included studies: 2005 – 2012 Follow-up ranged from 3 to 36 months	Baseline mean age ranged from 26 – 49.8 years Baseline mean BMI ranged from 30.3 – 49.7 kg/m^2 Baseline proportion of females ranged from 32% to 100%		LAGB n = 50	Conversion to open surgery Complications Average operating time Percentage excess weight loss Type 2 diabetes remission
Chakravarty, 2012, United Kingdom[24]	SR Years of included studies: 2003 - 2010 Follow-up ranged from 36 to 84 months	Included 5 RCTs Baseline mean age ranged from 33.8 – 45.8 years Baseline mean BMI ranged from 37 – 47.5 kg/m^2 Baseline proportion of females ranged from 75.6% to 84.3%	LAGB n = 252	RYGB n = 135 SG n = 40	Change in BMI from baseline Percentage excess weight loss Quality of life Change in comorbidities Operative time Hospital length of stay Complications
Randomized Controlled Trials					
Helmio, 2014, Finland[25]	RCT Length of follow up: 6 months	n = 240 Study authors did not report baseline participant characteristics Median baseline BMI in the study group was 44.7 kg/m^2	RYGB n = 119 (n = 111 at 6 months follow-up)	SG n = 121 (n = 119 at 6 months follow-up)	Percent excess weight loss Resolution of obesity-related comorbidities Morbidity and mortality associated with the procedures

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
Vix, 2014, France[26]	RCT Length of follow up: 12 months	n = 100 Mean age was 35 years Mean baseline BMI was 46.33 kg/m^2 82% of the study population was female	SG n = 55 (n = 48 at 12 months follow-up)	RYGB n = 45 (n = 44 at 12 months follow-up)	Percent excess weight loss Vitamin D level Parathyroid hormone level Calcium level
Angrisani, 2013, Italy[27]	RCT Length of follow up: 120 months	n = 51 Mean baseline age was 34 years Mean baseline BMI was 43.6 kg/m^2 82.4% of the study population was female	LAGB n = 27 (n = 22 at 120 months follow-up)	RYGB n = 24 (n = 21 at 120 months follow-up)	Percent excess weight loss Early complications (within 30 days of procedure) Late complications (more than 30 days after procedure) Reoperation Comorbidities
Keidar, 2013, Israel[28]	RCT Length of follow up: 12 months	n = 41 All participants had type 2 diabetes Mean baseline age was 49.6 years Mean baseline BMI was 42 kg/m^2	RYGB n = 22 (n = 19 at 12 months follow-up)	SG n = 19 (n = 18 at 12 months follow-up)	A1C Weight loss Treatment for diabetes

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
		41.5% of the study population was female			
Peterli, 2013, Switzerland[29]	RCT Length of follow up: 36 months	n = 217 Mean baseline age was 43 years Mean baseline BMI was 44 kg/m^2 72% of the study population was female	SG n = 107 (n = 38 at 36 months follow-up)	RYGB n = 110 (n = 32 at 36 months follow-up)	Operating time Complications Mean body weight reduction Quality of life (measured using the Gastrointestinal Quality of Life Index) Change in obesity-related comorbidities (type 2 diabetes, dyslipidemia, hypertension, obstructive sleep apnea, back/joint pain, GERD, depression)

BMI: body mass index; HDL: high density lipoprotein; HTA: health technology assessment; LAGB: laparoscopic adjustable gastric band; LDL: low density lipoprotein; MA: meta-analysis; RCT: randomized controlled trial; RYBG: Roux-en-Y gastric bypass; SG: sleeve gastrectomy; SR: systematic review

APPENDIX 3: Characteristics of the Included Economic Analyses

First Author, Publication Year, Country	Type of Economic Evaluation, Study Perspective	Patient Population	Intervention	Comparator(s)	Assumptions
Wang, 2014, United States[30]	CEA, CUA, healthcare system perspective	Reference case: 53-year old female with a BMI of 44 kg/m^2	RYGB	LAGB	None specified
Faria, 2013, Portugal[31]	CEA, CUA, societal perspective with universal coverage for healthcare	Reference case: mean age of 40 years and a mean BMI of 49.6 kg/m^2 Patient population followed same distribution as a previous cost-effectiveness study[34]	RYGB	LAGB	None specified

BMI: body mass index; CEA: cost effectiveness analysis; Cost utility analysis; LAGB: laparoscopic adjustable gastric band; RYGB: Roux-en-Y gastric bypass

APPENDIX 4: Critical Appraisal of Included Studies

First Author, Publication Year	Strengths	Limitations
Health Technology Assessment		
Institute of Health Economics, 2012, Canada[11]	• Objective of HTA was clearly stated • A comprehensive literature search strategy was used, including 6 databases, as well as the grey literature and HTA agencies for the effectiveness search, and 8 databases for the economic publication search • A quality assessment of included studies was conducted, and was duplicated by 2 reviewers in the effectiveness SR • The characteristics of the included studies was provided • List of excluded studies was provided • The characteristics of the included studies was provided	• Duplication of study selection and data collection was not completed • Search was limited to 2000 – 2010 • Publications were limited to English-language for the economic evaluation
Meta-Analyses		
Chang, 2014, South Korea and United States[12]	• Objective of SR was clearly stated • A comprehensive literature search strategy was used, including 5 databases • Duplication in study selection and data extraction (conducted by three reviewers) • A quality assessment of included studies was conducted • Statistical methods for combining results were described • The characteristics of the included studies was provided	• Grey literature was not searched • Timeframe of studies included was limited to January 1, 2003 to March 31, 2012 • A list of excluded studies was not provided • A reference list of the included studies was not provided in the original publication; instead lists were provided as supplements based on the question(s) they evaluated • Heterogeneity of combining study results was not reported
Kwon, 2014, South Korea and United States[13]	• Objective of SR was clearly stated • Duplication in study selection • A quality assessment of included studies was conducted • Statistical methods for combining results were	• The literature search strategy limited to 3 databases and reference lists of English articles • Unclear if data collection was duplicated • A list of excluded studies was not provided

First Author, Publication Year	Strengths	Limitations
	described • Heterogeneity was evaluated using the I-squared statistic • The characteristics of the included studies was provided • A conflict of interest statement was provided	• Likelihood of publication bias was not assessed
Li, 2014, China[14]	• Objective of SR was clearly stated • Duplication in study selection • A comprehensive literature search strategy was used, including 7 databases • Statistical methods for combining results were described • Heterogeneity was evaluated using the I-squared statistic • The characteristics of the included studies was provided • Likelihood of publication bias was assessed • A conflict of interest statement was provided	• Grey literature was not searched • Process for data collection was not described • A quality assessment of included studies was conducted • A list of excluded studies was not provided
Li, 2013, China[15]	• Objective of SR was clearly stated • Statistical methods for combining results were described • Heterogeneity was evaluated using the I-squared statistic • Likelihood of publication bias was assessed	• The literature search strategy limited to 2 databases and references in retrieved articles • Did not appear to be duplication in study selection or data extraction • A quality assessment of included studies was not conducted • The characteristics of the included studies was not provided • A list of excluded studies was not provided
Li, 2013, China[16]	• Objective of SR was clearly stated • Duplication in study selection • A comprehensive literature search strategy was used, including 5 databases • A quality assessment of included studies was conducted • Statistical methods for combining results were	• Grey literature was not searched • Description of data collection was not described • A list of excluded studies was not provided • Likelihood of publication bias was not assessed

First Author, Publication Year	Strengths	Limitations
	described • Heterogeneity was evaluated using the I-squared statistic • The characteristics of the included studies was provided • A conflict of interest statement was provided	
Wang, 2013, China[32]	• Objective of SR was clearly stated • Statistical methods for combining results were described • Heterogeneity was evaluated using the I-squared statistic • The characteristics of the included studies was provided • Likelihood of publication bias was assessed	• The literature search strategy limited to 2 databases from 2000 - 2012 • Although the authors state that the methodological quality of included studies was assessed, the authors do not report how it was assessed, or what the results of the assessment were • A list of excluded studies was not provided • A conflict of interest statement was not provided
Yang, 2013, China[18]	• Objective of SR was clearly stated • A comprehensive literature search strategy was used, including 5 databases, as well as reference lists of included studies were searched • Duplication in data extraction • A quality assessment of included studies was conducted • Statistical methods for combining results were described • Heterogeneity was evaluated using the I-squared statistic • The characteristics of the included studies was provided • Likelihood of publication bias was assessed • A conflict of interest statement was provided	• Unclear if study selection was duplicated • A list of excluded studies was not provided
Yip, 2013, New Zealand[19]	• Objective of SR was clearly stated • A quality assessment of included studies was conducted • Statistical methods for combining results were	• The literature search strategy limited to 2 databases from January 1, 2007 – April 30, 2012 • Did not appear to be duplication in study selection or data extraction • Although the authors stated that

First Author, Publication Year	Strengths	Limitations
	described • Likelihood of publication bias was assessed • A conflict of interest statement was provided	heterogeneity was evaluated using the I-squared statistic, the I-squared statistics were not reported for the meta-analyzed results • Limited data was provided on the characteristics of included studies • A list of excluded studies was not provided
Lynch, 2012, United Kingdom[20]	• Objective of SR was clearly stated • Statistical methods for combining results were described • The characteristics of the included studies was provided • Likelihood of publication bias was assessed • A conflict of interest statement was provided	• The literature search strategy limited to 2 databases • Did not appear to be duplication in study selection or data extraction • A quality assessment of included studies was not conducted • Heterogeneity of combining study results was not reported • Although this was called a meta-analyses, data comparing RYGB to LAGB was not meta-analyzed
Garb, 2009, United States[21]	• Objective of SR was clearly stated • Duplication in study selection and data extraction (conducted by three reviewers) • Statistical methods for combining results were described • Heterogeneity was evaluated using the I-squared statistic • The characteristics of the included studies was provided • Likelihood of publication bias was assessed	• The literature search strategy limited to 3 databases from 2003 - 2007 • A quality assessment of included studies was not conducted • A conflict of interest statement was not provided
Systematic Reviews		
Sarkhosh, 2013, Canada[22]	• Objective of SR was clearly stated • A comprehensive literature search strategy was used, including 14 databases, as well as the grey literature • Duplication in study selection and data extraction (conducted by three reviewers) • The characteristics of the included studies was provided	• Excluded non-English studies • List of excluded studies not provided • A quality assessment of included studies was not conducted • Likelihood of publication bias was not assessed

First Author, Publication Year	Strengths	Limitations
Trastulli, 2013, Italy[23]	• Objective of SR was clearly stated • A comprehensive literature search strategy was used, including 4 databases, the grey literature, and 6 relevant high-impact obesity journals • A quality assessment of included studies was conducted • The characteristics of the included studies was provided	• List of excluded studies not provided • Likelihood of publication bias was not assessed • No conflict of interest statement provided
Chakravarty, 2012, United Kingdom[24]	• Objective of SR was clearly stated • A quality assessment of included studies was conducted • Duplication in study selection and data extraction • List of excluded studies was provided • The characteristics of the included studies was provided • Conflict of interest statement provided	• While the literature search involved 4 separate databases, grey literature was not searched, nor were reference lists • Likelihood of publication bias was not assessed
Randomized Controlled Trials		
Helmio, 2014, Finland[25]	• Objective of the study was clearly stated • Concealment of allocation described (sealed envelopes) • Losses to follow-up were reported • Statistical analysis was described and was appropriate • Evaluated adverse events and complications associated with each procedure	• Process of randomization was not described • Study was not blinded • Surgical techniques were not described
Vix, 2014, France[26]	• Objective of the study was clearly stated • Surgical procedures were clearly described • Characteristics of study patients were clearly described • Confounding characteristics were similar between groups • Losses to follow up described	• Process of randomization was not described • No discussion regarding blinding or allocation concealment • No assessment of adverse events or complications associated with the procedures
Angrisani, 2013,	• Objective of the study was	• Process of randomization was not

First Author, Publication Year	Strengths	Limitations
Italy[27]	clearly stated • Outcomes were clearly described • Losses to follow up described • Important adverse events and complications were assessed	described • No discussion regarding blinding or allocation concealment • No discussion of statistical testing • Characteristics of study participants were not reported
Keidar, 2013, Israel[28]	• Objective of the study was clearly stated • Characteristics of study patients were clearly described • Process of randomization was described (online randomization software) • Losses to follow-up were reported • All procedures performed by a single surgeon	• Study was not blinded • Allocation was not concealed • No assessment of surgical complications
Peterli, 2013, Switzerland[29]	• Objective of the study was clearly stated • Characteristics of study patients were clearly described • Process of randomization was described (computer-based randomization) • Concealment of allocation described (sealed envelopes) • Important adverse events and complications were assessed • Losses to follow-up were reported	• The authors stated that the primary endpoint of the study was excessive BMI loss, however, the authors only reported change in body mass, and did not numerically report excessive BMI loss • Significant losses to follow-up by 36 months • Study was not blinded
Economic Analysis		
Wang, 2014, United States[30]	• Study question was clearly stated • Perspective was clearly stated • Costs were discounted at 3% per year • Conducted sensitivity analyses varying age, gender, early mortality, early complication rates baseline BMI, and BMI change after 5 years	• No assumptions stated • Evaluated direct costs only • Costs and outcomes used in the analyses were based on the Medicare database, and not listed, therefore it is unclear whether the results would be generalizable to the Canadian healthcare system • Authors used a natural history model to predict costs and outcomes after 5 years post-procedure due to lack of evidence in the literature
Faria, 2013, Portugal[31]	• Study question was clearly stated	• Unclear what costs were included in the analysis

First Author, Publication Year	Strengths	Limitations
	• Perspective was clearly stated • Costs were discounted at 3% per year	• No assumptions stated • Although the authors state they obtained distributions, probabilities, costs, and utilities from the literature “whenever available” (page 461), the authors do not report these values in the manuscript, therefore it is unclear if these cost were valued credibly • Sensitivity analyses were performed, but some were unrealistic (for example, people with morbid obesity with no comorbidities)

HTA: health technology assessment; SR: systematic review

APPENDIX 5: Main Study Findings and Authors' Conclusions

First Author, Publication Year	Main Study Findings	Authors' Conclusions
Health Technology Assessment		
Institute of Health Economics, 2012, Canada[11]	Hospital length of stay: • Two studies reported a significantly shorter length of stay with LAGB versus RYGB Reoperations and revisions: • Two studies found no significant difference between reoperation or reversals with RYGB and LABG, however, individuals who received LAGB had more late failed surgeries than RYGB Gastrointestinal disturbances: • Sixteen studies identified that there were significantly fewer late ulcers in patients who received LAGB compared to RYGB Surgical complications: • LAGB patients had a higher risk of late slippage and dilation relative to patients who received RYGB • LAGB patients had a reduced likelihood of early wound infections, late hernia, and late stenosis compared to RYGB patients Weight loss: • RYGB produced significantly greater reductions in BMI relative to LAGB, up to 5 years of follow up Comorbidities: • In six studies, there were no differences in resolution in comorbidities between LAGB and LAGB Health-related quality of life: • Quality of life was evaluated in one	"Of the three bariatric surgical procedures provided in Alberta, RYGB appears to be more effective than LAGB in reducing weight, but is associated with a higher risk of adverse events. Clinical research evidence was limited for SG. Preferences of the patient and experiences of the surgeon may influence the choice of surgery." – page 99

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	study comparing RYGB to LAGB using the SF-36. Results were not statistically different at 1 year for patients who received RYBG compared to those who received LAGB on all eight SF-36 domains. Mortality: • No studies comparing mortality between procedures were identified Cost effectiveness: • There were no direct comparisons between LAGB, RYGB and SG identified	
Meta-Analyses		
Chang, 2014, South Korea and United States[12]	Weight outcomes: Reduction in BMI at 1 year in RCTs: • RYGB: 14.53 kg/m^2 (95% CI: 12.25 – 16.82) • LAGB: 10.48 kg/m^2 (95% CI: 7.25 – 13.70) • SG: 16.20 kg/m^2 (95% CI: 7.95 – 24.45) Reduction in BMI at 1 year in observational studies: • RYGB: 14.32 kg/m^2 (95% CI: 9.62 – 19.02) • LAGB: 7.70 kg/m^2 (95% CI: 6.03 – 9.37) • SG: 12.14 kg/m^2 (95% CI: 10.26 – 14.02) Reduction in BMI at 5 years in RCTs: • RYGB: not reported • LAGB: 11.40 kg/m^2 (95% CI: -5.28 – 28.08) • SG: not reported Reduction in BMI at 5 years in observational studies: • RYGB: 15.96 kg/m^2 (95% CI: 11.40	RYGB was consistently associated with the greatest weight reduction and resolution of comorbidities relative to LAGB LAGB consistently had lower complication rates relative to RYGB SG appeared to be positioned between RYGB and LAGB for complications, weight loss, and resolution of comorbidities, but these results are based on a smaller number of SG studies available "LAGB is considered safer in terms of lower mortality and complication rates. However, the reoperation rate of LAGB is higher than that of RYGB and SG, and the weight loss outcomes of AGB are less substantial than RYGB or SG." – page 285

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	– 20.52) • LAGB: 12.36 kg/m^2 (95% CI: 7.79 – 16.92) • SG: 16.10 kg/m^2 (95% CI: 3.98 – 28.22) Reduction in percent excess weight at 1 year in RCTs: • RYGB: 72.32% (95% CI: 64.60 – 80.04) • LAGB: 33.39% (95% CI: 22.57 – 44.21) • SG: 69.70% (95% CI: 41.09 – 98.32) Reduction in percent excess weight at 1 year in observational studies: • RYGB: 63.31% (95% CI: 54.20 – 72.43) • LAGB: 34.26% (95% CI: 33.98 – 34.54) • SG: 51.49% (95% CI: 44.41 – 58.56) Reduction in percent excess weight at 5 years in RCTs: • RYGB: not reported • LAGB: 41.60% (95% CI: -9.75 – 92.95) • SG: not reported Reduction in percent excess weight at 5 years in observational studies: • RYGB: 64.92% (95% CI: 44.27 – 85.58) • LAGB: 57.23% (95% CI: 47.23 – 67.23) • SG: not reported Comorbidities outcomes: Diabetes remission in RCTs: • RYGB: 95.15% (95% CI: 88.38 – 98.80) • LAGB: 73.88% (95% CI: 36.06 – 96.18)	

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• SG: not reported Diabetes remission in observational studies: • RYGB: 92.83% (95% CI: 85.29 – 97.21) • LAGB: 67.58% (95% CI: 49.51 – 82.83) • SG: 85.53% (95% CI: 72.69 – 94.07) Hypertension remission in RCTs: • RYGB: 80.98% (95% CI: 68.21 – 91.52) • LAGB: 53.55% (95% CI: 12.52 – 89.63) • SG: not reported Hypertension remission in observational studies: • RYGB: 78.13% (95% CI: 63.67 – 88.76) • LAGB: 63.73% (95% CI: 51.74 – 75.34) • SG: 82.83% (95% CI: 68.19 – 92.01) Dyslipidemia remission in RCTs: • RYGB: 80.16% (95% CI: 61.68 – 94.19) • LAGB: 39.95% (95% CI: 4.69 – 87.05) • SG: not reported Dyslipidemia remission in observational studies: • RYGB: 63.22% (95% CI: 40.86 – 82.34) • LAGB: 60.91% (95% CI: 49.45 – 72.36) • SG: 82.86% (95% CI: 62.67 – 94.55) Cardiovascular disease remission in RCTs:	

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• RYGB: not reported • LAGB: not reported • SG: not reported Cardiovascular disease remission in observational studies: • RYGB: 22.0% (95% CI: 0.00 – 100.0) • LAGB: 78.0% (95% CI: 0.00 – 100.0) • SG: not reported Sleep apnea remission in RCTs: • RYGB: 95.41% (95% CI: 84.49 – 99.79) • LAGB: 94.26% (95% CI: 49.43 – 100.0) • SG: not reported Sleep apnea in observational studies: • RYGB: 94.68% (95% CI: 86.36 – 98.72) • LAGB: 71.14% (95% CI: 48.29 – 89.16) • SG: 90.77% (95% CI: 80.06 – 97.39) Complications outcomes: ≤ 30 day mortality in RCTs: • RYGB: 0.08% (95% CI: 0.01 – 0.30) • LAGB: 0.11% (95% CI: 0.01 – 0.50) • SG: 0.50% (95% CI: 0.01 – 3.88) ≤ 30 day mortality in observational studies: • RYGB: 0.38% (95% CI: 0.22 – 0.59) • LAGB: 0.07% (95% CI: 0.02 – 0.12) • SG: 0.29% (95% CI: 0.11 – 0.63) > 30 day mortality in RCTs: • RYGB: 0.39% (95% CI: 0.01 – 0.86)	

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• LAGB: 0.14% (95% CI: 0.00 – 0.55) • SG: 6.0% (95% CI: 0.00 – 100.00) > 30 day mortality in observational studies: • RYGB: 0.72% (95% CI: 0.28 – 1.30) • LAGB: 0.21% (95% CI: 0.08 – 0.37) • SG: 0.34% (95% CI: 0.14 – 0.60) Complication rates in RCTs: • RYGB: 21.0% (95% CI: 12.0 – 33.0) • LAGB: 13.0% (95% CI: 5.20 – 26.0) • SG: 13.0% (95% CI: 0.70 – 44.0) Complication rates in observational studies: • RYGB: 12.0% (95% CI: 7.30 – 17.0) • LAGB: 7.80% (95% CI: 3.90 – 13.0) • SG: 8.90% (95% CI: 5.60 – 13.0) Reoperation rates in RCTs: • RYGB: 2.56% (95% CI: 0.61 – 5.36) • LAGB: 12.23% (95% CI: 4.46 – 24.46) • SG: 9.05% (95% CI: 0.77 – 34.56) Reoperation rates in observational studies: • RYGB: 5.34% (95% CI: 4.48 – 6.48) • LAGB: 7.01% (95% CI: 3.99 – 11.24) • SG: 2.96% (95% CI: 1.70 – 4.71)	
Kwon, 2014, South Korea and United States[13]	Likelihood of anemia in patients with RYGB versus SG – RCTs: • OR: 1.43 (95% CI: 0.48 – 4.25) (I-squared = 63.9%) Likelihood of anemia in patients with	"In summary, the authors' findings suggest that SG is more beneficial than RYGB with regard to postoperative vitamin B12 deficiency risk in the analysis of RCTs, although the two methods

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	RYGB versus SG – observational studies: • OR: 1.68 (95% CI: 0.97 – 2.91) (I-squared = 0.0%) Likelihood of iron deficiency in patients with RYGB versus SG – RCTs: • OR: 0.83 (95% CI: 0.37 – 1.87) (I-squared = 0.0%) Likelihood of iron deficiency in patients with RYGB versus SG – observational studies: • OR: 1.78 (95% CI: 0.98 – 3.23) (I-squared = 0.0%) Likelihood of vitamin B12 deficiency in patients with RYGB versus SG – RCTs: • OR: 3.55 (95% CI: 1.26 – 10.01) (I-squared = 0.0%) Likelihood of vitamin B12 deficiency in patients with RYGB versus SG – observational studies: • OR: 2.49 (95% CI: 0.91 – 6.82) (I-squared = 63.2%)	are comparable in postoperative anemia and iron deficiency risk." – page 8 "Postoperative prophylactic iron and B12 supplementation, in addition to general multivitamin and mineral supplementation, is recommended based on subgroup analysis results, which showed comparable risks of nutritional deficiency associated with the 2 surgical methods." – page 8
Li, 2014, China[14]	Percent excess weight loss in RYGB versus SG: • Weighted mean difference: 5.70 (95% CI: -1.22 – 12.63) (I-squared = 88%) Resolution of type 2 diabetes in RYGB versus SG: • OR: 1.49 (95% CI: 1.04 – 2.12) (I-squared = 17%) – favors RYGB Resolution of hypertension in RYGB versus SG: • OR: 1.47 (95% CI: 1.15 – 1.86) (I-squared = 29%) – favors RYGB Resolution of hypercholesterolemia in RYGB versus SG: • OR: 2.41 (95% CI: 1.87 – 3.11) (I-squared = 45%) – favors RYGB	RYGB was significantly more likely to resolve obesity-related comorbidities relative to SG, but was associated with a significantly greater risk for postoperative complications and reoperation "Given the effect of bariatric surgery, as well as the risk of complications, clinicians and their patients need the best possible data to make informed decisions about treatment options." – page 20

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	Resolution of GERD in RYGB versus SG: • OR: 8.99 (95% CI: 4.77 – 16.95) (I-squared = 48%) – favors RYGB Resolution of arthritis in RYGB versus SG: • OR: 2.62 (95% CI: 1.38 – 5.00) (I-squared = 0%) – favors RYGB Postoperative complications in RYGB versus SG: • OR: 1.96 (95% CI: 1.26 – 3.04) (I-squared = 65%) – favors SG Reoperation in RYGB versus SG: • OR: 2.22 (95% CI: 1.37 – 3.60) (I-squared = 8%)	
Li, 2013, China[15]	Resolution of type 2 diabetes in RYGB versus SG: • OR: 2.46 (95% CI: 1.48 – 4.09) (I-squared = 61%) – favors RYGB Resolution of hypertension in RYGB versus SG: • OR: 0.81 (95% CI: 0.57 – 1.16) (I-squared = 70%) Percent excess weight loss in RYGB versus SG: • Mean difference: 8.27 (95% CI: 6.89 – 9.66) (I-squared = 93%) – favors RYGB	Combined results were associated with significant heterogeneity, and therefore must be interpreted with caution Patients who received RYGB were more likely to have resolution of type 2 diabetes and weight loss relative to SG "The straightforward conclusion from 16 included studies is that RYGB is a more effective treatment for morbid obesity and for surgical treatment of poorly controlled type 2 diabetes." – page 134
Li, 2013, China[16]	Percent excess weight loss in RYGB versus SG: • Weighted mean difference: 6.76 (95% CI: 4.61 – 8.91) (I-squared = 33%) – favors RYGB Low density lipoprotein in RYGB versus SG: • Weighted mean difference: -0.73 (95% CI: -1.25 – -0.22) (I-squared = 79%) – favors RYGB	"In summary, our meta-analysis has demonstrated that RYGB is more effective than SG for the surgical treatment of type 2 diabetes and control of metabolic syndrome. Patients treated with RYGB lost more weight than those treated with SG. Further high-quality RCTs with large sample sizes and long follow-up periods are needed to provide more reliable evidence." – pages

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	Triglycerides in RYGB versus SG: • Weighted mean difference: -0.23 (95% CI: -0.35 – -0.11) (I-squared = 38%) – favors RYGB Remission of type 2 diabetes in RYGB versus SG: • OR: 9.08 (95% CI: 2.39 – 34.41) (I-squared = 0%) – favors RYGB Postoperative complications in RYGB versus SG: • OR: 1.89 (95% CI: 1.07 – 3.33) (I-squared = 0%) – favors SG Reoperation in RYGB versus SG: • OR: 1.24 (95% CI: 0.37 – 4.16) (I-squared = 0%)	E163 – E164 No difference was found for likelihood of reoperation between RYGB and SG Complications were 1.89 times more likely in the RYGB group compared to the SG group
Wang, 2013, China[32]	Percent excess weight loss at 6 months in SG versus LAGB: • Mean difference: -12.55 (95% CI: -15.66 - -9.43) (I-squared: 80%) – favors SG Percent excess weight loss at 12 months in SG versus LAGB: • Mean difference: -4.97 (95% CI: -7.58 - -2.36) (I-squared: 83%) – favors SG Resolution of type 2 diabetes in SG versus LAGB: • OR: 0.34 (95% CI: 0.16 – 0.73) (I-squared = 54%) – favors SG	SG was associated with a larger weight loss and greater likelihood of type 2 diabetes resolution compared to LAGB Results must be interpreted with caution due to high heterogeneity "Although LAGB can significantly reduce weight, LSG had a greater effect on morbid obesity in terms of excess weight loss and improvement of type 2 diabetes." – page 984
Yang, 2013, China[18]	Change in BMI in RYGB versus SG: • Mean difference: 1.84 (95% CI: 0.50 – 3.18) (I-squared = 52%) – favors RYGB Change in fasting plasma glucose in RYGB versus SG: • Mean difference: -2.30 (95% CI: -7.47 – 2.88) (I-squared = 65%)	Results must be interpreted with caution due to high heterogeneity RYGB had a significantly greater improvement on BMI, total cholesterol, and HDL relative to SG "Both RYGB and SG have a clear effect on losing weight and

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	Change in A1C in RYGB versus SG: • Mean difference: 0.05 (95% CI: -0.35 – 0.44) (I-squared = 53%) Change in triglycerides in RYGB versus SG: • Mean difference: -8.02 (95% CI: -33.74 – 17.71) (I-squared = 83%) Change in total cholesterol in RYGB versus SG: • Mean difference: -17.43 (95% CI: -34.72 – -0.14) (I-squared = 63%) – favors RYGB Change in LDL in RYGB versus SG: • Mean difference: -18.64 (95% CI: -38.17 – 0.88) (I-squared = 83%) Change in HDL in RYGB versus SG: • Mean difference: 3.27 (95% CI: 0.48 – 6.06) (I-squared = 21%) – favors RYGB Adverse events were inconsistently reported, and therefore were not meta-analyzed. One study found the complication rate of RYGB to be 22%, and the complication rate of SG to be 8%. The same study found reoperation in 6% of those who underwent RYGB compared to 2% in those who underwent SG	ameliorating comorbidities; however, through our study, we found that RYGB may have a better effect on weight loss than SG." – page 1009
Yip, 2013, New Zealand[19]	Remission of type 2 diabetes in RYGB versus SG: • OR: 5.0 (95% CI: 0.7 – 38.1) (I-squared not reported) Percent excess BMI loss in RYBG versus SG: • Mean difference: 10.6 (95% CI: -4.2 – 25.5) (I-squared not reported)	No difference was found between RYGB and SG for percent excess BMI loss or remission of type 2 diabetes Meta-analyses were limited by the small amount of data available "This systematic review suggests both SG and RYGB are equally effective in causing type 2 diabetes remission and weight loss, at least as long as 3 years of follow-up." – pages 2001, 2002

First Author, Publication Year	Main Study Findings	Authors' Conclusions
Lynch, 2012, United Kingdom[20]	Pooled mean percent excess weight loss: • RYGB at 6 months: 54.8% (95% CI: 49.5 – 60.1) • LAGB at 6 months: 30.0% (95% CI: 27.1 – 32.9) • RYGB at 12 months: 72.6% (95% CI: 63.0 – 82.3) • LAGB at 12 months: 39.1% (95% CI: 25.5 – 52.8) Mortality within 30 days: • RYGB: 0.30% (95% CI: 0.037 – 1.09) • LAGB: 0.18% (95% CI: 0.05 – 1.02) Improvement or cure of diabetes (all types): • RYGB: 71.9% (95% CI: 63.2 – 79.5) • LAGB: not reported Improvement or cure of hypertension: • RYGB: 53.6% (95% CI: 47.0 – 60.1) • LAGB: 23% (95% CI: 18.0 – 28.7) Improvement or cure of lipid abnormalities: • RYGB: 38.1% (95% CI: 28.5 – 48.6) • LAGB: not reported Improvement or cure of obstructive sleep apnea: • RYGB: 88.7% (95% CI: 79.0 – 95.0) • LAGB: not reported Improvement or cure of joint disease: • RYGB: 17.8% (95% CI: 12.2 – 24.5) • LAGB: not reported	RYGB was associated with a greater pooled percent excess weight loss relative to LABG at 6 and 12 months RYGB was associated with greater improvement or cure in patients with hypertension compared to LAGB "Bariatric surgery in those ≥ 55 years has low absolute mortality and morbidity, although significantly higher than the < 55-year-old group." – page 1515
Garb, 2009, United States[21]	Percent excess weight loss at 1 year: • LAGB: 42.6% (95% CI: 37.3 – 47.9)	RYGB was associated with a greater composite percent excess weight loss, as well as percent

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• RYGB: 61.5% (95% CI: 57.4 – 65.5) Percent excess weight loss at 2 years: • LAGB: 50.3% (95% CI: 46.5 – 54.0) • RYGB: 69.7% (95% CI: 63.7 – 75.7) Percent excess weight loss at 3 years: • LAGB: 55.2% (95% CI: 50.7 – 59.7) • RYGB: 71.2% (95% CI: 60.5 – 82.0) Composite percent excess weight loss: • LAGB: 49.4% (95% CI: 44.9 – 54.0) • RYGB: 62.6% (95% CI: 58.6 – 66.6)	excess weight loss at years 1, 2 and 3 compared to LAGB "Problems were identified regarding data quality and patient follow-up rate." – page 1453
Systematic Reviews		
Sarkhosh, 2013, Canada[22]	Resolution or improvement of obstructive sleep apnea: • RYGB: based on 36 studies, an average of 79% of patients who received RYGB experienced either improvement or resolution of obstructive sleep apnea • LABG: based on results from 21 studies, 77% of study participants experienced either improvement or resolution of obstructive sleep apnea • SG: based on 8 studies, an average of 86% of study participants experienced resolution or improvement of obstructive sleep apnea Percent excess weight loss: • RYGB: based on 36 studies, the mean percent excess weight loss was 75.2% (SD: 26.8%) • LABG: based on results from 21 studies, the mean percent excess weight loss was 66.8% (SD:	Improvement or resolution of obstructive sleep apnea was similar among people who underwent RYGB, LABG, and SG RYGB was associated with the largest percent excess weight loss (75.2%), and SG was associated with the smallest percent excess weight loss (46.1%) "For obese individuals with obstructive sleep apnea, bariatric surgery remains a viable option in patients with sleep apnea." – page 417

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	33.0%) • SG: based on 8 studies, the mean percent excess weight loss was 46.1% (SD: 10.5%)	
Trastulli, 2013, Italy[23]	Mortality: • There were no deaths in any surgery groups Conversion to open surgery: • No patients required conversion to open surgery from laparoscopic surgery Complications, including leak, reoperation, and bleeding: • RYGB: ranged from 10% to 26.4% • LABG: ranged from 0% to 14% • SG: reported as 0% Mean operating time: • RYGB: 132.3 minutes (range 94 – 186 minutes) • LABG: not reported • SG: 50 minutes (range 35 – 120) Percent excess weight loss: • RYGB: ranged from 62.1% to 94.4% in 6 studies • LABG: ranged from 28.7% to 48% in 2 studies • SG: ranged from 49% to 81% in 7 studies Percent of patients with type 2 diabetes at baseline who were able to discontinue antidiabetes drugs: • RYGB: ranged from 78% to 100% in three studies • LABG: not reported • SG: ranged from 47% to 100% in 5 studies	"Considering the limitations of our study, we conclude that the evidence derived from the RCTs available in the literature suggests that SG is safe and highly feasible, with a relatively short operating time and the capability of ensuring effective weight loss in a short-term follow-up." – page 828 "The evidence supporting the use of LSG as a 1-stage procedure for morbid obesity lacks the data on long-term morbidity and weight loss durability." – page 828
Chakravarty, 2012, United Kingdom[24]	Mean reduction in BMI from baseline to 1 year: • RYGB: ranged from 8.4 to 15.9 kg/m^2 in two studies	"Operation time and hospital stay are considerably longer in RYGB and SG (compared with LAGB). While LAGB is advantageous with

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• LABG: ranged from 4.7 to 15.5 kg/m^2 in five studies • SG: was 25 kg/m^2 in one study Mean reduction in BMI from baseline to 5 years: • RYGB: was 14 kg/m^2 in one study • LABG: ranged from 8.2 to 8.5 kg/m^2 in two studies • SG: not reported Mean reduction in BMI from baseline to 7 years: • RYGB: not reported • LABG: ranged from 7.4 to 11.7 kg/m^2 in two studies • SG: not reported Mean percent excess weight loss from baseline to 1 year: • RYGB: ranged from 51.3% to 64.3% in two studies • LABG: ranged from 34.7% to 53.3% in five studies • SG: was 57.7% in one study Mean percent excess weight loss from baseline to 5 years: • RYGB: was 66% in one study • LABG: ranged from 33.2% to 47.5% in two studies • SG: not reported Mean percent excess weight loss baseline to 7 years: • RYGB: not reported • LABG: ranged from 29.9% to 54% in two studies • SG: not reported Quality of life: • Quality of life was evaluated in one study comparing RYGB to LAGB using the SF-36. Results were not statistically different at 1 year for	respect to operation length and could be more suited to high risk patients, three studies found a high reoperation rate." – page 178 "Future RCTs should use objective measures of comorbidities and quality of life, which are sufficiently powered to detect meaningful clinical differences. Assessment of specific subgroups may highlight a specific group for which LAGB is most appropriate." – page 180 "The current evidence base is comparing health outcomes of surgical procedures is limited and therefore final decisions about the choice of procedure must be a joint decision between surgeon and patient." – page 180

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	patients who received RYBG compared to those who received LAGB on all eight SF-36 domains. Time to return to work and resume normal daily activities was significantly sooner in the RYGB group versus LAGB Change in comorbidities: • This was assessed in LAGB in two studies and RYGB in one study. Two studies evaluated this – one study found that type 2 diabetes had initially resolved within two years of surgery, but had returned in all patients by seven years (n = 5). The second study found that all comorbidities resolved after 5 years with LAGB and RYGB, but overall prevalence was low. Mean operative time: • RYGB: ranged from 136.9 to 22 minutes in two studies • LABG: ranged from 60 to 68.2 minutes in three studies • SG: not reported Mean hospital length of stay: • RYGB: ranged from 3.1 to 4 days in two studies • LABG: ranged from 1.5 to 3.7 days in four studies • SG: not reported Early complications: • RYGB: ranged from 6% to 8.3% in two studies • LABG: ranged from 0% to 6.1% in four studies • SG: not reported Late complications: • RYGB: ranged from 4.2% to 26.1% in two studies	

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• LABG: ranged from 7.6% to 55.1% in five studies • SG: 15% in one study	
Randomized Controlled Trials		
Helmio, 2014, Finland[25]	Percent excess weight loss at 6 months: • RYGB: 52.9% • SG: 49.2% • p = 0.086 Improvement or resolution of type 2 diabetes at 6 months: • RYGB: 93.9% • SG: 84.3% • p = 0.585 Improvement or resolution of hypertension at 6 months: • RYGB: 81.9% • SG: 76.8% • p = 0.707 Improvement or resolution of hypercholesterolemia at 6 months: • RYGB: 69.0% • SG: 64.1% • p = 0.485 Morbidity and mortality associated with the procedures: • No deaths in either study group • One major complication in the SG group; 2 major complications in the RYGB group • Eight minor complications in the SG group; eleven in the RYGB group • Hospital readmission rate was 4.2% in the SG group and 2.7% in the RYGB group	Weight loss, resolution or improvement of obesity-related comorbidities, and morbidity associated with each bariatric procedure was similar in those who received SG and those who received RYGB "Long-term follow-up from prospective randomized trials comparing SG with RYGB is needed to elucidate the status of SG among the surgical treatment options for morbid obesity." – page 6
Vix, 2014, France[26]	Percent excess weight loss at 1 month: • RYGB: 25.39% • SG: 25.25% Percent excess weight loss at 3 months:	No statistically significant difference was found for percent excess weight loss between RYGB and SG at any time point "Starting from a similar

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	• RYGB: 43.46% • SG: 51.32% Percent excess weight loss at 6 months: • RYGB: 63.75% • SG: 63.67% Percent excess weight loss at 12 months: • RYGB: 80.38% • SG: 82.98% Vitamin D level at 1 month: • RYGB: 55.04 pmol/L (SD: 8.52) • SG: 58.35 pmol/L (SD: 13.88) • p = 0.28 Vitamin D level at 3 months: • RYGB: 54.81 pmol/L (SD: 7.65) • SG: 61.57 pmol/L (SD: 14.29) • p = 0.01 Vitamin D level at 6 months: • RYGB: 58.78 pmol/L (SD: 7.65) • SG: 61.18 pmol/L (SD: 8.01) • p = 0.14 Vitamin D level at 12 months: • RYGB: 56.15 pmol/L (SD: 8.18) • SG: 59.83 pmol/L (6.41) • p = 0.02 Parathyroid hormone level at 1 month: • RYGB: 42.69 ng/L (SD: 8.52) • SG: 43.64 ng/L (SD: 13.88) • p = 0.75 Parathyroid hormone level at 3 months: • RYGB: 44.71 ng/L (SD: 7.65) • SG: 28.64 ng/L (SD: 14.29) • p = 0.03 Parathyroid hormone level at 6 months: • RYGB: 44.9 ng/L (SD: 7.65) • SG: 25.83 ng/L (SD: 8.01)	preoperative vitamin D deficiency rate (84.6%), we observed a statistically significant improvement in our SG patients because the postoperative deficiency rate (at twelve months) dropped at 48%." – page 825 RYBG was associated with a persistent post-operative vitamin D deficiency, and it was significantly more common in RYGB compared to SG "The standard supplementation dose of cholecalciferol may need to be incremented in bariatric patients undergoing RYGB." – page 825

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	• p = 0.017 Parathyroid hormone level at 12 months: • RYGB: 41.43 ng/L (SD: 8.18) • SG: 20.46 ng/L (6.41) • p = 0.017 Calcium level was normal in both groups before and after surgery	
Angrisani, 2013, Italy[27]	Percent excess weight loss at 10 years: • RYGB: 69% (SD: 29%) • LAGB: 46% (SD: 27%) • p = 0.03 Early complications (within 30 days of procedure): • RYGB: 2 – one patient had a posterior pouch leak and the other had a jejunal perforation • LAGB: 0 Late complications (greater than 30 days after the procedure): • RYGB: 6 (4 with gastric pouch dilation, 1 with band erosion, and 1 with untreatable reflux symptoms – all required band removal) • LAGB: 6 (4 had gallstones, one had an internal hernia, and one had an incisional hernia – all required surgery for complications) Reoperation • RYGB: 6 (28.6%) • LAGB: 9 (40.9%) Comorbidities • No difference was found in terms of remission of comorbidities in people who received LAGB compared to those who received RYGB, although numbers were small (only 5 patients in total with complications at baseline returned for the 10 year follow up visit – all	RYGB was associated with a significantly greater percent excess weight loss at 10 years compared with LAGB Early complications were minimal in each group. Gastric pouch dilation was the most common late complication associated with LAGB, whereas gallstones was the most common complication associated with RYGB "For morbidly obese patients with BMI >35 and <50 kg/m^2, RYGB was unquestionably superior to LAGB in terms of excess weight loss results (%EWL ≥ 50%: 76.2% versus 46.2%, respectively) at 10 years." – page 412

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	had complete remission of their comorbidities)	
Keidar, 2013, Israel[28]	Percent excess weight loss at 3 months: • RYGB: 17.1% (SD: 3.1%) • SG: 20.1% (SD: 4.7%) Baseline A1C: • RYGB: 7.7% (SD: 1.3%) • SG: 8.3% (SD: 1.8%) A1C at three months: • RYGB: 6.37% (SD: 0.71%) • SG: 6.23% (SD: 0.69%) A1C at twelve months: • RYGB: 6.22% (SD: 0.5%) • SG: 5.97% (SD: 0.96%) Individuals requiring pharmacotherapy for type 2 diabetes at baseline: • RYGB: 16 (84.2%) • SG: 13 (72.2%) Individuals requiring pharmacotherapy for type 2 diabetes at twelve months: • RYGB: 10 (52.6%) • SG: 4 (22.2%) No significant difference between groups for A1C decrease or remission of type 2 diabetes	No significant difference was found between RYGB and SG for weight loss, change in A1C from baseline, or remission of type 2 diabetes "The fact that this study did not detect a major difference between the clinical effects of the two procedures should be viewed with caution. The study was randomised and baseline variables of both groups were similar, yet the sample size was modest…" – page 1917
Peterli, 2013, Switzerland[29]	Mean operative time: • RYGB: 108 minutes (SD: 42.3) • SG: 87.2 minutes (SD: 52.3) • P = 0.003 for comparison Complications: • One patient in each group had to be converted to an open procedure during laparoscopic surgery • Additional operations were performed in 36 people in the SG group and 26 people in the RYGB group (P = 0.09) • < 30 days post-surgery,	SG and RYGB appeared to be equally efficient with regards to weight loss at 1 year after procedure completion The operative time was significantly shorter for SG compared to RYGB, but there was no significant difference in complications within 30 days of surgery The need for additional surgeries was not different between the AG

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	complications occurred more frequently in the RYBG group (17.2%) compared to the SG group (8.4%), but this difference was not statistically significant (p = 0.067) • Severe complications requiring reoperation occurred in 4.5% of the RYGB group and 0.9% in the SG group (p = 0.21) Weight loss: • Mean weight loss in RYGB: 40.1kg • Mean weight loss in SG: 36.6kg • No significant difference between groups in terms of weight loss Resolution of comorbidities: • QOL was no different at 1 year among those who received SG (127 points) and RYGB (128 points), and was significantly improved in both groups from baseline (p < 0.0001) • There was no significant difference found between reduction in comorbidity at 1 year in those who received SG compared to those who received RYGB, except those who received SG were significantly less likely to have improvement with GERD (p = 0.008) Long-term complications: • Micronutrient deficiency was similar in both groups (n = 28 in SG group; n = 27 in the RYGB group)	and RYGB groups, but the frequency was high (33.6% in the SG group and 23.6% in the RYGB group) "Therefore, we believe that SG us a valuable surgical alternative for selected patients with morbid obesity." – page 694
Economic Analysis		
Wang, 2014, United States[30]	Lifetime simulation for the base case, with standard BMI trajectory: • Lifetime direct medical costs of RYGB: $169,074 • Lifetime direct medical costs of LAGB: $164,313 • QALY for RYGB: 13.4	"Our results suggest surgical procedures to treat morbid obesity improve patient quality of life and their life expectancy by reducing BMI and other comorbidities, but are associated with higher lifetime direct medical

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	• QALY for LAGB: 12.8 • ICER for RYGB compared to LAGB: $7,935 per QALY gained Lifetime simulation for the base case, with a weight stable model: • Lifetime direct medical costs of RYGB: $169,091 • Lifetime direct medical costs of LAGB: $164,076 • QALY for RYGB: 13.7 • QALY for LAGB: 12.7 • ICER for RYGB compared to LAGB: $5,015 per QALY gained Lifetime simulation for the base case, with maximum weight regain: • Lifetime direct medical costs of RYGB: $175,815 • Lifetime direct medical costs of LAGB: $171,001 • QALY for RYGB: 11.7 • QALY for LAGB: 11.4 • ICER for RYGB compared to LAGB: $16,047 per QALY gained	costs" relative to non-surgical interventions – page 261 Lifetime direct medical costs and QALYs were similar between RYGB and LAGB across all sensitivity analyses
Faria, 2013, Portugal[31]	Global population: • Lifetime cost of LAGB: 41,056 euro • Lifetime cost of RYGB: 29,254 euro • QALY for LABG: 15.09 • QALY for RYGB: 16.36 For patients with type 2 diabetes: • Lifetime cost of LAGB: 41,084 euro • Lifetime cost of RYGB: 29,399 euro • QALY for LAGB: 14.97 • QALY for RYGB: 16.41 For patients without comorbidities, and BMI of 25 – 30 kg/m^2: • Lifetime cost of LAGB: 23,122 euro • Lifetime cost of RYGB: 23,753 euro	"This study concludes that gastric bypass surgery improves health-related quality of life in morbidly obese patients and decreases overall health costs, even if societal and psychosocial costs associated with disability, unemployment, or social exclusion are not accounted for." – page 463 RYGB was considered dominant as it was consistently associated with higher QALY relative to LABG

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	• QALY for LAGB: 17.47 • QALY for RYGB: 17.52 For patients without comorbidities, and BMI of 30 – 35 kg/m^2: • Lifetime cost of LAGB: 23,827 euro • Lifetime cost of RYGB: 23,834 euro • QALY for LAGB: 17.20 • QALY for RYGB: 17.51 For patients without comorbidities, and BMI of 35 – 40 kg/m^2: • Lifetime cost of LAGB: 26,981 euro • Lifetime cost of RYGB: 23,654 euro • QALY for LAGB: 16.57 • QALY for RYGB: 17.40 For patients without comorbidities, and BMI of 40 – 50 kg/m^2: • Lifetime cost of LAGB: 36,605 euro • Lifetime cost of RYGB: 24,349 euro • QALY for LAGB: 15.65 • QALY for RYGB: 17.03 For patients without comorbidities, and BMI of 50 – 70 kg/m^2: • Lifetime cost of LAGB: 48,227 euro • Lifetime cost of RYGB: 34,071 euro • QALY for LAGB: 14.69 • QALY for RYGB: 15.85	

BMI: body mass index; CI: confidence interval; HTA: health technology assessment; ICER: incremental cost effectiveness ratio; LAGB: laparoscopic adjustable gastric band; MA: meta-analysis; OR: odds ratio QALY: quality-adjusted life year; QOL: quality of life; RCT: randomized controlled trial; RYBG: Roux-en-Y gastric bypass; SG: sleeve gastrectomy; SR: systematic review