| Table J-24. Studies evaluating independent predictive value of both BNP and NT-proBNP for the outcome of all-cause mortality in patients with decompensated heart failure | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Interval** | **Author**  **Year** | **Study Design**  **Population** | **n, mean age, %male** | **BNP Levels (pg/mL)** | **Prognostic Markers** | **Followup**  **Outcomes**  **(#events, #risk)** | **Model** | **Adjusted/Non-adjusted Covariates** | **Measure(s) of Risk** |
| **<31d** | Peacock44  2011  BACH | Cohort  Patients with acute HF | n=466  mean age: 70.8y(14)  58.6% male | ADM mean: BNP 764 (402-1,415)  D/C mean: NA  Cutpoint: NA | logBNP, logNT-proBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | 14d  14 day mortality | Cox proportional hazards | logNT-proBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | logBNP chi-square 0.1 p=0.768  c index=0.513 |
| Cohort  Patients with acute HF | n=466  mean age: 70.8y(14)  58.6% male | ADM mean: NT-proBNP 5,165 (2,332-10,096)  D/C mean: NA  Cutpoint: NA | logNT-proBNP, logBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | 14d  14 day mortality | Cox proportional hazards | logBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | logNT-proBNP chi-square 1.8 p=0.179  c index=0.586 |
| Noveanu42  2011 | Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | BNP, NT-proBNP at 24h, age, cTnT, eGFR\*, NYHA\* | 30d  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | BNP HR=NR per 100pg/mL increase, p=significant |
| Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | BNP, NT-proBNP at 48h, age, cTnT\*, eGFR\*, NYHA\* | 30d  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | BNP HR=NR per 100pg/mL increase, p=significant |

| Table J-24. Studies evaluating independent predictive value of both BNP and NT-proBNP for the outcome of all-cause mortality in patients with decompensated heart failure (continued) | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Interval** | **Author**  **Year** | **Study Design**  **Population** | **n, mean age, %male** | **BNP Levels (pg/mL)** | **Prognostic Markers** | **Followup**  **Outcomes**  **(#events, #risk)** | **Model** | **Adjusted/Non-adjusted Covariates** | **Measure(s) of Risk** |
| **<31d**  (cont’d) | Noveanu42  2011  (cont’d) | Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (,3068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | BNP, NT-proBNP D/C, age, cTnT\*, eGFR\*, NYHA | 30d  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | BNP HR=NR per 100pg/mL increase, p=significant |
| Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | BNP, NT-proBNP at 24 hrs, age, cTnT, eGFR\*, NYHA\* | 30d  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | NT-proBNP HR=NR per 1000pg/mL increase, p=NS |
| Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | BNP, NT-proBNP at 48 hrs, age, cTnT\*, eGFR\*, NYHA\* | 30d  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | NT-proBNP HR=NR per 1000pg/mL increase, p=NS |
| Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | BNP, NT-proBNP D/C, age, cTnT\*, eGFR\*, NYHA | 30d  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | NT-proBNP HR=NR per 1000pg/mL increase, p=0.05 |
| **2 to 3 months** | Boisot41  2008 | Cohort  Patients admitted with a diagnosis of acute decompensated HF | n=150  mean age: NR  99.0%male | ADM mean: 635 (304, 1,501)\*\*  D/C mean: 399 (174, 400)\*\*  Cutpoint: decrease of <10% | Decrease BNP <10%\*, BUN, ST2 decrease | 90d  All-cause mortality (24, 150) | Multivariable logistic regression and ROC analysis | Age >65\*, BUN, ST2 decrease, EF\*, rales\*, wheezing murmurs\*, CAD\*, MI\*, AF\* | Decrease BNP <10%  OR=1.15 (0.36-3.63), (p=0.817)  AUC=0.67, Se=0.63, Sp=0.67 |
| Cohort  Patients admitted with a diagnosis of acute decompensated HF | n=150  mean age: NR  99.0%male | ADM mean: 5,878 (2,297, 11,918)\*\*  D/C mean: 3,580 (1,379, 10,102)\*\*  Cutpoint: decrease of <3% | Decrease in NT-proBNP <3%, BUN, ST2 decrease | 90d  All-cause mortality (24, 150) | Multivariable logistic regression and ROC analysis | Age >65\*, BUN, ST2 decrease, EF\*, rales\*, wheezing murmurs\*, CAD\*, MI\*, AF\* | NT-proBNP <3% OR=0.19 (0.06-0.61) (p=0.005),  NT-proBNP % change from first to last sample  AUC=0.78,  Se=0.71, Sp=0.23 |
| Peacock44  2011  BACH | Cohort  Patients with acute HF | n=466,  mean age: 70.8y(14) 58.7%male | ADM mean: BNP 764 (402-1,415)  D/C mean: NR  Cutpoint: NR | logBNP, logNT-proBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | 90d  90 day mortality | Cox proportional hazards | logNT-proBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | logBNP chi-square 12.5 p<0.001  c index=0.636 |
| Patients with acute HF | n=466,  mean age: 70.8y(14) 58.7%male | ADM mean: NT-proBNP 5,165 (2,332-10,096)  D/C mean: NA  Cutpoint: NA | logBNP, logNT-proBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | 90d  90 day mortality | Cox proportional hazards | logNT-proBNP, BUN, MR-proANP, systolic BP, pulse oximetry, creatinine, age, troponin, MR-proADM, copeptin, copeptin and MR-proADM | logNT-proBNP chi-square 25.6 p<0.001  c index=0.693 |
| **2 to 3 months**  (cont’d) | Maisel40  2010  BACH | Cohort  Patients with acute HF presenting at ED with dyspnea | n=568  mean age: 71.2y(13.8)  62.5%male | ADM mean: NR  D/C mean: NR  Cutpoint: NR | logBNP, age, gender, BMI, creatinine | 90d  All-cause mortality (65, 568) | Multivariable cox regression | Age, gender, BMI, creatinine | logBNP HR=1.3 (0.9-1.9) per increase of 1 IQR, p=0.137 |
| Patients with acute HF presenting at ED with dyspnea | n=568  mean age: 71.2y(13.8)  62.5%male | ADM mean: NR  D/C mean: NR  Cutpoint: NR | logBNP, logMR-proADM, troponin, age, gender, BMI, creatinine | 90d  All-cause mortality (65, 568) | Multivariable cox regression | logMR-proADM, troponin, age, gender, BMI, creatinine | logBNP HR=0.9 (0.6-1.4) per increase of 1 IQR, p=0.57 |
| Patients with acute HF presenting at ED with dyspnea | n=568  mean age: 71.2y(13.8)  62.5%male | ADM mean: NR  D/C mean: NR  Cutpoint: NR | logNT-proBNP, age, gender, BMI, creatinine | 90d  All-cause mortality (65, 568) | Multivariable cox regression | Age, gender, BMI, creatinine | logNT-proBNP HR=1.5 (1.0-2.3) per increase of 1 IQR, p=0.041 |
| Patients with acute HF presenting at ED with dyspnea | n=568  mean age: 71.2y(13.8)  62.5%male | ADM mean: NR  D/C mean: NR  Cutpoint: NR | logNT-proBNP, logMR-proADM, troponin, age, gender, BMI, creatinine | 90d  All-cause mortality (65, 568) | Multivariable cox regression | logMR-proADM, troponin, age, gender, BMI, creatinine | log NT-proBNP HR=0.8 (0.5-1.4) per increase of 1 IQR, p=0.46 |
| **6 to 11 months** | Noveanu42  2011 | Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 1,315 (759, 2,349)\*\*  D/C mean: NR  Cutpoint: NR | BNP at 24h, age, cTnT, eGFR\*, NYHA\* | 1y  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | HR=1.02 (1.01-1.04) per 100 pg/mL increase, Se=0.65, Sp=0.76, AUC=0.77 (0.67-0.86) |
| BNP at 48h, age, cTnT\*, eGFR\*, NYHA | 1y  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | HR=1.03 (1.01-1.06) per 100 pg/mL increase, Se=0.76, Sp=0.71, AUC=0.78 (068-0.87) |
| BNP D/C, age, cTnT\*, eGFR\*, NYHA\* | 1y  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | HR=1.02 (1.01-1.03) per 100 pg/mL increase, Se=0.72, Sp=0.74, AUC=0.78 (0.67-0.88) |
| ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | NT-proBNP at 24h, age, cTnT, eGFR\*, NYHA\* | 1y  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | HR=1.01 (0.99-1.04) per 1000pg/mL increase, Se=0.69, Sp=0.77, AUC=0.73 (0.54-0.92) |
| Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | NT-proBNP at 48h, age, cTnT\*, eGFR\*, NYHA\* | 1y  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | HR=1.03 (0.99-1.07) per 1000pg/mL increase, Se=0.72, Sp=0.81, AUC= 0.75 (0.56-0.90) |
| Cohort  Patients with acute decompensated HF presenting at ED | n=171  mean age: 80y(73, 85)\*\*  60%male | ADM mean: 6,964 (3,068, 14,791)\*\*  D/C mean: NR  Cutpoint: NR | NT-proBNP D/C, age, cTnT\*, eGFR\*, NYHA | 1y  All-cause mortality (60, 171) | Multivariable cox regression and ROC analysis | Age, cTnT, eGFR, NYHA | HR=1.07 (1.01-1.13) per 1000pg/mL increase, Se=0.61, Sp=0.90, AUC= 0.77 (0.63-0.91) |
| **6 to 11 months**  (cont’d) | Sakhuja39  2007  PRIDE | Cohort  Patients with acute HF presenting to urban academic center | n=209  “increased cTnT” n=96  mean age: 74.3y(11.6)  58%male  “no increased cTnT” n=113  mean age: 71.4y(14.9)  45%male | ADM mean: Increase cTnT=544\*\*,  no-increase cTnT=221\*\*  D/C mean: NR  Cutpoint: 352 | BNP, cTnT, age, GFR, NYHA class | 12m  All-cause mortality (NR) | Multivariable cox regression and ROC analysis | cTnT, age, GFR, NYHA class | HR=2.53 (1.53-6.21), p=0.008 |
| ADM mean: Increase cTnT = 7,703\*\*, no-increase cTnT=2,287\*\*  D/C mean: NR  Cutpoint: 3,174 | NT-proBNP, cTnT, age, GFR, NYHA class | 12m  All-cause mortality (NR) | Multivariable cox regression and ROC analysis | cTnT, age, GFR, NYHA class | HR=2.76 (1.62-5.36), p=0.004 |
| Rehman43  2008  PRIDE | Cohort  Patients with acute HF | n=346  mean age: 73y(13)  68%male | ADM mean: 494 (203, 1,180)\*\*  D/C mean: NR  Cutpoint: >494 | BNP, ST2, CRP, NT-proBNP, age, prior chronic HF\*, BB, ACE inhibitor, NYHA\*, systolic BP, creatinine | 1y  Mortality (97, 346) | Multivariable cox regression and ROC analysis | ST2, CRP, NT-proBNP, age, prior chronic HF, BB, ACE inhibitor, NYHA, BP, BMI, S3 gallop, rates on lung exam, BUN, creatinine, WCC, Hb, pleural effusion | HR=2.12 (1.37-3.27), p=0.001 |
| ADM mean: 3,578 (1,574, 9,446)\*\*  D/C mean: NR  Cutpoint: >3,578 | NT-proBNP, ST2, CRP, BNP, age, prior chronic HF\*, BB, ACE inhibitor, NYHA\*, systolic BP, creatinine | 1y  Mortality (97, 346) | Multivariable cox regression and ROC analysis | ST2, CRP, BNP, age, prior chronic HF, BB, ACE inhibitor, NYHA, BP, BMI, S3 gallop, rates on lung exam, BUN, creatinine, WCC, Hb, pleural effusion | HR=1.87 (1.20-2.91), p=0.006 |

**Abbreviations:** ACE = angiotensin converting enzyme; ADM = admission; AF = atrial fibrillation; AUC=area under the curve; BACH = Biomarkers in Acute Heart Failure; BB = betablocker; BMI = body mass index; BNP = B-type natriuretic peptide; BP = blood pressure; BUN=blood urea nitrogen; CAD = coronary artery disease; 95% CI, = confidence interval; CRP = C-reactive protein; cTnT = cardiac troponin T; d = day(s); D/C = discharge; ED = emergency department; EF = ejection fraction; eGFR = estimated glomerular filtration rate; GFR = glomerular filtration rate; h = hour(s); Hb = hemoglobin; HF = heart failure; HR = hazard ratio; IQR = interquartile range; m = month(s); MI = myocardial infarction; MR-proADM = midregional pro-adrenomedullin; MR-proANP = midregional pro-atrial natriuretic peptide; n=number; NR = not reported; NS = non-significant; NT-proBNP = N-terminal pro-B-type natriuretic peptide; NYHA = New York Heart Association; OR = odds ratio; pg/mL = picograms per milliliter; PRIDE = Pro-BNP Investigation of Dyspnea in the Emergency Department; ROC = receiver operating characteristic; RR = relative risk; SD = standard deviation; WCC = white cell count; y = year(s)