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| --- |
| Table H-2. Detailed diagnostic properties of papers evaluating BNP in patients with symptoms suggestive of HF in the emergency department |
| Author,Year,Companion | Study Design | Population Type | nMean Age% Males | HF Prevalence (%) | Reference Standards | Index Test | Index Cutpoint (pg/mL) | Sensitivity (%) | Specificity (%) | LR+ | LR- | AUC |
|
| Alibay,1 2005 | Cross-sectional | Dyspnea, all | 16080.13y38 | 38 | 2 cardiologists | BNP | 50 | 99 | 31 | 1.43 | 0.03 | NR |
| BNP | 100 | 98 | 47 | 1.85 | 0.04 | NR |
| BNP | 150 | 94 | 61 | 2.41 | 0.10 | 0.82 |
| BNP | 200 | 87 | 64 | 2.42 | 0.20 | NR |
| Arenja,22011BASEL | Cohort | Dypsnea | 667 76(64-83)y 53 | 56.5 | 2 independent cardiologists | BNP | NR | NR | NR | NR | NR | 0.96 |
| Arques,3 2007  | Cross-sectional | Dyspnea, ≥70y | 4184y41 | 54 | 2 cardiologists; 1 chest physician | BNP | 200 | 96 | 74 | 3.63 | 0.06 | NR |
| BNP | 253 | 86 | 90 | 8.23 | 0.15 | 0.92 |
| BNP | ≥253 | 96 | 90 | 9.10 | 0.05 | NR |
| BNP | ≥253 | 96 | 90 | 9.10 | 0.05 | NR |
| BNP | ≥200 | 96 | 84 | 6.04 | 0.05 | NR |
| BNP | ≥200 | 96 | 79 | 4.55 | 0.06 | NR |
| Barcarse,42004 | Cross-sectional | Acute shortness of breath | 9864.6(1.2)100 | 58 | 1 cardiologist | BNP | 110 | NR | NR | NR | NR | 0.97 |
| Diagnose CHF, BNP>100 | 33NRNR | 58 | 1 cardiologist | BNP | 590 | NR | NR | NR | NR | 0.64 |
| Boldanova,52010BASEL  | Cross-sectional | Dyspnea, all | 452NRNR | 49 |  1 physician | BNP | NR | NR | NR | NR | NR | NR |
| Dyspnea, previous history of HF | 6473(11)y61 | 84 |  1 physician | BNP | 100 | 96 | 45 | 1.75 | 0.09 | NR |
| BNP | 403 | 80 | 77 | 3.48 | 0.26 | 0.84 |
| BNP | 500 | 76 | 77 | 3.30 | 0.31 | NR |
| Dyspnea, no previous history of HF | 38873(11)y52 | 44 |  1 physician | BNP | 100 | 94 | 59 | 2.29 | 0.10 | NR |
| BNP | 289 | 81 | 83 | 4.76 | 0.23 | 0.88 |
| BNP | 500 | 68 | 99 | 68.00 | 0.32 | NR |

| Table H-2. Detailed diagnostic properties of papers evaluating BNP in patients with symptoms suggestive of HF in the emergency department (continued) |
| --- |
| **Author,****Year,****Companion** | **Study Design** | **Population Type** | **n****Mean Age****% Males** | **HF Prevalence (%)** | **Reference Standards** | **Index Test** | **Index Cutpoint (pg/mL)** | **Sensitivity (%)** | **Specificity (%)** | **LR+** | **LR-** | **AUC** |
|
| Chenevier-Gobeaux,6 2005  | Cross-sectional | Dyspnea, all | 38179(12)yNR | 30 | Urgentists | BNP | NR | NR | NR | NR | NR | NR |
| Dyspnea, GFR <30y | 4183(11)yNR | 49 | Urgentists | BNP | 515 | 82 | 89 | 7.45 | 0.20 | 0.89 |
| Dyspnea, GFR 59 to 30y | 18781(10)yNR | 34 | Urgentists | BNP | 480 | 74 | 81 | 3.89 | 0.32 | 0.79 |
| Dyspnea, 89 to 60y | 14174(13)yNR | 20 | Urgentists | BNP | 290 | 76 | 88 | 6.33 | 0.27 | 0.84 |
| Chenevier-Gobeaux,72008Ray and Chenevier-Gobeaux 2005 | Cross-sectional | Dyspnea, all | 570NR48 | 44 | physicians | BNP | NR | NR | NR | NR | NR | NR |
| Acute dyspnea, ≥85y | 210NR35 | 52 | physicians | BNP | 250 | 85 | 64 | 2.36 | 0.23 | NR |
| BNP | 290 | 80 | 69 | 2.58 | 0.29 | 0.79 |
| BNP | 380 | 70 | 73 | 2.59 | 0.41 | NR |
| BNP | 400 | 67 | 75 | 2.68 | 0.44 | NR |
| BNP | 500 | 60 | 79 | 2.86 | 0.51 | NR |
| BNP | 590 | 55 | 85 | 3.67 | 0.53 | NR |
| Acute dyspnea, <85y | 360NR52 | 40 | physicians | BNP | 270 | 73 | 83 | 4.29 | 0.33 | 0.83 |
| Chenevier-Gobeaux,8 2010  | Cross-sectional | Dyspnea, >60y, | 37878 (12)y50 | 30 | 2 emergency department physicians | BNP | 100 ng/L | 99 | 41 | 1.68 | 0.02 | 0.82 |
| Tertile 3 (eGFR ≥58.6 ml/min/1.73 m2) | 12673 (13)y68 | 17 | 2 emergency department physicians | BNP | 210 ng/L | 86 | 71 | 2.97 | 0.20 | 0.85 |
| Tertile 2 (eGFR between 44.3 and 58.5 ml/min/1.73m2) | 12679 (11)y44 | 34 | 2 emergency department physicians | BNP | 280 ng/L | 88 | 72 | 3.14 | 0.17 | 0.86 |
|   |  | Tertile 1 (eGFR<44.3 ml/ min/1.73 m2), | 12683 (10)y39 | 39 | 2 emergency department physicians | BNP | 550 ng/L | 85 | 65 | 2.43 | 0.23 | 0.76 |
| Choi,92007 | Cross-sectional | Dyspnea, all | 1040NR56 | 36 | The final diagnosis of CHF was defined by transthoracic echocardiography. | BNP | 12.5 | 100 | 28 | 1.39 | 0.00 | 0.96 |
| BNP | 100 | 99 | 67 | 3.00 | 0.02 | NR |
| BNP | 191 | 96 | 84 | 5.82 | 0.05 | NR |
| BNP | 296.5 | 91 | 91 | 10.52 | 0.10 | 0.96 |
| BNP | 400 | 85 | 96 | 22.29 | 0.16 | NR |
| BNP | 496 | 70 | 97 | 25.96 | 0.31 | NR |
| BNP | 601 | 61 | 98 | 26.35 | 0.40 | NR |
| BNP | 983.5 | 40 | 99 | 33.25 | 0.61 | NR |
| Chung,10 2006  | Cross-sectional | Patients with dyspnea, all | 14379(10)44 | 50 | 1 cardiologist  | BNP | 100 | 100 | 41 | 1.65 | 0.00 | 0.85 |
| BNP | 400 | 87 | 76 | 3.63 | 0.17 | NR |
| History of HF | 80NRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.74 |
| No history of HF | 63NRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.94 |
| LVEF <50% | 67NRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.64 |
| LVEF ≥50% | 39NRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.87 |
| High serum creatinine | NRNRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.81 |
| Low serum creatinine | NRNRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.9 |
| Initial intermediate likelihood of HF  | 44NRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.79 |
|  |  | Low or high likelihood of HF  | 9NRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.86 |
| Patients ≥79 years | NRNRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.85 |
| Patients <79 years | NRNRNR | NR | 1 cardiologist  | BNP | NR | NR | NR | NR | NR | 0.88 |
| Collins,11 2006  | Cross-sectional | Dyspnea | NRNRNR | 39 | 2 senior cardiology fellows | BNP | ‘‘Indeterminate zone’’ (100 to ≤500 pg/mL) | NR | NR | NR | NR | NR |
| Coste,12 2006  | Cross-sectional | Acute dyspnea | 69972.8 (14.3)y68 | 60 | 2 cardiologists | BNP | NR | NR | NR | NR | NR | NR |
| Acute dyspnea, no history CHF | 525NRNR | NR | 2 cardiologists | BNP | The cutoff points delimiting the gray zones glow=167 ng/L (95% bootstrap CI 108 to 219) and gup= 472 ng/L (95% bootstrap CI 390 to 501) | NR | NR | 18.25 | 0.05 | NR |
| Acute dyspnea, history of CHF | 174NRNR | NR | 2 cardiologists | BNP | gup=334 ng/L (95% bootstrap CI 178 to 465); glow=0 | NR | NR | 3.35 | 0.01 | NR |
| Daniels,132006Breathing Not Properly Study | Cross-sectional | Dyspnea, all | 1,36865y56 | 46 | 2 cardiologists  | BNP | NR | NR | NR | NR | NR | NR |
| Dyspnea, BMI <25  | 52667.3y55.7 | 47 | 2 cardiologists  | BNP | 100 | 94 | 65 | 2.63 | 0.10 | 0.9 |
| Daniels,132006Breathing Not Properly Study (cont’d) | Cross-sectional | Dyspnea, 25 ≤BMI <35  | 59563.2y58 | 46 | 2 cardiologists  | BNP | 100 | 92 | 76 | 3.88 | 0.10 | 0.91 |
| Dyspnea, BMI ≥35  | 24756.7y46.3 | 44 | 2 cardiologists  | BNP | 100 | 77 | 84 | 4.85 | 0.27 | 0.88 |
| Dyspnea, BMI <25  | 52667.3y55.7 | 47 | 2 cardiologists  | BNP | 1 | 90 | NR | NR | NR | NR |
| Dyspnea, 25 ≤BMI <35  | 59563.2y58 | 46 | 2 cardiologists  | BNP | 110 | 90 | NR | NR | NR | NR |
| Dyspnea, BMI ≥35  | 24756.7y46.3 | 44 | 2 cardiologists  | BNP | 54 | 90 | NR | NR | NR | NR |
| Dao,14 2001  | Cross-sectional | Dyspnea, all | 25063y94 | 39 | 2 cardiologists  | BNP | 80 | 98 | 92 | 12.25 | 0.02 | 0.98 |
| BNP | 100 | 94 | 94 | 15.67 | 0.06 | NR |
| BNP | 115 | 90 | 96 | 22.50 | 0.10 | NR |
| BNP | 120 | 90 | 96 | 22.50 | 0.10 | NR |
| BNP | 150 | 87 | 97 | 29.00 | 0.13 | NR |
| Defilippi,15 2007  | Cohort | Dyspnea all | 831NR45.7 | 53 | 1 cardiologist | BNP | NR | NR | NR | NR | NR | NR |
| No kidney disease (kd), eGFR ≥60 | 43863.5(16.0)y43.8 | 45 | 1 cardiologist | BNP | 100 ng/L | 90 | 37 | 1.42 | 0.27 | 0.95 |
| Kidney disease eGFR <60 | 39369.3(13.1)y47.8 | 61 | 1 cardiologist | BNP | 200 ng/L | 82 | 53 | 1.74 | 0.34 | 0.68 |
| Dieplinger,162009Mueller, et al. 2005, Gegenhuber, et al. 2006 | Cross-sectional | Dyspnea | 251NRNR | 55 | Framingham score forHF plus echocardiographic evidence of systolic or diastolicdysfunction | BNP | 160 ng/L | 90 | 73 | 3.33 | 0.14 | 0.92 |
| Dieplinger,162009Mueller, et al. 2005, Gegenhuber, et al. 2006(cont’d) | Cross-sectional | Dyspnea attributable to acute destabilized emergency department HF | 13769 to 82y93 | 46 | Framingham score forHF plus echocardiographic evidence of systolic or diastolicdysfunction | BNP | NR | NR | NR | NR | NR | NR |
| Dyspnea not attributable to HF | 11468 to 82y95 | 8 | Framingham score forHF plus echocardiographic evidence of systolic or diastolicdysfunction | BNP | NR | NR | NR | NR | NR | NR |
| Gorissen,17 2007  | Cross-sectional | Acute dyspnea, all | 8043 to 90y55 | 50 | Consensus on clinical diag (cardiologist + pulmonologist) | BNP Centaur | 138 ng/L | 65 | 88 | 5.42 | 0.40 | 0.77 |
| BNP Triage | 225 ng/L | 73 | 78 | 3.32 | 0.35 | 0.78 |
| Acute dyspnea, <65 | 17NRNR | NR | Consensus on clinical diag (cardiologist + pulmonologist) | BNP Triage | 78 ng/L | 100 | 55 | 2.22 | 0.00 | 0.75 |
| BNP Centaur | 91 ng/L | 100 | 55 | 2.22 | 0.00 | 0.70 |
| Acute dyspnea, 65-75y | 23NRNR | NR | Consensus on clinical diag (cardiologist + pulmonologist) | BNP Triage | 260 ng/L | 82 | 83 | 4.82 | 0.22 | 0.79 |
| BNP Centaur | 188 ng/L | 73 | 83 | 4.29 | 0.33 | 0.77 |
| Acute dyspnea, >75y | 40NRNR | NR | Consensus on clinical diag (cardiologist + pulmonologist) | BNP Triage | 309 ng/L | 68 | 71 | 2.34 | 0.45 | 0.76 |
| BNP Centaur | 247 ng/L | 68 | 77 | 2.96 | 0.42 | 0.76 |
| Acute dyspnea, GFR >60 | 40NRNR | NR | Consensus on clinical diag (cardiologist + pulmonologist) | BNP Triage | 202 ng/L | 81 | 63 | 2.19 | 0.30 | 0.79 |
| BNP Triage | 127 ng/L | 73 | 85 | 4.87 | 0.32 | 0.79 |
| Acute dyspnea, GFR <60 | 40NRNR | NR | Consensus on clinical diag (cardiologist + pulmonologist) | BNP Centaur | 229 ng/L | 64 | 70 | 2.13 | 0.51 | 0.66 |
| BNP Centaur | 309 ng/L | 64 | 74 | 2.46 | 0.49 | 0.69 |
| Gruson,18 2008  | Cohort | Patients with dyspnea and/or chest pain (with cardiovascular and/or pulmonary disorders), all | 13769y56.2 | 23 | 1 cardiologist | BNP | NR | NR | NR | NR | NR | 0.93 |
| Gruson,19 2009 | Cross-sectional | Dyspnea, all | 9730–95y43 | 20 | Clinicians | SOB BNP | NR | 100 | 59 | 2.44 | 0.00 | NR |
| Gruson,20 2012 | Cohort | Dyspnea and/or chest pain, all | 15667y54.5 | 29.5 |  Clinicians | BNP | 100 ng/L | NR | NR | NR | NR | 0.91 |
| Havelka,21 2011  | Cross-sectional | Dyspnea, all | 5480y\*46 | NR | Discharge diagnosis | BNP | NR | NR | NR | NR | NR | 0.77 |
| Knudsen,23 2004aBreathing Not Properly Study | Cross-sectional | Acute dyspnea, all | 88064y55 | 51 | 2 cardiologists, Framingham, NHANES | BNP | 100 | 90 | 75 | 3.60 | 0.13 | NR |
| BNP | 200 | 80 | 87 | 6.15 | 0.23 | NR |
| BNP | 300 | 71 | 90 | 7.10 | 0.32 | NR |
| BNP | 400 | 64 | 92 | 8.00 | 0.39 | NR |
| Knudsen,22 2004b | Cross-sectional | Dyspnea all | 155NR44.5 | 48 | 2 cardiologists  | BNP | 100 | NR | NR | NR | NR | NR |
| Acute dyspnea, women | 8678y\*NR | 41 | 2 cardiologists | BNP | 50 | 100 | 37 | 1.59 | 0.00 | NR |
| BNP | 100 | 94 | 55 | 2.09 | 0.10 | NR |
| BNP | 150 | 91 | 59 | 2.22 | 0.15 | NR |
| BNP | 200 | 89 | 63 | 2.38 | 0.18 | 0.86 |
| Acute dyspnea, men | 6974y\*NR | 58 | 2 cardiologists | BNP | 50 | 95 | 38 | 1.53 | 0.13 | NR |
| BNP | 100 | 90 | 55 | 2.01 | 0.18 | NR |
| BNP | 150 | 93 | 62 | 2.44 | 0.12 | NR |
| BNP | 200 | 90 | 72 | 3.26 | 0.14 | 0.9 |
| Acute dyspnea, ≥76y | NRNRNR | NR | 2 cardiologists | BNP | 100 | NR | NR | NR | NR | 0.88 |
| Acute dyspnea, <76y | NRNRNR | NR | 2 cardiologists | BNP | 100 | NR | NR | NR | NR | 0.82 |
| Knudsen,24 2005Breathing Not Properly Study | Cohort | Dyspnea all | 1,431NRNR | 46 | 2 cardiologists | BNP | NR | NR | NR | NR | NR | NR |
| Atrial fibrillation | 29267 to 827y61.3 | 47 | 2 cardiologists | BNP | ≥50 | 99 | 21 | 1.24 | 0.07 | NR |
| BNP | ≥100 | 95 | 40 | 1.57 | 0.14 | NR |
| BNP | ≥200 | 85 | 73 | 3.12 | 0.20 | 0.084 |
| BNP | ≥300 | 74 | 80 | 3.63 | 0.32 | NR |
| BNP | ≥400 | 64 | 86 | 4.70 | 0.41 | NR |
| BNP | ≥500 | 55 | 88 | 4.50 | 0.51 | NR |
| BNP | ≥600 | 47 | 89 | 4.27 | 0.60 | NR |
| BNP | ≥700 | 43 | 89 | 3.86 | 0.65 | NR |
| BNP | ≥800 | 36 | 93 | 5.24 | 0.69 | NR |
| No atrial fibrillation | 1,13949 to 74y59.1 | 30 | 2 cardiologists | BNP | ≥50 | 96 | 65 | 2.75 | 0.06 | NR |
| BNP | ≥100 | 89 | 79 | 4.15 | 0.15 | NR |
| BNP | ≥200 | 79 | 88 | 6.69 | 0.24 | 0.91 |
| BNP | ≥300 | 71 | 91 | 7.96 | 0.32 | NR |
| BNP | ≥400 | 62 | 93 | 8.56 | 0.41 | NR |
| BNP | ≥500 | 55 | 94 | 9.03 | 0.48 | NR |
| BNP | ≥600 | 50 | 95 | 9.42 | 0.53 | NR |
| BNP | ≥700 | 47 | 96 | 11.80 | 0.55 | NR |
| BNP | ≥800 | 47 | 96 | 13.06 | 0.55 | NR |
| Atrial fibrillation by ECG upon admission | 158NRNR | NR | 2 cardiologists | BNP | NA | NR | NR | NR | NR | 0.80 |
| History of atrial fibrillation but no current AF | 134NR | NR | 2 cardiologists | BNP | NA | NR | NR | NR | NR | 0.86 |
| Lainchbury,252003  | Cross-sectional | Acute Dyspnea, all  | 20570(14)y49 | 34 | 2 cardiologists | BNP- Biosite point-of-care assay  | 20pmol/L69 pg/mL | 97 | 44 | 1.73 | 0.07 | NR |
| BNP- Biosite point-of-care assay  | 30pmol/L103 pg/mL | 97 | 49 | 1.90 | 0.06 | NR |
| BNP- Biosite point-of-care assay  | 60pmol/L206 pg/mL | 94 | 70 | 3.13 | 0.09 | 0.89 |
| BNP- Biosite point-of-care assay  | 80pmol/L275 pg/mL | 83 | 78 | 3.77 | 0.22 | NR |
| Acute dyspnea, all  | 20570(14)y49 | 34 | 2 cardiologists | BNP- Biosite point-of-care assay  | 100pmol/L345 pg/mL | 77 | 84 | 4.81 | 0.27 | NR |
| BNP- local clinical assay | 44pmol/L | 88 | 82 | 4.89 | 0.15 | NR |
| Logeart,26 2002 | Cross-sectional | Acute dyspnea, all | 16367y66.8 | 70 | 2 cardiologists and 1 pneumologist | BNP | 80 | 97 | 27 | 1.33 | 0.11 | NR |
| BNP | 100 | 96 | 31 | 1.39 | 0.13 | NR |
| BNP | 150 | 93 | 45 | 1.69 | 0.16 | NR |
| BNP | 200 | 93 | 56 | 2.11 | 0.13 | NR |
| BNP | 250 | 91 | 68 | 2.84 | 0.13 | NR |
| BNP | 300 | 88 | 87 | 6.77 | 0.14 | 0.93 |
| BNP | 400 | 79 | 93 | 11.29 | 0.23 | NR |
| Lokuge,27 2010SOB  | RCT | Dyspnea | 30674(11)y54 | 48 | 1 cardiologist, emerg or respirologist. | BNP | 101 | 92 | 51 | 1.88 | 0.16 | 0.87 |
| BNP | 265\* | 83 | 81 | 4.37 | 0.21 | NR |
| Maisel,28 2002BNP | Cross-sectional | Acute dyspnea | 1,58664y56 | 47 | 2 cardiologists | BNP | 50 | 97 | 62 | 2.55 | 0.05 | NR |
| BNP | 80 | 93 | 74 | 3.58 | 0.09 | NR |
| BNP | 100 | 90 | 76 | 3.75 | 0.13 | 0.91 |
| BNP | 125 | 87 | 79 | 4.14 | 0.16 | NR |
| BNP | 150 | 85 | 83 | 5.00 | 0.18 | NR |
| Maisel,29 2003Breathing Not Properly Study | Cross-sectional | Acute dyspnea  | 1,58664y56 | 47 | 2 cardiologists | BNP | 100 | 90 | 73 | 3.33 | 0.14 | 0.9 |
| BNP | 200 | 81 | 85 | 5.40 | 0.22 | NR |
| BNP | 300 | 73 | 89 | 6.64 | 0.30 | NR |
| BNP | 400 | 63 | 91 | 7.00 | 0.41 | NR |
| CHF  | 45264y56 | 47 | 2 cardiologists | BNP | 100 | 95 | 14 | 1.10 | 0.36 | NR |
| BNP | 200 | 89 | NR | NR | NR | NR |
| BNP | 300 | 83 | 39 | 1.36 | 0.44 | 0.66 |
| BNP | 400 | 74 | 50 | 1.48 | 0.52 | NR |
| Maisel,30 2004Breathing Not Properly Study | Cross-sectional | Dyspnea | 1,58664y56 | 47 | 2 cardiologists | BNP | 100 | 90 | 73 | 3.34 | 0.13 | NR |
| BNP | 200 | 81 | 85 | 5.46 | 0.22 | NR |
| BNP | 300 | 73 | 89 | 6.36 | 0.31 | NR |
| BNP | 400 | 63 | 91 | 7.04 | 0.41 | NR |
| 18 to 69y | NRNRNR | NR | 2 cardiologists | BNP | 100 | 86 | 82 | 4.69 | 0.17 | 0.91 |
| BNP | 200 | 77 | 91 | 8.45 | 0.25 | NR |
| BNP | 300 | 69 | 94 | 11.10 | 0.33 | NR |
| BNP | 400 | 60 | 95 | 11.23 | 0.43 | NR |
| 70 to 105y | NRNRNR | NR | 2 cardiologists | BNP | 100 | 94 | 53 | 2.00 | 0.12 | 0.84 |
| BNP | 200 | 85 | 72 | 3.03 | 0.21 | NR |
| BNP | 300 | 75 | 77 | 3.27 | 0.32 | NR |
| BNP | 400 | 65 | 83 | 3.85 | 0.42 | NR |
| Male | 883NRNR | 48 | 2 cardiologists | BNP | 100 | 92 | 76 | 3.84 | 0.10 | 0.91 |
| BNP | 200 | 84 | 88 | 6.93 | 0.18 | NR |
| BNP | 300 | 73 | 90 | 7.49 | 0.30 | NR |
| BNP | 400 | 64 | 93 | 9.00 | 0.39 | NR |
| Female | 703NRNR | 46 | 2 cardiologists | BNP | 100 | 88 | 59 | 2.16 | 0.20 | 0.87 |
| BNP | 200 | 78 | 82 | 4.27 | 0.27 | NR |
| BNP | 300 | 72 | 87 | 5.40 | 0.32 | NR |
| BNP | 400 | 61 | 89 | 5.55 | 0.44 | NR |
|  |  | Caucasian | 773NRNR | 50 | 2 cardiologists | BNP | 100 | 93 | 69 | 2.96 | 0.10 | 0.88 |
| BNP | 200 | 82 | 82 | 4.63 | 0.21 | NR |
| BNP | 300 | 72 | 86 | 5.11 | 0.33 | NR |
| BNP | 400 | 60 | 90 | 5.86 | 0.44 | NR |
| African American | 715NRNR | 44 | 2 cardiologists | BNP | 100 | 87 | 76 | 3.61 | 0.17 | 0.90 |
| BNP | 200 | 81 | 88 | 6.45 | 0.22 | NR |
| BNP | 300 | 74 | 91 | 8.24 | 0.28 | NR |
| BNP | 400 | 66 | 93 | 8.79 | 0.37 | NR |
| Maisel,312010BACH | Cross-sectional | Acute dyspnea, all | 1,641NRNR | 35 | 2 cardiologists | BNP | 100 | 96 | 62 | 2.51 | 0.07 | 0.91 |
| BNP | 300 | NR | NR | NR | NR | 0.9 |
| McCullough,322002aBreathing Not Properly Study | Cross-sectional | Dyspnea all | 41762.2y55.2 | 21 | 2 cardiologists, Framingham, NHANES | BNP | 100 | 93 | 77 | 4.10 | 0.09 | NR |
| McCullough,332002bBreathing Not Properly Study | Cross-sectional | Acute dyspnea | 153864y56 | 47 | 2 cardiologists | BNP | 100 | 90 | 73 | 3.33 | 0.14 | 0.9 |
| Morrison,34 2002  | Cross-sectional | Acute dyspnea | 321NRNR | 42 | 2 cardiologists, Framingham criteria, echocardiography, nuclear medicine, ejection fractions, or left ventriculography done at cardiac catheterization. | BNP | 94 | 86 | 98 | 43.00 | 0.14 | 0.99 |
| BNP | 105 | 86 | 94 | 14.33 | 0.15 | NR |
| BNP | 135 | 90 | 90 | 9.00 | 0.11 | NR |
| BNP | 195 | 94 | 85 | 6.27 | 0.07 | NR |
| BNP | 240 | 96 | 79 | 4.57 | 0.05 | NR |
| Mueller,35 2005 & Gegenhuber,362006  | Cross-sectional | Dyspnea all | 25158-82y93 | 55 | Framingham  | BNP | 100 ng/L | 96 | 61 | 2.46 | 0.07 | NR |
| BNP | 118 ng/L | 95 | 64 | 2.64 | 0.08 | NR |
| BNP | 160 ng/L | 90 | 73 | 3.33 | 0.14 | NR |
| BNP | 295 ng/L | 80 | 86 | 5.71 | 0.23 | NR |
| Noveanu,372009BASEL | RCT | Dyspnea, all | 452NRNR | NR | Internal medicine specialist | BNP | NR | NR | NR | NR | NR | NR |
| Shortness of breath, BMI ≥30  | 8672(15)y59 | 44 | Internal medicine specialist | BNP | 100 | 91 | 68 | 2.84 | 0.13 | NR |
| BNP | 182 | 85 | 83 | 5.00 | 0.18 | 0.88 |
| BNP | 500 | 56 | 96 | 14.00 | 0.46 | NR |
| Shortness of breath, BMI <30  | 36665(14)y58 | 50 | Internal medicine specialist | BNP | 100 | 96 | 56 | 2.18 | 0.07 | NR |
| BNP | 298 | 84 | 81 | 4.42 | 0.20 | 0.88 |
| BNP | 500 | 73 | 89 | 6.64 | 0.30 | NR |
| Pahle,38 2009Breathing Not Properly Study | Cross-sectional | Dyspnea | 1,58364(17)y56 | 47 | 2 cardiologists, Framingham, NHANES | BNP | NR | NR | NR | NR | NR | NR |
| Dyspnea, history of hypertension | 87956-77y54 | 54 | 2 cardiologists, Framingham, NHANES | BNP | 50 | 97 | 56 | 2.20 | 0.05 | NR |
| BNP | 100 | 90 | 72 | 3.21 | 0.14 | NR |
| BNP | 120 | 88 | 76 | 3.67 | 0.16 | NR |
| BNP | 140 | 86 | 78 | 3.91 | 0.18 | NR |
| BNP | 160 | 85 | 80 | 4.25 | 0.19 | NR |
| BNP | 194 | NR | NR | NR | NR | 0.88 |
| BNP | 180 | 83 | 83 | 4.88 | 0.20 | NR |
| BNP | 200 | 82 | 85 | 5.47 | 0.21 | NR |
| BNP | 300 | 74 | 88 | 6.17 | 0.30 | NR |
| Dyspnea, no history of hypertension | 60845-75y60 | 35 | 2 cardiologists, Framingham, NHANES | BNP | 50 | 98 | 70 | 3.27 | 0.03 | NR |
| BNP | 100 | 90 | 83 | 5.29 | 0.12 | NR |
| BNP | 115 | NR | NR | NR | NR | 0.93 |
| BNP | 120 | 87 | 85 | 5.80 | 0.15 | NR |
| BNP | 140 | 83 | 88 | 6.92 | 0.19 | NR |
| BNP | 160 | 82 | 89 | 7.45 | 0.20 | NR |
| BNP | 180 | 80 | 92 | 10.00 | 0.22 | NR |
| BNP | 200 | 79 | 93 | 11.29 | 0.23 | NR |
| BNP | 300 | 68 | 95 | 13.60 | 0.34 | NR |
| Pahle,382009Breathing Not Properly Study (cont’d) | Cross-sectional | Dyspnea, elevated emergency department BP | 84354-78y51.8 | 52 | 2 cardiologists, Framingham, NHANES | BNP | 50 | 97 | 61 | 2.49 | 0.05 | NR |
| BNP | 100 | 91 | 78 | 4.14 | 0.12 | NR |
| BNP | 120 | 88 | 80 | 4.40 | 0.15 | NR |
| BNP | 140 | 87 | 82 | 4.83 | 0.16 | NR |
| BNP | 150 | NR | NR | NR | NR | 0.90 |
| BNP | 160 | 85 | 84 | 5.31 | 0.18 | NR |
| BNP | 180 | 82 | 87 | 6.31 | 0.21 | NR |
| BNP | 200 | 81 | 87 | 6.23 | 0.22 | NR |
| BNP | 300 | 72 | 91 | 8.00 | 0.31 | NR |
| Dyspnea, no elevated emergency department BP | 74049-76y60 | 42 | 2 cardiologists, Framingham, NHANES | BNP | 50 | 97 | 63 | 2.62 | 0.05 | NR |
| BNP | 100 | 89 | 76 | 3.71 | 0.14 | NR |
| BNP | 120 | 87 | 78 | 3.95 | 0.17 | NR |
| BNP | 140 | 84 | 81 | 4.42 | 0.20 | NR |
| BNP | 160 | 84 | 84 | 5.25 | 0.19 | NR |
| BNP | 180 | 82 | 87 | 6.31 | 0.21 | NR |
| BNP | 200 | 81 | 89 | 7.36 | 0.21 | NR |
| BNP | 205 | NR | NR | NR | NR | 0.90 |
| BNP | 300 | 73 | 91 | 8.11 | 0.30 | NR |
| Parrinelo,392008  | Cross-sectional | Shortness of breath | 29267.5y53.5 | 59 | Cardiologist, Framingham | BNP | ≥100 | 95 | 88 | 7.58 | 0.06 | NR |
| BNP | ≥127 | 95 | 93 | 14.15 | 0.06 | 0.97 |
| Potocki,40 2010  | Cross-sectional | Dyspnea | 28777 (68–83)y52 | 54 | 2 cardiologists | BNP | BNP | NR | NR | NR | NR | NR |
| Ray,41 2005EPIDASA study | Cross-sectional | Dyspnea, ≥65y | 20265–100y49 | 44 | 2 independent experts (pulmonologist, cardiologist, emergency physician, or geriatric or internal physician) | BNP | 250 | 73 | 91 | 8.11 | 0.30 | 0.85 |
| Ray,42 2006EPIDASA study  | Cross-sectional | Acute dyspnea >65y | 30880y49 | 46 | 2 of cardiologists, pulmonologist, general medicine internist, geriatric, ED physician | BNP | 100 | 90 | 59 | 2.20 | 0.17 | NR |
| BNP | 150 | 85 | 71 | 2.93 | 0.21 | NR |
| BNP | 200 | 82 | 84 | 5.13 | 0.21 | NR |
| BNP | 250 | 78 | 90 | 7.80 | 0.24 | 0.87 |
| BNP | 300 | 72 | 92 | 9.00 | 0.30 | NR |
| BNP | 350 | 67 | 92 | 8.38 | 0.36 | NR |
| BNP | 400 | 60 | 95 | 12.00 | 0.42 | NR |
| Ro,43 2011 | Cross-sectional design | Symptoms of HF | 250 70.7±13.8y 58.8 | 42 | 1 cardiologist, discharge diagnosis, echocardiography | I-STAT BNP | 100 | 94.4 | 43.3 | 1.66 | 0.13 | 0.84 |
| Triage BNP | 100 | 87.7 | 52.5 | 1.85 | 0.23 | 0.81 |
| Rogers,442009aHEARD-IT  | Cohort | Dyspnea | 740NRNR | 50 | 2 cardiologists | BNP | 100 | 96 | 69 | 3.10 | 0.06 | 0.93 |
| BNP | 400 | NR | 93 | NR | NR | NR |
| BNP | Adjust BNP cut-off with 96% sen | 96 | 73 | 3.56 | 0.05 | 0.948 |
| Rogers,45 2009b | Cross-sectional | Dyspnea, all | 33572(11)yNR | 42 | 4 physicians | BNP | 100 | 91 | 54 | 1.98 | 0.17 | 0.85 |
| BNP | 400 | NR | 92 | NR | NR | NR |
| Dyspnea, age ≥75y | 171NRNR | NR | 4 physicians | BNP | 100 | 94 | 41 | 1.59 | 0.15 | NR |
| BNP | 184 | 91 | 66 | 2.68 | 0.14 | NR |
| Dyspnea, atrial fibrillation | 109NRNR | NR | 4 physicians | BNP | 100 | 92 | 26 | 1.24 | 0.31 | NR |
| BNP | 150 | 91 | 39 | 1.49 | 0.23 | NR |
| BNP | 449 | 91 | 78 | 4.14 | 0.12 | NR |
| Dyspnea, creatinine ≥2 mg/dl | 47NRNR | NR | 4 physicians | BNP | 100 | 100 | 30 | 1.43 | 0.00 | NR |
| Dyspnea, BMI ≥35 kg/m2 | 85NRNR | NR | 4 physicians | BNP | 25 | 91 | 25 | 1.21 | 0.36 | NR |
| BNP | 100 | 64 | 61 | 1.64 | 0.59 | NR |
| Sanz,46 2006  | Cross-sectional | Acute dyspnea | 10075(14.77)y67 | NR | Clinical, laboratory, imaging, and ECG data | BNP - ADVIA | 79 | 95 | 96 | 22.16 | 0.05 | NR |
| BNP - ADVIA | 100 | 86 | 98 | 39.09 | 0.14 | NR |
| BNP - Access | 116 | 93 | 96 | 21.11 | 0.07 | NR |
| BNP - Access | 100 | 95 | 89 | 8.58 | 0.05 | NR |
| BNP - ADVIA | NR | NR | NR | NR | NR | 0.96 |
| BPN - Access | NR | NR | NR | NR | NR | 0.97 |
| Shah,47 2009  | Cross-sectional | Acute dyspnea | 412NRNR | 37 | Panel of experts and “antihypertensive-and lipid lowering treatment to prevent heart attack” trial criteria | BNP | 100 | NR | NR | NR | NR | NR |
| Acute dyspnea, LVEF ≤40% | NRNRNR | NR | Panel of experts and “antihypertensive-and lipid lowering treatment to prevent heart attack” trial criteria | BNP | 100 | NR | NR | NR | NR | 0.88 |
| Acute dyspnea, LVEF≥50% | NRNRNR | NR | Panel of experts and “antihypertensive-and lipid lowering treatment to prevent heart attack” trial criteria | BNP | 100 | NR | NR | NR | NR | 0.57 |
| Acute dyspnea, diagnosis of diastolic function | NRNRNR | NR | Panel of experts and “antihypertensive-and lipid lowering treatment to prevent heart attack” trial criteria | BNP | 100 | NR | NR | NR | NR | 0.67 |
| Shah,48 2009  | Cohort | Acute dyspnea | 412NRNR | 36 | 2 physicians | BNP | 100 | NR | NR | NR | NR | 0.90 |
| Steg,492005Breathing Not Properly Study | Cross-sectional | Dyspnea | 70966.4(14.7)y43.3 | 69 | 2 cardiologists, Framingham, NHANES | BNP | 50 | 95 | 50 | 1.90 | 0.10 | NR |
| BNP | 80 | 92 | 72 | 3.29 | 0.11 | NR |
| BNP | 100 | 89 | 73 | 3.30 | 0.15 | NR |
| BNP | 125 | 83 | 83 | 4.88 | 0.20 | NR |
| BNP | 150 | 84 | 80 | 4.20 | 0.20 | NR |
| BNP | 162 | 86 | 79 | 4.10 | 0.18 | NR |
| Villacorta,50 2002 | Cross-sectional | Acute dyspnea | 7072.4y60.4 | 51 | 1 cardiologist | BNP | 200 | 100 | 97 | 33.33 | 0.00 | 0.99 |
| Wang,51 2010  | Cross-sectional | Acute dyspnea  | 8473y48 | 58 | 2 cardiologists | BNP | 100 | 94 | 34 | 1.43 | 0.18 | NR |
| BNP | 500 | 65 | 74 | 2.54 | 0.47 | NR |
| Wu,52 2004Breathing Not Properly Study | Cross-sectional | Dyspnea all | 1586NRNR | 47 | 2 cardiologists | BNP | 100 ng/L | NR | NR | NR | NR | NR |
| Dyspnea, without diabetes | 121965.6 (13.02)y59.4 | 40 | 2 cardiologists | BNP | 100 ng/L | NR | NR | NR | NR | 0.88 |
| Dyspnea, with diabetes | 36763.5(17.6)y5.4 | 59 | 2 cardiologists | BNP | 100 ng/L | NR | NR | NR | NR | 0.87 |

**Abbreviations:** AUC = area under the curve; BACH = Biomarkers in Acute Heart Failure; BASEL = B-Type Natriuretic Peptide for Acute Shortness of Breath Evaluation; BMI = body mass index; BNP=B-Type Natriuretic Peptide; BP=blood pressure; CHF = congestive heart failure; CI = confidence interval; ECG = electrocardiogram; eGFR = estimated glomerular filtration rate; EPIDASA = Epidemiological Study of Acute Dyspnea in Elderly Patients; GFR = glomerular filtration rate; glow = lower gray zone; gup=upper gray zone; HEARD-IT = Heart Failure and Audicor technology for Rapid Diagnosis and Initial Treatment; HF = heart failure; KD = kidney disease; kg/m2 = kilograms per meter squared; LR- = negative likelihood ratio; LR+ = positive likelihood ratio; LVEF = left ventricular ejection fraction; mg/dL = milligram per deciliter; mL/min/m2 = milliliter per minute per meters squared; NA = not applicable; ng/L = nanogram per liter; NHANES = National Health and Nutrition Examination Survey; NR = not reported ; pg/mL = picograms per milliliter; RCT = randomized controlled trial; SOB = shortness of breath; y = year(s)