

# Predicting the Future: Can This Patient With Acute Congestive Heart Failure Be Safely Discharged From the Emergency Department?

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## CLINICAL SCENARIO

A 72-year-old white woman with a medical history of heart failure and hypertension presents with increasing shortness of breath and bilateral leg swelling for the past 5 days. She denies any other associated symptoms such as chest pain, fever, or cough. Her medications include furosemide and digoxin, which have not been changed recently.

On examination, the patient has a respiratory rate of 22 breaths/min and an ambient pulse oximetry reading of 95%. Her blood pressure is 150/78 mm Hg, pulse rate is 88 beats/min, and temperature is 97.5°F (36.4°C). Lung auscultation reveals bibasilar crackles. Her legs have +1 pedal edema. You interpret her ECG as a sinus rhythm with no changes compared with her old ECG. The chest radiograph reveals findings consistent with mild heart failure. You contact the patient's primary care physician (PCP) regarding her admission, a routine disposition of heart failure patients presenting with exacerbation to your emergency department. She suggests that you give the patient additional furosemide in the ED and discharge her on an increased dose of furosemide, saying "Nothing bad will likely happen soon, and I'll see her tomorrow in my office." You are uncomfortable with this suggestion because you are not aware of any validated clinical decision rule (CDR) or empirically derived criteria identifying a subgroup of heart failure patients that can be safely discharged from the ED. Lacking further information to sway the PCP, you discharge the patient. After completing the shift, you decide to conduct a medical literature search and appraisal to address this topic.

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 FORMULATING THE QUESTION

Clinicians, as part of their daily duties, are frequently called on to predict the future as part of the process of making decisions on behalf of their patients. Clinicians who lack psychic power or crystal balls may seek tools derived from relevant clinical studies to assist with such predictions. These tools may, in turn, be qualitative or quantitative. Qualitative predictors, such as elements of history and physical examination, simply increase or decrease the likelihood of specific events in patients with a particular disease, condition, or injury. CDRs turn some combination of qualitative predictors into quantitative instruments predicting specific likelihoods of events in such patients.

Elements required to develop a searchable question regarding the likelihood of events include patient population, patient care setting, and outcome of interest. In this case, the patient population and care setting are adult patients presenting with heart failure to the ED. You decide to exclude children because the etiologies and clinical course of heart failure differ between children and adults. The patient population is further narrowed to heart failure patients presenting with primary exacerbation of their disease without accompanying acute comorbid illnesses (ie, pneumonia, gastrointestinal bleed) or clinically evident acute cardiac ischemia because these may independently alter the course and prognosis.

Several outcomes are of interest to you when trying to assess risk of an adverse medical event when treating a heart failure patient. The primary outcome of interest is death, especially death occurring within a short period after discharge. Outcomes of secondary interest include the need for readmission and the development of malignant arrhythmia, respiratory failure, myocardial infarction, cardiac arrest, and cardiogenic shock. You also need to designate the post-ED setting in which those events occur. The risk of adverse events may differ between admitted and discharged patients because they may be different in terms of their disease severity, intensity of therapy, and monitoring. Finally, the time period after the ED evaluation within which these events occur has to be defined. You decide to focus on short-term (30-day) death, major complications, or readmission for evaluation of these acute episodes. You choose those because they are more likely to be attributable to the admission decision at the time of emergency presentation than would be longer-term outcomes (ie, survival for 1 to 2 years). The question may then be reformulated: "Among adult patients presenting to the ED with an acute exacerbation of congestive heart failure (CHF) without other acute comorbid illnesses or obvious cardiac ischemia, are there identified empirical criteria or a validated clinical decision rule that can support a decision to discharge an apparently stable patient with minimal risk of death, major complications, or readmission within 30 days of ED presentation?"

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## SEARCHING FOR AND SELECTING THE BEST EVIDENCE

Having recently read the *Journal of the American Medical Association's* "Users' Guides to the Medical Literature" series on prognosis,<sup>1</sup> clinical practice guidelines,<sup>2,3</sup> and CDRs,<sup>4</sup> you realize the importance of establishing a set of criteria to evaluate and identify the best evidence to answer your question. You decide to focus on studies involving adult patients evaluated in the ED for primary exacerbation of heart failure without comorbid illnesses or obvious cardiac ischemia. Because you are interested in identifying patients who may be safely discharged, you want to find studies that assess the probability of adverse outcomes within 30 days of their ED evaluation. Practice guidelines, clinical decision rules, or observational studies of clinical outcomes of patients similar to yours might all address this issue.

You decide that you can confidently base your clinical behavior on CDRs incorporating those elements that have been prospectively validated against a broad spectrum of patients. In absence of such convincing evidence, you would be willing to consider CDRs that have been prospectively validated in a more narrowly defined population. In the absence of higher levels of evidence, you will consider cohort studies or unvalidated CDRs that identify prognostic factors of adverse outcomes. Such studies would be less likely to provide an adequate basis for reversing a decision to admit a patient presenting to the ED with acute CHF.

Before conducting your search, a colleague suggests that you review the Agency for Health Care Policy Research (AHCPR) Clinical Practice Guideline for the Evaluation and Management of Patients With Heart Failure, which offers criteria for hospital admission decisions.<sup>5</sup> Your review of the guideline raises several concerns. First, some of the criteria, such as ejection fraction or diastolic dysfunction, cannot be obtained in a timely fashion in the ED or are undocumented. Second, the AHCPR expert panel based their recommendations heavily on 3 studies that used cohorts of elderly Medicare patients<sup>6-8</sup> and patients who survived the index admis-

sion.<sup>6</sup> The results may not be generalizable to all adult heart failure patients presenting to the ED. Finally and most importantly, this guideline is consensus-based rather than evidence-based.

You conduct a search with MEDLINE, a readily accessible database of all the journals included in Index Medicus from 1966 to the present. Using online OVID as the search engine, you start your search with the term “heart failure” as a key word. OVID maps it to the medical subject heading (MeSH) term “heart failure, congestive.” You choose to limit the search to subheadings of “mortality,” “complications,” “prevention and control,” and “epidemiology.” To be sure you have not missed important articles, you also search a set of either exploded or “mapped to key word” terms of “practice guidelines,” “rule,” “pathway,” “prediction,” “prognosis,” “decision making,” “outcome and process assessment (healthcare),” “patient admission,” or “hospital mortality.”

You combine these 2 sets and limit the aforementioned combination to human study participants and English language. The search retrieves 303 articles. You were unable to locate any validated CDRs. The only articles that approximated your search criteria were 3 studies of inpatient cohorts<sup>9-11</sup> and 1 study of both inpatients and outpatients<sup>12</sup> that derived prognostic criteria for adverse outcome based on clinical information routinely obtained in the ED. Two studies used death as the outcome of interest,<sup>9,12</sup> 1 used death or readmission,<sup>11</sup> and the fourth used a combination of death and other events, such as malignant arrhythmia or cardiac arrest.<sup>10</sup>

Having heard that MEDLINE may be inefficient for searches of CDRs but lacking time to do exhaustive searches of all possible resources, you supplement your review by searching another database, Emergency Medical Abstracts (<http://ccme.org/EMA/index.html>), using the key word “CHF.” Again, you do not find a validated CDR. You do, however, identify a study on ICU triaging criteria for a cohort of patients with cardiogenic pulmonary edema admitted through the ED that was missed by your MEDLINE search.<sup>13</sup> Although these 5 articles do not fulfill your criteria for best clinical evidence and do not fit exactly into your clinical scenario of interest, you decide to review them because they can at least give you some idea whether your patient is at low risk for an adverse outcome.

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## ANALYZING THE EVIDENCE

Of the articles you have found through your search, some may be regarded as corresponding to phases in a process

of CDR development, whereas others merely attempt to identify individual predictors of clinical outcome in patients with acute CHF. The assessment of these 2 types of study is based on related but distinct criteria.<sup>1,4</sup> For a CDR to be useful to most clinicians, it must have been prospectively validated in one or several populations distinct from the one used to derive it.<sup>4</sup> The validation should also reflect or be consistent with the way the rule is to be actually used by clinicians. For example, if a set of clinical criteria are to be used by clinicians to identify patients for whom interventions, such as radiographs or hospital admissions, may be safely avoided, the validation study should involve explicit training of the clinicians in the study to use the rule for this purpose, even though all patients may still receive imaging or be admitted to the hospital in this phase. The performance of the decision rule must also satisfy the requirements of patients and their physicians. In the case at hand, a decision rule would have to be demonstrated to identify a subgroup of patients with acute CHF of sufficiently low risk for clinicians to be comfortable discharging them from the ED.

At the highest level of development, the actual impact of the decision rule on patient care and outcomes is studied. This may or may not involve randomized, controlled trials.<sup>4</sup> A decision rule that has merely been derived but has not been prospectively validated or subjected to impact analysis may be relevant to future research efforts, but can not yet be recommended for clinical use. In such a case, the study is useful only to the extent that identification of the individual clinical predictors may inform clinical decision-making. Your first task in reviewing the articles you have found is therefore to determine whether any of them constitute decision rules that have been sufficiently validated for use. If not, you will only be able to consider the evidence from the standpoint of criteria applicable to studies on prognostic determinants of outcome.<sup>1</sup>

The clinical practice setting is an important determinant of validity both for the development of decision rules and in simple cohort studies on prognostic questions.<sup>1,4</sup> In the case at hand, the study population should ideally include patients for whom clinicians would ordinarily consider outpatient management after stabilization and should not be restricted to patients admitted to the hospital. A study confined to patients assessed clinically to require admission to the hospital would be subject to bias in several predictable ways. Such patients should be expected to reflect a severity of disease at least as high as those discharged from the ED. Furthermore, most of us would expect hospital care to improve outcomes and

decrease bad event rates, or at least not to worsen them. Hence, predictors of higher risk for bad outcomes identified in a group of admitted patients, for whom the benefits of hospital care and monitoring are available, could also be expected to increase the risk for less severe patients who were discharged. Such an assumption could be challenged and might ultimately be disproved. However, it is consistent with clinicians' and patients' concerns for patient safety.

The effect of a strictly inpatient study population on the validity of criteria identified as decreasing the risk of bad events is harder to predict. On the one hand, the better outcomes of patients meeting such criteria might vanish if the positive effects of hospitalization were removed. On the other hand, predictors that might not seem to sufficiently decrease the event rates of patients in the inpatient setting to convince clinicians to use them as discharge criteria might actually define a much lower risk of events in a population already at significantly lower risk. Therefore, you will be inclined to dismiss the results of studies based only on admitted patients insofar as low-risk criteria are concerned. With these thoughts in mind, you proceed to examine the studies you have selected.

Selker et al<sup>9</sup> used 401 patients admitted from the ED for primary heart failure exacerbation to develop a predictive instrument for acute hospital mortality. This population is a subset of consenting participants prospectively enrolled in a 2-year multicenter study of coronary care unit admitting practices. The primary aim of the original study was to develop a predictive instrument for mortality in patients with chief complaints consistent with acute cardiac ischemia. Thus, patients with acute cardiac ischemia may have skewed the characteristics of the participants in the heart failure study, as evidenced by the fact that 43% of the patients with heart failure reported active chest pain. Eligible participants were male patients older than 30 years of age or female patients older than 40 years of age admitted with CHF not associated with acute myocardial infarction through the EDs of 6 hospitals. The mixture of teaching, community, urban, and rural hospitals allows the results of this study to be applied to a broad spectrum of hospital settings. How well your patient fits into the study cohort is difficult to ascertain because demographic information about the study participants is sketchy. The use of clinical information available in the first 10 minutes of ED presentation is of interest to you. However, the time to death was not defined. Although your impression is that most heart failure in-hospital deaths occur within 30 days, you do not have any information to confirm that assumption. In addition, deaths

that may have occurred shortly after hospital discharge were not included.

Another report that used death as the only outcome is the study by Cowie et al<sup>12</sup> of 220 British patients presenting to their PCP or ED with an incident case of heart failure. The authors provided estimates of cardiovascular mortality rates at 1, 3, 6, 12, and 18 months after incident presentation and developed a predictive model of mortality during the follow-up period. They were able to identify 90% of the new heart failure cases during the study period through an agreement among the general practitioners to refer their heart failure patients to a rapid access clinic or the designated ED and prospective examination of hospital admission records. You do not know whether the study participants presented with other acute comorbid conditions, although you suspect that the study population may be of lesser severity than your patient because 18% were referred to a rapid access clinic. The authors did provide extensive demographic data to allow you to assess how well your patient fits into the study population. You like the study because of its inclusion of outpatient mortality and development of a predictive model based on readily available information.

In contrast with the first 2 studies, Katz et al<sup>13</sup> were interested in other in-hospital complications in addition to death for a cohort of 108 patients admitted with cardiogenic pulmonary edema through the ED. Prospectively identifying such patients from admission records, these authors attempted to derive prognostic factors for in-hospital complications that occurred within 2 days of hospitalization and would require ICU admission for patients with an uncomplicated ED course. Definitions of complications and predictor variables were provided in the article or available from the authors.\*

You are concerned about how your patient fits into the study population because patients were recruited in a tertiary urban teaching hospital. You suspect that the study population may have a higher severity of illness than the general heart failure population because of the high rate of patient admissions (47%) to the ICU. Furthermore, the authors did not specify how many of their patients presented with other severe comorbid illnesses that may affect their prognosis. You are also not sure whether you would consider all the complications listed by the authors, such as insertion of pulmonary or peripheral arterial catheter, as your complications of interest. Additionally,

\*Complications were defined as hypotension, arrhythmias, myocardial infarction, recurrent pulmonary edema, late admission to ICU, intubation, pulmonary arterial catheter, arterial catheter, cardiopulmonary resuscitation, and death within 2 days.<sup>13</sup>

the prediction rule was derived for in-hospital complications within 2 days of admission, an insufficient length of follow-up for your admission decisionmaking.

Chin and Goldman<sup>10,11</sup> performed the other 2 studies using information readily obtainable in the ED to assess risk in heart failure patients. Both studies included patients admitted nonelectively with a complaint of shortness of breath or fatigue and evidence of pulmonary congestion on admission chest radiograph. The extensive patient demographic data provided in the articles allow you to judge how well your patient matches these study participants. Again, you are concerned about contamination of the subject population by patients with active cardiac ischemia, including 9% with acute myocardial infarction. Furthermore, you are not quite sure what to make of the fact that 17% of the study participants did not have heart failure as primary or secondary discharge diagnoses. Finally, both studies were performed in an urban teaching hospital that was a cardiac transplant center, a potential limitation to the generalizability of their findings.

In their 1996 study, Chin and Goldman<sup>10</sup> used in-hospital death or major complications as the outcome of interest in a cohort of 435 eligible patients. The list of complications (Figure) and diagnostic criteria were well defined in the article and appeared to be information easily obtainable from chart review. They were able to review all but 1 chart and reported good reproducibility of chart abstraction. Again, as in the study by Selker et al,<sup>9</sup> the time frame within which the events occurred was not defined. However, you had an estimate because the average length of heart failure admission in this study was 8 days, with an interquartile range of 3 to 10 days. You prefer this methodology because of its clear subject selection criteria, extensive demographic information, and the reproducibility and likely completeness of outcome data.

**Figure.**

*List of major in-hospital complications in the 1996 study by Chin et al.<sup>10</sup>*

Myocardial infarction
Nonfatal ventricular fibrillation
New Mobitz type II or new complete heart block
Cardiogenic shock
Cardiac arrest
Nonsurgical intubation
Implantation of intra-aortic balloon pump
Emergency valve surgery

The investigators chose to address postdischarge death and complications in a subsequent study. Thus, the prediction rule may not identify patients who did poorly shortly after discharge.

In the 1997 follow-up study by Chin and Goldman,<sup>11</sup> the primary outcome of interest was death after discharge or hospital readmission within 60 days. The cohort consisted of 257 of the 435 participants enrolled in the 1996 study. The remainder of the 1996 cohort either died during initial hospitalization, refused to participate, was lost to follow-up, or did not have proxy consent. The exclusion of almost 40% of the eligible population may have introduced a study bias. Your review suggests this because the enrolled population was more likely to be white, younger, and less tachypneic than patients who were not enrolled. Of particular concern was the exclusion of patients who died before hospital discharge (5%). These are patients you want to be able to identify and admit. Furthermore, the authors identified readmissions on the basis of patient recall or review of the medical records of the study hospital. Some patients who had poor recall or were readmitted to a different hospital may not have been included in the analysis. The use of deaths and readmission up to 60 days after ED presentation was also outside your time range of interest.

Having reviewed the designs and populations of the 5 studies, you turn your attention to which predictive models were used. Selker et al<sup>9</sup> used a logistic regression analysis to identify 4 clinical variables that predicted hospital death: (1) increased patient age, (2) depressed initial systolic blood pressure, (3) presence of ECG T wave flattening in at least 2 contiguous leads, and (4) absence of normal sinus rhythm with a rate between 60 and 100 beats/min. This prognostic instrument accurately discriminated between patients who survived and died as evidenced by an area under the receiver operating characteristic curve of 0.90. The findings suggest that younger patients presenting in sinus rhythm with a rate between 60 and 100 and with normotensive or hypertensive systolic blood pressure and no T wave flattening on ECG were at lower risk of death during their heart failure admission. However, the study did not specifically identify a low risk group of patients for whom outpatient therapy might be appropriate.

Cowie et al<sup>12</sup> identified lower systolic blood pressure, higher serum creatinine concentration, and greater extent of crackles on auscultation of the lungs as independent predictors of cardiovascular mortality. The risk of death can be estimated on the basis of the presence or absence of each risk factor. The predictive model was developed for

mortality through the entire follow-up period rather than just 1 month after presentation. Again, no low-risk group was identified.

The aim of the model by Katz et al<sup>13</sup> was also to identify patients at high risk. Through logistic regression, Katz et al determined that a history of prior episodes of pulmonary edema, presence of elevated jugular venous pressure, and elevated blood urea nitrogen (BUN) or creatinine were predictive of death and complications within 2 days of admission after an initially uncomplicated ED course.<sup>13</sup> Although the authors focused on the sensitivity and specificity of this rule in predicting the need for ICU care, the probability of adverse outcome based on the presence or absence of these criteria can be estimated from the equation given in the manuscript. Other variables such as T wave abnormality and diuresis of less than 1 liter within 4 hours are also associated with increased probability of adverse events but are not significant when combined with the aforementioned 3 criteria.

Chin and Goldman<sup>10</sup> found systolic blood pressure less than or equal to 90 mm Hg, respiratory rate more than 30 breaths/min, sodium less than or equal to 135 mmol/L, and presence of ST-T wave changes not known to be old or caused by digitalis effect to be independent predictors of inhospital mortality and major complications. The risk of an adverse outcome increased as the number of risk factors increased (0 risk factors, 6%; 1 risk factor, 17%; 2 risk factors, 44%; and 3 risk factors, 83%). As with the first 3 models, this prediction scheme did not identify a group of patients at low enough risk to be safely discharged rather than admitted.

In their 1997 follow-up study, Chin and Goldman<sup>11</sup> identified 3 independent predictors of 60-day mortality after hospital discharge: hypotension (systolic blood pressure  $\leq 100$  mm Hg), non-sinus rhythm, and diabetes. In contrast, 60-day readmission or death was predicted by single marital status, Charlson Comorbidity Index (CCI) score, systolic blood pressure less than or equal to 100 mm Hg, and absence of new ST-T wave changes on ECG. The CCI score is a generic weighted index of the effect of the number and severity of comorbid illnesses on the risk of mortality.<sup>14</sup> The latter model was used as a measure of the burden of comorbid illnesses on the risk of mortality in longitudinal studies. Chin and Goldman stratified patients into 4 risk groups based on a score (sum of points assigned to each risk factor based on hazard ratios [HR] [ie, 1 point for HR=1.0 to 1.9 and 2 points for HR=2.0 to 2.9]) used to assess the risk of readmission or death. The proportion of patients with an observed adverse outcome increased quickly with increasing risk

scores (0 to 1 points, 0%; 2 to 5 points, 24%; 6 to 7 points, 42%; >7 points, 72%). Although none of the 17 patients in the lowest risk group had an adverse outcome, the risk could be as high as 20% based on a 95% confidence interval for this small sample size.

#### APPLYING THE EVIDENCE

After reviewing the medical literature, you decide that none of the studies provide you with criteria suitable to predict whether your patient, or future similar patients, would have an acceptably low risk of a poor outcome if discharged home from the ED. All except for the study by Cowie et al<sup>12</sup> looked at likelihood of death or other events for inpatients only. Although discharged patients would presumably have lower disease severity than patients who were admitted, their level of therapy and intensity of monitoring may be lower than those received by inpatients.

How these factors affect the likelihood of an adverse outcome in discharged ED patients is unknown. Although Cowie et al<sup>12</sup> included a significant portion of patients managed as outpatients, these outpatients were referred to a rapid access clinic, implying a difference in severity and prognosis. Only Cowie et al and the 1997 study by Chin and Goldman<sup>11</sup> examined posthospitalization outcomes. Both the Selker et al<sup>9</sup> and Katz et al<sup>13</sup> rules are cumbersome to use because they require calculating a probability using a relatively complex equation or using a somewhat confusing table. The Cowie et al rule does not provide a way to estimate the risk if more than 1 risk factor is present.

Furthermore, all 3 papers did not define a low-risk category acceptable for outpatient therapy. Both Chin and Goldman<sup>10,11</sup> models leave a high probability of undesirable outcomes even for the low-risk group. For example, is a 6% risk of death or major complication acceptable for those without high-risk criteria? Does this truly define low risk? Although no adverse events after hospital discharge were observed in heart failure patients with a risk score of 0 to 1 in their later study, the risk could be as high as 20% in your ED.<sup>11</sup> You feel somewhat reassured that your patient does not fit the high-risk profile in all the models, but your uneasiness regarding her outcome as an outpatient remains.

In summary, your review of the evidence failed to identify a validated decision rule that would help you select for discharge after ED evaluation a group of heart failure patients at low risk of short-term morbidity and mortality. Your search confirmed that there is no single approach to

either resources or search strategies that guarantees that important studies will not be overlooked.

On the other hand, you are fairly confident that you have not overlooked a broadly validated CDR in this area. The development of a decision rule usually involves multiple studies performed by more than 1 research team. If such an instrument exists to aid with the admission decision of ED patients with acute CHF, you would most likely have detected it with your search.

You did identify cohort studies that provide information to help you assess your patient's risk of an adverse outcome, but the evidence is insufficient to help you determine who can be safely discharged. Pending the development of a validated clinical decision rule in this area, you will continue to base your decision to discharge such patients on your clinical experience and comfort level in collaborating with individual practitioners in other specialties. Awareness of what the clinical evidence does and does not tell us strengthens your clinical confidence in dealing with such practitioners in a reasoned fashion.

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## Critically Appraised Topic (CAT):

## “Can this patient with acute congestive heart failure be safely discharged from the ED?”

<b>Question</b>	Among adult patients presenting to the ED with an acute exacerbation of chronic heart failure without other acute comorbid illnesses or obvious cardiac ischemia, are there identified empiric criteria or a validated clinical decision rule that can support a decision to discharge an apparently stable patient with minimal risk of death, major complications, or readmission within 30 days of ED presentation?
<b>Reviewed by</b>	Hsieh M, Auble TE, Yealy DM
<b>Date</b>	December 19, 2000
<b>Expiration date</b>	December 19, 2002
<b>Clinical bottom line</b>	Review of the current medical literature revealed no validated decision rules that identified a group of patients with heart failure at low risk of short-term morbidity and mortality for discharge after their ED evaluation. Some cohort studies provide information to help assess a patient's risk of an adverse outcome, but the evidence is insufficient to determine who can be safely discharged or the risk of in-hospital death and the complication rate is too high.
<b>Search strategy</b>	We searched MEDLINE via OVID using MeSH terms “heart failure, congestive.” We limited the search to subheadings of “mortality,” “complications,” “prevention and control,” and “epidemiology,” and combined the above set with a set of either exploded or “mapped to key word” terms of “practice guidelines,” “rule,” “pathway,” “prediction,” “prognosis,” “decision making,” “outcome and process assessment (healthcare),” “patient admission,” or “hospital mortality.” We further limited the search to English language, human participants, and the years 1966 and December 2000. We searched Emergency Medical Abstracts with the term “CHF.” We selected studies that included CDRs on the probability of adverse outcome within 30 days of ED presentation in adult patients with CHF exacerbations.
<b>Citations</b>	<ol style="list-style-type: none"> <li>Selker H, Griffith J, D'Agostino R. A time-sensitive predictive instrument for acute hospital mortality due to congestive heart failure: development, testing, and use for comparing hospitals: a multicenter study. <i>Med Care</i>. 1994;32:1040-1052.</li> <li>Cowie MR, Wood DA, Coats AJS, et al. Survival of patients with a new diagnosis of heart failure: a population based study. <i>Heart</i>. 2000;83:505-510.</li> <li>Katz MH, Nicholson BW, Singer DE, et al. The triage decision in pulmonary edema. <i>J Gen Intern Med</i>. 1988;3:533-539.</li> <li>Chin M, Goldman L. Correlates of major complications or death in patients admitted to the hospital with congestive heart failure. <i>Arch Intern Med</i>. 1996;156:1814-1820.</li> <li>Chin M, Goldman L. Correlates of early hospital readmission or death in patients with congestive heart failure. <i>Am J Cardiol</i>. 1997;79:1640-1644.</li> </ol>
<b>Study characteristics</b>	<p><b>Population</b></p> <p><b>Selker et al:</b> Patients with primary CHF and no evidence of acute myocardial infarction admitted by the EDs of teaching and community hospitals.</p> <p><b>Cowie et al:</b> Patients with CHF referred to a rapid access clinic from a designated ED or their PCP.</p> <p><b>Katz et al:</b> Patients with cardiogenic pulmonary edema admitted by the ED of an urban teaching hospital.</p> <p><b>Chin and Goldman (1996):</b> Patients with dyspnea or fatigue and CHF on chest radiograph admitted nonelectively to an urban teaching hospital.</p> <p><b>Chin and Goldman (1997):</b> Same group mentioned previously who survived the hospitalization.</p> <p><b>Outcome of Interest and Follow-up Period</b></p> <p><b>Selker et al:</b> In-hospital mortality.</p> <p><b>Cowie et al:</b> Cardiovascular mortality for 1, 3, 6, 12, and 18 months.</p> <p><b>Katz et al:</b> In-hospital complications within 2 days of admission; in-hospital mortality.</p> <p><b>Chin and Goldman (1996):</b> In-hospital mortality; major complications.</p> <p><b>Chin and Goldman (1997):</b> Mortality or readmission within 60 days of discharge.</p>
<b>Critical appraisal</b>	<p><b>Selker et al:</b> High percentage of the study population with active chest pain may have skewed the patient characteristics. The authors did not attempt to identify a low-risk population. Overall quality fair to good.</p> <p><b>Cowie et al:</b> The investigators did not provide detailed information on demographics, accompanying acute comorbidities, or presence of active cardiac ischemia. No attempt was made at identifying a low-risk population. Overall quality good.</p> <p><b>Katz et al:</b> Limitations to this study's applicability to the clinical question includes higher illness severity, insufficient follow-up period for in-hospital complications as an outcome, inclusion of complications that may be clinically insignificant, and lack of information about accompanying acute comorbidities. No low-risk subset was identified. Overall quality fair.</p> <p><b>Chin and Goldman:</b> Limitations to their applicability include inclusion of patients without CHF as their primary or secondary discharge diagnoses, follow-up periods that were vague or outside of clinical interest, low-risk subgroup with still unacceptably high risk of adverse outcome. Overall quality fair to good.</p>

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**Critically Appraised Topic (CAT):****“Can this patient with acute congestive heart failure be safely discharged from the ED?”****(continued)**

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**Results*****Selker et al:***

1. Increased age
2. Lower SBP
3. T wave flattening
4. Absence of sinus rhythm between 60 and 100 mm Hg

***Cowie et al:***

1. Lower SBP
2. Higher BUN
3. Crackles on examination

***Katz et al:***

1. Prior pulmonary edema
2. Presence of jugular venous distention
3. Elevated BUN

***Chin and Goldman (1996):***

1. SBP  $\leq$ 90 mm Hg
2. Respiratory rate  $>$ 30 breaths/min
3. Sodium  $\leq$ 135 mmol/L
4. New ST-T wave changes not caused by digoxin toxicity

***Chin and Goldman (1997):*****Mortality only:**

1. SBP  $\leq$ 100 mm Hg
2. Non-sinus rhythm
3. Diabetes

**Mortality and readmission:**

1. Single marital status
2. CCI score
3. SBP  $\leq$ 100 mm Hg
4. New ST-T wave changes not caused by digoxin toxicity