

# Meta-Analysis of Risks for Short-Term Readmission in Patients With Heart Failure

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This investigation sought to quantify the risk factors for short-term readmission in patients with heart failure (HF). Electronic databases were systematically searched for studies reporting relative risk, odds ratio, and hazard ratio for the combined primary outcome of all-cause hospital readmission or all-cause mortality  $\leq 90$  days from discharge of patients with HF. Clinical characteristics, study design, type and incidence of outcome, univariable effect sizes for each risk factor, and their associated 95% confidence intervals were extracted. Each univariable effect size was pooled and computed in a separate meta-analysis using random-effects models weighted by inverse variance. The frequency of significance of each risk factor in multivariable models was also assessed to confirm their independence. Sixty-nine studies (2,038,524 patients) were included and 144 factors were reported, including 32 reported more than twice. The significant associations of the combined primary outcome were chronic lung disease, chronic kidney disease, atherosclerotic vascular disease (peripheral, coronary, and cerebrovascular), diabetes, anemia, lower systolic blood pressure, previous admission, multidisciplinary treatment, and use of beta-blockade and angiotensin-converting enzyme inhibition or angiotensin receptor blockade. In multivariable analyses, most of these variables remained independently associated with the combined primary outcome. However, age, male gender, black race, hypertension, dyslipidemia, smoking, atrial fibrillation, cancer, and uses of diuretics, aldosterone antagonists, and digoxin were not significant. In conclusion, noncardiovascular co-morbidities, poor physical condition, history of admission, and failure to use evidence-based medication are more strongly associated with 90-day readmission or death than standard risks in patients with HF. © 2015 Elsevier Inc. All rights reserved. (Am J Cardiol 2015;■:■-■)

Heart failure (HF) is a leading cause of hospital readmission in patients aged  $>65$  years.<sup>1</sup> Despite improvement in outcomes with medication, readmission rates after HF admission are still increasing. This poses significant problems including impaired quality of life and increased costs and resource utilization.<sup>2,3</sup> The recent inclusion of 30-day all-cause readmission or death as a major focus of quality improvement and payment reform attests to the seriousness of readmission in patients with HF as a health economic problem.<sup>2,4</sup> Many of these readmissions are predictable and, therefore, possibly preventable.<sup>1,5,6</sup> On these grounds, it is important for clinicians to identify which patients may be at highest risk of being readmitted. Although various strategies have been used to limit readmissions,<sup>7</sup> the processes of care in these programs have varied substantially and not all have been associated with lower readmission rates.<sup>8</sup> A better understanding of the risks for readmission is essential for more effective targeting of disease management strategies. Readmission is prone to occur relatively early, especially in the transition phase from hospital to home,<sup>9</sup> and the 90-day

risk of readmission has been widely published. In this study, we sought to quantify risk factors for the prediction of all-cause hospital readmission or all-cause mortality  $\leq 90$  days from discharge.

## Methods

We followed the Meta-analysis of Observational Studies in Epidemiology criteria for performing and reporting the present meta-analysis (Appendix 1).<sup>10</sup> The electronic databases PubMed, Scopus, PsychINFO, and the Evidence-Based Medicine Reviews on Ovid were searched using the medical subject heading (MeSH) terms patient readmission, risk, and HF. First, we performed a search using the MeSH term “patient readmission” and the key words “readmi\$” and “reosp\$” (using “\$” for truncation). Second, we searched using the MeSH term “risk” and the key words, “model\$,” “predict\$,” “use\$,” “util\$,” and “risk\$.” Third, we searched using the MeSH term “heart failure, congestive.” Combination of the term results from the patient readmission, risk, and HF searches included 4,536 articles. This search result was narrowed down using the follow-up descriptors, “30-day,” “60-day,” and “90-day.” The final search included a total of 882 articles (30-day readmission: 518 articles, 60-day readmission: 107 articles, 90-day readmission: 257 articles). Additional relevant articles were obtained from scrutiny of the reference lists of articles identified in the search, including a past systematic review.<sup>11–14</sup> From these lists, studies were included if they met each of the following criteria:

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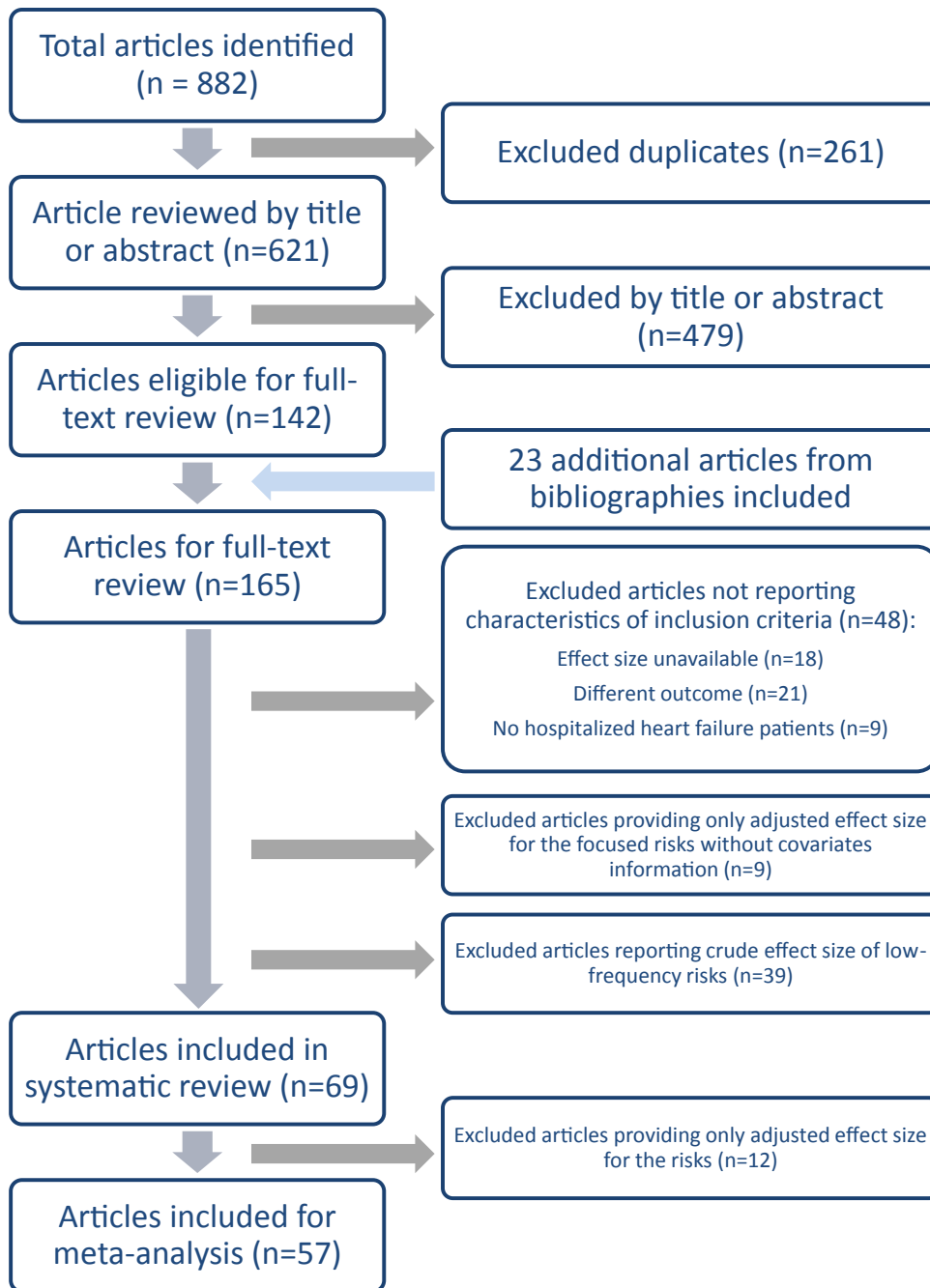


Figure 1. Process of article selection based on PRISMA.

- 1) studies of a full-length original article in a peer-reviewed English language journal;
- 2) studies done in human adults >18 years;
- 3) patients with an index hospitalization caused or complicated by HF;
- 4) studies reporting quantitative effect sizes in relative risk (RR), odds ratio (OR), or hazard ratio (HR) with 95% confidence intervals relating to primary outcome or studies reporting actual numbers of the patients with and without risk and the event rates in each group for the calculation of RR or univariable OR.

Studies reporting only adjusted effect size for individual risks without covariate information in the multivariable models were excluded because other independent predictors in those models were unknown, and the assessment of the heterogeneity of the adjusted analyses was impossible. The univariable effect sizes of low-frequency (reported in <3 studies) risk factors were also excluded.

The primary outcome was the combined end point of all-cause hospital readmission or all-cause mortality  $\leq 90$  days from discharge, and a secondary analysis was undertaken of outcomes at the combined end point of all-cause hospital readmission or all-cause mortality

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