Burden of Heart Failure after Hospitalization for Myocardial Infarction in the United States: A Targeted Literature Review

EPH213

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Introduction

- Heart failure (HF) is one of the most frequent complications following myocardial infarction (MI),[1] a leading cause of death in the United States (US).[2]
- Rates of hospitalization for HF (HHF) in the US are increasing: From 4.0/1000 US adults in 2013 to 4.9/1000 US adults in 2018.[1]
- HHF itself presents a substantial burden on the US health care system and leads to a significant increase in mortality risk.
- A synthesis of contemporary evidence on the burden of HF following MI is lacking.

Objective

- The objectives of this review were to summarize rates of HHF and HF-related mortality after MI, and estimates of direct medical costs of HHF after MI, among the overall population hospitalized for MI in the US.

Methods

- The Population, Exposure, Comparator, Outcomes, Study design (PECOS) criteria guiding the targeted literature review (TLR) are presented in Figure 1.
- Data from original articles (identified using MEDLINE; January 2018-May 2023), and American College of Cardiology (ACC) proceedings (2022, 2023), were tabulated and a gap analysis was performed.
- With the objective to summarize data on the overall population of those hospitalized for MI, publications were included if they contained a broad sample of patients hospitalized for MI.
- Studies including only a subset of patients hospitalized with MI were not summarized. Such subgroups included the following:
  - specific type of MI (e.g., only ST-elevation myocardial infarction [STEMI]);
  - indicators of severe MI (e.g., long-term intensive care unit stay, or only MI complicated by cardiogenic shock [CS]);
  - specific age groups not inclusive of the mean age at first MI (e.g., elderly adults 75 years or older, or adults 19-45 years old).

Figure 1. PECOS criteria

- **Population:** Patients (≥18 yrs) hospitalized for MI in the US
- **Exposure (risk factors):** Setting, study period, type of MI, age, sex, ethnicity/race, SDoH, comorbidities and ancillary conditions, CV sequelae, treatments for MI
- **Comparator:** Any
- **Outcome:** Rates of HHF and associated costs after MI, HF-related mortality after MI
- **Additional criteria:** Studies published in English (2018-2023), ACC conference abstracts (2021-2023), and studies with n>100 patients

Abbreviations: CV, cardiovascular; HF, heart failure; HHF, hospitalization for heart failure; MI, myocardial infarction; PECOS, Population, Exposure, Comparator, Outcomes, Study design; SDoH, social determinants of health; TLR, targeted literature review; US, United States; yrs, years.

Results

- From 2,665 publications, 11 studies met the PECOS criteria (Table 1).[4-14]

Table 1. Overview of included studies

Author, year	Study period	Brief sample description	Sample size	Results available by subgroup	Follow-up	Outcomes (after MI)		
						Rates of HHF	HF-related mortality	Cost of HHF
Prospective cohort study								
Blackston, 2020[4]	2003-2016	Pts ≥45 yrs hospitalized for MI with no history of CHD	1,122	Race	Median 3yrs	✓	✓	-
Database analysis								
Culler, 2019 [5]	2014	Medicare beneficiaries hospitalized for MI	143,286	PCI	90d	✓	-	-
Kwok, 2020 [7]	2010-2014	Pts hospitalized for MI discharged alive with 30d follow-up data	2,204,104	-	30d	✓	-	-
Qin, 2020[8]	2013-2014	Pts hospitalized for MI who underwent PCI	492,550	Age	30d	✓	-	-
Wellings, 2018[11]	2000-2015	Pts hospitalized in New Jersey with first MI	109,717	-	5yrs	✓	-	-
Yandrapalli, 2021a[13]	2014	Pts hospitalized for MI without cardiogenic shock	237,549	Age, sex, type of MI, comorbidities	6m	✓	✓	-
Yandrapalli, 2021b [12]				CKD	6m	✓	✓	-
Yandrapalli, 2021c [14]				diabetes	6m	✓	✓	-
Registry review (retrospective)								
Dreyer, 2020[6]	2009-2013	Pts ≥65 yrs hospitalized for MI	286,780	Type of MI	1yr	✓	-	-
Rymer, 2019[9]	2007-2010	Pts ≥65 yrs hospitalized for MI	53,471	Type of readmission	30d	✓	-	-
Shavadia, 2019[10]	2004-2006	Pts ≥65 yrs discharged on β-blocker and alive 3 years later w/o a recurrent MI	6,893	Use of β-blocker	3yrs	✓	-	-

Abbreviations: CHD, coronary heart disease; CKD, chronic kidney disease; d, days; HF, heart failure; HHF, hospitalization for heart failure; m, months; MI, myocardial infarction; PCI, percutaneous coronary intervention; pts, patients; yr, year.

- The characteristics of patients included in the studies were summarized and presented in Figure 2.

Figure 2. Range of patient characteristics from included studies at time of index myocardial infarction hospitalization

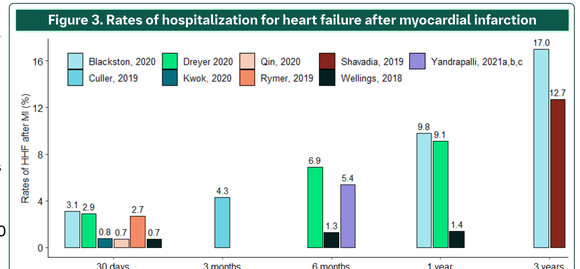
- Mean age: 63.3[11] – 77.0[9] yrs
- % presenting with a STEMI: 8.3%[10] - 45.1%[8]
- % presenting with cardiogenic shock: 1.7%[5] - 4.5%[8]
- % Males: 46.3%[10] - 69.0%[8]
- % presenting with HF : 1.2%[7] - 41.0%[5]
- % presenting with cardiac arrest: 0.8%[4] - 2.7%[8]

Abbreviations: HF, heart failure; STEMI, ST-elevation myocardial infarction; yrs, year.

Hospitalization for heart failure after myocardial infarction

- All 11 studies[4-14] characterized rates of HHF after MI (Figure 3).
- In three studies rates of HHF after MI were reported at multiple follow-up periods (Figure 3):[4,6,11]
  1) Database analysis (2000-2015) of 109,718 patients hospitalized for their first MI (mean age of 63.3 years) the rate of HHF at 30 days, 6 months and 1 year after MI were 0.7%, 1.3%, and 1.4%, respectively.[11]
  2) Retrospective registry review (2009-2013) with 286,780 patients (aged 65 years or older), the HHF rates at the same intervals were 2.9%, 6.9%, and 9.1%, respectively.[6]
  3) Prospective cohort study (2003-2016) of 1,122 patients (mean age of 73.2 years) with no history of coronary heart disease, the rates of experiencing a HF event (which was comprised of HHF or HF-related mortality) at 6 months, 1 year, and 3 years after MI were 6.9%, 9.1%, and 17.0%, respectively.[4]

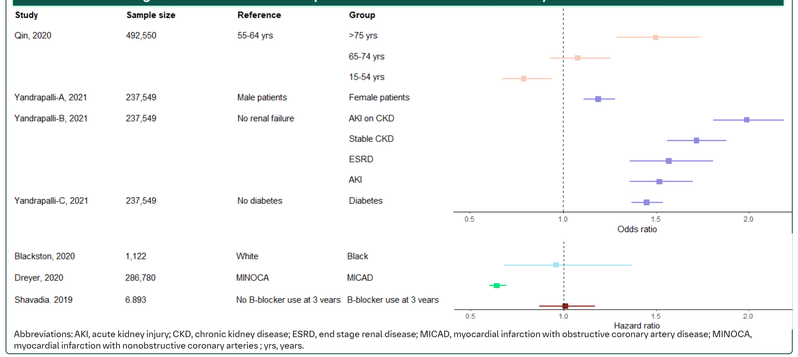
Figure 3. Rates of hospitalization for heart failure after myocardial infarction



Abbreviations: HHF, hospitalization for heart failure; MI, myocardial infarction.
Note: Blackston, 2020 reported rates of a HF event (which was comprised of HHF or HF-related mortality)

- Two database studies reported on the cause of readmission after MI.
  - HHF was the most common cause of hospital readmission, accounting for 13.2% (n = 492,550; mean age was not reported)[8] to 14.3% (n = 2,204,104; mean age of 70.3 years)[7] of readmissions.
- Among risk factors evaluated across studies, female, older, or other CV complications and comorbidities were associated with elevated rates of HHF after MI (Figure 4).[4-14]
  - In adjusted models, accounting for sociodemographic characteristics, pre-MI health status and MI characteristics, the association between Black race and elevated rates of HHF after MI was no longer significant.

Figure 4. Risk factors for hospitalization for heart failure after myocardial infarction



Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; ESRD, end stage renal disease; MICAD, myocardial infarction with obstructive coronary artery disease; MINOCA, myocardial infarction with nonobstructive coronary arteries ; yrs, years.

Heart failure-related mortality after myocardial infarction

- In three studies of the same sample from the National Inpatient Sample database (n = 237,549 patients hospitalized with MI without CS in 2014; mean age 66.7 years) HF-related mortality after MI was reported.[12-14]
  - Of the 12,934 patients who had a HHF within 6 months, 4.6% died during their admission.[12-14]
  - The presence of renal disease, particularly acute kidney injury with chronic kidney disease, and Black race were significant risk factors for HF-related mortality after MI.[12]
  - Sex and diabetes were not associated with increased risk of HF-related mortality.[13,14]
- All studies described case fatality rates, assessed as number of deaths among patients discharged alive from their index MI hospitalization.

Costs of hospitalization for heart failure after myocardial infarction

- No data on the cost of HHF after MI were identified.

Strengths & Limitations

- Due to the targeted nature of this review, some publications may have been missed, however the findings we have synthesized are reflective of a robust set of studies on a broad population of patients hospitalized for MI in the US.
  - A systematic review to confirm the identified gaps, explore evidence for specific patient subgroups, or use other databases such as EMBASE, may be warranted.
- As with any review we were limited by heterogeneity and reporting accuracy across the included studies.

Conclusions

- **HF is a common cause of admission after MI in the US,[7,8] and the studies identified highlight the burden and need for interventions to reduce the risk of HF after MI.**
- There is a gap in the literature regarding rates of HF-related mortality and the cost of HHF after MI.
  - No studies assessed all-cause mortality, while also describing HF- or CV- related mortality.
  - No studies compared costs after MI by whether patients were readmitted specifically for HF.

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