The Cost Burden of Worsening Heart Failure in the Medicare Fee For Service Population: An Actuarial Analysis

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EXECUTIVE SUMMARY

Heart failure (HF) is a prevalent and costly disease that affects approximately 6.5 million US adults.[1] Total direct medical costs of HF were estimated to be $21 billion in 2012 and projected to increase to $53 billion by 2030. The majority of those costs are contributed by HF patients age 65 and over - 81% of total HF costs in 2012 and projected to rise to 88% by 2030.[2]

Treatment for fluid overload in HF patients (worsening HF) is one of the most common causes of hospital inpatient admissions (admissions) in patients age 65 and over.[3,4] And HF admissions, as documented by a diagnosis of HF in the primary position on the inpatient claim, generate the highest number and highest rate of 30-day readmissions among the Medicare population.[5] Yet the typical designation of a HF admission, which restricts identification to admissions with HF coded in the primary position of the inpatient claim, underestimates the total burden of inpatient treatment for fluid overload in the HF population. Because fluid overload is defined by symptoms and signs, which are nonspecific, they are typically underreported on claims resulting in worsening HF not being coded. In addition, medical comorbidities (such as myocardial ischemia, uncontrolled hypertension, cardiac arrhythmias, pneumonia, and chronic obstructive pulmonary disease [COPD]) may lead to worsening HF and precipitate HF hospitalization.[6] A hospitalization precipitated by a medical comorbidity will typically be coded with the comorbidity as the principal diagnosis and not be classified as a HF hospitalization. A recent study, using medical records and claim data, identified twice the number of HF admissions compared to the number when a HF diagnosis code was required to be coded in the primary position of the inpatient claim.[7]

Considering this underreporting of HF admissions and the importance of more accurate estimates of the burden of HF admissions in the Medicare population, we created an expanded definition of HF admissions which considered admissions other than those coded with HF in the primary position of the admission. The expanded definition included HF-related DRGs with utilization of 2+ days of IV diuretics during the stay (1 day utilization for 1 day stays). Using this definition, we identified the rate and costs of HF admissions, the costs in the 30 days after HF admissions and the percentage of HF admissions that are readmissions. In addition, we identified the rate and costs of treatment for worsening HF in the outpatient setting, in cases where inpatient admission does not occur.

Using the 2014 Medicare 5% sample and the methodology described in Appendix C, we identified the following key metrics. In particular, we identified:

HF Population

- 17.1% of the HF population's admissions are for HF; 27.1% of the HF admissions are 30-day readmissions
- 6.9% of the HF population's costs are for HF admissions
- 4.6% of the HF population's costs are for care in the 30 days after discharge from HF admissions
- 0.21% of the HF population's costs are for outpatient treatment of worsening HF without admission

Total Medicare Population

- 7.1% of the total Medicare population's admissions are for HF
- 2.3% of the total Medicare population's costs are for HF admissions
- 1.5% of the total Medicare population's costs are for care in the 30 days after discharge from HF admissions
- 0.07% of the total Medicare population's costs are for outpatient treatment of worsening HF without admission

Total Episodes for Treatment of Worsening HF

- 82.1% are treated inpatient (Average cost per admission: $11,840)
- 11.6% are treated in the ED without admission (Average cost per visit: $1,208)
- 6.3% are treated in a hospital observation unit without admission (Average cost per visit: $3,189)

Figure 1 provides a summary of the costs associated with treatment for worsening HF on a per HF patient per month basis (PPPM) and a per total Medicare per member basis (PMPM).

Figure 1. Total Medicare Costs Associated with Treatment for Worsening HF

	Allowed $PPPM for the HF Population [A]	% of Total HF Population Allowed $PPPM [(A)/$3,541 PPPM]	Allowed $PMPM for the Total Medicare Population [B]	% of Total Medicare Population Allowed $PMPM [(B)/$1,064 PMPM]
Cost of HF Population	$3,540.67	100.0%	$353.25	33.2%
Cost of HF Population's Total Admissions	$1,856.66	52.4%	$185.24	17.4%
Cost of HF Population's HF Admissions	$242.64	6.9%	$24.21	2.3%
Cost of 30-Day Post HF Admission*	$161.42	4.6%	$16.11	1.5%
Cost of OP Treatment for Worsening HF**	$7.56	0.21%	$0.75	0.07%
Total Cost of Treatment for Worsening HF	**$411.63**	**11.6%**	**$41.07**	**3.9%**

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Premier Inpatient Database (2014 – 2016). Allowed costs include Medicare payment to providers plus patient cost sharing. Per Patient per Month (PPPM); Per Member per Month (PMPM).
* The 30-day post HF admission costs excludes readmissions for HF. ** The outpatient (OP) costs for worsening HF exclude costs captured in the 30-day post-HF admission costs.

Figure 2 provides an extrapolation of these findings to the total 2015 Medicare FFS population using published reports of total Medicare FFS enrollment and total allowed Medicare FFS costs in 2015.

Figure 2. Extrapolation of Medicare 5% Sample Results to the Total Medicare FFS Population

	2015 Medicare FFS Population
Number of Medicare FFS Beneficiaries	37,771,000
Number Medicare FFS Beneficiaries with HF (10.5% prevalence rate)	3,980,915
Total Medicare FFS Population Part A & B Costs (in millions)	$373,229
Total HF Population Costs (in millions) (33.2% of total Medicare Costs)	$123,862
Total Costs for Treatment of Worsening HF (in millions) (3.9% of total Medicare Costs)	$14,403
Total Admissions Among Medicare FFS Beneficiaries (329 admissions/1000)	12,130,460
Total HF Admissions Among Medicare FFS Beneficiaries (23 admissions/1000 or 7.1%)	857,241

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Office of the Actuary 2016 Board of Trustees Report. The costs only include Part A & B costs.

Our findings confirm that the cost of treatment for worsening HF, in the settings we analyzed, is a significant contributor to the Medicare FFS HF population's costs and the total Medicare FFS population's costs. The overwhelming majority of treatment for worsening HF occurs in the higher cost inpatient setting which highlights the need for earlier identification of patients with worsening HF to potentially shift a portion of inpatient treatment to outpatient settings. This shift in site of care for treatment of worsening HF could reduce the cost burden associated with treatment of HF beneficiaries in the Medicare population.

This report was commissioned by scPharmaceuticals, Inc. The findings reflect the research of the authors; Milliman does not endorse any product or organization. If this report is reproduced, we ask that it be reproduced in its entirety, as pieces taken out of context can be misleading. As with any economic or actuarial analysis, it is not possible to capture all factors that may be significant. Because we present national average data based on the 2014 Medicare 5% sample data, the findings should be interpreted carefully before they are applied to any particular situation. Findings for particular populations and for different time periods will vary from these findings. Tyler Engel is a member of the American Academy of Actuaries and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion in this report.

BACKGROUND

6.5 million Americans age 20 and older are estimated to have HF based on data from the National Health and Nutrition Examination Survey (NHANES) 2011-2014.[1] Projections suggest that number will increase to 8 million by 2030.[2] Moreover, HF prevalence increases with age, with an annual incidence approaching 21 per 1,000 for those age ≥ 65 years of age.[8] As a result, it is projected that the percentage of the HF population that is age ≥ 65 will increase from 62% in 2012 to 71% in 2030.[2] Annual total direct medical costs for HF were $21 billion in 2012 and are projected to increase to $53 billion in 2030, with the proportion contributed by the population age ≥ 65 increasing from 81% to 88% indicating that Medicare is the major payer for treatment of HF patients.[2]

A significant driver of costs for the HF population is inpatient admissions to treat worsening HF. Treatment for HF is the most common cause of hospitalization in patients age ≥ 85 and the second most common cause in patients age 65-84.[4] Additionally, claims-based studies have found that HF hospitalizations, as documented by a HF ICD-9/10 diagnosis code in the primary position of the inpatient claim, generate the highest number and highest rate of 30-day readmissions among the Medicare population.[5] Although there was a decline in the rate of admissions for treatment of HF among Medicare beneficiaries from 2001 to 2008, the readmission rate after HF hospitalization remained unchanged.[9]

HF patients are prone to episodes of fluid overload leading to worsening signs and symptoms of HF (particularly pulmonary and systemic congestion). When recognized in the outpatient setting (non ER or observation settings), worsening fluid overload in HF patients is typically treated with intensification of oral diuretic therapy, yet adequate absorption of oral drugs may decline as fluid overload increases. Either because of failure to recognize fluid overload earlier on or because it may develop very rapidly, many patients are admitted to hospitals for IV diuretic treatment to reduce fluid overload (see Appendix A: Primer on Worsening HF). Once admitted, a typical patient loses 8.4 ± 5.2 liters of fluid over 6.0 ± 2.4 days resulting in a weight loss of 6.9 ± 5.2 kg.[10]

A portion of HF admissions are considered potentially preventable and have been designated as "ambulatory care sensitive conditions" (ACSC: potentially preventable with timely and appropriate outpatient based management) by the Agency for Healthcare Research and Quality (AHRQ).[11] Considering that a portion of HF admissions are potentially preventable, the Medicare Shared Savings Program's (MSSP) and Medicare Advantage plans include HF admissions rates as a performance indicator.[12,13] In addition, Medicare's hospital readmission reduction program (HRRP) financially penalizes hospitals with HF readmission rates above a target threshold.[14,15]

Although there is a heightened focus on HF admission rates and the potentially preventable nature of these admissions, the rate of HF admissions is likely underreported. The AHRQ definition as well as the HRRP readmission rates after HF admissions restrict the definition of a HF admissions to those admission with a HF ICD-9/10 in the primary position of the admission. Yet fluid overload is defined by symptoms and signs, which are nonspecific and are typically underreported on claims resulting in worsening HF not being coded. In addition, medical comorbidities (such as myocardial ischemia, uncontrolled hypertension, cardiac arrhythmias, pneumonia, and COPD) may lead to worsening HF and precipitate HF hospitalization.[6] A hospitalization precipitated by a medical comorbidity will typically code the comorbidity as the principal diagnosis and will not be classified as a HF hospitalization. However, treatment for fluid overload may occur in individuals admitted for conditions other than HF. In US adults age 65 and older admitted for pneumonia, COPD, or HF, 18% of pneumonia and 19% of COPD patients also received IV diuretic treatment for HF.[16] Taking this into account, a 2016 study compared a claims-based algorithm for HF that had been validated by medical records with one relying on diagnosis coding for HF in the primary position on the claim and found that the validated claims-based algorithm yielded an estimate of twice the number of HF hospitalizations for the same population.[7]

Considering this under reporting of HF admissions and the need to more accurately quantify the burden of HF admissions in the Medicare population, we created an expanded claims-based definition of HF admissions. For this report, we assumed that all HF admissions, including those in our expanded definition, were related to worsening fluid overload. Using this definition, we analyzed the 2014 Medicare 5% sample claim data and the 2014-2016 Premier inpatient database to determine the rate and costs of HF admissions, the costs in the 30 days after HF admissions and the proportion of HF admissions that are readmissions. We aimed to characterize the role that fluid overload and diuretic treatment play in the burden of HF for Medicare and to highlight the potential economic benefit of treatment for fluid overload in settings other than inpatient hospital.

CLAIMS DATA ANALYSIS FINDINGS

We used the 2014 Medicare 5% FFS sample to identify beneficiaries with HF. We required that the 2014 denominator population have eligibility in all of 2013 (to calculate hierarchical condition category [HCC] risk scores) and 1+ month of eligibility in 2014 and have both Part A and B coverage and no Medicare Advantage enrollment for all months of eligibility. A description of the Medicare 5% sample data and coding logic for identification of HF can be found in Appendix C: Methodology.

Study Population Characteristics

1,441,306 Medicare beneficiaries in the 2014 Medicare 5% sample met our denominator criteria and 151,908 (10.5%) beneficiaries met identification criteria for HF. Figure 3 provides characteristics of the HF population compared to the total Medicare population, showing:

- The HF population was older on average
- The HF population had a higher proportion of institutionalized, aged-dual, and ESRD beneficiaries
- The HF population's average HCC risk score was 2x as high
- The HF population's average allowed monthly costs were more than 3x as high
- The HF population's average annual inpatient admission rate was more than 4x as high

Figure 3. Demographics of the Medicare and HF Populations

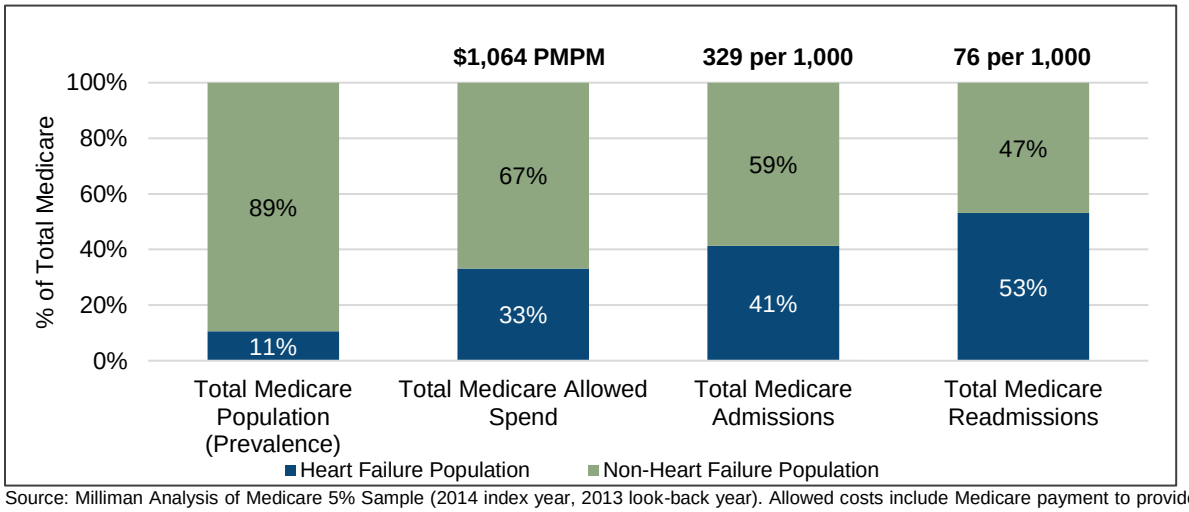
	Medicare 5% Sample Population	HF Population
Sample Size (n)	1,441,306	151,908
% of Total Medicare 5% Sample Population		10.5%
Eligibility Status (%)		
Aged Dual	10.4%	18.5%
Aged Non-Dual	72.7%	67.9%
Disabled	15.7%	8.7%
ESRD	1.2%	4.9%
% Institutionalized	3.2%	9.2%
Average Age	71.7	77.3
% Female	55.4%	54.2%
Average HCC Risk Score*	1.11	2.28
Total Allowed $PPPM	$1,064.45	$3,540.67
Total Allowed $PMPM	$1,064.45	$353.25
Inpatient Admission Allowed $PPPM	$421.92	$1,856.66
Inpatient Admission Allowed $PMPM	$421.92	$185.24
Admissions per 1,000 in the Medicare Population	329	136
Readmissions per 1,000 in the Medicare Population	76.0	40.4
Admissions per 1,000 in the HF Population		1,360
Readmissions per 1,000 in the HF Population		404.7
% of Admissions that are Readmissions	23.1%	29.8%

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year). Allowed costs include Medicare payment to providers plus patient cost sharing. Per Member per Month (PMPM); Per HF Patient per Month (PPPM). Institutionalized patients were identified using a proprietary claim algorithm that accounts for >3 consecutive months of nursing facility place of service claims.
*CMS Hierarchical Condition Category (HCC) risk scores excludes ESRD members as these are not available.

Considering the 10.5% HF prevalence rate in the Medicare population and significantly higher cost and admission rates per HF beneficiary, the HF population is a significant contributor to total Medicare population costs, admissions and readmissions. Figure 4 shows the HF population alone contributes:

- 33% of the total Medicare population allowed costs
- 41% of the total Medicare population admissions
- 53% of the total Medicare population readmissions

Figure 4. HF Prevalence, Allowed Costs, and Inpatient Admission Utilization as % of Total Medicare

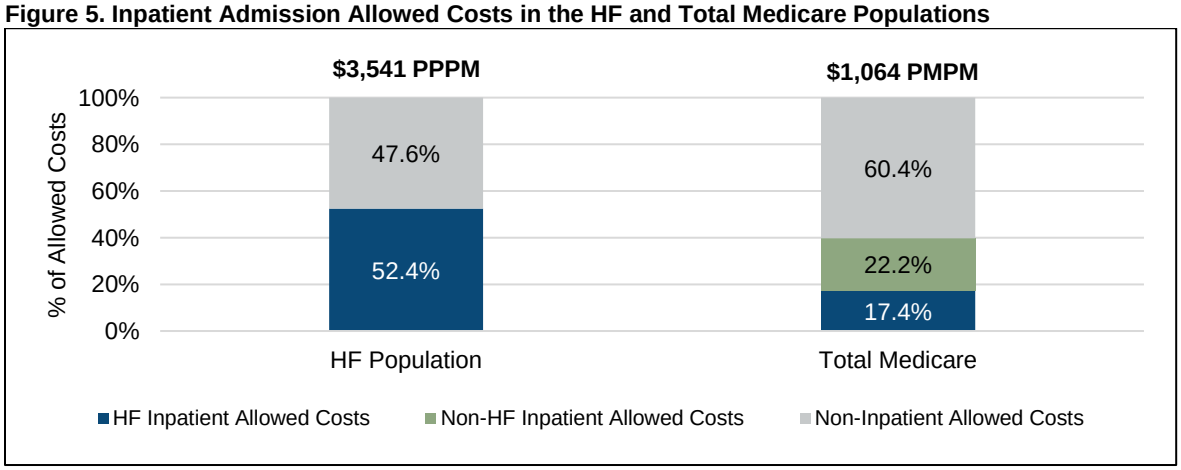


Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year). Allowed costs include Medicare payment to providers plus patient cost sharing. Per Member per Month (PMPM).

Inpatient admissions were a significant contributor to total HF population costs and Medicare population costs. Figure 5 shows:

- 52.4% of the HF population allowed costs was contributed by inpatient admission costs
- 17.4% of the Medicare population allowed costs was contributed by the HF population's inpatient admission costs

Figure 5. Inpatient Admission Allowed Costs in the HF and Total Medicare Populations



Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year). Inpatient admission costs include facility and professional costs. Allowed costs include Medicare payment to providers plus patient cost sharing. Per Member per Month (PMPM); Per HF Patient per Month (PPPM).

Utilization and Cost of HF Admissions

As noted in the background section, a prime opportunity for reducing costs in the HF population is reducing admissions for worsening HF, referred to as HF admissions in this analysis. The cost contribution of HF admissions to HF population costs and to the total Medicare population costs has been underestimated in many reports because of limiting the definition of HF admissions to those coded with a HF ICD-9/10 in the primary position of the inpatient claim, namely DRG 291, 292, 293. As noted in the background section, other admissions among the HF population, particularly several pulmonary and cardiac DRGs, may involve treatment for worsening HF even though a non-HF ICD-9/10 code is the final ICD-9/10 coded in the primary position of the inpatient admission claim.

To quantify the total utilization and cost of HF admissions, we looked for evidence of treatment for worsening HF with IV diuretics among HF-related pulmonary and cardiac DRGs listed in Figure 6. Because the Medicare 5% sample inpatient claims do not include drug administration detail, we analyzed the Premier inpatient hospital admission database which has detailed drug administration data during inpatient stays (see Appendix B for a description of the Premier database). We analyzed the inpatient admissions in the Premier 2014-2016 database for Medicare HF patients, and in particular, the proportion of HF-related admissions with 2+ days of IV diuretic use (1 day required for 1 day stays). We designated admissions with this diuretic use as HF admissions. Details of the Premier database and methodology used to designate an admission as HF appear in Appendix C: Methodology.

The percentage of each HF-related DRG with the indicated diuretic utilization identified in the Premier database, appears in Figure 6. We applied this percentage to the HF-related DRG admissions in our Medicare 5% sample analysis in order to calculate the total number HF admissions among the Medicare HF population. We consider these estimates conservative as Premier approximates roughly 5% of the Premier database admissions do not report drug details, and for those cases, we designated the admission as not having IV diuretic utilization. This 5% estimate might actually be higher since even for HF DRGs 291, 292 and 293, approximately 10% of the cases did not record utilization of IV diuretic therapy during the stay. Regardless, we assumed 100% of DRG 291, 292, 293 are for treatment of HF and for the HF-related admissions the percentages followed those identified in the Premier database analysis.

All HF admissions were grouped into two categories: (1) admissions with DRG 291, 292, or 293 (defined by a HF ICD-9 coded in the primary position of the inpatient admission) and (2) admissions with DRGs that are not 291, 292, or 293. These are referred to as ‘HF-related’ admissions.

Figure 6 shows that:

- 17.1% of the HF population’s admissions were for HF:
    - 11.1% for DRG 291, 292, 293
    - 6.0% for HF-related DRGs
- 7.1% of the total Medicare population’s admissions were for HF:
    - 4.6% for DRG 291, 292, 293
    - 2.5% for HF-related DRGs

Figure 6. HF Admissions (HF-related DRGs and HF DRG 291, 292, 293) in the HF Population by DRG

HF DRG	DRG Description	HF Admissions by DRG as a % of HF Admissions* (# of Admissions [A])	HF Admissions by DRG as a % of the HF Population's Total Admissions in the Medicare 5% Sample Analysis [(A)/ 191,113]	% of Admissions with Indicated Diuretic Use in the Premier Analysis [B] (# of Admissions with Indicated Diuretic Use)	HF Admissions as a % of the HF Population's Admissions in the Medicare 5% Sample [(A)*(B)/ 191,113]	HF Admissions as a % of the Total Medicare Population's Admissions in the Medicare 5% Sample [(A)*(B)/ 462,887]
HF Admissions		**54,800**	**28.7%**	**70.3% (333,055)****	**17.1% (32,712)**	**7.1%**
186	Pleural effusion w MCC	0.6% (319)	0.2%	41.8% (845)	0.1%	0.03%
187	Pleural effusion w CC	0.4% (198)	0.1%	34.7% (356)	0.04%	0.01%
188	Pleural effusion w/o CC/MCC	0.1% (50)	0.03%	36.3% (33)	0.01%	0.004%
189	Pulmonary edema & respiratory failure	7.3% (4,005)	2.1%	43.6% (14,678)	0.9%	0.4%
190	Chronic obstructive pulmonary disease w MCC	7.1% (3,872)	2.0%	43.0% (12,362)	0.9%	0.4%
191	Chronic obstructive pulmonary disease w CC	5.5% (3,017)	1.6%	19.6% (3,632)	0.3%	0.1%
192	Chronic obstructive pulmonary disease w/o CC/MCC	2.4% (1,298)	0.7%	20.5% (618)	0.1%	0.1%
193	Simple pneumonia & pleurisy w MCC	7.3% (3,982)	2.1%	41.2% (12,641)	0.9%	0.4%
194	Simple pneumonia & pleurisy w CC	6.6% (3,619)	1.9%	18.9% (3,154)	0.4%	0.1%
195	Simple pneumonia & pleurisy w/o CC/MCC	1.9% (1,055)	0.6%	18.9% (393)	0.1%	0.04%
204	Respiratory signs & symptoms	0.6% (332)	0.2%	29.5% (545)	0.1%	0.02%
205	Other respiratory system diagnoses w MCC	0.2% (100)	0.1%	41.2% (446)	0.02%	0.01%
206	Other respiratory system diagnoses w/o MCC	0.3% (154)	0.1%	19.7% (215)	0.02%	0.01%
207	Respiratory system diagnosis w ventilator support 96+ hours	2.2% (1,205)	0.6%	74.1% (4,715)	0.5%	0.2%
208	Respiratory system diagnosis w ventilator support <96 hours	3.5% (1,916)	1.0%	57.5% (8,917)	0.6%	0.2%
291	Heart failure & shock w MCC	17.2% (9,434)	4.9%	100.0% (122,895)	4.9%	2.0%
292	Heart failure & shock w CC	16.2% (8,851)	4.6%	100.0% (97,557)	4.6%	1.9%
293	Heart failure & shock w/o CC/MCC	5.5% (3,016)	1.6%	100.0% (29,470)	1.6%	0.7%
304	Hypertension w MCC	0.1% (82)	0.04%	53.3% (390)	0.02%	0.01%
305	Hypertension w/o MCC	0.5% (287)	0.2%	13.2% (182)	0.02%	0.01%
308	Cardiac arrhythmia & conduction disorders w MCC	4.8% (2,655)	1.4%	54.4% (15,026)	0.8%	0.3%
309	Cardiac arrhythmia & conduction disorders w CC	4.8% (2,604)	1.4%	14.2% (2,727)	0.2%	0.1%
310	Cardiac arrhythmia & conduction disorders w/o CC/MCC	2.3% (1,244)	0.7%	18.9% (667)	0.1%	0.1%
312	Syncope & collapse	2.7% (1,505)	0.8%	6.7% (591)	0.1%	0.02%

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Premier Inpatient Database (2014 – 2016). See Appendix C: Methodology. *A small proportion of admissions were excluded from several DRGs as the primary ICD-9 codes were unrelated to HF (see Figure 22 for details). **In the Premier analysis, 70.3% of the 473,652 HF DRG admissions were identified with diuretic use. Because the distribution of DRGs is different between the Premier database and the Medicare 5% Sample analysis, the proportion of total HF DRG admissions with diuretic use in the Medicare analysis is different than the proportion in the Premier database (59.7% of Medicare HF DRG admissions).

To estimate costs associated with HF admissions, we assumed the average cost of the DRGs with IV diuretic therapy were the same as the average cost of all admissions for the specified DRG. The costs associated with HF admissions appear in Figure 7 and indicate:

- 6.9% of the HF population costs was contributed by HF admissions:
    - 3.8% of costs contributed by DRG 291, 292, 293
    - 3.1% of costs contributed by HF-related DRGs
- 2.3% of total Medicare cost was contributed by the HF population's HF admissions:
    - 1.3% of costs contributed by DRG 291, 292, 293
    - 1.0% of costs contributed by HF-related DRGs
- The average cost of a HF admission was $11,840
    - The average cost of a DRG 291, 292, 293 admission was $10,753
    - The average cost of a HF-related DRG admission was $12,531

Figure 7. HF Admission Costs in the HF Population by DRG

HF DRG	DRG Description	Average Cost per Admission Based on the Medicare 5% Sample Analysis	Allowed $PPPM of HF Admission Costs [A]	Allowed $PMPM of HF Admission Costs [B]	% of all HF Population Inpatient Allowed Costs from HF Admissions [(A)/ $1,857 PPPM]	% of All HF Population Allowed Costs from HF Admissions [(A)/ $3,541 PPPM]	% of Total Medicare Population Allowed Costs from HF Admissions [(B)/ $1,064 PMPM]
HF Admissions		**$11,840**	**$242.64**	**$24.21**	**13.1%**	**6.9%**	**2.3%**
186	Pleural effusion w MCC	$14,690	$1.16	$0.12	0.1%	0.03%	0.01%
187	Pleural effusion w CC	$9,990	$0.41	$0.04	0.02%	0.01%	0.004%
188	Pleural effusion w/o CC/MCC	$7,370	$0.08	$0.01	0.004%	0.002%	0.001%
189	Pulmonary edema & respiratory failure	$14,523	$15.04	$1.50	0.8%	0.4%	0.1%
190	Chronic obstructive pulmonary disease w MCC	$10,640	$10.50	$1.05	0.6%	0.3%	0.1%
191	Chronic obstructive pulmonary disease w CC	$8,649	$3.04	$0.30	0.2%	0.1%	0.03%
192	Chronic obstructive pulmonary disease w/o CC/MCC	$6,754	$1.07	$0.11	0.1%	0.03%	0.01%
193	Simple pneumonia & pleurisy w MCC	$12,767	$12.43	$1.24	0.7%	0.4%	0.1%
194	Simple pneumonia & pleurisy w CC	$9,122	$3.70	$0.37	0.2%	0.1%	0.03%
195	Simple pneumonia & pleurisy w/o CC/MCC	$7,132	$0.84	$0.08	0.05%	0.02%	0.01%
204	Respiratory signs & symptoms	$7,315	$0.42	$0.04	0.02%	0.01%	0.004%
205	Other respiratory system diagnoses w MCC	$13,689	$0.33	$0.03	0.02%	0.01%	0.003%
206	Other respiratory system diagnoses w/o MCC	$7,977	$0.14	$0.01	0.01%	0.004%	0.001%
207	Respiratory system diagnosis w ventilator support 96+ hours	$58,543	$30.98	$3.09	1.7%	0.9%	0.3%
208	Respiratory system diagnosis w ventilator support <96 hours	$21,052	$13.75	$1.37	0.7%	0.4%	0.1%
291	Heart failure & shock w MCC	$13,491	$75.45	$7.53	4.1%	2.1%	0.7%
292	Heart failure & shock w CC	$9,262	$48.60	$4.85	2.6%	1.4%	0.5%
293	Heart failure & shock w/o CC/MCC	$6,567	$11.74	$1.17	0.6%	0.3%	0.1%
304	Hypertension w MCC	$10,503	$0.27	$0.03	0.01%	0.01%	0.003%
305	Hypertension w/o MCC	$6,350	$0.14	$0.01	0.01%	0.004%	0.001%
308	Cardiac arrhythmia & conduction disorders w MCC	$11,225	$9.62	$0.96	0.5%	0.3%	0.1%
309	Cardiac arrhythmia & conduction disorders w CC	$7,800	$1.71	$0.17	0.1%	0.05%	0.02%
310	Cardiac arrhythmia & conduction disorders w/o CC/MCC	$5,634	$0.79	$0.08	0.04%	0.02%	0.01%
312	Syncope & collapse	$7,593	$0.45	$0.05	0.02%	0.01%	0.004%

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Premier Inpatient Database (2014 – 2016). For additional information on the Premier analysis methodology for identifying qualifying HF admissions for diuretic use, see Appendix C: Methodology. Allowed costs include Medicare payment to providers plus patient cost sharing. Per Member per Month (PMPM); Per HF Patient per Month (PPPM).

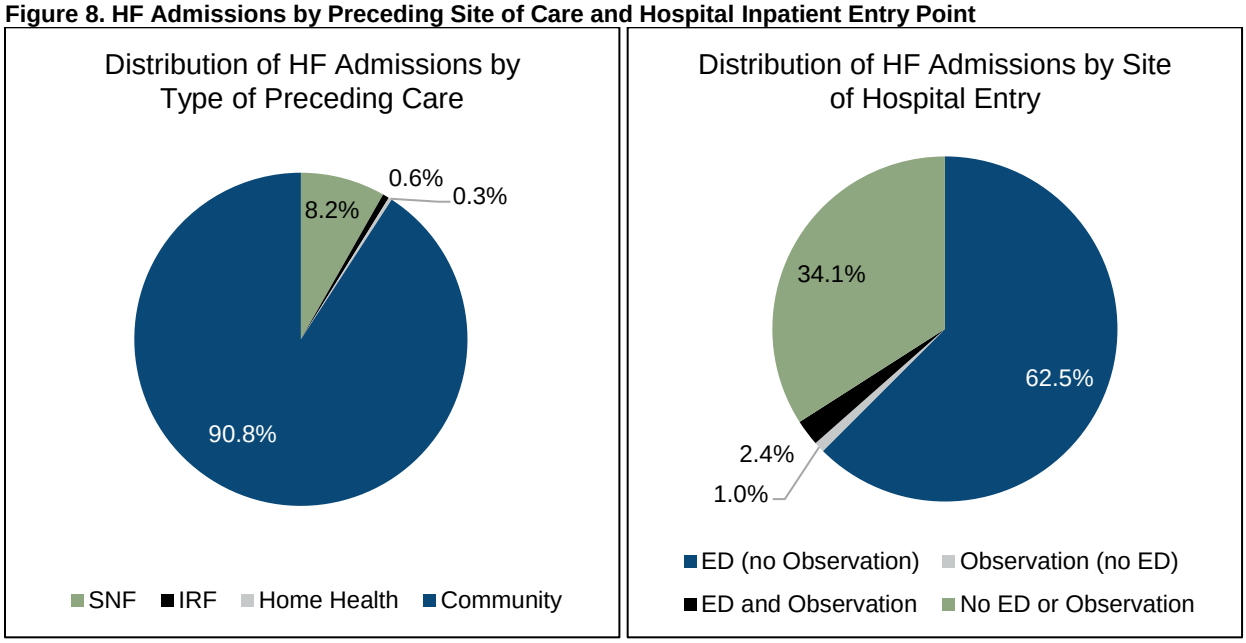
Site of Care Preceding HF Admissions and Site of Hospital Entry for Admissions

For the HF admissions in the Medicare 5% Sample, we identified the site of care preceding the HF admission (within 7 days prior to admission) as well as the site of hospital entry for each admission.

Figure 8 shows that:

- 8.2% of HF admissions had a preceding Skilled Nursing Facility (SNF) stay, 0.3% had a preceding Inpatient Rehabilitation Facility (IRF) stay and 0.6% were receiving home care prior to the stay. The remainder appeared to be treated in the community without home care services or care in a SNF or IRF during the 7 days preceding admission.
- 62.5% of HF admissions entered through the Emergency Department (ED), 1.0% through the observation unit, and 2.4% through both the ED and observation unit. The remainder were direct inpatient admissions.

Figure 8. HF Admissions by Preceding Site of Care and Hospital Inpatient Entry Point



Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year).
SNF: skilled nursing facility; IRF: inpatient rehabilitation facility. Preceding site of care was determined by SNF, IRF, or home health claims in the seven days prior to the HF admissions. Site of entry was determined by ED or observation claims on the same day or day prior to the HF admission.

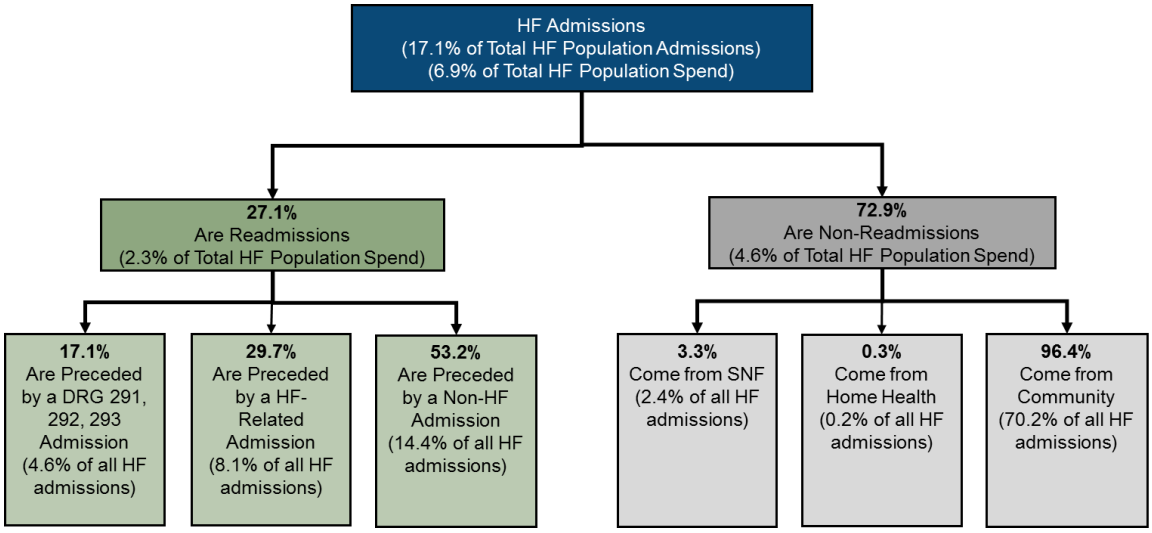
Utilization and Cost of HF Readmissions

In targeting HF admissions for reduction opportunities, it is useful to identify the proportion of HF admissions that are readmissions. Different strategies may be needed to reduce readmissions vs. non-readmissions, in particular, transition of care strategies. In addition, the strategies may differ based on the admission type that preceded the HF readmission.

Figure 9 shows the proportion of HF admissions that were readmissions and non-readmissions and their preceding admission or prior care.

- 27.1% of the HF admissions were 30-day readmissions
- 46.8% of the HF admissions designated as 30-day readmissions were preceded by a HF admission

Figure 9. HF Readmissions and Non-Readmissions in the HF Population



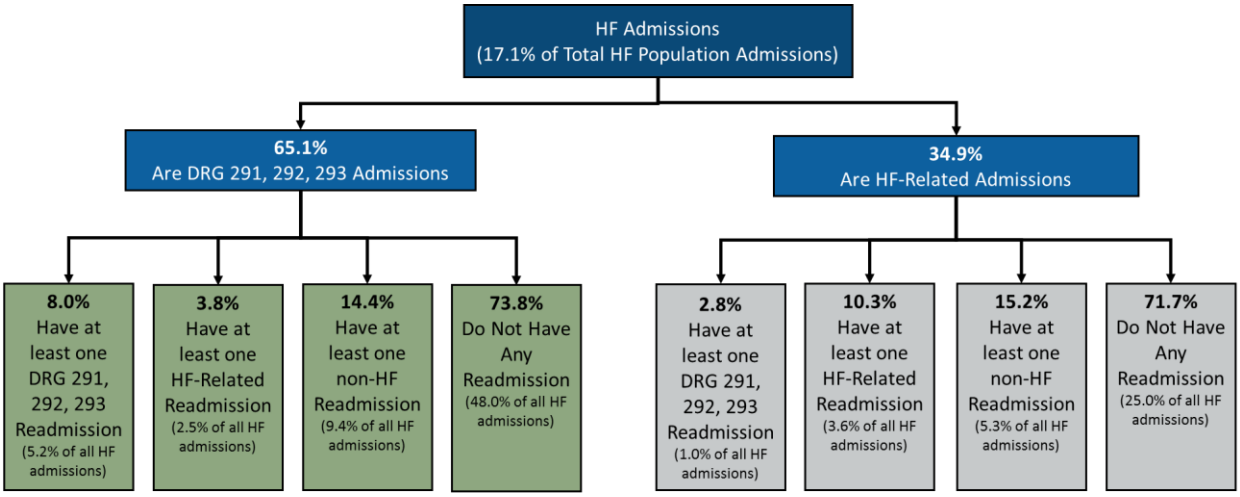
Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year).
Note: Readmission-related statistics are based only on the Medicare 5% Sample analysis admissions before applying Premier analysis results. HF-related admissions refer to HF admissions other than DRGs 291, 292, or 293 noted in Figure 6.

A subset of the readmissions among the HF population occur after DRG 291, 292 and 293 which can result in a financial penalty to hospitals by Medicare under the Medicare HRRP. We analyzed these admissions separately and the type of 30-day readmissions following these admissions. More aggressive transition of care strategies focused on HF management could potentially reduce readmissions designated as HF admissions.

Figure 10 presents HF admissions and readmissions:

- 26.2% of DRG 291, 292, 293 admissions have a readmission
- 11.8% of DRG 291, 292, 293 admissions have at least one HF or HF-related DRG readmission
- 28.3% of HF-related admissions had a readmission
- 13.1% of HF-related admissions have at least one HF or HF-related DRG readmission

Figure 10. Readmissions Following HF Admissions in the HF Population



Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year).
Note: Readmission-related statistics are based only on the Medicare 5% Sample analysis admissions before applying Premier analysis results. HF-related admissions refer to HF admissions other than DRGs of 291, 292, or 293.

Cost during the 30 Days after HF Admissions

In quantifying the cost associated with HF admissions, the 30-day post-acute care costs should be considered. 24.5% of patients received post-acute care in a SNF in the 30 days after a HF admission which would likely be avoided if the admission had been avoided. 34.1% of patients utilized home care, some of which would not be utilized if the admission had been avoided. Figure 11 presents the utilization and cost of major services in the 30-days after discharge from HF admissions.

- The weighted average cost in the 30 days after HF admissions was $11,143 ($10,642 following DRG 291, 292, 293 admissions, $11,640 following HF-related DRG admissions)
- Readmissions and SNF stays were the largest cost contributor in the 30 days after HF admissions
- 4.6% of the HF population's costs was contributed by the costs in the 30 days after HF admissions
- 1.5% of total Medicare population's costs was contributed by the costs in the 30 days after HF admissions

Figure 11. 30-Day Post-HF Admission Utilization and Costs

Utilization Type	% of HF Admissions with Utilization in Category	30-day Post-HF Admission Average Cost per Discharge	% of Average Post-HF Admission Costs
Inpatient Readmissions	26.3%	$5,675.64	50.9%
Acute Inpatient Rehab	2.2%	$454.14	4.1%
Skilled Nursing Facility	24.5%	$3,131.09	28.1%
Home care	34.1%	$513.92	4.6%
Outpatient facility		$693.75	6.2%
Outpatient professional		$404.79	3.6%
Other Outpatient		$269.37	2.4%
Total		**$11,142.69**	**100.0%**
Total Excluding HF Readmission Costs		**$9,148.92**	
% of Total HF Allowed Costs		**4.6%**	
% of Total Medicare Allowed Costs		**1.5%**	

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year). Allowed costs include Medicare payment to providers plus patient cost sharing. Per Member per Month (PMPM); Per HF Patient per Month (PPPM).

Outpatient Treatment of Worsening HF

In addition to HF admissions, we examined outpatient claims for treatment of worsening HF. We queried ED, observation unit, physician office, and urgent care claims for evidence of treatment for worsening HF. See Appendix C: Methodology for worsening HF treatment in outpatient settings qualifying coding details.

Figure 12 shows that treatment of worsening HF in outpatient settings was a small contributor to the HF population or total Medicare population cost. The small proportion of ED visits and observation unit stays that don't result in admission may indicate that many HF patients who present to the ED or observation unit with signs of worsening HF are admitted rather than treated and sent home. It may also be possible that HF patients that present to the ED with worsening HF are coded with precipitating conditions and therefore did not meet our identification criteria for qualifying as a treatment episode for worsening HF.

- 0.24% of total HF costs was contributed by treatment for worsening HF in outpatient settings
- 0.08% of total Medicare costs was contributed by treatment for worsening HF in outpatient settings

Figure 12. Utilization and Cost of Outpatient Treatment for Worsening HF by Setting

Outpatient Setting for Treatment of Worsening HF*	% of Total Outpatient Visits for HF Treatment	Average Cost of an Outpatient Visit for Worsening HF Treatment	Allowed HF Population $PPPM [A]	Total Allowed $PMPM [B]	% of Total HF Allowed Costs [(A)/ $3,541 PPPM]	% of Total Medicare Allowed Costs [(B)/ $1,064 PMPM]
ED	3.5%	$1,208	$3.33	$0.33	0.09%	0.03%
Observation Unit	9.6%	$3,189	$4.75	$0.47	0.13%	0.04%
Physician Office	0.1%	$467	$0.36	$0.04	0.01%	0.003%
Urgent Care	0.2%	$398	$0.01	$0.001	0.0001%	0.00005%
Total		**$1,680**	**$8.44**	**$0.84**	**0.24%**	**0.08%**

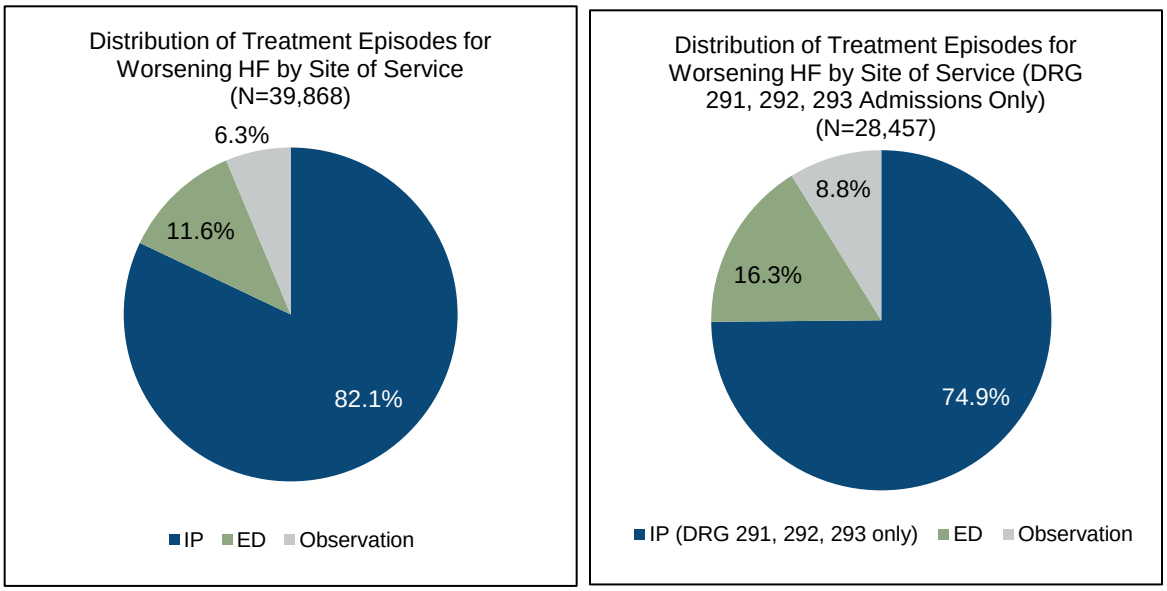
Source: Milliman Analysis of Medicare 5% Sample (2014 index year 2013 look-back year). Allowed costs include Medicare payment to providers + patient cost sharing. Outpatient visit costs include all costs on the day of the service. Per Member per Month (PMPM); Per HF Patient per Month (PPPM). *ED and observation unit visits are those not resulting in admission.

Distribution of Treatment Episodes for Worsening HF by Inpatient and Hospital Outpatient Settings

We identified the total number of treatment episodes for worsening HF across both hospital inpatient and hospital outpatient settings including ED (without admission) and observation unit (without admission). The overwhelming majority of worsening HF episodes are treated in the inpatient hospital setting as shown in Figure 13.

- 82.1% of all worsening HF episodes were treated inpatient, 11.6% in the ED (without admission), and 6.3% in an observation unit (without admission)
- When restricting the count of HF admissions to DRG 291, 292, 293 in combination with treatment episodes for worsening HF treated in the ED or observation unit, 74.9% were treated inpatient, 16.3% in the ED (without admission), and 8.8% in an observation unit (without admission)

Figure 13. Distribution of Treatment Episodes for Worsening HF by Site of Service



Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Premier Inpatient Database (2014 – 2016).

Total Cost of Treatment for Worsening HF

We considered the cost contribution of HF admissions, the cost in the 30 days after HF admissions and outpatient treatment for worsening HF as contributors to total HF population and total Medicare FFS population costs. To prevent double-counting of costs, the 30-day post-discharge costs excluded HF readmissions and the outpatient costs for treatment of worsening HF exclude 30-day post-HF discharge costs.

Figure 14 shows:

- 11.6% of the total HF population costs was associated with treatment for worsening HF
- 3.9% of the total Medicare population costs was associated with treatment for worsening HF

Figure 14. Total Medicare FFS Population Costs Associated with Treatment for Worsening HF

	Allowed $PPPM for the HF Population [A]	% of Total HF Population Allowed $PPPM [(A)/$3,541 PPPM]	Allowed $PMPM for the Total Medicare Population [B]	% of Total Medicare Population Allowed $PMPM [(B)/$1,064 PMPM]
Cost of HF Population	$3,540.67	100.0%	$353.25	33.2%
Cost of HF Population's Total Admissions	$1,856.66	52.4%	$185.24	17.4%
Cost of HF Population's HF Admissions	$242.64	6.9%	$24.21	2.3%
Cost of 30-Day Post HF Admission*	$161.42	4.6%	$16.11	1.5%
Cost of OP Treatment for Worsening HF**	$7.56	0.21%	$0.75	0.07%
Total Cost of Treatment for Worsening HF	**$411.63**	**11.6%**	**$41.07**	**3.9%**

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Premier Inpatient Database (2014 – 2016). Allowed costs include Medicare payment to providers plus patient cost sharing. Per Patient per Month (PPPM); Per Member per Month (PMPM). * The 30-day post HF admission costs excludes readmissions for HF. ** The outpatient (OP) costs for worsening HF exclude costs captured in the 30-day post-HF admission costs.

Extrapolation of 5% Sample Results to the Total Medicare 2015 FFS Population

Using total enrollment and expenditure figures from the "2016 Annual Report of The Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds", we applied the prevalence rate of HF, the proportion of costs attributed to the HF patient population, and admission rates to estimate the total number of HF patients, total Part A and Part B costs, and total number of HF admissions.[17] We do not attempt to extrapolate the findings of our analyses to the Medicare Advantage population of 17.5 million (31.7% of total Medicare lives) because the demographics, morbidity, and reimbursement for the Medicare Advantage beneficiaries differs from the FFS population and would require analysis of Medicare Advantage data.

Figure 15 summarizes the findings including:

- The HF FFS population contributed approximately $124 billion to total annual Medicare FFS costs
- Treatment of worsening HF costs contributed approximately $14 billion to total annual Medicare FFS costs
- HF admissions totaled approximately 857,241 admissions, or 7.1% of the total Medicare admissions (12,130,460)

Figure 15. Extrapolation of Medicare 5% Sample Results to the Total 2015 Medicare FFS Population

	Total 2015 Medicare FFS Population
Number of Medicare FFS Beneficiaries	37,771,000
Number Medicare FFS Beneficiaries with HF (10.5% prevalence rate)	3,980,915
Total Medicare FFS Population Part A & B Costs (in millions)	$373,229
Total HF Population Costs (in millions) (33.2% of total Medicare Costs)	$123,862
Total Costs for Treatment of Worsening HF (in millions) (3.9% of total Medicare Costs)	$14,403
Total Admissions Among Medicare FFS Beneficiaries (329 admissions/1000)	12,130,460
Total HF Admissions Among Medicare FFS Beneficiaries (23 admissions/1000 or 7.1%)	857,241

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year) and Office of the Actuary 2016 Board of Trustees Report.
Notes: The costs only include Part A & B costs. FFS: fee for service.

DISCUSSION

The cost to treat episodes of worsening HF is a significant contributor to Medicare FFS costs and has been underestimated in many reports based on restricting the definition to admissions coded with HF in the primary position of the claim. We expanded the definition to HF-related admissions receiving IV diuretic therapy which increased the number of HF admissions by 50%. This appears to be a conservative estimate compared to a recent study which identified a 100% higher rate of HF admissions than reported when considering only admissions coded with HF in the primary position of the claim.[7]

We calculated the cost contribution to the HF population and to the total FFS Medicare population associated with HF admissions, the 30 days after HF admission discharge and costs for outpatient treatment of worsening HF episodes that did not lead to admission. We identified that:

- 17.1% of the HF population's admissions and 7.1% of the total Medicare population's admissions are for HF
- 11.6% of total HF population costs and 3.9% of total Medicare costs are for HF admissions, 30-day post-discharge costs, and outpatient treatment of worsening HF

A portion of HF admissions are considered potentially preventable ACSCs that could be impacted by more timely and appropriate outpatient management of worsening HF. Medicare aims to reduce HF admissions through administering financial penalties under the HRRP, through inclusion of HF admissions as a performance metric for MSSP Accountable Care Organization's (ACOs) and through inclusion of HF admissions as a Healthcare Effectiveness Data and Information Set (HEDIS) metric for Medicare Advantage Plans. But efforts to reduce HF admissions have been disappointing in light of an abundance of disease management programs focused on HF.[9, 18]

Physicians suggest that many patients presenting to the ED with fluid overload symptoms primarily need decongestion that can be treated with IV diuretics without the need for an inpatient admission.[19] However, many patients presenting with these symptoms still get admitted. Additionally, researchers have suggested that treatment in an observation unit may be beneficial for those without high-risk symptoms.[20] Non-hospital settings for HF treatment such as outpatient clinics or the home environment may also reduce HF admissions. A 2016 study found that treatment of HF patients with worsening fluid overload in an outpatient clinic using IV diuretics was associated with a lower hospitalization rate than predicted.[21] Although some cases of worsening HF may occur quickly and without an opportunity for early intervention (e.g., "flash" pulmonary edema due to myocardial infarction), many instances occur in the setting of chronic HF, where fluid accumulates over a matter of days or even weeks and timely outpatient intensive diuretic management may prevent the need for inpatient treatment.

We identified that the majority of treatment for worsening HF is performed in the higher cost inpatient setting. Considering all of the annual treatment episodes for worsening HF among the HF FFS Medicare population in our study:

- 82.1% were treated in an inpatient setting incurring an average cost of $11,840 plus the $9,149 average cost incurred in the 30-day period after discharge (without including HF readmissions)
- 11.6% were treated in an ED (without admission) with an average cost of $1,208 per visit
- 6.3% were treated in an observation unit (without admission) with an average cost of $3,189 per stay

These findings highlight the need for evaluating treatment patterns for worsening HF and alternative systems of care that can shift the treatment to outpatient settings. A shift in treatment for worsening HF to lower cost outpatient settings could reduce the high cost associated with treatment of HF in the inpatient setting and much of the associated 30-day post-discharge costs. In addition, avoiding inpatient admission lowers the risk of adverse events associated with inpatient hospital stays. Additional costs that might be incurred with treatment of worsening HF in an outpatient setting should be considered, such as increased utilization of home care services, office visits and drug therapies.

TABLE OF ABBREVIATIONS

ACO	Accountable Care Organization
ACSC	Ambulatory care sensitive condition
ADHF	Acute decompensated heart failure
AHRQ	Agency for Healthcare Research and Quality
CMS	Centers for Medicare and Medicaid Services
COPD	Chronic obstructive pulmonary disease
DRG	Diagnosis related group
ED	Emergency department
ESRD	End stage renal disease
FFS	Fee-for-service
HCC	Hierarchical condition category
HCG	Health Cost Guidelines
HEDIS	Healthcare Effectiveness Data and Information Set
HF	Heart failure
HRRP	Hospital Readmissions Reduction Program
IRF	Inpatient rehabilitation facility
IV	Intravenous
NHANES	National Health and Nutrition Examination Survey
OP	Outpatient
PMPM	Per member per month
PPPM	Per patient per month
SNF	Skilled nursing facility

APPENDIX A: PRIMER ON WORSENING HF

Heart failure (HF) is defined as the clinical syndrome resulting from impairment of the heart's ability to fill with blood or to pump blood. It is marked clinically by fatigue and shortness of breath. Although some patients develop fluid overload-"congestion"-it is not universally present.

Recommended pharmacological management of chronic HF focuses on the use of vasodilating medications and beta blockers, with other medications reserved for particular situations. Diuretics are recommended to treat fluid overload.[22,23]

The terminology for clinical deterioration in HF, requiring unscheduled medical care and often hospitalization, is inconsistent. A widely accepted term is "acute decompensated heart failure" (ADHF). Most patients who develop ADHF do so in the context of chronic HF. Importantly, symptoms related to fluid overload, particularly shortness of breath, are what prompt HF patients to seek care for the condition.[24]

Physical examination findings in ADHF are those suggesting fluid overload in the lungs, abdomen, or periphery, as well as signs of cardiac and circulatory decompensation, including decreased urine output.[25]

Diagnostic testing may include chest radiography and electrocardiogram, while laboratory testing typically includes blood count, electrolytes, tests of kidney function, measurement of natriuretic peptide levels, and arterial blood gases, as well as screening tests for concomitant diabetes, thyroid disease, and pulmonary embolism.[25]

A common precipitating factor for worsening HF is nonadherence to prescribed regimens for medications, sodium intake, and/or fluid restriction in chronic HF. Other important factors include:[22]

- Acute cardiovascular disorders, such as myocardial infarction, valve disease, or endocarditis
- Infection, notably pneumonia or viral respiratory illness
- Arrhythmia, particularly atrial fibrillation
- Pulmonary embolism
- Uncontrolled hypertension
- Medication changes, including use of nonsteroidal anti-inflammatory drugs
- Alcohol or illegal drug use

Prompt use of loop diuretics, administered intravenously, is a cornerstone of treatment for HF, and guidelines recommend initiating diuretic treatment in the emergency department.[22]

When loop diuretics alone are inadequate, additional diuretics, low-dose dopamine, inotropic agents, or ultrafiltration may be applied. Generally, vasodilators are continued, though adjustment may be needed based on blood pressure and other clinical factors.[22,26]

Shortness of breath due to hypoxemia is treated with supplemental oxygen, and noninvasive or mechanical ventilation may be required in severe cases of pulmonary congestion.[22] Inotropic agents, such as dobutamine, dopamine, and milrinone, may be used for patients with congestion and low output not responsive to diuretics and for patients with hypotension.[26]

Opportunities to improve ADHF management remain. One issue is that the symptoms of ADHF are nonspecific, and that patients with HF have other multiple conditions. In one retrospective cohort study of patients aged 65 and older, 34% of patients hospitalized with HF also received treatment for pneumonia, 9% also received treatment for COPD, and 5% received treatment for all 3 conditions, underscoring the difficulty of diagnosis of HF in patients presenting with shortness of breath.[16]

APPENDIX B: KEY DATA SOURCES

Medicare 5% Sample. This Limited Data Set contains all Medicare FFS paid claims generated by a statistically-balanced sample of Medicare FFS beneficiaries. Information includes diagnosis codes, procedure codes, and diagnosis-related group (DRG) codes, along with site of service information as well as beneficiary age, eligibility status and an indicator for HMO enrollment. We used Medicare 5% beneficiary sample data in 2013-2014.

Milliman's 2015 65+ Health Cost Guidelines (HCGs). The HCGs provide a flexible but consistent basis for the determination of health claim costs and premium rates for a wide variety of health plans. The HCGs are developed as a result of Milliman's continuing research on healthcare costs. First developed in 1954, the HCGs have been updated and expanded annually since that time. The HCGs are continually monitored as they are used in measuring the experience or evaluating the rates of health plans, and as they are compared to other data sources. The HCGs were developed to be representative of the age and sex distribution for the Medicare FFS population. The Standard Demographics were developed using data from the Medicare 5% sample and publicly available Medicare demographic population data.

Premier Inpatient Database. The Premier Healthcare Database contains data from more than 660 million patient encounters, or one in every five discharges in the nation. Hospital discharge data in Premier's dynamic database are updated on a regular basis, and were available from January 2000 through the May 2016. The Premier database contains data from standard hospital discharge files, including a patient's demographic and disease state, and information on billed services, including medications, laboratory tests performed, diagnostics and therapeutic services in de-identified patient daily service records. In addition, information on hospital characteristics, including geographic location, bed size and teaching status, is also available. We used inpatient admissions discharged between 6/1/2014 and 5/31/2016 with Medicare as a primary payer and a diagnosis of HF in any position on the claim.

APPENDIX C: METHODOLOGY

2014 DENOMINATOR POPULATION AND HF POPULATION IDENTIFICATION CRITERIA

The following beneficiaries were included in the denominator population:

- Beneficiaries with eligibility in all months of 2013 and at least one month in 2014
- Beneficiaries with both Part A and Part B eligibility in all eligible months

Exclusion criteria:

- HMO enrollment – if a beneficiary switches status from HMO to FFS during 2013 or 2014, they were excluded from the denominator population

HF patients were identified as individuals with one or more qualifying claim type (Figure 16) coded with a HF ICD-9 diagnosis code (Figure 17) in any position on the claim in 2014.

Figure 16. Qualifying Claim Types

Claim type	CPT code	Revenue codes
Outpatient	99201-99205, 99211-99215, 99241-99245, 99341-99345, 99347-99350, 99381-99387, 99391-99397, 99401-99404, 99411, 99412, 99420, 99429, 99455, 99456, G0402, G0438,G0439,G0463,T1015	0510-0517,0519-0523, 0526-0529, 0982, 0983
Non-acute inpatient	99304-99310, 99315, 99316, 99318, 99324-99328, 99334-99337	0118, 0128, 0138, 0148, 0158, 0190-0194,0199, 0524, 0525, 0550-0552, 0559,0660-0663,0669
Acute inpatient	99221-99223, 99231-99233, 99238, 99239, 99251-99255, 99291,99468,99469,99471,99472,99475-99480	010x, 0110-0115, 0117,0119-0125, 0127,0129-0135, 0137,0139-0145, 0147,0149-0155, 0157,0159-0162, 0164,0166-0175,0179,0200-0204,0206-0214, 0219, 0720-0724, 0729, 0987
Observation	99217-99220	
Emergency department	99281-99285	0450-0452,0456,0459, 0981

Figure 17. HF ICD-9 Diagnosis Codes

ICD-9 Diagnosis Code	Code Description
428.0	Congestive heart failure, unspecified
428.1	Left heart failure
428.20	Systolic heart failure, unspecified
428.21	Systolic heart failure, acute
428.22	Systolic heart failure, chronic
428.23	Systolic heart failure, acute on chronic
428.30	Diastolic heart failure, unspecified
428.31	Diastolic heart failure, acute
428.32	Diastolic heart failure, chronic
428.33	Diastolic heart failure, acute on chronic
428.40	Combined systolic and diastolic heart failure, unspecified
428.41	Combined systolic and diastolic heart failure, acute
428.42	Combined systolic and diastolic heart failure, chronic
428.43	Combined systolic and diastolic heart failure, acute on chronic
428.9	Heart failure, unspecified
402.01	Malignant hypertension, with heart failure
402.11	Benign hypertension, with heart failure
402.91	Unspecified hypertension, with heart failure
404.01	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.03	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage V
404.11	Hypertensive heart and chronic kidney disease, benign, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.13	Hypertensive heart and chronic kidney disease, benign, with heart failure and with chronic kidney disease stage V
404.91	Hypertensive heart and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage I through stage IV or unspecified
404.93	Hypertensive heart and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage V

IDENTIFICATION CRITERIA FOR TREATMENT EPISODES OF WORSENING HF

Criteria for identifying outpatient treatment episodes for worsening HF varied depending on the site of service and were based on a combination of HF and “HF-related” ICD-9 diagnosis codes (Figure 17 and Figure 18) as well as the J code for infused furosemide (Figure 19). Outpatient visit costs include all costs on the day of the service. Figure 20 provides

the identification logic for treatment episodes for worsening HF in outpatient settings. Figure 21 provides the qualifying claim types used to identify outpatient sites of service.

Figure 18. ICD-9 Diagnosis Codes Used to Identify HF-Related Diagnoses

ICD-9 Diagnosis Code	Code Description
276.69	Fluid overload
514	Pulmonary congestion and hypostasis
518.4	Acute edema of lung, unspecified
518.81	Acute respiratory failure
518.83	Chronic respiratory failure
518.84	Acute and chronic respiratory failure
786	Dyspnea and respiratory abnormalities
782.3	Edema

Figure 19. J Code Used to Identify IV Diuretic Therapy

HCPCS J Code	Code Description
J1940	Furosemide injection

Figure 20. Identification Criteria for Treatment Episodes of Worsening HF by Site of Service

Site of Service	HF Identification Criteria
Physician Office and Urgent Care	Coded with at least one HF or HF-related ICD-9 diagnosis code (Figure 17 and Figure 18) in any position of the claim AND a J code claim for an infused diuretic (Figure 19)
ED and Observation Unit	(1) Coded with a HF ICD-9 diagnosis code (Figure 17) in the primary position of the claim OR (2) Coded with a HF-related ICD-9 diagnosis code (Figure 18) in the primary position of the claim and one HF ICD-9 diagnosis code (Figure 17) in any other position of the claim OR (3) Coded with a HF ICD-9 diagnosis code (Figure 17) or HF-related ICD-9 diagnosis code Figure 18) in any position of the claim and at least one J code diuretic claim (Figure 19)

Figure 21. Qualifying Claim Types Used to Identify Site of Service in Outpatient HF Episode Identification

Claim Type	CPT Code	Revenue Codes
Physician office	98966-98969, 99201-99205, 99211-99215, 99241-99245, 99324-99328, 99334-99337, 99339, 99340-99350, 99354-99355, 99358-99359, 99366-99368, 99374-99375, 99377-99380, 99415-99416, 99441-99449, 99499	0982-0983
Urgent care	99050-99051, 99053, 99056, 99058, 99060	0526
Home care	99500-99507, 99509-99512 ,99600-99602	0023, 0522, 0527, 0570-0572, 0579, 0580-0583, 0589-0590, 0599, 0640-0649, 0651-0654, 0660-0663, 0669, 0989
Observation	99217-99220	
Emergency department	99281-99285	0450-0452,0456,0459, 0981

We expanded the identification of HF admissions for DRG 291, 292, 293 to include "HF-related" admissions based on claim coding criteria. The HF-related DRGs were identified based on literature review and clinical input and are listed in Figure 22 along with DRG 291, 292, 293, which are definitively for the treatment of HF. A portion of these DRGs were excluded based on coding for unrelated ICD-9 codes (e.g. related to inhalation of vapors), prior to application of the percentages calculated from the Premier diuretic use analysis. As noted in Figure 6, the potential HF admissions were further analyzed to identify the portion with IV diuretic therapy which was required to be considered HF-related.

Figure 22. Potential HF Admissions in the HF Population and Percentage Excluded with Unrelated ICD-9 Codes

HF DRG	DRG Description	Count of All HF Admissions	Count of Included HF Admissions	% of Potential HF Admissions Excluded Based on ICD-9 Criteria
HF Admissions		55,041	54,800	0.4%
186	Pleural effusion w MCC	319	319	0.0%
187	Pleural effusion w CC	198	198	0.0%
188	Pleural effusion w/o CC/MCC	50	50	0.0%
189	Pulmonary edema & respiratory failure	4,005	4,005	0.0%
190	Chronic obstructive pulmonary disease w MCC	3,872	3,872	0.0%
191	Chronic obstructive pulmonary disease w CC	3,017	3,017	0.0%
192	Chronic obstructive pulmonary disease w/o CC/MCC	1,298	1,298	0.0%
193	Simple pneumonia & pleurisy w MCC	3,982	3,982	0.0%
194	Simple pneumonia & pleurisy w CC	3,619	3,619	0.0%
195	Simple pneumonia & pleurisy w/o CC/MCC	1,055	1,055	0.0%
204	Respiratory signs & symptoms	348	332	4.6%
205	Other respiratory system diagnoses w MCC	189	100	47.1%
206	Other respiratory system diagnoses w/o MCC	275	154	44.0%
207	Respiratory system diagnosis w ventilator support 96+ hours	1,213	1,205	0.7%
208	Respiratory system diagnosis w ventilator support <96 hours	1,923	1,916	0.4%
291	Heart failure & shock w MCC	9,434	9,434	0.0%
292	Heart failure & shock w CC	8,851	8,851	0.0%
293	Heart failure & shock w/o CC/MCC	3,016	3,016	0.0%
304	Hypertension w MCC	82	82	0.0%
305	Hypertension w/o MCC	287	287	0.0%
308	Cardiac arrhythmia & conduction disorders w MCC	2,655	2,655	0.0%
309	Cardiac arrhythmia & conduction disorders w CC	2,604	2,604	0.0%
310	Cardiac arrhythmia & conduction disorders w/o CC/MCC	1,244	1,244	0.0%
312	Syncope & collapse	1,505	1,505	0.0%

Source: Milliman Analysis of Medicare 5% Sample (2014 index year, 2013 look-back year).

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