Adding or Switching Diuretics Is Associated with Fewer CHF Exacerbations Than Increasing Dose or Frequency

Team A: Kersten Bartelt, RN; Grant Keane
Team B: Tom Elliott, MPharm GPhC; Joe Deckert, PhD
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Key Findings:

- CHF exacerbations were 40–60% more likely for patients who had their diuretic frequency increased compared to those who had their diuretic dosage increased.
- In contrast, CHF exacerbations were 7–13% less likely for patients who had an additional diuretic added or had their diuretic class switched compared to those who had their diuretic dosage increased.

Congestive heart failure (CHF) is a leading cause of emergency department visits and hospital admissions in the United States, with exacerbations driving substantial morbidity, mortality, and healthcare utilization.[1] Diuretics are a cornerstone of symptom management in patients with volume overload (which commonly occurs among patients with CHF), yet many patients experience persistent or worsening symptoms despite ongoing therapy.[2] When diuretic response is inadequate, clinicians commonly escalate treatment by increasing dose, increasing dosing frequency, changing diuretic class, or combining diuretics. While these strategies are widely used, comparative evidence on which escalation pathways are associated with better short-term outcomes is limited. Understanding how these common decisions relate to downstream exacerbations could help clinicians choose escalation strategies that minimize acute care utilization.

We studied 245,738 patients with CHF between January 2017 and October 2025 who had their first prescription for a loop diuretic, aldosterone antagonist diuretic, or low-ceiling diuretic. Patients were identified by their diuretic escalation event, categorized as an increase in medication dose, an increase in medication frequency, an increase in both dose and frequency, or a change to or addition of another diuretic type. When evaluating outcomes, we accounted for patient demographics, rurality and social vulnerability based on residence, BMI classification, prior ED utilization, duration on diuretic therapy, prior IV diuretic use, history of chronic kidney disease, history of heart failure, prior CHF exacerbations, and care setting type for the initial diuretic prescription.

Across outcomes, escalation strategies that increased diuretic frequency were consistently associated with worse short-term CHF outcomes compared to increasing dosage. Increasing diuretic frequency alone was associated with a 43–46% higher likelihood of CHF exacerbations in both the ED and inpatient settings compared to increasing dosage alone. Increasing both dose and frequency was associated with even larger increases (a 52–60% higher likelihood of exacerbation-related admission) compared to increasing the dosage alone. In contrast, modifying the diuretic regimen appeared more favorable. Adding an additional diuretic was associated with a 13% lower likelihood of ED visits for CHF exacerbations and a 7% lower likelihood of an admission for exacerbations compared with dose increases alone. Switching diuretic classes was also associated with a 12% lower likelihood of ED visits for exacerbations, though the association with admissions for exacerbations was small and not statistically significant.

ED Visit and Admission Likelihood for CHF Exacerbation by Diuretic Escalation Event

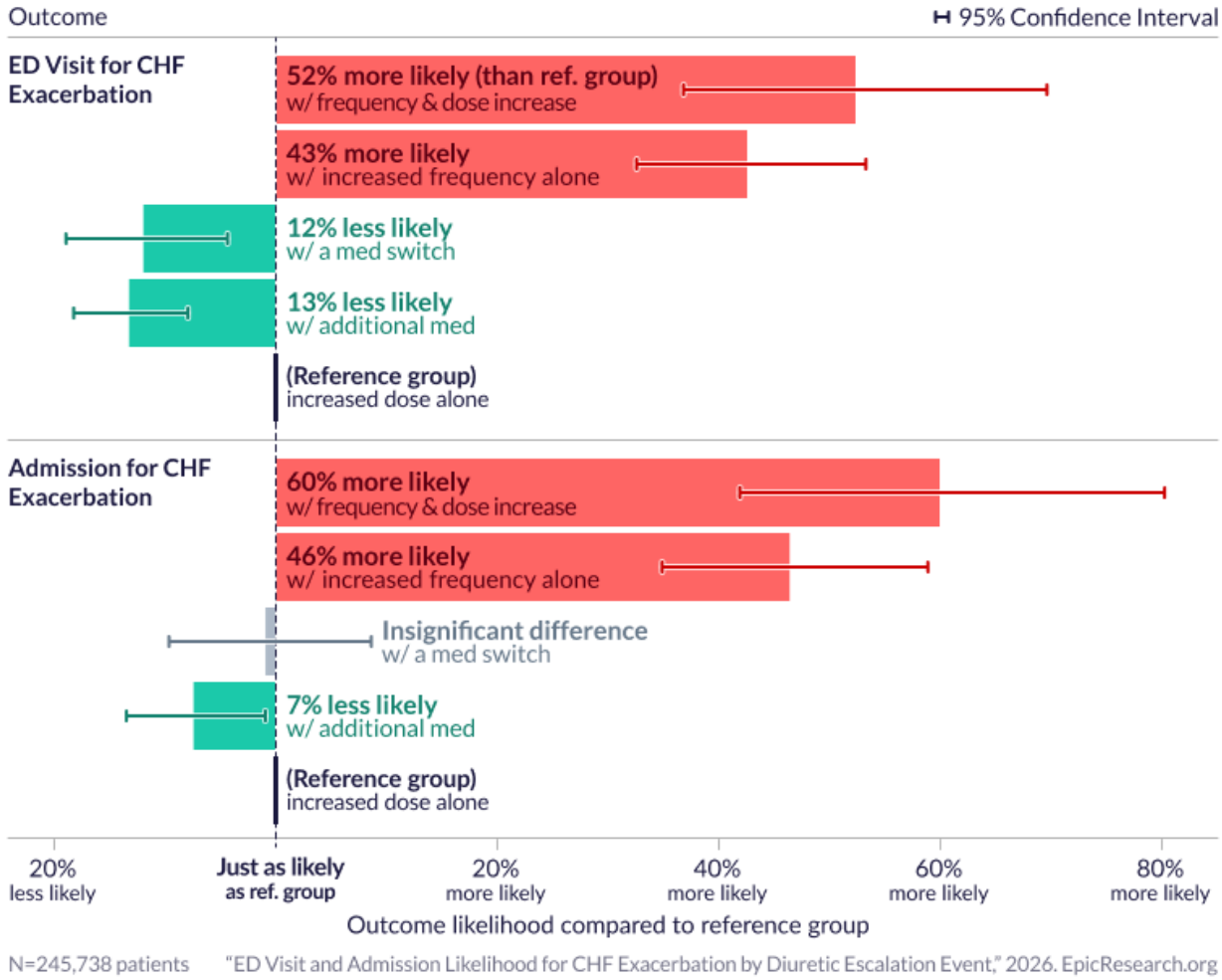

Figure 1. The likelihood of an ED visit or admission for CHF exacerbation by the diuretic escalation event the patient experienced.

Together, these patterns suggest that addressing inadequate response through combination or alternative diuretic therapy may be associated with fewer short-term exacerbations than strategies focused solely on intensifying dose or frequency.

These data come from Cosmos, a dataset created in collaboration with a community of Epic health systems representing more than 300 million patient records from 1,800 hospitals and more than 42,000 clinics from all 50 U.S. states, Canada, Lebanon, and Saudi Arabia. This study was completed by two teams that worked independently, each composed of a clinician and research scientists. The two teams came to similar conclusions. Graphics by Brian Olson.

References

1. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2022;145(18):e876-e894. doi:10.1161/CIR.0000000000001062

2. Colucci WS, Vader JM. Heart failure: Management of acute decompensation and volume overload. UpToDate. January 27, 2026. https://www.uptodate.com/contents/heart-failure-management-of-acute-decompensation-and-volume-overload. Accessed February 9, 2026.

Data Definitions

Term	Definition
Study period	1/1/2017 to 11/1/2025
Study population: inclusion	Patients with: • A new order that has a type of "prescription" for a **loop diuretic, aldosterone antagonist** diuretic, or **low-ceiling diuretic** that does not have a frequency of PRN or as needed. Must be the first diuretic prescribed for that patient. • A billing, encounter, or problem list diagnosis of CHF (ICD-10-CM code I50*) on or before their first prescription • A **face-to-face visit** at least 180 days following **index date** • An **OP face-to-face visit** at least one year prior to **index date** • An evaluated sex of male or female • Fits into one of the **Exposure buckets**
Study population: exclusion	Patients with: • A billing, encounter, or problem list diagnosis of cancer (C*) prior to or during the study period (6 months after index) • A prescription for a diuretic prior to the inclusion prescription • A patient-reported medication change during the study period • Evidence of **pregnancy** during study period
Exposures	Patients with: • An increase in medication frequency (from daily or less to more than once daily) • An increase in medication dosage • A change to or addition of another type of **diuretic**
Index date	Date of the **exposure** event
Outcomes	The following within 6 months of **index**: • CHF exacerbation: encounter or billing diagnosis with SNOMED code 96311000119109 in an ED visit • CHF exacerbation: encounter or billing diagnosis with SNOMED code 96311000119109 in an admission
Confounders	Age group: • <50 • 50-59 • 60-69 • 70+ Evaluated sex RUCA Social Vulnerability Index quintile BMI classification (most recent before index) Count of ED visits in prior year Duration on diuretic prior to switch event IV **diuretic** administration in year prior

	CKD: billing, encounter, or problem list diagnosis with ICD-10-CM code ICD-10-CM code N18* Refractory HF: billing, encounter, or problem list diagnosis with SNOMED code 67431000119105 Number of prior CHF Exacerbations (between med start and **index**) Encounter type of initial prescription: admission, outpatient, other
Loop diuretic	Medications with ATC code CO3C* or simple generic name is bumetanide, ethacrynate sodium/ethacrynic acid, furosemide, or torsemide
Aldosterone antagonist diuretic	Medication with ATC code C03DA*
Low-ceiling diuretic	Medication with ATC code C03BA* or C03AA*
Diuretics	Medications with ATC code C03*
Pregnancy	A pregnancy episode overlapping with the study period or a billing or encounter diagnosis with ICD-10-CM code O* during the study period or the nine months prior
Race and ethnicity	Non-exclusive flags for Black and Hispanic patients
Model specifications	Logistic regression
Limitations	This study did not account for left ventricular ejection fraction or New York Heart Association (NYHA) functional class, both of which are key indicators of heart failure subtype and disease severity that influence prognosis and response to diuretic therapy. As a result, differences in outcomes across escalation strategies may partially reflect unmeasured baseline severity or symptom burden rather than the effects of the escalation approach itself.

Table 1. ED Visit Likelihood for CHF Exacerbation by Diuretic Escalation Event

Term	Odds Ratio	Lower CI	Upper CI
(Intercept)	0.02	0.02	0.03
Additional Med	0.87	0.82	0.92
Dose & Frequency Increased	1.52	1.37	1.70
Increased Frequency	1.43	1.33	1.53
Switched Med	0.88	0.81	0.96
Prescribed Encounter Type Outpatient or Orders Only	1.20	1.07	1.34
Prescribed Encounter Type Other	0.83	0.74	0.94
Reliable Sex Male	1.06	1.01	1.11
Age 50-59	1.02	0.94	1.11
Age 60-69	0.90	0.84	0.98
Age 70+	0.85	0.78	0.92
RUCA Micropolitan	0.94	0.87	1.01
RUCA Other	0.84	0.54	1.31
RUCA Rural	0.76	0.65	0.88
RUCA Small Town	0.76	0.67	0.85
SVI Quintile 20-40	1.21	1.09	1.35
SVI Quintile 40-60	1.30	1.18	1.44

SVI Quintile 60-80	1.43	1.30	1.58
SVI Quintile 80-100	1.79	1.63	1.96
SVI Quintile Unknown	1.70	1.12	2.58
BMI Obese	0.77	0.72	0.82
BMI Overweight	0.83	0.78	0.88
BMI Severely Obese	0.75	0.69	0.81
BMI Underweight	1.02	0.86	1.21
BMI Unknown	0.34	0.14	0.81
Starting Med Loop Diuretic	1.23	1.16	1.31
Starting Med Low-Ceiling Diuretic	0.80	0.72	0.89
Starting Med Other Diuretic	0.88	0.64	1.23
Ejection Fraction >=50	0.71	0.65	0.78
Ejection Fraction 41-49	0.84	0.73	0.97
Ejection Fraction Unknown	0.74	0.69	0.79
Number of Prior Exacerbations	1.84	1.79	1.90
Days Since Med Start	1.00	1.00	1.00
Number of ED Visits	1.09	1.08	1.10
Had CKD	1.52	1.45	1.59
Had HF	0.94	0.29	3.02

Table 2. Admission Likelihood for CHF Exacerbation by Diuretic Escalation Event

Term	Odds Ratio	Lower CI	Upper CI
(Intercept)	0.02	0.01	0.02
Additional Med	0.93	0.87	0.99
Dose & Frequency Increased	1.60	1.42	1.80
Increased Frequency	1.46	1.35	1.59
Switched Med	0.99	0.90	1.09
Prescribed Encounter Type Outpatient or Orders Only	1.13	1.00	1.27
Prescribed Encounter Type Other	0.82	0.72	0.93
Reliable Sex Male	1.00	0.95	1.06
Age 50-59	1.03	0.94	1.13
Age 60-69	0.98	0.90	1.08
Age 70+	0.92	0.84	1.00
RUCA Micropolitan	0.79	0.72	0.86
RUCA Other	1.01	0.62	1.66
RUCA Rural	0.66	0.55	0.78
RUCA Small Town	0.59	0.51	0.69
SVI Quintile 20-40	1.25	1.12	1.41
SVI Quintile 40-60	1.31	1.17	1.47

SVI Quintile 60-80	1.42	1.27	1.58
SVI Quintile 80-100	1.85	1.67	2.06
SVI Quintile Unknown	1.77	1.10	2.85
BMI Obese	0.78	0.73	0.84
BMI Overweight	0.84	0.78	0.90
BMI Severely Obese	0.81	0.75	0.89
BMI Underweight	1.11	0.92	1.33
BMI Unknown	0.35	0.13	0.95
Starting Med Loop Diuretic	1.34	1.24	1.44
Starting Med Low-Ceiling Diuretic	0.77	0.68	0.87
Starting Med Other Diuretic	0.85	0.58	1.25
Ejection Fraction >=50	0.74	0.66	0.82
Ejection Fraction 41-49	0.87	0.74	1.02
Ejection Fraction Unknown	0.72	0.66	0.77
Number of Prior Exacerbations	1.61	1.56	1.66
Days Since Med Start	1.00	1.00	1.00
Number of ED Visits	1.07	1.07	1.08
Had CKD	1.75	1.66	1.84
Had HF	1.67	0.60	4.61