ORIGINAL RESEARCH

Reasons for Guideline Nonadherence at Heart Failure Discharge

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***Background*—**Cardiology has advanced guideline development and quality measurement. Recognizing the substantial benefits of guideline-directed medical therapy, this study aims to measure and explain apparent deviations in heart failure (HF) guideline adherence by clinicians at hospital discharge and describe any impact on readmission rates.

***Methods and Results*—**The extent of decongestion and prescription of neurohormonal therapy were recorded prospectively for 226 HF discharges, including 132 (58%) from an academic hospital and 94 (42%) from a community hospital. Among all discharges, 25% were discharged with residual congestion (30% academic versus 18% community, P=0.070). Among discharges of patients with HF with reduced ejection fraction, 37% (45% academic versus 18% community, P<0.001) were discharged without β-blocker therapy or with lower doses than at admission. Moreover, 46% of patients with HF with reduced ejection fraction (48% academic versus 39% community, P=0.390) were discharged without an angiotensin-converting enzyme inhibitor or angiotensin II receptor blocker or with lower doses than at admission. Renal dysfunction was the most common reason for discharge with congestion, and hypotension the most common reason for discharge with no or decreased neurohormonal therapy. There was a trend toward higher 90-day readmission rates after discharge with residual congestion.

***Conclusions*—**Clinicians frequently deviate from guidelines in both academic and community hospitals; however, this deviation may not always indicate poor quality. Application of guidelines recommended for stable populations is increasingly limited for hospitalized patients by hypotension, renal dysfunction, and inotrope use. Patients with renal dysfunction, hypotension, and recent inotrope use merit further study to determine best practices and possibly to adjust quality metrics for HF severity. **(*J Am Heart Assoc*. 2018;7:e008789. DOI: 10.1161/JAHA.118.008789.)**

Key Words: guideline adherence • quality • quality assessment • quality improvement • quality of care

Since the publication of the first coronary artery disease guidelines in the early 1960s, cardiology has been a leader in the development of clinical guidelines.[1] In mid-1990s, the American Heart Association and the American College of Cardiology published the first clinical guidelines for heart failure (HF).[2,3] Based in large part on the results of the SOLVD (Studies of Left Ventricular Dysfunction),[4] SAVE (Survival and Ventricular Enlargement),[5] CONSENSUS (Cooperative North Scandinavian Enalapril Survival Study),[6] COPERNICUS (Carvedilol Prospective Randomized Cumulative Survival Study),[7] MERIT-HR (Metoprolol CR/XL Randomized Intervention Trial in Congestive Heart Failure),[8] and CIBIS-II (Cardiac Insufficiency Bisoprolol Study II)[9] trials, HF guidelines have consistently focused on the benefits of neurohormonal therapy to delay progression and improve survival for patients with HF with reduced ejection fraction (HFrEF). More recent guidelines have also included emphasis on the importance of achieving and maintaining decongestion regardless of ejection fraction.[10–12]

Broad application of these guideline-directed medical therapies has decreased disease progression and improved outcomes in HFrEF.[13,14] As a result, patients are now less likely to require hospitalization for the once-typical course of decompensation reversed with simple intravenous diuresis.[15–18] The contemporary population of hospitalized HF patients is now older, with a longer duration of disease and a larger burden of right HF, cardiorenal syndrome, and noncardiac comorbidities. Many, if not most, have more

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Accompanying Tables S1 and S2 are available at http://jaha.ahajournals.org/content/7/15/e008789/DC1/embed/inline-supplementary-material-1.pdf

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Clinical Perspective

What Is New?

- This study describes the frequency of and reasons for noncompliance with heart failure (HF) guidelines at the time of hospital discharge from both academic and community hospitals.
- Among all HF discharges, 25% were done with residual congestion.
- Among discharges of patients with HR with reduced ejection fraction, 37% were discharged on less β-blocker and 46% were discharged on less angiotensin-converting enzyme inhibitor or angiotensin II receptor blocker compared with admission.
- Renal dysfunction was the most common reason for discharge with residual congestion, and hypotension was the most common reason for discharge with no or decreased neurohormonal therapy.
- Recent inotropic use was also commonly cited at the academic hospital.

What Are the Clinical Implications?

- Clinicians frequently deviate from guidelines at both academic and community hospitals.
- However, this may not always indicate poor-quality care.
- Application of traditional HF guidelines, which were developed in stable HF populations, at the time of hospital discharge is increasingly limited by hypotension, renal dysfunction, and recent inotrope use in more tenuous HF patients.
- Patients with renal dysfunction, hypotension, and recent inotrope use merit further study to determine best practices and possibly to adjust quality metrics for HF severity.

hemodynamic instability than those enrolled in the landmark trials that gave rise to our current HF guidelines.

Recent observational studies comparing patients discharged on and off neurohormonal therapy indicate that up to 50% of early postdischarge mortality may be associated with guideline nonadherence.[11] Although compelling, this difference in outcomes is much greater than seen between placebo and active treatment in trials and thus is unlikely to be related solely to the lack of guideline-directed therapies. An alternative explanation is that in the current era, hospitalization concentrates those more fragile HF patients for whom uptitration or even continuation of neurohormonal antagonists may be challenging, given hemodynamic, renal, or tolerability constraints.[19] In a recent sample of inpatients with on HF services at centers in the National Heart, Lung, and Blood Institute Heart Failure Network, 58% of those with HFrEF were not able to tolerate angiotensin-converting enzyme inhibitor (ACEi) or angiotensin II receptor blocker (ARB) therapy.[20]

Despite the changing disease profiles of hospitalized patients, adherence to guidelines derived from stable outpatients remains a standard measure of HF quality for patients at the time of hospital discharge. In the current era of alternative payment models, this assessment of quality has significant implications for provider and hospital reimbursement[21,22] and for the ranking of hospital programs. The lack of adequate adjustment for severity of heart disease and comorbidities risks penalizing providers and hospitals that care for more advanced HF patients or more vulnerable populations.

To begin to better apply and interpret metrics for adherence to guidelines, better understanding of the current hospitalized HF population and the clinical reasons for guideline nonadherence is necesssary.[23] This study aims to describe the population of patients hospitalized with HF at both academic and community hospitals, specifically, those discharged with less therapy than recommended by guidelines and the reasons reported by physicians for the guideline deviation at hospital discharge.

Methods

The data, analytic methods, and study materials will not be made available to other researchers for purposes of reproducing the results. Interested researchers may apply to the former Institute for Relevant Clinical Data Analytics (IRCDA) (contact info@ircda.org or http://www.scamps.org/) for access to available data.

Data Collection

This study opened April 4, 2013, and closed March 16, 2014, at Brigham and Women's Hospital, an academic hospital in Boston, Massachusetts, and opened September 16, 2013, and closed August 2, 2014, at Lancaster General Hospital, a community hospital in Lancaster, Pennsylvania. Both hospitals have designated multidisciplinary teams assigned to inpatient care, outpatient care, and the transition after HF hospitalization. All patients admitted to the HF services of either hospital during the study period with a primary diagnosis of HF were considered for inclusion. Exclusion criteria included new-onset HF, end-stage renal disease requiring hemodialysis, or end-stage HF requiring palliative care. Patients admitted for consideration of advanced therapies, including mechanical circulatory support or transplantation, were also excluded. Because this study was originally designed as a quality-improvement project and guideline adherence and reasons for nonadherence can vary between different admissions for the same patient, all analyses were performed at the admission/discharge level. No patients died before discharge.

To identify and analyze the reasons for guideline nonadherence, providers at both sites worked together to develop a

Table 1. Guideline Adherence Criteria

Guideline	Applicable to Patient Population	Definition
Decongestion*	All HF patients	(1) JVP ≤8 cmH_2O; (2) Pedal edema ≤1+ (trace or less); (3) Absence of orthopnea; (4) Absence of rales
Neurohormonal therapy	HFrEF patients, ejection fraction ≤40%	(1) If not on a β-blocker and/or ACEi/ARB at admission, initiate before or at discharge; (2) If on a β-blocker and/or ACEi/ARB at admission, discharge on at least the dose at admission

ACEi indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; HF, heart failure; HFrEF, heart failure with reduced ejection fraction; JVP, jugular venous pressure.
*Assessment of decongestion was performed by a board-certified HF and transplant cardiology attending physician.

standardized clinical assessment and management plan (SCAMP)[24–26] for all patients with HF. This guideline-based predischarge plan was implemented 24 hours before hospital discharge. In practice, the SCAMP served as a reminder of clinical guidelines and standardized the recording of reasons for nonadherence. Physicians participating in the study were not evaluated or penalized based on their rates of SCAMP adherence or on hospital length of stay or other outcomes.

Guideline Adherence Definitions and Outcomes

Decongestion was assessed in all HF patients by the advanced HF/transplant board-certified attending cardiologist on service. In this study, decongestion was defined as all of the following: jugular venous pressure ≤8 cm water, pedal edema of <1+ (trace or less), the absence of orthopnea, and the absence of rales. Initiation or continuation (relative to hospital admission) of neurohormonal therapy was assessed in patients with HFrEF only. For patients not on a β-blocker or ACEi/ARB at admission, initiation was defined as discharge on any dose of drug. For patients on a β-blocker or ACEi/ARB at admission, continuation was defined as discharge on at least their admission dose (Table 1).

When a patient was discharged with residual congestion or with lower dose or no neurohormonal therapy, physicians were asked to document the reason why by selecting from a list of prespecified reasons or free-texting "other" reasons. More than one reason could be documented for each discharge. In this study, hypotension was defined for each patient by the attending cardiologist based on an inability to further diurese or initiate/uptitrate neurohormonal therapy because of low and/or symptomatic blood pressures. All enrolled patients were followed for at least 90 days after discharge by study staff, and rates of all-cause readmission were assessed through electronic medical record review and follow-up phone calls.

The study was approved as a quality-improvement project and informed consent was waived by the institutional review board at each hospital. Oversight of the production of the SCAMP was provided by the IRCDA, a nonprofit tax-exempt organization for the development, implementation, and analysis of SCAMPs.

Statistical Analysis

All statistical analyses were performed at the admission/discharge level. Descriptive statistics are reported with frequencies, percentages, means (for normally distributed data), and medians (for non-normal data) with between-sample comparisons conducted using standard parametric or nonparametric tests, as appropriate. Fisher exact and χ^2 tests were used to compare changes in congestion status, perfusion status, neurohormonal dosing, and readmission rates between groups. Statistical analyses were conducted using SAS v9.3 (SAS Institute).

Results

Patient Characteristics

The study enrolled and analyzed 226 HF discharges, 132 (58%) from the academic hospital and 94 (42%) from the community hospital. At the academic hospital, the 132 discharges were derived from 115 patients. At the community hospital, the 94 discharges were derived from 87 patients. Completed SCAMP forms with documentation of guideline adherence, in which the attending cardiologist documented any reasons for guideline nonadherence, were available for 195 (86%) of discharges. As shown in Table 2, the academic-site HF population was younger (median age: 64 versus 79 years), more likely to be male (66% versus 48%), and from a minority population (29% versus 10%). The academic site population was also more likely to have HFrEF (79% versus 51%), a higher admission daily diuretic requirement (51% versus 3% on >240 mg/day of furosemide), and poorer renal function (49% versus 25% with blood urea

Table 2. Baseline Characteristics of HF Patients, Stratified by Admission Site

	Overall	Academic Hospital	Community Hospital	*P* Value (Academic vs Community)
Patients, n	226	132	94	
Demographics				
Age, y, median	69	64	79	…
Female, n (%)	94 (42)	45 (34)	49 (52)	0.006*
Ethnicity, n (%)				
White	179 (79)	95 (72)	84 (90)	0.001*
Black	36 (16)	31 (24)	5 (5)	<0.001*
Hispanic	5 (2)	5 (4)	0 (0)	0.056*
Unknown/other	6 (3)	1 (1)	5 (5)	0.035
Payer information, n (%)				
Commercial insurance	44 (20)	35 (27)	9 (10)	0.001*
Medicare	148 (65)	76 (58)	72 (77)	0.003*
Medicaid	21 (9)	15 (11)	6 (6)	0.204
Self-pay/other	13 (6)	6 (5)	7 (7)	0.358
Comorbidities, n (%)				
Anemia*	38 (17)	14 (11)	24 (28)	0.003*
COPD	74 (36)	37 (28)	37 (51)	0.073*
Depression	25 (14)	12 (14)	13 (15)	0.263
Malnutrition†	60 (29)	36 (29)	24 (28)	0.772
Renal disease‡	155 (71)	88 (67)	67 (77)	0.459
Stroke (history of)	32 (18)	19 (21)	13 (15)	0.904
HF type, n (%)				
HFrEF (EF ≤40%)	148 (68)	104 (79)	44 (51)	<0.001*
HFpEF (EF >40%)	71 (32)	28 (21)	43 (50)	<0.001*
HF severity				
Patients, n§	163	76	87	
Home loop diuretic dose (in furosemide equivalents), n (%)‖				
<100 mg/d	92 (56)	24 (32)	68 (78)	<0.001*
100–240 mg/d	29 (18)	13 (17)	16 (18)	0.834
>240 mg/d	42 (26)	39 (51)	3 (3)	<0.001*
Renal function (baseline BUN), n (%)				
<40 mg/dL	104 (64)	39 (51)	65 (75)	0.002*
40–80 mg/dL	53 (33)	32 (42)	21 (24)	0.015*
>80 mg/dL	6 (4)	5 (7)	1 (1)	0.066*

BUN indicates blood urea nitrogen; COPD, chronic obstructive pulmonary disease; EF, ejection fraction; HF, heart failure; HFrEF, heart failure with reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction.

*Anemia: hemoglobin <10 g/dL or hematocrit <30 mg/dL.

†Malnutrition: albumin <3.5 g/dL.

‡Renal disease: estimated glomerular filtration rate <60 mL/min/1.73m^2.

§Complete laboratory and pharmacy data at admission were not available for all patients.

‖Diuretic conversion: furosemide 40 mg=bumetanide 1 mg=torsemide 20 mg. This does not include doses of secondary diuretics such as hydrochlorothiazide or metalozone.

Table 3. Rates of Decongestion and Neurohormonal Therapy

Clinical Guideline	Overall	Academic Hospital	Community Hospital	*P* Value (Academic vs Community)
Complete decongestion at discharge				
Patients, n*	195	108	87	
Completely decongested at the time of discharge, n (%)	147 (75)	76 (70)	71 (82)	0.070
Initiated or maintained on neurohormonal therapy at discharge				
Patients with HFrEF, n	148	104	44	
β-Blockers, n (%)†				Fisher Exact‡
Not on β-blocker at admission or discharge	18 (12)	15 (14)	3 (7)	<0.001
Stopped or discharged on lower dose of β-blocker	37 (25)	32 (31)	5 (11)	
Started β-blocker or continued at same/higher dose†	86 (58)	53 (51)	33 (75)	
Changed medication within class	7 (5)	4 (4)	3 (7)	N/A
ACEi/ARB, n (%)†				Fisher Exact‡
Not on ACEi/ARB at admission or discharge	41 (28)	29 (28)	12 (27)	0.390
Stopped or discharged on lower dose of ACEi/ARB	26 (18)	21 (20)	5 (11)	
Started ACEi/ARB or continued same/higher dose†	78 (53)	52 (50)	26 (59)	
Changed medication within class	3 (2)	2 (3)	1 (4)	N/A

ACEi indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; HFrEF, heart failure with reduced ejection fraction.
*Completed documentation of guideline adherence was available for 195 (86%) of discharges.
†Denotes the category *guideline/SCAMP adherent* indicating patients who are either newly started on neurohormonal therapy or maintained on at least their admission dose at discharge.
‡Fisher exact test was performed across categories, excluding *changed medication within class* because it is unclear whether any given medication change across class is in adherence with guidelines.

nitrogen ≥40 mg/dL). In addition to being older, the community HF population had higher rates of anemia (28% versus 11%) and chronic obstructive pulmonary disease (51% versus 28%).

Guideline Adherence Rates

Guideline adherence rates are presented in Table 3. The rate of decongestion at the time of discharge was 75% among all discharges with a no difference between rates at the academic and community hospitals (82% versus 70%, respectively; *P*=0.070). Among 148 discharges with HFrEF, 58% were newly initiated or maintained on at least their admission dose of β-blocker therapy. In contrast, 25% had their admission dose of β-blocker decreased or stopped, and 12% were not on a β-blocker at admission or discharge. Similarly, of the 148 HFrEF discharges, 53% were newly initiated or maintained on at least their admission dose of ACEi/ARB. In contrast, 18% had their admission dose of ACEi/ARB decreased or stopped, and 28% were not on an ACEi/ARB at admission or discharge. Overall, guideline adherence rates for β-blockers were higher in the community hospital (75% versus 51%, *P*<0.001), whereas rates for ACEi/ARB adherence rates did not differ by site (59% community versus 50% academic, *P*=0.390).

Reasons for Guideline Nonadherence

The most common reason overall for discharge with residual congestion was *renal dysfunction* (27%) followed by *other* (25%) and *patient resistance/noncompliance* (21%; Figure 1A). Renal dysfunction was the most common reason for discharge with residual congestion at the academic hospital (38% versus 6%, *P*=0.019), whereas *best clinical compromise/chronic edema* was the most common reason at the community hospital (31% versus 6%, *P*=0.020; Figure 1B). There was also a higher rate of *plan for outpatient diuresis* at the community hospital (19% versus 0%, *P*=0.011). Both hospitals had high rates of other reasons for discharge with incomplete decongestion (28% academic and 19% community). Other reasons are described Figure 1B.

For patients with HFrEF, the most common reason for discharge on less or no β-blocker was *hypotension* (41%), followed by *inotropic therapy/cardiogenic shock* (29%; Figure 2A). Hypotension was cited at both sites as the most common reason for discharge on lower dose or no β-blocker (41% academic versus 44% community). There was a higher rate of inotropic therapy/cardiogenic shock in the academic hospital (38% versus 0%, *P*=0.023) and a higher rate of plan to increase at discharge in the community hospital (44% versus 0%, *P*<0.001; Figure 2B). At both sites, hypotension was the

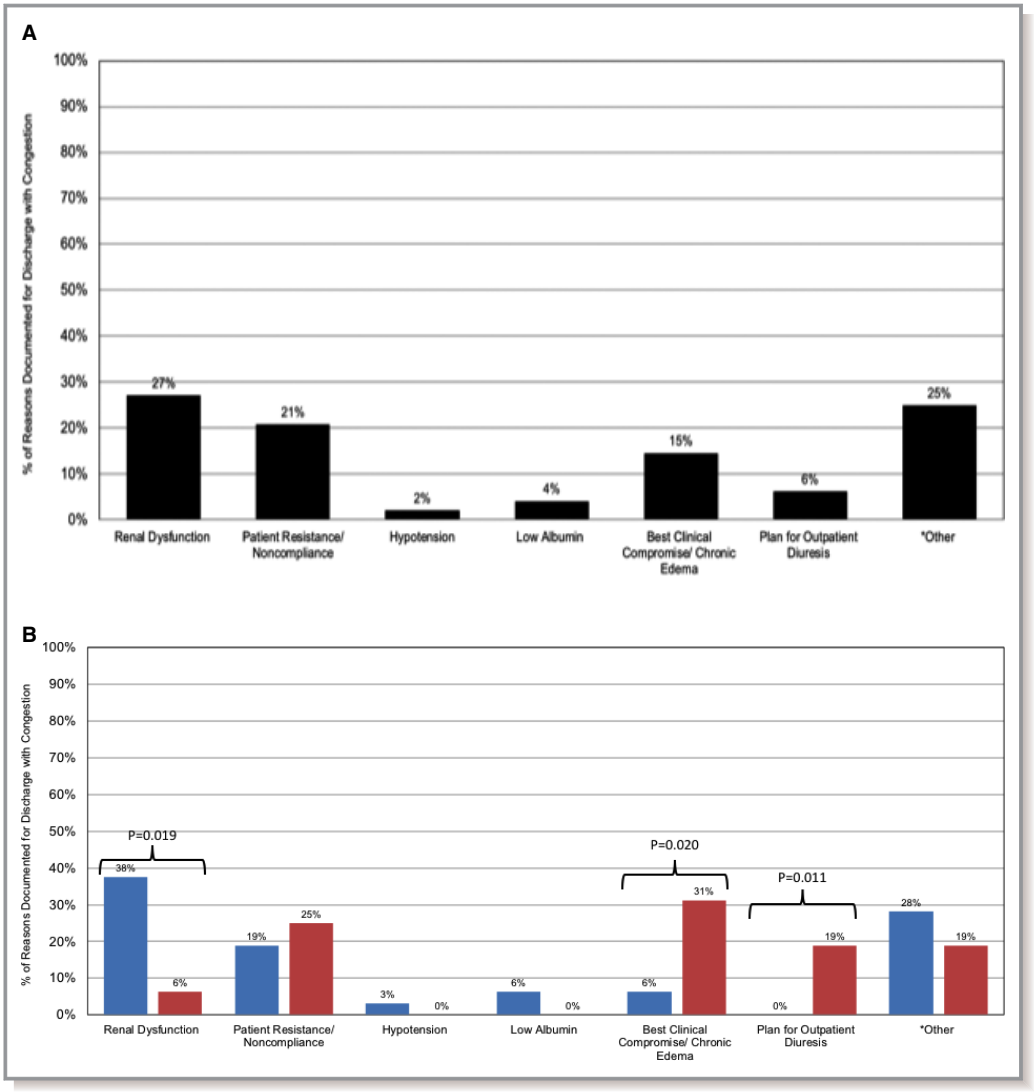

Figure 1. A, Reasons for deviation from decongestion guidelines (combined data). Percentages reflect all reasons documented for discharge with residual congestion. Multiple reasons for failure to comply with guidelines could be documented at discharge. *"Other" reasons for discharge with residual congestion included severe tricuspid regurgitation secondary to severe pulmonary hypertension (n=2), severe tricuspid regurgitation secondary to biventricular heart failure (n=2), edema caused by peripheral vascular disease (n=4), aortic stenosis (n=1), restrictive cardiomyopathy (n=1), noncardiac rales (n=1), and hospice (n=1). B, Reasons for deviation from decongestion guidelines (site specific data). Percentages reflect all reasons documented for discharge with residual congestion by site. Multiple reasons for failure to comply with guidelines could be documented at each discharge. *"Other" reasons for discharge with residual congestion: academic hospital (n=9)—severe tricuspid regurgitation secondary to severe pulmonary hypertension (n=2), severe tricuspid regurgitation secondary to biventricular heart failure (n=2), edema caused by peripheral vascular disease (n=2), aortic stenosis (n=1), restrictive cardiomyopathy (n=1), noncardiac rales (n=1); community hospital (n=3)—edema caused by peripheral vascular disease (n=2), hospice (n=1).

most commonly cited reason for discharge on less or no ACEi/ARB (Figure 3A and 3B). The next most common reason at both sites was *worsening renal function/hyperkalemia* (33% academic; 40% community; Figure 3B). Nineteen percent of discharges from the academic hospital were discharged on less ACEi/ARB secondary to inotropic therapy/cardiogenic shock.

Readmission Rates

Readmission within 30 days occurred in 21% of those discharged with residual congestion and 14% of those discharged without congestion (*P*=ns); readmission within 90 days occurred in 37% of those discharged with residual congestion and 23% of those discharged without congestion

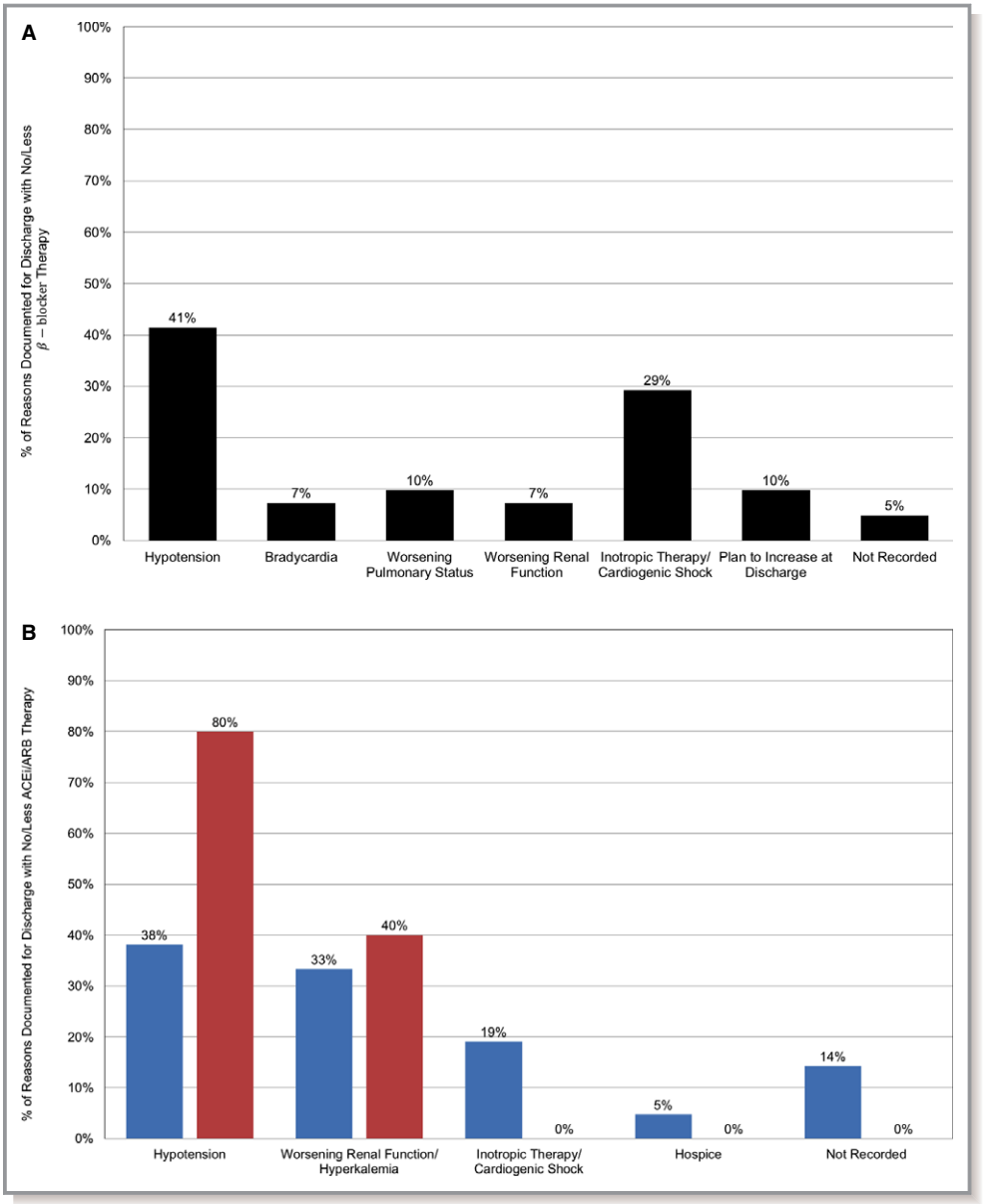

Figure 2. A, Reasons for deviation from β-blocker guidelines (combined data). Percentages reflect all reasons documented for discharge with less or no β-blocker therapy among those either not initiated or not maintained on at least their β-blocker dose at admission. Multiple reasons for failure to comply with guidelines could be documented for each discharge. Nonsignificant *P* values are omitted. B, Reasons for deviation from β-blocker guidelines (site specific). Percentages reflect all reasons documented for discharge with less or no β-blocker therapy among those either not initiated or not maintained on at least their β-blocker dose at admission, by site. Multiple reasons for failure to comply with guidelines could be documented for each discharge. Nonsignificant *P* values are omitted.

(*P*=0.051; Figure 4). There were no significant differences in the 30- or 90-day readmission rates between HFrEF patients based on neurohormonal therapy guideline adherence at discharge. Moreover, the reasons for readmission did not vary consistently based on congestion status or neurohormonal therapy status at discharge (Tables S1 and S2).

Discussion

Current guidelines recommend complete decongestion for patients with either HFrEF or HR with preserved ejection fraction before discharge. In this study we found that 75% of all HF discharges are clinically decongested at the time of discharge. This decongestion rate is similar, though slightly

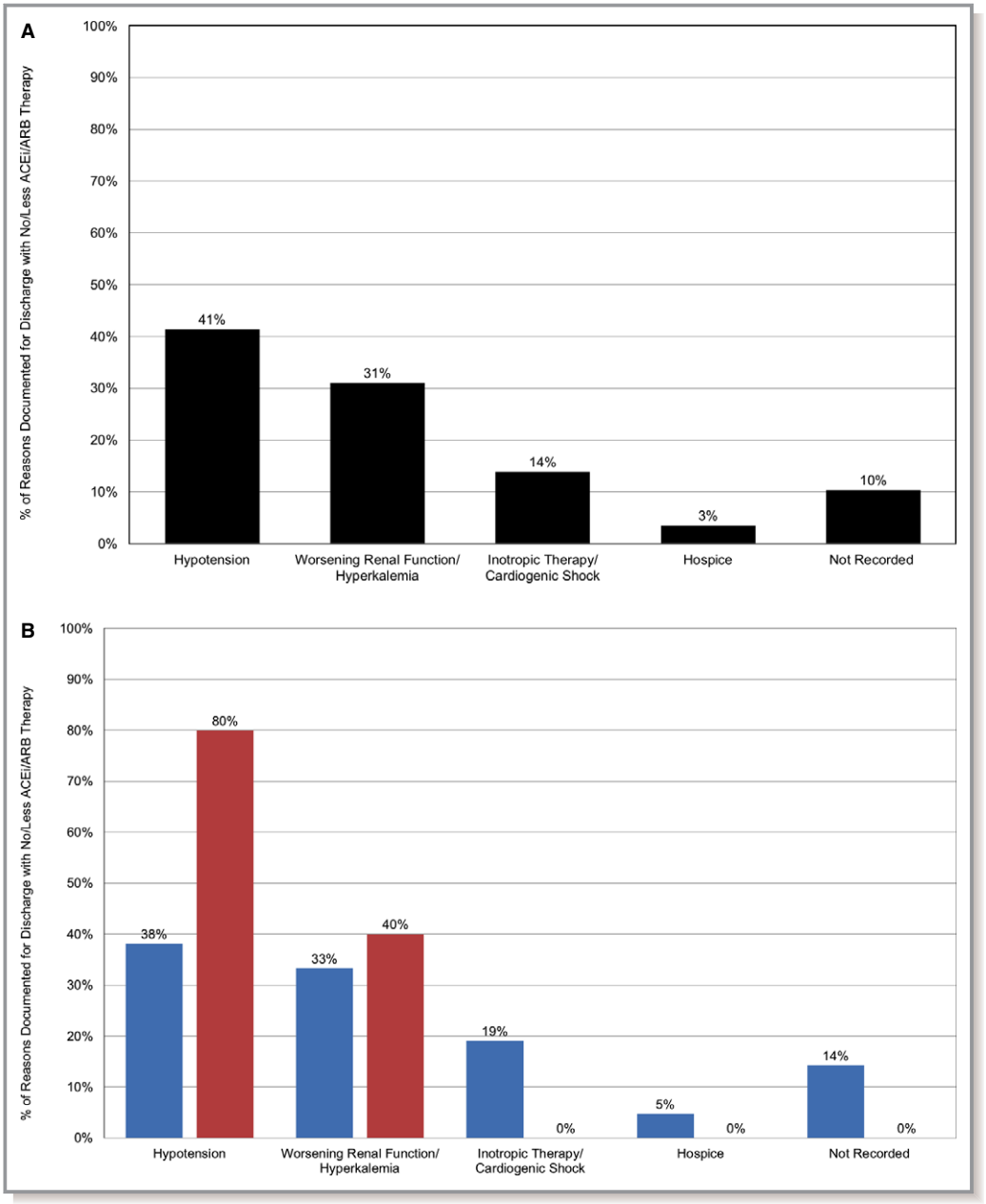

Figure 3. A, Reasons for deviation from angiotensin-converting enzyme inhibitor (ACEi) or angiotensin II receptor blocker (ARB) guidelines (combined data). Percentages reflect all reasons documented for discharge with less or no ACEi/ARB therapy among those either not initiated or maintained on at least their ACEi/ARB dose at admission. Multiple reasons for failure to comply with guidelines could be documented for each discharge. Nonsignificant *P* values are omitted. B, Reasons for deviation from ACEi/ARB guidelines (site specific). Percentages reflect all reasons documented for discharge with less or no ACEi/ARB therapy among those either not initiated or maintained on at least their ACEi/ARB dose at admission, by site. Multiple reasons for failure to comply with guidelines could be documented for each discharge. No *P* values are displayed because none are significant.

higher, than the ADHERE (Acute Decompensated Heart Failure National Registry),[27] OPTIMIZE-HF (Organized Program to Initiate Lifesaving Treatment in Hospitalized Patients With Heart Failure)[27] and IMPACT-HF (Initiation Management Predischarge: Process for Assessment of Carvedilol Therapy in Heart Failure)[28] studies, which found that ≈60% of patients were discharged completely decongested. Even between these studies, the rates of decongestion varied, depending on the definition of decongestion that was used. At present, there is no standard definition for decongestion.[29] In this study, we operationalized a simple, 4-part definition based on history and examination. Although advantageous from

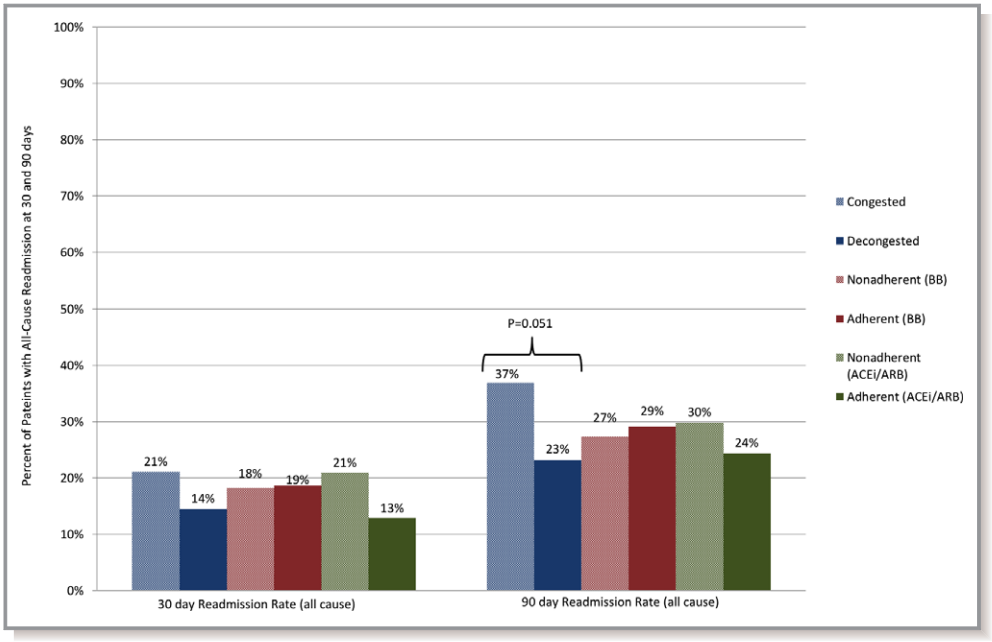

Figure 4. Thirty- and 90-day all-cause readmission rates based on congestion status and use of neurohormonal therapy at discharge. Percentages reflect all adherent or nonadherent patients readmitted to any hospital within 30 and 90 days of discharge. Only 1 *P* value that trends toward significance is included, and other nonsignificant *P* values are omitted. ACEi indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; BB, β-blocker.

efficiency and cost perspectives, most of the other reasons listed for incomplete decongestion represented situations in which the physical examination did not accurately reflect the patient's optimal volume status. Current guidelines also recommend the initiation or continuation and uptitration of neurohormonal doses toward target, when possible, by the time of hospital discharge for patients with HFrEF.[30] In this study, we found lower rates of adherence to guidelines regarding use of β-blockers (58%) and ACEi/ARB (53%) at discharge than have been observed in prior studies.[31,32] Several factors likely contribute to this. First, this study required that patients be either newly initiated or continued on at least their admission dose of neurohormonal therapy. Prior studies have not been able to consider discharge dose, and it is unclear whether the discharge dose, relative to the admission dose, portends a differential prognosis. Second, because the recommendation for neurohormonal therapy applies only to HFrEF patients, a disproportionate percentage of patients at the academic center were included in this analysis. In this academic center and likely others, many of the hospitalized HFrEF patients had advanced disease, as reflected in their diuretic dose, with 51% requiring >240 mg of furosemide equivalent per day and 49% having renal dysfunction. This is significant because current quality metrics do not account for disease severity as reflected in diuretic resistance. To our knowledge, this study is the first to examine the reasons for guideline nonadherence prospectively. The most common reasons for guideline nonadherence were renal dysfunction, hypotension, and recent inotropic therapy. These reasons all suggest more advanced and complex disease. Hypotension, in particular, has been associated with poor survival in patients with HF in 2 recently published studies.[19,33] At present, we do not know how much of the gap in guideline adherence represents a true deficiency of quality and how much reflects appropriate treatment for a more advanced HF population.

Finally, although we found a trend toward higher 90-day readmission rates among those discharged with residual congestion, we did not find significant differences in either 30- or 90-day readmission rates based on neurohormonal therapy use. However, other, observational data have shown a higher mortality in patients not discharged on recommended neurohormonal antagonist therapy.[11,13] It is not yet clear whether our lack of a difference in readmission rates is the result of a small sample size and limited follow-up. In any case, these observations raise vitally important questions. When readmission or mortality rates are higher without neurohormonal therapy, is it because these patients were missing the benefits of decongestion and neurohormonal therapy or because they have more advanced HF, or both? Certainly, renal dysfunction, hypotension, and recent perceived need for inotropic therapy portend worse outcomes, and it is never possible to eliminate all healthy user bias in observational studies, as demonstrated previously for implantable cardioverter-defibrillator implantation.[34]

We believe this study can help begin the discussion about when and how to safely use guideline-directed therapy in more complex HF patients and whether or not HF quality metrics can be adjusted to reflect HF severity and relevant comorbidities. To our knowledge, this study provides the first systematic description of attending providers' clinical reasoning when deciding not to follow guideline-directed therapy and a comparison of this process at an academic hospital and in a dedicated HF service at a community hospital. Given the well-documented benefits of guideline adherence in the vast majority of clinical circumstances, we believe these areas "beyond" our current guidelines merit specific focused research, perhaps initially with careful description and then with randomized trials. This research may be particularly important when considering the use of novel agents with more potent hemodynamic effects such as sacubitril/valsartan.

Limitations

This study is limited by its size and inclusion of only 1 academic hospital and 1 community hospital. Although this smaller population enabled the collection of granular clinical information, such as the reasons for guideline nonadherence, it limits the generalizability of the results. In addition, because this study was designed as a quality-improvement initiative, all data collection and analyses were performed at the admission/discharge level. However, the reasons for readmission are described in the supplementary material and demonstrate no clear association with guideline adherence status at discharge. Furthermore, the parsimonious requirements for collection of data limited further subdivision of patient groups, such as those for whom neurohormonal antagonists were stopped versus decreased or never started. In addition, because many patients, particularly those at the academic center, return to care from outside providers, it was not possible to collect data regarding use of neurohormonal therapy dosing or need for advanced therapies after discharge. Finally, one must also consider that these results were obtained as part of a collaborative quality-improvement initiative designed to improve guideline adherence; therefore, the results may overestimate the rate of adherence that might have been observed in the absence of systematic clinical reminders.

Conclusion

Clinical guidelines are an important tool for reducing variation and improving care. Routine collection and analysis of guideline adherence rates provide valuable insights into quality improvement; however, quality improvement and quality assurance should not be confused. Lower rates of guideline adherence may not always indicate poor quality. This study found that many hospitalized HF patients have more advanced disease and are phenotypically quite different from the populations with proven benefits from guideline adherence in large trials. As patients age, live longer with HF, and survive to develop other comorbid diseases, additional work is needed to determine how to accurately measure clinical quality for these patients and to do so in a way that does not penalize providers caring for more complex or vulnerable patients.

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Disclosures

None.

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Supplemental Material

Table S1. Reasons for Readmission within 30 Days of Discharge.

			Type of Readmission ≤ 30 days Since Discharge							
Guideline	**Status at discharge**	**Total Readmissions ≤30 Days Since Discharge (N)**	**Worsening HF**		**Cardio-Renal**		**Other Cardiovascular**		**Non-Cardiovascular**	
			N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Congestion	Congested	14	4	29%	2	14 %	5	36%	3	21%
	Decongested	22	12	55%	2	9%	2	9%	6	27%
Beta-Blocker Use	Not on ≥Admission Dose at Discharge	12	4	33%	1	8%	6	50%	1	8%
	On ≥Admission Dose at Discharge	18	8	44%	2	11 %	3	17%	5	28%
ACEi/ ARB Use	Not on ≥Admission Dose at Discharge	16	6	38%	2	13 %	4	25%	4	24%
	On ≥Admission Dose at Discharge	11	4	36%	1	9%	4	36%	2	18%

Not all readmissions resulted in repeat SCAMP enrollments. Among those with low ejection fractions, some changed medication within class for both beta-blockers and ACEi/ARB. Because it was not possible to determine the guideline compliance of these patients, they were excluded from the guideline adherence analysis.

Table S2. Reasons for Readmission within 90 Days of Discharge.

			Type of Readmission ≤ 90 days Since Discharge							
Guideline	**Status at discharge**	**Total Readmissions ≤90 Days Since Discharge (N)**	**Worsening HF**		**Cardio-Renal**		**Other Cardiovascular**		**Non-Cardiovascular**	
			N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Congestion	Congested	31	8	26%	2	6%	10	32%	11	35%
	Decongested	41	18	44%	4	10 %	5	12%	14	34%
Beta-Blocker Use	Not on ≥Admission Dose at Discharge	24	8	33%	2	8%	8	33%	6	25%
	On ≥Admission Dose at Discharge	32	12	38%	2	6%	8	25%	10	31%
ACEi/ ARB Use	Not on ≥Admission Dose at Discharge	25	9	36%	3	12 %	7	28%	6	24%
	On ≥Admission Dose at Discharge	27	9	33%	1	4%	9	33%	9	33%

Not all readmissions resulted in repeat SCAMP enrollments. Among those with low ejection fractions, some changed medication within class for both beta-blockers and ACEi/ARB. Because it was not possible to determine the guideline compliance of these patients, they were excluded from the guideline adherence analysis.