



# Quality Measures in Heart Failure: the Past, the Present, and the Future

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Published online: 2 February 2019

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## Abstract

**Purpose of Review** This paper reviews performance measure in health, their importance, and methodologic issues, focusing on metrics for health failure patients. Quality measures are instruments to assess structural aspects or processes of care aiming to guarantee that optimal patient outcomes are achieved. As heart failure is a chronic condition in which established therapies reduce mortality and hospital admissions, there are quite a lot of initiatives that aim to monitor for quality of care and to coordinate the disease management.

**Recent Findings** Several performance measures were validated for these patients, from process of care (left ventricular function assessment and use of ACEi/ARBs and beta-blockers) to health outcomes (hospital mortality and readmissions). In the early years, studies demonstrated a relationship between quality measurements and health outcomes. Nonetheless, more recent ones based on large databases of patients' medical records have shown that traditional indicators explain only a small fraction of health and patient reported- and perceived outcomes. Public reporting of quality measures and payment conditioned to the quality of care provided were not able to show benefit in terms of hard outcomes. Data science and big data methods are promising in providing actionable knowledge for quality improvement, with real-time data that could support decision-making.

**Summary** Heart failure is a chronic condition that has proven to be useful for measuring medical and healthcare quality. Evidence-based indicators have already reached high rates of adherence and are currently poorly correlated with outcomes. Using real-life data and based on the patient's perspective can be useful tools to improve these indicators.

**Keywords** Quality of care · Health indicators · Heart failure · Outcome · Readmission · Big data

## Introduction

Heart failure (HF) is a chronic condition remarkably associated with decrease survival, quality of life, and self-care. With a prevalence of 5.8 million in the USA alone, HF is associated with high morbidity, mortality, and healthcare expenditures. Close to 1 million hospitalizations for HF occur annually,

accounting for over 6.5 million hospital days and a substantial portion of the estimated \$37.2 billion that is spent each year on HF in the USA. Data from Medicare showed that HF is present in 14% of beneficiaries and these patients account for 43% of Medicare spending [1]. Although some progress has been made in reducing mortality in patients hospitalized with HF, rates of rehospitalization continue to rise, and approaches 30% within 60 to 90 days of discharge. Approximately half of HF patients have preserved or relatively preserved ejection fraction (EF); nonetheless, their post-discharge event rate is similar to those with reduced EF. HF readmission is increasingly being used as a quality metric, a basis for hospital reimbursement, and an outcome measure in HF clinical trials [2, 3]. In order to effectively improve outcome of HF patients, reduce the burden of disease, and offer better quality of life, it is important to characterize these patients, their profile, concomitant risk, and measure quality of care in a standardized manner [4]. This paper reviews performance measure in health, their importance, and methodologic issues, focusing on metrics described for HF patients. Data from several settings and real-world evidence will be described underlining its potential

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This article is part of the Topical Collection on *Implementation*

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use to access health system performance. The use of those data will allow the health scenario transformation with the creation of Big data, contributing to connect, with data transparency and accuracy, quality of care, reduction of costs, and empower patient.

## Quality Measurement in Health

Quality measurement in healthcare is the process of applying data to evaluate the performance of healthcare delivered, usually compared with recognized high-quality standards. These measures are developed to access the continuum of care within a clinical condition, a procedure, or among institutions. These measures are broadly classified into four categories: (1) structure, (2) process, (3) outcome, and (4) patient experience (Table 1) [5]. In the last decade, several international organizations have developed measures in the whole spectrum of care delivery and disease, with the assumptions that there is “The right care for the right person at the right time, the first time” (coted from Carolyn Clancy, Director of Agency for Healthcare Research and Quality in the USA).

Over the years, physicians, health plans, and health providers have been evaluated through these measures. A key step in the establishment of any performance measurement was to formulate robust conceptual framework, and meet several criteria, such as face validity, reproducibility,

acceptability, feasibility, reliability, and accuracy [5]. The rational being that gathering data on performance could help identify areas for improvement in a positive circle. For this to be true, it is very important that the data collected be analyzed and interpreted within organizational and political context. In other words, for indicators to provide relevant data, it is important that the measure is relevant to specific actors and attributable to an organization or professional, in an easy, transparent, and unambiguous way. For most of situations, careful data collection, analysis, and statistical risk adjustment to control for confounding are essential to achieve this goal.

In general, quality measures are used by different actors and purpose. Traditionally, indicators in health provide feedback to physicians on their performance. Several studies, randomized and observational ones, have demonstrated that peer feedback is a powerful strategy for better practicing medicine [6•]. They have also been used in public reporting of performance, as a way to promote system improvement and create a competitive environment [5]. More recently, they are the basis for payment of services and explicit financial incentives to reward health providers according to results [4]. These assessments can be done for in-patient, out-patient, or both settings.

As any improvement strategy to be successful, measure of quality requires a strong stewardship action for those hierarchically involved, from government, health plan directors, or hospital CMOs/CEOs. Quality measures should be planned and aligned in an accountable way, assuring completeness

**Table 1** Types of quality measures

Type	Description	Example	Advantages	Disadvantages
Structure	Evaluate the characteristics of care facilities, personnel, technologies, and policies related to care delivery.	Does the hospital have a 24/7 echocardiogram available?	Easy to collect and interpret. Clear opportunity to action. Indirectly capture patients' perception.	Maybe manipulated. Does not have a clear relationship with outcomes.
Process	Establishes whether the services provided are consistent with optimal clinical care, in a prompt and efficient manner.	Does all hospitalized patients are risk assessed for venous thromboembolism?	Easier to collect and interpret. Incorporated in daily routine. Requires smaller sample size. Can provide opportunity for improvement.	May be easily manipulated. Often specific and not continuous reflect care. Not necessarily related to outcome or patient satisfaction.
Outcome	Evaluates patient health.	What is the hospital mortality for pacemaker insertion?	Hard data, more difficult to manipulate. Directly related to all stakeholders. Enforce long-term commitment.	Difficult and time consuming to collect. Needs larger sample size. Subject to confounding, may need risk adjustment.
Patient experience	Provides assessment of patients' experiences and perceptions about their care.	Do patients report that received description for treatment options in ways that are easy to comprehend?	Final goal for stakeholders. Allows comparisons among organizations and group of patients.	Expensive and time-consuming. Needs risk adjustment. Importance of validated and standardized instruments.

and accuracy of data, defying and implementing actions based on results in an open and healthy political debate.

## Quality of Care for Heart Failure

Heart failure is a prevalent chronic condition that unified healthcare institutions and providers in a common disease to be compared and standardized. To date, several quality measures have been proposed for HF patients [7]. As healthcare models focus on patient care and away from disease-centered figures, quality-focused outcome measures become important tools to reflect the quality of care delivered within health institutions. From a historical perspective, in 1999, the Centers for Medicare and Medicaid Services (CMS) launched the National Heart Failure Project, focusing on four processes of care: assessment of left ventricular ejection fraction (LVEF), use of ACEi in patients with LV systolic dysfunction, discharge HF instructions, and smoking cessation counseling. Over the years, such metrics evolved and expanded to most dimensions of care, an initiative from the American College of Cardiology, American Heart Association, and the Physician Consortium for Performance Improvement (Table 2) [1]. Other international medical societies and organizations proposed quality markers in cardiology to measure quality in practice, for benchmarking, and in some cases accreditation of specific cardiology units [6•]. For HF care assessment, in-hospital mortality, length of hospital stay, and readmission are the most common outcomes suggested.

Although process of care of quality indicators are the metrics more frequently measured, there are important caveats for their use. For instance, they evaluate few elements of care

delivered, tend to focus on underuse prescriptions and not overuse or misuse, and are sensitive to denominators definitions (eligibility criteria or excluded cases). Considering these aspects, the hypothesis that better quality of care is associated with improved patient outcomes has been a challenge to prove for several diseases [2, 9]. Nonetheless, studies from 2000 to 2010 showed significant relationship between hospital-level processes and clinical outcomes among HF patients. Important to note that during that period, adherence to guidelines and good practice were much lower and improved significantly throughout the last 10 years.

In the hospital setting, an analysis of the OPTIMIZE-HF study, including 20,441 patients from 141 US hospitals, using a mortality outcome measure after 1 year of hospital discharge, showed that performance measures such as the hospital-level prescription of any beta-blocker, beta-blocker, aldosterone antagonists, and implantable cardioverter-defibrillator (ICD) were significantly associated with reduced clinical outcomes and can be used to discriminate the quality of care at the hospital level [10]. In the same study, involving 1,203,595 old patients who were admitted by HF, Medicare users, measures of structure, process, and outcomes were combined into a composite measure of quality as a predictor of performance for risk-adjusted mortality within 30 days. In this large database, patients treated at lower ranked 1-Star vs. 3-Star hospitals had an increase in risk-adjusted mortality by 1.47 [11]. Dy and col. reported the results of 895 US hospitals evaluating the quality measures of processes of care and patient outcomes for inpatients, specifically 30-day readmissions and mortality. Using a combined score of discharge instructions, LVEF assessment, and ACEi/ARB for LV dysfunction, overall adherence was very high, median was 95.7%, 30-day

**Table 2** Quality measures in heart failure

Quality measure	Type
Echocardiogram available, intensive care unit (ICU), trained team, specialized hospitalization unit	Structure
LVEF assessment	Process
Beta-blocker for patients with LV systolic dysfunction (LVSD), ACE (or ARB) for LVSD, Aldosterone antagonist for patients with LVSD, Counseling about implantable cardioverter-defibrillator (ICD) for patients with ejection fraction $\leq 35\%$ , Post-discharge appointment, Patient self-care education	
Mortality	Outcomes
30-day readmission	
Quality of life – Minnesota Questionnaire	Patient experience
Kansas Living with HF questionnaire	

Adapted from reference Bonow RO, Ganiats TG, Beam CT, et al. ACCF/AHA/AMA-PCPI 2011 Performance measures for adults with heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures and the American Medical Association–Physician Consortium for Performance Improvement. *Circulation* 2012;125:2382–2401 [8]

mortality was 11.3%, and readmissions was 24.8%. Only non-adherence to LV assessment was associated with higher mortality; and there were no significant correlations between processes of care and readmission [12].

One of the most used quality measures is hospital readmission [13]. At the same time, for more than a decade, we have known that admission rates vary across countries and hospitals, even after adjusting for differences in patient populations. To date, however, admission rates have been used as quality and accountability measures to some degree. Fischer et al. in a systematic review showed that readmission rates after HF were mostly not related to evidence-based standards defined by the ACC/AHA guidelines; although it could be more determined by post-discharge care [14]. Randomized trials in surgical patients have shown that improving the coordination of care, adherence to local protocols, better discharge planning, and early physician follow-up can lower readmission rates.

The CMS has supported the development and use of new quality outcome measures that focus on population-based admission rates among patients with chronic conditions in the Medicare Shared Savings Program and that enable fair comparisons among providers. An evaluation of 2.6 million Medicare beneficiaries aged 65 years and older has proposed the use of risk-standardized acute admission rates, including acute hospitalization for all causes, HF decompensation, adjustment for clinical condition, and disease severity [4]. As patients with chronic diseases accumulate risks over the decades, hospital readmission quality measure used in this way encourages hospitals to promote follow-up programs focused on the transition from hospital to home care, promoting health maintenance with an integral vision. Post-discharge disease management programs have been established to prevent readmission and reduce mortality and healthcare costs [15].

A recent systematic review of 47 trials studied different models of care: telephone contact, primary care follow-up, multiprofessional HF clinics, multiprofessional follow-up without HF clinics, and enhanced patient self-care. Home visit programs and clinic-based multidisciplinary programs reduced all-cause readmission within 3–6 months by 25% and 30%, respectively. Mortality rates in this period were reduced by 23% and 44%, respectively. The structured telephone support reduced mortality by 31% [3].

Nonetheless, it is important to note that hospital mortality rates and readmissions are poorly correlated, and in fact are competing risks since patients who die during their initial hospital stay or after discharge cannot be readmitted [16]. Using hospital readmission alone as a way to reward or penalize hospitals may be misleading and flawed [17]. Since the beginning of the Hospital Readmissions Reduction Program (HRRP) in the USA, a major healthcare policy to reduce readmissions by financially penalizing hospitals with higher than average 30-day risk-adjusted readmission, several studies

evaluate the true effect of such program. Data from clinical registries and large database have shown that reduction in readmissions following the HRRP was smaller than expected and short- and long-term mortality for HF has increased in the last years in these patients [18, 19].

It is essential that the selected quality measures be associated with patient outcomes, reflecting potential implications for the health system. The adoption of quality measures enables taxpayers, suppliers, and the general population to choose between hospitals for example.

## Patient Perspective of Care and Self-reported Status

Besides increasing survival and other hard outcomes, current management of HF is focused on reducing symptoms and improving quality of life (QoL). A variety of generic and disease-specific questionnaires are available to assess patient reported QoL, an example of patient-reported outcome measures (PROMs). Generic instruments, such as SF-36 and EQ-5D, have the advantage of allowing comparison of QoL among patients with different conditions, although they are less sensitive to the effect of therapies. Several HF-specific health-related QoL questionnaires have been described, validated, and translated in the literature [20]. The most well-known are the Kansas City Cardiomyopathy Questionnaire (KCCQ) and Minnesota Living with Heart Failure Questionnaire (MLHQ). A non-profit organization has launched a project to define consensus standard set of outcome measures and risk factors for tracking, comparing, and improving the outcomes of HF care, called the International Consortium for Health Outcomes Measurement (ICHOM) [21]. To date, several hospitals, health plans, and even research projects are referring to this standard set as a contemporary way to compare care delivered using a value-based perspective and patient opinion.

Thinking from the patient's point of view, is there a gold standard for care? The expectations of the patient are sometimes different from the expectations of the health teams: the patient wishes to have the shortest hospital stay, to receive adequate and enlightening guidelines about his/her health condition during hospitalization, and to remain symptom-free longer after discharge, with support from the health team for any clinical event. This point of view has now been included as a patient experience and should be incorporated into health institutions that excel in excellence. Patient perspectives are now considered in several governmental and pay-for-performance programs in the USA, UK, and Germany. A study from Dy and col. on data from 895 US hospitals after the advent of public reporting found that patient perspectives of care measures was significantly associated with 30-day readmissions, overall ratings, and discharge care [12].

## Future Perspective

The future of quality measures in heart failure is closely related to a substantial change in how data are being processed and analyzed in health, with the progressive “digitalization” of hospitals and health centers around the world. A challenge has been how to use unstructured medical notes and reports to retrieve useful information, a problem that are being solved by the use of Natural Language Processing methods [22]. Meystre et al. tested a new congestive heart failure treatment performance measure information extraction system in clinical notes of 1083 inpatients diagnosed with HF who were discharged from eight medical centers [23••]. This algorithm extracted left ventricular function mentions and values, HF medications, and documented reasons for a patient not receiving these medications. In general, this system extracted CHF medications with high recall (> 0.990) and good precision (0.960–0.978). Thus, the use of Natural Language Processing for medical extraction from medical notes seems promising to evaluate Quality Measures in Heart Failure and to improve the treatment offered to patients.

This automatically extracted data, as well as manually provided data, is used to feed large databases, which can be used to increase the quality of healthcare. In Ontario, Canada, for example, big data was used to create a cohort of 9.8 million patients with the goal of developing cardiovascular health and preventive care profiles [24]. In the USA, the Department of Veterans Affairs developed an accurate, stakeholder-informed, automated, natural language processing system to measure the quality of HF inpatient care [25]. Using a longitudinal electronic medical record data of heart failure patients admitted within a large healthcare system in Massachusetts, USA, Golas et al. [26] showed that deep learning techniques performed better than other traditional techniques in developing this EMR-based prediction model for 30-day readmissions in heart failure patients. The next goal is to transform healthcare big data into actionable knowledge for quality improvement and research that helps to improve patient care, and potentially limit healthcare costs, developing infrastructure with real-time data to support decision-making.

Another promising approach is to empower patient, giving them information of the quality of care in different institutions through public reporting of quality measures of each hospital. Public reporting is believed to help patients who choose the best hospitals, and encourage hospital managers to improve hospital performance [27]. However, recent data suggest the hospital-level process-outcome quality measure may be no longer associated with outcomes of heart failure such as mortality and readmission [12]. Moreover, an evaluation of Medicare’s public reporting initiative on hospital quality showed modest or no impact on mortality for heart failure and other key conditions [28]. Thus, the long-term effectiveness of public reporting in improving healthcare quality for heart failure is still uncertain.

Additional trend of recent years is the payment conditioned the quality of care provided. The object would be to encourage

the quality of hospital care and reduce spending on measures that do not bring real benefits to patients. One of the best-known programs for this purpose is the Hospital Value-Based Purchasing (HVBP) program, which started in 2013 in the USA. Although the idea seems very good, the results are still modest. A study that analyzed 2383 hospitals showed that HVBP was not associated with significant reductions in mortality among patients who were admitted for heart failure [29].

## Compliance With Ethical Standards

**Conflict of Interest** The authors declare that they have no conflicts of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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