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Abstract

Background: Performance measurement is essential for quality improvement and is inevitable in the shift to value-based payment. The National Quality Forum (NQF) is an important clearinghouse for national performance measures in health care in the United States.

Aim: We reviewed the NQF library of performance measures to highlight measures that are relevant to critical care medicine and we describe gaps and opportunities for the future of performance measurement in critical care medicine.

Conclusion: Crafting performance measures that address core aspects of critical care will be challenging as current outcome and performance measures have problems with validity. Future quality measures will likely focus on interdisciplinary measures across the continuum of patient care.

Keywords: critical care medicine; health policy; metrics; National Quality Forum; performance measurement

Abbreviations

ABCDE, Awakening and Breathing Coordination of daily sedation and

ventilator removal trials; Choice of sedative or analgesic exposure;

Delirium monitoring and management; and Early mobility and Exercise

ICU, intensive care unit

NQF, National Quality Forum

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The National Quality Forum Is Important to Critical Care Medicine

In 2009, as part of the Patient Protection and Affordable Care Act, the United States Department of Health and Human Services contracted the National Quality Forum (NQF) to, “establish a portfolio of quality and efficiency measures that will allow the federal government to more clearly see how and whether healthcare spending is achieving the best results for patients and taxpayers”¹. These measures are the tools that the federal government uses to assess high-value care and they will grow in importance over the next few years. With the recent passage of H.R. 2 (Medicare Access and CHIP Reauthorization Act of 2015), which effectively repealed the Sustainable Growth Rate formula, value-based payment models have been prioritized and further incentivized². By 2018, 90% of all Medicare payments will be performance-based³. Starting in 2019, Medicare payments will be based on whether the physician elects to join in the alternative payment program (APM) or the Merit-Based Incentive Payment System (MIPS). Under the APM program, physicians can participate in accountable care organization or patient-centered medical homes and are paid by the

rules of their organization. The MIPS program will pay physicians based on performance in four subcategories: clinical quality, resource utilization, clinical practice improvement, and meaningful use of electronic health record technology. Top performers stand to receive an annual performance adjustment of up to 10 percent⁴.

Critical care medicine is an important target for the NQF's work in establishing measures for high-value healthcare as the costs are very high. In 2010, the average intensive care unit (ICU) cost per day was estimated to be \$4,300. This accounted for 13.2% of hospital costs, 4.14% of national health expenditures, and 0.74% of the gross domestic product⁵. Here, we highlight NQF-endorsed measures relevant to critical care medicine, present challenges/opportunities for performance measurement in critical care nationally, and present context for future intersections of critical care medicine and performance measurement in the NQF.

What Kinds of Measures Are Intended for the NQF?

The science of performance measurement is relatively new and evolving. Within the NQF library, performance measures are selected from several candidate measures to satisfy specific scopes and aims. Endorsed measures are intended to exhibit strong validity between theoretical and

empirical definitions, demonstrate statistically robust measurement properties, and address previously prioritized national health strategies for which there is evidence of an existing gap in performance¹. NQF measures are preferably useful not only for quality improvement efforts within a single hospital, but also for benchmarking performance across many hospitals. These are demanding criteria, particularly if they are applied to patients who have dynamic and diverse diseases and who commonly require simultaneous and coordinated care from multiple medical specialists, nurses, respiratory therapists, pharmacists, and other healthcare professionals.

What Measures Does the NQF Hold for Critical Care Medicine?

Since the library of measures in the NQF is under regular review and updating, three of the authors (A.N., J.H., and U.S.) scrutinized the current library (as of January 3, 2016) of 627 NQF performance measures to evaluate the extent to which critical care medicine is represented. We strictly defined *critical care medicine* as pertaining to patient care in the ICU. From among all identified measures, we found only ten that were unambiguously attributable to critical care medicine (Table). These measures included both process (i.e., what the physician does rather than how the patient does) and outcome measures (i.e., how the patient's health status changes after health

care) and address core aspects of critical care medicine including: documentation of patient care preferences, ICU mortality, ICU length of stay, prolonged intubation, postoperative respiratory failure rate, thromboembolism prophylaxis, urinary tract infection, central venous catheter related infection, and management of severe sepsis and septic shock, including the timing of blood cultures. Additionally, we identified other measures that address processes or outcomes that are likely (but not certain) to occur in the ICU or to involve intensivists. We present examples of these diverse measures that include process and outcome measures (Table). The extent to which critical care practitioners affect performance on these measures would vary greatly according to the hospital setting and the practice patterns of physicians within a particular hospital given the diverse way care is delivered across health systems⁶.

What Are the Shortcomings of Current NQF Measures for Critical Care?

One outstanding finding from our review is that the current library of critical care medicine specific measures does not address some core aspects of critical care medicine, e.g. adherence to stress ulcer prophylaxis, delirium screening, and physician and nurse staffing models. Whether this is

a shortcoming may depend on how patient care is contextualized. For some, critical care is a specific care episode confined to admission and discharge from an ICU. For others, critical care is part of the arc of illness and recovery embedded within health management. Whether NQF performance measures reflect core aspects of critical care is debatable.

The methods of measuring critical care performance, alone or in the spectrum of care, are important to consider. The NQF library classifies measures according to important dimensions of high-value care, described as National Quality Strategy priorities, such as affordable care, patient safety, and effective communication and care coordination. The NQF also classifies measures according to structure, process, outcome, and efficiency. Selecting a top priority or best type of measure, such as process measures or outcome measures, is challenging for critical care and for other specialties. No strategy priority or measure type—whether structure, process, or outcome—is free from fault or risk of unintended consequences. Although *outcomes* would seem to refer to real events that are more relevant to patients, many outcome measures (even those most relevant to core aspects of critical care) have problems with validity. Important outcomes for critically ill patients include catheter-related bloodstream infection, pressure ulcers, sepsis, acute renal failure, acute respiratory distress syndrome, infection with hospital-

acquired infections, and gastrointestinal tract bleeding to name a few. These outcomes vary by frequency, severity, preventability, and importance, and are assessed as impacts on mortality, costs, or patient experience.

The influence of patient experience and, by extension, satisfaction on outcome measures is controversial. In some studies, better patient experience is positively linked to quality of clinical care and satisfied patients are more likely to be adherent to treatment⁷. However, to achieve higher patient satisfaction, physicians may yield to patient requests for medical services that are of little benefit and potentially harmful⁸. These variabilities make their use as quality measures challenging.

New work has demonstrated that outcome measures with seemingly strong face validity are susceptible to important biases and unintended consequences that reasonably call into question their value. The following outcome measures have been proposed: ICU length of stay (LOS), ICU in-hospital mortality, and risk adjusted prolonged intubation.

Confounders affect these quality measures. For instance, a high rate of transfer to a long-term acute care facility will improve a hospital's performance measures by reducing length of stay and mortality. However, the overall quality of care during the entire illness will be unaccounted⁹.

Risk prediction models underpin the two measures. The Acute Physiology

and Chronic Health Evaluation (APACHE), Mortality Probability Model (MPM), and the Simplified Acute Physiology Score (SAPS) are commonly used risk prediction models that allow for inter-hospital comparisons; however, these have their own inherent limitations. These systems require frequent recalibration and all of them under-predict mortality due to pulmonary diseases. These risk models can lead to under-prediction of disease severity and length of stay, giving the appearance of a worse outcome measure¹⁰. Other recent work on the statistical properties of benchmarking strongly suggests that many tried-and-true outcomes, such as surgical site infection after colorectal surgery, are too unreliable statistically to meaningfully differentiate hospital performance¹¹.

Process measures may seem to be a favorable alternative to the problems with outcome measures. However, the critical care community has witnessed that process measures can be problematic as well with noteworthy examples including β -blockade, activated protein C, and intermediate measures such as tight glucose control. Furthermore, historical experience with guidelines has illustrated that current best evidence can change. Thus, caution is necessary before connecting the dots between trial results, guidelines, performance metrics, and payment.

ICU related structure measures (i.e how a health care facility delivers care) is not a novel concept. For instance, the positive effect on ICU care through implementation of electronic medical records have been reported in the literature as early as 1980¹². Organizations such as the Leapfrog group have published recommended ICU structural performance measures¹³. However, as of this writing, critical care related structure measures have been notably absent from the NQF library.

Performance measures in the NQF are intended to focus primarily on value and patient-centered care. Theoretically, the NQF would eschew specialty-specific performance measures, but in practice this is not the case. The value and utility of performance measures that address ICU performance only within the arc of recovery for critically ill patients are not clear. A valuable example is the important difference between ICU mortality and 30-day mortality: Large, referral institutions have greater ICU mortality because smaller hospitals transfer sicker patients to these centers¹⁴. If large and small institutions are compared according to ICU mortality, large institutions appear to provide lower-quality care. In contrast, such a metric may be more acceptable for comparing quality across hospital systems (each containing small and large referral ICUs), but this has yet to be evaluated.

What Should the Specialty of Critical Care Aspire to in National Performance Metrics?

The aim of national performance metrics is to improve the value of care by incorporating quality, safety, costs, and the patient experience with measures suitable for internal quality improvement and external benchmarking. Many of the NQF performance measures are based on the Donabedian model of “outcomes,” “process,” and “structure.” These measures are particularly important to critical care medicine when its services are viewed as a distinct event in a patient’s care. Shared accountability measurements are significant to critical care when its services are viewed a part of a patient’s overall care. These are areas where the NQF performance measures can improve.

Despite its shortcomings, process measures have an important role for quality measurement in critical care medicine. An example is the ABCDE (Awakening and Breathing Coordination of daily sedation and ventilator removal trials; Choice of sedative or analgesic exposure; Delirium monitoring and management; and Early mobility and Exercise) bundle, which formalizes attempts to achieve ICU milestones. This bundle reduced ventilator days and delirium by focusing on a multidisciplinary approach to reduce sedation, initiate spontaneous breathing trials, and early ambulation¹⁵.

A related measure would benefit from critical reappraisal to ensure a robust evidence base before consideration for endorsement¹⁶. Acknowledging that best practices can change, the NQF has attempted to address this important limitation with scheduled measure maintenance, as with NQF measure 0500 for sepsis, which was scheduled for review and open comment upon completion of the Protocolized Care for Early Septic Shock (ProCESS) trial. The trial found no difference in mortality and adverse events between Early Goal Directed Therapy, a resuscitation protocol that used non-invasive monitors, and usual care¹⁷. The results would favor the removal of central venous pressure and ScvO₂ monitoring from NQF measure 0500.

The NQF library is deficient in the inclusion of structure performance measures for critical care medicine, yet how an organization utilizes equipment and resources to deliver care is a critical component to this specialty and can influence process and outcome measures. For instance, adherence to low tidal volume ventilation protocol for patients with acute respiratory distress syndrome has been shown to be higher when ICU nurse to patient ratio is 1:1 and a respiratory therapist is responsible for less than four ventilated patients¹⁸. In addition, both lower patients to nursing ratio and high intensity intensivist staffing (defined as mandatory intensivist consultation or all care directed by an intensivist) have both been

demonstrated to reduce ICU mortality^{19,20}. These would serve as good initial structure performance measures as they have strong validation in the literature.

Current performance metrics assess critical care medicine as a distinct event in a patient's care. With the passage of the Accountable Care Act in 2011, the focus in health care delivery will be one that incentivizes efficient and coordinate care. The new healthcare law focuses on prevention and reduction in unnecessary specialty referrals, medical tests, and avoidable complications such as hospital-acquired infections. Accountable Care Organizations (ACO) are charged with the responsibility of meeting these goals. How does this affect critical care medicine? From a holistic view point, critical care medicine can be seen as being a part of a continuum in a patient's medical care. Physicians and hospitals frequently have shared accountability for critically ill patients: often several specialists share the same patients and hospitals share critically ill patients through patient transfers. For critical care medicine to be incentivized, ACOs will need to focus on inclusion of hospital systems with specific specialty services based on the values of quality and efficiency. This will allow the ACO greater returns while it incurs the burden of financial risks and specialists' costs as a critically ill patient advances in their recovery. Meeting the challenge of

shared accountability is an important step for creating meaningful outcome measures for critical care medicine. Future NQF measures may be more likely to emphasize the interdisciplinary, integrated care and may focus on the demonstration of patient- and family-centered care and on long-term, functional outcomes, e.g cognition and memory²¹.

Stronger ties can be expected between payment and performance as a common approach to increase value in health care; however, these findings demonstrate gaps and opportunities for the critical care community to develop and test performance measures for the specialty. A refined NQF metric library will allow measurement of the effects of critical care medicine in the continuum of care and demonstrate the value of high-cost intensive care to critical care medicine physicians, their patients, and the public.

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Table. National Quality Forum Performance Measures for Critical Care Medicine

Measure No.	Title or Topic	Type of Measure	Qualifying Critical Care Criterion
Measures Specific to Critical Care Medicine			
0129	Risk-adjusted prolonged intubation	Outcome	Mechanical Ventilation
0138	Urinary catheter-associated UTI for ICU patients	Outcome	Patients in ICU
0139	Central line catheter-associated blood stream infection rate for ICU and high-risk nursery patients	Outcome	Patients in ICU
0356	Blood culture timing for patients in the ICU	Process	Patients in ICU
0372	ICU venous thromboembolism prophylaxis	Process	Patients in ICU
0500	Severe sepsis and septic shock: management bundle	Process	ICU disease
0533	Postoperative respiratory failure rate	Outcome	Patients in ICU
0702	ICU length-of-stay	Outcome	Patients in ICU
0703	ICU: in-hospital mortality rate	Outcome	Patients in ICU
1626	ICU patients with care preferences documented	Process	ICU patients surviving 48 h
0119	Risk-adjusted operative	Outcome	Commonly ICU

	mortality for CABG		patients
0120	Risk-adjusted operative mortality for aortic valve replacement	Outcome	Commonly ICU patients
0121	Risk-adjusted operative mortality for mitral valve replacement	Outcome	Commonly ICU patients
0122	Risk-adjusted operative mortality for mitral valve replacement + CABG	Outcome	Commonly ICU patients
0123	Risk-adjusted operative mortality for aortic valve replacement + CABG	Outcome	Commonly ICU patients
0128	Antibiotic prophylaxis duration for cardiac surgery	Process	Commonly ICU patients
0213	Percentage of cancer patients admitted to ICU in final 30 d	Process	Outcome is ICU admission
0300	Controlled blood glucose after cardiac surgery	Surrogate	Commonly ICU patients
0346	Iatrogenic pneumothorax rate	Outcome	Procedure common to ICU patients
0353	Failure to rescue 30-day mortality (risk-adjusted)	Outcome	Commonly ICU patients
0467	Acute stroke mortality rate	Outcome	Commonly ICU patients

1716	National Healthcare Safety Network (NHSN) facility-wide inpatient hospital-onset MRSA bacteremia outcome	Outcome	Commonly ICU patients
1717	NHSN facility wide inpatient hospital-onset Clostridium difficile infection outcome measure	Outcome	Commonly ICU patients
2065	Gastrointestinal hemorrhage mortality rate	Outcome	Commonly ICU patients
2459	In-hospital risk adjusted rate of bleeding event for patients undergoing PCI	Outcome	Commonly ICU patients
2726	Prevention of central venous catheter related blood stream infections	Process	Procedure common to ICU patients