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ICU Director Data

Using Data to Assess Value, Inform Local Change, and Relate to the External World

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Improving value within critical care remains a priority because it represents a significant portion of health-care spending, faces high rates of adverse events, and inconsistently delivers evidence-based practices. ICU directors are increasingly required to understand all aspects of the value provided by their units to inform local improvement efforts and relate effectively to external parties. A clear understanding of the overall process of measuring quality and value as well as the strengths, limitations, and potential application of individual metrics is critical to supporting this charge. In this review, we provide a conceptual framework for understanding value metrics, describe an approach to developing a value measurement program, and summarize common metrics to characterize ICU value. We first summarize how ICU value can be represented as a function of outcomes and costs. We expand this equation and relate it to both the classic structure-process-outcome framework for quality assessment and the Institute of Medicine's six aims of health care. We then describe how ICU leaders can develop their own value measurement process by identifying target areas, selecting appropriate measures, acquiring the necessary data, analyzing the data, and disseminating the findings. Within this measurement process, we summarize common metrics that can be used to characterize ICU value. As health care, in general, and critical care, in particular, changes and data become more available, it is increasingly important for ICU leaders to understand how to effectively acquire, evaluate, and apply data to improve the value of care provided to patients.

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ABBREVIATIONS: CLABSI = central line-associated bloodstream infection; EMR = electronic medical record; S-P-O = structure, process, outcome; VAE = ventilator-associated event; VAP = ventilator-associated pneumonia

US health care faces a value crisis. Despite spending more on health care per capita than any other country in the world, an estimated 200,000 to 400,000 Americans die annually from potentially preventable harm and frequently do not receive the recommended care that they should.[1-3] Although progress has been made, improving value within critical care remains a priority because it represents as much as 11% of total

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health-care spending,[4,5] faces high rates of adverse events,[6] and inconsistently delivers evidence-based practices.[7,8]

ICU directors are increasingly required to understand all aspects of the value provided by their units. The drive to measure and improve value comes from the need to support internal efforts to improve quality and as a response to growing external scrutiny, including the public reporting of specific quality metrics and reimbursement tied to the quality of care. As such, ICU directors need a clear understanding of unit metrics to support efforts to improve the effectiveness and efficiency of care provided in their units.

The primary goal of this article is to familiarize ICU leaders with the fundamentals of measuring ICU quality and value. We briefly describe a conceptual framework for understanding the components of health-care value, provide an approach to develop a value measurement program, and summarize common metrics that can be used to characterize ICU value.

Conceptual Framework for Value

The Quality and Value Relationship

At a basic level, the value provided by an ICU can be conceptually defined as the simple equation of a given outcome divided by the cost associated with obtaining that outcome (Fig 1). Although this formula can be useful conceptually, this model does not capture all the nuances related to health-care outcomes and costs needed to operationally measure health-care value. Despite these limitations, the simplified formula can be useful to begin conceptualizing the relationships among the elements of value.

Outcomes can include (1) the quality of care (ie, the degree to which the ICU effectively addresses the patient's medical condition), (2) the safety of care (ie, the risk of developing an adverse event from being in the ICU), and (3) the satisfaction of care (ie, patient and family experience of receiving care in the ICU). Cost includes both direct and indirect health-care costs associated with the ICU stay. Direct costs include pharmaceuticals, diagnostics, and other material costs. Indirect costs

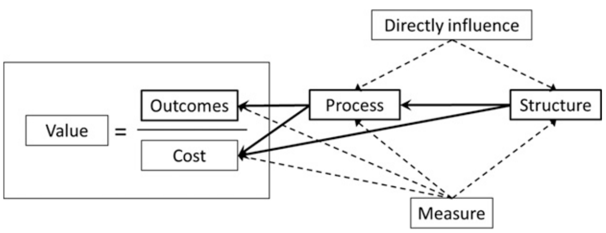

Figure 1 – *Relationship between value and quality components.*

include both financial and nonfinancial, such as the extensive hospital infrastructure needed to support ICU functions (eg, hospital building costs, hospital personnel salaries), pain and suffering associated with critical illness to the patient and family, provider emotional burnout, and the opportunity cost of critical illness (ie, patients, families, and providers not performing alternate activities because of the patient being in the ICU).

Determinants and Attributes of Quality Measures

Classically, assessing the quality of health-care delivery has been approached using Avedis Donabedian's framework, which links three domains: structure, process, and outcome (ie, the S-P-O model).[9,10] Structure refers to the conditions under which patients receive care and includes physical design attributes (eg, ICU room layout, location of sinks), materials (eg, medications, central line insertion carts, electronic medical record [EMR] systems), human resources (eg, number and education of staff), and organizational strategies to support standard practices (eg, decision support tools, communication tools, policies and protocols). Process refers to the care that patients actually receive and includes all actions designed to diagnose (eg, chest radiograph to evaluate for suspected pneumonia), treat (eg, antibiotic administration for sepsis), or prevent disease (eg, heparin for VTE prophylaxis). Outcomes are the end results of the care that patients receive, including mortality, morbidity, health-related quality of life, and health literacy. The S-P-O model can be integrated into the value equation to provide further insight into the modifiable factors that influence the determinants of value (Fig 1).

Each domain in the S-P-O model has specific characteristics that are useful when identifying potential ICU metrics. Structures can generally be directly modified by leaders using a variety of techniques, such as creating a central line insertion cart or modifying the ICU staffing model.[11,12] However, these changes may vary in feasibility due to resource limitations attributed to either fiscal constraints or other organizational factors.[13] Additionally, the impact of structural changes on health-care value is mediated by how this change influences the process of care delivery. Frequently, this means that structural metrics, while important, are insufficient to assess system change.

Process measures evaluate the actions of providers and most directly influence the outcome and cost determinants of health-care value. By reflecting discrete behaviors, process measures are particularly meaningful to clinicians because they can identify individually modifiable targets to improve patient care. Defining the eligible population for a given process measure is important to avoid measurement error. A process of care may be generally indicated in most patients with a disease but specifically contraindicated in selected individuals. For example, lung protective strategies are the standard of care for ARDS, frequently resulting in permissive hypercapnea.[14] In this setting, a process of care is generally indicated to prevent iatrogenic ventilator-induced injury. However, it is appropriate to avoid permissive hypercapnea in a trauma patient with a traumatic brain injury and significant cerebral edema who also has ARDS following a pulmonary contusion. Although this strategy could technically be considered nonadherence to lung protective ventilation, it would still be in the best interest of the patient to avoid cerebral herniation. Due to limitations in fully defining the eligible population, 100% adherence to a specific process metric may not always be appropriate and should be accounted for when defining unit goals and interpreting these measures.

Outcomes measures are generally the most meaningful to patients, payers, and other stakeholders because they represent the end result of care. However, although outcome measures are important metrics for ICU directors to assess, they are not directly modifiable by unit leaders. Additionally, overall outcomes measures are difficult to directly link to a specific provider behavior, which hinders their utility in supporting ICU improvement activities if presented without associated structure and process metrics. Outcome metrics also have the significant limitation of being influenced by patient factors such as severity of illness and comorbid disease. To be maximally interpretable, outcome measures, therefore, frequently require accurate risk adjustment to facilitate comparisons between different ICUs or to evaluate changes over time.[15] Although risk adjustment can help these comparisons, they are subject to inherent limitations, including the burden of additional data collection and variable performance across various populations.[16]

Building upon the Donabedian framework, the Institute of Medicine proposed in its 2001 report, *Crossing the Quality Chasm*, that high-quality health care should aim to be safe, effective, patient centered, timely, efficient, and equitable.[17] Safe care refers to the avoidance of injuries in the setting of therapy that is intended to help patients. Timely care seeks to minimize unnecessary and potentially harmful delays in health care. Effective care involves providing services based on scientific knowledge to all who could benefit (ie, avoiding underuse) and refraining from providing services to those not likely to benefit (ie, avoiding overuse). Delivering patient-centered health care is respectful and responsive to individual patient preferences, needs, and values and ensures that patient values guide all clinical decisions. Efficient care seeks to optimize how care is provided to minimize system waste. Equitable care ensures that health care does not vary in quality based on patient sex, ethnicity, geography, and socioeconomic status. Although the Institute of Medicine report was not aimed at a particular medical specialty or component of the care continuum, these attributes are directly applicable to the desired outcomes in the ICU setting and, therefore, guide ICU value measurement.

Developing an ICU Value Measurement Process

When initially developing an ICU value measurement process, it is helpful for ICU leaders to engage a multidisciplinary team. Because value does not exist solely within a specific health-care discipline or specialty, discussions involving as many members of the ICU team—physicians, nurses, advanced practice providers (nurse practitioners and physician assistants), pharmacists, respiratory therapists, dietitians, physical therapists, chaplains, social workers, and patient care assistants—can be crucial to a successful effort. For example, engaging team members from multiple disciplines can result in a more complete understanding of the factors influencing unit performance as well as facilitate subsequent interventions to improve value. Furthermore, early involvement of those who will be collecting and analyzing the data (eg, data analysts) in the process can be helpful because potential metrics are only valuable if their elements can be measured and analyzed. Finally, senior leadership in a health-care system often plays a key role in setting strategic priorities, focusing the ICU team on big-picture goals of a health-care entity, and providing necessary support. Within this broad context, multidisciplinary teams can be effective in developing and facilitating the measurement process and in designing and implementing interventions to improve unit performance. In developing a local approach to measurement, teams should optimally identify target areas (both external and internal), select meaningful and measurable metrics, acquire the necessary data, and analyze and disseminate the findings.

Identify Target Areas

External target areas and metrics for ICUs are typically predefined and mandated. For example, the Centers for

Disease Control and Prevention collects surveillance data on health-care-associated infections, including central line-associated bloodstream infections (CLABSIs) and catheter-associated urinary tract infections, through the National Healthcare Safety Network.[18] In addition, active surveillance is ongoing through the National Healthcare Safety Network for ventilator-associated events (VAEs).[19] A VAE is a newly defined entity comprising ventilator-associated conditions, infection-related ventilator-associated conditions, possible ventilator-associated pneumonia (VAP), and probable VAP that is intended to take the place of the previous VAP surveillance definition, which had previously been publicly reported despite concerns over its validity and reproducibility.[19] The Centers of Medicare & Medicaid Services publically reports hospital data on a variety of metrics, including core measures, patient safety indicators, and inpatient quality indicators as part of its Hospital Compare website.[20] Through the Choosing Wisely Campaign, groups such as the Critical Care Societies Collaborative and American Board of Internal Medicine are identifying measures that ICUs can take to more effectively use health-care resources.[21,22] On the state level, several health departments have mandatory reporting requirements relevant to ICU quality and value.[23,24]

Payers are increasingly examining quality and value metrics with the transition from volume-based reimbursement models (ie, fee for service) to reimbursement based on quality of care (ie, value-based purchasing or pay for performance).[25] The use of quality metrics to compare performance between individual providers and facilities is an integral part of these programs, and several ICU measures represent potential pay-for-performance targets. Through their public rating of hospitals based on metrics, health-care accrediting organizations, such as the Joint Commission, and large health-care purchasers, such as the Leapfrog Group, have also attempted to influence health-care quality in the ICU by proposing minimum staffing standards.[13]

When considering which value metrics to target for internal improvement efforts, ICU leaders and their teams can examine potential outcome and cost metrics for their units. Table 1[26-42] presents examples of global and organ system-specific value metrics with potential IOM domain classifications and operational descriptions. Teams may consider prioritizing which metric to evaluate by identifying those with the greatest opportunities for improvement and those that generate the most staff engagement. Rather than selecting a metric based on a single criterion (eg, potential impact, actionability), an alternate approach to prioritizing metrics can involve the unit team rating each candidate metric on specific attributes (described in more detail in the next section), including the perceived opportunity to improve (ie, importance), the ability to measure performance (ie, feasibility), and the ability to effect change (ie, actionability). By multiplying these component scores, teams could generate a priority score to help guide decision-making (eg, starting with the top-three metrics).[43]

Once a value target area has been identified, associated structures and processes should be evaluated to identify where to direct improvement efforts (Tables 2,[44-60] 3[61-65]). For example, an ICU with a higher-than-average CLABSI rate may choose to focus on the structures and processes associated with improvements in this outcome rather than on multiple other possible alternative target areas in which it already performs well. It is also worth considering additional outcomes with which those structures and processes are associated because many interventions are linked to more than one outcome.[66] For example, adherence to a ventilator liberation protocol may decrease the rate of VAEs, duration of mechanical ventilation, and ICU length of stay.

Select an Appropriate Metric

Metrics should be important, feasible, valid, and actionable (Table 4).[67] Important structure and process metrics are closely associated with important outcomes (eg, morbidity, mortality, cost). Selected structure or process measures should be strongly linked to important outcomes. The type of ICU should also be considered because the importance of metrics may vary depending on the patient population. For example, surgical site infection rates are important to surgical ICUs but less so for medical ICUs.

Feasible metrics are based on data that are accessible and can be evaluated using available resources. Factors to consider when judging feasibility include the cost of data collection, impact on clinician workload, accessibility of potential data sources, and availability of individuals with the requisite data analysis skills.

Valid metrics accurately reflect the outcome, process, or structures that they intend to measure. The target audience must believe that the metrics measure what they are designed to measure (ie, face validity), yield consistent results when collected by different individuals (ie, interrater reliability), and are replicable between different ICUs (eg, external validity). For example, the validity of using the prior VAP surveillance definition as

TABLE 1] Examples of Value Metrics, Institute of Medicine Aim, and Description

Metric	Aim	Description
Global		
Unadjusted ICU mortality[26, a]	S, E, P, Q	Percentage of patients in the ICU who die in the ICU
Risk-adjusted ICU mortality[27]	S, E, P, Q	Percentage of patients in the ICU who die in the ICU adjusted for severity of illness
Unadjusted ICU length of stay[26, a]	S, E, F	Mean ICU length of stay for all discharges (including deaths and transfers)
Delayed ICU admission[26]	T, E, Q	Percentage of ICU admissions (excluding interhospital transfers) delayed ≥ 4 h between order and transfer
ICU readmission[26]	S, E, P, F	Percentage of unplanned ICU readmissions within 48 h
Patient falls[28]	S, P	Number of falls per 1,000 patient days
Pressure ulcers[29]	S, E, P, F	Number of new-onset pressure ulcers per 1,000 patient days
Medication errors[30]	S, T, E, F	Percentage of administered medication doses with errors
ICU costs[4]	F	Average ICU costs per day
Patient/family satisfaction[31]	P	Average level of reported satisfaction (Family Satisfaction in the Intensive Care Unit survey)
Neurologic		
Pain[32]	T, E, P	Percentage of patient days during which pain was evaluated four or more times per shift and at a nonsignificant level
Agitation[32]	T, E, P	Percentage of patient days during which sedation was evaluated four or more times per shift and at either optimal or target sedation level
Delirium[32]	S, E, P	Percentage of patient days during which delirium was evaluated once per shift and delirium not present
Weakness[33]	S, E, P	Percentage of patients with clinically detected weakness with no plausible cause other than critical illness
Pulmonary		
Mechanical ventilation duration[26]	S, E, P, F	Mean number of days on mechanical ventilation for all patients receiving any invasive mechanical ventilation
ARDS[34]	S, E, P, F	Number of new-onset ARDS per 1,000 ventilator days
Unplanned extubations[35]	S, E, P, F	Number of unplanned extubations per 1,000 ventilator days
Infectious disease		
CLABSI[36, b]	S, E, P, F	Number of CLABSIs per 1,000 catheter days
CAUTI[37, b]	S, E, P, F	Number of CAUTIs per 1,000 catheter days
Probable VAP[38]	S, E, P, F	Number of probable VAPs per 1,000 ventilator days[19]
MRSA infection[26]	S, E, P, F	Number of MRSA infections per 1,000 patient days
VRE infection[26]	S, E, P, F	Number of new-onset VRE infections per 1,000 patient days
Clostridium difficile infection[39, a]	S, E, P, F	Number of new-onset *C difficile* infections per 1,000 patient days
GI		
GI bleeding[40]	S, E, P, F	Percentage of patients in whom macroscopic bleeding develops, resulting in hemodynamic instability or the need for RBC transfusion
Hematologic		
VTE[41]	S, E, P, F	Percentage of patients with new-onset VTE
Transfusion reaction[42, a]	S, E, P, F	Percentage of transfused units with a reaction

CAUTI = catheter-associated urinary tract infection; CLABSI = central line-associated bloodstream infection; E = effective; F = efficient; MRSA = methicillin-resistant *Staphylococcus aureus*; P = patient centered; Q = equitable; S = safe; T = timely; VAP = ventilator-associated pneumonia; VRE = vancomycin-resistant enterococci.

[a] National Quality Forum endorsed.

[b] Centers for Disease Control and Prevention/National Healthcare Safety Network reporting.

TABLE 2] Examples of Process Metrics for Value

Metric	Description
Global	
ICU nurse staffing[12,60]	Average nurse:patient ratio
Daily rounds by an intensivist[44]	Percentage of daily rounds led by an intensivist
Rounds including pharmacist[45]	Percentage of daily rounds with clinical pharmacist present
Daily goals/safety checklist[46]	Percentage of patient days with a completed daily goals checklist
Neurologic	
Effective pain assessment[32, a]	Percentage of patient days during which pain was evaluated four or more times per shift
Effective sedation assessment[32, b]	Percentage of patient days during which sedation was evaluated four or more times per shift
Effective delirium assessment[32]	Percentage of patient days with delirium assessed using formal tool
Sleep promotion[47]	Percentage of patient days with adherence to sleep promotion checklist
ICU mobilization[48]	Percentage of patient days receiving mobility therapy
Pulmonary	
Head-of-bed elevation[26]	Percentage of patient days where the head of bed is elevated $\geq$ 30°
Daily chlorhexidine oral care[49]	Percentage of patient days where patients had oral care with chlorhexidine
Lung protective ventilation[14,50]	Percentage of ventilator days on which patients with ARDS receive a tidal volume $<$ 6.5 mL/kg predicted body weight and plateau pressure $\leq$ 30 cm H_2O
Ventilator liberation protocol[26,51]	Percentage of ventilator days with protocol screening and completion
Cardiac	
Severe sepsis bundle[52, a]	Percentage of patients with severe sepsis for whom lactate level was measured, blood culture obtained prior to antibiotic administration, and broad-spectrum antibiotics administered within 3 h
Septic shock bundle[52, a]	Percentage of patients with septic shock for whom the severe sepsis bundle was met within 3 h and vasopressors were administered, central venous pressure and central venous oxygen saturation were measured, and lactate level was rechecked (if initially $\geq$ 4 mmol/L) within 6 h
Infectious disease	
Hand hygiene compliance[53]	Percentage of opportunities where health-care workers adhered to hand hygiene guidelines
Blood cultures for CAP[54,55, a]	Percentage of ICU patients with CAP with one or more sets of blood cultures performed within 24 h prior to or 24 h after hospital admission
CVC insertion protocol[36, a]	Percentage of CVC insertions in which the CVC was inserted with all elements of maximal sterile barrier technique (cap AND mask AND sterile gown AND sterile gloves AND large sterile sheet AND hand hygiene AND 2% chlorhexidine for cutaneous antisepsis)
GI	
Stress ulcer prophylaxis[26]	Percentage of ventilator days with stress ulcer prophylaxis administration
Enteral nutrition[56]	Percentage of patients receiving enteral nutrition within 24 h of ICU admission
Hematologic	
DVT prophylaxis[57, a]	Percentage of patient days with DVT prophylaxis administration
Appropriate use of blood transfusions[58, b]	Percentage of nonbleeding, hemodynamically stable patients receiving any RBC transfusion with a pretransfusion hemoglobin level $\leq$ 7 g/dL
Palliative	
Surrogate decision-maker[59, b]	Percentage of patients for whom a surrogate decision-maker or the absence of a surrogate is documented within 24 h of ICU admission
Goals of care[59]	Percentage of patients for whom goals of care are documented within 72 h of ICU admission

CAP = community-acquired pneumonia; CVC = central venous catheter.
[a] National Quality Forum endorsed.
[b] Critical Care Societies Collaborative[22] and American Board of Internal Medicine "Choosing Wisely" endorsed.

TABLE 3] Structural Intervention Types and Examples

Structural Intervention Type	Example
Physical design attributes	
ICU layout	Ambient noise in ICU[61]
Materials	
Equipment	Central line insertion cart[11]
Medications	Antibiotics on unit for severe sepsis[62]
Human resources	
Staff number	Interdisciplinary rounding with clinical pharmacists[45]
Staff education	Simulation-based learning for medication administration[30]
Organizational strategies	
Provider organization	Closed-ICU physician staffing model[12,44,63]
Policies	Transfusion policy[58]
Protocols	Paired sedation and ventilator weaning protocol[64]
Decision support	Daily reminders to remove urinary catheters[37]
Communication tools	Daily goals[46]
Monitoring and feedback system	Weekly feedback regarding sepsis care[65]

an outcome metric was regularly questioned, including the fact that the surveillance definition for VAP detected a significant number of patients who did not have pneumonia, it was unclear how many patients with pneumonia were missed by the diagnosis, and evaluators frequently classified potential VAP cases differently.[68,69]

TABLE 4] Desirable Value Metric Attributes

Attribute	Meaning
Important	Does the metric represent something important to the clinicians and patients in the ICU? Is there room for improvement?
Feasible	What resources are required to collect and analyze the data for this metric?
Valid	How well does the metric reflect what it is intending to convey (internal validity)? How well does the measure produce consistent results when collected by different people (ie, interrater reliability)? How well can the metric be replicated between ICUs for comparison (external validity)?
Actionable	Can an intervention be instituted to influence the metric? Does the measure respond to interventions designed to change it?

For these reasons, the alternative VAE metrics have been developed, with public reporting not currently mandated while validity and benchmarks are being evaluated.[19] Similarly, process metrics should effectively depict the behaviors that leaders are seeking to measure. For instance, rates of documented adherence to the central line insertion bundle elements should reflect the realities of clinical care, which frequently require intermittent quality checking and audits by team members.

Actionable metrics can be influenced directly or indirectly by deliberate interventions. For a measure to be actionable there must be room for improvement and an identifiable process or structure that can be changed to lead to improvement, and the metric needs to change in response to the improvement. For example, ICUs with high CLABSI or catheter-associated urinary tract infection rates can implement evidence-based strategies to improve and monitor their rates for improvement more readily than those with lower rates.[36,70] These ICUs should also focus on measuring and improving the related structures and processes that can be influenced and have the greatest room for improvement.

Acquire the Necessary Data

After defining the measure to be targeted, data sources need to be identified to measure the metric being examined. Potential data sources include administrative data, clinical data, surveys, and ancillary data (Table 5[71]). Administrative data are usually readily available, with no additional burden for collection. Clinical data can be obtained prospectively or retrospectively from medical records by manual review or direct extraction from EMR databases. Prospectively collected clinical data often require the commitment of human and financial resources, which can limit feasibility, particularly if collection involves large volumes of data or long assessment periods. Survey data include patient satisfaction surveys, such as the Hospital Consumer Assessment of Healthcare Providers and Systems survey and the Family Satisfaction in the Intensive Care Unit survey, as well as patient safety culture questionnaires, such as the Hospital Survey on Patient Safety.[72-74] Ancillary data can be found in additional monitoring systems, such as infection surveillance systems and adverse event reporting systems.

Much of the necessary data for an ICU are available in EMRs. Although EMRs are a valuable source for data on the quality of care, data extraction can require specialized training. Optimally, EMR vendors would ensure that the data needed to evaluate the quality and value of care are easy to obtain through both customizable

TABLE 5] Potential Data Sources for Value Metrics

Data Source	Benefits	Limitations	Typical Use (Example)
Administrative	Commonly available across institutions for large groups of patients No new data collection required	Delay in coding (not real time) Limited granularity Potential for coding errors	Structure (staffing ratio[12]) Process (RBC transfusion[58]) Outcome (length of stay) Cost (cost/d[4])
Manual chart abstraction	Good detail on focused areas Can translate free text from chart into more-structured data	Resource intensive per chart reviewed Limited scalability Depends on clinician documentation	Process (antibiotic administration for sepsis[52]) Outcome (length of stay)
EMR extraction	Larger population More discrete clinical data Potential to automate measurement, reducing ongoing resource utilization (more efficient in the long run) Potential real-time assessment	Depends on clinician documentation Initial development cost Advance system planning required (eg, variables, data repositories) Balance between discrete data and narrative	Process (antibiotic administration for sepsis[52]) Outcome (length of stay)
Survey	Provides data commonly not present in the medical record May be scaled depending on scope of project	Respondent burden Limited ability to integrate into other data reporting	Structure (staffing ratio[12]) Outcome (patient satisfaction[71])
Ancillary system (eg, infection surveillance and adverse event reporting systems)	Provide information commonly not present in medical records	Challenging to integrate with other systems for data gathering and reporting purposes Initial cost to develop system	Outcome (CLABSI[36]) Outcome (unplanned extubation[35])

EMR = electronic medical record. See Table 1 legend for expansion of other abbreviation.

reports and easier access to raw data for more detailed analysis; however, the ability to obtain these data from EMRs is currently variable. As such, individual hospitals and health systems often need to invest substantially in the human resources required to effectively use these information systems to reduce the burden of data collection.[75]

Data collection processes should also be pilot tested to ensure their feasibility and reliability. Leaders need to balance the feasibility of data collection and efficiency of measurement with the need for detailed results. If the data are to support a small, preliminary local evaluation, then efficiency is likely to be weighted more. If the scope of the work increases or the project will be ongoing, then the process may need to transition to more precise and automated collection and reporting methods.

Analyze and Disseminate the Findings

Once the data have been collected, they need to be analyzed and disseminated in an easily interpretable manner for target audiences. Frequently, successful completion of this task requires a data analyst or team with both statistical and clinical expertise along with access to necessary data analysis software. Given the smaller sample size of an ICU compared with the hospital or health system, statistical significance may be harder to detect and less meaningful than presenting data exceeding clinically significant bounds.[76]

Selecting an approach to display quality data can be influenced by the type of information being communicated and the goal of the communication, understanding that multiple, nonmutually exclusive goals may exist simultaneously. For example, if the goal is to show a change over time in relatively common occurrences (eg, CLABSI rates across multiple ICUs), then run charts can enable immediate appreciation of trends (Fig 2A).[77] If the goal is to foster competition, then unit data can be displayed relative to internal goals or external benchmarks using overlapping run charts or side-by-side bar graphs. For metrics with a low rate in a small number of opportunities (eg, CLABSIs in small ICUs), time since last event can be helpful (Fig 2B). Pareto charts, which show a combination of prioritized individual components (bars) along with a cumulative measure (line), can

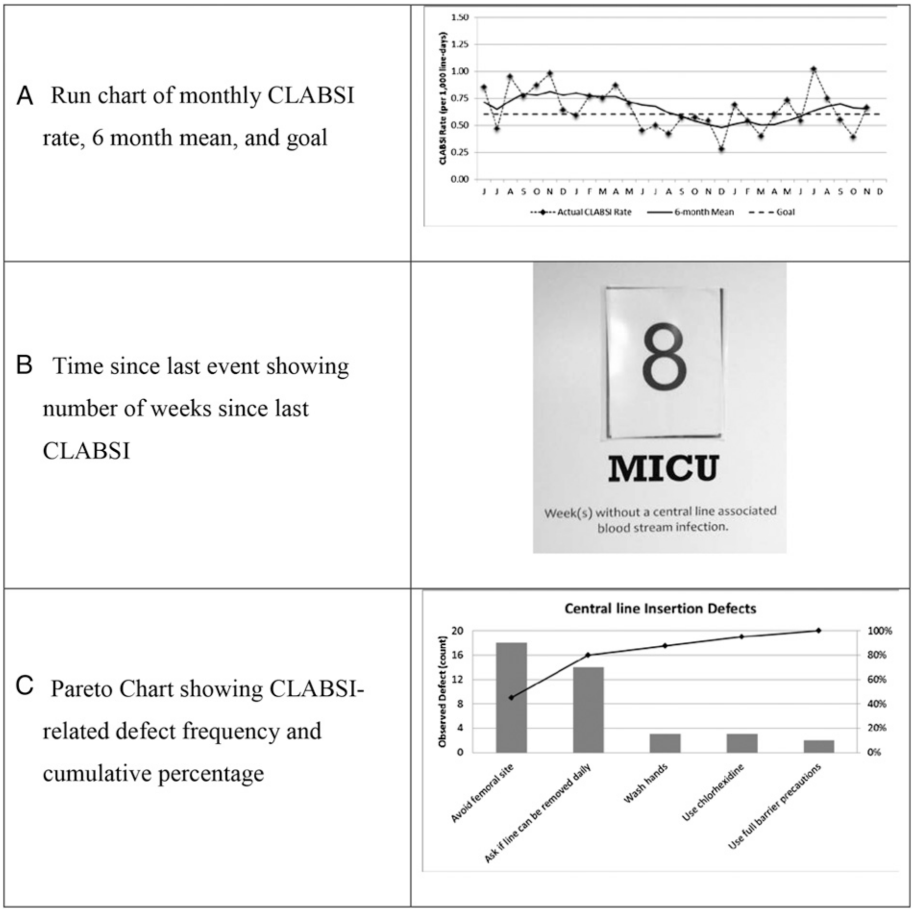

Figure 2 – A-C, *Example run chart (A), time since last event (B), and Pareto chart (C) related to CLABSIs. CLABSI = central line-associated bloodstream infection; MICU = medical ICU.*

help to prioritize process and structure targets that contribute to specific outcomes (Fig 2C).[77]

Evidence suggests that displaying ICU data for staff to review improves adherence with guidelines.[78] Scorecards are one method for displaying unit data, which can help to prioritize local needs, support audit and feedback, and track changes over time.[79,80] Scorecards can present data at various levels, such as aggregated to the unit level or granular down to the individual provider level. When considering the level of granularity of data presentation, unit directors should consider their ability to effectively attribute the metrics to a specific provider and balance the level of provider identification (eg, unit level, deidentified provider indicators, provider names) with the organizational culture of the ICU (eg, transparency, fair and just culture).

Conclusions

Quality and value metrics are gaining increasing prominence in a rapidly shifting health-care landscape. ICU directors are responsible for facilitating the delivery of high-quality and high-value care for patients within their ICUs. Improving the ability of ICU directors to identify, obtain, and evaluate relevant metrics is critical to ensuring that these units consistently deliver high-quality, high-value health care.

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