Understanding Patient Safety and Quality Outcome Data

Kathy Easter, MSN, RN, CCRN-K
Linda M. Tamburri, MS, RN, APN, CCRN

The need for nurses to understand patient safety and quality outcome data is pressing in the current era of data transparency. Health care outcomes data are now publicly reported and readily accessible to consumers, are necessary for performance-based reimbursement, and are required by government and regulatory agencies. In order for nurses at all levels of practice to own their outcomes and be accountable for making improvements, they must possess skills in collecting, analyzing, evaluating, and acting on outcome data. This article provides basic tools and clinical examples for nurses to use in a focused application of outcome data and a structured process for improving nursing care outcomes. (*Critical Care Nurse*. 2018; 38[6]:58-66)

The Institute of Medicine report *Health Professions Education: A Bridge to Quality* asserts that in order to improve the quality of health care in the United States, the education of health care professionals must be enhanced.[1] The report proposes 5 core competencies for health care professionals, including the competency of understanding and applying quality improvement practices. This competency comprises skills such as measuring quality of care, comparing one's own practices with the best practices of others, and improving quality by designing and testing care interventions.[1]

The majority of frontline nurses may not consider themselves skilled in data analysis and quality improvement, but they do in fact use large amounts of data on a daily basis when making evidence-based decisions for their acutely and critically ill patients. Nurses collect, analyze, and act on data from vital signs, hemodynamic parameters, fluid balances, and laboratory values. On the basis of their analyses of

CE 1.0 hour, CERP B

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Explain why nurses must develop competencies in understanding patient safety and quality outcome data
2. Analyze patient outcome data and compare unit or organization performance to internal and external benchmarks
3. Apply Plan-Do-Study-Act methodology to systematically evaluate and improve patient safety and quality outcomes

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these data, nurses alter and individualize patient interventions and evaluate the outcomes of their care. On a broader basis, nurses also review a variety of report cards containing patient outcomes data on hospital-acquired conditions and patient satisfaction. These quality, safety, and service outcomes are evidence of the quality of care that nurses provide.[2-7]

With the amount of data available today, it is essential that nurses at all levels of practice develop the necessary skill set to understand and manage quality and safety data. The need for these skills is amplified in an era of data transparency through public reporting, third-party reimbursement based on performance, government and regulatory agencies' requirements to reduce or eliminate hospital-acquired conditions, and consumers' expectations to remain free from harm during hospitalizations. The purpose of this article is to help frontline nurses understand the significance of public reporting as it relates to quality outcomes, become familiar with basic data terminology and measures of central tendency, and evaluate and improve quality and safety outcomes through Plan-Do-Study-Act (PDSA) cycles.

Impact of Publicly Reported Outcomes

Analyzing data to measure patient outcomes began more than 150 years ago when Florence Nightingale used statistical analyses to monitor postoperative complications and other hospital outcomes during the Crimean War.[2,4,6,8] Methods of evaluating health care quality, safety, and service have evolved through the years, and these outcomes have now become publicly reported information. Much of the outcome data that health care organizations submit to the Centers for Medicare and Medicaid Services (CMS) via the Hospital Inpatient Quality Reporting Program can be readily accessed through the Hospital Compare website (https://www.medicare.gov/hospitalcompare/search.html). Seven groups of measures are used to calculate overall hospital ratings: mortality, safety of care, readmission, patient experience, effectiveness of care, timeliness of care, and efficient use of medical imaging. On the basis of these measures, hospital summary scores and CMS star ratings are posted annually on the Hospital Compare website. Consumers can easily compare the safety, service, and quality of health care organizations by viewing these publicly reported data. They can then use this information when making decisions about where to obtain health care. The CMS star rating is based on a scale of 1 to 5, with 1 being the lowest and 5 the highest. In 2016, 4598 hospitals in the United States were assigned CMS star ratings. The majority of these hospitals were rated as average, receiving 3 stars from CMS. One hundred twelve underperformed and received 1 star, and 83 received top ratings at 5 stars.[9,10]

Although many publicly reported outcomes are the result of care provided by a team of multidisciplinary providers, certain outcomes have been identified as nursing-sensitive, meaning that they reflect the quality of care provided by nurses. The American Nurses Association defines nursing-sensitive indicators as structures and care processes that affect nursing care outcomes.[3,4,6] The most commonly reported nursing-sensitive indicators are pressure injury, falls and falls with injury, hospital-acquired infections, and patient satisfaction with nursing care. In 2008, CMS ended reimbursement to hospitals for expenses related to these "never events."[7,11] A recent concept analysis of nursing-sensitive indicators further supports these measures as being outcome attributes related to patient care.[12] In view of the impact that nursing has on patient outcomes and public reporting, a basic understanding of data terminology and analysis is imperative.

It is essential that nurses at all levels of practice develop the necessary skill set to understand and manage quality and safety data.

Data Terminology and Analysis

The term *data* is defined as factual information that provides a foundation for reasoning, inquiry, and

Authors

Kathy Easter is Magnet Program director, Robert Wood Johnson University Hospital, New Brunswick, New Jersey, and Robert Wood Johnson University Hospital Somerset, Somerville, New Jersey.

Linda M. Tamburri is a clinical nurse specialist for the Magnet/Quality Department, the critical care float pool, and the specialty care transport unit, Robert Wood Johnson University Hospital, New Brunswick, New Jersey.

Corresponding author: Linda M. Tamburri, MS, RN, APN, CCRN, Robert Wood Johnson University Hospital, 1 Robert Wood Johnson Place, New Brunswick, NJ 08901 (email: linda.tamburri@rwjbh.org).

decision-making; it is used as a springboard to make positive changes.[13] In order to analyze data, nurses must be able to describe data's general characteristics and distribution in the data set.[13,14]

Units of Measure

Data can be reported using different units of measure, depending on what is being counted. Door-to-needle time is measured in number of minutes for stroke patients receiving a thrombolytic agent. Patient satisfaction scores are measured as a percentage of patients responding in a particular way to standardized survey questions. Safety events, such as a unit's patient falls in 1 month, may be measured either as a raw number or as a rate. Raw numbers (eg, the total number of falls in 1 month) are easy to count and simple to understand; however, raw numbers make it difficult to compare 2 or more groups. A rate (eg, the number of patient falls per 1000 patient days) converts raw numbers into a common format that allows for comparisons between units, departments, and organizations, regardless of size or census. For example, if a large 30-bed progressive care unit had 2 patient falls in 1 month, and a smaller 18-bed progressive care unit also had 2 falls in the same month, the unit that had a better outcome cannot be ascertained by using raw numbers because of the difference in the units' bed capacity and census. Using the unit's number of patient days to calculate a fall rate, we determined that the large unit had a fall rate of 2.2 falls per 1000 patient days while the small unit had a fall rate of 3.7 falls per 1000 patient days. Thus, the larger unit had a better outcome related to patient falls. Rates are also used to report device-related infections such as catheter-associated urinary tract infections (CAUTIs) and central catheter–associated bloodstream infections (CLABSIs). These rates are calculated on the basis of the number of device days: CAUTIs per 1000 urinary catheter days and CLABSIs per 1000 central catheter days.

When examining patient quality and safety data, it is important to differentiate process measures from outcome measures.

Process Versus Outcomes

When examining patient quality and safety data, it is important to differentiate process measures from outcome measures. Process measures assess the interventions provided by the health care team, while outcome measures provide evidence of the effect of the interventions.[15] For example, in an effort to decrease CLABSIs, nurses in a trauma intensive care unit (ICU) conducted audits of medical records to determine whether their patients were being bathed with chlorhexidine gluconate every 24 hours according to best practice. The percentage of time that patients appropriately received a chlorhexidine gluconate bath is a process measure (the intervention), while the unit's CLABSI rate is the outcome measure (the effect). Outcomes may be a more valuable metric because they reflect the impact care has on the patient.

Measures of Central Tendency

The ability to describe data is essential to make performance comparisons between groups such as hospitals or patient care units. Measures of central tendency (mean, median, and mode) are often used to describe the values that are typical for a data set. The mean is the sum of all values in a data set divided by the total number of values.[13,14] It is often referred to as the arithmetic average and is the most commonly used measure of central tendency. The median is the midpoint of a data set, of which one-half of the values lie below it and one-half of the values lie above it.[14] The median is most often used to characterize a data set when extreme values or outliers are included. The mode is the value in the data set that occurs with the greatest frequency.[14] The mode is rarely used to compare quality and safety outcome data.

These measures of central tendency can be illustrated using an example of an academic medical center that has 7 critical care units. The numbers of fall injuries during the past year in each of the 7 critical care units are as follows: 18, 3, 2, 2, 2, 1, and 1. The mean of this data set is 4.14. The median is 2 and the mode is 2. Since the number 18 is not typical for the data set, its value skews the normal distribution, and it is therefore known as an outlier. In such cases, it is preferable to use the median. Data sets illustrating the mean, median, and mode are also shown in the Table.

Dispersion

The range, quartile rankings, and standard deviations are often used to describe the dispersion or variability of data contained within data sets. The range measures the variability or difference between the

Table Measures of central tendency

Measure	Definition and example
Mean	Sum of all values, divided by total number of values (average) 4 + 3 + 5 = 12, 12 ÷ 3 = **4**
Median	Half the values lie below and half the values lie above (midpoint) 0, 1, 9, **12**, 13, 20, 34
Mode	Most frequently appearing value 2, 0, **3**, 5, 1, 7, **3**, 2, 4, **3**, 6, 6

highest and lowest values in the data set.[13,14] In the example above, the range for the number of fall injuries in the critical care units is 17. It is calculated by subtracting the lowest number in the data set from the highest number in the data set (18 - 1 = 17).

Although the range provides a picture of variability between the extremes of the data set, national databases commonly use quartile, interquartile, and percentile rankings to further quantify variability to facilitate data set comparisons.[13,14] The median is represented by the 50th percentile. The 25th percentile is referred to as the first quartile. The 75th percentile is synonymous with the third quartile. Top decile performance indicates that the outcome data are better than 90% of the data in the entire data set.

The standard deviation is another method of measuring variability or dispersion in data sets. It measures the average amount that each number in the data set varies from its mean.[13,14] For the scope of this article, the concept of standard deviation and data distribution will be explored by examining a normal bell curve.

Normal Data Distribution

The most common way to measure data distribution is by evaluating where data fall on a bell curve (Figure 1). In a normal bell curve the mean, median, and mode are represented by the same value at the point where the center vertical line crosses the x-axis.[14] The left and right sides of the midpoint are mirror images, and the tails of the curve approach the x-axis but never touch it.[13,14] The distance between the mean and 1 SD to the left or right of the curve is 34%. In other words, 68% of the data fall within 1 SD of the mean. Fourteen percent of the data fall between -1 SD and -2 SDs or between +1 SD and +2 SDs from the midpoint of the curve, for a total of 28%. Moving farther away from the mean, the area beneath the curve decreases, and only 2% of the data are distributed in this part of the curve to the left and right of the mean, respectively.

A bell curve is frequently used to grade student tests by comparing individual student test scores against the mean of all scores. This method of grade calculation is commonly known as grading on a curve. When looking at a normal bell curve, 68% of students would receive an average grade of C, because 34% of the scores would fall to the right of the mean and 34% would fall to the left of the mean. Fourteen percent of students, whose scores fell between 1 SD and 2 SDs to the right of the mean, would receive a B. Two percent of students, whose scores

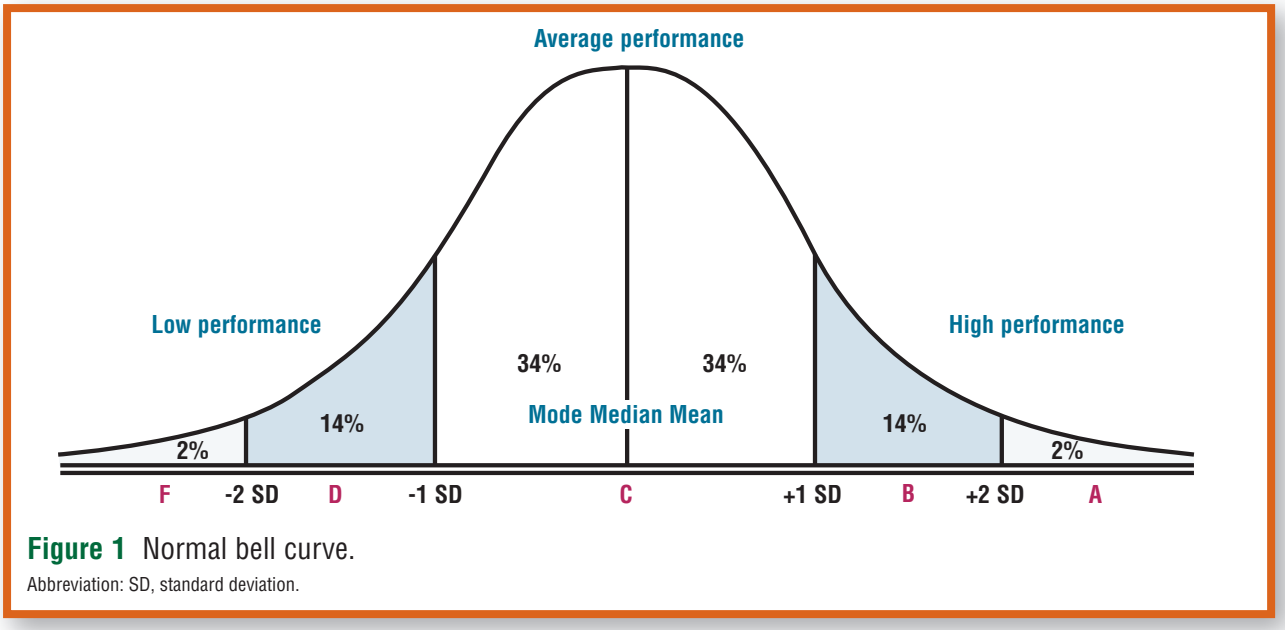


Figure 1 Normal bell curve.
Abbreviation: SD, standard deviation.

fell beyond 2 SDs to the right of the mean, would receive an A. Conversely, 14% of students, whose scores fell between 1 SD and 2 SDs to the left of the mean, would receive a D. Two percent of students, whose scores fell beyond 2 SDs to the left of the mean, would receive a grade of F (Figure 1).

Examining normal data distribution from the perspective of letter grades can help nurses understand how their unit's performance compares with other units on a variety of outcomes. Using responses from a pediatric intensive care unit (PICU) nurse satisfaction survey as an example, survey results show that the score for PICU teamwork is 2.9 on a scale of 1 (low) to 4 (high). The survey's national database reports that the mean score for teamwork among participating PICUs in the United States is also 2.9. When compared to other PICUs, this unit's performance is equal to the mean and is therefore considered average. In other words, the PICU would receive a letter grade of C for this measure. Units in the database that scored 1 SD or 2 SDs greater than 2.9 performed above average and would receive a letter grade of B or A, respectively. Units that scored 1 SD or 2 SDs less than 2.9 had below-average performance and would receive a D or an F. Although letter grades are not actually issued for nursing performance measures, using this analogy helps illustrate a unit's comparative standing among other units.

Examining normal data distribution using letter grades can help nurses understand how their unit's performance compares with other units.

Comparing Outcomes Through Benchmarking

The process of comparing outcome measures among hospitals or individual units is called benchmarking. It is done in order to assess one's own performance, evaluate it against that of high performers, and identify improvement opportunities.[16] Benchmarking can be done internally, in which comparisons are made within an organization, such as individual units comparing their outcomes to other units in the same hospital. External benchmarking is performed by organizations reporting their outcomes to a local or national database such as the National Database of Nursing Quality Indicators, National Healthcare Safety Network, and CMS. The benefit of external benchmarking is that it can identify other organizations' successful practices, which can then be tested in organizations striving for improvement.[15]

In order to make accurate comparisons when benchmarking, the reported data must be collected in the same way among all organizations in the database.[17] First, organizations must use the database's standardized definitions to identify outcome measures. For example, when reporting hospital-acquired pressure injuries, if some organizations in the database report all stages of hospital-acquired pressure injuries and other organizations report only pressure injuries designated stage II and above, then comparisons among the organizations will not be accurate. Second, all organizations must report data for the same period (eg, month, quarter, etc). Finally, all organizations must use the same unit of measure, as previously described.[17]

After data are reported and results are compiled, comparisons can be made among comparative cohorts, which are groups in the database with similar characteristics. Hospitals can compare their organizational performance with other hospitals of the same type within the database (eg, similar bed size, geographic location, academic medical centers, or Magnet organizations). Individual units can also benchmark their performance against other units in the database with similar patient populations, such as telemetry, step-down, critical care, pediatrics, and so on.

The advantage of external benchmarking over internal benchmarking is demonstrated in the following example. In the first quarter of 2016, through internal benchmarking, nurses in a cardiac care unit (CCU) noted that their unit's CAUTI rates were higher than the rates of other critical care units in their hospital. The CCU nurses set a goal to reduce their CAUTI rate by 50%, which would equal the rate of the hospital's top-performing unit. They examined their CAUTI prevention practices, reviewed the literature, and identified the need to expeditiously remove urinary catheters. The hospital had developed a nurse-driven urinary catheter removal protocol; however, the CCU team determined that it was not consistently implemented in their unit. After creating processes to ensure protocol adherence, the CCU team exceeded their CAUTI reduction goal when their CAUTI rate decreased by more than 70% over the next 5 quarters (Figure 2). Although the CCU team significantly reduced their CAUTI rate and surpassed the internal benchmark, they did not know that their performance was below that

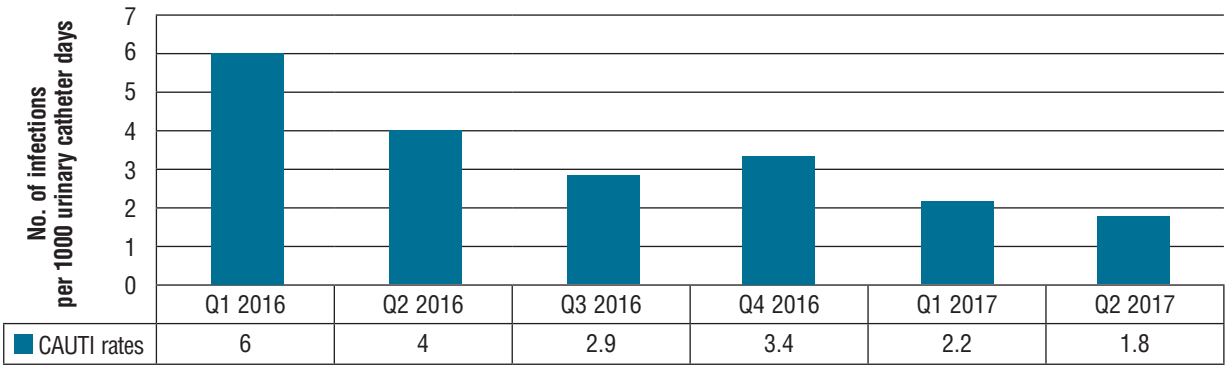


Figure 2 Catheter-associated urinary tract infection (CAUTI) rates in the cardiac care unit.

Abbreviation: Q, quarter.

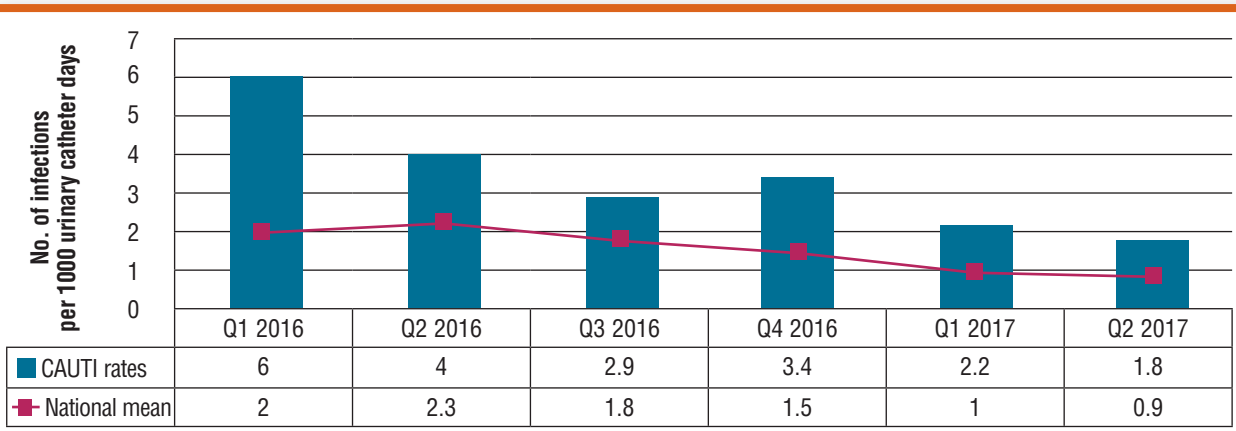


Figure 3 Catheter-associated urinary tract infection (CAUTI) rates in the cardiac care unit compared with benchmarks.

Abbreviation: Q, quarter.

of other CCUs because they did not externally benchmark their data against other hospitals. If the CCU team had compared their outcomes in a national database with those of CCUs in similar hospitals across the country (Figure 3), they would have learned that their unit's lowest CAUTI rate (1.8) was twice the national mean rate (0.9). This underperformance may be publicly reported and can negatively affect the hospital's reimbursement. External benchmarking also would have revealed that despite the substantial improvements made by the CCU team, additional practice changes were needed to further decrease their CAUTI rate. This example shows that using only internal benchmarks to evaluate outcomes may be misleading, and that both internal and external benchmarks should be reviewed for a clearer understanding of performance.

Acting on Data to Improve Outcomes

The purpose of analyzing outcome data and comparing unit or organizational performance to external benchmarks is to identify outcomes that need improvement and implement best practices to ensure that patients are receiving the safest and highest-quality care. The Institute for Healthcare Improvement's white paper on sustaining improvement asserts that in order for providers to achieve excellence in health care, "everyone has two interdependent roles: doing the work and improving the work."[18(p6)] Frontline staff members are often in the best position to determine the sources of safety or quality problems and devise effective solutions.

A systematic method for performance improvement is the PDSA model, which tests the effectiveness of small change before widespread implementation.[15,19-21]

The PDSA methodology can determine the relationship between changes in processes and outcomes.[15] The rationale for using the PDSA model to test change includes verifying that the new practices led to an improvement, assessing the magnitude of the improvement, and evaluating the cost and unanticipated effects of the change.[19] Health care teams can obtain tool kits and worksheets from online resources such as the websites of the Institute for Healthcare Improvement[22] and the Agency for Healthcare Research and Quality[23] to guide their steps in performance improvement activities.

Plan: Design Actions for Improvement

The first phase in the PDSA cycle is the Plan. Teams should start with 1 outcome that needs improvement, as there is a greater opportunity for success when beginning with small and manageable goals. The next step is to identify the root cause of the problem by looking for variations in practices, lack of continuity, communication failures, outdated practices, work-arounds, system breakdowns, inefficiencies, or redundancies.[20,24] A plan should be formulated that specifically addresses the identified root cause. For example, a plan to reeducate nurses on the dangers of look-alike, sound-alike medications will not improve patient safety if the root cause of the medication error is a supply problem, in which the at-risk drugs are stored side by side in the medication room.

Conducting a literature review will ensure that improvement plans are based on current, evidence-based practices. Professional guidelines developed by clinical specialty organizations, such as the American Association of Critical-Care Nurses, are also valuable resources.[25] Consultation with colleagues in high-performing units or other organizations can also be a good source of potential solutions, provided the root cause of the problem and the patient populations are comparable.[20,24,25] The plan should include an explicit prediction that will guide the PDSA cycle,[26] for example, "Separating the storage location of look-alike, sound-alike medications will decrease medication errors involving these drugs."

Do: Make a Change

Implementing any change requires all team members to be well informed of their role in, and the reasons for, the new practice. Overcoming resistance to change is a common challenge to quality improvement efforts, and engaging stakeholders in intervention development is a benefit of the PDSA process.[26] Once the change is implemented, feedback should be obtained on any difficulties or barriers that arise. Data collection during this time is important to measure the impact of change. Tracking process measures, such as the percentage of time that CCU staff in an earlier example correctly followed the urinary catheter removal protocol, will reveal how consistently the change was applied. Collecting outcome data, such as CCU CAUTI rates, will document how the change affected patients.

Study: Analyze Change Effectiveness

Comparing data before and after a change enables nurses to determine the effectiveness of the new practice.[3] Questions the team can ask during data analysis include the following: What was the change in outcomes? Are the results aligned with unit and organizational goals? What factors contributed to a lack of improvement? Was the degree of improvement worth the cost or effort of the change? What was learned and what more needs to be learned about the effect of the change?[19,20]

Act: Implement or Alter Change

Data analysis and lessons learned will provide direction for the Act phase, in which there are 3 primary options: adopt, adapt, or abandon.[20] If the test of change produced favorable outcomes, the team should decide if the change will be permanently adopted and consider expansion to other areas. Partially successful changes should be altered and the PDSA cycle repeated. Interventions that did not produce positive change may be abandoned, but in these cases teams should not become discouraged, as this process results in valuable learning, which is one of the benefits of the PDSA cycle.[21,26] Abandoning an intervention should be followed by the team returning to the Plan stage and repeating a new PDSA cycle. Multiple PDSA cycles are frequently needed to refine the new process until a robust solution has been created.[20] Without repeated PDSA cycles, interventions may not be optimized.[21]

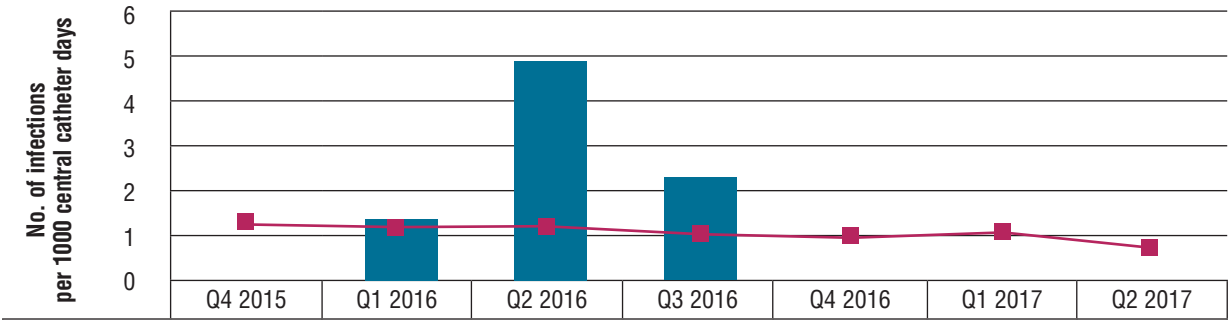
Conclusion

Significant changes in today's health care environment, including financial reimbursement, regulatory requirements, consumer expectations, and public reporting of safety and quality outcomes, obligate health care providers to expand their knowledge and skills in quality

The following case study illustrates the use of data analysis and PDSA cycles to improve patient care quality and safety. A combined medical/surgical ICU had a long-standing record of CLABSI rates consistently outperforming the national benchmark, but in the first 2 quarters of 2016 the CLABSI rate increased (Figure 4). The data were reviewed at the ICU practice council meetings, and nurses began the first PDSA cycle to test improvements. In the Plan phase, when drilling down to determine the root cause of the problem, they found that a new early mobility protocol had been implemented at the same time the CLABSI rates increased. The team hypothesized that increased patient mobility was contributing to the rise in infections, and they developed a plan to simply gather information. Four nurses volunteered to observe patients during mobilization for 1 week to identify the specific root cause (Do). They observed that 35% of central catheter dressings became loose during patient ambulation (Study). The Act phase led to the determination that another PDSA cycle was needed to test a new change.

During PDSA cycle 2, the Plan was to ensure that dressings were secure before and after mobility activities. The team educated all unit nurses on this new practice, and a checklist was used by charge nurses to audit dressing integrity after mobility (Do). The unit had a decrease in third-quarter 2016 CLABSI rates, but they did not outperform the benchmark (Study). Despite increased attention to dressing integrity, dressings continued to become loose during mobility activities, leading to frequent dressing changes. The team learned from this PDSA cycle that additional interventions were needed, and they decided to conduct another cycle to test a new dressing (Act).

PDSA cycle 3 began with the team asking their unit representative on the hospital's product evaluation committee to present their findings and request approval to trial a larger central catheter dressing (Plan). Samples of 2 larger dressings were obtained, a trial was conducted for 4 weeks, and the team selected a new dressing (Do). Use of the larger dressing resulted in the ICU's return to a zero CLABSI rate, which was sustained for the next 3 quarters, as shown in Figure 4 (Study). The team recommended that their practices be adopted by the hospital's other ICUs (Act). The ICU nurses' analysis of their outcome data, focused response to a rise in infection rates, and implementation of small tests of change using multiple PDSA cycles improved care and enhanced the safety of their patients with central catheters.



	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017
CLABSI rates	0	1.4	4.9	2.3	0	0	0
National mean	1.3	1.2	1.2	1	1	1.1	0.8

Figure 4 Central catheter-associated blood stream infection (CLABSI) rates in the intensive care unit compared with benchmarks.

Abbreviation: Q, quarter.

improvement. As the largest component of the health care workforce, clinical nurses must acquire these skills and be engaged in quality monitoring and improvement processes to ensure safe and high-quality outcomes for their patients. Nurses need to understand basic data terminology and data collection methods, differentiate between process and outcome measures, and interpret data reports in order to make comparisons to critically

evaluate their unit and hospital performance against benchmarks. Understanding outcome data will empower nurses to apply this information to structured improvement processes such as the PDSA methodology. Nurses who actively participate in unit-based systematic quality improvement efforts will make significant contributions to creating a health care system driven by the needs of patients and their families. CCN

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None reported.

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See also

To learn more about patient safety in the critical care setting, read "Recognizing the Ordinary as Extraordinary: Insight Into the 'Way We Work' to Improve Patient Safety Outcomes" by Henneman in the *American Journal of Critical Care,* July 2017;26:272-277. Available at **www.ajcconline.org**.

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