Measuring Healthcare Quality Performance Using Severity-Adjustment Indicators

A VISICU White Paper

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BACKGROUND

Hospitals in the United States are under increasing pressure to improve patient care while reducing costs. ICUs serve a critical role in today's hospital, caring for the sickest patients and supporting core activities of most major service lines. While accounting for only 10-15 percent of total beds, ICUs account for half of all patient deaths and a third of all inpatient costs.

ICU patients are at high risk for complications, outcomes vary widely, and preventable deaths are not uncommon. Adverse outcomes are primarily the result of outmoded systems of work, and systems need to evolve to improve safety and quality of care for ICU patients. Measuring ICU performance accurately is a key component of quality improvement. Outcomes for ICU patients (mortality and length of stay), however, vary greatly depending upon the nature of the problem that brought the patient to the hospital, the chronic health status of the patient, the severity of illness on admission to the ICU, and how long the patient was in the hospital prior to ICU admission. With rising patient acuity, raw mortality and LOS data often fail to reflect ICU performance. To accurately assess ICU performance – or to analyze the effect of new initiatives – we must use data adjusted for severity of illness.

While this need is widely recognized, most hospitals struggle with tracking ICU performance. Yet effective tools do exist, and some hospitals have been applying severity adjustment to ICU mortality performance for more than two decades. To illustrate how important this is, consider an ICU that experiences a decrease in mortality from one quarter to the next. Without adjustment for severity, the ICU director cannot determine whether the decrease resulted from lower-than-average patient acuity levels or from a change in the quality of patient care. Severity-adjustment ensures that any differences can be attributed to healthcare interventions and not to differences between populations.

As with mortality, severity-adjustment allows for better assessment of length of stay (LOS) performance. ICU LOS is the single most important determinant of hospital cost, and thus has direct impact on hospital financial performance. Because LOS varies greatly depending on the cause for ICU admission and severity of illness, raw LOS data cannot be used. By severity-adjusting LOS data, hospitals can more accurately evaluate ICU performance in this key area. Adjusting LOS for severity of illness also permits hospitals to compare performance data before and after implementation of new quality initiatives.

DEVELOPMENTS IN SEVERITY-ADJUSTMENT

A number of severity-adjusted methodologies have been developed for use in ICU patients. Each uses physiologic data collected from the patient's first day in the ICU as severity of illness indicators. Many hospitals are using the APACHE® algorithms (Cerner Corporation, Kansas City) as a comprehensive severity-adjustment tool for measuring ICU performance.

Originally introduced in the early 1980s as a research project, APACHE scoring uses mathematical regression equations that weight physiologic parameters to develop an Acute Physiology Score, or APS. The APS provides a good representation of severity of illness. In 1991, admission diagnosis was added to the Apache III model. Hospital and ICU LOS predictions were also generated based on the behavior of a very large ICU patient population. The current APACHE methodology processes 17 physiologic data points from the first ICU day and adds additional points for age and selected chronic health conditions. This aggregate score is then combined with ICU admission diagnosis to predict ICU and hospital mortality as well as LOS for each ICU patient.

The correlation between a patient's APS and mortality is shown in Figure 1. Mortality will typically increase with greater severity of illness or APS.

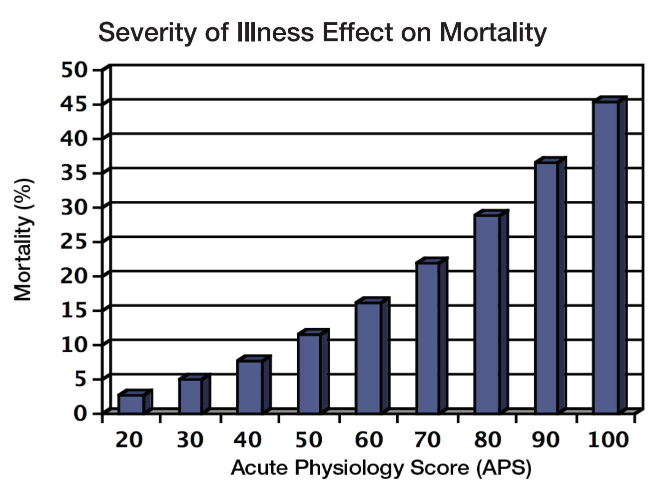

Figure 1. Correlation between mortality and a patient's acute physiology score in the APACHE® data set.

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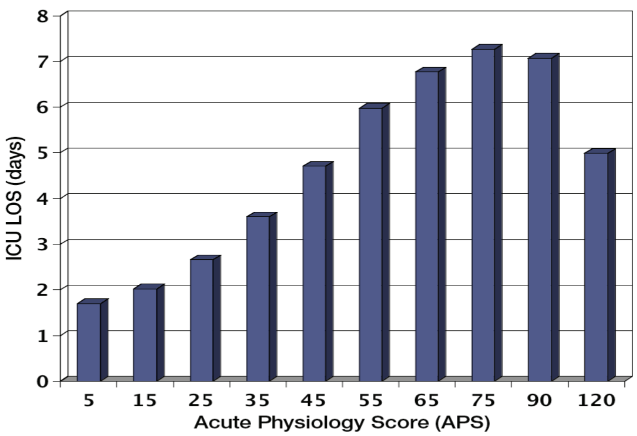

Figure 2. Correlation between ICU length of stay and a patient's acute physiology score in the APACHE® data set.

A similar impact of APS on length of stay is observed, with LOS increasing with severity of illness for all but the highest severity patients (Figure 2). This correlation begins to reverse in patients with physiology scores above 75 since these patients have an increased rate of mortality and thus experience a shorter resulting LOS.

DEVELOPMENTS IN PATIENT ACUITY

Over time, levels of acuity have risen for patients admitted to ICUs (Figure 3 reveals actual ICU patient acuity levels measured over a two-year period at a typical tertiary-care facility). The acuity continues to grow and is expected to increase LOS and mortality rates still further. By tracking patient APS and adjusting for severity of illness, ICUs can gain a more accurate understanding of their performance over time.

The increasing severity of illness over time is expected to translate into higher mortality rates and longer LOS in the ICU. Without severity-adjustment, increases in raw mortality would be ascribed incorrectly to a decline in quality of care and, similarly, improvements in ICU care that resulted in lower mortality and LOS would be missed.

USE OF AGGREGATE DATA

Severity-adjustment of ICU outcomes can be used to analyze performance of a single ICU, to compare performance of several hospitals within a health system, or to examine a much larger group of ICUs. APACHE benchmarks mortality and LOS performance against the performance of its reference population of ICU patients from hospitals across the United States. To do this, APACHE uses the Standardized Mortality Ratio (SMR), which compares the actual number of deaths in the ICUs being analyzed against those in the reference population.

Approximately 70 percent of all hospitals with *e*ICU® Programs are tracking mortality performance using APACHE III (migrating to APACHE IV in Q1-2008). In aggregate, *e*ICU Program sites have an SMR that is 30 percent better than predicted by APACHE. To put this into context, if the sum of predicted mortality across all hospitals is 10,000, an actual SMR that is 30 percent lower than APACHE predictions would translate to a relative savings of 3,000 lives.

To demonstrate the impact associated with implementation of a quality improvement measure—an *e*ICU® Program in this case—standardized mortality rates were aggregated for 170,000 ICU patients across all *e*ICU hospitals, as shown in Figure 4. Over a 2 year period, both ICU and hospital SMRs show steady improvement with actual SMR trending downward over time below the baseline of 1.0. This baseline represents actual mortality rates that are consistent with APACHE predicted values. The SMR improvement resulting from the *e*ICU Program implementation across the hospital aggregate resulted in 6,600 saved lives.

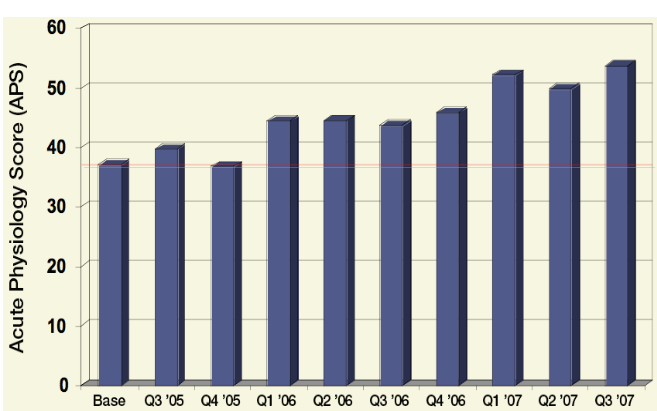

Figure 3. ICU Patient Acuity Levels for typical tertiary care facility from April 2005 to October 2007.

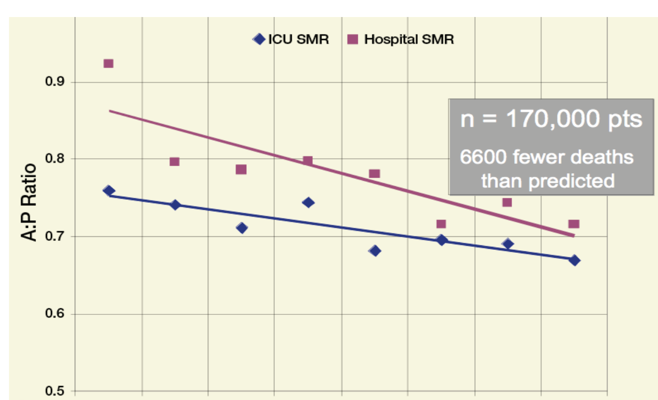

Figure 4. Standardized Mortality Ratios of actual to predicted mortality aggregated across eICU® hospitals.

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USE OF PRE/POST IMPLEMENTATION DATA

Severity-adjusted outcomes also can be very helpful in evaluating the individual effectiveness of quality improvement initiatives. For this purpose, hospitals compare severity-adjusted performance scores before and after implementation of the new initiative.

To illustrate this, take a look at one large regional rural health system that recently reported results using this method to compare length of stay performance before and after implementation of a new program for improving clinical and financial outcomes. Figure 5 shows the impact of an *e*ICU Program based on a comparison of data for the two years after *e*ICU Program implementation to that of the year prior to go-live. The hospital found that in their tertiary care center, ICU LOS went from 13 percent higher than APACHE-predicted (ratio = 1.13) to 40 percent lower than predicted (ratio = 0.6), a decrease of 46.8 percent. Severity-adjusted ICU LOS fell in their smaller regional facilities by 35 percent after program implementation. Severity-adjusted hospital LOS also decreased (by 21 percent in the tertiary hospital and 10 percent in the regional facilities). Cumulatively, the analysis showed an annual reduction of 4,146 ICU days and 572 hospital days, for a dollar savings of $6.4 million across the four hospitals after implementation of the *e*ICU Program.[1]

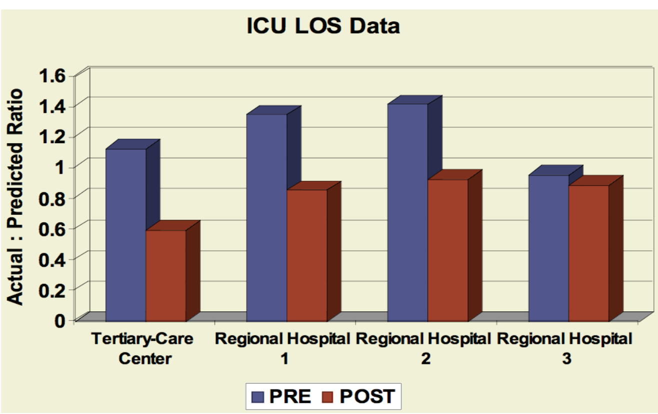

Figure 5. Data tracked over a 3 year period shows evidence of clinical improvement after implementation of an e*ICU® Program.*

CONCLUSIONS

Use of APACHE III or other ICU severity-adjustment tools makes predictions of patient mortality and LOS in the average population possible. By comparing these predictions with actual outcomes, hospitals are able to measure and track performance over time. Severity-adjustment, as outlined in the examples discussed here, can be used to validate performance improvement and ROI associated with best-practice initiatives, pay-for-performance, gain-sharing, and other quality improvement programs. Severity-adjustment also can be used to normalize data for performance benchmarking as an aide to improving and sustaining performance over time.

REFERENCE:

1. Zawada, Edward T., et al., "Financial Benefit of a Tele-Intensivist Program to a Rural Health System," *CHEST 2007 Meeting Abstracts* 132: 444.

FOR MORE INFORMATION:
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