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High-value care in the surgical intensive care unit: effect on ancillary resources

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ABSTRACT

Background: Changes in health care policies have influenced transformations in hospital systems to be cost-efficient while maintaining robust outcomes. This is particularly important in intensive care units where significant resources are used to care for critically ill patients. We sought to determine whether high-value care processes (HVCp) implemented in a surgical intensive care unit (SICU) have an impact on commonly used ancillary tests.

Materials and methods: An implementation phase using a Lean Six Sigma approach was performed in October 2014 at a 24-bed large academic center SICU with aims to decrease orders of excessive daily laboratory tests and X-rays. The HVCp implemented included use of daily checklists, staff education, and visual reminders emphasizing the importance of appropriate laboratory tests and chest X-rays. Preintervention (July 2014–October 2014) and post-intervention (November 2014–June 2015) phases were compared.

Results: Average SICU census, case mix index (4.3 *versus* 4.4, $P = 0.57$), all patient refined severity of illness (3.2 *versus* 3.2, $P = 0.91$), and SICU mortality (7.1% *versus* 5.1%, $P = 0.18$) were similar in both phases. A significant reduction of excessive laboratory tests was evident after the implementation period. Eight hundred sixty-five arterial blood gases/mo were obtained in the preintervention phase compared with 420 arterial blood gases/mo after intervention ($P = 0.004$), representing a 51.4% reduction. Similar results were obtained with complete blood counts, basic metabolic profiles, coagulation profiles, and chest X-rays (12%, 17.8%, 30.2%, and 20.3% reductions, respectively), a total estimated cost savings of $59,137/mo and prevention of excess phlebotomy of approximately 4 L of blood/mo.

Conclusions: By implementing an HVCp including a checklist, visual reminders, and provider education, we significantly reduced the use of commonly ordered ancillary tests in the SICU without affecting outcomes, resulting in an annual cost savings of $710,000.

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Introduction

In 2014, the national health care expenditures of the United States were estimated to be $3.0 trillion, averaging over $9000 spent per capita.[1] Recent changes in national health care policies have influenced transformations in hospital systems to provide cost-efficient care while maintaining high-value and robust outcomes.[2] Various initiatives for cost-containment have included identifying strategies for eliminating waste while maintaining value-added care[3], as emphasized in the Lean Six Sigma approach that was conceived by manufacturers and subsequently adopted into health care.[4]

This is of particular importance in intensive care units (ICUs) where significant resources are used in the care of critically ill patients.[5] The use of serial or daily basic laboratory tests and routine chest X-rays (CXRs) may be contributing to the financial burden of health care without demonstrating clinical benefit, as these ancillary tests can account for up to 25% of ICU expenses.[6] Furthermore, excess blood draws for laboratory tests can cause phlebotomy-induced anemia, patient discomfort, and other complications.[7–9]

We sought to determine whether a high-value care process (HVCp) implemented in a tertiary surgical intensive care unit (SICU) would have an impact on commonly used ancillary tests as well as in the amount of blood drawn per patient. We hypothesize that by using this HVCp, we will see a reduction in the quantity of ordered tests, iatrogenic anemia, and significant cost savings.

Material and methods

Intervention

An implementation phase using a Lean Six Sigma approach was initiated on October 2014 in a 24-bed trauma/SICU of a large academic center. During the observation phase, it was noted that daily laboratory tests were being ordered on most patients in the SICU. Many times, patients also had standing orders of serial laboratory tests in the form of arterial blood gases (ABGs) or complete blood counts (CBCs) obtained every 2–4 h. Routine daily CXRs were obtained on mechanically ventilated patients as well. With the aim to decrease orders of excessive daily laboratory tests and CXRs, a HVCp was implemented and included the use of:

- A daily checklist.
- Physician, nursing, and resident/fellow education.
- Display of visual reminders emphasizing the importance of appropriate use of laboratory tests and CXRs. Visual reminders to “Stop and Think,” “Remember to ask what labs and/or X-rays are ordered for today and tomorrow?” and “Are they really needed?” were displayed throughout the SICU.
- Standardization on the use of *continuous capnography* on ventilated patients.

The checklist used on daily morning rounds by the intensivists included questions such as “Are labs/X-rays ordered for today or tomorrow? Are they needed?” Although the ICU residents and/or fellows were the primary prescribers of laboratory tests and CXRs, education involved the nursing staff and other consulting physicians. In addition, the use of continuous capnography was further standardized as part of the implementation process on ventilated patients to follow CO_2 trends when respiratory rates or tidal volumes were manipulated. It was encouraged that the appropriateness of orders be determined by the clinical judgment of the prescriber after considering patients’ clinical condition and physical examination. Obtaining serial laboratory tests (i.e., CBC every 4 h) were discouraged and instead were ordered on an as-needed basis. Routine daily CXRs on mechanically ventilated patients were also discouraged but were obtained when clinically indicated (i.e., declining respiratory status, pulmonary edema).

Data collection

Data were collected and maintained by the institution’s Resource Outcomes Management group in an ICU Resource Management Database. These data included monthly SICU census characteristics such as number of patients, patient days, bed days, case mix index, all patient refined severity of illness, ICU adjusted length of stay, and mortality. The monthly quantity of laboratory tests and CXRs ordered, quantity of tests per patient, and the estimated costs of tests were calculated. Direct costs per test/imaging were calculated as the following: $11.06 per CBC, $13.30 per basic metabolic panel (BMP), $25.00 per coagulation profile, $100.00 per ABG, and $43.00 per CXR. Volume required for phlebotomy per laboratory test was estimated by nursing staff as the following: 3 cc per CBC, 3 cc per BMP, 5 cc per coagulation profile (Coags), 1 cc per ABG, and 10 cc per occurrence of blood draw for wasted blood.

Data analysis

Monthly SICU census characteristics, monthly laboratory tests and CXRs, and estimated costs were compared between preintervention months (July 2014–October 2014) and post-intervention months (November 2014–June 2015). The 1-y study period was chosen based on the institution’s fiscal and academic year (July 2014–June 2015). This also ensured that there were no major changes in the ICU personnel (residents and fellows) used during the study. The same group of residents, fellows, and attending intensivists provided care for the SICU patients throughout July 2014 to June 2015. Statistical analysis was performed via Statistical Package for the Social Sciences (version 22, SPSS Inc, Chicago, IL). Data were reported as means and standard deviation or raw percentages. The Student’s *t*-test or Mann–Whitney *U* test was used to compare means for parametric or nonparametric data, respectively. Differences were considered statistically significant when *P* values were ≤ 0.05. This study was approved by the Institutional Review Board of Cedars-Sinai Medical Center.