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Variance in Severity-Adjusted Resource Consumption in Intensive Care Units is impacted by Patients Undergoing Heart Surgery and Neurosurgery

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Description

Patients who are critically ill or who have undergone major, complex surgery require intensive care to avoid death and disability. The evolution of resources required for ICU care and the evaluation of ICU performance in saving lives are of significant interest due to the high mortality rate of ICU patients and the high costs of ICU care. We recently demonstrated a significant decrease in illness-adjusted hospital mortality (standardized mortality ratio; SMR) in ICU patients over time without an increase in severity-adjusted resource use ratio (SRUR) or a significant difference in mortality or resource use between ICUs [1].

In tertiary care hospitals, cardiac surgery and intracranial neurosurgery patients typically receive postoperative care in the intensive care unit (ICU). In our study on variation in resource utilization and outcome, we found that intracranial neurosurgery and head trauma accounted for 9% of approximately 70,000 admissions in 17 intensive care units in Finland, Estonia, and Switzerland between 2015 and 2017. These two distinct groups of ICU patients are likely to have different outcomes as well as different patterns of resource utilization from the general ICU population. The majority of these patients are admitted following elective surgery. The majority of cardiac surgery patients, who require brief but intensive care, have low mortality rates. Sedation may make it difficult to determine the severity of a head trauma patient's illness, but many neurosurgical patients are admitted for observation and minimal treatment. In intensive care units, the effects of cardiac surgery, neurosurgery, or both are unknown [2].

SRURs and SMR were previously found to be influenced by ICU category and illness severity. Additionally, a higher SMR was associated with the small non-university ICU category, and university ICUs had lower SMR ranges and higher SRUR ranges than non-university ICUs. We hypothesized that patients undergoing neurosurgery and cardiac surgery who were treated in university intensive care units might be a contributing factor. If these major patient groups are understood, it will be simpler to compare how resources are utilized in various intensive care units (ICUs) and may assist in optimizing resource allocation.

Our method of analysis was comparable to that previously described. The study population was described using frequencies (n), percentages (%), means, standard deviations (SD), medians, and percentiles. The chi-squared test and an analysis of variance were used to look for differences between ICU categories. We used box plots to describe SRUR by calendar year. Gamma distributed hierarchical regression models with clusters on hospitals were used to investigate ICU-related factors connected to costSRURLOS and costSRURTISS. The following ICU-related variables were included: We used bivariable and multivariable models in which each of the aforementioned variables was adjusted for the calendar year, based on a custom model, ICU-category (university, small/large non-university), median SAPS-II, and SMR. Relative risk estimates (RR) with confidence intervals of 95 percent were presented alongside standardized continuous variables that were centered and expressed per one standard deviation increase. For all analyses, R 4.1.2 (R Team Core) was used. R: Vienna, Austria, a statistical computing environment and language. The R Foundation for Statistical Computing is the acronym R.

SRURLOS and SRURTISS did not differ across all cohorts when cardiac surgery or neurosurgery were excluded. This was true regardless of the cost separation method. On the other hand, specific ICUs underwent significant modifications. SRURs decreased in all ICUs, non-university ICUs, and one university ICU that did not have in-house cardiac or neurosurgery services. All ICUs were ranked in the same order, beginning with SRURLOS and SRURTISS, when the overall population's SRURs increased. However, the responses of the intensive care units (ICUs) with either a neurosurgery or cardiac service, or both, were significantly more variable, ranging from minor decreases to significant enhancements in each ICU. After cardiac surgery or cardiac and neurosurgery were excluded, the maximum change in rank from the initial was 2 in 2015–2016 and 3 in 2017 (rank increase indicating higher SRUR). ICUs in ranks 1–5 (high performers), 6–11 (middle performers), and 12–17 (low performers) remained the same regardless of cost separation based on TISS or LOS. The one and only exception to this was in 2017, when three ICUs ranked 3–6 on the SRURTISS scale changed their status from "high performers" to "middle performers" [3,4].

These observations suggest that when evaluating resource utilization, intensive care for neurosurgery and cardiac surgery has a significant impact on the cost structure of multidisciplinary intensive care units. Using a novel approach to SRUR analysis, we looked at how the SRURs were affected by different patient subpopulations. The same method can be used to evaluate the impact of actual or potential differences in the case mix on resource utilization as long as the total resource use (in the form of costs or other indicators) and the patient level resource use (such as LOS or TISS) are known. It is necessary to address the main features of this new approach in order to facilitate critical interpretation of our findings [5].

Conclusion

The SRUR of an individual ICU is the ratio of observed to expected resources used to produce survivors. When a subpopulation is excluded, the total costs of each ICU are reduced by the subpopulation's share. This cost separation can be achieved by using either the TISS or LOS subpopulation proportion. As a result, the total costs of the remaining population, including TISS and LOS, will decrease, typically in different proportions. The remaining costs, TISS, and LOS, are used to recalculate the observed and anticipated costs for the remaining population. The separation of a subpopulation will therefore have an impact on the mean costs of TISS and LOS as well as the observed and anticipated costs for the severity strata. This is shown for one ICU as an illustration for the year 2017. The relative changes in each of these variables will also have an effect on the total impact on SRURs and ICUs in the subpopulation without admissions.

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Conflict of Interest

None.

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