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Implementation of 24/7 radiology services in an academic medical centre level 1 trauma centre: Impact on trauma resuscitation unit length of stay and economic benefit analysis

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ABSTRACT

Study objective: To evaluate the impact of 24/7 radiology services on trauma resuscitation unit (TRU) length of stay (LOS) for patients with minor trauma and to analyse the economic benefits of such an impact from trauma centre perspective.
Methods: The study was HIPAA compliant and had IRB approval. Data were extracted from hospital and radiology information systems. Inclusion criteria specified patients: (a) with minor trauma (i.e., Injury Severity Score < 16 and Maximum Abbreviated Injury Scale < 4); (b) cross-sectional imaging performed between 12 and 7 AM; and (c) admission during 2006 (before 24/7 coverage; comparison group 1) or 2007 (24/7 coverage). Mean, median, standard deviation, and variance for the groups were determined. The theoretical economic benefit achieved with 24/7 radiology coverage was estimated from decreases in TRU LOS for each patient.
Results: Totals of 1087 and 1323 patients for 2006 and 2007, respectively, met our selection criteria. Mean TRU LOS decreased from 11.19 to 8.25 h (26%; $P < 0.001$). The median decreased from 10.8 to 7.2 h (33%; $P < 0.001$). The (Q3–Q1) indicator, used as a proxy for variance and spread, decreased from 7.36 to 5.76 h. Theoretical economic benefits from 24/7 radiology coverage were achieved by the product of TRU bed fixed costs with mean decrease in TRU LOS for the calendar year 2007, which equaled $340,069.
Conclusion: The economic benefits of 24/7 radiology services are related to LOS, which can be shortened by limiting patient discharge delays resulting from report unavailability. This can be a cost-saving replacement for conventional radiology practice when the trauma centre makes appropriate use of vacant TRU beds to realise its opportunity cost.

Introduction

Background

Hospital-based radiologists are facing increasing pressure to provide 24/7 coverage. This is a direct consequence of the extraordinary success achieved in applying advanced imaging methods to the care of patients seen in emergency and trauma departments,[1] and it is difficult to argue against 24/7 coverage from a quality-of-care point of view. Multidetector-row computed tomography (MDCT) is heavily used in emergency and trauma centres, helping in comprehensive whole-body evaluation and diagnosis of internal organ injuries, with transformational effects on treatment. Thus, therapeutic procedures and diagnostic evaluations must be concomitant events to enable trauma care initiation as quickly as possible and enhance workflow in the evaluation of polytrauma patients.

Importance

To improve the standard of patient care and to meet the expectations of the hospital to provide speciality-level expertise even during the overnight shift, the radiology department at R. Adams Cowley Shock Trauma Center (STC), a freestanding trauma hospital that is a part of the University of Maryland Medical Center (Baltimore) has adopted 24/7 services in January 2007. Since implementation of overnight coverage, all cross sectional imaging studies were promptly reviewed and final electronic reports

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provided by the attending emergency radiologist with presumed decrease in mean radiology report turn around time (TAT). Trauma patients with minor injuries, who previously would have been observed, may have been safely discharged home according to relevant clinical protocols after initiation of 24/7 services. This practice could have decreased the trauma resuscitation unit (TRU) length of stay (LOS) by decreasing discharge delays due to report unavailability in patients with minor trauma, who are usually discharged without hospital admission. Such a decrease should result in cost-of-care savings for these patients and create an opportunity for the hospital to care for new revenue-generating patients. Prompt provision of final imaging reports should also decrease indirect costs, not only in patients with minor injuries but also in all patients, with decreases in unnecessary operative interventions and per-patient resource utilisation for care and an increase in the efficiency of the trauma team and quality of care. Similar services were provided to the University Emergency Department (ED), which is a separate entity from STC and to an affiliated community hospital ED by the same in-house radiologist, but we did not attempt to calculate the effect on their LOS due to heterogeneity of patient population in emergency departments.

Goals of this investigation

Our working hypothesis was that 24/7 coverage is a cost-saving replacement for conventional (non-24/7) radiology coverage when considered from the perspective of trauma centre and decreases TRU LOS in patients with minor trauma. The purpose of this current assessment was to test this hypothesis. Measuring benefits from decreased indirect costs will not be undertaken, because it is difficult to assign costs to the entities involved, with many confounding factors affecting such costs in a retrospective study. In Medical economics, the economic impact from a particular policy is usually calculated with respect to many different perspectives, which influences what is counted as cost or benefit.

Materials and methods

Study design

This retrospective study was conducted at STC, which houses more than 100 inpatient beds dedicated to emergency surgery, resuscitation, intensive care, and acute surgical care. The facility has a dedicated resuscitation unit with 12 beds.

The study was Health Insurance Portability and Accountability Act compliant and was approved by our institutional review board, from which a waiver of informed consent was obtained.

Setting

The radiology section at STC works in three daily shifts. Before January 2007, in-house attending trauma radiologists provided services for the two shifts from 7 AM to 4 PM and 4 PM to 12 midnight. Radiology resident physicians provided services for the last shift, from 12 midnight to 7 AM. Residents provided preliminary reports for all admission cross-sectional imaging studies performed during that shift. Patients were treated appropriately and admitted into the hospital or discharged home based on preliminary diagnostic reports and clinical conditions. However, some patients who were suspected to have major trauma in spite of no or minor injuries reported on preliminary interpretations were observed and discharged only after provision of an official radiology report. Final reports were reviewed and provided during the next daytime shift (after 7 AM) for all the studies performed during the overnight shift. Thus, there was a long mean report turn around time (TAT). TAT is defined as the time that elapses between the imaging study completion to the availability of the final report. The long TAT may have resulted in longer lengths of stay (LOS) in the trauma resuscitation unit. Such delays in discharge may create bottlenecks in moving patients through the hospital system, limiting the ability of the STC, which often runs at capacity, to care for patients. Our retrospective study design did not allow us to evaluate the discrepancy rates between radiology residents and the final reports of the attending in interpretations of on-call imaging studies, however there are studies which have specifically looked into this issue.[2,3] The reported discrepancies ranged from 3.3% to as high as 13.6% in these studies. Though the rate of missed injuries may be low, the practice of trauma surgeons at our institution was to withhold discharge until a final interpretation was rendered, as some of these injuries can cause a patient to decompensate rapidly increasing the morbidity and mortality.

Selection of participants

Selection criteria included: (a) patients with minor trauma (i.e., Injury Severity Score [ISS] < 16 and Maximum Abbreviated Injury Scale [MAIS] < 4); (b) patients who were studied with cross-sectional imaging between 12 midnight and 7 AM; and (c) patients admitted during 2006 (pre-24/7 coverage; comparison group 1) or 2007 (after 24/7 coverage; study population).

Methods of measurement

A list of patients who underwent cross-sectional imaging (including MDCT of the body, magnetic resonance imaging of brain or spine, or any combination of these) between 12 midnights and 7 AM during calendar years 2006 and 2007 was extracted from the radiology information system (RIS). A second list of patients with ISS (Injury Severity Scores) < 16 and MAIS (Maximum Abbreviated Injury Scale) scores < 4 admitted to the STC during the 2 year study period was obtained from the hospital information system (HIS). These injury scores typically are used to define "minor injury", and similar criteria were used in previous research studies.[4,5] Additional information collected from the HIS included age, ISS, MAIS, TRU LOS, and hospital LOS. Both lists were cross-matched to generate the database, which constituted the study population (list from 2007) and comparison group 1 (2006). Patients who expired during their hospital stay were excluded from analysis. Because other factors may influence LOS during these 2 years, we used two additional comparison groups: a comparison group including all patients admitted between 7 AM and 12 midnight to the hospital with minor trauma during 2006 (comparison group 2) and a similar group for 2007 (comparison group 3) to measure the variation in LOS between these two calendar years.

Definitions of cost

Hospital costs are categorised as fixed or variable.[6] Fixed costs are the hospital overhead costs, including capital, employee salaries, building maintenance, and utilities. Fixed costs are not saved when a particular service is not provided or total output of services is reduced by the hospital. These costs are usually assigned by the hospital to individual patients. Variable costs include patient care supplies, laboratory reagents, medications, and other items. These costs change with output and can be saved by the hospital when a service is not provided.[7]

Primary data analysis

Univariate analysis was used to check the normality of the data and to calculate the mean, median standard deviation and variance