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Protecting trauma patients from duplicated computed tomography scans: the relevance of integrated care systems



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Abstract

BACKGROUND: Duplicated computed tomography (CT) scans in transferred trauma patients have been described in university-based trauma systems. This study compares CT utilization between a university-based nonintegrated system (NIS) and a vertically integrated regional healthcare system (IS).

METHODS: Trauma patients transferred to 2 Level I trauma centers were prospectively identified at the time of transfer. Imaging obtained before and subsequent to transfer and the reason for CT imaging at the Level I center were captured by real-time reporting.

RESULTS: Four hundred eighty-one patients were reviewed (207 at NIS and 274 at IS). Ninety-nine patients (48%) at NIS and 45 (16%) at IS underwent duplicate scanning of at least one body region. Inadequate scan quality and incomplete imaging were the most common reason category reported at NIS (54%) and IS (78%).

CONCLUSIONS: Fewer patients received duplicated scans within the vertically IS as compared with a traditional university-based referral system. Our findings suggest that the adoption of features of a vertically IS, particularly improved transferability of radiographic studies, may improve patient care in other system types.

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Trauma systems in the United States have evolved as a series of regional networks that direct patients to designated trauma centers. Patients injured in rural areas are typically stabilized at critical access hospitals and those with significant traumatic injury are transferred to state or American College of Surgeons (ACS)-designated trauma centers. Triage of injured patients in rural medical centers is often variable depending on the facility and provider resources that are locally available. Several factors contribute to the performance of initial computed tomography (CT) scanning at the referring center, including fear of litigation and a desire to provide the receiving trauma center with a

definitive diagnosis.¹ Nevertheless, many patients have imaging performed at the referring hospital, which is then duplicated at the receiving trauma center.^{2,3} Patients are also frequently subjected to additional or completion CT studies at the trauma center for a comprehensive trauma evaluation. This may result in inefficiency, redundancy, patient discomfort, increased radiation exposure, and increased cost.

The majority of ACS-designated Level 1 trauma centers in the United States are at academic medical centers (AMCs).⁴ Integrated healthcare systems exist in which a single organization owns or administers multiple hospitals within a geographic region, including a Level 1 or 2 trauma center as their referral center. Vertically integrated systems (ISs) use the same electronic medical record and electronic radiology system throughout their facilities. This structure allows for access to patient data by the receiving trauma center when patients are transferred within the system.

Prior studies have evaluated duplicated CT scanning in AMC-based tertiary referral systems but have not included data from a vertically integrated trauma system. The goal of this study is to compare the difference in CT utilization frequency and reasons for duplicated or additionally obtained CT scans at 2 regional Level 1 trauma centers, 1 AMC-based nonintegrated center, and the other within a vertically integrated regional healthcare system. Our hypothesis was that an IS would have a lower rate of duplicated CT scans when compared with a nonintegrated system (NIS).

Methods

This is a prospective cohort study of patients referred to one of the 2 regional Level 1 adult trauma centers in Salt Lake City, UT, over a 6-month period. The University of Utah Medical Center is an urban ACS-verified Level 1 trauma center within an AMC with an annual average trauma admission volume of 1,100 patients. Intermountain Medical Center (IMC) is a university-affiliated teaching hospital with an ACS-verified Level 1 trauma center. It serves as the flagship hospital within the vertically integrated Intermountain Healthcare (IHC) system. The IHC network consists of 22 hospitals in 2 states with fully integrated electronic medical record and radiology picture archiving and communication system (PACS) systems. The average annual trauma admission volume at IMC is 1,800 patients per year. Each hospital has both fixed-wing and helicopter-based air-medical transport systems and standard ground emergency medical system availability. Each serves approximately the same 4-state catchment area. The University of Utah Medical Center is representative of a nonintegrated healthcare system for the purposes of this study and will be referred to as NIS, while IMC is representative of an integrated healthcare system and will be referred to as IS.

Transferred trauma patients who received a CT scan at a referring hospital were prospectively identified at their time

of arrival at each of the Level 1 trauma centers. If a patient did not have any CT scans at either the referring or the receiving center, then they were excluded. The CT images were recorded by the body region(s) obtained and whether the images were transferred on disc or electronically. All CT images on CD discs were scanned into the trauma centers' electronic radiology system, although this process was not always immediately available. The discs were collected for later review by the principle investigator at NIS and by a designated individual at IS. If the disc did not contain the CT studies completed before transfer, then the medical record, including referring hospital documentation, was examined for evidence of studies performed before the transfer.

CT studies ordered at the receiving facility were included if they were ordered in the trauma bay by the trauma team leader or subspecialty physicians caring for the patient. CT scans were recorded in the database categorized by body region. The separate CT body regions included the following: head, cervical spine, thoracic spine, lumbar spine, chest, abdomen, pelvis, and other. Data collection forms were secured in the emergency department, and then were collected by a study designee. Duplicated scans were defined as any body region that had already been CT scanned at the referring hospital. Additional scans were defined as any body region that was not scanned before the trauma patient's transfer to the tertiary trauma facility. A trauma team member completed a data collection sheet in real time that indicated the reason for duplicate or additionally obtained CT scans. The documented reasons were categorized into one of the 5 following categories: technical difficulty; change in clinical condition; inadequate, incomplete, or poor quality images; physician preference; or other. Technical difficulty included images not included on disc, inability to open images on disc, or no disc/images transferred with the patient. If a reason for CT imaging was not identified, the principle investigator contacted the trauma team to obtain the reason for imaging obtained at the receiving trauma center. If a reason was unable to be provided, it was documented as unknown. Data entry was completed within 72 hours of transfer. The study PI was responsible for reviewing all entered data.

Statistical analysis was performed using STATA version 11.2 (College Station, TX). Patient demographics were compared using chi-square test. The Wilcoxon rank-sum test was used for comparison of reason for repeat CT scans. Fisher's exact test and chi-square tests were used for further comparative analysis as appropriate. Institutional review board approval was obtained at both institutions.

Results

Four hundred ninety-nine patients were evaluated from the 2 centers. The NIS cohort included 217 consecutive trauma transfers between December 1, 2009 and May 28, 2010. The IS evaluated 282 consecutive trauma transfers

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