

# Pediatric Trauma Transfer Imaging Inefficiencies - Opportunities for Improvement with Cloud Technology

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## Abstract

**Background:** This study examines the inefficiencies of radiologic imaging transfers from one hospital to the other during pediatric trauma transfers in an era of cloud based information sharing.

**Methods:** Retrospective review of all patients transferred to a pediatric trauma center from 2008-2014 was performed. Imaging was reviewed for whether imaging accompanied the patient, whether imaging was able to be uploaded onto computer for records, whether imaging had to be repeated, and whether imaging obtained at OSH was done per universal pediatric trauma guidelines.

**Results:** Of the 3567 patients retrospectively reviewed, 521 met our inclusion criteria. Imaging was sent with the patient 87.7% of the time. Imaging was unable to be uploaded 27.8% of the time. CT imaging had to be repeated 1.2% of the time. CT scan was not done per universal pediatric trauma guidelines 1.2% of the time.

**Conclusion:** Our study demonstrated that current imaging transfer is inefficient, leads to excess ionizing radiation, and increased healthcare costs. Universal implementation of cloud based radiology has the potential to eliminate excess ionizing radiation to children, improve patient care, and save cost to healthcare system.

**Keywords:** Radiologic imaging; Pediatric trauma; Ionizing radiation; Malignancy; Healthcare; Streamline patient

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## Introduction

Pediatric trauma patients are often transferred from rural outside hospitals (OSH) to accredited trauma centers for definitive treatment. This transfer is often unnecessarily delayed for additional diagnostic evaluation, including radiographic studies [1-6]. Imaging prior to transfer delays the care of the patient by increasing the amount of time it takes to upload imaging. Imaging is typically sent with the patient on a CD-ROM, an outdated form of information transfer invented in the 1980s. Oftentimes, imaging is unable to be uploaded or the image is lost en-route resulting in repeat imaging of child. This exposes children to excess ionizing radiation.

Ionizing radiation in children has been proven to be a risk factor

for malignancy in the future. Evidence from studies conducted following the Chernobyl accident, nuclear tests, environmental radiation pollution and indoor accidental contamination reveals consistently increased chromosome aberration and micronuclei frequency in exposed than in referent children [7-11].

In the age of cloud-based computing, which enables the use of virtually unlimited online server storage space, imaging could be viewed instantly and amount of radiation can be reduced dramatically [12-14]. In addition, radiation exposure can be tracked for every individual in a centralized imaging system. However, making imaging available for use in cloud has not been prevalent throughout the United States and outdated form of image transfer continues to persist.

Our study aims to evaluate how often imaging for pediatric

trauma patients transferred to our designated trauma center was performed at the outside hospital, how often imaging accompanied the patient, how often imaging was unable to be uploaded to the system, how often imaging had to be repeated, and how long the trauma transfer took place.

## Methods

We conducted a retrospective chart analysis of all patients transferred from outside medical facilities to our Level I Pediatric Trauma Care center from 2008 to 2014. A total of 1774 charts met inclusion criteria. Inclusion criteria included age between 0-21, all race, all gender.

We evaluated the charts for demographic information of the transferred patient; whether imaging was performed at the outside facility; whether imaging was sent with the patient; whether imaging could be uploaded onto computer system at accepting facility; whether repeat imaging had to be performed, whether computed tomography (CT) scans were performed unnecessarily, whether laboratory results taken at outside facility were sent with the patient or had to be repeated. Statistical Package for the Social Sciences (SPSS) Version 21 (SPSS, Chicago, IL) was used for statistical analysis.

## Results

The mean age of trauma transfer was 6.8 years. Males comprised 64% of the transfers. Falls resulting in fractures were the most common cause of trauma (66%). The average time it took from time of arrival to the outside facility to departure was 155.35 minutes. Imaging was performed at the outside hospital 90% of the time. Imaging was sent with the patient 79% of the time. Imaging was unable to be uploaded to electronic records at accepting facility 29% of the time. Repeat CT had to be performed 4% of the time; repeat x-ray had to be performed 28% of the time. Labs had to be repeated 4% of the time.

## Discussion

Cloud based radiology systems have become widely available and have been implemented in several small private hospitals throughout the United States and several studies show that cloud technology can be extremely cost effective if implemented nationwide [15-17]. The majority of hospitals do not use cloud based radiology and rely on archaic methods of imaging transfer such as CD-ROMs. The reason for this is unclear but has been speculated to be due to issues with Health Insurance Portability and Accountability Act of 1996 (HIPAA) compliance and the financial investments of hospitals in the currently utilized radiology systems [15-17]. Allowing patient information to become available over the internet is a risk to loss of confidential patient information and this is one drawback for cloud based radiology systems that is preventing such a system to become widely incorporated. However, the current system of CD-ROM

transfer poses the same security threats. The loss of imaging on CD-ROM is a large patient confidentiality threat. A lost CD-ROM is a tangible object that can be taken and opened by anyone. Password protected electronic imaging is a much safer, HIPAA compliant alternative.

There is also a risk of loss of information as having medical information on one network may be hard to manage. However, such issues with data management can be solved and worked through once cloud based radiology system becomes available and should not deter the government from implementation of such a system as the benefits outweigh the risks.

In addition, the current method of imaging transfer results in inefficiencies that are not only costly to the healthcare system, but expose children to unnecessary ionizing radiation predisposing them to future malignancies, delay definitive care of the patients, expose patients to loss of confidentiality, and result in frustrations of healthcare teams taking care of patients [15-17]. In addition, there is no system that is available that can track the imaging of one patient for the entirety of the patient's life in one place. Such practices are outdated and unnecessary in an age where the internet and cloud based services are widely available.

The movement towards electronic medical records has been made with the Patient Protection and Affordable Health Act in 2010 already. However, literature review shows that the road to the switch from paper charting to electronic medical records was filled with doubt and similar worries about personal health information security [18-21]. Paper based charting was found to be inefficient and outdated proven through analyzing 5 decades data [18-22]. Since March 2014, all hospitals have implemented EMR and preliminary studies demonstrate improvement in the care of patients [23].

The Compact Disc (CD) was an evolution of Laser Disc technology. Prototypes were developed by Philips and Sony independently from the mid-to-late 1970s. The two companies then collaborated to produce a standard format and related player technology which was made commercially available in 1982. The advent of the internet developed in the late 1980s has transformed technology today making cloud based systems an available option. The healthcare systems, however, have not caught on to the available technology just yet and rely on the CD transfer of imaging thirty years after the invention of internet.

Our study demonstrated pediatric trauma inefficiencies in transfer of patients using archaic technological systems. There is no reason to adhere to old methods of image transfer when new methods exist. Healthcare administration as well as the federal government should take into account these inefficiencies and new available technology and work to create a universal cloud based system to further streamline patient healthcare, retain healthcare information efficiently, and improve the outcomes of all patients.

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