



## Original Article

## Incidence and pathology of repeat CT abdomen and pelvis in an adult emergency department population



Barry Hahn, MD <sup>a,\*</sup>, Anna Akita, MD <sup>a</sup>, Lane Rankin, MD <sup>a</sup>, Maria Scibilia, RN <sup>a</sup>, Gabriella Trovato, RN <sup>a</sup>, Marion Foley, RN <sup>b</sup>, David Hirschorn, MD <sup>b</sup>

<sup>a</sup> From the Department of Emergency Medicine, Staten Island University Hospital, Staten Island, NY

<sup>b</sup> From the Department of Radiology, Staten Island University Hospital, Staten Island, NY

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## ABSTRACT

**Introduction:** Our objective was to identify the incidence of adult patients who undergo more than one computed tomography (CT) abdomen and pelvis within 1 year and detect the incidence of significant pathology on these repeat scans.

**Methods:** All adults with an initial CT within 12 months and then during an emergency department visit were retrospectively identified.

**Results:** A percentage of 21.1 of the repeat CT scans were positive. Approximately 20% of positive repeat CT scans occurred within the first month and nearly 70% within 6 months of the initial CT scan.

**Conclusions:** Many patients undergo multiple CT scans within a 1 year time frame with significant pathology identified.

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## 1. Introduction

Abdominal pain is a common complaint among emergency department (ED) patients and accounts for over 11% of all visits nationally [1]. The differential diagnosis of abdominal pain is broad, and the diagnosis can be challenging. Traditionally, radiographs were utilized; however, computed tomography (CT) has clearly been shown to be superior to plain radiographs for the diagnosis of a multitude of conditions [2]. In addition, CT continues to become more readily available, faster to perform, and more sensitive [3]. Consequently, CT scanning is increasingly prevalent in EDs across the country. The percentage of visits associated with a CT scan also increased substantially. Some estimate that as many as one third of all CT scans performed in the United States are unnecessary [4]. Moreover, CT has risks. It is a moderate-to-high radiation diagnostic technique that exposes many patients each year to unnecessary radiation. In addition, the indirect effect of CT use can be increased length of visit in the ED due to the long waiting period for imaging results. This can contribute to crowding

and can increase the risk of medical error [5]. The Food and Drug Administration (FDA), along with other medical organizations, has undertaken initiatives to identify and reduce unnecessary radiation exposure, with a focus on the types of imaging procedures that are associated with the highest radiation doses, including CT [6]. The FDA's main goals are to promote safe use of medical imaging devices, support informed clinical decision-making, and increase patient awareness [7]. The American College of Radiology and the Radiological Society of North America formed the Joint Task Force on Adult Radiation Protection to address concerns about the surge of public exposure to ionizing radiation from medical imaging. The Joint Task Force collaborated with the American Association of Physicists in Medicine and the American Society of Radiologic Technologists to create the Image Wisely campaign with the objective of lowering the amount of radiation used in medically necessary imaging studies and eliminating unnecessary procedures [6]. The Image Gently Campaign is an initiative of the Alliance for Radiation Safety in Pediatric Imaging. The campaign's goal is to change practice by increasing awareness of the opportunities to promote radiation protection in the imaging of children [8]. Finally, The American College of Radiology (ACR) Appropriateness Criteria are evidence-based guidelines to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition. Employing these guidelines can help providers enhance quality of care and contribute to the most efficacious use of radiology [9]. A complete list of radiation reduction strategies is beyond the scope of this paper. Some techniques include (a) patient protocols, such as pediatric weight and age-based protocols; (b) precise radiographic field shaping with

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\* Corresponding author. Department of Emergency, Medicine, Staten Island University Hospital, 475 Seaview Avenue, Staten Island, NY, 10305. Tel.: +1-718-226-9158; fax: +1-718-226-6964.

E-mail address: [bhahn@nshs.edu](mailto:bhahn@nshs.edu) (B. Hahn).

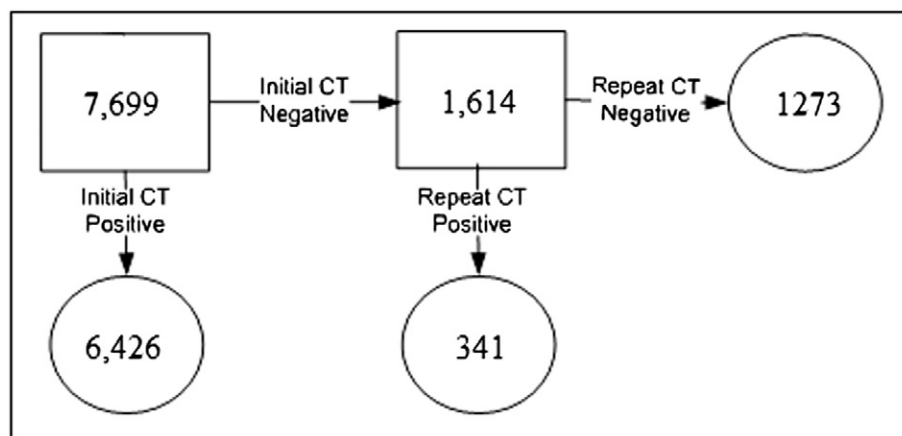


Fig. 1. Incidence of 1-year repeat CT of the abdomen and pelvis in a pediatric ED 1/2004–6/2011.

newer devices that utilize dual-spot tube to provide precise switching focal spots and deliver high-resolution images; (c) more dose-efficient designs; and (d) adaptive reconstruction methods and filters to reduce noise and retain image features. Repeat CT abdomen and pelvis (CTAP) among adult patients that return to the ED within 1 year may be an example of unnecessary radiation exposure. Anecdotal evidence, at our hospital, indicates that both the initial and repeat scans indicate no significant pathology. The objective of this study is to identify the incidence of adult patients who undergo more than one CTAP within 1 year and to detect the incidence of significant pathology on these repeat scans. (See Fig. 1.)

## 2. Materials and methods

A retrospective chart review was conducted at XXXX, a 700-bed, tertiary-care teaching facility in XXXX, XX. The adult ED has a census of 71,000 patient visits per year. Abdominal pain is the presenting complaint in approximately 10% of cases. On average, 8500 CTAPs were performed in the ED every year since 2004. The study was approved by the institutional review board at XXXX.

An electronic database was queried for the time period between January 2004 and June 2011 to identify potential subjects. This time period was analyzed because the electronic database was initiated in 2004. Study eligibility included age greater than 18 years, an initial CTAP as an ED patient, inpatient or outpatient, and a second CTAP within 12 months and during an ED visit. No distinction was made if CT technique included intravenous and/or oral contrast. Participants were excluded if CT results were unavailable for review or the indication for CT was trauma. Repeat CTAP during the same patient encounter (either same ED visit or inpatient stay) was also excluded.

Patient records were reviewed by trained research associates and subsequently by a board-certified emergency medicine physician. Information was recorded on a standardized data collection sheet, and radiographic diagnoses were obtained from computerized reports. All radiographic reports were dictated by a board-certified radiologist.

Reports were categorized by study staff as positive or negative based on predetermined CTAP ED pathology [10,11]. Negative CTAPs are those that did not require acute intervention while in the ED. Positive CTAPs are those that did require an intervention during the ED encounter. Indeterminate results were excluded. Demographic data included age at time of the second CTAP and gender of the patient.

All data were entered into a Microsoft Excel database (Microsoft, Redmond, WA, USA), and descriptive statistics were analyzed using Statistical Analysis System (SAS) 9.3 (SAS. In. 9.2 ed. Cary: SAS Institute Inc.; 2011). Univariate analysis was used to summarize the distribution of repeat CTAP scans by frequency, duration, and age group.

## 3. Results

During the 8 1/2-year observation period, 1614 ED visits had at least one prior ED admission involving an abdominal CT scan (Table 1). All cases were included in the final analysis. The majority of subjects had one repeat scan ( $n = 1361$ , 84.3%), 158 cases had two repeat scans (9.7%), and 95 had three or more repeat scans (Table 1).

Three hundred forty-one of the repeat CT scans (21.1%) were positive. Two hundred fifty-three diagnoses were identified after a first repeat CT scan, 55 were identified after two repeat CT scans, 19 were identified after three repeat CT scans, and 14 cases were identified after four or more repeat CT scans. The two most common diagnoses identified after multiple scans were urinary tract stone ( $n = 24$ , 27.3%) and colitis ( $n = 15$ , 17.0%). Nearly 60% of the positive cases ( $n = 200$ ) were attributable to the three most prevalent diagnoses: urinary tract stone in 118 cases (34.6%), colitis in 49 cases (14.4%), and bowel obstruction in 33 cases (9.7%) (Table 2). The remaining positive CT scans diagnosed: diverticulitis in 27 cases (7.9%), pancreatitis in 23 cases (6.7%), "other" diagnosed in 23 cases (6.7%), abscess diagnosed in 19 cases (5.6%), appendicitis diagnosed in 14 cases (4.1%), gynecological process in 10 cases (3.4%), and bowel perforation in 5 cases (1.5%). Approximately 20% (73 cases) of the positive repeat CT scans occurred within the first month of the initial CT scan, and approximately 70%

Table 1  
Results of repeat CT scans among ED patients, admitted for abdominal pain, at Staten Island University Hospital (SIUH) between 2004 and 2011

	Repeat CT scan						Total	
	First scan		Second scans		≥3 scans			
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Number of CT scans								
All CT scans	1361	84.30	158	9.70	95	6.00	1614	100.00
Positive CT scans	253	18.58	55	34.81	33	34.74	341	21.13
Interval between CT scans	Mean	S.D.	Mean	S.D.	Mean	S.D.		
Days since first negative scan	133.98	110.94	122.29	104.06	91.27	81.00		

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