Trends in Diagnostic CT Among Fee-For-Service Enrollees, 2000-2011

Ghassan B. Hamra, PhD[a], Richard C. Semelka, MD[b], Lauren M. B. Burke, MD[b], Virginia Pate, MS[c], M. Alan Brookhart, PhD[c]

Objectives: To examine trends in the use of diagnostic CT in aggregate and for 4 major body regions (abdomen/pelvis, head/neck, chest, and spine) in an 11-year US nationwide analysis.

Methods: We summarize records from a large, mostly fee-for-service insurance claims database from 2000 to 2011.

Results: Rates of diagnostic CT have increased substantially from 2000 to 2011; however, changes in rates are disparate for different age groups and body regions. As others have shown, there has been a notable increase in use of diagnostic CT from 2000 to 2011. However, from 2009 to 2011, diagnostic CT studies of the chest, abdomen/pelvis, and head/neck have leveled off or decreased, whereas CTs of the spine show a continued increase in many groups.

Conclusions: In general, the increase in the rate of CT study performance has slowed, whereas spine CT continued to escalate. Future research should consider whether the increase in use of spine CT leads to a benefit that outweighs the risk associated with the increased population-level cancer risk.

Key Words: CT, diagnostic radiology, trends, radiation exposure

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INTRODUCTION

The use of ionizing radiation as a diagnostic tool is an essential part of medicine. Of particular interest are diagnostic CT scans, the use of which has increased to an annual rate of 70 million scans [1,2]. The dramatic rise in use of CT scanners may be attributable to the fact that they are capable of providing clinicians with consistent image quality and high temporal resolution [3]. Indeed, rates of use have increased from 2.7 million scans in 1995 to 16.2 million in 2007, a 5.9-fold change [4].

Because CT scans expose patients to more radiation than traditional radiography, the sharp increase in CT usage has translated into an increase in population exposure to ionizing radiation. In 2006, the collective doses due to traditional radiography and CT scans were estimated at 96,200 and 437,523 person-Sv, respectively [1]. On an individual basis, a patient undergoing a diagnostic scan may experience a benefit that outweighs the low risk of cancer associated with the exam [5]; on a population scale, a large number of individuals receiving low radiation dose will increase the population cancer risk [6,7].

In a recent study, Smith-Bindman et al examined the use of diagnostic imaging in a large, integrated health system and found that the use of diagnostic radiology has sharply increased over the past 15 years [8]. The authors showed that the use of CT scans had seen a greater increase relative to other forms of diagnostic radiology, such as x-rays [8]. Prior studies examining trends in CT use have evaluated fee-for-service insured populations [9,10]. These studies have focused on relatively homogeneous populations, such as single, private insurers [10] or Medicare populations [1,9], and often examine only trends of overall CT use.

Rates of diagnostic CT vary by body region. In 2006, head/neck, abdomen, chest, and spine diagnostic CTs represented about 28%, 16%, 32%, and 6% of total diagnostic CT scans used, respectively [1]. To the best of our knowledge, the analysis of heterogeneous payer aggregates and examination of trends in CT scanning of

[a]Section of Environment and Radiation, International Agency for Research on Cancer, Lyon, France.

[b]Department of Radiology, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

[c]Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Correspondence and reprint requests: Ghassan Hamra, Section of Environment and Radiation, International Agency for Research on Cancer, 150 Cours Albert Thomas, 69006 Lyon, France; e-mail: hamrag@fellows.iarc.fr.

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patients of differing age or individual body regions has been rarely studied; however, this type of analysis can provide a more accurate picture of the evolving use of diagnostic CT in the United States.

The purpose of our study is to assess trends in CT use from 2000 to 2011 in data from a geographically dispersed health care database that contains information from multiple, private employer-provided insurance and Medicare Supplemental insurance. We specifically analyzed trends in CTs performed based on patient age and anatomical region (head/neck, abdomen/pelvis, chest, and spine) to provide a more detailed understanding of changes in patterns of use.

METHODS

This study utilized the MarketScan Research Databases (Thomson Healthcare, Inc), which includes insurance plan information and insurance claims for more than 100 million Americans who have private, employer-based insurance or Medicare Supplemental insurance. The majority of insurance plans represented in this database are based on a fee-for-service model.

Identification of diagnostic CT procedures was based on Current Procedural Terminology coding system as published by the AMA [11]. The coding system discriminates CT procedures used for diagnostic purposes from those used for treatment purposes. Procedures were only included in which CT was the exclusive imaging source; that is, codes for PET procedures with CT were excluded. In addition, codes were excluded for follow-up procedures (CPT code 74380) and nonspecific CT scans (CPT code 76497), the latter of which may indicate interventional purposes.

Statistical Analyses

Rates of CT use are considered in aggregate and for 4 major anatomic sites: head/neck, abdomen/pelvis, chest, and spine. Groups were also divided by gender and age, where age was calculated as the age on July 1 of the given year. Age groups were: <1, 1 to 9, 10 to 17, 18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 65, and 65+. For each year, only those enrollees who were continuously enrolled in the database for the entire year were included in the rate calculations. Codes that identify multiple scans performed on the same region are treated as a single diagnostic procedure. Similarly, to avoid over counting, multiple claims for diagnostic procedures performed on the same region on the same day were counted as single scan, as in previous work [8].

Rate of change is calculated as the percent change in the rate of use of diagnostic CT scans by age, gender, and body regions groups from 2000 to 2011. Although others have reported annual rate of change, we provide graphics of the rate of CT use by body region, age group, and gender group per year from 2000 to 2011 to provide a clear visualization of what is are largely nonlinear changes over time. Rates are reported as number of scans per 1,000 enrollees per year. All data were managed and analyzed in SAS, version 9.2 (SAS Institute Cary, NC).

RESULTS

Over the time period from 2000 to 2011, there were a total of approximately 122 million enrollees. Of this number, approximately 84 million were continuously enrolled for at least one year; these individuals contributed approximately 257 million person-years of follow-up. Approximately 48% were male and 52% were female. There were a total of 35.6 million scans performed from 2000 to 2011. The 4 major body regions of interest account for 34.5 million, or 97%, of total diagnostic CT scans. Head/neck, abdomen/pelvis, chest, and spine scans represented 32.6%, 38.6%, 21.1%, and 4.8% of the 35.6 million total scans, respectively.

The MarketScan data show a clear increase in rate of CT use from 2000 to 2011. Figure 1 shows the trends from 2000 to 2011 for all diagnostic CT procedures collectively, separated by gender and age. Elderly subjects (65+) experienced the largest absolute increase in scans used; however, as a percentage change, evaluated by gender, the change from 2000 to 2011 for males and females aged 65+ was 72% and 87%, respectively. In comparison, males and females aged 18 to 24 saw a 135% and 129% increase in use of diagnostic CT from 2000 to 2011, respectively (Table 1). Male and female children <1 year old experienced a 4% and 3% decrease in overall diagnostic CT use from 2000 to 2011, respectively.

From 2009 to 2011, most age groups experienced a modest to substantial decrease in use of diagnostic CT. Both males and females in younger age groups, <1 and 1 to 9, experienced 17% to 25% decreases in the use of diagnostic CT, whereas most other age groups experience a 3% to 9% decrease from 2009 to 2011. The exception was the elderly, 65+ and males aged 18 to 24, who experienced little to no change (0%) in use of diagnostic CT from 2009 to 2011 (Table 2).

Head and Neck

Rates of use of head and neck diagnostic CT scans showed a modest increase since 2000. Among males, the greatest relative change in use was among those aged 18 to 24, who showed an 88% increase in use from 2000 to 2011; females of the same age group showed a 50% increase in use. However, females aged 65+ experienced the greatest percent increase over the period 2000 to 2010, 65%, compared with males aged 65+, who experienced a 56% increase. From 2009 to 2011, rate of head and neck CT use decreased across all age groups; the decrease ranges from 21% and 25% for females and males aged <1, respectively, to 6% and 3% among 55- to 64-year-old females and males, respectively. The exceptions were males and females aged 65+ who experience a 3% and 2% increase in use from 2009 to 2011, respectively.