Inpatient CT and MRI Utilization: Trends in the Academic Hospital Setting

Rajan Agarwal, MD, MBA[a,b], Meredith Bergey, MSc, MPH[a], Seema Sonnad, PhD[a], Howard Butowsky, MBA[a], Mythreyi Bhargavan, PhD[c], Michael H. Bleshman, MD[a]

Purpose: The aim of this study was to determine trends in the utilization of inpatient CT and MRI at academic medical centers.

Methods: Surveys requesting inpatient CT volumes, inpatient MRI volumes, discharges excluding newborns, and case-adjusted mix index from 2002 to 2007 were e-mailed to all 123 members of the Society of Chairmen of Academic Radiology Departments. CT and MRI studies per discharge were adjusted using the case mix index (CMI) provided by each hospital to adjust for the differences in patient mix at participating institutions. Trends in adjusted inpatient imaging utilization were compared over time and across responding institutions.

Results: Twenty-two of 123 chairs (17.9%) of academic radiology departments, representing all geographic regions and a wide variability in National Institutes of Health research funding ranking, provided responses to our survey. Between 2002 and 2007, there was an increase in median CMI-adjusted CT studies per discharge of 28.0% and an increase in median CMI-adjusted MRI studies per discharge of 19.8%. The largest annual percentage increase in CT utilization (20.2%) occurred from 2003 to 2004, and there was negative growth between 2006 and 2007 of −3.74%. The largest annual percentage increase in MRI utilization (13.9%) occurred from 2006 to 2007, with 3 years of negative growth from 2002 to 2003, 2004 to 2005, and 2005 to 2006. In 2007, there was a wide range in CMI-adjusted CT studies per discharge between institutions from 0.16 to 0.75, with a mean of 0.40 ± 0.18, with a corresponding wide range in CMI-adjusted MRI studies per discharge of 0.04 to 0.16, with a mean of 0.09 ± 0.03.

Conclusion: There has been large growth in inpatient CT and MRI utilization at academic medical centers. This growth is variable over time and between institutions. Practice leaders can use this information to compare themselves with their peers and to monitor the impact of programmatic improvements on inpatient imaging utilization and in discussions with health system leaders who would like to improve system profitability by decreasing costly inpatient imaging procedures.

Key Words: CT, MRI, utilization of imaging, academic medical center, inpatient, medical economics, radiology, socioeconomic issues

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INTRODUCTION

Between 2002 and 2007, total health care expenditures in the United States increased by 40% from $1.60 trillion to $2.24 trillion, accounting for 15.9% of the gross domestic product in 2007 [1]. These rapidly increasing health care costs threaten the sustainability of public programs such as Medicare and Medicaid, decrease the competitiveness of American companies in our increasingly global economy, and decrease the ability of individual consumers to afford health insurance and health care.

[a]Department of Radiology, University of Pennsylvania Health System, Philadelphia, Pennsylvania.

[b]Radiology Group of Abington, Abington, Pennsylvania.

[c]Research Department, American College of Radiology, Reston, Virginia.

Corresponding author and reprints: Rajan Agarwal, MD, MBA, Radiology Group of Abington, 1200 Old York Road, Abington, PA 19001; e-mail: rajan.agarwal@gmail.com.

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As policymakers and payers attempt to control costs, much attention has been given to the rapid rise of imaging-related expenditures, which are the most rapidly rising costs of physician services [2-4]. Imaging costs were estimated to be $100 billion in 2005, or approximately 5% to 6% of total health expenditures [5].

This rapid rise in imaging costs is largely attributable to increases in the utilization of so-called advanced imaging, which includes high-margin imaging procedures: CT and MRI. Between 2003 and 2007, CT and MRI utilization in the Medicare population increased at annual rates of 12.6% and 10.6%, respectively. In comparison, chest x-rays and x-rays of the bones increased annually by 1.3% and 3.4%, respectively [6].

When examining where this increase in imaging volumes is occurring, much of the attention has been centered on outpatient care. A US Government Accountability Office [7] study in 2008 found that by 2006, about two-thirds of spending on physician imaging services occurred in physician office settings, an indicator of a shift toward providing imaging services in physicians' offices as opposed to providing such services in inpatient hospital or other institutional settings. A 2009 study by Levin et al [8] demonstrated that total growth of imaging in hospital inpatient settings between 1996 and 2006 was 15%, compared with 25% in hospital outpatient sites and 63% in private office outpatient settings. The rapid increase in outpatient imaging utilization is posited by many to be related to technical component financial incentives, such as large profit margins and the ability of nonradiologist physicians to self-refer [8-17].

Such technical component financial incentives do not exist for inpatient imaging, for which reimbursement is most often included as part of the per diem or fixed global reimbursement of the diagnosis-related group assigned to the patient during admission. Therefore, increasing inpatient imaging volumes does not increase revenue. The ultimate impact on hospital profitability is unclear because it is uncertain whether increased inpatient imaging decreases or increases overall hospital costs; if, for example, increased inpatient imaging can lead to reduced lengths of stay, hospitals may stand to profit from increased inpatient imaging volumes. However, until such financial outcomes research is performed, hospital administrators may operate under the assumption that increasing inpatient imaging volumes lead to additional costs and therefore decreased profitability. As a consequence, ordering physicians, radiologists, and radiology administrators may be unjustifiably pressured by health system administrators to control inpatient imaging volumes.

This study was designed to examine trends in volumes of inpatient procedures at academic medical centers. Attention was given to CT and MRI, which generally are believed to account for the largest inpatient imaging costs. By doing so, we hope to provide radiology leaders with a benchmark by which to compare themselves with their peers in an attempt to understand if they are doing more, the same, or fewer inpatient CT or MRI studies.

METHODS

Study Design and Population

This was a retrospective cohort study. Surveys requesting inpatient CT volumes, inpatient MRI volumes, discharges excluding newborns, and case-adjusted mix index from 2002 to 2007 were e-mailed to all 123 members of the Society of Chairmen of Academic Radiology Departments). At least 3 follow-up e-mails were sent to increase the response rate.

CT and MRI studies per discharge were adjusted using the case mix index (CMI) provided by each hospital to adjust for the differences in patient mix at participating institutions because it was assumed that hospitals with higher CMIs (sicker patients) would use more imaging services. The adjustment was made by dividing an institution's number of CT or MRI studies per discharge by its CMI. The CMI is the average diagnosis-related group weight for all of a hospital's Medicare patients and applied to its entire population. It can be used to adjust the average cost per patient (or day) for a given hospital relative to the adjusted average cost for other hospitals by dividing the average cost per patient (or day) by the hospital's calculated CMI. The adjusted average cost per patient would reflect the charges reported for the types of cases treated in that year. If a hospital has a CMI > 1.00, its adjusted cost per patient or per day will be lowered. Conversely, if a hospital has a CMI < 1.00, its adjusted cost will be higher.

Statistical Analysis

The following descriptive analyses were performed: mean, median, standard deviation, growth rate, and compounded annual growth rate (CAGR).

Box plots for CMI-adjusted CT and MRI studies per discharge were created to examine trends (Figures 1 and 2). The center box contains the middle 50% of the data, the upper edge of the box indicates the 75th percentile of the data set, and the lower edge indicates the 25th percentile. The range of the middle 2 quartiles represents the interquartile range. The line in the box indicates the median. The lines outside the box represent the minimum and maximum data values.