ORIGINAL ARTICLE

Adoption of Radiation Technology Among Privately Insured Nonelderly Patients With Cancer in the United States, 2008 to 2014: A Claims-Based Analysis

SA-CME

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Abstract

Despite enthusiasm for advanced radiation technologies, understanding of their adoption in recent years is limited. The aim of this study was to elucidate utilization trends of conventional radiation, intensity-modulated radiotherapy (IMRT), brachytherapy, proton radiotherapy, stereotactic body radiotherapy (SBRT), and stereotactic radiosurgery (SRS) using a large convenience sample of irradiated patients with cancer identified from private insurance claims in the United States. The unit of analysis was a claim corresponding to a fraction of delivered radiotherapy from 2008 to 2014. Each claim was assigned a disease site on the basis of the diagnosis code and a radiation technology on the basis of the procedure code. In 2014, conventional radiation and IMRT constituted 56% and 39% of all radiation treatment claims, respectively, while brachytherapy constituted 2%, proton radiotherapy 1%, SBRT 1%, and SRS <1%. Compared with the first quarter of 2008, the proportional contribution of conventional radiation and brachytherapy to all radiation claims each decreased by 16% in the fourth quarter of 2014. In contrast, proportional contribution increased by 32% for IMRT, 83% for proton radiotherapy, 124% for SRS, and 309% for SBRT. Prostate cancer constituted 60% of all proton claims in 2008 but declined to 37% by 2014. SBRT was used to treat a variety of disease sites, most commonly primary lung (25%), prostate (12%), secondary bone (9%), and secondary lung (9%), in 2014. In this claims-based analysis of younger patients with private insurance, conventional radiation and IMRT were the most commonly used technologies from 2008 to 2014, while SBRT showed the most robust growth over the study period.

Key Words: Radiotherapy, radiologic technology, clinical practice patterns, technology adoption, stereotactic body radiotherapy

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INTRODUCTION

Marked innovations in target localization and radiation delivery have led to the adoption of advanced technologies such as intensity-modulated radiotherapy (IMRT), stereotactic body radiotherapy (SBRT), and proton radiotherapy. Despite enthusiasm for these techniques, knowledge about their adoption in recent years is limited to surveys [1,2], disease site–specific studies [3], or cost-focused studies [4]. Understanding utilization trends of emerging technologies can inform decisions about future capital equipment and manpower needs, appropriate physician training requirements, and future research directions. We thus sought to elucidate the utilization trends of different radiation modalities among nonelderly patients with cancer irradiated between 2008 and 2014 using a private insurance claims database.

METHODS

Data Source

The MarketScan Commercial Claims and Encounters database (Truven Health Analytics, Ann Arbor,

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Michigan) is a collection of individual-level claims for individuals younger than 65 years. The data are aggregated from more than 100 health insurers in the United States that provide private insurance to employees, spouses, and dependents [5].

Study Subjects and Variables

The time period of analysis was January 1, 2008, to December 31, 2014. Patients with cancer were selected on the basis of the presence of one or more claims with a primary International Classification of Diseases, ninth rev, diagnosis code of a neoplasm. For these patients, our unit of analysis was a claim with a Current Procedural Terminology or Healthcare Common Procedure Coding System procedure code corresponding to a fraction of radiation delivery. Each claim was categorized to a disease site on the basis of the primary diagnosis code (Supplemental Table 1). If the primary diagnosis code was "radiotherapy encounter," the second diagnosis code was used, if available. Each claim was assigned a radiation technology of conventional, IMRT, proton, brachytherapy, or stereotactic on the basis of the procedure code (Supplemental Table 2). Stereotactic codes were further categorized as intracranial stereotactic radiosurgery (SRS) or extracranial SBRT on the basis of the anatomic site of the claim's diagnosis code (Supplemental Tables 3), and secondary sites were further subclassified for these technologies (Supplemental Table 4).

Statistical Analysis

The total number of claims per modality was computed on a quarterly basis. The primary measures of interest were the proportion of all radiation claims each technology constituted and the relative change of this proportion over time, indexed to the first quarter of the study period. To assess for disease site–specific contributions to utilization trends, the most common disease sites treated with each technology each year were determined. Data analysis was performed using SAS version 9.4 (SAS Institute, Cary, North Carolina).

RESULTS

Radiation Technology Utilization

The annual number of identified radiation claims by technology is shown in Supplemental Table 5. The proportional contribution of each technology to annual radiation treatment claims is shown in Figure 1A. Conventional radiation and IMRT accounted for more than 95% of claims each year. The change in the proportion each technology constituted of total claims on a quarterly basis, relative to the proportion in the first quarter of 2008, is shown in Figure 1B. Compared with the first quarter of 2008, the proportion of conventional radiation and brachytherapy to all radiation claims in the fourth quarter of 2014 each decreased by 16%. In contrast, the proportional contribution over this time period increased by 32% for IMRT, 83% for proton radiotherapy, 124% for SRS, and 309% for SBRT. The growth in IMRT, proton, and SRS use was largely limited to 2008 to 2011, while SBRT utilization increased throughout the study period.

Disease Site Analysis

For each technology, the most commonly treated disease sites in 2014 and the corresponding proportions of radiation treatments these sites constituted in 2008, 2011, and 2014 are shown in Figure 2. The most common site treated with conventional radiation was the breast, accounting for 54% of claims in 2014. IMRT was used most frequently for prostate (32%), head and neck (16%), breast (9%), central nervous system (7%), and lung (5%) disease in 2014. Proton radiation was used most commonly for prostate cancer, although this declined from 60% of claims in 2008 to 37% in 2014. Brachytherapy for breast cancer decreased from 43% of claims in 2008 to 35% in 2014, and prostate brachytherapy decreased from 16% to 10%. SBRT was used to treat a variety of disease sites, most commonly primary lung (25%), prostate (12%), secondary bone (9%), secondary lung (9%), and breast (7%) in 2014.

DISCUSSION

In this claims-based analysis of radiotherapy utilization between 2008 and 2014, we found that conventional radiotherapy and IMRT were the most commonly used technologies by far. Although constituting a small fraction of total radiotherapy delivery, the proportional contribution of SBRT had a 3-fold increase between the first quarter of 2008 and the fourth quarter of 2014, findings consistent with survey results published in 2011 [2]. The continued rapid adoption of SBRT over the entire study period in contrast to the relatively stable proportional use of other technologies over the latter half of the study period was the most striking finding of this analysis and has important implications for our field.

With regard to capital equipment projections, survey-based data from 2010 indicated that approximately two-thirds of practicing radiation oncologists possessed the