Geographic access to brachytherapy services in the United States

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ABSTRACT

PURPOSE: Disparities in geographic access to medical care exist in nearly all fields of medicine including radiation oncology. We aim to update knowledge of the geographic distribution of radiation oncologists in the United States.

METHODS AND MATERIALS: We used the Physician and Other Supplier Public Use File (PUF) from the Centers for Medicare & Medicaid Services (CMS) as well as the International Atomic Energy Agency (IAEA) Directory of Radiotherapy Centers (DIRAC) database to identify practices that either coded for or are marked as having access to brachytherapy services. Geographic analysis was performed on several levels including United States (US) Census region, Dartmouth Atlas Health Care Referral Region, and the county level.

RESULTS: We identified 327 providers that billed for a brachytherapy code during the calendar year 2018 and 564 facilities providing brachytherapy. Within the 306 HRRs in the US, 149 have access to brachytherapy. This represents 247.5 million people based on 2018 estimates of population from the US Census Bureau. This implies that 76.7% of people within the US live in an HRR with access to brachytherapy, and, conversely, that 75.3 million people (23.3%) do not. Numerically, counties in metropolitan areas were more likely to have access to brachytherapy than those outside of a metropolitan area.

CONCLUSIONS: Geographic disparities exist in access to brachytherapy; metropolitan counties are more likely to have access than non-metropolitan counties. We support continued development of databases of brachytherapy providers and programs that may support travel and lodging costs to minimize these disparities. © 2021 American Brachytherapy Society. Published by Elsevier Inc. All rights reserved.

Keywords: Brachytherapy; Geography; Rural; Disparities

Introduction

Geographic access to medical care varies for nearly every specialty in American medicine (1-3). This variation impacts both access to critical medical services and influences the types of medical care that individuals may receive (4). Radiation oncology (RO) is particularly vulnerable to geographic disparities in access to care given the unique nature of RO treatments, often requiring multiple visits over a prolonged time period, and substantial high fixed cost infrastructure requirements for radiation facilities. A previous analysis found that in terms of access to any RO services, non-metropolitan areas had approximately one-third the density of practicing radiation oncologists as metropolitan areas (5). An additional recent analysis showed that increasing distance from an RO facility was inversely correlated with likelihood of receiving radiation therapy (RT) for prostate cancer, emphasizing the role that geography plays in influencing practice patterns in RO (6).

Brachytherapy is emblematic of many of these access challenges – it requires specialized machinery, the capability of maintaining a radioactive source, and unique skill sets. A recent survey of RO residency graduates showed that while nearly all residents view brachytherapy as an im-
portant skill to develop during residency (97%), only 54% expressed confidence in developing a brachytherapy practice post-residency (7). However, brachytherapy remains a critical component in the curative treatment of several malignancies including prostate and gynecologic cancers (8-10). Despite the critical role brachytherapy plays in the treatment of these malignancies, its use continues to decline (11, 12). As such, defining the geographic access to brachytherapy is essential to better understand where disparities lie and improve access to clinical care for patients. Therefore, we aimed to characterize US geographic access to brachytherapy.

Methods and materials

To maximize our capture of facilities or physicians who are able to perform brachytherapy we used two sources; one to gather physicians who may have billed for brachytherapy services, and another to capture brachytherapy facilities. The Physician and Other Supplier Public Use File (PUF) from the Centers for Medicare & Medicaid Services (CMS) is a database encompassing 100% of the final-action physician/supplier part B non-institutional line items of the Medicare fee for service population. We used this database from the calendar year 2018, the most recent publicly available data (13). We included all providers who billed the following CPT brachytherapy codes: 77767, 77768, 77770, 77771, 77772, 77778, 77761, 77762, and 77763. These codes reflect radiation treatment delivery for LDR interstitial and intracavitary brachytherapy and HDR brachytherapy. We did not include codes for electronic brachytherapy and intraoperative RT. Because an analysis solely of the Medicare population (predominantly over the age of 65) likely underrepresents the usage of brachytherapy for those with gynecologic malignancies, which primarily effect those under the age of 65, we further identified the location of all sites demarcated as having brachytherapy in the International Atomic Energy Agency (IAEA) Directory of Radiotherapy Centers (DIRAC) database, which was further curated for recency and quality-checked by American Society for Radiation Oncology (ASTRO) staff through July of 2020 (14, 15). The address to each practice was geocoded using the Google Maps API within QGIS 3.12.

We defined access to brachytherapy as the presence of either a physician who billed for brachytherapy during the year 2018 or facility brachytherapy availability within the DIRAC database. We considered three geographic units for this analysis. On a macroscopic scale, we evaluated access by US Census Bureau defined regions. These represent four large clusters of American states. We also considered data by Hospital Referral Region (HRR) as defined by the Dartmouth Atlas Project. HRRs represent regional health care markets for tertiary medical care (16). They are widely used in academic research as well as in various CMS publications (17, 18). We also considered each brachytherapy provider on a county level and defined the rural-urban continuum code (RUCC) for each provider. The RUCC is a nine-point scale defined by the United States Department of Agriculture (USDA) that places each county in the US in either a metropolitan or non-municipal area. An RUCC of 4 or higher places a county in a non-metropolitan area which has been previously used as a surrogate for defining a “rural” area (5). Maps were generated using QGIS version 3.10.

Results

Of the 4548 RO providers in the CMS Physician and Other Suppliers PUF, 327 (7.2%) billed for a brachytherapy code during the calendar year 2018. Within the DIRAC database, we identified 564 facilities providing brachytherapy. When combining these databases, 75 of 327 providers who billed for brachytherapy were in a county without a brachytherapy site in the DIRAC database; 316 of 564 sites in the DIRAC database were in a county without a provider coding for brachytherapy. Table 1 shows the number of providers and facilities by region. Within the 306 HRRs in the US, 149 have access to brachytherapy. This represents 247.5 million people based on 2018 estimates of

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**Table 1**

<table>
<thead>
<tr>
<th>US census region</th>
<th>Population (2018)</th>
<th>Number of brachytherapy providers billing medicare in 2018</th>
<th>Number of brachytherapy sites in DIRAC database</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northeast</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(CT, ME, MA, NH, NJ, NY, PA RI, VT)</td>
<td>56,046,620</td>
<td>51</td>
<td>103</td>
</tr>
<tr>
<td><strong>Midwest</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(IL, IA, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI)</td>
<td>68,236,628</td>
<td>58</td>
<td>159</td>
</tr>
<tr>
<td><strong>South</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV)</td>
<td>124,569,433</td>
<td>148</td>
<td>198</td>
</tr>
<tr>
<td><strong>West</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(AK, AZ, CA, CO, HI, ID, MT, NM, OR, NV, UT, WA, WY)</td>
<td>77,834,820</td>
<td>70</td>
<td>104</td>
</tr>
</tbody>
</table>
population from the US Census Bureau. This implies that 76.7% of people within the United States live in an HRR with access to brachytherapy, and, conversely, that 75.3 million people (23.3%) do not. This is shown geographically in Fig. 1. Among the 1,236 counties in the US in a metropolitan area, 349 (28.2%) have brachytherapy access; among the 1,996 counties in the US in a non-metropolitan area, 63 (3.2%) have access to brachytherapy.

Discussion

These data underscore the limited access to brachytherapy in the US. Approximately one quarter of the population lives in a HRR without access to brachytherapy. This directly impacts the logistical hurdles to cancer care that many patients in this country face, especially those with genitourinary and gynecologic malignancies. Further, this data underscores that lack of access to brachytherapy is most pronounced among those living in non-metropolitan areas. This is consistent with prior analysis showing the density of radiation oncologists is drastically reduced in non-metropolitan areas relative to metro areas (5). While optimally, access would be enhanced by opening additional brachytherapy centers in non-metropolitan areas, the large upfront capital costs associated with this make it unlikely to be a viable near-term solution. As such, we would emphasize that programs to support travel and lodging for patients who would have to commute burdensome distances for brachytherapy should be prioritized to mitigate disparities in access. It is critical to continue to monitor these numbers over time as the utilization of brachytherapy continues to decline, which may be exacerbated by upcoming changes to the payment structure for the field of RO.

There are several limitations inherent to this analysis. The CMS Physician and Other Supplier PUF does not capture institutional billing and likely underrepresents the true number of physicians in the US who practice brachytherapy. Likewise, it only reflects Medicare billing which, given the demographics of the disease, does not capture many younger patients with cervical cancer for whom brachytherapy is vital in management. We attempted to ameliorate this by also including brachytherapy facilities derived from the DIRAC database, but we also acknowledge that this is also at risk of underascertainment. By combining these two sources of data, we aim to present the most complete analysis of geographic access to brachytherapy yet published, but we do recognize that some centers may go uncaptured. A consequence of this approach to maximize the capture of institutions participating in brachytherapy is the heterogeneous ascertainment of which facilities can offer low dose rate (LDR) and high dose rate (HDR) brachytherapy. Consequently, our confidence in further analysis in geographic access to brachytherapy by HDR and/or LDR availability is limited. Further, neither data source used collects data on diagnoses for which brachytherapy is used at any given location.
Future analysis to determine the available of brachytherapy specifically for gynecologic or prostate cancers, for example, would be of value in ascertaining the true access to brachytherapy services for various patient populations.

Conclusion

We found that much of the US population (76.6%) lives in an HRR with access to brachytherapy, however, this leaves 75.3 million people living in an HRR that does not. Non-metropolitan counties are less likely to have access to brachytherapy than metropolitan counties. We suggest that programs to support travel and lodging for patients from areas without access to brachytherapy are critical to ensure optimal and equitable cancer care.

Acknowledgements

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References