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No oncology patient left behind: Challenges and solutions in rural radiation oncology

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Summary

Health inequities and decreasing median American lifespan, potentiated by the worldwide COVID 19 crisis, have taken centre stage in the public consciousness. Specifically, for this discourse, rural radiation oncology challenges external to the pandemic and unique to the rural American radiation oncology care delivery result from a confluence of the following: a) increased incidence of cancer in the United States;[1] b) recent legislative emphasis on rural healthcare equity initiatives;[2] c) pandemic-associated delays in cancer screening, diagnosis, and treatment[3,4] with resultant presentation of advanced oncologic stages; d) social spotlight on healthcare equity and inclusion for disenfranchised populations.[5]

We will attempt to delineate these issues and propose widely applicable common-sense solutions. We will review what has transpired at the University of Kentucky over the last two decades, specifically at radiation oncology centre in Morehead, a clinic in eastern Kentucky in the Appalachian foothills. While much more work remains ahead, this clinic has successfully applied many of the initiatives discussed.

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Introduction

Some describe the health care disparity being discussed as the phenomenon of the "rural divide".[6] In this context, why does a discussion regarding rural radiation oncology delivery really matter? One cannot thoroughly discuss radiation oncology without addressing the global issues of general oncology. Radiation medicine, in general, is at the distal end of the service line because of downstream referral patterns and largely depends on hospital subspecialties for diagnosis and ongoing co-management. The specific topic of addressing rural radiation oncology access in the USA is only minimally addressed in the published scientific literature thus far. The magnitude of the problem is large and growing within the United States and internationally, but it is still a quiet epidemic that has garnered little attention. Akin to the rural opioid crisis which silently, for a time, wreaked havoc in rural America,[7] the statistics regarding access to oncology care in rural America are equally concerning. A recent article from the American Society of Clinical Oncology (ASCO) cited several concerning oncology statistics in general (Box 1).

Practitioners outside the field of radiation oncology will and should take interest in the global expansion of rural radiotherapy access for societal and economic importance of expanding global equity in radiotherapy. This endeavour has been an ongoing and complicated effort universally. Atun et al. published an analysis on population-based cancer control and the positive economic benefits and additional discounted life-years of a linear scale-up on radiotherapy services and the robust return on the investment in doing so. This international study of radiotherapy programmes cites many similar challenges that US rural initiatives face: disproportionate geo-distribution of cancers, evolving cancer burden profile dynamics, difficulty with modelling of resource estimation as needed as a ratio to volumes expected,

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An overview of some of the challenges:

- 19% of the U.S. population lives in rural areas, only seven percent of oncologists practice in these areas.
- More than 70% of U.S. counties do not have any medical oncologists.
- In rural localities, there is only *one* oncologist per 100,000 residents, contrasted to urban areas this ratio is *five* oncologists per 100,000 residents.
- Four in ten rural Americans who have or had cancer have verbalised that there aren't cancer specialists in reasonable proximity to their community.
- 36% of patients in rural areas state they had to travel too far to see the physician managing their care, versus 19% of non-rural patients.[8]

Box 1

determination of accurate radiotherapy utilization (RTU) with available capacity and projected future investment required, tangible economic benefits and how to partner public and private collaborations most effectively for future funding, among others. Global struggles are similar to the ones we face here and can be broadly classified into regulatory, technical and structural. Failures to recognise the roadblocks and innovate in radiotherapy service delivery are illustrated well in this discourse. Ontario's crisis of long wait-lists for radiotherapy services in the 1990's is a well-documented concrete example and contributed to generalised unrest in the political and public health arena. These issues are all potentially present in America as well, additive to a very unique, confusing and unwieldly insurance system. [9]

The US is unique in its private payor model with behemoth health insurance companies and its tie, for many Americans, to full-time employment. Lack of persistent health insurance subscribership despite the Affordable Care Act (ACA) or "Obamacare" implementation also impacts these issues. Additionally, nearly two-thirds of the rural uninsured populations live in states that did not participate in Medicaid expansion when the ACA was initiated. Additionally, in rural Appalachia, many young healthy working individuals who would ideally offset the costs of ill patients in insurance pools struggle to pay employer-sponsored insurance premiums. These patients, who are ineligible for Medicare or Medicaid, often remain under- or uninsured, along with non-working members of their households including children. These patients self-admittedly utilise healthcare as a "last resort", and unfortunately disproportionately present to cancer centres in later stages of disease, which often require more complicated and expensive care.[10,11]

The Census Bureau defines rurality as clusters of population less than 2,500 habitants.[12] Of those in small or isolated towns, 88·2% of patients need to travel >30 minutes to the nearest radiotherapy centre, and 47·0% need to travel >60 minutes.[14] Kentucky is a prime example of this phenomena with 40·8% of the population considered rural as of 2019,[13] Radiological Physics Centre (RPC) monitored radiation facilities represent a national accredited quality monitored physics facility and only 19 exist in the Commonwealth.[14,15]

Finally, radiation oncology is a highly technical and small specialty, but a crucial component of treatment in over 50% of cancer diagnoses. The dearth of specialists and increasing complexity of care makes national equitable disbursement difficult, leading to a glut in some locales and undersupply in others.

Part I: Challenges

Maldistribution of primary care physicians and radiation oncologists. Rural radiation oncologists, many of whom are retiring in next 5 years, already comprise a minority of the overall workforce (12-13%).[16] This number has been steadily decreasing over the last 5 years due to non-replacement and is projected to worsen in the next decade. This lack of family physicians and radiation oncologists in general is emblematic of the lack of physician-led medical care in rural areas. Broadly trained family medicine physicians provide a resource for the initial appropriate screening/detection and an avenue for diagnosis of earlier stage malignancies in which radiation is generally most appropriately utilised. Family physicians also support radiation oncologists through co-management of complex patients during radiation. Without them, radiation oncologists in rural areas are often left alone with the burden to navigate these other comorbidities that can complicate holistic and optimal cancer care. Primary physicians are not being trained in the numbers needed due to decrease in Medicare funding of available residency seats.[17] While many have proposed training mid-level nurse practitioners to fill the gap, the goal of permanently placing rural nurse practitioners has not been achieved and thus has not mitigated this access problem.[18] Rural patients often have complex, multi-organ system comorbidities and the current doctor of nurse practitioner (DNP) training programmes, 85% of which are entirely non-clinical, leaves newly-minted nurse practitioners woefully unprepared to collaborate effectively with radiation oncologists to care for these patients.[19] Statistics show that the diaspora of nurse practitioners has largely been to more sought after urban or non-oncologic areas rather than the rural cancer centres in need.[20] As the primary care pipeline diminishes, many radiation oncologists find rural areas increasingly less desirable to practice without a supportive medical infrastructure.

Hospital Facilities Closure. Many rural hospitals have been under duress of closure for some time, and the current COVID-19 pandemic has amplified this challenge. The close tie of rural radiation oncology facilities to collaborative rural hospitals cannot be underestimated. Since the start of the pandemic, 21 rural hospitals closed and many more have gone bankrupt but are keeping their doors open.[21,22] Rural family physicians are also retiring at a higher rate than they are being replaced.[22] The dearth of trained physicians and closing facilities diminished access to cancer screenings and treatment for rural patients. Physically free-standing radiation facilities, such as the University of Kentucky in Morehead, collaborate and are often very dependent on local community hospitals for initial diagnosis and ongoing imaging and co-management of this patient cohort are directly affected by this negative domino effect.[23,24] Hospital support staff shortage and high census numbers forced many hospital systems to secondarily prioritise or delay cancer work-up and management in the hospital.

Lack of teleconnectivity, telemedicine, and transportation. While telemedicine has been around for decades,[25] the COVID-19 pandemic created explosive growth in utilisation.[26] However, growth was hampered in certain areas, such as Appalachia, because of lack of broadband connectivity. Telemedicine is a deployable solution that needs to be fully examined, developed and leveraged in radiation oncology but is fettered by scarce distribution of internet networks. Just 60% of rural residents use broadband, compared to 70% of urban residents and 73%of suburban residents.[8] Separately, in other locales, confusing and restrictive governance regarding telehealth administration also unnecessarily fettered access. Telemedicine seemed to be the perfect solution as an informal survey query in our own University of Kentucky satellite shows that transportation and lack of long-term housing to visit a physician and receive therapy is one of the most insurmountable obstacles (*unpublished*); unfortunately, this potential solution was also not realised in many communities. Telemedicine and utilisation of a virtual private network (VPN) can allow remote dosimetry planning, clinical chart rounds, and some physics quality assurance without having daily on-site technical personnel, as our satellite has done. In the same vein, some routine follow-up care can be done via tele-medicine.

The state of Kentucky has made general connectivity one of its top goals with its Kentucky Broadband Initiative.[27] Educational efforts by ancillary staff (nutrition, nursing, palliative medicine) can be delivered through a cost-effective digital format that can be patient driven to make supportive care more accessible, less personnel intensive and effective. Success can be defined as improved compliance with radiotherapy regimens and reduced attrition. This could serve as a model initiative globally and be expanded in the future.

Perhaps the most overwhelming and basic hindrance is daily accessibility, something we have witnessed in our Morehead clinic. A total of 1·6 million U. S. rural households do not have cars, with the highest proportion found in the south, Appalachia, the southwest, and Alaska.[8] Housing options near treatment facilities funded by philanthropic endeavours or other sources combined with hypofractionation regimens, when appropriate, represent a potentially powerful, if partial, solution to improve access. Relative to our Morehead practice, our patients utilise one transportation servicer. Examination of the online bus schedules shows limited availability of pick-up locations and few daily routes.[28] Rural transit assistance programmes and public transportation are useful and need to be expanded or those who have an appropriate indication for radiotherapy will be less likely to be able to travel and receive it.

Lack of radiation oncology awareness, literacy, and social determinants of health. For many patients and practicing physicians outside the field, radiotherapy remains a daunting black box. This lack of familiarity and understanding of this highly technical modality and its evidenced based utilisation has led to misinformation and under-utilisation of a very cost-effective therapy.[29,30] Studies have shown that rural cohorts are less likely to receive adjuvant treatment for cancers even in primary sites with proven benefit. Baldwin et al. reported that rural residence can influence radiotherapy receipt, and in selected cancers, sociodemographic factors, cancer type and stage, and state of residence have even greater influence over cancer patients' receipt of radiotherapy.[31] This suggests the need for further qualitative research to determine whether both patients fully understand and if physicians are effectively communicating the benefits and risks of radiotherapy so that patients can make fully informed decisions about its use, regardless of where they live.[31,32] The authors' personal experience corroborates the misunderstandings and subsequent avoidance of radiotherapy administration in the rural cohort.

Financial aspects: capital investment, private equity and the Certificate of Need (CON). Capital expenditure for design and construction of radiation vaults and facilities is a multi-million-dollar venture. Ongoing expenses for maintenance, service contracts and technical expertise needed for operating and maintaining these facilities and their equipment are high. Certificate of need (CON) laws were initially engineered to foster equitable access to treatment for patients, and to limit the potential for over-utilisation and unnecessary medical expense. Counterintuitively, formal data has shown that

in Northeastern U.S. CON states have significantly higher travel times than non-CON states, which could limit availability and access to cancer treatments.[13] Kentucky is a CON state but to this date, no formal studies in this particular Midwest geography as a correlative of availability and travel time exist.

Part II: Multi-tiered solutions

Student, resident and attending physician education. As Nobel Laureate Nelson Mandela once said, "*Education is the most powerful weapon which you can use to change the world*". Nowhere is this truer than in the practice of medicine. Education and learning are enduring activities with different facets at different levels, but can and should include everyone – from patients, to medical trainees and practicing physicians, to senior physician leadership willing to allocate resources in order to provide cutting edge care. As the Accreditation Council for Graduate Medical Education, (ACGME), resident review committees, and medical education deans design medical college curricula, there needs to be an evolution, plasticity, and modernisation of the process. Incorporating radiation oncology didactics in the first two years of medical school and spearheading a dedicated rotation in radiation oncology as part of the general oncology experience would be helpful, particularly in medical schools that train the majority of rural physicians.

For current radiation oncology house staff, integrating a compulsory rural radiation oncology rotation during would allow residents to experience the positives of rural communities during training including the following: closely knit social circles, less traffic and noise, slower paced lifestyle, and outdoor activities. In addition, residents could observe and possibly be inspired by the challenges of a generalist practice, incorporating more holistic practices as well as a broad role in palliative care. Mentorship from an experienced radiation oncologist would likely facilitate this model and provide a fulfilling educational experience. Currently no rural radiation oncology requirement exists for accredited residencies.

Residents also currently deal with expensive education. Undergraduate and medical education over the last 20 years has increased at 18 times the consumer price index, and the percentage of physicians leaving medical school with greater than $300,000 in debt had doubled in the six years from 2010-2016.[33] Loan repayment options, such as those offered by National Health Service Corps (NHSC), incentivise those with high debt burden to practice in rural areas that they otherwise might not choose.[34]

In many cases, a rural radiation oncology centre could benefit from a staffing model that relies on a relationship with academic faculty such as done at the University of Kentucky. One advantage would be that this would facilitate intermittent university-sponsored oncology-centric educational offerings in order to enhance the awareness of local physicians of newer clinical knowledge and treatments. Education regarding cost-effective use of resources and case management scenarios is often desirable. An example of this might be the use of hypofractionation regimens as appropriate in the palliative or curative setting (e.g. prostate, skin). Discussion of these clinical scenarios, whether in a formal tumour board setting or not, can facilitate more cost-effective care particularly when referring physicians don't initially consider radiation as a treatment option. In addition, education can help dispel myths regarding toxicities of radiotherapy, which are often extremely overstated and over-emphasised. Palliation of cancer-related pain, bleeding, and compressive symptoms with radiotherapy is typically an effective, low morbidity treatment option that improves quality of life and can, in some cases, extend life.[30] Referring physicians should have a basic understanding of these treatment options.

Value based hypofractionation. The radiotherapy fractionation paradigm over the past few years has evolved to hypofractionation in many palliative and curative situations. Ultimately no solution will eliminate the need for a patient to be treated in person at a radiation facility. One can, however, minimise the number of trips. In some oncologic situations, the "Quad Shot" has been useful for prompt haemostasis and pain control, and a single fraction can often effectively palliate osseous metastases.[40] A large single fraction of spatially fractionated radiotherapy (SFR) radiotherapy synergises with a later, shortened conventional radiation course for durable tumour control in advanced tumours, e.g. head and neck cancers.[35] Hypofractionation for breast, prostate, and rectal cancer are becoming standard in many institutions.[36] as supported by the recent FAST Trial (CRUKE/04/015) in breast cancer and the ultra-hypofractionated versus conventionally fractionated radiotherapy for prostate cancer (HYPO-RT-PC trial).[36-38] All these regimens minimise time away from work in a population whose occupation is more likely to be transient and seasonal and less likely to be protected by the Family Medical Leave Act (FMLA), sick leave, disability insurance or other labour-related protections.

Clinical trial research enrollment. Radiation oncology practice is significantly impacted by clinical trial outcomes, and opportunities to enroll patients in prospective trials is often desirable. National Cancer Institute (NCI) funded cooperative oncology groups like NRG Oncology should create dedicated funding mechanisms from participating institutions to support trial accruals

from rural practices. This would open clinical trial access to patients in these communities and increase the applicability of the trial data to these populations who are often under-served. Embedding a nurse navigator, funded by either a cooperative group, can garner trust, facilitate trial participation, reduce attrition, and increase access to investigational treatments. Studies have shown positive social results from clinical trial enrollment, despite 42% of community oncologists reporting challenges with finding nearby clinical trials for their patients.[8]

The National Cancer Institute Community Oncology Research Programme (NCORP) is the primary route of accrual to NCI cancer control symptom management trials and to health-related quality of life trials. These trials are embedded into National Clinical Trials Network (NCTN). NCORP aims to have research that is reflective of national diversity, so the evidence generated is applicable to the entire community, not just some. "NCORP seeks to eliminate all gaps: racial, ethnic, and underserved (i.e. rural) geography." NCORP also has funding and grants for management and oversight of clinical trial work[39] Currently, there are 46 community sites and 14 are listed as Minority/Underserved Community Sites. None currently exist inside Kentucky.

National quality and access initiatives. Various national professional societies, including the American Society for Radiation Oncology (ASTRO), American College of Radiation Oncology (ACRO), and American Society of Clinical Oncology (ASCO) offer practice accreditation opportunities as a strategy to enhance the quality of practice. While formalised accreditation may represent a barrier to entry and thus not appropriate, remote peer review and quality assurance evaluation can help to ensure evidenced based, high quality radiation oncology administration. ASTRO has created a rural peer-to-peer mentor where rural sites can register centrally and have a fellow radiation oncologist review charts and treatment plans. These national initiatives make peer review possible, better ensuring that high quality care and some oversight can be done remotely.[41]

Part III: national and regional legislative initiatives related to rural oncology services

The year 2021 marks the 50th anniversary of the National Cancer Act. The National Cancer Institute was established by the National Cancer Act of 1971 by President Richard Nixon as part of his "war on cancer," which had become the nation's second leading cause of death in 1970.[42] The National Cancer Act created a direct legislative and financial pathways for establishing a budget pipeline from the NCI director to the president without any intermediaries. Even though 2021 marked the 50-year anniversary of this law, cancer incidence in US is increasing. However, due to advances in cancer care, the death rate from cancer is decreasing.[43]

A newly introduced legislation, the Rural Physician Workforce Production Act of 2021 (S. 1893), is an attempt to address the rural physician shortage by creating support for rural residency training opportunities. The motivation behind the legislation is that those who train in rural communities are more likely to stay in those same areas to practice. Investing in rural residency training is a vital component of addressing the rural physician shortage."[44] This needs to be done comprehensively for residents and fellows of all subspecialties, including radiation oncology.

The original "Cancer Moonshot" initiative was eclipsed by the COVID-19 crisis; and consideration should be given to restarting this to encourage community collaboration as one of its tenets. The more recent "Rural Telehealth Initiative" and "Rethinking Rural Health" proposals suggested updating payment rules under the Inpatient Prospective Payment System (IPPS), which would be a positive step. As part of this effort, Centre for Medicare Service (CMS) updated payment rules to benefit rural physicians to start fiscal year 2021. Although not specific to radiation oncology, the rule changes are supposed to address financial disadvantages experienced by rural physicians. CMS also launched a payment model via the Community Health Access and Rural Transformation (CHART) initiative to address a long-standing complaint about the definition of "originating site" in telehealth, which had been yet another obstacle for physicians in implementing teleoncology services.[32]

Rural inhabitants suffer disproportionately from under-insured and uninsured status.[10,11] A recent study published in ASTRO's major journal documented the wide variation in Medicaid payment rates for radiation oncology services, with much of the data pointing to under-reimbursement in rural zip codes.[45] In radiation oncology, bundled payment methodologies have been proposed and the negotiation of the final payment rule has been quite contentious. Hence, ASTRO is attempting to make global recommendations on how to make the model more workable especially for rural practices.[46]

Conclusions and final remarks

Kentucky had the highest cancer incidence in America in 2021 and the aforementioned efforts for the Commonwealth and adjoining areas cannot come soon enough.[47] Maintaining access for cancer patients in rural settings should be prioritised to avoid the US being faced with another public health catastrophe like the opioid or COVID-19 crisis. Radiation oncology is a small and highly technical specialty requiring specialised training and is often not well understood as a treatment modality by the medical community or the public. Radiation plays a pivotal role in over half of cancer

treatment regimens, and its essential role cannot be overstated. Without proper planning and decisive action, the evolving legislative and logistical changes attributable to the COVID-19 pandemic will continue to hamper access to care in our current rural model. A renaissance will require a multi-pronged, collaborative approach incorporating bottom-up plus top-down solutions that involve patients, private-public partnership, radiation oncology leadership, national societies, hospital administration, and politicians. The problem is getting more acute and will continue to worsen unless this is addressed in the near term to prevent rural radiotherapy services from becoming the proverbial mirage in the desert.

Contributors

AK contributed to conceptualization outline and writing of initial draft and review.
MR contributed to conceptualization outline, writing sections, draft editing, organisation and final review.
MK contributed to writing of initial draft, reference validation and review.
WM contributed to writing sections of revised draft, editing and final review.

Statement of ethics

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Declaration of interests

The authors have no conflicts of interest to declare.

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