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Towards mitigating radiological health disparities using virtual strategies in global medical physics education: A RAD-AID International example

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ABSTRACT

Purpose: The global distribution of radiological health services is extremely heterogeneous. In the past few years, it has been shown that approximately 90% of the population in the low-income world lacks access to radiotherapy and between one-half and two-thirds of the world's population lacks availability of diagnostic imaging. One of the primary drivers of this global heterogeneity is a critical shortage in the global radiological health workforce, of which medical physicists are an essential component. The pandemic illustrated the effectiveness of virtual learning which has subsequently been used to supplement education in various global health settings. Methodology: Building off experiences in other fields, medical physics volunteers from the international nonprofit organization, RAD-AID International, have implemented four didactic virtual global medical physics educational initiatives: (1) a medical physics lecture series open to physicists all over the world, (2) a medical physics course for radiation oncology residents at the University of Nairobi in Kenya, (3) a medical physics course for radiology residents at Georgetown Public Hospital in Guyana, and (4) practical radiation treatment planning workshops open to physicists and dosimetrists all over the world. Results: These initiatives illustrate four distinct methods through which medical physicists in high-income countries can supplement the education of medical physicists, students, and physicians in lower resource regions of the world. Conclusion: This work serves as a roadmap for other organizations or motivated individuals looking to become engaged in global medical physics outreach. It also demonstrates the variety of educational activities that constitute global medical physics education.

Keywords: *Global Health, Medical Physics Education, RAD-AID*

INTRODUCTION

Cancer remains a global health crisis and stands as the second leading cause of death worldwide [1]. Although traditionally perceived as a disease predominantly affecting high-income countries, projections indicate that by 2030, the majority of global cancer deaths will occur in low- and middle-income countries (LMICs) [2]. Radiotherapy is a cornerstone of cancer care, with approximately 50% of cancer patients requiring radiation at some point during their treatment [3]. However, over 90% of the population in low-income countries lacks access to even basic radiotherapy services [4]. A critical barrier to addressing this disparity is the shortage of a well-trained global radiation oncology workforce [5]. For instance, Elmore et al. [6] estimated that the number of practicing radiation oncologists would need to increase more than twenty-fold to meet optimal global demand by 2030. Similarly, achieving adequate medical physics staffing in LMICs requires a comparable increase [7]. Yet, current training capacities fall far short of these needs. In response, the 2015 Lancet Oncology Commission [8] called for innovative strategies to train radiotherapy professionals worldwide. Reinforcing this urgency, a recent study surveying institutional leaders in LMICs recommended adopting novel educational approaches to address disparities in medical physics education [9].

A similar gap exists in access to diagnostic imaging in LMICs [10–12]. The World Health Organization estimates that between one-half and two-thirds of the global population lacks basic diagnostic imaging services [13]. As with radiotherapy, a key barrier is the inadequate size of the global radiology workforce [14,15]. To address this, experts have advocated for creative and targeted educational strategies in global radiology education [16].

The COVID-19 pandemic accelerated the adoption of remote education across many sectors, demonstrating its efficacy in diverse global health settings [17,18], including surgical training [19] and pediatric care [20]. Virtual methods have also been employed to supplement the education of radiological health professionals in LMICs [21,22]. Notably, Yorke et al. [23] highlighted the efforts of Rayos Contra Cancer, which delivered topic-specific educational programs to radiation oncology treatment teams, primarily in Spanish-speaking regions.

Medical physics forms an essential pillar of the radiological health sciences [24]. Medical physicists are integral to radiation oncology and diagnostic radiology teams, ensuring the safe and effective delivery of patient care. Their role continues to expand into other areas of medicine [25,26]. Additionally, radiation oncologists [27], radiologists [28], radiation therapists [29], and imaging technologists [30] must possess a foundational understanding of medical physics to practice effectively. Therefore, access to medical physics education is a prerequisite for expanding radiological health services worldwide. Yet, receiving such an education remains an insurmountable challenge in many regions. For example, Ige et al. [31] reported that in 2020, only four of approximately fifty countries in sub-Saharan Africa (sSA) offered graduate medical physics education or formal clinical training programs. Addressing these stark inequities is a daunting task for the global medical physics community. Nevertheless, global-minded physicists in high-income countries (HICs) can make meaningful contributions by providing and supplementing education for learners in LMICs.

RAD-AID International, a non-profit, volunteer-based organization, operates in over forty LMICs across Africa, Asia, the Americas, Eastern Europe, and the South Pacific [32]. Founded in 2008 to enhance access to diagnostic radiology in LMICs [33], RAD-AID has steadily expanded its efforts in radiation oncology [34]. Through diverse educational initiatives targeting varied audiences, RAD-AID volunteers have made significant contributions to medical physics education. This manuscript highlights four specific examples of HIC-LMIC educational exchanges facilitated by RAD-AID: a global medical physics lecture series, a course for radiation oncology residents at the University of Nairobi in Kenya, a course for radiology residents at Georgetown Public Hospital in Guyana, and practical radiation treatment planning workshops. These examples aim to serve as a roadmap for philanthropic organizations or individuals seeking to engage in global medical physics outreach and to showcase the breadth of educational activities contributing to this vital field.

MATERIAL AND METHODS

This study was deemed exempt from institutional review board (IRB) approval.

Global Medical Physics Education Lecture Series (Sub-Section)

The Global Medical Physics Education Lecture Series (GMPELS) was established in August 2022 with the aim of enhancing educational opportunities and fostering collaboration within the global medical physics community. Initially, lectures were promoted exclusively via LinkedIn, but after the sixth lecture, a Google Form was introduced to facilitate consistent communication with interested individuals. This form collected respondent details, including name, email, country of origin and residence, occupation, institutional affiliation, and interest in medical physics. The form also inquired about topics of interest for future lectures, enabling organizers to invite relevant presenters. The link to the form was disseminated via LinkedIn and through an International Organization of Medical Physics

(IOMP) webinar chat function. The form was made publicly accessible on April 2, 2023, and remains open indefinitely.

To ensure data consistency, duplicate entries were reviewed and removed, spelling errors were corrected, and country name variations were standardized. Registrant data were analyzed by global regions, following World Health Organization (WHO) classifications [35], including the Americas, Southeast Asia, Europe, the Eastern Mediterranean, the Western Pacific, and Sub-Saharan Africa. English-speaking countries were defined as those where English is an official or majority language, and an additional classification considered whether a registrant's country of origin was historically part of the British Empire.

GMPELS lectures were scheduled in the late morning Eastern Time to accommodate West Coast presenters while allowing for reasonable evening attendance in South Asia. The lectures were conducted on Zoom at approximately monthly intervals and delivered primarily by U.S.-based medical physicists, with one exception featuring a U.S.-based radiation oncologist. Each lecture was recorded and uploaded to YouTube and the RAD-AID Learning Center for asynchronous access. A total of nineteen lectures were delivered between August 2022 and July 2024, covering topics in both radiotherapy and diagnostic imaging.

University of Nairobi Medical Physics for Radiation Oncology Residents Course (Sub-Section)

In early 2023, the leadership of the University of Nairobi's radiation oncology residency program requested a physics course for their 26 radiation oncology physician residents. RAD-AID volunteers developed a curriculum based on American Society for Radiation Oncology (ASTRO) recommendations [36, 37] while incorporating additional topics relevant to low-resource settings. The course, launched in May 2023, consisted of 25 one-hour lectures delivered biweekly over one year by ten U.S.-based medical physicists. The course curriculum is outlined in Table 2.

Table 1. Represents the list of topics that have been presented thus far at the Global Medical Physics Education Lecture Series. Nine lectures have been radiation therapy-focused, while eight have been imaging-focused. Two of the lectures have been sufficiently general to span both radiology and radiation oncology.

Global Medical Physics Educational Series Lectures

Lecture	Topic
1	Physical Principles of Ultrasound
2	Application of Brachytherapy
3	Clinical Ultrasound
4	Modern Linear Accelerator Technology
5	Small Field Dosimetry
6	Principles of Inverse Planning
7	Physical of Inverse Planning
8	Building Cultures of Safety
9	Surface-Guided Radiotherapy
10	MRI Contrast Generation
11	Motion Management in Radiotherapy
12	Management of Unplanned Treatment Interruptions
13	Breathing Motion Dynamics in Lung Radiotherapy
14	Overview of Medical Physics
15	MRI Safety
16	RBE Modeling in Ion Therapy
17	Parallel Imaging
18	Expanding Access to Brachytherapy
19	Cardiac MRI

Table 2. Illustrates the curriculum delivered to the radiation oncology residents at the University of Nairobi in Kenya.

Curriculum for University of Nairobi Radiation Oncology Residents

Lecture	Topic
1	Radioactive Decay
2	Radiation Production
3	Interaction of Radiation with Matter
4	Measurement of Radiation
5	Radiation Detection
6	Megavoltage Treatment Units
7	Calibration
8	X-Ray Imaging
9	Computed Tomography
10	Radiation Safety
11	Nuclear Medicine
12	Brachytherapy I
13	Brachytherapy II
14	Ultrasound I
15	Ultrasound II
16	Magnetic Resonance Imaging I
17	Magnetic Resonance Imaging II
18	Dose Distribution and Treatment Plan Analysis
19	MU Calculations
20	Treatment Planning I
21	Treatment Planning II
22	Intensity Modulated Radiation Therapy
23	Electron Therapy
24	Quality Assurance
25	Stereotactic Procedures

Table 3. Illustrates the curriculum delivered to the radiology residents at the Georgetown Public Hospital in Guyana.

Curriculum for Georgetown Public Hospital Radiology Residents

Lecture	Topic
1	Basics of Radiation
2	Image Quality and Informatics
3	Radiography
4	Mammography
5	Fluoroscopy
6	Radiation Protection and Safety
7	Computed Tomography I
8	Computed Tomography II
9	Ultrasound I
10	Ultrasound II
11	Magnetic Resonance Imaging I
12	Magnetic Resonance Imaging II
13	Magnetic Resonance Imaging III
14	Nuclear Medicine
15	Physics Review

Georgetown Public Hospital Medical Physics for Radiology Residents Course (Sub-Section)

RAD-AID has collaborated with Georgetown Public Hospital since 2017, supporting the establishment of a radiology residency program. In 2022, residency leadership requested a medical physics course to supplement their training. An initial series of five lectures across diagnostic imaging modalities was developed, with topics based on resident-submitted questions. At the conclusion of the lecture series, a 75-question multiple-choice exam was administered, which all residents successfully passed.

Recognizing the need for a more comprehensive curriculum, RAD-AID developed a structured physics lecture series in 2024. The new curriculum consisted of 14 virtual lectures covering all diagnostic imaging modalities, radiation protection, and biological effects of radiation. The course was delivered over five weeks, with three weekly sessions including lectures and interactive Q&A discussions using the Poll Everywhere platform. Residents were assigned reading materials and online modules available through the Radiological Society of North America (RSNA) prior to each session. A 100-question multiple-choice exam was administered three weeks after the final review session.

Radiation Treatment Planning Workshop (Sub-Section)

The first radiation treatment planning workshop was held in October 2023, with a second edition following in February 2024. These workshops were advertised through RAD-AID's social media platforms and via email to personal contacts, particularly in Kenya and Nigeria. A Google Form was used to register participants, collecting information on their name, country, profession, institution, familiarity with treatment planning topics, and preferred future topics.

The workshops were designed as hands-on training sessions illustrating the full treatment planning process. The first workshop provided a general overview of treatment planning, covering physics principles, 3D techniques, and inverse planning. The second workshop focused on breast cancer planning, covering 3D breast tangents, comprehensive 3D breast planning (including nodal coverage), IMRT breast techniques, and VMAT breast techniques. Each tutorial was delivered by a U.S.-based certified medical dosimetrist, except for the physics tutorial, which was led by a U.S.-based physicist. Data from registrants were analyzed by WHO-defined global regions and whether their country was English-speaking or formerly part of the British Empire.

RESULTS

Global Medical Physics Education Lecture Series (Sub-Section)

A total of 226 individuals registered for GMPELS after removing duplicate entries, representing 60 countries across five continents. Figure 1A illustrates the global distribution of registrants, with the largest contingents from India (18.6%), Nigeria (13.3%), and the United States (7.1%). Figure 2A shows the distribution by WHO regions, highlighting strong participation from Southeast Asia (31.0%), Africa (22.6%), and the Eastern Mediterranean (17.2%). Additionally, 62.4% of registrants originated from English-speaking countries, and 70.8% from former British Empire nations (Figure 2B).

Figure 2: Depicts selected demographics of the registrants for the Global Medical Physics Education Lecture Series (GMPELS) and the treatment planning workshops. Fig. 2.A. shows the distribution of GMPELS registrants classified by World Health Organization (WHO) Global Region, where each region is fairly evenly represented with the exception of the Western Pacific Region. Fig. 2.B. further classifies GMPELS registrants based on whether they come from English-speaking countries. Fig 2.C. shows the distribution of the treatment planning workshops registrants classified by WHO Global Region, where the majority of registrants (90.8%) come from the African Region. Fig. 2.D. classifies registrants of the treatment planning workshops based on whether they come from English-speaking countries, where it can be seen that the majority (89.8%) do hail from English-speaking countries.

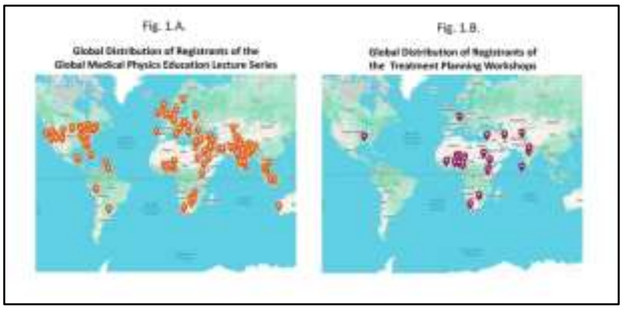

Figure 1: Illustrates the global distribution of registrants for the Global Medical Physics Education Lecture Series (Fig. 1.A.) and the treatment planning workshops (Fig. 1.B.).

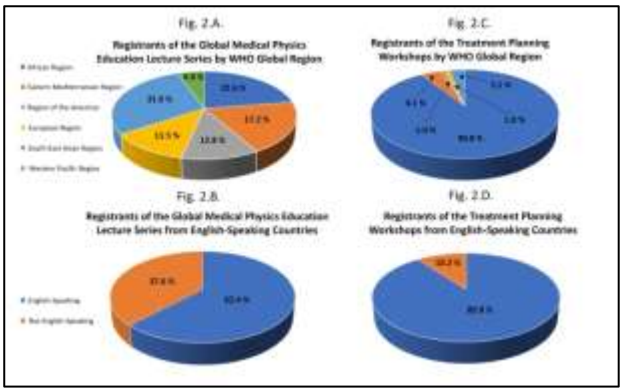

Figure 3: Illustrates the countries in which RAD-AID International has at least one partner institution.

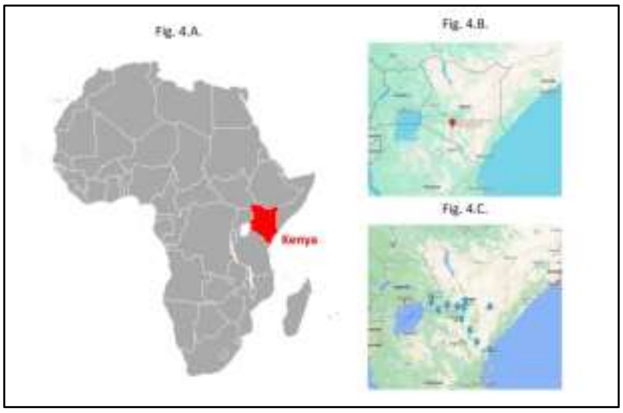

Figure 4: Provides geographic orientation for the medical physics course for radiation oncology residents at the University of Nairobi. Fig. 4.A. depicts the location of Kenya within Africa. It can be seen that Kenya is located in East Africa on the Swahili Coast of the Indian Ocean. Fig. 4.B. depicts the location of the University of Nairobi within Kenya. Fig. 4.C. depicts the location of the twelve proposed regional cancer centers [67] throughout Kenya in Kenya's Ministry of Health's effort to decentralize radiotherapy in the East African nation.

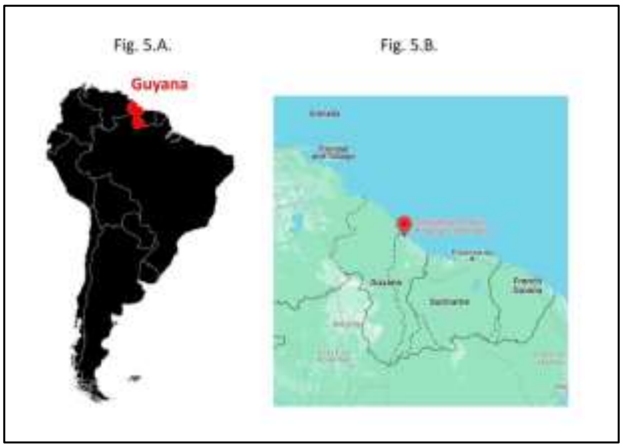

Figure 5: provides geographic orientation for the medical physics course for radiology residents at Georgetown Public Hospital. Fig. 5.A. depicts the location of Guyana within South America. It can be seen that Guyana is located in the northernmost part of South America on the Caribbean Coast. 5.B. depicts the location of Georgetown Public Hospital within Guyana.

LinkedIn was the primary means of discovery, cited by 54.9% of registrants, though peer referrals (19.5%) also played a significant role, suggesting enthusiasm among medical physicists and students in LMICs. 8.4% and 5.8% of registrants learned about GMPELS through WhatsApp and Facebook, respectively, despite these platforms not being used for promotion.

The majority of registrants (55.8%) were clinical medical physicists, with medical physics students (17.2%) and academic medical physicists (11.1%) also well represented. As of July 5, 2024, 17 GMPELS lectures had been uploaded to YouTube, garnering 2,868 views, with an average of 168.7 (±160.3) views per lecture. The most-watched lectures were on small field dosimetry (549 views), ultrasound principles (422 views), and MRI principles (412 views). Live seminar attendance ranged from 25 to 40 attendees, peaking at 78.

University of Nairobi Medical Physics for Radiation Oncology Residents Course (Sub-Section)

The course was successfully completed in May 2024, establishing a strong relationship between the University of Nairobi residency program and RAD-AID. As a result of this partnership, US-based radiation oncologists initiated a separate clinical lecture series six months after the physics course began.

Georgetown Public Hospital Medical Physics for Radiology Residents Course (Sub-Section)

The expanded 2024 course also saw high engagement, with residents praising the quality of instruction and interactive elements. All residents passed the final exam, with scores exceeding 70%. The recorded lectures will be made available on the RAD-AID Learning Center for use by other programs.

Radiation Treatment Planning Workshop (Sub-Section)

The two workshops attracted 98 registrants from 14 countries, with the majority (90.8%) from sub-Saharan Africa. Figure 1B illustrates the geographic distribution, with Nigeria accounting for 63.3% of registrants, largely due to one author's personal contacts. Figure 2C highlights the African region's dominant representation in this initiative. Figure 2D shows that 89.8% of registrants came from English-speaking countries and former British Empire nations.

The workshops provided hands-on training in treatment planning, and participants expressed appreciation for the practical, applied focus. Recordings of the sessions will be included in the RAD-AID Learning Center for broader dissemination within the organization.

DISCUSSION

As previously noted, RAD-AID International is a nonprofit organization established in 2008 with the mission of addressing disparities in global radiological health services. Dedicated to improving access to radiology for underserved and resource-limited populations, RAD-AID pursues its goals through the donation of radiological equipment, the provision of hospital support, and a robust commitment to educational outreach [38]. The organization operates in partnership with more than 100 hospitals across over 40 countries, as illustrated in Figure 3, and its impact is driven by a diverse network of over 16,000 volunteers. Embracing a holistic approach, RAD-AID incorporates expertise from radiologists, technologists, nurses, and other professionals to comprehensively address the multifaceted needs of radiology programs worldwide [39]. A relatively recent addition to RAD-AID's cohort of initiatives is the medical physics operational program. Each of the projects described in this manuscript was led by a medical physicist volunteering within this program, or by a dosimetrist working under the radiation oncology operational program in the case of the treatment planning workshops. This multidisciplinary collaboration exemplifies RAD-AID's commitment to fostering innovative solutions and sustainable impact in global radiological health care.

The COVID-19 pandemic [40] has profoundly transformed how humans communicate and interact with their environment [41]. Beginning in March 2020, as societies were forced into isolation, human interactions adapted by shifting to virtual platforms such as Zoom and other online tools [42]. This shift revolutionized education across all levels, from elementary schooling to adult and professional education [43]. Given the inherently long-distance nature of global health initiatives, these virtual strategies were swiftly integrated into numerous global health applications [44]. Virtual communication has become so pervasive that distance, once a significant barrier, no longer poses the same constraints. Many of the authors regularly participate in weekly virtual meetings with colleagues in Africa and Asia, discussing research, clinical collaborations, and mentoring relationships with physicists and students across the globe. While challenges persist, particularly regarding internet connectivity in LMICs, especially in rural sSA [45], the virtual revolution of the past five years has significantly expanded opportunities. These advancements have enabled medical physicists and students in some of the most remote regions to access educational initiatives offered by physicists in high-income countries (HICs). The global medical physics educational programs detailed in this manuscript are a direct outcome of these technological advancements, promising to redefine the landscape of medical physics education in LMICs and bridge long-standing gaps in access and opportunity.

The GMPELS was established on the belief that quality medical physics education should be accessible to all, regardless of geographic location. In HICs, it is easy to overlook the relative accessibility of advanced medical physics education [46]. This acknowledgment is not intended to trivialize the time, effort, and financial sacrifices required in HICs but rather to underscore the profound disparities in access globally. Opportunities in the field are highly geographically heterogeneous, presenting significant barriers for those in LMICs, where graduate education programs and clinical residency training are often unavailable. The corresponding author, having undertaken multiple mission trips to radiology and radiation oncology departments in LMICs—including five in Africa and one in Asia—has repeatedly observed the immense challenges faced by aspiring medical physicists in these regions. Without local programs, pursuing education often necessitates relocation to North America, Europe, or Asia, a financially prohibitive prospect for many. While funding opportunities through the IAEA and nonprofit organizations exist, they are highly competitive due to the comprehensive support they offer [47]. It was against this backdrop that the GMPELS and treatment planning workshops were initiated. These efforts, while modest in scope, aim to address this entrenched issue and provide a framework for broader solutions. The hope is that such initiatives inspire further collaboration and participation in LMIC-HIC educational exchanges. With a critical mass of medical physicists contributing diverse expertise, the establishment of an online medical physics graduate program for LMICs could become feasible. These initiatives were conceived and executed with this long-term vision in mind, seeking to create meaningful and sustainable change in global medical physics education.

The GMPELS was originally envisioned as a platform to address topics particularly relevant to physicists in LMICs, with a focus on lower-cost technology solutions. However, during the registration process, participants were invited to suggest future lecture topics, and many expressed interest in advanced, high-cost technologies such as proton therapy [48], MRI-guided radiotherapy [49-53], functional imaging [54-56], and specialized procedures [57, 58]. Attendees frequently conveyed their enthusiasm for learning about these advanced subjects, even if such technologies are not yet feasible in their countries, highlighting the limited opportunities they have to gain exposure to these topics. In response to this feedback, GMPELS has sought to balance its original focus on fundamental medical physics concepts and low-cost technologies with the inclusion of lectures on advanced techniques. This gradual integration reflects the evolving needs and aspirations of its audience while continuing to prioritize the accessibility and practicality of the curriculum for participants in LMICs.

Kenya, an East African nation situated along the Indian Ocean, shares borders with Somalia, Ethiopia, South Sudan, Uganda, and Tanzania. Its largest research university, the University of Nairobi, is located in the country's highland capital city, Nairobi [59]. The official languages of Kenya are Swahili and English [60], the latter a legacy of British colonial rule, which spanned from 1895 to 1963 [61]. In many African nations, cancer care is often centralized in the capital city, significantly limiting access for much of the population [62]. Recognizing this challenge, Kenya's Ministry of Health is actively working to improve treatment accessibility and decentralize cancer care across the country [63]. To achieve this, the Ministry has outlined plans to establish twelve regional cancer centers and two national referral hospitals distributed throughout Kenya [64]. Figure 4 provides a comprehensive visual representation, illustrating Kenya's location within Africa [Fig. 4.A], the University of Nairobi's position within Kenya [Fig. 4.B], and the planned locations of the proposed cancer centers [Fig. 4.C].

Cancer control in sub-Saharan Africa (sSA), and in LMICs more broadly, represents a growing and multifaceted challenge. A recent Lancet Oncology Commission [65] on cancer in sSA projected that over the next 15 years, an additional 5,000 megavoltage (MV) radiotherapy units will be required to achieve equity in cancer care. While this figure highlights the scale of the need, the issue extends far beyond simply increasing the number of MV units to meet the commonly cited benchmark of one MV unit per million people [66]. These units must also be strategically distributed to ensure accessibility for the entire population, and facilities must be staffed by personnel with the requisite education and training to deliver safe and effective care. For instance, in Kenya, if all MV units were concentrated in the capital city of Nairobi, a patient requiring radiotherapy in Lokichogio would face a journey of over twenty hours to access treatment. For many individuals in rural sSA, where a substantial proportion of the population survives on approximately $1 per day [67], the economic and logistical barriers of traveling such a distance for weeks of treatment are insurmountable. In larger countries with less developed infrastructure, such as the Democratic Republic of the Congo, patients may be located even farther from the nearest treatment facility, exacerbating issues of geographic accessibility. Given these realities, it is essential that governments in sSA and other low-resource settings adopt a deliberate approach to decentralizing radiotherapy services. By following the example of Kenya's Ministry of Health, which has committed to spreading radiotherapy centers throughout the country, other nations can work toward equitable access to cancer care, addressing not only the quantity but also the distribution of radiotherapy resources.

However, there are sufficient challenges associated with staffing twelve new cancer centers. To run a radiation oncology department, one needs radiation and/or clinical oncologists, medical physicists, radiation therapists, and nurses. Since so many new centers will be opening in the coming years, it is necessary to train these individuals within the country. A medical physics master's program was recently created in Kenya, as was an online forum through which medical physicists can exchange ideas [68] within the country. In addition to RAD-AID's physics work in Kenya, the organization Medical Physics for World Benefit (MPWB) is also quite active there. However, radiation oncologists and radiation therapists also need to understand a great deal of medical physics to safely practice in their field. After starting a very large radiation oncology physician residency program by the standards of even large academic institutions in HICs, with twenty-six residents, the program leadership at the University of Nairobi reached out to RAD-AID for assistance in their residents' physics training which spurred the course described above. Presumably, many other LMIC institutions are in a similar predicament, needing physics training for their physician trainees, so it could be extremely fruitful to offer a similar medical physics course to many LMIC institutions throughout the planet simultaneously.

Guyana, an English-speaking nation on the northern coast of South America, borders Venezuela, Suriname, and Brazil. Nestled along the Caribbean Sea, it is one of the most sparsely populated countries in the world, with much of its southern region enveloped by the vast Amazon rainforest [69]. The majority of the population resides near the capital city, Georgetown, situated at the confluence of the Demerara River and the Caribbean Sea. Georgetown is home to Georgetown Public Hospital, the largest hospital in the country and its principal teaching institution [70]. Figure 5 provides a visual representation of Guyana's location within South America [Fig. 5.A] and the position of Georgetown Public Hospital within the country [Fig. 5.B].

As noted earlier, Georgetown Public Hospital has cultivated a longstanding partnership with RAD-AID. Since the establishment of its radiology residency program in 2017, RAD-AID's Guyana regional program has played an integral role in the clinical education of its residents. In 2021, an initial physics course was coordinated for the residents. At that time, however, the RAD-AID medical physics group was newly formed and still in the process of gaining traction and expanding its volunteer base. Feedback from the residents following the 2021 course provided valuable insights that informed significant curriculum improvements. By 2024, the course had been refined to be more comprehensive and rigorous, tailored specifically to the needs of physician residents with limited prior exposure to physics, thereby ensuring a more effective and accessible learning experience.

In LMICs, the responsibilities of medical physicists differ significantly from those in HICs, where dosimetrists typically handle the majority of radiation treatment planning [71]. In LMICs, this critical task often falls to medical physicists, consuming a considerable portion of their time, particularly in high-volume centers. While future advancements in artificial intelligence, such as the radiation planning assistant [72], hold promise for alleviating this workload, treatment planning remains the single most time-intensive responsibility for therapeutic medical physicists in LMICs today. Recognizing this challenge, and in response to registrants of the GMPELS who frequently requested topics related to treatment planning, a series of dedicated radiation treatment planning workshops was developed. These workshops differ substantially from the other three educational initiatives described in this manuscript, as they emphasize practical, hands-on learning over traditional didactic instruction. Led by experienced dosimetrists, each workshop takes participants step-by-step through the process of creating a treatment plan for a specific technique. Topics covered include simulation considerations, contouring, beam arrangements, optimization (in the case of inverse planning techniques), plan adjustments to meet physician requirements, dose calculation, plan finalization, and treatment delivery considerations. Presentations are delivered using either a live demonstration with commercial treatment planning software or an extensive series of images from a previously planned case. Each session concludes with a comprehensive discussion period, allowing attendees to ask detailed questions and collaboratively explore specific aspects of treatment planning with the presenter. The first workshop was anatomical site-agnostic, providing a general overview of treatment planning techniques. Building on its success, the second workshop focused specifically on breast cancer treatment planning, and the third workshop focused on pelvic planning.

One of the significant challenges in global health is the linguistic diversity among healthcare practitioners worldwide [73]. The majority of global health research is published in English [74], and much of the outreach within this field is conducted by English-speaking communities. This dynamic, as part of broader discussions on decolonizing global health [75], has been identified as a significant contributor to inequities within global health systems [76]. Consequently, acknowledging and addressing language dynamics is crucial for ensuring inclusivity and equity in global health initiatives. In the specific context of medical physics, language barriers are starkly evident. A study by Ige et al. in 2020 [31] documented all graduate and clinical training programs in medical physics across sSA, identifying 17 graduate programs and five clinical training programs. Notably, all were located in English-speaking countries, with no equivalent programs in French- or Portuguese-speaking nations, despite French being the official language in over 20 countries in the region. This linguistic imbalance underscores the structural inequities within the field. To better understand the linguistic and historical dynamics influencing participation in GMPELS and the treatment planning workshops, we quantified the percentage of registrants from English-speaking countries and those from countries formerly part of the British Empire. As reported, 62.4% of GMPELS registrants and 89.8% of treatment planning workshop participants were from English-speaking countries. Similarly, 70.8% and 91.8% of participants in these initiatives, respectively, hailed from countries with a colonial history tied to the British Empire. These findings highlight a significant bias in our outreach efforts, which primarily cater to English-speaking audiences. Moving forward, a more deliberate effort is required to engage medical physics learners from non-English-speaking regions. Strategies could include delivering lectures in other languages, expanding event promotion to target physicists in non-English-speaking countries, and collaborating with international organizations such as Physicien Médical sans Frontières (PMSF) [77] and Rayos Contra Cancer [78]. Such initiatives would help bridge existing linguistic divides and ensure that global medical physics education becomes truly inclusive and representative.

While didactic educational initiatives are an essential component of addressing global disparities, they represent only one part of the solution. Equally important, and not covered in this report, are clinical educational initiatives. RAD-AID's medical physics team is actively involved in a range of clinical education activities, both on-site and remote, including radiation facility shielding, quality assurance testing, imaging protocol development, and the establishment of safety programs for MRI and radiation use. Arguably, a stronger emphasis on clinical medical physics education is needed to complement didactic efforts and more effectively address global inequities in radiation oncology and radiology. Practical, hands-on training equips medical physicists with the skills necessary to implement safe, effective, and locally appropriate solutions, thereby creating a more immediate and sustainable impact on healthcare outcomes in low-resource settings.

The primary limitation of this report lies in the narrow scope of its reach. Despite attracting hundreds of attendees and garnering thousands of views online, these initiatives merely scratch the surface of the immense disparities that persist within the radiological health sciences on a global scale. By publishing this manuscript, we hope to provide a roadmap for others to replicate or to serve as a foundation for a more comprehensive, coordinated effort led by physicists from HICs to support the education of colleagues in LMICs. This report outlines four distinct categories of educational outreach activities in which medical physicists can meaningfully engage: regular didactic seminars accessible to medical physicists worldwide, a targeted medical physics course for radiation oncology residents in Africa, a parallel course for diagnostic radiology residents in South America, and practical treatment planning workshops open to physicists and dosimetrists globally. When combined with the clinical educational initiatives described above, these efforts represent an important step toward addressing the barriers that hinder equitable access to radiological health services. By fostering knowledge exchange and collaboration, initiatives like these can help mitigate global disparities in medical physics education and contribute meaningfully to the broader goal of improving global health.

CONCLUSION

The initiatives detailed in this manuscript reflect a concerted effort to bridge the significant gaps in medical physics education and training between HICs and LMICs. They illustrate the power of collaboration, innovation, and dedication in addressing the profound inequities that limit access to essential radiological health services. By integrating virtual platforms, fostering global partnerships, and balancing didactic learning with practical, hands-on training, these programs provide a model for how targeted educational efforts can make a tangible difference. While these initiatives are only a beginning, they underscore the importance of sustained, coordinated actions to equip medical physicists and allied professionals with the knowledge and skills necessary to advance global health equity. It is through continued collective efforts that the vision of accessible, high-quality radiological health care for all can become a reality.

Conflict of Interest

There are no conflicts of interest and no acknowledgements.

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