Establishment of Twinning Partnership to Improve Pediatric Radiotherapy Outcomes Globally

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ABSTRACT

PURPOSE Pediatric radiotherapy is a necessary and challenging component of oncologic care for children in low- and middle-income countries (LMICs). Collaboration between institutions in LMICs and high-income countries (HICs) has been shown to be effective in improving oncologic treatment outcomes; however, literature regarding pediatric radiotherapy twinning partnerships is limited.

METHODS Emory University has a long-standing twinning collaboration with Tikur Anbessa Specialized Hospital (TASH) for certain medical specialties. After securing institutional funding, a faculty member and a resident from the Emory University Department of Radiation Oncology set out to establish a twinning program with TASH for pediatric radiotherapy.

RESULTS Emory and TASH faculty and residents established initial communications virtually via email and video correspondence. TASH residents and faculty completed surveys regarding pediatric radiotherapy institutional and educational needs to outline goals of collaboration. Five lectures and case-based practicums were identified focused on Wilms tumor, medulloblastoma, rhabdomyosarcoma, Hodgkin lymphoma, and palliative radiotherapy. The Emory team then conducted a visit to TASH during which lectures and practicums were delivered. The Emory team directly observed and guided simulation and treatment planning procedures. TASH residents practiced decision making, simulation, contouring, and field placement for Wilms tumor cases on the basis of didactics and feedback provided by the Emory team. Additionally, a needs assessment regarding pediatric oncologic resources was completed. Clinical care pathways and standard operating procedures were drafted by collaborators. Virtual peer-review sessions were established to continue collaborations abroad and plan for next in-person visit.

CONCLUSION Collaborative efforts by global experts have helped to establish and improve treatment protocols for childhood cancer. The presented twinning experience may serve as a model for other LMIC and HIC centers for establishing similar partnerships.

ACCOMPANYING CONTENT

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INTRODUCTION

Childhood cancer is prevalent throughout the world.[1] With modern technologies and therapies, high-income countries (HICs) now report cure rates as high as 80% for children with cancer.[2,3] However, low- and middle-income countries (LMICs) struggle with lack of health care resources and infrastructure, resulting in upward of 90% of pediatric oncologic deaths occurring in these countries.[2-4] As radiotherapy is a critical component of care for children with malignancies, improving quality and access to pediatric radiotherapy services in LMICs is vital.[5]

Ethiopia is a low-income country (LIC) in sub-Saharan Africa with a multitude of distinct ethnic groups, languages, and religions.[6] It is home to an estimated 100 million people and is the second most populous country in Africa.[6,7] Previous epidemiologic data from Ethiopia suggest that at least 64,000 new cases of cancer occur annually.[7] Despite the growing population and significant cancer burden, there are numerous challenges to adequate delivery of radiotherapy in this country where it is estimated that 70% of patients would benefit from radiation at some point in their disease course.[6-10]

CONTEXT

Key Objective

How can institutions establish effective twinning partnerships between low- and middle-income countries (LMICs) and high-income countries (HICs) in pediatric radiotherapy?

Knowledge Generated

An effective twinning partnership requires the prioritization of LMIC goals and capabilities through virtual and in-country discussions, needs assessments, interactive training, and adapted resources. After in-country visits, plans for future virtual and in-country training, research, and mentorship are necessary for long-term success.

Relevance

The presented twinning experience in pediatric radiotherapy between Emory University and Tikur Anbessa Specialized Hospital may serve as a model for other LMIC and HIC institutions interested in establishing similar partnerships.

Tikur Anbessa Specialized Hospital (TASH) was established in Addis Ababa, Ethiopia, in 1961 and currently treats over 500,000 outpatients and 21,000 inpatients annually.[11] TASH is currently the largest hospital and referral center in Ethiopia.[6,11] It is home to one of three functioning linear accelerators in the country, which treats over 1,700 patients annually.[6] The School of Medicine at TASH was established in 1972 under the Addis Ababa University (AAU) and educates many medical students and residents, including 36 clinical oncology residents.[11]

Here, we present our experience establishing a partnership between TASH (LIC institution) and the Emory University (HIC institution). Collaboration between institutions in LMICs and HICs has been shown to be effective in improving oncologic treatment outcomes and is recommended by the WHO.[12–18] However, it is difficult to create and sustain such affiliations, and literature regarding pediatric radiotherapy twinning partnerships remains scarce.

METHODS

Residents and faculty from various specialties at the Emory University had been traveling to Addis Ababa, Ethiopia, for 1-month long clinical rotations at TASH since 2012, including one radiation oncology resident in 2018.[19,20] The previous radiation oncology resident focused his time on training in head and neck contouring for intensity-modulated radiotherapy (IMRT) because of the recent installation of a linear accelerator at TASH.[20] Despite these previous visits, a long-term relationship had not been created with the radiotherapy department at this institution. Notably, before installation of the linear accelerator, few pediatric patients were being treated with radiotherapy at TASH, attributable to unacceptably high toxicities with 2D techniques and lack of anesthesia capability in the radiotherapy department.[6]

Because of the long-standing relationship between Emory and TASH in other medical specialties, one radiation oncology resident and one pediatric radiotherapy faculty member set out to establish a twinning collaboration with TASH in pediatric radiotherapy in 2022-2023.[21] Prioritization of pediatric radiotherapy was supported by the leadership at TASH because of understanding of the basics of IMRT treatment planning and desire to meet WHO initiative for childhood cancer goals.[22] Institutional funding for travel and accommodations in Addis Ababa was secured through the Emory Global Health Residency Scholars Program, with additional aid from the American College of Radiation Oncology (ACRO).[19]

After securing funding, the attending-resident team developed a partnership, completed a needs assessment, and created resources in preparation for the in-person visit to TASH. The team proceeded to travel to Ethiopia for a 1-month long visit to TASH during which they delivered didactic lectures, conducted interactive training, and adapted resources. Upon return to the HIC, plans for future collaboration were established.

RESULTS

Partnership Development

Emory and TASH radiotherapy faculty and residents initially established correspondence virtually via email and video 5 months before the expected in-country visit. Clinical faculty, physics faculty, dosimetry faculty, and clinical residents were included in correspondence. TASH faculty and residents were encouraging and supportive of partnership development. Communication challenges included different time zones, scheduling around multiple faculty members, poor Internet connectivity, and language barriers.

Needs Assessment and Gap Analysis

To identify goals of collaboration, a pediatric radiotherapy needs assessment survey was developed by the Emory

faculty and the resident (Fig 1). Needs assessment questions were completed by radiation oncology clinical faculty members at TASH. Initial questions focused on current general departmental radiotherapy needs, including number of radiotherapy machines, brachytherapy capability, and staff capacity. Additional questions centered on details of pediatric oncology practices at TASH, including number of pediatric radiotherapy patients treated, availability of pediatric trained radiotherapy staff, anesthesia capabilities, and challenges and priorities for pediatric radiotherapy at TASH. Following completion of the questionnaire, team members met virtually to discuss the results.

Results of needs assessment indicated that TASH houses one functioning linear accelerator using 6 megavolts (MV) and 16 MV energies. Treatments have been initiated on this machine since November 2020. Capabilities include 3-dimensional conformal radiotherapy, IMRT, volumetric modulated arc therapy, and electron therapy. There are also two cobalt-60 machines; however, typically one or both are nonfunctioning. One high-dose-rate brachytherapy machine with cobalt source is available for gynecological treatments. There are no other radiotherapy services available at TASH.

There are seven clinical oncology faculty at TASH who serve as both radiation and medical oncologists. Four medical physicists and eight radiation therapists are employed in the department. Thirty-six clinical oncology residents are currently in training at AAU. One hundred thirty to 150 patients are treated with radiotherapy daily at TASH. Greater than 70% of both adult and pediatric cases are treated with palliative intent, as the majority of patients present with advanced disease. Pediatric patients with curative disease are prioritized for radiotherapy.

The pediatric hematology and oncology department provides chemotherapy services at TASH, with additional outpatient chemotherapy services available at a satellite location, Amestengha. Over 900 pediatric patients with cancer (0-18 years old) are seen or treated per month. Pediatric patients are seen or treated in the TASH inpatient ward (50-60 patients per month), the TASH pediatric emergency ward (80-100 patients per month), and at Amestengha (750-850 patients per month).

Six thousand to 8,000 patients with pediatric cancer are seen at TASH annually. More than 900 of these patients are new diagnoses, most commonly including Hodgkin lymphoma, medulloblastoma, Wilms tumor, neuroblastoma, rhabdomyosarcoma, and palliative cases. Pediatric patients come to TASH from all geographic regions in the country and sometimes neighboring countries; however the majority are from areas nearby Addis Ababa because of socioeconomic barriers. One clinical oncology faculty member, one medical

Pediatric Radiotherapy Needs Assessment Questions

General Questions:

1. How many radiotherapy machines are available at your institution? Please describe the machines:
2. How many brachytherapy machines are available at your institution?
3. Please describe any other radiotherapy services at your institution:
4. How many radiotherapy physicians work at your institution?
5. How many radiotherapy trainees are at your institution?
6. How many medical physicists work in the radiotherapy department at your institution?
7. How many radiation therapists work in the radiotherapy department at your institution?
8. How many total patients are treated annually at your institution?

Pediatric Specific Questions:

1. How many pediatric patients are treated annually at your institution?
2. From which geographic regions do pediatric patients come from?
3. Which machines are used for pediatric radiotherapy patients?
4. How many radiotherapy providers treat pediatric patients?
5. What percentage of pediatric patients are treated with palliative intent?
6. Please describe anesthesia capability available at your institution:
7. Please describe any multidisciplinary pediatric oncology activities at your institution:
8. Please rate your comfort level in treating pediatric patients: very comfortable, comfortable, neutral, uncomfortable, very uncomfortable:
9. Please describe your current pediatric radiotherapy regimens and protocols in detail:
10. Please describe your challenges when treating pediatric radiotherapy patients:
11. Please describe your priorities for improving care for pediatric radiotherapy patients:
12. Please describe any interests, needs, or questions regarding pediatric oncology that you have not mentioned above:

FIG. 1. Image of needs assessment questionnaire.

physicist, and one radiation therapist received pediatric specific training at the Children Center Hospital, Egypt.

Anesthesia services are available for pediatric patients; however, challenges include coordination and equipment availability. Pediatric multidisciplinary tumor conferences occur weekly with medical oncology, radiation oncology, surgical oncology, radiology, pathology, and residents. Radiotherapy protocols from Children's Oncology Group and International Society for Pediatric Oncology (SIOP) are used routinely and are chosen on the basis of the disease presentation and availability of resources.

Challenges with pediatric radiotherapy at TASH (Table 1) include lack of radiotherapy machines available for use in the country. Difficulty accessing existing radiotherapy machines and frequent machine downtime result in significant treatment delays and interruptions. There is a shortage of pediatric immobilization devices and inadequate on-board imaging, preventing swift and accurate treatments. Furthermore, there is a shortage of pediatric radiotherapy–trained and dedicated faculty and staff to develop pediatric-specific protocols and guidelines. Infrastructure and supportive resources that are needed include child-friendly waiting and consultation rooms, play therapy, psychosocial support, nutrition support, and anesthesia support. Many patient families travel from remote parts of Ethiopia for treatment and struggle with transportation and lodging. Difficulties with care coordination between disciplines make it challenging to implement combination treatment protocols and appropriate time radiotherapy. There is poor coordination with palliative care and pediatric oncology for toxicity management, supportive care measures, and disease surveillance.

TABLE 1. List of Challenges for Adequate Pediatric Radiotherapy Delivery on the Basis of Needs Assessment and In-Country Observations

Category	Challenges
Physical resources	Lack of available radiotherapy machines Limited access to and frequent downtime of radiotherapy machines Shortage of pediatric immobilization devices Lack of child-friendly waiting and consultation rooms Lack of anesthesia resources, including drugs and equipment
Technical resources	Inadequate on-board imaging Two energies available for use on linear accelerator (6 MV and 16 MV) Few computers in department for treatment planning Few treatment planning software licenses, including lack of remote treatment planning capability
Personnel	Lack of pediatric radiotherapy-trained and dedicated faculty and staff, including physicians, radiation therapists, physicists, nurses, and additional support staff Lack of pediatric anesthesia trained faculty and staff Lack of pediatric palliative care trained faculty and staff to manage toxicities and goals of care Lack of repair maintenance personnel
Support resources	Lack of child life specialists and play therapy Limited access to nutrition support Lack of pediatric palliative care services
Care coordination	Difficulty coordinating care with pediatric anesthesia for diagnostic imaging, simulation scans, and radiotherapy delivery Difficulty with coordinating timing of radiation treatments in relation to chemotherapy and surgeries Poor coordination with pediatric oncology for follow-up and disease surveillance
Patient and family barriers	Lack of health insurance Difficulties with transportation and lodging

Abbreviation: MV, megavolt.

Pediatric radiotherapy goals for TASH included (1) mentorship and training for professionals, (2) strengthening of multidisciplinary teams, (3) creation of clinical care pathways, (4) expansion of resources and infrastructure, and (5) development of organized and specialized pediatric oncology services and processes (Fig 2).

Action Planning

After needs assessment and goal delineation, Emory and TASH teams created outlines and resources to prepare for in-country visit. The schedule included introduction and orientation to TASH radiotherapy department, didactic lectures, and interactive training (Table 2). Didactic lecture topics chosen were commonly seen pediatric radiotherapy cases identified on needs assessment, including Wilms tumor, medulloblastoma, rhabdomyosarcoma, Hodgkin lymphoma, and palliative radiotherapy. Interactive training focused on highest-impact pediatric malignancies and available cases.

Didactic Lectures

The Emory team arrived in Addis Ababa in February 2023. The Emory team delivered five didactic lectures over the course of 2 weeks to faculty and residents in the radiotherapy department (Data Supplement). Lectures focused on evidence-based guidelines and protocols adapted for LMIC setting. After each lecture, there was an opportunity for discussion between Emory and TASH team members regarding specific processes and challenges at TASH for each disease. Discussion informed interactive training with TASH team and future initiatives.

Interactive Training

The Emory team observed radiotherapy simulation, treatment planning, and radiotherapy delivery at TASH while in-country. Interactive training of residents and radiation therapists for pediatric computed tomography (CT) simulation was completed on the basis of available patient cases during visit, including Wilms tumor, rhabdomyosarcoma, and Hodgkin lymphoma. Direct observation and feedback were provided regarding patient setup, use of immobilization devices, isocenter placement, and CT imaging processes.

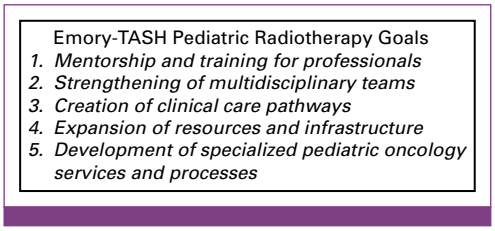

FIG. 2. Goals of Emory-Tikur Anbessa Specialized Hospital (TASH) collaboration, delineated from needs assessment.

Treatment planning and plan evaluation training sessions were led by the Emory team for groups of five to eight AAU residents at a time. Wilms tumor was chosen as the focus of these training sessions. Multiple Wilms cases were prepared by TASH residents. Contouring, field placement, treatment planning, and plan evaluation of these cases was completed by the Emory team in an interactive fashion. After these sessions, TASH residents independently completed decision making, treatment planning, and plan evaluation for additional Wilms cases and presented them to the Emory team for review.

Adapted Resources

Clinical care pathways and standard operating procedures (SOP) for Wilms tumor and craniospinal irradiation (CSI) were adapted from Emory resources (Data Supplement). Emory resources were chosen to facilitate collaboration between Emory and TASH team members. Wilms tumor clinical care pathways focused on the ideal CT simulation setup and treatment planning guidelines. CSI SOP was created in collaboration with Emory and TASH medical physicists and dosimetrists, with a focus on details of treatment planning and delivery goals.

TABLE 2. Outline of Schedule for Emory-TASH Collaboration

Week	Scheduled Activities
Week 1	Introductions and orientation to the department by TASH team Wilms tumor and medulloblastoma didactic lectures delivered by Emory team Direct observation and feedback of simulation procedures, treatment planning, plan evaluation, and radiotherapy delivery procedures with a focus on Wilms tumor by Emory team Meeting with multidisciplinary team, including pediatric oncologists
Week 2	Rhabdomyosarcoma, Hodgkin lymphoma, and palliative radiotherapy didactic lectures delivered by Emory team Direct observation and feedback of simulation procedures, treatment planning, plan evaluation, and radiotherapy delivery procedures with a focus on rhabdomyosarcoma and Hodgkin lymphoma by Emory team Independent decision making, treatment planning, and plan evaluation presented at session by TASH residents, moderated by Emory team
Week 3	Development of standard operating procedures for craniospinal irradiation by Emory-TASH teams Direct observation and feedback of simulation procedures, treatment planning, plan evaluation, and radiotherapy delivery procedures by Emory team
Week 4	Development of clinical care pathway for Wilms tumor by Emory-TASH teams Direct observation and feedback of simulation procedures, treatment planning, plan evaluation, and radiotherapy delivery procedures by Emory team Development of plans for future collaboration

Abbreviation: TASH, Tikur Anbessa Specialized Hospital.

Future Partnership

Before departure from Ethiopia, Emory and TASH teams established goals for continued collaborations abroad and plans for next in-person visit. Notably, virtual peer-review sessions were established on a monthly basis to review pediatric radiotherapy cases and maintain regular contact. Contact information for Emory experts in pediatric radiotherapy was distributed to the TASH team to facilitate future virtual discussion of complex cases.

Furthermore, one faculty and one resident at TASH presented data pertaining to the Emory-TASH collaboration at an international conference after the visit. TASH faculty and trainees were also invited to Emory for an in-person visit for additional training. Emory team members planned for yearly in-person visits to TASH, as funding permits. Evaluation of twinning partnership will occur on an annual basis through discussion of progress in Emory-TASH pediatric radiotherapy goals (Fig 2). There will be an opportunity to modify or add new goals.

Impact Measurement

All clinical oncology faculty members at TASH who deliver radiotherapy (n = 5) received pediatric radiotherapy didactic training from an expert in the field, compared with only a single faculty member receiving pediatric-specific training previously. All clinical oncology residents at TASH rotating on radiation oncology (n = 8) during the in-country visit received pediatric radiotherapy–specific didactic and interactive training. Notably, all residents had never or minimally (0-5 cases) contoured pediatric cases, put on fields for three-dimensional (3D) Wilms cases, or put on fields for 3D CSI cases. After the Emory team visit, all participating clinical oncology residents had completed six new pediatric radiotherapy cases with guidance of an expert in the field. Two cases included placement of fields for Wilms and two cases included placement of fields for CSI cases. Emory and TASH teams have participated in two virtual pediatric peer-review sessions to date. During these sessions, four pediatric cases were reviewed with minor or major changes made to all cases.

Costs

There was no cost to virtual partnership activities. Costs of in-country visit included the price of round-trip flights for the two Emory team members, in addition to 1 month of hotel accommodations and food. There were no costs for TASH team members; however, there was significant time investment required for participation in didactic and interactive training.

DISCUSSION

Progress in pediatric radiation oncology is the result of the efforts of collaborators around the globe. We identified strategies to improve collaboration between radiotherapy institutions in HICs and LMICs to improve childhood outcomes internationally. After comprehensive preparation and needs assessment, we successfully developed a twinning partnership between TASH and the Emory University with the goal of sustainable enhancement of pediatric radiotherapy outcomes in Ethiopia. This collaborative relationship may be replicated at other institutions.

Previous literature regarding pediatric radiotherapy in LMICs focus on epidemiology, barriers to radiotherapy delivery, and patterns of care.[2-10] Data regarding solutions to these challenges are limited; however, institutional partnerships between radiotherapy departments represent one such avenue. Twinning partnerships have been effectively implemented in other medical specialties, including emergency medicine, psychiatry, and infectious diseases.[12,13,21-23] However, to our knowledge, this is the first outline of a formal implementation in pediatric radiation oncology. The International Atomic Energy Agency supports the use of twinning partnerships to improve pediatric radiotherapy delivery in LMICs because of the excessive variation in pediatric cancer outcomes.[24]

Barriers to creation of successful twinning partnerships exist in both HICs and LMICs. Notable challenges with communication among collaborators include time zone differences, language barriers, cultural practices, and scheduling difficulties.[25-27] The remote environment has eased some of these obstacles using virtual meetings and telehealth tools. Collaborators in LMICs often struggle with lack of resources, poor health care infrastructure, high patient volume, minimal ancillary support, ethical challenges, political uncertainty, and provider burnout.[28-30] Many factors lack the possibility of immediate resolution.

Collaborators in HICs often struggle with difficulty in procurement of funding for global health endeavors, minimal postgraduate training in global health competencies, unfavorable attitudes toward global health among departmental leaders, and difficulty adapting HIC guidelines to LMIC contexts.[31-36] Improving access to funding, training, and mentorship in global health among HIC providers would facilitate successful twinning partnerships.

Global health partnerships between HICs and LMICs are often criticized for lack of sustainable and meaningful change. For example, HIC collaborators may export novel technology without providing education to LMIC providers regarding the proper indications and use. Furthermore, HIC providers may use LMIC relationships to fill their curriculum vitae with publications, rather than prioritizing LMIC needs.

A limitation of our experience is the lack of long-term follow-up to provide an in-depth assessment of impact. Monthly peer-review sessions enable identification of the number of changes made to pediatric radiotherapy plans secondary to partnership. Additional areas of interest include measurement of patient-specific outcomes, including survival and toxicities, and measurement of changes made to institutional pediatric oncology practices.

Our twinning experience provides guidelines for prioritizing LMIC goals through initial needs assessment and virtual discussions with LMIC teams. Time spent in-country should be focused on adaptive training for LMIC providers. LMIC collaborators must take ownership of academic endeavors. Furthermore, routine communication must be continued after in-country visit to create sustainable improvements. With the support of HIC collaborators, two providers at TASH were able to submit data to international conferences after Emory's visit. Virtual Emory-TASH peer-review sessions encourage continued collaboration and open communication.

Collaboration between HICs and LMICs may provide opportunities to improve childhood cancer outcomes globally. Prioritizing LMIC goals and capabilities through discussion, needs assessment, and adapted resources is essential for an effective twinning partnership. Our experience may serve as a model for other centers interested in establishing similar partnerships.

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