A MEDICAL PHYSICS PEER SUPPORT FORUM FOR MEDICAL PHYSICISTS IN KENYA

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***Abstract*— While many Low-to-Middle-Income-Country (LMIC) focused radiotherapy educational efforts are directed at oncologists, few opportunities exist for medical physicists. To fill this gap in Kenya, a Kenyan Physicists Forum (KPF) was created. The forum is open to physicists at any Kenyan radiation therapy centre with the goal of hosting monthly online meetings to discuss medical physics topics of interest to the participants. Invitations were sent to previously established contacts requesting participation in an informational survey and approval from an immediate supervisor in order to verify alignment with local learning objectives. The survey yielded information about the applicants' backgrounds, work environment and aspirations for the forum. Meetings took place online. Discussion topics were chosen by the Kenyan physicists and sessions were either seminar or discussion based. Eleven meetings were held in the first year, each attended by 4-12 people. Over the year, the forum grew from 12 to 22 members by word of mouth. After one year, a 'Help us improve' survey was sent to all participants and included questions with both rating scale and free text responses. Eight physicists completed the 'Help us Improve' survey. The average score for rating scale questions was 10.4/14. Based on the one year survey responses, the forum is performing reasonably well. Barriers to participation were availability and technology connectivity problems. Meeting discussion choices revealed the diversity of practice, with some centres being ready for IMRT, while others were just embarking on 3D planning. A key positive effect of the forum: increased connections among Kenyan physicists. The survey also highlighted interests in advanced technology, artificial intelligence, and research. The Kenyan Physicists Forum is a useful model for interacting with and assisting LMIC physicists.**

Keywords— **LMIC, Physicists Forum, virtual meetings.**

I. Introduction

There are many organizations assisting Low-to-Middle-Income-Countries (LMICs) with building their capacity to treat cancer patients[1]. A main contender in this space is the International Atomic Energy Agency (IAEA), which assists countries with their radiation therapy infrastructure from design to staff training[2,3]. Another prominent contributor is Radiating Hope, an organization which helps provide radiation equipment to LMICs and assists with installation and training[4]. EmpowerRT provides an inexpensive alternative to provide IMRT on non-MLC linear accelerators using compensators[5,6]. Rayos Contra Cancer is a United States based organization which offers education and training for radiation oncology professionals in LMICs through multi-institutional collaborations referred to as "Telehealth Brigades"[7,8]. Many other efforts focus on education and are often directed at physicians [9,10,11,12,13]. Even when the audience is a mix of oncologists, medical physicists and therapists, the educational materials focus more on the process of therapy and less on the technology that supports it. Outside of these efforts, there is no clear help for everyday issues for medical physicists in LMICs, who often work with no or few colleagues. In an effort to fill this gap for physicists in Kenya, a solution modeled on oncology rounds was implemented. However, instead of presenting a particular patient treatment challenge, the focus was on challenges related to medical physics. To this end, the Kenyan Physicists Forum (KPF) was created and opened to physicists at any Kenyan radiation therapy centre. The goal of the KPF is to provide a space for Kenyan physicists to meet online on a monthly basis to discuss medical physics topics of interest to the participants.

II. Background

Prior to beginning this project, both authors had some initial contact with radiation treatment facilities in Kenya. SP visited Kenyatta National Hospital in Nairobi[14] and MvP visited the Moi Teaching & Referral Hospital in Eldoret. The concept of a forum was conceived by MvP after attending a number of seminars directed at radiation oncology departments in LMICs and observing many interactions between oncologists or surgeons[9] on different continents. During background research, MvP came across an article in the Washington Daily News about SP's visit to a cancer centre in Nairobi in 2017[15]. The authors connected via e-mail to discuss being co-directors of a

forum for medical physicists and agreed this was an interesting and feasible idea.

The goal of the forum was to provide an opportunity for Kenyan medical physics trainees and practicing physicists to discuss challenges and solutions related to physics problems encountered in modern radiotherapy techniques. Kenyan physicists would be invited to lead and/or participate in topics most relevant to them. Regularly occurring distance learning web-based sessions were chosen as the platform in order to enable real time interactions.

III. Materials and methods

To begin the forum, formal invitations were sent to contacts requesting both approval from an immediate supervisor and participation in a basic informational survey. The supervisor's approval was meant as assurance that the goals of the forum were in line with the trainee's departmental learning goals and objectives. The survey provided information about the background of the physicists, the environment in which they worked, and their aspirations for the forum. Due to the limited initial contact list, participants were encouraged to distribute the invitation to their interested colleagues.

Beginning in November of 2018, meetings took place online once per month using either Gotomeeting, Skype or WebEx. Each meeting focused on a medical physics topic chosen by the Kenyan physicists. Topics of interest during the first year were CTSim QA, linac commissioning, HDR QA, IMRT H&N planning, IMRT QA and beam modelling for treatment planning systems. For two of the topics, CT Simulation QA and Linear Accelerator Acceptance Testing and Commissioning, pre-meeting surveys were conducted to better assess the current practices and needs of the participants. 1.5 hours were allocated for each session. If a seminar lecture seemed appropriate for a given topic, one of the KPF directors would seek out an expert who was likely to have a presentation available. At the conclusion of the meetings, either slide sets or video recordings were provided to the participants depending on which were available.

After 1 year, participants were asked to evaluate the forum. A questionnaire consisting of both rating scale and free text response questions was distributed to the attendees and used to assess the effectiveness of the meetings, reasons for non-attendance and to request input for improvements. The questionnaire was sent via Google Forms to all forum members with a request to return responses within two weeks. Questions based on a rating scale were set up so that a higher number reflected a better result. The questions addressed scheduling, communication during sessions, time allotted to Q&A, utility of answers, how much was learned during each session, the usefulness of the information shared for each topic, whether participants watched the video recording, and whether access to the video was found to be useful. The latter two were 'yes' or 'no' questions; the others were rating questions with a scale from 1 to 4. Responses to open answer questions were collected and investigated for common themes.

IV. Results

Invitations to join the forum were e-mailed mid-August of 2018. Since the inaugural meeting on November 5, 2018, 10 additional meetings have occurred. Meetings are generally attended by 4 – 12 people, with 6 people attending regularly. The number of sessions per topic ranged from one to four and each session lasted for the full scheduled time of 1.5 hours.

The group has grown by word of mouth from 12 to 22 people and also includes one member from a country other than Kenya. The 22 participants are associated with 12 different institutions that include three public institutions, seven private institutions, one university, one government regulatory agency (See Figure 1) and one non-Kenyan institution not included in the figure. The number of participants per institution range from one to five with one institution having five participants (large public hospital) and seven institutions having one participant (See Figure 2). The technology used by the participants includes Cobalt-60 teletherapy machines, linear accelerators, high dose rate (HDR) brachytherapy units, and CT Simulators. An additional linear accelerator at a public centre is expected to come on-line in by early 2021. The types of treatment planning employed by the facilities range from 2-D manual planning to IMRT and/or VMAT treatment planning. Seven participants reported themselves as students or trainees. The reported years of experience for those working as medical physicists ranged from one to eight with an average experience of 4.5 years.

Fig. 1 Participation in the KPF by number of participants per institution.

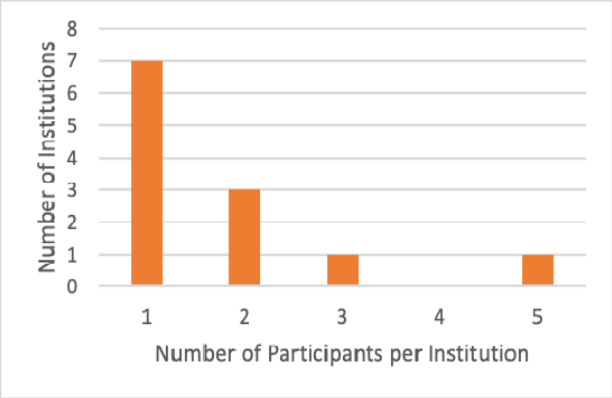
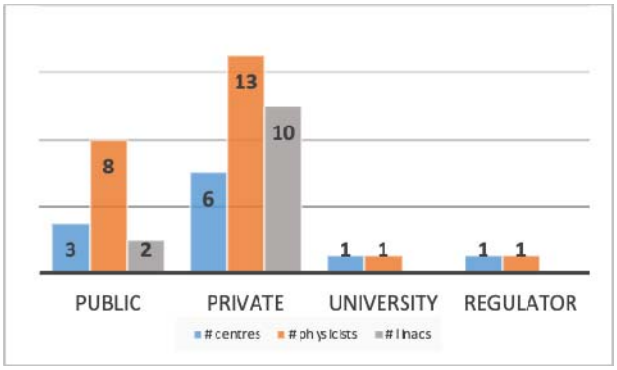


Fig. 2 Participants by institution type and number of external treatment machines per institution.



Four centres responded to the CT Simulation pre-meeting survey. All four centres had access to multi-slice CT simulators (4 – 64 slices), but only three of the four had appropriate accessories for radiation therapy planning such as a flat table-top and lasers for marking isocentre. Two of the centres had a CT simulator in their radiation oncology department, while the other two had access to CT simulators in the diagnostic departments. The physicists were able to do some QA on their scanners, but did not have access to a CTDI phantom and ion chamber, Catphan (or similar) QA phantom or an electron density phantom. None of the physicists reported having access to manuals for their CT Simulators. The results of the survey are listed in Appendix A.

Four centres responded to the pre-meeting survey about linear accelerator details. All centres had at least one linear accelerator and all were expecting new accelerators in the next two years. Vendors of current and future accelerators included Varian, Siemens and Elekta. All centres either have or have access to a beam scanning system, but one centre did not own a calibrated ion chamber. All centres had survey meters and physicists were responsible for performing radiation surveys. The planning systems used included Varian Eclipse, Philips Pinnacle (in near future), Elekta Monaco/Xio and Prowess. One centre started with a remote planning service but switched to local Eclipse planning in 2020. Linear accelerator acceptance and commissioning training ranged from none to attendance of a certificate course. Only one respondent reported having a list of data required to commission a treatment planning system. Further details of the linear accelerator survey have been omitted in order to maintain the anonymity of the respondents.

The response rate to the one-year survey was 8 out of 22 or 36% and did not include responses from members who had not attended any sessions. The overall score was 10.4/14 for the rating scale questions. The survey results are available in Appendix B.

V. Discussion

The inaugural meeting on November 5, 2018 was largely a meet and greet session. Subsequent meetings focused on a medical physics topic chosen by the Kenyan physicists. Inviting other physicists in Canada and the United States to deliver seminar lectures proved effective in that the information provided was not limited to the knowledge of two individuals.

The response rate for the two pre-meeting surveys was low, which may be due partly to the smaller number of centres participating at the time. The information provided in the surveys did provide insight into the participating centers and was considered useful by the KPF directors. However, due to the low response rate relative to the effort involved in creating the surveys, further pre-meeting surveys were not conducted.

The CT Simulation pre-meeting survey revealed a lack of QA phantoms and equipment manuals at the responding centres. During the forum session, alternative QA procedures were discussed and have been implemented by some of the Kenyan physicists. Additionally, links to on-line copies of CT Simulation manuals were shared with the participants.

The linear accelerator pre-meeting survey revealed the broad range of technology and practices among the participants. The access to 3D scanning tanks was

encouraging. Points of concern included the lack of training of some of the participants regarding linear accelerator acceptance and commissioning, and that one centre did not own a calibrated ion chamber.

During the forum sessions, online connection problems did exist and typically required 5 – 15 minutes to resolve. Occasionally, connection problems were severe enough to prevent one or two participants from attending a particular session. There were some reports of failed connection attempts and one meeting had to be rescheduled due to software incompatibilities between the host and connecting institutions. Difficulties with establishing connections persisted throughout the year and could take on the order of 15 minutes to resolve. There were also a few times when connections were lost entirely during the session, but these interruptions were brief, with the session continuing after about 5 minutes.

Meeting attendance appears to be topic dependent. The increase in group size over the year and the addition of a physicist from outside Kenya indicates that the attendees feel the forum is useful.

The response rate to the one year survey was 8 out of 22 or 36%. Response rates for surveys that collect data from individuals have been reported to average 52.7% with a standard deviation of 20.4%. [16] The response rate for the one-year survey falls within one standard deviation of this reported average response rate. The survey results showed that the forum is doing a reasonably good job, with an overall score of 10.4/14 on the rating questions. Items highlighted by the survey included the challenge of getting a large number of people from different centres together at the same time and the importance of online meeting etiquette in the form of non-speakers muting their microphones to minimize noise. Comments on the choice of topics showed the diversity of practice at the different centres, with some requesting more advanced topics such as IMRT planning and others wanting to postpone advanced topics to the future. Barriers to participation were largely two-fold: scheduling and technology problems.

The survey results, as well as a number of e-mails on the topic during the year, showed that the forum was much appreciated and reasonably effective in improving practices at Kenyan centres. The responses to "Please provide a brief description of changes to processes as a result of participation in the forum" are copied in Table 1.

The multiple requests about new technology and research opportunities was encouraging and the possibility of starting a research project within this group is under discussion. Potential publications would help Kenyan physicists achieve recognition in the field[17]. Another particularly positive outcome of the forum is the increased communication among physicists at different Kenyan centres, thereby fostering interactions and mutual assistance among them. Even before the forum started, there were some ideas about creating a physics society such as the Canadian COMP (Canadian Organization of Medical Physicists) and AAPM (American Association of Physicists in Medicine). The forum may also be able to assist with the newly created Kenyan Medical Physics Society, which has the potential to help the profession in Africa[17].

Table 1: Responses to "Please provide a brief description of changes to processes as a result of participation in the forum"

Improved my understanding, as such no changes implemented so far
We started doing some CT QA at XXX cancer center
Member mobilization
I would wish we focus more on IMRT,VMAT and Beam modelling since many centres now are planning to role out the technique
Even though we had commenced attempts at CT QA, we did not realize that we didn't have some phantoms requisite for performance of some of the tests until during the sessions. We've since sought alternatives about the CT QA.
We have introduced slice thickness as part of QA in our CT simulator We are doing absolute dose measurement for the CT sim I also learnt tips for planning a good IMRT plan and since then am so happy with my plans
I have been enlightened in all the topics discussed. This has greatly affected my planning especially IMRT and IMRT QA. HDR QA also improved what we have always been doing as a center

Conclusion

A Kenyan Physicists Forum was created with the aim of assisting Kenyan physicists with increasing their access to knowledge on topics related to medical physics. In the first year the forum has grown from 12 to 22 members (excluding the authors) and has received positive feedback

with regard to improvement in processes and practices. The main challenges are scheduling and connectivity.

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Appendix A CT Simulation Pre-Meeting Survey

Questions:	**Survey Responses**			
	Respondent 1	**Respondent 2**	**Respondent 3**	**Respondent 4**
Are CT Simulation specific scan protocols used for CT Simulations?	No	Yes	Yes	Yes
What slice thickness is typically used for CT Simulation patients? (Check all that apply)	3 mm	2 mm; 3 mm	3 mm; 5 mm	3 mm; 5 mm
What kV is typically used for CT Simulation scans? (Check all that apply)	120 kV	110 kV	120 kV	100, 110, 120 kV
Is automatic exposure control used on your CT Scanner?	Yes	Yes	Yes	No
Do you currently perform QA on the CT Scanner?	No	Yes	No	Yes
How often is CT Scanner QA performed? (Check all the apply)	We are planning to start performing	Daily	Semi-Annually; Daily warm up	Daily warm up; Annually
Who completes the QA? (Select all that apply)	N/A	Physicist; Radiation Therapist	X-Ray Technologist; Biomedical Engineers	Service provider
Do you have access to CT Simulation QA Equipment?	No	Yes	Yes	Yes
Do you have access to a daily laser QA device or a similar device?	No	Yes	No	Yes
Do you have access to a daily CT scanner QA device or a similar device as shown below?	Yes	Yes	Yes	Yes
Do you have access to a laser QA phantom similar to this one?	Yes	No	Yes	Yes
Do you have access to a Catphan QA phantom?	No	No	No	No
If you have access to a Catphan QA phantom, what model is the phantom?	N/A			
Do you have access to a CTDI phantom and ion chamber?	No	No	No	No
Do you have access to an electron density phantom?	No	No	No	No
Do you have manuals for all of your QA equipment?	No	Yes	No	No
If you are missing any manuals for QA equipment, please list them below.	There is no manual	-	None is available	-

Appendix B. First year 'Help us Improve' survey results from 8 participants

Tables below give the number of responders who responded as given in column heading.
Numerics above tables indicate points system used in assessment.

Please rate the following on a scale from 1 – 4

	1	**2**	**3**	**4**
	Bad	Needs Improvement	Acceptable	Excellent
Scheduling of session	0	0	4	4
Communication during session	0	0	3	5
Time allotted to Q&A	0	2	2	4
Utility of answers to questions	0	0	3	5

Please rate how much your learned during the sessions on each topic

	0	**1**	**2**	**3**	**4**
	Did not attend	Nothing new	Something new	Improved understanding	New full understanding
CTSim QA (4)Dec-Mar	1	0	3	3	1
Linac Commissioning (2) Apr-May	1	0	1	6	0
HDR QA (1) Jun	1	0	1	5	1
IMRT planning (1) Jul	0	1	2	5	0
IMRT QA (1) Sep	1	1	1	4	1
Beam modelling (1) Oct	3	0	2	3	0

How useful was the information shared during the sessions?

	0	**1**	**2**	**3**	**4**
	Did not attend	Not useful	Will affect future process	Improved existing process	Newly implemented in clinic
CTSim QA (4)Dec-Mar	3	0	1	2	2
Linac Commissioning (2) Apr-May	2	0	4	1	1
HDR QA (1) Jun	2	0	2	4	0
IMRT planning (1) Jul	1	0	3	3	1
IMRT QA (1) Sep	0	0	3	5	0
Beam modelling (1) Oct	3	0	2	2	1

If you did not attend the forum online session, did you watch the video recording of the session?

	0	**1**
	No	Yes
CTSim QA (4)Dec-Mar	3	3
Linac Commissioning (2) Apr-2May	3	3
HDR QA2 (1) Jun	3	3
IMRT planning (1) Jul	2	4
IMRT QA (1) Sep	2	3
Beam modelling (1) Oct	1	4

Regardless of whether or not you attended the online forum session, do you find having access to recordings of the sessions helpful?

0	**1**
No	Yes
2	6

Short answer questions – answer summaries

1. **What would make it easier for you to participate?**
   Early notice of topic and date
   Resend link to meeting the day before the meeting

2. **What can we do to improve the sessions?**
   Choose topics that are relevant to most centres – leave advanced topics till later
   Keep requesting non-speakers to mute their microphones
   More time for Q&A, at least 30 minutes
   Start focusing on advanced techniques since most centres are switching to IMRT/VMAT

3. **Please describe other barriers to participation in the forum**
   Timing of the meetings; perhaps they should be later in the day
   Technology barriers, malfunction of connectivity, sound quality

4. **Please provide a brief description of changes to processes as a result of participation in the forum**
   Improved QA processes
   Better communication among Kenyan physicists
   Better plans

5. **What would keep you most interested in attending future sessions?**
   Depends on topics discussed
   Workshop of conference

6. **Please suggest topics for future sessions**
   SRS
   SBRT
   LDR brachy (prostate)
   Treatment planning algorithms
   Small field dosimetry

Radiobiology – compensation for missing treatment
MU calculations
Commissioning for IMRT
Beam modelling
QA
3D H&N planning in Eclipse (also other sites)
Commissioning a Truebeam/Vitalbeam
Incident reporting
Monte Carlo in RT
Research openings/collaboration in RT
Technology advances in RT
More IMRT, VMAT and beam modelling
Machine learning, AI in RT
Imaging in RT
Applied nuclear medicine physics
Calculation algorithms
HDR source calibration
IMRT planning review