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ORIGINAL ARTICLE

RADIOLOGY RESIDENTS' PERCEPTION OF WORKING AND TRAINING FROM HOME DURING COVID-19 PANDEMIC

Tesfaye Kebede, MD[1*], Bethlehem Eyob, MD[2]

ABSTRACT

Introduction: *The spread of coronavirus disease 2019 (COVID-19) pandemic disrupted the personal and professional lives of many throughout the world. To mitigate the spread of the virus, Addis Ababa University introduced an online teaching/learning method which minimized the physical engagement of faculty members and residents. Online teaching is a major shift in the history of the country's oldest and largest university.*

Objectives: *This study aimed to investigate how trainees managed to cope up with the sudden changes in the teaching/learning system, and assess the ensuing satisfaction with the new method of teaching/learning.*

Methods: *Descriptive research design was implemented and analysis of variance (ANOVA) and T-tests were used to test hypotheses. Analysis of data collected from 58 radiology residents found that, the residents appreciated the participatory nature of the newly introduced online learning method.*

Results: The results showed that residents have accepted the new teaching/learning method and are satisfied with it. Furthermore, tests of hypotheses revealed that there is no significant difference in level of satisfaction between female and male residents as well as throughout the three years of radiology residency training.

Conclusion: *The new method of teaching/learning has a positive acceptance among trainees and there was high level of satisfaction with the new method. Poor internet network, reduced in-person mentoring, failure to make engaging discussions due to large number of participants were the common challenges to online teaching in the setting.*

Key words:*COVID-19 Pandemic, Radiology Residents', teach and work from home*

INTRODUCTION

Since its discovery in Wuhan Province of China in December, 2019, it took COVID-19 only few months to become the number one global health issue. Slow reaction from political and health sector regulators immensely contributed to the virus' fast spread in different parts of the globe infecting nearly more than 35 million people and claiming the lives of millions of people(1, 2). As we are in the middle of the pandemic, no authoritative source could predict the exact impact of the pandemic and remains as subject for future research. One thing for sure is the life of human beings surviving the pandemic will never be the same.

Most importantly, despite various efforts to cure the virus, both modern/scientific and indigenous/ traditional knowledge-based(3-5), neither of them brought fruit. The basic recommendations from prominent scientists and international health organizations such as WHO and health sector regulators are keeping physical distance and staying at home as much as possible.

The demand for primary care physicians and medical specialists in the developed world was among the outstanding research inquiries over the last several decades (6-9). Hospital-based physicians such as radiologists and anesthesiologists, who once were at the higher level of job insecurity are now among the physicians at the greatest demand (10).

The issue of shortage of medical professionals, primary care physicians as well as medical specialists, needs no scientific enquiry when it comes to the developing world. Over those long years, regulators and hospital administrators throughout the world have endeavored to bridge the gap through various mechanisms including working extra hours and working from home.

The advent of technological innovations beginning from late 20th century has made working from home easier and comparative studies have also shown that working from home is as effective as medical center based services (11).

[1] Associate professor at Department of Radiology, College of Health Sciences , Addis Ababa University.
[2] Final year Radiology resident at Department of Radiology, College of Health Sciences , Addis Ababa University.
*Corresponding Author E-mail: kebedetesfaye@yahoo.com

Despite its contribution in alleviating the shortage of radiologists (12, 13), working from home has also adversely affected their health, social life, and professional productivity (14) resulting in stress (15) . The ever increasing need for real-time imaging interpretation has forced radiologists to even work extra hours beyond their regular working hours (14).

Global and national health sector organizations such as WHO and National Health Ministries promoted 'staying at home' among the first line preventive mechanisms to survive the pandemic. As a result, the pandemic compelled professionals around the world to stay at home and work from home. Working from home has become the 'new normal' for medical and non-medical professionals. For radiologists, though, working from home is not a phenomenon triggered by the COVID-19.

Unlike the practices in other parts of the world, 'working and teaching/learning from home' is a new phenomenon for developing countries like Ethiopia. Although the change in learning modality will definitely have an impact on trainees, discerning whether this impact (positive or otherwise) is worth investigating. The current study aimed to investigate how trainees managed to cope up with the sudden changes in the teaching learning process, assess the ensuing satisfaction with the new method of learning, and draw important lessons that must be either sustained or treated in the aftermath of the pandemic.

METHODOLOGY

Research Approach and Design

The study followed a mixed research approach whereby quantitative data were used to measure satisfaction and its association with respondent's attributes (specific objectives 1 & 2) and qualitative data using open ended questions were also used to identify the challenges of the new teaching and learning method introduced due to coronavirus pandemic. The study also followed descriptive research design for the level of satisfaction of radiology residents and to identify the challenges and opportunities of working and teaching from home in pandemic situation.

The Research Setting

The current research was conducted at Addis Ababa University, College of Health Sciences, Department of Radiology where a total of 25 academic staffs are working in the facilities of Tikur Anbessa Specialized Hospital. The Department has a Radiology Residency Teaching Program involves direct patient contact while performing radiological procedures such as ultrasound, contrast studies of the gastrointestinal systems and interventional radiology.

At undergraduate level, radiology course is given as a short course, as a result, graduate medical doctors have limited exposure as to the discipline. The residency, on the other hand, includes doing radiological procedures like Ultrasound (US), intervention, fluorography procedures and interpretation of the findings as well as interpreting other cross-sectional imaging like Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI). This is also the practice in all radiological services throughout Ethiopia (16).

In Tikur Anbesa Specialized Hospital about 200 radiographs (X-rays) are taken and more than 120 patients are scanned with US in four exam rooms on each day. More than 60 patients are scanned with CT and 20-30 patients have MRI performed daily. In addition, about 20-25 US and/or CT-guided interventions are done by the department weekly. As part of the residency training program, all cases except ultrasound studies are also discussed daily in groups in each departmental unit which constitute 10-12 trainees including the consultants. Therefore, before the interruption following COVID-19 pandemic, in one reporting room with an area of 57.6 square meter, there will be 50-60 people discussing and reporting at a time.

Besides the consultation sessions, as part of the teaching learning process, trainees have daily afternoon teaching sessions from 1:30pm–3:00pm where all residents and staffs meet together to discuss on imaging of patients. The other activity of the department is daily interdepartmental joint conferences which take about 60-75 minutes to discuss cases which need collaborative discussions for clinical management. In the department conference room which is 57 sqm there will be more than 120 people. Following the pandemic beginning from March 2020, most of the residency program's activities went online to allow faculty members and trainees to work, teach and learn from home except for minimum possible physical gathering to sustain the departmental daily routines.

Data Source and Collection Methods

The research subjects were trainees of a three-year residency program at Department of Radiology in College of Health Sciences, Addis Ababa University during the academic year 2019/2020. The trainees were at first, second or third year of the residency program. In order to attain the objectives of the study, the researchers used primary source of data collected using a self-administered questionnaire. Therefore, the questionnaires were administered both in print and online versions.

While participants were encouraged (through email and text message reminders) to fill the questionnaires online to avoid physical contact; the principal means of the virus' spread, some willing participants preferred to complete the printout version of the instrument.

Since the face-to-face learning system was aborted in the middle of the academic year and was immediately replaced by the online learning system due to the surge of the global pandemic in Ethiopia, the study participants had the chance to recall their past experiences and provide feedback by comparing the two alternative systems of learning. Hence, in the survey, the residents were asked to compare the participatory nature of the newly introduced teaching learning method and to rate their satisfaction with it. They were also requested to list the challenges they face and the opportunities they explored due to the change in methods of instruction following measures to mitigate the impact of the pandemic. In order to avoid potential bias from power balance (Venaktesh et al., 2019); a bias that may happen if the survey is conducted by the trainer researcher (the first author) who is a faculty member of Department of Radiology, the survey was administered by the student researcher (the second author).

Hypotheses

In line with the second specific objective of the study, the researchers posit that satisfaction with the new method of learning might be affected by the participant's gender and her/his level of residency study (whether the trainee is from Year-I, Year-II or Year-III). Accordingly, the following two research hypotheses are formulated.

H_1: There is a significant difference in the level of satisfaction between female and male radiology residency program trainees.

H_2: There is a significant difference in the level of satisfaction among trainees from the three levels of radiology residency program.

Method of Data Analysis

The quantitative data collected was analyzed using descriptive statistics tools. Besides the descriptive statistics analysis, T-test and ANNOVA were used to test the two hypotheses; i.e. whether there is a difference in the level of satisfaction among gender groups and levels/years of residency study. Furthermore, the open-ended responses of participants were coded to extract common themes using qualitative data analysis tools.

Ethical Considerations

The authors obtained ethical approval from the Research and Ethics Committee of the department of radiology of the College of Health Sciences at Addis Ababa University and informed consent was obtained from the study participants.

RESULT

The following sub-sections provide analysis of data collected from radiology residency trainees pursuing their study in a developing country that introduced online-based learning in response to mitigating the spread of COVID-19.

A total of 58 respondents participated in this research among which 74% were male and 26% were female respondents. Forty-one percent of the respondents were in their first year of training, and those in second and third years of training accounted for 33% and 26% respectively.

Satisfaction with the New Learning System

Satisfaction with online learning system was measured by 10 items adapted from Sun et al., 2008(12). Some of the ten items were modified by the authors to fit the residency training situations in the University. The 10 items measuring students' satisfaction with the new online method of learning try to capture satisfaction from three different perspectives: (1) whether they support the decision (at department and at university levels) to resume the training program despite the pandemic situation, (2) whether they want to take online courses in the future or recommend the new method of teaching continued to be applied after the end of the current crisis, and (3) the nature of the courses and the way they were delivered. (Table 1)

All of the ten items measuring satisfaction have above average results. Besides, the minimum average satisfaction level per item was item number 10 where the average satisfaction rating was 6.15 out of 7 (Std. Dev. 1.15) (Table 2). This finding clearly indicates that on average, the new method of teaching/learning has a positive acceptance among radiology residents at Department of Radiology, Addis Ababa University.

Table 1: Descriptive statistics of Radiology residents' satisfactions with presentations and case discussions at TASH, 2020

Items	Mean	Std. Deviation
The Department's decision to continue residency teaching via the Internet was a wise one	6.67	0.57
If I had an opportunity to take another course via the Internet, I would gladly do so	6.52	0.71
I am satisfied with the University's decision to resume residency classes via the online teaching modality	6.45	0.98
I was disappointed with the way the on-line courses are worked out(R)	6.24	1.08
I would recommend my Department to continue teaching my junior fellows on-line	6.19	1.13
I was very satisfied with the on-line courses delivered by my Department	6.19	1.05
I will take as many courses via the Internet as I can in the future	6.11	1.16
Conducting the course via the Internet made it more difficult than other courses I have taken (R)	5.79	1.37
I feel that this e-learning served my needs well	5.69	0.94
If I had it to do over, I would not take the courses I am currently taking via the Internet(R)	5.68	1.68
Overall	6.15	1.15

* Questions Marked with (R) mark were reverse coded

Table 2: Descriptive statistics of *Radiology residents' perception of* Participatory nature of case discussions and seminar presentations at TASH, 2020

Items	Mean	Std. Deviation
I received prompt comments from instructors during my presentations	6.00	1.06
My instructors consider web-based online learning using different technologies useful	5.93	1.08
I received prompt comments on case consultations I seek online	5.17	1.48
I received prompt comments from classmates during my presentations	4.86	1.66
Overall	5.50	1.41

Participatory nature of the presentations and case discussions

We measured the participatory nature of case and seminar presentations using four questions. The first three questions evaluated the trainer to trainee dimension of the relationship while the fourth question focused on another important element of the relationship-the trainee-to-trainee relationship.

In the current study, participants had a higher average rating (5.50) for the participatory nature of presentations (Table 2) Further investigation of the individual components of the participation revealed that the trainer-to-trainee relation was a significant contributor of the observed higher satisfaction level. However, the trainee-to-trainee relationship has been impaired due to the introduction of the online learning system (4.86 out of 7).

Based on this finding we recommend that to increase students' satisfaction (17), trainers in Department of Radiology shall make consideration and facilitate student-to-student interactions in future online lectures and case presentations.

The effect of Respondents' Attributes on Level of Satisfaction

Besides the higher level of satisfaction with the new online based learning method observed from the descriptive data, in line with the second research objective, we wanted to further investigate whether there was a significant difference between different trainee attributes: the gender groups and level of residency training, by testing the two research hypotheses. The hypotheses in null and alternate/research forms are:
The subsequent two subsections present the test results and their interpretations.

Test of Difference in Satisfaction among Gender Groups

To test first hypothesis that *'there is no significant difference in the level of satisfaction between female and male radiology residency program trainees'* the two tailed test results were used. P value of 10.08% is well above 5% level of significance implying failure to reject the null hypothesis (Table 3).

Therefore, we concluded that there is no significant difference in the level of satisfaction with online learning system introduced by the Department of Radiology; the new teaching learning method served the needs of both female and male radiology trainees.

Table 3: Two-Sample t-Test showing the difference between male and female residents' satisfaction with online learning system at TASH, 2020

	Female	**Male**
Mean	6.29	6.11
Variance	0.12	0.49
Observations	15	43
Hypothesized Mean Difference	0	
Df	48	
t Stat	1.295	
P(T<=t) one-tail	0.1008	
t Critical one-tail	1.677	
P(T<=t) two-tail	0.2016	
t Critical two-tail	2.011	

Test of Difference in Satisfaction among Different Years of Residency Study

Due to the difference in the level of rigor, nature of courses, level of supervision, and learning objective in the different years of radiology residency training, the researchers were also interested in knowing whether there is a difference in the level of satisfaction with the new online system of learning among first, second and third year radiology residency trainees. This was done by testing the null hypothesis that '*There is no significant difference in the level of satisfaction among trainees from the three levels of radiology residency program.'*

In testing the difference in levels of satisfaction among the different levels of study, we had a single factor (satisfaction with online learning method) and three levels of study (first, second and third year radiology residency training). Therefore, we run a single factor analysis of variance (ANOVA) test and found the result (Table 4) that there was no evidence to reject the null hypothesis that '*there is no significant difference in the level of satisfaction among trainees from the three levels of the radiology residency program*'. This result indicated that students at all levels of the radiology residency program were equally satisfied. The evidence also implied that the university's decision to resume classes was able to bring a positive fruit in terms of keeping students satisfied even in the middle of an international health crisis.

Similar to the tests of difference in the level of satisfaction among different groups of trainees, we have conducted t-tests for test of difference in perception about the participatory nature of presentation between female and male trainees. In addition, we performed ANOVA test to check whether the participation levels were the same among the different years of residency training. While the t-test confirmed that there was a significant difference in perception about the participatory nature of the presentations among the gender groups, ANOVA results indicated that there was no difference among the three levels of residency study in trainees' perception of the participatory nature of online presentation (both results not reported).

Table 4: Single Factor ANOVA showing the difference in levels of satisfaction among the different levels of residency (Resident I – Resident III) at TASH, 2020

Groups	Count	Sum	Average	Variance
R-I	15	89.04	5.94	0.4712
R-II	19	116.60	6.14	0.5836
R-III	24	151.38	6.31	0.1780

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.28	2	0.6402	1.6612	0.1993	3.1650

Results of Qualitative Data Analysis

This section presents analysis of qualitative information collected using two open ended questions in the data collection instrument. The first question requested respondents if they recommend the new system be sustained as part of the teaching learning system after the end of the pandemics. The second question on its part encouraged participants to list out the major challenges they had faced because of the introduction of the remote teaching learning system. The actual responses obtained are summarized as follows.

Analysis of open-ended responses on participants' view of whether they recommend the sustained use of the online teaching/learning system in the aftermath of the pandemic found that most trainees (72%) recommended continued use of the online learning system anticipating that the online teaching/learning system will ensure quality of training by (1) saving money, energy and time, (2) creating one-stop access to (audio, video and documentary) resources, (3) fostering experience sharing among specialists from in-country and abroad thereby building capacity of training institutions, (4) enhancing knowledge sharing between trainees and trainers in and out of the university, and (5) adding flexibility to the existing traditional face-to-face system. However the number of good reasons for recommending the online modality's use in the future, some of the participants doubted to recommend the online learning system for its disregard of in-person mentoring, failure to make engaging discussions, and neglect of practical aspects of most medical school trainings.

Finally, respondents were asked to express the major challenges they faced as a result of the introduction of online teaching/learning modality. Systematic coding and analysis of responses identified that poor internet network access, compromises practicality of trainings and difficulty of assessing trainees' engagement as the three major bottlenecks from obtaining the best out of the online teaching/learning system.

In addition, although the findings from statistical tests reveal no difference in level of satisfaction among the different levels of study, first year trainees spotted that the 'one size fits all' nature of presentations makes it difficult for them to identify and grasp the major focus areas of the discussions pertinent to their level.

DISCUSSIONS

'Working and Training from home' is a new concept introduced after the finding of coronavirus victims in Ethiopia. In many of the postgraduate specialty training programs in Addis Ababa University, teaching and learning activity was unthinkable without physical gathering of faculty and trainees before COVID-19. However, due to the spread of the virus in the country, especially in the capital city Addis Ababa (where the University is placed) students in the College of Health Sciences are obliged to continue studying amid increased spread of the pandemic by changing the mode of learning to online technology systems. Besides the health consequences (death and illness) of the pandemic, studies focusing on the psychological, socioeconomic and political consequences are beginning to emerge *(18, 19).* Education, including radiology training, is one of the sectors worst affected by the pandemic (16, 20)

Analysis of data collected from 58 radiology residency program trainees (of which 25% were female) found that, the residents appreciated the participatory nature of the newly introduced online learning method. The trainer-trainee dimension of the participatory nature of case presentations showed a higher rating. The result from measurement of the student-student dimension, however, provided an important feedback that Department of Radiology should take as potential area of improvement.

Furthermore, the result from analysis of trainees' satisfaction with the new online based teaching/learning method which requires the trainers to work from home indicates that the residents have on average higher levels of satisfaction which was also the case in other radiology institutions where virtual learning introduced during COVID-19 pandemic resulted in a high trainee satisfaction.(21) This finding implies that the trainees accepted the new method and are satisfied with it.

Hypotheses tests using t-test and analysis of variance were used to test whether there was significant difference between gender groups and the levels of years of study. The results confirmed that the satisfaction levels are the same both among gender groups and levels of residency training. Taking trainees' higher level of satisfaction as a wake-up call from the COVID-19 pandemic, the University shall use this opportunity to consider designing a teaching-learning system that blends form of the traditional face-to-face and the online learning system which was also shown to improve performance, satisfaction and engagement in medical education.(22, 23)

In addition, analysis of open-ended responses on whether participants recommend the continued use of the online teaching/learning system in the future found that the online teaching/learning system is recommended as it is believed to ensure quality of education by saving money, energy and time, ease sharing of knowledge and (audio, video and documentary) resources, and add flexibility to the existing traditional face-to-face system(22).

However, some participants expressed their view that the new teaching/learning system might disregard in-person mentoring, may not engage all attendants into discussions, and also huge reliance on the online system neglects the practical aspects of residency trainings.

The aforementioned points can take as potential areas of improvement for the radiology residency training program and thus would be a sufficient impetus for evaluating the weaknesses of the teaching learning system and start working towards a high-quality residency training program that could tap the benefits of using online teaching/ learning technologies.

Finally, when asked about the major challenges they encounter with the new modality, trainees spotted that poor internet network access, compromise of practical trainings, difficulty of assessing trainees' level of engagement and the *'one size fits all'* nature of presentations were the major bottlenecks of the online teaching/learning system.
Besides, this study has several limitations; among which are being single institution study involving a single department and didn't include faculty perceptions.

It can thus be concluded that although the coronavirus pandemic disrupted the radiology residency training program at Department of Radiology in Addis Ababa University like any other training institution, it has also given to the existing training system a timely wake-up call by bringing into light the demerits of the face-to-face that could be supplemented by introduction of online learning in the aftermath of the pandemic.

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