Original Article

Trends of radiology caseload and report turnaround time before and after COVID-19 pandemic at the tertiary teaching hospital, Addis Ababa, Ethiopia

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Abstract

Background: Coronavirus pandemic has drastically change health institutions due to modifications to the health service delivery system. In line with this, patients visiting health institutions have markedly reduced numbers resulting in a reduced caseload of practicing physicians.

Objective: This paper assessed the caseload in the radiology department of Tikur Anbessa Specialized Hospital and reported turnaround times before and after the COVID-19 pandemic in a tertiary teaching hospital.

Methods: Institution-based Cross-sectional study design was employed for the radiology caseload. All patients' groups seen in radiology department in all the modalities 6 months before and after the announcement of the COVID-19 in Ethiopia. For the evaluation of radiology report turnaround time, simple random sampling was employed using the source population as those 6 months before in 6 months after the declaration of Covid in Ethiopia. Data entry and analysis were done using SPSS version 16 statistical software. Time series analysis with 95% CI was used to determine the association between different variables for radiology caseloads.

Result: The trend of patient load showed a marked decrease after the COVID-19 pandemic in the radiology department. The turnaround time from study time to residents' report time (ST-RT) - after COVID-19 for MRI was increased by 17 hours. But resident report time to consultant verification time (RRT-CVT) was decreased by 1 day after the COVID-19 pandemic. For computed tomography [CT], ST-RT has decreased by 1 day and 4 hours but RRT-CVT time showed a slight increment by 1 hour and 30 min as compared to before COVID-19. This resulted in reduced exposure of residents and delays of verified patient reports.

Conclusion: there is a decrease in patient load and an increase in turnaround time of radiology case reports after the COVID-19 pandemic compared with the trend before the pandemic. This will affect patient care and resident teaching. The department should look for ways of improving patient care and resident teaching through different innovative methods like the introduction of virtual education and teleradiology. [*Ethiop. J. Health Dev*. 2022; 36(4):00-00]

Keywords: Patient load, Turnaround time, COVID-19

Introduction

Immediately after the first confirmed case of COVID-19-19 in Ethiopia in March 2020, the Government of Ethiopia took several public health measures to prevent increased levels of infection. These included closing all schools and restricting large gatherings and movements of people(1).

Radiology departments worldwide, including the radiology department at TASH, instituted policies and procedures designed to continue the radiology service and education during the COVID-19 pandemic and temporarily postponing all nonemergent imaging examinations and interventions(2, 3). Since it was mandatory to avoid transmission among radiology staff, institutions took additional measures to implement social distancing like spacing reporting, developing shift systems, and working remotely from home (2). Online platforms were established for the exempted faculty members and those who are sick and staying at home to access the imaging server and make timely reporting of the imaging studies.

Though Tikur Anbesa Hospital was not a COVID-19 treatment center until this research was conducted, but it took its preparedness measures by closing all undergraduate programs except final year medical students who were part of the management team to control the spread of the infection among the staff and patients. Some of these measures included making the staff work on schedule, establishing the phone clinic where follow-up patients were accessed via phone calls, and making necessary measures and advice.

In actual terms, patient load and faculty workload are not synonymous since there are activities beyond actual reporting of exams like protocoling, managing flow, assessing and counseling patients, communicating results to patients, referring physicians, and discussing emergency cases with emergency doctors.

Delays in result reporting can lead to dissatisfaction among referring providers and their patients(4). Radiology report turnaround time (TAT) is one metric frequently used as a marker of radiologist efficiency(5). The definition of TAT varies and must be viewed in the eyes of the primary stakeholder. For example, the referring healthcare provider may consider TAT as the time from when an order for a diagnostic imaging study is placed until results are received. In contrast, the radiologist typically views TAT as when a study is complete and available for interpretation until the final signature. So in this article, we refer to TAT as the time from which the imaging study is completed up to when the final verification of the report is made.

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While many factors are known to affect the workload and radiology report turnaround times(6, 7), the effect of the COVID-19 pandemic on these critical factors that determine the performance of the radiology department is not yet established as the disease is new to the world. Since the pandemic has brought a significant effect on the health system structure and organization, it will probably also have an effect on the workload and report turnaround time of the department. Assessing the workload and reporting turnaround time will help to know the current situation caused by the pandemic and to take the necessary measures to improve the department's activities, thereby positively affecting patient management and increasing referring physician satisfaction. In addition, it would be used as a baseline for future preparedness in subsequent waves of the pandemic and other emergencies. So this study will assess the trend of workload and report the turnaround time of the radiology department of TASH before and after COVID-19.

Material and methods
Research setting
The study was done in the Department of Radiology, College of Health Science in Addis Ababa University which is found in the capital city, Addis Ababa, which is the largest public educational institution and a specialized referral hospital in the country established in the year 1978 G.C.

The department of radiology is one of the departments of the college of health sciences which is involved in the provision of imaging services and teaching the radiological sciences and interventions. The department currently has more than 20 full-time academic staff. Except for 3 of the academic staff who are being gone training, all academics have some spatiality training in different areas of radiology. The modalities currently available in the department include x-ray, ultrasound, CT (computed tomography) scan, and magnetic resonance imaging (MRI).

Academic activities have also been reorganized, and all academic activities (seminars, resident case presentations, lectures, multidisciplinary team joint meetings, and resident case consultations with the elderly) have been held at Google conferences and zoom conferences. The residents were also divided into two groups. Only one group was allowed to come physically to the department, and the other group remained home and an exchange of the group was done every two weeks. Most radiological reports are typed and saved to PACS by faculty and/or residents of report cases.

Study design
A retrospective cross-sectional study was conducted in the radiology departments of Tikur, the Anbessa Specialized Hospital. Radiology caseloads before and after the Covid pandemic were studied. Confidentiality of the collected data was maintained by omitting patient identifiers from the study.

Inclusion and exclusion
All patients were recorded 6 months before the declaration of the COVID-19 pandemic in Ethiopia [01 September 2019-28 February 2020] and 6 months after the pandemic. [01 March 2020-30 August 2020] were included irrespective of the type of imaging study made. All imaging studies that were not sent to the department picture archiving and communication software and those that were not reported were excluded from the study.

Sample size
To calculate the radiology caseload before and after the declaration of the COVID-19 pandemic, all imaging studies were made 6 months before and 6 months after the pandemic was taken. For the report turnaround time of imaging studies, the sample size was estimated using Daniel's formula (15), where P=50%, since there was no previous reported study in the area; d=margin of error; Z=standard score, corresponding to 1.96, with a 95% confidence interval, and 5% margin of error. The total calculated sample size was 384.

Sampling procedure
All imaging studies were collected from MedWeb, the department of picture archiving and communication software [PACS]. All imaging studies 6 months before and after the pandemic were collected irrespective of the type of imaging study and report status.

All studies were categorized based on the type of imaging modality used to sample the report turnaround time. All studies not sent to the department PACS and those sent to the PACS but not reported were excluded from the list and equal proportions from each modality were taken using simple random sampling.

Study outcomes
Total radiology caseload and report turnaround time 6 months before the declaration of the COVID-19 pandemic and 6 months after the pandemic.

Operational definition
- PACS is picture archiving and communication software which are used primarily in healthcare organizations to store and digitally transmit electronic images and clinically-relevant reports securely.
- Study acquisition is acquiring a specific imaging study.
- Turnaround time: the time taken from the study acquisition to resident report time and from resident report time to senior verification time.
- Caseload/workload: the total number of patients seen in the specific modality six months before and after the identification of coronavirus disease in Ethiopia.
- None sent study: imaging studies done but not loaded on the department's picture archiving and communication software. [MedWeb]
- None reported study: examination taken and loaded on the MedWeb but not reported or verified.

Data processing and Analysis

Data entry and cleaning were done using SPSS, version 16, statistical software. Each patient study time, resident report time, and senior report time was entered into the SPSS statistical software. Frequencies, and time series analysis were calculated for each independent variable [patient load before and after COVID-19]. The trend of the dependent variables (turnaround time and total patient load for each modality) was calculated on time series analysis. Interpretation and inferences were made, and results were presented in tables and figures.

Ethical Clearance

Ethical clearance was obtained from the department's ethics and research committee. All studies were collected by removing patient identifiers. All the details of patient data and use are anonymously kept confidential.

Result

The total number of imaging studies, excluding the non-sent studies [imaging studies that were done but not loaded to the department PACS] was 22752 before and 15773 after COVID-19. There is a reduction in the total number of imaging studies done after the COVID-19 pandemic, irrespective of the type of study done.

There were a total of 138472 radiologic studies in the department archive. The number of radiologic studies done but not sent to the archive system before and after the COVID-19 pandemic was 7528 and 8553, respectively. The number of comprehensive radiologic studies which were performed but not reported report before COVID-19 was 5141, and after was 5138. As we see from table 1, there was an 81% reduction in MRI studies done after the COVID-19 declaration.

Table 1: **Total studies done before and after COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, September 2019-september 2020 G.C**

MODALITY	BEFORE	AFTER	Decreased IN %
Radiograph	8530	7022	17.7
CT	6253	4639	25.8
MR	3004	550	81.7
US	3754	2502	33.4
DOPPLER	347	265	23.6
PEDI US	782	774	1.0
PROCEDURE	82	21	74.4
TOTAL	22752	15773	30.7

All the imaging studies performed at all modalities including image-guided interventions showed a decline ranging from 17.7% up to 74.4% after the introduction of the COVID-19 pandemic except for pediatric US examinations which showed only a 1% drop after the pandemic. (Fig 1, 2, and 3). So these resulted in the diagnosis and early management of disease conditions like malignancies which may affect the subsequent survival of patients. In addition, there is a reduction in residents' exposure to the different radiological procedures which will impact their procedural skills.

Figure 1: Trend of patients load for Radiographs Radiograph before and after COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, September 2019 - August 2020 G.C
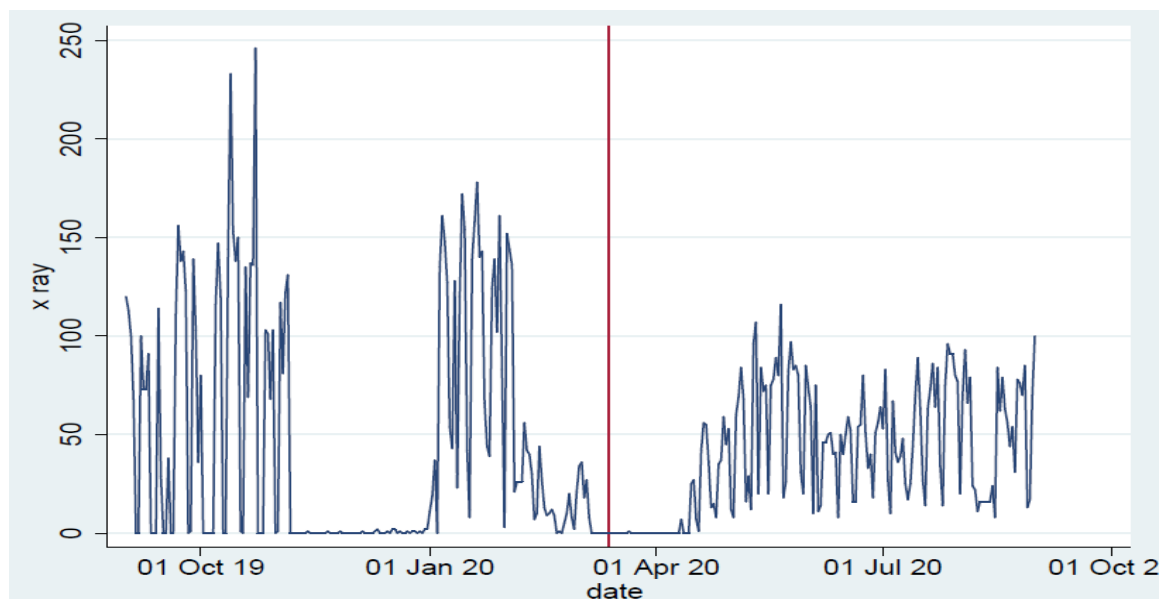
Figure 2: Trend of patients load for Computed Tomography before and after COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, September 2019 - August 2020 G.C.
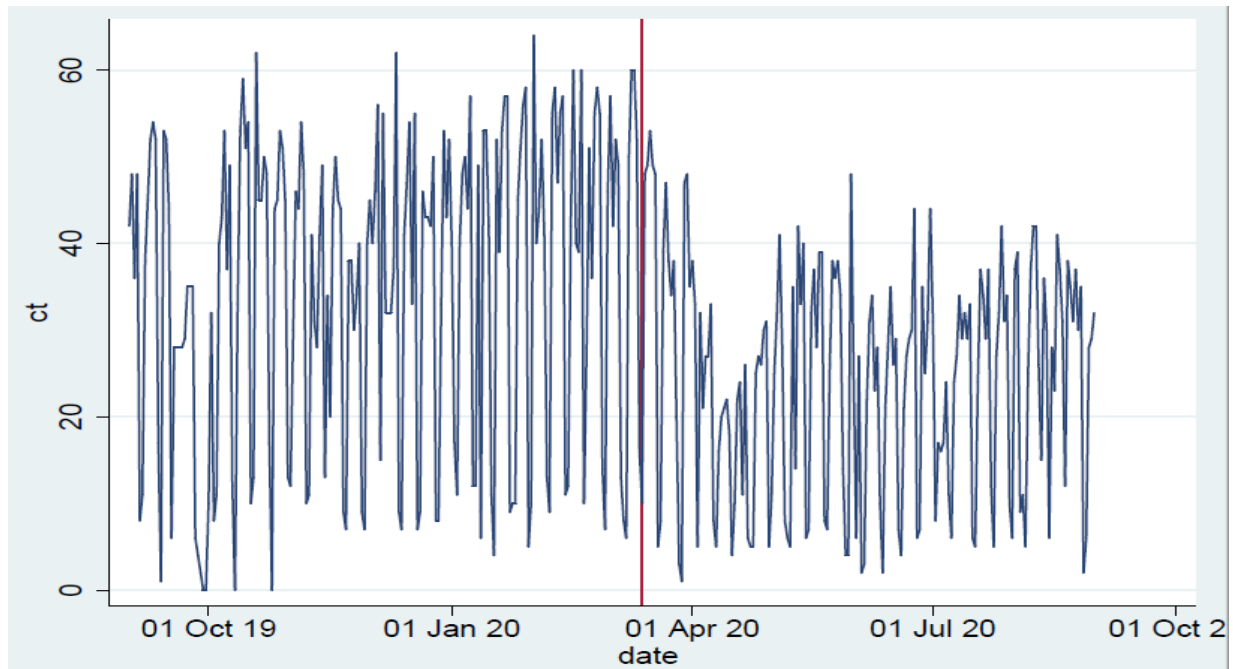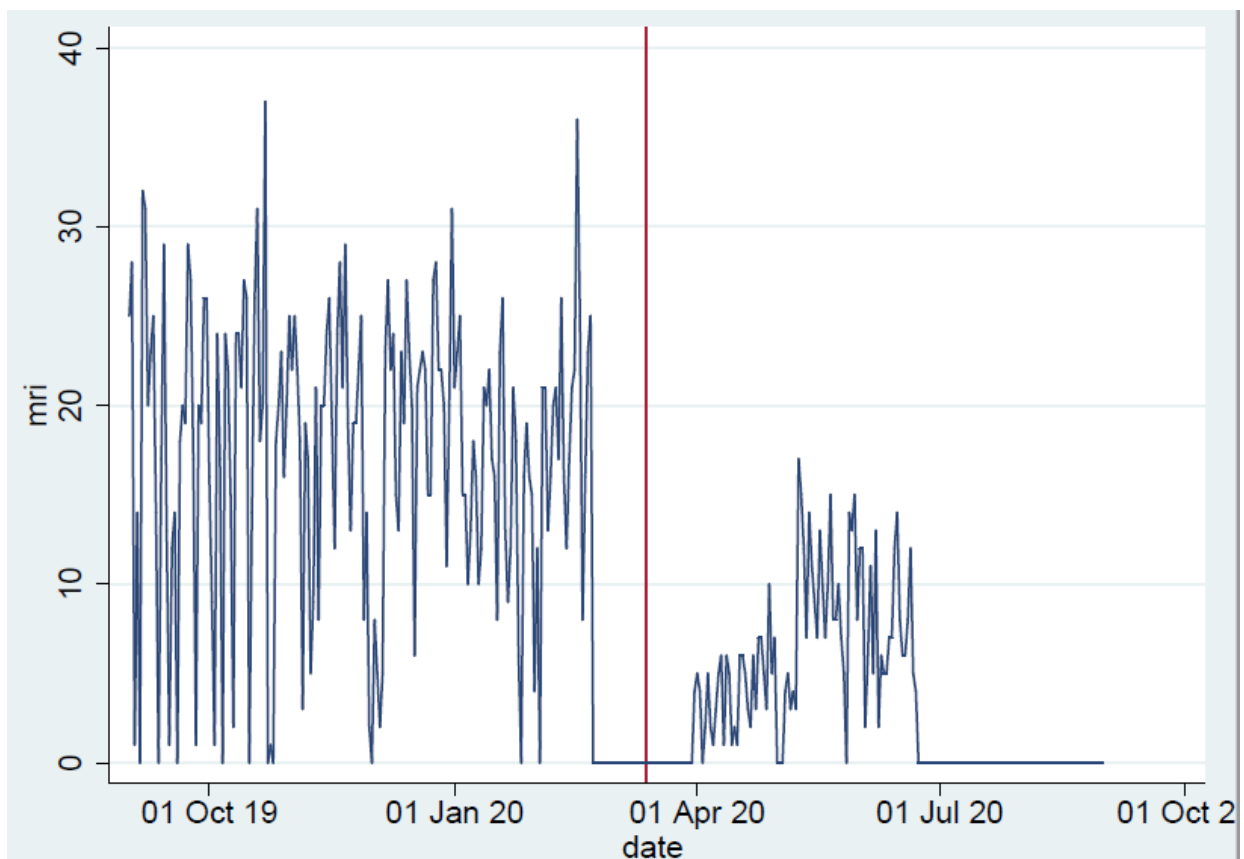

Figure 3: Trend of patients load for Magnetic Resonant Imaging before and after COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, *September* 2019 - August 2020 G.C.


Time series analysis showed variability caused by time was 45.8% (R square =0.458) which is significant (p-value = .001). Since we took equal months before and after COVID-19, the significant variability in the number of patient loads seen in each modality is caused by COVID-19 pandemic. (fig 4).

Figure 4: Time series analysis for patient loads in all the modalities before and after COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, and September 2019-August 2020 G.C

The peak image acquisition time before and after the COVID-19 pandemic was nearly similar (fig 5). The reason
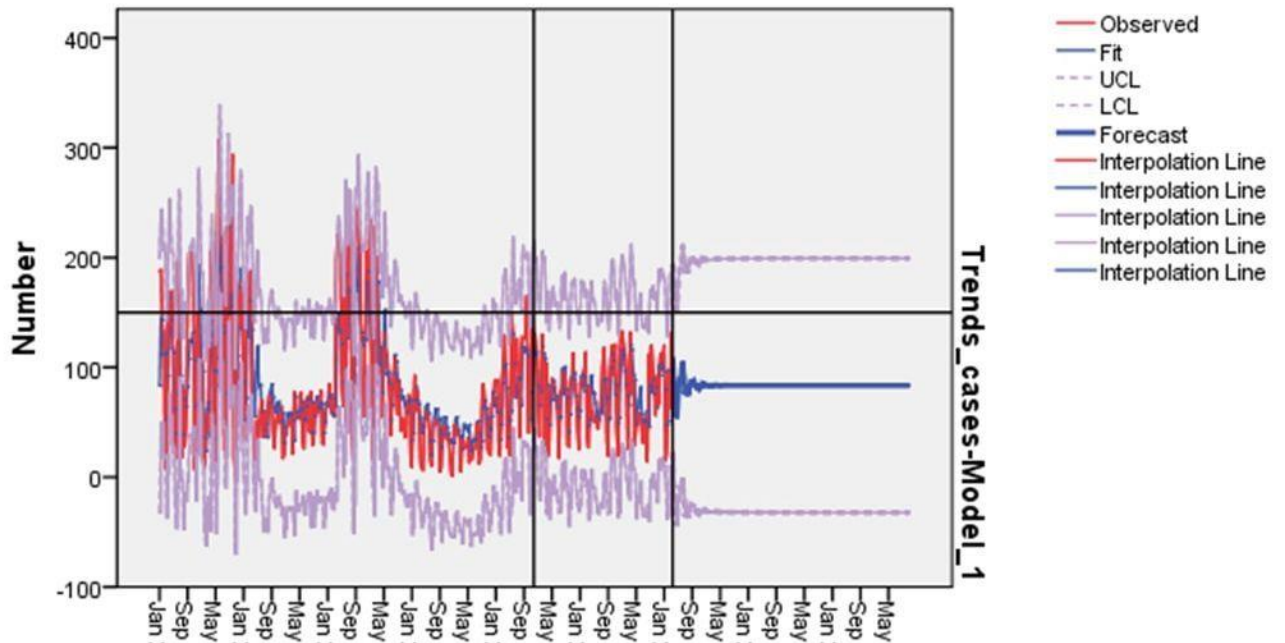
for this is that except for appointing non-emergent imaging, the image acquisition schedule was not changed after the COVID-19 pandemic.

Figure 5: Acquisition time per 24 hour before and after COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, September 2019-August 2020 G.C
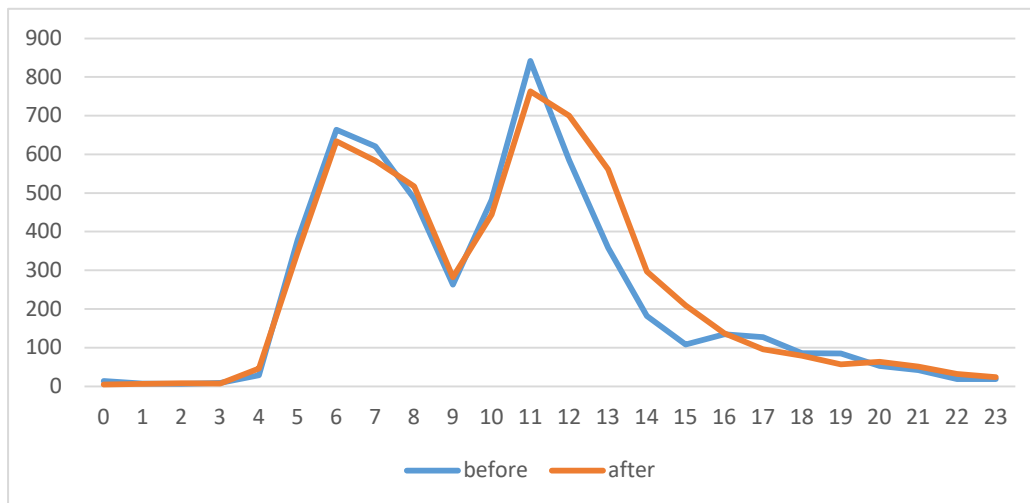
Patient load for residents and seniors before the COVID-19 pandemic

The average number of cases reported before the COVID-19 pandemic declaration by a single resident and faculty member [staff radiologist] was 4.3 cases per day and 3.2 cases per day respectively. These have decreased after the COVID-19 pandemic declaration to 3 cases and 2 cases per day, respectively (table 2)

Table 2: **patient load on residents and seniors before COVID-19, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, 2019-2020 G.C**

Before COVID-19 pandemic		
	Residents	**Seniors**
Total studies	22670	9339
Per month	94 cases/month/ resident	70.8cases/month/senior
Per day	4.3 cases/day/resident	3.2 cases/day/senior
After COVID-19 pandemic		
Total	15752	5210
Per month	65.6 cases/month/ resident	43.4 cases/month/senior
Per day	3 cases/day/resident	2 cases/day/senior

Turnaround time

As was seen in table 3, there was an overall reduction in the turnaround time of imaging reports for both ST-RRT(study time to resident report time) and RRT-SVT(resident report time to senior verification time) irrespective of the imaging studies made. There is a reduction in the total amount of time from the acquisition of the study for final verification of the report by 3 hours for MRI and 26.5 hours for CT imaging studies after the declaration of Covid. Nevertheless, academics and residents are still working as planned, which is expected to increase the turnaround time of video reports. Home teaching and work have been introduced, but the department has facilitated the reporting process and led to an overall reduction in reporting turnaround time. These resulted in reduced hospitalist stay patients for collecting their imaging reports.

Table 3: Average study time to resident report time and resident report time to senior verification time, TAT, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, September 2019-August 2020 G.C.

MODALITY	TIME/MODALITY	BEFORE	AFTER	DIFFERENCE
MRI	ST-RRT, MR	3days, 11:16	4days, 4:30	↑17 HOUR
	RRT-SVT, MR	1 day, 18:18	18:45	↓24 HOUR
CT	ST-RRT, CT	3days, 7:48	2 days, 3:23	↓28 HOUR
	RRT-SVT, CT	1 day, 6:08	1 day, 7:37	↑1.5 HOUR
Radiograph	ST-RRT, XR	2 days, 13:53	1 day, 16:18	↓21 HOUR

Paired T-test was done to compare the means of turnaround times for ST-RRT and RRT-SVT before and after COVID and showed a significant reduction for RRT-SVT for MRI after COVID-19(p-value=0.004) and delay in RRT-SVT for CT after COVID-19(p-value=0.001)   (table   4)

Table 4: Paired T test done to compare means of TAT for X-ray, CT and MRI, Tikur Anbessa Specialized Hospital, AAU, Ethiopia, September 2019-september 2020 G.C

Variable	Paired Differences					t	df	Sig(2-tailed)
				95% CI of the difference				
	Mean	**Std Deviation**	**Std Error Mean**	**Upper**	**Lower**			
ST-RRT B - ST-RRT of x ray	.89712475	5.903897404	7.81990314	-6.69390083	2.46363959	1.147	56	.256
ST-RRT B - ST-RRT A CT scan	7.138276	4.72762142	.57330831	-1.85815579	.43050056	-1.245	67	.217
RRT-SVT B - RRT-SVT A CT scan	4.2687295	5.70951831	.69238080	2.88673172	5.65072743	6.165	67	.001
ST-RRT B - ST-RRT A MRI	.12909604	6.007758087	7.82143482	-1.43653423	1.69472632	.165	58	.869
RRT-SVT B - RTR-SVT A	2.7375823	6.922429341	9.01223537	9.33587479	4.54157730	3.038	58	.004

Discussion

After the 1ˢᵗ declaration of COVID-19 infection by the Ethiopian Federal Ministry of Health, there was a progressive reduction in the radiology caseload at all levels of imaging sections; radiographs, ultrasound, CT, and MRI. There was a marked reduction in image-guided interventions too. The radiology caseload reduction is mainly due to the different measures taken by the country in general and the health institution in the department.

In addition to the marked reduction in patient load during the COVID-19 pandemic, which was also the case in other imaging departments (8), it has markedly impacted the perceived well-being and educational missions of radiology residency programs locally and internationally (9, 10). Since the discipline requires that trainees have adequate exposure to the different imaging studies, which is based on the total number of imaging studies observed, performed, and reported, the

reduction in imaging caseloads affects the department's teaching-learning process despite measures taken by the department to improve service delivery and resident education.

Despite only half of the total number of residents and faculty being scheduled to work at a time, in addition to the self-isolation of residents and faculty from work due to COVID-19 infection, there was an overall reduction in the turnaround time of studies. This can partly be explained by the simultaneous reduction of patient load and introduction of the teach and work from a home model by the department in which the few studies were continuously reviewed and reported remotely outside the institution. This also improves service delivery and reduces hospital stay for patients waiting for the imaging report.

The total number of non-sent studies to the PACS for review and reporting was slightly higher after the COVID-19 pandemic, which increased from 24.9% to 31.5 % of the total archived studies. The possible explanations for the increase in the number of unsent studies could be the increase in the proportions of emergency and trauma patients who were mostly sent to the referring physician for quick management decisions without being pushed to the archive or discussed with the resident immediately after acquisitions. Emergency imaging which needs a radiologist's opinion was pushed to the PACS system for review and reporting.

There was a statistically significant delay in the verification of the CT reports by the senior radiologist after the declaration of COVID-19 compared with the time it took before the declaration by 1.5 hours. This can be explained by the fact that some radiology consultants were exempt from working at the institution due to their increased vulnerability to COVID-19 infection. Even if remote access was established to access imaging studies from home for those exempted faculty members, working from home was difficult due to the poor Internet connectivity from both sides.

The significant reduction in report turnaround time of MRI studies, as shown in this study, was not only due to the marked reduction in the number of patients visiting the hospital for MRI studies but also because the machine stopped functioning after 2 months of COVID-19 declaration. As it is also shown in other works of literature that there is a relationship between workload and turnaround time (11).

It is a well-established fact that a well-planned PACS deployment simplifies imaging workflow and improves patient care throughout the hospital while delivering substantial financial benefits (12, 13). Using also speech recognition instead of typing reports, which is not in place in the institution which the research was conducted is also shown to increase radiologists productivity(14) which in turn also improve the TAT which is a measure of the efficiency of a radiologist (11).

Conclusion

This study showed COVID-19 had brought a significant reduction in caseload. Even if the impact of a reduction in patient load on radiology training and competency is not known so far because of the newness of the challenge faced, the department should look for means of compensating for the reduction in caseloads to keep the pace of the academics.

Authors recommend

Imaging departments have alternative measures like establishing a teaching file server [where teaching cases from the routine daily practice will be edited and collected for future teaching] to compensate for reduced radiology caseload partly and maintain resident exposure during such pandemics and future waves.

Improving access to academic staff to work from home by improving their access to Internet service will improve the turnaround time of imaging reports, especially for emergency case, improving patient care.

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