DISSERTATION

At

U4RAD Technologies LLP

(15th march 2022- 15th June 2022)

Reporting Errors in Teleradiology: A descriptive study to analyse the leading causes of reporting errors in Teleradiology**.**

By

Bhawana Dobhal

(PG/20/015)

Health IT Management

Under the Guidance of: Dr. Anandhi Ramachandran

POST GRADUATE DIPLOMA IN HOSPITAL AND HEALTH MANAGEMENT2019-21

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT AND RESEARCH

COMPLETION OF DISSERTATION

The certificate is Awarded to

Ms. Bhawana

in recognition of having successfully completed herinternship in the

Department of Radiology

and has successfully completed her Project on

Reporting Errors in Teleradiology: A descriptive study to analyze the leading causes of reporting errors in Teleradiology.

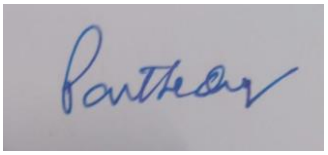
at

U4RAD Technologies

She comes across as a committed, sincere & diligent person who hasa strong drive

& zeal for learning.

We wish her all the best for future endeavors.



Mr. Partha Dey

Founder and CEO

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Ms. Bhawana** student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from International Institute of Health ManagementResearch, New Delhi has undergone internship training at **U4RAD Technologies LLP** from **14th March 2022 to 14th June 2022.**

The Candidate has successfully carried out the study designated to him during internshiptraining and his/her approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements.

I wish her all success in all his/her future endeavors.

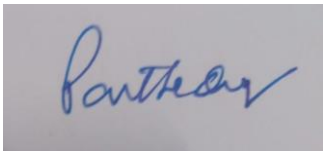
Dr. Sumesh Kumar
Associate Dean, Academic and Student Affairs
IIHMR, New Delhi

Dr. Anandhi Ramachandran
Associate Professor
IIHMR, New Delhi

Certificate from Dissertation Advisory Committee

This is to certify that **Bhawana Dobhal**, a graduate student of the **PGDM (Hospital & Health Management)** has worked under our guidance and supervision. She is submitting this dissertation titled **"Reporting Errors in Teleradiology**: A descriptive study to analyze the leading causes of reporting errors in Teleradiology**"** at "**U4RAD Technologies"** in partial fulfilment of the requirements for the sward of the **PGDM (Hospital & Health Management).**

This dissertation has the requisite standard and to the best of our knowledge, no part ofit has been reproduced from any other dissertation, monograph, report, or book.



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CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **"Reporting Errors in Teleradiology**: A descriptive study to analyze the leading causes of reporting errors in Teleradiology" submitted by **Ms. Bhawana, Enrollment No. PG/20/015** under the supervision of **Dr. Anandhi Ramachandran,** for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from **14th March 2021 to 14th June 2021** embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

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FEEDBACK FORM

Name of the Student: Ms. Bhawana

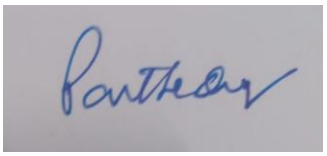
Dissertation Organization: U4RAD Technologies

LLP

Attendance: 100%

Objectives achieved: 100%

Deliverables: Worked with the IT team and provide them the requirements for software development.



Organization Mentor (Dissertation)

Date: 13-07-21

Place: Gurgaon

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I acknowledge the tremendous contribution of my guide in completion of the project right from the word goes. I would like to render my sincere thanks to **Mr. Partha Dey (Founder and CEO, U4RAD)** for providing me the opportunity to complete my dissertation.

I extend my words of thanks to all the staff for always being so cooperative and facilitating me. I am extremely grateful to my parents for their love, prayers, caring andsacrifices for educating and preparing us for our future. Finally, my thanks to all the people who have supported me to complete the research work directly or indirectly.

ORGANIZATION PROFILE

U4RAD TECHNOLOGIES LLP

U4RAD is revolutionizing radiology reporting with AI-assisted image analytics and a smart reporting toolkit.

They're revolutionizing remote radiology reporting by enabling process improvement, appropriate digital intervention, and selected AI (Artificial Intelligence) application to help Radiologists become more efficient. Their AI-assisted Radiology Reporting technology will result in higher-quality diagnoses and shorter turnaround times.

They want to double the productivity of radiologist reporting. They created an AI algorithm that can detect COVID 19 from a chest X-ray in a matter of seconds with >90%confidence, allowing it to be used as a Rapid Detection tool for the pandemic.

PUSHERS- DREAMERS- LEADERS:

Mr. Partha Dey

Founder and CEO

Partha Dey, Founder of Max Healthcare (Head Operations), Artemis Hospital Gurgaon (Chief Operating Officer), Apollo Gleneagles Kolkata (Center Administrator), Member ofCII, HIMSS, UNDP, AMCHAM and IMAI, Pioneer in promotion of AI-Cognitive technologyin healthcare, was managing healthcare vertical for IBM in India/SA, Member of CII, HIMSS, UNDP, AMCHAM and IMAI, Member of CII.

Dr. Piyush Pandit

Director and Co- Promoter

Dr. Piyush Pandit is a Senior Radiologist who specializes in MR imaging and has over 25 years of clinical experience. Dr. Pandit has a unique combination of clinical reporting anddiagnostic center management experience. He was a key player in developing new radiology imaging centers and effectively administering them as a member of the core management team in a number of businesses. Dr. Pandit has worked in reputable diagnostic institutions in Delhi, including Dr. Gulati Imaging and MR Centre, where he has created a higher level of reporting and has a great connection with referringclinicians.

Dr. Vivek Sahi

Director

A dynamic healthcare IT professional with over 24 years of experience in clinical practice, healthcare management, quality consulting, clinical change management, and healthcare digital transformation.

He is passionate about healthcare information technology and has a unique capacity tocombine clinical knowledge, healthcare management expertise, and qualitymanagement skills to clearly understand and not only resolve difficulties faced by providers and payers, but also to assist them in developing and implementing solutionsthat effectively and efficiently satisfy their needs.

He's also interested in teaching physicians about EMRs and IT systems, as well as ensuring that electronic medical/health records are adopted through change management, as well as mentoring students and physicians preparing for jobs in healthcare administration and informatics.

His areas of expertise include IT Product Strategy, Mergers & Acquisitions, Product/Solution Business Planning & Development, Clinical Intelligence/Analytics Solutions, Provider & Payer Data Warehousing, EMR/HIS Configuration & Implementation, CPOE, CDSS, BCMA, Clinical Transformation, Healthcare Provider Process Optimization, CPOE, CDSS, BCMA, Clinical Transformation, Clinical Transformation, Clinical Transformation, Clinical Transformation, Clinical Transformation, Clinical Transformation, Clinical IT Training for Physicians, Project Management, and Business Development, Product sales, telemedicine, healthcare population data management, digital transformation consulting, Big Data, Artificial intelligence, and career counselling for healthcare management students.

Abstract:

Introduction: Every year, radiologists do one billion radiologic exams, with the majority of these being interpreted by them. A written report from a qualified radiologist should accompany every imaging operation, according to the majority of professional organisations. This makes up a significant portion of what working radiologists accomplish on a daily basis. [1]

Radiologic interpretation is a complicated psychophysiological and cognitive process that is subject to broad range of errors, which includes perceptual and cognitive mistakes. Perceptual mistakes can occur when there is first recognition step of image perception. Visual mistake occurs when an anomaly is discovered retrospectively on image but it wasn't observed by radiologist at time of interpretation. A finding must be sufficiently evident and viewable in hindsight by radiologist or by opinion of his/ her colleagues to be termed a perceptual mistake. [4]

Methodology: The data is being used to analyse the different types of reporting errors in teleradiology. Non-probability Purposive Sampling method is used to choose sample. A descriptive study was carried out. The duration of the collected and analysed data is from 01st August 2021 – 30th May 2022.

Result: The average rate or error at U4RAD was found 0.3%. Total no of cases that were reported in the duration (1st august 2021- 30th may 2022) 81324. 217 teleradiology reports were analysed which includes Xray, MRI and CT reports. There were errors in these reports. Further the errors are being categorized to know the distribution of different errors in teleradiology. Fig.1 shows the errors are being categorized as incomplete history, incomplete report, missed findings (under reading), missed interpretation, negligence, review, Single study reported instead of multiple study, typing error, Wrong part mentioned in wrong study (Female reported in male and vice versa) and wrong report. Table 1 shows the most common error found in these reports was missed findings which constitutes 45% of the total errors. Typing error constitutes 14% of the total errors.

Conclusion: Errors will often occur, but some can be avoided by paying close attention to the thought processes we use, being mindful of possible prejudices and system flaws that can lead to errors, and employing all necessary available techniques to mitigate these negative factors. However, if we believe that any technique will completely eradicate radiology error, we are deceiving both ourselves and the patients who depend on our advice.

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Introduction

Every year, radiologists do one billion radiologic exams, with the majority of these being interpreted by them. A written report from a qualified radiologist should accompany every imaging operation, according to the majority of professional organisations. This makes up a significant portion of what working radiologists accomplish on a daily basis. [1]

Radiologist reports should not be considered definitive or indisputable, despite the fact that the public and even referring doctors do not always appreciate them. They are professional consultations that result in views, which are conclusions reached after a thorough examination of the data. "A view held about a specific subject or point; a judgement formed; a belief,". Although radiological diagnosis can frequently be conclusive, mostly, imaging interpretation is highly impacted by patient's clinical situations, relevant previous histories and prior imaging & a plethora of other things, such as unconscious preconceptions. [3]

It is difficult to define what constitutes radiological error in this context. The term "error" implies that there is no space for disagreement about what is "correct," and that the reporting radiologist should have been able to make the correct diagnosis or study but was unable to do so. Genuine disagreements about diagnosis or "failure" to notice an issue that can be noticed in retrospect are widespread in real life.[2]

Radiologic interpretation is a complicated psychophysiological and cognitive process that is subject to broad range of errors, which includes perceptual and cognitive mistakes. Perceptual mistakes can occur when there is first recognition step of image perception. Visual mistake occurs when an anomaly is discovered retrospectively on image but it wasn't observed by radiologist at time of interpretation. A finding must be sufficiently evident and viewable in hindsight by radiologist or by opinion of his/ her colleagues to be termed a perceptual mistake. [4]

When an abnormality is observed on a picture but its significance is misunderstood, a cognitive or interpretive error occurs, leading to the in- correct final interpretation. This kind of mistake could be caused by a radiologist's deficiency of experience, or deceptive clinical details that distort the apparent pre-test likelihood of disease; it could also be caused by a radiologist unintentionally increasing a mistake done by fellow in prior radiology report (known as satisfaction of report). [1]

Review of Literature:

Review of a number of studies that have been published and analysed the frequency of radiological errors/anomalies from 1949 to the present. Leonard Berlin has extensively written on the subject, citing studies that show a daily radiologist error rate of 3 to 5 percent and a retrospective mistake rate of 30 percent. [5] 40 million radiologist errors per year are calculated using a 4 percent error rate applied to 1 billion studies worldwide each year. [6]

Cognitive and perceptual errors are two categories often used to classify radiologic errors. When an anomaly is detected but the reporting radiologist misinterprets or fails to properly describe its importance, cognitive mistakes arise. 30 to 40 percent of all errors are cognitive errors. The more frequent perceptual error (60–80%) happens when the radiologist misses the anomaly in the first place but later realises that it was obvious [6]. Across a wide range of modalities, situations, and locales, the reported rate of perceptual mistake remains constant. [6]

A study on error categories was presented in 1992 by Renfrew and co-authors at problem case conferences held in a US university teaching hospital. [8] Under-reading (where the anomaly was missed) and flawed reasoning were the most prevalent types (including over-reading, misinterpretation, reporting misleading information or limited differential diagnoses). Lesser numbers were a result of complacency, ignorance (the finding was known, but in both cases was assigned to the incorrect reason), and poor communication (abnormality identified, but intent of report not conveyed to the clinician). [8]

The Renfrew classification was expanded upon in 2014 when Kim and Mansfield produced a classification scheme for radiological mistakes [9,10]. In a US Army medical facility over an 8-year period, problem case

conferences were used to review 1269 errors that were committed by faculty radiologists. The majority of errors (54%) occurred in situations involving plain radiography, followed by cross-sectional studies with significant amounts of data (30.5%) and (11.4%). [9,10]

Table 1: Kim & Mansfield radiologic error categorization, 2014 [9]

Under-reading	Abnormality visible, but not reported.	42%
Satisfaction of search	After having identified a first abnormality, radiologist fails to continue to look for additional abnormalities.	22%
Faulty reasoning	Abnormalities identified, but attributed to wrong cause.	9%
Abnormalities outside area of interest (but visible)	Many on first or last image of CT or MR series, suggesting radiologist's attention not fully engaged at beginning or end of reviewing series.	7%
Satisfaction of report (alliterative reasoning)	Uncritical reliance on previous report in reaching diagnosis, leading to perpetuation of error through consecutive studies.	6%
Failure to consult prior imaging studies		5%
Inaccurate or incomplete clinical history		2%
Correct report failing to reach referring clinician		0.08%

A 2013 study on the reasons for errors in radiography was published by Adrian Brady, Risteárd Laoide, Peter McCarthy, and Ronan McDermott. They listed "staff shortage," "excess workload," "unavailability of previous studies and inadequacy of clinical information" as the four main factors contributing to radiologic error. They also mentioned "availability of trained and certified Radiographers, Physicists, and other staff members within radiology departments."

One of the many compelling arguments against the use of remote teleradiology reporting for radiologic tests is the insufficiency of clinical information provided to the reporting radiologist, according to a 1995 study by Berlin L and Berlin JW. The accuracy of CXR interpretations has grown from 16 to 72 percent for trainees and from 38 to 84 percent for consultant-grade radiologists with knowledge of the patient's clinical history. [12]

Purpose of the study

Since medical imaging is an important part of diagnostic processes, it can be a source of diagnostic errors during the reporting of the diagnosis. The aim of the study is to identify different types of reporting errors in diagnostic process.

Objectives

- To analyse different types of reporting errors in teleradiology.
- To determine main causes for reporting errors in teleradiology.
- To suggest measures for minimizing radiological errors during reporting.

Methodology

- **Study location**: U4RAD
- **Study population**: Patients who had undergone CT, XRAY and MRI scans.
- **Study design**: This is a descriptive study.
- **Data collection method**: Quantitative Secondary data provided by the organization.
- **Sample Selection**: The data is being used to analyse the different types of reporting errors in teleradiology. Non- probability Purposive Sampling method is used to choose sample. The duration of the collected and analysed data is from 01st August 2021 – 30th May 2022.
- **Data Analysis Tool**: Excel is being used for data analysis.

Results:

The average rate or error at U4RAD was found 0.3%. Total no of cases that were reported in the duration (1st august 2021- 30th may 2022) 81324.

217 teleradiology reports were analysed which includes Xray, MRI and CT reports. There were errors in these reports. Further the errors are being categorized to know the distribution of different errors in teleradiology. Fig.1 shows the errors are being categorized as incomplete history, incomplete report, missed findings (under reading), missed interpretation, negligence, review, Single study reported instead of multiple study, typing error, Wrong part mentioned in wrong study (Female reported in male and vice versa) and wrong report. Table 1 shows the most common error found in these reports was missed findings which constitutes 45% of the total errors. Typing error constitutes 14% of the total errors.

Fig1. Distribution of different types of errors (%) at u4rad.

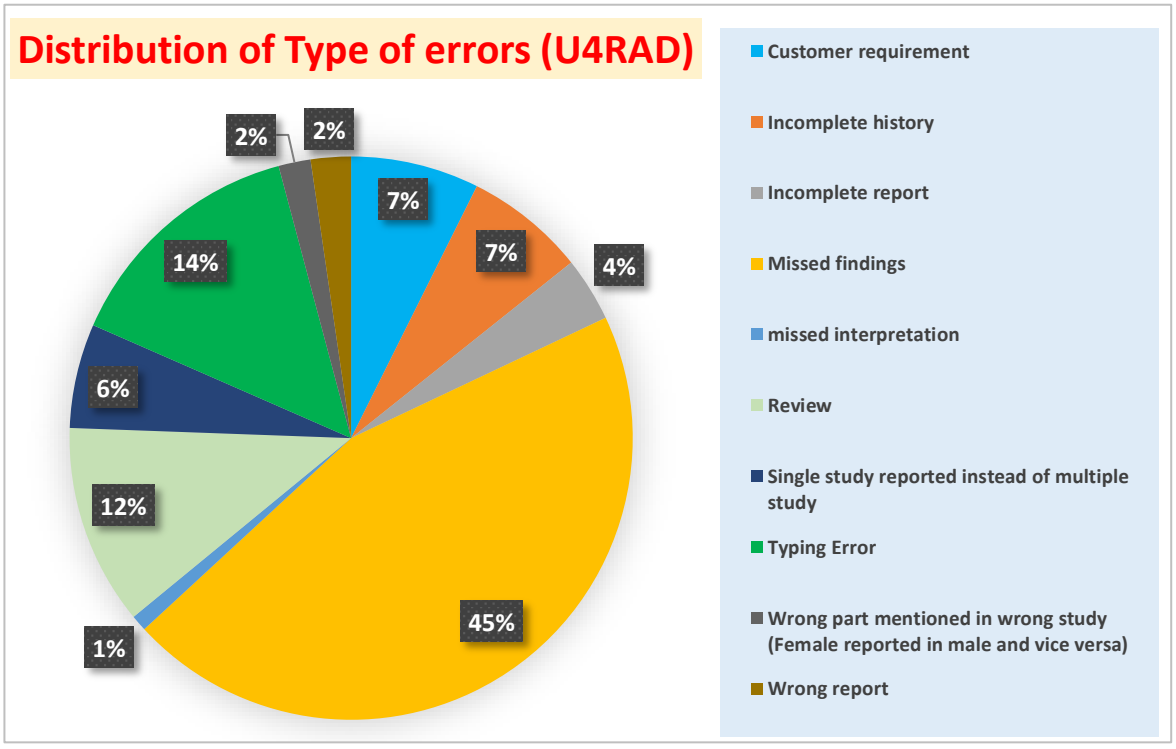
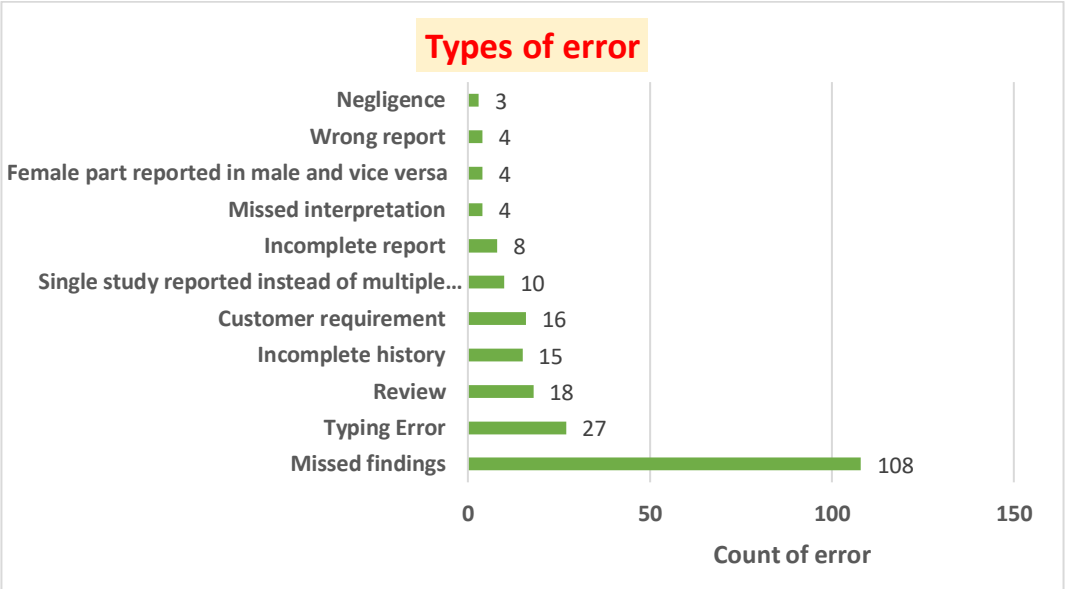


Fig.2: Types of errors(count) at u4rad.



It was found that CT and MRI reports in total constitute more than 95% errors, XRAY reports constitutes only 4% of errors.

Fig.3 Distribution of different modalities at u4rad.

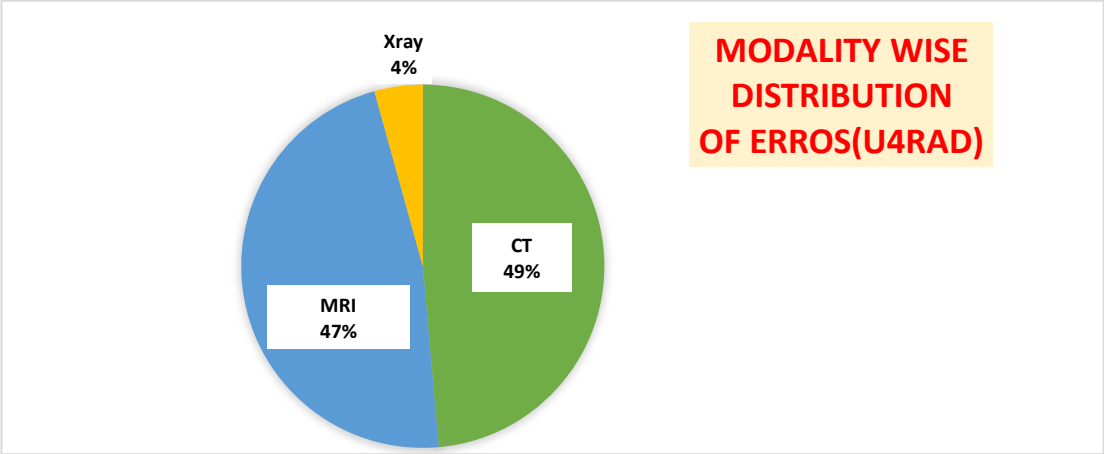
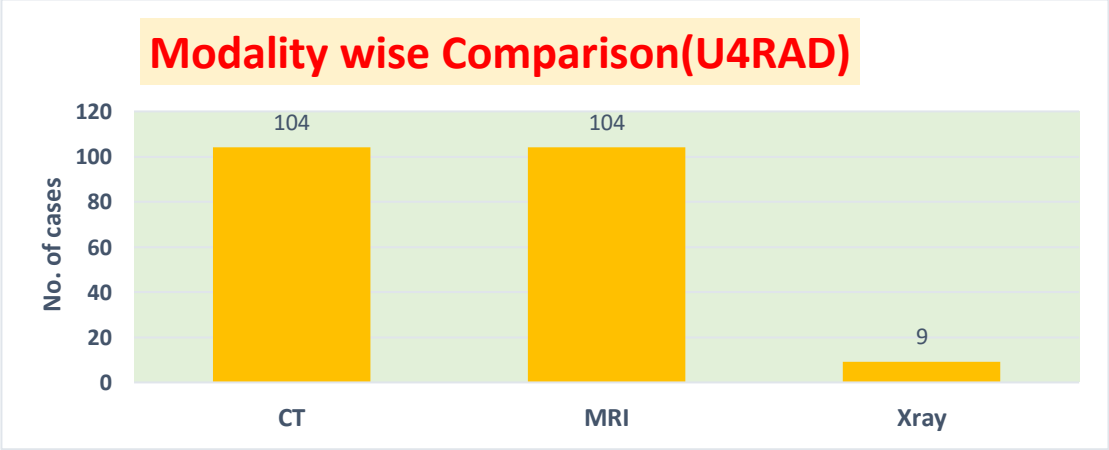


Fig.4 Graph of comparison of different modalities at u4rad.



In this study, further analysis done on categorization of error based on different body parts scan in which it was found that abdomen scans alone constitute 16% of the errors. While, Brain scans constitutes 10% of the error and chest scans contributed 12% to errors.

Fig.5 Distribution of errors based on the scanned body part at u4rad.

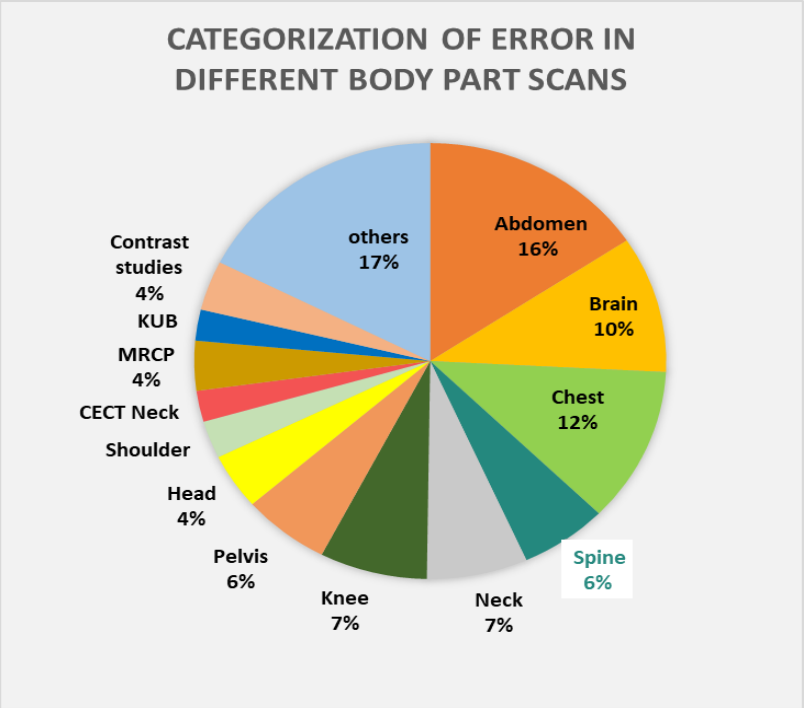
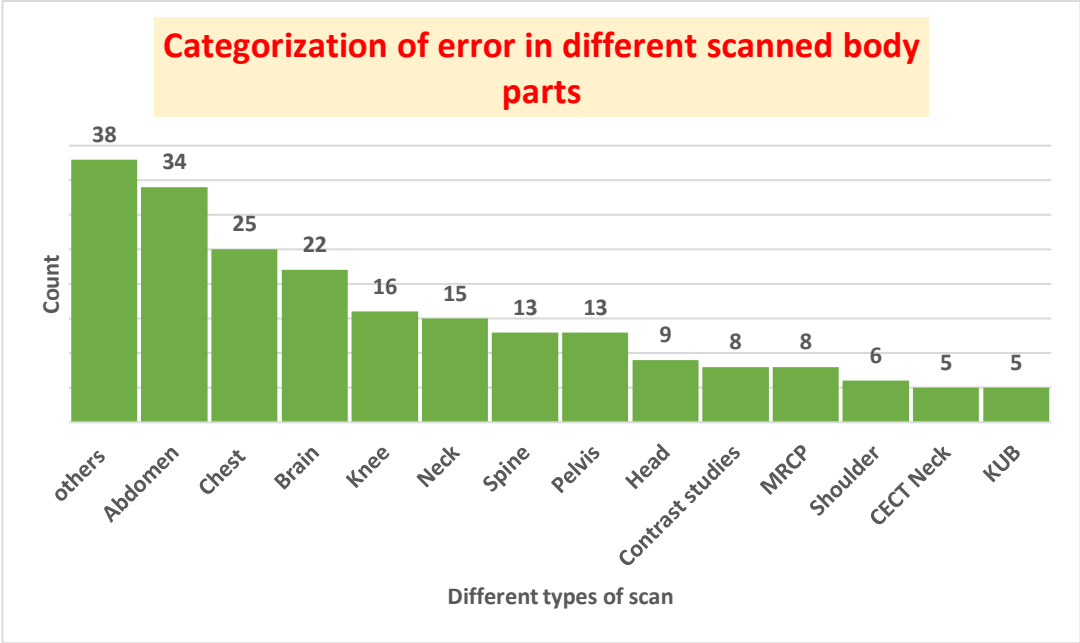


Fig.6: Error comparison based on the scanned body part at u4rad.



Missed findings were seen as a major cause of error, so the categorization of missed findings is being done modality and scanned body part wise. It shows that 17% of the missed findings were seen in abdomen studies. 94% of the missed findings were MRI and CT scans.

Fig.7: Categorization of missed findings based on modalities at u4rad.

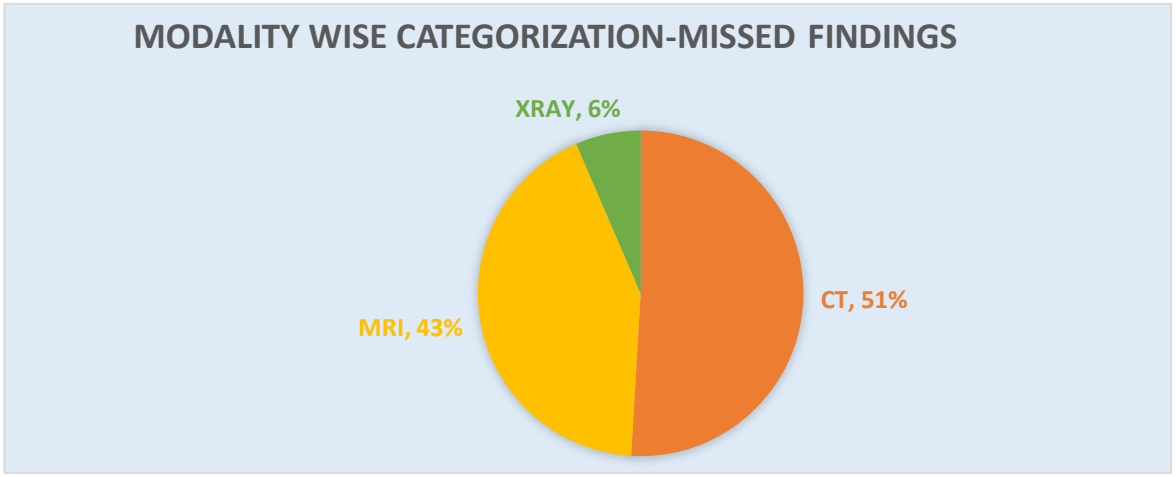


Fig.8: Scanned body part wise comparison of missed findings at u4rad.

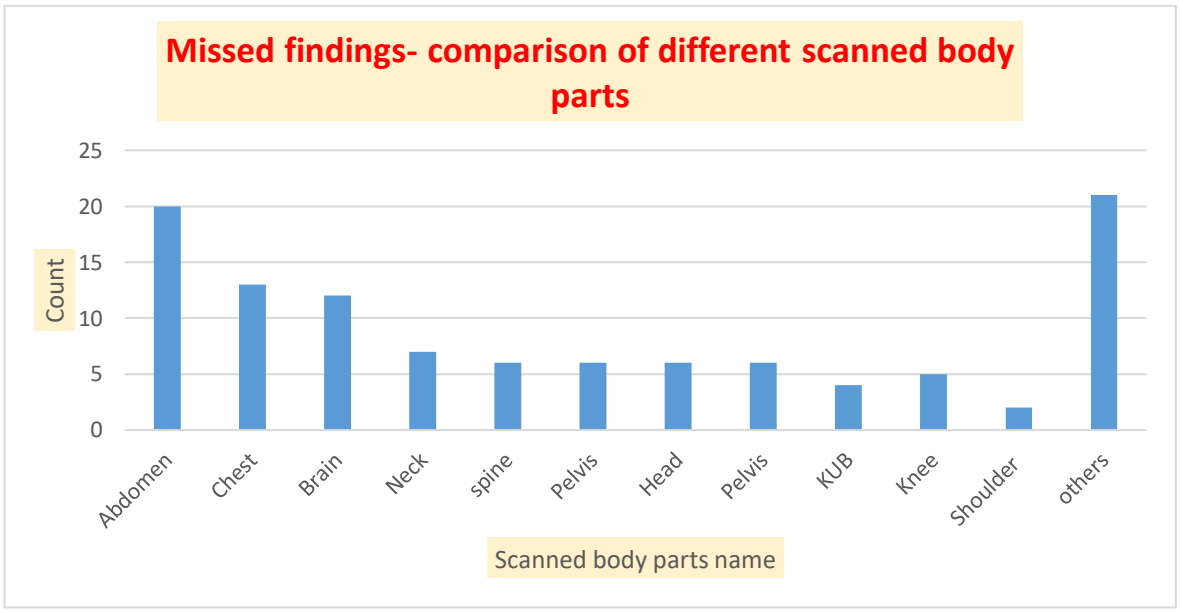
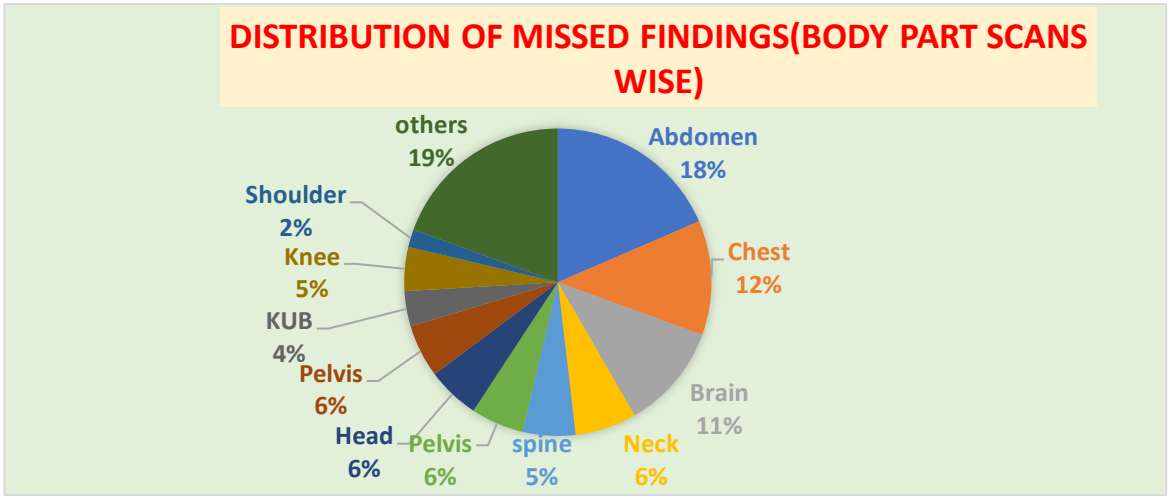


Fig.9: Distribution of missed findings based on different body scans at u4rad.



MRI and CT modality are further analysed based on types of error. The result shows missed finding still a major reason of error in both modalities. Typing error constituted 18% of errors in CT while in MRI it was 11%.

Fig.10: Distribution of MRI modality based on types of error at u4rad.

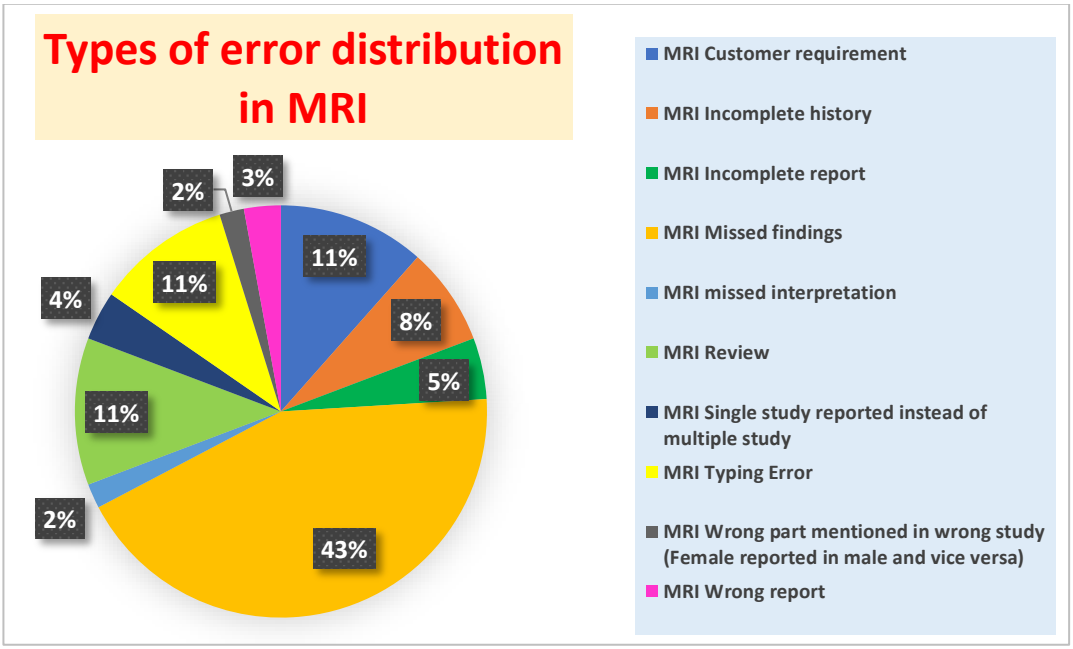
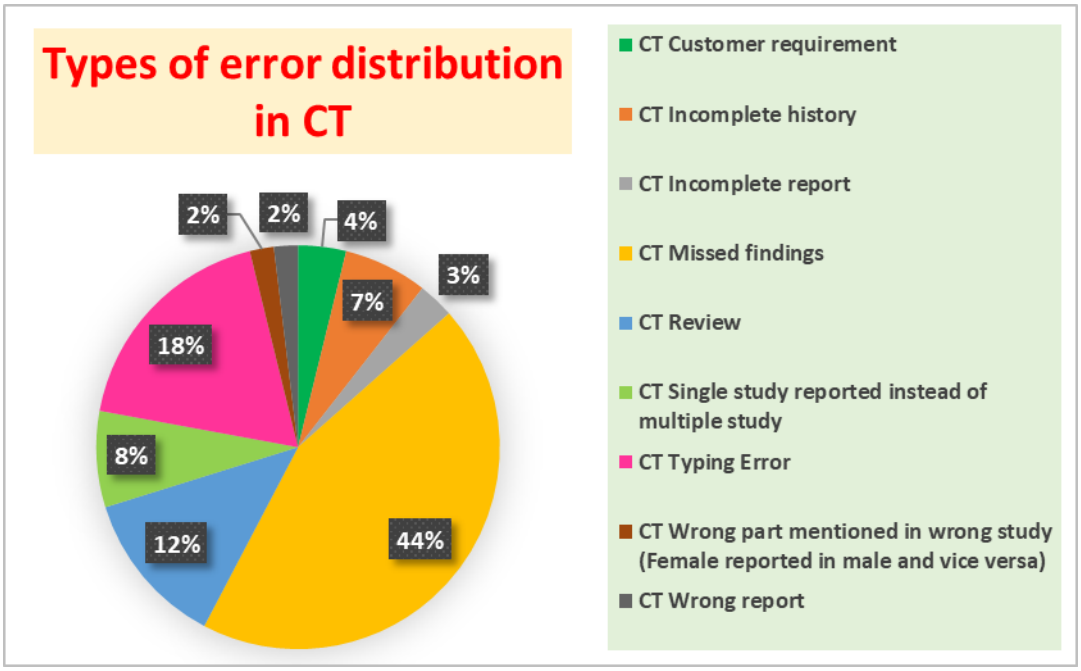


Fig.11: Distribution of CT modality based on types of error at u4rad.



Discussion:
This study identifies different types of errors in teleradiology reports which further shows errors distribution in different modalities. In this study it was found that missed findings (under reading) contributed 50% to the errors, which is similar in Kim's study. [9]

In 2014, Kim's study described that incomplete history constitutes 2% of the total errors while this study shows 7% errors are due to the incomplete history. Typing error was also one of the cause of errors in radiology reports which constitutes 12% of the total errors in this study.

In earlier studies errors were being categorized as perceptual and cognitive errors, this study classified errors further. Modality wise distribution shows CT and MRI reports have more errors than XRAY's reports, both constituted 95% of the errors. Abdomen scan reports has highest rate of errors compared to other body part scans.

In this study it was found that in 2% reports radiologist mentioned female part in the male patient reports which is a very rare error. Further missed findings are categorized based on the modality where it was found that CT and MRI modality have major error identified as missed findings. 94% missed findings were seen in CT and MRI only. Similarly, it is evaluated that body parts scans such as abdomen, chest and brain has more missed findings than other body part scans. 18% of the missed findings were seen in abdomen studies while 12% seen in chest studies and 10% seen in brain studies.

In this study incomplete history causes error in 7% of the reports which Berlin also showed in his study published in 1995 that incomplete history was one of the causes of error, Berlin's study explained that knowledge of clinical history decreases the errors. [12]

The main causes of error that are identified in this study is missed findings (50%), typing error (12%) and incomplete history (7%).

Limitations of the study

- The data set is small to determine significant causes of errors in radiology.
- The data was not adequate to do the root cause analysis of the errors. The data was only limited to the description of modality, what type of body part scan and the type of error.

Recommendations:

1. AI in radiology: AI has demonstrated accuracy and sensitivity in the diagnosis of imaging abnormalities, which can reduce the error of missed results. AI is being used in diagnostic medical imaging. As AI will assist radiologists in highlighting any aberrant findings that they might otherwise overlook. The decision to follow the AI ideas or not will ultimately be made by the radiologist. However, this technology will increase the awareness of radiologists and lower reporting errors.

2. Automation of reports

Errors happening due to clerical mistakes such as one noted above can be reduced by automating the process of report formation. Instead of typing the whole report or usingtemplates, findings can be selected by the radiologists just like a computer based Multiple choice questions (MCQs). These questions will be provided by the system in which the radiologist is reporting cases. This method of reporting will highly reduce theerrors.

3. Fail-safe Strategies for Harm Prevention and Risk Reduction

In recent years, much emphasis has been put on improving checks and balances to mitigate the possible harm of errors after they have occurred, as well as developing initiating methods to aid primary recognition of mistakes, ideally before any irreversibleharm has occurred. Direct reporting of results to patients may also act as a fail-safe mechanism for ensuring adequate follow-up and reducing the risk of damage done by inadequate statement between radiologists & clinicians.

4. Root cause Analysis

A better way is to lay hold of system-centered way, targeting on determining what has occurred, why it has occurred & what has to be done to prevent it from occurring again:this is what "root cause analysis" is all about.

Conclusion:

In the radiologist's report, a consultant referring patient for an imaging exam is gaping forsome things: consistency & finishing off detection of specific interpretations, a coherentadvice about the root cause of any anomalies found & where possible, advice on what additional inquiries might be beneficial.

The radiologist's response to needs can vary depending on person to person; few of us always try to contain most probable precise judgement in the reports, however it can occasionally come at cost of a thorough list ofdifferential diagnoses that is in- coherent.

Others believe it is more beneficial to generate a concise report and strong advice while acknowledging the possibility that wemay be wrong only some (hopefully most) of the time. With time, we have come to realize that succinctness encapsulated nature of confidence that must exist between a referring doctor & radiologist.

Both sides of the deal (as well as the patients in the middle) must agree and recognize that there will always be a level of fallibility. Of course,it is our duty to reduce the constraints on our success to the greatest extent possible; some of the techniques mentioned below will assist us in this endeavor.

However, radiological investigation reporting is not permanently a precise discipline; it is more ofan art of applying logical information & considerate to a pallet of greys, attempting to gap the specific & meaningful from insignificant, ensuring the word-picture we build coheres to a coherent and reliable whole, and striving to be vigilant advisors about acceptable procedures.

Errors will often occur, but some can be avoided by paying close attention to the thoughtprocesses we use, being mindful of possible prejudices and system flaws that can lead to errors, and employing all necessary available techniques to mitigate these negative factors.

However, if we believe that any technique will completely eradicate radiology error, we are deceiving both ourselves and the patients who depend on our advice.

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