DISSERTATION TRAINING

AT

U4RAD TECHNOLOGIES PVT LTD

(Feb 24 to May 24, 2025)

A Report on

REPORTING ERRORS IN MEDICAL IMAGING IN A

TELERADIOLOGY REPORTING SYSTEM

By

DR KASHISH MAHAJAN
(PG/23/047)

UNDER THE GUIDANCE OF – DR ARCHANA THAKUR

PGDM (Hospital and Health Management)

2023-2025

IIHMR DELHI

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U4RAD

The certificate is awarded to

DR. KASHISH MAHAJAN

in recognition of having successfully completed her Internship in the

'OPERATIONS Department'

and has successfully completed
her Project on

**"REPORTING ERRORS IN MEDICAL IMAGING IN A
TELERADIOLOGY REPORTING SYSTEM"**

'24TH FEB TO 24TH MAY 2025'

**'U4RAD TECHNOLOGIES PVT LTD'
SECTOR - 50 GURGAON ,HARYANA**

She comes across as a committed, sincere & diligent person who has a strong drive & zeal for learning.

We wish her all the best for future endeavors.

Training & Development

CEO & FOUNDER

U4rad Technologies Private Limited

U4RAD technologies pvt ltd, Sec 51, Gurgaon ,Haryana , India , 122001.www.u4rad.com

TO WHOMSOEVER IT MAY CONCERN

This is to certify that DR KASHISH MAHAJAN student of PGDM (Hospital & Health Management) from International Institute of Health Management Research, New Delhi has undergone internship training at U4RAD TECHNOLOGIES PVT LTD from 24TH FEB 2025 to 24TH May 2025.

The Candidate has successfully carried out the study designated to him during internship training and her approach to the study has been sincere, scientific and analytical.
The Internship is in fulfillment of the course requirements.

I wish her success in all her future endeavors.

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

Mentor

IIHMR, New Delhi

Certificate of Approval

The following dissertation titled **REPORTING ERRORS IN MEDICAL IMAGING IN A TELERADIOLOGY REPORTING SYSTEM** at **IIHMR Delhi** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **PGDM (Hospital & Health Management)** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

Name	Signature
Dr. Sumesh Kumar	
Dr. Shikha Bassi	Bassi
Minakshi Gautam	

Certificate from Dissertation Advisory Committee

This is to certify that **DR KASHISH MAHAJAN,** 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 MEDICAL IMAGING IN A TELERADIOLOGY REPORTING SYSTEM**" at "U4RAD TECHNOLOGIES PVT LTD" in partial fulfillment of the requirements for the award of the **PGDM (Hospital & Health Management).**

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

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Dr Archana Thakur,
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Kriti

Dr Kriti Aggarwal
AGM Operations

U4RAD Technologies Pvt Ltd

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **REPORTING ERRORS IN MEDICAL IMAGING IN A TELERADIOLOGY REPORTING SYSTEM** and submitted by **DR KASHISH MAHAJAN** Enrollment No. **PG/23/047** under the supervision of **DR ARCHANA THAKUR** for award of PGDM (Hospital & Health Management) of The Institute carried out during the period **from 24TH FEB 2025 to 24TH MAY 2025** 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.

Kashish Mahajan

Signature

FEEDBACK FORM

Name of the Student: DR. KASHISH MAHAJAN

Name of the Organisation in Which Dissertation Has Been Completed: U4RAD TECHNOLOGIES PVT. LTD.

Area of Dissertation: OPERATIONS

Attendance: Regular

Objectives achieved: Reporting errors in medical imaging in a teleradiology reporting system.

Deliverables: To evaluate reporting errors done by radiologist.

Strengths: Sincere
Disciplined
Hardworking.

Suggestions for Improvement:
Study case studies for smooth operations.

Suggestions for Institute (course curriculum, industry interaction, placement, alumni):
Provide opportunity for more field visits.

Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH (IIHMR)

Plot No. 3, Sector 18A, Phase- II, Dwarka, New Delhi- 110075
Ph. +91-11-30418900, www.iihmrdelhi.edu.in

CERTIFICATE ON PLAGIARISM CHECK

Name of Student (in block letter)	Dr./Mr./Ms.: DR. KASHISH MAHAJAN		
Enrollment/Roll No.	PG/23/047	Batch Year	2023 - 2025
Course Specialization (Choose one)	Hospital Management	Health Management	Healthcare IT
Name of Guide/Supervisor	Dr./ Prof.: DR. ARCHANA THAKUR		
Title of the Dissertation/Summer Assignment	REPORTING ERRORS IN MEDICAL IMAGING IN A TELERADIOLOGY REPORTING SYSTEM		
Plagiarism detect software used	"TURNITIN" 6%		
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My Institute - **International Institute of Health Management Research (IIHMR), Delhi** deserves the foremost appreciation for providing me with the opportunities to understand my capabilities. I would like to thank one and all in the IIHMR team for providing me with a platform for my professional career as well as for helping me boost all my capabilities and making me confident enough to work for a health care organisation. I would like to thank **Dr Archana Thakur (Associate Professor and Mentor), Dr. Sumesh Kumar (Associate Dean, Academic and Student Affairs), Dr. Sutapa B. Neogi (Director)** for their continuous support.

I acknowledge the tremendous contribution of my guide in completion of the project to **Dr Kriti Aggarwal (AGM- Operations)** and **Mr. Partha Dey (Founder and CEO, U4RAD)** for providing me with the opportunity to complete my dissertation.

I extend my thanks to all the staff for always being so cooperative and facilitating me. I am extremely grateful to my parents for their love, prayers, care and sacrifices for educating and preparing us for our future. Finally, my thanks to all the people who have helped 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) applications 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 of CII, HIMSS, UNDP, AMCHAM and IMAI, Pioneer in promotion of AI-Cognitive technology in healthcare, was managing healthcare vertical for IBM in India/SA, Member of CII, HIMSS, UNDP, AMCHAM and IMAI, Member of CII.

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 to combine clinical knowledge, healthcare management expertise, and quality management skills to clearly understand and not only resolve difficulties faced by providers and payers, but also to assist them in developing and implementing solutions that 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.

PREFACE

Abstract

The process of arriving at a medical diagnosis is incredibly complicated and prone to errors. Missing/delayed diagnoses can result in patient harm and missed treatment chances. Errors and inconsistencies in radiological practice are too common. Since medical imaging is an important part of the overall diagnostic process, it can also be a source of diagnostic inaccuracy. Although certain diagnoses may be abandoned due to technical/physical shortcomings of the modalities (such as imaging resolution and intrinsic/ extrinsic contrast), most of the lost radiologic interpretations are outstanding to film interpretation mistakes by radiologists. Imaging interpretation is a human undertaking that relies on difficult psychophysiological & cognitive processes, and it is prone to a lot of errors, including perceptual and cognitive mistakes (where an essential abnormality is not visible on the images).

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PROJECT REPORT

BACKGROUND

An error represents a deviation from the ordinary norm, regardless of whether it results in any damage. A diagnostic error has been defined as a diagnosis that is missed, wrong or delayed as discovered by later conclusive tests or findings [1]

Medical imaging is an indispensable tool in modern-day clinical practice, playing a pivotal role in the diagnosis, monitoring, and treatment planning of a wide range of diseases. From X-rays and CT scans to MRIs and ultrasounds, imaging techniques have evolved to become integral components of healthcare delivery across both primary and tertiary care settings. The radiologist, a highly skilled medical practitioner at the center of this diagnostic process, oversees analyzing the obtained images and producing narrative or structured reports to help physicians manage patients.

Even with the sophisticated technology that supports imaging modalities, radiology reporting errors continue to be a major global concern. These mistakes fall into two general categories: perceptual errors, which ignore abnormalities, and cognitive errors, which entail identifying an abnormality but using the wrong clinical reasoning or misinterpretation. Adding, human factors like tiredness and in burnout situations, also technical mistakes etc. can all increase the risk of missed or inaccurate diagnoses. Errors in radiology reporting are common indeed, according to studies. Error rates found to be between 3% and 5%.[2] Such disparities can have harmful effects, which results in incorrect diagnoses, delayed treatment, leading to poor patient outcomes like morbidity and death. Moreover, radiological errors are the source of malpractice claims.

Advantages of teleradiology include better workflow standardization, lesser turnaround times, and economic friendly. Technologies like artificial intelligence (AI) algorithms and structured reporting templates are frequently used in teleradiology platforms. To improve overall accuracy, AI-based image analysis is being used increasingly to flag possible abnormalities and help in cross-verifications. [3]

The goal of the study is to investigate reporting errors in a teleradiology reporting system. The study includes categorizing the types of errors occurring within the system—whether perceptual, cognitive, or technical, and how these influence error trends.

CATEGORIZATION OF REPORTING ERRORS

CLASSIFICATION	TYPE OF ERROR
System Error	Report auto-saved but not finalized Clinical history not imported into report view System uploaded wrong patient demographics Double reporting not triggered by system on flagged study Delayed AI flag processing by >2 hours
Human/ Clerical	Typing error
Cognitive Error	Missed interpretations
Perceptual Error	Missed findings Extra study reported

REVIEW OF LITERATURE:

One of the studies was done by Berlin et al. (2007) in a U.S.-based review focusing diagnostic radiology and medical malpractice.[4] The study highlighted that errors in radiological interpretation are, to some extent, unavoidable due to the inherently subjective nature of reading medical images. Even highly experienced radiologists can make mistakes, particularly when under stress or experiencing mental fatigue. According to Berlin, the typical error rate in radiology practice ranges from 3% to 5%. To lower these issues, the authors recommended implementing peer review systems and second-opinion protocols, to minimize diagnostic errors.

Waite et al. (2017) conducted an observational analysis focusing on interpretive errors in radiology.[5] Their investigation involved reviewing reported error cases featured in the *American Journal of Roentgenology (AJR)*, with an emphasis on identifying contributing factors at both the human and systemic levels. The findings included interruptions, limited time, fatigue, and excessive information significantly contributed to diagnostic mistakes.

In the United Kingdom, Briggs et al. (2008) carried out a retrospective audit focusing on challenging CT and MRI cases.[6] The study compared diagnostic reports made by general radiologists with those reviewed by neuroradiologists who had advanced subspecialty training. It was observed that second opinions provided by these experts often led to notable changes in both diagnosis and treatment planning. Among the 506 cases analyzed from 2004, a substantial number showed discrepancies that only became evident through specialist review.

Brady et al. (2017) conducted a narrative review in Ireland that emphasized the potential of artificial intelligence (AI) in minimizing radiological errors.[7] A key focus was placed on the classification of errors and strategies to prevent them. In addition, the study advocated for the adoption of structured AI-assisted reporting to enhance diagnostic accuracy.

Building on this, Donald et al. (2012) evaluated the effectiveness of hospital-based error reporting systems and their role in strengthening radiology quality assurance processes.[8]

RATIONALE –

Since medical imaging is pivotal in diagnostic processes, reporting inaccuracies can have severe consequences, leading to misdiagnoses, treatment delays, and increased healthcare costs. This study aims to analyze reporting errors in a teleradiology reporting system, identify their patterns and contributing factors, and explore strategies to enhance accuracy and minimize discrepancies. Understanding these errors will help improve the reliability of remote radiology interpretation and optimize patient care. The study aims to bridge gaps in diagnostic precision through comparative analysis and structured recommendations.

RESEARCH QUESTION-

What are the most common types of reporting errors in medical imaging in a teleradiology reporting system?

According to **PICO** format:

P- All medical imaging reports in a teleradiology reporting system in the duration of 4 months from January-April 2025.

I – Teleradiology AI reporting bot

C - No comparison

O – 1. Trend of reporting errors in four consecutive months 2. Pattern of reporting errors

OBJECTIVES-

To assess pattern and trend of reporting errors in medical imaging records over four consecutive months in a teleradiology reporting system

METHODOLOGY: -

This study is as a **secondary data analysis** focusing on reporting errors in medical imaging within a teleradiology setup. The research was carried out using data sourced from **U4RAD Technologies Pvt. Ltd**, a teleradiology company. The aim of the study is to analyze the trends, types, and causes of reporting errors, particularly in the context of digital remote reporting and automation.

STUDY LOCATION AND DESIGN

The study was conducted at U4RAD Technologies Pvt. Ltd, a health-tech start-up. The study design is a retrospective, observational analysis of secondary data, collected over a four-month period—January to April 2025. This period was carefully chosen to identify error patterns in different types of modalities and to see how things changed after a new bot system was added.

STUDY POPULATION AND SAMPLING METHOD

All radiology imaging reports over a period of four months are included in the study. The modalities include CT, MRI, X-RAYS. The technique used is a universal sampling technique. Types of error, frequency, and patterns over time was studied. The study dataset contained 648 medical imaging reporting errors in total.

SOURCE AND TOOL FOR DATA COLLECTION

The source is the U4RAD reporting bot system, to provide data directly. All reporting errors found during the quality assurance (QA) and verification phases are recorded by the bot. Perceptual, cognitive, technical, and system-generated disparities are among them. Additionally, the bot records metadata like the report date, modality, reporting time, and reviewer comments.

Microsoft Excel was used as the main data management tool to compile and manage.

DATA ANALYSIS PLAN

The compiled data was subjected to descriptive analysis using graphical and categorical techniques. The plan was structured into the following key steps:

Trend Analysis

A **line diagram** was used to depict the **time trend** of reporting errors across the four-month period. This visual representation helped in understanding whether errors were increasing, decreasing, or fluctuating, and whether any temporal correlation existed with workflow changes, including the **implementation of the upgraded bot system**.

Day-wise Error Distribution

A **bar graph** was plotted to show the **day-wise distribution of reporting errors**, which helped in identifying specific days or reporting loads where error peaks occurred. This form of analysis provided insights into operational inefficiencies or peak workload periods.

Categorization of Errors

Each of the 648 errors was classified into one of four predefined categories:

System Errors: Errors arising due to glitches in software, platform lags, or incorrect automation flags.

Human Fatigue: Errors likely resulting from radiologist fatigue or overburdened work schedules.

Cognitive Errors: Errors involving misinterpretation of detected findings despite correct image recognition.

Perceptual Errors: Errors where abnormalities were completely missed in the initial read.

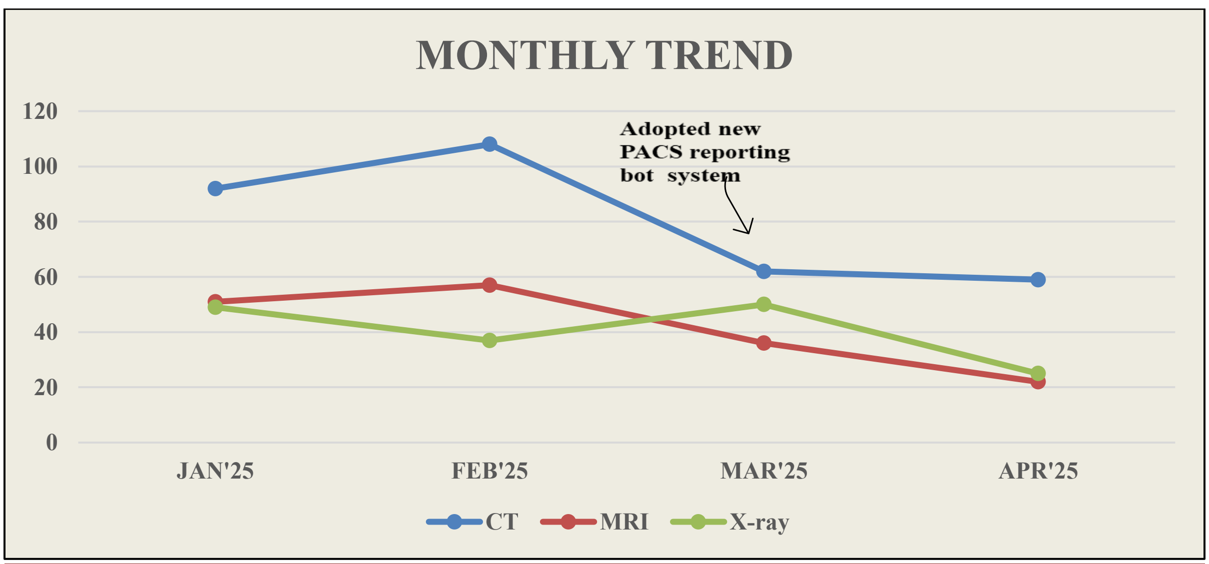
The **proportion of each error type** was calculated for the total dataset and **stratified by modality** (X-ray, CT, MRI). This allowed modality-specific error analysis, which is essential given the varying complexity of different imaging techniques.

Comparative Analysis: Pre and Post Bot Upgrade

To assess the effectiveness of the system enhancement, a comparative analysis was carried out to evaluate the frequency and types of errors before and after the upgrade of the reporting bot. This comparison aimed to determine whether AI and workflow automation improvements had a measurable impact on reducing errors.

DATA ANALYSIS & RESULTS INTERPRETATIONS:

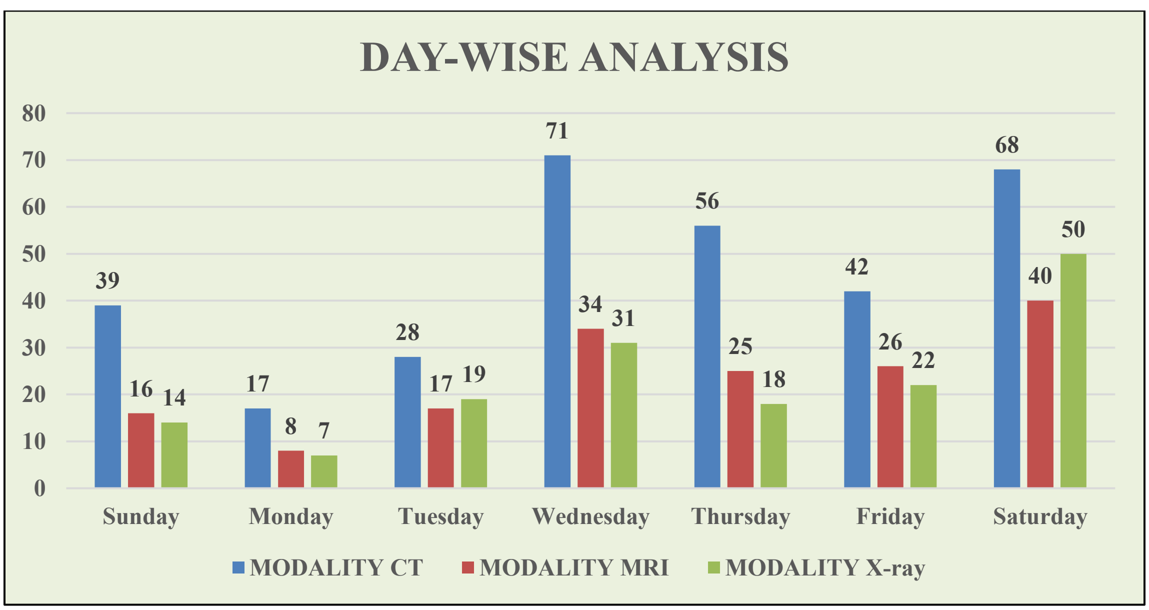
MONTHLY TREND OF REPORTING ERRORS



DATA INTERPRETATIONS: -

- 648 imaging errors in all were examined
- The most errors were consistently found in CT scan reports. The number of errors increased from about 92 in January to about 105 in February before dropping precipitously to 65 in March and 60 in April.
- From 50 in January to 58 in February, MRI-related errors increased slightly before gradually declining to 42 in March and 26 in April.
- X-ray errors began at 49 in January, fell to 40 in February, increased momentarily to 48 in March, and then sharply decreased to 25 in April.

DAY-WISE TREND OF MODALITY ERROR TYPES



DATA INTERPRETATIONS:

- **CT scan errors** (blue bars) were the highest among all three modalities on every day of the week. Wednesday reported the maximum CT errors (71 cases), followed closely by Saturday (68 errors) and Thursday (56 errors). This trend suggests that mid-week and weekend days may experience higher patient volumes or reporting pressure, potentially leading to increased oversight in complex imaging like CT. Monday, in contrast, showed the lowest CT error count (17)
- For **MRI reports** (red bars), the highest number of errors occurred on Saturday (40 errors), with a secondary peak on Wednesday (34 errors). These values align with the CT trend, implying that overlapping workload or staffing constraints on these days may impact accuracy across multiple imaging types. Monday again recorded the lowest MRI error count (8), indicating fewer cases or improved vigilance early in the week.
- **X-ray errors** (green bars) followed a similar distribution, peaking at 50 cases on Saturday, followed by 31 on Wednesday, and the least number on Monday (7 errors). This reflects the broader pattern seen across modalities—weekend and mid-week periods tend to be associated with higher error occurrences.

DISTRIBUTION OF REPORTING ERRORS
(JAN-APRIL 2025)

Categorise	Total n (%)	CT n (%)	MRI n (%)	X-ray n (%)
Clerical	141 (21.76%)	86 (26.79%)	41 (24.70%)	14 (8.70%)
Cognitive	87 (13.43%)	36 (11.21%)	27 (16.27%)	24 (14.91%)
Perceptual	414 (63.89%)	197 (61.37%)	96 (57.83%)	121 (75.16%)
System	6 (0.93%)	2 (0.62%)	2 (1.20%)	2 (1.24%)
Total	648 (100%)	321 (100%)	166 (100%)	161 (100%)

DATA INTERPRETATIONS: -

- The analysis of reporting errors revealed that **perceptual errors** were the most dominant category, accounting for **63.89%** of all cases. These errors, where abnormalities were missed despite being visible, were especially frequent in X-ray reports (75.16%), followed by CT

(61.37%) and MRI (57.83%). This indicates consistent visual oversight, particularly in high-volume, rapid-read settings like X-rays.

- **Clerical errors** formed 21.76% of total errors, highest in CT (26.79%) and MRI (24.70%), often due to documentation or input inaccuracies. Cognitive errors—linked to misinterpretation of identified findings—contributed 13.43%, more prevalent in MRI and X-ray, reflecting complexity in anatomical or pathological judgment.
- **System errors** were minimal (0.93%), suggesting good technical system reliability.

DISTRIBUTION OF REPORTING ERROR BEFORE AND AFTER CHANGE IN SYSTEM

Error Type	Jan-Feb 2025 n (%)	Mar-Apr 2025 n (%)
Clerical	81 (21.77%)	58 (21.01%)
Cognitive	63 (16.94%)	25 (9.06%)
Perceptual	225 (60.48%)	190 (68.84%)
System	3 (0.81%)	3 (1.09%)
Total	372 (100%)	276 (100%)

DATA INTERPRETATIONS:

- A comparison of error types during **Jan–Feb 2025 (pre-bot) and Mar–Apr 2025 (post-bot)** reveals insightful shifts in reporting trends. Although the total number of errors decreased from **372 to 276**, changes within error categories further emphasize the impact of system enhancement.
- Cognitive errors saw a sharp drop from 16.94% to 9.06%, indicating improved interpretive accuracy post-implementation. This reduction suggests the PACS bot likely to aid radiologists in clinical reasoning, reducing misinterpretations.
- Clerical errors remained relatively stable (around 21%) across both periods, suggesting that human input-related issues persisted despite automation and may require focused training or template redesign.
- Interestingly, perceptual errors increased in proportion from 60.48% to 68.84%, despite an overall drop in absolute numbers. This may indicate that while the bot helped with interpretation and clerical processes, visual detection errors remained a persistent challenge, highlighting the need for AI-based visual support tools.
- System errors remained minimal and unchanged, underscoring the technical reliability of both pre- and post-implementation platforms.

DISCUSSION:

Overall Error Reduction Post Bot Implementation:

The transition to the new PACS bot system in March 2025 demonstrated a clear reduction in the total number of reporting errors—from 372 cases in Jan–Feb to 276 cases in Mar–Apr. This 25.8% reduction highlights the effectiveness of automation and structured workflows in minimizing human-dependent clerical and cognitive lapses. Notably, cognitive errors dropped from 16.94% to 9.06%, indicating improved interpretation accuracy, possibly due to better reporting templates, decision support tools, and reduced manual workload.

Persistent Perceptual Errors Demand Deeper Attention:

Despite the overall improvement, perceptual errors remained the most dominant category, accounting for 63.89% of all errors and even increasing proportionally post-bot implementation (from 60.48% to 68.84%). These errors involve missed abnormalities that are visible but not recognized by the radiologist. Their persistence reflects the limitations of current AI and automation in enhancing visual perception. High perceptual error rates, particularly in X-rays (75.16%), indicate a need for AI-enabled flagging tools, peer review systems, or double-reading models, especially for high-volume modalities.

Modalities-Specific and Day-Wise Trends Suggest Operational Bottlenecks:

CT reports recorded the highest number of errors across all days, followed by MRI and X-ray. Error spikes at mid-week (Wednesday) and on weekends (Saturday) suggest workload-induced fatigue or staffing imbalances. These temporal trends provide operational insights for redistributing caseloads, modifying shift patterns, or introducing mid-week breaks or staggered reporting protocols.

Clerical Errors Highlight Human-System Interaction Gaps:

Although clerical errors showed a slight reduction post-bot, they remained steady at over 21%, especially in CT and MRI modalities. These may arise due to incomplete data entry, incorrect patient identifiers, or mislabeling, pointing to the need for user-friendly interfaces, auto-fill functions, and mandatory field checks before report submission.

Minimal System Errors Confirm Technical Stability:

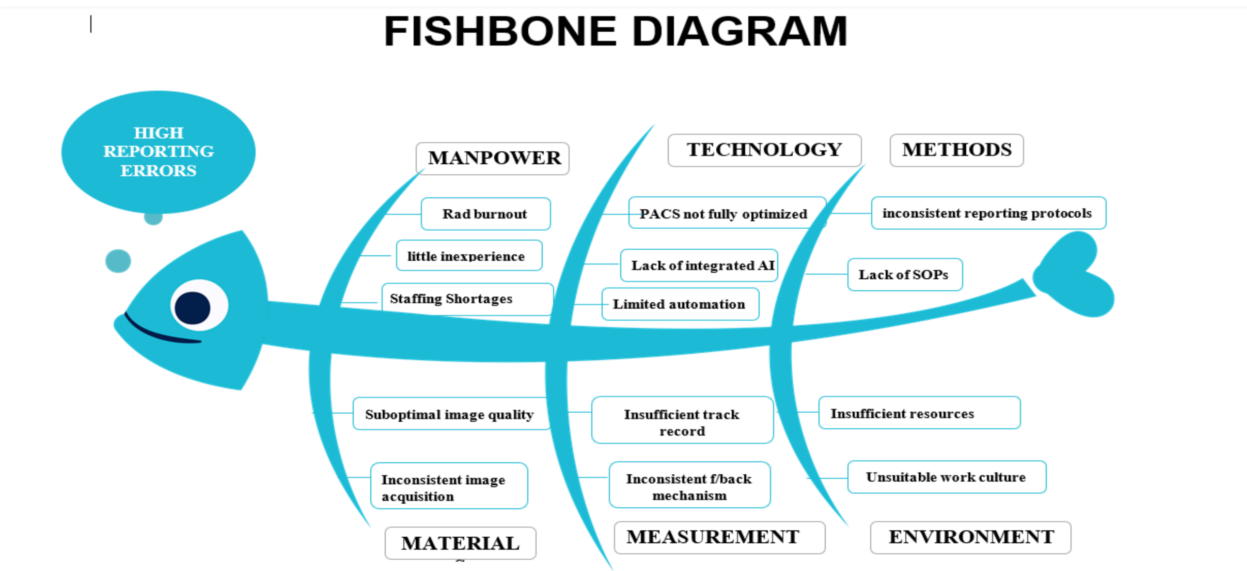
System-related errors were negligible (under 1%), indicating high reliability of the PACS environment itself. This reinforces that human factors, rather than technical faults, are the primary contributors to reporting inaccuracies.

BOTTLENECKS:

Based on the detailed analysis of reporting errors across various modalities and time periods, the following key bottlenecks have been identified within the teleradiology reporting system at U4RAD Technologies:

- **High Perceptual Error Volume:**
  Perceptual errors were the most frequent, comprising nearly 64% of total reporting errors, highest in X-rays (75.16%). These errors arise from missed findings during interpretation and highlight a need for AI-assisted tools, second reads, or advanced alert systems to support radiologists in identifying subtle abnormalities.
- **Persistent Clerical Errors Despite Automation:**
  Over 21% of errors were clerical, involving incorrect demographics or typographical mistakes. Despite the PACS bot system, these errors indicate the need for improved user training, interface design, and enforced validation protocols during report generation.
- **Performance Variability Due to Workload and Fatigue:**
  Wednesdays and Saturdays showed error peaks, especially in CT scans, suggesting fatigue and high volume as major contributors. This points to a need for better workload distribution, staff rotation, and fatigue mitigation strategies to ensure consistent reporting quality.

To assess these factors and to get significant recommendations, an **Ishikawa fishbone diagram** is being used in my study. The main issue is represented by the diagram's head, and possible causal factors found during brainstorming or research sessions are represented by the "fish bones."



RECOMMENDATIONS:

Based on the detailed analysis of error patterns in the U4RAD teleradiology reporting system, the following targeted interventions are recommended to enhance diagnostic accuracy and operational efficiency:

1. **Specialized Advanced Training Programs**

   Radiologists should undergo structured, modality-specific training to sharpen their diagnostic acumen, particularly for high-error modalities like X-rays. Regular workshops and simulation-based learning can help reduce perceptual and cognitive mistakes.

2. **Double Reading and Second Opinions**

   Implementing a routine system of double-reading, especially for complex or high-risk cases, can significantly reduce oversight. Involving subspecialty radiologists for second opinions can further strengthen diagnostic validation.

3. **Structured Reporting Templates**

   Using standardized templates ensures consistency, minimizes ambiguity, and reduces clerical and cognitive errors. It also facilitates easy review, comparison, and audit of reports.

4. **Image Acquisition Protocol Review**

   A portion of perceptual errors may stem from suboptimal imaging quality. Regular assessment of imaging protocols across modalities can ensure better visualization and reduce interpretive difficulties.

5. **Clerical Workflow Optimization and Automation**

   Automating data entry for demographics and clinical history using integrated HIS/RIS systems can reduce manual lapses. Embedding validation checkpoints and digital checklists can help catch clerical errors before final sign-off.

6. **Fatigue and Workload Management**

   Introducing fatigue mitigation strategies such as rotational duty hours, mandatory rest breaks, and workload equalization during peak error days (e.g., Wednesdays and Saturdays) can stabilize performance and reduce human fatigue.

7. **Feedback and Mentorship Mechanism**

   Establishing a culture of continuous feedback through regular audit cycles and peer reviews encourages learning from errors. Mentorship programs for junior radiologists can help build confidence and skill.

8. **System Integration and Interoperability Improvements**

   To ensure real-time access to patient data for informed reporting.

LIMITATIONS:

While this study provides valuable insights into nature and trends of reporting errors in a teleradiology environment, certain limitations must be acknowledged to contextualize the findings and guide future research:

1. Single-Center Scope

   The study was conducted exclusively within a single teleradiology company—U4RAD Technologies. As operational practices, reporting workflows, and quality assurance mechanisms can vary significantly across institutions and geographies, the generalizability of results to other settings remains limited.

2. Short Study Duration

   Data collection spanned a period of only four months (January to April 2025). This relatively short timeframe restricts the ability to identify long-term patterns, seasonal variations in caseloads, or cyclical fluctuations in radiologist performance. Longer surveillance would provide a more comprehensive understanding of recurring trends.

3. Limited Focus on Contributing Factors

   Although errors were categorized into perceptual, cognitive, clerical, and system-based, deeper root-cause analysis—such as workload analysis, radiologist experience level or reporting environment—was not performed. These contextual factors could have provided further insight into why specific errors occurred.

4. Technology Transition Influence

   The mid-study adoption of a new PACS bot reporting system may have influenced reporting behavior and error trends in a way that could confound results. The study does not isolate or adjust for this variable's direct effect on reporting accuracy.

5. Exclusion of Non-Imaging Modalities

   The study focused only on imaging errors in CT, MRI, and X-ray reports. Other imaging modalities such as ultrasound, PET-CT, and interventional procedures were not included, which narrows the scope of applicability.

CONCLUSION:

This study aimed to analyze the types, frequency, and contributing factors of medical imaging reporting errors in a teleradiology setting, using four months of data from U4RAD Technologies. The findings present a clear picture of nature and distribution of errors across CT, MRI, and X-ray modalities, while also highlighting the operational impact of introducing a new PACS-integrated bot reportingsystem.

A major outcome of this analysis was the significant reduction in overall reporting errors post-implementation of the PACS bot, particularly in the clerical and cognitive error categories. This affirms the critical role of automation in enhancing reporting consistency and minimizing manual documentation lapses. However, the persistent and high proportion of perceptual errors, in X-ray.

The study also found notable variations in error frequency based on the day of the week, with mid-week and weekend days (Wednesdays and Saturdays) seeing error peaks, particularly in CT modalities. These trends reflect underlying challenges such as radiologist fatigue, uneven workload distribution, and potential staffing gaps, all of which contribute to diagnostic inconsistencies.

While the system upgrade demonstrated clear benefits, it also revealed areas that require focused improvement. There is an urgent need for targeted, modality-specific interventions such as advanced radiologist training, integration of AI-based diagnostic support tools, improved image acquisition protocols, and structured reporting formats. Additionally, optimizing clerical workflows, automating routine tasks, and promoting fatigue mitigation strategies can collectively enhance diagnostic safety

In conclusion, technology has initiated meaningful progress in error reduction, but sustainable improvement will depend on a balanced approach that blends human expertise, process optimization, and intelligent systems. By fostering a culture of continuous feedback, peer learning, and quality assurance, teleradiology platforms like U4RAD can lead the way in ensuring higher standards of patient care and diagnostic excellence.

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