INTERNSHIP TRAINING

At

U4RAD Technologies LLP

REPORTING ERRORS IN MEDICAL IMAGING: AN ANALYSIS OF RANDOMLY SELECTED IMAGING RECORDS

By

Kriti Aggarwal

PG/19/038

Hospital Management

Under the Guidance of: Dr. Vinay Tripathi

POST GRADUATE DIPLOMA IN HOSPITAL AND HEALTH MANAGEMENT

2019-21

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT AND RESEARCH

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COMPLETION OF DISSERTATION

The certificate is Awarded to

Dr. Kriti Aggarwal

in recognition of having successfully completed her

Internship in the department of

Radiology

and has successfully completed her Project on

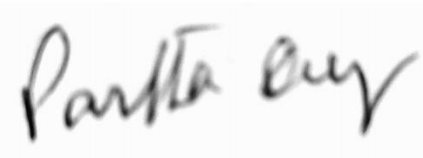
Reporting errors in medical imaging: An analysis of randomly selected imaging records at

U4RAD

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.



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This is to certify that **Dr. Kriti Aggarwal** student of Post Graduate Diploma in Hospital and Health Management (PGDHM) from International Institute of Health Management Research, New Delhi has undergone internship training at **U4RAD Technologies LLP** from **12th February 2021 to 12th May 2021.**

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

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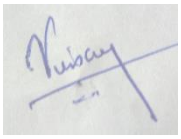


Ms. Divya Aggarwal
Associate Dean, Academic and Student Affairs
IIHMR, New Delhi

Mentor
IIHMR, New Delhi

Certificate of Approval

The following dissertation titled **"Reporting errors in medical imaging: An analysis of randomly selected imaging records"** at **"U4RAD Technologies LLP"** 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 **Post Graduate Diploma in Health and Hospital 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. Nitish Dogra

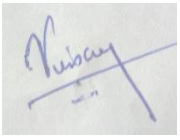
Dr. Sumant Swain

Dr. Pankaj Gupta

Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Kriti Aggarwal**, 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: An analysis of randomly selected imaging records**" at "**U4RAD Technologies LLP**" 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.



Mentor: Dr. Vinay Tripathi,
Associate Professor,
IIHMR, Delhi

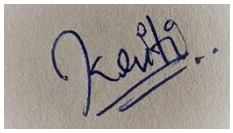
Mr. Partha Dey
Founder and CEO
U4RAD Technologies LLP

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH,

NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **"Reporting errors in medical imaging: An analysis of randomly selected imaging records"** and submitted by **Dr. Kriti Aggarwal, Enrollment No. PG/19/038** under the supervision of **Dr. Vinay Tripathi** for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from **12th February 2021 to 12th May 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.



Signature

FEEDBACK FORM

Name of the Student: Dr. Kriti Aggarwal

Dissertation Organization: U4RAD Technologies LLP

Area of Dissertation: Hospital

Attendance: 100%

Objectives achieved: Successfully completed "Reporting errors in medical imaging: an analysis of randomly selected imaging records"

Deliverables: Adequate and in- Depth analysis of Reports related to errors.

Strengths: A very committed, sincere, cooperative, and positive nature person with strong zeal for learning.

Suggestions for Improvement: Nil.

Suggestions for Institute (course curriculum, industry interaction, placement, alumni): Vigorous industry exposure across hospitals.

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

Date: 24-6-21

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.

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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 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. 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 and diagnostic 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 referring clinicians.

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, 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.

1. PREFACE

1.1 . 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 overall diagnostic process, it can also be 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).

2. DISSERTATION REPORT

2.1 INTRODUCTION

Annually, one billion radiologic tests are conducted worldwide, with radiologists interpreting the majority of them. The majority of professional bodies accept that all imaging procedures should involve a written report by an expert radiologist. This is a large part of what practicing radiologists do on a regular basis. We don't always get it right the first time.

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.

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.

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.

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).

2.2LITERATURE REVIEW

A selection of published studies, dating from 1949 till today, that have evaluated occurrence of radiological mistakes/anomalies are reviewed. Leonard Berlin has written enormously on the topic, citing a day-to-day radiologist error rate of 3to 5% & retrospective mistake rate of 30% among these studies. Applying a 4percent mistake rate to 1 billion annual studies in the world results in approximately 40 million radiologist mistakes per year.

Many papers cited (along with a slew of other, related studies) identify retrospective evaluation with different degrees of blindness at time of re- evaluation. There have also been several prospective studies conducted. A significant disputable rate of 5 to 9% was found between 2 observers when reading emergency plain images, with 3 to 6% mistake rate/ observer.

The norm by which the original report is calculated may have an impact on error or discrepancy rates. A 2007 analysis of effects of second reading CT & MRI studies by specialist neuroradiologists found a 13percent major & 21percent minor dispute average.

The majority of these studies depend on finding inter-observer variance. Intra-observer variance, on the other hand, should not be overlooked. 3 experienced abdomen imaging radiologists were faced with blindly reinterpreting 60 abdomen & pelvis CTs, 30 out of which had been detected by someone else & 30 out of which they had reported on their own previously. There were significant inter-observer & intra-observer differences of 26percent & 32percent, respectively.

Same studies have been published in the literature for over 60 years; the examples above demonstrate the accuracy of disputable rates across various modalities, subspecialties & time. With all these consistently high disputable rates, it's hard to believe that these "errors" are solely result of "bad radiologists."

2.3 Rationale

Since medical imaging is an important part of diagnostic processes, it can be a source of diagnostic inaccuracy. So, in this study, I propose to review the medical imaging reports.

2.4 Objectives

1. To review the diagnostic reports.
2. To determine the extent of reporting errors.
3. To suggest measures for minimizing reporting errors.

2.5 Methodology

Study location: U4RAD

Study units: Patients who had undergone CT and MRI scans.

Sample size: 362 (CT- 220, MRI- 142).

Keywords: Radiology, Error, diagnostic, Misdiagnosis, Imaging, Reports.

Sampling strategy: This study is based on qualitative secondary data. Systematic Sampling method is used to choose sample. A sample size of 362 is taken out of 6004 reports under study with confidence level of 95% and margin of error 5%.

Review Method: Cases reviewed by another Radiologist other than reporting radiologist.

Study duration: 3 months (February- April, 2021)

Limitations: Time Constraint (due to which unable to include X-rays and large duration), Resources, Prevalence of Covid 19.

2.6 FINDINGS

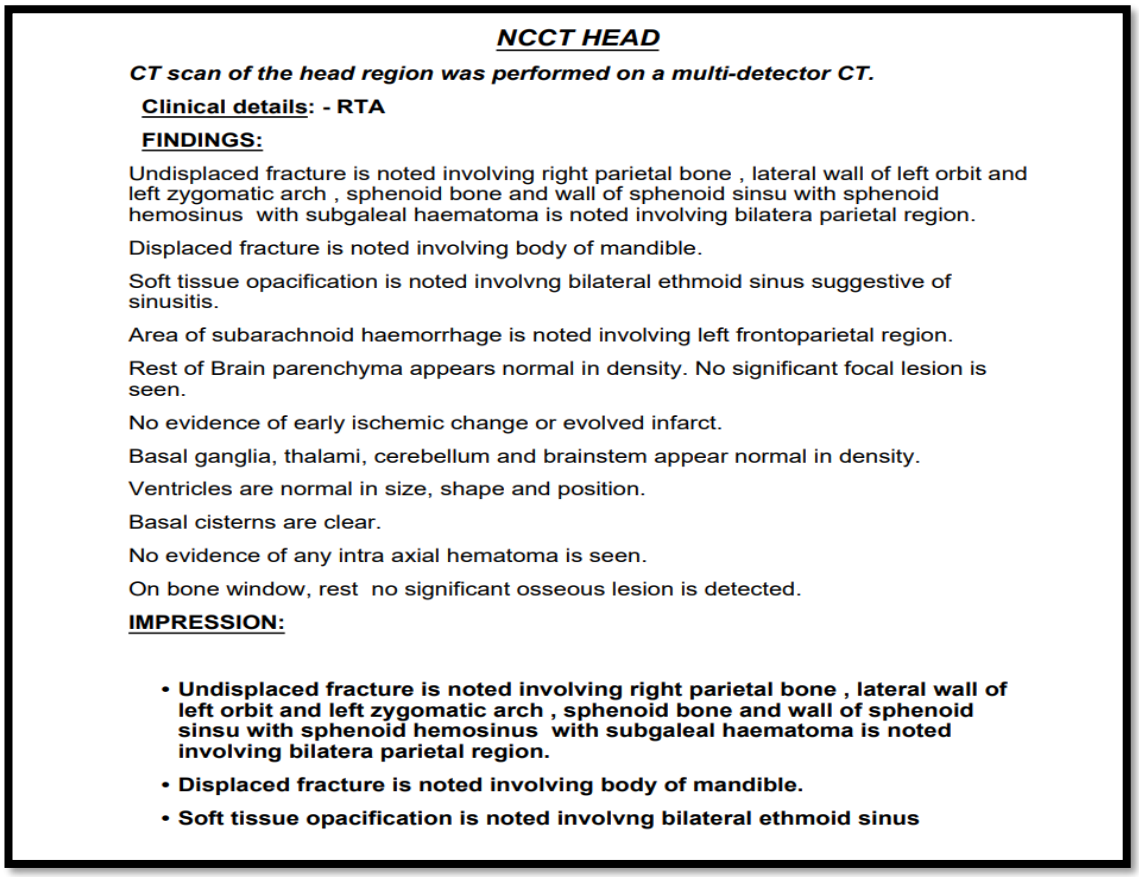
362 reports were analyzed for the duration of 3 months- February to April, 2021. Out of which, errors in 3 reports were found. In 2 reports, cognitive mistakes (in which defect is detected visually but importance of detection is incorrectly appreciated) were found. Findings which were visible in the scan were not entered in report. In 1 report, clerical error (a mistake made in copying or writing out a document) was found (see Figure 1). Findings which are seen in CT Face were mistakenly entered into the findings of CT Brain. Therefore, it can be said that there is a reporting error of 0.008%.

Classification of CTs:

Part Scanned	Count	Purpose
Chest	117	Covid Screening, Shortness of Breath
Abdomen	33	Pain
Brain	45	Trauma
Musculoskeletal Structures and spine	25	Trauma
Total	**220**	

Classification of MRIs:

Part Scanned	Count	Purpose
Brain	83	Headache and Vertigo
Spine	30	Backache
Abdomen	15	Detection of cancer
Musculoskeletal Structures	14	Injury
Total	**142**	



NCCT HEAD

CT scan of the head region was performed on a multi-detector CT.

Clinical details: - RTA

FINDINGS:

Undisplaced fracture is noted involving right parietal bone , lateral wall of left orbit and left zygomatic arch , sphenoid bone and wall of sphenoid sinsu with sphenoid hemosinus with subgaleal haematoma is noted involving bilatera parietal region.

Displaced fracture is noted involving body of mandible.

Soft tissue opacification is noted involvng bilateral ethmoid sinus suggestive of sinusitis.

Area of subarachnoid haemorrhage is noted involving left frontoparietal region.

Rest of Brain parenchyma appears normal in density. No significant focal lesion is seen.

No evidence of early ischemic change or evolved infarct.

Basal ganglia, thalami, cerebellum and brainstem appear normal in density.

Ventricles are normal in size, shape and position.

Basal cisterns are clear.

No evidence of any intra axial hematoma is seen.

On bone window, rest no significant osseous lesion is detected.

IMPRESSION:

- **Undisplaced fracture is noted involving right parietal bone , lateral wall of left orbit and left zygomatic arch , sphenoid bone and wall of sphenoid sinsu with sphenoid hemosinus with subgaleal haematoma is noted involving bilatera parietal region.**
- **Displaced fracture is noted involving body of mandible.**
- **Soft tissue opacification is noted involvng bilateral ethmoid sinus**

Figure 2.6.1: Illustration showing Clerical Error

2.7 Recommendations

1. Cognitive Bias and Debiasing Techniques

The majority of radiologist errors are caused by faulty/ biased cognitive systems**.** It is obvious when significance of recognized finding is misjudged, but is also seen in case of apparent perceived mistakes, where not able to recognize a finding can be affected by bias in the radiologist's perceptions of what findings are likely, as well as a priority choice regarding what is being looked for on the provided image. To address these types of mistakes, methods for cognitive de- biasing & meta- cognitive interventions have been devised, including

(a) educational interventions such as increased feedback & centered education

(b) approaches such as reflective review that aim to enhance clinical reasoning and decision-making and error analysis and

(c) cognitive aids, such as integrated decision support and informatics resources that make it easier to access knowledge and expert opinions. Ongoing research focuses on educational approaches, metacognition (e.g., "thinking about thinking" methods, meditation, and mindfulness), slowing-down strategies, group-decision strategies, environmental and cultural interventions, as well as mindfulness and urging doctors to maintain their skepticism even though they think they have made the right diagnosis.

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 using templates, 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 the errors.

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 irreversible harm 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.

2.8 CONCLUSION

In the radiologist's report, a consultant referring patient for a imaging exam is gaping for some things: consistency & finishing off detection of specific interpretations, a coherent advice 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 of differential diagnoses that is in- coherent. Others believe it is more beneficial to generate a concise report and strong advice while acknowledging the possibility that we may 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 of an 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 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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