Internship Training

at

Teleradiology Solutions, Bangalore

EFFICIENCY OF MANPOWER V/S SPEECH RECOGNITION TOOL

by

Vaishali Goyal

PG/18/089

Under the guidance of

Dr. Pankaj Talreja

Post Graduate Diploma in Hospital and Health Management

2018-20

International Institute of Health Management Research
New Delhi

Internship Training

at

Teleradiology Solutions, Bangalore

EFFICIENCY OF MANPOWER V/S SPEECH RECOGNITION TOOL

by

Vaishali Goyal

PG/18/089

Under the guidance of

Dr. Pankaj Talreja

Post Graduate Diploma in Hospital and Health Management

2018-20

International Institute of Health Management Research
New Delhi

Acknowledgements

The completion of this report required a lot of guidance & support from my company, college, my mentor & also my managers at Teleradiology Solutions.

I wish to express my immense gratitude to the Senior Manager of Operations Department, Mr. Akram Pervez, who supervised me in every step, without whom I would not be able to complete this dissertation report, titled, "**EFFICIENCY OF MANPOWER V/S SPEECH RECOGNITION TOOL."**

I would also like to thank Ms. Margi Raj, my colleague & mentor, who explained to me the concepts about High Image Count & also grateful to Mr. Asif Ebrahim, Head of Operations Department for allowing me to work flexibly & letting me complete my dissertation report on this topic.

I am also very much obliged to **my Mentor at IIHMR, Delhi Dr. Pankaj Talreja** for always showing me the right path, helping me & advising me in every way possible.

I would also like to express my gratitude to my college, IIHMR Delhi, for a detailed & informative curriculum.

TRS®
SOLUTIONS LLP

(Completion of Dissertation from respective organization)

The certificate is awarded to

VAISHALI GOYAL

in recognition of having successfully completed his/her
Internship in the department of

OPERATIONS

and has successfully completed his/her Project on

EFFICIENCY OF MANPOWER V/S SPEECH RECOGNITION TOOL

Date: - 26/6/2020

TELERADIOLOGY SOLUTIONS, BANGALORE

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.

K. Akram Pervez
Training & Development

Dupika.M
Head- Human Resources

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Vaishali Goyal** 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 **Teleradiology Solutions, Bangalore** from 5rd February 2020 to 31st May 2020.

The Candidate has successfully carried out the study designated to her 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 all the success in future endeavors.

Dr Pankaj Talreja
Associate Professor

IIHMR, New Delhi

Dr. Pradeep K Panda
Dean Academics and Student Affairs

IIHMR, New Delhi

Certificate of Approval

The following dissertation titled **"EFFICIENCY OF MANPOWER V/S SPEECH RECOGNITION TOOL"** at **"Teleradiology Solutions, Bangalore"** 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
Ms. Divya Aggarwal	_____
Dr Preetha GS	_____
Dr. Sumesh Kumar	_____
Dr. SB Arora	_____

Certificate from Dissertation Advisory Committee

This is to certify that **Ms. Vaishali Goyal,** a graduate student of the **Post- Graduate Diploma in Health and Hospital Management** has worked under our guidance and supervision. She is submitting this dissertation titled "**Efficiency of Manpower V/S Speech Recognition Tool**" at "Teleradiology Solutions, Bangalore" in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital 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.

Dr. Pankaj Talreja
Assistant Professor
IIHMR, Delhi

Mr. Akram Pervez
Sr. Manager- Operations
Teleradiology Solutions

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled, '**Efficiency of Manpower V/S Speech Recognition Tool**' and submitted by **Vaishali Goyal**, Enrolment No. **PG/10/089** under the supervision of Dr Pankaj Talreja for award of Postgraduate Diploma in Hospital and Health Management of the Institute carried out during the period from 5th Feb to 31st May, 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.

Ms. Vaishali Goyal

FEEDBACK FORM

Name of the Student: Ms. Vaishali Goyal

Dissertation Organisation: Teleradiology Solutions, Bangalore

Area of Dissertation: Operations Department

Attendance: She has been very regular and punctual in terms of attendance.

Objectives achieved:

1. Analysed manpower versus voice recognition tool efficiency.
2. Schedule optimization to improve team productivity and turnaround times.

Deliverables:
Assisted to understand the main factors that we have to consider before replacing the team with voice recognition tool and the pros and cons of the implementation ensuring the client satisfaction is not compromised.

Strengths: Hardworking, Proactive, focused, continuous learning.

Suggestions for Improvement: Attention to detail, lateral thinking and work on improving analytical skills.

Suggestions for Institute (course curriculum, industry interaction, placement, alumni):
Need to include in the course curriculum on practical training on data management and analytical skills.

K. Akram Pervez

Mr Akram Pervez

Sr. Manager- Operations

Teleradiology Solutions

Abstract

Teleradiology Solutions provide remote services to different hospitals situated across world. It has variegated teams of skilled employees who work to get the error free report done within TAT. The **radiologists** working at the center receive cases from various hospitals. They are provided with a team of **Medical Transcriptionists** (MT), who work alongside them & function on various support work, such as, typing the report, **loading of images**, rectifying the errors & coordination- retrieving **prior images** when needed.

This study has been conducted on radiologists who use MT & **Voice Recognition (VR)** - a speech recognition tool that does all the work as an MT, except loading of images & coordination. Hence, to determine if VR can work as efficiently as the team of MTs, two analysis were done based on convenient sampling. The first analysis revealed that all the MT users had lesser TAT, except one, when compared to the VR users. Also, one radiologist who switched between MT & VR had lesser TAT when working with VR. This indicates that the TAT of VR users depends on the efficiency with which the tool was used. Since VR users also had to load images on their own, image standardization was done to reduce image count. The second analysis showed that although VR & MT provided radiologist were taking less time in reading low image count cases, however, the overall TAT of VR provided radiologists remained higher when compared with MT provided radiologists. Also, one VR using radiologist had higher TAT in reading low image count cases- Supposed reason; priors' non-availability.

After analysing both types of studies, it was realized that VR would be able to work with the man-power efficiency only after the presence of all the support work that an MT provides other than just typing of reports & spell-check.

Key words: Radiologists, Medical Transcriptionists, Voice Recognition, Loading of images, Prior images.

Abbreviations

TRS: Teleradiology Solutions

T2: Telerad Tech

TAT: Turnaround Time

ABR: American Board of Radiologist

RIS: Radiologist Information System

P2P: Print to PACS

MT: Medical Transcriptionist

VR: Voice Recognition

SLA: Service Level Agreement

MRN: Medical Record Number

Contents

Introduction

Teleradiology Solutions is an organization, providing remote services across countries. For this, the company is equipped with variegated employees who are skilled in their respective fields. It has radiologists working at the center who receive cases from various hospitals- situated in different parts of the world. Radiologists are provided with an additional team of Medical Transcriptionists, who work alongside radiologists & provide them with all the significant support. When Radiologists view the scanned images & dictate the result, the MT working with them would listen to the radiologist's dictation & type the result into report. MT is also responsible for loading of cases, rectifying the errors & coordinating with different team in order to get the patients' prior study images when needed.

Since the recent past, companies have stepped up their business skills with the help of introduction of various type of technology. At TRS, the work done by MTs can be substituted with a technology based device, where radiologists using such speech recognition tool could work with similar efficiency even while working alone (i.e. without any support provided from MT)

Since there was a possibility of technology being able to do the same work as man-power, the research was conducted for the same. **The purpose of the research** is to analyze the time taken by radiologists who work with MT & VR (speech recognition tool), to understand about the efficiency of radiologists while working with MT & VR.

Such introduction of technology would also help in transferring the manpower to some other productive work, so that their inputs could bring effective results. This would allow the MTs to be indulged in different projects that keep happening in the company. This would also allow both the teams to be independent, such that, one's absence won't affect the productivity of another.

Aim: To analyze the efficiency of radiologists using MT & VR, so that the team of Medical Transcriptionists could be substituted with a technology driven tool & moved to new projects.

Objectives:

1. To gather data & analyze the time taken by MT & VR provided radiologists to read all types of cases.
2. Investigate about all the necessary task that MT perform in order to substitute them with technology.
3. To reduce the high image count cases received from hospitals.
4. To determine the time taken by MT & VR provided radiologists, individually, while working with High & Low Image Count cases.

Research Methodology

The study uses primary & secondary data to analyze the efficiency of radiologists working with a speech recognition tool in comparison to the radiologists working with MTs.

The data has been collected from company's software, RADSpa & E-Rad. The data has also been collected through questionnaires & surveys about VR.

The data for the entire analysis is collected from 1st March 2020 to 1st May 2020.

Sampling: Convenient Sampling.

Out of 30 Radiologists, 19 work with MT, 1 switches between MT & VR & the remaining 10 are provided with VR. Hence, 3 Radiologists with MT & other 3 with VR are chosen as per the convenience. The remaining 1 radiologist who work with both MT & VR is analyzed separately. Radiologists', hospitals & Patient's name have not been disclosed, hence random letters were used to recognize them.

For the analysis of the data, Microsoft Excel is used.

Limitations of the study:

1. Radiologists working with VR were new as compared to the experienced radiologists working with MT.
2. The number of hospitals following the standard of images was very less.
3. Time Constraint.

Literature Review

In the development of human civilization, technology has played a vital role, where the advancements in technology has brought the businesses to where they are today. It is innocuous to say that all the invention & advancements in technology could only be possible because of the intelligence & hard work of mankind. - Technology cannot replace manpower.

In a research paper on **Voice Recognition Dictation: Radiologist as Transcriptionist**- Researchers have compared the efficiency of the technology based tool with manpower, where they found that reports dictated with voice recognition took 50% longer to dictate despite being 24% shorter than those conventionally transcribed, the frequency of errors was increased & the time spent by the radiologists on each report was more, resulting in increase in the overall cost. At last, through a survey it was found that all the radiologists showed dissatisfaction with voice recognition with the feelings of frustration, and increased fatigue. In summary, in non-academic settings, utilizing radiologists as transcriptionist resulted in more error ridden radiology reports and increased costs compared with conventional transcription services.

In another research paper on **Automatic Speech Recognition Implementations in Healthcare;** Researcher discussed about the importance & necessity of such Automatic speech recognition tool. In the research paper, the importance of such automatic speech recognition tool was expressed, where the researcher discussed about the fact that a person speaks 300 words per minute, but due to the limitation that comes with typing those words via keyboard, volume of task done get limited. He discussed about the limitation of man-power, such as, to increase the volume of work, mastery over keyboard is an absolute requirement. Transcriptionist job is laborious where time & productivity are inversely related. But with Automatic Speech Recognition, a person would just have to speak at its own pace & the text will automatically be displayed. He also assured that with continuing developments and advances in speech recognition this technology will increasingly become part of mainstream healthcare systems. However, despite varied benefits of such tool, the level of its penetration is low.

Organization Profile

Teleradiology Solutions Private Ltd.

Teleradiology Solutions Private Limited (www.Telradsol.com) is one of the first Teleradiology providers to be established worldwide and has been providing radiology service since its inception in 2002 by Two Yale University trained physician, Dr. Arjun Kalyanpur and Dr. Sunita Maheshwari. It provides teleradiology services to over 150 hospitals in 25 countries- including United States, Singapore, Nigeria, India, etc. Services provided include reporting of all noninvasive imaging modalities including radiographs, ultrasound, CT, MRI, PET- CT, X-Rays. Services are provided across the globe with the focus on rapid turnaround reporting in the emergency/acute setting. The team of experienced and highly qualified radiologist is situated internationally (Israel, United States and Europe) as well as in metropolises, Tier 2 and Tier 3 cities of India (Bangalore, Delhi, Mumbai, Hyderabad). Teleradiology solutions is among the first Teleradiology organizations to obtain Joint Commission accreditation and was rated the No. 1 Teleradiology provider in the US by KLAS (and also awarded the title of best in KLAS) in an independent survey in the year 2011. TRS as an organization has a strong academic focus with daily teaching sessions and weekly live e-lectures by both its own as well as external faculty using a comprehensive e- learning platform. TRS also has an academically inclined group with over 200 publications and presentations by the group that include exceptionally high quality radiologists trained at top universities (e.g. Cornell, Harvard, Yale, Mallinckrodt, Stanford, Baylor, John Hopkins through its innovative teaching portal (http://www.radguru.net). It provides valuable online teaching resources to radiologist globally. TRS has also collaborated with ministry of health, Tripura with 12000+ studies reported so far. Partnership between Teleradiology solution and GE health care has created landmark to improve access and availability of advanced radiology service

Telemedicine service provider: TRS leverage technology for the various services it provides from e-teaching to teleradiology to telemedicine, making it a company with difference.

Vision, Mission, Goals & Core Values

Vision: To excel in the field of International Teleradiology and become the role model for the industry.

Mission: To offer superior International Teleradiology services clients in underserved sector of the market worldwide.

Values: To conduct the practice of International Teleradiology in an ethical manner with patient care, patient safety and patient privacy at the core.

Goals:

- To focus on technology, innovation, research and operational efficiencies in order to always remain ahead of the competitors to provide the best value to clients
- To provide a fulfilling & satisfying work environment for our employees, without discriminations.
- To educate and train physicians, technologist and support staff and to use innovative technologies to maximize the reach of such training resources to the community at large.

Core values:

- Greatness lies in getting it right every single time
- Always learning and improving
- Always helping community
- Work is fun, more work is more fun
- Positive energy and passion
- Client satisfaction is our satisfaction
- Every minute counts

Teleradiology Solutions Group

Telerad Tech (T2): TRS subsidiary technology company has developed a cutting edge radiology workflow platform. RADSpaTM which optimizes the efficiency and productivity of radiologists by delivering images anywhere at any time.

Image core Lab: TRS has joint research partnerships with major technology vendors and with biotechnology majors for clinical trials radiology via its specialized Image Core Lab

Telerad Foundations: Through Telerad Foundations, TRS provides high tele-diagnostics to remote parts of Asia and Africa to the poor sections where there are patients and scanners but no doctor to interpret the images.

People for people: It is a trust fund for free playgrounds, set up in 2002- an aim to make the world around it, especially for children, a little happier. Till date, People 4 people has installed more than 250+ playgrounds for Government schools in Karnataka.

RXDX multispecialty clinic: (Prescription Diagnosis) Telerad RxDx is presently operating a state of the art multispecialty and acute health care in 3 centers- Telerad Tech, Image Core Lab Telerad Foundation; People 4 People.

Healthe minds: Healthe minds is a startup focusing on providing mental health therapy & wellness advice through an innovative, easy to use and engaging online platform. The app allows individuals to access a panel of experts such as Physiatrists, Psychologist, Counselors and life coaches through scheduling and booking of sessions and online real time consultations and follow ups.

Teleradiology Solutions

TRS is one of the oldest part of the entire Teleradiology group. TRS deals with various clients across globe. The countries where we have our client hospitals are, America, Singapore, Nigeria, India etc.

'A perfectly awake mind can do the best work.'- At TRS we have adopted this mantra where we exploit the opportunity behind different time-zones.

Since our client hospitals belong to varied time-zones, we cover for them when it is their night & our day, **the Nighthawk services**. Because at that time, it is morning for us & all our radiologists work with a completely fresh mind.

Cases are received from them, & all the Radiologists who are scheduled at different shifts read the cases – sitting in different countries.

The main concepts that are followed by heart at TRS are:

1. Rapid Turnaround time
2. Quality Work

We have different teams who handle these work, such as, RIS P2P, Assigners, Coordinators, Radiologists, MT, and Proofers & ensure that case should be read within TAT.

Since different client hospital has different SLA for TAT, focus is needed to see which case is coming from which hospital & how fast the case is to be read. Depending upon the TAT under which the case has to be done, case is assigned to different radiologists.

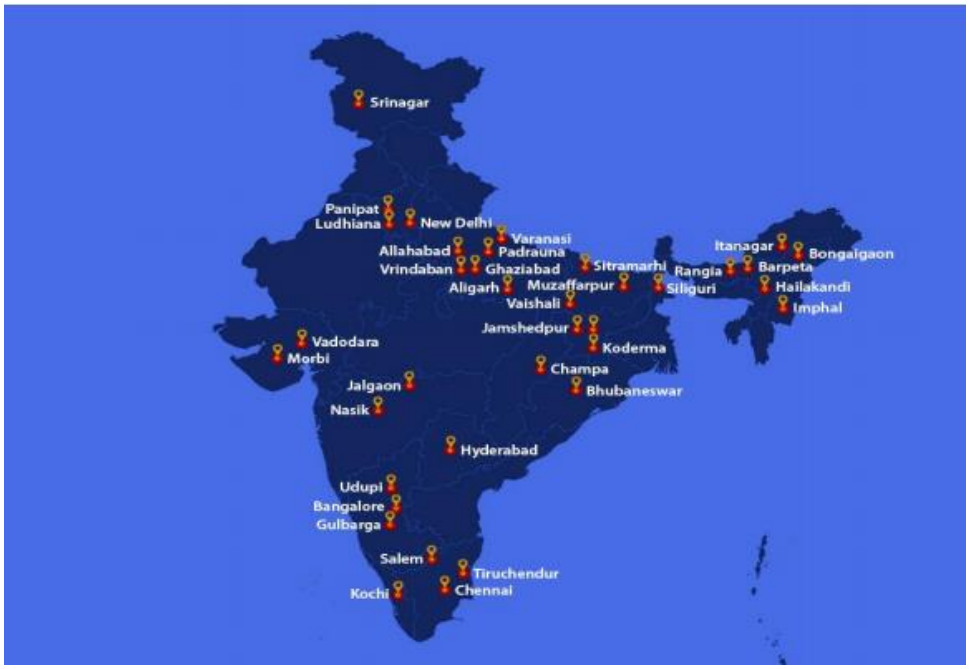
Service Level Agreement:

At the time of contract between TRS & Hospital, SLA is signed in which both the parties mutually decide a TAT in which they would expect each case's report to be completed & sent off to them.

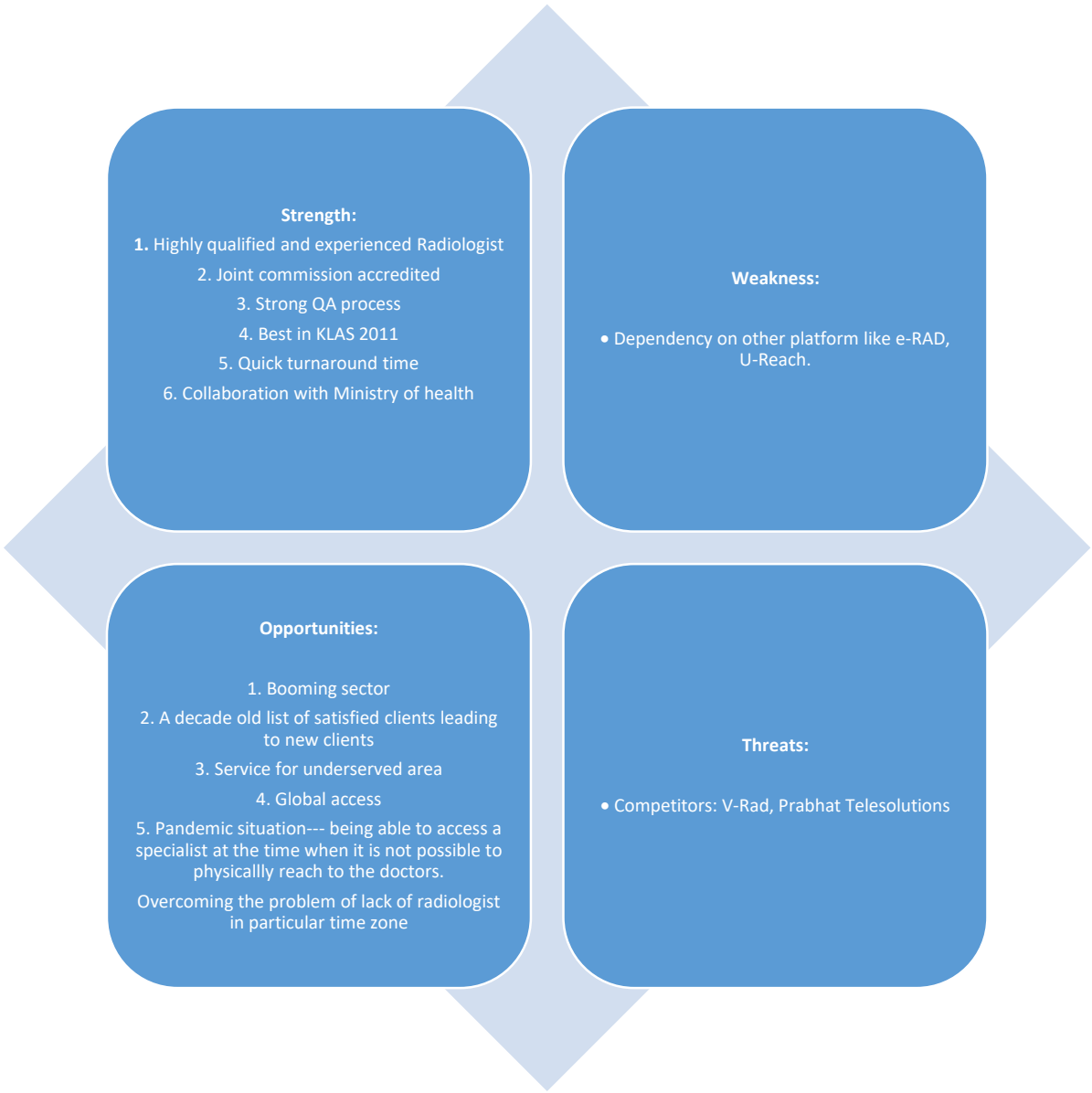
Since reading the case so fast, can cause some error, our team of Quality assurance ensure that report sent are error free & correct. For that we have a different team of Proofers, Peer-Reviewers, Radiologists, etc.

Clients

Teleradiology clients includes; care providers both in private and government and Diagnostic centers in India and across the world, including, United states, Singapore, Canada, Puerto Rico, Europe, Nigeria, Zimbabwe, Cameroon, Ethiopia, Uganda, Tanzania, Thailand, Nepal, Maldives, etc.



SWOT Analysis of Teleradiology Solutions



List of software used by TRS:

- **RADSpa**: RADSpa is the cloud based software on which clients send their cases and the radiologist do the reporting. It also provides interface to operations and other teams to understand the TAT time for particular case

- **eRAD**: eRAD is the outsourced software where hospitals/clients send the images of the cases.

- **Ureach**: Ureach is the outsourced software where hospitals send the request sheet, worksheet and prior reports.

Teams involved in process:

1. **RADSpa(software) support team**:
   - Team handles issues related to software.

2. **IT team:**
   - Issues related to IT
   - Issues related to image loading

3. **Quality assurance team:**
   - To analyze radiologist proficiency.
   - Quality check for part time radiologist.
   - Peer review process for already sent reports.

4. **RIS team:**
   - Team raises the order on behalf of hospital as per request sheet.

5. **P2P (print to packs):**
   - Check the image counts and cross check the order raised by RIS team.
   - Attach the request sheet, worksheet and prior report with the order.

6. **Assigner:**
   - Assign the cases as per assigning protocol.

7. Coordinator:

- Case assigning (As per Hospital, peer review, Radiologist, Techs Protocol).
- Take care of "call for" (if images or reports are missing or incomplete for interpreting final report).
- Reassigning the cases when the radiologist is backed up.
- Continuously be in contact with radiologist for issue resolution.
- Contact with hospital for any discrepancy related to any case.
- Scheduling of part time and in- house radiologist.
- Training of new radiologist.

8. Radiologist:

- Understand the study and do final reporting.
- Put call for code for additional details.

9. Medical Transcription:

- Type the report as per radiologist's instruction.
- Check the typed final report.

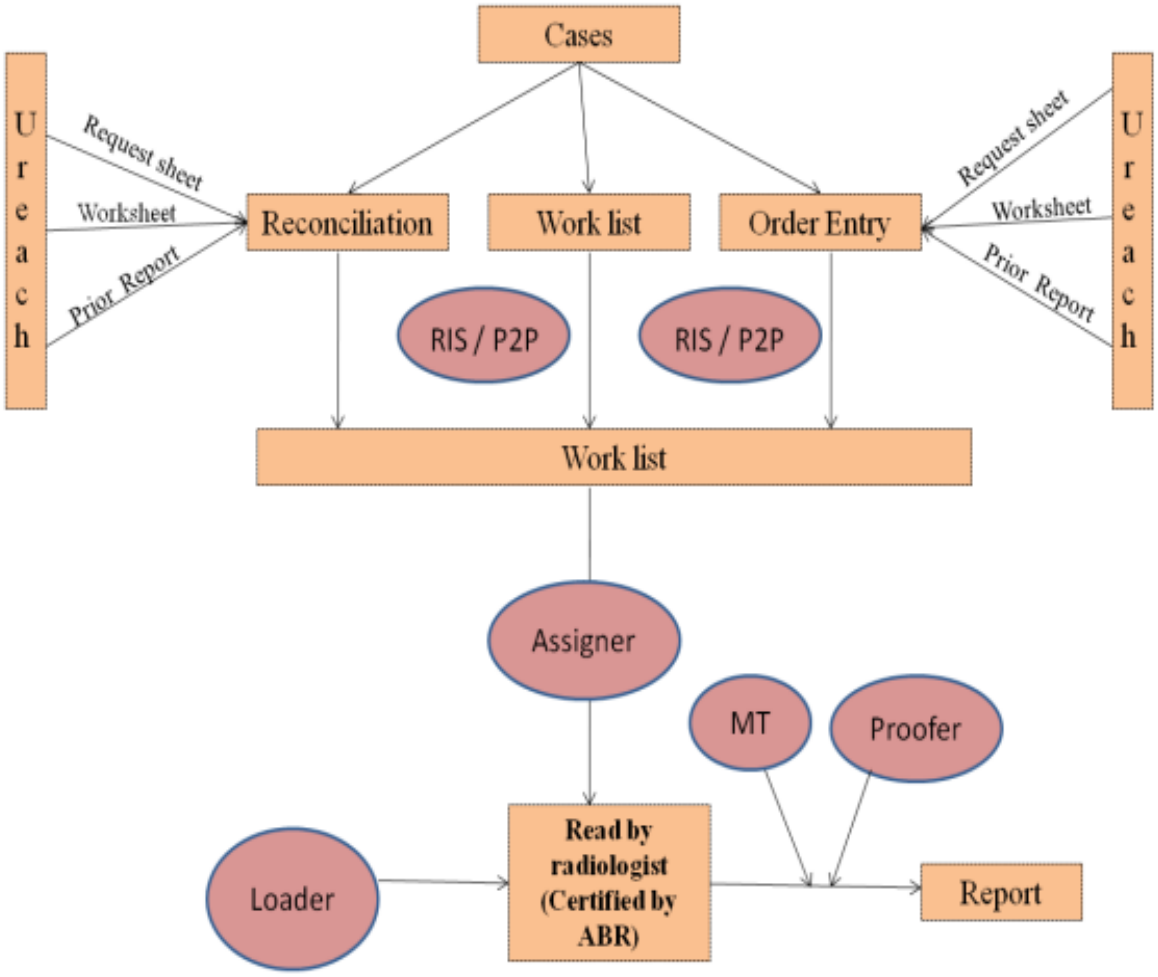
10. CC (call center):

- Staff will clear all the doubts from the clients.
- They attend all call for codes to fetch or to deliver the information to complete the report.

11. Proofer:

- Proof the report before sending out the case.

Cases Workflow



Workflow:

1. Cases: Cases could be from any client hospital country, such as, India, America, Nigeria, etc.

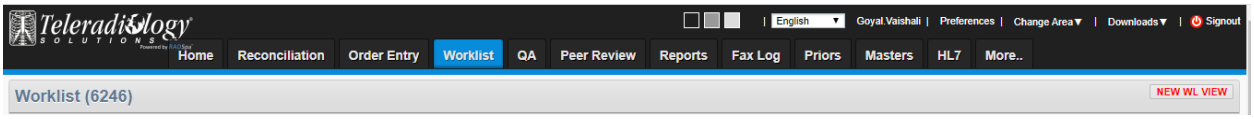
2. Hospital: Client hospitals fall under two categories:
    - *Preliminary hospital*: Reports sent to these hospitals are not final, i.e., hospital after receiving preliminary report from TRS would finalize the report with the help of their own radiologist. This way more than half work of their own radiologist gets less tedious.

    - *Final Hospital*: Report that would be sent from TRS would be final. Our Radiologists would report what has happened to the patient according to the images they see, & the exact reports are sent to the hospital doctors.

    Workflow remains the same for both type of hospitals.

3. RADSpa: RADSpa is TRS own software where images are received, viewed, report is written & contains various other operational features.

    It contains various tabs as follows:



4. Scanned Images:

    - Patients are scanned for various Modality & Procedures depending on the problem they have or the test they are recommended by their Physicians.

    - Modality includes- XR, CR, CT, NM, MR, etc.
    - The scan could be for various body parts- Head, Chest, Abdomen, Pelvis, Foot, etc.

RISP2P

- When a patient comes to the hospital, their technologist takes various scans of the patient based on the problem they have.
- The Hospital technologist would send these scanned images to TRS via Teleradiology software- RADSpa.

Hospitals can send this information in 3 ways:

1. Information is received in the reconciliation tab of RADSpa.
2. Information is received as an invoice via U-Reach (A Third Party Software).
3. Information is received directly in the wordlist.

The first team to receive these scanned images at TRS is RISP2P Team, i.e. Radiology Information System & Print to PACS.

- When information is received in the Reconciliation page, RISP2P member matches the information present on RADSpa with the Fax sheet sent by the hospital in the U-Reach. This information is typed via hospital technologist themselves. RIS P2P individual would press the order button and the case would appear in the ***Worklist*** in Unassigned status.

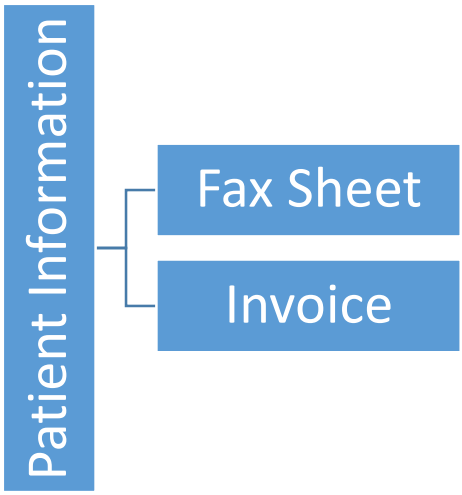
- When information is received via invoice in U-Reach, RISP2P members would listen to the Patient's information & type important information themselves on the reconciliation page. They would press the order button and the case would appear in the worklist in Unassigned status.

- When information comes directly into the worklist, RISP2P member would just have to press the order button and it starts appearing in unassigned status to other team members.

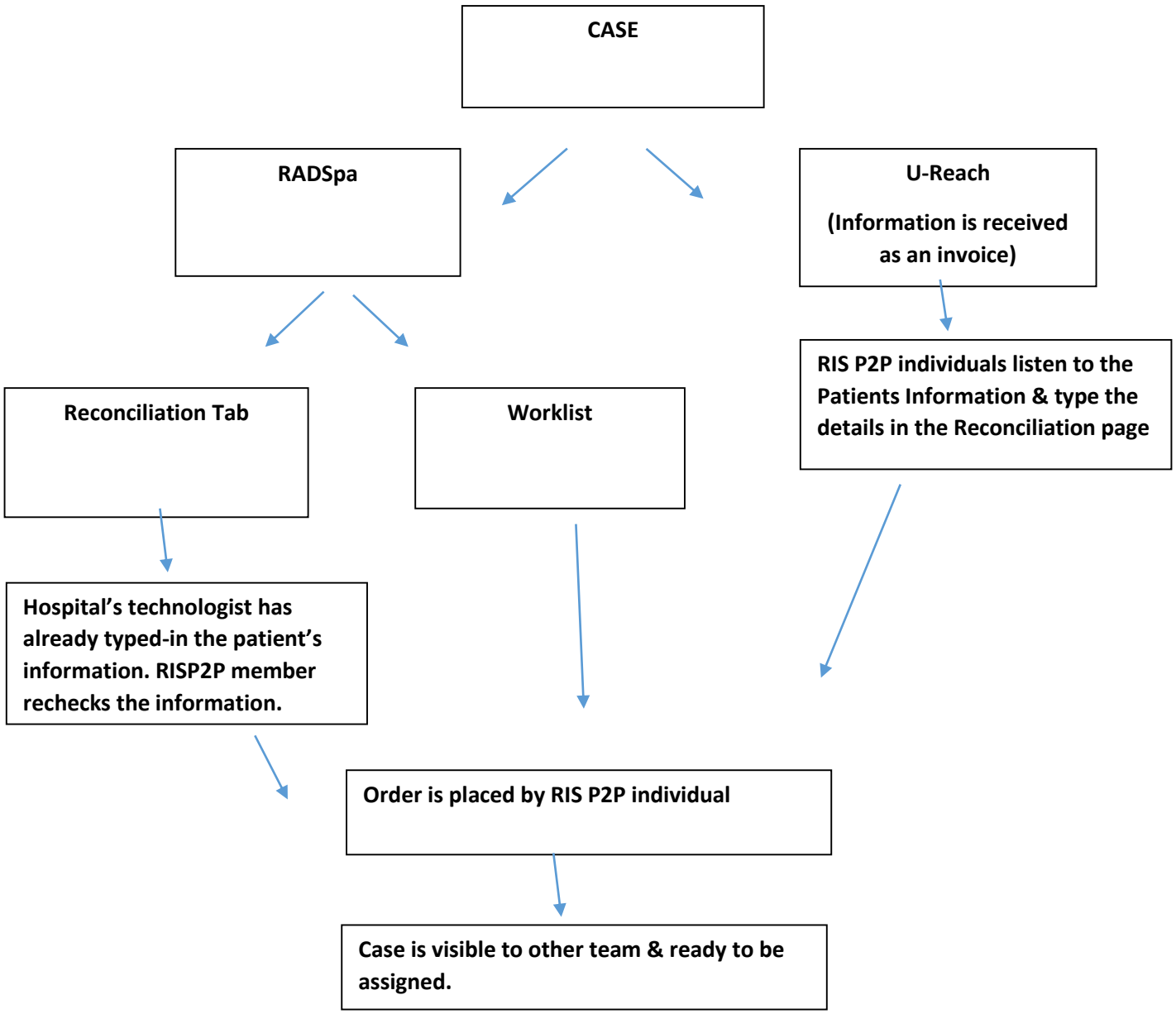
Patient's Information

Patient's information include:

1. Patient's history of any serious illness.
2. Previous Scans.
3. Patient's Age, Gender, MRN (Medical Registration Number), Date of Birth.
4. Recommendation from the Hospital's technologist for the patient.



RIS P2P Workflow



Assigners

- As soon as the case reaches the Worklist in unassigned status, the team of assigners assign the cases to the Radiologists.

- Assigning is based on various protocols in which we look if the particular radiologist is credentialed (holds license) to read the case of that country or not, if yes, then the case is assigned to that radiologist.

Coordinators

- Coordinators would manage if the team is following the protocols before assigning.

- They are also the point of contact between In-house Radiologists, ABRs & the assigners.

Radiologists

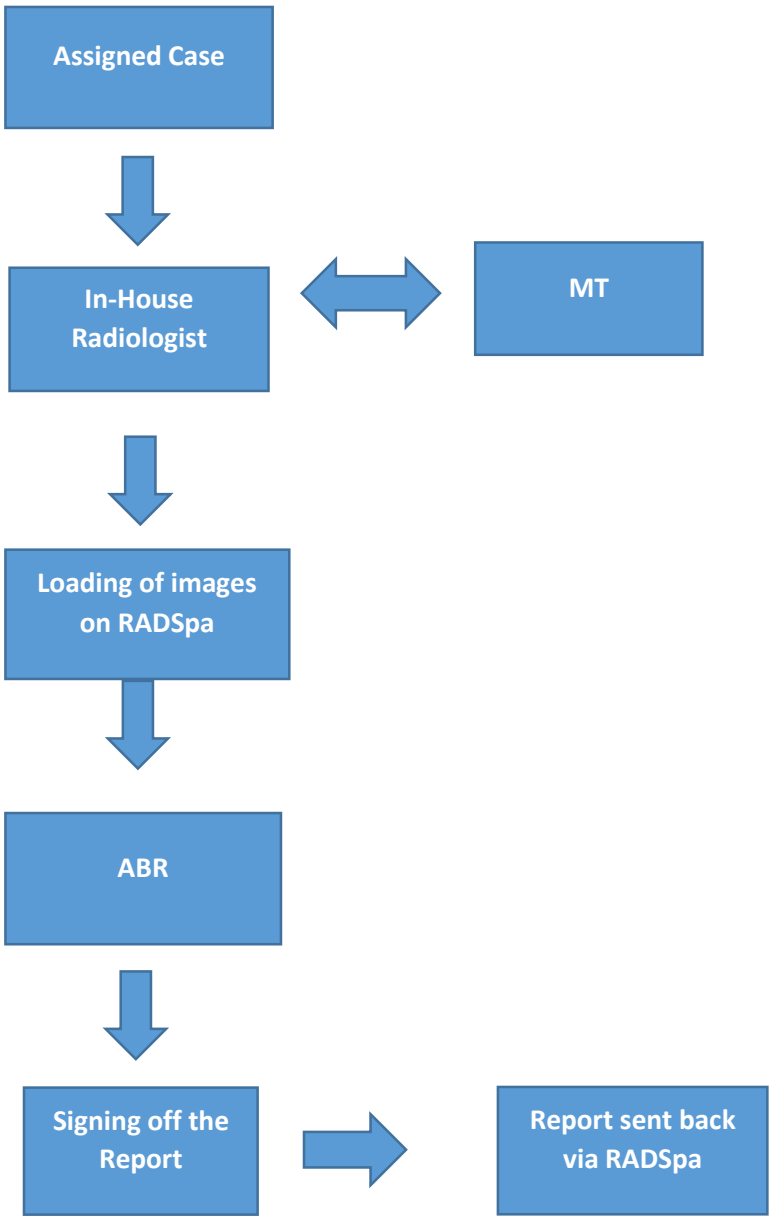
There are various types of Radiologist at TRS:

a. In-House Radiologists: Such Radiologists read cases for Indian client hospitals or review the cases done by the ABRs.

b. America Based Radiologists: Such Radiologists are based in America & read the cases received from American Hospitals.

c. FRCRs & MD: Such Radiologists come under the Elective workflow, i.e., Singapore, Nigeria, India cases.

Radiologists:



Medical Transcriptionist

- MT is the person who works alongside Radiologist.
- When Radiologists view the scanned images & dictates the result, the MT working with the Rad would listen to the Radiologist's dictation & type the result into report.
- MT is also responsible for **proof-read the case, loading of cases, rectify the errors & retrieving the prior images of patients' when needed**.
- At TRS, MT is provided to some radiologists.
- While some Radiologists are provided with MT, a new technology has been adopted by TRS for others.
- A new technological tool called ***VR***, has been adopted at TRS that allows Radiologist to work alone.
- **VR is a smart device that would type the dictation provided by radiologist into the report.**
- It checks for any spell error and also contains software that understands medical terminology.

Moving the team of MTs into another productive & making radiologists independent

To move the team of MTs, we would require the substitution of support work provided by them, by:

1. **A *software* for dictation, spell check & understanding of medical terminology.**

- TRS has adopted a new software called VR that has all the above mentioned features & also allows Radiologists to work independently,
- Feedback from Radiologists is also taken about VR. Common feedbacks were:
  - Low understanding of Medical Terminology.
  - Lower grasp for short-keys.
- The lacks found after taking feedback was conveyed to resource provider, wherein they rectified the product on the basis of our suggestion.

2. **Faster loading of images.**

- Scanned images are received in the company's software; either E-Rad or RADSpa.
- These images are received in various *slice thickness* where thin slice thickness images are higher in number & thicker slice thickness images are lesser in number.
- Maximum of the hospitals send images in multiple sets containing images of varied slice thickness. For example: 0.5mm, 0.75mm, 1mm, 2mm, 2.5mm, 3mm etc.
- Slice thickness 0.5 mm – 2 mm (or less than 2mm) takes a lot of time to load either on E-Rad or RADSpa.
- Since loading of such images ultimately increases the TAT of the case. A new strategy has been adopted where we have formulated a **new standard for the images received on software.**
- For this standardized format, Senior Radiologists help was taken, to decide what slice thickness images were sufficient to read the case easily.

Teleradiology SOLUTIONS

TRS imaging requirements

Procedure Names	Axial	Bone or lung algorithm	Sagittal reformats - bone or soft tissue	Coronal reformats - bone or soft tissue	Others
	3 or 5 mm-One set only	Axial 3 or 5 mm - One set only	(=/> 2 or 3 mm - One set only)	(=/> 2 or 3 mm - One set only)	
CT head	Axial	Bone	Soft tissue	Soft tissue	
CT maxface/orbits/sinuses	Axial	Bone	Bone	Bone	
CT soft tissue neck	Axial		Soft tissue	Soft tissue	
CT C, T, and L spines	Axial	Bone	Bone	Bone	
CT chest	Axial	Lung	Soft tissue	Soft tissue	
CT abd and pelvis	Axial	Lung (bases only)	Soft tissue	Soft tissue	
CT chest, abd and pelvis	Axial	Lung	Soft tissue	Soft tissue	
CT pelvis	Axial	Bone	Bone	Bone	
CT angio head	Axial		Soft tissue	Soft tissue	MIPS
CT angio neck	Axial		Soft tissue	Soft tissue	MIPS
CT angio chest - PE	Axial	Lung	Soft tissue	Soft tissue	MIPS not required, prefer MPRs
CT angio chest, abd and pel	Axial	Lung (Chest only)	Soft tissue	Soft tissue	
CT angio abd and pel	Axial		Soft tissue	Soft tissue	
CT angio lower ext/venogram	Axial		Soft tissue	Soft tissue	MIPS
CT extremity	Axial	Bone	Bone	Bone	

Fig: TRS imaging requirements standard

Communication among TRS & Client Hospital:

- To convey about the new standard of images, the names of the hospitals that send thin slice thickness images were found.
- For this, another software was used called E-Rad.
- After gathering the data for each hospital separately, a summary of individual case was created & a mail with complete information about slice thickness & the new standard of images was sent.
- All the clients were expected to follow the new standard.
- However, only few client hospitals lowered the image count. Constant follow-ups were being done with those who continued to send cases with high image count.
- Hence, in further study, we are conducting an analysis to see the difference between the TAT of client hospital who send images according to the formulated standard & those who don't.

- Summary of High Image Count Cases:

MRN No.	Image Count	Procedure	Unnecessary Images	Hospital
7XXXXXX	1497	CT Angio chest and abdomen	Received 2 sets of Axials in 1mm & 3mm slice thickness. 1mm slice thickness with 404 images is not required.	XYZ Hospital
7XXXXXXY	2701	Angiogram Head	Received 2 sets of Axials in 0.5mm & 1mm slice thickness. 0.5 mm with 1098 images is not required. Also, 3 MIP with images 166, 101 & 101 are not required either. Total 1466 images are not required.	XYZ Hospital
2XXXXXYY	1188	CT KUB	Received 2 sets of Axials. 5mm & 0.625mm. 0.625 mm slice thickness with 760 images is not required	ABC Hospital
1XXXXXXYYY	1866	CT Chest Abdomen & Pelvis	Received 2 sets of Axial; 5mm & 0.625mm. 0.625 mm with 1021 images is not required.	ABC Hospital

3. Coordination with the other team members.

- Sometimes radiologists need patients' prior study images to read the case.
- Hence, MT working with them convey about the need of priors to the coordinators who take that request further to other team members.

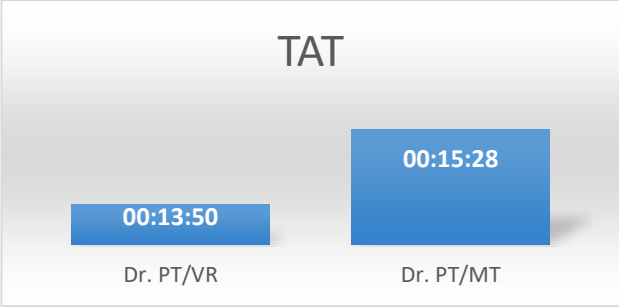
Investigating if VR alone is sufficient to replace MTs

- Analysis is done between Radiologists who use MT & those who use VR.
- If Time taken by MT users is more than VR users, then VR can directly replace MTs without any further interference with the images.
- But if time taken by MT Users turns out to be lesser than the VR users then the standardized image format would have to be used & conveyed to the client hospital in order to reduce the TAT.

First Analysis

Analysis on Dr. PT who switches between MT & VR.

Name	Total no. of cases	Average TAT
Dr. PT/MT	65	0:15:28
Dr. PT/VR	65	0:13:50



Inference:

- ❖ This analysis suggests that Dr. PT takes more time with MT whereas he performs better when he works independently.
- ❖ It signifies that ability to handle technology also affects TAT.

Analysis on Dr. GA, Dr. DM & Dr. SH who use MT whenever they work.

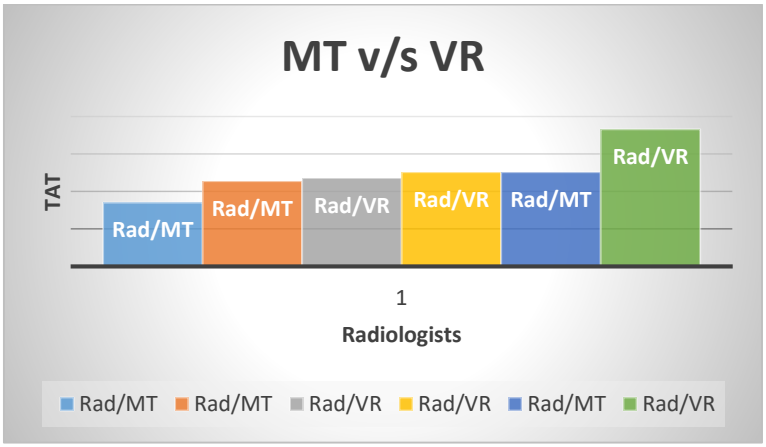
Radiologists who have MT:

Doctor	Number of Cases	Average TAT
Dr. GA	100	0:12:17
Dr. DM	100	0:16:23
Dr. SH	100	0:18:07

Analysis on Dr. CA, Dr. HA & Dr. NA who use VR whenever they work.

Radiologists who have VR:

Doctor	Number of Cases	Average TAT
Dr. CA	100	0:18:05
Dr. HA	100	0:16:59
Dr. NA	100	0:26:21



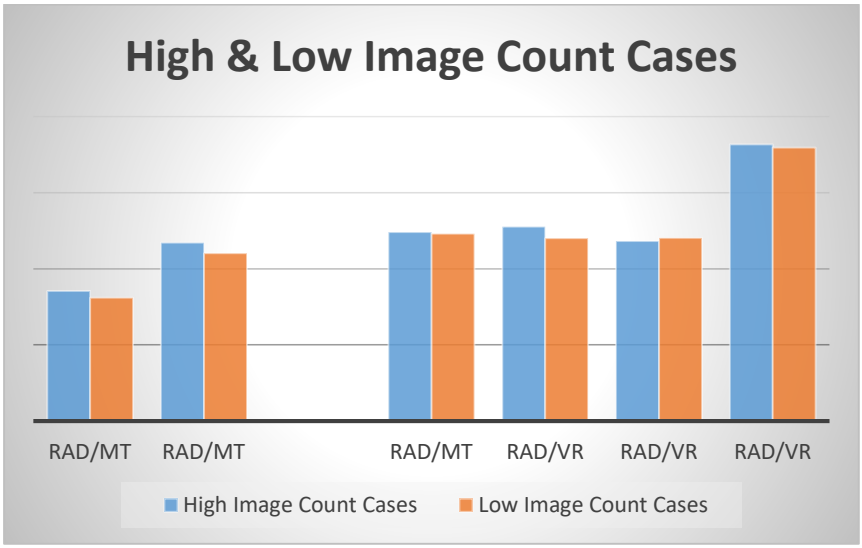
Inference:

- Above analysis shows that the MT provided radiologist were reading the reports quickly as compared to the VR provided radiologists.
- 1 Rad who switches between VR & MT took less amount of time while working with VR– indicating that the ability to handle technology is also a factor that can affect TAT.

Second Analysis

TAT Analysis between cases with high & low image count:

Name	MT/VR	No. of Cases Analyzed	Average TAT of High Image Count Cases	Average TAT of Lower Image Count Cases
Dr. GA	MT	20	0:12:18	0:11:39
Dr. DM	MT	20	0:16:21	0:16:53
Dr. SH	MT	20	0:17:52	0:17:43
Dr. CA	VR	20	0:18:24	0:17:17
Dr. HA	VR	20	0:17:01	0:17:04
Dr. NA	VR	20	0:26:10	0:25:53



Inference:

- Radiologists took less time in reading low image count cases.
- One radiologist took more time in reading low image count cases.
- On comparing the TAT of MT with VR provided radiologist, reading a low image count case, respectively, revealed that MT Users took less time.

Result

- **In the first analysis** of TAT difference between MT & VR provided Radiologists, **TAT of MT provided radiologists was lesser as compared to the TAT of VR provided radiologists,** indicating that substitution of VR, alone, in place of MTs was not working as radiologists were taking more time while working with VR.
- **Second analysis** showcased that TAT of MT & VR using radiologists was reduced as compared to the first analysis TAT, however, High image count were taking more TAT in both the cases.
- TAT of VR using radiologists remained higher than TAT MT users in both the analysis.
- In some cases, radiologists took more time in reading Low Image Count cases, which revealed that other support work of MT, i.e. coordination to retrieve patient's priors was also important.

Discussion

The primary purpose of this research was to analyze the efficiency of radiologists working with VR & MT, respectively, **so that the entire team of MT could be moved to some other pronounced projects**. Literature review had suggested the importance of such speech recognition tools in increasing the volume of task done in a given amount of time- as it does not have any limitations of requiring mastery over keyboard. Another research had revealed that similar speech recognition tool brought dissatisfied results where radiologists were taking more time even in short reports & the cost was increasing. Hence, to make this research relevant, specific necessities of radiologists were taken into consideration**. Maximum of the tasks that were done by an MT were dissected into different components**; such as- typing the dictation done by the radiologists, spell check, loading of cases. All the tasks, **except loading of the images & coordination with other team members** could be done by VR. Since MTs also load the images for doctors on another monitor when doctor are studying the images on first, whereas the *radiologists working with VR had to load images on their own*, a standard was created in order to reduce the high image count cases received from hospitals. As low image count take less time to load on the software. Hence, MT & VR provided radiologists were analyzed based on the time taken by them to read a case with low & high image count, separately.

The results revealed that although the VR & MT provided radiologist were taking less amount of time in reading low image count cases, however, the overall TAT of VR provided radiologist remained higher when compared with MT provided radiologist. **This could be due to the other support provided by MTs such as Coordination.**

However, one radiologist who switched between VR & MT from week to week, took less time in reading cases with VR. This indicates that the TAT of VR users also depends on the efficiency with which the tool was used.

After analyzing both type of studies, it was realized that the TAT of radiologist is affected by various support work provided by MTs, other than typing of reports, those are: Availability of low image count cases, patient's prior images & the ability to use technology.

Conclusion

The above research revealed that technology holds the power to work as efficiently as the man-power **only when applied smartly**. In this study, the speech recognition tool, i.e. VR would be able to work with the man-power efficiency only after the presence of all the other support work that an MT provides, rather than just typing of reports & spell-check. The other support work includes, the availability of all the priors of the patients' into RADSpa & also, the low image count cases where all the hospitals should be following the standardized format of the images. Without the presence of low image count cases, the availability of priors & ability to handle technology, VR cannot work as efficiently as the man-power.

References

1. https://medium.com/@vanshgupta_75500/article-technology-cannot-replace-manpower-7c8ad93bb624
2. https://www.emerald.com/insight/content/doi/10.1108/01437720310464972/full/html
3. https://onlinelibrary.wiley.com/doi/abs/10.1111/1468-005X.00053
4. https://link.springer.com/article/10.1007/s10278-007-9039-2
5. https://www.scss.tcd.ie/publications/theses/diss/2005/TCD-CS-DISSERTATION-2005-013.pdf