

EFFECT OF CLINICAL INFORMATION PROVISION IN HMIS FOR MRI REFERRALS ON TURNAROUND TIME (TAT)

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ABSTRACT

PURPOSE: The absence of clinical information presented in MRI referrals hinders diagnostics completion and reporting accuracy, decreases radiologists confidence in accurate reporting, increases turnaround times, and eventually delays treatment, which could correlate to gaps in HMIS workflows, broken clinical workflows, or errors in reporting workflows. **METHODS:** This retrospective cross-sectional study having a sample size of n=112 including MRI referrals from April to May 2025 was conducted at Lady Reading Hospital, Peshawar. Referrals for which complete clinical information such as history or the differential diagnosis were not given properly set as incomplete, while all others were set as complete. The analysis includes TAT (turnaround time) and RR-TIME (referral-to-report time). All analysis were done using SPSS v27. The non-parametric Mann-Whitney U test measured differences in TAT among different groups, and effect sizes were calculated with Cohen's r. **RESULTS:** Of 112 referrals, 76 (67.9%) cases were having complete clinical information and 36 (32.1%) incompletes. The mean TAT time for complete clinical information is 22 hours 31 minutes and for incomplete clinical information is 43 hours 55 minutes. Complete referrals had significantly shorter TAT (Mean Rank = 49.17 vs 71.97; $p = 0.001$, $r = 0.33$) and referral-to-report times (Mean Rank = 50.30 vs 69.58; $p = 0.003$, $r = 0.28$). Referrals having differentials and full clinical history also decreases turnaround time ($p < 0.001$, $r = 0.25-0.68$). **CONCLUSION:** The clinical information added to HMIS for MRI referrals optimizes operational workflow in the radiology department, reduces the turnaround time for the report, and enhances the reliability and confidence of the radiologists on the diagnosis. Therefore, standardized referral forms, structured HMIS clinical documentation prompts, and specific teaching are necessary to optimize documentation quality, resource utilization, and optimum patient care outcomes.

Keywords: HMIS, MRI, Clinical Information, Turnaround Time, Radiology Efficiency, Referral Quality

Introduction

The scope of HMIS within healthcare configurations is unbounded within healthcare configurations, given the divergent healthcare units facilitate care integration, communication, and coordination. HMIS ensures inter and intra departmental transmission of essential patient data then transferred communication within healthcare tiers is coordinated and timely to avoid delays.¹ Given the dependence of the radiology divisions on requests for imaging, along with clinical information for guiding

and streamlining the decision for timely and accurate reporting. HMIS within radiology divisions transforms reporting turnaround times positively along with clinical imaging requests.² Imaging requests omit critical clinical information and data. Clinical data encourages the radiology unit to achieve defined and explicit reporting for diagnostic assessments. Clinical information reduces unnecessary and redundant procedures for patient optimum radiology and diagnostic assessments. Positive

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information assists and streamlines reporting with an explicit focus, ascertaining clinical relevance and problem solving during diagnostic assessments.³ The radiologists have confidence of his findings and diagnosis while reporting if clinical information is provided, which reduces radiology turnaround times significantly with the healthcare system enhancement and constructiveness. However, if communication of clinical information is inconsistent, deficient and devoid of system and focus while referring, results in significant hampering of the reporting. This creates unnecessary reporting flow gaps and errors by radiology unit.⁴

TAT is a major key performance indicator (KPI) for a radiology department. From the time of referral to the time a report is available, MRIs, are the most resource-sensitive and tend to have the most delays when it comes to TAT. If MRI's are delayed, it could cause a domino effect where diagnosis is delayed, hospital stay is unnecessarily prolonged, overall healthcare expenses are heightened, and most importantly, the patient's welfare plummets. Out of all the factors constituting MRI TAT, the clinical data entered into the HMIS system at the time of the referral, are the most manageable, economical aspects that substantially improve the workflow.^{5,6} The most recent research indicates that structured and explicit clinical details provided with referrals assists more effective triage, decreases the level of uncertainty, and optimizes the radiology workflow.^{7,8} Notwithstanding these advantages, there is scant evidence to assess the impact of clinical information provided in HMIS on MRI TAT, particularly in Pakistan and other developing healthcare systems. This study exists on the issue of how the level of clinical information in HMIS referrals impacts the workflow and reporting turnaround time of radiologists in the tertiary care hospitals of Peshawar, Khyber Pakhtunkhwa.^{9,10}

The present study therefore attempts to determine the proportion of MRI referrals from different specialties that provide complete and incomplete clinical information in HMIS. The main aim of this study is to analyze the level of clinical information provided against the TAT for MRI referrals and to measure the TAT to radiologists and the reporting efficiency as captured through scan to report time for clinical information, differential diagnosis, and patient history. This research also aims to contribute to the local evidence generation that is intended to enhance the referral benchmarks of the HMIS, foster improved cross departmental cooperation,

and as a result, enhance the efficiency and diagnostic precision of the radiology departments.

The hypothesis of our research is:

The absence of clinical information presented in MRI referrals hinders diagnostics completion and reporting accuracy, decreased radiologist confidence for accurate reporting, increases turnaround times, and eventually delayed treatment, which could correlate to gaps in HMIS workflows, broken clinical workflows, or gaps in reporting workflows. Yet, regional evidence to appropriately quantify and categorize this issue in developed clinical systems has remained scarce.

Methodology

This retrospective cross-sectional study was completed from 1st April to 31st May 2025 within the MRI Section of the Department of Radiology, Medical Teaching Institution (MTI), Lady Reading Hospital (LRH) in Peshawar. The study intends to evaluate the effects of clinical information incompleteness in HMIS-based MRI referrals on radiology productivity. Radiology productivity in this case was assessed via reporting productivity metrics TAT (Turnaround Time) usually defined as scan to report time and referral-to-report metrics RR-TIME. During the sampling, 112 HMIS MRI referrals were captured. The sample size was derived utilizing OpenEpi analytic software, which indicated an appropriate sampling frame of 95% confidence, 80% power, and medium effect size (Cohen's $d = 0.5$) to observe differences in TAT among the larger study groups within the capped sample of completed referrals. A systematic sampling approach was employed, whereby every 5th MRI referral completed within the study period was included. Sampling continued until the predetermined sample size of 112 referrals was achieved. Both inpatient and outpatient referrals were reviewed for active cases, while those captured in the Emergency department or outside the HMIS perimeter were excluded from this study.

After receiving consent from the MTI-LRH IRB, HMIS data was pulled backwards using a structured form, and a data collection form was filled. The data collection form included patient demographics, the referring specialty, consistence of clinical details, and the presence of a differential diagnosis, any rejected referrals, and MRI turnaround times. A referral's clinical data was

said to be completely informative if it contained a clear clinical indication, relevant patient history, and a differential diagnosis; while those referrals missing any of these elements were said to be 'incomplete'. The scan-to-report time or turnaround time used to indicate the duration between the MRI scan and report generation, and the referral-to-report time was the duration from submission of the referral to the report being available. In order to maintain confidentiality, all patient identifiers were eliminated.

Data analysis utilized SPSS (Statistical Package for the Social Sciences) version 27. For descriptive statistics, continuous variables were summarized using means and standard deviations, whereas for categorical variables, the summary included counts and percentages. The normality of turnaround time (TAT) variables was assessed using the Shapiro-Wilk test. The test outcomes indicated that the data were not normally distributed, hence the application of non-parametric tests. The Mann-Whitney U test was used to analyze the difference in TAT for referrals where clinical information was complete versus incomplete, as well as for cases where differential diagnoses and complete clinical histories were present versus absent. The means of effect sizes were interpreted using Cohen's *r*. The relationship of the variables in the categorical portion of the data was tested using the Chi-square test and Fisher's exact test where appropriate. A significance level of 0.05 was utilized. The study maintained the confidentiality and the ethical handling of the data, ensuring that no identifying information was included.

Results

(Tab.1) indicates that there were 112 MRI referrals scrutinized within different fields of specialties. Out of these referrals, 76 referrals (67.9%) had adequate clinical information while 36 (32.1%) were incomplete. Clinical information completeness varied greatly amongst the specialties that were referring the patients. Moderate completions were seen within the medicine (52.8%), neurology (38.5%), and orthopedics (50%) specialties. However, gynecology, surgery, pediatric surgery, and gastroenterology had 100% incompleteness rates. On the contrary, referrals from dermatology, neurosurgery, nephrology, acute medical unit (AMU) and other had

100% completion rates. This emphasizes the great lack of clinical information within the HMIS referrals that are supplied to different domains within the same department. The difference could be attributed to lack of clinical documentation and the lack of understanding of the importance of thorough patient information, especially the history, when requests for imaging studies are made.

Referring Specialty	Complete Clinical Information (n, %)	Incomplete Clinical Information (n, %)
Gynecology	0 (0%)	2 (100%)
Medicine	19 (52.8%)	17 (47.2%)
Surgery	0 (0%)	1 (100%)
Dermatology	1 (100%)	0 (0%)
Others	40 (100%)	0 (0%)
Pediatric Surgery	0 (0%)	1 (100%)
Neurology	5 (38.5%)	8 (61.5%)
Orthopedic	2 (50%)	2 (50%)
AMU	3 (100%)	0 (0%)
Neurosurgery	4 (100%)	0 (0%)
Nephrology	1 (100%)	0 (0%)
Endocrinology	1 (33.3%)	2 (66.7%)
Gastroenterology	0 (0%)	3 (100%)

Table 1: Distribution of complete vs incomplete clinical information by referring specialty (n = 112)

(Tab.2) illustrates the relationship between the completeness of clinical information and the MRI turnaround time (TAT). TAT values were not normally distributed for both referral groups. Although TAT was not normally distributed, Mean \pm SD (hours) was calculated for descriptive purposes using the explore function in SPSS. The Mann-Whitney U test was used to compare TAT between complete and incomplete clinical information groups. There was a significant difference in TAT for referrals with complete and incomplete clinical information ($U = 811.000$, $Z = -3.470$, $p = 0.001$). For complete clinical information, the mean MRI turnaround time was 22 hours 31 minutes, with a standard deviation of 26 hours 20 minutes. For incomplete clinical information, the mean MRI turnaround time was 43 hours 55 minutes, with a standard deviation of 45 hours 14 minutes. The TAT was less for referrals with complete clinical information than with incomplete information suggesting that MRI reports were processed faster when adequate clinical details were provided in the

HMIS referral. Providing complete clinical details in the HMIS system clearly improves the efficiency of the radiology department by decreasing the reporting lag time. Enhanced efficiency increases the system's capability to respond to demands, thus improving overall effectiveness.

Clinical Information (HMIS Referral)	N	Mean ± SD (hours:minutes)	Mann-Whitney U	Z	P-value
Complete Clinical Information	76	22:31 ± 26:20	811.000	-3.470	0.001
Incomplete Clinical Information	36	43:55 ± 45:14	-	-	-

Table 2: Comparison of turnaround time (TAT) between complete and incomplete clinical information groups using mann - whitney U test (n = 112)

(Tab.3) demonstrates the impact of clinical information on MRI efficiency. Mann-Whitney U tests were conducted to assess the effect of clinical information on both scan-to-report time (TAT-TIME) and referral-to-report time (RR-TIME). Referrals with complete clinical history had significantly shorter scan-to-report times (Mean Rank = 49.17) compared to incomplete history (Mean Rank = 71.97; U = 811.000, Z = -3.470, p = 0.001, r = 0.33). Similarly, complete clinical history was associated with reduced overall referral-to-report time (Mean Rank = 50.30 vs 69.58; U = 897.000, Z = -2.934, p = 0.003, r = 0.28). Referrals including a

Factor	Outcome	Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	P-value	r
Complete Clinical History	TAT-TIME	Yes	76	49.17	3737.00	811.000	-3.470	0.001	0.33
		No	36	71.97	2591.00				
History	RR-TIME	Yes	76	50.30	3823.00	897.000	-2.934	0.003	0.28
		No	36	69.58	2505.00				
Differential Diagnosis	TAT-TIME	Yes	52	75.62	3932.00	566.000	-7.223	0.000	0.68
		No	60	39.93	2396.00				
Diagnosis	RR-TIME	Yes	35	68.74	2406.00	919.000	-2.690	0.007	0.25
		No	77	50.94	3922.00				
Complete History	TAT-TIME	Yes	52	75.62	3932.00	566.000	-7.223	0.000	0.68
		No	60	39.93	2396.00				
History	RR-TIME	Yes	52	71.86	3736.50	761.500	-4.659	0.000	0.44
		No	60	43.19	2591.50				

Note: "Mean Rank" is used here because Mann-Whitney U is a non-parametric test; r = effect size (Cohen's r).

Table 3: Effect of clinical information on MRI turnaround time (scan-to-report & referral-to-report)

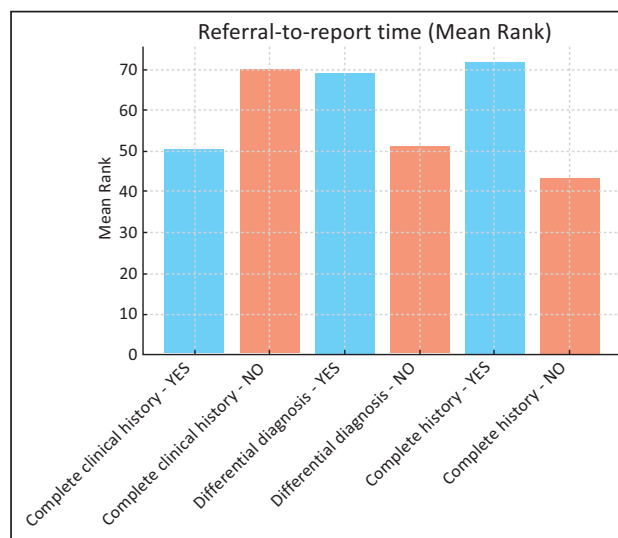
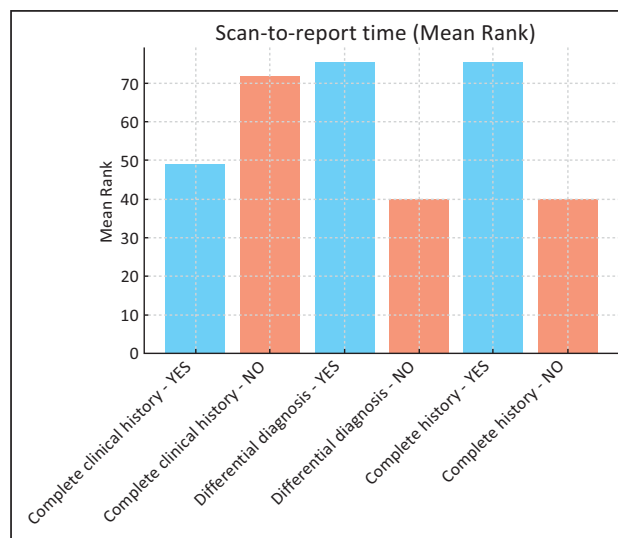


Figure 1: Impact of complete clinical information i.e. differential diagnosis and complete history on scan-to-report and referral-to-report times (Mean Rank)

differential diagnosis had markedly faster scan-to-report times (Mean Rank = 75.62 vs 39.93; U = 566.000, Z = -7.223, p < 0.001, r = 0.68) and shorter referral-to-report times (Mean Rank = 68.74 vs 50.94; U = 919.000, Z = -2.690, p = 0.007, r = 0.25). Finally, the presence of a complete patient history also significantly reduced scan-to-report times (Mean Rank = 75.62 vs 39.93; U = 566.000, Z = -7.223, p < 0.001, r = 0.68) and referral-to-report times (Mean Rank = 71.86 vs 43.19; U = 761.500, Z = -4.659, p < 0.001, r = 0.44).

The data presented in this study demonstrates that complete clinical information including clinical history and differential diagnosis significantly enhances

reporting timeframe and overall workflow. This efficiency improvement in HMIS MRI referrals underscores the importance of detailed and well-structured referral documentation.

Discussion

The impact that complete clinical data has on the radiology workflow and the reduction of turnaround time (TAT) is increasingly being evidenced in the HMIS MRI referrals studies. In the conducted study analyzing 112 MRI referrals, 67.9% of the referrals were complete in all clinical particulars, while 32.1% were not. Such marked differences referring to the quality of documentation in subspecialty divisions suggest a documentation gap, and a lack of understanding the importance of a complete clinical information to be obtained prior to the radiology study.¹¹ There are, however, construction specialties that include, dermatology, neurosurgery, nephrology and the acute medical unit that were very complete in the documentation of clinical particulars. In contrast, the gynecology, surgery, pediatric surgery and the gastroenterology departments had the unfortunate exemption of 100% of the referrals being completely sterile of context. These marked discrepancies pointed out, suggest a likely absence of alignment in institutional documentation standards and referral training protocols, not to mention potential delays in patient care and inefficient allocation of radiology services and resources.^{12,13}

Our findings indicate that there is a strong and significant relationship between completeness of clinical data and TAT of MRI examinations. The TAT was less for referrals with complete clinical information than with incomplete information suggesting that MRI reports were processed faster when adequate clinical details were provided in the HMIS referral. Complete clinical history referrals had significantly lower TAT (Mean Rank = 49.17) and referral-to-report times (Mean Rank = 50.30) than incomplete referrals. Our results therefore supporting our hypothesis. This indicates that sufficient clinical information positively streamlines the workflow of the radiology department. Adding differential diagnoses and pertinent history data further decreased reporting time. This demonstrates the ability of radiologists to make faster imaging diagnoses when there are higher standards of clinical data.¹⁴ This is consistent with

previous literature which states that more detailed referral information reduces diagnostic ambiguity and interpretative error and subsequently amplifies the radiologist's confidence, which, in turn, optimizes patient care efficiency. The effect sizes in our study, which ranged from moderate to large ($r = 0.25 - 0.68$), suggest that an adequate amount of clinical data concerning TAT is effectually and clinically significant, and not simply just a statistic.^{15,16}

In the context of the current study, limited research has been published regarding healthcare shortages like in Pakistan, wherein the availability of advanced radiology services is strained while the delivery of MRI's is overshadowed by the exorbitant costs and delay in acquisition. Slow TAT attributed to missing referrals is a responsibility that can subsequently be transferred to the healthcare providers in the form of extra costs from a prolonged stay, delay in diagnosis, other procedures and management.¹⁷ Moreover, coordination of clinical documentation by the primary healthcare provider coupled with training on the role of the referral to other clinical departments and the timeliness demanded of the degree of the referral can help eliminate excess clinical time while improving patient management.¹⁸ This research also sets its agenda in defining areas that can be improved regarding the quality of the systems in order to achieve better outcomes. Departments with a persistent pattern of incomplete referrals would greatly benefit from the use of structured clinical perform as or HMIS reminders. Automated reminders for incomplete referrals can also help prevent over-reliant radiology instructions, thereby improving the time from scanning to reporting, and subsequently from referring to reporting. Follow-up studies could assess the shift in terms of result and overall gauge of a hospital in the future with the addition of such measures to the available ones.^{19,20}

As noted, this study supports our hypothesis how the organized and detailed clinical information contained in a HMIS based MRI referral improves a radiologist's efficiency by reducing their reporting turnaround times. Complete patient history and projected working diagnoses contained in electronic referrals are easily and inexpensively maintained. Moreover, their presence enhances productivity by improving the ratio between the number of tests and patients to hospital staff, while directly benefiting the patients. Greater diagnostic competence and efficiency of referrals warrant a strategy

of standardized referral systems and specific training programs on clinical referral-radiologist communication to ensure a more proactive clinical system and improved responsiveness from radiologists.

Conclusion

This study evaluates how the extent and quality of clinical data in MRI referrals affect the efficiency of the radiology workflow and how diagnostic confidence of radiologists depends on the information being referred to them. The radiology workflow efficiency and reporting turnaround times improve in proportion to the extent and completeness of clinical information case holders provide in referrals. Comprehensive patient histories and differential diagnoses reduce the time between the completion of the scan and the report, as well as the times in the referral-to-report cycle, thereby demonstrating the value of clinical information to the radiologist's workflow. Incomplete and summary referrals slow down and diminish the confidence of the reporting, which may reduce the quality of care, extend a patient's hospitalization, and increase their suffering in the process.

CONFLICT OF INTEREST: None

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