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Original Article

Discrepancy Rates in Chest X-Ray Interpretation by Radiology Residents: A Retrospective Performance Audit

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Abstract

Background: Chest radiography is a cornerstone of diagnostic imaging and plays a critical role in the evaluation of respiratory, cardiac, and traumatic conditions. Accurate and timely interpretation of chest X-rays is essential, as reporting errors can directly influence clinical decision-making, treatment initiation, and patient outcomes. Interpretation variability is well recognized in radiology practice and may arise from perceptual errors, misinterpretation, or limited clinical experience. In many academic institutions, preliminary interpretations during on-call hours are provided by radiology residents, making assessment of their diagnostic performance an important component of quality assurance.

Objective: To evaluate the discrepancy rate between preliminary chest radiograph interpretations by radiology residents and final reports issued by attending radiologists, with particular focus on key thoracic and pediatric findings.

Methodology: This retrospective study reviewed chest radiographs (anteroposterior and posteroanterior views) interpreted by radiology residents during on-call hours at Rehman Medical Institute, Peshawar, from June 1, 2022, to June 30, 2024. Resident preliminary reports were compared with attending radiologist final reports. Discrepancies were categorized as major, minor, or none based on clinical significance. Interobserver agreement was assessed using Cohen's kappa (κ) statistics.

Results: A total of 552 chest radiographs were analyzed, including 285 studies reported by junior residents (1st–2nd year) and 267 by senior residents (3rd–4th year). Discrepancy rates varied across diagnostic categories, ranging from 5% to 32%, with higher discrepancy rates observed among junior residents. Cohen's kappa values ranged from 0.22 (fair agreement) to 0.58 (moderate agreement), with consistently better agreement demonstrated by senior residents.

Conclusion: Radiology residents showed high concordance with attending radiologists for major findings such as pneumothorax, consolidation, and cardiomegaly. However, discrepancies were more frequent for subtle findings and pediatric conditions, including transient tachypnea of the newborn, meconium aspiration, and cardiac anomalies. These findings highlight the need for targeted educational interventions and continuous performance monitoring to enhance diagnostic accuracy and patient safety.

Keywords: Chest Radiography, Diagnostic Discrepancy, Interobserver Agreement, Quality Assurance, Radiology Residency Training.

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Introduction

Chest radiography remains one of the most frequently utilized imaging modalities worldwide and plays a pivotal role in the diagnosis and management of a wide range of clinical conditions, including respiratory infections, cardiovascular disease, and traumatic injuries [1,2]. Owing to its accessibility and rapid acquisition, chest X-ray interpretation often serves as the first diagnostic step guiding urgent clinical decisions, particularly in emergency and inpatient settings. Consequently, accuracy and timeliness in reporting are essential for optimal patient care. Interpretation of chest radiographs is inherently subjective and prone to interobserver variability [3]. Discrepancies in radiology reporting may arise from perceptual errors, such as failure to detect abnormalities, or interpretative errors, including inaccurate or incomplete diagnostic conclusions [4]. Although routine discrepancy rates have been reported to range between 3% and 5%, retrospective double-reading studies have demonstrated rates as high as 30%, underscoring the inevitability of diagnostic variation in clinical practice [4]. Such discrepancies may have important clinical consequences, including delayed diagnosis, inappropriate treatment, and adverse patient outcomes [5].

Many academic institutions face challenges in providing continuous on-site coverage by attending radiologists. As a result, on-call radiology services are frequently supported by residents, who provide preliminary interpretations that directly influence immediate patient management [6]. This role is particularly critical during emergency situations, where residents often act as the primary interpreters of imaging studies [7,8]. The accuracy of these preliminary reports is therefore a key determinant of patient safety and quality of care.

Given the clinical importance of resident interpretations, performance evaluation and quality assurance are essential components of radiology residency training programs [9]. Regular assessment of discrepancy rates helps identify areas requiring additional training, promotes diagnostic consistency, and supports continuous improvement in radiological services [6,7,10-12]. Previous studies have also demonstrated that variability among attending radiologists can influence discrepancy rates, highlighting the importance of standardized reporting practices and calibration sessions to reduce interobserver differences [6]. In this context, the present study aimed to assess the rate and nature of discrepancies between preliminary chest radiograph interpretations by radiology residents and final reports verified by attending radiologists at a tertiary care teaching hospital. By systematically analyzing discrepancy patterns across resident training levels and diagnostic categories, this study seeks to provide insights that may inform targeted educational strategies, improve reporting accuracy, and ultimately enhance patient care outcomes.

Methodology

Study Design

This retrospective performance audit was conducted to evaluate discrepancies between preliminary chest radiograph interpretations made by radiology residents and final reports issued by attending radiologists. The study reviewed chest X-ray examinations interpreted during on-call hours over a two-year period, from June 1, 2022, to June 30, 2024, at Rehman Medical Institute (RMI), Peshawar, Pakistan. The retrospective design allowed for objective comparison of resident and consultant reports without influencing reporting behavior.

Ethics

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Rehman Medical Institute, Peshawar (Ethical Committee Reference No. RMI/RMI-REC/Article Approval/125). Due to the retrospective nature of the study and use of anonymized patient data, the requirement for informed consent was waived. All procedures were conducted in accordance with institutional ethical standards and the principles of the Declaration of Helsinki.

Setting

The study was conducted in the Radiology Department of Rehman Medical Institute, a tertiary care teaching hospital in Peshawar, Pakistan. The institution provides 24-hour radiology services, with on-call coverage primarily managed by radiology residents. During on-call hours, residents issue preliminary interpretations, which are subsequently reviewed and finalized by attending radiologists.

Participants

All chest radiographs (anteroposterior and posteroanterior views) interpreted by radiology residents during the specified study period were eligible for inclusion. Both junior residents (1st and 2nd year) and senior residents (3rd and 4th year) were included. Studies were excluded if either the resident preliminary report or the attending radiologist's final report was missing or incomplete. A total of 552 chest radiographs meeting inclusion criteria were analyzed.

Variables

The primary outcome variable was the presence and type of discrepancy between resident and attending radiologist interpretations. Discrepancies were categorized as major, minor, or none. Key diagnostic variables assessed included consolidation, pneumothorax, cardiomegaly, subtle interstitial changes, acute respiratory distress syndrome (ARDS), transient tachypnea of the newborn (TTN), cardiac anomalies, and meconium aspiration. Resident training level (junior versus senior) was analyzed as an explanatory variable.

Data Sources/Measurement

Data were extracted from the hospital's Radiology Information System (RIS). Information collected included patient demographics (age and sex), resident preliminary reports, and attending radiologist final reports. Discrepancies were classified using a predefined three-tier system:

- **Major discrepancy**, defined as a difference likely to alter patient management (e.g., missed pneumothorax or misdiagnosed pneumonia).
- **Minor discrepancy,** defined as interpretative differences unlikely to significantly affect management (e.g., variation in size description of findings).
- **No discrepancy,** indicating complete agreement between resident and attending reports.

Bias

To minimize assessment bias, discrepancies were defined using standardized criteria applied uniformly across all cases. As the attending radiologist's report represented the final verified interpretation, it was considered the reference standard. The retrospective design reduced observer influence on reporting behavior; however, the study acknowledges potential reporting bias inherent to retrospective analyses.

Study Size

The study included all eligible chest radiographs interpreted during the study period, resulting in a final sample size of 552 cases. This sample was considered adequate to assess discrepancy patterns across multiple diagnostic categories and resident training levels.

Quantitative Variables

Quantitative variables included frequencies and percentages of discrepancies across diagnostic categories and resident levels. Cohen's kappa (κ) statistic was used as a continuous measure to quantify interobserver agreement beyond chance.

Statistical Methods

Statistical analysis was performed to assess concordance between resident and attending radiologist interpretations. Cohen's kappa statistic was calculated for each diagnostic category and interpreted as follows: <0 poor agreement, 0.00–0.20 slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 substantial agreement, and 0.81–1.00 almost perfect agreement. Chi-square testing was used where appropriate to compare discrepancy rates between junior and senior residents. A 95% confidence interval was applied, and statistical significance was determined accordingly.

Results

Participants

A total of 552 chest radiographs were included in the final analysis to evaluate concordance and discrepancy between preliminary interpretations by radiology residents and final reports issued by attending radiologists. Of these cases, 348 (63%) were male and 204 (37%) were female. The study population predominantly comprised pediatric patients, with 347 cases (62%) aged below 18 years, followed by 138 patients (25%) aged 18–40 years, 43 patients (7.7%) aged 41–65 years, and 24 patients (4.3%) aged over 65 years (Table 1). Regarding resident involvement, 285 radiographs (51.6%) were interpreted by junior residents (1st and 2nd year), while 267 radiographs (48.4%) were interpreted by senior residents (3rd and 4th year) (Figure 1).

Descriptive Data

Chest radiographs were evaluated across multiple diagnostic categories, including consolidation, pneumothorax, cardiomegaly, subtle interstitial changes, acute respiratory distress syndrome (ARDS), transient tachypnea of the newborn (TTN), cardiac anomalies, and meconium aspiration. Consolidation emerged as the most frequently encountered finding, while pneumothorax was the least common. Overall, junior residents demonstrated higher rates of discordance across most diagnostic categories compared with senior residents. Pediatric-specific conditions, particularly TTN, meconium aspiration, and congenital cardiac anomalies, accounted for a substantial proportion of discrepancies, especially among junior residents.

Outcome Data

Discrepancy rates varied notably depending on the diagnostic category and resident training level. Across all findings, discrepancy rates ranged from approximately 5% to 32% (Table 2). Junior residents consistently showed higher discrepancy rates compared to senior residents.

Interobserver agreement, assessed using Cohen's kappa statistic, ranged from 0.22 (fair agreement) for subtle interstitial changes to 0.58 (moderate agreement) for pneumothorax among senior residents. The majority of discrepancies were classified as minor, while major discrepancies accounted for approximately 15% of all discordant cases (Figure 2).

Main Results

For consolidation, concordance between junior residents and attending radiologists was 82%, with a discrepancy rate of 18% and a kappa value of 0.38, indicating fair agreement. Senior residents demonstrated higher concordance at 87%, with a discrepancy rate of 13% and a kappa of 0.43, reflecting moderate agreement. In cases of subtle interstitial changes, junior residents showed a concordance of 72% (kappa = 0.23), whereas senior residents achieved 81% concordance (kappa = 0.29), highlighting persistent interpretative challenges even at advanced training levels (Table 3).

For cardiomegaly, junior residents exhibited 74% concordance with attending reports (kappa = 0.30), compared to 84% concordance among senior residents (kappa = 0.40). Detection of pneumothorax demonstrated comparatively higher agreement, with junior residents showing 77% concordance (kappa = 0.42) and senior residents 85% concordance (kappa = 0.58), representing moderate agreement. Pediatric conditions posed the greatest diagnostic challenge. TTN showed the highest discrepancy rate among junior residents (31%), whereas senior residents demonstrated markedly improved performance with a discrepancy rate of only 5% (Table 4). Similar trends were observed for meconium aspiration and cardiac anomalies, where senior residents consistently outperformed junior counterparts. Overall, senior residents demonstrated better diagnostic consistency across all evaluated parameters, underscoring the positive impact of advancing training and clinical exposure.

Table 1: Demographic characteristics of study participants.

Variables		N	%
Age Group	<18 years	347	62
	18-40 years	138	25
	41-65 years	43	7.7
	>65 years	24	4.3
Gender	Male	348	63
	Female	204	36
Academic Year	Junior (1st/2nd Year)	285	51.0
	Senior (3rd/4th Year)	267	48.3

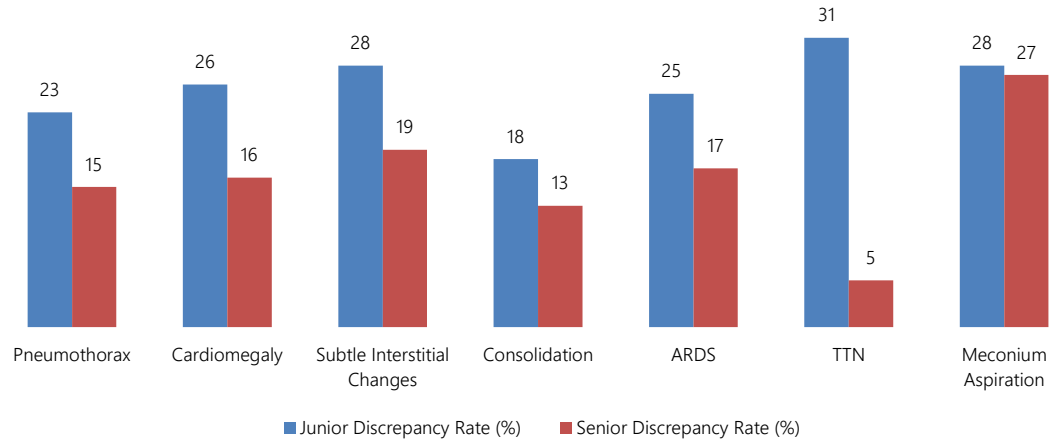


Figure 1: Discrepancy rates by resident level across key diagnostic findings.

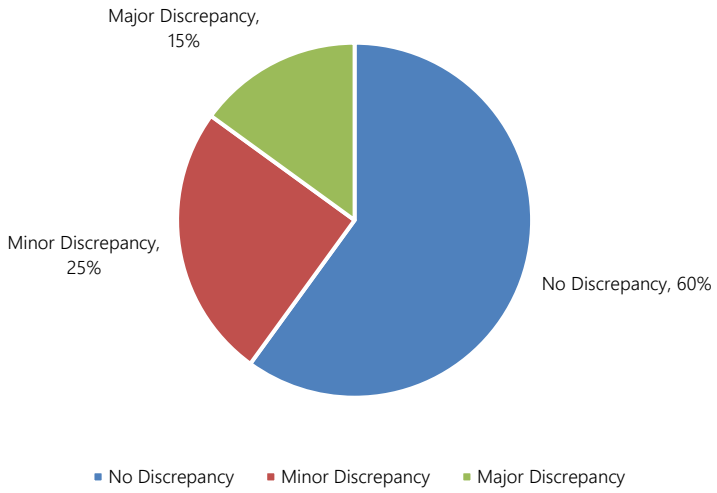


Figure 2: Overall distribution of discrepancy types across all cases.

Table 2: Discrepancy Rates by Residents Training level.

Finding Category	Resident Level	Total Cases	Concordant	Discordant	Discrepancy Rate (%)	Kappa (κ)	Chi-Square Value
Pneumothorax	Junior	26	20	6	23 (95% CI ±0.05)	0.41	4.71
	Senior	20	17	3	15 (95% CI ±0.05)	0.58	8.23
Cardiomegaly	Junior	41	30	11	26 (95% CI ±0.05)	0.29	3.61
	Senior	48	40	8	16 (95% CI ±0.05)	0.40	7.68
Subtle interstitial changes	Junior	25	18	7	28 (95% CI ±0.05)	0.22	1.88
	Senior	31	25	6	19 (95% CI ±0.05)	0.29	2.76
Consolidation	Junior	53	43	10	18 (95% CI ±0.05)	0.38	8.54
	Senior	58	50	8	13 (95% CI ±0.05)	0.42	11.45
ARDS	Junior	51	38	13	25 (95% CI ±0.05)	0.32	6.32
	Senior	47	39	8	17 (95% CI ±0.05)	0.45	10.58
TTN	Junior	29	20	9	31 (95% CI ±0.05)	0.24	2.70
	Senior	37	32	2	5 (95% CI ±0.05)	0.46	8.15
Meconium aspiration	Junior	28	20	8	28 (95% CI ±0.05)	0.37	5.10
	Senior	22	16	6	27 (95% CI ±0.05)	0.43	4.77

Table 3: Diagnostic Concordance Between Residents and Consultant Radiologist for Selected Chest Radiographic Findings.

A. Consolidation

Resident Level		Consultant		Total
		No	Yes	
Junior	No	5	7	12
	Yes	3	38	41
	Total	8	45	53
Senior	No	4	6	10
	Yes	2	46	48
	Total	6	52	58

B. Subtle Interstitial Changes

Resident Level		Consultant		Total
		No	Yes	
Junior	No	2	6	8
	Yes	1	16	17
	Total	3	22	25
Senior	No	2	4	6
	Yes	2	23	25
	Total	4	27	31

C. Cardiomegaly

Resident Level		Consultant		Total
		No	Yes	
Junior	No	5	5	10
	Yes	6	25	31
	Total	11	30	41
Senior	No	4	4	8
	Yes	4	36	40
	Total	8	40	48

D. Pneumothorax

Resident Level		Consultant		Total
		No	Yes	
Junior	No	4	4	8
	Yes	2	16	18
	Total	6	20	26
Senior	No	3	3	6
	Yes	0	14	14
	Total	3	17	20

Discussion

The present study evaluated the concordance between preliminary chest radiograph interpretations by radiology residents and final reports issued by attending radiologists during on-call hours at a tertiary care teaching hospital. The findings demonstrate measurable variability in interpretation accuracy, with discrepancy rates ranging from approximately 5% to 32% across diagnostic categories. These results reinforce the established understanding that interpretative discrepancies are an inherent aspect of radiology practice, particularly in high-volume and time-sensitive clinical settings [3,4,5].

A consistent and important observation of this study was the higher discrepancy rate among junior residents compared to senior residents. This finding aligns well with previous literature, which has repeatedly shown that diagnostic accuracy improves with experience, particularly for subtle or less frequently encountered radiographic findings [11–13]. Junior residents demonstrated relatively

good concordance for acute and life-threatening findings such as pneumothorax and consolidation, suggesting that early training appropriately emphasizes recognition of critical abnormalities. Similar trends have been reported by Cooper et al. and Jeong et al., who observed fewer major discrepancies in senior trainees and greater diagnostic consistency with increasing experience [7,8].

The discrepancy rates observed in this study are comparable to those reported in prior audits of resident performance. Issa et al. reported a lower overall discrepancy rate of 1.62% in emergency radiology studies; however, their analysis focused primarily on high-acuity cases, which may benefit from heightened vigilance and more structured reporting workflows [5]. In contrast, the broader diagnostic spectrum evaluated in the present study likely contributed to the higher observed discrepancy range. Wildenberg et al. highlighted the role of attending radiologist variability in influencing discrepancy rates, emphasizing the importance of standardized reporting and calibration among faculty, which indirectly affects resident learning and performance [6]. Our findings support this observation and suggest that structured supervision and feedback may further reduce discrepancies.

One of the most notable challenges identified in this study was the interpretation of pediatric chest radiographs and subtle findings, including transient tachypnea of the newborn (TTN), meconium aspiration, cardiac anomalies, and subtle interstitial changes. These categories demonstrated the highest discrepancy rates, particularly among junior residents. Pediatric imaging is widely recognized as a demanding subspecialty due to age-specific normal variants, subtle radiographic signs, and limited exposure during early residency training [10,13-15]. Similar difficulties have been reported in previous studies assessing resident performance in pediatric and emergency radiology settings [8,15].

The findings of this study carry important implications for radiology education and quality assurance. Targeted educational interventions focusing on subtle radiographic findings and pediatric chest imaging may help reduce discrepancy rates, especially among junior residents. Structured reporting templates, case-based learning, simulation tools, and regular discrepancy review meetings may enhance diagnostic consistency and confidence [6,9,12]. Additionally, frequent, constructive feedback from attending radiologists has been shown to accelerate resident learning and improve reporting accuracy [7,10].

Limitations

Despite its strengths, this study has several limitations that should be acknowledged. First, the investigation was conducted at a single tertiary care institution, which may limit the generalizability of the findings to other healthcare settings with different patient populations, training structures, or reporting workflows. Second, although the sample size was adequate for evaluating overall discrepancy patterns, it may not fully capture variability across all diagnostic subcategories or individual resident performance levels. Third, the retrospective design relies on the accuracy and completeness of existing radiology reports and clinical documentation, introducing the potential for reporting or selection bias. Finally, the study focused exclusively on chest radiographs; therefore, the results may not be directly applicable to other imaging modalities such as computed tomography, magnetic resonance imaging, or ultrasound, which pose distinct interpretative challenges.

Conclusion

This retrospective performance audit demonstrates that radiology residents generally show good concordance with attending radiologists in the interpretation of chest radiographs, particularly for major and acute findings such as pneumothorax, consolidation, and cardiomegaly. However, higher discrepancy rates were observed for subtle findings and pediatric conditions, with junior residents being disproportionately affected. These findings underscore the value of ongoing discrepancy monitoring as a performance indicator and quality assurance tool within radiology training programs. Targeted educational strategies, standardized reporting practices, and structured feedback mechanisms may further enhance diagnostic accuracy, promote patient safety, and improve the overall quality of radiological services.

Authors' Contributions:

All authors meet the ICMJE criteria for authorship.

Author 1: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 2: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Author 3: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.

Author 4: Analysis and interpretation of data, critical revision, final approval, agreed to be accountable for all the work.

Author 5: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.

Author 6&7: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

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