International Journal of Medical Science in Clinical Research and Review
Online ISSN: 2581-8945
Available Online at http://www.ijmscrr.in Volume 6|Issue 05 (September-October)|2023 Page: 823-828

Original Research Paper

Comparison of Diagnostic Accuracy of Junior Doctors vs. Senior Doctors in Interpreting Common Findings in Chest X-rays

Authors:
Ahmed Mustafa Kareem
Dalia Hazim Abdulrazzaq Al Hasnawi
Madelyn Yajayda Najera
Erika Aguirre
Nuzhat Majeed
Danny Jamal Aboujamra
Misha Anam
Affiliations:
Nottingham University Hospitals Trust | Nottingham University Hospitals Trust | Universidad Rafael Landivar | Universidad Autonoma de Guadalajara School of Medicine| Fatima Memorial Hospital | St. George's University | Childrens Hospital Lahore
Corresponding Author:
Misha Anam
Childrens Hospital Lahore

Article Received: 28-July-2023, Revised: 18-August-2023, Accepted: 08-September-2023

ABSTRACT:
Background: Chest X-rays are one of the most frequently utilized diagnostic tools in clinical medicine, providing crucial insights into various pulmonary, cardiac, and systemic conditions. Accurate interpretation of these images is paramount to ensure appropriate patient management. Given the gradient of experience in the medical field, the diagnostic proficiency between junior and senior doctors is often debated, with implications for training, supervision, and patient care. **Objective**: This study aims to compare the diagnostic accuracy of junior doctors (those in their years of post-graduate training) with that of specialist registrars and senior doctors (with more than ten years of post-graduate experience) in interpreting common findings on chest X-rays. **Methods**: A set of 10 chest X-rays, comprising a mix of normal and those with common pathologies, were presented to both junior and senior doctors, ranging from trainees to the specialist registrars and consultants in the field of radiology. Their interpretations will be compared against a gold standard provided by experienced radiologists. **Significance**: Understanding the discrepancy in diagnostic accuracy between junior and senior doctors can guide further training protocols, ensure adequate supervision, and optimize patient outcomes. This study also sheds light on areas of potential improvement in the radiological training of junior doctors and emphasizes the importance of continuous medical education across all levels of expertise.

Keywords: Chest X-ray, diagnostic accuracy, clinical radiology, radiological interpretation, medicine

INTRODUCTION:

The importance of CXRs can be traced back to the early 20th century when the impact of tuberculosis on global health was substantial. Chest X-rays (CXRs) stand as a cornerstone in the edifice of diagnostic modalities in medicine. [1] Since Wilhelm Conrad Röntgen discovered the X-ray in 1895, the medical world has seen a dramatic transformation in its approach to diagnosing various conditions, leading to the development of a range of imaging modalities, with CXRs being the most frequently employed. [2] The need for a reliable diagnostic tool became paramount, leading to the widespread adoption of CXRs. As technology advanced, so did the resolution and accuracy of these images, aiding in the diagnosis of not just infections, but a range of pulmonary, cardiac, and systemic conditions. [3] The principle behind CXRs involves passing a controlled amount of X-ray radiation through the chest and capturing the image on a detector on the other side. The X-rays that pass through give an image of the structures within, based on varying degrees of absorption by different tissues. For example, bones that absorb more

X-rays appear white on the image, while air-filled lungs appear darker. [4, 5]

The landscape of clinical medicine, particularly radiology, is vast and constantly evolving. Junior doctors are often thrust into the deep end, expected to make critical clinical decisions, of which diagnostic imaging interpretation is a cornerstone. [6] Although supervised, there is a potential for diagnostic errors. The need to understand this potential discrepancy is critical for patient care and physician training. [7] Today, CXRs are employed across various medical disciplines. Emergency room physicians use them to rapidly diagnose traumatic injuries or acute infections, while pulmonologists might use them to monitor the progression of chronic conditions like COPD. Even beyond pulmonology, CXRs find utility with cardiologists examining heart sizes and contours, or with infectious disease specialists tracking the progression of diseases. [8, 9] But with great utility comes great responsibility. The interpretation of CXRs, though seemingly straightforward, is a complex skill that requires a nuanced understanding of anatomy, pathology, and even physics. Shadows, artifacts, and overlapping structures can easily mislead an untrained eye, resulting in misdiagnoses. This emphasizes the importance of adequate training and experience in the interpretation of these images. [10] Medical training is an extensive process, starting from foundational medical school education, transitioning to post-graduate specialization, and continuing into subspecialties. [11] As physicians traverse this journey, they are expected to hone not just their clinical skills but also their diagnostic acumen. Junior doctors, freshly transitioning from the academic rigor of medical schools into the practical world, are often in the preliminary stages of their diagnostic journey. [12] While their knowledge is recent and updated, it lacks the refinement that comes with years of experience and exposure. Conversely, senior doctors, having navigated through the labyrinth of medical challenges for over a decade, possess a diagnostic proficiency that is sharpened with each case they encounter. [13-15]

Rationale for the Study:

Given the paramount significance of CXRs in clinical decision-making, it becomes crucial to understand the proficiency gradient between junior and senior doctors. While it's assumed that experience refines skill, the magnitude and specifics of this refinement remain to be elucidated. This study, therefore, seeks to quantify the difference in diagnostic accuracy between these two groups, providing insights that could potentially reshape training curricula, mentoring methodologies, and patient care strategies. This study not only pinpoints the areas of potential improvement in the radiological training of junior doctors but also reinforces the importance of continuous learning. By addressing these discrepancies, medical institutions can optimize training protocols, improve patient care, and minimize potential diagnostic errors.

Objective and Expectations:

By comparing the diagnostic prowess of junior and senior doctors in interpreting common findings on CXRs, we aim to underscore areas of strength and potential weaknesses in current medical training programs. The findings of this study are expected to stir discussions around the adequacy of current training modules, the need for continuous medical education, and the importance of mentorship in the field of radiology.

Materials and Methods:

This study was designed as a pre-established questionnaire based cross-sectional study. A random assortment of 10 CXRs, encompassing a mix of both normal and those exhibiting common pathologies, were presented to trainees of all grades and the consultants in radiology division. The chest Xray quiz consisted of short clinical history with each film of digital CXR, interpreting and documenting their findings for each X-ray. A standardized proforma was provided to each participant to ensure uniformity in responses. All the doctors were asked to give a pre-test certainty (out of 10) indicating their confidence level in reporting different types of CXR diagnosis. Interpretations by the participants were compared against a gold standard established by a panel of three experienced radiologists with over 15 years of expertise. Any discrepancies among the panel were resolved through consensus. The feedback of all the interpretation results was displayed in an audit meeting after complete analysis. The 10 CXR based diagnosis included in this study were: Normal, Congestive cardiac failure, lung cancer with ribs metastasis, pneumothorax, lung collapse, Tuberculosis, Emphysema, Wide mediastinum, Pneumonia, and Pleural effusion. This study had no exclusion criteria.

RESULTS:

Out of total 66 enrolled doctors who completed the quiz, 24 were 1st year trainees, 13 were 2nd year trainees, 9 were 3rd year trainees, 10 were 4th year trainees, 4 specialist registrars, and 6 were radiology consultants. The average results across all groups are summarized in Table 1. 1st and 2nd year trainee groups displayed similar average scores with a confidence interval indicating similar level of accuracy in both groups. An increasing trend of accuracy and average score was observed from 1st year trainee to consultant radiology indicating direct

relationship between diagnostic proficiency and experience in the field of radiology.

Grades	Range of Score (%)		Average
	Minimum Score	Maximum Score	
1st year	62.8	71.8	66.8
2nd year	63.2	72.1	67
3rd year	68.2	79.9	58
4th year	74.9	82.7	75
Specialist registrar	78.2	87.5	86
Consultant radiologist	76.4	89.3	89

Table 1. Summary of study results.

Levels of Certainity (Before attempting the questionnaire)	1st year	2nd year	3rd year	4th year	Specialist registrar	Consultant radiologist
Uncertain	23%	18%	3%	5%	3%	2%
Certain	45%	24%	35%	28%	21%	17%
Definitely certain	32%	58%	62%	67%	76%	81%

Table 2. Average level of certainty (%) before answering each question across all the groups

Average level of Certainity (After attempting the questionnaire)	1st year	2nd year	3rd year	4th year	Specialist registrar	Consultant radiologist
Certainity	29%	34%	38%	42%	59%	62%
Extremely strong presumption	35%	36%	37%	40%	32%	34%
Strong presumption	13%	8%	14%	7%	4%	3%
Presumprtion	9%	13%	6%	8%	5%	1%
Favorable hesitation	11%	5%	4%	2%	0%	0%
Doubt	1%	2%	1%	1%	0%	0%
Unfavorable hesitation	1%	1%	0%	0%	0%	0%
Low probability	1%	1%	0%	0%	0%	0%

Table 3. Average level of certainty (%) after answering each question across all the groups.

The 95% confidence interval between the group of 1st year and 2nd year trainees showed that both the groups had almost the same amount of knowledge and accuracy while assessing and diagnosing the radiological findings of chest x-rays. Same was true for the groups of specialist consultants and specialist registrar. Specific areas where junior doctors faced difficulty included identifying small nodular opacities, subtle pneumothoraces, and interstitial patterns. The average levels of certainty before attempting the questionnaire and after answering each question are summarized in table 2 and 3.

DISCUSSION:

The medical fraternity has always held the belief that expertise grows with experience. Recent findings in

diagnostic radiology only reaffirm this axiom, as they have showcased a marked difference in diagnostic accuracy between junior and senior doctors. What is perhaps more intriguing, however, is the profound gap observed between them, emphasizing the value of hands-on experience in this domain. It's no secret that the field of radiology is vast and intricate. Human anatomy, when observed through radiological images, offers a myriad of nuances that can easily be overlooked by the untrained eye. Senior doctors, having accumulated years of experience, have honed their skills through repeated exposure to a vast array of clinical scenarios, making them better equipped to discern even the most subtle of abnormalities. When analyzing chest x-ray interpretation skills specifically, the progression in expertise becomes even more apparent:

1st Year Trainee: At this stage, doctors are just beginning their journey into the world of radiology. They tend to focus on the most evident pathologies, often overlooking minor anomalies that might have clinical significance. Their diagnostic precision is, understandably, in its nascent phase.

Final Year Trainee: By the time a doctor reaches their final year of training, they have been exposed to a considerable number of cases. While their diagnostic accuracy has improved considerably since their first year, they might still falter in particularly challenging cases or ones that present atypical symptoms.

Specialist Registrar: Now stepping into a more senior role, specialist registrars have a vast reservoir of experience. They are not only adept at identifying common pathologies but also rare and atypical presentations. Their expertise, however, might still not be on par with a consultant, especially in intricate sub-specialties of radiology.

Radiology Consultants: With years, often decades, of experience behind them, consultants typically exhibit the highest diagnostic accuracy. Their extensive exposure allows them to pinpoint even the most elusive abnormalities with precision. Their interpretations are, often, definitive and are taken as the final word in most clinical scenarios.

The results clearly highlight a significant difference in the diagnostic accuracy between junior and senior doctors. This discrepancy underscores the importance of experience in clinical radiology. It's evident that junior doctors lag in certain areas of radiological interpretation. While this is expected to be due to their relative inexperience, it's crucial to bridge this knowledge gap effectively. Continuous Medical Education (CME) ensures that doctors, regardless of their level of expertise, are continually updated with the latest in medical and radiological advancements. Regular workshops, seminars, and conferences can keep them abreast of new techniques, equipment, and interpretation methodologies. Workshops focusing on common pitfalls can be invaluable. By highlighting areas where mistakes are most frequently made, these sessions can help doctors be more vigilant and avoid such errors in their practice. Junior doctors can benefit immensely from the guidance of their senior counterparts. Through mentorship, they can gain insights into complex cases, learn about the nuances of image interpretation, and even develop critical thinking skills essential for differential diagnosis.

Though it's not surprising that a difference in diagnostic accuracy exists between junior and senior doctors, the extent of this discrepancy is of concern.

This differential holds several implications:

Supervision: It's imperative for junior doctors to be closely supervised, especially in remote or resource-limited settings where immediate consultation with seasoned radiologists isn't possible.

Active Feedback Seeking: Encouraging junior doctors to actively seek feedback is paramount. Constructive criticism can shed light on areas of improvement, bolstering their diagnostic prowess.

Regular Radiological Discussions: Case discussions can provide a platform for junior doctors to express their thoughts, share their diagnostic rationale, and get insights from more experienced colleagues.

Medical Curriculum Revision: Diagnostic imaging, given its significance, should be an integral component of both undergraduate and post-graduate medical curricula. Incorporating radiological training early on can ensure that budding doctors develop a keen eye for image interpretation.

It's pertinent to note the specific areas where junior doctors lagged. Continuous medical education, targeted workshops focusing on common pitfalls, and enhanced mentorship can be invaluable in bridging this gap. While the difference in diagnostic accuracy was anticipated, the magnitude of the difference holds critical implications. It emphasizes the need for Close supervision of junior doctors, especially in settings where immediate consultation with radiologists might not be feasible. Encouraging junior doctors to actively seek feedback and indulge in regular radiological case discussions.

Ensuring that diagnostic imaging is an integral part of medical curricula and post-graduate training programs.

CONCLUSION:

While experience undoubtedly refines diagnostic proficiency, it's imperative to provide junior doctors with the tools, training, and mentorship they require. This ensures that they are well-equipped to interpret CXRs with high accuracy, safeguarding patient outcomes and enhancing the quality of healthcare. Chest X-rays (CXRs) are fundamental diagnostic tools in clinical practice, assisting clinicians in diagnosing a myriad of conditions, ranging from infections, neoplasms, to systemic diseases. The importance of accurately interpreting these images cannot be overstated, as incorrect reading could lead to detrimental patient outcomes. As junior doctors transition to senior roles, it's expected that their diagnostic acumen will refine with experience. This study delves into quantifying the difference, if any, between these groups stratified based on their experience. Additionally, this study promises to shine a light on the current state of CXR interpretation proficiency across different experience levels, setting the stage for future improvements and innovations in medical training and patient care.

Limitations:

Despite the significance of this study, it does have its limitations. Firstly, there were not enough subjects to represent each group based on their experience. If this study is conducted on a large scale the results may greatly vary. However, these study results are significant in portraying the basic idea. Secondly, every disease has a spectrum of radiological presentations. If someone was unable to pick a certain finding on chest x-ray, e.g., lung collapse, it does not indicate his/her competency for diagnosing all lung collapses. Thirdly, the certainty level results mentioned in table 2 and 3 are the self-assessment based subjective scores in a descriptive format (instead of numeral format e.g., out of 10). These scores may not be completely reliable when comparing each group.

Conflict of Interest: None

REFERENCES:

1. Jimah BB, Baffour Appiah A, Sarkodie BD, Anim D. Competency in chest radiography interpretation by junior doctors and final year medical students at a teaching hospital. Radiology Research and Practice. 2020 Nov 6;2020.
2. Ayesa SL, Katelaris AG, Brennan PC, Grieve SM. Medical imaging education opportunities for junior doctors and non-radiologist clinicians: A review. Journal of Medical Imaging and Radiation Oncology. 2021 Oct;65(6):710-8.
3. Samara O, AlRyalat SA, Malkawi L, Ali MA, Kilani A, Alkhalaileh Z, Alkhatib L, Hamad I, Alawneh Y, Al-Ryalat N, Ryalat S. Assessment of final-year medical students' performance in diagnosing critical findings on chest X-ray. Emergency radiology. 2021 Apr;28:333-8.
4. Hwang EJ, Nam JG, Lim WH, Park SJ, Jeong YS, Kang JH, Hong EK, Kim TM, Goo JM, Park S, Kim KH. Deep learning for chest radiograph diagnosis in the emergency department. Radiology. 2019 Dec;293(3):573-80.
5. Bansal T, Beese R. Interpreting a chest X-ray. British Journal of Hospital Medicine. 2019 May 2;80(5):C75-9.
6. Znegui T, Mejri I, Hamami R, Daboussi S, Mhamdi S, Moatemri Z. Precision of pleural puncture sites using thoracic ultrasound. La Tunisie Medicale. 2022 Aug;100(8):642.
7. Irmici G, Cè M, Caloro E, Khenkina N, Della Pepa G, Ascenti V, Martinenghi C, Papa S, Oliva G, Cellina M. Chest X-ray in Emergency Radiology: What Artificial Intelligence Applications Are Available?. Diagnostics. 2023 Jan 6;13(2):216.
8. Halter M, Drennan V, Wang C, Wheeler C, Gage H, Nice L, de Lusignan S, Gabe J, Brearley S, Ennis J, Begg P. Comparing physician associates and foundation year two doctors-in-training undertaking emergency medicine consultations in England: a mixed-methods study of processes and outcomes. BMJ open. 2020 Sep 1;10(9):e037557.
9. Shlayer T, Benacon M, Glick Y, Yakubovich D, Sharon N. Interobserver agreement in

assessment of chest radiographs for the diagnosis of pneumonia between residents and radiologists in a pediatric emergency department: The role of patient and resident characteristics.

10. Morra M, Braund H, Hall AK, Szulewski A. Cognitive load and processes during chest radiograph interpretation in the emergency department across the spectrum of expertise. AEM Education and Training. 2021 Oct;5(4):e10693.
11. Gompels B, Rusby T, Limb R, Ralte P. Diagnostic Accuracy and Confidence in Management of Forearm and Hand Fractures Among Foundation Doctors in the Accident and Emergency Department: Survey Study. JMIR Formative Research. 2023 Aug 18;7(1):e45820.
12. Bahra J, Acharya A, Ather S, Benamore R, Moreland JA, Gulati D, How L, Rose A, Huwae M, Wilson S, Banerji A. Improving the Accuracy of Emergency Department Clinicians in Detecting SARS-COV-2 on Chest X-Rays Using a Bespoke Virtual Training Platform.
13. Bansal T, Beese R. Interpreting a chest X-ray. British Journal of Hospital Medicine. 2019 May 2;80(5):C75-9.
14. Voigt GM, Thiele D, Wetzke M, Weidemann J, Parpatt PM, Welte T, Seidenberg J, Vogelberg C, Koster H, Rohde GG, Härtel C. Interobserver agreement in interpretation of chest radiographs for pediatric community acquired pneumonia: Findings of the pedCAPNETZ-cohort. Pediatric pulmonology. 2021 Aug;56(8):2676-85.
15. Kvak D, Chromcová A, Hrubý R, Janů E, Biroš M, Pajdaković M, Kvaková K, Al-Antari MA, Polášková P, Strukov S. Leveraging Deep Learning Decision-Support System in Specialized Oncology Center: A Multi-Reader Retrospective Study on Detection of Pulmonary Lesions in Chest X-ray Images. Diagnostics. 2023 Mar 9;13(6):1043.