Original Article

Clinical-year Students' Competency in Chest X-ray Interpretation: A Theoretical-based Intervention

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Abstract

Background: Chest radiography is important in detecting chest abnormalities, an essential skill for medical students during their transition into clinical years. Although critical, limited research has evaluated students' competencies in chest X-ray interpretation, a recognized area of weakness.

Objectives: This study aims to (1) assess medical students' competencies and confidence in chest X-ray interpretation, (2) measure the effectiveness of an educational intervention, and (3) determine the influence of clinical history on students' decision-making.

Materials and Methods: This experimental pre- and post-design study included clinical-year students from College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia, and was conducted between November 2022 and April 2023. It was executed in three phases: pre-intervention assessment, an intervention involving a lecture based on Thomas and Kern's six-step approach, and a post-intervention assessment.

Results: The study comprised 77 students. Mean self-reported knowledge and confidence scores were 3.08 ± 0.6 and 2.78 ± 0.7, respectively. There was a significant difference in the mean scores for the pre-test without clinical history (6.29 ± 2.38) compared with the pre-test with clinical history scores (8.58 ± 2.65) ($P < 0.001$). Post-intervention scores were also significant (9.40 ± 2.91) compared to both pre-tests without and with clinical history ($P < 0.001$ and 0.034, respectively). Students exhibited high accuracy in diagnosing pneumoperitoneum with and without clinical history (88% and 97%, respectively). Confidence scores were elevated when clinical history was provided and the students had access to their patients' histories.

Conclusions: A lecture-based intervention built on Thomas and Kern's approach markedly enhanced students' capacities to interpret chest X-rays. Integrating clinical history proved beneficial, underscoring the necessity for comprehensive teaching methodologies in medical education.

Keywords: Chest X-ray, competency, interpretation, medical students, medical education, Saudi Arabia

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INTRODUCTION

Chest X-rays (CXRs) remain integral for detecting and diagnosing critical medical conditions despite advances in medical imaging.[1] Accurate interpretation of CXRs can be lifesaving, whereas errors may lead to grave consequences. Medical students, as prospective physicians, must recognize common CXR features. Although many medical schools introduce students to CXR abnormalities early,[2] they often postpone structured radiological training until the clinical years.[3] Major impeding factors to developing proficiency in CXR interpretation include insufficient training, limited hands-on experience, and inadequate feedback.[4,5] Cheung *et al*.[6] found that medical students and junior doctors frequently exhibit low confidence and competence in radiograph interpretation attributed to limited formal training throughout their undergraduate years. Jimah *et al*.[7] and Alburayh *et al*.[8] similarly mentioned the lack of structured teaching and exposure to variety of clinical cases, which hinders students' capability to identify subtle or uncommon abnormalities, such as lung collapse or atypical pneumonias. This contrasts with more successful identification of other conditions.

Wentzell *et al.* reported that early exposure to e-learning radiology modules improved medical students' skills and confidence in CXR interpretation; however, without interactive feedback it can lead to recurrent diagnostic inaccuracies and lowers confidence.[9]

The lack of clinical context plays a major role in CXR misinterpretation.[7] As a result, students tend to rely entirely on visual recognition patterns, confusing pleural effusion with lung consolidation or overlooking atypical presentations of common pathologies. Dreyer *et al*.[10] emphasized that integrating clinical history into radiology education not only helps in prioritizing differential diagnoses but also enhances students' ability to approach CXRs holistically. Integrating clinical history with radiology education bridges the gap between theoretical learning and real-life diagnostic demands, ensuring a more comprehensive approach to training.

Notable deficiencies remain in the literature in studies that assess comprehensive educational interventions combining clinical context with image analysis. Studies such as those by Dreyer *et al*.,[10] Eisen *et al*.,[11] and Samara *et al*.[12] were conducted to evaluate diagnostic accuracy and skill deficits but focused on standalone teaching methods or overlooked the importance of the clinical history in guiding image interpretation. Similarly, interventions like SAFMEDS,[13] E-learning resources,[14] and interleaved techniques[15] have proven to be highly effective in specific areas but lack the comprehensive approach required to address everyday diagnostic challenges.

This study intends to study the effect of implementing a structured educational intervention consisting of a theory-based lecture with case-based learning, with a focus on incorporating clinical context into the educational framework. The theory-based lecture presents core knowledge and a systematic approach to interpreting CXRs, equipping students with the necessary strategies to confidently and accurately diagnose prevalent chest pathologies. The case-based learning component resembles three successive surveys intended to simulate progressive learning and application. Unlike prior studies that only assessed interpretation skills, our approach investigates how combining imaging with clinical context can improve diagnostic accuracy, decision-making, and confidence.

MATERIALS AND METHODS

Study design, setting, and subjects

An experimental pre- and post-study design was applied to a single group. This study design was chosen because it was appropriate for implementing our intervention and studying its effectiveness. This study was divided into three steps: pre-intervention assessment, intervention induction, and post-intervention assessment. This study was conducted at King Fahd Hospital of the University (KFHU) affiliated with the College of Medicine at Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia, between November 2022 and April 2023.

This study assessed clinical-year students and interns before and after the intervention. All fourth- ($n = 240$), fifth- (224), and sixth-year students (245), and interns (229) enrolled in the academic year 2022–23 were eligible and invited to participate. These groups were selected because they had started their clinical rotations, and had completed the chest radiology course in their early fourth year of study. For this study, the research team used a non-probability sampling technique, specifically, convenience sampling. This technique was reasonable for implementing this course because of the cost and time frame required for completion.[16]

Institutional Review Board IRB approval was obtained before the study was conducted. All participants were asked to provide informed consent and were informed that they could withdraw at any time during the study period. Finally, all obtained information was kept confidential and coded.

Educational Material and Assessment

All the materials were developed by members of the Radiology and Medical Educational departments, Faculty of Medicine, Imam Abdulrahman Bin Faisal University, based on the six-step approach proposed by Thomas and Kern, which consists of Problem Identification and General Needs Assessment, Targeted Needs Assessment, Goals and Objectives, Educational Strategies, Implementation, and Evaluation and Feedback.[16] As this approach is used by educators when a learning gap is found, it was used as a framework to design educational interventions, and all these steps build the basis for the development of this course.[16] Kirkpatrick's Evaluation Model aims to evaluate the effectiveness of learning and training courses implemented in writing assessment tools.[17] All assessments were based on Bloom's revised taxonomy to assess multiple cognitive levels.[18] Six levels form Bloom's revised taxonomy: remembering, understanding, applying, analyzing, evaluating, and creating.[18] Lecture goals and objectives were designed to align with the study aims.

Course objectives

1. ABCs of interpretation, including technique and basic anatomy
2. Developing a proper and consistent basic approach and skills in analyzing CXRs
3. Learning vital CXRs signs and finding
4. Different pathologies to see in CXR including pneumothorax, lung consolidation, pleural effusions, pneumoperitoneum, lung collapses, and lung masses
5. Application of knowledge with case-based learning.

Data collection instruments

All the materials were written and delivered in English. A multi-item tool written by radiology and medical education experts was used, which was validated by two radiology consultants. The first part consisted of the participants' demographics, including age, gender, grade point average (GPA), academic year, and radiology as a future career choice—a self-evaluation on a five-point Likert scale for knowledge and confidence in diagnosing CXR. The second part consisted of three assessments, each with eight radiological cases [Figures 1 and 2]. These cases were selected as commonly encountered in our radiology department at KFHU and considered Not-To-Be-Missed, as they may endanger patients' lives due to their high mortality and morbidity rates. Each case carried a weight of two points, graded on a scale of 0-16 (Minimum 0 and maximum 16).

Two assessments were carried out on the same day before the intervention. The initial assessment did not include the clinical history of the patients to assess foundational knowledge. The research team used the same cases in the second assessment; however, the patient's clinical history was provided. A theory-based lecture was delivered on the same day after the above-mentioned surveys. After completion of the intervention, a third assessment was conducted on the same day using a different set of images with the same diagnosis as the ones used in the first two surveys, some with the clinical history provided and others without, to allow the students to apply the newly acquired knowledge. Each case in the assessment demonstrated either a normal or abnormal crucial CXR finding with multiple-choice questions and with or without a clinical history. After each case, self-confidence about the chosen diagnosis was rated on a five-point Likert scale from 1 (not confident at all) to 5 (extremely confident). The assessment was structured using the same process for all steps. All assessments were used to assess students' baseline knowledge, overall improvement during the intervention, and whether clinical history could affect student diagnosis. All tests assessed different aspects, such as knowledge, skills, clinical history role, and confidence; this was correlated with the second level in Kirkpatrick's model learning.[17]

Data collection procedure

Assessments were conducted in a supervised environment, and all data was collected electronically. The research team illustrated the purpose of the study to all participants before starting. The autonomy and confidentiality of participants were considered; participation was voluntary, and their consent was obtained before they started. A QR code was shown, and all participants were asked to scan it. An electronic questionnaire was made using QuestionPro™. All images were presented through teaching hall screens to prevent device discrepancies and to control the 30 seconds provided to interpret each image. All participants attended the session in person during the allocated time. The questionnaire settings were edited for one submission per IP address to eliminate duplication and prevent the option to go back to the previous question or move to the next question without answering the current question. Demographic data were collected during the first pre-intervention assessment, and participants were assigned an identifier throughout the study. The research team implemented this system throughout the study. Obtained information remained confidential and was coded automatically by QuestionPro™. All participants were expected to complete the questionnaire, as it was mandatory to answer all questions to be able to submit the response.

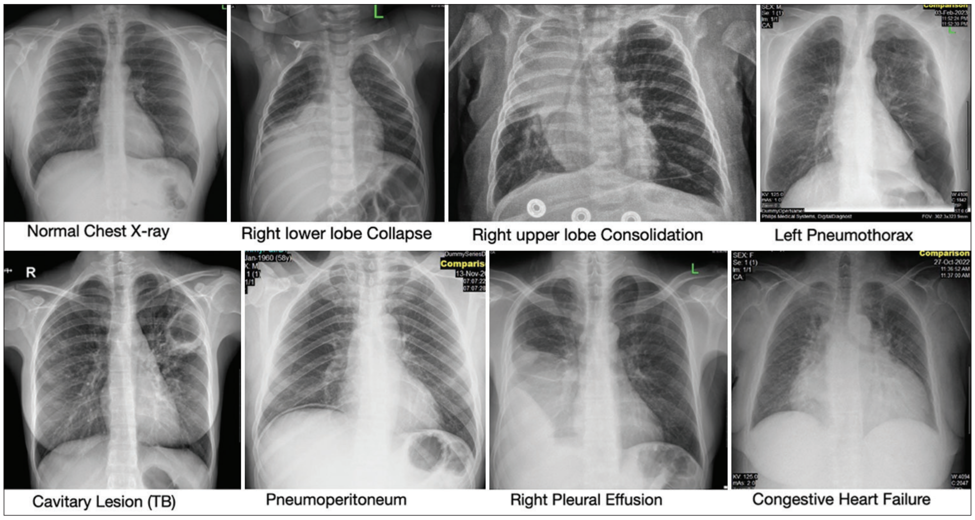

Figure 1: Cases used in both pre- and post-intervention assessments

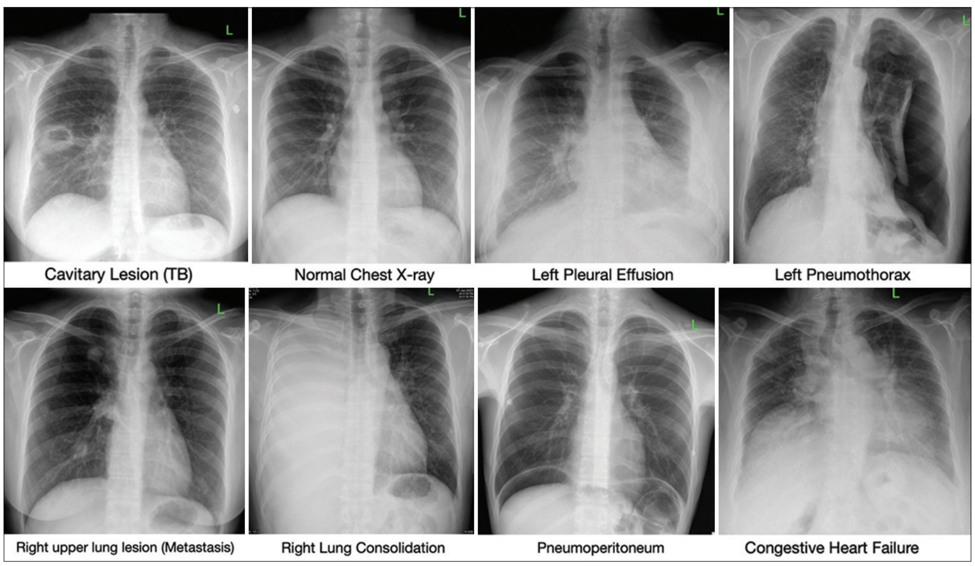

Figure 2: Cases used in post-intervention assessments

Data collection timeline

Data was collected in one session on March 12, 2023. An announcement of the study was shared via university email for the targeted population; all registered personnel were notified of the venue and time.

Study conduction framework

- Pre-Intervention: Demographic data were collected, and baseline levels were established using two cases each with and without clinical history
- Intervention induction: The designed course was delivered to the study subjects in person, which was a single 1-hour session
- Post-intervention: After the intervention, a post-intervention-assessment was conducted using eight cases: four each with and without clinical history.

Data analysis

SPSS version 27 was used for data analysis. Categorical variables (GPA, gender, academic level, future career choice, knowledge, and confidence) were represented using numbers and percentages.[19] Mean and standard deviation were used to describe continuous variables (age and test scores).[19] The normality test was carried out using Shapiro–Wilk[20] test on the distribution of the pre-intervention-assessment without history, pre-intervention-assessment with clinical history, post-intervention assessment scores, and confidence ratings. Paired *t*-tests were used to compare the scores[19] between the pre-intervention-assessment with and without clinical history, the pre-intervention-assessment without history and post-intervention-assessment, and the pre-intervention-assessment with clinical history and post-intervention-assessment. A repeated measures multivariate analysis of variance (MANOVA)[19] was done to see the effect of various students' factors (independent variables) with the dependent variable (mean differences in pre- and post-intervention scores). The effect size was calculated with partial Eta squared.[21] Threshold values for partial Eta squared are considered as having small (.01), medium (.06), and large effects (.14).[22] P value < 0.05 was considered as statistical significance, with a 95% confidence interval.

RESULTS

A total of 77 students (8.2%) were assessed for knowledge and confidence in interpreting chest radiographs, of which 75 students (10.7%) completed the post-test, with 2 students failing to complete the third assessment. Most students were female (57.1%), in the sixth year (53.2%), and had a very good GPA (3.75 to <4.5) (54.5%). Further, 31 (40.3%) students were interested in radiology as a future career. In terms of self-reported knowledge, the mean score was 3.1 ± 0.6, with the majority having an "Acceptable" level (71.4%), and only 9 students (11.7%) having "Poor" knowledge. Similarly, in terms of self-reported confidence level, the mean score was 2.8 ± 0.7, where 45 (58.4%) had an "Acceptable" level of confidence in interpreting chest radiographs, whereas 22 (28.6%) had "Poor" levels [Table 1].

Table 1: Baseline characteristics of the participants (*N*=77)

Variables	*n* (%)
Gender	
Male	33 (42.9)
Female	44 (57.1)
Academic year	
Fourth	25 (32.5)
Fifth	9 (11.7)
Sixth	41 (53.2)
Intern	2 (2.6)
GPA Grade point average	
4.5 and above	24 (31.2)
3.75–<4.5	42 (54.5)
2.75–<3.75	11 (14.3)
Interest in radiology as a future career	
Yes	31 (40.3)
No	46 (59.7)
Self-reported knowledge level (mean=3.08±0.6)	
Poor	9 (11.7)
Acceptable	55 (71.4)
Good	11 (14.3)
Very good	2 (2.6)
Self-reported confidence level (mean=2.78±0.7)	
Very poor	2 (2.6)
Poor	22 (28.6)
Acceptable	45 (58.4)
Good	7 (9.1)
Very good	1 (1.3)

The MANOVA findings revealed that academic year had a significant impact on post-intervention scores in interpretation of cases without clinical history, with a small effect size [F (1,68) = 4.001, ηp^2 = 5.6%, P = 0.049]. Moreover, both academic year [F (1,68) = 8.682, ηp^2 = 11.3%, P = 0.004] and GPA [F (1,68) = 7.584, ηp^2 = 10.0%, P = 0.008] had a significant effect on post-intervention scores, with a medium effect size when compared with pre-test with history. Further analysis of pre-test scores with and without clinical history indicated that academic year significantly influenced mean differences in test scores [F (1,70) = 4.36, ηp^2 = 5.9%, P = 0.040], with a small effect size [Table 2].

The results of the correct answers are summarized in Table 3, which presents the percentage of correct answers for each case, both with and without clinical history. In the case of pneumoperitoneum, students demonstrated a high level of accuracy in diagnosing the condition both without (88%) and with (97%) clinical history. However, for normal CXRs, only (23%) were able to answer correctly without history and there was a slight decrease in accuracy (17%) with history. For pleural effusion, congestive heart failure, pneumonia, and pneumothorax, students showed an improvement in their diagnostic accuracy when provided with clinical history. The percentage of correct answers increased from 49% to 60% for pleural effusion, from 17% to 43% for congestive heart failure, from 21% to 60% for pneumonia, and from 52% to 65% for pneumothorax. The student's ability to diagnose tuberculosis (TB) remained consistent with and without clinical history, with correct answers at 69% without history and 70% with history. In the case of consolidation, the percentage of correct answers increased from 10% without history to 31% with history. In addition, the mean confidence score for both with and without clinical history is illustrated in Table 3. The confidence scores range from 0 (not at all confident) to 5 (extremely confident). Overall, the mean confidence scores in diagnosing medical conditions were higher when students had access to patient history. For instance, the mean confidence score for diagnosing pneumoperitoneum with patient history was 3.99, compared to 3.66 without patient history (P = 004). Similarly, the mean confidence score for diagnosing pleural effusion was 3.96 with patient history and 3.42 without patient history (P < 0.001). These results suggest that having access to patient history can positively impact students› confidence in making accurate diagnoses. This effect is observed across all medical conditions examined in this study.

The mean knowledge score before intervention without clinical history (pre-test without clinical history) was found to be lesser (6.29 ± 2.38) when compared to scores before intervention with clinical history (pre-test with clinical history) (8.58 ± 2.65), which showed significant differences ($P < 0.001$). The post-intervention scores were found to be significantly higher (9.40 ± 2.91) when compared with both pre-test without clinical history ($P < 0.001$) and pre-test with clinical history ($P = 0.034$). Pearson's correlation scores showed a significant low correlation between pre-test without clinical history and post-intervention scores (rho = 0.316, $P = 0.006$). At the same time, a correlation was observed between pre-test with clinical history and post-test scores, but this was not significant (rho = 0.163, $P = 0.162$) [Table 4].

DISCUSSION

The study highlights significant improvements in student diagnostic accuracy and confidence scores following a structured educational intervention. Scores increased markedly when clinical histories were provided, emphasizing the importance of combining core imaging principles with contextual patient information to develop interpretation skills and prepare students for real-life medical practice.

The competency of CXR interpretation might be different in both educational and clinical settings, and any conclusions drawn from one study may not apply to the other.[23] A condensed course of commonly encountered CXR abnormalities may benefit clinical-year medical students, as they have already undergone radiology courses and are familiar with the basics of CXR interpretation, which was included in this study's lecture-based intervention built according to the six-step approach proposed by Thomas and Kern.[16] This curriculum development approach aims

Table 2: Differences in multiple dependent variables before and after the intervention

Source	Pre-test without history versus post-test scores				Pre-test with history versus post-test scores				Pre-test with clinical history versus pre-test without clinical history			
	Mean square	F	P	η^2	Mean square	F	P	η^2	Mean square	F	P	η^2
Intercept	103.543	12.273	0.001	0.153	94.073	13.327	0.001	0.164	84.249	9.502	0.003	0.12
Gender	5.778	0.685	0.411	0.01	8.44	1.196	0.278	0.017	0.029	0.003	0.955	0.000
Academic year	33.751*	4.001	0.049	0.056	61.284**	8.682	0.004	0.113	38.705*	4.366	0.04	0.059
GPA	15.58	1.847	0.179	0.026	53.532**	7.584	0.008	0.1	6.003	0.677	0.413	0.01
Interest in radiology as a future career	5.83	0.691	0.409	0.01	18.506	2.622	0.11	0.037	5.813	0.656	0.421	0.009
Self-reported knowledge level	6.756	0.801	0.374	0.012	12.58	1.782	0.186	0.026	0.671	0.076	0.784	0.001
Self-reported confidence level	1.09	0.129	0.72	0.002	0.401	0.057	0.812	0.001	0.203	0.023	0.88	0
Error	8.437				7.059				8.866			

*$P<0.05$; **$P<0.01$. F – ANOVA value; GPA – Grade point average

Table 3: Comparison between correct answers and mean confidence scores in cases with and without clinical history

Diagnosis	Without clinical history		With clinical history		P
	Correct answers (%)	Confidence score, mean±SD	Correct answers (%)	Confidence score, mean±SD	
Pneumoperitoneum	88	3.66±1.353	97	3.99±1.219	0.004
Normal chest-X-ray	23	2.97±1.203	17	3.05±1.276	0.607
Pleural effusion	49	3.42±1.174	60	3.96±1.081	<0.001
Congestive heart failure	17	2.97±1.203	43	3.43±1.302	<0.001
Pneumonia	21	3.06±1.408	60	3.43±1.261	0.062
Pneumothorax	52	2.65±1.295	65	3.56±1.419	<0.001
TB	69	3.00±1.235	70	3.86±1.132	<0.001
Consolidation	10	2.73±1.120	31	3.12±1.256	0.01

SD – Standard deviation; TB – Tuberculosis

Table 4: Comparison of knowledge score before and after intervention

Assessment pairs	Mean±SD	P	Pearson's correlation	
			rho	P
Pair 1				
Pre-test without clinical history	6.2857±2.38337	<0.001	0.410*	<0.001
Pre-test with clinical history	8.5844±2.65246			
Pair 2				
Pre-test with clinical history	8.5844±2.65246	0.034	0.163	0.162
Post-test	9.4±2.90851			
Pair 3				
Pre-test without clinical history	6.2857±2.38337	<0.001	0.316	0.006
Post-test	9.4±2.90851			

SD – Standard deviation. *>0.4 - Moderate Correlation to provide "a practical, theoretically sound approach to developing, implementing, evaluating, and continually improving educational experiences in medicine."[16] This study showed statistically significant post-intervention knowledge scores, supporting our hypothesis by showing an increase in students' competence in interpreting CXRs. This significant difference can be attributed to the intervention design. Given that this study enhanced educational outcomes by improving post-test knowledge scores, this exemplifies the educational outcomes of The Kirkpatrick Evaluation Model Level 2. This level involves the extent of knowledge, skills, and attitudes that the participants improved during the training.[17]

GPA and academic year affected post-intervention scores, which may suggest that higher-level students benefited the most from the course. A study comparing sixth-year medical students with third-year medical students in radiology training found that the former had an increased percentage of correct answers post-training. This may indicate that senior students have more clinical experience and easier adjustment to learning new medical terms.[24] On the other hand, Jeffrey *et al*.[25] found that final-year medical students performed poorly in interpreting simple chest radiographs, which could reflect a lack of interest in radiology, as few of them expressed interest in the specialty. Moreover, self-reported knowledge levels prior to the assessment did not show any significant effect on the score results, suggesting that students may overestimate or underestimate their knowledge levels; thus, an objective measure of knowledge is needed.

This study is among few that have assessed the competency of medical students in reading CXRs, and we designed three assessments to achieve this objective. The results indicated that providing a clinical history can enhance the performance of medical students in reading CXRs. Specifically, the authors observed a statistically significant difference in the mean score of the pre-intervention assessment with clinical history compared to the mean score of the pre-intervention assessment without clinical history. The positive impact of clinical history has also been demonstrated in previous studies that support these findings.[14,15]

To provide a broader perspective on this study's findings, the authors compared their baseline scores with those of Jimah *et al*.[7] The authors discovered that medical students scored 30% and 55% when not given a clinical history and when given a clinical history, respectively, which was consistent with the findings of the current study. The authors attributed the agreement between the two studies to various methodological similarities, such as using the same procedures, administering a comparable number of questions (16 vs. 20), and having a similar sample size. Despite the fact that this study and that of Jimah *et al*. included medical students who had received formal training before assessment, Jimah *et al*. reported that medical students scored lower than other training levels, which the authors found noteworthy. While Jimah *et al*. did not provide a P value for medical students, the overall significance of clinical history was <0.006, which supports the authors' findings. Similarly, Dunne *et al*.[26] reported an accuracy level of approximately 20% at baseline, with a 10% improvement after providing a 1-hour radiology lecture.

In contrast to the current study's findings, Jimah *et al*.[7] reported a mean test score of 75% without a clinical history in their cross-sectional study. It is important to note that the discrepancy in mean scores can be attributed to several factors such as population differences between the two studies. Specifically, all participants in the study by Jimah *et al*. study were final-year medical students, whereas only half of the current study population consisted of final-year medical students. Additionally, other factors that could have contributed to the discrepancy include the use of an unsupervised setting, focusing only on life-threatening conditions compared to this study, which covered more advanced but common pathologies, and the unspecified approach of considering an answer correct if the pathology was identified, regardless of the level of detail.

Focusing on the radiology course during medical training is needed to enhance the confidence of doctors.[14] These study results showed a baseline of confidence for undergraduates, where the majority (58.4%) had an acceptable level followed by poor confidence level (28.6%) in interpreting chest radiographs. When the clinical history was provided with the case, the overall mean confidence scores for the students were higher compared to the same case without the clinical scenario, indicating that the clinical scenario positively affected student confidence. In general, the highest mean score in the pre-test was for pneumoperitoneum, while in Samara *et al*.,[12] the participants scored the highest confidence level in tension pneumothorax.

There is a disparity between the results of this study and those of other studies. This study found that most participants provided correct answers for pneumoperitoneum, TB, and pneumothorax, and provided less correct answers for consolidations, pneumonia, signs of congestive heart failure, and normal CXR findings. Providing clinical history to the same cases seemed to improve the percentage of correct answers in all cases, except for the normal CXR. Similarly, participants in Scheiner *et al*.[27] had a high percentage of patients with congestive heart failure, pneumoperitoneum, and pneumothorax. In Cheung *et al*.,[6] 87% of students were able to detect pleural effusions, 67% could spot the normal CXR, 60% spotted upper zone consolidation, and only (13%) for lower zone consolidation. Contrary to the findings of the present study, Cheung *et al*.[6] reported a lower percentage of correct answers for pneumothorax (47%). Additionally, in the study by Samara *et al*.,[12] students most commonly answered pneumoperitoneum correctly (93.8%), followed by normal CXR (74%). This study and the aforementioned studies[6,7] found areas of weakness in their results. These weaknesses can be further emphasized in CXR education, including normal CXR findings, congestive heart failure, pneumonia, lung consolidations, lung collapse, and flail chest.

Limitations and recommendations

Limitations of the study include the inability to predict long-term effects from a single-session intervention, substantial variations in medical knowledge among participants, and possibly, an inadequate number of interns at the peak of medical knowledge. It is also imperative to discuss the limitations of using convenience sampling in this study. While this method enabled efficient recruitment of participants, it may not represent a broader population of medical students, which limits the generalizability of our findings. Although valuable, the reliance on self-reported confidence levels also introduces bias, as students might overestimate or underestimate their abilities. Future research should consider random sampling methods and incorporate objective performance measures to validate these findings.

Recommendations encompass clinically oriented radiology teaching aligned with patients' histories and physical findings, not solely pathophysiology or images. The authors advocate dynamic methodologies such as The Six-Step Approach by Thomas and Kern, concentrating on problem identification and ongoing evaluation.

CONCLUSION

The study revealed the significant influence of a lecture-based intervention on students' ability to interpret chest X-rays. Providing clinical history enhanced outcomes and assurance in diagnosing various medical conditions. With marked disparities in accuracy and confidence, depending on the diagnosis and inclusion of clinical history, the study emphasizes the importance of tailored education strategies. These strategies can empower medical students to foster essential competencies and self-assurance as future physicians. The study also emphasizes focusing on particular chest X-ray interpretation areas, including normal findings and prevalent pathologies such as congestive heart failure and pneumonia, where student performance was low in the current study.

Ethical considerations

The study was approved by the Institutional Review Board of Imam Abdulrahman Bin Faisal University (Ref. No: IRB-UGS-2022-01-422; date: 06/11/2022), Dammam, Saudi Arabia. All study participants provided written consent before inclusion in the study. The study adhered to the principles of the Declaration of Helsinki, 2013.

Peer review

This article was peer-reviewed by two independent and anonymous reviewers.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author contributions

Conceptualization: M.J., A.F., A.D., G.O., A.H., R.S., and M.Q.; Methodology: A.F.; A.H., R.S., M.Q., T.H.; A.D., G.O., K.K., and H.A; Data analysis: A.D. and G.O.; Writing – Original Draft: A.F., A.D., G.O., A.H., R.S., and M.Q.; Writing – Review & Editing: K.K., T.H., A.E., and M.J.; Supervision: T.H. and A.E.

All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

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