Clinicians' Interpretation of Unreported Chest Radiographs in Biologic Prescription Workup Service: A Comprehensive Analysis

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Abstract

Chest X-ray (CXR) is an essential and widely used tool that plays an integral role in identifying pulmonary and cardiovascular conditions. This cross-sectional study assessed the confidence and competence of clinicians, including junior speciality trainees, higher speciality trainees and specialist nurses, interpreting chest X-rays before starting biologic treatment. An online survey was used to collect data from clinicians in various healthcare settings, focusing on their experience, training, confidence levels, and CXR interpretation proficiency. The survey uncovered clinicians' insufficient confidence in interpreting the pre-biological screening chest X-rays despite their clinical expertise. This uncertainty raises concerns about potential misinterpretations, affecting timely treatment decisions. A Kruskal-Wallis test indicated a significant difference between training levels required with a P-value of 0.001, rejecting the null hypothesis. Subsequently, a Dunn-Bonferroni test revealed that the Higher Specialty Trainee-Specialist Nurse pair differed significantly, with the Specialist Nurse group requiring more training. This study highlighted the need for enhanced radiology education for clinicians involved in chest radiograph interpretation for pre-biological screening. Implementing structured training program is essential to improve skills and ensure accurate interpretation of non-formally reported chest radiographs, ultimately enhancing patient outcomes and healthcare practices.

Introduction

Accounting for 25% of all radiographic scans, chest radiography (CXR) is an essential diagnostic tool to assess the airways, pulmonary parenchyma and vessels, mediastinum, heart, pleura, and chest wall with the average of 236 CXRs per 1000 patients per year. [1]. CXR is performed to investigate and monitor wide spectrum of diseases for instance pneumonia, heart failure or pneumothorax, investigating suspected lung cancer, tuberculosis (TB) or interstitial lung diseases [2].

Despite its extensive use in radiography, CXR interpretation remains a formidable challenge [3]. International studies among medical students and postgraduate doctors highlight insufficient radiological skills emphasizing the crucial role of radiology training [4]. As a general concept, thorough comprehension of thorax anatomy is a crucial element for precise CXR interpretation [3]. Standard chest X-rays are typically taken in posterior-anterior (PA) and left lateral positions for best image quality, as PA minimizes heart magnification and enhances spatial resolution. However, if patients cannot stand or bedside imaging is needed, anterior-posterior (AP) projections are used, which can magnify the heart and result in potential issues like poor positioning, inspiration, motion artifacts, overlap, and reduced image contrast [3]. In addition, technical issues such as overexposure, under exposure, projection and normal variations can further complicate CXR interpretation [5]. Despite CXR interpretation skills are considered an important aspect of clinical medical training, for medical students and junior doctors, studies elsewhere proved that postgraduate doctors' Chest radiograph interpretation are poor [6]. International studies also depicted that both medical interns and final year medical students alike are largely limited in their ability to make radiological diagnoses of simple and commonplace situations [7].One of the important uses of chest X-ray is screening process prior to starting biological treatments.

Biologic and small-molecule medications have revolutionized the treatment approach of multiple systemic inflammatory diseases such as rheumatoid arthritis (RA) [8]. Rheumatoid arthritis is a persistent systemic inflammatory condition primarily impacting the synovial joints [9]. In the early stages, rheumatoid arthritis affects small joints, proceeding to large joints and potentially affecting the skin, eyes, heart, kidneys, and lungs. In many cases, joint damage occurs, leading to the weakening of tendons and ligaments [10].

This study, assessed the level of confidence of clinicians including specialty trainees, core level trainees and rheumatology specialist nurses in interpreting chest X-ray prior to initiating biologic treatment at a busy NHS University Teaching Hospital. The aim is to identify areas for potential improvement in radiology teaching. The existing knowledge is there have been no prior studies exploring this specialist topic.

Materials And Methods

A cross-sectional study was carried out at the Busy NHS University Teaching Hospital in question. The hospital has approximately 1,000 beds and provides the main accident and emergency service for its region in the East midlands. This study was conducted between May,2023 and August 2023 encompassing three main departments: Rheumatology, Dermatology and Gastroenterology.

The study population incorporated all levels of junior doctors (Foundation year one and two, Core level trainees and specialty registrars) rotating within these three main departments (Rheumatology, Dermatology and Gastroenterology) in addition to specialist nurses. Out of the 56 participants, all willingly took part and provided their informed consent after being briefed on the study's purpose.

An online survey of 7 questions was constructed by using windows forms and the QR code was distributed to all doctors rotating within rheumatology, dermatology, and gastroenterology departments within the hospital as well as distributing the questionnaire via email. The objective was to evaluate participants' knowledge of pre-biologic prescription workup and their confidence in interpreting CXR prior to commencing biologic treatment. The questionnaire did not incorporate clinical data or radiological images. The Pre-biologic workup survey can be viewed online.

(https://forms.office.com/Pages/DesignPageV2.aspx?
prevorigin=Marketing&origin=NeoPortalPage&subpage=design&id=DQSIkWdsW0yxEjajBLZtrQAAAAAAAAAAANAAVqxXeFURUlDN1ZXN1FZWkY3MEY5V

The questionnaire collected data on clinician grades, their familiarity with pre-biologic workup for rheumatic disease patients requiring biologics, their ability to identify contraindications for biologic treatment and their confidence interpreting unreported CXR before commencing biologic therapies. Additionally, the survey inquired about clinician's interest in receiving training on CXR interpretation. Notably, there was no specified time limits or scoring for questionnaire completion.

STATISTICAL ANALYSIS:

The data was organized in a spreadsheet using EXCEL 2021. In this study, an evaluation of the clinician's grade as the independent variable, which was then compared to the dependent variables assessing clinician familiarity, confidence, and training requirement in interpreting CXR prior to initiating biologic treatments. Results were considered to be statistically significant when P <0.05 in all analyses [7]. Prior to this study, there was no prior knowledge concerning clinicians' familiarity and confidence in interpreting CXR before starting biologic therapies in line with hospital guidelines. No existing studies were available for reference. Consequently, the formal sample size calculation was omitted during the planning stage. The actual participant count was determined by practical constraints. However, efforts were made to include as many participants as possible in the study. Data were categorized and depicted according to their types. Since the data exhibited a non-normal distribution, non-parametric methods were utilized [4]. Thus, Kruskall-Wallis Test was employed when comparing more than two groups with their responses [11].

Results

Before analyzing the data, variable transformations were conducted and merged specific variables. Clinician grades were subsequently divided into three groups: that is Junior specialty trainees, Higher specialty trainees and specialist Nurses. Junior specialty trainees (consisting of first- and second-year trainees and core medical trainees) the second group comprised specialist nurses and the third group the Higher specialist trainees (comprising Trust grade doctors and specialist registrars) for comparative analysis [Figure 1].

In addition to the aforementioned data transformations, participant responses were consolidated by grouping those who reported 'familiar' and 'very familiar' with pre-biologic workup for patients with rheumatic diseases requiring biologics into a single category labeled 'familiar'. Similarly, responses from participant who indicated 'neither familiar nor not familiar' 'not familiar and not very familiar' were merged to form the 'not familiar' category [Figure 2]. These transformations were implemented to enhance the clarity and interpret ability of analysis.

Furthermore, there was a refining process of participant responses by grouping individuals who expressed 'confident' and 'very confident' levels of competence in identifying contraindications to biologic treatment based on medical history, interpreting chest X-rays before commencing biologic treatment [Figure 3], and providing comments on chest-X-rays without a formal report [Figure 4]. This combined group was categorized as 'confident'. Correspondingly, participants who chose responses such as 'not confident', 'neither confident nor not very confident' and 'not very confident' were Integrated to establish the 'not confident' category.

In relation to the training requirements these responses were left in ordinal form from 'no training required' to 'some training required' to 'full training required'. These categories were left unchanged to facilitate methodological rigor and enhance the clarity of the analyzed data. With regards to the participants, a total of 56 responses were receive, including 11% from junior speciality trainees, 20% from specialist nurses, and 69% from higher speciality trainees [Figure 5].

Data analyses revealed that 78% of the participants exhibited familiarity with the pre-Biologic work up required for patients with rheumatic disease necessitating Biologics, while 12.5% of participants indicated a lack of familiarity. Additionally, 62.5% of participants demonstrated confidence in recognising contraindications to Biologic treatment through medical history, whereas 37.5% did not. In terms of confidence in interpreting chest X-rays before initiating Biologic treatment, 57.7% of participants displayed confidence, while 48.2% did not. With regard to confidence in interpreting a chest X-ray as 'normal' without a formal report, 57.1% of participants displayed confidence, while 42.8 % did not. When participants were surveyed regarding their need for CXR interpretation training, a significant majority, 78.6% of respondents, expressed a clear desire for such training, while a smaller portion did not perceive it as necessary [Figure 6].
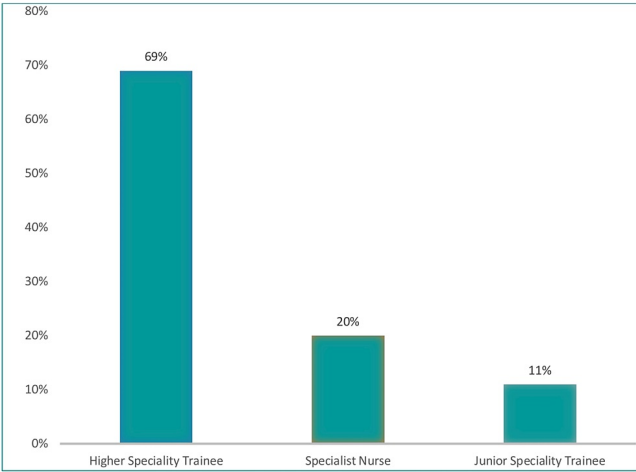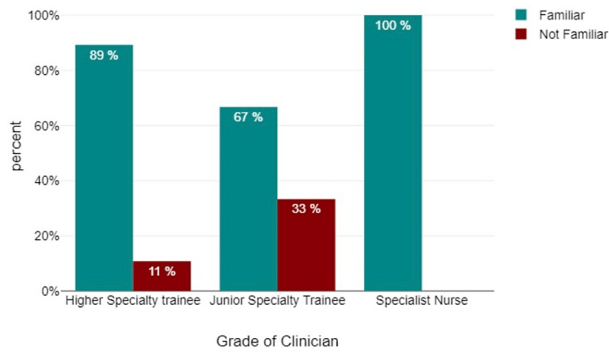

FIGURE 1: Grade of Clinician

FIGURE 2: Are you familiar with pre-biologic workup for patients with Rheumatic disease needing biologics?
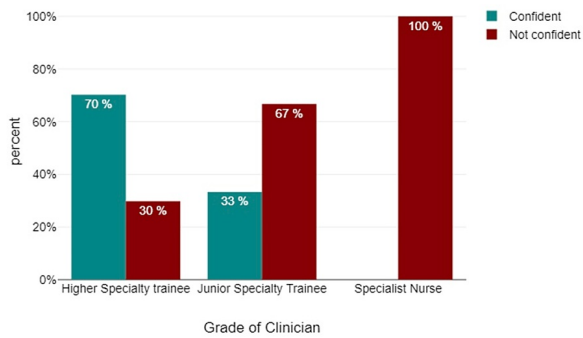

FIGURE 3: Do you feel confident interpreting Chest X-ray prior to starting biologic treatment?
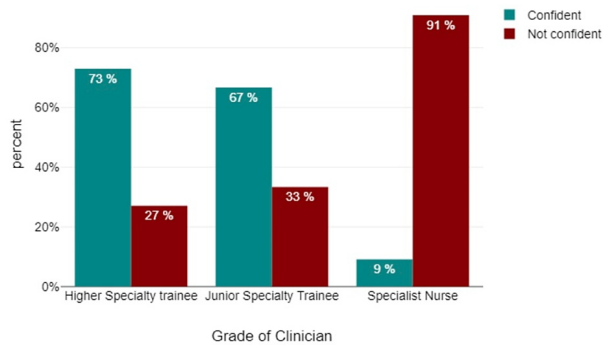

FIGURE 4: Do you feel confident in commencing on Chest X-ray as a normal chest X-ray without a report?
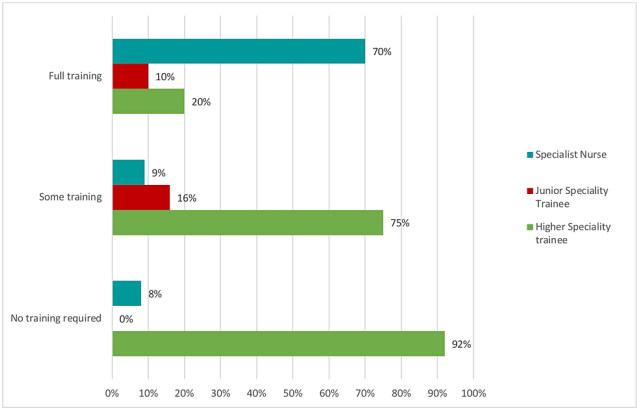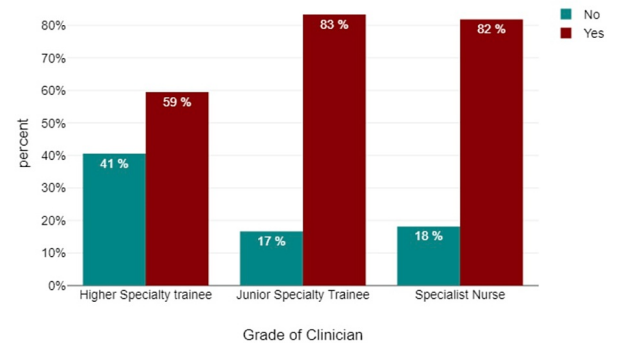
FIGURE 5: Level of Training Required

FIGURE 6: Do you feel you need more training in chest X-ray reporting?

Explanation of the Kruskal-Wallis test

A Kruskal-Wallis test showed that there is a significant difference between the categories of the independent variable with respect to the dependent variable that What level of training do you think you need if you feel you need Chest X-ray training? [Table 1]. The p value is 0.001. Thus, with the available data, the null hypothesis is rejected [Table 2].

As the Kruskal-Wallis test showed that there was a significant difference between groups, a Dunn-Bonferroni test was used to compare the groups in pairs to find out which ones were significantly different. The Dunn-Bonferroni test showed that the pairwise group comparison of Higher Specialty trainee - Specialist Nurse has an adjusted p-value of less than 0.05, and thus, based on the available data, it can be assumed that the two groups are significantly different, and the Specialist Nurse group require more training than the Higher Specialty trainee group [Table 3].

Groups	n	Median	Mean Rank
Higher Specialty trainee	**37**	**2**	**23**
Junior Specialty Trainee	6	2	32
Specialist Nurse	11	3	40
Total	54	2	

TABLE 1: Ranks of the Clinician Groups for Kruskal-Wallis Analysis

	Chi^2	df	p
What level of training do you think you need if you feel you need Chest X-ray training?	13	2	0.001

TABLE 2: Kruskal-Wallis Test of the groups

Groups	Test Statistic	Std. Error	Std. Test Statistic	P	Adj.P
Higher Specialty Trainee – Junior Specialty Trainee	-9	6	-1	.144	.432
Higher Specialty Trainee – Specialist Nurse	-17	5	-4	<0.001	0.001
Junior Specialty Trainee – Specialist Nurse	-8	7	-1	.263	.79

TABLE 3: Dunn Bonferroni test (Post hoc test) as the Kruskal-Wallis tests was significant.

Discussion

In the era of digital advancement, accurate CXR interpretation remains a diagnostic challenge [12]. This study addressed the question whether Clinicians of different grades were familiar with the pre-Biologic screen and assessed their level of certainty interpreting chest X-ray without a formal report prior to initiating Biologic therapies. A cross-sectional study was carried out at Leicester Royal Infirmary. This study was conducted across rheumatology, dermatology, and gastroenterology departments via an online survey of 7 questions. Data from 56 participants were collected and analyzed using Krystal-Wallis test, yielding significant Z and R values for all questions. Plain films remain integral in daily clinical practice and are expected to maintain their significance in the foreseeable future [5]

While most clinicians were acquainted with pre-Biologic screening, this study revealed wide range of confidence and certainty levels among clinicians when interpreting CXR without a formal report. One potential rationale for this variation is the lack of formal training and guidance. As Vincent et al., argued that expecting clinicians to acquire these skills without support is unrealistic [13], [14]. Another possible explanation is that an excessive reliance on radiologist might affect the confidence and certainty in CXR interpretation.

A study was conducted by S. Samuel explaining that merely 29% of medical schools require a diagnostic radiology training [15], leading to the absence of specific CXR interpretation training in undergraduate medical education [16]. Additionally, despite the typical expectation that accuracy and confidence in chest radiograph interpretation would increase with seniority, a study in 2003 revealed a contrary trend, with overall skill levels remaining suboptimal [5]. The issue of inadequate radiological training is not confined to a single region; it's a national concern. While some trusts do offer radiology departments, the emphasis on their importance remains insufficient [5]. This deficiency has a direct impact on the quality of service provided to the community.

Another study found that seniority had a positive impact on the level of confidence in CXR interpretation [2]. However, a separate study in the UK, conducted among final year medical students, revealed that less than 25% of them were confident and accurate in interpreting CXRs. This low confidence was attributed to limited formal training (ranging from to 24 hours with a median of 21 hours) [17]. The absence of formal accreditation for CXR interpretation within local medical training programs poses a genuine issue, potentially affecting the quality of CXR interpretation skills among future doctors. This, in turn, may lead to delays in patient management and poorly controlled disease symptoms, ultimately impacting the efficacy of therapies [2]. Other separate study indicated that subjects found it challenging to interpret normal plain radiographs [18].

Another study was conducted Among junior doctors revealed that only 30.3% of house officers were proficient in interpreting CXRs. This deficiency could be attributed to limited formal training opportunities or the lack of emphasis on chest radiograph competency within the competency scheme [7]. Inadequate CXR interpretation skills will be reflected on the competency managing patients in the outpatient department, which makes the majority of patients reviews across three main departments: rheumatology, dermatology, and gastroenterology. This can, result in prolonged waiting hours. In some studies, it was observed that the time between the onset of symptoms of conditions like rheumatoid arthritis RA and the initiation of medication in various countries, including the UK, ranged from 6 to 19 months [19].

This study showed that despite the majority of respondence were familiar with the pre biologic and the majority of participants were higher speciality registrars, their confidence interpreting CXR remained sub optimum. This can be attributed to absence of an adequate training program. The lack of confidence can be reflected on longer waiting hours and delay of starting biological therapies. This can reflect its effect on the quality of care delivered for patients and subsequent outcome and response to biological treatment.

Furthermore, this study highlighted an important issue in this Trust that, according to the existing knowledge, has not been assessed by previously.

Potential Solutions:

1. Providing junior trainees and Specialist nurses with sufficient training to robust their confidence interpreting CXR [20]. In one of the studies, the importance of using PACS (picture archiving and communication system) rather than plain films was highlighted, owing to better resolution and the ability to modify the images by altering the grey scale to reduce the effect of technical factors such as incorrect exposure [5].

2. Periodic refresher courses for all clinicians involved in chest x-ray reporting so as the maintain skill level.

Limitations of the study:

1. Poor response rate: A major number of the collected data was from distributing the questionnaire via email. Although most of the online participant were aware of the purpose of this study, reluctance to reply remained an issue. Hence, the total online responses received comprised only 26.7% of the total participants.

2. Selection bias: The other limitation of this study was the possibility of selection bias. This might be linked to the fact that those contributors with more experience and confidence completed the questionnaire.

Conclusions

The importance and the value of this study is the utilization of descriptive ordinal values on the original questionnaire used (very confident, confident, neither confident nor not confident, not confident, not very confident) rather than numerical values taking into consideration that "confident" and "certainty" are subjective and vary based on individual self-assessment. This provided more reliable results that reflect the actual level of confidence among clinicians.

This study identified a gap in the competency and certainty in interpreting CXR among clinicians who were responsible and familiar with pre-biologic screening. Hence, this issue needs to be addressed and the inadequacy among clinician needs to be improved via structured training programs.

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Additional Information

Disclosures

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