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Chest X-ray Positioning in Suspected Infection in the Emergency Department: Patient Characteristics and Outcome Associations

Sofie Hjort Bendixen [1*] | Stig Holm Ovesen [1,2] | Marie Kristine Jessen [1,3] | Jesper Weile [1,2]

[1]Research Center for Emergency Medicine, Department of Clinical Medicine, Aarhus University, Denmark [2]Department of Emergency Medicine, Horsens Regional Hospital, Horsens, Denmark [3]Department of Anesthesiology and Intensive Care, Aarhus University Hospital, Aarhus, Denmark

Correspondence (*): sofie_bendixen@hotmail.com

Abstract

Introduction: Chest radiography (CXR) is the first-choice imaging for diagnosing suspected infection in the emergency department (ED). However, previous descriptions of x-ray modalities are sparse. The objective was a) to describe CXR modalities in patients with suspected infection, findings, and image quality, and b) to investigate associations between patient characteristics and modalities.

Methods: In this secondary analysis of a prospective cohort study, we included ED patients with suspected infection and a CXR performed while admitted. We used binary regression to investigate which patient characteristics were associated with getting a sitting CXR (sitCXR) or supine CXR (supCXR).

Results: Out of 979 included patients, 60% were erect (eCXR), 15% were sitting (sitCXR), and 25% were supine CXR (supCXR). We observed a higher relative risk (RR; 95%CI) of having a sitCXR or supCXR if patients were 60–79 years or >80 years (2.3; 1.7–3.0 or 3.2; 2.5–4.3), had renal failure (1.5; 1.2–1.8), heart failure (1.4; 1.1–1.8), do-not-resuscitate/do-not-intubate-orders (2.5; 2.2–2.8), systolic blood pressure ≤100 mmHg (1.6; 1.3–1.9), respiratory rate ≥22 min (1.4; 1.2–1.6), and saturation <90% (1.6; 1.3–2.0).

Conclusion: SitCXR and supCXR are common in ED patients with suspected infection. Patients receiving sitCXR and supCXR were older, comorbid, and presented with abnormal vital signs.

Keywords: Chest x-ray; Infection; Imaging; Emergency medicine

Introduction

Chest radiography (CXR) is the first-choice imaging in the diagnostic work-up of emergency department (ED) patients with suspected infection.[1-5] CXR provides fast, relatively inexpensive clinical information and low radiation exposure compared to, for example, CT scans.[2] However, its diagnostic accuracy is low to moderate in the diagnosis of pneumothorax, pleural effusion, heart failure, and pneumonia compared to other imaging modalities.[1, 6-18]

The standard CXR in the ED is performed in an erect position (eCXR) in two recordings: posteroanterior and lateral projections, and can alternatively be performed as sitting (sitCXR) or supine (supCXR) anteroposterior projection.[2] However, supCXR has lower diagnostic accuracy than standard eCXR,[1,2, 6, 9, 10] making image interpretation difficult and potentially leading to missed pathology and delayed or unnecessary treatment. Patients receiving supCXR rather than eCXR are described as older and clinically worse,[9, 13, 16, 19] but descriptions of the populations receiving different modalities of CXR are scarce, and large studies have not yet been performed.

With the emerging availability of low-dose computed tomography and point-of-care ultrasound, which both outperform sitCXR and supCXR in accuracy,[7, 19] it may be appropriate to consider alternative imaging in the ED for patients where inferior sitCXR and supCXR are current standards, since eCXR is not possible. However, firstly, more data must be available on the general characteristics associated with different modalities of CXR, especially to show in which cases eCXR is not possible.

The objective of this study was to a) describe the used CXR modalities in ED patients with suspected infection, findings, and image quality, and b) investigate if specific patient characteristics are associated with different CXR modalities.

Methods

STUDY DESIGN AND SETTING

This was a secondary analysis of a prospective cohort study, including all adult patients with suspected infection admitted to one of three EDs in the Central Denmark Region (Aarhus University Hospital, Herning Regional Hospital, and Randers Regional Hospital) from January 20, 2020, to March 2, 2020.[20] From this cohort, all patients with a CXR during admission were included in this study.

HVAD VED VI?

Røntgen af lungerne ved diagnostisk udredning i akutmodtagelser udføres som standard med patienten i stående position, men kan alternativt udføres siddende eller rygliggende. Sidstnævnte giver dårligere diagnostisk nøjagtighed, hvilket potentielt kan føre til oversete tegn på sygdom og til forsinket eller unødvendig behandling.

Fact box (in Danish)

Yearly contacts in the EDs vary between 15,000 and 63,000 patients, and they serve a total population of 0.9 million people. The EDs provide 24-hour emergency care to all acute patients except for stroke, STEMI, obstetric, and psychiatric patients.

According to Danish law, the Danish Patient Safety Authority approved the study (case no.: 31-1521-188 + 1-45-70-69-20) and waived it from the ethics committee.

PARTICIPANTS

This cohort included: adult patients (≥ 18 years) with suspected infection defined as having either a blood culture sent for microbiological examination and/or intravenous antibiotic administered within six hours from ED arrival and a CXR during the ED admission. Only the first presentation with all inclusion criteria fulfilled within the study period, and Danish citizens with a valid Danish personal identification number were included in the present analysis. Patients admitted with (a) severe trauma defined by the trauma criteria used at each hospital, (b) serious bleeding defined as the use of more than two units

of red blood cells, or (c) prophylactic antibiotics due to scheduled surgery were excluded.[20]

CXR METRICS

Imaging variables: time format variables (requisition and examination time) for the first CXR requested in the ED, portable CXRs, the total number of CXRs, and chest CT scans throughout the patient's hospital stay were retrieved from routinely collected data from the electronic patient record at each hospital.

CXR INTERPRETATION

CXR position, quality, and findings were manually reviewed in the medical records by one observer (SHB), entered into a REDCap-database, and linked to patient and administrative variables using the personal identification number. CXR position (erect, sitting, or supine) was determined based on the CXR image label or by notification in the radiologists' interpretation. CXR quality was defined as suboptimal if description of "suboptimal inspiration" or "rotated images", and unusable by notification in the interpretation. CXR pathology variables were identified in the interpretation and categorized as "Present", or "Uncertain" if the radiologist used the terms "impression of" or "couldn't be excluded". Only newly identified findings were included in the analysis. Inter-observer agreement of CXR details was assessed by a review of 10% of records by two independent observers. See Supplementary Material for categorization of radiologists' interpretations; Table S1.

OTHER PATIENT AND ADMINISTRATIVE VARIABLES

Descriptive data on sex, age, initial vital signs, organ dysfunction, administration of antibiotics, 90-day mortality, in-hospital mortality, ED length of stay, and in-hospital length of stay were retrieved from routinely collected data from the electronic patient record at each hospital. Prior medical history/comorbidities were classified according to diagnosis coding (diabetes mellitus and solid tumor) or manual medical chart review (renal disease, heart failure, chronic obstructive pulmonary disease (COPD), and do-not-resuscitate/do-not-intubate (DNR/DNI) orders). Any mention of renal failure or a prior history of elevated creatinine was used to define renal failure. An ejection fraction of <40% was chosen as a cut-off to determine systolic heart failure. COPD was defined as a prior history of FEV1/FVC<70% or any mention of COPD. The presence of DNR/DNI orders in the chart at admission or decision of those within six hours of ED arrival was used to determine DNR/DNI orders. The most likely source of infection was determined through a chart review of the ED charts and grouped into the following categories: respiratory, urinary, skin/soft tissue, abdominal, bacteremia with no other source, viral, other, unknown, and no suspected infection.

OUTCOMES

The primary outcome was the descriptive distribution of the CXR modalities of the first CXR requested in the ED, findings, and image quality. We also report associations between patients' characteristics and different CXR modalities.

STATISTICAL ANALYSIS

Descriptive categorical data are reported as counts and proportions (%), and continuous data as medians (first and third quartiles, IQR). Distributions were assessed for normality using visual inspection of histograms and quantile-quantile plots. Associations were investigated using the absolute and relative differences between proportions with 95% confidence intervals (95% CI) calculated based on binary regression. In this analysis, the sitCXR and supCXR were combined into one group.

Data were analyzed using Stata version 17 (StataCorp LP, College Station, TX, USA).

Results

PATIENT CHARACTERISTICS AND CXR POSITION

Of the 1,924 patients with suspected infection, 982 (51%) had a CXR performed in one of the three EDs. Three patients were excluded; one with a missing radiologist's interpretation, and two had an indeterminate CXR position. A total of 979 patients were included in the study. See Supplementary Material for patient flowchart (Figure S1).

Out of 979 included patients, 589 (60%) had an eCXR, 144 (15%) had a sitCXR, and 246 (25%) had a supCXR performed. The overall median age was 74 years (IQR: 63, 83), and 509 (52%) patients were male. Patients who had an eCXR taken were younger, with a median age of 70 years, compared to those with sitting or supine CXR, who were older, with median ages of 81.5 and 79 years, respectively. Common comorbidities overall included COPD (27%), renal failure (13%), diabetes (6%), and heart failure (6%). Patients with a sitCXR had a higher prevalence of COPD (40%), compared to those with an eCXR (23%) and supCXR (28%). Patients with a supCXR had the highest percentage of DNR/DNI orders (40%), while those with an eCXR had the lowest (8%). The most common focus of infection was the respiratory tract (43%). Antibiotics were administered to most patients (78% overall), with higher rates in the sitCXR (85%) and supCXR groups (87%). In-hospital mortality was lowest in the eCXR group (2%), while 90-day mortality was highest in the supCXR group (34%). Baseline patient characteristics are summarized in Table 1.

Table 1. Baseline characteristics

Variable	Erect CXR n=589 (60%)	Sitting CXR n=144 (15%)	Supine CXR n=246 (25%)	Total n=979	Missing n (%)
Age, y	70 (56; 80)	81.5 (70; 88)	79 (72; 85)	74 (63; 83)	0 (0%)
Male sex, n (%)	290 (49%)	67 (47%)	152 (62%)	509 (52%)	0 (0%)
Weight, kg	75 (63; 87)	70.5 (58.2; 84.7)	72.6 (60.5; 85)	74 (62; 86)	38 (4%)
Height, cm	170 (164; 178)	168 (162; 175)	170 (164; 177)	170 (163; 178)	50 (5%)
BMI, kg/m^2	25.4 (22.6; 28.7)	25 (20.8; 30.1)	24.8 (22.1; 28.4)	25.2 (22.2; 28.6)	55 (6%)
Prior medical history of/comorbidities, n (%)					
COPD*	135 (23%)	57 (40%)	69 (28%)	261 (27%)	0 (0%)
Renal failure†	56 (10%)	27 (19%)	43 (18%)	126 (13%)	0 (0%)
Diabetes‡	29 (5%)	10 (7%)	18 (7%)	57 (6%)	0 (0%)
Heart failure§	28 (5%)	10 (7%)	23 (9%)	61 (6%)	0 (0%)
Solid tumor‖	23 (4%)	1 (1%)	7 (3%)	31 (3%)	0 (0%)
DNR/DNI orders	46 (8%)	37 (26%)	109 (44%)	192 (20%)	0 (0%)
Vital signs, first observed					
Respiratory rate, /min	20 (18; 24)	22 (18; 25)	22 (18; 28)	20 (18; 24)	2 (0.2%)
Saturation, %	96 (94; 98)	95 (92; 97)	95 (92; 97)	95 (93; 98)	2 (0.2%)
Heart rate, /min	93 (81; 106)	93.5 (80.3; 115)	97 (80; 110)	93 (81; 108)	2 (0.2%)
Systolic blood pressure, mmHg	138 (123; 153)	135 (119; 156)	132 (113; 152)	136 (120; 153)	3 (0.3%)
Temperature, °C	38.0 (37.4; 38.7)	37.9 (37.1; 38.5)	37.9 (37; 38.8)	38.0 (37.3; 38.7)	4 (0.4%)
GCS	15 (15; 15)	15 (15; 15)	15 (14; 15)	15 (15; 15)	2 (0.2%)
Blood tests					
CRP, mg/L	71 (29; 144)	74 (26; 154)	80 (23; 153)	73 (27; 149)	13 (1.3%)
Leukocytes, 10^9/L	10.4 (7.8; 14.1)	11.7 (8.4; 16.1)	12.3 (9.5; 16.4)	10.9 (8.3; 15)	9 (0.9%)
Lactate, mmol/L	1.5 (1.0; 2.1)	1.5 (1.1; 2.32)	1.7 (1.1; 2.8)	1.5 (1.1; 2.3)	494 (50%)
D-dimer, mmol/L	0.74 (0.50; 1.80)	1.55 (0.70; 3.20)	1.45 (0.65; 3.93)	1.00 (1.55; 2.45)	809 (83%)
Creatinine, mmol/L	73 (59; 97)	86 (62; 109)	86 (60; 126)	77 (60; 105)	14 (1.4%)
Suspected infectious focus within 6 hours, n (%)					
Respiratory¶	254 (43%)	71 (49%)	96 (39%)	421 (43%)	
Urinary	70 (12%)	24 (17%)	57 (23%)	151 (15%)	
Skin/soft tissue	26 (4%)	9 (6%)	14 (6%)	49 (5%)	
Abdominal	42 (7%)	11 (7%)	10 (4%)	63 (6%)	
Viral	60 (10%)	6 (4%)	6 (2%)	72 (7%)	

Bacteremia with no other source	1 (0.2%)	2 (1.4%)	0 (0%)	3 (0.3%)	
Other	28 (5%)	2 (1%)	6 (2%)	36 (4%)	
Unknown	54 (9%)	9 (6%)	40 (16%)	103 (11%)	
No suspected infection	54 (9%)	10 (7%)	17 (7%)	81 (8%)	0 (0%)
Antibiotic administration, n (%)**					
Overall	430 (73%)	122 (85%)	214 (87%)	766 (78%)	0 (0%)
ED	373 (63%)	105 (73%)	201 (82%)	679 (69%)	0 (0%)
Length of stay					
ED, h (median (IQR))	9 (5; 20)	13 (5; 24)	13 (6; 23)	10 (6; 21)	0 (0%)
In-hospital, d (median (IQR))	1.9 (0.4; 4.2)	3.6 (1.0; 7.0)	3.7 (0.8; 6.1)	2.5 (0.6; 5.6)	0 (0%)
Mortality, n (%)					
In-hospital mortality	13 (2%)	10 (7%)	26 (11%)	49 (5%)	0 (0%)
90-day mortality	47 (8%)	30 (21%)	83 (34%)	160 (16%)	0 (0%)

Note: All data are presented as medians with (interquartile range) if not otherwise stated.
Abbreviations: CXR, chest x-ray; BMI, body mass index; ED, emergency department; COPD, chronic obstructive pulmonary disease; DNR/DNI, Do-not-resuscitate or do-not-intubate; GCS, Glasgow Coma Scale (ranges 3-15); CRP, C-reactive peptide; IV, intravenous; OR, oral
*COPD mentioned in the chart before admission or prior history with FEV1/FVC < 70%.
†Renal failure of any kind mentioned in chart or prior history of elevated creatinine.
‡Type 1 or type 2 diabetes in ICD-coding in previous hospital discharge diagnoses.
§Heart failure was defined as an ejection fraction < 40%.
‖Solid tumor including metastasis in ICD-coding in previous hospital discharge diagnoses.
¶ Including acute exacerbation of COPD
**Including intravenous and peroral antibiotic

Table 1 (continued).

CXR FINDINGS AND IMAGE QUALITY

The result of the inter-observer agreement of CXR position, quality, and pathology variables indicated almost perfect agreement beyond change (κ = 0.92) according to Landis et al.[21] with the percentage of agreement ranging from a minimum 94% to a maximum of 100% (lowest κ = 0.66; highest κ = 1). See Supplementary Material for complete oversight, Table S2.

The most frequently reported newly identified finding was infiltrates (28%). The prevalence of newly identified edema, pleural effusion, and atelectasis was higher in patients examined with a sitCXR or supCXR (Table 2). The radiologists had a higher prevalence of uncertainty with their interpretation of pathology, and the prevalence of uncertainty by all findings was higher in sitCXR and supCXR. The rate of suboptimal radiographs was 3% within eCXR, 6% within sitCXR, and 12% within supCXR. Table 2 summarizes the characteristics of CXR, image quality, and findings.

Table 2. Characteristics of CXR, image quality and findings.

Variable	Erect CXR n=589 (60%)	Sitting CXR n=144 (15%)	Supine CXR n=246 (25%)	Total n=979
Portable CXR	0 (0%)	1 (1%)	17 (7%)	18 (2%)
Time to requisition, h (median (IQR))	1.5 (1.0; 2.5)	1.5 (0.9; 2.3)	1.3 (0.6; 2.2)	1.4 (0.9; 2.3)
Time to examination, h (median (IQR))	2.5 (1.6; 3.9)	2.7 (1.7; 4.3)	2.2 (1.3; 3.4)	2.5 (1.6; 3.8)
Number of CXR during admission, n (median (IQR))	1 (1; 1)	1 (1; 1)	1 (1; 1)	1 (1; 1)
>1 CXR during admission	38 (7%)	18 (13%)	24 (10%)	80 (8%)
CT-thorax during admission	70 (12%)	22 (15%)	30 (12%)	122 (13%)
CXR quality				

Suboptimal CXR	17 (3%)	8 (6%)	30 (12%)	55 (6%)
Not usable CXR	0 (0%)	0 (0%)	1 (0%)	1 (0%)
Findings*				
Enlarged heart				
Present	45 (8%)	11 (8%)	20 (8%)	76 (8%)
Uncertain	4 (1%)	2 (1%)	8 (3%)	14 (1%)
Infiltrate				
Present	168 (29%)	40 (28%)	66 (27%)	274 (28%)
Uncertain	13 (2%)	6 (4%)	19 (8%)	38 (4%)
Edema				
Present	39 (7%)	25 (17%)	18 (7%)	82 (8%)
Uncertain	1 (0%)	1 (1%)	5 (2%)	7 (1%)
Pleural effusion				
Present	59 (10%)	24 (17%)	38 (15%)	121 (12%)
Uncertain	8 (1%)	5 (4%)	4 (2%)	17 (2%)
Atelectasis				
Present	68 (12%)	20 (14%)	42 (17%)	130 (13%)
Uncertain	1 (0%)	0 (0%)	0 (0%)	1 (0%)
Pneumothorax				
Present	1 (0%)	1 (1%)	2 (1%)	4 (0%)
Uncertain	1 (0%)	0 (0.0%)	1 (0%)	2 (0%)

All data are presented as counts and proportions (%) if not otherwise stated.
Abbreviations: CXR, chest x-ray; CT, computerized tomography
*Only newly identified findings

Table 2 (continued).

PATIENT CHARACTERISTICS ASSOCIATED WITH SITTING OR SUPINE CXR

Patients aged 60–79 years and >80 years had a significantly higher risk of receiving a sitCXR or supCXR (RR: 2.26; 95% CI: 1.79–3.03 and RR: 3.24; 95% CI: 2.46–4.26, respectively). Additionally, there was a significantly higher risk of getting a sitCXR or supCXR performed if the patients had prior medical history/comorbidities such as COPD (RR: 1.32; 95% CI: 1.12–1.54), renal failure (RR: 1.48; 95% CI: 1.24–1.77), heart failure (RR: 1.39; 95% CI: 1.09–1.78), and DNR/DNI orders at admission (RR: 2.45; 95% CI: 2.15–2.80). Furthermore, patients with abnormal vital signs, including systolic blood pressure ≤100 mmHg (RR: 1.57; 95% CI: 1.28–1.94), heart rates ≥100 min (RR: 1.26; 95% CI: 1.08–1.47), respiratory rate ≥22 min (RR: 1.40; 95% CI: 1.29–1.63), and saturation of <90% (RR: 1.60; 95% CI: 1.30–1.98), also had a significantly higher risk of getting sitCXR or supCXR. Table 3 summarizes patient characteristics associated with sitCXR or supCXR.

Table 3. Associations between patient characteristics and sitting or supine CXR.

Variables	Proportion of sitting or supine CXR, % (n/N)	Absolut difference, (95% CI)	Relative difference, (95%CI)
Sex			
Female	0.36 (171/470)		
Male	0.43 (219/509)	0.07 (0.01; 0.13)	1.18 (1.01; 1.38)
Age, y			
<60	0.18 (47/268)		
60-79	0.40 (141/355)	0.22 (0.15; 0.29)	2.26 (1.70; 3.03)
80+	0.60 (202/356)	0.39 (0.32; 0.46)	3.24 (2.46; 4.26)
COPD			
No	0.37 (264/718)		
Yes	0.48 (126/261)	0.12 (0.05; 0.19)	1.31 (1.12; 1.54)
Renal failure			
No	0.38 (320/853)		
Yes	0.56 (70/126)	0.18 (0.09; 0.27)	1.48 (1.24; 1.77)
Diabetes			
No	0.39 (362/922)		
Yes	0.49 (28/57)	0.10 (-0.03; 0.23)	1.25 (0.95; 1.65)
Heart failure			
No	0.39 (357/918)		
Yes	0.54 (33/61)	0.15 (0.02; 0.28)	1.39 (1.09; 1.78)
Solid tumor			
No	0.40 (382/948)		
Yes	0.26 (8/31)	-0.15 (-0.30; 0.01)	0.64 (0.35; 1.17)
DNR/DNI orders			
No	0.31 (244/787)		
Yes	0.76 (146/192)	0.45 (0.38; 0.52)	2.45 (2.15; 2.80)
First systolic blood pressure			
>100 mmHg	0.38 (346/906)		
≤100 mmHg	0.60 (42/70)	0.22 (0.10; 0.34)	1.57 (1.28; 1.94)
First heart rate			
≤100 min	0.36 (223/616)		
>100 min	0.46 (165/361)	0.10 (0.03; 0.16)	1.26 (1.08; 1.47)
First respiratory rate			
< 22 min	0.34 (184/545)		
≥22 min	0.47 (204/432)	0.14 (0.07; 0.20)	1.40 (1.20; 1.63)
First saturation			
≥90%	0.38 (347/910)		
<90%	0.61 (41/67)	0.23 (0.11; 0.35)	1.61 (1.30; 1.98)
First temperature			
<38°C	0.43 (203/478)		
≥38°C	0.37 (184/497)	-0.06 (-0.12; 0.01)	0.87 (0.75; 1.02)

Abbreviations: CXR, chest x-ray; COPD, chronic obstructive pulmonary disease; DNR/DNI, Do-not-resuscitate or do-not-intubate.

Discussion

In a cohort of patients with suspected infection in three Danish EDs, 979 (51%) had a CXR while admitted. In this observational study, we characterized them and found that 60% were erect CXR (eCXR), 25% were supine (supCXR), and 15% were sitting (sitCXR).

The most common finding on the CXR was infiltrates (28%), and the sitCXR and supCXR were more likely to have uncertainty by all findings and suboptimal radiographs (6% and 12%). Our analysis revealed that patients who were 60-79 years old and over 80 years old had a higher risk of having a sitCXR and supCXR (RR:2.3; 95% CI: 1.7–3.0 and 3.2; 95% CI: 2.5–4.3), as did those with comorbidities (RRs ranging from 1.25 to 2.45) and abnormal vital signs (RRs ranging from 1.26 to 1.61).

Our research reveals that among patients with suspected infection, the majority had a CXR ordered when the most likely focus of infection was the respiratory tract (43%). Interestingly, CXRs were also requested for patients with suspected infections in other areas, such as the urinary tract (15%) and abdomen (6%). There are several reasons why CXR might be ordered for patients suspected of having a urinary tract or abdominal infection such as: 1) Differential diagnosis: If a patient present with atypical symptoms or if there is a uncertainty about source of infection 2) Comorbidities: Patients with multiple health issues may have overlapping symptoms 3) Clinical Protocol: Some healthcare facilitates may have protocols that recommend CXR for infection without a focus yet.

Several previous studies have reported a lower diagnostic accuracy of supCXR than standard eCXR,[1, 2, 6, 9, 10] making image interpretation more difficult. Despite this knowledge, a quarter of all CXRs in the present study were performed as supCXR. The low quality of images may be explained by multiple factors. The patients examined in these positions were older, and elderly patients are, in most cases, unable to perform sufficient deep inspiration and maintain apnea during the x-ray because of kyphosis, muscular weakness, or neurological disorders,[10, 13] Another explanation may be the impact of the x-ray source direction,[2] or that some of them were portable CXR which has limitations in obtaining high-quality imaging.[1, 22]

HVAD TILFØJER STUDIET?

40% af patienterne i denne kohorte fik et siddende (15%) eller liggende (25%) røntgen af lungerne. Det er en overraskende høj andel, som får en diagnostisk undersøgelse med nedsat diagnostisk nøjagtighed. Resultaterne indikerer også, at læger ret simpelt kan forudsige, hvilke patienter der har størst risiko for at få foretaget en siddende eller rygliggende røntgenoptagelse – nemlig ældre patienter med komorbiditet eller dårlige vitalparametre.

Fact box (in Danish)

Elderly patients are likely to have extensive comorbidities, and it should be considered that the association between age and CXR modality is mediated by comorbidity. Our findings confirm the speculation that these determinants—age, comorbidities, and vital signs—prevent some patients from receiving a standard eCXR. Our findings align with previous studies in this field.[9, 13, 16, 19, 23] The present study is the largest to date with these parameters as the primary outcome, and the alignment also supports the validity of the findings.

We found an association towards higher mortality in patients with supCXR or sitCXR. These patients also had more comorbidities and were clinically worse. These characteristics serve as strong confounders for any potential causal relationship between CXR modality and patient outcomes. The present study was not intended to investigate any such relationship. However, CXR modality could potentially serve as a strong, yet simple, predictor of mortality, similar to what has previously been found for impaired mobility on presentation.[24]

One question that should be raised is whether emergency physicians would change their choice of imaging modality if they were aware of the low diagnostic accuracy of supCXR and its simultaneously high utilization. Ultra-

low-dose chest CT has been reported to be equal to or better in detecting several abnormalities compared to supCXR.[7, 19] Other studies reported that lung ultrasound was more accurate than eCXR for diagnosing pneumonia in multimorbid and frail patients admitted to the acute-geriatric ward,[13, 23] and could be used as a first step examination in very old multimorbid patients with suspicion of pneumonia instead of sitCXR and supCXR.[13, 23] In light of the present study reporting high numbers of inferior supCXR, it is important for emergency physicians to be aware of different CXR modalities and their diagnostic accuracy and consider incorporating this knowledge into the diagnostic approach for patients with suspected infection. By doing so, we can improve patient care and potentially decrease the risk of missed diagnoses or unnecessary testing. Future studies should continue to investigate the clinical benefit of different image modalities for the best of patients.

LIMITATIONS

There are several limitations to this study. First, our predefined cohort was conducted during winter, with high pulmonary and viral infection rates, possibly increasing the admission rate of multimorbid and elderly patients in the ED and limiting generalizability to other seasons. Second, if the data had been collected purposefully, variables such as the clinical frailty scale or mobility could have been included in patient characteristics, as the habitual level of function likely influences the feasibility of different CXR positions. Third, variation in radiographers' attempts to obtain patients in erect positions may have impacted the number of sitCXR and supCXR, regardless of age, comorbidities, and vital signs, thereby possibly underestimating the true association. Finally, while some of the data were collected manually by a single extractor, one of the most important considerations—the CXR position—showed sufficient agreement in an inter-observer agreement test on 10% of the data ($\kappa = 0.92$).

HVORDAN KAN STUDIET BRUGES I DANSKE AKUTMODTAGELSER?

Dette studie kan bidrage til at identificere patienter med øget risiko for siddende eller rygliggende røntgen af lungerne, så akutlægen mere proaktivt kan beslutte, om siddende eller rygliggende optagelse er den ønskede undersøgelse, eller om man bør overveje en anden billeddiagnostisk modalitet.

Fact box (in Danish)

Conclusion

Despite low diagnostic accuracy, sitting and supine CXR are common in emergency department (ED) patients with suspected infection. Having a sitting or supine, instead of erect, CXR seems to be easily predictable (i.e., older, more comorbid, and with worse vital signs). The information obtained from this study may be utilized to guide future research in optimizing diagnostic imaging workup. Further research should investigate whether alternative diagnostic imaging strategies could provide better diagnostic accuracy and improved clinical outcomes in patients with suspected infections admitted to the ED.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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