

Chest radiography in general practice: indications, diagnostic yield and consequences for patient management

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ABSTRACT

Background

Chest radiography (CXR) is frequently performed in Western societies. There is insufficient knowledge of its diagnostic value in terms of changes in patient management decisions in primary care.

Aim

To assess the influence of CXR on patient management in general practice.

Design of study

Prospective cohort study.

Setting

Seventy-eight GPs and three general hospitals in the Netherlands.

Method

Patients ($n = 792$) aged ≥ 18 years referred by their GPs for CXR were included. The main outcome was change in patient management assessed by means of questionnaires filled in by GPs before and after CXR.

Results

Mean age of the patients was 57.3 ± 16.2 years and 53% were male. Clinically relevant abnormalities were found in 24% of the CXRs. Patient management changed in 60% of the patients following CXR. Main changes included: fewer referrals to a medical specialist (from 26 to 12%); reduction in initiation or change in therapy (from 24 to 15%); and more frequent reassurance (from 25 to 46%). However, this reassurance was not perceived as such in a quarter of these patients. A change in patient management occurred significantly more frequently in patients with complaints of cough (67%), those who exhibited abnormalities during physical examination (69%), or those with a suspected diagnosis of pneumonia (68%).

Conclusion

Patient management by the GP changed in 60% of patients following CXR. CXR substantially reduced the number of referrals and initiation or change in therapy, and more patients were reassured by their GP. Thus, CXR is an important diagnostic tool for GPs and seems a cost-effective diagnostic test.

Keywords

chest radiography; general practice; patient care management.

INTRODUCTION

Chest radiography (CXR) is an important diagnostic method for evaluation of the airways, pulmonary parenchyma and vessels, mediastinum, heart, pleura and chest wall.¹ It is one of the most widely used diagnostic imaging techniques in Western societies; on average 236 CXRs per 1000 patients per year are performed and this technique accounts for 25% of the annual total numbers of diagnostic imaging procedures.² In the Netherlands, annually approximately 500 000 CXRs are requested by GPs.³

The frequency with which even relatively inexpensive and non-invasive diagnostic tests are performed leads to high costs in health care. Unnecessary diagnostic investigations may lead to incidental findings, or to additional unnecessary diagnostic procedures or even over treatment.

Current guidelines for CXR are aimed mainly at diseases instead of at the complaints with which patients present themselves, and even lacking in the Netherlands.^{1,4-10} We are aware of only few studies on CXR in patients referred by GPs. Geitung *et al*¹¹ concluded that the clinical utility of CXR was high enough to justify its costs, and Lim *et al*¹² showed that GPs do act on results of abnormal CXRs. The

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studies of Guyer *et al*¹³ and Keogan *et al*¹⁴ reported clinically relevant abnormalities in 21 and 23% of patients referred for CXR by GPs, respectively. Clearly, the full value of CXR cannot be assessed in terms of positive findings alone. The relevance of detected abnormalities must be assessed with respect to clinical practice, because positive findings may be incidental and without any consequences. Negative examinations can also have potential value when they result in changes of patient management and can be very helpful in reassuring the patient. Neither of these studies cited both positive and negative findings in detail, nor assessed the value of CXR in terms of changes in patient management.

The objective of this study was to assess the influence of both positive and negative findings of CXR on the change in patient management in general practice and to evaluate the consequences of the CXR according to the patient.

METHOD

Participants

This prospective cohort study was conducted from April 2003 to December 2004. In total, 78 GPs in the catchment area of one of three participating general hospitals located in three main cities in the Netherlands (Jeroen Bosch Hospital in 's-Hertogenbosch; Gelre Hospitals in Apeldoorn; 'Onze Lieve Vrouwe Gasthuis' in Amsterdam) were involved. Twenty-eight GPs (36%) worked in a solo practice; 58 (74%) were male, and 40 GPs (51%) graduated between 1968–1980, 19 (24%) between 1980–1990 and 19 (24%) between 1990 and 1997. All patients aged 18 years and older who were referred for CXR (standard posteroanterior and lateral view) by their GP to one of these hospitals were included in the study. The patients received an exclusion form from their GP, which they could return to the study coordinator if we were not allowed to use their data for this study.

Measurements

All GPs were asked to fill in a standardised form before requesting a CXR, including information on history, physical examination, indication, suspected diagnosis, and proposed patient management. The anticipated patient management was filled in as if no CXR would be performed. The management options included: referral to a medical specialist; initiation or change in therapy; reassurance of the patient; and follow-up by the GP (watchful waiting or additional diagnostic testing). The GP could choose only one of these management options. After the GP requests a CXR a patient can be referred for CXR to the general hospital at the same

How this fits in

To our knowledge, this prospective cohort study is the first study that has assessed the influence of both positive and negative findings of chest radiography (CXR) on the change in patient management in general practice and evaluated the consequences of the CXR according to the patient. CXR led to changes in patient management in 60% of the patients referred by GPs, which is one of the prerequisites for successfully influencing clinically relevant patient outcomes. CXR resulted in fewer referrals to a medical specialist, a reduction in the number of patients with initiation or change in therapy, and more frequent reassurance of the patient. CXR is an important diagnostic tool for GPs and seems a cost-effective diagnostic test.

day. In general all CXRs are reported by a radiologist within 24 hours. Any significant abnormalities will be verbally reported to the GP, before the official radiologic report is sent by mail. Therefore, significant abnormalities will normally be received by GPs within 1 day, and they directly can adjust their patient management plan. When no significant pathology is detected with CXR, it can take up to 4 days before the GP receives the official radiologic report. After the GP received the report, he or she filled in a second questionnaire; again including the suspected diagnosis and anticipated patient management plan.

The reports of CXR were collected in the three hospitals to determine the findings of CXR. These findings were categorised into six groups (the first four groups were considered clinically relevant abnormalities):

- Malignancy;
- Pneumonia;
- COPD/asthma/chronic bronchitis;
- Other clinically relevant abnormalities (heart failure and unclear abnormalities that required further investigation according to the radiologist);
- The follow-up of abnormalities detected previously on CXR;
- No abnormality.

Six months after the CXR a short questionnaire was sent to all patients, in order to assess the consequences of CXR according to the patient (response rate = 79%). They could choose one of the following options: definite diagnosis; better treatment; reassurance; nothing; or other. With this information we could check whether reassurance of the patient as reported by the GP was really perceived as reassurance by the patient.

Statistical analysis

The primary outcome measure for our study was the proportion of patients in whom there was a change in

Table 1. Patient characteristics (n = 792).

	n (%)
Mean \pm SD in years	57.3 \pm 16.2
Sex	
Male	423 (53)
Female	369 (47)
Prior diagnoses	
Malignancy (various locations n = 29; lung n = 9)	38 (5)
Cardiovascular	95 (12)
Pneumonia	76 (10)
COPD/asthma/chronic bronchitis	143 (18)
History taking	
Smoking	142 (18)
Pain	172 (22)
Respiratory complaints	
Haemoptysis	53 (7)
Cough	394 (50)
Dyspnoea	199 (25)
Other symptoms of respiratory infection ^a	117 (15)
General complaints	
Weight loss	31 (4)
Fever	53 (7)
General malaise	101 (13)
Abnormalities during physical examination ^b	317 (40)
Suspected diagnosis pneumonia according to GP	193 (24)
Suspected diagnosis malignancy according to GP	142 (18)

^aAbnormal sputum, nasal congestion, throat symptoms, and complaints of a cold.^bA physical examination was considered abnormal when abnormalities were detected with auscultation (such as wheeze), percussion (such as dullness), or palpation (such as pain). SD = standard deviation.

patient management by the GP following CXR. This proportion and the corresponding 95% confidence interval (CI) were calculated using the statistical program Confidence Interval Analysis.¹⁵ Additionally, subgroup analyses were performed to assess whether the patient and GP characteristics influenced the proportion of change in patient management. Associations were tested with χ^2 tests and regarded as significant when the *P*-value was ≤ 0.05 . Data were analysed using SPSS for Windows version 11.0.

RESULTS

In total, 870 patients aged 18 years or older were referred for CXR. Patient management plans for 78 patients (9%) were not filled in by the GP before and/or after CXR. These patients were excluded from the study, resulting in a study population of 792 patients. Their patient characteristics were comparable with the included patients.

The mean age of the patients at time of CXR was 57.3 years (standard deviation = 16.2) and 53% were male. Fifty per cent of the patients had a history of cough and 25% of dyspnoea. Abnormalities with physical examination were found in 40% of the patients. The most common

suspected diagnosis was pneumonia (24%) and malignancy (18%) (Table 1).

The radiology reports of CXR showed no abnormality in 416 patients (53%) and follow-up of an abnormality detected previously on CXR in 179 patients (23%). Clinically relevant abnormalities were found in 197 CXRs (25%), these included: malignancy (*n* = 11; 1%); pneumonia (*n* = 44; 5%); COPD/asthma/chronic bronchitis (*n* = 99; 13%); and other clinically relevant abnormalities that required further investigation according to the radiologist (*n* = 43; 5%). As expected, all patients with a malignancy were referred to medical specialists after CXR, with the exception of one patient, in this case the GP wanted to wait for the results of the additional CT-scan before further action. Patients with pneumonia were mainly treated by the GP with a prescription of antibiotics. Notably, 29 patients (4%) with no abnormalities detected on CXR were referred to a medical specialist. Fifteen patients had unclear complaints that needed further examination, in nine patients lung pathology was excluded and these patients were referred to another medical specialist, such as a cardiologist. In four patients a clinically relevant abnormality was found with another examination (such as abdominal ultrasound), and CXR was used as a screening tool in one patient.

The proportion of patients in whom CXR resulted in a change in patient management was 60% (95% CI = 57 to 64%). Main changes in patient management plans after CXR included: a reduction in anticipated referrals to a medical specialist from 203 (26%) to 97 (12%); a reduction in the number of patients with initiation or change in therapy from 187 (24%) to 119 (15%), which was demonstrated mainly by a reduction in the anticipated prescription of drugs such as antibiotics; and more frequent reassurance of the patient, from 195 (25%) to 363 (46%) patients (Table 2).

Subgroup analyses revealed that the proportion of patients in whom patient management changed after CXR was significantly higher among patients who complained of cough (67%), who exhibited abnormalities during physical examination (69%) or had a suspected diagnosis of pneumonia (68%) (Table 3). The characteristics of the GPs (solo or group practice, sex and year of graduation) had little influence on the proportion of change in management of 60%.

Almost one-fifth of the patients who returned the questionnaire reported that CXR had no consequences, and approximately 50% of the patients were reassured after CXR. It was noted that a quarter of the 363 patients who were reportedly reassured by their GP after CXR failed to perceive the result of the CXR as reassurance.

Table 2. Patient management plans for GPs before and after chest radiography *n* (%).

After <i>n</i> (%; 95% CI)	Before (<i>n</i>)				Total
	Referral medical specialist	Therapeutic management	Reassurance	Follow-up by GP ^a	
Referral medical specialist	48 (24; 18 to 30)	22 (12; 8 to 17)	8 (4; 2 to 8)	19 (9; 6 to 14)	97 ^b (12; 10 to 15)
Therapeutic management	29 (14; 10 to 20)	45 (24; 18 to 31)	15 (8; 5 to 12)	30 (14; 10 to 20)	119 ^b (15; 13 to 18)
Reassurance	89 (44; 37 to 51)	57 (30; 24 to 37)	141 (72; 66 to 78)	76 (37; 30 to 43)	363 ^b (46; 42 to 49)
Follow-up by GP ^a	37 (18; 14 to 24)	63 (34; 27 to 41)	31 (16; 11 to 22)	82 (40; 33 to 46)	213 (27; 24 to 30)
Total	203 (26; 23 to 29)	187 (24; 21 to 27)	195 (25; 22 to 28)	207 (26; 23 to 29)	792

^aFollow-up by GP: predominantly watchful waiting or additional diagnostic testing, such as spirometry or laboratory investigation. ^bThe differences in proportions of patient management after chest radiography were significant with a *P*-value ≤ 0.05 (95% confidence intervals did not overlap).

DISCUSSION

Summary of main findings

The proportion of patients for whom patient management changed following CXR was 60%. Main changes included: fewer referrals to a medical specialist (from 26 to 12%); a reduction in the number of patients with initiation or change in therapy (from 24 to 15%), especially fewer prescriptions of drugs such as antibiotics; and more frequent reassurance of the patient (from 25 to 46%).

Subgroup analyses revealed that the proportion of patients in whom patient management changed after CXR was significantly higher among patients with complaints of cough (67%), those who exhibited abnormalities during physical examination (69%) or those with a suspected diagnosis of pneumonia (68%).

Strengths and the limitations of the study

Primary care patients referred for CXR have a broad range of complaints, the indications for the tests vary widely, and many different diseases can be detected with CXR. Both a cross-sectional design or randomised controlled trial were not feasible, for reasons such as absence of a valid reference test, complex logistics, the need for large sample sizes to show statistically significant differences, and ethical considerations. A prospective cohort study provided a pragmatic and valid way to assess the effectiveness of CXR, however some limitations must be mentioned. An important limitation of this type of study is the fact that the GPs assess the value of the diagnostic test by filling in the patient management before and after the test. In this way GPs may influence the estimated value of a diagnostic test, because most GPs would be keen to present their requested test as having some value. Besides, it was impossible to verify whether or not the GP really would have conducted the anticipated patient management in accordance with the plan made on the standardised form before CXR was

performed. This could result in an overestimation of intended referrals to medical specialists. This study does not prove that the patient actually benefits from the diagnostic procedure, such as in terms of morbidity, mortality or quality of life. However, the study is the first to show that the procedure often leads to changes in patient management, which is one of the prerequisites for successfully influencing clinically relevant patient outcomes. Finally, the interval of 6 months between the short questionnaire after CXR

Table 3. Proportion of changes in patient management after chest radiography in relevant subgroups.

	Change in management		<i>P</i> -value
	<i>n</i>	%	
All patients	476	60	
Age			
<60 years	249	59	0.56
≥60 years	227	61	
Sex			
Male	260	61	0.40
Female	216	59	
Prior diagnoses			
Malignancy (various locations <i>n</i> = 20; lung <i>n</i> = 8)	28	74	0.080
Pneumonia	32	50	0.10
COPD/asthma/chronic bronchitis	90	63	0.44
History taking			
Smoking	93	66	0.15
Haemoptysis	32	60	0.97
Cough	264	67	<0.001
Dyspnoea	129	65	0.12
Fever	36	68	0.23
Abnormalities during physical examination ^a	219	69	<0.001
Suspected diagnosis pneumonia according to GP	132	68	0.007
Suspected diagnosis malignancy according to GP	91	64	0.29

^aA physical examination was considered abnormal when abnormalities were detected with auscultation (such as wheeze), percussion (such as dullness), or palpation (such as pain).

could have influenced the accurateness of recalling and reporting by the patients.

Comparison with existing literature

To our knowledge this is the first study that has investigated the influence of CXR on patient management in general practice. Our results are in line with the conclusion of Geitung *et al*¹¹ that the clinical utility of CXR was high enough to justify its costs after performing a study in 55 patients in general practice. The studies of Guyer *et al*¹³ and Keogan *et al*¹⁴ reported clinically relevant abnormalities in 21% of 1.163 and 23% of 2.017 patients referred for CXR by GPs, respectively. The 24% clinically relevant abnormalities found in our study is comparable. In addition, our study showed that the full value of CXR cannot be assessed in terms of positive findings alone. Negative findings are important for exclusion of diseases and, therefore, for reassurance of the patient. However, such findings can also result either in referral of patients to a medical specialist for further evaluation of their complaints when a CXR fails to show any abnormalities, or in the referral of patients to another medical specialist, such as a cardiologist, when lung pathology is excluded.

The changes in GPs' patient management plans after CXR in patients with a higher proportion of change in patient management (that is, cough, exhibited abnormalities during physical examination or a suspected diagnosis of pneumonia) were fewer anticipated referrals to a medical specialist, a reduction in the number of patients with initiation or change in therapy and more frequent reassurance of the patient. It is widely known that thorough history taking and physical examination before commencement of a more advanced workup, such as a radiological examination, is very important. This study showed that even after a history and physical examination of the patient the influence of CXR on patient management was substantial. We expected that the ability of GPs to establish a more specific patient management plan after gaining detailed information of the patient with physical examination would result in a smaller proportion change in management after CXR. However the proportion of change in patient management increased to almost 70% in patients with abnormalities detected during physical examination.

Almost 80% of the questionnaires were returned by the patients, which increased the validity of these results. Approximately 50% of patients were reassured by their GP after CXR. Our study showed that in almost one-quarter of the patients who were reassured by their GP after CXR, the patient did not perceive this as reassurance. Therefore, CXR did not have much value for these patients, because no referral or treatment followed after the radiological investigation and reassurance was not achieved.

Implications for clinical practice

In conclusion, the GP's patient management strategy was changed for 60% of patients following CXR. CXR substantially reduced the number of referrals to a medical specialist and initiation or change in therapy, and more patients were reassured by their GP. Thus, CXR is an important diagnostic tool for GPs and seems a cost-effective diagnostic test.

Ethics committee

This study was approved by the Medical Ethics Review Board of the University Medical Centre Utrecht (02/121)

Competing interests

None

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