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Prevalence and influence of diagnostic tests for acute respiratory tract infections in primary care

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Summary

Background: General practitioners (GPs) use diagnostic tests to help distinguish between viral and bacterial acute respiratory tract infections (ARTI). We investigated the prevalence of these tests, and how tests are associated with diagnosis, treatment and patient satisfaction.

Methods: As part of a clinical trial, 45 GPs screened 1108 patients with ARTI and collected information on signs and symptoms, diagnostic test results, and subsequent diagnosis and treatment. A sample of 636 patients was interviewed after 7 days and their opinions recorded. We used multivariate mixed models to estimate associations between the use of tests and (1) baseline characteristics, (2) subsequent antibiotic treatment, and (3) patient satisfaction.

Results: GPs carried out at least one test in 42% of the 1108 patients screened. The tests used were (percentage of patients): CRP (35%), leucocyte count (17%), rapid Strep A (9%), chest X-ray (5%), sinus X-ray (1%), and throat culture (1%). The use of tests was associated with increasing patient age, education, and degree of discomfort. Antibiotic therapy was strongly associated with a positive test, with odds ratios of 26 (95% CI, 10–67) for a CRP above 50 mg/l; 9.6 (95% CI, 3.6–26) for a leucocyte count above 10 000/µl; and 122 (4.4–3435) for a positive StrepA test. There was no evidence of an association between the use of tests and patient satisfaction.

Conclusions: Nearly half of these patients with ARTI received a diagnostic test. Older patients, those with higher education and those in more discomfort were more likely to get tests. A positive test was strongly associated with antibiotic treatment.

Key words: respiratory tract infections; primary care; diagnostic tests; prevalence; antibiotic therapy

Introduction

Antibiotics are often prescribed for acute respiratory tract infections (ARTI) in primary care, although ARTI are mainly viral in origin and self-limiting [1]. A correct aetiologic diagnosis is crucial for the judicious use of antibiotics, but even with laboratory or radiographic tests it is difficult to distinguish between viral and bacterial ARTI [2]. The unnecessary use of antibiotics increases both bacterial resistance to common pathogens [3] and drug expenditure [4]. Increasing bacterial resistance together with a dramatic reduction in investment in developing new anti-infective agents has created a pressing public health problem [5].

Some Scandinavian studies have suggested that diagnostic tests for ARTI are overused in primary care [6, 7]. However, apart from questionnaire studies [8], little is known about how Swiss general practitioners (GPs) diagnose and treat ARTI. In this study we use prospectively collected data on diagnostic tests and treatment for ARTI from all patients screened for a randomised controlled trial (ISRCTN57824788) [9]. We considered (1) whether patient baseline characteristics were associated with the use of tests, (2) whether test results were associated with ARTI-diagnosis and antibiotic treatment, and (3) whether the use of diagnostic tests was associated with patient satisfaction or enablement.

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Methods

Design and participants

The patients in this study were those screened in a cluster randomised controlled trial [9]. This trial evaluated the effect of training GPs in communication skills on the prescription of antibiotics for ARTI in primary care. We invited all 345 GPs in two cantons (Basel-Stadt and Aargau – in both, self-dispensation of drugs is not allowed) to participate in the trial; 45 gave written informed consent and were recruited. The first 30 GPs were randomised in equal numbers to receive both evidence-based guidelines for the management of ARTI and training in patient-centred communication, or evidence-based guidelines only. The remaining 15 GPs served as a control without any intervention, to blind the physicians in the other two groups to the true comparison. Between January and May 2004 study GPs screened consecutive patients aged 18 years or older, with a first consultation for an acute infection of the respiratory system (symptoms first experienced within the previous 28 days) until each GP had recruited 20 patients for the trial (see flow-diagram of participants, figure 1 of [9]). Possible diagnoses were common cold, rhinosinusitis, pharyngitis, exudative tonsillitis, laryngitis, otitis media, bronchitis, exacerbated COPD, influenza, and community-acquired pneumonia.

Data and outcomes

We obtained baseline data on all eligible GPs from the registry of the Swiss Medical Association. Study GPs used a case report form to collect baseline data on signs and symptoms, diagnostic tests, diagnosis, co-morbidity and prescribed medication for each of the 1108 patients screened. Medical students, blinded to the goal of the trial, interviewed a sample of 636 patients at 7 days by phone. Due to limited resources they interviewed only recruited patients in the two randomised groups and a convenience sample (one third) of the recruited patients in the control group (response rate >98%; see figure 1 of [9]). Patient satisfaction and enablement were measured using validated scales [10, 11]. We entered the collected data electronically into a database using Teleform®-Software (Cardwell, Cardiff, GB).

Outcomes of interest for this secondary analysis were the use of diagnostic tests such as C-reactive protein (CRP), leucocyte count, rapid *Streptococcus* A antigen detection (StrepA) test, throat cultures, sinus and chest X-ray; the results of these tests; the subsequent diagnosis, prescription of antibiotics, and patient satisfaction and enablement.

Statistical methods

First we estimated the association between patient baseline characteristics and the use of diagnostic tests using logistic and proportional odds regression. We fit generalised linear mixed models with the GP as a random effect, and with trial group and patient baseline characteristics as fixed effects (age, gender, degree of discomfort at baseline, days with restrictions before consultation). As a sensitivity analysis we re-fit these models to data from patients interviewed at 7 days, with patient education as an additional fixed effect, because patient education was recorded at the 7-day interview.

Second we estimated the association between test results and subsequent antibiotic therapy using logistic regression. We fit models for (1) patients receiving a CRP-test (n = 317), (2) patients with a leucocyte count (n = 160), (3) patients receiving a rapid StrepA-test (n = 78), and (4) patients without a test (n = 547). Each model used the same random and fixed effects as before.

Third we estimated the association between the use of diagnostic tests and complete patient satisfaction or patient enablement (scored on a scale from 0 to 12) using logistic or linear regression respectively. Each model used the GP as a random effect and the same fixed effects as before except that patient education and their degree of discomfort at 7 days were added as additional fixed effects. We used Stata 8.2 (Stata Corp, College Station, Texas, USA) for all analyses.

Results

Data from the Swiss Medical Association suggests that participating GPs were similar to all eligible GPs in the 2 cantons with respect to characteristics recorded by the Association [9]. The median age of the 45 participating GPs was 52 years (interquartile range, IQR, 11); 18% were female; 58% and 33% were board approved in General Medicine and Internal Medicine, respectively, with a median of 9.2 years (IQR 3.0) of postgraduate training and of 14 years (IQR 15) of experience in private practice.

Among the 1108 screened patients with ARTI, the median age was 42 years (IQR 26); 58% were women; the median degree of discomfort (on an increasing scale from 1 to 10) at consultation was 5 (IQR 3); and the median days with restrictions from ARTI before consultation was 4 (IQR 4) [9].

Prevalence of diagnostic tests

Most of the 45 GPs were able to carry out diagnostic tests in-house: 96% could provide a near-patient CRP, 91% could provide a leucocyte count, 80% could provide a rapid StrepA test, and 64% could provide an X-ray (table 1).

Of the 1108 screened patients, GPs carried out at least 1 diagnostic test in 460 (42%) patients, and at least 2 in 226 (20%). The most common tests were the near-patient CRP test (35% of patients) and a leucocyte count (17% of patients) (table 2). Of the 189 patients with a leucocyte count, 181 (96%) received a CRP test as well. Of the 94 performed rapid StrepA tests, 79 (84%) were indicated according to current guidelines (at least 2 of the 4 Centor criteria: tonsillar exudates, absence of cough, history of fever, tender anterior cervical adenopathy) [12]. Although a chest X-ray is recommended for the diagnosis of a community-acquired pneumonia, 5 (25%) of the 20 patients appointed that diagnosis did not have one.

Table 1

Overview of diagnostic tests used for ARTI in general practice.

Number of general practices n (%)	45 (100)
CRP test	
NycoCard® Single test	32 (71)
QuickRead®	7 (16)
Other near-patient CRP tests	4 (9)
Sent to external laboratory	2 (4)
Leucocyte count	
Automatic cell counter	19 (42)
Microscope	19 (42)
QBC®	3 (7)
Sent to external laboratory	4 (9)
Rapid StrepA test	
Testpack plus StrepA with OBC II® (Abbott)	12 (27)
NEO StrepA® (Intex)	9 (20)
Others	15 (33)
None	9 (20)
X-ray facility	
Available in practice	29 (64)

CRP, C-reactive protein; rapid StrepA test, rapid *Streptococcus* A antigen detection test.

Association between patient characteristics and use of tests

The use and number of diagnostic tests for ARTI were associated with older age, a higher patient education and a higher degree of discomfort at baseline (table 3). Similar results were found in patients interviewed at 7 days.

Association between test results and diagnosis and treatment

Among patients given a StrepA test, 86% of those with a positive test were diagnosed as having exudative tonsillitis; 41% of those with a negative test were diagnosed as having pharyngitis (table 4). Most patients with low CRP (<50 mg/l) or a low leucocyte count (<10 000/µl) were diagnosed as having a common cold, whereas higher values were more likely to receive a more "serious" diagnosis. These findings suggest that GPs take test results into account when making a diagnosis.

A positive test result was strongly associated with subsequent antibiotic therapy with odds ratios of 26 (95% confidence interval [CI], 10–67) for

Table 2

Prevalence of diagnostic tests for ARTI in a clinical trial.

Diagnosis	Total n	No tests* n (%)	CRP n (%)	Leucocytes n (%)	X-ray chest n (%)	X-ray sinus n (%)	Rapid StrepA n (%)	Throat-culture n (%)
Common cold	427	282 (66)	132 (31)	55 (13)	8 (1.9)	3 (0.7)	13 (3.0)	1 (0.2)
Acute rhinosinusitis	171	106 (62)	57 (33)	38 (22)	4 (2.3)	9 (5.3)	7 (4.1)	0
Acute pharyngitis	109	52 (48)	37 (34)	12 (11)	3 (2.8)	0	32 (29)	2 (1.8)
Acute exudative tonsillitis	51	13 (26)	13 (26)	10 (20)	0	0	35 (69)	7 (14)
Acute laryngitis	29	15 (52)	12 (41)	5 (17)	2 (6.9)	0	4 (14)	0
Acute otitis media	23	18 (78)	5 (22)	3 (13)	0	0	0	0
Acute bronchitis	160	76 (48)	78 (49)	36 (23)	20 (13)	2 (1.3)	2 (1.3)	0
Influenza	100	76 (76)	23 (23)	16 (16)	6 (6.0)	0	0	0
Exacerbated COPD	18	8 (44)	10 (56)	3 (17)	2 (11)	0	0	0
CAP	20	2 (10)	15 (75)	11 (55)	15 (75)	1 (5.0)	1 (5.0)	0
Total	1108	648 (59)	382 (35)	189 (17)	60 (5.4)	15 (1.4)	94 (8.5)	10 (0.9)

* History taking and clinical examination only

CRP, C-reactive protein; rapid StrepA, rapid *Streptococcus* A antigen detection test; CAP, community-acquired pneumonia

Table 3

Predictors for diagnostic tests.

Predictors for tests	Odds ratio (95% confidence interval) n = 932 *	
	Use of tests (yes/no)	Number of tests (0,1,…,5)
Degree of discomfort (1–10)	1.16 (1.06–1.27)	1.16 (1.08–1.25)
Days with restrictions	1.02 (0.98–1.07)	1.02 (0.98–1.06)
Age (per 10 years)	1.12 (1.00–1.24)	1.14 (1.04–1.25)
Gender (men)	1.21 (0.87–1.67)	1.28 (0.96 –1.70)
Education (per 5 years) **	1.42 (1.04–1.94)	1.35 (1.02–1.77)
Treatment group of GPs:		
Control	1.00 (reference)	1.00 (reference)
Guidelines	0.58 (0.20–1.65)	0.47 (0.16–0.78)
Guidelines + communication training	1.70 (0.59–4.87)	1.71 (0.66–4.46)

* Multivariate mixed models for binary (left column) and ordinal (right column) outcomes with the GP as a random effect. Missing values led to a reduced sample.

** Based on sensitivity analysis (n = 630) with education as an additional fixed effect in the model

Table 4
Diagnoses of ARTI by test result.

Diagnosis	CRP – n (%) n = 382		Leucocytes – n (%) n = 189		X-ray chest – n (%) n = 60		Rapid StrepA – n (%) n = 94	
	>50 mg/l n = 70	<50 mg/l n = 312	>10 000/µl n = 41	<10 000/µl n = 148	infiltrate n = 13	no infiltrate n = 47	positive n = 21	negative n = 73
Common cold	3 (4.3)	129 (41)	4 (9.8)	51 (35)	0	8 (17)	0	13 (18)
Acute rhinosinusitis	12 (17)	45 (14)	9 (22)	29 (20)	0	4 (8.5)	1 (4.8)	6 (8.2)
Acute pharyngitis	6 (8.6)	31 (9.9)	2 (4.9)	10 (6.8)	0	3 (6.4)	2 (9.5)	30 (41)
Acute exudative tonsillitis	8 (11)	5 (1.6)	9 (22)	1 (0.7)	0	0	18 (86)	17 (23)
Acute laryngitis	1 (1.4)	11 (3.5)	1 (2.4)	4 (2.7)	0	2 (4.3)	0	4 (5.5)
Acute otitis media	0	5 (1.6)	0	3 (2.0)	0	0	0	0
Acute bronchitis	20 (29)	58 (19)	6 (15)	30 (20)	0	20 (43)	0	2 (2.7)
Influenza	5 (7.1)	18 (5.8)	1 (2.4)	15 (10)	0	6 (13)	0	0
Exacerbated COPD	6 (8.6)	4 (1.3)	1 (2.4)	2 (1.4)	0	2 (4.3)	0	0
CAP	9 (13)	6 (1.9)	8 (20)	3 (2.0)	13 (100)	2 (4.3)	0	1 (1.4)

CRP, C-reactive protein; rapid StrepA, rapid *Streptococcus* A antigen detection test; CAP, community-acquired pneumonia

Table 5
Odds ratios for the association of test results with antibiotic therapy.

Predictors for antibiotic treatment	Odds ratio (95% confidence interval)			
	Patients with CRP-test, n = 317 *	Patients with leucocyte-count, n = 160 *	Patients with rapid StrepA-test, n = 78 *	Patients with no test, n = 547 *
CRP >50 mg/l	26.4 (10.4–67.1)			
Leucocytes >10 000/µl		9.6 (3.6–25.7)		
Rapid StrepA positive			122 (4.4–3435)	
Degree of discomfort (1–10)	1.10 (0.92–1.31)	1.22 (0.95–1.56)	2.38 (1.30–4.38)	1.34 (1.14–1.58)
Days with restrictions	1.10 (1.02–1.19)	1.07 (0.96–1.19)	1.06 (0.87–1.29)	1.05 (0.97–1.13)
Age (per 10 years)	1.14 (0.91–1.42)	1.13 (0.83–1.52)	1.11 (0.61–2.04)	1.21 (0.98–1.49)
Gender (men)	1.89 (0.96–3.67)	1.49 (0.63–3.49)	2.02 (0.41–10.0)	0.68 (0.36–1.28)
Treatment group of GPs:				
Control	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Guidelines	0.58 (0.18–1.90)	0.97 (0.24–3.87)	1.40 (0.14–14.0)	0.71 (0.29–1.74)
Guidelines + communication training	0.54 (0.18–1.62)	1.25 (0.37–4.20)	6.05 (0.69–52.8)	0.25 (0.08–0.79)

CRP, C-reactive protein; rapid StrepA, rapid *Streptococcus* A antigen detection test
* Missing values led to reduced samples.

a CRP above 50 mg/l, 9.6 (95% CI, 3.6–26) for a leucocyte count above 10 000/µl, and 122 (95% CI, 4.4–3435) for a positive StrepA test (table 5). This suggests that GPs rely on test results when deciding whether to prescribe antibiotics for ARTI.

Association between test use and patient satisfaction and enablement

In multivariate modelling, there was no evidence of an association between the use of diagnostic tests and either complete patient satisfaction (odds ratio 0.97 [95% CI, 0.64–1.5]) or the patient enablement score (coefficient –0.21 (95% CI, [–0.61]–0.18). However, wide confidence intervals do not rule out a weaker association.

Discussion

GPs carried out diagnostic tests in 42% of 1108 first consultations for ARTI. GPs were more likely to use tests when patients were older, better educated or felt more discomfort. The data suggest that GPs relied on test results when making decisions about diagnosis and antibiotic treatment. However, there was no evidence for a strong association between the use of tests and patient satisfaction or enablement.

This study has strengths and weaknesses. We used data collected in a clinical trial [9], and this may reduce the external validity of our results. GPs may behave differently when monitored in the setting of a trial (a Hawthorne effect [13]), and those

who participate in a trial are perhaps more motivated than other GPs. Moreover, the evidence-based guidelines for ARTI given to two thirds of the GPs in our trial may have influenced their behaviour. However, the trial intervention was designed to reduce antibiotic use, and the evidence-based guidelines were focused on the appropriate use of antibiotic therapy rather than on the use of diagnostic tests. Two large surveys in Sweden both reported a similar distribution of ARTI diagnoses and similar use of the CRP test (in 42% [6] and in 31% [7] of patients respectively, compared to 35% in this study). Like all GPs in Switzerland, study GPs with in-house lab facilities potentially have a financial incentive to carry out diagnostic tests, because they get reimbursed by social health insurers for the use of these tests. However, their use of CRP and rapid StrepA tests was no more frequent than in Swedish primary health care centres where GPs have no such financial incentive [6, 7].

Strengths of this study were its wide range of documented clinical information and the prospective design with data from patients linked to data from their GP. We used validated instruments to measure patient satisfaction [10] and enablement [11]. In all our analyses, we took into account the clustered nature of the trial design and its 3 intervention groups.

Evidence-based guidelines recommend the use of rapid StrepA tests when there are at least 2 out of 4 Centor criteria (tonsillar exudates, absence of cough, history of fever, tender anterior cervical adenopathy) [12]. These were met in 84% of our patients with a StrepA test that indicates fair agreement with guidelines. There was no excessive use of rapid StrepA tests among our patients (8.5%) as found in Sweden (22% of encounters) [7]. The use of throat cultures (less than 1% of our patients) is discouraged by guidelines, mainly because they do not allow "real-time" decisions. So, if no rapid test is available, antibiotics should be reserved for patients with 3 or 4 Centor criteria [12]. Given that 64% of the GPs had an X-ray machine available in their practice, it is surprising that only 75% of patients with the diagnosis of pneumonia actually received a chest X-ray. An identical result has already been found in a questionnaire carried out in Basel-Stadt and Basel-Land in 1997 [8]. There are no specific guidelines for other tests, except that they should not be used routinely [14].

We found that 51% of the patients assigned typically viral diagnoses (common cold, laryngitis, influenza, bronchitis) with a CRP >50 mg/l received antibiotics without any further justification from signs, symptoms or comorbidity. This may indicate a misinterpretation of CRP and a non-optimal use of antibiotics. Similar results were found in Switzerland in 1997 [8] and in Sweden [6]. However, we did not find a large percentage of patients who received antibiotic therapy despite a negative StrepA test for tonsillitis (18%) as reported in the Swiss questionnaire (75%) [8].

Other studies suggest that patient satisfaction is mainly influenced by the amount of time spent with the physician and the information provided and not by the prescription received [15, 16]. This is consistent with our study, where there was no strong association between the use of tests and patient satisfaction or enablement.

Results from this study suggest that GPs relied on results of diagnostic tests when making decisions about antibiotic therapy. Unfortunately CRP or leucocyte counts do not accurately distinguish between viral and bacterial infections [7, 14]. The intervention of our trial may have had a subtle effect on GPs' testing and prescribing behaviour. GPs in the guidelines and communication training group were perhaps more likely to carry out diagnostic tests (table 3: OR 1.70; 95% CI, 0.59–4.87), but less likely to prescribe antibiotics to those patients not given a test (table 5: OR 0.25; 95% CI, 0.08–0.79). We see this shift in behaviour as a consequence of GPs trying to prescribe fewer antibiotics while still maintaining patient safety. There is an obvious need for more accurate diagnostic tests, and we are currently running a trial where antibiotic therapy for patients with ARTI is guided by a new Procalcitonin test [17].

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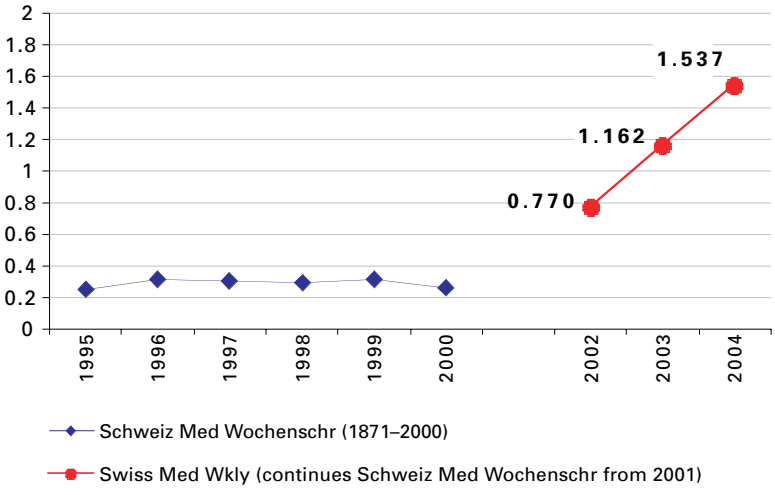

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