EDITOR'S CHOICE

Which symptoms and clinical features correctly identify serious respiratory infection in children attending a paediatric assessment unit?

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ABSTRACT

Objective Parent-reported symptoms are frequently used to triage children, but little is known about which symptoms identify children with serious respiratory infections. The authors aimed to identify symptoms and triage findings predictive of serious respiratory infection, and to quantify agreement between parent and nurse assessment.

Design Prospective diagnostic cohort study.

Setting Paediatric Assessment Unit, University Hospitals Coventry and Warwickshire NHS Trust.

Patients 535 children aged between 3 months and 12 years with suspected acute infection.

Methods Parents completed a symptom questionnaire on arrival. Children were triaged by a nurse, who measured routine vital signs. The final diagnosis at discharge was used as the outcome. Symptoms and triage findings were analysed to identify features diagnostic of serious respiratory infection. Agreement between parent and triage nurse assessment was measured and kappa values calculated.

Results Parent-reported symptoms were poor indicators of serious respiratory infection (positive likelihood ratio (LR+) 0.56–1.93) and agreed poorly with nurse assessment (kappa 0.22–0.56). The best predictor was clinical assessment of respiratory distress (LR+ 5.04). Oxygen saturations <94% were highly specific (specificity 95.1%) but had poor sensitivity (35.6%). Tachypnoea (defined by current Advanced Paediatric Life Support standards) offered little discriminatory value.

Conclusion Parent-reported symptoms were unreliable discriminators of serious respiratory infection in children with suspected acute infection, and did not correlate well with nurse assessment. Using symptoms to identify higher risk children in this setting is unreliable. Nurse triage assessment of respiratory distress and some vital signs are important predictors.

What is already known on this topic

- Parent report that 'this illness is different' is predictive of serious childhood infection, and vital signs such as respiratory rate are associated with pneumonia.
- Respiratory symptoms are the most common reason for children to consult a doctor, although the incidence of serious respiratory infection is relatively low.

What this study adds

- Parent-reported symptoms are poor predictors of serious respiratory infection in children attending a paediatric assessment unit.
- Triage nurses and parents do not agree about whether or not respiratory distress is present.
- Tachycardia and decreased oxygen saturations are better predictors of serious respiratory infection than tachypnoea in children presenting with acute infection in this setting.

INTRODUCTION

Symptoms of respiratory tract infection in childhood are common; more than two thirds of children experience such symptoms over a 6-month period[1] and they are the most common reason for young children to present to a doctor.[2] Serious lower respiratory tract infections, although relatively uncommon, are still the most frequent type of serious infection in children,[3] and identifying children most at risk is important.

Observational studies and systematic reviews have focused on physical and laboratory findings. Raised respiratory rate was the best predictor of childhood pneumonia in a systematic review,[4] a finding confirmed by other authors[5–8] and used in WHO diagnostic criteria.[9 10] In contrast, the value of other vital signs and clinical findings is inconsistent between studies,[7 8 11 12] and the value of parental history unknown. Parent's consulting behaviour is influenced by their interpretation of symptoms[1] as well as many other factors such as maternal age, parity, housing situation and educational attainment.[2] Telephone-based triage, now common in many countries, uses parent-reported symptoms to identify children requiring face-to-face clinical assessment. Surprisingly little is known about which symptoms are most useful in identifying children with serious respiratory infection. Overall parental concern that 'this illness is different' as well as the clinician 'feeling that something is wrong' are associated with serious paediatric infections in primary care settings,[4 13] but triggers for these intuitive responses are unknown. Kai highlighted anxiety experienced by parents in making sense of their child's illness, and frustration with apparent disregard of worrying symptoms by the doctor.[14]

The aim of this study was to identify whether parent-reported symptoms, nurse triage assessment and vital signs were useful for identifying children with serious respiratory infection presenting to a paediatric assessment unit (PAU). In addition, we wanted to determine how well

parents and triage nurses agreed about the presence or absence of respiratory features.

METHODS

We used data from 700 children attending the PAU at University Hospitals Coventry and Warwickshire NHS Trust between April 2005 and April 2006, with acute infection suspected by parents, the referring clinician or the triage nurse. The recruitment, methods and outcome of this cohort have been described previously.[15] Immunosuppressed patients, and those with infection secondary to penetrative trauma, and children with non-infective exacerbations of asthma were excluded. On arrival, parents completed a questionnaire asking about the presence or absence of 22 symptoms. Triage nurses recorded information on a standard series of clinical features, and measured vital signs. Children were followed until discharge from the PAU or from the ward if admitted. Chest radiographs were performed on admission at the discretion of the clinical team, and interpreted on a single reading by a radiologist not blinded to clinical details. Outcomes were based on final diagnosis made by the paediatric team, confirmed by telephone follow-up and independent notes review as required.[15] Ethics approval was obtained from Coventry Local Research Ethics Committee.

Study population

From the primary cohort of 700 children, we identified a group of 535 children aged between 3 months and 12 years, with suspected acute infection (figure 1). We excluded 97 children who obviously did not have respiratory illness at presentation, in whom there was a visible cutaneous source of infection (eg, cellulitis or local abscess), who had non-febrile seizures or clearly non-infective conditions, or in whom the diagnosis was appendicitis. We excluded 68 children over 12 years of age because their symptoms were likely to have been self-reported rather than reported by parents.

Outcome

Children were categorised into three groups based on final diagnosis (figure 1): group A included those with serious respiratory tract infection, group B those with other foci of serious infection and group C those with minor or no infection. Children in group A consisted of those with consolidation observed on chest radiograph, a clinical diagnosis of lower respiratory tract infection, or respiratory tract infection requiring both hospital admission and at least one inpatient treatment, namely supplementary oxygen, intravenous fluids, intravenous antibiotics or nasogastric tube feeding.

Definitions of predictors

We determined the value of three main types of predictors: the 22 symptoms reported by parents, the nurse triage data and vital signs. Nurse triage findings were documented on a form in routine use in the PAU, and included the presence or absence of respiratory signs (recession, cough, wheeze, stridor, tracheal tug, irregular breathing and respiratory effort). The presence or absence of features of respiratory distress was coded by MT (blinded to

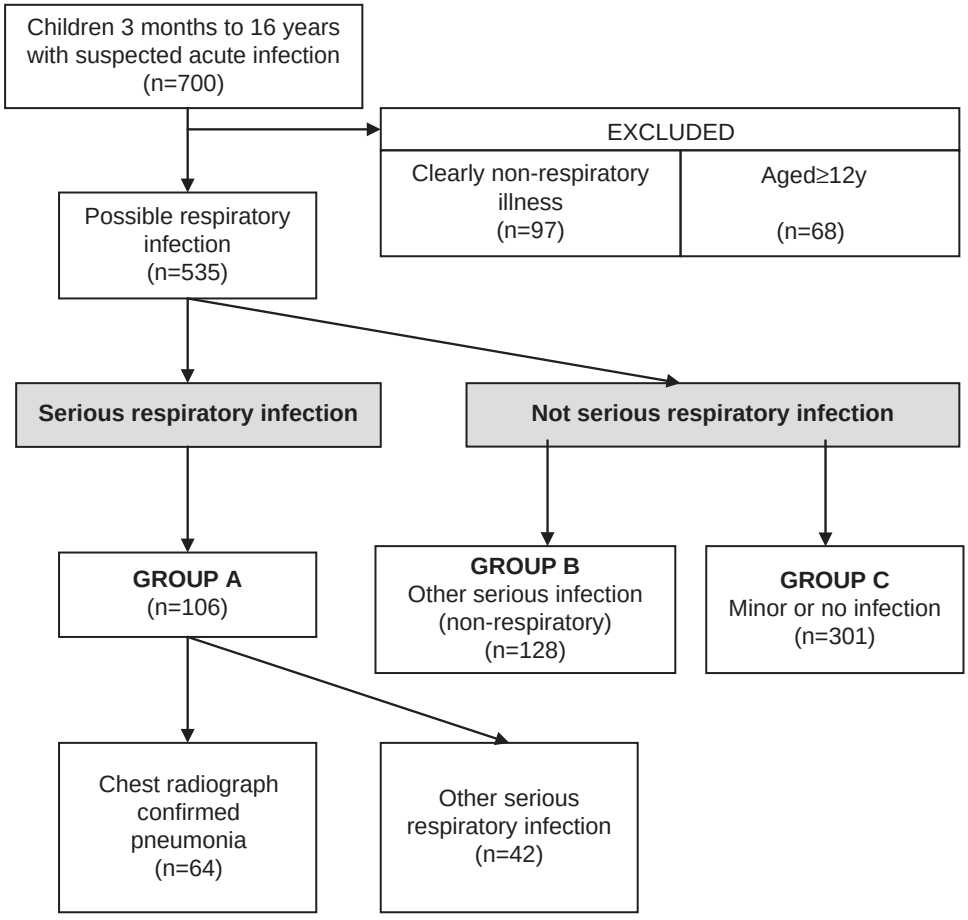

Figure 1 Flow chart of study participants and outcome groups.

outcome) into a binary outcome of respiratory distress present or absent. Other features documented by the triage nurse were cyanosis, colour, rash, skin turgor, appearance of eyes, fontanelle, mucous membranes, capillary refill time and clinical severity scores.[15] Respiratory rate was measured by clinical counting, temperature was measured using a Welch Allyn SureTemp Plus axillary thermometer (Welch Allyn, Skaneagles Falls, NY 13153-0220, USA), and heart rate and oxygen saturations were measured using a Nellcor N20E pulse oximeter (Nellcor Boulder, CO80301, USA). Vital signs were used as binary (normal/abnormal) variables. Tachypnoea was defined using Advanced Paediatric Life Support (APLS) standards for age.[16] Tachycardia was defined by APLS standards for age, as well as heart rate above the 90th percentile corrected for age and temperature.[16 17] Fever was defined as greater than 38°C and greater than 39°C. Missing values are reported in the results where relevant.

Analyses

We constructed 2×2 contingency tables for all predictors (parent-reported symptoms, triage nurse findings and vital signs) with outcome. The primary comparison was between children with serious respiratory infection (group A) and children without serious respiratory infection (groups B and C). The secondary comparison compared group A with group C to identify differences when children with serious non-respiratory infections were removed from the analysis. We constructed 2×2 contingency tables for inter-observer variability of symptoms reported by parents or the triage nurse, and calculated kappa statistics of variability.

Significant associations were identified using χ^2 and Fisher's exact tests. We determined sensitivity, specificity, positive and negative predictive values and likelihood ratios of significant variables using a confidence interval calculator.[18] Logistic regression by the enter method was used to adjust significant variables after χ^2 analysis ($p<0.05$), removing non-significant variables from the model in a step-wise manner until only significant variables remained. SPSS software (v 14.0) was used for analyses.

RESULTS

Description of the cohort

The baseline characteristics of the cohort of 535 children are shown in table 1. Approximately half (53.1%) of the children were male, with a mean age of 3.5 years (SD 3.2). A total of 260 children (48.6%) were referred from primary care.

Of the 259 children (48.6%) who were admitted to hospital, 20 were admitted to the high dependency unit (nine with serious respiratory infections and 11 with serious non-respiratory infections). A chest radiograph was performed in 134 (25.0%) of the 535 children.

Overall, 106 (19.8%) of the children had a serious respiratory infection (group A), 128 (23.9%) had a serious non-respiratory infection (group B) and 301 (56.3%) had minor or no infection (group C) (table 2). Of the children in group A without radiologically-confirmed pneumonia, 11 had a clinical diagnosis of lower respiratory tract infection, and 31 had a viral respiratory tract infection requiring hospital admission and inpatient treatment: 19 had bronchiolitis, nine had upper respiratory tract infection with significant systemic illness, and one each had viral pneumonia, croup and admission to rule out sepsis.

Predictors of serious respiratory infection

Parent-reported symptoms significantly associated with serious respiratory infection were cough, breathing difficulty, pallor and wheeze (table 3). The presence of cough provided moderate sensitivity (70.8%) and low specificity (62.0%) for serious respiratory infections compared to other infections, but all other symptoms had poor sensitivity and variable specificity (71.6–81.4%) (table 4). All of the parent-reported symptoms had positive likelihood ratios (LR+) below 2.0.

Cough was also the most sensitive clinical feature for serious respiratory infection noted by the triage nurses (sensitivity 80.2%), and several nurse-reported clinical features were highly specific, that is, respiratory distress (88.6%), wheeze (93.0%), dehydration (93.5%) and absence of non-blanching rash (91.1%). Nurse-reported respiratory distress had the highest LR+ (5.04), while other features had LR+ close to or below 2.0. None of the vital signs were highly sensitive for respiratory infection, although two were moderately sensitive: tachycardia based on APLS cut-offs (sensitivity 70.8%), and respiratory rate exceeding APLS cut-offs (66.0%). However, several were highly specific: oxygen saturations <94% (specificity 94.9%), heart rate exceeding the 90th centile for age and temperature (specificity 84.5%) and temperature >39°C (specificity 79%). Indeed, saturations <94% had a LR+ of 7.0.

We repeated the analyses by comparing the frequency of clinical features in children with serious respiratory infection with those with minor or no infection (ie, removing the 128 children with serious infections which had non-respiratory foci). This showed that all parent-reported symptoms apart from pallor (LR+ 1.73, 95% CI 1.28 to 2.32), became weaker

Table 1 Baseline characteristics of a cohort of 535 children presenting to a paediatric assessment unit with suspected acute infection

	n (%)
Sex	
Male	284 (53.1)
Female	251 (46.9)
Age (years)	
Mean±SD	3.5±3.2
Age distribution	
<1 year	108 (20.2)
1–2 years	136 (25.4)
2–5 years	150 (28.0)
5–12 years	141 (26.4)
Ethnicity	
Caucasian	386 (72.1)
Asian	72 (13.5)
Black	20 (3.7)
Mixed	12 (2.2)
Chinese or other	21 (3.9)
Not recorded	24 (4.5)
Source of referral	
Primary care	260 (48.6)
Self-referral or Accident and Emergency	147 (27.5)
Emergency ambulance	102 (19.1)
Other	26 (4.9)
Admission	
Admitted	259 (48.4)
Admitted, plus ≥1 intervention	170 (31.8)
High dependency unit	20 (3.7)
Final diagnosis	
Significant respiratory infection	106 (19.8)
Other significant infection	128 (23.9)
Minor or no infection	301 (56.3)

Table 2 Final diagnoses of a cohort of 535 children presenting to a paediatric assessment unit with acute infection

Outcome group, n (%)	Diagnosis	Frequency, n (%)	Admissions, n (% of diagnosis group)	Admission plus ≥1 intervention,* n (% of diagnosis group)
Group A (serious respiratory infection), 106 (19.8)	Chest x-ray confirmed pneumonia	64 (12.0)	54 (84.4)	51 (79.7)
	Other serious respiratory infection	42 (7.9)	37 (88.1)	36 (85.7)
Group B (serious other infection), 128 (23.9)	Convulsion secondary to acute infection	45 (8.4)	16 (35.6)	1 (2.2)
	UTI with systemic symptoms	29 (5.4)	18 (62.1)	14 (48.3)
	Viral illness requiring hospital intervention	26 (4.9)	26 (100)	26 (100)
	Viral gastrointestinal illness requiring hospital intervention	15 (2.8)	15 (100)	15 (100)
	Positive sterile site cultures	8 (1.5)	8 (100)	8 (100)
	Other	3 (0.6)	3 (100)	3 (100)
	Meningitis/meningococcal disease	2 (0.4)	2 (100)	2 (100)
Group C (minor or no infection), 301 (56.3)	URTI, including croup	137 (25.6)	21 (15.3)	0 (0)
	Viral gastroenteritis	44 (8.2)	16 (36.4)	5 (11.4)
	Bronchiolitis or viral induced wheeze	32 (6.0)	10 (31.3)	0 (0)
	Viral illness, unspecified	24 (4.5)	3 (12.5)	0 (0)
	Viral exanthema	19 (3.6)	4 (21.1)	0 (0)
	Non-specific abdominal pain	18 (3.4)	12 (66.7)	5 (27.8)
	Uncomplicated UTI	15 (2.8)	7 (46.7)	3 (20.0)
	Not infection	12 (2.2)	7 (58.3)	1 (8.3)

*Supplementary oxygen, intravenous fluids, intravenous antibiotics or nasogastric tube feeding.
URTI, upper respiratory tract infection; UTI, urinary tract infection.

predictors when children with serious respiratory infections were compared to children with minor or no infection. This was also the case for nurse triage findings; however, nurse-reported respiratory distress and dehydration remained useful predictors (LR+ 4.12, 95% CI 2.98 to 5.71 and LR+ 2.21, 95% CI 1.14 to 4.28, respectively). Vital signs became generally more predictive of serious respiratory infection when compared to children with minor or no infection, particularly saturations <94% (LR+ 8.63, 95% CI 4.68 to 15.9), temperature ≥39°C (LR+ 2.26, 95% CI 1.53 to 3.34) and tachycardia over the 90th centile for age and temperature (LR+ 2.51, 95% CI 1.68 to 3.77).

Following logistic regression, four clinical features remained independently associated with the primary outcome of serious respiratory infection compared to children with serious non-respiratory infections and those with minor or no infections: nurse assessed respiratory distress, oxygen saturations, fever ≥39°C and nurse-reported cough (table 5). Although confidence intervals were wide, the two features which had the largest adjusted odds ratios in the final model were nurse-reported respiratory distress (adjusted OR 5.42) and oxygen saturations <94% (adjusted OR 5.07). When the regression was repeated comparing children with serious respiratory infection to only those with minor or no infection, the final model was identical except that parent report of pallor replaced nurse-reported cough (table 5).

Agreement between parent- and nurse-reported symptoms

There was poor inter-observer agreement between parent- and nurse-reported symptoms (table 6). Only half (50.9%) of parents reported the presence of breathing difficulty in children whom the nurse assessed as having respiratory distress. Breathing difficulty was also reported by parents in nearly one fifth (18.5%) of children in whom the nurse found no respiratory distress. Kappa values for parent and nurse agreement ranged from 0.22 (fever) to 0.56 (rash).

DISCUSSION

Main findings

Parent-reported symptoms were not accurate predictors of serious respiratory infection in children under 12 years of age presenting to a PAU. Two symptoms, breathing difficulty and wheeze, had moderate specificity (77.9% and 81.4%, respectively) but poor sensitivity (41.5% and 36.8%, respectively). Moreover, we found poor agreement between parents and triage nurses concerning the presence or absence of symptoms. In particular, parents did not report the presence of breathing difficulty in half the children in whom the nurse noted this was present. Based on our findings, parental history alone does not adequately discriminate those with serious respiratory infection in this setting. Clinical assessment of respiratory distress by a nurse was the most useful predictor of a subsequent diagnosis of serious respiratory infection, and provided most discrimination between children with serious respiratory infection compared to those with minor infections. Vital signs also offered some discriminating value: oxygen saturations <94% were a highly specific (95.1%) but not sensitive (35.6%) marker of serious respiratory infection, supporting their use as a rule-in test. Surprisingly, tachypnoea (at least as defined by current APLS standards)[16] offered little discriminatory value. We did not identify any substantial rule-out predictors.

Strengths of this study

This is the first study to prospectively determine the diagnostic value of symptoms reported by parents using a consistent approach (ie, symptom questionnaire), rather than relying on symptoms recorded in medical or nursing notes. All parents completed the symptoms questionnaire. We included all children with suspected acute infection (excluding those with a visible non-respiratory cause) in the analyses, rather than limiting inclusion to only those with cough and fever or those who had a chest radiograph, which could introduce selection bias. We deliberately selected outcomes for serious respiratory infections which reflected pragmatic clinical outcomes, rather than restricting this to radiologically confirmed pneumonia, as chest radiographs are not always used to make a diagnosis and decide treatment.[19] Finally, vital signs, including oxygen saturations, were recorded consistently by triage nurses.

Study limitations

Our study is subject to several limitations. Since our reference standard was based on clinical diagnosis rather than

Table 3 Comparison of frequency of clinical features in children with and without serious respiratory infection

	Serious respiratory infection	Not serious respiratory infection	
	Group A (N=106), n (%)	Group B (N=128), n (%)	Group C (N=301), n (%)
Age			
<1 year	18 (17.0)	23 (18.0)	67 (22.3)
<5 year	80 (75.5)	106 (82.8)	208 (69.1)
Parent-reported symptom			
Cough	75 (70.8)***	28 (21.9)	135 (44.9)
Difficult or laboured breathing	44 (41.5)***	14 (10.9)	76 (25.2)
Pale colour	45 (42.5)**	48 (37.5)	74 (24.6)
Wheeze	39 (37.8)***	9 (7.0)	73 (24.3)
Rash or spots on skin	11 (10.4)*	25 (19.5)	55 (18.3)
Fever or high temperature	79 (74.5)	99 (77.3)	210 (69.8)
Irritable or miserable	58 (54.7)	63 (49.2)	160 (53.2)
Refusing food/feeds	50 (47.2)	59 (46.1)	148 (49.2)
Drowsy/very sleepy	49 (46.2)	61 (47.7)	127 (42.2)
Runny nose	46 (43.4)	36 (28.1)	119 (39.5)
Vomiting	39 (36.8)	52 (40.6)	111 (36.2)
Nausea	27 (25.5)	27 (21.1)	71 (23.6)
Tummy pain	24 (22.6)	28 (21.9)	79 (26.2)
Cold hands or feet	23 (21.7)	33 (25.8)	59 (19.6)
Sore throat	23 (21.7)	17 (13.3)	80 (26.6)
Headache†	13/88 (14.8)	21/105 (20.0)	58/234 (24.8)
Aches all over	11 (10.4)	11 (8.6)	24 (8.0)
Ear pain	9 (8.5)	4 (3.1)	33 (11.0)
Confused†	7/88 (8.0)	14/105 (13.3)	17/234 (7.3)
Hurts to look at lights	4 (3.8)	6 (4.7)	11 (3.7)
Pain in legs or arms	4 (3.8)	11 (8.6)	21 (7.0)
Neck painful or stiff	3 (2.8)	13 (10.2)	20 (6.6)
Triage nurse assessment			
Cough	85 (80.2)***	30 (23.4)	143 (47.5)
Respiratory distress	61 (57.5)***	7 (5.5)	42 (14.0)
Pallor	52 (49.1)**	48 (37.5)	101 (33.6)
Wheeze	16 (15.1)*	1 (1.0)	29 (9.6)
Dehydration	14 (13.2)**	10 (7.8)	18 (6.0)
Rash	9 (8.5)***	37 (28.9)	65 (21.6)
Non-blanching rash	2 (1.9)**	20 (15.6)	18 (6.0)
Vital signs			
RR >APLS	70 (66.0)***	41 (32.0)	127 (42.2)
Temperature ≥38°C	59/104 (56.7)**	75 (58.6)	110/297 (37.0)
Temperature ≥39°C	34/104 (32.7)**	42 (32.8)	43/297 (14.5)
Saturations <94%	37/104 (35.6)***	8/121 (66.7)	12/291 (4.1)
Pulse >APLS	75 (70.8)***	80 (62.5)	132 (43.9)
Pulse >90th percentile for age and temperature	34/104 (32.7)***	26/125 (20.8)	38/292 (13.0)

*p<0.05, **p<0.01, ***p< 0.001, comparison of serious respiratory infection versus not serious respiratory infection.
†Data only available for children >1 year old.
APLS, Advanced Paediatric Life Support; RR, respiratory rate.

radiological or microbiological findings, we accept that this may have introduced subjectivity into the assessment of outcome. Although vital signs were recorded consistently, we did not standardise the measurement of respiratory rate, which was measured by clinical counting. This is known to be inaccurate in children,[8 20] and can be improved by counting over 1 min.[10 21] This may explain why we did not find respiratory rate to be as predictive as in previous studies.

Nurse assessment of respiratory distress was not blinded to respiratory rate or saturations which, in addition to influencing nurse assessment findings, would likely influence subsequent clinical management, which may explain why this was a highly significant predictor of final outcome. We deliberately used simple and rapid parent questionnaires with present/absent responses and avoided more detailed questions (eg, related to severity), which maximised response but overlooked levels of abnormality and variation in parents' interpretation of the meaning of symptoms.[22] Previous assessment/triage and referral by a health professional to PAU may have influenced parents' opinions about whether a symptom was present, and there was a lack of interaction between parents and clinicians in determining meaning. We were not able to assess demographic factors previously shown to contribute to health beliefs and health-seeking behaviour,[1 14] although most

Table 4 Diagnostic characteristics of significant predictors of serious respiratory infection in 535 children attending a paediatric assessment unit

	Sensitivity % (95% CI)	Specificity % (95% CI)	LR+ (95% CI)	LR- (95% CI)
Parent-reported symptom				
Cough	70.8 (61.5 to 78.6)	62.0 (57.3 to 66.5)	1.86 (1.57 to 2.21)	0.47 (0.35 to 0.64)
Breathing difficulty	41.5 (32.6 to 51.0)	77.9 (73.6 to 81.6)	1.88 (1.40 to 2.51)	0.75 (0.64 to 0.89)
Pallor	42.5 (33.5 to 52.0)	71.6 (67.1 to 75.6)	1.49 (1.14 to 1.95)	0.80 (0.68 to 0.96)
Wheeze	36.8 (28.2 to 46.3)	81.4 (77.4 to 84.8)	1.93 (1.40 to 2.64)	0.78 (0.67 to 0.91)
Rash	10.4 (5.9 to 17.6)	81.4 (77.4 to 84.8)	0.56 (0.31 to 1.00)	1.10 (1.10 to 1.20)
Triage nurse assessment				
Cough	80.2 (71.6 to 86.7)	59.7 (55.0 to 64.2)	1.99 (1.71 to 2.31)	0.33 (0.23 to 0.49)
Respiratory distress	57.5 (48.0 to 66.5)	88.6 (85.2 to 91.3)	5.04 (3.70 to 6.87)	0.48 (0.38 to 0.60)
Pallor	49.1 (39.7 to 58.4)	65.3 (60.6 to 69.6)	1.41 (1.12 to 1.78)	0.78 (0.64 to 0.95)
Wheeze	15.1 (9.5 to 23.1)	93.0 (90.2 to 95.1)	2.16 (1.22 to 3.81)	0.91 (0.84 to 0.99)
Dehydration	13.2 (8.0 to 21.0)	93.5 (90.7 to 95.4)	2.02 (1.11 to 3.71)	0.93 (0.86 to 1.00)
Rash	8.50 (4.5 to 15.4)	76.2 (72.0 to 80.0)	0.36 (0.19 to 0.68)	1.20 (1.11 to 1.30)
Non-blanching rash	1.90 (0.5 to 6.6)	91.1 (88.1 to 93.5)	0.21 (0.05 to 0.87)	1.08 (1.04 to 1.12)
Vital signs				
RR >APLS	66.0 (56.6 to 74.4)	60.8 (56.1 to 65.3)	1.69 (1.41 to 2.02)	0.56 (0.42 to 0.74)
Temperature ≥38°C	56.7 (47.1 to 65.8)	56.5 (51.7 to 61.1)	1.30 (1.07 to 1.59)	0.77 (0.61 to 0.97)
Temperature ≥39°C	32.7 (24.4 to 42.2)	80.0 (75.9 to 83.5)	1.64 (1.17 to 2.29)	0.84 (0.73 to 0.97)
Saturations <94%	35.6 (27.0 to 45.1)	95.1 (92.6 to 96.8)	7.33 (4.45 to 12.08)	0.68 (0.59 to 0.78)
Pulse >APLS	70.8 (61.5 to 78.6)	50.6 (45.9 to 55.3)	1.43 (1.23 to 1.67)	0.58 (0.42 to 0.79)
Pulse >90th percentile for age and temperature	32.7 (24.4 to 42.2)	84.7 (80.9 to 87.8)	2.13 (1.49 to 3.04)	0.80 (0.69 to 0.92)

APLS, Advanced Paediatric Life Support; RR, respiratory rate.

Table 5 Adjusted ORs after logistic regression analysis

	Serious respiratory infection versus other (A vs B+C)	Serious respiratory infection versus minor or no infection (A vs C)
	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Nurse-reported respiratory distress	5.42 (3.08 to 9.52)	5.97 (3.36 to 10.62)
Saturations <94%	5.07 (2.55 to 10.07)	8.41 (3.85 to 18.36)
Temperature ≥39oC	2.37 (1.34 to 4.20)	3.30 (1.76 to 6.19)
Parent-reported pallor	NS	2.50 (1.41 to 4.43)
Nurse-reported cough	2.71 (1.51 to 4.89)	NS

NS, not significant.

Table 6 Symptoms: inter-observer agreement between parents and nurses in 535 children with possible acute respiratory infection

	Nurse reports present		Nurse reports absent		
	Parent reports present	Parent reports absent	Parent reports present	Parent reports absent	
Symptom	n (%)	n (%)	n (%)	n (%)	Kappa
Rash	65/111 (58.6)	46/111 (41.4)	26/424 (6.1)	398/424 (93.9)	0.56
Cough	187/258 (72.5)	71/258 (27.5)	51/277 (18.4)	226/277 (81.6)	0.54
Wheeze	34/46 (73.9)	12/46 (26.1)	87/489 (18.6)	402/489 (81.4)	0.32
Breathing difficulty	56/110 (50.9)	54/110 (49.1)	78/425 (17.8)	347/425 (81.6)	0.30
Pallor	95/201 (47.3)	106/201 (52.7)	72/334 (21.6)	262/334 (78.4)	0.27
Fever*	207/244 (84.8)	37/244 (15.2)	178/285 (62.5)	107/285 (37.5)	0.22

*Temperature data not available for six participants.

participants in our study came from a relatively deprived urban setting in the UK. Given the high incidence of serious respiratory infection in the study population, which may reflect the relatively deprived urban setting of the study, verification bias might overestimate the sensitivity of predictors, and thus limit application to lower prevalence populations.

Implications

This study has highlighted some major gaps in our understanding of how children with serious respiratory infection are currently identified. Our findings suggest that the symptoms noted by the parents are poor predictors of serious respiratory infection, and correlate poorly with nurse assessment. The prevalence of serious respiratory infection in our population was high, so the predictive value of parent-reported symptoms needs to be quantified in community populations. The telephone triage of children in the community, both by call centres like NHS Direct, and by telephone consultations with primary care clinicians, relies almost entirely on parental history. Our study highlights the need for further research

into the value of parental history in these settings, to compare parent-reported symptoms by telephone to both clinical findings and final outcome. Additional research could also further target what contributes to parents' and clinicians' feeling that 'something is wrong' in children presenting with respiratory infections.[13] Our research confirms the diagnostic value of vital signs, particularly oxygen saturations and heart rate. The apparent discrepancy in the predictive value of objective respiratory signs is intriguing; respiratory rate was not a useful predictor, whereas nurse-assessed respiratory distress was the most useful predictor of serious respiratory infection.

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