Esther T van der Werf, Niamh M Redmond, Sophie Turnbull, Hannah Thornton, Matthew Thompson, Paul Little, Tim J Peters, Peter S Blair and Alastair D Hay

Parental and clinician agreement of illness severity in children with RTIs:

secondary analysis of data from a prospective cohort study

Abstract

Background
Severity assessments of respiratory tract infection (RTI) in children are known to differ between parents and clinicians, but determinants of perceived severity are unknown.

Aim
To investigate the (dis)agreement between, and compare the determinants of, parent and clinician severity scores.

Design and setting
Secondary analysis of data from a prospective cohort study of 8394 children presenting to primary care with acute (≤28 days) cough and RTI.

Method
Data on sociodemographic factors, parent-reported symptoms, clinician-reported findings, and severity assessments were used. Kappa (κ)-statistics were used to investigate (dis) agreement, whereas multivariable logistic regression was used to identify the factors associated with illness severity.

Results
Parents reported higher illness severity (mean 5.2 [standard deviation (SD) 1.8], median 5 [interquartile range (IQR) 4–7]), than clinicians (mean 3.1 [SD 1.7], median 3 [IQR 2–4], $P<0.0001$). There was low positive correlation between these scores (+0.43) and poor inter-rater agreement between parents and clinicians (κ 0.049). The number of clinical signs was highly correlated with clinician scores (+0.71). Parent-reported symptoms (in the previous 24 hours) that were independently associated with higher illness severity scores, in order of importance, were: severe fever, severe cough, rapid breathing, severe reduced eating, moderate-to-severe reduced fluid intake, severe disturbed sleep, and change in cry. Three of these symptoms (severe fever, rapid breathing, and change in cry) along with inter/subcostal recession, crackles/crepitations, nasal flaring, wheeze, and drowsiness/irritability were associated with higher clinician scores.

Conclusion
Clinicians and parents use different factors and make different judgements about the severity of children's RTI. Improved understanding of the factors that concern parents could improve parent–clinician communication and consultation outcomes.

Keywords
fever; illness severity assessment; primary health care; respiratory tract infections.

INTRODUCTION

Respiratory tract infection (RTI) is the most common reason parents take children to consult in primary care worldwide,[1] and many of these children are prescribed antibiotics unnecessarily. The decision to seek medical advice is complex,[2,3] as parents rely on their child's physical expression of illness and their own interpretation of the symptoms.[4] Clinicians also report consultations for RTI as being complex because they manage clinical uncertainty regarding diagnosis and prognosis, which often results in 'just-in-case' antibiotic prescribing.[5]

Patient-centred care has been shown to improve the quality of doctor–patient communication, consultations, and illness outcomes,[6] but reaching a shared understanding of the nature of the problem and its severity is central to such care.[7,8] Illness severity can best be described as the magnitude of the patient-perceived, clinically significant manifestations of disease processes that are associated with decrements in health-related quality of life or health status.[9] In children's consultations, there are three interacting perceptions — that of the child, parent, and clinician — which affect the assessment of illness severity, and assessments are likely to vary due to the different factors taken into account.

Parent-perceived severe illness in children with RTI is one reason why parents choose to consult in primary care,[10] and a clinician's illness severity assessment might be the guiding factor for antibiotic treatment choice. Misinterpretation of a child's illness severity might not only lead to overconsultation, but also to overtreatment. In-depth knowledge of the differences in the factors that determine illness severity assessment — and, particularly, (dis)agreement between parents' and clinicians' assessments — may be important in improving parent–clinician communication and the management of children with RTI in primary care. As such, this study aimed to:

- investigate (dis)agreement between clinicians' and parents' illness severity scores; and
- identify and compare the determinants of high parent and clinician severity scores

ET van der Werf, PhD, senior lecturer in epidemiology, Centre for Academic Primary Care, Population Health Sciences, Bristol Medical School, University of Bristol, Bristol, UK; School of Medicine, Taylor's University, Selangor DE, Malaysia. **NM Redmond**, PhD, research fellow, Centre for Academic Primary Care, Population Health Sciences, Bristol Medical School, University of Bristol; National Institute for Health Research Collaborations for Leadership in Applied Health Research and Care West (NIHR CLAHRC West), University Hospitals Bristol NHS Foundation Trust, Bristol, UK. **S Turnbull**, MSc, senior research associate; **H Thornton**, PhD, senior research associate; **AD Hay**, FRCGP, GP and professor of primary care, Centre for Academic Primary Care, Population Health Sciences; **TJ Peters**, PhD, professor of primary care health services research; **PS Blair**, PhD, professor of epidemiology and statistics, Population Health Sciences, Bristol Medical School, University of Bristol, Bristol, UK. **M Thompson**, MD, MPH, PhD, GP and professor of family medicine, Department of Family Medicine, University of Washington, Seattle, WA, US. **P Little**, FMedSci, GP and professor of primary care research, Primary Care and Population Sciences Unit, University of Southampton, Southampton, UK.

Address for correspondence
Esther van der Werf, School of Medicine, Taylor's University, Lakeside Campus, 1, Jalan Taylor's, 47500 Subang Jaya, Selangor DE, Malaysia.
Email: Esther.vanderwerf@taylors.edu.my

Submitted: 4 July 2018; **Editor's response:** 22 August 2018; **final acceptance:** 13 November 2018.

How this fits in

The decisions parents make regarding the seeking of medical advice are complex. An improved mutual understanding of the factors taken into account when assessing illness severity could facilitate better parent–clinician communication and improved parental understanding about the symptoms that necessitate consultation.

for children presenting to primary care with cough and RTI.

METHOD

Design and study population

Data were used from the TARGET study,[11] a multicentre prospective cohort study of children with acute (≤28 days) cough and RTI recruited between July 2011 and May 2013. The design of that study has been described in detail and the main results published elsewhere.[11,12] In brief, GPs and prescribing nurse practitioners (hereafter referred to as 'clinicians') working in primary care centres — GP surgeries, walk-in centres, GP out-of-hours centres, or polyclinics — were recruited and trained by four UK hubs (Bristol, London, Oxford, and Southampton). The clinicians recruited children to the study if they were eligible, which was defined as:

- being aged 3 months–16 years; *and*
- having presented with the main symptom of acute (≤28 days) cough with other RTI symptoms (such as fever and coryza).

Children with an infected exacerbation of asthma and those who were severely unwell (for example, those who required same-day hospital assessment or admission) were included. Children were excluded if they:

- presented with a non-infective exacerbation of asthma;
- were at high risk of serious infection (immunocompromised, for example, with cystic fibrosis);
- required a throat swab for clinical management (which was taken for research purposes in a subgroup of children);
- had been previously recruited to the study;
- had recently participated in other research; or
- had registered at the practice temporarily.

Measurements

After obtaining informed written parent consent, clinicians completed a structured online or paper-based case report form (CRF) (available from the authors on request). The form recorded:

- seven sociodemographic items;
- four illness history/trajectory items;
- 29 parent-reported symptoms (including whether mild, moderate, or severe in the previous 24 hours);
- 14 physical examination signs (including vital signs); and
- the prescription of antibiotics (none, immediate, or delayed) or referral to secondary care for acute assessment.

Children's diagnosis of current asthma was checked by reviewing medical notes; asthma was deemed to be present if it had been recorded in the notes and asthma medication had been issued in the previous 12 months. Socioeconomic status, based on the patient's postcode, was assessed using the Indices of Multiple Deprivation (IMD), with scores ranging from 0 (least deprived) to >90 (most deprived). Illness severity was measured independently by parents and by a clinician using a 0–10 visual analogue scale (VAS), as outlined by McCormack *et al*,[13] ranging from 0 (well) to 10 (very unwell).

Variables

Illness severity scores. In the main analysis, children were coded as having 'high parent-reported illness severity' if the severity score, as assessed by their parent, was ≥7; 'high clinician-reported illness severity' was coded if the clinician's score totalled ≥4. For subanalysis, three illness severity groups were used to determine agreement between the parent's and the clinician's scores:

- parent score < clinician score: 'less ill';
- parent score = clinician score: 'as ill'; and
- parent score > clinician score: 'more ill'.

Symptom severity. For symptom severity (mild, moderate, or severe) in the 24 hours prior to consultation, each variable was split depending on the prevalence:

- 'severe': if at least 5% of the whole cohort fell into this category; or
- 'moderate-to-severe': if the proportion was smaller than this.

Clinical cut-offs. In case of dichotomising,

commonly used clinical cut-offs were used for continuous data where possible (for example, temperature ≥37.8°C). Age-related heart rate, respiratory rate, and oxygen saturations were coded as raised or normal/low according to *Advanced Paediatric Life Support: the Practical Approach*.[14]

Data analysis

The clinician score data were heavily skewed so a non-parametric approach that makes no assumption about distribution was chosen. Illness severity scores from parents and clinicians were compared using the non-parametric approach for unpaired data. Medians, interquartile ranges (IQRs), and the Mann–Whitney test were used to investigate differences between group *scores* (lower/equal/higher).

To determine the association between the number of symptoms and signs reported in the global illness severity scores, correlation was determined between the parent illness severity score and the number of parent-reported symptoms, and between the clinician illness severity score and the number of symptoms and signs (both separately and added together). Correlation and agreement were calculated using Spearman's rho (r) and kappa (κ) statistics respectively. To control for anchoring, the rounded mean difference between the parent's score and the clinician's score was added to the clinician's score and κ recalculated.

Univariable and multivariable logistic regression was used to identify the sociodemographic and clinical factors independently associated with parent- and clinician-reported illness severity. Multivariable models were derived through several iterations using backward stepwise logistic regression, including all variables that were statistically significant in the univariable analyses (P<0.01) where missing data were <1%. The authors controlled for age, sex, and ethnicity, as well as the presence of other symptoms or signs already in the model.

Two separate multivariable models were determined for high clinician score: one included demographics and symptoms (for comparison with the parental model), and the other included demographics, symptoms, and clinical signs. The latter clinician model included a combined variable for parent-reported severe fever or clinician-measured temperature ≥37.8°C, and a combined variable for parent-reported rapid breathing or clinician-measured raised respiratory rate. The final models were constructed in the following order:

- sociodemographic status;
- clinical history;
- parent-reported symptoms; and
- for clinician model two, clinical examination.

To reduce the problem of multiple comparisons in the analysis, each listed symptom in the CRF was only tested in terms of whether it was present during the illness, and had been moderate or severe in the previous 24 hours.

Table 1. Characteristics of children (n = 8394) and parents

Characteristic	Median	IQR	Based on N[a]
Child's age, years	3	1–6	8394
Number of children in home	2	1–2	8355
Family deprivation score[b]	16.7	8.8–29.5	8201
Illness duration at recruitment, days	5	3–10	8390
Number of parent-reported symptoms prior to consultation[c]	7	5–9	8320
Number of parent-reported symptoms within 24 hours of consultation[c]	6	4–8	8229
Characteristic	**% (*n*)**	***Based on N[a]**	
Child's sex, male	51.6 (4331)	8394	
Child's ethnicity, white	78.4 (6546)	8349	
Mother a current smoker	18.0 (1491)	8285	
Breastfeeding at 3 months	44.2 (3441)	7784	
Illness got worse recently	66.0 (5533)	8383	

[a]Total N *variable specific data included in analysis. [b]The Indices for Multiple Deprivation score ranges from 0 (least deprived) to >90 (most deprived). Ethnicity, deprivation score, and prevalence of maternal smoking were similar to national figures.[12,13] [c]Median of positively reported parent-reported symptoms from the case report form out of a possible 20. IQR = interquartile range.*

RESULTS

In total, 8394 children were recruited to the study across the four centres. There was no difference in parent-reported illness severity scores between the 164 children declining participation (median 3, IQR 2–4) and the final recruited sample (median 3, IQR 2–4). For those declining participation, global illness severity scores were accrued as a result of a clinician's recruitment log, where clinicians were asked to record reasons for not inviting potentially eligible children to participate and to report the same global illness severity scores.

Children's median age was 3 years (IQR 1–6 years) (Table 1), with 1392 (16.6%) aged <1 year. In total, 51.6% were boys and 78.4% were white; the mother's median age at the child's birth was 30 years, and 18.0% of recruited children's mothers were current smokers. Families' median deprivation score was 16.7 (IQR 8.8–29.5). Ethnicity,

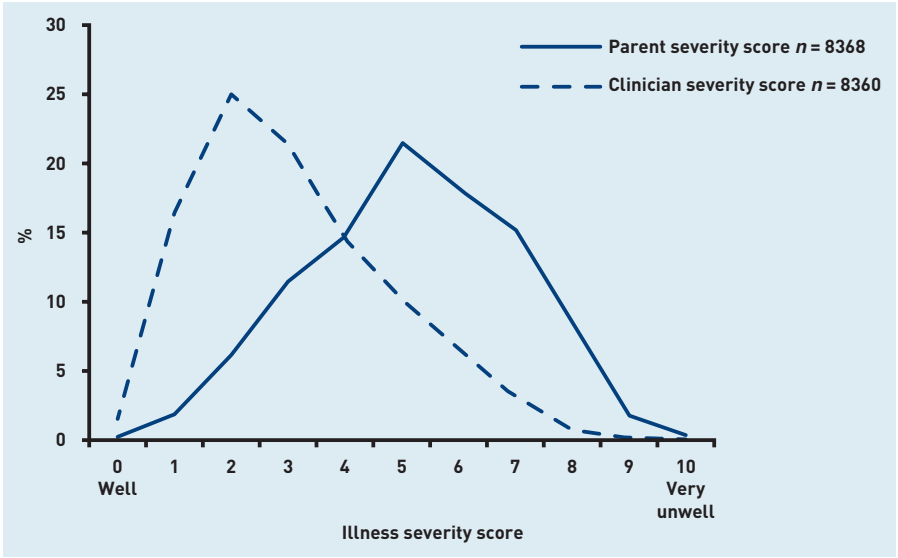

Figure 1. Distribution of illness severity scores.

Table 2. Parent and clinician illness severity scores

Severity of illness score	Mean[a] (SD)	Median	Range	IQR
Parent (8360/8394, 99.6%)	5.2 (1.8)	5	0–10	4–7
Clinician (8368/8394, 99.7%)	3.1 (1.7)	3	0–9	2–4
	n **(total *n* = 8337)[b]**	**%**		
Parental score < clinician score	478	5.7		
Parental score = clinician score	1236	14.8		
Parental score > clinician score	6623	79.4		

[a]P<0.0001 (Wilcoxon test score). [b]Number of children with parent and clinician score. IQR = interquartile range. SD = standard deviation.

Figure 2. Comparison of clinician and parent illness severity scores.
[a]To control for anchoring, the rounded mean difference between the parental score and clinician score was added to the clinician score.

deprivation score, and prevalence of maternal smoking were similar to national figures.[15,16] The median illness duration at recruitment was 5 days (IQR 3–10 days, range 0–28 days); the median number of parent-reported symptoms was seven (IQR 5–9, range 1–16) prior to consultation and six (IQR 4–8, range 0–16) within 24 hours of the consultation (Table 1).

Parent-reported illness severity score	Clinician-reported illness severity score											
	0, %	1, %	2, %	3, %	4, %	5, %	6, %	7, %	8, %	9, %	10, %	Total, %
0, %	0	0	0	0	0	0	0	0	0	0	0	0
1, %	0	1	0	0	0	0	0	0	0	0	0	2
2, %	0	3	3	0	0	0	0	0	0	0	0	6
3, %	0	3	4	3	1	0	0	0	0	0	0	12
4, %	0	3	5	4	2	1	0	0	0	0	0	15
5, %	0	3	5	5	4	3	1	0	0	0	0	22
6, %	0	1	4	4	4	3	2	0	0	0	0	18
7, %	0	1	3	3	3	2	2	1	0	0	0	15
8, %	0	1	1	2	1	1	1	1	0	0	0	8
9, %	0	0	0	0	0	0	0	0	0	0	0	2
10, %	0	0	0	0	0	0	0	0	0	0	0	0
Total, %	2	17	25	22	14	10	7	3	1	0	0	100

Percentages rounded to the nearest whole number, with the lightest blue representing 0% through to dark blue representing 5% of children with a similar score by parent and clinician.

Inter-rater agreement: parental score – clinician score: 14.8%, κ 0.049.
Parental score – clinician score + 2:[a] 20.6%, κ 0.064.

Illness severity

All in all, 8360 (99.6%) children had complete parent and clinician illness severity score data. Parent severity scores (mean 5.2 [standard deviation {SD} 1.8], median 5, range 0–10, IQR 4–7) were higher (P<0.0001) than clinician scores (mean 3.1 [SD 1.7], median 3, range 0–9, IQR 2–4) (Figure 1, Table 2). Parents scored illness severity lower than clinicians in 5.7% of cases, the same in 14.8% of cases, and higher in 79.4% of cases (Table 2).

The authors found evidence of a low positive correlation (Spearman's r 0.43, P<0.001) and poor inter-rater agreement between the parent and clinician illness severity scores (κ 0.049) (Figure 2), the parent scores and the number of parent-reported symptoms (Spearman's r 0.37), and the clinician scores and the number of parent-reported symptoms (Spearman's r 0.34). The clinician scores and the number of clinical signs are strongly positive correlated (Spearman's r 0.71); moderate positive correlation was found between clinician scores and the number of parent-reported symptoms plus the number of clinical signs (Spearman's r 0.60). Anchor controlling for the inter-rater agreement did not improve κ (0.064) (Figure 2).

Univariable analyses

All but one variable (oxygen saturation) had <1% data missing. There was no evidence of differences between children with high parent illness scores compared with those with low scores regarding age, sex, ethnicity, number of consultations in the previous 12 months, and current asthma. There was no evidence of differences between children with high clinician illness scores compared with those with low scores regarding ethnicity, number of consultations in the previous 12 months, and parent-reported moderate-to-severe diarrhoea (data not shown). Table 3 summarises the sociodemographic and clinical factors that were associated with higher and lower parent and clinician scores.

Multivariable analyses

Parent severity scores. The model included 8208/8394 (97.8%) of the children in the cohort. Eight predictors were strongly associated with parent severity scores at P<0.001:

Table 3. Univariable associations (*P*<0.01) with parental and clinician illness severity score

	Parent high severity score (≥7)[a]		Parent normal and low severity score (<7)			Clinician high severity score (≥4)[a]		Clinician normal and low severity score (<4)		
Significant variables	***n***	**%**	***n***	**%**	***P*-value**	***n***	**%**	***n***	**%**	***P*-value**
Sociodemographics and past medical history										
Male	[b]	[b]	[b]	[b]	[b]	1578/2938	53.7	2735/5422	50.4	<0.010
≥2 children at home	1493/2134	70.0	4004/6196	64.6	<0.001	2035/2925	69.6	3457/5397	64.1	<0.001
Illness deteriorated recently before consultation	1742/2143	81.3	3778/6216	60.8	<0.001	2300/2936	78.3	3214/5414	59.4	<0.001
Current asthma[c]	[b]	[b]	[b]	[b]	[b]	308/2938	10.5	437/5422	8.1	<0.001
Parent-/carer-reported general symptoms										
Change in cry	498/2132	23.4	880/6207	14.2	<0.001	634/2930	21.6	742/5403	13.7	<0.001
Rapid breathing	1085/2143	50.6	1885/6223	30.3	<0.001	1419/2938	48.3	1549/5419	28.6	<0.001
Wheezing/whistling in the chest	991/2143	46.2	2287/6220	36.8	<0.001	1395/2937	47.5	1879/5418	34.7	<0.001
Vomiting, including after a cough	738/2143	34.4	1603/6233	25.7	<0.001	933/2938	31.8	1407/5419	26.0	<0.001
Parent-/carer-reported symptoms (in previous 24 hours)										
Severe dry cough	256/2137	12.0	302/6202	4.9	<0.001	242/2931	8.3	319/5401	5.9	<0.001
Severe fever	296/2134	13.9	243/6204	3.9	<0.001	347/2922	11.9	193/5406	3.6	<0.001
Severe disturbed sleep	539/2133	25.3	806/6193	13.0	<0.001	625/2923	21.4	722/5394	13.4	<0.001
Severe reduction in eating	217/2131	10.2	210/6201	3.4	<0.001	252/2918	8.6	177/5405	3.3	<0.001
Rapid breathing	712/2137	33.3	916/6216	14.7	<0.001	852/2934	29.0	777/5410	14.4	<0.001
Moderate-to-severe wheezing in chest	581/2141	27.1	1033/6211	16.6	<0.001	784/2931	26.7	827/5412	15.3	<0.001
Moderate-to-severe diarrhoea	126/2143	5.9	216/6216	3.5	<0.001	[b]	[b]	[b]	[b]	[b]
Moderate-to-severe vomiting (including after a cough)	316/2138	14.8	521/6219	8.4	<0.001	340/2934	11.6	496/5414	9.2	<0.001
Moderate-to-severe reduced fluid intake	467/2133	21.9	688/6212	11.1	<0.001	551/2924	18.8	601/5412	11.1	<0.001
Moderate-to-severe reduction in urine passed	202/2132	9.5	260/6206	4.2	<0.001	261/2931	8.9	203/5401	3.8	<0.001
General clinical examination										
Pallor[d]	[d]	[d]	[d]	[d]	[d]	331/2934	11.3	489/5416	9.0	<0.001
Grunting	[d]	[d]	[d]	[d]	[d]	59/2933	2.0	16/5416	0.3	<0.001
Nasal flaring	[d]	[d]	[d]	[d]	[d]	79/2934	2.7	22/5417	0.4	<0.001
Temperature ≥37.8°C	[d]	[d]	[d]	[d]	[d]	690/2929	23.6	351/5409	6.5	<0.001
Raised respiratory rate (age-related cut-offs)	[d]	[d]	[d]	[d]	[d]	681/2932	23.2	560/5395	10.4	<0.001
Low oxygen saturation (≤95%)	[d]	[d]	[d]	[d]	[d]	234/1378	17.0	167/2804	6.0	<0.001
Irritable or drowsy	[d]	[d]	[d]	[d]	[d]	88/2936	3.0	29/5413	0.5	<0.001
Clinician's gut feeling that something is wrong	[d]	[d]	[d]	[d]	[d]	1213/2931	41.4	483/5413	8.9	<0.001
Inflamed pharynx/tonsils	[d]	[d]	[d]	[d]	[d]	196/928	21.1	187/5403	3.5	<0.001
Chest examination										
Wheeze[d]	[d]	[d]	[d]	[d]	[d]	776/2931	26.5	454/5416	8.4	<0.001
Crackles/crepitations	[d]	[d]	[d]	[d]	[d]	1140/2932	38.9	452/5415	8.3	<0.001
Raised respiratory rate (age-related cut-offs)	[d]	[d]	[d]	[d]	[d]	681/2932	23.2	560/5395	10.4	<0.001
Inter/subcostal recession	[d]	[d]	[d]	[d]	[d]	350/2934	11.9	53/5416	1.0	<0.001

*[a]Based on upper quartile of total dataset (*n *= 8394). [b]Not significantly associated. [c]Defined as present if asthma in medical notes and asthma medication issued in the previous 12 months. [d]Parents were not expected to clinically examine their child.*

- one demographic variable, ≥2 children at home (odds ratio [OR] 1.28, 95% CI = 1.15 to 1.44); and
- seven parent-reported symptoms, in order of importance:
  - severe fever (OR 2.58, 95% CI = 2.12 to 3.13);
  - severe dry cough (OR 1.93, 95% CI = 1.60 to 2.34);
  - rapid breathing (OR 1.88, 95% CI = 1.69 to 2.10);
  - severe reduction in eating (OR 1.58, 95% CI = 1.26 to 1.98);
  - moderate-to-severe reduced fluid intake (OR 1.55, 95% CI = 1.34 to 1.80);
  - severe disturbed sleep (OR 1.32, 95% CI = 1.14 to 1.52); and
  - change in cry (OR 1.30, 95% CI = 1.13 to 1.49).

Together these gave an area under the receiver operating characteristic curve (AUROC) of 0.68 (95% CI = 0.66 to 0.69) (Table 4).

Clinician severity scores. Two multivariable regression models were derived: one to compare with the parental model including demographics and parent-reported symptoms only (model one), and one including demographics, parent-reported symptoms, and clinical signs (model two). Both models included 8198/8394 (97.7%) of the children in the cohort. Model one identified four predictors with $P<0.001$, the last three of which were reported by a parent:

- illness deterioration recently before consultation (OR 2.11, 95% CI = 1.89 to 2.34);
- severe fever (OR 3.04, 95% CI = 2.52 to 3.67);
- rapid breathing (OR 1.78, 95% CI = 1.61 to 1.98); and

Table 4. Final multivariable predictors of high parent illness severity score and high clinician illness severity score (all $P<0.01$)

		Illness of severity score					
		High parent score (≥7) (AUROC 0.68, 95% CI = 0.66 to 0.69)		**High clinician score (≥4)** (AUROC 0.67, 95% CI = 0.66 to 0.68)		**High clinician score (≥4)** (AUROC 0.79, 95% CI = 0.79 to 0.80)	
		Model 1 (Demographics and symptoms)		**Model 1** (Demographics and symptoms)		**Model 2** (Demographics, symptoms, and clinical signs)	
	Source	**Odds ratio**	**95% CI**	**Odds ratio**	**95% CI**	**Odds ratio**	**95% CI**
Sociodemographic							
≥2 children at home	Parent	1.28	1.15 to 1.44		[a]		[a]
Clinical history							
Illness deteriorated recently before consultation	Parent		[a]	2.11	1.89 to 2.34	1.90	1.69 to 2.13
Symptoms							
Change in cry	Parent	1.30	1.13 to 1.49	1.29	1.14 to 1.46	1.39	1.21 to 1.59
Rapid breathing/raised respiratory rate[b]	Parent/clinician	1.88	1.69 to 2.10	1.78	1.61 to 1.98	1.43	1.28 to 1.59
Severe fever/temperature ≥37.8°C	Parent/clinician	2.58	2.12 to 3.13	3.04	2.52 to 3.67	3.58	3.12 to 4.10
Severe dry cough	Parent	1.93	1.60 to 2.34		[a]		[a]
Severe disturbed sleep	Parent	1.32	1.14 to 1.52		[a]		[a]
Severe reduced eating	Parent	1.58	1.26 to 1.98		[a]		[a]
Moderate-to-severe reduced fluid intake	Parent	1.55	1.34 to 1.80		[a]		[a]
Clinical examination							
Pallor	Clinician	–	–	–	–	0.58	0.49 to 0.70
Irritable or drowsy	Clinician	–	–	–	–	1.91	1.22 to 2.99
Nasal flaring	Clinician	–	–	–	–	3.08	1.76 to 5.41
Inter/subcostal recession	Clinician	–	–	–	–	4.91	3.54 to 6.82
Wheeze	Clinician	–	–	–	–	2.31	1.98 to 2.68
Crackles/crepitations	Clinician	–	–	–	–	4.79	4.18 to 5.50

[a]P≥0.01 and therefore not included in the model. [b]Age-related cut-offs. AUROC = area under the receiver operating characteristic curve. CI = confidence interval.

- change in cry (OR 1.29, 95% CI = 1.14 to 1.46).

The combined AUROC was 0.67 (95% CI = 0.66 to 0.68) (Table 4).

Adding clinical examination did not change model-one factors included but identified six additional signs. In order of importance, these were:

- inter/subcostal recession (OR 4.91, 95% CI = 3.54 to 6.82);
- crackles/crepitation (OR 4.79, 95% CI = 4.18 to 5.50);
- nasal flaring (OR 3.08, 95% CI = 1.76 to 5.41);
- wheeze (OR 2.31, 95% CI = 1.98 to 2.68);
- irritability/drowsiness (OR 1.91, 95% CI = 1.22 to 2.99); and
- pallor (OR 0.58, 95% CI = 0.49 to 0.70).

Together these gave an AUROC of 0.79 (95% CI = 0.78 to 0.80) (Table 4).

As clinicians were only able to take the oxygen saturation level for just over half of the children recruited (n = 4194, 50%), a multivariable model was derived using this smaller number of children. This sensitivity analysis did not substantially change the final models (data not shown).

DISCUSSION

Summary

Parent and clinician global illness severity assessment differed, with parents considering their child more unwell than clinicians. Factors associated with illness severity also differed between parents and clinicians, with parents relying on symptoms and clinician's on physical examination findings. That said, severe fever and rapid breathing were important for both parents and clinicians.

Strengths and limitations

The data used were from a well-characterised, large (England — London, Bristol, Southampton, and Oxford), representative cohort of children presenting to primary care with the most common problem managed by primary care health services. Participating children had similar levels of overall illness severity as those who were invited to participate in the study but declined to do so. Baseline characteristics were pragmatic, measured according to routine clinical practice, and had high level of completeness. The main outcome is clinically relevant and a stringent model retention criterion (P<0.01) was used because of the many candidate predictors. The study question described in this article was not the focus of the cohort study but a secondary hypothesis.

The main limitation was the use of a VAS to measure illness severity. This provides a simple technique for measuring subjective experience and has been established as valid and reliable in a range of clinical and research applications;[13] however, although ease of use is frequently cited as a major advantage over other scales, it has been pointed out that a VAS requires the ability to transform a complex assessment into a visual-spatial display, involving perceptual judgement and accuracy.[17] The VAS used in this study was anchored by 0 (well) and 10 (very unwell). During decision making, anchoring occurs when individuals use an initial piece of information to make subsequent judgements. Once an anchor is set, other judgements are made by adjusting away from that anchor. Anchor points of parents and clinicians might differ as clinicians are likely to be used to seeing many more ill children than parents (none of the clinicians gave a score of 10/10 [very unwell]), which might lead to a lower score of illness severity in general. As such, the poor agreement found between parent and clinician scores might be partly due to anchoring. However, agreement remained poor when adjustments were made for changes in anchoring and the authors found that different parent and clinician factors were associated with high severity scores.

Information on any prior assessment (for example, GP triage, NHS 111 triage, or pharmacist recommendation) that might have influenced a parent's decision to consult a GP was not included in the analyses but could have consequently influenced the parent's illness severity assessment.

Another limitation is that, although parents are taught to look out for signs of respiratory distress by GPs and 111 in general, comparisons were not like with like: parents did not clinically examine their child and might not be aware of clinical signs such as inter/subcostal recession. As such, modelling the drivers of severity scores was always going to give different results. However, this does reflect the actual situation that parents and clinicians must navigate.

Comparison with existing literature

The poor agreement between parent and clinician illness severity assessments found in the study presented here is consistent

with the results of a previous systematic review of qualitative evidence on the interaction of primary care consultations for children with acute minor illnesses.[18] That review concluded that common misunderstandings occur when parents and clinicians speak about the 'seriousness' of the illness, with parents and clinicians talking at cross-purposes: parents are seeking to justify their decision to consult, whereas clinicians seek to justify non-antibiotic treatment strategies.[18]

Although the analysis presented here showed that clinicians do take into consideration parent-reported symptoms, they seem to rely on clinical examination. The exploratory analysis on the correlation between the number of symptoms and clinical signs reported and the illness severity scores showed that the number of parent-reported symptoms does not influence the parent score, but the number of clinical signs does influence the clinician score. As such, the authors believe that the type of parent-reported symptom may be more important than the number, but for clinicians it could be a case of 'the more clinical signs, the more they worry' (meaning a higher score). This is consistent with qualitative evidence showing that GPs not only rely on the initial assessment, but also feel the need for a more deductive assessment, including physical examination, to refine their diagnosis and rule out serious illness.[5] A study by Blacklock *et al*, in which symptoms and clinical features correctly identify serious respiratory infection in children attending a paediatric assessment unit, showed that parent-reported symptoms were unreliable discriminators of serious acute respiratory infection in children.[19] Nurse trial assessment of respiratory distress and some vital signs, such as a temperature of ≥40°C, have also been found to be important predictors, which is in line with the findings presented here.[19]

The main analyses from this cohort study found that parent-reported fever and clinician-measured inter/subcostal recession, as well as wheeze on auscultation, are prognostically significant; these factors have been shown to have predictive utility in identifying children at risk of future hospitalisation resulting from their RTI.[12] These factors are also included as intermediate/red flags in the traffic-light system for identifying risk of serious illness published by the National Institute for Health and Care Excellence (NICE):

- fever (moderate and high);
- inter/subcostal recession (high); and
- wheeze (moderate).[20]

It is possible that parents have intuitively identified these factors as important and, therefore, also use them to assess illness severity.

Nothing was found in the literature to explain the counterintuitive findings of pallor and one child in the home being associated with lower illness severity scores. Contrary to the finding presented here, pallor is one of the red-flag symptoms identified in the NICE traffic-light system for identifying risk of serious illness in children with feverish illness.

Implications for practice

Interventions to promote self-care — one of the cornerstones of the NHS's sustainability strategy — should take account of the concerns that are likely to be the main drivers of parents seeking medical help. Some symptoms that are of importance to parents (severe dry cough, reduced eating, and disturbed sleep) have not shown to be predictive of poor outcome[12] and may be important targets for reassurance, for example, the likelihood of a parent perceiving illness to be severe is 14–52% higher for parents if their child's sleep has been disturbed but disturbed sleep was not a predictor of illness severity for clinicians. Moreover, how to identify and address these concerns should be included in primary care clinician (medical and nursing) training programmes, as recommended by Health Education England's recent strategy document, *Tackling Antimicrobial Resistance*.[21]

The study presented here showed that fever is associated with both high parent and clinician illness severity scores. Education on managing fever for parents and clinicians is key to making better-informed decisions as to when, or if, to consult and improving parent–clinician communication. In some cases, parent concerns regarding fever are the result of lack of experience and knowledge;[22,23] empowering parents and teaching them about alarm symptoms could ameliorate illness anxiety and, possibly, improve use of primary care services.[24] Advice on self-management for parents and carers could be provided to help patients self-manage fever.[25] However, severe fever in a primary care setting is also associated with serious infection[26] so parents may be correct to be concerned; as such, fever and fever management should be an important item

in guidelines (produced, for example, by NICE) and telephone triage protocols (for example, via NHS 111) on acute RTI.

Clinicians need to recognise that parents reach different conclusions and use different factors when making judgements about illness severity. Improved understanding of the factors that concern parents could improve parent–clinician communication and the quality of consultations, thereby also improving child health outcomes. Understanding parents' concerns and educating them about clinicians' concerns need to be part of day-to-day practice; balancing the two is essential to successfully manage patients with minor infection. Parent education should continue to be an important element of clinical care.

Funding

The TARGET Programme at the University of Bristol is funded by the National Institute for Health Research's Programme Grants for Applied Research (reference: RP-PG-0608-10018).

Ethical approval

The study was approved by the South West — Central Bristol Research Ethics Committee (reference number 10/H0102/54).

Provenance

Freely submitted; externally peer reviewed.

Competing interests

The authors have declared no competing interests.

Discuss this article

Contribute and read comments about this article: **bjgp.org/letters**

REFERENCES

1. Hay AD, Heron J, Ness A, ALSPAC study team. The prevalence of symptoms and consultations in pre-school children in the Avon Longitudinal Study of Parents and Children (ALSPAC): a prospective cohort study. *Fam Pract* 2005; **22(4):** 367–374.
2. Cabral C, Lucas PJ, Ingram J, *et al.* 'It's safer to ...' parent consulting and clinician antibiotic prescribing decisions for children with respiratory tract infections: an analysis across four qualitative studies. *Soc Sci Med* 2015; **136–137:** 156–164.
3. Ingram J, Cabral C, Hay AD, *et al.* Parents' information needs, self-efficacy and influences on consulting for childhood respiratory tract infections: a qualitative study. *BMC Fam Pract* 2013; **14:** 106.
4. Ertmann RK, Reventlow S, Söderström M. Is my child sick? Parents' management of signs of illness and experiences of the medical encounter: parents of recurrently sick children urge for more cooperation. *Scand J Prim Health Care* 2011; **29(1):** 23–27.
5. Horwood J, Cabral C, Hay AD, Ingram J. Primary care clinician antibiotic prescribing decisions in consultations for children with RTIs: a qualitative interview study. *Br J Gen Pract* 2016; DOI: https://doi.org/10.3399/bjgp16X683821.
6. Stewart MA. Effective physician-patient communication and health outcomes: a review. *CMAJ* 1995; **152(9):** 1423–1433.
7. Stewart M. Towards a global definition of patient centred care. *BMJ* 2001; **322(7284):** 444–445.
8. Stewart M, Brown JB, Donner A, *et al.* The impact of patient-centered care on outcomes. *J Fam Pract* 2000; **49(9):** 796–804.
9. Clarke SA, Davies H, Jenney M, *et al.* Parental communication and children's behaviour following diagnosis of childhood leukaemia. *Psychooncology* 2005; **14(4):** 274–281.
10. Wyke S, Hewison J, Russell IT. Respiratory illness in children: what makes parents decide to consult? *Br J Gen Pract* 1990; **40(335):** 226–229.
11. Redmond NM, Davies R, Christensen H, *et al.* The TARGET cohort study protocol: a prospective primary care cohort study to derive and validate a clinical prediction rule to improve the targeting of antibiotics in children with respiratory tract illnesses. *BMC Health Serv Res* 2013; **13(1):** 322.
12. Hay AD, Redmond NM, Turnbull S, *et al.* Development and internal validation of a clinical rule to improve antibiotic use in children presenting to primary care with acute respiratory tract infection and cough: a prognostic cohort study. *Lancet Respir Med* 2016; **4(11):** 902–910.
13. McCormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: a critical review. *Psychol Med* 1988; **18(4):** 1007–1019.
14. Mackway-Jones K, Molyneux E, Phillips B, Wieteska S. eds. *Advanced paediatric life support: the practical approach.* 4th edn. Oxford: Blackwell Publishing Ltd, 2005.
15. Office for National Statistics. *2011 Census: population and household estimates for England and Wales, March 2011.* 2012.
16. Office for National Statistics. *Integrated household survey (experimental statistics): April 2011 to March 2012. Sexual identity, smoking prevalence and perceived general health using data from the Integrated Household Survey.* 2012. https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/sexuality/bulletins/integratedhouseholdsurvey/2012-09-28 (accessed 28 Feb 2019).
17. Carlsson AM. Assessment of chronic pain I: aspects of the reliability and validity of the visual analogue scale. *Pain* 1983; **16(1):** 87–101.
18. Cabral C, Horwood J, Hay AD, Lucas PJ. How communication affects prescription decisions in consultations for acute illness in children: a systematic review and meta-ethnography. *BMC Fam Pract* 2014; **15:** 63.
19. Blacklock C, Mayon-White R, Coad N, Thompson M. Which symptoms and clinical features correctly identify serious respiratory infection in children attending a paediatric assessment unit? *Arch Dis Child* 2011; **96(8):** 708–714.
20. National Institute for Health and Care Excellence. *Fever in under 5s: assessment and initial management. CG160.* London: NICE, 2013. Last updated: August 2017. https://www.nice.org.uk/guidance/cg160 (accessed 28 Feb 2019).
21. Health Education England. *Tackling antimicrobial resistance: educational priorities.* 2018. https://www.hee.nhs.uk/sites/default/files/documents/Tackling%20antimicrobial%20resistance%20-%20educational%20priorities%20report.pdf (accessed 28 Feb 2019).
22. Kai J. What worries parents when their preschool children are acutely ill, and why: a qualitative study. *BMJ* 1996; **313(7063):** 983–986.
23. Kelly M, Sahm LJ, Shiely F, *et al.* Parental knowledge, attitudes and beliefs on fever: a cross-sectional study in Ireland. *BMJ Open* 2017; **7(7):** e015684.
24. de Bont EG, Dinant GJ, Elshout G, *et al.* An illness-focused interactive booklet to optimise management and medication for childhood fever and infections in out-of-hours primary care: study protocol for a cluster randomised trial. *Trials* 2016; **17(1):** 547.
25. Martin DD. Fever: views in anthroposophic medicine and their scientific validity. *Evid Based Complement Alternat Med* 2016; **2016:** 3642659.
26. Van den Bruel A, Haj-Hassan T, Thompson M, *et al.* Diagnostic value of clinical features at presentation to identify serious infection in children in developed countries: a systematic review. *Lancet* 2010; **375(9717):** 834–845.