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BMJ Open Clinical management and impact of scarlet fever in the modern era: findings from a cross-sectional study of cases in London, 2018–2019

Michael Trent Herdman ^(b),^{1,2} Rebecca Cordery,³ Basel Karo,¹ Amrit Kaur Purba,³ Lipi Begum,³ Theresa Lamagni,¹ Chuin Kee,⁴ Sooria Balasegaram,¹ Shiranee Sriskandan ^(b) ^{5,6,7}

ABSTRACT

Objectives In response to increasing incidence of scarlet fever and wider outbreaks of group A streptococcal infections in London, we aimed to characterise the epidemiology, symptoms, management and consequences of scarlet fever, and to identify factors associated with delayed diagnosis.

Design and setting Cross-sectional community-based study of children with scarlet fever notified to London's three Health Protection Teams, 2018–2019.

Participants From 2575 directly invited notified cases plus invitations via parental networks at 410 schools/ nurseries with notified outbreaks of confirmed/probable scarlet fever, we received 477 responses (19% of those directly invited), of which 412 met the case definition. Median age was 4 years (range <1 to 16), 48% were female, and 70% were of white ethnicity.

Outcome measures Preplanned measures included quantitative description of case demographics, symptoms, care-seeking, and clinical, social, and economic impact on cases and households. After survey completion, secondary analyses of factors associated with delayed diagnosis (by logistic regression) and consequences of delayed diagnosis (by Cox's regression), and qualitative analysis of free text comments were added.

Results Rash was reported for 89% of cases, but followed onset of other symptoms for 71%, with a median 1-day delay. Pattern of onset varied with age: sore throat was more common at onset among children 5 years and older (OR3.1, 95% Cl 1.9 to 5.0). At first consultation, for 28%, scarlet fever was not considered: in these cases, symptoms were frequently attributed to viral infection (60%, 64/106). Delay in diagnosis beyond first consultation occurred more frequently among children aged 5+ who presented with sore throat (OR 2.8 vs 5+without sore throat; 95% Cl 1.3 to 5.8). Cases with delayed diagnosis took, on average, 1 day longer to return to baseline activities.

Conclusions Scarlet fever may be initially overlooked, especially among older children presenting with sore throat. Raising awareness among carers and practitioners may aid identification and timely treatment.

Strengths and limitations of this study

- We describe the clinical features and epidemiology of a disease that has seen limited observational research since the early 20th century.
- We quantify delayed diagnosis and identify factors associated with this delay and the consequences of delays for cases and their household members.
- We ascertain not only clinical consequences for participating cases, but evidence of onward transmission, time off school and time off work for carers.
- By surveying parents and guardians of notified cases, we obtain the perspective of carers on the impact of illness on the case and household (though, in consequence, we do not directly capture the perspective and rationale of clinicians).
- The survey's low response rate highlights the risk of selection bias: participants may not fully represent the population affected by scarlet fever.

INTRODUCTION

Background and rationale

Improving clinical and public health management of scarlet fever depends on updating our understanding of the disease. Classical descriptions of its presentation and transmission from the early 20th century do not adequately reflect modern demographics, clinical practice or modern understanding of the pathogenesis and epidemiology of superantigen-expressing group A streptococci (GAS).¹⁻⁴ Incidence of scarlet fever in England and Wales declined from the 1940s to the mid-2010s, but increased markedly in the 5 years leading up to the pandemic lockdown of 2020, coinciding with the emergence of a dominant, more toxigenic lineage of GAS.⁵⁻¹⁰

Recognising scarlet fever and commencing antibiotics and public health actions reduces the risk of sequelae and onward transmission.¹⁰

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Correspondence to Prof. Shiranee Sriskandan; s.sriskandan@imperial.ac.uk Scarlet fever is a notifiable infectious disease in England, usually diagnosed from symptoms and signs, with or without confirmation of GAS expressing erythrogenic toxins. The triad of fever, sore throat and rash is typical, but non-specific: this presentation may be mistaken for viral infection, or for mild pharyngitis or tonsillitis if the rash appears after other symptoms.¹¹ Clinicians face a challenge in distinguishing scarlet fever and other severe manifestations of GAS infection—for which antibiotics should be commenced early—from viral upper respiratory tract infections, for which antibiotics should be avoided.

Scarlet fever has consequences not only for the infected individual, but also for their household and community. To prevent onward transmission, identified cases are excluded from school or nursery until 24 hours after starting antibiotics; this has an educational cost for the case, plus a wider economic impact on parents or guardians who provide childcare. Given the high transmissibility of GAS, household members also face a greater risk of infection. Updating our understanding of the disease includes updating our assessment of these wider consequences.

Objectives

To inform clinical and public health practice during a surge in scarlet fever notifications in London, we surveyed the parents and guardians of cases, characterising presenting features and healthcare experience, analysing factors associated with delayed diagnosis, and identifying the health and economic impact of late recognition for cases and their households.¹⁰

METHODS

Study design and recruitment

We sent postal invitations to an online survey (Select-Survey V.4.0) to parents and guardians of all children under 16 with scarlet fever notified by clinicians to Public Health England (PHE) Health Protection Teams (HPTs) in 1 March 2018–31 May 2018 in London (online supplemental file 1). From 1 March 2019 to 31 May 2019, a modified version of the survey (omitting or rewording some questions, adding others) was sent to parents/ guardians of notified sporadic cases and circulated to parental networks of schools or nurseries with notified outbreaks (online supplemental file 2). We did not send follow-up invitations to non-respondents. Public health management of cases and outbreaks was according to national guidelines used by HPTs.¹²

The case definition of scarlet fever matched PHE guidance definitions of confirmed or probable scarlet fever: for sporadic cases identified through statutory notification (including the index cases of suspected outbreaks), a case constituted a clinical diagnosis of scarlet fever by a health professional (with or without detection of GAS on a throat swab); in the context of an established outbreak, cases required a credible report of signs or symptoms consistent with scarlet fever with a close epidemiological link to a confirmed or probable case (with or without confirmation by a health professional).¹²

Surveys collected data on demographics, medical history, contact history, symptoms, care-seeking behaviour, diagnoses and clinical management by health professionals, impact on household caregivers, and knowledge and attitudes regarding scarlet fever on the part of the responding parent or guardian.

Participant information was provided as preamble to the survey. Participation was voluntary and anonymised. Informed consent was inferred from survey participation.

Data analysis

Quantitative data description and analysis were performed using Stata V.14.2 and GraphPad Prism V.7.0. Study size was determined pragmatically, attempting to contact as many notified cases and schools/nurseries as possible over the course of two high-transmission seasons.

Age was collected as a continuous variable and stratified to under 5 years or 5 years and older to increase statistical power and reflect the age at which school attendance starts. Other demographic and clinical exposure variables were ascertained and analysed dichotomously. Ethnicity proportions were compared with Department for Education primary schools data for London.¹³ In assessing symptoms and signs, description was restricted to cases diagnosed by a health professional.

For analysis of variables associated with delayed diagnosis, the outcome was defined dichotomously as a case for whom scarlet fever was not considered in the differential diagnosis at the first consultation with a clinician (in the recollection of the responding parent or guardian). A logistic regression model was constructed using a stepwise, subtractive approach. Models were compared using Akaike's information criteria and Bayesian information criteria, with likelihood ratio tests used to address ambiguous comparisons, and stratifying as required to address effect modification.

Consequences of delayed diagnosis (defined dichotomously as above) were assessed in terms of days until recovery to normal activity, days of school/nursery missed, and days of work missed by parents/guardians, constructing Cox's proportional hazards regression models for each outcome (subject to the condition of proportionality). The model for time to recovery to normal activity was limited to data from the 2019 survey, as it was not ascertained in 2018. Missing values were addressed in regression models by introducing an additional category for unknown values of categorical variables. Cases with missing values for the outcome variables in Cox's regression were excluded from the analysis.

Qualitative textual analysis

Free text volunteered by respondents was coded in NVivo V.13 and Microsoft Excel using a thematic matrix for responses concerning perception of scarlet fever, and analysed to characterise experiences of the illness,

accessibility of information and care, experiences of the health service, and impact on the case and their household, and identify ramifications for providers of clinical practice and health protection.

Patient and public involvement

Parents of children who had been directly affected by severe GAS infection were involved in the design and content of the questionnaire, while parents of children with other illnesses were involved in trialling the questionnaire. Patients were not directly involved in the development of the original research question or the mode of recruitment and conduct of the study. As responses were anonymous, results cannot be directly disseminated to participants.

RESULTS

Demographic characteristics of participating cases

London HPTs identified 4172 cases of confirmed or probable scarlet fever in children 0-14 years old, and 263 school/nursery outbreaks in 2018, plus 2656 cases and 147 school/nursery outbreaks in 2019. We contacted parents or guardians of 1703 cases notified March-May 2018, plus 872 cases notified March-May 2019 (along with an unknown number contacted through dissemination of invitations via parental networks in outbreakaffected schools/nurseries). Surveys were completed for 477 children (response rate 19% of those directly invited; unknown response rate from schools/nurseries), 412 of whom met the case definition (339 in 2018, and 73 in 2019). Median age was 4 years (IQR 2-6; range <1 year to 16). In 381 cases (92%), scarlet fever was diagnosed by a health professional; 31 cases (8%) had a confirmed epidemiological link to an outbreak but may not have been diagnosed by a health professional, and hence were excluded from analyses of clinical features.

Case characteristics are described in table 1. Compared to 2015 Department for Education estimates for all children in primary schools in London, responses showed a higher proportion of white participants (70% vs 42% in primary schools, p<0.001) and lower proportions of participants of Asian/Asian British (12% vs 20%, p<0.001) and black/African/Caribbean/black British ethnicity (5% vs 21%, p<0.001).¹³

Clinical characteristics

Rash was the most commonly identified symptom, reported by 89% of respondents (table 2). Fever and sore throat were more likely than rash to be noted first. Among respondents commenting on the timing of the rash relative to other symptoms, 71% (32 of 45 responding) reported the rash followed other symptoms, with a median 1-day delay (IQR 0–2.5 days; range 0–15 days). Cases with a history of recurrent sore throat were more likely to present with sore throat initially (OR 1.9, 95% CI 1.2 to 2.9, p=0.008), and substantially more

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 Table 1
 Demographic characteristics of participating scarlet fever cases (n=412)

	Cases	
Characteristics	N (%)	
Age group		
0–2 years	66 (16)	
3–4 years	156 (38)	
5–9 years	177 (43)	
10–16 years	12 (3)	
missing	1	
Sex		
Female	197 (48)	
Male	212 (52)	
Missing/prefer not to say	3	
Ethnicity		
Asian/Asian British	47 (12)	
Black/African/Caribbean/Black British	21 (5)	
Mixed/multiple ethnicities	48 (12)	
White	287 (70)	
Other	5 (1)	
Missing/prefer not to say	4	
School group		
Nursery/play group	167 (43)	
Reception class	85 (20)	
Primary school year 1	48 (12)	
Primary school year 2	31 (8)	
Primary school year 3	28 (7)	
School beyond year 3	33 (8)	
Missing/none volunteered	20	
General health prior to scarlet fever		
Ever hospitalised (for any reason)	107 (26)	
Follow-up in outpatient clinic	38 (9)	
Chronic underlying illness*	8 (2)	
Upper respiratory tract history		
≥1 episode of sore throat in preceding year	190 (49)	
Previous isolation of GAS	13 (3)	
Previous tonsillectomy	11 (3)	

*Four report asthma; three report recurrent tonsillitis. GAS, group A streptococci.

likely to experience a sore throat at some point in the illness (OR 11.3, 95% CI 4.4 to 29.3, p<0.001).

Seventy per cent of respondents characterising the rash (19/27) described it as sand-papery or rough to feel, 63% (17/27) as red, 26% (7/27) as comprising small spots, 19% (5/27) as pink, 15% (4/27) as itchy, and 4% (1/27) as peeling off. Median duration of the rash was 5 days (IQR 3–8 days; range 1–14 days). 69% (18/26) reported the rash first appeared on the trunk, 19% (5/26) on the

Diarrhoea

	All ages	Under 5 years old	5 years and older	χ^2 test p value
Symptom	n/total (%)	n/total (%)	n/total (%)	<5 year vs ≥5 year
First symptom(s) noted:	:			
Fever	154/338 (46)	97/180 (54)	57/158 (36)	0.001
Sore throat	132/338 (39)	48/180 (27)	84/158 (53)	<0.001
Rash	115/338 (34)	72/180 (40)	43/158 (27)	0.014
Not playing/tiredness	57/338 (17)	36/180 (20)	21/158 (13)	0.101
Symptom ever noted:				
Rash	336/377 (89)	187/207 (90)	149/170 (88)	0.404
Fever	327/370 (88)	184/204 (90)	143/166 (86)	0.227
Sore Throat	289/355 (81)	151/192 (79)	138/163 (85)	0.147
Tiredness	249/338 (74)	136/180 (76)	113/158 (72)	0.401
Enlarged tonsils	180/279 (65)	100/155 (65)	80/124 (65)	1
Not eating	216/338 (64)	126/180 (70)	90/158 (57)	0.013
Not playing	158/338 (47)	86/180 (48)	72/158 (46)	0.685
Headache	124/338 (37)	53/180 (29)	71/158 (45)	0.003
Pus on tonsils	101/270 (37)	54/151 (36)	47/119 (40)	0.53
Sore tongue	102/338 (30)	57/180 (32)	45/158 (28)	0.525
Stomach ache	94/338 (28)	44/180 (24)	50/158 (32)	0.141
Vomiting	77/338 (23)	48/180 (27)	29/158 (18)	0.07
Swollen tongue	52/338 (15)	28/180 (16)	24/158 (15)	0.926
Earache	50/338 (15)	21/180 (12)	29/158 (18)	0.085

24/180 (13)

face, and 12% (4/26) on the arms and legs. Rash was identified in 89% of White cases and 90% of cases of other ethnicities (p=0.75).

38/338 (11)

The pattern of symptoms at onset varied with age. Sore throat was a more common initial symptom among cases 5 years and older (OR 3.1, 95% CI 1.9 to 5.0, p<0.001). Rash and fever were less likely at onset among cases 5 years and older (respectively OR 0.6, 95% CI 0.4 to 0.9, p=0.014; OR 0.5, 95% CI 0.3 to 0.8, p=0.001).

Differential diagnosis and clinical management

Table 3 summarises the sources of care sought for cases. Median duration from onset of symptoms to seeing a health professional was 2 days (IQR 1-3 days; range <1-14 days). For 31% of cases, additional consultations were undertaken (with 14% requiring three or more consultations).

At the first consultation with a doctor, 72% of cases (268/374) had scarlet fever as the diagnosis (or part of the differential diagnosis). When the diagnosis was delayed, 60% (64/106) had their illness ascribed to a viral infection, 21% (22/106) to tonsillitis, and 13% (14/106) to pharyngitis. Throat swabs were taken from 44% of cases (148/338). Of those who knew the results of the swab, 91% (75/82) reported GAS was isolated. Antibiotic prescribing practices are described in online

supplemental table S1. Ninety-three per cent of cases were prescribed an agent consistent with clinical guidelines.

0.195

Burden and impact of disease

14/158 (9)

Eighty per cent of cases (329/402) missed school because of their illness, with a median of 3 days lost (IQR 2-4 days; range 1-14 days). 86% of cases (316/369) were treated with over-the-counter medications (such as paracetamol or ibuprofen) in addition to prescribed antibiotics. Median time from starting antibiotics to return to normal activity such as attending school or nursery was 2 days (IQR 1-4 days; range 0-8 days, asked only in 2019, with 71 respondents).

For 53% of cases (198/372), at least one carer took time off work, with a median total of 2 days taken as leave (IQR 1–3; range 0–11 days). In 23% of cases (92/398), a carer became ill themselves. In 22% (67/301), the child's usual carers required additional help with care during the illness—provided by family members for 80%, paid professionals for 15%, and friends for 5%. In 11% of cases (37/337), other children in the household also missed school: predominantly because they were unwell themselves; less frequently because of dependence on the caregiver to transport siblings to school. In 2019, 43% (34/79) reported other unwell family members: 29 with sore throat, 10 with tonsillitis, 6 with scarlet fever,

Table 3 Pathways of care for partic	ipating cases
Care pathways (among n responding)	n (%)
First source of advice (332):	
General practitioner	267 (80)
NHS Direct telephone advice	39 (12)
Walk-in centre	30 (9)
Hospital emergency department	27 (8)
Internet	26 (8)
Urgent care centre	16 (5)
Local pharmacy	14 (4)
School nurse	3 (1)
Initial differential included SF (367)	265 (72)
Repeat visit to HCW needed (380)	116 (31)
Source of second consultation (116):	
General practice	71 (61)
Emergency department	14 (12)
Urgent care centre	11 (9)
Other	5 (4)
Reason for second consultation (116):	
Child developed new symptom(s)	44 (38)
Worried that it could be scarlet fever	37 (32)
Asked to come back if not better	19 (16)
Could not take prescribed medication	6 (5)
Called back due to swab result	6 (5)
Other*	4 (3)
Hospitalised (326)	7 (2)

*Two for further investigations, two for specialist consultation. HCW, Health Care Worker; NHS, National Health Service; SF, Scarlet Fever.

one each with cellulitis and conjunctivitis (11 households identified multiple illnesses).

Risk factors for delayed diagnosis

In a logistic model for delayed diagnosis among 321 cases in 2018, the strongest fit was provided by variables for age (under 5 years vs 5 and older), sore throat at onset, and interaction between these variables (table 4, online supplemental table S2). No other variables affected the model fit. Among cases aged 5 years and older, those with sore throat present at symptom onset had 2.8 times the odds of a delayed diagnosis compared with those without (95% CI 1.3 to 5.8, p<0.01). Among cases aged under 5, we found no evidence of an association between sore throat and delayed diagnosis (aOR 0.6, 95% CI 0.3 to 1.5, p=0.33).

Consequences of delayed diagnosis

Cases returned to normal activity faster when scarlet fever was considered at the first consultation (33/52; ascertained in 2019 only), with a median recovery time of 2 days from starting antibiotics when scarlet fever was considered, vs 3 when it was not, and an HR for recovery

of 0.53 (95%CI 0.28 to 0.99; p=0.047; online supplemental figure S1). Cases diagnosed without delay returned to school sooner, with a median of 2 days off (246/298) and 3 days for those with delay (92/298) (HR 0.77, 95% CI 0.59 to 0.99; p=0.045). We found no difference in days of work missed by carers between the two groups, with a median of 2 days missed for both (HR 0.91, 95% CI 0.64 to 1. 29; p=0.592). Due to the phrasing of the survey, we could not distinguish between disease burden on patients who commenced antibiotics before scarlet fever was diagnosed (for another indication), and those who did so only once diagnosed.

Qualitative synthesis

In thematic analysis of 194 free-text comments (table 5), some respondents reported reassurance that a diagnosis was made promptly by practitioners who recognised the syndrome: others were disappointed that antibiotic treatment was delayed where symptoms were attributed to viral infection. Representativeness of online resources was questioned, such as the difficulty in finding depictions of the rash on non-White skin. While some respondents noted rapid recovery and minimal impact, others recorded spread of streptococcal infections to carers and other household members, and a wider impact of the time demands and stress of providing care to unwell children.

DISCUSSION Summary

Undertaken at a time of increased incidence, this study provides an update on the epidemiology and presentation of scarlet fever, identifies opportunities to improve recognition, and highlights the previously unquantified burden of disease on affected households. Most cases eventually experienced fever, rash and sore throat, but older children were more likely to experience sore throat first, perhaps because younger children were less able to recognise and describe a sore throat. The sand-papery rash of scarlet fever was eventually perceived by most carers, but it tended to appear after other symptoms, a median of 1 day later. Faced with the clinical challenge of distinguishing scarlet fever from viral exanthems and other causes of fever and sore throat, an awareness of the timing and sand-papery character of scarlet fever's rash may help practitioners make the diagnosis and commence treatment.

Practitioners should be alert to circumstances in which scarlet fever is easily overlooked. In this survey, a delay in diagnosis among older children was 2.8 times as likely when a sore throat was present at onset, with symptoms often ascribed to viral infection. Timely recognition of scarlet fever in this age group could expedite antibiotic treatment, shorten the period of infectivity, and reduce onward propagation of GAS.

Our findings highlight the interconnectedness of scarlet fever and GAS infections more widely: 43% of respondents in 2019 reported unwell family members, many
 Table 4
 Crude analysis of demographic and clinical variables associated with delayed diagnosis (diagnosis of scarlet fever not considered at first consultation with healthcare; n=374)

Variable		All cases N	Delayed diagnosis N (%)	Crude OR	95% CI	χ^2 test p value
Age (years)	0 to 2	62	12 (19)	1		
	3 to 4	145	37 (26)	1.43	0.68 to 2.98	
	5 to 6	88	27 (31)	1.84	0.84 to 4.04	
	7 to 16	79	30 (38)	2.55	1.15 to 5.65	0.01*
Sex	Female	176	46 (26)	1		
	Male	197	60 (30)	1.24	0.79 to 1.95	0.36
Ethnicity	White	265	77 (29)	1		
	Mixed	44	10 (23)	0.72	0.34 to 1.53	
	Asian	41	11 (27)	0.9	0.43 to 1.88	
	Black	18	6 (33)	1.22	0.44 to 3.38	
	Other	5	1 (20)	0.61	0.07 to 5.78	0.59†
Educational setting	Nursery	156	36 (23)	1		
	School	200	66 (33)	1.64	1.02 to 2.65	0.04
Healthy at baseline	Yes	339	97 (29)	1		
	No	31	9 (29)	1.02	0.45 to 2.30	0.96
Past sore throat or	Yes	175	58 (33)	1		
tonsillitis	No	179	43 (24)	0.64	0.40 to 1.01	0.06
Known SF contact	Yes	125	34 (27)	1		
	No	83	30 (36)	1.51	0.83 to 2.76	0.17
Sore Throat at onset	Yes	128	42 (33)	1		
	No	193	44 (23)	0.6	0.37 to 1.00	0.05
Fever at onset	Yes	147	39 (27)	1		
	No	174	47 (27)	1.02	0.62 to 1.68	0.92
Tiredness at onset	Yes	55	68 (26)	1		
	No	266	18 (33)	0.71	0.38 to 1.32	0.28
Rash at onset	Yes	109	24 (22)	1		
	No	212	62 (29)	1.46	0.85 to 2.52	0.17

 $^{*}\chi^{2}$ test for trend.

 $+\chi^2$ test for homogeneity.

SF, Scarlet Fever.

with symptoms attributable to GAS (scarlet fever, pharyngitis, tonsillitis, cellulitis). Such epidemiological links are important both in assessing the full impact of the disease, and in guiding clinical and public health management. Asking about unwell contacts may lead to the diagnosis: a key consideration not only for scarlet fever, but also for other infections presenting with fever, rash and upper respiratory symptoms of major clinical and public health concern (such as measles and rubella).¹⁴

Comparison with existing literature and guidance

The clinical features of scarlet fever described by respondents corroborate classical descriptions of the disease from the early 20th century, and the information contained in current UK public health and clinical guidance.^{4 12 15 16} The ability of clinicians and parents to distinguish scarlet fever from more common and less severe infections is the key to its effective treatment. Current UK clinical guidance for sore throat advises primary care physicians to give antibiotics only when a more serious condition (such as suppurative infection or sepsis) is suspected.¹⁷ Fever-PAIN and Centor scores are validated in rapid appraisal for GAS pharyngitis, but scarlet fever falls outside their scope.^{18 19} When it appears and is recognised, the rash of scarlet fever should prompt practitioners to commence antibiotics-particularly during the spring season when incidence typically increases (from March to May in the UK).²⁰ The public health importance of prompt diagnosis and treatment is underscored by the 12-fold greater risk of invasive GAS among household contacts of scarlet fever cases.¹⁰ Advice to avoid unnecessary antibiotics for most sore throats is valuable to antimicrobial stewardship: the caveat is that scarlet fever and other GAS infections require antibiotics to prevent complications and reduce onward spread.

Table 5 Thematic analysis of free-tex	t comments from respondents to questionr	naires, 2018–2019
Thematic analysis:	Implications for public health:	Implications for clinical practice:
 Experience of illness and care: Perceived stigma and fear of spread in family or school. Valued leaflets shared in school outbreaks. Noted lack of representation in online materials (including lack of images of the rash on darker skin). 	 Need for reassurance of confidentiality. Value of rapid communication and dissemination of information during outbreaks. Importance of inclusive and diverse educational materials. 	 Clinical communication should take account of fears of complications, transmission and stigma. Need for clinical and parental awareness of presentation across entire population and of how the rash presents on all skin types.
 Causes of delays Perceived link between slow communication to parents and delays in controlling outbreaks. Some observed misdiagnosis or failure to note characteristic features at early consultations; other impressed by rapid recognition and treatment by health professionals. Some experienced delays awaiting swab results. 	 Circulation of information through school channels can help parents engage with public health response. Communicate public health surveillance and guidance to clinicians and schools, especially during seasonal peaks and outbreaks, to aid recognition. Timely public health action may start before microbiological confirmation. 	 Alertness to outbreaks in households and schools can inform clinical index of suspicion. Balanced practice of sound antibiotic stewardship for childhood fevers and sore throats, with timely initiation for scarlet fever and invasive infections. Consider swabbing and issuing prescription, with clear guidance on when to start, to avoid delay.
 Consequences of delays Worry, annoyance, and anger that late diagnosis could increase risk of complications. Carers and other household members reported secondary infections or fear of secondary infections. Wider economic and social impact of caring for children during recovery and exclusion. 	 Balanced messaging: treatment is important but severe complications are rare. Communicate the risk of secondary household cases: scarlet fever and other GAS infections. Calculations of disease burden should address impact on health, education and income, for entire household. 	 Awareness and timely identification preserve trust in practitioners. Be alert to secondary cases of scarlet fever and other GAS infections: screen for other unwell household members, and communicate risk when diagnosis is made.

GAS, group A streptococci.

In some contexts, a patient's risk of developing autoimmune sequelae of GAS infection (acute rheumatic fever or poststreptococcal glomerulonephritis) may influence a clinician's decision to prescribe antibiotics. For example, clinical guidance in Australia and New Zealand advises that patients at higher risk of such sequelae (such as members of some indigenous populations and children living in crowded accommodation) might warrant a lower threshold for prescribing antibiotics.^{21 22}

In this study, 80% of children missed school/nursery for a median of 3 days. Time to recovery and return to school was longer when diagnosis was delayed. As the average primary school pupil misses 7.4 days a year, this increase is substantial.^{23 24} Scarlet fever affected almost 32 000 children in the UK in 2018^{25} ; the direct medical costs, including hospital admissions (1 in 40 case in 2014), plus the risk of secondary GAS infections, and the non-medical costs of childcare, lost education and time off of work for parents and carers, amount to a sizeable health and economic burden.^{5 26}

Strengths and limitations

By surveying notified scarlet fever cases, this study draws on the experience of patients and households accessing primary care. However, the low response rate to survey invitations highlights a risk of selection bias. Parents of cases with a more severe illness may have been more motivated to respond to the survey; in this case, failure to include mild or atypical cases could have led to overestimation of disease burden. Alternatively, if parents facing greater obstacles to care were less likely to participate, the survey may have under-represented underserved communities.

Compared with the population at risk, more cases were white than would be expected by chance. This discrepancy could represent bias in recognition or notification, given that invasive GAS infection is observed with higher incidence in ethnicities other than white.²⁴ ²⁷ ²⁸ It is important that educational materials for the public and for clinicians represents the population at risk equitably: failure to depict a diverse population may prevent awareness of how the rash appears on all skin types. Respondents observed difficulty finding illustrations of the rash on non-white skin, corroborating under-representation in educational materials noted elsewhere.^{29–31} Systematic collection of data on ethnicity when conditions such as scarlet fever are notified can help identify disparities in access to care, so that they can be addressed.³²

The timing of the survey in relation to the clinical episode presents challenges, and a risk of ascertainment bias. Surveying a parent/guardian too soon after the clinical episode would risk failing to ascertain the full burden of disease on the patient and household, if longer-term complications are not captured; surveying too late would risk recall bias, if the respondent misremembers the

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details of the illness and its management. A longitudinal study of cases and households affected by scarlet fever would overcome these limitations, and provide further insights into the clinical and economic impact of infection and the variables associated with adverse outcomes.

Because this survey sought the perspective of parents and carers, it did not fully capture the perspective and practice of clinicians. We report aspects of clinical management—such as differential diagnosis, isolation of GAS and choice of antibiotics—to the extent that they were known and recalled by respondents. Clinicians may also have identified subtle clinical symptoms and signs not recognised by respondents: this could account for the small number of cases with a diagnosis of scarlet fever for whom rash or fever was not reported. A parallel survey of primary care practitioners with access to medical records would corroborate these observations, reduce the likelihood of recall bias, and help identify challenges of clinical decision-making for patients with possible scarlet fever.

Implications for practice and research

Differentiating scarlet fever from viral infections presents a clinical challenge: sore throat is common to both conditions, and the rash of scarlet fever, though characteristic, may be subtle or delayed. The challenge of keeping diagnostic algorithms and recommendations up to date is underlined further by the emergence of a new cause of acute febrile illness, namely COVID-19.³³ When there is diagnostic uncertainty, clinical priorities include ruling out measles (for which links to known cases and vaccination history are key)¹⁴ and directing antibiotic therapy appropriately.

In managing outbreaks of GAS, there may be a role for molecular point-of-care tests, to guide prescribing decisions for clinically ambiguous cases where the pretest probability is high, though their use in this setting requires further evaluation.^{18 34 35} Until the sensitivity, timeliness and cost-effectiveness of diagnostic tests improve, the diagnosis of scarlet fever usually depends on clinical evaluation of symptoms and signs, in the context of current epidemiological trends, with subsequent microbiological confirmation where possible.³⁵ Alertness to seasonal peaks in scarlet fever and the occurrence of local outbreaks may help set an appropriate index of suspicion.^{5 36} Increased local incidence should drive more communication between clinicians and carers about symptoms of concern (such as a sand-papery rash), so that new symptoms can be evaluated as they evolve. The need for sound antimicrobial stewardship should not preclude access to timely clinical diagnosis of scarlet fever, microbiological testing, and empirical prescribing where they are indicated.

Further research into the interplay of scarlet fever and invasive GAS at a population level will help direct diagnostic, treatment and public health strategies to reduce the impact of outbreaks. The strains of GAS that cause scarlet fever also trigger outbreaks of pharyngitis and invasive GAS infections. As such, a single case of scarlet fever may signal a larger outbreak of unrecognised GAS infections.^{5 7 37} The wider impact that controlling scarlet fever may have on the clinical and economic burden of GAS should be considered in evaluating new interventions, such as diagnostic tests and vaccines. Meanwhile, effective control of scarlet fever and GAS depends on the coordinated efforts of clinicians and public health practitioners to identify cases and outbreaks early, implement appropriate treatment and prevent onward transmission.

Author affiliations

¹National Infection Service, Public Health England (now UK Health Security Agency), London, UK

²UK Field Epidemiology Training Programme, Public Health England (now UK Health Security Agency), London, UK

³South London Health Protection Team, Public Health England (now UK Health Security Agency), London, UK

⁴Oak Lodge Medical Centre, Barnet, North Central London CCG, London, UK ⁵Department of Infectious Disease, Imperial College London, London, UK ⁶NIHR Health Protection Research Unit in Healthcare-associated infection and AMR, Imperial College London, London, UK

⁷MRC Centre for Molecular Bacteriology and Infection, Imperial College London, London, UK

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ORCID iDs

Michael Trent Herdman http://orcid.org/0000-0002-4662-9352 Shiranee Sriskandan http://orcid.org/0000-0002-5214-4941

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Introduction

Thank you for your interest in our research on scarlet fever. Scarlet fever is not normally a dangerous infection but it is quite infectious and spreads easily.

We would like to collect more information about each case of suspected scarlet fever so that we can describe the symptoms better, find out how quickly children respond to treatment, and measure the effect on families' everyday lives. This is important because the number of cases of scarlet fever has risen in the last few years and we need to be sure that the best advice is provided to families, schools and doctors.

The survey is entirely voluntary and your decision has no effect on the treatment that you and your child have in future.

It should take no longer than 15 minutes. Your child's name will not be put on the questionnaire. This means that no one can identify you or your child from this.

The survey is completely confidential; it is designed so that you cannot be identified even by the research team who have contacted you. If there are questions that you prefer not to answer then please just leave those out or tick the box 'prefer not to say'.

Study Contacts

Head of Operations, NIHR Health Protection Research Unit, Section of Infectious Diseases, Imperial College London, Du Cane Road, London W12 ONN. Email <u>head.ops@imperial.ac.uk</u>

Scarlet Fever Study Nurse, South London Health Protection Team, Public Health England, Zone C, 3rd Floor, Skipton House, 80 London Road, London SE1 6LH Telephone 0344 326 2052 Email <u>phe.slhpt@nhs.net</u>



new scarlet fever

Section A : About your child

1. Enter your child's age at time of scarlet fever*

	scarlet fever		Page 2
2.	Gender		
	○ Male	○ Female	\bigcirc Prefer not to say
3.	Ethnicity		
	\bigcirc White British		
	\bigcirc White Irish		
	O White: any other background		
	Mixed White and Black Carlbbea Mixed White and Black African	in	
	\bigcirc Mixed White and Black Amean		
	O Mixed Any other mixed backgrou	und	
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	\bigcirc Other Ethnic Group: Chinese		
	O Any Other Ethnic Group		
	O Prefer not to say		
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ч.	following? (please tick one)	level, was your clina t	tending/ and your ennu attend any of th
	Playgroup/toddler group	Day nursery	School nursery
	\Box Other type of nursery	School Reception	n class
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	mm/yyyy		
	\sim		
	\sim		
6.	If in school above Reception	class, please state Yea	r Group (1-13)
6.	If in school above Reception	class, please state Yea	r Group (1-13)
6.	If in school above Reception	class, please state Yea	r Group (1-13)
6.	If in school above Reception	class, please state Yea h (before scarlet fe	r Group (1-13) ver suspected)
6.	If in school above Reception	class, please state Yea h (before scarlet fe	r Group (1-13) ver suspected)
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() Yes		0	No	
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new	scarlet fever		Pa
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28. How many days did the fever last in total? (give number of days or state if you can't say)

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Did your child Nurofen)?	I have an over the	e counter medicatior	to help with fever (f	or example Calpo
⊖Yes		ONo	⊖ Can't sa	y
How many da (give number	ys after starting of days or state	the over-the-counter if you can't say)	r medicine did the fev	er go away?
				~
				\checkmark
What other sy	/mptoms did you	r child have? Tick all	that apply	_
Vomiting	Diarrhoea	□ Not eating	Not playing	Headache
Other, please	describe			
	<i>.</i>			
What was the	very first sympt	Sore throat	noticed?	
Fever		Not playing/tirednes	S	
Can't say				
U Other, please	describe		1	
Was your chil	d in contact with	children with suspe	cted scarlet fever bef	ore they fell ill?
⊖Yes		\bigcirc No	\bigcirc Not sure	
	e contact:		school	
	od		□ family home	
neighbourhoo	anacif.			
 neighbourhoo Other, please 	specity			
neighbourhoo Other, please				
Other, please	d in contact with	other children with	sore throat or tonsilli	tis before they fe
Conternation of the second se	d in contact with	other children with	sore throat or tonsilli	tis before they fe
Conter, please Conter, please Was your chil Yes	d in contact with	other children with ONo	sore throat or tonsilli O Not sure	tis before they fe
Chief neighbourhoo Chier, please Was your chil Yes Where was th nursery	d in contact with	other children with O No	sore throat or tonsilli O Not sure	tis before they fel
Chief neighbourhoo Chier, please Chief Neighbourhoo Was your chil Yes Where was th nursery nursery neighbourhoo	d in contact with	other children with	sore throat or tonsilli Not sure school family home	tis before they fe
neighbourhoo Other, please Was your chil Yes Where was the nursery neighbourhoo Other, please	d in contact with	Other children with	sore throat or tonsilli Not sure school family home	tis before they fe
Chief neighbourhoo Chier, please Was your chil Yes Where was th nursery neighbourhoo Chier, please Chier, please	d in contact with	Other children with	sore throat or tonsilli Not sure school family home	tis before they fe
Chief in the initial sector of the initial	d in contact with ne contact? nd specify	Other children with	sore throat or tonsilli Not sure school family home nth before they fell il	tis before they fe
Ineighbourhood Other, please Was your chile Yes Where was the Inursery Ineighbourhood Other, please Other, please Did your child scarlet fever?	d in contact with e contact? d specify	Other children with	sore throat or tonsilli Not sure school family home nth before they fell il	tis before they fel

new scarlet fever			Page 6 of 12
38. What did they have? T common cold (runny nos vomiting or diarrhoea	ick all that apply se)	☐ cough ☐ fever	☐ influenza (flu) ☐ rash
Nublic Health England			
U U			new scarlet fever
Section C: Use of hea	Ithcare for suspected s	scarlet fever	
39. Where did you first se	ek advice when your ch	ild fell ill? Tic	k any that apply
GP/family doctor Walk-in centre NHS Direct Other, please specify	☐ Local pharmacy ☐ Urgent Care Centre ☐ Internet	Schoo Hospit None	l nurse al Emergency Department of the above
40. Did your child see a do ○ Yes ○ No	octor or nurse for this il	Iness?	
41. With regard to the firs	t time that your child s	aw a doctor o entre	r nurse, where were they based?
42. How many days after	first symptom onset did	l your child fir	st see a doctor/ nurse? (give
number of days or sta	te if you can't say)		~
43. Was a throat swab tak \Box Yes		□Can't say	
44. Did the swab show gro	Dup A streptococcus	don't know	
]	
45. If your child had a con throat/tonsil abscess meningitis Other, please describe	nplication or additional	problem plea	se tell us what it was □pneumonia (chest infection) □skin or soft tissue infection
46. What was the suspect	ed diagnosis when you	r child first sa	w a doctor? Tick any that apply

Sore throat Influenza (flu) Measies A viral infection Not sure Scarlet fever Did your child need to see any doctor or nurse again for this illness? Yes No Where were they based? Emergency Department Other, please specify Emergency Department Why did your child need to see a doctor again? Tick any that apply Was asked to come back if no better Child developed a new symptom(s) Child could not take prescribed medicine Called back due to swab result Worright that to could be scarlet fever Child developed a new symptom(s) Other, please specify Sarlet fever? Other, please specify Sarlet fever? Was your child admitted to hospital at any stage? Sarlet fever? Yes No Was your child admitted to hospital at any stage? Child developed a Child could not take Complication Can't Sarlet Sarlet Sarlet What was the reason for hospital admission? Obcors unsure of Pever Child developed a Child could not take Complication Can't Sarlet How many nights did they stay in hospital? Give number of nights Was y	age 7 o
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□ Other, please specify	
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Image: specify Image:	
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○Yes ○No Were antibiotics given to start immediately, or antibiotics to collect if things did not in (delayed antibiotics)?	
Were antibiotics given to start immediately, or antibiotics to collect if things did not in (delayed antibiotics)?	
(delayed antibiotics)?	mprove
	-
\bigcirc Yes immediate \bigcirc Yes delayed \bigcirc Can't say	

57. Please tell us the name o	of the anti	biotic if p	ossible:				
Azithromycin							
Erythromycin							
Cephalexin							
□ Augmentin □ Can't say							
58. How many days was the	antibiotic	to be tak	en for?	—	\bigcirc	\bigcirc	0.14
$\bigcirc 1 \qquad \bigcirc 2 \qquad \bigcirc 3$	○4	\bigcirc 5	06	07	08	09	\bigcirc 10
L							
59. How many times per day	was it to	be taken?	?				
01 02		Оз		0 4		○ Can'i	t say
Other, please specify							
60. How many days did your	child actu	ually take	the antibi	iotic for?	0	0	
$\bigcirc 1 \bigcirc 2 \bigcirc 3$	04	○5	06	07	08	09	\bigcirc 10
Other, please specify							
61. If your child did not take	the antih	iotic or to	ok the an	tibiotic fo	r fewer d	avs than i	orescribe
61. If your child did not take please can you tell us wh	the antib ly?	iotic or to	ok the an	tibiotic fo	r fewer d	ays than p	orescribe
61. If your child did not take please can you tell us wh	the antib y?	iotic or to	ook the an	tibiotic fo	r fewer d	ays than p ped because	e my child o
61. If your child did not take please can you tell us wh Was getting better anyway	the antib by? Diffic Not a antibioti	cult to collect able to return	bok the an t prescriptio n to nursery	tibiotic fo n //school on	r fewer da Stopp better	ays than p ped because easant taste	e my child g
61. If your child did not take please can you tell us wh Was getting better anyway Too many doses per day Don't like giving my child	the antib y? Diffic Not a antibioti	cult to collect able to return cs t say	t prescriptio	tibiotic fo n ı/school on	r fewer da Stopp better Unple	ays than p bed because easant taste	e my child g
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 61. If your child did not take please can you tell us wh Was getting better anyway Too many doses per day Don't like giving my child medicines Other, please specify 62. Did you use other medici 	the antib ny? Diffic Not a antibioti Can't	biotic or to cult to collect able to return cs t say hild's symp	bok the an t prescriptio n to nursery	tibiotic fo n //school on ck all that	r fewer d Stop better Unple	ays than p ped because easant taste	e my child g
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 61. If your child did not take please can you tell us wh Was getting better anyway Too many doses per day Don't like giving my child medicines Other, please specify 62. Did you use other medici Paracetamol e.g. Calpol Other, please specify 	the antib ny? Diffic Not a antibioti Can't nes for ch	biotic or to cult to collect able to return cs t say hild's symp	bok the an t prescriptio n to nursery n to nursery ptoms? Ti ofen e.g. Nu	tibiotic fo n ı/school on ck all that urofen	r fewer da Stopp better Unple	ays than p bed because easant taste	ense
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 61. If your child did not take please can you tell us what was getting better anyway Too many doses per day Don't like giving my child medicines Other, please specify 62. Did you use other medicines 64. Other, please specify 65. If so how were these obtain the purchased by you Other, please specify Other, please specify 	the antib y? Diffic Not a antibioti Can't nes for ch	biotic or to cult to collect able to return cs t say hild's symp Dibupr	pok the an t prescriptio n to nursery ptoms? Ti ofen e.g. Nu	tibiotic fo n r/school on ck all that urofen ł by your GP	r fewer da Stopp better Unple	ays than p bed because easant taste	else
 61. If your child did not take please can you tell us wh Was getting better anyway Too many doses per day Don't like giving my child medicines Other, please specify 62. Did you use other medici Paracetamol e.g. Calpol Other, please specify 63. If so how were these obt Purchased by you Other, please specify 	nes for ch	hild's symp	pok the an t prescriptio n to nursery ptoms? Ti ofen e.g. Nu	tibiotic fo n //school on ck all that urofen	r fewer d	ays than p bed because easant taste	else
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new scarlet fever

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Section D How your child's illness affected other people

65.	Did your child m	niss days a	at nursery/school	due to t	his illn	ess?
	O Yes O No					

66. How many days of school or nursery, that they would normally have attended, did your child miss?

O 1	02	O 3	O 4	05
06	07	O More than 7	🔿 Can't say	
Other, pleas	se specify			

67. Did you miss time from work due to your child's illness?

 \bigcirc Yes \bigcirc No

68. If so, how many days did you miss?

O 1	02	O 3	O 4	05
06	07	\bigcirc More than 7	○ Can't say	
Other, plea	se specify			

69. If so, was this to provide care for your sick child? ○ Yes ○ No

70. Did you become ill during your child's illness?

O Yes O No

71. Did you lose income when away from worK?

 \bigcirc Yes \bigcirc No

72. Did you have to use any of the following to take time from work?

annual leave	🗌 sick leave
Compassionate leave	☐ family leave
Other, please specify	

73. If so, how many days did you use?

O 1	0 2	Оз	O 4	05
06	07	\bigcirc More than 7	○ Can't say	
Other, pleas	se specify			

74. Did anot	her caregiver miss tim	e from work due to yo	ır child's illness?	
\bigcirc Yes \bigcirc M	٩o			
75 If so wa	s this to provide care	for your sick child?		
	No	for your sick clinic:		
76. Did they	become ill during you	r child's illness?		
\bigcirc Yes \bigcirc N	No			
77. Did they	lose income when aw	ay from work?		
⊖Yes⊖N	No			
78. Did they	use any of the following	ng to take time off wor	k?	
annual	leave ssionate leave		☐ sick leave	
Other, j	please specify			
79. If so, ho	w many days did they	use?	\bigcirc .	<u> </u>
$\bigcirc 1$	$\bigcirc 2$	\bigcirc 3	$\bigcirc 4$	\bigcirc 5
Other (nlease specify			
80. Did you l OYesON	nave to find alternative	e childcare due to your	child's illness?	
81. If so, wh	o was this?			
Friend Other,	Family member	Professiona	al (paid for) childcare	
L				
	w many days did you r	reed help?		
82. If so, ho	O 2	Оз	<u></u>	○ 5
82. If so, ho	\sim	\sim		
82. If so, ho 01 06 004ber		\bigcirc More than 7	⊖ Can't say	
82. If so, ho 01 06 00ther, j	O 7 please specify	O More than 7	O Can't say	
82. If so, ho 01 06 00ther, p	○ 7 please specify	O More than 7	⊖ Can't say	
 82. If so, how 1 6 Other, p 83. Did any of 	O 7 please specify of your other children	O More than 7	chool due to your	child's illness?
 82. If so, how 1 6 Other, p 83. Did any of Yes Of State 	⊖ 7 please specify of your other children	O More than 7	chool due to your	child's illness?
 82. If so, how 1 6 Other, p 83. Did any of Yes Of Mark 	ି 7 please specify of your other children	O More than 7	chool due to your	child's illness?
 82. If so, hor 1 6 Other, j 83. Did any of Yes Or 84. If so, hor 	⊖ 7 please specify of your other children No w many days did other	• children miss?	chool due to your	child's illness?
 82. If so, how 1 6 Other, p 83. Did any of Yes Of 84. If so, how 1 6 	⊖ 7 please specify of your other children No w many days did other ⊖ 2 ⊖ 7	O More than 7	⊖ Can't say chool due to your ⊖ 4	child's illness?
 82. If so, how 1 6 Other, p 83. Did any of Other of Other	 ○ 7 please specify of your other children No w many days did other ○ 2 ○ 7 please specify 	○ More than 7 miss days at nursery/s • children miss? ○ 3 ○ More than 7	⊖ Can't say chool due to your ○ 4 ○ Can't say	child's illness? O 5
 82. If so, hor 1 6 Other, j 83. Did any of the other, j 84. If so, hor 1 6 Other, j 	☐ 7 please specify of your other children No w many days did other ☐ 2 ☐ 7 olease specify	O More than 7 miss days at nursery/s • children miss? O 3 O More than 7	⊖ Can't say chool due to your ○ 4 ○ Can't say	child's illness? 〇 5
 82. If so, hor 1 6 Other, p 83. Did any of the second s	☐ 7 please specify of your other children No w many days did other ☐ 2 ☐ 7 please specify	O More than 7 miss days at nursery/s • children miss? 3 O More than 7	⊖ Can't say chool due to your ○ 4 ○ Can't say	child's illness?

	carlet fever			Page 11 of 1
[□ Older children helped to look a □ Other, please specify	fter younger child		
36. V	We are interested to know	how a diagnosis of suspected	d scarlet f	ever affected how you felt.
ŀ	Had you heard of scarlet fe	ver before?		
(○ Yes ○ No			
87 T	lf ves, what was your impr	ession about it? Tick all that	apply	
[Historical and dangerous illnes	Scentury ago	ired a	\Box Historical illness that is making a omeback
[Historical illness that never	\Box A childhood illness with rash th	hat is rare	A childhood illness with rash that
" [t	A childhood illness that can be reated with antibiotics	A childhood illness that cannot present be prevented by vaccinati	tat [ion st	A childhood illness caused by treptococcal bacteria
[Anything else?			
	If yos, what was your imprivil	accion about it? Tick all that	tannly	
,0. 1	\Box Can cause sore throat & \Box Ca	uses fewer sore throats than \Box	Can cause	e impetigo
te	onsillitis viruse	es (s	skin conditio	$\Box \text{ Can infect wounds}$
ا d	□ Can rarely cause more □ Ra Jangerous infections necro □ Anything else?	tising fasciitis and toxic shock pe	enicillin	vaccine against it
91. F	How did other people react	to your child's illness? Tick a	all that ap	ply
[No reaction	Less worried than r	me 🗌 Mor	e worried than me
l	\Box Contacted me to ask how my c	child was 🗌 Offered to help	∐ Кер	t their child away from my child
	what was the most helpful		ou? LICK all	
02. V	LCD/family doctor			
02. V	Urgent Care Centre	Hospital Emergency Department		Family/friends
02. V [[GP/family doctor GP/family doctor Urgent Care Centre NHS Direct	Hospital Emergency Department		☐ Family/friends ☐ Public Health England
92. V [[[GP/family doctor GP/family doctor GUrgent Care Centre NHS Direct None of these	Hospital Emergency Department Internet		School/Huisery Family/friends Public Health England
92. V [[[[GP/family doctor GP/family doctor Grant Care Centre Grant Care Ce	Hospital Emergency Department Internet		School/Huisery Family/friends Public Health England

new scarlet fever

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Thank you so much for your help in completing the survey. This will help us to improve services and preventative strategies in the future when dealing with cases of scarlet fever. Please click done to submit your answers.

School Survey of Scarlet fever

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School Survey of Scarlet fever

Introduction

Thank you for your interest in our research on scarlet fever. Scarlet fever is not normally a dangerous infection however it is quite infectious and spreads easily.

We would like to collect more information about each child with suspected scarlet fever and on those children in the school who remain well. This will then allow us to describe the symptoms better, find out how quickly children respond to treatment, and measure the effect of scarlet fever infection on the everyday lives of families compared to other infections circulating at this time of the year. This is important because the number of cases of scarlet fever has risen in the last few years and we need to be sure that the best advice is provided to families, schools and doctors.

The survey is entirely voluntary, and your decision has no effect on the treatment that you and your child have in future.

Please note the questionnaire has been designed so that in some instances, depending on your response to specific questions you may miss questions and be directed to questions further on in the questionnaire. Additionally, should you not be able to answer any question, please do leave it blank and move to the next question.

It should take no longer than 15 minutes. Your child's name will not be put on the questionnaire and they will remain anonymous. This means that no one can identify you or your child from this.

The survey is completely confidential; it is designed so that you cannot be identified even by the research team who have contacted you. If there are questions that you prefer not to answer then please just leave those out or tick the box 'prefer not to say'.

Study Contacts

Head of Operations, NIHR Health Protection Research Unit, Section of Infectious Diseases, Imperial College London, Du Cane Road, London W12 ONN. Email <u>head.ops@imperial.ac.uk</u>

Scarlet Fever Study Nurse, South London Health Protection Team, Public Health England, Zone C, 3rd Floor, Skipton House, 80 London Road, London SE1 6LH Telephone 0344 326 2052 Email <u>phe.slhpt@nhs.net</u>



School Survey of Scarlet fever

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Section A : About your child

1. How old is your child?*

(If you have more than one child at this school/ nursery, please complete this survey separately for each child) The value must be between 0 and 15, inclusive.



2. Gender

 \bigcirc Male

 \bigcirc Female

 \bigcirc Prefer not to say

3. Ethnicity

- \bigcirc White British
- O White Irish
- O White: any other background
- \bigcirc Mixed White and Black Caribbean
- \bigcirc Mixed White and Black African
- \bigcirc Mixed White and Asian
- \bigcirc Mixed Any other mixed background
- \bigcirc Asian or Asian British Indian
- O Asian or Asian British Pakistani
- \bigcirc Asian or Asian British Bangladeshi
- O Asian/Asian British Any other Asian background
- \bigcirc Black or Black British Caribbean
- O Black or Black British African
- \bigcirc Black or Black British Any other Black background
- \bigcirc Other Ethnic Group: Chinese
- \bigcirc Any Other Ethnic Group
- O Prefer not to say

4. Does your child attend any of the following? (please tick all that apply)

Playgroup/toddler group

□ School nursery □ Primary school Reception class Day nursery
 Other type of nursery
 Primary school Year 1-6

5. How long has your child been at nursery or school in the UK?

- \bigcirc Less than 1 year
- 🔾 1 2 years
- 3 4 years
- \bigcirc 5 years and over

6. If your child is in a school class, please state the Year Group

- Infant
- O_1
- О2
- Оз
- 04
- 05
- 06

Your child's usual health

7. Is your child normally quite healthy?

 \bigcirc Yes

 \bigcirc No

Supplemental materia	l p	laced on this supplement	tal material which	has been supplied by	y the author(s)
Scho	ool Survey of Scarlet	fever			Page 3 of 12
8.	Is your child under	follow up at a spe	cialist clinic?		
	⊖ Yes	○ No		() F	Prefer not to say
9	Has your child been	admitted to hose	ital for any co	ndition in the	nact?
5.	⊖ Yes			OF	Prefer not to say
10	Approximately how last 12 months over	many days off sc rall ?	hool or nurser	y due to illness	has your child had in the
	O Up to 2 days				
	\bigcirc 3 - 6 days				
	\bigcirc 1 - 2 weeks				
	\bigcirc 5 weeks and over				
11	. How many times ha	is your child had a	sore throat o	r tonsillitis in t	he last 12
	months (including i	f they have one n	ow)?		
	$\bigcirc 0$	$\bigcirc 1$	02		
	04	05	0 M	ore than 5	⊖ Can't say
13	• Has your child had a • Yes • No	a tonsillectomy (t	onsils remove	d)?	
14	As far as you know September 2018)?	did your child rec	eive a nasal fl	u vaccine this s	eason (any time since
	⊖Yes				
	ONO				
15	When did vour child	l receive the nasa	l flu vaccine?		
	O September 2018				
	October 2018				
	O November 2018				
	O December 2018				
	O January 2019				
	\bigcirc February 2019 \bigcirc Don't know				
16		relationship to the	child?	\bigcirc	
		Gua	rulan	\bigcirc	
			lising in the		
17	now many people (Inclucing you) are	$\bigcirc 3$	same househol \[] \[] \]	a with your child?
		∪ Z	\bigcirc 5	∪4	U more than 4
18					
10					

School Survey of Scarlet fever

O more than 4

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How many o	other children age	d 11 and under are li	ving in the same	household with your
child?				
00	01	02	Оз	04

<u>ko</u> k
Public Health
England

School Survey of Scarlet fever

Section B About your child and your child's recent illness (suspected scarlet fever), if relevant

- 19. Has your child been ill in the last four weeks with fever, rash, sore throat or tonsillitis? ○Yes ○No
- 20. Has your child been diagnosed with scarlet fever by a doctor or nurse in the last four weeks? O Yes

ОNо

21. Has your child had a new rash in the last four weeks? (not including long term skin conditions e.g. eczema)

○ Yes ○ No

- 22. If your child had a rash, where did the rash FIRST appear?
 - Face Body Arms/legs

○ Don't know

23. What was the rash like? Tick any that apply

🗆 red
\Box sand-papery/rough to feel
\Box peeled off
🗌 Can't say
Other, please specify

] pink	
small	spots
itchy	

24. How many days did the rash last in total? (give number of days)

25. As far as you know, has your child had a sore throat or difficulty swallowing in the last four weeks?

OYes

 \bigcirc No

26. How many days did the sore throat or difficulty swallowing last in total? (give number of days)

Supplemental material	BMJ Publishing	g Group Limited (BMJ) discl l on this supplemental materi	laims all liability and re ial which has been supp	sponsibility arising from any reliance lied by the author(s)	BMJ Oper
Scho	School Survey of Scarlet fever			Page 5 of 12	
72		a your child had onlar	and toncils in the	last 4 weeks?	
27.			ged tonsits in the		
28.	As far as you know, did	l your child have pus	(white spots) on t	their tonsils?	
	○Yes	○ No		\bigcirc Tonsils previously removed	
29.	As far as you know, has shivering/feeling very	s your child had a fev hot to touch) in the la	er (a temperature ast four weeks?	e above 37.5 C or	
	OYes		\bigcirc No		
30.	What was the highest t you don't know)	emperature measure	d in Celsius? (giv	re measurement or indicate if	
	○ Under 37.5 °C ○ 37.5 - 38 °C ○ 38.1 - 38.5 °C				
	○ 38.1 - 38.5 °C ○ 38.6 - 39 °C				
	○ 39.1 - 39.5 °C				
	\bigcirc More than 39.5 °C \bigcirc don't know				
31.	How many days did the	e fever last in total? (give number of da	ays)	
32.	example Calpol or Nurc	ofen)?	over the counter m	redication to help with rever (for	
	⊖Yes		\bigcirc No		
33.	As far as you know, has four weeks?	s your child had impe	tigo (a common n	nild skin infection) in the last	
	○ Yes ○ No				
34.	As far as you know, has	s your child had a flu	like illness in the	last four weeks?	
	○ Yes				
	⊖ No				
35.	As far as you know, has	s your child been in c	ontact with anyon	ne with suspected scarlet fever?	
	○Yes		○ No		
36.	Where was the contact Tick all that apply	with scarlet fever?			
	nursery		□ school		
	neighbourhood Other, please specify		∐ family hon	ne	
	A = 6-1				
37.	As far as you know, has throat or tonsillitis in t	s your child been in c he last four weeks?	contact with other	r children or adults with sore	
	○Yes		○ No		

School Survey of Scarlet fever

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38. \	Where	was	the	conta	ct(s)	?
--------------	-------	-----	-----	-------	-------	---

Tick all that apply

nursery neighbourhood

Other, please specify

□ school □ family home



School Survey of Scarlet fever

Section C: Use of healthcare for	r suspected scarlet fever
----------------------------------	---------------------------

- 39. When your child was ill in the last four weeks, where did you first seek advice ? Tick all that apply
 - GP/family doctor
 - School nurse

None of the aboveOther, please specify

- Hospital Emergency Department
- Practice nurse
 Walk-in centre
 NHS Direct

Local pharmacy
Urgent Care Centre
Internet

O Don't know

- 40. How many days after first symptom onset did your child first see a doctor/ nurse? (give number of days)
- 41. As far as you know, was a throat swab taken?

ΟY	'es
----	-----

○ No

42. Did the swab show group A streptococcus (the bacteria which causes Scarlet fever)?

○ Yes	⊖ No
\bigcirc Other result, please specify	

43. What was the suspected diagnosis when your child FIRST saw a doctor? Tick any that apply

Tonsillitis	🗌 Influenza (flu)	Measles
A viral infection	🗆 Scarlet fever	□ Not sure
\Box Other, please specify		

44. Did your child need to see a doctor or nurse again for this illness? ○ Yes ○ No

45. Where were they based?

GP Urgent Care Centre

Emergency Department

hool Survey of Scarlet fever			Page 7 of 1
Other, please specify			
46. Why did your child need t	o see a doctor again?	Tick any that apply	
\Box Was asked to come back if r	not better	\Box Child developed a new	w symptom(s)
\Box Child could not take prescrit	oed medicine	\Box Called back due to sv	vab result
\Box Worried that it could be sca	rlet fever		
\Box Other, please specify			
47. Has your child been admi ○Yes ○No	tted to hospital in the	last four weeks?	
48. What was the reason for	hospital admission?		
Tick all that apply			
\Box Doctors unsure of diagnosis	🗌 Fever was	high 🗌 Chi	ld developed a new symptom
\Box Child could not take prescrib	bed medicine \Box Child deve	loped a complication	
\Box Other, please specify			
50. Was your child given anti O Yes O No O Don't know	biotics?		
50. Was your child given anti O Yes O No O Don't know	biotics?		
50. Was your child given anti O Yes No O Don't know 51. When were antibiotics ta	biotics? ken?		
 50. Was your child given antion Yes No Don't know 51. When were antibiotics take Just in hospital In hospital and to take home Just to take at home 	biotics? ken? e		
50. Was your child given anti Yes No Don't know 51. When were antibiotics tak Just in hospital In hospital and to take home Just to take at home	biotics? ken? e	alv or to start only if t	nings did not improve?
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 	biotics? ken? e t antibiotics immediate ◯Yes delayed	ely or to start only if the Can't	nings did not improve? say
50. Was your child given anti Yes No Don't know 51. When were antibiotics tak Just in hospital In hospital and to take home Just to take at home 52. Were you advised to start Yes immediate	biotics? ken? e t antibiotics immediate ○Yes delayed	ely or to start only if tl ○ Can't	nings did not improve? say
50. Was your child given anti Yes No Don't know 51. When were antibiotics tal Just in hospital In hospital and to take home Just to take at home 52. Were you advised to start Yes immediate 53. How many days after the number of days)	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d	ely or to start only if ti O Can't id your child START to	nings did not improve? say take antibiotics (give
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rask days) 	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d	ely or to start only if th Can't id your child START to START TO take antibion	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tal Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rasidays) State number of days or if child did not start of the st	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s	ely or to start only if th Can't id your child START to START TO take antibio	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tal Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rask days) State number of days or if child did not 0-1 	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s	ely or to start only if th Can't id your child START to START TO take antibion	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tal Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rasidays) State number of days or if child did not on the number of d	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s	ely or to start only if th Can't lid your child START to START TO take antibion	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rasid days) State number of days or if child did num	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s	ely or to start only if th Can't lid your child START to START TO take antibion	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rasil days) State number of days or if child did num	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s	ely or to start only if th Can't id your child START to START TO take antibion	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rasil days) State number of days or if child did num	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s	ely or to start only if ti Can't id your child START to START TO take antibio	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to start Yes immediate 53. How many days after the number of days) 54. How many days after rasil days) State number of days or if child did num	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s ot have a rash	ely or to start only if tl Can't id your child START to START TO take antibio	nings did not improve? ^{say} take antibiotics (give tics (give number of
 50. Was your child given anti Yes No Don't know 51. When were antibiotics tail Just in hospital In hospital and to take home 52. Were you advised to starf Yes immediate 53. How many days after the number of days) 54. How many days after rasidays) State number of days or if child did not a compare the number of days or if child did not have a rash 	biotics? ken? e t antibiotics immediate OYes delayed first symptom onset d h onset did your child s ot have a rash	ely or to start only if th Can't id your child START to START TO take antibion	nings did not improve? say take antibiotics (give tics (give number of

School Survey of Scarlet fever

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○0-1 days
O 2
Оз
O 4
05
\bigcirc 6 or more
○ Not applicable

56. Please tell us the name of the antibiotic if possible:

57. Please tell us the dose of your antibiotic if possible:

- 125mg
 250mg
 375mg
 500mg
 1 g
- Don't know

 \Box Other, please specify

58. How many times per day was it to be taken?

\bigcirc_1	-	02		Оз	O 3 O 4		\bigcirc Can't say		
59. How n	nany days	was the a	antibiotic	to be tak	en for?				
\bigcirc 1	○ 2	Оз	○4	05	06	○7	08	09	○10
60. How n	nany days	did your	child ACT	UALLY tal	ke the ant	ibiotic fo	?		
\bigcirc 1	02	Оз	04	○5	06	○7	08	09	○10
please Tick all th Was Stop Not Don	e can you the apply getting bett because able to return the giving bett because able to return the giving be	tell us wh ter anyway e my child g m to nursery my child m	y? ot better //school on edicines	antibiotics		☐ Dif ☐ To ☐ Un	ficult to coll o many dos pleasant ta:	lect prescrip es per day ste	tion
	er, please sp	ecify	ac for ch	ild's symi		ck all that	annly		
□ Para	cetamol e.g.	. Calpol		Ibupr	ofen e.g. Nu	urofen	аныл	Nothing	else

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Section D How your child's illness affected other people

63. If your child was ill, did your child miss days at nursery/school?

- Yes
- ⊖ No
- \bigcirc Not applicable

64. How many days of school or nursery, that they would normally have attended, did your child miss?

01	O 2	O 3
04	05	06
07	O More than 7	\bigcirc Not applicable, child not ill

65. How many days after starting antibiotics did your child feel well enough to resume normal activities, such as going to school or nursery?

- 00
- 01
- О2
- Оз
- Ο4
- Ο5
- 06
- 07
- O More than 7

 \bigcirc Not applicable, my child was not ill

66. Did you become ill during your child's illness?

- OYes
- O No

O Not applicable

67. Did you miss time from work to provide care for your sick child?

○ Yes ○ No

O Not applicable

68. If so, how many days did you miss?

01	02	Оз	O 4	05
06	07	\bigcirc More than 7		

69. As a result, did you lose income when away from work?

□ Yes □ No

□ Not applicable

70. Did you have to use any of the following to take time from work to care for your sick child?

	0			
	e vata laava			
	se specify			
1. If so, how n	nany days did you	use?		
\bigcirc_1	O 2	Оз	O 4	0 5
06	○7	\bigcirc More than 7		
2. Did another	caregiver miss tin	ne from work to care fo	r vour sick child?	
⊖Yes⊖No			,	
3. As a result,	did they lose inco	me when away from wo	ork?	
4. Did they use	e any of the follow	ing to take time off wo	rk to care for your	sick child?
∐ annual leav	e		∐sick leave	
└ compassior	nate leave		☐ family leave	
└ Other, plea	se specify			
5. If so, how n	nany days did they	use?		
\bigcirc 1	O 2	Оз	O 4	0 5
	\bigcirc -	<u> </u>	0	
○6 5. Did they be e ○Yes ○No	come ill during you	• More than 7	⊖ Can't say	
 ○ 6 76. Did they bee ○ Yes ○ No 77. Did you hav ○ Yes ○ No 78. If so, who w ○ Friend ○ Friend ○ Family mer ○ Professiona ○ Other plos 	come ill during you e to find alternativ vas this? nber I (paid for) childcare	ل More than 7 ur child's illness? ve childcare due to your	∙ child's illness?	
 ○ 6 76. Did they beg ○ Yes ○ No 77. Did you hav ○ Yes ○ No 78. If so, who w ○ Friend ○ Family men ○ Professiona ○ Other, plea 	come ill during you e to find alternativ vas this? nber I (paid for) childcare se specify	السريم More than 7 ur child's illness? ve childcare due to your	∙ child's illness?	
 ○ 6 ○ Did they beg ○ Yes ○ No 7. Did you hav ○ Yes ○ No 8. If so, who v ○ Friend ○ Friend ○ Family men ○ Professiona ○ Other, plea 	come ill during you e to find alternativ vas this? nber I (paid for) childcare se specify	Ve childcare due to you	∙ child's illness?	
 ○ 6 76. Did they ber ○ Yes ○ No 77. Did you hav ○ Yes ○ No 78. If so, who v ○ Friend ○ Friend ○ Frofessiona ○ Other, plea 9. If so, how n ○ 1 	come ill during you e to find alternativ vas this? hober I (paid for) childcare se specify	More than 7 ur child's illness? ve childcare due to your	• child's illness?	∩r.
 ○ 6 P6. Did they ber ○ Yes ○ No P7. Did you hav ○ Yes ○ No P7. Did you hav ○ Yes ○ No P8. If so, who v ○ Friend ○ Friend ○ Friend ○ Friend ○ Professiona ○ Other, plea ○ Other, plea ○ 1 	come ill during you e to find alternativ vas this? nber I (paid for) childcare se specify	Nore than 7 ur child's illness? ve childcare due to your need help?	⊖ Can't say	05
 ○ 6 76. Did they beg ○ Yes ○ No 77. Did you hav ○ Yes ○ No 78. If so, who w ○ Friend ○ Family mer ○ Professiona ○ Other, plea 9. If so, how m ○ 1 ○ 6 	come ill during you e to find alternativ vas this? nber I (paid for) childcare se specify nany days did you 2 7	More than 7 ur child's illness? ve childcare due to your need help? 3 More than 7	⊖ Can't say	05
 ○ 6 ○ Did they ber ○ Yes ○ No ? Did you hav ○ Yes ○ No ? Did you hav ○ Yes ○ No ? Did so, who v ○ Professiona ○ Other, plea ○ Other, plea ? If so, how n ○ 1 ○ 6 0. Did any of y ○ Yes ○ No 	come ill during you e to find alternativ vas this? nber I (paid for) childcare se specify nany days did you 2 7 rour other children	More than 7 ur child's illness? ve childcare due to your need help? 3 More than 7 miss days at nursery/s	⊖ Can't say • child's illness? ⊖ 4 school due to your	⊖5 • child's illness?
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	f Scarlet fever			Page I
□ Worried th	at my other child	ren were also si	ck	
Older child	ren helped to loo!	k after younger	child	
Other, plea	ase specify	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
83 Before vou	had this letter	from the sc	hool or nursery had	you heard of scarlet fever befor
		nom the se	noor or nursery, nuu	you heard of scarlet level belo
04 Tf				
84. If yes, what	t was your imp	pression abo		
☐ Historical a	ind dangerous illn	ess	☐ Historical illness t	hat disappeared a century ago
Historical il	llness that is mak	ing a comeback	Historical illness t	hat never went away
A childhood	d illness with rash	that is rare	A childhood illnes	s with rash that can be very infectious
□ A childhood	d illness that can	be treated with	□ A childhood illnes	s that cannot at present be prevented
antibiotics			vaccination	
A childhood	d illness caused b	y streptococcal		
bacteria				
Anything e	lse?			
Can be trea	ated with penicilli lse?	n 	shock	vaccine against it
	na mast halnfu	l sources of	information for you	when your child is unwell? Tick
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School Survey of Scarlet fever

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Thank you so much for your help in completing the survey. This will help us to improve services and preventative strategies in the future when dealing with cases of scarlet fever. Please click done to submit your answers.

ONLINE SUPPLEMENTARY MATERIALS

Supplementary File 1: 2018 Online Questionnaire

Supplementary File 2: 2019 Online Questionnaire

Supplementary File 3: STROBE Checklist for Cross-Sectional Analysis

Antibiotic Treatment Characteristics	n	(%)				
Antibiotic Prescribed (n=311)						
Penicillin V ¹	235	(76%)				
Amoxicillin ²	44	(14%)				
Azithromycin ³	15	(5%)				
Erythromycin	14	(5%)				
Other agent	6	(2%)				
Recommended Start (n=319)						
Immediate (once prescribed)	303	(95%)				
In the event of worsening symptoms	16	(5%)				
Prescribed Recommended Duration (n=288)						
Yes	238	(83%)				
No	50	(17%)				
Took Full Prescribed Course (n=339)						
Yes	294	(87%)				
No	45	(13%)				
Reason for Stopping Early (n=39)						
Clinical improvement	16	(41%)				
Doses excessive	7	(18%)				
Unpleasant taste	6	(15%)				
Other reasons	10	(26%)				

Supplementary Table S1: Antibiotic prescribing patterns described by respondents (n=339)

¹As recommended first line in NICE guidance; ²As recommended if unable to swallow tablets; ³As recommended if penicillin-allergic.

Supplementary Table S2: Stratified model for associations with delayed diagnosis of scarlet fever among cases in 2018 (n=321).

	% with delayed	Stratum-		Wald	Likelihood ratio
Stratified	diagnosis	specific		test	test for interaction
exposure variable	(n/total)	adjusted OR ¹	(95% CI)	P-value	P-value
5 years and older					
No sore throat at onset	21% (14/68)	1.00			
Sore throat at onset	42% (34/81)	2.79	(1.34-5.82)	0.006	0.009
Under 5 years old					
No Sore throat at onset	31% (11/35)	1.00			
Sore throat at onset	17% (8/47)	0.65	(0.27-1.55)	0.328	

Supplementary Figure S1. Recovery of scarlet fever cases among those in whom diagnosis was delayed or not delayed beyond first consultation with a health professional. Days elapsed from onset of symptoms to clinical recovery (n=52, Panel A), return to school (n=298, Panel B), and return to work for carers (n=161 Panel C).

