Antibiotic prescribing for respiratory tract infection: exploring drivers of cognitive effort and factors associated with inappropriate prescribing

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KEY MESSAGES

- Antibiotics are over-prescribed for respiratory tract infections
- Fast (automatic) and slow (analytical) thinking influences prescribing decisions
- Physicians find managing patients with longer illness durations difficult
- Physicians interpret the same items of diagnostic information in different ways
- Certain interpretations are linked with inappropriate prescribing
- Interventions should target differing interpretations and both modes of thinking

ABSTRACT

Background: Antibiotics are over-prescribed for upper respiratory tract infection (URTI). It is unclear how factors known to influence prescribing decisions operate 'in the moment': dual process theories, which propose two systems of thought ('automatic' and 'analytical'), may inform this.

Objective(s): Investigate cognitive processes underlying antibiotic prescribing for URTI and the factors associated with inappropriate prescribing.

Methods: We conducted a mixed methods study. Primary care physicians in Scotland (n=158) made prescribing decisions for patient scenarios describing sore throat or otitis media delivered online. Decision difficulty and decision time were recorded. Decisions were categorised as appropriate or inappropriate based on clinical guidelines. Regression analyses explored relationships between scenario and physician characteristics, and decision difficulty, time, and appropriateness. A sub-group (n=5) verbalised their thoughts (think-aloud) whilst making decisions for a subset of scenarios. Interviews were analysed inductively.

Results: Illness duration of 4+ days was associated with greater difficulty. Inappropriate prescribing was associated with clinical factors suggesting viral cause, and with patient preference *against* antibiotics. In interviews, physicians made appropriate decisions quickly for easier cases, with little deliberation, reflecting automatic-type processes. For more difficult cases, physicians deliberated over information in some instances, but not in others, with inappropriate prescribing occurring in both instances. Some interpretations of illness duration and unilateral ear examination findings (for otitis media) were associated with inappropriate prescribing.

Conclusion: Both automatic and analytical processes may lead to inappropriate prescribing. Interventions to support appropriate prescribing may benefit from targeting interpretation of illness duration and otitis media ear exam findings; and facilitating appropriate use of both modes of thinking.

KEYWORDS

Anti-Bacterial Agents; Clinical Decision-Making; Inappropriate Prescribing; Physicians, Primary Care; Primary Health Care; Respiratory Tract Infections

LAY SUMMARY

Antibiotics are often used to treat the common cold and ear/nose/throat infections, but typically don't work for these issues. We explored the reasons why this prescribing may happen, and some of the difficulties doctors might experience when making these treatment decisions. Doctors reviewed written descriptions of patients and decided whether or not to prescribe antibiotics. Some of these doctors also took part in an interview where they 'thought aloud' (said what they were thinking as they were thinking it) while considering the patient descriptions. When the patient had been ill for four or more days, this made decisions more difficult. Sometimes decisions to prescribe due to this illness duration and due to findings from an ear exam were not in line with guidelines for prescribing. Some decisions to prescribe seemed to be more related to automatic habits, while others occurred after careful deliberation over the information. Doctors need more support to make decisions involving these factors, and may benefit from strategies to help them to use their automatic/habitual thinking and their deliberative thinking in the best ways.

BACKGROUND

Antibiotics are frequently prescribed in primary care for upper respiratory tract infection (URTI) despite their minimal benefit and concerns about antibiotic resistance [1,2]. Inappropriate prescribing is related to clinical signs and symptoms, longer time in practice, higher workload, time pressure, fear of complications, diagnostic uncertainty, and perceived patient expectations [3,4]. Also, physicians may prescribe antibiotics when not clinically indicated to maintain good relationships and avoid conflict [5]. Few studies have investigated the influence of multiple factors simultaneously [3,4], and it is not clear how these factors come in to play at the moment of making a prescribing decision. Improving our understanding of this could contribute to the design of more effective practice improvement interventions, which often fail to address the specific factors influencing prescribing [6].

Dual process theories may contribute to this area. These theories propose that two systems guide decision-making: system one is 'automatic', with reasoning processes described as heuristic, implicit, and immediate [7]. System two is 'analytical', deliberate, reflective, and slow [7]. Both types of processes play a role in clinical decision-making [8,9]. In primary care, Presseau and colleagues [10] found that both processes predicted provision of guideline-recommended care for people with type 2 diabetes. Given that interventions (e.g. educational meetings [11]) often target analytical-type processes by providing information and requiring providers to make explicit decisions to change, such findings indicate that developing interventions which simultaneously target both modes of thinking may maximize effectiveness.

In addition, it is often postulated that inappropriateness decisions result from relying too heavily on automatic-type processes, and that allowing more time for providers to engage their reflective thinking can combat this [12]. While 'slowing down' when needed is important

[13], there is a growing body of evidence indicating that errors can result from either set of cognitive processes, and that allowing for the use of analytical-type processes by increasing the time available does not reduce errors [14]. In fact, encouraging more time can lead to more errors [14], suggesting that automatic-type processes can sometimes be advantageous. In a previous study investigating antibiotic prescribing for written scenarios describing patients with URTI [15], we found that appropriate decisions (i.e. antibiotics not prescribed) were more likely where the involvement of more automatic-type processes was indicated (by shorter decision time and lower experienced difficulty), suggesting that appropriate decisions can be made quickly using a less effortful cognitive process. Further investigating what drives levels of cognitive effort could be informative for the design of interventions which appropriately target each mode of thinking. Informed by dual process theories, the aims of this study was were therefore to i) investigate the cognitive (automatic and analytical) processes underlying primary care physicians' antibiotic prescribing decision-making for URTI, and ii) investigate the factors associated with inappropriate prescribing decisions.

METHODS

Design

An online patient scenario study followed by interviews. Methods are reported in accordance with the Good Reporting of A Mixed Methods Study (GRAMMS) Checklist (Supplementary File 1). Qualitative and quantitative methods were necessary as our research questions focused on assessment of relationships between variables and on physicians' perceptions.

Scenario development

Full scenario development details are provided in Supplementary File 2. Figure 1 provides an example scenario. Scenarios were constructed around two diagnoses, sore throat and otitis

media. A set of *factors* (e.g. sex) with pre-specified *levels* (e.g. male/female) were systematically varied across scenarios. We generated an optimised fractional factorial design which provided 24 sore throat and 24 otitis media scenarios (three blocks of eight for each). A range of statements were written for each factor level and randomly assigned to scenarios [16]. CDB and a physician colleague (EP) reviewed scenarios for clarity and clinical realism: modifications were made based on their feedback. All scenario factors, levels, and statements, and the 48 scenarios used, are included in Supplementary File 3.

FIGURE 1 HERE

Given that perceived expectations influence prescribing [5], we explored the impact on decisions when patient expectations conflicted with clinical information. Conflict was coded as present in scenarios where immediate prescribing was not clinically appropriate, but either a) antibiotics were mentioned/firmly asked for; and/or b) there were significant personal consequences of illness (e.g. missing work).

Participants and recruitment

Eligible participants were primary care physicians in Scotland. Following Green [17] (minimum sample size for regression of 50 + 8 × number of predictors), our target sample size was 298. Recognising that studies recruiting physicians often have low response rates [18], the Scottish Primary Care Research Network sent invitation emails on our behalf to their email list, which included most physicians in Scotland [19]. Participants were offered entry into a prize draw to win a £50 Amazon voucher.

Online scenario study procedure

The study was hosted by LifeGuide [20]. The programming code was written with assistance from a software engineer (CJ). The site was piloted (by EP and EB), resulting in minor

wording changes. The software randomised participants to one block of eight scenarios for each set. Participants reviewed each scenario and selected their decision (immediate prescription; delayed prescription (to be used after a specified time period if still unwell); no antibiotic prescription). Since dual process theories hypothesize that slower analytical processes can become involved to correct a response initially generated by automatic processes, we inferred that longer decision time and increased decision difficulty indicated greater likelihood of the involvement of more analytical processes. Time spent reviewing each scenario was recorded to represent decision time. Participants indicated how difficult they found each decision on a scale from 1 (not at all difficult) to 10 (extremely difficult). Participants responded to items assessing their past prescribing behaviour (approximate number of their last 10 patients they prescribed antibiotics for), and habit (extent to which they agreed it was their usual practice to prescribe antibiotics, on a 1 (strongly agree) – 7 (strongly disagree) scale), and provided demographic characteristics.

Online scenario study analysis

If the resulting decision was appropriate in accordance with at least one of three guidelines, we coded this as an appropriate decision 21–23. Immediate prescribing decisions were scored as inappropriate when prescribing was not recommended in these guidelines. Whilst guidelines may not be universally applicable to every individual patient, in general they represent best practices. Linear and logistic regression analyses were used to explore the impact of scenario and physician characteristics on decision difficulty, time, and appropriateness. Characteristics which were significant predictors at the $p<.05$ level or had an effect size (B) greater than 0.2 in simple regression analyses in SPSS were taken forward to multiple regression analysis, conducted in STATA using the *cluster* option. The natural logarithmic transformation was used for the skewed time data. Data points where the decision was missing were excluded. The scenario mean was imputed for missing difficulty ratings.

Median scenario time was imputed for scenarios viewed more than once, and for outliers (>3 SDs above the scenario mean). Missing data on physician characteristics were also imputed: the mean was imputed for continuous variables, while for categorical variables, missing values were included within a separate category in the analyses.

Think-aloud interviews

Participants were invited to a follow-up interview to 'think-aloud' (verbalise their thoughts [24]) while making decisions for a sub-set of the scenarios. This method has been used with healthcare providers to reveal variations in practice [25]. As think-aloud studies aim to generate rich data from a relatively small sample [26], we aimed to recruit a convenience sample of five physicians. Participants were offered a £20 Amazon voucher. As think-aloud involves considerable effort, no more than ten scenarios are typically used [27,28]. We selected seven scenarios which differed in decision difficulty, time, and appropriateness in the online study, and developed an interview topic guide which described the think aloud process [24,26]. Materials were reviewed by a primary care physician (JP). No changes were needed. Interviews were audio-recorded and transcribed verbatim by NM. Data were analysed thematically, informed by the analysis process outlined by Braun and Clarke (2006). In the initial phase (familiarisation), NM reviewed and re-reviewed the transcripts to become immersed in the data. Transcripts were then coded by NM using an inductive approach, focusing on how scenario characteristics were interpreted and used to inform prescribing decisions. Coding was reviewed by and discussed with JA, which provided opportunities to reflect on, challenge, and strengthen the developing analysis. Key themes were developed from the coded data through discussion [29] and included reflection on the quantitative data. In line with dual process theories, we interpreted deliberation over the scenario characteristics as potentially reflecting the involvement of

more analytical-type processes, with a lack of deliberation potentially reflecting the involvement of more automatic-type processes.

RESULTS

Participant recruitment and characteristics

Of 3895 physicians invited, 163 (4%) participated, and 158 were analysed (two withdrew; three provided no decisions). Physician characteristics are summarised in Table 1. Compared to the population of primary care physicians in Scotland, the sample included a greater proportion of physicians working in single-handed practices and who were trainers.

TABLE 1 HERE

Decision-making for sore throat

For the sore throat scenarios, 1222 decisions were analysed (42 missing decisions excluded; four difficulty ratings and 81 time scores imputed). The mean (SD) difficulty rating was 3.3 (1.9), median (IQR) decision time was 22.0 (15.0) seconds, and 7% of decisions were inappropriate. Twelve variables explained 22.5% of the variance in difficulty (Table 2, Supplementary File 4). Difficulty was higher in the presence of six patient factors (illness duration 4+ days; inflamed tonsils; purulent tonsils; female; significant personal consequences of illness; worry) and six physician factors (single-handed practice; urban location; non-trainer; no academic link; missing data for academic link; lower workload; higher prescribing rate for last 10 patients). Four variables explained 19.7% of the variance in decision time (Table 2, Supplementary File 4). Decision time was longer when illness duration was 4+ days, the patient had purulent tonsils, the patient was a child, and when decision difficulty was higher. Three variables explained 26.4% of the variance in decision appropriateness (Table 2, Supplementary File 4). Inappropriate prescribing was more likely

when the patient had cough/cold symptoms, fever was absent, and when the patient/parent preferred *not* to have antibiotics.

TABLE 2 HERE

Decision-making for otitis media

For the otitis media scenarios, 1239 decisions were analysed (25 missing decisions excluded; five difficulty ratings and 68 time scores imputed). The mean (SD) difficulty rating was 3.9 (1.9), median (IQR) decision time was 20.0 (12.0) seconds, and 13% of decisions were inappropriate. Seven variables explained 14.6% of the variance in difficulty (Table 3, Supplementary File 5). Difficulty was higher for three patient factors (illness duration 4+ days; male; having no antibiotic preference; mentioning/asking for antibiotics) and four physician factors (single-handed practice; non-trainer; missing data for academic link; lower workload). Five variables explained 12.7% of the variance in decision time (Table 3, Supplementary File 5). Decision time was longer when the patient preferred no antibiotics, the patient was re-consulting, data were missing for physician trainer status, the physician had no academic link, and when decision difficulty was higher. Ten variables explained 32.0% of the variance in decision appropriateness (Table 3, Supplementary File 5). Inappropriate prescribing was more likely for four patient factors (mild examination findings; preference against antibiotics; no significant personal consequences of illness; conflict present), four physician factors (partnership practice; missing data for practice type; missing data for practice location; non-trainer status; higher prescribing rate for last 10 URTI patients), and when the scenario word count and decision time were higher. There were also group effects in these analyses (with the nine groups reflecting the possible combinations of scenario sets seen).

TABLE 3 HERE

Think-aloud interviews

The five participants (three male; two female) had been qualified for 2-24 years and worked in four NHS Scotland Health Boards (Tayside, Greater Glasgow & Clyde, Lothian, Forth Valley). Table 4 includes their decisions and difficulty ratings for the scenarios reviewed, with aggregate data from the online study.

TABLE 4 HERE

For cases rated easier in the online study (scenarios ST1 and OM1), participants made decisions quickly, with little deliberation, noting that the clinical information did not indicate antibiotics. This may reflect automatic-type decision processes.

> *"I would provide no antibiotic prescription and it would be not at all difficult and I wouldn't give it a second thought"* (P5, ST1)

For the more difficult cases (ST2, OM2, OM3) there was more deliberation over guidelines, clinical details (illness duration, fever, unilateral ear exam findings), and parental enquiry about antibiotics, which led to inappropriate prescribing. This may reflect analytical-type processes. However, some inappropriate decisions were made based on unilateral ear exam findings and illness duration, with no deliberation. This may reflect automatic-type processes.

> *"he has a cough.. guidelines would be maybe suggesting that wouldn't be antibiotics for the sore throat.. he's fevered for a week and he's still got a temperature.. I think he's put up with it long enough and needs to get better"* (P1, ST2)

> *"the kids got definite one sided redness.. at five days, I would tend to treat"* (P4, OM3)

Across all scenarios, duration of illness perceived as extended led to prescribing for some participants, but delayed/no prescribing for others.

> *"six days into it I'm not sure it is gonna get better without giving something"* (P4, OM2)

> *"at six days you think well he's surely over the worst of it"* (P2, OM2)

Similarly, prescribing was linked with unilateral ear exam findings for some participants, but bilateral findings for others.

> *"I would give an immediate antibiotic because it's one ear"* (P1, OM2)

> *"we do tend to be more [..] open to [..] using antibiotics if [..] both ears are affected"* (P2, OM4)

DISCUSSION

While we identified a broad range of factors associated with antibiotic prescribing for URTI, here we discuss common themes across the URTI types. Duration of illness of 4+ days was associated with greater decision difficulty. Inappropriate prescribing was associated with clinical findings suggesting viral cause, and with the patient preferring *not to have* antibiotics. In think-aloud interviews, physicians deliberated over the case details in some instances (reflecting analytical-type decision processes) but didn't in others (reflecting automatic-type processes). Perceptions of long illness durations were linked to prescribing for some physicians, but not for others. For otitis media, unilateral exam findings were an indication for prescribing or of a bacterial cause for some physicians: the opposite was true for others.

Strengths and limitations

A wide range of factors potentially influencing decision-making were systematically and simultaneously investigated. The think-aloud study supplemented the quantitative results by revealing how scenario details were understood and evaluated. To reflect real practice, all decision types (immediate/delayed/no prescribing) were appropriate for some scenarios [22]. However, the inclusion of these scenarios in the analyses makes it harder to detect significant associations, and the wide confidence intervals in our decision appropriateness analyses likely reflect this. Only 158 survey responses were received, and there were differences between our sample and the population of primary care physicians in Scotland, which may affect the generalizability of our results. A further 254 logged in, but reported that the website crashed their practice computers, which had older versions of web browsers installed. Although we did not achieve our target sample size of 298, over 1000 data points were included in analyses since participants responded to multiple scenarios. Whilst the five Think-Aloud participants responded to seven patient scenarios thereby providing 35 responses for analysis, we may not have achieved thematic saturation with five participants.

Comparison with existing literature

To our knowledge, the association between longer illness duration and greater difficulty has not been reported elsewhere. The think-aloud study helped us explore this further and identify differing interpretations. The interpretation that the patient was likely over the worst of the illness, or would soon recover on their own, led to appropriate decisions. However, the interpretation that the patient was not recovering on their own led to inappropriate prescribing. Prescribing on the basis of duration is not addressed in guidelines [22], but longer symptom durations are associated with prescribing [30,31]. These findings emphasise the need

for practice improvement interventions to address illness duration.

We also found that inappropriate prescribing was associated with clinical findings suggesting viral cause. In the think-aloud study, some inappropriate prescribing decisions for otitis media were made on the basis of unilateral ear examination findings. Unilateral findings are *less* likely to be bacterial in nature than bilateral findings [32], and guidelines [22] do not recommend prescribing in these cases. Other studies have found prescribing to be associated with abnormal ear findings [33,34], but the issue of laterality was not mentioned. The interpretation of antibiotic need based on laterality warrants further investigation to determine whether this is a widespread issue.

Inappropriate decisions were also more likely when the patient preferred *not to have* antibiotics. This may have been interpreted as an indication that the patient does not routinely take antibiotics, which may have increased perceptions of severity or antibiotic need given that the patient had presented. While some physicians prescribe antibiotics to maintain good relationships with patients, others note that asking about expectations, even without meeting them, can improve relations [5]. The influence of patient expectations on prescribing decision-making may therefore be quite complex, and practice improvement interventions focused on communication skills can help rectify misunderstandings [35].

Greater decision difficulty was associated with longer decision time. This is consistent with our previous secondary analysis [15], psychological research [36], and with the dual process perspective [7] that greater difficulty indicates the involvement of analytical-type processes. Our secondary analysis found that such decisions were less likely to be appropriate [15]. Similarly, Norman and colleagues found a negative correlation between time and accuracy [37]. In our current study, there was a negative association between decision time and decision appropriateness for otitis media only. Although this study cannot confirm whether automatic and/or analytical processes were used, the think-aloud findings suggest that both processes

may be associated with inappropriate prescribing and therefore could be targeted with interventions.

Supports for antibiotic prescribing decision-making are currently available for primary care physicians in Scotland. For example, the Scottish Antimicrobial Prescribing Group, part of Healthcare Improvement Scotland (a specialist NHS Board in Scotland which supports uptake of evidence-based practices), provide resources including an audit tool, an educational toolkit, and guidance on setting up defaults within electronic prescribing systems 38. Our results, combined with wider literature, suggest that further work may be required to target underlying automatic processes. Educational interventions often focus on increasing uptake of guidelines or on recognition of aspects of automatic processing such as cognitive heuristics, but these have had limited success 14,39. Although in the early stages of evaluation, educational interventions which focus on the use of patient stories to recalibrate pattern recognition processes and associated heuristics have shown some success in improving decision-making 39. In addition~~, a~~ppropriate use of automatic-type processes could be facilitated based on 'fast-and-frugal' heuristics paradigms, which involve rapid processing of key information to come to a decision [40]. Fischer and colleagues [41] compared a fast-and-frugal decision tree to a more complex tool and found that both performed similarly well in targeting macrolide antibiotic prescribing for pneumonia: however, the fast-and-frugal tree was more straightforward and could be easily memorised. In addition, in the context that physicians use *"mindlines"* (internalised guidelines largely informed by experience, colleagues, opinion leaders, and patients) when making decisions [42], an intervention could involve integration of prompts into electronic medical records, combined with the recruitment and training of local opinion leaders to disseminate the key messages.

CONCLUSIONS

This study used systematically-designed patient scenarios in combination with the think-aloud method to investigate primary care physicians' antibiotic prescribing for URTI. Inappropriate prescribing decisions reflected both automatic- and analytical-type cognitive processes. Longer duration of illness was linked with greater decision difficulty. Inappropriate prescribing was associated with clinical findings suggesting viral cause, and with the patient preferring *not* to have antibiotics. Decisions related to illness duration and, for otitis media, unilateral ear examination findings, were not concordant across physicians. Interventions to support physicians may benefit from a dual process perspective, for example facilitating appropriate use of automatic-type decision processes to assist physicians in the context of time constraints.

DECLARATIONS

Ethics approval

This study was approved by NHS Grampian National Research Ethics Service (14/NS/0079). Completion of the online study was taken as implied consent to participate. Informed consent was obtained from interview participants. Data were collected in 2014-2015 and stored securely at the University of Aberdeen.

Data availability

Datasets are available from the corresponding author on reasonable request.

Competing interests

The authors declare they have no competing interests.

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Table 1. Characteristics of 158 primary care physician participants in Scotland in 2014-2015

Characteristic		Participants (N=158)	Workforce in Scotland[a]
		N (%), or Mean (SD) Range	
Sex[t]	**Male**	79 (50.0%)	2220 (45.7%)
	Female	69 (43.7%)	2638 (54.3%)
	Unspecified	10 (6.3%)	-
Age[b,g]		44.1 (9.3) 26-66	44.3 (9.7) 24-76
NHS Scotland Health Board	**Ayrshire & Arran**	6 (3.8%)	315 (6.5%)
	Borders	2 (1.3%)	119 (2.5%)
	Dumfries & Galloway	8 (5.1%)	151 (3.1%)
	Fife	10 (6.3%)	280 (5.8%)
	Forth Valley	13 (8.2%)	251 (5.2%)
	Grampian	22 (13.9%)	549 (11.3%)
	Greater Glasgow & Clyde	34 (21.5%)	1,073 (22.1%)
	Highland	20 (12.7%)	391 (8.0%)
	Lanarkshire	3 (1.9%)	406 (8.4%)
	Lothian	12 (7.6%)	855 (17.6%)
	Orkney	0 (0%)	29 (0.6%)
	Shetland	2 (1.3%)	28 (0.6%)
	Tayside	24 (15.2%)	378 (7.8%)
	Western Isles	2 (1.3%)	38 (0.8%)
Practice type[h]	**Single-handed**	24 (15.2%)	84 (1.7%)
	Partnership	116 (73.4%)	4813 (98.3%)
	Unspecified	18 (11.4%)	-
Practice location	**Urban**	55 (34.8%)	-
	Suburban	48 (30.4%)	-
	Rural	43 (27.2%)	-
	Unspecified	12 (7.6%)	-
Trainer[i]	**No**	118 (74.7%)	4070 (91.7%)
	Yes	28 (17.7%)	365 (8.2%)
	Unspecified	12 (7.6%)	-
Academic link	**No**	116 (73.4%)	-
	Yes	29 (18.4%)	-
	Unspecified	13 (8.2%)	-
Years qualified[b]		14.9 (9.5), 0-38	-
Hours per week spent seeing patients[c]		25.0 (8.9), 5-50	-
Patients seen per hour[d]		5.8 (0.9), 3-10	-
Workload[e]		144.3 (59.1), 20-360	-

Note: *NHS=National Health Service; SD=standard deviation*

[a]Sex and NHS Scotland Health Board data gathered in December 2013, obtained from ISD Scotland [49] website; mean (SD) age, age range, trainer, and practice type data obtained through personal correspondence with ISD Scotland, data provisional as at 1st October 2014

[b]Missing responses: 10

[c]Missing responses: 14

[d]Missing responses: 13

[e]Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week. Missing responses: 15

[f]Sex: continuity-corrected $\chi 2(1)=3.109$, $p=0.078$

[g]Mean age: one-sample t-test: $t(147)=-.269$, $p=0.78$)

[h]Practice type: Fisher's exact test $p<0.001$, 2-sided

[i]Trainer status: continuity-corrected $\chi 2(1)=20.228$, $p<0.001$

Table 2. Significant predictors in multiple linear regression models predicting perceived decision difficulty, decision time, and decision appropriateness for the sore throat scenarios completed by 158 primary care physician participants in Scotland in 2014-2015

Outcome	Predictor		B	SE of B	95% CI
Perceived decision difficulty	Duration	<4 days	REF	-	-
		4+ days	.608***	.098	.414 to .803
	Inflamed tonsils	Absent	REF	-	-
		Present	.466***	.106	.258 to .675
	Purulent tonsils	Absent	REF	-	-
		Present	.492***	.100	.295 to .689
	Sex	Male	REF	-	-
		Female	.318**	.090	.140 to .496
	Life-world circumstances	Absent	REF	-	-
		Present	.798***	.189	.425 to 1.171
	Concern	Absent	REF	-	-
		Present	.226*	.106	.016 to .435
	Practice type	Single-handed	REF	-	-
		Partnership	.018	.256	-.488 to .524
		Unspecified	-1.402**	.479	-2.348 to -.456
	Practice location	Urban	REF	-	-
		Suburban	-.466*	.209	-.880 to -.053
		Rural	-.467	.237	-.936 to .001
		Unspecified	.291	.555	-.805 to 1.387
	Trainer	No	REF	-	-
		Yes	-.177	.219	-.609 to .254
		Unspecified	-1.555*	.631	-2.802 to -.308
	Academic link	No	REF	-	-
		Yes	-.496*	.222	-.934 to -.059
		Unspecified	2.622***	.520	1.594 to 3.649
	Workload[a]		-.006**	.002	-.009 to -.002
	Past behaviour[b]		.176*	.071	.035 to .317
Outcome	**Predictor**		**B**	**SE of B**	**95% CI**
$\log_e$ decision time (in seconds)	Duration	<4 days	REF	-	-
		4+ days	.069*	.027	.016 to .122
	Purulent tonsils	Absent	REF	-	-
		Present	.091*	.035	.022 to .161
	Age	Adult	REF	-	-
		Child	.097***	.023	.051 to .142
	Perceived decision difficulty rating		.071***	.010	.051 to .091
Outcome	**Predictor**		**OR**	**SE of B**	**95% CI**
Decision appropriateness[C]	Cough/cold symptoms	Absent	REF	-	-
		Present	7.971***	4.470	2.656 to 23.924

	Fever	Absent	REF	-	-
		Present	.475*	.175	.231 to .976
	Antibiotic preference	Prefer not to have	REF	-	-
		No preference	.438	.346	.093 to 2.060
		Mentions	.094**	.081	.017 to .509
		Firmly asks for	.108**	.072	.029 to .399

Note: **p<0.05 **p<0.01 ***p<0.001; n=1222 data points*

CI=confidence interval; OR = odds ratio; REF=Reference category for categorical predictor; SE=standard error

Difficulty response scale: not at all difficult (1) - extremely difficult (10)

[a]Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week

[b]Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10

[C]Appropriate decisions coded as 0, inappropriate decisions coded as 1

Table 3. Significant predictors in multiple linear regression models predicting perceived decision difficulty, decision time, and decision appropriateness for the otitis media scenarios completed by 158 primary care physician participants in Scotland in 2014-2015

Outcome	Predictor		B	SE of B	95% CI
Perceived decision difficulty	Study group	1	REF	-	-
		2	.995*	.498	.012 to 1.979
		3	.790	.503	-.203 to 1.784
		4	1.111*	.426	.270 to 1.951
		5	.235	.466	-.685 to 1.156
		6	.421	.490	-.546 to 1.389
		7	.374	.447	-.509 to 1.257
		8	.562	.424	-.275 to 1.400
		9	1.253**	.445	.374 to 2.132
	Duration	<4 days	REF	-	-
		4+ days	.208*	.086	.037 to .378
	Sex	Male	REF	-	-
		Female	-.327***	.079	-.482 to -.171
	Antibiotic preference	Prefer not	REF	-	-
		No preference	.411**	.120	.175 to .647
		Mentions	.471**	.144	.186 to .755
		Firmly asks for	.414**	.146	.125 to .703
	Practice type	Single-handed	REF	-	-
		Partnership	-.369	.340	-1.041 to .303
		Unspecified	-2.195***	.513	-3.208 to -1.182
	Trainer	No	REF	-	-
		Yes	-.294	.271	-.828 to .241
		Unspecified	-1.683*	.671	-3.008 to -.358
	Academic link	No	REF	-	-
		Yes	-.468	.273	-1.007 to .072
		Unspecified	2.363***	.588	1.202 to 3.524
	Workload[a]		-.004*	.002	-.008 to -.0002
Outcome	**Predictor**		**B**	**SE of B**	**95% CI**
$\log_e$ decision time (in seconds)	Antibiotic preference	Prefer not	REF	-	-
		No preference	.0002	.031	-.061 to .061
		Mentions	-.084*	.040	-.163 to -.005
		Firmly asks for	-.102**	.033	-.168 to -.037
	Consultation number	First	REF	-	-
		Re-consultation	.068**	.026	.017 to .119
	Trainer	No	REF	-	-
		Yes	-.052	.066	-.182 to .078
		Unspecified	.982*	.430	.131 to 1.832
	Academic link	No	REF	-	-

		Yes	-.062	.067	-.193 to .070
		Unspecified	-.949***	.174	-1.293 to -.605
	Perceived decision difficulty rating		.060***	.012	.038 to .083
Outcome	**Predictor**		**OR**	**SE of B**	**95% CI**
Decision appropriateness[b]	Study group	1	REF	-	-
		2	.770	.447	.247 to 2.405
		3	.489	.484	.071 to 3.395
		4	.776	.357	.315 to 1.914
		5	.622	.439	.156 to 2.478
		6	.179	.206	.019 to 1.708
		7	1.201	.568	.476 to 3.034
		8	.232*	.146	.068 to .798
		9	.256	.298	.026 to 2.498
	Scenario word count (centred on lowest count)		1.146*	.067	1.021 to 1.286
	Exam	Mild[c]	REF	-	-
		Severe[d]	.143***	.065	.058 to .349
	Antibiotic preference	Prefer not	REF	-	-
		No preference	.748	.335	.311 to 1.797
		Mentions	.141*	.116	.028 to .705
		Firmly asks for	.563	.413	.134 to 2.372
	Life-world circumstances	Absent	REF	-	-
		Present	.115**	.090	.025 to .530
	Conflict	Absent	REF	-	-
		Present	7.953***	3.508	3.350 to 18.880
	Practice type	Single-handed	REF	-	-
		Partnership	2.112*	.741	1.062 to 4.200
		Unspecified	6.938**	.4.696	1.841 to 26.145
	Practice location	Urban	REF	-	-
		Suburban	1.159	.346	.645 to 2.080
		Rural	.920	.303	.483 to 1.753
		Unspecified	59.545***	43.244	14.344 to 247.189
	Trainer	No	REF	-	-
		Yes	.685	.222	.363 to 1.294
		Unspecified	.004***	.005	.0004 to .040
	Past behaviour[e]		1.518***	.136	1.273 to 1.810
	Log_e decision time score (seconds)		1.962*	.525	1.161 to 3.314

Note: **p<0.05 **p<0.01 ***p<0.001; N=1239 data points*

CI=confidence interval; OR = odds ration; REF=Reference category for categorical predictor; SE=standard error

Difficulty response scale: not at all difficult (1) - extremely difficult (10)

[a]Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week

[b]Appropriate decisions coded as 0, inappropriate decisions coded as 1

[c]Minor redness in at least one tympanic membrane or definite redness and dullness in one tympanic membrane

[d]Definite redness & dullness in both tympanic membranes or discharge in at least one ear

[e]Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10

Table 4. Decisions and difficulty ratings of 5 primary care physician participants in Scotland in 2014-2015 for each Think-aloud study scenario, with corresponding summary data from the online study completed by 158 primary care physician participants in Scotland in 2014-2015

Online study	**Think-aloud study**				
% inappropriate decisions Mean (SD) difficulty rating	**Participant prescribing decision & difficulty rating**				
	P1	**P2**	**P3**	**P4**	**P5**
Scenario ST1 Male, child, sore throat, duration <4 days, cough/cold symptoms, no fever, mildly inflamed tonsils, no pus, no swollen glands, first consultation, history similar problems, parent not too worried, previously had antibiotics, prefer not to have antibiotics, self-medicating					
0% 1.9 (1.3)	**No** 1	**No** 1	**No** 2	**No** 2	**No** 1
Scenario ST2 Male, child, sore throat, duration 4+ days, cough/cold symptoms, fever, inflamed tonsils, no pus, swollen glands, re-consultation, no history similar problems, parent worried, no previous antibiotics, asks about antibiotics, self-medicating, off work and school and keen to get back					
31.4% 4.2 (2.2)	Immediate 2	**Delayed** 10	**No** 4	**Delayed** 6	**No** 2
Scenario ST3 Female, child, sore throat, duration 4+ days, no cough/cold symptoms, fever, inflamed tonsils, pus, no swollen glands, first consultation, no history similar problems, parent worried, no previous antibiotics, prefer not to have antibiotics, self-medicating					
0% 4.0 (1.8)	**Immediate** 2	**Delayed** 7	**Delayed** 7	**Immediate** 3	**Immediate** 2
Scenario OM1 Female, age <2, earache, duration <4 days, no fever, one tympanic membrane slightly red, first consultation, no history similar problems, parent worried, no previous antibiotics, prefer not to have antibiotics, self-medicating					
6.4% 3.0 (1.6)	**Delayed** 3	**No** 3	**No** 3	**No** 4	**No** 2
Scenario OM2 Male, age <2, earache, duration 4+ days, no fever, definite redness and dullness in one tympanic membrane, first consultation, history similar problems, parent not too worried, no previous antibiotics, no preference on antibiotics, self-medicating, other children at home to be looked after so wants him to get better quickly					
37.8% 4.5 (2.0)	Immediate 4	**Delayed** 10	**No** 3	Immediate 4	**Delayed** 4
Scenario OM3 Female, age 2-5, earache, duration 4+ days, no fever, definite redness and dullness in one tympanic membrane, first consultation, history similar problems, parent worried, no previous antibiotics, asks about antibiotics, self-medicating					
48.9% 4.0 (1.5)	Immediate 2	**Delayed** 10	**No** 4	Immediate 3	**Delayed** 3
Scenario OM4 Male, age <2, earache, duration 4+ days, no fever, definite redness and dullness in both tympanic membranes, re-consultation, no history similar problems, parent not too worried, no					

previous antibiotics, asks about antibiotics, self-medicating, holiday abroad in a few days and wants him to get better for it					
0% 4.5 (1.9)	**Delayed** 3	**Immediate** 10	**No** 6	**Immediate** 3	**Delayed** 6

Note: Appropriate decisions in bold; *SD=standard deviation*
Prescribing decisions: no = no prescribing; delayed = provide delayed prescription; immediate = provide immediate prescription
Difficulty response scale: not at all difficult (1) - extremely difficult (10)

FIGURE CAPTIONS

Figure 1. Example scenario (with corresponding factors, levels and statements) used in the online study exploring factors associated with inappropriate antibiotic prescribing completed by 158 primary care physician participants in Scotland in 2014-2015

SUPPLEMENTARY FILES

Supplementary File 1: Reporting checklist

Supplementary File 2: Scenario development details

Supplementary File 3: Scenario factors, levels, and statements, and the 48 scenarios used

Supplementary File 4: Full results of all regression analyses for sore throat scenarios

Supplementary File 5: Full results of all regression analyses for otitis media scenarios

Sore throat scenario 3

Male, age 11 years

Symptoms: For a week has had a sore throat, has a cough and runny nose and has been sneezing, has a fever

Examination: Temperature 38.3°C, inflamed tonsils, no pus on tonsils, cervical lymph nodes swollen

Significant past: Second visit with this complaint, no previous sore throat complaints in past 12 months

Parent's comments: Feeling worried, doesn't think antibiotics given before for similar illnesses but asks whether he might need antibiotics, been giving him painkillers which are providing some relief, off work and child off school and keen for them to get back

Factor	Level	Statement
Cough/cold symptoms	Present	has a cough and runny nose and has been sneezing
Fever in last 24 hours	Present	has a fever temperature 38.3°C
Swollen cervical nodes/glands	Present	cervical lymph nodes swollen
Purulent tonsils	Absent	no pus on tonsils
Inflamed tonsils	Present	inflamed tonsils
Duration of illness	4+ days	for a week
Age	Child	age 11 years
Sex	Male	male
Antibiotic treatment preference	Wonders about/suggests/ mentions/asks about antibiotics	asks whether he might need antibiotics
Consultation number	Re-consultation	second visit with this complaint
History of similar problems	Absent	no previous sore throat complaints in past 12 months
Life-world circumstances	Present	off work and child off school and keen for them to get back
Antibiotics received previously for similar problem	No	doesn't think antibiotics given before for similar illnesses
Patient concern	Worried	feeling worried
Use of self-medication	Present	been giving him painkillers which are providing some relief

190x338mm (300 x 300 DPI)

Antibiotic prescribing for respiratory tract infection: exploring drivers of cognitive effort and factors associated with inappropriate prescribing

Authors

Nicola McCleary, Jill J Francis, Marion K Campbell, Craig R Ramsay, Christopher D Burton, Julia L. Allan

Supplementary File 1: Good Reporting of A Mixed Methods Study (GRAMMS) Checklist

Guideline	**Section: page**
Describe the justification for using a mixed methods approach to the research question	Design: p7
Describe the design in terms of the purpose, priority and sequence of methods	Design: p7
Describe each method in terms of sampling, data collection and analysis	Quantitative: p8-9 Qualitative: p9
Describe where integration has occurred, how it has occurred and who has participated in it	Think-aloud interviews: p9
Describe any limitation of one method associated with the present of the other method	Strengths and limitations: p14
Describe any insights gained from mixing or integrating methods	Discussion: p14

O'Cathain A, Murphy E, Nicholl J. The quality of mixed methods studies in health services research. J Health Serv Res Policy. 2008;13(2):92-98.

Antibiotic prescribing for respiratory tract infection: exploring drivers of cognitive effort and factors associated with inappropriate prescribing

Authors

Nicola McCleary, Jill J Francis, Marion K Campbell, Craig R Ramsay, Christopher D Burton, Julia L. Allan

Supplementary File 2: Scenario development

Two upper respiratory tract infection (URTI) diagnoses, acute sore throat/pharyngitis/tonsillitis and acute otitis media, were selected so that results could be compared across two URTI types. An extensive list of factors which could be included in the scenarios was created based on literature, the relevant NICE guideline [1], and clinical scores for sore throat [2,3] (Table s1). It was not feasible to include all factors in the scenarios which could potentially influence decision-making. A sub-set were selected with assistance from our academic GP colleague on our author team (Chris Burton), who reviewed the list of potential factors and levels and a summary of the guideline recommendations, and selected clinical factors and respective levels which reflected the situations covered by the guidelines and which, in his professional opinion, were commonly present or would commonly be sought during consultations. CB also highlighted implausible combinations of factor levels which were to be avoided (e.g., for sore throat, presence of purulent tonsils with absence of inflamed tonsils). The non-clinical factors and levels were selected based on the CB's recommendations, the guideline recommendations, and whether our previous work [4] or wider literature suggested the factor may influence decision-making. Table s2 presents the factors and levels selected, with justifications for inclusion.

Table s1. Potential scenario factors

Potential factor	Suggested levels
Patient age	Child (infant or older) or adult or elderly Minimum 3 months: NICE guidelines focus on prescribing of antibiotics for self-limiting respiratory tract infections in adults and children aged 3 months and older
Patient sex	Male or female
Attendance frequency	Infrequent or average or frequent
Patient concern	Patient/parent worried/anxious or not
Patient treatment preference	a. Patient/parent requests antibiotic, or demands antibiotic, or prefers not to have antibiotics, or has no preference e b. GP perceives that patient/parent wants/expects antibiotic or not
Past treatment with antibiotics for similar problem	Past treatment or not
Life-world circumstances (Important economic/social factors for the patient)	Present or not (Example circumstances: disrupted school/work schedules & quick recovery needed; there are younger children in family who may get ill; pending trip/holiday; history of missing school/work for related problems; mother caring for young children; parents ability to provide effective care to sick child)
Socio-economic status	High or medium or low (Indicated by education level/income/address?)
Day of the week	Mon or Tue or Wed or Thurs or Fri
Time of consultation	Morning or afternoon
Location of consultation	Surgery or home visit
Duration of illness	Shorter or longer than durations for specific diagnoses specified in NICE guidelines?
Consultation number	First consultation or follow-up encounter for same episode
Self-management	a. Whether patient has been using decongestants/OTC painkillers or not b. Whether patient improving under self-medication or not
Presence of comorbidity	a. Patient has asthma or not

	b. Patient has COPD or not c. Patient has other chronic respiratory illness or not d. Patient has cardiovascular disease or not e. Patient has diabetes or not
Relevant previous problem	a. Patient has history of otitis media (applicable to children only?) b. Patient has acute rheumatic fever in history? c. Patient has recent history of similar problems?
Smoking status	Current smoker or ex-smoker or non-smoker
Symptoms & signs: nasal	
Rhinorrhoea (runny nose)	Present or not
Blocked nose	Present or not
Sneezing	Present or not
Purulent nasal drainage	Present or not
Coloured nasal drainage	Present or not
Purulent secretions in nasal cavity on inspection	Present or not
Pus exuding from ostium	Present or not
Coryza	Present or not
Symptoms & signs: throat & neck	
Cough	Present or not
Sputum	None or clear or discoloured/purulent
Sore throat	Present or not
Red throat	Present or not
Pain when swallowing	Present or not
Difficulty swallowing	Present or not
Inflamed fauces	Present or not
Red fauces	Present or not
Exudate/pus on tonsils	Present or not
Large tonsils	Present or not
Pink tonsils	Present or not
Red tonsils	Present or not
Exudate/pus on pharynx	Present or not
Inflamed pharynx	Present or not

Red pharynx	Present or not
Hoarseness	Present or not
Cervical lymph nodes	Cervical lymphadenopathy/swollen/tender/large or not
Symptoms & signs: chest	
Auscultation findings	a. Wheeze or not b. Shortness of breath (dyspnoea) or not c. Crepitations/crackles/rales or not d. Rhonchi or not e. Reduced vesicular breathing or not f. Percussion dullness or not g. Bronchial breathing or not h. Diminished breath sounds or not
Reported wheeze	Present or not
Respiration rate (tachypnoea)	Too high or not
Aspiration risk	Present or not
Chest/thoracic pain	Present or not
Symptoms & signs: ear	
Earache	Present or not
Eardrum/tympanic membrane	a. Discharging or not b. Indrawn or not c. Injected or not d. Dull (light reflexes lost) or not e. Bulging or not f. Perforated or not g. Colour (diffusely) red or (diffusely) pink or normal h. Asymmetric or not
Mobility on insufflation	Present or not
Effusion	Present or not
Symptoms & signs: sinus	
Maxillary/facial/frontal pain	a. Present or not b. Present when bending forward or not

Tooth/jaw pain	Present or not
Sinus pain	Present or not
Sinus pressure	Present or not
Sinus tenderness on examination	Present or not
Tender on facial pressure or percussion	Present or not
Symptoms & signs: general	
GP perception of appearance/severity of illness	Patient appears very ill/unwell or moderately ill/unwell or normal
Patient perception of severity of illness	Patient feeling very ill/unwell or moderately ill/unwell
Temperature/fever	Provide specific temperature or Indicate if fever present or not?
Headache	Present or not
Muscle ache	Present or not
Stomach ache	Present or not
Nausea	Present or not
Vomiting	Present or not
Loss of appetite	Present or not
Fatigue	Present or not
Malaise	Present or not
Disturbed sleep	Present or not
Interference with normal activities	Present or not
Child crying	Present or not

Table s2. Scenario factors and levels, and justifications for inclusion in the scenarios

Factor	Description	Levels	Justification
Cough/cold symptoms[a]	Whether the patient has a cough or symptoms such as runny nose, blocked nose, and/or sneezing	Absent Present	Selected by CB as key indicator; included in Centor criteria and/or FeverPAIN score & levels correspond to the scoring system(s)
Fever in last 24 hours[a]	Whether the patient has had a fever in the past 24 hours		
Swollen cervical nodes/glands[b]	Whether the patient has swollen cervical nodes/glands		
Purulent tonsils[a]	Whether the patient has pus on tonsils		
Inflamed tonsils[c]	Whether the patient has inflamed tonsils		
Use of self-medication	Whether the patient has self-medicated using painkillers		Evidence suggests may be associated with decision-making; levels replicate our previous analysis
Examination	Results of ear examination	Minor redness in at least one TM Definite redness & dullness in one TM Definite redness & dullness in both TMs Discharge in at least one ear	Selected by CB as key indicator; included in NICE guideline; levels correspond to guideline recommendations
Duration of illness[c]	How long the patient has been suffering from URTI	<4 days 4+ days	Selected by CB as key indicator; levels don't replicate our previous analysis, as NICE guideline specifies typical duration as 1 week for sore throat & 4 days for otitis media: levels selected to ensure scenarios represent straightforward URTI

Factor	Description	Levels	Justification
			Sore throat: included in FeverPAIN score, levels correspond to the scoring system; evidence suggests may be associated with decision-making
Age	Patient age	Sore throat Child Adult Otitis media Child <2 Child 2-5	Present in real consultation; evidence suggests may be associated with decision-making Sore throat: levels replicate our previous analysis although do not include older adults on advice from CB Otitis media: selected by CB as key indicator; included in NICE guideline; levels correspond to guideline recommendations
Sex	Patient sex	Male Female	Present in real consultation; evidence suggests may be associated with decision-making
Antibiotic treatment preference	The patient's/parent's preference relating to antibiotic treatment for URTI	Prefer not to have antibiotics No preference Wonders about/suggests/ mentions/asks about antibiotics Firmly asks for antibiotics	Included in NICE guideline; evidence suggests may be associated with decision-making; levels differ from our previous analysis, on advice from CB

Factor	Description	Levels	Justification
Consultation number	Whether this is the first or a re-consultation for current URTI	First consultation Re-consultation	Evidence suggests may be associated with decision-making; levels replicate our previous analysis
History of similar problems	Whether the patient has any relevant previous problems	Absent Present	
Life-world circumstances	Whether the patient/parent has any significant personal consequences of URTI (e.g. missing a pending trip or event, missing work)		
Antibiotics received previously for similar problem	Whether patient previously received antibiotics for an URTI	No Yes	
Patient concern	Whether patient/parent is worried about URTI	Not worried Worried	

Note: *Green=sore throat scenarios only; blue=otitis media scenarios only; CB=Chris Burton; TM=tympanic membrane; URTI=upper respiratory tract infection*
[a]Centor & FeverPAIN criteria; [b]Centor criteria; [c]FeverPAIN criteria

Most factors had only two levels (e.g. present/absent), to limit the number of scenarios included and thus the sample size required to conduct the analyses. The 15 sore throat scenario factors comprised 14 factors with two levels and one factor with four levels, while the 10 otitis media scenario factors comprised eight factors with two levels and two factors with four levels (Tables s3 & s4). A full factorial design would require the creation of 65,536 sore throat scenarios ($2^{14} \times 4^{1}$) and 4,096 otitis media scenarios ($2^{8} \times 4^{2}$). Since this was not feasible, sub-sets of scenarios were selected, with a view to including experimentally optimal combinations of factors. The OPTEX procedure within SAS was used to generate an optimised experimental design where implausible combinations of factor levels were excluded.

The optimality of an optimised experimental design is judged based on the *optimality criterion*: this is a single number that summarizes how efficient a design is relative to theoretically optimal designs that may not be possible [5,6]. The criterion can range between 0 (inefficient design) and 1 (efficient design) [5], and should ideally be close to 1. The *d-optimality criterion* was used to judge the optimality of the experimental design generated for this study because it focuses on minimising the variance and co-variance when the chosen sub-set is compared to all other possible subsets [6]. To generate an optimal experimental design using OPTEX, a specific algorithm must be selected to search through all possible combinations of factors for an experimentally optimal sub-set [6]. The *Modified Federov algorithm* was selected for this study because although it generally takes longer to run than other algorithms, it typically finds the most optimal design [6]. A main effects model was specified since the aim of the study was to investigate the main effects of scenario factors.

Table s3. Sore throat scenario factors and levels, with SAS coding information

Factor	SAS name	Level	Coding
Cough or cold symptoms	CC	Present	0 (-1)
		Absent	1
Fever in last 24 hours	FEVER	Absent	0 (-1)
		Present	1
Duration of illness	DURATION	4+ days	0 (-1)
		0-3 days	1
Inflamed tonsils	INFTONS	Absent	0 (-1)
		Present	1
Swollen cervical nodes/glands	SWGLANDS	Absent	0 (-1)
		Present	1
Purulent tonsils	PURTONS	Absent	0 (-1)
		Present	1
Age	AGE	Adult	0 (-1)
		Child	1
Sex	SEX	Male	0 (-1)
		Female	1
Abx treatment preference	ABXPREF	No preference	0 (-1)
		Prefer not to have abx	1 (-0.33)
		Wonders/suggests/mentions/ asks for abx	2 (0.33)
		Firmly asks for abx	3 (1)
Consultation number	CONNUM	First consultation	0 (-1)
		Re-consultation	1
Use of self-medication	SELFMED	Absent	0 (-1)
		Present	1
History of similar problems	HIST	Absent	0 (-1)
		Present	1
Life-world circumstances	LIFEWORL	Absent	0 (-1)
		Present	1
Antibiotics received previously for similar problem	PREVABX	No	0 (-1)
		Yes	1
Patient concern	CONCERN	Not worried/anxious	0 (-1)
		Worried/anxious	1

Table s4. Otitis media scenario factors and levels, with SAS coding information

Factor	SAS name	Level	Coding
Age	AGE	Child 2-5	0
		Child <2	1
Duration	DURATION	<4 days	0
		4+ days	1
Examination	EXAM	Minor redness at least 1 TM	0
		Definite redness & dullness 1 TM	1
		Definite redness & dullness both TMs	2
		Discharge in at least 1 ear	3
Sex	SEX	Male	0
		Female	1
Abx treatment preference (parental)	ABXPREF	No preference	0
		Prefer not to have abx	1
		Wonders /suggests/mentions/ asks for abx	2
		Firmly asks for abx	3
Consultation number	CONNUM	First consultation	0
		Re-consultation	1
History of similar problems	HIST	Absent	0
		Present	1
Life-world circumstances	LIFEWORL	Absent	0
		Present	1
Antibiotics received previously for similar problem	PREVABX	No	0
		Yes	1
Patient concern (parental)	CONCERN	Not worried/anxious	0
		Worried/anxious	1

A blocked design was selected as it achieved the optimal balance between statistical efficiency and feasibility. Each scenario set (otitis media/sore throat) had three blocks of eight scenarios, resulting in 24 scenarios in each set and 48 scenarios altogether. Tables s5 and s6 include details of the scenario sets generated. Participants were randomised to one block of each type, and therefore responded to eight sore throat scenarios and eight otitis media scenarios. This design had D-optimality measures greater than .9 for both the otitis media and sore throat sets, and was feasible in that participants would be responding to only 16 scenarios, while 48 scenarios could be assessed overall. Some properties of the design were assessed, including level balance (whether all levels of a factor appear roughly equally) and orthogonality (whether there are correlations between pairs of factors). There was some

level imbalance and a few correlations between factors due to the implausible combinations of levels that had been excluded. However, no factors were completely confounded.

Table s5. Sore throat scenario set generated in SAS

BLOCK	CC	FEVER	DURATION	INFTONS	SWGLANDS	PURTONS	AGE	SEX	CONNUM	SELFMED	HIST	LIFEWORL	PREVABX	CONCERN	ABXPREF
1	-1	1	1	1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	1
1	1	1	-1	1	-1	1	1	1	-1	1	-1	-1	-1	1	0.3333333333
1	-1	1	-1	1	1	-1	1	-1	1	1	-1	1	-1	1	0.3333333333
1	1	-1	-1	1	1	-1	-1	1	-1	-1	1	1	1	-1	1
1	1	1	-1	-1	-1	-1	-1	1	1	1	1	-1	1	-1	-1
1	1	1	1	1	1	1	-1	-1	-1	1	1	1	-1	1	1
1	-1	-1	1	-1	-1	-1	1	-1	-1	1	1	-1	1	-1	0.3333333333
1	-1	-1	-1	1	-1	1	-1	1	-1	1	1	-1	-1	-1	-1
2	-1	1	-1	-1	-1	-1	-1	1	-1	-1	1	-1	-1	-1	0.3333333333
2	-1	1	1	1	-1	-1	-1	1	-1	1	1	1	1	1	0.3333333333
2	1	-1	1	1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	0.3333333333
2	-1	-1	-1	1	1	1	-1	1	1	1	1	-1	-1	1	0.3333333333
2	1	1	-1	1	-1	-1	1	-1	1	1	1	1	-1	-1	-1
2	1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	1	-1	-1	0.3333333333
2	1	1	1	1	1	1	1	-1	-1	1	-1	-1	-1	-1	1
2	-1	-1	-1	1	1	-1	1	-1	-1	1	1	-1	1	1	-1
3	1	-1	-1	1	-1	-1	-1	-1	1	1	-1	-1	-1	1	1
3	-1	1	-1	-1	-1	-1	1	-1	-1	1	1	1	-1	1	1
3	1	-1	1	-1	-1	-1	1	1	-1	1	-1	1	-1	1	-1
3	1	1	-1	1	-1	1	-1	-1	-1	-1	1	-1	1	-1	0.3333333333
3	-1	-1	1	1	1	1	-1	-1	-1	-1	-1	1	-1	-1	-1
3	-1	-1	-1	1	-1	1	1	1	1	1	1	1	1	-1	1
3	1	-1	1	1	1	-1	1	1	-1	1	1	-1	-1	-1	0.3333333333
3	-1	1	-1	1	1	-1	-1	1	-1	1	-1	-1	-1	-1	0.3333333333

Table s6. Otitis media scenario set generated in SAS

BLOCK	AGE	DURATION	EXAM	SEX	ABXPREF	CONNUM	HIST	LIFEWORL	PREVABX	CONCERN

1	0	0	0	0	2	0	1	1	0	0
1	0	0	1	1	3	0	0	1	0	0
1	1	1	2	1	3	1	1	0	0	0
1	1	1	0	0	2	0	1	1	1	1
1	0	1	2	1	0	0	0	1	0	1
1	0	1	3	0	1	1	1	0	0	1
1	0	0	3	0	0	0	1	0	1	0
1	1	1	1	0	0	1	0	0	0	1
2	1	1	2	0	2	1	0	1	0	0
2	0	1	0	1	0	1	1	0	0	1
2	0	1	2	0	1	0	1	0	1	0
2	1	0	0	1	1	0	0	0	0	1
2	1	0	3	1	0	0	1	1	0	0
2	0	1	1	1	2	0	1	0	0	1
2	0	0	1	0	3	0	1	0	1	1
2	1	1	3	1	3	0	1	1	1	1
3	0	1	3	1	2	0	0	0	0	0
3	1	0	2	1	2	0	1	0	1	1
3	1	1	1	0	0	0	1	1	0	0
3	0	1	3	0	2	1	0	1	0	1
3	0	0	2	0	3	0	1	1	0	1
3	1	1	1	1	1	1	1	0	1	0
3	0	1	0	1	0	1	1	1	1	0
3	1	1	0	0	3	0	0	0	0	0

The scenarios were then written, following the recommendations of Heverly and colleagues [7]. For maximum consistency, one statement would be written for each level of each scenario factor. However, this may compromise scenario realism: for example, it would not be realistic for all patients to indicate an antibiotic preference in the same way. Therefore, there was some variation in wording. For each level, specific statements which represented the level were written after reviewing the sources used to identify scenario content. Statements were numbered sequentially, and random number lists obtained from *random.org* were used to assign statements to corresponding scenarios. All sore throat scenarios included the additional information that the patient had a sore throat, while all otitis media scenarios noted that the patient had earache and a mildly raised temperature and that symptomatic treatment had been attempted with painkillers (on advice from GP colleagues who reviewed the scenarios).

All of the statements and half of the scenarios were reviewed by CB and a teaching GP colleague (Ewan Paterson), who advised that the order in which the scenario information was presented, certain combinations of factor levels, and some of the language used was atypical. Based on this feedback, the SAS OPTEX procedure was re-run with further unrealistic combinations of factor levels excluded, and new scenario subsets were selected. The wording of some of the statements was modified, statements were reassigned to scenarios, and the order in which the scenario information was presented was modified. The final scenarios (included below) were then ready to be programmed into the online study platform.

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Antibiotic prescribing for respiratory tract infection: exploring drivers of cognitive effort and factors associated with inappropriate prescribing

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Supplementary File 3: Scenario factors, levels, and statements, and the 48 scenarios used

All factors, levels, and corresponding statements used in the scenarios are presented in Tables s7 and s8.

Table s7. Factors and levels used in sore throat scenarios, and statements used to represent factor levels

Factor	Level	Statements
Cough or cold symptoms	Present	1. Has a cough 2. No cough but has a runny nose and has been sneezing 3. No cough but has a blocked nose and has been sneezing 4. Has a cough and runny nose and has been sneezing 5. Has a cough and blocked nose and has been sneezing 6. Has a cough and a cold
	Absent	1. No cough or cold symptoms 2. No cough or other common symptoms of the cold
Fever	Present	1. Been feeling feverish; temperature (38.1/38.2/38.3/38.4/38.5°C) 2. Reports being fevered; temperature (38.1/38.2/38.3/38.4/38.5°C) 3. Has a fever; temperature (38.1/38.2/38.3/38.4/38.5°C)
	Absent	1. Has not been feverish; temperature (37.1/37.2/37.3/37.4/37.5°C) 2. Reports no fever; temperature (37.1/37.2/37.3/37.4/37.5°C) 3. No fever; temperature (37.1/37.2/37.3/37.4/37.5°C)

Duration of illness	0-3 days	1. ….for the past (2 days/ 3 days/ …since yesterday) 2. ….since (yesterday/ for 2 days/ 3 days) 3. For the last (2 days/ 3 days/since yesterday)…
	4+ days	1. ….for the past (4 days/ 5 days/ 6 days/ week) 2. ….for (4 days/5 days/ 6 days/ a week) 3. For the last (4 days/ 5 days/ 6 days/ week)….
Inflamed tonsils	Absent	1. Tonsils mildly inflamed 2. Mildly inflamed tonsils
	Present	1. Tonsils inflamed 2. Inflamed tonsils
Purulent tonsils	Present	1. Pus on tonsils 2. …with pus present
	Absent	1. No pus on tonsils 2. …and/but no pus
Swollen cervical nodes/glands	Present	1. Cervical lymph nodes swollen 2. Swollen cervical lymph nodes
	Absent	1. Cervical lymph nodes not swollen 2. No swollen cervical lymph nodes
Age	Child	1. Age (5-15) years
	Adult	1. Age (18-50) years
Sex	Male	1. Male
	Female	2. Female
Antibiotic treatment preference	Prefer not to have antibiotics	1. Would rather not have antibiotics if possible 2. Would prefer not to have antibiotics if possible
	No preference	1. Does not have a preference in relation to antibiotics 2. Has no specific preference regarding antibiotics
	Wonders about/suggests/ mentions/asks about antibiotics	1. Wonders whether antibiotics might help 2. Mentions antibiotics might help 3. Asks whether (he/she) might need antibiotics
	Firmly asks for antibiotics	1. Says that (he/she) needs antibiotics to clear it 2. Says that only antibiotics work 3. Asks for antibiotics

Consultation number	First consultation for current problem	1. First visit with this complaint 2. Consulting for the first time with this complaint
	Re-consultation for current problem	1. Second visit with this complaint 2. Consulting for the second time with this complaint
Use of self-medication	Present	1. Been taking/giving (him/her) paracetamol which is providing some relief 2. Been taking/giving (him/her) ibuprofen which is providing some relief 3. Been taking/giving (him/her) painkillers which are providing some relief
	Absent	1. Hasn't been taking painkillers 2. Not been taking any painkillers
History of similar problems	Present	1. In the last 12 months, has had one previous sore throat complaint 2. In the last 12 months, has had two previous sore throat complaints 3. One previous sore throat complaint in past 12 months 4. Two previous sore throat complaints in past 12 months
	Absent	1. In the last 12 months has had no previous sore throat complaints 2. No previous sore throat complaints in past 12 months
Life-world circumstances	Present	1. Off work and keen to get back/off work and child off school and keen for them to get back/child off school and keen for (him/her) to get back 2. Has (other) children at home to be looked after so wants (him/her) to get better quickly 3. Going on holiday abroad in a few days and wants (him/her) to get better for it 4. Has an important event in a few days so wants (him/her) to get better quickly
	Absent	N/A
Antibiotics received previously for similar problem	Yes	1. Given antibiotics before for similar illnesses 2. Previously given antibiotics for similar illnesses 3. Given antibiotics before for similar previous complaints
	No	1. Doesn't think antibiotics given before for similar illnesses 2. Doesn't think antibiotics received previously for similar illnesses 3. Not given antibiotics for similar previous complaints
Patient concern	Worried	1. Worried about (illness/him/her) 2. Feeling worried
	Not worried	1. Not particularly worried about (illness/him/her) 2. Not feeling particularly worried

Table s8. Factors and levels used in otitis media scenarios, and statements used to represent factor levels

Factor	Levels	Statements
Age	Child (approx. 18 months (<2))	1. Age (15-22) months
	Child (approx. 4 years (2-5))	1. Age (2-5) years
Duration	<4 days	1. ….for the past (2 days/ 3 days/ …since yesterday) 2. ….since (yesterday/ for 2 days/ 3 days) 3. For the last (2 days/ 3 days/since yesterday)
	4+ days	1. ….for the past (4 days/ 5 days/ 6 days/ week) 2. ….for (4 days/5 days/ 6 days/ a week) 3. For the last (4 days/ 5 days/ 6 days/ week)….
Examination	Minor redness in at least one tympanic membrane	1. Slight redness in one tympanic membrane 2. One tympanic membrane slightly red 3. Slight redness in both tympanic membranes 4. Slight redness in tympanic membranes bilaterally
	Definite redness & dullness one tympanic membrane	1. Definite redness and dullness in one tympanic membrane 2. One tympanic membrane has definite redness and dullness
	Definite redness & dullness both tympanic membranes	1. Definite redness and dullness in both tympanic membranes 2. Definite redness and dullness in tympanic membranes bilaterally
	Discharge in at least one ear	1. Discharge in one ear 2. Discharge in both ears 3. One ear discharging 4. Both ears discharging
Sex	Male	Male
	Female	Female
Antibiotic treatment preference (PARENTAL)	Prefer not to have antibiotics	1. Would rather not have antibiotics if possible 2. Would prefer not to have antibiotics if possible
	No preference	1. Does not have a preference in relation to antibiotics 2. Has no specific preference regarding antibiotics
	Wonders about/suggests/ mentions/asks about abx	1. Wonders whether antibiotics might help 2. Mentions antibiotics might help 3. Asks whether (he/she) might need antibiotics

	Firmly asks for antibiotics	1. Says that (he/she) needs antibiotics to clear it 2. Says that only antibiotics work 3. Asks for antibiotics
Consultation number	First consultation for current problem	1. First visit with this complaint 2. Consulting for the first time with this complaint
	Re-consultation for current problem	1. Second visit with this complaint 2. Consulting for the second time with this complaint
History of similar problems	Present	1. In the last 12 months has had one previous earache complaint 2. In the last 12 months has had two previous earache complaints 3. One previous earache complaint in past 12 months 4. Two previous earache complaints in past 12 months
	Absent	1. In the last 12 months has had no previous earache complaints 2. No previous earache complaints in past 12 months
Life-world circumstances	Present	1. Off work to look after (him/her) and keen to get back/off work and child off (school/nursery) and keen for them to get back/child off (school/nursery) and keen for (him/her) to get back 2. Has other children at home to be looked after so wants (him/her) to get better quickly 3. Going on holiday abroad in a few days and wants (him/her) to get better for it 4. Has an important event in a few days so wants (him/her) to get better quickly
	Absent	N/A
Antibiotics received previously for similar problem (PARENTAL)	Yes	1. Given antibiotics before for similar illnesses 2. Previously given antibiotics for similar illnesses 3. Given antibiotics before for similar previous complaints
	No	1. Doesn't think antibiotics given before for similar illnesses 2. Doesn't think antibiotics received previously for similar illnesses 3. Not given antibiotics for similar previous complaints
Patient concern (PARENTAL)	Worried	1. Worried about (him/her) 2. Feeling worried
	Not worried	1. Not particularly worried about (him/her) 2. Not feeling particularly worried

The 48 scenarios used in the online study

Sore throat

Block 1

1. Female, age 22 years

   Symptoms: For the last 2 days has had a sore throat, no cough but has a blocked nose and has been sneezing, been feeling feverish

   Examination: Temperature 38.2°C, tonsils inflamed, no pus on tonsils, no swollen cervical lymph nodes

   Significant past: First visit with this complaint, no previous sore throat complaints in past 12 months

   Patient's comments: Not feeling particularly worried, doesn't think antibiotics received previously for similar illnesses but asks for antibiotics, not been taking any painkillers

2. Female, 10 years

   Symptoms: For 6 days has had a sore throat, no cough or other common symptoms of the cold, has a fever

   Examination: Temperature 38.5°C, inflamed tonsils, pus on tonsils, no swollen cervical lymph nodes

   Significant past: Consulting for the first time with this complaint, in the last 12 months has had no previous sore throat complaints

   Parent's comments: Worried about her, doesn't think antibiotics given before for similar illnesses and would prefer not to have antibiotics if possible, been giving her paracetamol which is providing some relief

   [SCENARIO ST3 IN THINK-ALOUD STUDY]

3. Male, age 11 years

   Symptoms: For a week has had a sore throat, has a cough and runny nose and has been sneezing, has a fever

   Examination: Temperature 38.3°C, inflamed tonsils, no pus on tonsils, cervical lymph nodes swollen

   Significant past: Second visit with this complaint, no previous sore throat complaints in past 12 months

   Parent's comments: Feeling worried, doesn't think antibiotics given before for similar illnesses but asks whether he might need antibiotics, been giving him painkillers which are providing some relief, off work and child off school and keen for them to get back

   [SCENARIO ST2 IN THINK-ALOUD STUDY]

4. Female, age 31 years

Symptoms: For the last week has had a sore throat, no cough or other common symptoms of the cold, has not been feverish
Examination: Temperature 37.4°C, inflamed tonsils but no pus, cervical lymph nodes swollen
Significant past: First visit with this complaint, two previous sore throat complaints in past 12 months
Patient's comments: Not feeling particularly worried, given antibiotics before for similar previous complaints and says that only antibiotics work, not been taking any painkillers, going on holiday abroad in a few days and wants to get better for it

5. Female, age 25 years

Symptoms: For 4 days has had a sore throat, no cough or cold symptoms, reports being fevered
Examination: Temperature 38.1°C, mildly inflamed tonsils and no pus, no swollen cervical lymph nodes
Significant past: Second visit with this complaint, in the last 12 months has had two previous sore throat complaints
Patient's comments: Not feeling particularly worried, given antibiotics before for similar illnesses but does not have a preference in relation to antibiotics, been taking painkillers which are providing some relief

6. Male, age 34 years

Symptoms: For the past 2 days has had a sore throat, no cough or other common symptoms of the cold, reports being fevered
Examination: Temperature 38.1°C, tonsils inflamed, pus on tonsils, cervical lymph nodes swollen
Significant past: Consulting for the first time with this complaint, in the last 12 months has had two previous sore throat complaints
Patient's comments: Worried about illness, not given antibiotics for similar previous complaints but says that he needs antibiotics to clear it, been taking ibuprofen which is providing some relief, going on holiday abroad in a few days and wants to get better for it

7. Male, age 9 years

Symptoms: For 3 days has had a sore throat, no cough but has a runny nose and has been sneezing, no fever
Examination: Temperature 37.1°C, mildly inflamed tonsils and no pus, cervical lymph nodes not swollen
Significant past: Consulting for the first time with this complaint, one previous sore throat complaint in past 12 months
Parent's comments: Not feeling particularly worried, previously given antibiotics for similar illnesses but would prefer not to have antibiotics if possible, been giving him painkillers which are providing some relief

[SCENARIO ST1 IN THINK-ALOUD STUDY]

8. Female, age 21 years

Symptoms: For the past 5 days has had a sore throat, has a cough and runny nose and has been sneezing, reports no fever
Examination: Temperature 37.2°C, tonsils inflamed with pus present, no swollen cervical lymph nodes

Significant past: First visit with this complaint, in the last 12 months has had two previous sore throat complaints
Patient's comments: Not particularly worried about illness, doesn't think antibiotics given before for similar illnesses and has no specific preference regarding antibiotics, been taking paracetamol which is providing some relief

Block 2

9. Female, age 36 years

Symptoms: For the past 5 days has had a sore throat, has a cough, been feeling feverish
Examination: Temperature 38.5°C, tonsils mildly inflamed, no pus on tonsils, cervical lymph nodes not swollen

Significant past: Consulting for the first time with this complaint, one previous sore throat complaint in past 12 months
Patient's comments: Not particularly worried about illness, not given antibiotics for similar previous complaints but wonders whether antibiotics might help, hasn't been taking painkillers

10. Female, age 18 years

Symptoms: Since yesterday has had a sore throat, no cough but has a blocked nose and has been sneezing, reports being fevered
Examination: Temperature 38.3°C, inflamed tonsils, no pus on tonsils, cervical lymph nodes not swollen
Significant past: Consulting for the first time with this complaint, one previous sore throat complaint in past 12 months
Patient's comments: Feeling worried, given antibiotics before for similar illnesses and wonders whether antibiotics might help, been taking painkillers which are providing some relief, going on holiday abroad in a few days and wants to get better for it

11. Male, age 20 years

Symptoms: Since yesterday has had a sore throat, no cough or other common symptoms of the cold, reports no fever
Examination: Temperature 37.3°C, tonsils inflamed, no pus on tonsils, cervical lymph nodes not swollen
Significant past: Consulting for the first time with this complaint, in the last 12 months has had one previous sore throat complaint

Patient's comments: Not feeling particularly worried, doesn't think antibiotics given before for similar illnesses and would prefer not to have antibiotics if possible, not been taking any painkillers

12. Female, age 50 years

Symptoms: For the last 6 days has had a sore throat, has a cough and blocked nose and has been sneezing, reports no fever
Examination: Temperature 37.2°C, inflamed tonsils, pus on tonsils, swollen cervical lymph nodes

Significant past: Second visit with this complaint, in the last 12 months has had one previous sore throat complaint
Patient's comments: Worried about illness, not given antibiotics for similar previous complaints and would rather not have antibiotics if possible, been taking paracetamol which is providing some relief

13. Male, age 13 years

Symptoms: For the last 4 days has had a sore throat, no cough or other common symptoms of the cold, been feeling feverish
Examination: Temperature 38.2°C, inflamed tonsils, no pus on tonsils, cervical lymph nodes not swollen
Significant past: Consulting for the second time with this complaint, two previous sore throat complaints in past 12 months
Parent's comments: Not particularly worried about him, not given antibiotics for similar previous complaints and has no specific preference regarding antibiotics, been giving him paracetamol which is providing some relief, has other children at home to be looked after so wants him to get better quickly

14. Male, age 45 years

Symptoms: For the last 6 days has had a sore throat, no cough or cold symptoms, reports no fever

Examination: Temperature 37.5°C, tonsils mildly inflamed and no pus, cervical lymph nodes not swollen
Significant past: Consulting for the first time with this complaint, in the last 12 months has had no previous sore throat complaints
Patient's comments: Not particularly worried about illness, doesn't think antibiotics given before for similar illnesses but asks whether he might need antibiotics, been taking ibuprofen which is providing some relief, off work and keen to get back

15. Male, age 5 years

Symptoms: For 2 days has had a sore throat, no cough or cold symptoms, reports being fevered
Examination: Temperature 38.4°C, inflamed tonsils, pus on tonsils, swollen cervical lymph nodes

Significant past: First visit with this complaint, no previous sore throat complaints in past 12 months
Parent's comments: Not feeling particularly worried, doesn't think antibiotics received previously for similar illnesses but asks for antibiotics, been giving him ibuprofen which is providing some relief

16. Male, age 14 years

Symptoms: For the past week has had a sore throat, has a cough and a cold, has not been feverish
Examination: Temperature 37.4°C, tonsils inflamed but no pus, cervical lymph nodes swollen
Significant past: First visit with this complaint, in the last 12 months has had two previous sore throat complaints
Parent's comments: Feeling worried, previously given antibiotics for similar illnesses but does not have a preference in relation to antibiotics, been giving him painkillers which are providing some relief

Block 3

17. Male, age 30 years

Symptoms: For 5 days has had a sore throat, no cough or cold symptoms, no fever
Examination: Temperature 37.3°C, tonsils inflamed but no pus, no swollen cervical lymph nodes
Significant past: Consulting for the second time with this complaint, no previous sore throat complaints in past 12 months
Patient's comments: Feeling worried, doesn't think antibiotics received previously for similar illnesses but asks for antibiotics, been taking paracetamol which is providing some relief

18. Male, age 15 years

Symptoms: For the past 4 days has had a sore throat, has a cough, been feeling feverish
Examination: Temperature 38.5°C, tonsils mildly inflamed and no pus, no swollen cervical lymph nodes
Significant past: Consulting for the first time with this complaint, one previous sore throat complaint in past 12 months
Parent's comments: Worried about him, not given antibiotics for similar previous complaints but says that he needs antibiotics to clear it, been giving him painkillers which are providing some relief, has other children at home to be looked after so wants him to get better quickly

19. Female, age 12 years

Symptoms: For the last 3 days has had a sore throat, no cough or cold symptoms, no fever
Examination: Temperature 37.4°C, mildly inflamed tonsils and no pus, no swollen cervical lymph nodes
Significant past: First visit with this complaint, in the last 12 months has had no previous sore throat complaints
Parent's comments: Worried about her, doesn't think antibiotics given before for similar illnesses and does not have a preference in relation to antibiotics, been giving her ibuprofen which is providing some relief, has an important event in a few days so wants her to get better quickly

20. Male, age 46 years
Symptoms: For the last week has had a sore throat, no cough or cold symptoms, has a fever
Examination: Temperature 38.4°C, inflamed tonsils with pus present, cervical lymph nodes not swollen

Significant past: First visit with this complaint, two previous sore throat complaints in past 12 months
Patient's comments: Not feeling particularly worried, given antibiotics before for similar illnesses and mentions antibiotics might help, hasn't been taking painkillers

21. Male, age 28 years
Symptoms: For the past 3 days has had a sore throat, has a cough and a cold, has not been feverish
Examination: Temperature 37.3°C, inflamed tonsils with pus present, swollen cervical lymph nodes

Significant past: First visit with this complaint, in the last 12 months has had no previous sore throat complaints
Patient's comments: Not particularly worried about illness, doesn't think antibiotics received previously for similar illnesses and has no specific preference regarding antibiotics, hasn't been taking painkillers, off work and keen to get back

22. Female, age 8 years

Symptoms: For 5 days has had a sore throat, no cough but has a runny nose and has been sneezing, no fever
Examination: Temperature 37.1°C, tonsils inflamed with pus present, cervical lymph nodes not swollen

Significant past: Consulting for the second time with this complaint, in the last 12 months has had one previous sore throat complaint
Parent's comments: Not particularly worried about her, given antibiotics before for similar previous complaints and says that only antibiotics work, been giving her ibuprofen which is providing some relief, has an important event in a few days so wants her to get better quickly

23. Female, age 6 years
Symptoms: Since yesterday has had a sore throat, no cough or other common symptoms of the cold, has not been feverish

Examination: Temperature 37.5°C, tonsils inflamed, no pus on tonsils, swollen cervical lymph nodes
Significant past: Consulting for the first time with this complaint, in the last 12 months has had one previous sore throat complaint

Parent's comments: Not particularly worried about her, not given antibiotics for similar previous complaints but mentions antibiotics might help, been giving her paracetamol which is providing some relief

24. Female, age 38 years

Symptoms: For the past 6 days has had a sore throat, has a cough and blocked nose and has been sneezing, has a fever
Examination: Temperature 38.3°C, tonsils inflamed, no pus on tonsils, swollen cervical lymph nodes

Significant past: First visit with this complaint, no previous sore throat complaints in past 12 months
Patient's comments: Not particularly worried about illness, doesn't think antibiotics received previously for similar illnesses and would rather not have antibiotics if possible, been taking ibuprofen which is providing some relief

Acute otitis media

Block 1

1. Male, age 2 years

Symptoms: Has had earache since yesterday

Examination: Temperature 37.5°C, slight redness in one tympanic membrane
Significant past: Consulting for the first time with this complaint, in the last 12 months has had two previous earache complaints

Parent's comments: Not particularly worried about him, doesn't think antibiotics given before for similar illnesses but asks whether he might need antibiotics, been giving him painkillers which are providing some relief, going on holiday abroad in a few days and wants him to get better for it

2. Female, age 4 years

Symptoms: Has had earache for the last 3 days

Examination: Temperature 37.5°C, definite redness and dullness in one tympanic membrane
Significant past: First visit with this complaint, in the last 12 months has had no previous earache complaints
Parent's comments: Not feeling particularly worried, doesn't think antibiotics received previously for similar illnesses but says that she needs antibiotics to clear it, been giving her painkillers which are providing some relief, has other children at home to be looked after so wants her to get better quickly

3. Female, age 22 months

Symptoms: Has had earache for the last 4 days
Examination: Temperature 37.5°C, definite redness and dullness in both tympanic membranes
Significant past: Second visit with this complaint, in the last 12 months has had one previous earache complaint

Parent's comments: Not particularly worried about her, not given antibiotics for similar previous complaints but asks for antibiotics, been giving her painkillers which are providing some relief

4. Male, age 17 months

Symptoms: Has had earache for the past week
Examination: Temperature 37.5°C, one tympanic membrane slightly red
Significant past: First visit with this complaint, in the last 12 months has had one previous earache complaint

Parent's comments: Worried about him, given antibiotics before for similar illnesses and wonders whether antibiotics might help, been giving him painkillers which are providing some relief, has an important event in a few days so wants him to get better quickly

5. Female, age 4 years

Symptoms: Has had earache for the past 6 days
Examination: Temperature 37.5°C, definite redness and dullness in tympanic membranes bilaterally
Significant past: Consulting for the first time with this complaint, in the last 12 months has had no previous earache complaints

Parent's comments: Worried about her, doesn't think antibiotics received previously for similar illnesses and does not have a preference in relation to antibiotics, been giving her painkillers which are providing some relief, off work to look after her and keen to get back

6. Male, age 3 years

Symptoms: Has had earache for the past week
Examination: Temperature 37.5°C, one ear discharging

Significant past: Second visit with this complaint, in the last 12 months has had one previous earache complaint
Parent's comments: Worried about him, not given antibiotics for similar previous complaints and would rather not have antibiotics if possible, been giving him painkillers which are providing some relief

7. Male, age 2 years

Symptoms: Has had earache for the past 2 days
Examination: Temperature 37.5°C, one ear discharging
Significant past: Consulting for the first time with this complaint, two previous earache complaints in past 12 months

Parent's comments: Not particularly worried about him, previously given antibiotics for similar illnesses but has no specific preference regarding antibiotics, been giving him painkillers which are providing some relief

8. Male, age 17 months

Symptoms: Has had earache for 4 days

Examination: Temperature 37.5°C, definite redness and dullness in one tympanic membrane

Significant past: Consulting for the second time with this complaint, no previous earache complaints in past 12 months
Parent's comments: Feeling worried, doesn't think antibiotics received previously for similar illnesses and does not have a preference in relation to antibiotics, been giving him painkillers which are providing some relief

Block 2

9. Male, age 16 months

Symptoms: Has had earache for the last 4 days
Examination: Temperature 37.5°C, definite redness and dullness in both tympanic membranes

Significant past: Consulting for the second time with this complaint, no previous earache complaints in past 12 months
Parent's comments: Not feeling particularly worried, doesn't think antibiotics given before for similar illnesses but asks whether he might need antibiotics, been giving him painkillers which are providing some relief, going on holiday abroad in a few days and wants him to get better for it
[SCENARIO OM4 IN THINK-ALOUD STUDY]

10. Female, age 4 years

Symptoms: Has had earache for the last week
Examination: Temperature 37.5°C, slight redness in tympanic membranes bilaterally

Significant past: Consulting for the second time with this complaint, two previous earache complaints in past 12 months
Parent's comments: Worried about her, not given antibiotics for similar previous complaints and has no specific preference regarding antibiotics, been giving her painkillers which are providing some relief

11. Male, age 5 years

Symptoms: Has had earache for 5 days
Examination: Temperature 37.5°C, definite redness and dullness in both tympanic membranes

Significant past: First visit with this complaint, two previous earache complaints in past 12 months
Parent's comments: Not particularly worried about him, given antibiotics before for similar illnesses but would prefer not to have antibiotics if possible, been giving him painkillers which are providing some relief

12. Female, age 15 months

Symptoms: Has had earache for the last 2 days
Examination: Temperature 37.5°C, one tympanic membrane slightly red
Significant past: Consulting for the first time with this complaint, in the last 12 months has had no previous earache complaints

Parent's comments: Feeling worried, doesn't think antibiotics given before for similar illnesses and would prefer not to have antibiotics if possible, been giving her painkillers which are providing some relief

[SCENARIO OM1 IN THINK-ALOUD STUDY]

13. Female, age 20 months

Symptoms: Has had earache for 3 days
Examination: Temperature 37.5°C, discharge in both ears
Significant past: Consulting for the first time with this complaint, one previous earache complaint in past 12 months

Parent's comments: Not feeling particularly worried, not given antibiotics for similar previous complaints and has no specific preference regarding antibiotics, been giving her painkillers which are providing some relief, off work and child off nursery and keen for them to get back

14. Female, age 2 years

Symptoms: Has had earache for the past 5 days

Examination: Temperature 37.5°C, one tympanic membrane has definite redness and dullness
Significant past: Consulting for the first time with this complaint, in the last 12 months has had two previous earache complaints
Parent's comments: Feeling worried, doesn't think antibiotics given before for similar illnesses but wonders whether antibiotics might help, been giving her painkillers which are providing some relief

[SCENARIO OM3 IN THINK-ALOUD STUDY]

15. Male, age 5 years

Symptoms: Has had earache since yesterday
Examination: Temperature 37.5°C, one tympanic membrane has definite redness and dullness

Significant past: First visit with this complaint, one previous earache complaint in past 12 months
Parent's comments: Worried about him, given antibiotics before for similar illnesses and says that only antibiotics work, been giving him painkillers which are providing some relief

16. Female, age 19 months

Symptoms: Has had earache for 5 days

Examination: Temperature 37.5°C, both ears discharging

Significant past: Consulting for the first time with this complaint, in the last 12 months has had one previous earache complaint
Parent's comments: Feeling worried, previously given antibiotics for similar illnesses and says that only antibiotics work, been giving her painkillers which are providing some relief, going on holiday abroad in a few days and wants her to get better for it

Block 3

17. Female, age 5 years
    Symptoms: Has had earache for the last 6 days
    Examination: Temperature 37.5°C, discharge in both ears
    Significant past: Consulting for the first time with this complaint, no previous earache complaints in past 12 months
    Parent's comments: Not feeling particularly worried, doesn't think antibiotics received previously for similar illnesses but wonders whether antibiotics might help, been giving her painkillers which are providing some relief

18. Female, age 22 months
    Symptoms: Has had earache for 3 days
    Examination: Temperature 37.5°C, definite redness and dullness in tympanic membranes bilaterally
    Significant past: First visit with this complaint, two previous earache complaints in past 12 months
    Parent's comments: Worried about her, given antibiotics before for similar previous complaints and mentions antibiotics might help, been giving her painkillers which are providing some relief

19. Male, age 18 months
    Symptoms: Has had earache for the past 6 days
    Examination: Temperature 37.5°C, definite redness and dullness in one tympanic membrane
    Significant past: First visit with this complaint, one previous earache complaint in past 12 months
    Parent's comments: Not feeling particularly worried, doesn't think antibiotics received previously for similar illnesses and does not have a preference in relation to antibiotics, been giving him painkillers which are providing some relief, has other children at home to be looked after so wants him to get better quickly
    [SCENARIO OM2 IN THINK-ALOUD STUDY]

20. Male, age 3 years
    Symptoms: Has had earache for 6 days
    Examination: Temperature 37.5°C, discharge in one ear
    Significant past: Second visit with this complaint, no previous earache complaints in past 12 months
    Parent's comments: Feeling worried, doesn't think antibiotics given before for similar illnesses but mentions antibiotics might help, been giving him painkillers which are providing some relief, has an important event in a few days so wants him to get better quickly

21. Male, age 3 years

Symptoms: Has had earache since yesterday
Examination: Temperature 37.5°C, definite redness and dullness in tympanic membranes bilaterally
Significant past: First visit with this complaint, in the last 12 months has had two previous earache complaints
Parent's comments: Feeling worried, not given antibiotics for similar previous complaints but asks for antibiotics, been giving him painkillers which are providing some relief, child off nursery and keen for him to get back

22. Female, age 20 months

Symptoms: Has had earache for the last 5 days

Examination: Temperature 37.5°C, one tympanic membrane has definite redness and dullness
Significant past: Consulting for the second time with this complaint, in the last 12 months has had two previous earache complaints
Parent's comments: Not particularly worried about her, given antibiotics before for similar previous complaints but would rather not have antibiotics if possible, been giving her painkillers which are providing some relief

23. Female, age 2 years

Symptoms: Has had earache for 4 days

Examination: Temperature 37.5°C, slight redness in both tympanic membranes
Significant past: Second visit with this complaint, one previous earache complaint in past 12 months

Parent's comments: Not feeling particularly worried, given antibiotics before for similar previous complaints but has no specific preference regarding antibiotics, been giving her painkillers which are providing some relief, has other children at home to be looked after so wants her to get better quickly

24. Male, age 21 months

Symptoms: Has had earache for the last week

Examination: Temperature 37.5°C, slight redness in tympanic membranes bilaterally

Significant past: First visit with this complaint, in the last 12 months has had no previous earache complaints
Parent's comments: Not particularly worried about him, doesn't think antibiotics given before for similar illnesses but says that he needs antibiotics to clear it, been giving him painkillers which are providing some relief

Antibiotic prescribing for respiratory tract infection: exploring drivers of cognitive effort and factors associated with inappropriate prescribing

Authors

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Supplementary File 4: Full results of all simple and multiple regression analyses for the sore throat scenarios

Table S9. Results of linear regression analysis predicting perceived decision difficulty for the sore throat scenarios

Predictor		Simple regression			Multiple regression		
		B	SE of B	95% CI	B	SE of B	95% CI
Responder type	Early	REF					
	Late	.019	.119	-.214 to .251			
Study group	1	REF	-	-	-	-	-
	2	.538*	.237	.073 to 1.003	.555	.395	-.225 to 1.334
	3	.298	.221	-.136 to .732	.258	.405	-.542 to 1.059
	4	.223	.218	-.205 to .651	.636	.401	-.157 to 1.429
	5	-.140	.209	-.550 to .269	-.033	.350	-.724 to .659
	6	-.406	.228	-.854 to .041	-.247	.316	-.872 to .377
	7	.014	.202	-.383 to .412	.403	.356	-.300 to 1.105
	8	.367	.232	-.088 to .822	.494	.356	-.210 to 1.198
	9	.490*	.232	.034 to .946	.687	.395	-.094 to 1.468
Scenario block	1	.330*	.133	.068 to .591			
	2	REF	-	-			
	3	.336*	.133	.075 to .598			
Scenario	1	-1.307***	.362	-2.016 to -.598			
	2	REF	-	-			
	3	.235	.360	-.471 to .941			
	4	.220	.362	-.490 to .929			
	5	-.878*	.363	-1.591 to -.165			
	6	-.314	.360	-1.020 to .392			
	7	-2.039***	.360	-2.745 to -1.333			
	8	-.210	.363	-.923 to .503			
	9	-1.078**	.360	-1.784 to -.373			

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
	10	-.307	.358	-1.010 to .395			
	11	-1.765***	.356	-2.464 to -1.065			
	12	.039	.358	-.664 to .741			
	13	-.490	.356	-1.189 to .209			
	14	-1.480***	.362	-2.190 to -.771			
	15	-.961**	.358	-1.664 to -.259			
	16	-.905*	.356	-1.604 to -.206			
	17	-.765*	.360	-1.471 to -.059			
	18	-.220	.362	-.930 to .489			
	19	-1.200**	.362	-1.910 to -.491			
	20	-.157	.360	-.863 to .549			
	21	-.400	.362	-1.110 to .309			
	22	.431	.360	-.275 to 1.137			
	23	-1.260**	.362	-1.970 to -.551			
	24	-.686	.360	-1.392 to .020			
Scenario word count (centred on lowest count)		.019**	.006	.008 to .031	-.014	.009	-.032 to .004
Cough & cold symptoms	Absent	REF	-	-	-	-	-
	Present	.218*	.109	.003 to .432	.100	.089	-.076 to .276
Fever	Absent	REF	-	-	-	-	-
	Present	.270*	.109	.056 to .484	.181	.092	-.001 to .362
Duration	<4 days	REF	-	-	-	-	-
	4+ days	.667***	.111	.448 to .885	.608***	.098	.414 to .803
Inflamed tonsils	Absent	REF	-	-	-	-	-
	Present	.672***	.125	.426 to .918	.466***	.106	.258 to .675
Swollen glands	Absent	REF	-	-	-	-	-
	Present	.315**	.113	.095 to .536	.072	.114	-.154 to .298
Purulent tonsils	Absent	REF	-	-	-	-	-
	Present	.674***	.114	.449 to .898	.492***	.100	.295 to .689
Age	Adult	REF	-	-			
	Child	.010	.111	-.207 to .228			
Sex	Male	REF	-	-	-	-	-
	Female	.259*	.109	.045 to .473	.318**	.090	.140 to .496
Antibiotic preference	Prefer not to have	REF	-	-	-	-	-
	No preference	.212	.161	-.105 to .528	-.019	.124	-.263 to .226
	Mentions	.224	.161	-.092 to .541	-.004	.139	-.278 to .270
	Firmly asks for	.475**	.156	.170 to .781	.020	.124	-.224 to .265

Predictor		Simple regression			Multiple regression		
		B	SE of B	95% CI	B	SE of B	95% CI
Consultation number	First	REF	-	-	-	-	-
	Re-consultation	.550***	.125	.305 to .796	.099	.120	-.138 to .335
Self-medication	Absent	REF	-	-			
	Present	.147	.126	-.101 to .395			
History	Absent	REF	-	-			
	Present	.128	.113	-.094 to .350			
Life-world circumstances	Absent	REF	-	-	-	-	-
	Present	.507***	.110	.291 to .723	.798***	.189	.425 to 1.171
Previous antibiotics	No	REF	-	-			
	Yes	.177	.120	-.058 to .413			
Concern	Absent	REF	-	-	-	-	-
	Present	.425***	.112	.205 to .646	.226*	.106	.016 to .435
Conflict	Absent	REF	-	-			
	Present	.137	.110	-.078 to .353			
GP sex	Male	REF	-	-	-	-	-
	Female	.370**	.111	.151 to .588	-.037	.210	-.452 to .378
	Unspecified	.334	.288	-.231 to .899	-.510	.676	-1.845 to .824
GP age		-.010	.006	-.022 to .001			
GP practice type	Single-handed	REF	-	-	-	-	-
	Partnership	-.190	.152	-.488 to .109	.018	.256	-.488 to .524
	Unspecified	-.562*	.228	-1.010 to -.114	-1.402**	.479	-2.348 to -.456
GP practice location	Urban	REF	-	-	-	-	-
	Suburban	-.329*	.134	-.592 to -.067	-.466*	.209	-.880 to -.053
	Rural	-.185	.138	-.456 to .086	-.467	.237	-.936 to .001
	Unspecified	.041	.257	-.464 to .546	.291	.555	-.805 to 1.387
GP trainer	No	REF	-	-	-	-	-
	Yes	-.181	.143	-.461 to .099	-.177	.219	-.609 to .254
	Unspecified	.203	.249	-.285 to .691	-1.555*	.631	-2.802 to -.308
GP academic link	No	REF	-	-	-	-	-
	Yes	-.277*	.141	-.554 to -.001	-.496*	.222	-.934 to -.059
	Unspecified	.222	.235	-.240 to .683	2.622***	.520	1.594 to 3.649
Years qualified as GP		-.011	.006	-.023 to .000			
GP workload[a]		-.004***	.001	-.006 to -.002	-.006**	.002	-.009 to -.002
GP past behaviour[b]		.251***	.034	.183 to .318	.176*	.071	.035 to .317
GP habit[c]		-.312***	.044	-.399 to -.225	-.157	.090	-.334 to .021

Note: **p<0.05 **p<0.01 ***p<0.001; N=1222 difficulty ratings; multiple regression R^2=.225*

CI=confidence interval; GP=General Practitioner; REF=Reference category for categorical predictor; SE=standard error

Difficulty response scale: not at all difficult (1) - extremely difficult (10)
[a]*Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week*
[b]*Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10*
[c]*Extent of agreement that usual practice to prescribe immediate antibiotics for upper respiratory tract infection patients: response scale: strongly agree (1) – strongly disagree (7)*

Table S10. Results of linear regression analyses predicting $\log_e$ decision time (in seconds) for the sore throat scenarios

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
Responder type	Early	REF	-	-			
	Late	-.008	.031	-.069 to .052			
Study group	1	REF	-	-	-	-	-
	2	.073	.061	-.047 to .194	.019	.100	-.179 to .217
	3	-.026	.057	-.138 to .086	-.067	.110	-.284 to .150
	4	-.168**	.056	-.278 to -.057	-.171	.108	-.385 to .043
	5	-.015	.054	-.121 to .091	-.041	.108	-.255 to .173
	6	-.045	.059	-.161 to .070	-.014	.130	-.271 to .242
	7	.080	.052	-.023 to .182	.024	.092	-.158 to .206
	8	.166**	.060	.049 to .283	.103	.111	-.116 to .321
	9	.115	.060	-.003 to .233	.031	.113	-.193 to .255
Scenario block	1	.084*	.034	.017 to .152			
	2	REF	-	-			
	3	.187***	.034	.119 to .254			
Scenario	1	-.393***	.094	-.578 to -.208			
	2	REF	-	-			
	3	.070	.094	-.114 to .255			
	4	-.156	.094	-.341 to .029			
	5	-.289**	.095	-.475 to -.103			
	6	-.145	.094	-.329 to .039			
	7	-.364***	.094	-.548 to -.180			
	8	-.066	.095	-.252 to .121			
	9	-.317**	.094	-.501 to -.133			
	10	-.283**	.093	-.466 to -.099			
	11	-.475***	.093	-.657 to -.292			
	12	-.156	.093	-.339 to .028			
	13	-.002	.093	-.185 to .180			
	14	-.373***	.094	-.558 to -.188			
	15	-.232*	.093	-.416 to -.049			
	16	-.180	.093	-.363 to .002			
	17	-.101	.094	-.285 to .083			
	18	-.042	.094	-.227 to .143			
	19	.013	.094	-.172 to .198			
	20	-.157	.094	-.341 to .028			
	21	.035	.094	-.151 to .220			

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
	22	.157	.094	-.027 to .341			
	23	-.279**	.094	-.464 to -.094			
	24	-.143	.094	-.328 to .041			
Scenario word count (centred on lowest count)		.185***	.048	.091 to .280	.002	.003	-.005 to .009
Cough & cold symptoms	Absent	REF	-	-			
	Present	.042	.028	-.013 to .098			
Fever	Absent	REF	-	-			
	Present	.003	.028	-.052 to .059			
Duration	<4 days	REF	-	-	-	-	-
	4+ days	.122***	.029	.064 to .179	.069*	.027	.016 to .122
Inflamed tonsils	Absent	REF	-	-	-	-	-
	Present	.089**	.033	.025 to .154	.029	.025	-.021 to .078
Swollen glands	Absent	REF	-	-			
	Present	.047	.029	-.010 to .105			
Purulent tonsils	Absent	REF	-	-	-	-	-
	Present	.136***	.030	.077 to .194	.091*	.035	.022 to .161
Age	Adult	REF	-	-	-	-	-
	Child	.130***	.029	.074 to .186	.097***	.023	.051 to .142
Sex	Male	REF	-	-			
	Female	.006	.028	-.050 to .061			
Antibiotic preference	Prefer not to have	REF	-	-	-	-	-
	No preference	.148***	.042	.066 to .230	.067	.038	-.008 to .142
	Mentions	.007	.042	-.075 to .088	-.040	.050	-.140 to .059
	Firmly asks for	.099*	.040	.020 to .178	-.035	.046	-.125 to .055
Consultation number	First	REF	-	-	-	-	-
	Re-consultation	.147***	.032	.083 to .211	.036	.036	-.035 to .107
Self-medication	Absent	REF	-	-	-	-	-
	Present	.112**	.033	.048 to .176	-.024	.044	-.111 to .062
History	Absent	REF	-	-	-	-	-
	Present	-.059*	.029	-.117 to -.002	-.045	.029	-.103 to .012
Life-world circumstances	Absent	REF	-	-	-	-	-
	Present	.153***	.028	.097 to .209	.046	.066	-.086 to .177
Previous antibiotics	No	REF	-	-			
	Yes	-.027	.031	-.089 to .034			
Concern	Absent	REF	-	-	-	-	-

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
	Present	.111***	.029	.054 to .168	.041	.028	-.015 to .096
Conflict	Absent	REF	-	-	-	-	-
	Present	.074*	.028	.018 to .129	.037	.049	-.060 to .133
GP sex	Male	REF	-	-	-	-	-
	Female	.098**	.029	.041 to .155	.033	.054	-.074 to .141
	Unspecified	.030	.075	-.117 to .177	.019	.408	-.787 to .826
GP age		-.001	.002	-.004 to .002			
GP practice type	Single-handed	REF	-	-	-	-	-
	Partnership	-.143***	.039	-.220 to -.065	-.112	.067	-.245 to .021
	Unspecified	-.225***	.059	-.341 to -.110	-.146	.144	-.430 to .138
GP practice location	Urban	REF	-	-			
	Suburban	-.007	.035	-.075 to .061			
	Rural	-.059	.036	-.129 to .011			
	Unspecified	-.018	.067	-.149 to .113			
GP trainer	No	REF	-	-	-	-	-
	Yes	-.098**	.037	-.170 to -.025	-.087	.061	-.208 to .034
	Unspecified	-.029	.064	-.156 to .097	.046	.393	-.730 to .822
GP academic link	No	REF	-	-			
	Yes	-.065	.037	-.136 to .007			
	Unspecified	-.091	.061	-.211 to .029			
Years qualified as GP		-.002	.002	-.005 to .001			
GP workload[a]		.000	.000	-.001 to .000			
GP past behaviour[b]		.011	.009	-.007 to .029			
GP habit[c]		-.013	.012	-.036 to .010			
Perceived decision difficulty rating[d]		.086***	.007	.072 to .100	.071***	.010	.051 to .091

Note: **p<0.05 **p<0.01 ***p<0.001; N=1222 time scores; multiple regression R^2=.197*
CI=confidence interval; GP=General Practitioner; REF=Reference category for categorical predictor; SE=standard error
[a]Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week
[b]Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10
[c]Extent of agreement that usual practice to prescribe immediate antibiotics for upper respiratory tract infection patients: response scale: strongly agree (1) – strongly disagree (7)
[d]Response scale: not at all difficult (1) - extremely difficult (10)

Table S11. Results of logistic regression analyses predicting decision appropriateness for the sore throat scenarios

Predictor		Simple regression				Multiple regression		
		B	SE of B	OR	95% CI	SE of B	OR	95% CI
Responder type	Early	REF	-	-	-			
	Late	-.321	.254	.726	.441 to 1.194			
Study group	1	REF	-	-	-	-	-	-
	2	-.298	.510	.742	.273 to 2.018	.380	.624	.189 to 2.056
	3	-.240	.465	.787	.316 to 1.959	.405	..684	.214 to 2.185
	4	.531	.388	1.700	.795 to 3.636	.759	1.108	.289 to 4.242
	5	-.773	.506	.462	.171 to 1.245	.217	.356	.107 to 1.176
	6	-.856	.585	.425	.135 to 1.337	.241	.353	.092 to 1.347
	7	-.086	.408	.918	.413 to 2.040	.280	.353	.075 to 1.668
	8	.278	.429	1.320	.569 to 3.062	.291	.442	.122 to 1.604
	9	.288	.429	1.333	.575 to 3.093	.395	.572	.148 to 2.212
Scenario block	1	.037	.282	1.037	.597 to 1.802			
	2	REF	-	-	-			
	3	.312	..266	1.367	.811 to 2.303			
Scenario	1	17.311	5628.236	32969311.486	.000 to .			
	2	REF	-	-	-			
	3	20.420	5628.236	738512577.281	.000 to .			
	4	19.388	5628.236	262987763.712	.000 to .			
	5	.000	8040.268	1.000	.000 to .			
	6	.000	7959.461	1.000	.000 to .			
	7	.000	7959.461	1.000	.000 to .			
	8	18.473	5628.236	105358451.922	.000 to .			
	9	18.004	5628.236	65938622.972	.000 to .			
	10	18.962	5628.236	171861304.554	.000 to .			
	11	17.252	5628.236	31067235.823	.000 to .			
	12	19.887	5628.236	433425826.606	.000 to .			
	13	19.320	5628.236	245836387.818	.000 to .			
	14	.000	7999.158	1.000	.000 to .			
	15	.000	7921.102	1.000	.000 to .			
	16	17.252	5628.236	31067235.823	.000 to .			
	17	17.291	5628.236	32309925.256	.000 to .			
	18	19.210	5628.236	220294944.928	.000 to .			
	19	17.311	5628.236	32969311.486	.000 to .			
	20	.000	7959.461	1.000	.000 to .			
	21	19.687	5628.236	354621130.859	.000 to .			

Predictor		Simple regression				Multiple regression		
		B	SE of B	OR	95% CI	SE of B	OR	95% CI
	22	20.327	5628.236	673123442.835	.000 to .			
	23	17.311	5628.236	32969311.486	.000 to .			
	24	18.004	5628.236	65938622.972	.000 to .			
Scenario word count (centred on lowest count)		.067	.013	1.069***	1.043 to 1.096	.160	1.189	.914 to 1.548
Cough & cold symptoms	Absent	REF	-	-	-	-	-	-
	Present	1.466	.271	4.332***	2.549 to 7.361	4.470	7.971***	2.656 to 23.924
Fever	Absent	REF	-	-	-	-	-	-
	Present	-.271	.222	.762	.494 to 1.177	.175	.475*	.231 to .976
Duration	<4 days	REF	-	-	-	-	-	-
	4+ days	.922	.271	2.514**	1.478 to 4.274	5.254	5.597	.889 to 35.240
Inflamed tonsils	Absent	REF	-	-	-	-	-	-
	Present	1.127	.358	3.086**	1.530 to 6.226	1.126	2.303	.883 to 6.004
Swollen glands	Absent	REF	-	-	-	-	-	-
	Present	.668	.221	1.951**	1.265 to 3.009	2.409	2.972	.607 to 14.554
Purulent tonsils	Absent	REF	-	-	-	-	-	-
	Present	.434	.223	1.543	.996 to 2.391	.742	1.135	.315 to 4.086
Age	Adult	REF	-	-	-	-	-	-
	Child	.475	.221	1.608*	1.043 to 2.478	.374	.348	.042 to 2.866
Sex	Male	REF	-	-				
	Female	.188	.221	1.206	.783 to 1.860			
Antibiotic preference	Prefer not to have	REF	-	-	-	-	-	-
	No preference	.257	.356	1.293	.644 to 2.598	.346	.438	.093 to 2.060
	Mentions	.398	.347	1.489	.753 to 2.941	.081	.094**	.017 to .509
	Firmly asks for	.475	.335	1.609	.835 to 3.099	.072	.108**	.029 to .399
Consultation number	First	REF	-	-	-	-	-	-
	Re-consultation	1.475	.225	4.370***	2.811 to 6.793	..460	.778	.244 to 2.479
Self-medication	Absent	REF	-	-	-			
	Present	.148	.263	1.159	.692 to 1.942			
History	Absent	REF	-	-	-			
	Present	.170	.232	1.185	.751 to 1.869			
Life-world circumstances	Absent	REF	-	-	-	-	-	-
	Present	1.501	.250	4.486***	2.750 to 7.318	.317	.114	.001 to 26.044
Previous antibiotics	No	REF	-	-	-			
	Yes	.115	.237	1.122	.704 to 1.787			
Concern	Absent	REF	-	-	-	-	-	-

Predictor		Simple regression				Multiple regression		
		B	SE of B	OR	95% CI	SE of B	OR	95% CI
	Present	.372	.221	1.450	.940 to 2.238	2.041	2.453	.481 to 12.523
Conflict	Absent	REF	-	-	-	-	-	-
	Present	1.296	.271	3.656***	2.152 to 6.212	446.584	164.929	.817 to 33275.42
GP sex	Male	REF	-	-	-	-	-	-
	Female	-.276	.233	.759	.480 to 1.198	.208	.759	.444 to 1.300
	Unspecified	.727	.436	2.068	.880 to 4.859	1.420	1.021	.067 to 15.603
GP age		.025	.012	1.025*	1.001 to 1.050			
GP practice type	Single-handed	REF	-	-	-	-	-	-
	Partnership	.188	.337	1.207	.624 to 2.335	.560	1.312	.568 to 3.029
	Unspecified	.848	.422	2.336*	1.021 to 5.343	1.317	2.074	.598 to 7.199
GP practice location	Urban	REF	-	-	-	-	-	-
	Suburban	.252	.271	1.287	.757 to 2.188	.439	1.317	.686 to 2.531
	Rural	.005	.295	1.005	.564 to 1.790	.304	.868	.437 to 1.724
	Unspecified	.751	.426	2.119	.920 to 4.883	1.319	.967	.067 to 14.017
GP trainer	No	REF	-	-	-			
	Yes	-.432	.333	.650	.338 to 1.248			
	Unspecified	.590	.398	1.804	.826 to 3.937			
GP academic link	No	REF	-	-	-			
	Yes	-.016	.289	.985	.558 to 1.736			
	Unspecified	.514	.397	1.672	.768 to 3.639			
Years qualified as GP		.024	.012	1.024*	1.001 to 1.048	.016	1.029	.999 to 1.061
GP workload[a]		.002	.002	1.002	.999 to 1.006			
GP past behaviour[b]		.147	.067	1.158*	1.016 to 1.320	.103	1.045	.861 to 1.269
GP habit[c]		-.200	.079	.818*	.701 to .956	.113	.782	.590 to 1.038
Decision difficulty rating[d]		.211	.053	1.235***	1.113 to 1.370	.080	1.072	.927 to 1.240
Log_e decision time score[e]		.477	.215	1.611*	1.057 to 2.455	.276	.945	.534 to 1.675

Note: *Appropriate decisions coded as 0, inappropriate decisions coded as 1*

**p<0.05 **p<0.01 ***p<0.001; N=1222 decisions; multiple regression McFadden Pseudo-R^2=.264*

CI=confidence interval; GP=General Practitioner; OR=odds ratio; REF=Reference category for categorical predictor; SE=standard error

[a]*Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week*

[b]*Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10*

[c]*Extent of agreement that usual practice to prescribe immediate antibiotics for upper respiratory tract infection patients: response scale: strongly agree (1) – strongly disagree (7)*

[d]*Response scale: not at all difficult (1) - extremely difficult (10)*

[e]*Measured in seconds*

Antibiotic prescribing for respiratory tract infection: exploring drivers of cognitive effort and factors associated with inappropriate prescribing

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Supplementary File 5: Full results of all simple and multiple regression analyses for the otitis media scenarios

Table S12. Results of linear regression analyses predicting perceived decision difficulty for the otitis media scenarios

Predictor		Simple regression			Multiple regression		
		B	SE of B	95% CI	B	SE of B	95% CI
Responder type	Early	REF	-	-			
	Late	-.120	.119	-.353 to .114			
Study group	1	REF	-	-	-	-	-
	2	.820**	.238	.354 to 1.287	.995*	.498	.012 to 1.979
	3	.815***	.221	.382 to 1.248	.790	.503	-.203 to 1.784
	4	.801***	.215	.378 to 1.224	1.111*	.426	.270 to 1.951
	5	.237	.209	-.173 to .647	.235	.466	-.685 to 1.156
	6	.409	.228	-.039 to .857	.421	.490	-.546 to 1.389
	7	.043	.203	-.355 to .441	.374	.447	-.509 to 1.257
	8	.318	.232	-.137 to .773	.562	.424	-.275 to 1.400
	9	1.139***	.232	.684 to 1.594	1.253**	.445	.374 to 2.132
Scenario block	1	-.534***	.133	-.794 to -.273			
	2	-.363*	141	-.640 to -.086			
	3	REF	-	-			
Scenario	1	REF	-	-			
	2	.031	.339	-.634 to .696			
	3	-.189	.340	-.857 to .478			
	4	.278	.342	-.392 to .948			
	5	-.125	.348	-.807 to .557			
	6	.129	.342	-.541 to .799			
	7	-.054	.340	-.721 to .614			
	8	.375	.342	-.295 to 1.045			
	9	.843*	.368	.121 to 1.566			

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
	10	.460	.368	-.262 to 1.183			
	11	.187	.366	-.531 to .906			
	12	-.604	.368	-1.326 to .119			
	13	.141	.368	-.582 to .863			
	14	.396	.368	-.326 to 1.119			
	15	.396	.368	-.326 to 1.119			
	16	-4.906E-14	.366	-.718 to .718			
	17	.592	.371	-.135 to 1.319			
	18	.686	.373	-.046 to 1.418			
	19	.886*	.373	.154 to 1.618			
	20	.597	.373	-.134 to 1.329			
	21	.557	.371	-.170 to 1.284			
	22	.019	.371	-.708 to .746			
	23	.332	.371	-.395 to 1.059			
	24	1.080**	.375	.343 to 1.816			
Scenario word count (centred on lowest count)		-.002	.006	-.015 to .011			
Age	Child 2-5	REF	-	-			
	Child <2	.060	.111	-.157 to .277			
Duration	<4 days	REF	-	-	-	-	-
	4+ days	.215	.116	-.012 to .442	.208*	.086	.037 to .378
Exam	Mild[a]	REF	-	-			
	Severe[b]	-.039	.110	-.255 to .176			
Sex	Male	REF	-	-	-	-	-
	Female	-.272*	.110	-.487 to -.057	-.327***	.079	-.482 to -.171
Antibiotic preference	Prefer not to have	REF	-	-	-	-	-
	No preference	.313	.169	-.019 to .644	.411**	.120	.175 to .647
	Mentions	.502**	.170	.169 to .836	.471**	.144	.186 to .755
	Firmly asks for	.314	.174	-.028 to .655	.414**	.146	.125 to .703
Consultation number	First	REF	-	-			
	Re-consultation	.047	.116	-.181 to .275			
History	Absent	REF	-	-			
	Present	-.078	.117	-.307 to .150			
Life-world circumstances	Absent	REF	-	-			
	Present	.047	.110	-.169 to .264			
Previous antibiotics	No	REF	-	-			
	Yes	-.068	.117	-.298 to .162			
Concern	Absent	REF	-	-			

Predictor		Simple regression			Multiple regression		
		B	SE of B	95% CI	B	SE of B	95% CI
	Present	-.025	.110	-.241 to .190			
Conflict	Absent	REF	-	-			
	Present	.129	.111	-.089 to .348			
GP sex	Male	REF	-	-	-	-	-
	Female	.482***	.112	.263 to .702	.070	.255	-.434 to .575
	Unspecified	.789**	.263	.272 to 1.305	.631	.689	-.730 to 1.99
GP age		-.015*	.006	-.026 to -.003			
GP practice type	Single-handed	REF	-	-	-	-	-
	Partnership	-.465**	.153	-.765 to -.165	-.369	.340	-1.041 to .303
	Unspecified	-.783***	.223	-1.220 to -.346	-2.195***	.513	-3.208 to -1.182
GP practice location	Urban	REF	-	-	-	-	-
	Suburban	-.112	.135	-.378 to .153	-.235	.266	-.760 to .290
	Rural	-.133	.139	-.406 to .140	-.344	.259	-.857 to .168
	Unspecified	.455	.243	-.022 to .931	.518	.607	-.681 to 1.718
GP trainer	No	REF	-	-	-	-	-
	Yes	-.393**	.143	-.674 to -.112	-.294	.271	-.828 to .241
	Unspecified	.455	.233	-.001 to .912	-1.683*	.671	-3.008 to -.358
GP academic link	No	REF	-	-	-	-	-
	Yes	-.258	.142	-.535 to .020	-.468	.273	-1.007 to .072
	Unspecified	.468*	.222	.032 to .904	2.363***	.588	1.202 to 3.524
Years qualified as GP		-.016**	.006	-.028 to -.004	-.004	.013	-.029 to .022
GP workload[c]		-.003**	.001	-.005 to -.001	-.004*	.002	-.008 to -.0002
GP past behaviour[d]		.203***	.035	.135 to .272	.155	.091	-.024 to .334
GP habit[e]		-.232***	.045	-.321 to .142	-.052	.116	-.282 to .178

Note: **p<0.05 **p<0.01 ***p<0.001; N=1239 difficulty ratings; multiple regression R^2=.146*
CI=confidence interval; GP=General Practitioner; REF=Reference category for categorical predictor; SE=standard error
Difficulty response scale: not at all difficult (1) - extremely difficult (10)
[a]Minor redness in at least one tympanic membrane or definite redness and dullness in one tympanic membrane
[b]Definite redness & dullness in both tympanic membranes or discharge in at least one ear
[c]Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week
[d]Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10
[e]Extent of agreement that usual practice to prescribe immediate antibiotics for upper respiratory tract infection patients: response scale: strongly agree (1) – strongly disagree (7)

Table S13. Results of linear regression analyses predicting $\log_e$ decision time (in seconds) for the otitis media scenarios

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
Responder type	Early	REF	-	-			
	Late	-.024	.031	-.085 to .037			
Study group	1	REF	-	-	-	-	-
	2	.128*	.063	.006 to .251	.085	.117	-.146 to .316
	3	.081	.058	-.033 to .195	.021	.107	-.191 to .233
	4	.048	.057	-.063 to .160	-.035	.117	-.267 to .196
	5	.079	.055	-.029 to .187	.020	.106	-.190 to .230
	6	.061	.060	-.057 to .179	.087	.146	-.201 to .375
	7	.120*	.053	.016 to .225	.082	.099	-.114 to .278
	8	.173**	.061	.053 to .293	.138	.114	-.087 to .364
	9	.262***	.061	.142 to .382	.180	.121	-.059 to .419
Scenario block	1	-.072*	.035	-.140 to -.004			
	2	-.010	.037	-.083 to .063			
	3	REF	-	-			
Scenario	1	REF	-	-			
	2	-.020	.088	-.192 to .152			
	3	-.118	.088	-.291 to .055			
	4	-.034	.089	-.208 to .139			
	5	-.039	.090	-.215 to .138			
	6	.072	.089	-.102 to .246			
	7	-.065	.088	-.238 to .108			
	8	.231**	.089	.057 to .404			
	9	.197*	.095	.010 to .385			
	10	.202*	.095	.014 to .389			
	11	.096	.095	-.090 to .283			
	12	-.028	.095	-.215 to .159			
	13	.079	.095	-.108 to .266			
	14	.034	.095	-.154 to .221			
	15	-.101	.095	-.289 to .086			
	16	.041	.095	-.145 to .227			
	17	-.026	.096	-.215 to .162			
	18	-.117	.097	-.307 to .072			
	19	.263**	.097	.073 to .452			
	20	.090	.097	-.099 to .280			
	21	.046	.096	-.142 to .235			

Predictor		Simple regression			Multiple regression		
		B	SE of B	95% CI	B	SE of B	95% CI
	22	.264**	.096	.075 to .452			
	23	.049	.096	-.139 to .238			
	24	.031	.097	-.160 to .222			
Scenario word count (centred on lowest count)		.003	.002	.000 to .006			
Age	Child 2-5	REF	-	-			
	Child <2	.047	.029	-.009 to .104			
Duration	<4 days	REF	-	-	-	-	-
	4+ days	.104**	.030	.045 to .164	.039	.025	-.010 to .088
Exam	Mild[a]	REF	-	-			
	Severe[b]	-.054	.029	-.110 to .002			
Sex	Male	REF	-	-			
	Female	-.044	.029	-.100 to .012			
Antibiotic preference	Prefer not to have	REF	-	-	-	-	-
	No preference	-.002	.044	-.089 to .084	.0002	.031	-.061 to .061
	Mentions	-.080	.044	-.167 to .006	-.084*	.040	-.163 to -.005
	Firmly asks for	-.124**	.045	-.213 to -.035	-.102**	.033	-.168 to -.037
Consultation number	First	REF	-	-	-	-	-
	Re-consultation	.110***	.030	.051 to .169	.068**	.026	.017 to .119
History	Absent	REF	-	-			
	Present	-.019	.030	-.078 to .041			
Life-world circumstances	Absent	REF	-	-			
	Present	.016	.029	-.040 to .072			
Previous antibiotics	No	REF	-	-			
	Yes	-.047	.031	-.107 to .013			
Concern	Absent	REF	-	-			
	Present	-.014	.029	-.0740to .042			
Conflict	Absent	REF	-	-			
	Present	-.046	.029	-.103 to .011			
GP sex	Male	REF	-	-	-	-	-
	Female	.109***	.029	.051 to .166	.032	.056	-.079 to .143
	Unspecified	.065	.069	-.070 to .201	-.098	.415	-.917 to .721
GP age		.000	.002	-.003 to .003			
GP practice type	Single-handed	REF	-	-	-	-	-
	Partnership	-.156***	.040	-.234 to -.078	-.120	.072	-.261 to .022
	Unspecified	-.190**	.058	-.304 to -.076	-.016	.135	-.283 to .250
GP practice	Urban	REF	-	-			

Predictor		Simple regression			Multiple regression		
		B	**SE of B**	**95% CI**	**B**	**SE of B**	**95% CI**
location	Suburban	-.004	.035	-.073 to .065			
	Rural	-.064	.036	-.135 to .007			
	Unspecified	-.022	.063	-.102 to .146			
GP trainer	No	REF	-	-	-	-	-
	Yes	-.084*	.038	-.158 to -.011	-.052	.066	-.182 to .078
	Unspecified	.020	.061	-.100 to .139	.982*	.430	.131 to 1.832
GP academic link	No	REF	-	-	-	-	-
	Yes	-.087*	.037	-.159 to -.014	-.062	.067	-.193 to .070
	Unspecified	-.069	.058	-.183 to .044	-.949***	.174	-1.293 to -.605
Years qualified as GP		-.001	.002	-.004 to .002			
GP workload[c]		.000057	.000	.000 to .001			
GP past behaviour[d]		.012	.009	-.006 to .030			
GP habit[e]		-.013	.012	-.037 to .010			
Perceived decision difficulty rating[f]		.064***	.007	.050 to .078	.060***	.012	.038 to .083

Note: **p<0.05 **p<0.01 ***p<0.001; N=1239 time scores; multiple regression R^2=.127*

CI=confidence interval; GP=General Practitioner; REF=Reference category for categorical predictor; SE=standard error

[a]*Minor redness in at least one tympanic membrane or definite redness and dullness in one tympanic membrane*

[b]*Definite redness & dullness in both tympanic membranes or discharge in at least one ear*

[c]*Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week*

[d]*Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10*

[e]*Extent of agreement that usual practice to prescribe immediate antibiotics for upper respiratory tract infection patients: response scale: strongly agree (1) – strongly disagree (7)*

[f]*Response scale: not at all difficult (1) - extremely difficult (10)*

Table S14. Results of logistic regression analyses predicting decision appropriateness for the otitis media scenarios

Predictor		Simple regression				Multiple regression		
		B	SE of B	OR	95% CI	SE of B	OR	95% CI
Responder type	Early	REF	-	-	-			
	Late	.299	.176	1.349	.955 to 1.906			
Study group	1	REF	-	-	-	-	-	-
	2	.152	.336	1.165	.603 to 2.249	.447	.770	.247 to 2.405
	3	-.027	.323	.973	.517 to 1.833	.484	.489	.071 to 3.395
	4	.036	.312	1.037	.563 to 1.910	.357	.776	.315 to 1.914
	5	-.446	.333	.640	.333 to 1.231	.439	.622	.156 to 2.478
	6	-.916	.424	.400*	.174 to .918	.206	.179	.019 to 1.708
	7	-.056	.298	.946	.527 to 1.697	.568	1.201	.476 to 3.034
	8	-.512	.382	.599	.283 to 1.268	.146	.232*	.068 to .798
	9	-.416	.373	.660	.318 to 1.370	.298	.256	.026 to 2.498
Scenario block	1	.375	.209	1.454	.966 to 2.190			
	2	.112	.230	1.119	.713 to 1.756			
	3	REF	-	-	-			
Scenario	1	REF	-	-	-			
	2	2.250	.777	9.490**	2.071 to 43.486			
	3	-17.769	5063.838	.000	.000 to .			
	4	2.692	.768	14.762***	3.276 to 66.516			
	5	2.715	.771	15.103***	3.333 to 68.439			
	6	-17.769	5104.512	.000	.000 to .			
	7	-17.769	5063.838	.000	.000 to .			
	8	2.692	.768	14.762***	3.276 to 66.516			
	9	-17.769	5862.747	.000	.000 to .			
	10	1.512	.841	4.537	.873 to 23.580			
	11	1.282	.860	3.605	.668 to 19.444			
	12	.748	.934	2.114	.339 to 13.182			
	13	-17.769	5862.747	.000	.000 to .			
	14	3.391	.775	29.708***	6.499 to 135.805			
	15	1.994	.808	7.342*	1.506 to 35.806			
	16	-17.769	5801.356	.000	.000 to .			
	17	-17.769	5926.130	.000	.000 to .			
	18	-17.769	5991.614	.000	.000 to .			
	19	2.935	.781	18.821***	4.069 to 87.061			
	20	-17.769	5991.614	.000	.000 to .			
	21	1.083	.889	2.952	.517 to 16.854			

Predictor		Simple regression				Multiple regression		
		B	SE of B	OR	95% CI	SE of B	OR	95% CI
	22	1.876	.817	6.526*	1.316 to 32.365			
	23	1.537	.841	4.650	.894 to 24.187			
	24	1.380	.861	3.974	.735 to 21.497			
Scenario word count (centred on lowest count)		.043	.010	1.044***	1.025 to 1.064	.067	1.146*	1.021 to 1.286
Age	Child 2-5	REF	-	-	-			
	Child <2	.009	.169	1.009	.724 to 1.406			
Duration	<4 days	REF	-	-	-	-	-	-
	4+ days	.797	.205	2.219***	1.485 to 3.317	2.544	3.765	1.001 to 14.157
Exam	Mild[a]	REF	-	-	-	-	-	-
	Severe[b]	-1.757	.217	.172***	.113 to .264	.065	.143***	.058 to .349
Sex	Male	REF	-	-	-			
	Female	.029	.169	1.030	.740 to 1.433			
Antibiotic preference	Prefer not to have	REF	-	-	-	-	-	-
	No preference	.974	.293	2.649**	1.492 to 4.705	.335	.748	.311 to 1.797
	Mentions	.525	.305	1.691	.929 to 3.077	.116	.141*	.028 to .705
	Firmly asks for	.324	.319	1.382	.740 to 2.583	.413	.563	.134 to 2.372
Consultation number	First	REF	-	-	-	-	-	-
	Re-consultation	-.500	.193	.606*	.415 to .885	.320	.577	.194 to 1.713
History	Absent	REF	-	-	-	-	-	-
	Present	-.249	.174	.780	.554 to 1.097	.736	1.998	.971 to 4.112
Life-world circumstances	Absent	REF	-	-	-	-	-	-
	Present	.234	.169	1.263	.908 to 1.758	.090	.115**	.025 to .530
Previous antibiotics	No	REF	-	-	-			
	Yes	-.163	.184	.849	.592 to 1.218			
Concern	Absent	REF	-	-	-	-	-	-
	Present	.682	.175	1.979**	1.405 to 2.788	4.883	5.133	.795 to 33.120
Conflict	Absent	REF	-	-	-	-	-	-
	Present	1.564	.190	4.778***	3.293 to 6.935	3.508	7.953***	3.350 to 18.880
GP sex	Male	REF	-	-	-	-	-	-
	Female	.199	.174	1.221	.867 to 1.718	.270	1.009	.598 to 1.704
	Unspecified	.564	.357	1.758	.873 to 3.541	.956	1.889	.686 to 5.199
GP age		-.022	.009	.979*	.961 to .997			
GP practice type	Single-handed	REF	-	-	-	-	-	-
	Partnership	.356	.266	1.427	.847 to 2.406	.741	2.112*	1.062 to 4.200
	Unspecified	.913	.334	2.491**	1.294 to 4.795	.4.696	6.938**	1.841 to 26.145
GP practice	Urban	REF	-	-	-	-	-	-

Predictor		Simple regression				Multiple regression		
		B	SE of B	OR	95% CI	SE of B	OR	95% CI
location	Suburban	-.080	.208	.923	.613 to 1.388	.346	1.159	.645 to 2.080
	Rural	-.191	.220	.826	.537 to 1.272	.303	.920	.483 to 1.753
	Unspecified	.575	.315	1.777	.958 to 3.295	43.244	59.545***	14.344 to 247.189
GP trainer	No	REF	-	-	-	-	-	-
	Yes	-.362	.244	.696	.432 to 1.123	.222	.685	.363 to 1.294
	Unspecified	.208	.329	1.231	.645 to 2.347	.005	.004***	.0004 to .040
GP academic link	No	REF	-	-	-	-	-	-
	Yes	-.248	.233	.780	.494 to 1.231	.169	.559	.309 to 1.012
	Unspecified	.196	.317	1.217	.653 to 2.267	.949	1.047	.177 to 6.185
Years qualified as GP		-.022	.009	.978*	.961 to .996	.013	.974	.948 to 1.001
GP workload[c]		.000	.001	1.000	.997 to 1.003			
GP past behaviour[d]		.283	.051	1.326***	1.199 to 1.467	.136	1.518***	1.273 to 1.810
GP habit[e]		-.243	.062	.784***	.695 to .885	.131	.945	.721 to 1.240
Perceived decision difficulty rating[f]		.062	.043	1.063	.978 to 1.156			
Log_e decision time score[g]		.584	.161	1.793***	1.308 to 2.456	.525	1.962*	1.161 to 3.314

Note: *Appropriate decisions coded as 0, inappropriate decisions coded as 1*

**p<0.05 **p<0.01 ***p<0.001; N=1239 decisions; multiple regression McFadden Pseudo-R^2=.320*

CI=confidence interval; GP=General Practitioner; OR=odds ratio; REF=Reference category for categorical predictor; SE=standard error

[a]*Minor redness in at least one tympanic membrane or definite redness and dullness in one tympanic membrane*

[b]*Definite redness & dullness in both tympanic membranes or discharge in at least one ear*

[c]*Calculated from hours per week seeing patients x patients seen per hour, so represents number of patients seen per week*

[d]*Reported number of last 10 upper respiratory tract infection patients immediate antibiotics prescribed for: response scale: 1-10*

[e]*Extent of agreement that usual practice to prescribe immediate antibiotics for upper respiratory tract infection patients: response scale: strongly agree (1) – strongly disagree (7)*

[f]*Response scale: not at all difficult (1) - extremely difficult (10)*

[g]*Measured in seconds*