



## Communication Study

## Reducing inappropriate antibiotics prescribing: The role of online commentary on physical examination findings

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## ABSTRACT

**Objective:** This study investigates the relationship of 'online commentary' (contemporaneous physician comments about physical examination [PE] findings) with (i) parent questioning of the treatment recommendation and (ii) inappropriate antibiotic prescribing.**Methods:** A nested cross-sectional study of 522 encounters motivated by upper respiratory symptoms in 27 California pediatric practices (38 pediatricians). Physicians completed a post-visit survey regarding physical examination findings, diagnosis, treatment, and whether they perceived the parent as expecting an antibiotic. Taped encounters were coded for 'problem' online commentary (PE findings discussed as significant or clearly abnormal) and 'no problem' online commentary (PE findings discussed reassuringly as normal or insignificant).**Results:** Online commentary during the PE occurred in 71% of visits with viral diagnoses ( $n = 261$ ). Compared to similar cases with 'no problem' online commentary, 'problem' comments were associated with a 13% greater probability of parents questioning a non-antibiotic treatment plan (95% CI 0–26%,  $p = .05$ ) and a 27% (95% CI: 2–52%,  $p < .05$ ) greater probability of an inappropriate antibiotic prescription.**Conclusion:** With viral illnesses, problematic online comments are associated with more pediatrician–parent conflict over non-antibiotic treatment recommendations. This may increase inappropriate antibiotic prescribing.**Practice implications:** In viral cases, physicians should consider avoiding the use of problematic online commentary.

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## 1. Introduction

Inappropriate antibiotic prescribing for viral upper respiratory tract infections (URI) is common in the United States [1]. Nearly one-third of patients diagnosed with the common cold receive an antibiotic prescription, and prescribing for bronchitis and other viral illnesses are estimated to be higher than 50% [2,3]. While a number of recent studies indicate that inappropriate antibiotic prescribing may have peaked in the 1990s [4–11], there is evidence to suggest that declining prescribing rates are primarily driven by decreased rates of office visits for respiratory tract infections

[8,12]. For patients presenting with URIs, physicians' rates of prescribing show a relatively modest and uneven decrease [8,12], together with increased reliance on broad-spectrum agents [1,4,10]. Inappropriate use of antibiotics has led to increased resistance among many strains of bacteria that commonly infect both children and adults [13–17], posing risks both to the individual and the community [13,15,18–20].

Upper respiratory tract infections are a common reason that parents seek medical care for illness in their children [3,21], and account for approximately 75% of children's antibiotic prescriptions [8]. Although 50–70% of parents report a pre-visit expectation that their child will be given antibiotics [22,23], 65–70% of these infections are viral and thus cannot effectively be so treated [24–29].

We previously identified a communication practice in which physicians convey their physical examination findings during, as opposed to after, the physical exam [30]. We call this communication practice *online commentary*. We identified two main types of online commentary: *no problem* online and *problem*

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**Table 1**  
Communication conduct.

Speaker	Communication behavior	Definition	Example	Frequency
Physician	Problem online commentary	(i) Report of an abnormal physical examination (PE) finding	“Her ear is draining fluid” “There’s inflammation there”	10% (26/261) <sup>a</sup> kappa = 0.71 <sup>§</sup>
		(ii) Evaluation of a PE finding as significant	“His cough sounds pretty chesty” “Her lungs sound awful” “This ear is quite red.” “There’s some pus on her tonsils.”	
Physician	No problem online commentary	(i) Absence of abnormal PE findings	“I don’t see anything in that ear” “I don’t feel any swollen glands.” “I don’t hear any crackles in her lungs”	61% (160/261) <sup>a</sup> kappa = 0.71 <sup>§</sup>
		(ii) Evaluation of a present sign as unproblematic	“Her nose isn’t too bad” “This is only a little bit red” “Just a slight wheeze today”	
		(iii) Presence of normal PE findings	“Her ears look completely normal” “Lungs sound clear”	
Physician	Recommendation against antibiotic treatment	Physician’s treatment recommendation includes a recommendation against the use of an antibiotic	“I think we’re in good shape here I don’t think he needs antibiotics because it wouldn’t work” or “We can make him more comfortable but there’s no antibiotic that’s gonna touch it.”	15% (40/261) <sup>a</sup> kappa = 0.77
Parent	Questioning the treatment plan	Parent questions the treatment or states a preference for a treatment different from the one the physician recommended	Following a suggestion to use over the counter cough medicine, a parent questions the treatment being recommended – “The Robitussin just isn’t working” or, following a recommendation of over the counter medication the parent asks “So, you don’t think he needs any antibiotics?”	13% (35/261) kappa = 0.55

<sup>a</sup> Denominator includes only those cases where the initial diagnosis was non-bacterial, i.e., viral or other (e.g., asthma).

<sup>§</sup> Kappa score is aggregated across the two classes of online commentary.

online (see Table 1). In no problem online, the physician provides reassurance by discussing normal findings on the physical examination (PE) or by suggesting that positive findings are minor and/or not significant. In problem online, PE findings are reported as being clearly abnormal and/or are evaluated as significant. We hypothesized that ‘no problem’ online commentary would be associated with a reduction in the probability of inappropriate prescribing [30]. Correspondingly, we also hypothesized that ‘problem’ online commentary would be associated with an increase in the probability of inappropriate prescribing, and that offering no commentary on physical examination findings would be neutral in its effects.

In a subsequent paper, we found some evidence that when children had viral illnesses, physicians who used problematic online commentary inappropriately prescribed antibiotics more often than physicians who exclusively used no problem online [31]. However, because this prior work was done with a relatively small, homogenous population of parents and physicians, the results were suggestive rather than conclusive.

Our previous work also demonstrated that when physicians perceived parents as expecting antibiotics they were significantly more likely to inappropriately prescribe them for viral diagnoses [23]. In a prior analysis of data from the current study, we found that physicians had a higher probability of perceiving a parent as expecting antibiotics if the parent questioned the physician’s non-antibiotic treatment plan for her child [32]. We also found that a key determinant of parents questioning the physician’s treatment plan was the physician ruling out the need for antibiotics when discussing the plan [32]. These prior findings led us to question whether using problematic online commentary in the context of an

ultimately viral diagnosis might also increase the probability that a parent would question the physician’s treatment plan.

We theorized that upon a viral diagnosis, a parent would not question a non-antibiotic treatment plan if the physician had made only reassuring comments about the child’s physical exam (‘no problem’ online) or made no comments about the exam at all (no online). In contrast, we theorized that describing a child’s physical examination findings as concerning (‘problem’ online), but then assigning a diagnosis that did not warrant antibiotic treatment, might result in cognitive dissonance for the parent [33], and thus increase the probability that she would question a non-antibiotic treatment plan.

The primary goals of the current study are to examine the relationships among physician online commentary use, parent questioning of the physician’s treatment plan, and the physician’s ultimate prescribing decision. We hypothesize that in viral cases, if the physician used problematic online commentary, the parent would more often question the physician’s non-antibiotic treatment plan. We further hypothesize that problematic online commentary in viral cases would be associated with higher rates of inappropriate prescribing above and beyond the increase associated with physician perceptions that parents expect antibiotics.

## 2. Methods

### 2.1. Study design

We conducted a nested cross-sectional study of 522 pediatric encounters October 2000 through June 2001 clustered within 38

pediatricians (approximately 15 encounters/physician) in 27 community pediatric practices in Los Angeles County. Physicians were told that the purpose of the study was to examine parent expectations, doctor–parent communication, and parent satisfaction with acute care visits. To decrease potential Hawthorne effects on the study outcomes, physicians were not informed that one of the main objectives of the study was to examine the relationship between parental expectations and physician antibiotic prescribing decisions. The University of California, Los Angeles (UCLA) General Campus Institutional Review Board (IRB) allowed this withholding of information under the condition that the physicians be debriefed at the end of the study about the main study objectives.

For a one to three week period, all parents who brought their child to see a participating physician were screened for eligibility in the waiting rooms of the physician's office until 15 apparently eligible parents agreed to participate. The study description provided to parents was the same as the description provided to physicians. For parents to be eligible, children had to be between the ages of six months and ten years old, present with respiratory tract infection symptoms (cough, nasal congestion, ear pain, or throat pain), and to have had no antibiotics during the prior two weeks. The parent had to be able to speak and read English.

All physician and parent participants gave written informed consent; all study procedures were reviewed and approved by the University of California, Los Angeles General Campus Institutional Review Board.

## 2.2. Data collection procedures

Each pediatric visit was videotaped. After the visit, physicians completed a self-administered questionnaire regarding their physical examination findings, their diagnosis, the treatments they suggested or prescribed, their perceptions of parent expectations for the visit, their level of diagnostic uncertainty, presence of a local influenza epidemic, patient load for the day (slow, average, busy), and day of the week (Monday through Friday). Physician perceptions of parent expectations for antibiotics were measured by physicians' responses to the following statement: "At the beginning of this visit, this parent expected me to prescribe an antibiotic," with response options of *Strongly Agree*, *Somewhat Agree*, *Uncertain*, *Somewhat Disagree*, and *Strongly Disagree*. Responses were then dichotomized so that the first two ratings were labeled "physician perceives a parental expectation for antibiotics," whereas the other ratings were labeled "physician perceives no parental expectation for antibiotics." Diagnostic uncertainty was ascertained by examining physician responses to the following statement: "I am very certain of the diagnosis in this case," with response options of *Strongly Agree*, *Somewhat Agree*, *Uncertain*, *Somewhat Disagree*, and *Strongly Disagree*. Responses were dichotomized so that the first two ratings were labeled "physician has high certainty about diagnosis."

Diagnosis was indicated by selecting one choice from a list (acute otitis media, asthma, bacterial bronchitis, bacterial pneumonia, bronchiolitis, conjunctivitis, croup, mycoplasma infection, otitis externa, otitis media with effusion, streptococcal pharyngitis, sinusitis, viral bronchitis, viral pharyngitis, viral pneumonia, viral stomatitis, or viral URI), or by writing in an alternate diagnosis. For the purposes of this study, the following diagnoses were coded as viral: all cases of bronchitis (both bacterial and viral bronchitis), bronchiolitis, croup, viral pharyngitis, viral pneumonia, viral stomatitis, and viral upper respiratory infection. Oral and injectable antibacterial drugs were considered antibiotics for analysis purposes. Topical antibiotics and all other antimicrobials prescribed or administered (e.g., antivirals) were not included in analyses related to antibiotic prescribing. Inappropriate antibiotic

prescribing was defined as the prescription of antibiotics for a viral upper respiratory infection.

Physician demographics were recorded on study enrollment and included: physician age (<40, 40–65, >65), physician race/ethnicity, and physician gender.

Parent and child demographic characteristics were collected on a pre-visit questionnaire and included the following: parent age (<30 versus other), parent gender, child age (<=12 months "infant" versus other), parent/child race/ethnicity, and parent socioeconomic status (SES) (very low, low, medium, or high). Additional variables collected on the questionnaire included: parent expectations for antibiotics, duration of the child's illness (<2 days versus >=2 days), number of reported symptoms (<=2 versus >2), parent anxiety level (extremely or very worried versus somewhat or not very worried about child's illness), child history of chronic illness, past experience with the physician regarding receiving antibiotics for colds and sore throat, whether the child could attend daycare when sick, and parent length of relationship with the child's physician (<=1 year versus >1 year).

## 2.3. Communication conduct

### 2.3.1. Online commentary

As described in previous research [30,31], online commentary consists of statements, delivered simultaneous with or otherwise embedded in the physical examination about what the physician is seeing, hearing or feeling. Online comments are to be distinguished from the description of physical findings emerging during the presentation of a diagnosis. Online comments can be expressed as an evaluation (e.g., "looks good") or as the report of an observation (e.g., "no redness"). As summarized in Table 1, we distinguish between 'no problem' online commentary, in which PE findings are characterized as absent, mild or normal, and 'problem' online commentary in which PE findings are characterized as concerning or significant.

Because the diagnostic and treatment implications of a single 'problem' online comment ("left ear is red and bulging") may 'trump' a string of previous reassuring 'no problem' comments, we summarized the aggregate incidence of online commentary during the entire physical examination in terms of three distinct patterns:

- (1) *No online commentary*: the physician remains silent about all findings encountered during the physical examination.
- (2) *'Any problem'* online commentary: the physician describes at least one PE finding as marked or significant.
- (3) *'Only no problem'* online commentary: the physician describes at least one PE finding and the physician's comments only describe findings as absent, mild, or normal.

Trained research assistants coded each online comment in the 522 videotaped encounters. These codes were then consolidated into one of the three overall visit patterns described above. One of the authors (JH) independently coded a 15% random sample of the encounters a second time to test inter-coder reliability of the coding scheme using the kappa statistic.

### 2.3.2. Parent questioning of the treatment plan

We also coded for whether the parent questioned the physician's treatment recommendation [32]. Weighted kappa statistics were calculated to examine inter-rater reliability for coding this communication behavior using a 13% sample of the encounters.

## 2.4. Analytic methods

For all analyses the physician–parent encounter, clustered within physicians and clinic sites, was the unit of analysis. All multivariate logistic regressions corrected for the effects of this

hierarchical structure on standard errors [34] and included site intercepts.

We constructed a model to examine the key predictors of parents questioning of non-antibiotic treatment plans. Bivariate relationships between parent questioning of the treatment plan and several candidate predictor variables were tested including: whether the physician explicitly ruled out the need for antibiotic treatment [32], whether the physician offered any 'problem' online commentary, parent age, parent gender, child age, parent/child race/ethnicity, parent SES, physician age, physician race/ethnicity, physician gender, and parent/physician racial/ethnic concordance. Independent variables with a relationship to the outcome at the  $p < .10$  level were retained in the model. For this analysis, we focused on the potential influence of 'problem' online commentary as a factor associated with parent questioning, and the omitted comparison group for the online variable consisted of all cases where the physician either exclusively used 'no problem' online commentary or made no online comments at all.

Because of the strong confounding of parent race/ethnicity and socioeconomic status in the sample, independent estimates of race/ethnicity and SES in multivariate models were not well identified, and large standard errors resulted when both were included simultaneously. Thus, we constructed a combined variable with eight mutually exclusive categories having sufficient sample size for precise estimates. These categories included: very low SES/any race-ethnicity (65/74 were Hispanic), low SES/Hispanic, low SES/other race-ethnicity, medium SES/white (reference group), medium SES/Hispanic, medium SES/African-American, medium SES/Asian, and high SES/any race-ethnicity (60/105 were white, non-Hispanic).

We also constructed a model to examine the key predictors of inappropriate antibiotic prescribing. Based on our prior findings regarding the bivariate relationship of online commentary to inappropriate antibiotic prescribing [31], we hypothesized that no problem online would be protective against inappropriate antibiotic prescribing, any problem online would be detrimental, and no online would be neutral. Thus, for this model, any problem online and no online were compared to a reference group of exclusively no problem online. Other independent predictor variables that were examined bivariately included: parent expectations for antibiotics, physician perceptions of parental expectations, duration of illness, number of reported symptoms, parent anxiety level, past experience with the physician regarding receiving antibiotics for colds and sore throat, physical examination findings (fever, abnormal appearance of the ear drums, purulent rhinorrhea, red throat, wheezing on lung examination), the physician's level of diagnostic uncertainty, presence of a local influenza epidemic, patient load for the day, day of the week, whether the child could attend daycare when sick, length of relationship with the child's physician, and child, parent, and physician demographics. Independent variables with a relationship to the outcome at the  $p < .10$  level in bivariate analyses were retained for the multivariate model.

Logistic regressions are presented in the form of multivariate adjusted proportions with 95% confidence intervals for each statistically significant predictor variable ( $p < .05$ ). This format displays the change in the probability of an outcome associated with a one-unit change in each significant predictor variable, holding all other independent variables constant [35].

### 3. Results

Thirty-eight of 59 invited eligible pediatricians agreed to participate (64% participation rate), one to four from each of 27 practices [22]. Of the 678 parents invited to participate, 570 agreed (84%). Twenty-seven participating parents were later determined

to be ineligible because their children did not have an eligible diagnosis (e.g., earwax impaction or gastroenteritis) yielding a sample of 543 participating parents of 651 invited eligibles (eligible participation rate 83%). Twenty-one encounters (4%) were not conducted in English thus yielding a sample of 522 complete encounters for the current communication analysis.

Parents averaged 34 years old, with a median income of approximately \$40 000 (Table 2). Eighty-six percent were female, 53% were Hispanic, and 68% had attended at least some college (Table 2). Study parents under-represented Asians, non-Hispanic whites, and those with no secondary education relative to the adult population of Los Angeles County in 2000 [22].

Seventy-one percent of participating physicians were male, 71% were non-Hispanic white or Asian, and 42% were 40–65 years of age [32]. Compared to all California physicians (1998–1999 data), study physicians were more often male, less often non-Hispanic white, and more often Hispanic or "other" race/ethnicity [22].

Fifty percent (261/522) of the patients were diagnosed with viral illnesses, and 16% (41/261) of these patients received an antibiotic prescription (Table 3).

**Table 2**  
Patient, parent and physician demographics.

Demographic characteristics	
Parents (N = 522)	
Age < 30 years	185 (35%)
Female	449 (83%)
Known pediatrician for more than one year	373 (72%)
Race/ethnicity	
White (non-Hispanic)	144 (28%)
Latino	276 (53%)
African-American	63 (12%)
Asian	39 (7%)
Education	
Less than high school	81 (16%)
High school graduate	84 (16%)
Some college	231 (44%)
Bachelor's degree or more	126 (24%)
Income	
<20k	96 (18%)
20–40k	169 (32%)
41–80k	155 (30%)
>80k	102 (20%)
Parents combined race/ethnicity and SES <sup>§</sup>	
High (any race/ethnicity)	105 (20%)
Medium	
White	78 (15%)
Hispanic	139 (27%)
African-American	40 (8%)
Asian	20 (4%)
Low	
(Hispanic)	53 (10%)
(Other race/ethnicity)	13 (2%)
Very low (any race/ethnicity)	74 (14%)
Physicians (N = 38)	
Female	11 (29%)
Age	
<40	13 (36%)
40–65	17 (42%)
>65	8 (22%)
Patients (N = 522)	
Age	
<=1 year	78 (15%)
>1 year	444 (85%)

<sup>§</sup> The SES group definitions are as follows: high, education greater than a Bachelor's degree and annual income of \$40 000–\$80 000 or more than \$80 000; low, high school education and annual income less than \$40 000; very low, less than a high school education and annual income less than \$40 000; and medium, all others.

**Table 3**  
Variation in visit characteristics among patients diagnosed with a viral condition.

Characteristic	
Parents expecting antibiotics	65% (169/261)
Parents perceived as expecting antibiotics by MD	30% (79/261)
Parents who were very worried about their child's condition	29% (76/261)
Antibiotic prescribing rate for viral infections	16% (41/261)
Parent has known pediatrician for more than one year	72% (188/261)

**Table 4**  
Multivariate adjusted predictors of parents questioning the treatment plan.

Variables	Change in probability of parent questioning Rx plan (%)	95% CI
Any problem online commentary <sup>§</sup>	13	0%–26%*
Physician rules out need for antibiotics	24	6%, 43%**
Child is infant (<year)	11	–2%, 24%
Physician age (comparing those <=65 to those >65)	7	–68%, 81%

\*  $p = .05$ .\*\*  $p < .05$ .

§ Compared to cases where either only 'no problem' online or no online at all was used.

### 3.1. Online commentary use

Online commentary was a prevalent feature of physician communication behavior in our data. Online commentary occurred during the physical examination in 71% of visits where viral diagnoses were made ( $n = 261$ ). In 61% of these encounters, only 'no problem' online comments were made, while in 10%, physicians made at least one problematic online comment (Table 1).

### 3.2. Online commentary and physician–parent concordance on treatment recommendations

Only two aspects of the visit predicted parental questioning of the treatment plan: both involved physicians' communications with parents (Table 4). For viral cases, the use of 'problem' online commentary was associated with a 13% increase in the rate of parents questioning a subsequent treatment plan that did not include an antibiotic prescription compared to when no online or only no problem online was employed (95% CI 0%, 26%,  $p = .05$ ). Similar to our previous findings [32], statements ruling out the need for antibiotics were associated with an independent 24 percentage point greater probability that a parent would question the treatment plan (95% CI 6%, 44%,  $p = .01$ ).

### 3.3. Online commentary and inappropriate antibiotic prescribing

For viral cases, when physicians used 'problematic' online commentary rather than exclusively 'no problem' online they inappropriately prescribed antibiotics in an additional 27% of encounters beyond what would have been expected with exclusively no problem online commentary (95% CI 2%, 52%,  $p = .03$  [Table 5]). Physicians who made no online comments, rather than exclusively using 'no problem' online commentary for children with viral illnesses showed a non-significant trend of being 4% more likely to inappropriately prescribe antibiotics (95% CI –6%, 94%,  $p = .09$ ). Other significant predictors of inappropriate prescribing included physicians' perceptions that parents expected antibiotics, very low parent socioeconomic status, and several physical examination findings (presence of rhonchi or wheezing on lung examination, presence of purulent rhinorrhea, and red throat) (Table 5).

**Table 5**  
Multivariate adjusted predictors of inappropriately prescribing antibiotics.

Predictor variable	Change in probability of MD inappropriately prescribing (base rate = 16%) (%)	95% CI <sup>†</sup>
Any problem online commentary <sup>†</sup>	27 <sup>*</sup>	2%, 52%
No online commentary <sup>†</sup>	4	–6%, 94%
Parent expects to receive antibiotics	3	–15%, 20%
Physician perceives parent as expecting antibiotics	26 <sup>***</sup>	13%, 48%
Parents with high SES <sup>§</sup>	–1	–3%, 1%
Parents with medium SES <sup>§</sup>		
Hispanic	0	–1%, 0%
African-American	–1	–3%, 1%
Asian	–2	–13%, 9%
Parents with low SES <sup>§</sup>	3	–4%, 10%
Parents with very low SES <sup>§</sup>	20 <sup>*</sup>	2%, 38%
Child presents with 2+ symptoms	2	–25%, 30%
Child has been sick for 2+ days	–7	–15%, 2%
Parent is <30 years old	1	–1%, 3%
Abnormal appearance of the tympanic membranes	6	–79%, 90%
Rhonchi or wheezing on lung examination	26 <sup>**</sup>	7%, 45%
Presence of purulent rhinorrhea	35 <sup>†</sup>	7%, 63%
Red throat	26 <sup>†</sup>	4%, 47%
Patient febrile at home and in physician's office	12	–9%, 32%
Parent is very anxious about the child's current illness	10	–7%, 27%

Abbreviations: CI, confidence interval; SES, socioeconomic status.

\*  $p < .05$  for increase or decrease in probability of the outcome.\*\*  $p < .01$  for increase or decrease in probability of the outcome.\*\*\*  $p < .001$  for increase or decrease in probability of the outcome.

† Relative to only no problem online commentary.

§ Analysis is relative to non-Hispanic white parents with medium SES.

The SES group definitions are as follows: high, education greater than a Bachelor's degree and annual income of \$40,000–\$80,000 or more than, \$80,000; low, high school education and annual income less than \$40,000; very low, less than a high school education and annual income less than \$40,000; and medium, all others.

## 4. Discussion and conclusion

### 4.1. Discussion

Physicians' perceptions that parents expect an antibiotic for their child strongly contribute to inappropriate antibiotic prescribing [23,32,36]. Nonetheless, physicians are not without resources to influence parent expectations. In this study, we hypothesized that 'no problem' online commentary would be one such resource with the potential to influence inappropriate prescribing.

Our results indicate that inappropriate prescribing is strongly and positively related to 'problem' relative to 'no problem,' online commentary. 'Problem' online commentary is also associated with an increased probability of parents questioning the physician's non-antibiotic treatment plan. This may contribute to the association between 'problem' online commentary and inappropriate prescribing, given that parent questioning is itself strongly related to the physician's perception that the parent expects antibiotic treatment [32].

'No problem' online commentary appears to represent the most promising approach to discussing physical examination findings in the process of diagnosing an illness that will likely not require antibiotic treatment. Nonetheless, 'problem' online comments occurred in 14% of viral encounters and may engender inappropriate prescribing. These results suggest that a fair amount of inappropriate prescribing might be avoided if physicians are

encouraged to shift from using 'problem' online or no online at all to making reassuring comments during the physical examination.

If the observed association is entirely causal, replacing problem online with exclusively no problem online would reduce inappropriate prescribing in those viral encounters by 27 percentage points and would by itself reduce the total rate of inappropriate prescribing by 4 percentage points ( $27\% \times 14\%$  (the frequency of problem online commentary use during visits for viral illness) = 4%), a marked improvement in clinical practice with appreciable benefits to public health. The value of 'no problem' online commentary relative to physician silence or 'no online' is less clear. The data suggest that in viral illness encounters, 'no problem' online commentary may reduce inappropriate prescribing relative to remaining silent during the physical examination, however, this trend does not reach statistical significance (4 percentage point decrease in inappropriate prescribing;  $p = .09$ ). Even if this effect were entirely causal, switching from silence (no online) to 'no problem' online would reduce inappropriate prescribing by only 1 percentage point ( $4\% \times 28\%$  (the frequency of no online use during visits for viral illness) = 1%), a considerably smaller potential impact than from eliminating the use of problematic online in viral encounters.

#### 4.2. Conclusions

Many physicians inform parents about physical examination findings as they emerge. The motivations for this online commentary may be diverse: to reassure parents that their child is better than expected, confirm (and perhaps legitimate) the parents' concerns that led to the visit in the first place, or simply to satisfy the parent's interest in their child's condition at the earliest opportunity. However, whether intended or not, this form of communication may also shape parents' expectations about diagnostic and treatment outcomes. Clinicians should consider the consequences of raising parental expectations for an antibiotic with an announcement of a 'problem' examination finding, or of being seen to commit themselves to a prescription by the same action.

In addition to influencing perceptions, 'no problem' online commentary may contribute to rapport building by giving insight into the physician's reasoning about symptoms, and reassuring parents that symptoms are mild. It may also serve to overtly address concerns that parents may have raised during problem presentation in a way that silence during the PE does not.

In recent years medical educators and others have increasingly worked to identify communication strategies that are effective, teachable, and beneficial to patients and physicians [38,39]. 'No problem' online commentary is such a strategy, and one that is already in relatively widespread use. Future interventions should consider a range of communication practices physicians can use both to educate parents about the appropriateness of antibiotic medications early in the visit and to prepare parents for the subsequent diagnosis and treatment recommendation.

#### 4.3. Practice implications

In cases for which a diagnosis of viral upper respiratory infection appears likely, physicians should consider avoiding the use of online commentary which could be understood as indicating problematic physical examination findings.

#### 4.4. Limitations

This study has several limitations. First, it was conducted in Los Angeles, CA, and the results may not be generalizable to different populations of parents and physicians in different geographic locations. Second, our physician population under-represented

female pediatricians (29%), although physician gender did not appear to be an important predictor of the observed outcomes. It is also possible that in typical, unobserved encounters, these same physicians may more often act upon perceived pressure to prescribe antibiotics. In a prior study with a similar design, a significant Hawthorne effect was observed on antibiotic prescribing patterns [37]. It is our expectation that such Hawthorne effects are more likely to cause us to underestimate the strength of associations between communication behaviors and prescribing decisions than to over-estimate them. Finally, as is always the case with observational data, other unmeasured factors that may be associated with both the use of these communication practices and the outcomes of interest may be responsible for some of the observed associations.

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