Letters

Time of Day and the Decision to Prescribe Antibiotics

Clinicians make many patient care decisions each day. The cumulative cognitive demand of these decisions may erode clinicians' abilities to resist making potentially inappropriate choices. Psychologists, who refer to the erosion of self-control after making repeated decisions as *decision fatigue*,[1,2] have found evidence that it affects nonmedical professionals. For example, as court sessions wear on, judges are more likely to deny parole, the "easier" or "safer" option.[3]

In primary care, prescribing unnecessary antibiotics for acute respiratory infections (ARIs) is a common, inappropriate service. Clinicians may prescribe unnecessary antibiotics—again, the easy, safe option—due to perceived or explicit patient demand, a desire to do something meaningful for patients, a desire to conclude visits quickly, or an unrealistic fear of complications.[4,5] We hypothesized that decision fatigue, if present, would increase clinicians' likelihood of prescribing antibiotics for patients presenting with ARIs as clinic sessions wore on.

Methods | The protocol for this study was approved by the Partners HealthCare Human Research Committee, including a waiver of patient informed consent. We merged billing and elec-

Table. Sample Characteristics and Antibiotic Prescribing[a]

Characteristic	Overall Sample (N = 21 867)	Antibiotic		P Value
		Prescribed (9722 [44%])	Not Prescribed (12 145 [56%])	
Patient age, mean (SD), y	40.4 (12.0)	40.9 (11.9)	40.0 (12.1)	<.001
Median annual household income by zip code, mean (SD), $	76 481 (28 522)	78 134 (29 009)	75 158 (28 057)	<.001
Patient sex, No. (%)				
Men	7111 (33)	3115 (32)	3996 (33)	.18
Women	14 756 (67)	6607 (68)	8149 (67)	
Patient race/ethnicity				
White	15 958 (73)	7327 (75)	8631 (71)	
Latino	2276 (10)	983 (10)	1293 (11)	
Black	1296 (6)	498 (5)	798 (7)	<.001
Asian	1041 (5)	365 (4)	676 (6)	
Other/unknown	1296 (6)	549 (6)	747 (6)	
Language				
English	20 042 (92)	8969 (92)	11 073 (91)	
Spanish	1196 (5)	512 (5)	684 (6)	.003
Other	629 (3)	241 (2)	388 (3)	
Insurance				
Private	18 762 (86)	8367 (86)	10 395 (86)	
Medicaid	2003 (9)	856 (9)	1147 (9)	
Medicare	474 (2)	202 (2)	272 (2)	.15
None or other	628 (3)	297 (3)	331 (3)	
Clinician type				
Staff physician	17 206 (79)	7221 (74)	9985 (82)	
Nurse practitioner or physician assistant	4196 (19)	2320 (24)	1876 (15)	<.001
Fellow (physician trainee)	465 (2)	181 (2)	284 (2)	
Clinician is the primary care clinician				
Yes	4938 (23)	2180 (22)	2758 (23)	
No	5708 (26)	2909 (30)	2799 (23)	<.001
Unknown	11 221 (51)	4633 (48)	6588 (54)	
Diagnosis type[b]				
Antibiotics sometimes indicated	7544 (35)	5301 (55)	2243 (18)	<.001
Antibiotics never indicated	14 323 (65)	4421 (45)	9902 (82)	

[a] Percentages may not sum to 100 owing to rounding.

[b] Diagnoses for which antibiotics are sometimes indicated were otitis media (International Classification of Diseases, Ninth Revision [ICD-9] 381 and 382), sinusitis (ICD-9 461 and 473), pneumonia (ICD-9 481-486), and streptococcal pharyngitis (ICD-9 034.0). Diagnoses for which antibiotics are never indicated were nonspecific upper respiratory infection (ICD-9 460, 464, and 465), acute bronchitis (ICD-9 466 and 490), influenza (ICD-9 487), and nonstreptococcal pharyngitis (ICD-9 462 and 463).

Figure. Antibiotic Prescribing by Hour of the Day
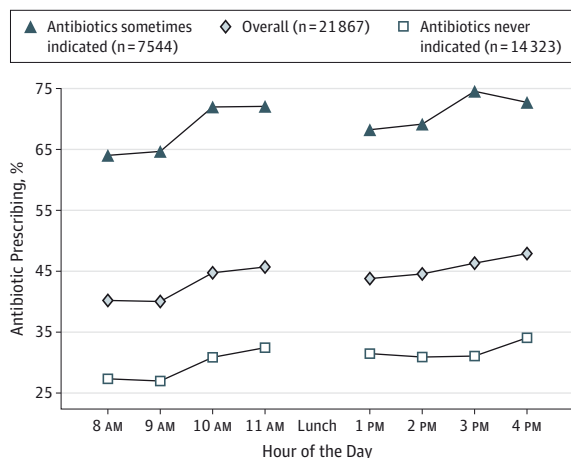
Diagnoses for which antibiotics are sometimes indicated were otitis media, sinusitis, pneumonia, and streptococcal pharyngitis. Diagnoses for which antibiotics are never indicated were acute bronchitis, nonspecific upper respiratory infection, influenza, and nonstreptococcal pharyngitis. Linear trend in session hours (combining 8 AM with 1 PM, 9 AM with 2 PM, 10 AM with 3 PM, and 11 AM with 4 PM): $P < .001$ for antibiotics sometimes indicated; $P < .001$ for all acute respiratory infection visits; and $P < .002$ for antibiotics never indicated. During clinic sessions, the proportion of acute respiratory infection visits for which antibiotics were sometimes indicated did not vary significantly from hour to hour ($P = .64$).

tronic health record data for patient visits to 1 of 23 Partners HealthCare-affiliated primary care practices between May 1, 2011, and September 30, 2012. We identified visit diagnoses using billing codes, and, using electronic health record data, identified visit times, antibiotic prescriptions, and chronic illnesses.[6]

We analyzed ARI visits by adults (aged 18-64 years), which occurred during two 4-hour sessions—8 AM to noon and 1 PM to 5 PM—Monday through Friday. We excluded visits by patients with chronic illnesses (eg, cancer, diabetes mellitus) or concomitant acute diagnoses (eg, skin infections) for which antibiotics would be indicated. We excluded clinicians who had fewer than 40 ARI visits during the study. Consistent with national guidelines, we classified specific ARI diagnoses as *antibiotics sometimes indicated* or *antibiotics never indicated* (Table).[6]

Clinicians worked in 4-hour morning and afternoon sessions; many clinicians worked only 1 session on a given day. We used the scheduled hour of each ARI visit (1 through 4) to represent visit time.

Using logistic regression, we estimated the probability of antibiotic prescribing for ARI visits as a function of session hour, number of visits per session, calendar month of visit, patient-level confounders (Table), and fixed effects for clinicians. We used generalized estimating equations to account for clinician-level clustering. We used SAS (version 9.3, SAS Institute) and considered $P < .05$ statistically significant.

Results | There were 21 867 ARI visits to 204 clinicians in 23 practices that met our inclusion criteria; 44% resulted in antibiotic prescriptions (Table). Antibiotic prescribing increased throughout the morning and afternoon clinic sessions for an-

tibiotics sometimes indicated and antibiotics never indicated ARIs (Figure). Relative to the first hour of a session, the adjusted odds ratios of antibiotic prescribing in the second, third, and fourth hours were 1.01 (95% CI, 0.91-1.13), 1.14 (95% CI, 1.02-1.27), and 1.26 (95% CI, 1.13-1.41), respectively ($P < .001$ for linear trend).

Discussion | We found that primary care clinicians' likelihood of prescribing antibiotics for ARIs increased during clinic sessions, consistent with the hypothesis that decision fatigue progressively impairs clinicians' ability to resist ordering inappropriate treatments.

This finding should be interpreted in the context of the study design: we studied ARI visits in a single health care system, scheduled time was a proxy for actual visit time, and unmeasured confounding is possible. In addition, we used visit time as a proxy for decision fatigue, but other accumulating factors (eg, glucose depletion or general fatigue) could contribute to our findings.

Remedies for decision fatigue might include time-dependent decision support, modified schedules, shorter sessions, mandatory breaks, or snacks.[3] Further studies could clarify the sources of the problem and test corresponding solutions.

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Cigarette Purchases at Pharmacies by Patients at High Risk of Smoking-Related Illness

Cigarette smoking can make managing chronic diseases more difficult. For instance, in patients with certain respiratory conditions, smoking increases the risk of acute exacerbation, can worsen disease control, and may limit the effectiveness of inhaled corticosteroids.[1] Similarly, by raising blood pressure, smoking can make it challenging to effectively control hypertension and may increase the risk of atherosclerosis and coronary heart disease.[2] Smoking can also increase the risk of serious adverse drug events. Oral contraceptive (OC) users older than 35 years who smoke have a 9-fold higher risk of myocardial infarction and venous thromboembolism compared with nonsmokers.[3,4]

A visit to the pharmacy to fill a prescription is, paradoxically, often an opportunity to purchase cigarettes. Using a deidentified database of linked retail pharmacy purchases and prescription data, we estimated the incidence and frequency of cigarette purchases made in retail pharmacies by individuals filling prescriptions for asthma or chronic obstructive pulmonary disease (COPD), hypertension, and OC medications.

Methods | The study population was drawn from a previously defined cohort of 361 114 patients who received pharmacy benefits through Caremark and filled a statin prescription between January 1, 2011, and June 30, 2012. This cohort included linked data from all purchases at CVS retail locations made with a CVS loyalty card that patients receive as a Caremark benefit and all prescription fills in the year before the patient's first statin prescription.

Within this cohort, we identified individuals who filled a prescription for an antihypertensive, asthma or COPD, or OC medication during the 365-day observation period and set the date of the patient's first prescription fill for a drug of interest as the index date. We identified cigarette purchases after a patient's index date and defined a co-purchase as a day on which an individual purchased cigarettes and had medication available, using a 7-day grace period to allow for modest nonadherence. Oral contraceptive users were restricted to women aged at least 35 years, consistent with US Food and Drug Administration label warnings.[5] The institutional review board of Brigham and Women's Hospital approved this study.

Results | Of 38 939 patients taking a medication in a class of interest, 6.0% of asthma or COPD medication users, 5.1% of

Table. Store Purchase Characteristics of All Patients and Those Who Purchased Cigarettes

Characteristic	Medication Class		
	Asthma/COPD[a]	Antihypertensive[b]	Oral Contraceptive
All Patients			
Total sample, No.	5033	31 708	2198
Monthly store visits			
Mean (SD)	0.9 (1.2)	0.9 (1.1)	0.9 (1.2)
Median (IQR)	0.5 (0.2-1.3)	0.5 (0.2-1.1)	0.5 (0.2-1.2)
Total store visits, median (IQR)	3 (1-10)	3 (1-9)	3 (1-9)
Patients With ≥1 Cigarette Purchase			
No. (%) of total	303 (6.0)	1604 (5.1)	106 (4.8)
Monthly store visits			
Mean (SD)	1.9 (1.7)	1.8 (1.9)	1.9 (1.8)
Median (IQR)	1.4 (0.7-2.7)	1.2 (0.6-2.4)	1.4 (0.7-2.9)
Monthly store visits with a cigarette purchase			
Mean (SD)	0.5 (0.7)	0.5 (1.0)	0.6 (1.0)
Median (IQR)	0.3 (0.1-0.5)	0.2 (0.1-0.5)	0.2 (0.1-0.5)
Total store visits, median (IQR)	11 (5-23)	11 (5-23)	12 (5-25)
Total store visits with a cigarette purchase, median (IQR)	2 (1-4)	2 (1-4)	2 (1-4)

Abbreviations: COPD, chronic obstructive pulmonary disease; IQR, interquartile range.

[a] Inhaled anticholinergics, inhaled corticosteroids, leukotriene modulators, long-acting β-agonists, and adrenergic combinations.

[b] Angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, direct renin inhibitors, anti-adrenergic antihypertensives, β-blockers, diuretics, and calcium channel blockers.