

Statistical analysis: Lee.

Administrative, technical, or material support: All authors.

Conflict of Interest Disclosures: None reported.

Additional Contributions: Ramy R. Saleh, MD, Department of Medicine, McGill University, reviewed the manuscript. We thank the resident physicians who collected the data in the context of patient care, as well as our attending physicians, who strive to provide patients with the best care. None of the contributors were compensated.

1. Chopra V, O'Horo JC, Rogers MA, Maki DG, Safdar N. The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: a systematic review and meta-analysis. *Infect Control Hosp Epidemiol*. 2013;34(9):908-918.
2. Chopra V, Anand S, Hickner A, et al. Risk of venous thromboembolism associated with peripherally inserted central catheters: a systematic review and meta-analysis. *Lancet*. 2013;382(9889):311-325.
3. Chopra V, Govindan S, Kuhn L, et al. Do clinicians know which of their patients have central venous catheters? a multicenter observational study. *Ann Intern Med*. 2014;161(8):562-567.
4. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. *Am J Infect Control*. 2008;36(5):309-332.
5. Lee TC, Frenette C, Jayaraman D, Green L, Pilote L. Antibiotic self-stewardship: trainee-led structured antibiotic time-outs to improve antimicrobial use. *Ann Intern Med*. 2014;161(10)(suppl):S53-S58.
6. Al-Abri M, Wong BM, Leis JA. A urinary catheter left in place for slightly too long: a teachable moment. *JAMA Intern Med*. 2015;175(2):163.
7. Kalra R, Kraemer RR. Urinary catheterization—when good intentions go awry: a teachable moment. *JAMA Intern Med*. 2014;174(10):1547-1548.

Editor's Note

A Simple Approach to Reducing Inappropriate Use of Central Venous Catheters

Central venous catheters are commonly used in hospitalized patients. Many are not indicated, evidence of benefit is scant, and all put patients at risk for thrombosis and infection. In this issue, McDonald and Lee¹ describe a simple intervention—making inpatient teams aware that a patient has a central venous catheter and the probable indication for the catheter—that appears to have resulted in a major reduction in the prevalence of inappropriate use of central venous catheters. While we applaud this effort, additional evidence is needed, as this intervention took place at 1 hospital and there was no concurrent control group. But we hope the study will stimulate additional research, preferably randomized clinical trials, to document the efficacy of interventions to reduce the use of inappropriate central venous catheters.

Deborah Grady, MD, MPH

Conflict of Interest Disclosures: None reported.

1. McDonald EG, Lee TC. Reduction of central venous catheter use in medical inpatients through regular physician audits using an online tool [published online May 4, 2015]. *JAMA Intern Med*. doi:10.1001/jamainternmed.2015.1292.

Antibiotic Prescribing for Acute Respiratory Infections in Direct-to-Consumer Telemedicine Visits

Direct-to-consumer (DTC) telemedicine companies provide consumers with around-the-clock access to care for common nonemergent conditions through telephone and live video visits via personal computers and mobile phone apps. Approximately 1 million DTC telemedicine visits between patients and

Table 1. Adult Teladoc Users and Nonusers With ARI Visits^a

Characteristic	No. (%) of Users for ARI Visits		P Value
	Teladoc (n = 1725)	Non-Teladoc (n = 64 099) ^b	
Sex			
Men	629 (36.5)	24 824 (38.7)	.06
Women	1096 (63.5)	39 275 (61.3)	
Age, y			
18-30	273 (15.8)	11 756 (18.3)	<.01
31-50	912 (52.9)	27 642 (43.1)	
≥51	540 (31.3)	24 701 (38.5)	
Chronic illness			
0	1489 (86.3)	49 870 (77.8)	<.01
≥1	236 (13.7)	14 229 (22.2)	
Location			
Urban	1579 (93.7)	59 508 (94.6)	.10
Rural	107 (6.3)	3411 (5.4)	

Abbreviation: ARI, acute respiratory infection.

^a Encompasses study period: April 2012–October 2014.

^b Nonusers were limited to those with at least 1 visit to any site for care during the study period.

physicians serving these companies, without an established relationship, were delivered in 2014.¹

DTC telemedicine is often more convenient and less expensive than in-person visits. However, concerns about the quality of these services have been expressed^{2,3}: lack of a physician-patient relationship and access to medical records; limitations of the physical examination; and barriers to testing could lead to overuse of antibiotics.

There have been few evaluations of DTC telemedicine quality. Using health plan claims, we compared antibiotic prescribing rates for acute respiratory infection (ARI) between Teladoc, a large DTC telemedicine company, and physician offices.

Methods | In April 2012, the California Public Employees' Retirement System first offered Teladoc as a covered benefit. We limited the study population to members aged 18 to 64 years, who were continuously enrolled from April 2012 to October 2013 who had 1 or more ARI visits. This study was approved by the institutional review board for RAND Corporation.

We identified ARI visits using *International Classification of Diseases, Ninth Revision* diagnosis codes based on prior methods.⁴ We eliminated follow-up visits at any site within 21 days and visits with competing diagnoses that may have required antibiotics. We identified any oral antibiotic prescription within 3 days of the visit and defined broad-spectrum antibiotics as macrolides and fluoroquinolones.

We compared antibiotic and broad-spectrum antibiotic prescribing rates for Teladoc and physician offices. In multivariate models, we adjusted for sex, age, chronic illness (using the Charlson Comorbidity Index), site of care, and ARI diagnoses. Using the predictive margin method, we report predicted prescribing rates, adjusting for covariates.⁵

Results | Teladoc users were less likely to be 51 years of age or older or have 1 or more chronic illnesses (Table 1). In both un-

Table 2. Antibiotic Prescribing Comparing Teladoc and Physician Offices (Unadjusted)

	Teladoc, No. (%)	Physician Office, No. (%)	P Value
Visits			
All ARI visits	1219	85 149	NA
Otitis media	53 (4.4)	12 402 (14.6)	<.01
Pharyngitis	134 (11.0)	15 475 (18.2)	<.01
Sinusitis	397 (32.6)	25 418 (29.9)	.04
URI or nasopharyngitis	364 (29.9)	20 345 (23.9)	<.01
Bronchitis	202 (16.6)	15 383 (18.1)	.18
Influenza	56 (4.6)	2186 (2.6)	<.01
Antibiotic prescribed			
All ARI visits	679 (55.7)	47 105 (55.3)	.79
Otitis media	31 (58.5)	5851 (47.1)	.09
Pharyngitis	97 (72.4)	8199 (53.0)	<.01
Sinusitis	317 (79.9)	19 555 (76.9)	.17
URI or nasopharyngitis	62 (17.0)	7506 (36.9)	<.01
Bronchitis	156 (77.2)	10 562 (68.7)	<.01
Influenza	7 (12.5)	466 (21.3)	.11
Broad-spectrum antibiotic prescribed^a			
All ARI visits	587 (86.5)	26 514 (56.3)	<.01
Otitis media	27 (87.1)	2263 (38.7)	<.01
Pharyngitis	84 (86.6)	4080 (49.8)	<.01
Sinusitis	270 (85.2)	9762 (49.9)	<.01
URI or nasopharyngitis	50 (80.7)	4973 (66.2)	.02
Bronchitis	147 (94.2)	8022 (75.9)	<.01
Influenza	5 (71.4)	338 (72.5)	.95

Abbreviations: ARI, acute respiratory infection; NA, not applicable; URI, upper respiratory infection.

^a Conditional on antibiotic being prescribed.

adjusted and unadjusted analyses, the fraction of ARI visits at which an antibiotic was prescribed was similar for Teladoc and physician offices (Table 2). The adjusted antibiotic prescribing rate for all ARI visits was 58% for Teladoc vs 55% at physician offices ($P = .07$). This pattern varied by specific diagnosis, with Teladoc more likely to prescribe antibiotics for pharyngitis and bronchitis and less likely for upper respiratory infection and nasopharyngitis.

The most common antibiotics prescribed were similar across sites: azithromycin (Teladoc, 58% vs physician offices, 45%); amoxicillin (Teladoc, 27% vs physician offices, 29%); and levofloxacin (Teladoc, 3% vs physician offices, 5%). For cases in which an antibiotic was prescribed, the adjusted broad-spectrum antibiotic prescribing rate for all ARI visits was 86% for Teladoc vs 56% at physician offices ($P < .01$).

Discussion | Antibiotic prescribing rates for ARIs overall were similar for Teladoc and physician offices. However, both settings had high rates of inappropriate prescribing for conditions such as bronchitis; consistent with prior research that half of outpatient antibiotic prescriptions are not clinically indicated.⁶

When antibiotics were prescribed, Teladoc used more broad-spectrum antibiotics. This is concerning because overuse increases costs and contributes to antibiotic resistance. Greater use

of broad-spectrum antibiotics may be driven by the tendency for physicians serving DTC companies to practice conservatively, with limited diagnostic information. DTC companies can work to lower rates through targeted quality-improvement initiatives to change physician behavior (eg, timely feedback), as well as direct education to patients to influence demand.

Our study had several limitations. Differences in patients and the complexity of conditions seen across settings may not be accounted fully in multivariate models. Furthermore, there is subjectivity in assigning individual ARI diagnoses, and in some cases, the diagnosis may be selected to align with the chosen treatment.

Use of DTC telemedicine is increasing rapidly despite lack of research about whether it is offering care of comparable quality. Our research suggests overuse of broad-spectrum antibiotics for ARI visits. Studies such as this can inform the coverage decisions of insurers and employers and ongoing policy debates in the United States about the appropriateness of different models of telemedicine.

Lori Uscher-Pines, PhD, MSc

Andrew Mulcahy, PhD

David Cowling, PhD

Gerald Hunter, MS

Rachel Burns, MPH

Ateev Mehrotra, MD, MPH

Author Affiliations: The RAND Corporation, Arlington, Virginia (Uscher-Pines, Mulcahy); The RAND Corporation, Pittsburgh, Pennsylvania (Hunter, Burns); California Public Employees' Retirement System, Sacramento (Cowling); Harvard Medical School, Boston, Massachusetts (Mehrotra).

Corresponding Author: Lori Uscher-Pines, PhD, MSc, RAND Corporation, 1200 S Hayes St, Arlington, VA 22202 (luscherp@rand.org).

Published Online: May 26, 2015. doi:10.1001/jamainternmed.2015.2024.

Conflict of Interest Disclosures: None reported.

Funding/Support: Support for this work comes from a grant from the California Health Care Foundation. Dr Mehrotra also reported receipt of support from a National Institutes of Health (NIH) grant (R21 AI097759-01).

Role of the Funder/Sponsor: The California Health Care Foundation and NIH had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

1. Dougherty C. Am I sick? Google has a doctor waiting on video. *New York Times*. October 13, 2014. http://bits.blogs.nytimes.com/2014/10/13/am-i-sick-google-has-a-doctor-waiting-on-video/?_php=true&type=blogs&_php=true&type=blogs&_php=true&type=blogs&emc=edit_tu_20141014&nl=technology&nid=31581203&r=4. Accessed January 10, 2015.

2. Federation of State Medical Boards. Model policy for the appropriate use of telemedicine technologies in the practice of medicine. April 2014. http://www.fsmb.org/Media/Default/PDF/FSMB/Advocacy/FSMB_Telemedicine_Policy.pdf. Accessed February 10, 2015.

3. American Medical Association. Telemedicine: is prescription writing allowed? <http://www.ama-assn.org/ama/pub/physician-resources/legal-topics/telemedicine.page>. Accessed January 5, 2015.

4. Mehrotra A, Gidengil CA, Setodji CM, Burns RM, Linder JA. Antibiotic prescribing for acute respiratory infections at retail clinics. *Am J Manag Care*. 2015;21(4):294-302. <http://www.ajmc.com/journals/issue/2015/2015-vol21-n4/antibiotic-prescribing-for-respiratory-infections-at-retail-clinics-physician-practices-and-emergency-departments>. Accessed February 11, 2015.

5. Graubard BI, Korn EL. Predictive margins with survey data. *Biometrics*. 1999; 55(2):652-659.

6. Lee G, Reveles K, Attridge R, et al. Outpatient antibiotic prescribing in the United States: 2000 to 2010 [published online June 11, 2014]. *BMC Med*. doi:10.1186/1741-7015-12-96.