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The Volume-Quality Relationship in Antibiotic Prescribing: When More Isn't Better

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Abstract

For many surgeries and high-risk medical conditions, higher volume providers provide higher quality care. The impact of volume on more common medical conditions such as acute respiratory infections (ARIs) has not been examined. Using electronic health record data for adult ambulatory ARI visits, we divided primary care physicians into ARI volume quintiles. We fitted a linear regression model of antibiotic prescribing rates across quintiles to assess for a significant difference in trend. Higher ARI volume physicians had lower quality across a number of domains, including higher antibiotic prescribing rates, higher broad-spectrum antibiotic prescribing, and lower guideline concordance. Physicians with a higher volume of cases manage ARI very differently and are more likely to prescribe antibiotics. When they prescribe an antibiotic for a diagnosis for which an antibiotic may be indicated, they are less likely to prescribe guideline-concordant antibiotics. Given that high-volume physicians account for the bulk of ARI visits, efforts targeting this group are likely to yield important population effects in improving quality.

Keywords

acute respiratory infections, antibiotic prescribing, primary care, quality of care

Introduction

For surgeries and high-risk medical conditions, higher volume physicians, on average, provide higher quality of care.[1] However, the impact of volume on more basic medical conditions, where the acquisition of procedure- or diagnosis-specific expertise may be less relevant, has not been examined. Inappropriate antibiotic prescribing for acute respiratory infections (ARIs) is common and leads to many negative public health consequences including increased antibiotic resistance, adverse drug reactions, and increased cost.[2] We examined whether primary care physicians who see a higher volume of ARI visits provide higher quality of care in terms of antibiotic prescribing.

Methods

We obtained electronic health record data for all 2012 adult ambulatory visits for ARIs to primary care physicians in a large integrated health system that was affiliated with an academic medical center. The health system is located in the Northeastern United States, and operates more than 20 hospitals and 400 outpatient sites. Based on prior work,[3] we divided ARI diagnoses (based on International Classification of Diseases, Ninth Revision, Clinical Modification codes) into 2 groups: (1) "antibiotic-appropriate diagnoses" (antibiotics *may* be indicated), including streptococcal pharyngitis (034.x), otitis media (381.x, 382.x), sinusitis (461.x), and pneumonia (481.x, 482.x, 483.x, 485.x, 486.x), and (2) "non-antibiotic-appropriate diagnoses" (antibiotics are never indicated), including non-specific upper respiratory infection (URI; 460.x, 465.x), non-streptococcal pharyngitis (462.x), and bronchitis (466.x, 490.x, 491.21). We identified oral antibiotic prescriptions, and calculated the antibiotic prescribing rate for the following: all ARI visits, individual conditions, non-antibiotic-appropriate diagnoses, antibiotic-appropriate diagnoses, guideline concordance (for antibiotic-appropriate

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Table 1. Antibiotic Prescribing Rates for Acute Respiratory Infections Broken Down by Physician Volume Quintiles.

		Volume quintile for physicians (range of ARI visits among physicians in quintile) (*n* physicians in quintile)					
	No. of visits	1 (1-3) (*n* = 158) (lowest volume)	2 (4-9) (*n* = 121)	3 (10-32) (*n* = 133)	4 (33-74) (*n* = 136)	5 (75-1196) (*n* = 137) (highest volume)	*P* value[a]
Fraction of visits				%			
Antibiotic-appropriate ARI visits	14 370	36	39	41	43	46	.001
Prescribing rates				%			
All ARI visits	31 973	37	42	48	56	66	<.001
Non-antibiotic-appropriate ARI visits	17 603	29	30	41	49	58	<.001
Upper respiratory infection	7634	16	17	24	34	42	<.001
Acute bronchitis	4580	59	55	55	67	75	<.001
Non-streptococcal pharyngitis	5389	31	31	39	47	52	<.001
Antibiotic-appropriate ARI visits	14 370	59	64	60	65	74	<.001
Otitis media	3906	71	67	46	50	56	.09
Sinusitis	8553	76	76	80	85	89	<.001
Streptococcal pharyngitis	219	100	73	78	74	86	.65
Pneumonia	1692	16	37	41	35	40	.05
Broad-spectrum antibiotics[b]	15 987	55	54	60	63	65	.001
Guideline-concordant antibiotics[c]	9340	63	60	46	45	44	<.001

Note. ARI = acute respiratory infection.
[a]The *P* value is for linear trend across quintiles.
[b]This represents the broad-spectrum antibiotic prescribing rate for all ARI visits at which an antibiotic was prescribed.
[c]This represents the guideline-concordant antibiotic prescribing rate for antibiotic-appropriate ARI visits at which an antibiotic was prescribed.

diagnoses only), and broad spectrum (across all visits at which an antibiotic was prescribed). We defined guideline concordance as antibiotic prescriptions for antibiotic-appropriate diagnoses that were the first-line antibiotic recommended for the specific condition based on national guidelines: amoxicillin-clavulanate or amoxicillin for sinusitis,[4,5] a macrolide or doxycycline for pneumonia,[6] amoxicillin or penicillin for streptocccal pharyngitis,[7,8] and amoxicillin for otitis media.[9] We defined broad-spectrum antibiotics as macrolides, quinolones, amoxicillin-clavulanate, and second- and third-generation cephalosporins.[10] We divided physicians into quintiles by ARI visit volume and generated prescribing rates for each quintile using average prescribing rates for clinicians. We fitted a linear regression model of prescribing rates across quintiles to assess for a significant difference in trend.

Results

During 2012, 685 clinicians had 31 973 ARI visits and the overall antibiotic prescribing rate was 50%. For all ARI cases, physicians in higher volume quintiles were more likely to list an antibiotic-appropriate diagnosis versus a non-antibiotic-appropriate diagnosis ($P < .001$; Table 1). Physicians in higher volume quintiles had a higher antibiotic prescribing rate across all ARI visits ($P < .001$; Table 1), for non-antibiotic-appropriate ARI diagnoses ($P < .001$), for antibiotic-appropriate ARI diagnoses, and for 4 individual diagnoses: URI, bronchitis, non-streptococcal pharyngitis, and sinusitis (all *P*s < .001). Broad-spectrum antibiotic prescribing increased significantly as volume increased ($P = .001$), whereas guideline-concordant antibiotic prescribing decreased significantly ($P < .001$; Table 1).

Discussion

Physicians with a higher volume of cases manage ARI in a very different manner. They are much more likely to list a diagnosis where an antibiotic may be appropriate. However, for both non-antibiotic-appropriate diagnoses and antibiotic-appropriate diagnoses, higher volume physicians are more likely to prescribe antibiotics. When they prescribe an antibiotic for a diagnosis for which an antibiotic may be indicated, they are less likely to prescribe guideline-concordant antibiotics. In contrast to previous studies on the volume-outcome relationship, for ARI visits, higher volume physicians appear to provide lower quality care than lower volume physicians.

The relationship between volume and quality is generally thought to be due to increasing physician experience leading to better performance or decision making, which in turn can lead to improved outcomes. However, in the case of ARI visits, additional volume is unlikely to add substantively to the physician's expertise. In fact, at a certain threshold, higher volume may be associated with lower quality if physicians are rushed. Lower volume might also be a proxy for part-time status, which has been associated with higher quality.[11]

One key limitation of our study is that it relies on physician diagnostic coding. Higher volume physicians may see a different patient mix, but physicians have substantial discretion in selecting specific ARI diagnoses. Also, antibiotic prescribing is not always indicated for many visits even for "antibiotic-appropriate" diagnoses.[5] In addition, it is possible that physicians who are more likely to prescribe are also simply more likely to document diagnoses well, resulting in a systematic reporting bias.

Another limitation is that we did not measure physicians' overall visit volume or time spent with each patient, potential markers of whether a physician is rushed. And finally, this is a single health system study, which may constrain the generalizability of our results more broadly.

Our results help inform efforts to identify targets for intervention. Given that high-volume physicians account for the bulk of ARI visits, efforts targeting this group are likely to yield important population effects in improving quality.

Declaration of Conflicting Interests

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