

Low Uptake of Rapid Diagnostic Tests for Respiratory Tract Infections in an Urban Safety Net Hospital

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Background. Rapid diagnostic tests (RDTs) have been developed with the aim of providing accurate results in a timely manner. Despite this, studies report that provider uptake remains low.

Methods. We conducted a retrospective analysis of ambulatory, urgent care, and emergency department (ED) encounters at an urban safety net hospital with a primary diagnosis of an upper or lower respiratory tract infection (eg, bronchitis, pharyngitis, acute sinusitis) from January 1, 2016, to December 31, 2018. We collected RDT type and results, antibiotics prescribed, demographic and clinical patient information, and provider demographics.

Results. RDT use was low; a test was performed at 29.5% of the 33 494 visits. The RDT most often ordered was the rapid Group A *Streptococcus* (GAS) test (n = 7352), predominantly for visits with a discharge diagnosis of pharyngitis (n = 5818). Though antibiotic prescription was more likely if the test was positive (relative risk [RR], 1.68; 95% confidence interval [CI], 1.58–1.8), 92.46% of streptococcal pharyngitis cases with a negative test were prescribed an antibiotic. The Comprehensive Respiratory Panel (CRP) was ordered in 2498 visits; influenza was the most commonly detected pathogen. Physicians in the ED were most likely to order a CRP. Antibiotic prescription was lower if the CRP was not ordered compared with a negative CRP result (RR, 0.77; 95% CI, 0.7–0.84). There was no difference in prescribing by CRP result (negative vs positive).

Conclusions. RDTs are used infrequently in the outpatient setting, and impact on prescribing was inconsistent. Further work is needed to determine barriers to RDT use and to address potential solutions.

Keywords. antibiotics; antimicrobial stewardship; rapid diagnostics; respiratory tract infections.

Antibiotics are inappropriately prescribed 30%–50% of the time [1–3]. In the outpatient setting, respiratory tract infections (RTIs) account for ~60% of all antibiotic prescriptions despite the fact that most RTIs are caused by viruses [4, 5]. A recent analysis of antibiotic prescribing for privately insured patients in the United States found that the top 3 diagnoses where antibiotics were inappropriately given were acute bronchitis, upper RTI, and cough [3]. Previous work conducted by our team found that inappropriate prescribing in the outpatient setting was highest in visits with a diagnosis of acute bronchitis [1]. Though treatment guidelines exist, providers continue to prescribe antibiotics when they are not warranted [6].

Rapid diagnostic tests (RDTs) have been developed to guide appropriate antibiotic prescribing [7–10]. RDTs are accurate [11, 12] provide results quickly [13], and have been shown to improve prescribing and shorten emergency department (ED) visits [6, 14]. Despite this, uptake by providers remains low [4, 13–16] and the impact of RDTs on improving clinical management has been found to be inconsistent [11, 12]. Prior studies of RDT use have been limited to specific populations (eg, Department of Veterans Affairs [VA] or pediatric patients), specific diagnoses such as pharyngitis or influenza [9, 13, 15, 17] or restricted to peak periods for influenza [9, 17]. Given the limitations of the published data, we sought to examine practices at our own institution, an urban safety net hospital that serves a diverse population. Many of our patients have unstable housing, which can make the provision of consistent care and reliable follow-up difficult. Those patients might benefit greatly from RDTs. In this study, we examined the uptake of RDTs for a broad range of RTIs in multiple outpatient clinics, urgent care, and the ED over a 3-year period. We describe the frequency of RDT use and describe the association between RDTs and antibiotic prescribing for RTIs.

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METHODS

Design, Setting, and Participants

We conducted a retrospective analysis of all outpatient, urgent care, and ED visits for patients seen at an urban safety net hospital from January 1, 2016, to December 31, 2018. Visits with a primary ICD10 code for the following RTIs were included: acute viral upper respiratory tract infection (URTI), acute bronchitis, acute bronchiolitis, acute sinusitis, nonstreptococcal and streptococcal pharyngitis, influenza, viral and bacterial pneumonia, acute suppurative and nonsuppurative otitis. Diagnoses with small sample sizes were aggregated with other diagnostic categories (Supplementary Table 1). Care settings were collapsed into 4 categories: urgent care, ED, outpatient pediatrics, and other outpatient departments (family medicine, geriatrics, internal medicine, surgical specialties, medical specialties). The denominator for the study was unique encounters; thus individual patients could be represented multiple times in the sample. The Boston University Medical Campus Institutional Review Board approved this study.

For each visit, we recorded whether a rapid Group A *Streptococcus* (GAS) test, a Comprehensive Respiratory Panel (CRP), or a procalcitonin was performed. The rapid GAS test (OSOM Ultra Strep A) is an immunochromatographic test that qualitatively detects GAS antigen from a throat swab and has a sensitivity of 96% (95% confidence interval [CI], 94.4%–97.6%) and a specificity of 97.8% (95% CI, 96.6%–99%). The test is performed as a point-of-care test (POCT) on site in the pediatric and adolescent clinics at our facility. All other departments send throat swabs to the microbiology laboratory for GAS antigen testing. None of the departments conduct GAS polymerase chain reactions. Turnaround time (TAT) for the POCT in the clinic is ~5 minutes plus a small amount of hands-on preparation time. In the microbiology laboratory, the average TAT is 20 minutes for the day shift and 30–60 minutes for the night shift. The CRP (FilmArray Respiratory Panel) utilizes a nasopharyngeal swab, tests for 20 respiratory pathogens (17 viruses and 3 bacteria), and has an overall sensitivity and specificity of 84%–100% and 98%–100%, respectively. The turnaround time is ~1 hour. Procalcitonin (PCT) is a biomarker used to identify bacterial infections and detect sepsis in patients. Through 2017, we used the VIDAS BRAHMS PCT, and in 2018 the ALINITY i BRAHMS PCT was implemented. Both tests measure PCT in serum or plasma, and the TAT is ~2–3 hours.

Primary Measures and Outcomes

Patient data were extracted from the electronic health record (EHR). Demographic and clinical patient variables included age (≤ 18 years, 19–64 years, and ≥ 65 years of age), sex, race/ethnicity, insurance type, primary discharge diagnosis, Charlson comorbidity index, and comorbidities such as asthma that are not captured in the Charlson index but are noted in the literature to be risk factors for RTIs [18–20]. The provider associated

with each visit and their demographics (provider type [MD, DO, NP, PA], age, sex, department, length of employment at the hospital) were recorded. The primary outcome was receipt of an RDT. For each unique visit, we collected data on RDTs ordered and the result. For CRP, we noted if the panel was positive and the specific pathogen(s) detected. All influenza and RSV testing included in the analyses was done via the CRP. For rapid GAS, we noted if the test was positive or negative. Due to the small number of PCT tests ordered, these data were excluded from further analysis. The secondary outcome of interest was prescription of antibiotics. For each unique visit, we collected information on antibiotics prescribed and examined this in relation to receipt of an RDT and the result of the test. Given that the prescribing outcome of interest was antibiotic prescription, we did not examine the prescription of antiviral treatments over the study period.

Statistical Analysis

There were 33 494 visits extracted from the EHR. Figure 1 details the diagnoses included in the final analytical samples, based on sample size restrictions. CRP analyses were restricted to visits for acute viral URTI, bronchiolitis, pneumonia, and influenza. Rapid GAS test analyses were restricted to visits with diagnoses of pharyngitis (both streptococcal and nonstreptococcal) and acute viral URTI. Apart from age and department, test use and treatment of patients were similar between POCT and rapid GAS (data not shown). All rapid GAS analyses combined both the POCT and laboratory tests, adjusting for age and department. We examined the distribution of clinical and demographic patient variables across the analytic sample, as well as the patient and provider factors associated with receipt of an RDT. Each RDT was assessed separately, as >1 test may be administered at a visit, and indications for each test differ. Univariate and bivariate analyses examined the unadjusted relationship between patient and provider variables and receipt of an RDT. Chi-square and Fisher exact tests were used for categorical variables, and Wilcoxon and Kruskal-Wallis tests for continuous variables. Adjusted analyses utilized a nested repeated-measures Poisson regression with an independent correlation structure to model the relative risk of receiving an RDT. The model captured the correlation between patients seen by the same provider over the 3-year period. Variables in the final model were assessed based on a P value $\leq .05$ in the bivariate analyses, clinical risk factors for RTIs as noted in the literature, and impact on model fit. Model fit was examined by comparing the Quasi Information Criterion (QIC) statistics of nested models. Variables were added one at a time and differences between the QIC were examined. The smaller QIC indicated a better model fit for the data. Patient sex, race, insurance status, and comorbidities did not significantly change or impact model fit and were not included in the final adjusted models.

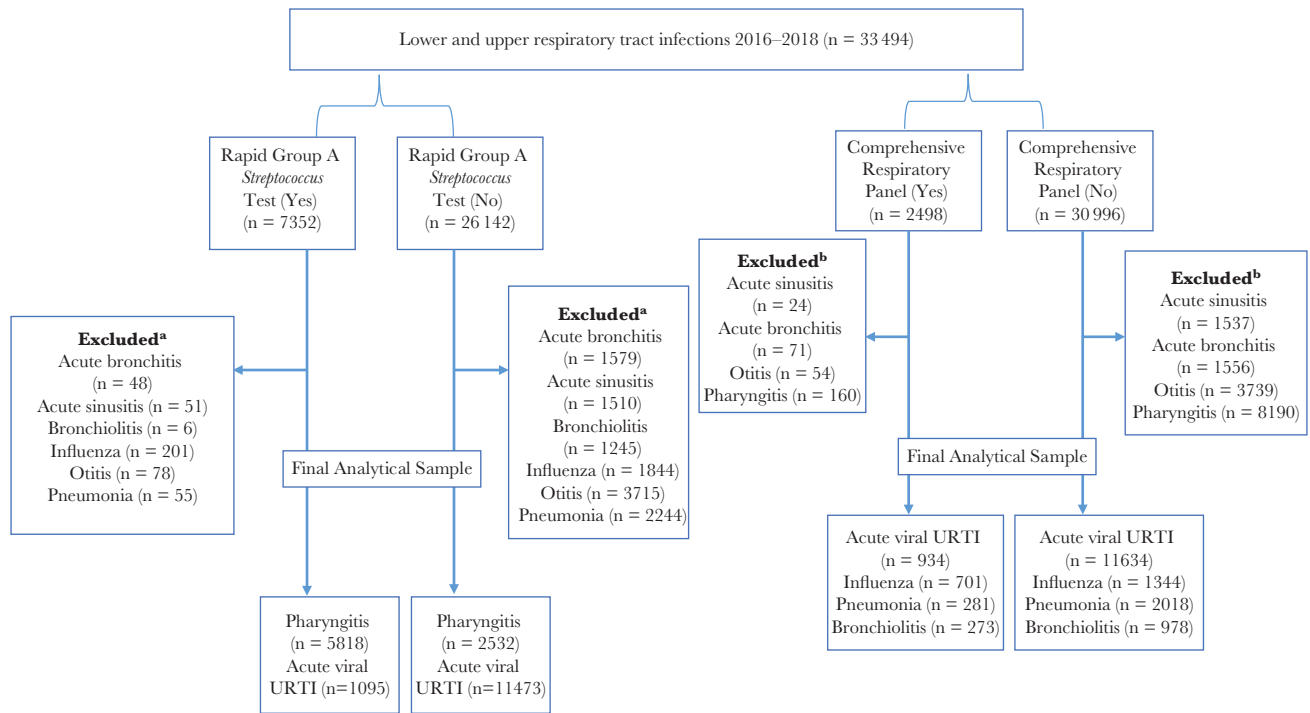


Figure 1. Diagnoses included in the final analytical samples for the rapid *Streptococcus* test and comprehensive respiratory panel analyses. ^aExcluded given the small number of visits where a rapid *Streptococcus* test was done. ^bExcluded given the small number of visits where the comprehensive respiratory panel was done. Abbreviation: URTI, upper respiratory tract infection.

Two secondary analyses examined the relationship between (1) RDT use and receipt of an antibiotic prescription and (2) RDT test results (positive or negative) and antibiotic prescribing. Receipt of an antibiotic was coded as yes or no. Bivariate and adjusted models utilized the approach described above. All statistical analyses were conducted using SAS (version 9.4; SAS Institute Inc., Cary, NC, USA). Testing was 2-sided and done at the .05 level of significance.

RESULTS

Overview of Study Sample

Of the 33,494 RTI visits between 2016 and 2018, acute viral URTIs were the most common diagnosis, accounting for 37.2% of encounters. Most patients were seen in the ED (51.3%) and were treated by physicians (77.4%) (see [Supplementary Table 2](#) for a description of the full sample).

Rapid Diagnostic Test Use

RDTs were used in 29.5% of visits ([Figure 1](#)). The most commonly ordered RDT was the rapid GAS test (n = 7,352, 21.9%). Rapid GAS was primarily used in visits with a discharge diagnosis of pharyngitis, which accounted for 79% of all rapid GAS tests. The CRP was ordered in 2,498 (7.5%) visits and was inconsistently used across RTIs ([Figures 1](#) and [2](#)), with 1.5% of acute sinusitis and 4.4% of bronchitis cases receiving a CRP. Conversely, 34.3% of influenza and 21.8% of bronchiolitis cases

received a CRP. There were 314 visits where both the rapid GAS and CRP were ordered, and these were primarily visits with a discharge diagnosis of pharyngitis (n = 202). PCT was the least utilized of all RDTs, used in only 72 (0.2%) visits.

Rapid GAS Test

There were 8,350 visits with a discharge diagnosis of pharyngitis; 5,818 (non-*Streptococcus* = 4,050, *Streptococcus* = 1,768) received a rapid GAS test ([Table 1](#)), and 1,818 (31.3%) of those tests were positive. There were 12,568 visits with a discharge diagnosis of acute viral URTI, and 1,095 (8.7%) received a rapid GAS test, 13 (1.2%) of which were positive. Unadjusted analyses showed no differences in overall test use by the presence of risk factors such as asthma or sickle cell disease. Thirty-five percent of patients 19–64 years received a rapid GAS test, compared with 32.1% and 10.9% of those ≤18 and ≥65 years of age, respectively. There was a higher proportion of test use in urgent care compared with all other locations ([Table 1](#)). Advanced care practitioners (nurse practitioners [NPs]/physician assistants [PAs]) had a higher proportion of test use compared with physicians (41.4% vs 30.5%). In adjusted analyses, the results remained the same, with the exception of patient age and location of care. The likelihood of test use was higher in patients aged ≤18 years compared with all other age groups. Compared with all other locations, the likelihood of test use was higher in the ED and urgent care ([Table 2](#)).

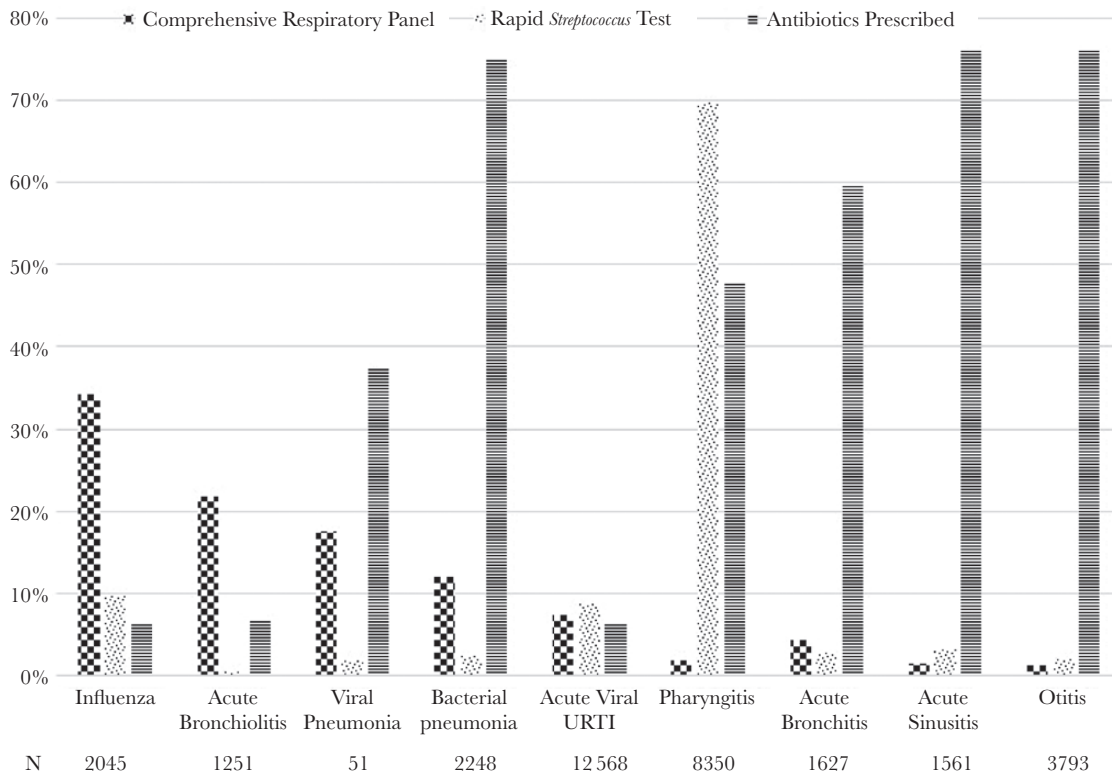


Figure 2. Distribution of rapid diagnostic test use and prescription of antibiotics by respiratory tract infection diagnosis (n = 33 494). The total number of diagnoses for each respiratory tract infection is provided beneath each diagnosis. Checkered bars: proportion of visits during which the comprehensive respiratory panel was ordered for that diagnosis. Dotted bars: proportion of visits during which the rapid *Streptococcus* test was ordered for each diagnosis. Horizontal lined bar: proportion of visits for each diagnosis that resulted in an antibiotic prescription. Abbreviation: URTI, upper respiratory tract infection.

Comprehensive Respiratory Panel

Of 18 163 visits included in the CRP analysis, a CRP was ordered in 2189 (12.1%) visits (Figure 1). In 80.8% of cases, CRP was positive for at least 1 pathogen, most commonly influenza (45%) (Supplementary Table 3). CRP use was most prevalent for older patients, 14.9% of those aged ≥ 65 years, compared with 11.9% of those aged ≤ 18 years and 19–64 years. Patients were more likely to receive a test if they were seen in the ED or in the winter. There were no differences in CRP use by provider gender, but physicians were more likely to order CRP compared with NPs/PAs (13.9% vs 4.1%). In adjusted analyses, predictors of CRP use remained the same. The likelihood of ordering CRP increased with age and was higher in physicians and for ED visits or visits that occurred during the winter months (Table 2).

Overview of Antibiotic Prescribing

Over one-third (n = 11 777, 35.2%) of all visits resulted in an antibiotic prescription; the highest proportion of prescriptions was at visits with a diagnosis of acute sinusitis (76.2%) (Figure 2). Antibiotic prescriptions were most prevalent in urgent care (46.6% of visits) and for patients aged 19–64 years (40%) (Supplementary Table 2). Non-Hispanic white patients received the highest proportion of prescriptions (44.4%), although they only accounted for 14% of the sample. Non-Hispanic black

patients comprised 50% of patients seen, but only 33.2% were prescribed an antibiotic (Supplementary Table 2).

Rapid Diagnostic Test Use and Antibiotic Prescribing

Approximately 6% (n = 823) of acute viral URTI cases received an antibiotic. Of these, 115 received a rapid GAS (12 were positive and 113 negative). Almost half (n = 3999, 47.9%) of pharyngitis cases received an antibiotic prescription, 76.4% (n = 2984) of which received GAS testing. Antibiotics were more often prescribed if there was a discharge diagnosis of streptococcal pharyngitis. There were 199 (8.6%) visits with a diagnosis of streptococcal pharyngitis with a negative rapid GAS test; 92.5% of these resulted in an antibiotic prescription. In adjusted models, there was an increased risk of receiving an antibiotic prescription if the rapid GAS was positive compared with negative (relative risk [RR], 1.68; 95% CI, 1.58–1.80). There was no difference in prescribing if the rapid GAS was not done (RR, 1.05; 95% CI, 0.98–1.13) compared with a negative test (Table 3).

Antibiotic prescribing was lowest in visits with a CRP positive for influenza (Supplementary Table 3). However, adjusted analyses showed no significant difference in prescribing between cases with a negative CRP and CRP positive for influenza (RR, 1.10; 95% CI, 0.87–1.39) or any other viral pathogen

Table 1. Patient and Provider Characteristics for Lower and Upper Respiratory Tract Infections by Receipt of the Rapid Group A *Streptococcus* Test (n = 20 918) or the Comprehensive Respiratory Panel (n = 18 163), 2016–2018

Variable	Rapid Group A <i>Streptococcus</i> Test/Yes, No. (%) ^a	Rapid Group A <i>Streptococcus</i> Test/No, No. (%) ^a	PValue	Comprehensive Respiratory Panel/ Yes, No. (%) ^b	Comprehensive Respiratory Panel/ No, No. (%) ^b	PValue
Total/No.	6913 (33.05)	14 005 (66.95)		2189 (12.05)	15 974 (87.95)	
Patient demographics						
Sex						
Male	2830 (30.89)	6333 (69.11)	<.0001	1087 (12.63)	7519 (87.37)	.02
Female	4083 (34.73)	7672 (65.27)		1102 (11.53)	8455 (88.47)	
Age categories						
≤18 y	3018 (32.07)	6392 (67.93)	<.0001	1070 (11.85)	7963 (88.15)	.007
19–64 y	3797 (35.78)	6816 (64.22)		934 (11.85)	6950 (88.15)	
≥65 y	98 (10.95)	797 (89.05)		185 (14.85)	1061 (85.15)	
Insurance type						
Medicare	190 (15.83)	1010 (84.17)	<.0001	207 (13.97)	1275 (86.03)	.12
Medicaid	4360 (31.95)	9285 (68.05)		1455 (11.92)	10 748 (88.08)	
Commercial	1771 (38.29)	2854 (61.71)		415 (11.87)	3081 (88.13)	
Other/unknown	592 (40.88)	856 (59.12)		112 (11.41)	870 (88.59)	
Race/ethnicity ^c						
Hispanic	1616 (33.3)	3237 (66.7)	<.0001	587 (13.72)	3692 (86.28)	.0002
Non-Hispanic white	736 (29.77)	1736 (70.23)		302 (12.65)	2085 (87.35)	
Non-Hispanic black	3713 (33.47)	7380 (66.53)		1038 (11.16)	8262 (88.84)	
Other	173 (27.72)	451 (72.28)		87 (13.77)	545 (86.23)	
Declined/unknown	674 (35.97)	1200 (64.03)		175 (11.18)	1390 (88.82)	
Diagnosis						
Influenza	N/A	N/A		701 (34.28)	1344 (65.72)	<.0001
Pneumonia	N/A	N/A		281 (12.22)	2018 (87.78)	
Acute bronchiolitis	N/A	N/A		273 (21.82)	978 (78.18)	
Acute viral upper respiratory tract infections	1095 (8.71)	11 473 (91.29)	<.0001	934 (7.43)	11 634 (92.57)	
Pharyngitis						
Non- <i>Streptococcus</i>	4050 (67.06)	1989 (32.94)		N/A	N/A	
<i>Streptococcus</i>	1768 (76.5)	543 (23.5)		N/A	N/A	
Age-adjusted Charlson comorbidity						
Yes	2466 (27.99)	6345 (72.01)	<.0001	1151 (13.18)	7582 (86.82)	<.0001
No	4447 (36.73)	7660 (63.27)		1038 (11.01)	8392 (88.99)	
Sickle cell						
Yes	85 (33.73)	167 (66.27)	.82	44 (19.82)	178 (80.18)	.0003
No	6828 (33.04)	13 838 (66.96)		2145 (11.96)	15 796 (88.04)	
Asthma						
Yes	1430 (19.42)	2632 (64.8)	.001	470 (12.68)	3236 (87.32)	.19
No	5483 (32.53)	11 373 (67.47)		1719 (11.89)	12 738 (88.11)	
Provider demographics						
Age, median ± IQR, y	43 ± 17	42 ± 16	<.0001	42 ± 15	42 ± 16	.71
Sex						
Male	1631 (27.19)	4367 (72.81)	<.0001	688 (12.54)	4798 (87.46)	.18
Female	5282 (35.4)	9638 (64.6)		1501 (11.84)	11 176 (88.16)	
Provider type						
MD/DO	4899 (30.51)	11 159 (69.49)	<.0001	2050 (13.86)	12 736 (86.14)	<.0001
NP/PA	2014 (41.44)	2846 (58.56)		139 (4.12)	3238 (95.88)	
Department ^c						
Urgent care	1500 (43.81)	1924 (56.19)	<.0001	90 (4.26)	2025 (95.74)	<.0001
Pediatrics	1084 (32.02)	2301 (67.98)		237 (7.79)	2804 (92.21)	
Emergency department	3717 (32.98)	7555 (67.02)		1795 (16.76)	8914 (83.24)	
Other outpatient	611 (21.54)	2225 (78.46)		67 (2.92)	2231 (97.08)	
Years employed at BMC, median ± IQR	6.14 ± 13.18	5.97 ± 11.23	.78	6.65 ± 14.10	5.49 ± 11.55	<.0001
Season						
Winter	2051 (29.76)	4840 (70.24)	<.0001	1121 (15.6)	6066 (84.4)	<.0001

Table 1. Continued

Variable	Rapid Group A <i>Streptococcus</i> Test/Yes, No. (%) ^a	Rapid Group A <i>Streptococcus</i> Test/No, No. (%) ^a	PValue	Comprehensive Respiratory Panel/ Yes, No. (%) ^b	Comprehensive Respiratory Panel/ No, No. (%) ^b	PValue
Spring	1891 (37.98)	3088 (62.02)		377 (10.10)	3356 (89.9)	
Summer	1415 (39.78)	2142 (60.22)		127 (5.73)	2090 (94.27)	
Fall	1556 (28.34)	3935 (71.66)		564 (11.22)	4462 (88.78)	
Year of service						
2016	2272 (32.25)	4772 (67.75)	.0001	549 (9.5)	5230 (90.5)	<.0001
2017	2418 (34.99)	4492 (65.01)		803 (13.66)	5074 (86.34)	
2018	2223 (31.92)	4741 (68.08)		837 (12.86)	5670 (87.14)	

Abbreviations: BMC, Boston Medical Center; IQR, interquartile range.

^aRapid *Streptococcus* restricted to diagnoses of pharyngitis (*Streptococcus* and non-*Streptococcus*) and acute viral upper respiratory tract infections.

^bComprehensive respiratory panel restricted to the following diagnoses: acute viral upper respiratory tract infection, pneumonia (viral and bacterial), influenza, bronchiolitis.

^cRace/ethnicity: 2 observations with missing data; Department: 1 observation with missing data.

(RR, 0.97; 95% CI, 0.86–1.10) (Table 3). There was a significantly reduced risk of getting an antibiotic prescription if the CRP was not done (RR, 0.77; 95% CI, 0.7–0.84) compared with a negative test.

DISCUSSION

Rapid diagnostic tests for RTIs were utilized infrequently in the outpatient setting over the 3-year study period. RDT use overall and by test type varied significantly by patient age, department, and discharge diagnosis. Rapid GAS test use was most prevalent in diagnoses of pharyngitis; 70% of those cases received a test. CRP, though useful for several RTIs, was primarily used in cases of influenza. Antibiotic prescribing was associated with diagnoses rather than the results of the RDTs. Providers who determined that the patient had streptococcal pharyngitis prescribed antibiotics regardless of the result of the rapid GAS test. Although prescribing was greater when the CRP was ordered compared with visits without, there was no difference in prescribing practices based on the results of the test.

Our findings are consistent with studies that show that despite evidence that RDTs have accurate diagnostic capabilities, fast TATs, and can improve antibiotic prescribing, low use persists [10, 17, 21, 22]. This has also been shown outside the United States. In France, RDTs have been readily available to general practitioners since 2002 and improve prescribing in pediatric pharyngitis cases, but uptake of tests has been low [13]. In Japan, although prescribing was improved with the use of RDTs for streptococcal pharyngitis, out of 1.27 million outpatient visits from 2013 to 2015, only 5.6% received a test [23].

Studies in many countries indicate that factors linked to poor uptake of RDTs are varied. Across Europe, providers state that time, patient expectations, and overreliance on test results are barriers to RDT use [24, 25]. In the United States and the Netherlands, providers highlight cost and impact on clinic flow as barriers [7, 10]. For example, UCLA researchers suggested that underutilization of infectious disease POCTs was due to

differences in clinic flow in various ambulatory settings, with urgent care able to incorporate POCTs more seamlessly [26]. We also observed differences in RDT use by location of care. The ED, where most tests were done, is less likely to suffer disruption to its workflow. ED visits are generally longer than outpatient primary care visits, and patients typically receive several tests, allowing for providers to more easily incorporate an additional test such as RDTs into their practice.

A positive rapid GAS test had the most direct implications for antibiotic prescribing for pharyngitis. Studies, including our own, show a consistent pattern of prescribing when the test is positive [2, 23]. Discrepancies arise in the presence of a negative rapid GAS test [27]. Two family health clinics in New Mexico showed that rapid GAS testing in adult patients reduced inappropriate prescribing of antibiotics [6]. However, retail clinics in Minneapolis and Baltimore found that 30% of patients with a negative GAS test still receive an antibiotic [27]. Our findings suggest that these differences may be related to providers using clinical judgment to guide prescribing when the rapid GAS test is negative. Patients with a negative test and a diagnosis of acute viral URTI very rarely received an antibiotic. In contrast, those with a negative test and a diagnosis of streptococcal pharyngitis were prescribed antibiotics. Prescribing of antibiotics has been linked to the practice of starting antibiotics before receiving test results and the continuation of antibiotic treatment after a negative result [28]. The initiation and continuation of antibiotics is likely driven by clinical presentation and patient risk factors such as exposure to a contact with streptococcal pharyngitis.

For CRP, similar inconsistencies between test results and impact on antibiotic prescribing exist. A systematic review of pediatric populations from the United States, Europe, Australia, and Asia found that RDTs for influenza and multiplex tests for viral respiratory pathogens did not consistently result in appropriate antiviral and antibacterial prescription [15]. Another study at the VA demonstrated that although RDTs improved diagnosis and treatment of influenza, the benefit did not extend to other viral pathogens [4]. Similarly, we found that prescribing did not

Table 2. Likelihood of Receiving the Rapid Group A *Streptococcus* Test (n = 20 918) or the Comprehensive Respiratory Panel (n = 18 163) in Outpatient Visits With a Diagnosis of a Lower or Upper Respiratory Tract Infection

Variable	Rapid Group A <i>Streptococcus</i> Relative Risk (95% Confidence Interval) ^a	P Value
Department		
ED	Ref	
Urgent care	0.97 (0.92–1.01)	.17
Outpatient pediatrics	0.79 (0.76–0.83)	<.0001
Other outpatient	0.65 (0.61–0.70)	<.0001
Patient age		
≤18 y	Ref	
19–64 y	0.74 (0.72–0.78)	<.0001
≥65 y	0.48 (0.41–0.57)	<.0001
Provider type		
MD/DO	Ref	
NP/PA	1.27 (1.22–1.33)	<.0001
Comprehensive Respiratory Panel Relative Risk (95% Confidence Interval)^b		
Department		
ED	Ref	
Urgent care	0.31 (0.25–0.39)	<.0001
Outpatient pediatrics	0.67 (0.58–0.77)	<.0001
Other outpatient	0.20 (0.15–0.25)	<.0001
Patient age		
≤18 y	Ref	
19–64 y	1.29 (1.18–1.42)	<.0001
≥65 y	1.79 (1.55–2.06)	<.0001
Provider type		
MD/DO	Ref	
NP/PA	0.56 (0.47–0.68)	<.0001
Season		
Winter	Ref	
Spring	0.83 (0.74–0.92)	.0007
Summer	0.52 (0.43–0.62)	<.0001
Fall	0.95 (0.86–1.05)	.31

Abbreviation: ED, emergency department.

^aModel adjusted for streptococcal pharyngitis, nonstreptococcal pharyngitis, and acute viral upper respiratory tract infections.

^bModel adjusted for the following diagnoses: influenza, acute viral upper respiratory tract infections, bronchiolitis, viral and bacterial pneumonia.

differ based on the result of the CRP. Patients with a positive viral pathogen received fewer antibiotics than those with a negative test, but this was not significantly different. However, patients with a negative test were more likely to get an antibiotic compared with those with no CRP ordered, likely because the clinician who did not order a CRP had already decided the patient had a viral syndrome that did not require antibiotic treatment. In addition, the CRP does not include the most common bacterial pathogens; thus even a positive viral result does not rule out a bacterial infection.

We found that patients diagnosed with acute bronchitis or sinusitis rarely received the CRP but accounted for the vast majority

of antibiotics prescribed, despite evidence that antibiotics are often inappropriate [1, 29]. This is further exacerbated by the fact that few data supporting the utility of these tests in such cases exist, and clinical guidelines for sinusitis and bronchitis, as well as pneumonia, do not make mention of the use of rapid diagnostics and instead focus on clinical symptoms [30–33]. Several studies on CRP focus on influenza and the reduction of antibiotic use but rarely assess the utility of the test in these other RTIs [4, 34]. One exception is a small study with 8 clinically diagnosed and treated bronchitis cases that showed that antibiotic use could have been avoided had CRP been used [35]. This lack of data highlights the gap between product development and clinical utility, as providers are without a reliable RDT to improve clinical practice in the situations where it is most needed.

The interpretation of the results of multiplex diagnostic tests in the context of clinical presentation can be challenging, and clear-cut guidance is lacking [21]. In 5 states across the United States, primary care providers stated that test results often would not change clinical decisions, as treatment was determined based on clinical presentation [7]. The tendency was to trust a negative result to rule out an infection rather than rely on positive results to rule in a condition [7]. In a 1-year surveillance study of inpatient neonates in Syracuse, New York, 52% tested positive for a viral respiratory pathogen even in the absence of clinical indications, and a positive test was associated with increased length of stay and ventilator support [36]. This highlights the need for population-specific guidelines, as the implications of a positive test in a high-risk population such as neonates will differ from those in otherwise healthy individuals. A study in 5 hospitals in the Netherlands showed that clinicians were knowledgeable about the technical aspects of the rapid diagnostics; however, there was a demand for the development of clinical guidelines [37].

Table 3. Relative Risk of Receiving an Antibiotic Prescription by Rapid Diagnostic Test Use and Result

Rapid Group A <i>Streptococcus</i> Test Result ^a	Risk Ratio (95% Confidence Interval)	P Value
Negative	Ref	
Positive	1.68 (1.58–1.80)	<.0001
Rapid <i>Streptococcus</i> test not done	1.05 (0.98–1.13)	.16
Comprehensive Respiratory Panel Result^b		
Negative	Ref	
Positive for influenza	1.10 (0.87–1.39)	.43
Positive for other viral pathogen	0.97 (0.86–1.10)	.67
CRP not done	0.77 (0.70–0.84)	<.0001

^aModel adjusted for streptococcal and nonstreptococcal pharyngitis (n = 20 870); excludes tests with no result (n = 48).

^bModel adjusted for department and the following diagnoses: acute viral upper respiratory tract infection, pneumonia (viral and bacterial), bronchiolitis, influenza (n = 18 120); excludes positive bacteria results (n = 43).

Although this study provides insight into RDT use at a safety net hospital, there are some limitations. As a single-site study, the results may not be applicable to other settings. Because the study is retrospective, we cannot confirm the temporal relationship between diagnosis, prescribing, and availability of RDT results. The use of prescription data also prevents us from determining whether the prescription was filled or if the medication was taken after discharge from the ED or after the outpatient visit. Furthermore, the use of discharge diagnoses fails to capture information on presenting symptoms or presumptive diagnoses, which often guide testing and treatment decisions. Finally, the data set only included the primary discharge diagnosis, and it is possible that we did not capture all RTIs diagnosed at each visit.

Despite these limitations, our study provides the groundwork for continued examination of the role of RDTs in an urban safety net hospital with a complex patient population that often has unstable housing and inconsistent access to care. Our ongoing research, through qualitative interviews with providers, seeks to improve uptake of RDTs in cases such as influenza and streptococcal pharyngitis, where the course of treatment is often more straightforward and RDTs can be very useful. In clinical scenarios where tests are underused and the advantage of these diagnostic tests remains unclear, we seek to explore ways in which we can improve clinical utility.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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