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BRIEF REPORT

Validity of Coronavirus Disease 2019 *International Classification of Diseases, Tenth Revision* in the Urgent Care Setting and Impact on Antibiotic Prescribing Rates

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We validated different coronavirus disease 2019 (COVID-19) *International Classification of Diseases, Tenth Edition* (ICD-10) encounter definitions across 2 urgent care clinics.

Sensitivity of definitions varied throughout the pandemic.

Inclusion of COVID-19 and COVID-19-like illness (CLI) ICD-10s rendered highest sensitivity but lowest specificity.

Antibiotic prescribing rates were low for COVID-19 ICD-10 encounters, increasing with CLI ICD-10 encounters.

Keywords. antibiotic prescribing; billing data; COVID-19; urgent care.

Billing data in the form of *International Classification of Diseases, Tenth Edition* (ICD-10) are valuable for identification of infectious syndromes for disease surveillance and monitoring vaccine effectiveness. In addition, billing data are important for tracking inappropriate antibiotic prescribing and monitoring ambulatory antibiotic stewardship efforts with a focus on antibiotic overuse for respiratory viral infections [1–3]. Data describing the usage and validity of new coronavirus disease 2019 (COVID-19) ICD-10s in clinical practice are limited and focused on acute care settings early in the pandemic [4, 5]. As the pandemic evolves and COVID-19 hospitalizations decrease, the proportion of patients managed in the outpatient setting has increased. Now that COVID-19 is one of the most common respiratory viral infections, ICD-10 validation in ambulatory care settings is critical for ongoing disease surveillance, COVID-19 research, and monitoring antibiotic prescribing practices. Our objective was to validate COVID-19 and related ICD-10s in an academic urgent care setting and determine antibiotic prescribing rates (APR) for different encounter definitions.

METHODS

In this retrospective analysis, we included telemedicine and in-person visits from 2 academic urgent care clinics at Stanford Health Care staffed by 22 regular providers (13 physicians, 9 advance practice providers) from January 2020 to March 2022. Only visits in which a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) nucleic acid amplification test (NAAT) was performed within 5 days before or 2 days after the encounter visit were included. For all clinical encounters, we extracted encounter date, associated ICD-10s, antibiotic prescriptions, and SARS-CoV-2 NAAT results from the electronic medical record.

We defined "COVID-19 ICD-10s" as the 9 ICD-10s most likely to reflect active infection (eg, COVID-19, virus identified, U07.1) (Supplementary Table 1), excluding post-COVID-19 or exposure. We defined 394 ICD-10s as "COVID-19-like illness" (CLI) including 387 ICD-10s that were categorized as CLI in a vaccine efficacy trial plus 7 similar ICD-10s used in our setting (eg, body aches, R52) (Supplementary Table 2) [2]. We also categorized 9 ICD-10s as "asymptomatic COVID-19 ICD-10s" because they suggested either a history of COVID-19 or asymptomatic screening (Supplementary Table 1).

We used 3 different "COVID-19 encounter" definitions: encounters with (1) ≥1 COVID-19 ICD-10, (2) ≥1 CLI ICD-10, and (3) ≥1 COVID-19 or CLI ICD-10. We used positive NAAT results as the reference standard to calculate the sensitivity and specificity of COVID-19 ICD-10 encounter definitions to predict true COVID-19 infection. We estimated the sensitivity of an encounter definition as the proportion of encounters with a positive NAAT that also met a COVID-19 encounter definition and specificity as the proportion of encounters with a negative NAAT that did not meet a COVID-19 encounter definition (Appendix). We calculated APR as the proportion of encounters in which an antibacterial drug (Supplementary Table 3) was prescribed at the index visit. This quality improvement project was deemed nonhuman subjects research by the Stanford Panel on Human Subjects in Medical Research.

RESULTS

During the study period there were 77 599 encounters, 56% (43 648) of which were telemedicine visits. Most encounters were

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Table 1. Sensitivity, Specificity, and Antibiotic Prescribing Rate by COVID-19 Encounter Definition and NAAT Across 2 Academic Urgent Care Clinics

Encounters	Number of Encounters	Sensitivity	Specificity	APR[a] (No./%)
Total Urgent Care Encounters	77 599			
Urgent Care Encounters With a COVID-19 Encounter Definition				
COVID-19 ICD-10	3414 (4%)	1288/1850 (70%)	11 294/11 412 (99%)	67 (2%)
CLI ICD-10	27 858 (36%)	623/1850 (34%)	3924/11 412 (34%)	2927 (11%)
CLI or COVID-19 ICD-10	30 543 (39%)	1719/1850 (93%)	3836/11 412 (34%)	2955 (10%)
Urgent Care Encounters Associated With NAAT				
NAAT performed	13 262	–	–	842 (6%)
Positive NAAT	1850	–	–	47 (3%)

Abbreviations: APR, antibiotic prescribing rate; CLI, COVID-like illness; COVID-19, coronavirus disease 2019; ICD-10, *International Classification of Diseases, Tenth Revision*; NAAT, nucleic acid amplification test.

[a]Calculated as proportion of encounters with antibiotic prescription divided by total number of encounters. See Supplement for detailed 2 × 2 tables.

for patients ≥8 years old (74 098; 95%). Of all encounters, 4% (3414) had ≥1 COVID-19 ICD-10% and 36% (27 858) had ≥1 CLI ICD-10; 39% (30 543) had ≥1 COVID-19 or CLI ICD-10. Only 3 COVID-19 ICD-10s were used by our clinicians (U07.1, J12.82, and B34.2) (Supplementary Figure 1.)

A total of 17% (13 262 of 77 599) of encounters were associated with a SARS-CoV-2 test and were included in the sensitivity/specificity analysis (2020–7763 [59%], 2021–4434 [33%], 2022–1065 [8%]). Of all NAAT results, 1850 (14%) were positive (2020–1144 [62% of all positives], 2021–490 [26%], 2022–216 [12%]). Severe acute respiratory syndrome coronavirus 2 tests resulted the day of or up to 2 days postencounter (75% [9986 of 13 262]).

Of the encounters with a NAAT result, 70% (9295 of 13 262) met at least 1 COVID-19 encounter definition. The sensitivity of an encounter having ≥1 COVID-19 ICD-10 to predict a positive NAAT was 70% (1288 of 1850). The specificity of an encounter without ≥1 COVID-19 ICD-10 to predict a negative COVID test was 99% (11 294 of 11 412) (Supplementary Table 4). Including CLI ICD-10s in the definition increased the sensitivity to 93% (1719 of 1850), whereas the specificity fell to 34% (3836 of 11 412) (Table 1, Supplementary Tables 5 and 6). Including NAAT results up to 5 days or 7 days after the encounter date did not meaningfully change the sensitivity and specificity of the COVID-19 definitions (Supplementary Tables 7 and 8) The sensitivity of the COVID-19 ICD-10 and CLI ICD-10 encounter definitions varied over time; however, the performance of the composite encounter definition of COVID-19 or CLI ICD-10 remained stable (Figure 1).

Only 0.07% (131 of 1850) of the encounters associated with a positive NAAT result had neither a COVID-19 nor CLI ICD-10. Half (65 of 131, 50%) of these encounters were associated with asymptomatic COVID-19 ICD-10s (Supplementary Table 1). Removing encounters with only asymptomatic COVID19 ICD-10s did not impact the sensitivity and specificity of the COVID-19 or CLI ICD-10 definitions (Supplementary Table 9).

The APR differed across COVID-19 encounter definitions. Encounters with COVID-19 ICD-10s had the lowest APR (2%). When CLI ICD-10s were included, the APR increased to 10%. The APRs remained relatively stable across the course of the pandemic (Supplementary Figure 2). For encounters with a positive NAAT, APR was similar to encounters with COVID-19 ICD-10s (Table 1).

DISCUSSION

We found that sensitivity of a COVID-19 ICD-10 during urgent care encounters was 70% with high specificity 99%. When CLI ICD-10 was included in the COVID-19 encounter definition, sensitivity increased to 93% but specificity decreased to 34%. The APR was low for COVID-19 ICD-s and increased with inclusion of CLI ICD-10s.

Our results differ from available COVID-19 ICD-10 validation data likely because of differences in study populations, pandemic time frames included, and definitions used. Two studies by Kadri et al [5] and Kluberg et al [6] from inpatient billing data reported a 98% and 95% sensitivity, respectively, for ICD-10 U07.1 ("COVID-19, virus identified"). Both studies included data only from the first year of the pandemic and used a positive NAAT up to 2–4 weeks before hospital admission for sensitivity calculations. Similarly, Wu et al [7] reported an 81.3% sensitivity for ICD-10 U07.1 in patients presenting to the emergency department (ED) 1 day prior and up to 7 days after a NAAT result. Bhatt et al [4] reported a much lower sensitivity of 49% for ICD-10 U07.1 when calculating sensitivity using NAAT results during index hospitalization, which more closely mirrors our findings. We used a narrower window of SARS-CoV-2 testing to focus on antibiotic prescribing for acute COVID-19 presentations and found that approximately two thirds of tests resulted the same day or after the encounter. It is possible that symptomatic patients present to the urgent care setting earlier in their course of illness before a diagnosis is made compared with those who present to the ED later in their course of illness when symptoms are more severe. Thus, providers in the urgent care setting may be less likely to have access to NAAT results before coding for an encounter that may limit the sensitivity of ICD-10s.

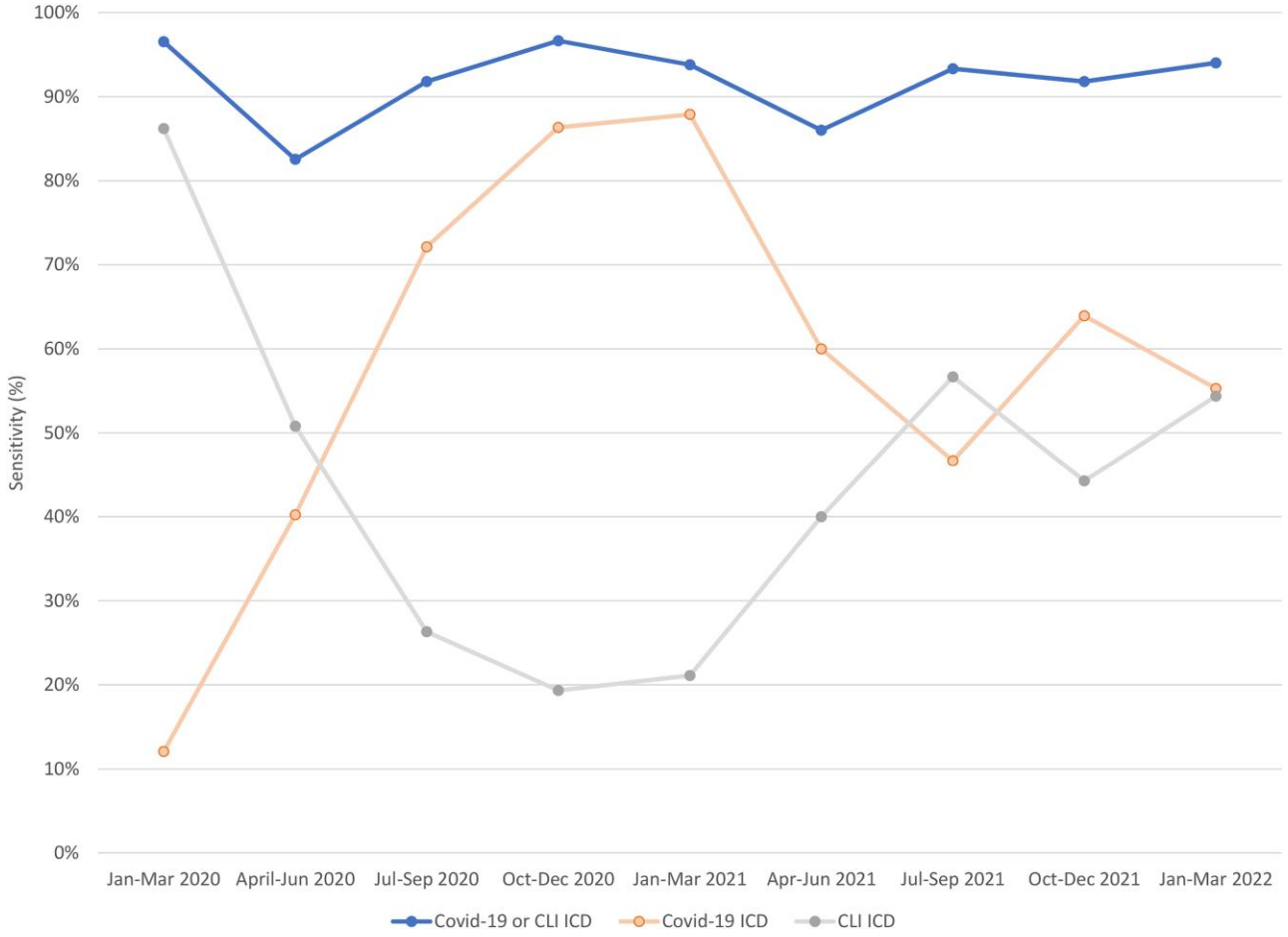

Figure 1. Sensitivity of different coronavirus disease 2019 (COVID-19) encounter definitions against positive nucleic acid amplification test over time. CLI, COVID-like illness; ICD-10, *International Classification of Diseases, Tenth Revision.*

We found that including CLI ICD-10s in a COVID-19 encounter definition increased sensitivity with stability over time. This composite definition may account for factors that disproportionately impact individual definitions, including changes in coding practices, access to test results, and type of testing performed. The ideal COVID-19 encounter definition may then depend on intended purpose. For example, for disease surveillance, increased sensitivity at expense of specificity may be important when testing is limited or variable [8]. However, to isolate COVID-19 impact, a narrow encounter definition with increased specificity not reliant on laboratory testing may be desirable as more home testing becomes available.

We found APR increased from 2% to 10% when we included CLI ICD-10s in the COVID-19 encounter definition. Although some CLI ICD-10s reflect conditions for which antibiotics are indicated (eg, bacterial pneumonia), the majority are for diagnoses for which antibiotics are sometimes or rarely indicated [9–11]. Therefore, the combined COVID-19 and CLI ICD-10 encounter definition could be used to more accurately describe antibiotic prescribing across respiratory conditions, an important target for outpatient antibiotic stewardship.

Our project has limitations. First, this was a single-center analysis limiting generalizability of our findings. Second, like similar studies, we only included NAAT results given the limited access to antigen test results; however, the decrease in NAAT testing performed by pandemic year might be partly accounted for by a corresponding increase in antigen testing. In addition, we did not include outside institution SARS-CoV-2 testing. Third, we included only billing data in our analysis, which, due to coding variation practices and errors, may not accurately represent the true prescriber intent for any given encounter nor accurately confirm the presence of associated symptoms representative of active COVID-19 infection for positive NAAT results.

CONCLUSIONS

Sensitivity of COVID-19 ICD-10s to identify encounters with positive COVID-19 NAAT results changed over the course of the pandemic although this appears to have stabilized. Using both a COVID-19 and combined "CLI or COVID-19 ICD-10" encounter definition, outpatient stewardship

programs may better assess the impact of COVID-19 infection, proven and suspected, on antibiotic prescribing. As the pandemic evolves, further study is needed to determine the impact of positive antigen testing on the performance of COVID-19 ICD-10 in identifying COVID-19 encounters.

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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Author contributions. NM, SO, DH, and MH led project development, collected and analyzed data, and contributed to and reviewed the manuscript. ES, AC, EM, and ALH contributed to the study design and contributed to and reviewed the manuscript.

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Potential conflicts of interest. All authors: No reported conflicts of interest.

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