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Universal SARS-CoV-2 Testing of Emergency Department Admissions Increases Emergency Department Length of Stay



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Study objective: Our institution experienced a change in SARS-CoV-2 testing policy as well as substantial changes in local COVID-19 prevalence, allowing for a unique examination of the relationship between SARS-CoV-2 testing and emergency department (ED) length of stay.

Methods: This was an observational interrupted time series of all patients admitted to an academic health system between March 15, 2020, and September 30, 2020. Given testing limitations from March 15 to April 24, all patients receiving SARS-CoV-2 tests were symptomatic. On April 24, testing was expanded to all ED admissions. The primary and secondary outcomes were ED length of stay and number needed to test to obtain a positive, respectively.

Results: A total of 70,856 patients were cared for in the EDs during the 7-month period. The testing change increased admission length of stay by 1.89 hours (95% confidence interval 1.39 to 2.38). The number needed to test was 2.5 patients and was highest yield on April 1, 2020, when the state positivity rate was 39.7%; however, the number needed to test exceeded 170 patients by Sept 1, 2020, at which point the state positivity rate was 0.5%.

Conclusion: Although universal SARS-CoV-2 testing of ED admissions may meaningfully support mitigation and containment efforts, the clinical cost of testing all admissions amid low community positivity is notable. In our system, universal ED SARS-CoV-2 testing was associated with a 24% increase in admission length of stay alongside the detection of only 1 positive case every other day. Given the known harms and risks of ED boarding and crowding, solutions must be developed to support regular operational flow while balancing infection prevention needs. [Ann Emerg Med. 2022;79:182-186.]

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INTRODUCTION

Despite expanding SARS-CoV-2 testing resources and availability, COVID-19 continues to spread and remains a persistent public health threat. Given evidence of viral transmission by asymptomatic persons, pandemic mitigation efforts necessitate identification of asymptomatic individuals. Depending on local disease prevalence, rates of asymptomatic patients testing positive range from 1% to as high as 30%.¹ Within hospitals, identification and isolation of asymptomatic individuals with SARS-CoV-2 has garnered much attention as a method to prevent outbreaks, reduce bed transfers of cohorted patients, and allay fears of hospital-acquired COVID-19.

Universal preadmission patient testing continues to be a challenge. Similarly to influenza, identifying which patients require isolation facilitates early cohorting of infected

patients, which helps to limit staff and patient exposure and allows more efficient bed management.^{2,3} A similar approach has been employed in emergency departments with regard to COVID-19. However, in low-prevalence areas, this approach may unnecessarily delay care, given that most molecular tests utilized in hospital-based EDs require extended turnaround times. As ED volumes continue to rebound toward pre-COVID-19 numbers, further extending length of stay exacerbates ED crowding and boarding—both of which have been associated with poor outcomes.^{4,5}

Specifically, our institution transitioned from symptomatic to universal SARS-CoV-2 screening of ED admissions congruent with a community prevalence that changed from one of the highest in the nation in March 2020 to one of the lowest 7 months later. We examined the

Editor's Capsule Summary*What is already known on this topic*

COVID-19 surges have overwhelmed emergency departments at different times during the pandemic, but it is unclear how universal testing impacted patient throughput once it was available.

What question this study addressed

This study looked at the influence of universal testing in one academic ED during differing levels of community prevalence throughout a 6-month period in 2020.

What this study adds to our knowledge

Even with greater testing capability, COVID testing of all ED hospital admissions led to patient throughput delays.

How this is relevant to clinical practice

Balancing larger public health needs with the judicious ordering of tests is necessary to meet the needs of the patient population. Universal COVID testing can delay care with variable yield based on community prevalence at the time.

association between ED-based SARS-CoV-2 screening approaches and ED length of stay.

METHODS**Study Design and Sample Acquisition**

This was an observational interrupted time series of all ED patients seen in a tertiary care health system composed of an academic, community, and freestanding ED with a combined total annual visit volume exceeding 190,000 patients. Functionally, patients could transfer between health care system hospital sites based on inpatient bed availability. Processes for admission were the same across all sites, with the only exception being that patients admitted from the freestanding ED were transferred to one of the other 2 sites on bed availability. Of note, these EDs do not have observation units, and patients in observation are managed by inpatient teams. Given this is a billing distinction without effect on bed assignment, observation or inpatient status was not subanalyzed. We constructed a data set inclusive of all ED timestamps, diagnoses, and SARS-CoV-2 tests from the institutional data warehouse between March 15, 2020, and September 30, 2020. Given testing limitations, from March 15, 2020, to April 24, 2020, only patients under investigation with lower respiratory tract infection symptoms, fever, or clinical suspicion for COVID-19 were tested. On April 24,

testing was expanded from symptomatic patients to all ED admissions. Although there was greater overall test availability, rapid molecular tests were still limited and preferentially used for ED specimens.

SARS-CoV-2 Test Characteristics

RT-PCR testing was performed locally using either an emergency use authorized variation of the Centers for Disease Control and Prevention (CDC) protocol or GeneXpert Xpress (Cepheid). Internal validation data support the comparability of these assays, and a real-life application of these specific assays has been published.^{6,7} Preuniversal testing patients under investigation were admitted to an isolation floor, swabbed for SARS-CoV-2, and appropriately reassigned based on results. After universal testing was implemented, GeneXpert Xpress tests were prioritized for the ED, and other testing platforms were used only if Xpress was not available. Samples were not subject to batch loading. Xpress tests were run locally. [Appendix E1](http://www.annemergmed.com) (available at <http://www.annemergmed.com>) shows average turnaround time by site.

Analyses and Outcomes

The primary analysis examined the relationship between ED testing strategy (symptomatic versus universal) and ED length of stay. The primary outcome was ED length of stay stratified between admitted and discharged patients. Consistent with national metrics, ED length of stay was defined as the time in minutes between ED arrival and ED departure.⁸ Boarding length of stay was defined as the time in minutes from ED admit order to ED departure. We constructed autoregressive integrated moving average regression models (ARIMA) adjusting for ED census, ICU admissions, COVID-19 inpatient count, non-COVID-19 inpatient count, net hospital admissions, and week of testing.⁹ ED census was used as a marker of ED crowding.^{10,11} Hospital active capacity (as opposed to total overall beds) is dependent on staffing resources and can change unpredictably. The daily net hospital admissions were calculated as discharges subtracted from admissions as a proxy for daily changes in hospital capacity, which has been adapted from the Scottish Government, who used this metric to measure dynamic capacity of COVID-19 patients throughout the pandemic.¹² Of note, the 3 EDs were pooled because several operational processes, such as load balancing arrivals between EDs, cross campus ED transfers, and cross campus hospitalization, make length of stay a reflection of the total system and not a site-specific phenomenon.¹³ However, site-specific analysis is available in [Appendix E1](#). Ten of 200 (6.5%) data were imputed using Kalman filtering, as justified in prior literature for COVID-19 and ARIMA modeling.^{14,15}

The secondary analysis focused on diagnostic yield of ED screening for SARS-CoV-2. The diagnostic yield was measured as the proportion of ED SARS-CoV-2 tests returning a positive result. For this analysis, we report descriptive statistics of the diagnostic yield as well as the number needed to test at the weekly level. Furthermore, to provide context, we concurrently report the community prevalence of COVID-19 from publicly available information.^{16,17} Data analysis was conducted using R version 3.6.3. This study was approved by the University Institutional Review Board.

RESULTS

Study Characteristics

A total of 70,856 patients were cared for in the EDs during the 7-month study period. There were 11,541 (16.3%) patients in the preuniversal testing period, and of these, 3,910 (33.9%) were admitted and 3,364 (86%) were symptomatic and tested. Of the patients seen after the policy change, 18,311 (30.9%) were admitted, and all were tested (Appendix E1).

Primary Outcome: Policy Change and ED Length of Stay

Given the setting of declining ED visits and rising ED admissions, we found significant effects of the universal testing policy on ED length of stay (adjusting for covariates) for admitted patients (Figure 1).¹⁸ The universal testing policy was associated with a 1.89-hour increase in

ED admitted length of stay (95% confidence interval [CI] 1.39 to 2.38) and represents a 24% increase in admission length of stay (full model, Appendix E1). Similarly, ED discharge length of stay increased by 0.19 hours (95% CI 0.09 to 0.3) after the policy change. Finally, ED boarding length of stay increased by 1.58 hours (95% CI 1.15 to 2.01).

Secondary Outcome: Number Needed to Test and Community Positivity Rate

With regard to the secondary outcome, boarding length of stay increased by 1.18 hours (95% CI 0.37 to 2.0). Finally, given the increase in ED length of stay with universal testing, we calculated the number needed to test to obtain a single positive test among ED admissions. The lowest number needed to test was 2.5 patients the week beginning April 1, 2020, when the highest state positivity rate was 39.7%, and highest number needed to test exceeded 170 patients the week beginning Sept 1, 2020, concurrent with the lowest state positivity rate (0.5%) (Figure 2).

LIMITATIONS

There are several limitations to this study. First, generalizability may be limited as a single institution; however, the conceptual framework of analyzing length of stay as a function of testing strategy can be done elsewhere to inform policy decisions. Furthermore, the benefit of this universal testing policy is dependent on the COVID-19 burden in the region, so our results must be taken in the context of individual regional COVID-19 trends. Given the dates of the study, vaccines were not yet available, and if our hospital relaxed testing for asymptomatic, fully vaccinated individuals, the results may be more muted. To date, despite one of the highest vaccination rates and lowest infection rates in the country, we have not relaxed testing standards. However, we could expect that increased vaccinations are likely to only increase the number needed to test and, in turn, extend these effects on hospital flow. Finally, we did not explore patient-specific outcomes such as left without being seen, mortality, or clinical decompensation within this study.

DISCUSSION

As the COVID-19 pandemic evolves across the United States with heterogeneous community prevalence and variable access to testing resources in the ED, hospitals will increasingly face the need to make operational decisions balancing COVID-19 mitigation efforts with operational pressures. We found that the common operational change to universal screening was associated with a 24% increase in ED length of stay for admitted patients and that this delay

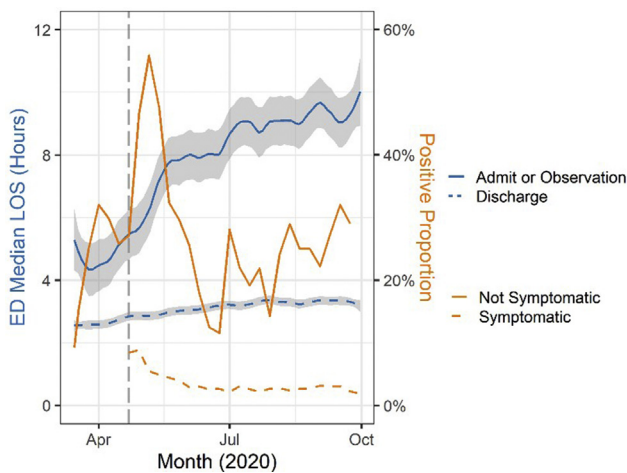


Figure 1. ED median length of stay for admitted and discharged patients as it related to COVID-19 positive proportion in symptomatic and asymptomatic individuals over time. Gray shaded area indicates standard error around a locally weighted scatterplot smoothed line. Vertical dashed line indicates start of universal testing policy on April 24, 2020.

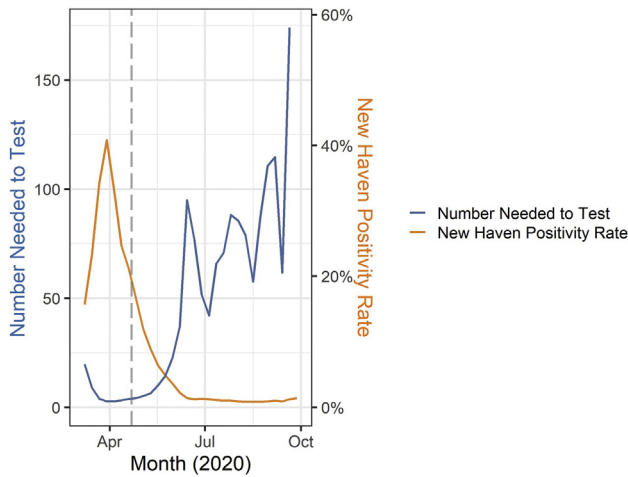


Figure 2. Number needed to test to get a single positive result and New Haven positivity rate over time. Vertical dashed line indicates start of universal testing policy on April 24, 2020.

in care was sustained as community prevalence of COVID-19 declined and health system resources rebounded.

Despite increased testing availability and the ED SARS-CoV-2 rapid test taking as little as 45 minutes laboratory time to complete, overall ED length of stay increased. This is due to inefficiencies related to manual and often fragmented processes around collection, transport, analysis, and bedding systems that have a large cumulative effect. Notably, specimens must be hand-delivered to the laboratory due to infection prevention concerns about using a pneumatic tube system. Of note, the clinical admission decision was not affected by the policy, and the influence of universal testing directly increased boarding times for admitted patients. Qualitatively, clinicians ordered this test early during clinical workups, but a delay in leaving the ED was still observed. Finally, despite allowing high-suspicion COVID-19 patients to be placed on a “COVID-19 Unit” before test results returned, prolonged ED length of stay was still observed.

We confirmed Ford et al’s¹ findings of a low positivity rate among asymptomatic individuals across a broader time frame of 7 months (Appendix E1). There is likely a meaningful infection prevention benefit to universal screening of ED admissions; however, it must be balanced with potential harms of ED crowding and inefficient resource usage during times of low diagnostic yield. When examining the community positivity rate at the COVID-19 peak compared to its nadir against the number of ED patients needed to test to obtain a positive, the onerous effects are exponential when community prevalence is low. With 100 admissions per day across the EDs, community positivity of 0.5% translates to a number needed to test of nearly 170. Although extended ED length of stay may be

warranted at times of high community prevalence and higher risk of within-hospital transmission, it is less clear at times of low prevalence when a positive test might be expected every other day. This number needed to test is likely to continue to rise as community vaccination rates improve and the prevalence rate of COVID-19 decreases alongside adherence to other nonpharmaceutical interventions (eg, social distancing). However, the effects of COVID-19 variants on viral prevalence are not yet fully understood, and loosening masking requirements and increasing occupancy limits may further promote community spread. Furthermore, our number needed to test estimates are likely conservative, given that false positives are more likely at times of low prevalence. A universal testing strategy is needed to identify asymptomatic individuals and can be possible without creating delays by exploring alternative policies related to bedding asymptomatic patients pending SARS-CoV-2 results or less-sensitive screening tests with confirmatory molecular tests, which has been successful at some institutions.¹⁹ Unfortunately, the rapid testing approach with reflex to PCR was not commercially available until late 2020, given initial supply was bought by the federal government.²⁰ Additionally, early CDC guidance was to not use pneumatic tube systems for SARS-CoV-2 swab transport, despite such systems being used with other viral samples to significantly decrease turnaround times associated with sample movement from patient to the laboratory.^{21,22} We recognize that simple symptom-based strategies may be too simplistic given the evolution of the pandemic with new variants, what we know about asymptomatic transmission, and widespread availability of new vaccines. So, symptom-based strategies might be explored for populations in which infection prevention strategies can be preserved without hindering length of stay, such as symptom-based testing for fully vaccinated individuals.

In conclusion, although universal COVID-19 testing of ED admissions may support mitigation and containment efforts, the clinical cost of testing all ED admissions, particularly amid low community prevalence, is notable. In our system, universal COVID-19 testing was associated with a nearly 3-hour increase in ED length of stay for all admitted patients alongside the detection of only 1 positive case every other day. Furthermore, as vaccination reduces community prevalence, innovative admission and infection prevention practices that can facilitate patient admission prior to SARS-CoV-2 testing results may offer a more practical solution to reducing patient exposure to the known harms and risks of ED crowding and boarding. Future research needs to include cost-benefit/effectiveness to better understand how to balance safety and patient

experience and to consider a number needed to test or community prevalence threshold for initiating/discontinuing asymptomatic testing.

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