Table 1. Results of Antibody Positivity by Department, Presence or Absence of Symptoms and Reported Negative PCR Test

			Symptomatic		Asymptomatic		Symptomatic Negative PCR	
Department	Total	Positive IgG (%)	Total	Positive IgG (%)	Total	Positive IgG (%)	Total	Positive IgG (%)
Ambulatory care	232	51(22)	143	38(27)	89	13(15)	143	16(11)
Behavioral health/Psychiatry	104	27(26)	65	22(34)	39	5(13)	65	16(25)
Critical care/ICU	418	47(11)	201	36(18)	217	11(5)	201	13(6)
Emergency department	309	80(26)	177	65(37)	132	15	177	32(18)
Medical-surgical unit/Inpatient	219	34(16)	122	30(25)	97	4(4)	122	6(5)
Not applicable	26	10(38)	12	6(50)	14	4(29)	12	3(25)
OB/Gyn	81	15(19)	38	12(32)	43	3(7)	38	3(8)
Other healthcare worker	296	61(21)	137	41(30)	159	20(13)	137	16(12)
Trauma service	15	2(13)	12	2(17)	3	0(0)	12	1(8)
Total	1700	327(19)	907	252(28)	793	75(9)	907	106 (12)

Note. PCR, polymerase chain reaction; ICU, intensive care unit; OB/Gyn, obstetrics and gynecology.

investigation is necessary to understand the reasons for this finding. The low rate of antibody development in critical care areas could be explained by the controlled environment and lower volume compared to other areas. Finally, 12% of hospital staff who developed antibodies in spite of a negative PCR test could be explained by false-negative PCR testing, infection after the PCR test, or inaccurate self-report.

It is unclear whether the presence of IgG antibodies confers long-term immunity. Emphasis is being placed on antibody testing for reopening the economy and return-to-work policies.[7,8] However, only 1 in 5 healthcare workers developed antibodies during the peak of the pandemic at our hospital; thus, the utility of antibody testing to guide staffing considerations is limited. Ultimately, development of prophylactic treatments and therapies for COVID-19 is needed to ensure the safety of our healthcare workers pending the arrival of a vaccine.

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Nudging empiric prescribing: Embedding antimicrobial stewardship program order sets into a general medicine admission order set

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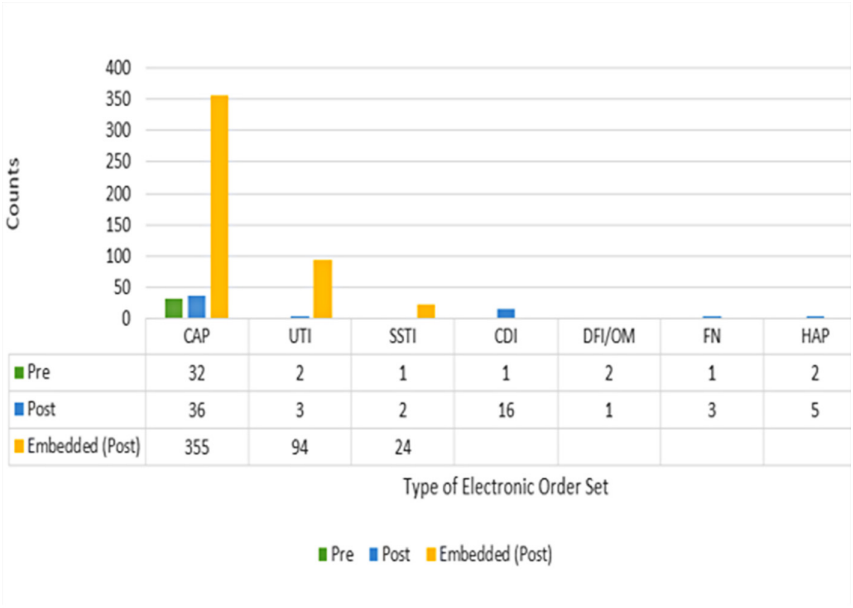
The use of facility-specific clinical practice guidelines and clinical decision-making tools are recommended as part of an antimicrobial stewardship program (ASP).[1] Clinical decision-making tools are diverse and can include complex computer algorithms, checklists, and electronic order sets.[2] They have been shown to improve adherence to evidence-based antibiotic prescribing, reducing unnecessary antibiotic use[2-5] and improving appropriateness of



Legend:
CAP: community-acquired pneumonia; UTI: urinary tract infection; SSTI: cellulitis;
CDI: *Clostridioides difficile* infection; DFI/OM: diabetic foot infection/osteomyelitis;
FN: febrile neutropenia; HAP: hospital-acquired pneumonia

Fig. 1. Electronic order set usage pre- and post-intervention.

therapy.[3] Additionally, the use of order sets has been associated with reduced length of hospital stay.[4] An environmental scan of our institution's numerous electronic order sets (EOSs) showed very poor use by clinicians of <10 times annually.

The primary objective of this study was to evaluate the impact of simplifying certain ASP EOSs with physician feedback and embedding these revised EOSs into the General Medicine Admission EOS, which is frequently used by our institution's internists.

Methods

This study was conducted at a 400-bed community hospital in Toronto, Canada. An ASP was established at our institution in 2011, with a multimodal approach including prospective audit and feedback, development of guidelines and order sets, microbiology laboratory report optimization, and education. The study team consisted of a lead ASP physician and 2 full-time equivalent ASP-trained pharmacists during the study period. This study, including both pre- and postintervention periods, was conducted from January 1, 2016, to June 30, 2018.

The existing standalone ASP electronic order sets for community-acquired pneumonia (CAP), urinary tract infection (UTI), and skin and soft-tissue infection (SSTI) were reviewed prior to embedding by the ASP pharmacist, the ASP physician, a clinical informatics specialist, and the chief medical information officer, who is a practicing general internist. To reduce duplication with the general medicine admission EOS, only the antibiotic section was included from the standalone ASP EOS and other sections were excluded (ie, orders for cultures, imaging, and laboratory markers). The antibiotic section was optimized to align with local guidelines, then (1) antibiotic choices were rearranged to prioritize oral options, (2) minimum duration of therapy was used as the preset duration, and (3) high-risk antibiotics associated with *Clostridioides difficile* infection (CDI) were removed. For instance, the 7-day option for CAP, 14-day option for complicated pyelonephritis, clindamycin in the SSTI EOS and ciprofloxacin for cystitis were removed (later replaced by amoxicillin-clavulanate). General internists were informed of the embedded ASP EOS prior to its implementation on March 30, 2017.

We used a before-and-after study design; the preintervention period was January 1, 2016, to March 29, 2017, and the postintervention period was March 30, 2017, to June 30, 2018. The primary outcome was change in use of embedded ASP EOSs compared to the corresponding standalone ASP EOS preintervention using percentages. The use data for standalone ASP EOSs for the 3 conditions were collected, in addition to data for nonembedded ASP EOS (eg, CDI, hospital-acquired pneumonia) which were used as controls. This study was approved by the research ethics board at Unity Health Toronto on July 16, 2019.

Results

We observed a large increase in the use of embedded EOSs compared to the corresponding standalone EOS. The standalone control EOS use remained similar before and after the intervention, except for a 16-fold increase in CDI EOS use. An 11-fold (355 vs 32) increase in CAP EOS use occurred, as well as a 47-fold (94 vs 2) increase in UTI EOS use and a 24-fold (24 vs 1) increase in SSTI EOS use (Fig. 1).

Discussion

Although 'nudging'[6] has been previously applied to ASP principles, literature on successful and sustainable nudging interventions remains scarce. We embedded ASP EOS into a more frequently used EOS, which led to a large increase in EOS use and a decrease in fluoroquinolone use. We hypothesized that the stepwise simplification and prioritization of ASP-recommended antibiotic options with the embedded ASP EOS changed the prescribing habits of our general internists to some extent. Additionally, the inclusion of some clinician feedback in designing the embedded EOS likely contributed to ease of appropriate empiric antibiotic prescribing using these.

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However, our study has several limitations. Given its retrospective before-and-after study design, several confounding factors likely contributed to changes in EOS use and antibiotic use over time. We tried to account for these by tracking changes in the corresponding standalone ASP EOS as well as nonembedded ASP EOS. We found minimal change in standalone ASP EOS use, which supported our hypothesis that embedding EOS increased its uptake. Other limitations of our study include not being able to assess the percentage use of embedded ASP EOSs in relation to the number of patients diagnosed with CAP, UTI, and cellulitis as well as not undertaking an audit on appropriateness of diagnosis and antibiotic selection for patients with embedded ASP EOS orders. There is a no specific discharge code for CAP nor codes for the UTI and cellulitis cases of interest, and we were unable to address these study limitations. Future studies on a similar intervention should consider the inclusion of these outcomes.

To fully optimize ASPs and to achieve a long-term sustainable impact on patient outcomes, information technology must be employed. The approach of embedding ASP EOSs into a more frequently used EOS has the potential to improve antibiotic prescribing using existing resources with minimal cost.

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Improved empiric antibiotic prescribing for acute cystitis with use of local urinary antibiogram and clinical decision support system

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Acute cystitis accounts for a significant proportion of ambulatory care visits every year in the United States. Empiric antibiotic selection varies widely among providers, even those working within the same health system. Current Infectious Diseases Society of America guidelines emphasize the use of local susceptibility data for determining initial antimicrobial therapy.[1] Previous findings suggest that site-specific antibiograms (ie, urine, blood, etc) may result in improved empirical therapy.[2] We collated a local urinary antibiogram to promote recommended empiric antibiotic therapies for the treatment of cystitis. A clinical decision support system (CDSS) and order set were nested within the electronic medical record to encourage guideline-concordant prescribing. Using a quasi-experimental time series analysis, we assessed the impact of this intervention on β-lactam and fluoroquinolone prescribing rates for outpatient acute cystitis.

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Methods

We performed a quasi-experimental, interrupted time series analysis to evaluate the effect of a local antibiogram-guided order set on antibiotic class selection for the treatment of outpatient urinary tract infections. Patients were treated in the Durham Veterans' Affairs Health Care System (DVAHCS) from April 2016 through October 2019. Encounters were identified retrospectively using the following criteria: outpatient visits with appropriate *International Classification of Disease, Ninth Revision* (ICD-9) or ICD-10 documentation for acute cystitis, a collected urine culture, and an antibiotic prescription filled within 24 hours of visit through the DVAHCS pharmacy. Prescribing data were associated with the appropriate encounter. In total, 5,517 prescriptions were analyzed.

The study consisted of a preintervention phase (April 2016 through July 2018), an intervention period (August 2018), and a postintervention phase (September 2018 through October 2019). During the preintervention phase, a local urinary antibiogram, stratified by admission status, was created from all urine cultures across DVAHCS to inform empiric antibiotic choices. *Escherichia coli* was the most commonly isolated pathogen (n = 531 isolates, 41% of all outpatient urine cultures), with the following susceptibility profile: cefazolin 91%, ciprofloxacin 71%, and trimethoprim-

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