PROGRAM PROFILE

Incorporation of Clinical Staff Pharmacists in the Emergency Department Sepsis Response at a Single Institution

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Background: Sepsis is a medical emergency in which timely, appropriate antibiotic therapy improves patient outcomes. While the addition of emergency department (ED) pharmacists has been found to optimize timely antimicrobial therapy in patients with sepsis, the role of clinical staff pharmacists (CSPs) in the sepsis response has not been studied.
Methods: We implemented a process of incorporating CSPs in sepsis antimicrobial management in the ED. To evaluate the accuracy of antimicrobial selection by CSPs with a sepsis antibiotic algorithm and vancomycin dosing nomogram, a retrospective cohort study was conducted on patients with sepsis presenting to the ED from December 3, 2018 through March 31, 2020.
Results: Of the 157 sepsis alerts included in this study, CSPs correctly used the antibiotic selection algorithm in 154 (98%) instances and the vancomycin dosing nomogram in 147 (94%) instances.
Conclusions: A process incorporating CSPs into the ED sepsis response resulted in high rates of accuracy for antibiotic selection and vancomycin dosing.

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Fed Pract. 2022;39(4). Published online April 13. doi:10.12788/fp.0246

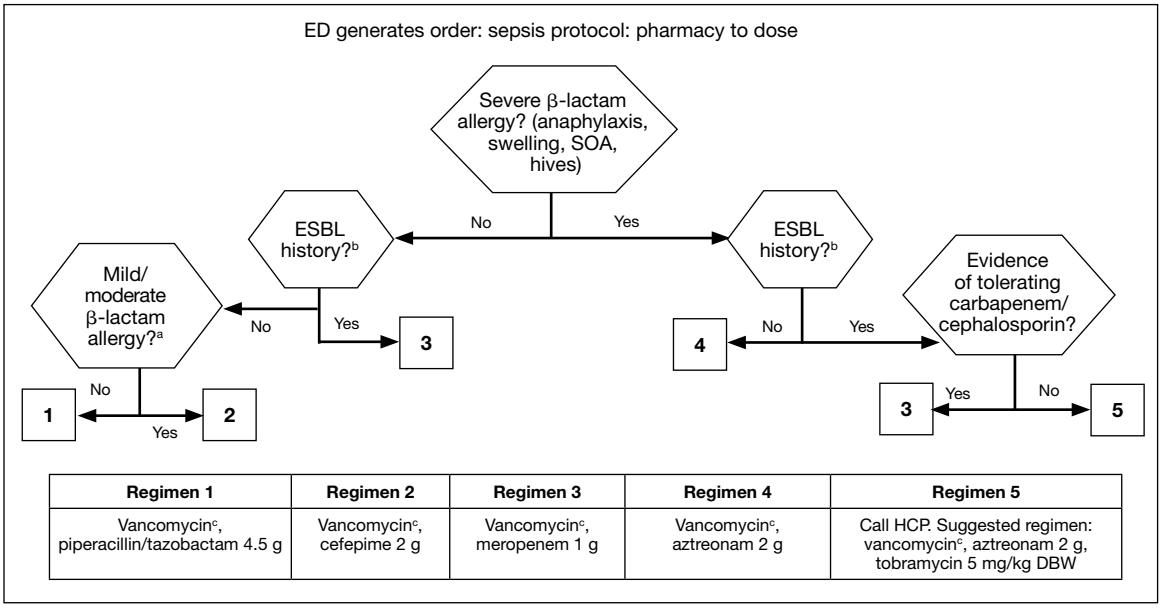
Sepsis is life-threatening organ dysfunction caused by dysregulated host response to an infection that can progress to shock. Sepsis is a major cause of death in the United States, with > 1 million people developing sepsis and > 250,000 people dying from sepsis annually.[1] The Surviving Sepsis Campaign (SSC) guidelines recommend treating sepsis as an emergency with timely administration of fluids and antibiotics, as administering antibiotics within the first hour has been found to reduce mortality and disease progression. In addition, empiric antibiotic regimens should be chosen to target the most probable pathogens and dosing should be optimized. To achieve this, the SSC guidelines recommend that hospitals develop quality improvement (QI) programs developed by a multidisciplinary group to improve sepsis recognition and response using a protocolized approach.[2]

There are several studies describing efforts to improve the sepsis response at facilities, some of which have evaluated the addition of a pharmacist into the sepsis response, particularly in the emergency department (ED). Some studies found improved selection and decreased time to antibiotic administration with the addition of an ED pharmacist.[3-7] Despite this, ED pharmacists are not present in all hospitals, with a 2015 national survey reporting the presence of an ED pharmacist in 68.7% of respondents at 187 facilities. Even facilities with ED pharmacists often have limited hours of coverage, with at least 8 hours of coverage in 49.4% of facilities with an ED pharmacist and no weekend coverage at 34.8% of these facilities.[8]

While many hospitals do not routinely employ ED pharmacists, most hospitals have clinical staff pharmacists (CSPs), and many inpatient hospital pharmacies are staffed with CSPs 24 hours per day, 7 days per week. A 2017 survey conducted by the American Society of Health-System Pharmacists (ASHP) found 43% of all hospital pharmacy departments were staffed by a CSP around the clock, with the prevalence increasing to 56.7 to 100% in hospitals with > 100 beds.[9] As a result, CSPs may be a useful resource to assist with the management of patients with sepsis in hospitals without an ED pharmacist.

At the Lexington Veterans Affairs Health Care System (LVAHCS) in Kentucky, the inpatient pharmacy department is staffed with a CSP 24/7 but does not have an ED pharmacist. Therefore, when an interdisciplinary group developed an ED sepsis bundle as part of a QI initiative on sepsis recognition and response, the group took a unique approach of incorporating CSPs into the response team to assist with antimicrobial selection and dosing. An antibiotic selection algorithm and vancomycin dosing nomogram were developed to aid CSPs to select and dose antibiotics (Figure, Table 1). We

FIGURE Antibiotic Selection Algorithm



Abbreviations: DBW, dosing body weight; ESBL, extended spectrum β-lactamases; SOA, shortness of air.
[a]Itching, N/V, minor rash (not hives). If patient has tolerated cephalosporins, use regimen 2; use regimen 4 with any concerns.
[b]Posting (top right) → Infection Control alert in Computerized Patient Record System describes any patient ESBL history.
[c]Use vancomycin dosing nomogram.

describe the implementation of this process and evaluate CSPs' accuracy in antimicrobial selection and vancomycin dosing.

METHODS

Lexington VAHCS is a 94-bed hospital that provides services to veterans, including an ED, inpatient medical services, surgical services, acute mental health, progressive care, and intensive care units. This facility has 1 antimicrobial stewardship clinical pharmacy specialist, 2 critical care clinical pharmacy specialists, and 16 full-time CSPs with 24-hour CSP coverage. The annual ED volume at the time of this study was approximately 21,000 patients.

Consistent with the SSC guideline recommendation to develop multidisciplinary QI initiatives on sepsis recognition and response, an Interdisciplinary Sepsis Committee (ISC) was created in 2018 comprised of ED, pulmonary, critical care, and infectious diseases licensed independent practitioners (LIPs), ED nurses, and pharmacists. The ISC developed a comprehensive set of sepsis tools that included a sepsis screening tool used by ED triage nurses to provide early detection of sepsis and an updated electronic order set to decrease time to appropriate treatment. This order set included automatic orders for blood cultures and serum lactate, the initiation of IV crystalloids, as well as a Sepsis Alert order placed by ED LIPs which alerted CSPs to a patient with sepsis in the ED.

TABLE 1 Vancomycin Dosing Nomogram

Weight, kg	40-49	50-59	60-69	70-79	≥ 80
Loading dose, mg (25 mg/kg)	1000	1250	1500	1750	2000

To ensure a protocol-based approach by the CSPs responding to the sepsis alert, an antibiotic algorithm and vancomycin dosing nomogram were developed by the ISC based on current guideline recommendations and the local antibiogram. These were subsequently approved by ED practitioners, the pharmacy and therapeutics committee, and the critical care committee. The antibiotic algorithm prompts CSPs to perform a chart review to identify β-lactam allergies, evaluate the severity of the allergy and which agents the patient has tolerated in the past, as well as determine whether the patient has a history of extended spectrum β-lactamase (ESBL)–producing organisms from previous cultures. A decision tree then guides CSPs toward the selection of 1 of 5 empiric antibiotic

TABLE 2 Patient Demographics

Characteristics	Total (n = 157)
Sex, No. (%)	
Male	156 (98)
Female	1 (2)
Age, median, y (IQR)	72 (65.3–72.0)
Race, No. (%)	
White	139 (88.5)
Black or African American	14 (8.9)
Native Hawaiian or other Pacific Islander	1 (0.6)
Unknown	3 (1.9)
Weight, median, kg (IQR)	88 (73.5–102.0)
Body mass index ≥ 30, No. (%)	97 (62)
Antibiotic regimen ordered, No. (%)	
Vancomycin + piperacillin/tazobactam	120 (77)
Vancomycin + cefepime	13 (8)
Vancomycin + meropenem	8 (5)
Vancomycin + aztreonam	16 (10)
Call practitioner for regimen	0 (0)

regimens to cover all likely pathogens. The medication orders are then entered by the CSPs as a telephone order from the ED LIP per protocol. Unless patients had a true vancomycin allergy, all patients received vancomycin as the empiric gram-positive backbone of the regimen. The vancomycin dosing nomogram was created to ensure an appropriate and consistent vancomycin weight-based loading dose was administered.

Prior to implementation, the antimicrobial stewardship pharmacist educated CSPs on the use of these tools, including simulated orders for mock sepsis alerts to ensure competency. A copy of the algorithm and nomogram were emailed to all CSPs and posted in a prominent location in the pharmacy.

As part of continuous performance improvement efforts of the ISC, a retrospective cohort study was conducted through chart review on patients at the Lexington VAHCS with an order for a sepsis alert in the ED from December 3, 2018 to May 31, 2020 to assess the accuracy of the CSPs' antibiotic selection and dosing. Patients were excluded if they had a vancomycin allergy or if the ED practitioner ordered antibiotics prior to the CSPs placing orders. Patients could be included more than once in the study if they had sepsis alerts placed on different dates.

The primary outcomes were CSPs' accuracy in antimicrobial selection with the antibiotic selection algorithm and vancomycin dosing nomogram. The antibiotic selection was deemed accurate if the appropriate antibiotic regimen was selected based on allergy status and previous cultures as directed in the algorithm. The vancomycin dose was considered accurate if the dose chosen was appropriate based on the patient's weight at the time of ED presentation. Secondary outcomes included time to administration of antibiotics from ED presentation as well as time to antibiotics administration from sepsis alert initiation. Time of administration was considered the time the antibiotics were scanned in the bar code medication administration (BCMA) system.

Descriptive statistics were used with data presented as percentages for nominal data and median as IQR for continuous data. In accordance with our facility's project assessment process, this project was determined not to constitute human subjects research; therefore, this QI project did not require review by the institutional review board.

RESULTS

Between December 3, 2018 and May 31, 2020, 160 sepsis alerts were ordered by ED practitioners. Of the 160 patients, 157 were included in the final data analysis. Two patients were excluded due to vancomycin allergy, and 1 patient because the physician ordered antibiotics prior to pharmacist order entry. The population was largely composed of male patients (98%) with a median age of 72 years (Table 2).

Of 157 sepsis alerts, the antibiotic selection algorithm was used appropriately in 154 (98%) instances (Table 3). Chart reviews were performed in instances of antimicrobial selection different from the algorithm. Of the 3 patients who received antibiotics not consistent with the algorithm, 1 patient without a history of ESBL-producing organisms in their culture history received meropenem instead of piperacillin/tazobactam. Another patient without a penicillin allergy received cefepime (plus metronidazole ordered separately from the ED practitioner) instead of piperacillin/tazobactam, and the third patient received piperacillin/tazobactam instead of meropenem despite a culture history of ESBL-producing organisms. Vancomycin dose was appropriate

according to the weight-based nomogram in 147 cases (94%). The median time to administration of first dose antibiotics was 39 minutes after the sepsis alert order was placed and 96 minutes after initial ED presentation.

DISCUSSION

This study found extremely high rates of accuracy among CSPs for both the antibiotic selection algorithm (98%) and the vancomycin dosing nomogram (94%). Moreover, analysis of the 3 patients who received antibiotics that were inconsistent with the algorithm revealed that 2 of these patients arguably still received adequate empiric coverage, increasing the percentage of patients receiving appropriate empiric antibiotics to 99.4%. Similarly, chart review of 10 patients who received vancomycin doses that deviated from the nomogram revealed that in at least 3 cases, patients were likely given correct vancomycin doses based on the patient's last known weight. However, when actual current weights were recorded soon after admission, the updated weights rendered the initial vancomycin loading dose incorrect when this analysis was performed. Thus, the adherence to the vancomycin dosing nomogram is higher than it appears.

Median time to antibiotic administration from the sepsis alert was 39 minutes —well within SSC recommendations (60 minutes).[2] Previous internal analyses at Lexington VAHCS demonstrated the mean time to first dose of antibiotics in the ED has been 39 minutes since about 2015. Thus, this initiative did not necessarily make this process quicker; however it did remove 1 responsibility from LIPs so that they could focus their efforts on other components of sepsis management.

Further studies are needed to evaluate the effects of this initiative on other aspects of the sepsis bundle, such as volume of fluid administered and appropriateness of laboratory tests. It was noted that while the time to first-dose antibiotic administration was < 1 hour from order placement, the median time from ED presentation to antibiotic administration was 96 minutes. This suggests that another focus of the sepsis workgroup should be on speeding recognition of sepsis, triggering the sepsis alert even sooner, and evaluating the feasibility of storing first doses of antibiotics in the automatic dispensing cabinets in the ED.

TABLE 3 Antibiotic Administration Outcomes

Outcomes	Totals
Clinical staff pharmacist accuracy, No. (%)	
Antimicrobial selection with antibiotic algorithm	154 (98)
Vancomycin dosing nomogram	147 (94)
Time to antibiotic initiation, median (IQR), min	
From emergency department presentation	96 (66-128)
From sepsis alert	39 (24-50)

Limitations

This descriptive study evaluating CSPs' ability to accurately use the newly developed antibiotic selection algorithm and vancomycin dosing nomogram had no control group for outcome comparison. This study was not designed to evaluate clinical outcomes, such as mortality, so the impact of these interventions need to be further studied. In addition, as veterans receive most of their care at our facility, with their allergies and previous cultures readily available in our electronic health record, this process may not be feasible at other facilities where patients' care is divided among multiple facilities/systems.

Moreover, as the veteran population studied was predominately male patients aged > 60 years, implementation at other hospitals may require the dosing nomograms and treatment algorithms to be adapted for a broader population, such as children and pregnant women. In particular, the ISC chose to implement an algorithm that did not differentiate between suspected source of infections and included anti-Pseudomonal coverage in all regimens based on the most encountered diseases among our veteran population and our local antibiogram; implementation at other facilities would require a thoughtful evaluation of the most appropriate site-specific regimen. Finally, many of the CSPs at our facility are board certified and/or residency trained, so more staff development may be required prior to implementation at other facilities, depending on the experience and comfort level of the CSPs.

Strengths

This study describes an example of a protocolized and multidisciplinary approach to improve sepsis recognition and standardize

the response, consistent with SSC guideline recommendations. To the best of our knowledge, this is the first study to demonstrate the incorporation of CSPs into the interdisciplinary sepsis response. This allows for CSPs to practice at the top of their license and contributes to their professional development. Although it was not formally assessed, anecdotally CSPs reported that this process presented a negligible addition to their workload (< 5 minutes was the most reported time requirement), and they expressed satisfaction with their involvement in the sepsis response. Overall, this presents a possible solution to improve the sepsis response in hospitals without a dedicated ED pharmacist.

CONCLUSIONS

This study describes the successful incorporation of CSPs into the sepsis response in the ED. As CSPs are more likely than ED pharmacists to be present at a facility, they are arguably an underused resource whose clinical skills can be used to optimize the treatment of patients with sepsis.

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The authors report no actual or potential conflicts of interest or outside sources of funding with regard to this article.

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Ethics and consent

This project was determined not to constitute human subjects research; therefore, this quality improvement project did not require review by the institutional review board.

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