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Appropriate Use of Vancomycin in a Pediatric Emergency Department Through the Use of a Standardized Electronic Guideline[1]

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Objectives a. Compare utilization of vancomycin in the ED prior to and after implementation of standardized treatment guideline and order template (STGOT); b. assess the appropriate use as initial therapy based on indication versus admitting diagnosis.
Methods: Chart audits on all patients who received vancomycin and were admitted. Overall utilization and appropriateness of starting therapy were compared pre-and post-STGOT implementation.
Results: Overall utilization of vancomycin was 4% pre-STGOT compared to 3% post-STGOT; 98% of patients pre-STGOT compared to 99% post-STGOT received vancomycin appropriately.
Conclusion: There was no difference in vancomycin utilization and appropriateness of initiating therapy after STGOT implementation.

THERE IS A global trend of increasing antimicrobial resistance which has been driven primarily by overuse of antibiotics. The rapid emergence of methicillin resistant staphylococcus aureus (MRSA) infections has resulted in an increase in vancomycin utilization in hospitals. Inappropriate vancomycin use has been reported to be major risk factor for developing vancomycin-resistant enterococcus (VRE), a significant pathogen causing morbidity and mortality in hospitalized patients. The Centers for Disease Control (CDC) has recommended the avoidance of the routine use of vancomycin to slow the emergence of antimicrobial resistance among hospitalized patients which they declared "a public health crisis" almost 10 years ago (CDC, 1995) and expressed concern about this issue even in the 1980s when MRSA infections were first encountered in healthcare settings (Frieden, 2010).

National consensus guidelines and individual studies have been published delineating indications for vancomycin use, primarily targeted at adult populations and the febrile neutropenic patient (Davey, Brown, & Fenelon, 2005; Drori-Zeides, Raveh, & Schlesinger, 2000; Freifeld et al., 2011; Hughes et al, 2002). There are several pediatric studies (Hing, Bek, Lin, & Li, 2004; Hopkins, Sinkowitz-Cochran, Rudin, Keyserling, & Jarvis, 2000; Shah, Sinkowitz-Cochran, Keyserling & Jarvis, 1999) focusing on specific cohorts of patients—oncologic, neurosurgical, neonatal—which delineate utilization patterns and "risk factors" for initiation of vancomycin therapy and/or its continuation. Furthermore, there is one published study (Bolon, Arnold, & Feldman, 2005) which showed that a standardized antibiotic order form intervention did not improve or reduce vancomycin use in pediatric patients.

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There is no published evidence regarding vancomycin's appropriate use in the pediatric emergency department (ED) for patients presenting with various symptoms and medical conditions. The patient population in a pediatric ED is more global with a wider spectrum of symptom complexes and presumed diagnoses that cannot be confirmed immediately. Initiating therapy in an ED presents challenges as conclusive diagnoses and/or culture results are usually not known. In this setting, overutilization of vancomycin may occur because of these special circumstances, or perhaps, lead to ongoing therapy during hospitalization. In our children's hospital, there was a perception by healthcare workers that there was overutilization of vancomycin in our ED.

Due to the process by which medications are ordered and stored in our emergency department, we do not have any current data on the utilization of vancomycin, unlike the resources we have to monitor utilization on our inpatients. As part of our global efforts in implementing an antimicrobial stewardship process with vancomycin on a hospital-wide basis, we felt it was imperative to look at the appropriateness of its utilization in our emergency department on patients who were admitted to our hospital. Thus, the objectives of our study were; *a*) to compare overall utilization of vancomycin in the ED prior to and after implementation of a standardized treatment guideline and order template (STGOT) and *b*) to assess the appropriate use as initial therapy based on indication versus admitting diagnosis.

Methods

A retrospective chart review was completed on all patients < 21 years of age who received IV vancomycin in the pediatric emergency department and were admitted to the hospital from January 2009 through May 2012. Data were queried through two electronic reporting systems. An evidence- and consensus-based STGOT was developed as part of a hospital-wide vancomycin utilization improvement project. This STGOT was converted to an electronic format for the ED electronic health record and implemented on November 3, 2009. The indications are listed in Table 1. Pre-implementation analysis was completed using data from ED encounters occurring January 2009 through November 2009. These data were compared to post-STGOT data from January 2010 through May 2012.

Individual chart audits were performed from January 2010 through May 2012 to look at the indications for vancomycin chosen by the prescriber whether the patient was admitted and the admitting diagnosis. We used both the admitting diagnosis and the documented findings in the ED chart to determine the appropriateness of the ordered vancomycin as this methodology reflects real-time ED practice.

Utilization rates were calculated: total number of patients receiving IV vancomycin/total number of patients admitted from the pediatric ED during the time period. Appropriateness of indication was assessed by looking at the chosen indication, review of the ED chart, and the admitting diagnosis and determined yes or no. This study was approved by the institutional review board at our medical center as well as our hospital.

Table 1 Indications for vancomycin treatment.

1	Suspected gram-positive infection in patients who are seriously ill
2	Serious allergy to beta-lactam antibiotics
3	Prosthetic device implantation requiring major sx (Excludes *ventriculoperitoneal* (VP) shunt and catheter placement)
4	Endocarditis prophylaxis
5	Surgical prophylaxis (2 dose maximum recommended for empiric therapy)
6	Suspected neonatal sepsis or documented necrotizing enterocolitis (NEC)
7	Suspected cerebrospinal (CSF) infection or bacterial meningitis due to Streptococcus pneumonia
8	Febrile/Neutropenic cancer patient that meet selected criteria…
8a	Other agents ineffective or sensitive only to vancomycin
8b	Clinically suspected serious catheter-related infections (e.g. bacteremia, cellulitis)
8c	Known colonization with penicillin- and cephalosporin-resistant pneumococci or methicillin-resistant
8d	Positive results of blood cultures for gram + bacteria before susceptibility testing complete
8e	Hypotension or other evidence of cardiovascular impairment
8f	Patient has had intensive chemotherapy that produces substantial mucosal damage
8g	Afebrile neutropenic patients receiving prophylaxis with quinolones before onset of fever
9	Other… (free text) [a]

[a] Abscess, CSF cultures growing gram positive cocci (GPC) in clusters, febrile neonate with neutropenia.

Charts were reviewed independently by two authors to increase validity. The first author reviewed each chart and determined appropriateness. Then, the second author reviewed the chart independent of the first author to validate if the first author's conclusion were accurate. If there were disagreement, then the data were reviewed by both authors together to reach consensus. The first author has worked in a pediatric emergency department for 6 years and has conducted chart audits for 3 years including sedation and transfer chart audits. The second author has worked in a pediatric emergency department for 10 years and serves as the medical director of medication safety at our hospital.

Results

During the pre-STGOT period from January to November 2009, 249/6713 (4%) admitted patients received vancomycin as compared to 462/13371 (3%) of admitted during the post STGOT period from January 2010 to November 2011. There was no statistical difference in utilization rates pre- and post-STGOT.