What are the roles of Carbapenems, in an Institution Specific Epidemiological Antibiogram, in East Trinidad?

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ABSTRACT

Objectives: This document provides an overview of the development of an institution specific epidemiological antibiogram. Emphasis was on last line antibiotics, such as carbapenems.

Methods: Antibiograms, for the year 2013, of various organisms were retrieved from the computerized database of the Microscan© [Siemens Healthcare] at the microbiology laboratory, of the Sangre Grande Hospital in East Trinidad, West Indies. This was divided into blood and urine specimen antibiograms. All wards and hospital clinics were included. A twenty [20] percent [%], cut off was used to determine that a particular antibiotic or antibiotic class could be used for empiric therapy. All organisms were not chosen. Only the most common and clinically relevant were chosen.

Results: Blood: *Escherichia coli*, *Klebsiella pneumonia*, *Proteus mirabilis* : Imipenem, meropenem, ertapenem showed greater than 80% sensitivity, respectively. *Pseudomonas aeruginosa*: ceftazidime, ciprofloxacin, gentamicin, levofloxacin and tazobactam/piperacillin showed 100%, 80%, 80%, 100% and 100% sensitivity, respectively. Urines: *Escherichia coli*, *Klebsiella pneumonia*, *Proteus mirabilis*: Imipenem, meropenem, ertapenem, were greater than 80 % sensitive. *Enterobacter cloacae*: Imipenem, meropenem were 92%, 100% sensitive. *Pseudomonas aeruginosa*: tazobactam-piperacillin and amikacin were both 85% susceptible.. *Acinetobacter baumanii/haemolyticus*: All antibiotics were above the 20 % resistance threshold.

Conclusion: Patient specific antibiograms and unit specific trends [e.g. ICU, surgical wards, and outpatient clinic] can be used as a guide in patients with less severe infections. Carbapenems can still be used empirically, in east Trinidad, for sepsis.

Keywords: Antibiogram, Epidemiological antibiogram, Resistance, Trinidad

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INTRODUCTION

Empiric antibiotic therapy should be based on, among other things [1] surveillance data within the hospital or community, [2] individualization [3] use of unit based therapy [i.e. based on the antibiograms and surveillance data of a particular ward] (1).

This document gives general antimicrobial surveillance trends for urine and blood specimens. It does not provide data on all organisms, but on the most common and most clinically significant pathogens.

Data has shown that resistance rates of 3%-20% have been used to decide that an antibiotic is unsuitable for empiric therapy. This varies by antibiotic and type of infection clinical, in vitro data and mathematical modeling. For this document we will use a threshold of 20% resistance to define an antibiotic as unsuitable for first line therapy (2,3).

It is important to develop guidelines which can be useful for a particular institution or country. Antibiograms in one country may differ from that of another country. Thus guidelines for one country or institution may not be applicable to another. This epidemiological antibiogram, was prepared for a hospital in east, Trinidad.

Stelling and Sosa of The Alliance for the Prudent Use of Antibiotics, have indicated that in preparing epidemiologic antibiograms, that if resistance rates are above the recommended thresholds for common and important organisms, health professionals should be particularly attentive to monitoring for treatment failures and the need to revise formularies and treatment guidelines (3). This document is intended to help other hospitals prepare their own epidemiological antibiograms.

METHODOLOGY

Antibiograms, for the year 2013, of various organisms were retrieved from the computerized database of the Microscan© [Siemens Healthcare] at the microbiology laboratory, of the Sangre Grande County Hospital in East Trinidad, West Indies. This was divided into blood and urine specimen antibiograms. All wards and hospital clinics were included.

A twenty [20] percent [%], cut off was used to determine that a particular antibiotic or antibiotic class could be used for empiric therapy.

All organisms were not chosen. Only the most common and clinically relevant were chosen.

Ethical Approval

Ethical approval was obtained from the Eastern Regional Health Authority's ethics committee.

RESULTS

BLOOD: **Gram Negative Bacteria**: For 2013 1] 38, *Escherichia coli* 2] 15, *Klebsiella pneumoniae* 3] 8, *Proteus mirabilis* and 4] 5, *Pseudomonas aeruginosa* were isolated from all wards and departments.

Escherichia coli: Imipenem, meropenem, ertapenem and amikacin showed 100%, 100%, 95% and 92% sensitivity, respectively. All other antibiotics exceeded the 20% resistance threshold.

Klebsiella pneumonia: Imipenem, meropenem, ertapenem and amikacin showed 100%, 100%, 93% and 100% sensitivity, respectively. All other antibiotics exceeded the 20% resistance threshold. *Proteus mirabilis*: Imipenem, meropenem, ertapenem, amikacin, co-amoxiclav, ceftriaxone, ciprofloxacin, cefepime, cefuroxime, levofloxacin, tazobactam-piperacillin and

trimetoprim-sulfametoxazole showed sensitivities of 88%, 100%, 88%, 100%, 88%, 88%, 88%, 88%, 88%, 88%, 88% and 88% respectively. *Pseudomonas aeruginosa*: Amikacin, ceftazidime, ciprofloxacin, gentamicin, levofloxacin and tazobactam/piperacillin showed 100%, 100%, 80%, 80%, 100% and 100% sensitivity, respectively. The carbapenems were actually greater than 20% resistant, for this organism.

Gram Positive Bacteria: For 2013 1] 40, *S. aureus* 2] 6, Streptococcus Group B 3] 11, *Enterococcus* spp. and 4] 1, *Listeria monocytogenes* were isolated from all blood culture from all wards and departments. *S. aureus*: Trimetoprim/sulfametoxazole, gentamicin and tetracycline were 85%, 82% and 88% sensitive respectively. Linezolid, Synercid and vancomycin were 90%, 100% and approximately greater than 80% sensitive respectively. Streptococcus Group B: Ampicillin, penicillin and clindamycin were 83%, 83% and 100% sensitive, respectively. *Listeria monocytogenes*: Ampicillin and penicillin were both 100% sensitive. *Enterococcus* spp.: All *Enterococcus* spp. were greater than 80% sensitive to ampicillin, vancomycin and linezolid.

URINES: **Gram Negative Bacteria**: For 2013 1] 259, *Escherichia coli*, 2] 75, *Klebsiella pneumoniae* 3] 27, *Proteus mirabilis* 4] 20, *Pseudomonas aeruginosa* 5] 13, *Enterobacter cloacae* 6] 9, *Acinetobacter baumanii/haemolyticus.*

Escherichia coli: Imipenem, meropenem, ertapenem, amikacin, gentamicin and tazobactam/piperacillin were 98%, 100%, 95%, 93%, 83%, 83% sensitive, respectively. All other antibiotics exceeded the 20% resistance threshold. *Klebsiella pneumonia*: Imipenem, meropenem, ertapenem and amikacin were 99%, 100%, 97%, 100% sensitive, respectively. All other antibiotics exceeded the 20% resistance threshold. *Proteus mirabilis*: Imipenem, meropenem, ertapenem, amikacin, co-amoxiclav, ceftriaxone, ciprofloxacin, cefepime, cefuroxime, levofloxacin, tazobactam-piperacillin and trimetoprim-sulfametoxazole, gentamicin

showed 96%, 100%, 93%, 81%, 100%, 85%, 85%, 85%, 85%, 93%, 93%, 81%, 89% sensitivity, respectively. *Pseudomonas aeruginosa*: tazobactam-piperacillin and amikacin were both 85% susceptible. All other antibiotics exceeded the 20% resistance threshold, including the carbapenems. *Enterobacter cloacae*: Imipenem, meropenem, amikacin were 92%, 100% and 85% sensitive, respectively. All other antibiotics exceeded the 20% resistance threshold.

Acinetobacter baumanii/haemolyticus: All antibiotics were above the 20 % resistance thresholds. The tetracyclines were most sensitive, at 67% sensitivity. **Gram Positive Bacteria**: For 2013 1] 21, *Enterococcus faecalis* 2] 14, *Staphylococcus saprophyticus* 3] 11, *Staphylococcus aureus* were isolated from all wards and departments. *Enterococcus faecalis*: Ampicillin and vancomycin were 90% and 95% sensitive, respectively. *Staphylococcus saprophyticus*: Trimethoprim/sulfametoxazole, gentamicin were 100% and 86% sensitive, respectively.

Staphylocossus aureus: Trimethoprim/sulfametoxazole, gentamicin, were 100% and 82% sensitive.

DISCUSSION

Blood: In general carbepenems appear useful as first line empiric therapy, in blood stream infections, except if *P. aeruginosa* is suspected. Especially if combination therapy is needed with a beta-lactam antibiotic (4,5). Aminoglycosides or flouroquinolones may be of better use empiricaly, for synergy. For empiric therapy, vancomycin and linezolid does not have to be first line, empirically. Ampicillin and Gentamicin appears adequate. If *S. aureus* is suspected, vancomycin may be considered with a view to de-escalate, based on the patient's antibiogram or department specific data.

Urines: In general carbepenems or tazobactam-piperacillin appear useful as first line empiric therapy, except if *Acinetobacter baumanii/haemolyticus* is suspected. In this case aminoglycosides or flouroquinolones may be of better use empirically, for synergy. In general trimethoprim/sulfametoxazole and gentamicin appear useful as first line empiric therapy for urinary tract infection caused by Gram positive cocci. Thus vancomycin and linezolid can be reserved.

Broad spectrum antibiotics recommended in this guide should be used initially, only in critically ill patients, were Surviving Sepsis Guidelines recommend starting antibiotics within the first few hours of diagnosis of sepsis (4). Patient specific antibiograms and unit specific trend [e.g. ICU, surgical wards, outpatient clinic] can be used as a guide in patients with less severe infections. Thus this recommendation should be tailored as appropriate (1). This will help reduce the development of resistance.

Vancomycin or linezolid are recommended as empiric therapy if Gram positive organisms are suspected. This should be used in critically ill patients, were Surviving Sepsis Guidelines recommend starting antibiotics within the first few hours of diagnosis of sepsis (4). Patient specific antibiograms and unit specific trend [e.g. ICU, surgical wards, outpatient clinic] can be used as a guide in patients with less severe infections.

Enterobacteriaceae, *Pseudomonas aeruginosa* and *Acinetobacter baumanii/haemolyticus* appear to have developed significant resistance. Thus carbapenems, which should be reserved as last line agents, currently have to be used as first line agents. This is a worrying phenomenon. In fact carbapenem resistant enterobacteriaciae have been highlighted by the Center for Disease Control, Atlanta, in their publication, Guidance for Control of Carbapenem-resistant Enterobacteriaceae (7).

Institutional prevention programs, in east Trinidad, are being implemented to prevent the development of wide spread carbapenem resistance. This includes hand hygiene compliance, antibiotic stewardship, surveillance, early identification and reporting to the ward staff and other related activities. These strategies are being implemented in a “bundled care” approach (8).

Stelling and Sosa have shown that thresholds such as 3%, 5%, 10% and 20% can be used, this especially depends on the bacteria and antimicrobial being considered (3,9). For Gram negative and Gram positive organisms used, in preparing this epidemiological antibiogram, any resistance threshold less than 20 % would not have been feasible, for most Gram negative organisms. Thus it can be seen that the problem of antibiotic resistance in east Trinidad is of great significance. It is thus recommended that a figure such as 20%, for a resistance threshold, be used initially and adjust it in 5% increments, to achieve an adequate assessment of the utility of antimicrobials in a particular setting. Vancomycin and linezolid’s empiric use can be preserved for bacteremia or septicemia and bacteriuria.

Lastly, we should note that we should correlate microbiological data with clinical data. This is to ensure we treat the patient and not the culture. A patient may have a positive culture but be asymptomatic. Alternatively a non-pathogenic bacterium may be isolated.

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