Predicting Antimicrobial Resistance and Incidence from Indicators of Antimicrobial Use

Elise Fortin, PhD(c)1,2, Robert W. Platt, PhD, Patricia Fontella, MD PhD, David L. Buckeridge, MD PhD and Caroline Quach, MD MSc1,2

1) Epidemiology, Biostatistics, and Occupational Health, McGill University, Canada; 2) Institut National De Santé Publique Du Québec, Canada.

# 185

In our ICUs, indicators of AM use predicted resistance (p <0.01).

Methods

STUDY DESIGN AND POPULATION

Retrospective cohort study on all patients admitted to 3 neonatal, 2 pediatric and 4 adult ICUs in Montréal, between April 2006 and March 2010. Resistance / AM use combinations studied are listed in Table 1.

ANTIMICROBIAL USE (see poster 221)

For each combination, indicators of AM use were successively correlated with prevalence of resistance. Resistance / antimicrobial combinations

Prevalence of resistance:

- Resistance per ICU admissions, excluding strains when
- Courses / pd

- 0.20

- 0.20

- 0.21

- 0.70

- 0.21

- 0.70

Background: Indicators of antimicrobial (AM) use have been described, but the optimal indicator for predicting AM resistance in hospital settings, especially when including pediatric populations, is unknown.

Objective: This study compared accuracies of 15 AM use indicators in the prediction of resistance, in nine intensive care units (ICUs).

Methods: All patients admitted to participating ICUs between 2006 and 2010 were studied retrospectively. Prevalence and incidence of resistance in endotracheal cultures were both estimated per 4-week period. AM use was measured per 4-week period, using 15 different indicators. Resistance AM use combinations were:

- Methicillin-resistant S. aureus / piperacillin (p <0.01)
- Methicillin-resistant S. aureus / piperacillin + quinolones
- Pseudomonas / carbapenems
- Pseudomonas / aminoglycosides + quinolones
- Pseudomonas / carbapenems
- Klebsiella / carbapenems
- Klebsiella / piperacillin-tazobactam
- Coliforms / quinolones
- Carbapenem-resistant E. coli / piperacillin-tazobactam
- Carbapenem-resistant E. coli / Klebsiella sp. or Proteus sp.
- Coliforms / carbapenems
- Quinolone-resistant coliforms / quinolones
- Carbapenem-resistant E. coli, Klebsiella sp. or Proteus sp.
- Carbapenem-resistant E. coli, Klebsiella sp. or Proteus sp.
- Quinolone-resistant Pseudomonas sp. / carbapenems
- Aminoglycoside-resistant coliforms / aminoglycosides
- Carbapenem-resistant Pseudomonas sp. / carbapenems
- Methicillin-resistant S. aureus / piperacillin + quinolones

Results

Table 1. Most accurate and least accurate indicators in predicting resistance prevalence, for each selected resistance / antimicrobial combination.

<table>
<thead>
<tr>
<th>Resistance / antimicrobial combination</th>
<th>Most accurate</th>
<th>Least accurate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indicator</td>
<td>Regression</td>
</tr>
<tr>
<td></td>
<td>(cases / 100 adm)</td>
<td>(p-value)</td>
</tr>
<tr>
<td>Methicillin-resistant S. aureus / piperacillin</td>
<td>DDD / patients</td>
<td>Identity (1)</td>
</tr>
<tr>
<td>Methicillin-resistant S. aureus / piperacillin + quinolones</td>
<td>DDD / adm</td>
<td>Log</td>
</tr>
<tr>
<td>Pseudomonas / carbapenems</td>
<td>Courses / pd</td>
<td>Identity</td>
</tr>
<tr>
<td>Pseudomonas / aminoglycosides + quinolones</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Pseudomonas / carbapenems</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Klebsiella / carbapenems</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Klebsiella / piperacillin-tazobactam</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Coliforms / carbapenems</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
</tbody>
</table>

Table 2. Most accurate and least accurate indicators in predicting resistance incidence rates, for each selected resistance / antimicrobial combination.

<table>
<thead>
<tr>
<th>Resistance / antimicrobial combination</th>
<th>Most accurate</th>
<th>Least accurate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indicator</td>
<td>Regression</td>
</tr>
<tr>
<td></td>
<td>(cases / 100 adm)</td>
<td>(p-value)</td>
</tr>
<tr>
<td>Methicillin-resistant S. aureus / piperacillin</td>
<td>DDD / patients</td>
<td>Identity (1)</td>
</tr>
<tr>
<td>Methicillin-resistant S. aureus / piperacillin + quinolones</td>
<td>DDD / adm</td>
<td>Log</td>
</tr>
<tr>
<td>Pseudomonas / carbapenems</td>
<td>Courses / pd</td>
<td>Identity</td>
</tr>
<tr>
<td>Pseudomonas / aminoglycosides + quinolones</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Pseudomonas / carbapenems</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Klebsiella / carbapenems</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Klebsiella / piperacillin-tazobactam</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
<tr>
<td>Coliforms / carbapenems</td>
<td>Courses / adm</td>
<td>Identity</td>
</tr>
</tbody>
</table>

Results

Resistance PREVALENCE (TABLE 1)

A difference between MAEs could only be detected for two combinations.

1) When using quinolone use for predicting prevalence of resistance to quinolones in Pseudomonas sp. For this combination, the most accurate indicator (courses / patient-days, multiplicative model, 1-period time lag) was better (p<0.0043) than the least accurate indicator (Exposed / 100 admissions, multiplicative, model 1-period time lag: +34.7 % bigger). After further verifications, it was significantly better than the 5 least accurate regression models.

2) When using carbapenem use for predicting prevalence of carbapenem resistance in Pseudomonas sp. For this combination, the most accurate indicator (courses / patient-days, multiplicative model, no time lag) was better (p<0.0006) than the least accurate indicator (DDD / 100 admissions, multiplicative, model 1-period time lag: 39.8 % bigger). After further verifications, it was significantly better than the 7 least accurate regression models.

Resistance INCIDENCE RATES (TABLE 2)

No statistical difference was observed between MAEs.

Conclusion

In our ICUs, indicators of AM use predicted resistance with similar accuracy, except for two combinations.

Further research is necessary to verify if this result is attributable to a lack of statistical power (see poster 160).

Contact information

Caroline Quach, MD MSc FRCPC Infectious Diseases Division and Medical Microbiology Department McGill University Health Center caroline.quach@mcgill.ca

Phone: 1-514-934-1934, Fax: 514-398-3520

Elise Fortin, PhD(c), Infectious Diseases Division, McGill University Health Center elisefortin@mcgill.ca

Phone: 1-418-666-7000 #319

Centre universitaire de santé McGill
McGill University Health Centre