Impact of Antimicrobial Stewardship (AMS) Program in an Intensive Care Unit

Organisation Name: SESLHD
Presenter(s): Michael Piza

HRT 1520 Innovations Workshops and Awards
19-20 November 2015, Sydney
Key problem
To deliver evidence-based safe and effective antibiotic therapy

Aim of Innovation
To improve health care outcomes, control antibiotic resistance and reduce economic costs

Changes implemented
Implementation of Antibiotic Stewardship (AMS) Program in November 2008
Evaluation of Impact of AMS in an ICU of a large tertiary facility

Outcomes
- Significant reduction in the use of some specific broad spectrum antibiotics
- Significant reductions in antibiotic related expenditure
- Antibiotic resistance remains under control during study phase, including quarterly reductions in resistance to Ciprofloxacin (-13.4%, p=0.09) and Imipenem (-6.2%, p=0.34), but not statistically significant
- No increase in ICU mortality during study phase
- No increase in LOS

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Health Service: SESLHD
Key Problem

• Inappropriate empiric antibiotic therapy has been found to be associated with an increase in;
  • Economic costs (Roberts RR, 2009)
  • Patient morbidity and mortality (Irequi M 2002, Kollef MH 2000)
  • Antibiotic resistance (WHO, 2014)
Key Problem

Why Antimicrobial stewardship at SGH?

• *Clostridium difficile* rates ↑ 2006

• **MRAB** closed ICU March – April 2007

• **VRE** emergence SGH early 2008
  → 10 bacteraemia in 12 months
  → Screening: up to 30-35% VRE some wards

→”VRE Working party” - multi-prong approach: Included AMS
Key Problem

• In November 2008 Infectious Diseases Specialists and the Director of Pharmacy at SGH, initiated an Antimicrobial Stewardship Strategy (AMS) prompted by ongoing outbreaks of antimicrobial resistant microorganisms (VRE, MRAB).

• In 2011 Australian Commission into Safety and Quality established an National AMS initiative.
Aim of this innovation

The objective of the AMS was to ensure:

• Delivery of evidence-based safe and effective antibiotic therapy targeted to the infection

With an aim to reduce:

• Mortality and morbidity associated with infection
• Antimicrobial resistance
• Cost associated with antimicrobial usage
Setting of innovation

Intensive Care Unit (ICU)

- Servicing a 600 bed tertiary referral hospital
- Comprising 15 medical and surgical beds
- Wide range of casemix
- Unrestricted access to antibiotics (except for reserve agents)
Key Changes Implemented

Before November 2008, there was NO:

- Formal antimicrobial prescribing guidelines
- Formal process for review of antimicrobial prescriptions
- Antimicrobial education program
## Key Changes Implemented

### List of AMS strategies and interventions

- Appointment of AMS Pharmacist
- Multidisciplinary meetings to develop consensus on prescribing guidelines
- Twice weekly ICU AMS patient bedside rounds with Infectious Diseases and Microbiology consultant review to optimize antimicrobial prescribing
- Advice, interpretation and selective antibiotic susceptibility reporting by microbiologist
- Development of dosing and treatment duration alerts, based on endorsed antimicrobial guidelines, in prescription order sets of clinical information system (CIS)
- Development of a patient specific antimicrobial duration Gantt chart for the CIS
- Daily review of all prescribed antimicrobials by AMS pharmacist
- Recommendations for individualized doses based on patient pharmacokinetic variability
- Education to medical and nursing staff on patients pharmacokinetic variability, dosing and on management of various infection diseases
- Audit and feedback to ICU medical and nursing staff quarterly, using NAUSP
Analysis of Interrupted Time Series

1) ABs usage rates (DDD/1000 OBDs)
2) ABs resistance (% positive cultures)
3) Cost ($ per OBD)
Outcome without the intervention = intercept at time 0 (November 2008) + (pre-slope × time*)

WAS COMPARED TO

Outcome with the intervention = intercept at time 0 (November 2008) + (pre-slope × time) + (Δ slope × time since the intervention) + Δ level

Adapted from Ansari et al 2013
Change in Antimicrobial Use Before and After AMS Intervention

- Significant Long Term Reductions in Meropenem Use
- Significant Immediate Increase in Vancomycin Use

Relative change in monthly rate of use: 
-4.4% (-7.5% to -1.3%)  
P=0.007

Immediate change at time intervention introduced: 
63.7% (18.4% to 108.9%) 
P=0.007
Change in Antimicrobial Resistance Before and After AMS Intervention

Gram Negative Pathogens Resistance To:

- **Ceftriaxone**
- **Ciprofloxacin**
- **Imipenem**
- **Timentin**
- **Ampicillin**

Change in % Resistance After AMS implemented: -26.633 to 2.317, p=0.087
Change in Antimicrobial Costs Before and After AMS Intervention

Significant Long Term Reductions in Overall Antibiotic Costs

ANTIBIOTIC EXPENDITURE

Significant Relative Reduction in Monthly ABs Expenditure Before Intervention to After: -1.0% (-1.5% to -0.6%), p < 0.001
### Negligible Impact on Mortality and LOS

#### OUTCOME ALL ICU

<table>
<thead>
<tr>
<th>Outcome</th>
<th>BEFORE AMS N=2524</th>
<th>AFTER AMS N=2803</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline morbidity: Median APACHE Score</td>
<td>17.4</td>
<td>17</td>
<td>0.254*</td>
</tr>
<tr>
<td>In-ICU mortality</td>
<td>327 (12.9%)</td>
<td>334 (11.9%)</td>
<td>0.261†</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>4.8</td>
<td>4.8</td>
<td>0.952Ψ</td>
</tr>
</tbody>
</table>

#### OUTCOME ICU Blood Stream Infection Cohort

<table>
<thead>
<tr>
<th>Outcome</th>
<th>BEFORE AMS N=95</th>
<th>AFTER AMS N=95</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted 30 day mortality % of cohort</td>
<td>36 (38%)</td>
<td>24 (25%)</td>
<td>0.086†</td>
</tr>
<tr>
<td>Adjusted 30 day mortality IRR adjusted by Morbidity using APACHE Scores IRR</td>
<td>1.00 (CI 0.59 to 1.71) (Intervention phase relative to pre-intervention)</td>
<td>0.992‡</td>
<td></td>
</tr>
<tr>
<td>Length of Stay</td>
<td>17.3</td>
<td>15.4</td>
<td>0.492Ψ</td>
</tr>
</tbody>
</table>

* Mann Whitney U test
† Chi square test
Ψ Two-sample t-test
‡ Poisson regression incidence rate ratios
Lessons Learnt and future steps

• Current positive outcomes from AMS program
  • Significant change in antibiotic prescribing behaviour—decline in broad spectrum antibiotics (meropenem) usage without increase in other broad spectrum antibiotics
  • Increase in precision of loading doses and body weight dosing for severe MRSA sepsis indicated by reduced variation in Vancomycin dosage
  • Significant reductions in antibiotic expenditure
  • Keeping Antibiotic Resistance in Control
  • No adverse impact on mortality or LOS

• The AMS program is a key strategy in the control of antibiotic resistant organisms, within a wider multi factorial context

• Next step is to expand the evaluation of the AMS to hospital wide
Contact for this Innovation

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