Antimicrobial Resistance and Papua New Guinea

WHY is it important?
HOW has the problem arisen?
WHAT can we do?

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Dedication
1. Antimicrobial resistance kills

Antimicrobial resistant infections often fail to respond to standard treatment, resulting in **prolonged illness, higher health care expenditures, and a greater risk of death.**
14 yr old girl, PMGH Feb 2013

- Presented with sepsis, acute onset
- Febrile, hypotensive, thin
- Suspected endocarditis but no direct evidence
  - Given gentamicin and flucloxacillin
  - Poor response to treatment

Day 4 - Blood cultures: Gram positive cocci (staph)-identified as MRSA (methicillin-resistant *Staphylococcus aureus*)
PMGH stats- Staphylococcus aureus from blood

• 2011-12 60% of 41 events due to MRSA

• Empiric cover required

[MRSA is resistant to all available betalactam (penicillin-type) antibiotics]
Between April 1998 and March 2000, multi-resistant enteric gram-negative sepsis occurred in 106 of 5331 paediatric admissions (2%), but caused 87 (25%) of 353 deaths.

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Nosocomial</th>
<th>Community acquired</th>
<th>Chloramphenicol sensitivity</th>
<th>Gentamicin sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klebsiella sp*</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa*</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Escherichia coli*</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Citrobacter freundii</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Enterobacter sp</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Morganella morganii</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Burkholderia capsaci</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Acinetobacter sp</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Serratia sp</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Providentia sp</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Aeromonas sp</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Alcaligenes sp</td>
<td>0</td>
<td>1</td>
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*We could not be certain of the origin of one additional isolate of each of these three bacteria.

Sensitivity of bacterial isolates and place of acquisition.
## Risk of Death is Higher in Patients Infected with Resistant Strains

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<th>Resistant</th>
<th>Not resistant</th>
<th>RR (95% CI)</th>
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<td>23.6</td>
<td>12.6</td>
<td>2.02 (1.41 to 2.90)</td>
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<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Klebsiella pneumoniae resistant to:</strong></td>
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<td></td>
<td></td>
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<tr>
<td>3rd gen. cephalosporins</td>
<td>20</td>
<td>10.1</td>
<td>1.93 (1.13 to 3.31)</td>
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<tr>
<td>Carbapenems</td>
<td>27</td>
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*Antimicrobial Resistance*  
*Global Report on Surveillance 2014*
Risk of Death is Higher in Patients Infected with Resistant Strains

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Resistant organisms - Up to twice the risk of dying
2. AMR hampers the control of infectious diseases

AMR reduces the effectiveness of treatment; thus *patients remain infectious for a longer time, increasing the risk of spreading* resistant microorganisms to others.
Catherina Abraham

Aged 20 years, flew to Cairns from Torres Strait, 2012 diagnosed with XDR-TB.

After almost a year in an isolation ward at Cairns Base Hospital, she died on 8 March 2013.

Secondary case, aged 32 also died.

3. AMR increases the costs of health care

Resistant infections require more expensive therapies and longer duration of treatment.

Catherine’s treatment cost Queensland Health about $500,000 and would have cost $1 million had she lived to complete it.
4. The achievements of modern medicine are put at risk by AMR

– organ transplantation
– cancer chemotherapy
– major surgery
5. AMR threatens health security, damages trade and economies

**Thailand**
- Population: 70m
- >38,000 deaths
- >3.2m hospital days

*Overall societal costs*
- US$ 84.6–202.8 mill. direct
- >US$1.3 billion indirect

*Source: Pumart et al 2012*

**United States**
- Population: 300m
- >23,000 deaths
- >2.0m illnesses

*Overall societal costs*
- Up to $20 billion direct
- Up to $35 billion indirect

*Source: US CDC 2013*

WHO 2014
AMR in PNG

1. WHY is it an important problem?
2. HOW has the problem arisen?
3. WHAT do we have to do?
How does resistance arise?

1. **mutational change** in bacterial chromosome with clonal expansion of a resistant subpopulation

AND/OR

2. **horizontal transfer** of new resistance gene(s) from another bacterial species by direct transfer and recombination

**Antibiotic exposure increases the rate of both processes**

**Antibiotics select and promote growth of resistant subpopulations**
Antibiotic usage drives resistance!
Correlation of resistance with Antimicrobial Use in Community-Acquired Infections in Europe, 1997-2000

Erythromycin-R. S. pneumoniae from community-acquired RTIs (%, 1998)

Community consumption of macrolides and lincosamides (DDD per 1,000 inh-days, 1997)

R²=0.76   P<0.001

Nalidixic acid-R. E. coli from community-acquired uncomplicated UTIs (%, 1999-2000)

Community consumption of fluoroquinolones (DDD per 1,000 inh-days, 1999)

R²=0.55   P=0.002


Source: Kahlmeter G. Clin Microbiol Infect 2001;7(Suppl 1): 86; and ESAC.
Declining usage: hospital antibiotic sales (kg), IMS data
E. coli from blood & CSF in the UK - a recent fall in resistance

- coincides with decreased use = decreasing selection?
- If plasmids can’t be lost, is this strain displacement?
How are antibiotics used in PNG?

- PMGH (Steven Yennie, 2012)
  - Medical ward 72% of patients receiving an anti-infective (excluding TB and ARV treatment)

- Alotau Hospital (Nick Ferguson, Nov 2012)
  - Medical ward: 60% of patients on anti-infective
  - Obstetric ward: 34%
Common survey findings

• Very prolonged courses, prolonged IV courses
• Undocumented reasons for therapy
• Treatments not in accord with Standard Treatment Guidelines
On patrol 1979....
AMR in PNG

1. WHY is it an important problem?
2. HOW has the problem arisen?
3. WHAT do we do now?
The containment of antibiotic resistance needs coordination

- **Surveillance**
  - Resistance patterns
  - Antibiotic usage
  - Health care associated infections

- **Decrease the need for antibiotics**
  - Prevention of disease
  - Prevention of bacterial spread

- **Use antibiotics properly**
  - Diagnostics
  - Rational use

- **Coordinate national activities**

- **Knowledge education, information, research**

- **International collaboration**

*ReAct Action on Antibiotic Resistance*
Is science the answer?

• New antibiotics?
• New vaccines?
• More research etc?
Vital question - how do we preserve a scarce resource?

Personal responsibility & accountability – responsible antibiotic use and infection control

Prevent over the counter access

Leadership and governance – national and local
Infection prevention & control

- **Surveillance**
  - Resistance patterns
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[www.react.org](http://www.react.org)
Lessons learned from Semmelweis (1861)

Hand disinfection saving women’s lives in Vienna

**Graph:***

- **Y-axis:** Percentage
- **X-axis:** Years (1841 to 1850)
- **Legend:**
  - Orange dots: First
  - Grey dots: Second

**Legend:**
- **Intervention:** May 15, 1847
No hand rub

Alcohol hand rub used


MRSA= methicillin-resistant *Staphylococcus aureus*
Point of care availability of Alcohol-based hand rub at PMGH, Goroka Hospital

- Rub hands BEFORE and AFTER EVERY patient contact
- Teach patients and relatives to use the rub
“Standard precautions” : the basis for protecting ALL patients & staff

Always follow these **standard precautions**

- Perform hand hygiene before and after every patient contact
- Clean and reprocess shared patient equipment
- Use personal protective equipment when risk of body fluid exposure
- Follow respiratory hygiene and cough etiquette
- Use and dispose of sharps safely
- Use aseptic technique
- Perform routine environmental cleaning
- Handle and dispose of waste and used linen safely
**F-A-S-T** strategy for TB & DR-TB control

**Finding TB Patients:**
The most infectious TB patients are the ones that we don’t know about because they are not being treated. Undiagnosed TB patients can be in clinics, waiting areas, hospital emergency rooms, and wards that care for surgical or other medical problems. Asking all patients about TB symptoms, such as chronic cough, fever, and weight loss can lead to finding previously unsuspected TB cases, as can observing patients for cough in waiting rooms, registration areas, and admission holding areas.

**Actively:**
TB is usually diagnosed passively, occurring when patients’ symptoms lead them to seek help. However, symptoms, such as cough, fever, and weight loss can be present for a long time, be attributed to other conditions, or be overshadowed by other pressing issues. The **FAST** strategy incorporates specifically trained staff called “cough monitors” or “cough surveillance officers” whose job is to identify patients with chronic cough and other TB symptoms, and promptly collect sputum, which would ideally be sent for rapid molecular testing.

**Separating safely:**
MDR-TB patients should be moved to a well-ventilated area to prevent the transmission of MDR-TB to other patients.

**Treatment:**
Treatment is the final and most important step in preventing transmission of TB to others. Patients become non-infectious soon after starting effective TB treatment.
F-A-S-T strategy for TB & DR-TB control

PMGH TB isolation facility
Practical and Therapeutic Options: using antibiotics properly

- Surveillance
  - Resistance patterns
  - Antibiotic usage
  - Health care associated infections

- Decrease the need for antibiotics
  - Prevention of disease
  - Prevention of bacterial spread

- Use antibiotics properly
  - Diagnostics
  - Rational use

- Coordinate national activities
  - Knowledge education, information, research

- International collaboration

www.react.org
Priority diagnostic methods for provincial/tertiary hospitals

• Blood cultures
• Reliable Antimicrobial Susceptibility Testing
What can I do?

1. Walk the talk - advocate for change, lead the way and become antibiotic stewards
2. Take infection control practices seriously - Semmelweis was right - hand hygiene saves lives
3. Work with your laboratory to improve diagnostics and resistance testing
4. Regularly review your unit’s current prescribing against standard treatment guidelines and patient microbiology results
Thank you!