Infection control in critical care
- Preventing nosocomial infections
- Isolation of patients with MROs
- Infectious Complications of Cardiac Surgery and prevention
Preventing nosocomial infections
Common belief in medical field

Nosocomial infection is an unpredictable complication

But is actually......
Potentially preventable adverse events
How is it handled in other industry?

- Faulty floor mats; accelerator pedal gets stuck
- Between 2007-10 – Toyota recalls 5.7 million vehicles
- Settles ~ 1 billion claims for economic loss

89 deaths (as of 2010) – potentially linked to this problem
Infection control has to be made integral part of clinical care
Bugs are not what they used to be
MRSA is getting too thick skinned

Electron microscopy of cell wall of the MRSA with MIC 2 µg/ml

A Norazah et al. MJM, 2009 64; 166-67
<table>
<thead>
<tr>
<th>Specimen</th>
<th>IMI</th>
<th>MERO</th>
<th>ERTA</th>
<th>DORI</th>
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All NDM; MIC using Etest

Dr Norazah, IMR
Cost of antimicrobial resistance

Attributable mean total cost of patients infected with MDR organism vs non-MDR organism

- Carbapenem resistance nonfermenters
  - US$ 58,457 and US$85,229
- ESBL Enterobacteriaceae
  - US$ 1584 - US$30,093
- MRSA
  - US$1014 – US$40,090
- In US – cost of MDR pathogens – US$3.5 billion is excess health care costs annually

Decreasing hospital acquired infections

- CLABSI
- UTI
- VAP
- SSI
Interventions to Reduce CVC-Associated BSI$^{45}$

- Clean hands before touching patient or handling line
- Clean skin with chlorhexidine
- Use full-barrier precautions during CVC insertion (large sterile drape, mask, hat, sterile gown, and sterile gloves)
- Avoid femoral site if possible
- Remove unnecessary catheters
Central venous lines

- CVC-associated bloodstream infection increases the risk of an SSI by 5.2 times in cardiac surgery patients.
- CVCs with multiple lumens are associated with a higher risk of infection (OR = 2.15; 95% confidence interval [CI], 1.00-4.66).
- CVC dressings - chlorhexidine-impregnated sponges - reduce the number of CRBSI (1.4 v 0.6 per 1,000 catheter days).
Central venous lines

- Changing a CVC over a guidewire increases the likelihood of infection by >4 times (odds ratio [OR] = 4.59, p < 0.0001)
- Failure to remove an infected CVC increases the chance of treatment failure by 6-fold (OR = 6.6; 95% CI, 1.8-23.8; p = 0.004)
Arterial Lines

- Colinsed with similar organisms to CVC
- Related infections less than CVL - (1.7 [1.2-2.3] v 2.7 [2.6-2.9] per 1,000 device days)
- If any blood stream infection – replace arterial catheter along with CVL
Urinary catheters

- Longer the CBD – higher the risk of bacteriuria
- Bacteriuria does not mean catheter-associated UTI (CA-UTI)
- Nurse led reminder system – can reduce CA-UTI by 50%
Pneumonia

- VAP after cardiac surgery is associated
  - with longer ICU stays (25.5 ± 3 days),
  - longer length of hospitalization (40.7 ± 35.1 vs 16.1 ± 30.1 days, p< 0.0001)
  - higher mortality (50%-55%)
  - Increased cost
Components of VAP prevention bundles

- Staff education campaign
- Hand hygiene
- Head of bed elevation
- Thromboembolism prophylaxis
- Stress ulcer prophylaxis
- Oral care with CHG
- Orogastric rather than nasogastric tubes
- Avoid gastric over distension
- Aspiration of subglottic secretions
- Lung protective ventilation
- Ventilator weaning protocols
- Daily sedation interruption
- Daily assessment of readiness to extubate
- grouping of evidenced-based practices that individually improve care
- facilitates implementation
Care bundles in infection control

Jasper van der Slegt et al., Plos 2013
VAP Prevention Bundles

Head of bed elevation
Stress ulcer prophylaxis
Deep venous thrombosis prophylaxis
Followed commands
Assessment of ability to extubate

112 ICUs,
550,800 ventilator days

Isolation of patients with MROs
Steps to isolation

1. identifying an at-risk patient;
2. obtaining a specimen for culture or PCR;
3. testing the specimen for multi-resistance;
4. providing the nurse or physician with the result
5. placing the patient in a private room or cohorting the patient with other carriers;
6. posting signs indicating that the patient is in isolation
7. stocking the patient’s room with isolation supplies;
8. requiring visitors and HCWs who care for the patient to wear gloves and gowns;
9. enforcing strict hand hygiene;
10. providing for adequate environmental hygiene, including waste removal
<table>
<thead>
<tr>
<th>Item</th>
<th>Action</th>
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<tbody>
<tr>
<td>Landing gear</td>
<td>Check down</td>
</tr>
<tr>
<td>Autopilot</td>
<td>Off</td>
</tr>
<tr>
<td>Landing speed</td>
<td>140 KIAS</td>
</tr>
<tr>
<td>After touchdown</td>
<td>Apply reverse thrust</td>
</tr>
<tr>
<td></td>
<td>60 KIAS: cancel reverse thrust</td>
</tr>
<tr>
<td>Spoilers</td>
<td>Verify extended</td>
</tr>
<tr>
<td>Brakes</td>
<td>As required</td>
</tr>
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</table>

Landing procedure checklist for a Boeing 737-800 aircraft. Adapted from the Atlantic Sun Airways CAT B pilot procedures and checklists series [52]. KIAS, knots indicated airspeed.
Contact precaution adherence

- On room entry
  - Hand hygiene – 19.4%
  - Gloves – 67.5%
  - Gowns – 67.9%

- On room exit
  - Hand hygiene – 48.4%
  - Gloves – 63.5%
  - Gowns – 77.1%

Clock SA. et al., AJIC 2010;38:105-111
Equipment associated adherence

- **Signages**
  - Gloving on entry
    - 67.5% vs 22.7%
  - Gowning on entry
    - 67.9% vs 2.2%

- **Gloves of all sizes**
  - 49.4 – 72.1% had all glove sizes
  - In rooms with all glove sizes
    - Adherence to gloving on entry higher
      - 72% vs 63.4%; p=0.032

Clock SA. et al., AJIC 2010;38:105-111
Role of environment in infection control
Role of environment

Independently predictive of healthcare worker contamination with multidrug-resistant bacteria

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Odds Ratio (95% Confidence Interval)</th>
<th>p</th>
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<tbody>
<tr>
<td>Positive multidrug-resistant bacteria environmental culture</td>
<td>4.15 (2.66–6.47)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Duration in room &gt;5 mins</td>
<td>1.99 (1.15–3.43)</td>
<td>.014</td>
</tr>
<tr>
<td>Performing physical examination</td>
<td>1.74 (1.10–2.77)</td>
<td>.019</td>
</tr>
<tr>
<td>Contact with ventilator</td>
<td>1.78 (1.12–2.82)</td>
<td>.014</td>
</tr>
</tbody>
</table>

Acinetobacter in the environment

Role of environmental cleaning in controlling an outbreak of *Acinetobacter baumannii* on a neurosurgical intensive care unit

M. Denton, M.H. Wilcox, P. Parnell, D. Green, V. Keer, P.M. Hawkey, I. Evans, P. Murphy

*Journal of Hospital Infection (2004) 56, 106-110*

‘Healthcare planners need to be aware that hospital cleaning is invaluable in controlling outbreaks…..’
Risk of acquiring MDR from prior occupant

- 511 consecutive patients
- Patients with MDR GNB at ICU admission excluded
- ICU acquired
  - *P. aeruginosa* – 16%
  - *A. baumannii* – 11%
  - ESBL-GNB – 9%
- Risk for acquiring from prior occupant
  - MDR *P. aeruginosa* - OR 2.3, 95% CI 1.2–4.3, p 0.012
  - MDR *A. baumannii* - OR 4.2, 95% CI 2–8.8, p <0.001
  - ESBL GNB – not significant

Prevention of SSI
Antibiotic Prophylaxis

- Commonly used – Cefuroxime, Cefazolin
- Cephalosporins - within 60 minutes of the incision time, however, within 30 minutes is ideal
- Vancomycin and Clindamycin begin infusion - 60 to 120 minutes before the incision.
- Procedures more than three to four hours in length require additional intra-operative doses of antibiotics.
- BMI ≥ 30 – will need higher doses
- Discontinue within 48 hours – increases the emergence of MDR
Pre operative hair removal

- Use clippers not razors
- Do it as close to the time of surgery as possible
- Don’t do it in operating room
Pre operative showering

- Twice – night before and day of operation
- Chlorhexidine – do not use it on mucous membranes – including genital area
- Freshly laundered towels, linen and clothing
- Do not shave below neck
Preoperative Nasal Cultures for *Staphylococcus aureus* and Decolonization Therapy with Mupirocin

<table>
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<th>Approach</th>
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<tr>
<td>Neither screen nor treat preoperative nasal carriage of <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>Screen—and treat if positive—only patients at high risk of infection, high risk of MRSA colonization, or both</td>
</tr>
<tr>
<td>Screen all patients and treat if positive</td>
</tr>
<tr>
<td>Treat all patients with mupirocin ointment empirically, without screening</td>
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Sugar control

- Aim for perioperative sugar control – 7-10mmol/l
Audit and feedback
Feedback is important

- Head of bed elevation (HOB)
- Hand hygiene compliance (HH)

- P₁ – base line observation
- P₂ – feedback to unit leaders
- P₃ – feedback to unit leaders and staff (poster in staff area)

<table>
<thead>
<tr>
<th></th>
<th>HOB</th>
<th>HH</th>
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<tbody>
<tr>
<td>P₁</td>
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<tr>
<td>P₂</td>
<td>*88%</td>
<td>47%</td>
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<tr>
<td>P₃</td>
<td>*92%</td>
<td>*71%</td>
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Thank you