Ventilator Associated Pneumonia

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VAP: What is it?

- Occurs in intubated patients in ICUs (usually >48 hours)
- Histological hallmark is:
  - Multifocal disease favouring dependent lung segments
  - Different stages of development and severity
  - Cultures grow heterogeneous microbial flora
- Pathogenesis likely to involve repeated seepage of oral fluids around the ETT cuff causing multiple microaspirations, bronchiolitis and VAP
- Clinical features include gradual onset of fever, tachypnoea and hypoxaemia combined with an increase in the quantity and purulence of ETT secretions and patchy diffuse opacities on the CXR

VAP: Is it Important?

FROM THE LITERATURE:

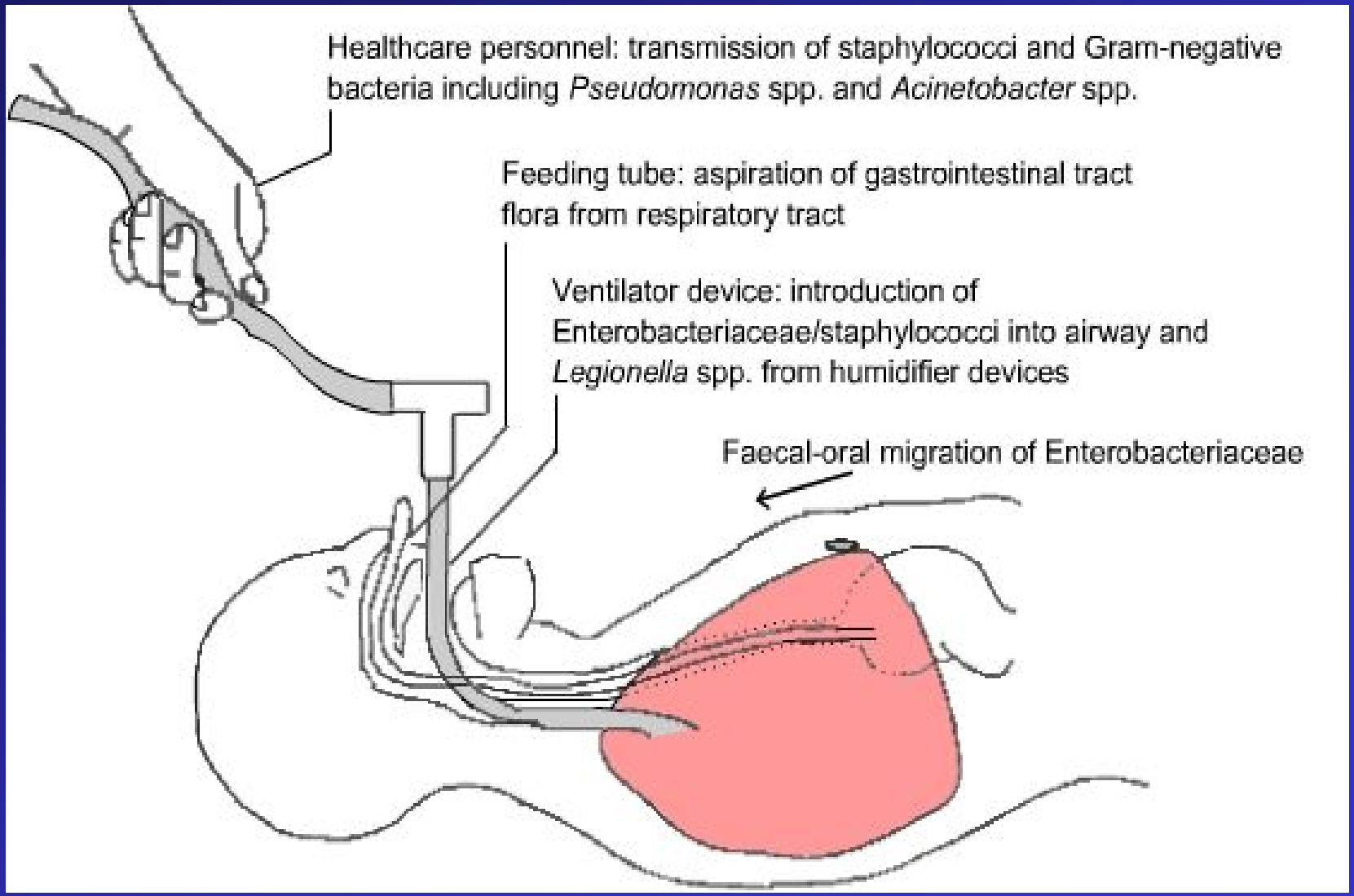
- Said to be the most frequent infection in the ICU
- One of the most studied and written about topics in critical care
- Affects between 9 and 27% intubated patients
- Doubles the risk of death
- Increases
  - Duration of ventilation
  - Length of stay in ICU
  - Length of stay in hospital
  - Cost of hospitalisation

Klompas. JAMA 2007; 1583-1593; Heyland et al Am J Resp Crit Care Med 1999; 159:1249-1256; Safdar et al Crit Care Med 2005; 33:2184-2193

TALK TO COLLEAGUES:

- Not a major problem in Australian and New Zealand Intensive Care Units

VAP: Aetiology



VAP Rate:
A Quality Indicator?

Institute of Healthcare Improvement (IHI) 100,000 Lives Campaign

- Six evidenced based interventions or care bundles of which one targets VAP
- Estimated 26,000 lives saved by eliminating VAP
- Version adopted by Victorian DHS and NSW Health as SSSL (Safer Systems Saving Lives)
- Data also collected VicNISS and NSW Health

VAP: Diagnosis

- Diagnostic criteria are controversial
  - Criteria of Johanson (1972)
  - Clinical Pulmonary Infection Score (CPIS)
  - CDC Criteria
- Use of different criteria in the same cohort of patient give VAP rates ranging from 4 to 48%

  Minei et al Shock 2000; 14:331-336
- Criteria that assess incidence may be different from those that direct management
  - Repeatability
  - Microbiological diagnosis

Johanson Criteria for Ventilator-Associated Pneumonia

- Presence of new or persistent infiltrates on CXR

Plus any two of

- Febrile >38.3C
- Leukocytosis or leucopaenia
  - (subsequently defined as >11 and < 3.5 x $10^3/mm^3$)
- Purulent tracheobronchial secretions

Clinical Pulmonary Infection Score (CPIS)

Sign	0	1	2
Temperature C	36.5 - 38.4	38.5-38.9	<36 or >39
WCC	4.0-11.0	<4.0 or > 11.0	>500 band forms
Oxygenation PaO_2/FiO_2	>240 or ARDS		<240 and no ARDS
Chest X Ray	No infiltrate	Diffuse (or patchy) infiltrates	Localized Infiltrate
Tracheal secretions score*	<14	>14	purulent
Culture of tracheal aspirate	Pathogenic bacteria cultured minimal or no growth	Pathogenic bacteria cultured moderate or more growth	Moderate or greater growth of pathogenic bacteria same as on original Gram stain

Total score > 6 suggests VAP

*Score calculated by quantifying amount of tracheal secretions on a subjective 0-4 scale multiple times per day then summing score for the day

CDC National Healthcare Safety Network Definition for Ventilator-Associated Pneumonia (1)

- **Radiology Signs**

Two or more serial radiographs with at least one of the following

New or progressive and persistent infiltrate

Consolidation

Cavitation

- **Clinical Signs**

At least one of the following

Fever (Temp>38C) with no other recognised cause

Leucopaenia (WBC<4.0) or Leucocytosis (WBC>12.0)

For adults over 70 years – altered mental status with no other cause

Plus at least two of the following

New onset of purulent sputum, or change in character of sputum or increased respiratory secretions or increased need for suction

New-onset or worsening cough, or dyspnoea or tachypnoea

Rales or bronchial breath sounds

Worsening gas exchange, increased oxygen requirement or increased ventilation demand

CDC National Healthcare Safety Network Definition for Ventilator-Associated Pneumonia (2)

- **Microbiology Criteria (optional)**

At least one of the following

Positive growth in blood culture not related to any other source of infection

Positive growth in culture of pleural fluid

Positive quantitative culture from bronchoalveolar lavage $>10^4$ CFU/ml

Positive quantitative culture from protected specimen brush $>10^3$ CFU/ml

Five per cent or more of cells with intracellular bacteria on direct microscopic examination of Gram-stained bronchoalveolar lavage fluid

Histopathological evidence of pneumonia

Accuracy of Diagnostic Criteria in VAP

- Gold Standard is histological examination of the lungs at multiple sites (post mortem)
- Recent Systematic Review (14 studies in 655 patients)
  - New infiltrate on CXR — summary LR 1.7 (95% CI 1.1-2.5)
  - Above plus 2 clinical signs — summary LR 2.8 (95% CI 0.97-7.9)
  - CPIS > 6 — summary LR 2.1 (95% CI 0.92-4.8)
  - No CXR infiltrate — summary LR 0.35 (95% CI 0.14-0.87)
  - +ve Gram Stain
    - tracheal aspirate — summary LR 2.1 (95% CI 0.81-5.5)
    - Mini BAL — summary LR 5.3 (95% CI 1.3-220)
    - Bronchoscopic-guided BAL — summary LR 18 (95% CI 1.1-302)
  - > 10^5 CFU tracheal aspirate — summary LR 9.6 (95% CI 2.4-38)

Klompas M. Does this patient have Ventilator Associated Pneumonia. JAMA 2007; 297: 1583-1593

Is There a Need for Microbiological Diagnosis?

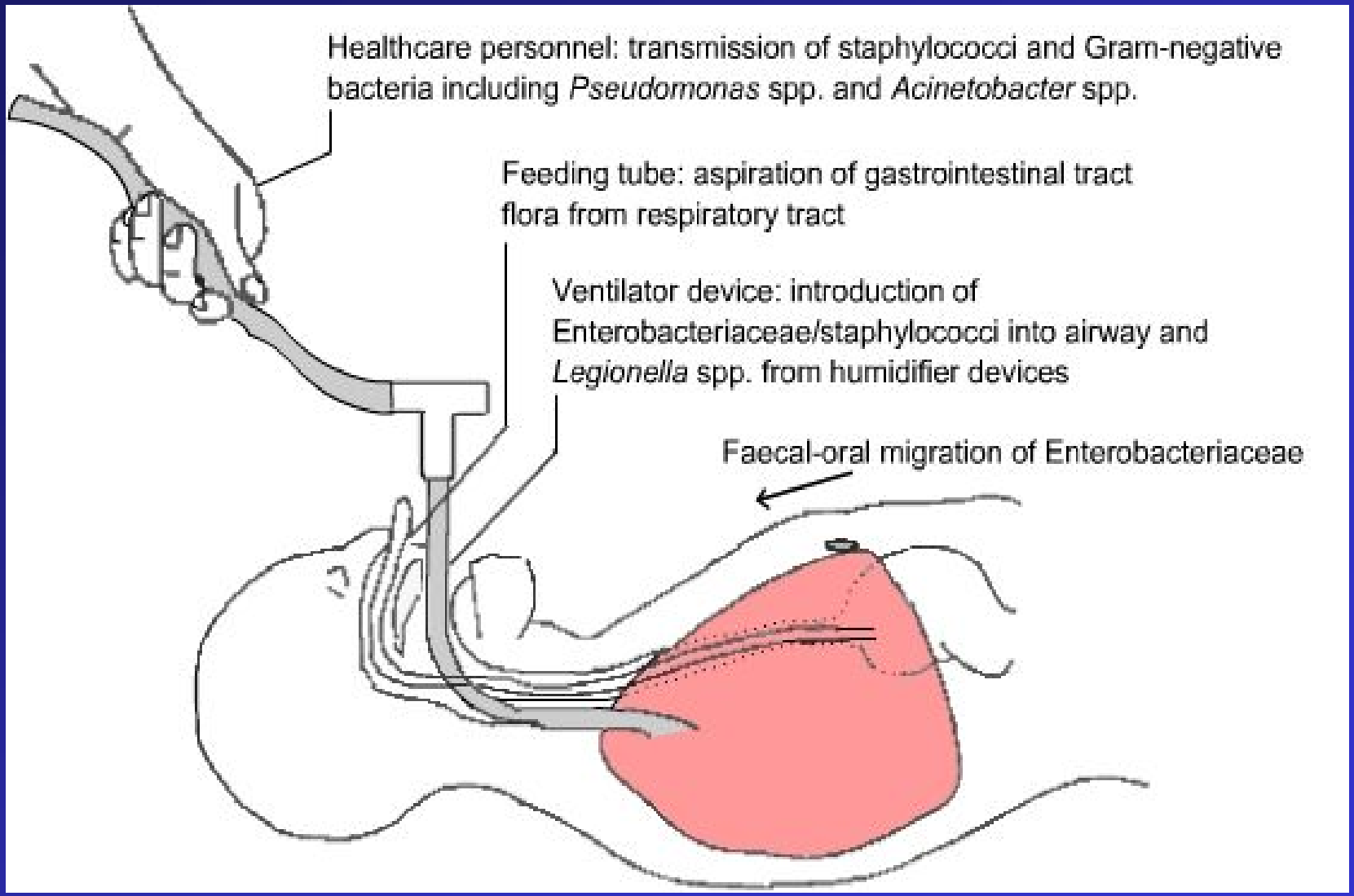
- Not necessary for definition using Johanson, CPIS or CDC criteria
- Surely necessary for appropriate management
  - Suspect VAP from clinical criteria
  - Obtain specimen from respiratory tract for microbiological diagnosis
  - Start empirical broad spectrum antibiotics with knowledge of usual pathogens in the particular ICU
  - Narrow spectrum when pathogen known

Which Diagnostic Technique?

Canadian Critical Care Trials Group. A Randomized Trial of Diagnostic Techniques for Ventilator-Associated Pneumonia. N Engl J Med 2006; 355:2619-30

- RCT of bronchoalveolar lavage with quantitative cultures vs endotracheal aspirate and non-quantitative cultures in immunocompetent patients with VAP
- Enrolled 740 patients in 28 ICUs in Canada and US
- Findings were no significant difference in:
  - Primary outcome (28 day mortality rate) 18.9% vs 18.4% (p=0.94)
  - Rate of targeted therapy 74.2% vs 74.6% (p=0.90)
  - Days alive without antibiotics 10.4 ± 7.5 vs 10.6 ± 7.9 (p= 0.86)
  - Maximum organ dysfunction score 8.3 ± 3.6 vs 8.6 ± 4.0 (p=0.26)
  - Length of stay in the ICU or hospital

VAP as a QI : Prevention



VAP or VAC: Does it Matter?

- VAP Bundle

Handwashing

Head Elevation

Mouth Care Protocol

Circuit changes

HMEs

?Mobilisation (out of bed)

?Closed suction systems

?Endotracheal Tube

- Subglottic suction
- Biofilm
- Cuff modification

- VAC Bundle

Head Elevation

DVT prophylaxis

Gastric acid inhibition

Pressure Care Policy

Analgesia Protocol

Sedation “holidays”

Bowel protocol

Feeding Protocol

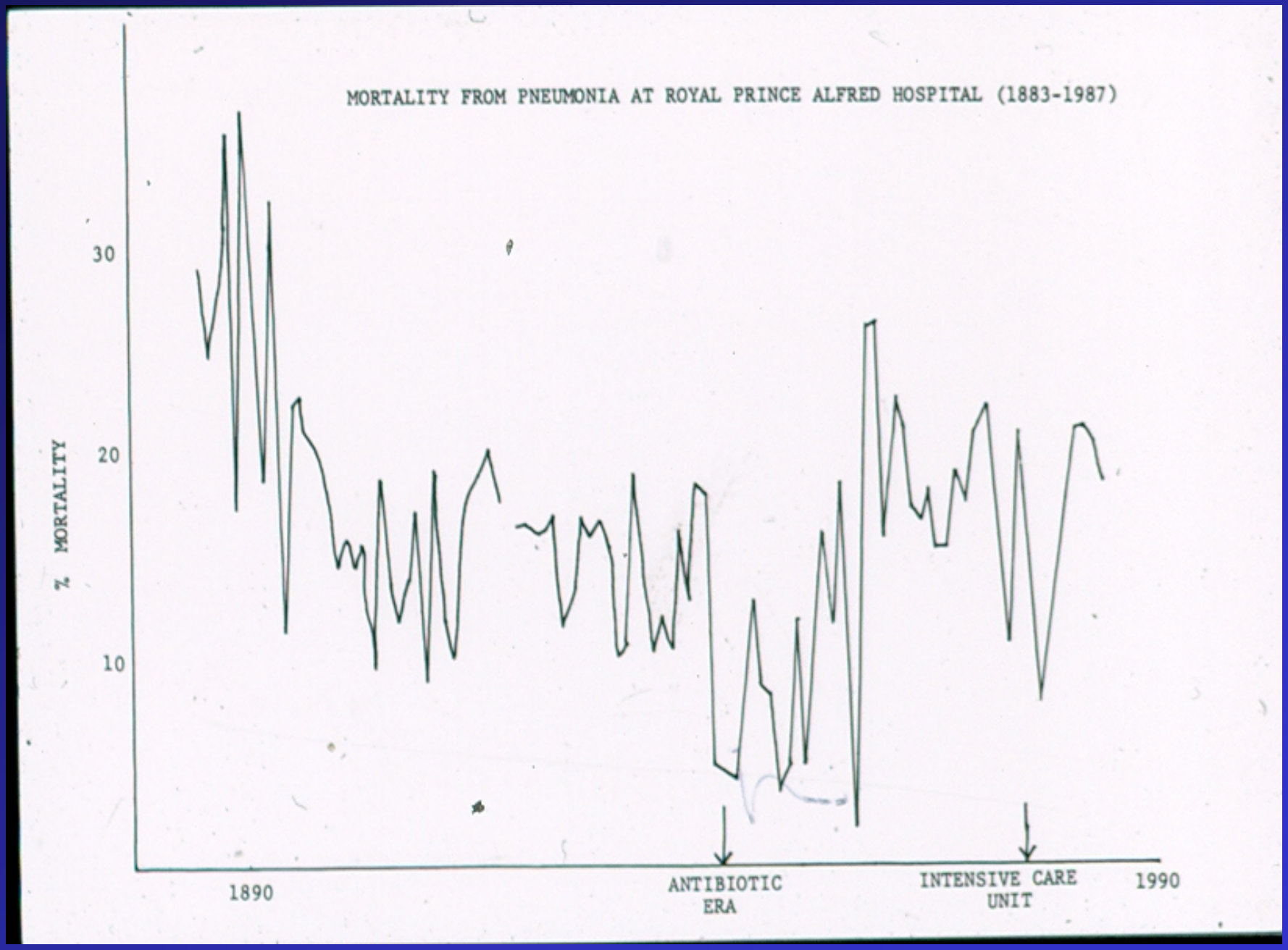
A Problem Is……

- By introducing the VAC bundle, the IHI 100,000 lives campaign claims to have:
  - Eliminated VAP in 14 US hospitals
  - Almost eliminated VAP in 5 others
- Does this mean that investigation of:
  - other methods of prevention
  - Refinements of diagnosis (esp microbiological)
  - Improved management

Become irrelevant??

Current Issues For Us

- Is VAP a major problem in Australia and New Zealand?
  - How do we define it?
  - Are specific patients subgroups at risk
- Are there better preventative measures than the VAC bundle
- Further investigation of microaspiration and immobility as aetiological factors
- Microbiological diagnosis
- Treatment


MORTALITY FROM PNEUMONIA AT ROYAL PRINCE ALFRED HOSPITAL (1883-1987)
% MORTALITY
30
20
10
1890
ANTIBIOTIC ERA
INTENSIVE CARE UNIT
1990