The Evolving Role of Epidemiology in Infection Prevention and Control
Prof. Jacqui Reilly, Glasgow Caledonian University
Broadcast live from the Infection Prevention Society Conference, Sep.20.10

The evolving role of epidemiology in infection prevention and control: past present and future

Overview

- Past: The historical contribution of epidemiology to infection prevention
- Present: The role of epidemiology in our current understanding of HAI
- Future: How the role of epidemiology will continue to evolve and contribute to infection prevention

The past

Epidemiology

- Epidemiology is the study of disease in human populations.
- This branch of science has been essential in saving the lives of millions of people by discovering the risk factors of many diseases.
- Epidemiology has prompted advances in medicine and better ways of controlling and preventing disease.

What defines epidemiologists?

- ‘It may seem a strange principle to enunciate as the very first requirement in a Hospital that it should do the sick no harm’. [Florence Nightingale, 1859]
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#### A brief history of the contribution of epidemiology to IP&C

- **18th century**
- 100 years later...
- **Bacteriological era**
- End of 19th century
- **ID hospitals in the early 20th century**
- 1960s onward

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#### Elements of successful HAI reduction

- Intensive surveillance (led by an ICN)
- Intensive control
- Programme of regular feedback to staff
  - **20% reduction over 5 years**
  - Interested/involved physician
  - **38% over 5 years**

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#### Comparisons with the epidemiology of public health issues

- There are **307432** new cases of colorectal cancer in the EU each year
- There are **85000** new cases of TB in EU each year
- With over **4 million** new cases of HAI in the EU each year, patient safety is a serious concern

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#### Prevalence of HAI

- **Europe:**
  - Approximately **4 100 000** patients are estimated to acquire a healthcare-associated infection in the EU every year.
  - The number of deaths occurring as the direct consequence of these infections is estimated to be at least **37 000**

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#### The present

-'We must measure and feedback the infection rates of all HAI problems to be reduced'

Haley RW, IPS 2009

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HAI prevalence across Europe

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Prevalence</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute UTI</td>
<td>2.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>MRSA</td>
<td>0.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Other bacteria</td>
<td>3.8%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Blood, skin, bone</td>
<td>2.4%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1.9%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Other</td>
<td>4.5%</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

Epidemiology of HAI in acute hospitals

<table>
<thead>
<tr>
<th>HA Type</th>
<th>Patients</th>
<th>%</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>5</td>
<td>5</td>
<td>5.1</td>
<td>11</td>
</tr>
<tr>
<td>Other bacteria</td>
<td>2</td>
<td>2</td>
<td>1.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Acute UTI</td>
<td>15</td>
<td>15</td>
<td>13.9</td>
<td>17.5</td>
</tr>
<tr>
<td>Blood, skin, bone</td>
<td>3</td>
<td>3</td>
<td>2.1</td>
<td>5.7</td>
</tr>
<tr>
<td>Sepsis</td>
<td>6</td>
<td>6</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>3</td>
<td>2.6</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Epidemiology of HAI in acute specialties

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Patients with HAI</th>
<th>HAI Prevalence (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urology</td>
<td>8</td>
<td>8 (6.9-10)</td>
</tr>
<tr>
<td>Gastro</td>
<td>4</td>
<td>3 (2.4-5.1)</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>5</td>
<td>3 (1.9-5.1)</td>
</tr>
<tr>
<td>Orthopaedic</td>
<td>10</td>
<td>7 (5.1-10.1)</td>
</tr>
<tr>
<td>Neurology</td>
<td>2</td>
<td>2 (1.7-2.5)</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>2</td>
<td>2 (1.9-2.9)</td>
</tr>
</tbody>
</table>

What is the impact of HAI in terms of length of stay on NHS activity?

- Those patients with HAI stay in hospital 70% longer than those without
- Normal LOS varies by specialty:
  - 3.2 additional days in obstetrics
  - 13.7 days in care of the elderly

What are the costs associated with HAI?

- Almost £200 million per year in Scotland in acute hospitals in Scotland (Reilly et al 2007)
- Close to £1 billion in the rest of the UK (Plowman et al 2001)
- €billions in Europe

Towards zero HAI

- What is the irreducible minimum?
- How will we know we are there?
- New technologies and infection prevention interventions may mean that zero infections is achievable in the future?
- Need to better understand effectiveness of existing practice: Absence of evidence is not absence of effect

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Beginning to happen…

‘Insanity: doing the same thing over and over again and expecting different results.’
(Albert Einstein)

New challenges for HAI epidemiology

IPC efforts need to address all of the healthcare collectives

The epidemiology of HAI in the community

- Advancing technologies in surgery
- Changes in demography of hospital patients having surgery
- Average length of stay post op has reduced
- Many infections present after discharge from hospital

SSI: reducing incidence or length of stay?

HPS (2010) Annual report on HAI surveillance HPS, Scotland

Post discharge surveillance

HPS (2010) Annual report on HAI surveillance HPS, Scotland

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Innovative approaches

- "Your call is important to us. Please stay on the line until your call is no longer important to you."


Identifying risk factors

- **Intrinsic**
  - Research
  - Extrinsic
  - Guidance
  - Gaps


Using epidemiology to improve care

- **New approaches for new(ish) issues**

- **New approaches for new issues**
  - MRSA screening
    - Healthcare delivery system
    - Emerging technologies (TAT)
    - Effective interventions (LOS)
    - Innovative approaches (CRA)
    - Best bang for your buck?


New approaches for new(ish) issues

- **New approaches for new issues**
  - **MRSA screening**
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"Let all men know how empty and worthless is the power of kings, for there is none worthy of the name, but He whom heaven, earth, and sea obey by eternal laws" King Canute

Where will epidemiology go in the 21st century and beyond?
• A rapidly changing discipline
  – Healthcare epidemiology recognised as a specialist subject
• Molecular epidemiology
  – Refine our measurement techniques
  – Biomarkers of disease
• Genetic epidemiology
  – Post genome mapping era
  – Gene environment interactions
• Statistical models
  – Multi-factorial nature of IPC
• Implementation of the findings
  – Policy and practice

Already beginning to happen…
• Transmission of multidrug-resistant Acinetobacter baumannii (MDR-Aci) from military casualties to civilians due to shared care.
• In a recent hospital outbreak in Birmingham, six patients were colonised with MDR-Aci isolates indistinguishable using standard techniques. Used whole-genome sequencing to identify single nucleotide polymorphisms in these isolates, allowing discrimination between alternative epidemiological hypotheses in this setting

Hyping health risks?
• ’one death is a tragedy, 1000 are a statistic’


Lewis T et al (2010) High-throughput whole-genome sequencing to dissect the epidemiology of Acinetobacter baumannii isolates from a hospital outbreak JHI Vol 75, Issue 1, Pages 37-41
"It could be said for epidemiology, with respect to disease etiology and prevention, what is frequently said about democracy as a system of government: they both have many problems and weaknesses, but they still represent the best available approach for the achievement of their respective objectives."

(Trichopoulos D, Professor of epidemiology, Harvard 1996)

A word of warning

- ‘When you have two data points, it is very likely that one will be different from the other.’ Deming, 1992.
- Bad epidemiology results in inappropriate IP&C activities
  - Change the HAI definition to count fewer events. VAP rates vary from 20% to 80% with different definitions.
  - Don’t count infections if colonised on admission (universal MRSA screening is coming!)
  - Change from clinical surveillance to entirely microbiologically based computer surveillance (Rates of SSI, VAP & post op pneumonia will drop to < half)

Maintaining and developing the role of epidemiology in IPC

- New roles: clinical epidemiology, surveillance coordinator, nurse epidemiologist, molecular epidemiologist
- Epidemiology competencies (ECDC 2009)
- Healthcare epidemiology competencies (HPA 2010)
- IPS competencies (epidemiology)
- Educating society, policy makers, the media and the public

Summary of the contribution of epidemiology to the past, present and future of infection prevention and control

- Epidemiology has informed the development of infection prevention and control to date
- Current epidemiology informs us that the burden of HAI in the UK and wider Europe is a patient safety concern and there is a burden of avoidable infection in healthcare
- There is a on going need for more epidemiology in order that we might reach the irreducible minimum of HAI
- Understanding and using epidemiology to enable management and improvement is a critical component of IP&C- locally, nationally and internationally.
- Epidemiology can be expected to play a major role in the future of IPC.

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Professor Jacqui Reilly
EM Cotterall Lecture
IPS 2010