Surveillance of Antibiotic Resistance
Dr. Alan Johnson, NHS
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Surveillance of Antibiotic Resistance
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Colindale, London

Epidemiology
• The study of the distribution and determination of health-related states or events in specified populations and the application of this study to control of health problems

Epidemiology of Antibiotic Resistance
• The cornerstone of epidemiology is surveillance
• Surveillance involves collection of relevant data that inform as to the prevalence of antibiotic resistance

Making Use of Surveillance Data
• Guide empirical prescribing
• Determine burden of disease
  • Resources required
  • Future action
• Use surveillance for measuring outcomes of intervention strategies

Surveillance of Antibiotic Resistance
• Data needs to be:
  • Collected
  • Stored
  • Analysed
  • Made available
  • Acted upon

Different Approaches to the Surveillance of Antibiotic Resistance
• Continuous surveillance
• Point prevalence (“snapshot”) surveys
Surveillance of Antibiotic Resistance

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Surveillance of Antibiotic Resistance

• Scope:
  • Local/National/International

• Focus:
  • Organism
  • Disease
  • Patient groups

For surveillance to be undertaken, a source of data is required

Hospital microbiology laboratories routinely identify bacteria isolated from patients and test them for antibiotic susceptibility

Results stored on laboratory database

Sentinel laboratories

• Local testing (collection of data)
• Centralized testing (collection of isolates)

Choice of sentinel laboratories

• Geography
• Type of hospital

Standard methods

Standard panels of antibiotics tested

Continuous Surveillance in England and Wales

• Since 1974, hospitals in England & Wales have reported cases of bacteraemia to the HPA
• Since 1989, laboratories have also reported results of susceptibility testing of isolates
• Voluntary scheme


Source: routine laboratory reporting to CDSC

* 2002 is provisional data

Staphylococcus aureus

Methicillin resistance as a proportion of reports with methicillin susceptibility information

Source: routine laboratory reporting to CDSC
Mandatory Reporting of *Staphylococcus aureus* and MRSA

- From April 2001, the Department of Health made it mandatory for all acute NHS trusts in England to report
  - All cases of bacteraemia caused by *S. aureus*
  - The proportion of cases due to MRSA
- Similar schemes in England, Wales, Scotland & N. Ireland

Mandatory Reporting of MRSA Bacteraemia in England, April 2003-March 2004

- Single specialty Trusts
  - 0.09 per 1000 bed days
- General Acute Trusts
  - 0.16 per 1000 bed days
- Specialist Trust
  - 0.24 per 1000 bed days

MRSA Bacteraemia Surveillance in Wales, Oct 2001-Des 2003

- 13 Trusts (Overall MRSA rate, 43%)
- General surgery 59.8%
- ITU 57.9%
- Haematology 46.8%
- General Med 41.5%
- Trauma/orthopaedics 36.6%
- Paediatrics 6.3%

DoH Press Release: 5 November 2004

Hospital superbug must be halved

Bloodstream infections with the hospital superbug MRSA must be halved in three years, the government has said.

*Health Secretary John Reid tasked NHS hospitals with achieving a year on year reduction up to and beyond March 2008.*

MRSA bacteraemia rate in specialist Trusts (April 2002 - March 2003)

- [Graph of MRSA bacteraemia rate* in specialist trusts (April 2002 - March 2003) with 95% confidence intervals.

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Resistance Rates in Hospital Units
(Fridkin et al. CID 29:245-52, 1999)

- MRSA in the Community
  - MRSA classically a HOSPITAL problem
  - Concern that MRSA would “escape” into the community (via nursing homes?)
  - Evidence of emergence of MRSA in community unrelated to the hospital environment

- Community MRSA
  - Commonly resistant to few antibiotics
  - DNA profiles distinct from hospital strains
  - Presence of Panton-Valentine Leuocidin (PVL)

- What does C-MRSA cause?
  - Primarily: skin and soft tissue infections
  - More rarely: severe invasive disease
    - Necrotising pneumonia, bacteraemia, septic arthritis, endocarditis,
  - At risk groups
    - Children
    - Sports teams
    - Military recruits
    - Prison inmates
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Community-MRSA – Worldwide Reports

Surveillance of Antimicrobial Resistance in the Community
- Most surveillance studies use data from hospital microbiology laboratories
- Most data refers to hospitalised patients
- The majority of antibiotic use is in the community
- How do we undertake surveillance in the community?

Surveillance of Antimicrobial Resistance in the Community
- GPs prescribe antibiotics empirically
- GPs do not routinely sample patients for microbiological investigation (unless repeated treatment failure)

Q. Is International Surveillance Important?
A. Yes!
- Individuals infected or colonised with resistant pathogens may travel from one country (or continent) to another.

Surveillance of Antimicrobial Resistance in the Community
- Community surveillance via GPs?
  - Time factor (extended consultation times)
  - Would results be used just for surveillance or for patient management?
  - Would patients need to give informed consent?
  - Resources (increased costs for GPs, specimen transport, increased laboratory workloads; source of funding; etc)

Global Spread of a Multi-resistant Pneumococcal (serotype 23F) Clone

A Webber Training Teleclass
Hosted by Maria Bennallick maria@webbertraining.com
www.webbertraining.com Page 5
International Clones of Multi-resistant Pneumococci

• Using MLST, 26 clones of multi-resistant pneumococci have been recognised
• Classified by the Pneumococcal Molecular Epidemiology Network (PMEN)

PMEN Clones of Pneumococci in the UK

• All invasive pneumococci collected from a hospital in Berkshire between Jan 2000 and March 2001
• 56 patients
• 18 resistant isolates found
  • 14 ery-R were England14-9 clone
  • 3 pen-R were Spain9V-3 clone
  • 1 multi-R was Spain6B-2 clone

EARSS

• European Antimicrobial Resistance Surveillance System
• Member states of EU plus Iceland, Norway & Switzerland
• Sentinel laboratories in each country
• Two national coordinators for each country
• Resistance in nosocomial S. aureus bacteraemia and invasive S. pneumoniae from the community
• http://www.earss.rivm.nl

PEARSS 2002: MRSA Rates

Penicillin Non-susceptible Pneumococci, 1998-99

Correlation Between Out-Patient Sales of β-lactam Antibiotics and Penicillin Resistance in Pneumococci
Strategies to Reduce Antibiotic Resistance

- Antibiotic use appears to be a driving force for emergence of resistance
  - Less antibiotic use
  - Better tailored use

Macrolide-Resistance in Finland

- Reduced use from 1992 onwards was associated with reduced resistance in group A streptococci from 1994 onwards
- Erythromycin resistance in *S. pneumoniae* in Finland rose from 0.6% in 1990 to 2.4% in 1995

Declining sulphonamide use, UK

Sulphonamide resistance in *E. coli* in London

<table>
<thead>
<tr>
<th>Year</th>
<th>No</th>
<th>% Resistant</th>
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<tr>
<td>1991</td>
<td>360</td>
<td>39.2</td>
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<tr>
<td>1999</td>
<td>365</td>
<td>45.8</td>
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Strategies to Reduce Antibiotic Resistance

- Not going to be easy!

Strategies to Reduce Antibiotic Resistance

- Prevention of cross-infection
- Vaccines (e.g. pneumococci)
- Development of new antibiotics

The Next Few Teleclasses

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<tr>
<th>Date</th>
<th>Topic</th>
<th>Speaker Webinar Link</th>
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<tr>
<td>July 18</td>
<td>Infection Surveillance in the UK</td>
<td>Dr. Allan Johnson, NHS <a href="#">Link</a></td>
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<tr>
<td>July 27</td>
<td>Dermal Absorption of Alcohol Disinfectants</td>
<td>Dr. Axel Kramer, Germany <a href="#">Link</a></td>
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<td>August 17</td>
<td>The Spectre of a Flu Pandemic – Is It Inevitable?</td>
<td>Dr. Lance Jennings, New Zealand <a href="#">Link</a></td>
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<td>August 24</td>
<td>How to Assess Risk of Disease Transmission When There is a Failure to Follow Recommended Disinfection and Sterilization Principles</td>
<td>Dr. William Rutala, UNC <a href="#">Link</a></td>
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For the full teleclass schedule – [www.webbertraining.com](http://www.webbertraining.com)