Hospital Infection Control from a Developing Country’s Perspective

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Background

Known Infections
The Iceberg Effect
Unknown Infections

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Microbes & Humans

- Microbes: $5 \times 10^{31}$
  (50,000,000,000,000,000,000,000,000,000,000,000,000)
- Humans: $6 \times 10^9$
  (6,000,000,000)

Microbiology in the 21st century, ASM, 2004

Super Bugs

Original Article

Outbreak of Vancomycin Resistant Enterococcus in a Hematology/Oncology Unit in a Korean University Hospital, and Risk Factors Related to Patients, Staff, Hospital Care and Facilities

Study Finds Spread of Resistant Staph

B The Associated Press

Dangerous drug-resistant staphylococcus infections are spreading outside long-term care settings, with hospital outbreaks.

Antimicrobial resistance of Neisseria gonorrhoeae in Japan, 1993–2002: continuous increasing of ciprofloxacin-resistant isolates

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Financial Effects

- USA $ 6.65 B
- Europe € 7 B
- UK £ 1 B
- Turkey $ 1 B
### Cost Effectiveness

<table>
<thead>
<tr>
<th>Infection</th>
<th>Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAP</td>
<td>$25,072</td>
</tr>
<tr>
<td>Bacteremia</td>
<td>$23,242</td>
</tr>
<tr>
<td>Surgical Site infection</td>
<td>$10,443</td>
</tr>
<tr>
<td>UTI</td>
<td>$758</td>
</tr>
</tbody>
</table>


### Prevalence

**Developed countries**

- Canada: 11.6%
- USA: 4.6%
- UK & Ireland: 7.6%
- Switzerland: 10.1%
- France: 8.7%
- Greece: 8.5%
- Italy: 8.3%
- Cyprus: 7.9%

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Prevalence
Developing countries

Lithuania: 9.2%
Latvia: 5.7%
Albania: 11.2%
Morocco: 17.8%
Lao PDR: 11.6%
Thailand: 7.3%
Malaysia: 13.6%

Device-associated infection rates in critical care in developing countries

Table 1. Device-associated infection rates in critical care in developing countries compared with the United States National Healthcare Safety Network rates

<table>
<thead>
<tr>
<th>Surveillance network, study period, country</th>
<th>Setting</th>
<th>No. of patients</th>
<th>CLA-BSI*</th>
<th>VAP#</th>
<th>CR-UTI#</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCC, 2002–2007, 16 developing countries†</td>
<td>PICU</td>
<td>1,838</td>
<td>6.5</td>
<td>7.6</td>
<td>4.0</td>
</tr>
<tr>
<td>NHSN, 2006–2007, USA</td>
<td>PICU</td>
<td>/</td>
<td>2.9</td>
<td>2.1</td>
<td>5.0</td>
</tr>
<tr>
<td>INCC, 2002–2007, 18 developing countries†</td>
<td>Adult ICU</td>
<td>26,195</td>
<td>8.9</td>
<td>20.0</td>
<td>6.6</td>
</tr>
<tr>
<td>NHSN, 2006–2007, USA</td>
<td>Adult ICU</td>
<td>/</td>
<td>1.5</td>
<td>2.3</td>
<td>3.1</td>
</tr>
</tbody>
</table>

* Overall (point) mean infection rates/100 device-days
† INCC = International Nosocomial Infection Control Consortium; NHSN = National Healthcare Safety Network; PICU = paediatric intensive care unit; CLA-BSI = central line-associated bloodstream infection; VAP = ventilator-associated pneumonia; CR-UTI = catheter-related urinary tract infection.
‡ Argentina, Brazil, Colombia, Costa Rica, Cuba, El Salvador, India, Kosovo, Lebanon, Macedonia, Mexico, Morocco, Nigeria, Peru, Philippines, Turkey, Uruguay
§ Medical/surgical ICU.
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Reported incidence rates

Catheter-associated bloodstream infections in surveillance networks in ICUs

- NHSN: 2.7 per 1000 catheter-days (1.5/1’000 – 6.8/1’000)
- Michigan: 2.7 per 1000 catheter-days (median before intervention)
- Germany: 2.1 per 1000 catheter-days
- 18 developing countries: 8.9 per 1000 catheter-days

Status of Hospital Infection Control Measures at Seven Major Tertiary Care Hospitals of Northern Punjab
April 2010. Journal of the College of Physicians and Surgeons—Pakistan: JCPSP 2010;266-70
Source - Pubmed
Aamer Ikram - Sayed Ibrar Hussain Shah - Sajida Naseem - Show all 8 authors
Saifullah Khan Niaz

Bacterial biofilm-based catheter-associated urinary tract infections: Causative pathogens and antibiotic resistance

Nargis Sabir, MBBS - Aamer Ikram, MBBS, MCPS, FCPS, PhD, FRSTMH, FRCP, FRCPah, Gohar Zaman, MBBS, FCPS, Luqman Satti, MBBS, FCPS, Adee Gardezi, MBBS, FCPS, Abecas Ahmed, MBBS, Parvez Ahmed, MBBS, MCPS, FCPS, FRCP

AJIC 2017

AJIC 2016

Hospital Infection Control Report 2016-2015: Accepted and In Press, American Journal Infection Control (AJIC) 2016

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Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study

Lancet August 11, 2010


Gram-negative Enterobacteriaceae with resistance to carbapenem conferred by NDM-1 are potentially a major global health problem

New Delhi Metallo Beta lactamase (NDM)

- Unknown distribution of NDM producers
- Sporadic spread of NDM producers
- Outbreaks caused by NDM producers
- Endemicity of NDM producers

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Emergence of Resistance in Clinical Settings; Community

Emergence of an Extensively Drug-Resistant Salmonella enterica Serovar Typhi Clone Harboring a Promiscuous Plasmid Encoding Resistance to Fluoroquinolones and Third-Generation Cephalosporins

Emergence of Resistance in Clinical Settings; Health Care Settings

Candida auris: A rapidly emerging cause of hospital-acquired multidrug-resistant fungal infections globally

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Candida auris: A rapidly emerging cause of hospital-acquired MDR fungal infections globally

PLoS Pathog. 2017 May; 13(5)

Retail sales of carbapenem antibiotics to treat Gram-negative bacteria are increasing rapidly in India and Pakistan

Source: Based on data obtained under license from MD Health ARAS (January 2003 – December 2012). MD Health Incorporated. All rights reserved.

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Length of Stay in ICU

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean LOS</th>
<th>SD</th>
<th>Extra LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>236</td>
<td>4.31</td>
<td>+/- 2.66</td>
<td></td>
</tr>
<tr>
<td>HAI</td>
<td>120</td>
<td>15.73</td>
<td>+/- 12.69</td>
<td>11.42</td>
</tr>
<tr>
<td>VAP</td>
<td>54</td>
<td>21.89</td>
<td>+/- 14.97</td>
<td>17.58</td>
</tr>
<tr>
<td>CLABSI</td>
<td>32</td>
<td>25.88</td>
<td>+/- 17.95</td>
<td>21.57</td>
</tr>
<tr>
<td>CAUTI</td>
<td>44</td>
<td>18.04</td>
<td>+/- 15.24</td>
<td>13.73</td>
</tr>
</tbody>
</table>

Mortality Rate in ICU

Surveillance of device-associated infections in intensive care units of a tertiary care hospital. JIH 2016

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Surveillance of device-associated infections in intensive care units of a tertiary care hospital. JIH 2016

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Areas of Concern

- Legislative coverage
- Guidelines, policies
- IPC programs
- Oversight
- Training opportunities
- Infectious waste management
- Antimicrobial usage
- Clinical Auditing
- Multifaceted approach

Why infection control is important?

- Prevents transmission of infections
- Shortens patient’s stay in the hospital
- Decreases hospitalization cost
- Reduces morbidity and mortality
- Containment of AMR
- An indicator of safe care to patient
Factors involved in HAI

- The micro-organisms
- The host (patient)
- The carriers (Staff)
- The environment
- Treatment

Chain of Infection

- Patient
- Employee
- Environment
- Equipment
- Visitors

- Source
- Host

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**Infection Control Components**

- Best Practices
- Local Surveillance
- Infection Control Program
- Sterilisation and Disinfection

**Infection Control Activities**

- Surveillance & trends
- Monitoring methods of control
- Identification & Outbreak investigation
- Advice: day to day, isolation, liaison, prevention
- Management of injuries
- Auditing
- Staff Education/Immunization

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Responsibility

- Infection Control Committee
  - Infection Control team
  - Core group
- HCW
- Medical officers
- Nursing staff

Infection Control is Everyone’s Business
Preventive Measures

- Interruption of transmission of microorganisms
  - Care of equipment
- Interruption of person to person transmission
  - Hand washing
  - Barrier precautions

Why We Wash Our Hands?

Clean Hands are Healers
Dirty Hands are Killers
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Infectious waste

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Sharps

Infectious waste

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Antibiotic prescribing

- 35% of the total healthcare budget is spent on antimicrobials in developing countries versus 11% in developed countries

Antibiotics are now “endangered species” facing extinction due to the worldwide emergence of antibiotic resistance
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Where are we?

New Antimicrobials
We are here
Resistance

Years

Compliance < 40%

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An approach to infection control in developing countries

Infection Control Team/Infection Control Programme
Audit (process) & outcome Surveillance

Unsafe practices
Wasteful practices
Divert resources
Evidence Based Practice
Cost-effective

To reduce infection rate to "irreducible minimum"
Prioritizing risks

<table>
<thead>
<tr>
<th>SEVERITY</th>
<th>FREQUENCY</th>
<th>Risk Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High severity Low frequency (Blood stream infections)</td>
<td>High severity High frequency (Blood-borne infections from re-use of syringes &amp; needles)</td>
<td></td>
</tr>
<tr>
<td>Low severity Low frequency (Infections from linen)</td>
<td>Intermediate severity High frequency (Surgical site infections)</td>
<td></td>
</tr>
</tbody>
</table>

Cost Saving Measures

- **Routine**
  - Microbiological Swabbing of environment
  - Disinfectants for environmental cleaning e.g. floors & walls
  - Fumigation of isolation room with formaldehyde

- **Unnecessary**
  - Use of overshoes and dust attracting matt
  - Personal Protective Equipment in the Intensive Care, & Neonatal Unit

- **Excessive/unnecessary use of**
  - IM/IV injections
  - Insertion of indwelling devices e.g. IV lines, urinary catheters, nasogastric tube
  - Antibiotics both for prophylaxis and treatment

[Damani NN. Journal of Hospital infection 2007; 65(S1): 153-154.]
Cost Effective Practices

- Education and practical training in
  - Hand hygiene
  - Aseptic technique
  - Appropriate use of PPE
  - Sharp use and disposal in robust containers
- Provision of alcoholic hand rub and hand washing facilities for hand hygiene
- Use of adequately sterile items for invasive procedures
- Use of single-use disposable sterile needles and syringes
- Adequate decontamination of items/equipment between patients
- Provision of Hep B vaccination for healthcare workers
- Post exposure management of healthcare workers

Containment of AMR

Requires Global Efforts

International level

- WHO Containment of AMR 2015
  - (Global Action Plan for AMR)
- UN general Assembly high level meeting on AMR 2016
- Collaboration between countries; GARP
WHO Initiatives

- Increased collaboration between governments, nongovernmental organizations, professional groups and international agencies
- Networking that undertake surveillance of antimicrobial use and AMR
- International approach for control of counterfeit drugs
- Incentives for R&D for new drugs and vaccines
- Forming new, and reinforcing existing programmes to contain AMR

Regional Initiatives

- Regional Committee meeting in Timor Leste 2015
  - Member states passed a key resolution for steadfast political commitment and multi-sectoral coordination to tackle AMR
- Jaipur Declaration 2011 on AMR
  - Calls for comprehensive action against the irrational use of antibiotics
- Berlin declaration 2017
  - G20 health ministers in 2017 recognized the increasing threat of AMR
  - Members pledged to develop national action plans to tackle AMR, in line with the One Health approach, with interventions aimed at agriculture, livestock, and human health

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Containment of AMR

- National
  - Joint policies/guidelines from health ministry, agriculture & environment
  - National policy implementation
  - Advocacy and dissemination of information
- Role of professional bodies
- Community and Individual
- Public Private Partnership

National Strategies

National Committee to work in coordination with regulatory bodies:
- AMR surveillance & antimicrobial utilization
- Evaluate the impact of AMR preventive and control strategies
- Register all dispensing outlets
- Ensure availability of antimicrobials with prescription only
- Bind legally all manufacturers to report data on antimicrobial distribution
- Enhance coverage of immunization
- Develop national action plans and allocate resources
Community Level

- IC in community (Public Health)
  - Hand washing
  - Sanitation
  - Clean drinking water (chlorination)
  - Immunization

Health Care Settings Level

Establish an IPC Committee

12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults

Clinicians hold the solution…
Take steps NOW to prevent antimicrobial resistance!

1. Break the chain
2. Isolate the pathogen
3. Treat infection, not colonization
4. Treat infection, not contamination
5. Practice antimicrobial control
6. Use local data
7. Use antimicrobials wisely
8. Diagnose & treat effectively
9. Prevent transmission
10. Isolate when needed
11. Know when to say "no" to vanco
12. Get the catheters out
13. Target the pathogen
14. Access the experts
15. Vaccinate

Good Microbiology Practices

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Laboratory and its Role in Containment of AMR

Early identification of microorganisms and fast reporting of antimicrobial susceptibility result

Laboratory Quality Management System
Laboratory Information System
Data Management and Analysis

AMR Surveillance

Clinical bacteriology in low-resource settings: today’s solutions

Sian Umbach*, Jean Baptiste Ronnet*, Timothy Walsh, Cobie Ferguson, Jennifer Cox, Erik Vliegh, Delphine Marty, Melinde Serrat, Olinan Vanpoucke, Jim Jacobs, on behalf of the Bacteriology in Low Resource Settings working group

Low-resource settings are disproportionately burdened by infectious diseases and antimicrobial resistance. Good quality clinical bacteriology through a well functioning reference laboratory network is necessary for effective resistance control, but low-resource settings face infrastructural, technical, and behavioural challenges in the implementation of clinical bacteriology. In this Personal View, we explore what constitutes successful implementation of clinical bacteriology in low-resource settings and describe a framework for implementation that is suitable for general referral hospitals in low-income and middle-income countries with a moderate infrastructure. Most microbiological techniques and equipment are not developed for the specific needs of such settings. Pending the arrival of a new generation diagnostics for these settings, we suggest focus on improving, adapting, and implementing conventional, culture-based techniques. Priorities in low-resource settings include harmonised quality assured, and localised equipment, consumables, and techniques, and rationalised bacterial identification and testing for antimicrobial resistance. Diagnostics should be integrated into clinical care and patient management, clinically relevant specimens must be appropriately selected and prioritised. Open-access training materials and information management tools should be developed. Also important is the need for onsite validation and field adoption of diagnostics in low-resource settings, with considerable shortening of the time between development.
Challenges to Overcome

- Infections beyond health care facilities
- Congregate settings and in community (carriers of MDR organisms)
- Lack of responsibility and accountability
- Deficient IPC support in congregate settings
Way Forward

- Infection Prevention & Control Program
- Diagnostic Stewardship
- Antibiotic Stewardship
- Risk assessment of AMR in the food chain, environment in a public health perspective
- A higher profile research on IC and AMR in health care settings
- Enough funding for research to address current gaps

Good Infection Control Practices

- Aseptic technique for all sterile procedures
- Remove indwelling devices when no longer needed
- Isolation of patient with communicable diseases/multi-resistant organism
- Placing mechanically ventilated patients in a semi-recumbent position
- Minimize number of people in OT
- Staff education and training

Damani NN. Journal of Hospital infection 2007; 65(S1): 151-4
Policies

- Policy for hand hygiene
- Policy of Hepatitis B vaccination
- Disinfectant policy
- Needle stick injury policy
- Waste management policy

Impact of Staff Education Programme on Ventilator-associated Pneumonia

Reduction in incidence of VAP from 13.2 to 6.5 episodes /1000 ventilator days

Salahuddin N et al. / Hosp Infect 2004;57: 223-227

Reduction in incidence of VAP from 12.6 to 5.7 episodes /1000 ventilator days


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SENIC
Study on the Efficacy of Nosocomial Infection Control

- 1 infection control nurse per 200 to 250 beds
- 1 hospital epidemiologist per hospital (1000 beds)
- Organized surveillance for nosocomial infections
- Feedback of nosocomial infection rates


IC–Quarterly Report

1. Period: ____________________
2. Hospital / Institute: ____________________
3. Hospital Classified as: ____________________
4. In Charge: ____________________

5. Infection Control Committee:
   Composition
   President: ____________________
   No. of Members: ____________________
   Administrative Officer member ICC: ____________________
   Nursing Officer member ICC: ____________________
   Is any of the sanitary staff member: ____________________
   Last infection control meeting held on: ____________________

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Nosocomial infections in NICU

- Active involvement of mother in regular monitoring of babies
- Strict hand washing before and after handling babies
- Co-bedding of mother and infant (use of a heated cot as required & minimum use of incubators)
- Encourage breast feeding (less need for Parenteral feeding)
- All procedures were undertaken by trained nurse
- Minimal visitors

Infection Control & Quality Healthcare in the New Millenium

Multidisciplinary team approach

1847
1863
1958
1970
1980
1990
2000

Pittet D, Am J Infect Control 2005, 33:258

Message

Continuous surveillance
Judicious antibiotic monitoring
Proper infection control policies
Strict implementation
Stringent sterilization & disinfection
Regular auditing
Efficient Infection control network
Apposite waste disposal

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