Hardware or Software? Interventions for a Sustainable Infection Control Programme
Prof. Joost Hopman, Radboud University Medical Centre, Netherlands
A Webber Training Teleclass

Joost Hopman, MD, DTMH
Consultant Microbiologist, Head of Infection Control Unit
Radboud University Medical Centre Nijmegen, The Netherlands
Senior Lecturer Community Health, Stellenbosch University, South Africa

Hosted by Claire Kilpatrick
WHO Infection Prevention and Control Global Unit

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Learning Objectives

1. Identify components of infrastructure that could be improved from IPC perspective
2. To evaluate quality monitoring systems for cleaning and disinfection
3. Compare interventions in high and low resource settings

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Infectiepreventie=Teamwork

- Prof. Andreas Voss
- Prof. Shaheen Mehtar (ICAN, Stellenbosch University)
- Prof. Benedetta Allegranzi (Infection Control Unit – WHO HQ)
- Prof. Hans van der Hoeven
- Drs. Cathy van Beek
- Prof. Paul Verweij/Prof. Fred Sweep/Prof. Heiman Wertheim
- Prof. Stefaan Berge
- Prof. Robert Sauerwein
- Dr. Jack Meintjes (Stellenbosch University)
- Dr. Alma Tostmann
- Dr. Chantal Bleeker-Rovers
- Drs. Nannet van der Geest
- Dr. Janette Rahamat
- IPC unit Tygerberg hospital
- Afdeling Service bedrijf
- Afdeling Medische microbiologie

Why infection prevention?

Fu Qiao, MD
Infection Control Practitioner
West China Hospital, 4300 beds,
Sichuan University.

Resistentie

Wensen Chen, MPH, MBBS
Jiangsu Province Hospital, 3000 beds

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China- CARSS surveillance data
1338 hospitals

4th Netherlands, 2014, *E. coli* Cephalosporin resistance 5.7%

EU, 2014, *E. coli* Cephalosporin resistance 12%

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Infection prevention = Risk reduction

Future of Hospitals
less Bricks, more Bytes, and a different Behaviour

less and Safer Bricks, more Bytes, and a different Behaviour

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Behavior

Behavior in IPC

- Hand hygiene
- Compliance with standard precautions
- Compliance with transmission based precautions
- Adherence to cleaning and disinfection protocols

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Implementation

SAVE LIVES: Clean Your Hands - WHO's global annual call to action for health workers

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Radboudumc Campaign

- Clear message and strong leadership
  - Board of directors and Department leadership

- Intake meetings with head of departments
- Advisory board: chair Medical staff, chair nursing staff, chair patient advisory council
- Choice of Module A module B
  - A: Infrastructure, education, feedback of compliance data
  - B: A + accountability culture

- Evaluation meetings with head of department

35 clinical departments
2 departments module B

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Infrastructure

- Technical improvements:
  - Beddispensers and walldispensers
  - Addressing allergy and allergy prevention
  - Standardized instructions
  - Reminders
  - Rules with regard to clothes and jewelry:
  - Foam, gels and different flavors of disinfectants
Why Handdisinfection?

All clinical departments:
  Staff - head IPC
  Nursing -IPC nurse

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Awareness in the departments

- IPC linked nurses
  - Internally educated on IPC
  - Central figure for IPC in the department
  - Supervised by IPC nurse
- Hospital wide meetings with linked nurses from all departments
  - Themes
  - Difficulties, challenges and best practices

Measuring Hand hygiene Compliance

Baseline in 2011: 4 major departments 38% compliance
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Patient participation

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Next steps hand disinfection in 2016

- Focus on OPD
- Keeping up good practices
  - Leadership/role models
  - Accountability for behavior
  - Patient participation for specific patient groups
  - Sharing of best practices

Conclusion

- Multi-modal approach of WHO can be highly effective:
  - Facilitate towards an optimal infrastructure
  - Compliance Measurements and Feedback
  - Education of HCW is underestimated
- Hospital-Leadership:
  - Full support
  - Personal commitment
  - Adequate Budget

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Detection of Transmission in NICU
DNA Markers as Surrogate Indicators

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Lessons from history

Removal of the 'Cholera' handle of the Broad Street Pump, London, 1854

Edmonds, et al, Applied Microbiology, 1972


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ICU in Radboudumc

- Radboud university medical center: 953 patient beds
- 50 single bed ICU rooms, 35 beds operational
- Selective digestive tract decontamination (SDD)\(^1\)
- Low MRSA and VRE rates
- Standard contact precautions
- Increasing global resistance (GNB)
- 2 outbreaks related to the sinks
  - *Klebsiella pneumoniae* ESBL
  - *Enterobacter cloacae* ESBL

\(^1\)N Engl J Med 2009; 360:2138-2141, may 2009

Study methods

- **Study design**: intervention study
- **Objective**: to investigate the effect of the removal of all hand washing sinks from the patient rooms at the Intensive Care unit on the MDRO colonisation rate in ICU patients
- **Study period**:
  - Pre-intervention study period: 12 months prior to sink removal
  - Post intervention period: 12 months after sink removal
- **Intervention**: In the summer of 2014, hand washing sinks were removed from all patient rooms at all intensive care units and a 'water-free' method of patient care was introduced.

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Methods

- **Patient selection:** All patients admitted at the ICU during the pre or post intervention periods
- **Length of stay:** Investigate the effect of prolonged LOS on colonization
- **Selective digestive tract decontamination:** routine weekly screening
  - Gram negative Bacilli (GNB)
  - Yeast

- **Main outcome measures:**
  1. The MDRO colonization rate:
     \[
     \frac{\text{the number of primary positive microbiological results}}{1000 \text{ ICU admission days}}
     \]
  2. Colonisation rate ratio:
     \[
     \frac{\text{colonisation rate post-intervention}}{\text{colonisation rate pre-intervention}}
     \]

Results

<table>
<thead>
<tr>
<th>Pre-intervention</th>
<th>Intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2013 - May 2014</td>
<td>September 2014 - August 2015</td>
<td></td>
</tr>
<tr>
<td>1351 patients</td>
<td>1307 patients</td>
<td></td>
</tr>
<tr>
<td>Median age 62 y [IQR 50-70]</td>
<td>Median age 63 y [IQR 52-71]</td>
<td></td>
</tr>
</tbody>
</table>
ICU-room pre-intervention

ICU-room post-intervention

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Segmented regression analysis of the interrupted time series data

Statistically significant immediate effect on the colonisation rate of gram negative bacilli, but not on the colonisation rate of yeasts

Conclusion

This study showed that removal of the hand washing sinks from all patient rooms at the ICU and the introduction of ‘water-free’ patient care resulted in a statistically significant decrease of patient colonization with ICU-acquired GNB.

This decrease in patient colonization was even more apparent for patients with an increased LOS. J.Hopman, et al, unpublished data

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Anti-bacterial coating of surfaces?

Nano-coating toetsenborden

J. Hopman, et al, unpublished data

Cleaning and disinfection

Ghana

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Sierra Leone

Kenya

Nederland

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Evidenced based medicine

Evidenced based cleaning?

MRSA-positive patients tend to shed their own strain of MRSA into the near-patient environment.

- Two-thirds of HCW will acquire the patient’s strain on gloved hands or apron.
- Without direct contact 4 out of 10 will still exit the room carrying the patient’s strain of MRSA on hands or apron.

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Reduction in Acquisition of Vancomycin-Resistant Enterococcus after Enforcement of Routine Environmental Cleaning Measures
Mary K. Kendal, Mark J. M. Benton, Donald W. Blom, Elizabeth A. Lyda, David A. M. C. van de Vijver, and Robert A. Wolkstein.

Background. The role of environmental contamination in nosocomial cross-transmission of antibiotic-resistant bacteria has been unravelled. Using vancomycin-resistant enterococci (VRE) as a marker organism, we investigated the effects of improved environmental cleaning with and without promotion of hand hygiene adherence on the spread of VRE in a medical intensive care unit.

Methods. The study comprised a baseline period (period 1), a period of educational intervention to improve environmental cleaning (period 2), a “washout” period without any specific intervention, and a “recovery” period obtained from patients in two similar medical intensive care units.

Results. Mean proportion of positive results of cultures of environmental and hand samples decreased in period 2 and remained low thereafter. In a Cox proportional hazards model, the hazard ratios for acquiring VRE during periods 2–4 were 0.34 (95% confidence interval, 0.19–0.61); the only determinant explaining the difference in VRE acquisition was admission to the intensive care unit during period 1.

Conclusions. Decreasing environmental contamination may help to control the spread of some antibiotic-resistant bacteria in hospitals.

Mean proportion of positive results of cultures of environmental and hand samples decreased in period 2 and remained low thereafter.

CID 2006;42 June Hayden

Distribution of multi-resistant Gram-negative versus Gram-positive bacteria in the hospital inanimate environment

*Department of Infection Control, University Hospital Aachen, 52075 Aachen, Germany
†Institute of Medical Statistics, University of Technology, 52074 Aachen, Germany
Department of Medical Microbiology, University Hospital Aachen, 52075 Aachen, Germany

The environmental detection rate for MRSA or VRE was 24.7% compared with 4.9% for multi-resistant gramnegative bacteria.

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“The most common nosocomial pathogens (gram positives and Enterobacteriaceae) may well survive or persist on surfaces for months and can thereby be a continuous source of transmission if no regular preventive surface disinfection is performed.”

Sources for transmission

- **DIRECT**
  - Hands- contact
  - Nasal-droplet
  - Throat- droplet
  - Stool-aerosol

- **INDIRECT**
  - Bedpans/urinals
  - Dressing trolleys
  - Mattresses
  - Mops & buckets
  - Hand disinfection equipment

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What is included in housekeeping?

• Differs from one country to another and from one hospital to another
• Housekeeping falls under a separate section and is not a nursing duty
• However, the nurse-in-charge is responsible for the cleanliness of the ward and surrounding areas.
• Time pressure, number of nurses available!!

Housekeeping

• Cleaning of the ward and surrounding areas
• Removal of waste
• Removal of linen
• Stocks of fresh linen
• Replacing waste containers
• Replacing hand decontamination items
• Cleaning ward disinfectors
• Cleaning non clinical equipment
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Systems to evaluate environmental cleanliness, process indicators

- Visual inspection
- ATP
- Fluorescence marker
- Microbiology
  - Bacterial or viral culture
  - PCR

Average RLU cleaned by domestic staff were 64% lower compared with surfaces cleaned by clinical supportive staff

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ATP Sampling

- Rapid
- Use it for training
- Low variation in samples
- Biological contamination is not synonymous with microbiological contamination!

Finding a benchmark for monitoring hospital cleanliness

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Bacterial culture

Laboratory

- Culture of bacteria → susceptibility testing, molecular typing
- Availability of a lab and trained personnel
- Slow

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Barriers and bridges to infection prevention and control: results of a qualitative case study of a Netherlands’ surgical unit

Chantal Backer,1 Patricia B Moon2 Naemi Kroonman,3 Gariff Taylor,4 Anne Salas,5 Marc J M Borlen,5 Ada C M Grijpmaal-Bakker2

ABSTRACT

Objective: To describe the work environment infection prevention and control (IPSC) practice at the target surgical unit. To clarify the barriers and bridges to IPSC that healthcare workers identify in visualisation of their work environment and to collect monthly specific IPSC-related observations.

Design: This qualitative case study analyses a socio-psychological approach to health services, informed the research design and provided a framework to better understand the complexity of implementing effective IPC.

Setting: The study was conducted in a surgical unit at a hospital. The study involved healthcare workers from the various surgical wards of the hospital.

Methods: Research methods included semi-structured interviews (n=2) and collection of relevant and supporting procedures. The case study included photo-diary of the work of the unit (n=10). The final participant was the head of the unit (IPSC-related observations).

Results: The findings illustrate some challenges and circumstances present that may influence the work environment of healthcare workers, including the need to observe and coordinate the implementation of infection control measures.

Key messages: The findings indicate some conditions and circumstances that could influence the work environment of healthcare workers, including the need to observe and coordinate the implementation of infection control measures.

Keywords: Barriers, bridges, IPSC, surgical unit, work environment.
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Effect of surface coating and finish upon the cleanability of bed rails and the spread of Staphylococcus aureus
S. Ali, G. Moore*, A.P.R. Wilson
Department of Clinical Microbiology, University College London Hospital, London, UK

SUMMARY
Background: Bacterial reservoirs in the near-patient environment are likely vectors of healthcare-acquired infections.
Aim: To conduct a laboratory-based study to confirm a previous clinical finding of higher numbers of bacteria on plastic than on painted steel bed rails.
Methods: Six different surfaces were inoculated with Staphylococcus aureus suspended in a range of synthetic swab eluates and incubated for 48 hours. The number of colonies on different substrates was counted.

Transfer from rail to fingertip ranged from 22%-38%

Mechanical vs manual cleaning of hospital beds: a prospective intervention study
J. Hopman*, M. Nillesen*, E. de Both*, J. Witte*, S. Teerenstra*, M. Hulscher*, A. Voss, A. P
1 Department of Medical Microbiology, Radboud University Medical Centre, Nijmegen, The Netherlands
2 Department of Process Improvement and Innovation, Radboud University Medical Centre, Nijmegen, The Netherlands
3 Scientific Institute for Quality of Healthcare, IQ Healthcare, Radboud University Medical Centre, Nijmegen, The Netherlands
4 Department for Health Evidence, Section Biostatistics, Radboud University Medical Centre, Nijmegen, The Netherlands
5 Department of Medical Microbiology and Infectious Diseases, Canisius-Wilhelmina Hospital, Nijmegen, The Netherlands

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Training of domestic service personnel

Fig. 1

Mechanical versus manual bed cleaning

J. Hopman et al, JHI 2015

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Mechanical versus manual bed cleaning

Fig 3

A

B

Bed cleaning

% of positive cultures (% RLQ)

Type of cleaning

manual (n=150)

mechanical (n=150)

J.Hopman et al, JHI 2015

Manual cleaning of hospital mattresses: an observational study comparing high- and low-resource settings

J. Hopman\textsuperscript{a,b,c}, B. Hakizimana\textsuperscript{b}, W.A.J. Meintjes\textsuperscript{b}, M. Nillesen\textsuperscript{a}, E. de Both\textsuperscript{a}, A. Voss\textsuperscript{a}, S. Mehtar\textsuperscript{b}

\textsuperscript{a}Department of Medical Microbiology, Radboud University Medical Center, Nijmegen, The Netherlands
\textsuperscript{b}Academic Unit for Infection Prevention and Control, Division of Community Health, Department of Interdisciplinary Health Sciences, Faculty of Medicine and Health Sciences, Stellenbosch University, South Africa
\textsuperscript{c}Department of Medical Microbiology and Infectious Diseases, Radboud University Medical Center and Curaçao--Wilhelmina Hospital, Nijmegen, The Netherlands

J.Hopman, JHI 2015

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Adenosine triphosphate (ATP) levels (relative light units: RLU) measured before and after manual cleaning in South Africa under ‘routine’ circumstances. Measurements of three locations on 96 beds.

Adenosine triphosphate (ATP) levels (relative light units: RLU) measured on three locations on 150 beds in The Netherlands and 96 beds in South Africa after manual cleaning under ‘routine’ circumstances. ns, not significant.
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Tygerberg Academic Hospital: percentage of beds with <250 relative light units (RLU) measured by ATP categorized by type of detergent used for cleaning. Fresh Soap, N = 26; Combination, N = 4; Sparkle, N = 34; Handysan, N = 24; D-germ, N = 2; Bioscrub, N = 6

Table I
Factors associated with adenosine triphosphate levels >250 RLU after cleaning (N = 96 beds)

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%)</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beds in wards with a very high turnover</td>
<td>31 (32.3)</td>
<td>7.3 (2.1–25.6)</td>
<td>0.001</td>
</tr>
<tr>
<td>Highly contaminated beds before cleaning</td>
<td>22 (22.9)</td>
<td>6.5 (1.9–21.6)</td>
<td>0.002</td>
</tr>
<tr>
<td>Beds cleaned with disinfectants</td>
<td>8 (8.3)</td>
<td>14.6 (3–71.7)</td>
<td>0.001</td>
</tr>
<tr>
<td>Beds cleaned by a trained person</td>
<td>18 (18.8)</td>
<td>0.1 (0–2.1)</td>
<td>0.043</td>
</tr>
<tr>
<td>Beds cleaned by dedicated cleaners</td>
<td>12 (12.5)</td>
<td>0.2 (0–3.5)</td>
<td>0.133</td>
</tr>
</tbody>
</table>

RLU, relative light units; OR, odds ratio; CI, confidence interval.

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Conclusions

**less and Safer** Bricks, more Bytes, and a different Behaviour

- Standardized infection prevention is essential for implementation
- Focus on 3 pillars:
  - Hand hygiene and standard precautions
  - Transmission-based precautions
  - Cleaning and disinfection

- Included in nursing and MD programs!
- Hospital design and infrastructure has major impact on IPC
  - High resource settings
  - Low resource settings
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Keep it empty!

Coming Soon

September 26  (Free Teleclass – Broadcast live from the annual conference of the Infection Prevention Society – www.ips.uk.net)
HOW CAN WE IMPROVE IMPROVEMENT?
Dr. Mary Woods, University of Cambridge Academy of Social Sciences

September 27  (Free Teleclass – Broadcast live from the annual conference of the Infection Prevention Society – www.ips.uk.net)
Debate: ARE CONTACT PRECAUTIONS ESSENTIAL FOR THE MANAGEMENT OF PATIENTS WITH MDROs?
Prof. Eli Perencevich, University of Iowa & Dr. Fidelma Fitzpatrick, Royal College of Surgeons in Ireland

September 28  (Free Teleclass – Broadcast live from the annual conference of the Infection Prevention Society – www.ips.uk.net)
USING SCIENCE TO GUIDE HAND HYGIENE SURVEILLANCE AND IMPROVEMENT
Prof. Eli Perencevich, University of Iowa

www.webbertraining.com/schedulept1.php

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