

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

Hardware or software? Interventions for a sustainable infection control programme

Joost Hopman, MD, DTMH

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Radboud University Medical Centre Nijmegen, The Netherlands
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Hosted by Claire Kilpatrick
WHO Infection Prevention and Control Global Unit



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September 22, 2016

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?



2016 Delegation

- Wensen Chen, MPH, MBBS, Jiangsu Province Hospital (China)
- Jehan El Kholy, MD, Cairo Medical School (Egypt)
- Vandana Kalwaje Edwaras, PhD, FRCPE, MD, MBBS, Kasturba Medical College (India)
- Corey Forde, DM, MBBS, Queen Elizabeth Hospital (Barbados)
- Jan Grallert, PhD, Clinical Excellence Commission (Australia)
- Ahmed Mohammed Hakawi, MD, King Fahad Medical City (Saudi Arabia)
- Joost Hopman, DTMH, MD, Radboud University Medical Center (Netherlands)
- Amer Iqbal, FRCPath(UK), FRCPE(Edin), MChB, FRCM(Microbiology), BSc, MBBS, PhD, Armed Forces Institute of Pathology (Pakistan)
- Susan Sale, Prince of Wales Hospital (Australia)
- Uday Kelkar, Diploma in Management, MD, MBBS, Central Government Health Scheme, Govt of India, (India)
- Thana Khawcharoenrat, MSc, MD, Thammasat University (Thailand)
- Rosalinda Khabiberto Lusi, MD, PhD, Santa Casa de São Paulo School of Medical Sciences (Brazil)
- Sujan Babu Marahatta, PhD, Harmanan Memorial Institute of Health Sciences (Nepal)
- Nathalie McMorris, MSc, DM, MD, MBBS, National Public Health Laboratory (Zimbabwe)
- Hbogori Maurice Maruga, BSN & PH, Infection Prevention Network Kenya (Kenya)
- Philip Oluyiwola Oshun, FRCPath, MPH, MBBS, Lagos University Teaching Hospital (Nigeria)
- Fu Qiao, MD, West China Hospital, Sichuan University (China)
- Ratna Rao, CIC, MD, Apollo Hospital, Hyderabad (India)

Fu Qiao, MD

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



Wensen Chen, MPH, MBBS

Jiangsu Province Hospital, 3000
 beds

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China- CARSS surveillance data

1338 hospitals

Year	MRSA (%)	CTX-R-ECO (%)	IMP-R-PA (%)	IMP-R-AB (%)
2012	45.8	69.7	25.4	37.1
2013	56.5	66.6	22.3	35.7
2014	54.5	60.0	20.0	36.0
2015	58.0	60.3	21.3	35.8

SURVEILLANCE REPORT Antimicrobial resistance surveillance in Europe 2014


Table 3.4. *Escherichia coli*. Total number of invasive isolates tested (N) and percentage with resistance to third-generation cephalosporins (CR), including 95% confidence intervals (95% CI), EU/EEA countries, 2011-2014.

Country	N	%	95% CI	N	%	95% CI	N	%	95% CI	N	%	95% CI
Netherlands	4498	5.7	5.2-6.2	4295	6.1	5.6-6.6	3949	5.8	5.3-6.3	4401	5.7	5.2-6.2
EU/EEA	94	9.4	8.0-10.8	813	9.9	9.2-10.6	102	9.8	8.9-10.7	88	9.8	8.9-10.7

4^{de} Netherlands, 2014, *E. coli* Cephalosporine resistance 5,7%

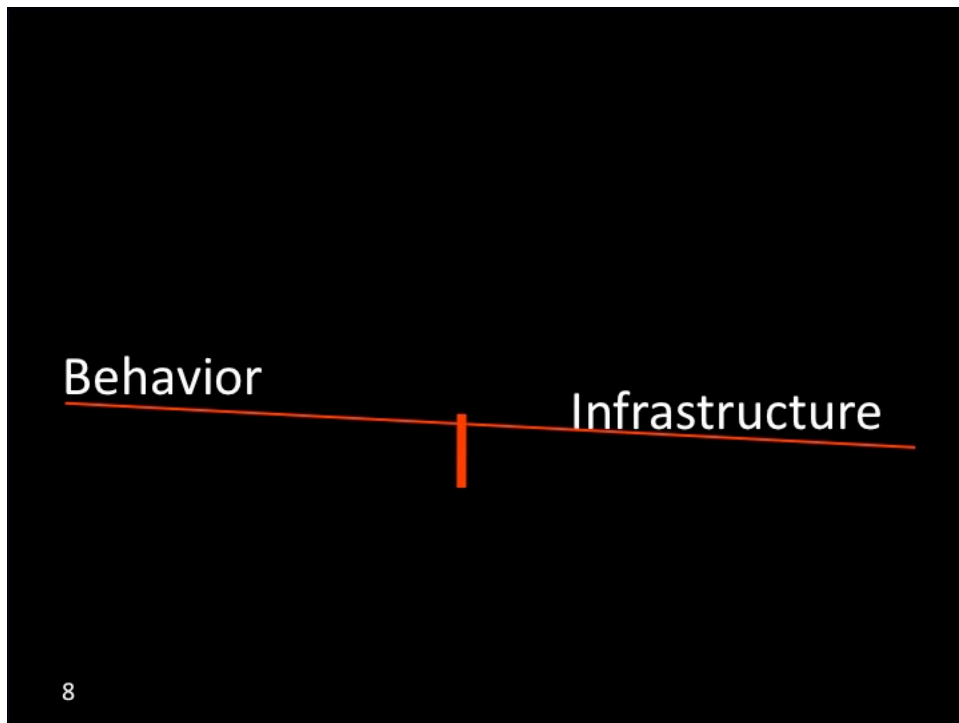
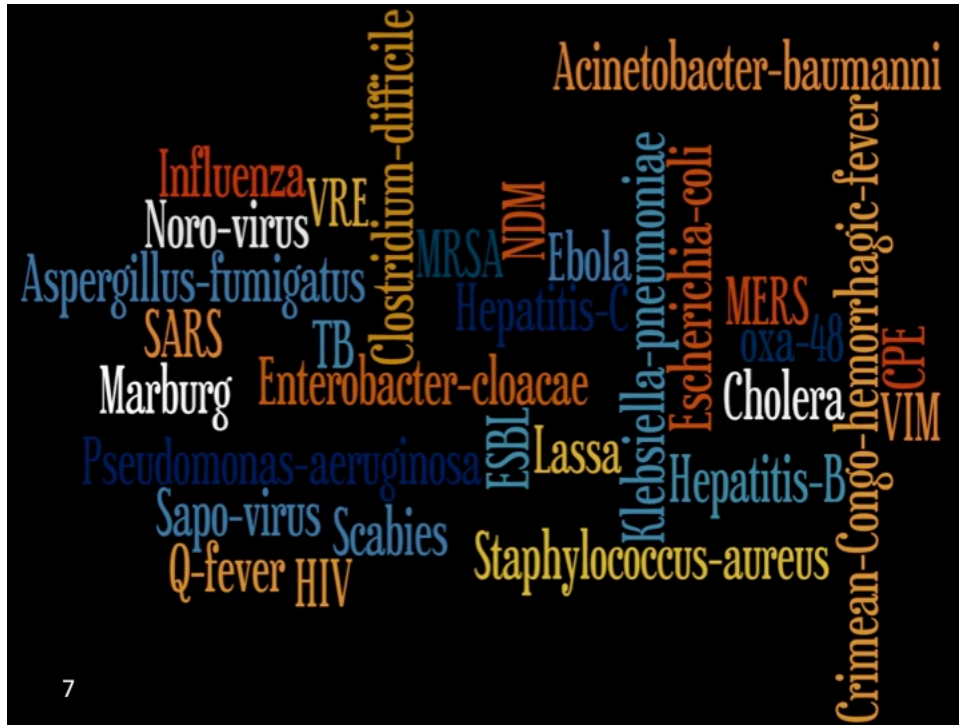
EU, 2014, *E. coli* Cephalosporine resistance 12%

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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 in IPC

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




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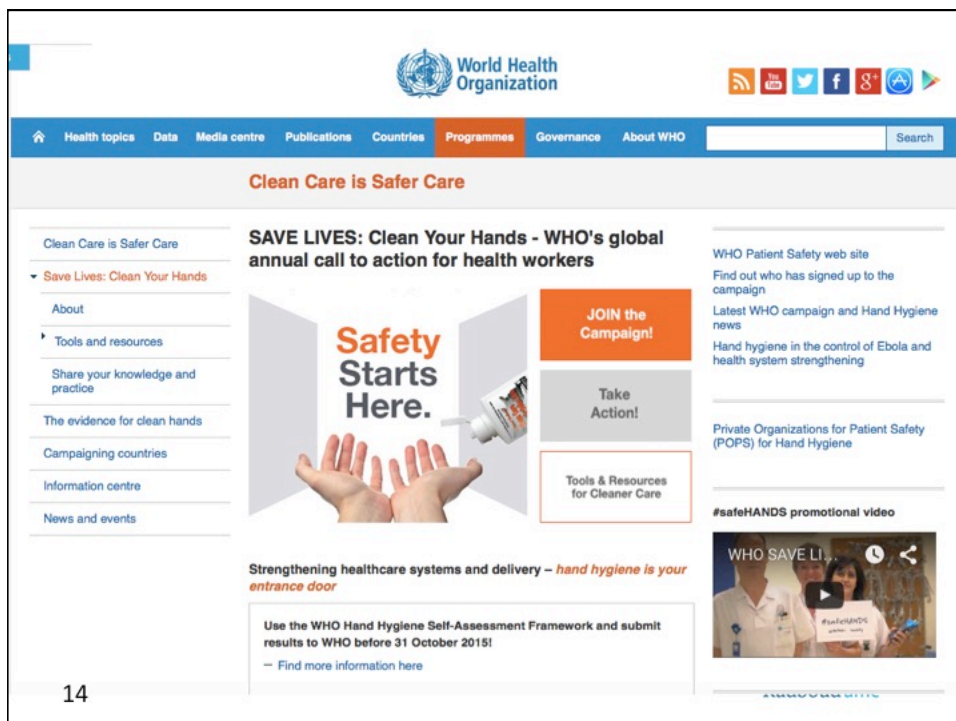
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Implementation



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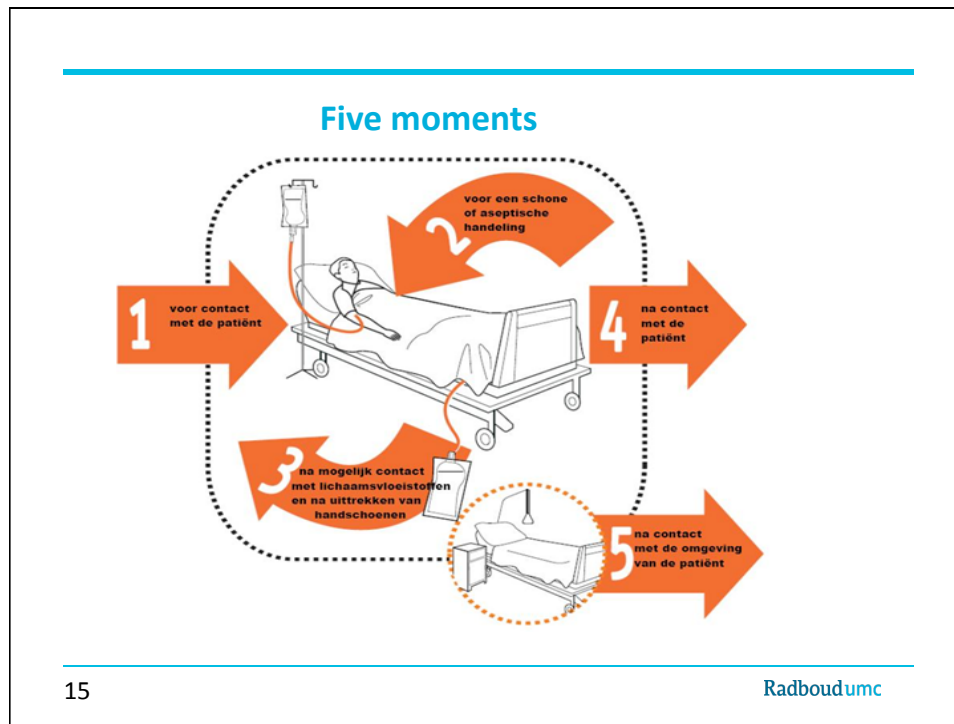


The screenshot shows the WHO website's 'Clean Care is Safer Care' campaign page. At the top, the WHO logo and navigation menu are visible. The main heading is 'Clean Care is Safer Care'. Below it, the campaign title reads 'SAVE LIVES: Clean Your Hands - WHO's global annual call to action for health workers'. A central graphic features the text 'Safety Starts Here.' with an image of hands being washed. To the right of the graphic are buttons for 'JOIN the Campaign!', 'Take Action!', and 'Tools & Resources for Cleaner Care'. A sidebar on the left lists navigation options like 'About', 'Tools and resources', and 'Share your knowledge and practice'. On the right, there are links to 'WHO Patient Safety web site', 'Latest WHO campaign and Hand Hygiene news', and a '#safeHANDS promotional video'.

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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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The screenshot shows the Radboudumc intranet interface. The main content area is titled 'Handdesinfectie' and includes a sub-header 'Laat je aanspreken op onderstaande punten'. Below this, there is a list of bullet points providing instructions on hand hygiene, such as 'Desinfecteer je handen met de juiste techniek' and 'Handen worden uitsluitend gewassen bij zichtbare vuiltoesetting'. To the right of the main text, there are several sidebar sections: 'Heb jij de juiste techniek?' with an image of hands being washed, 'Contactpersonen' with a list of roles, and a 'Toolbox' containing various resources like 'Dreucite handdesinfectie' and 'Inhoudsopgave afdeling'. At the bottom left of the page, the number '17' is displayed, and at the bottom right, the 'Radboudumc' logo is visible.

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

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Reminders



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Education

Why Handdisinfection?

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

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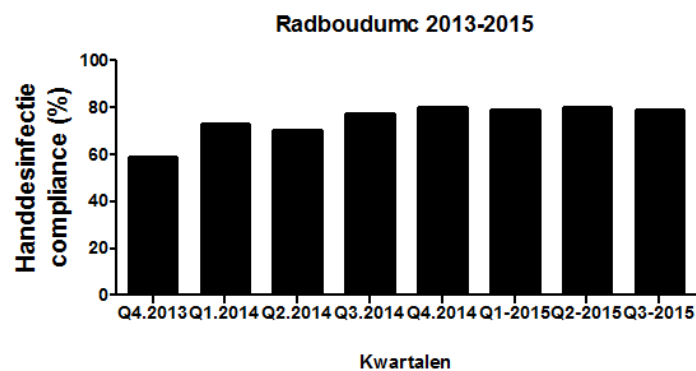
Awareness in the departments

- 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

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Measuring Hand hygiene Compliance

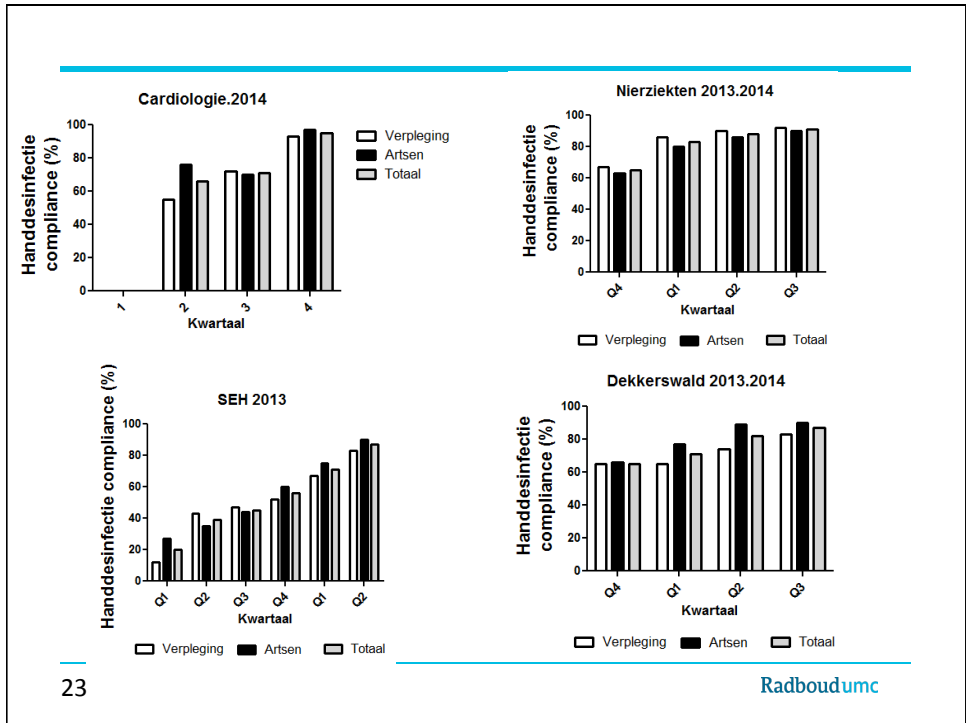


Baseline in 2011: 4 major departments 38% compliance

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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

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Conclusion

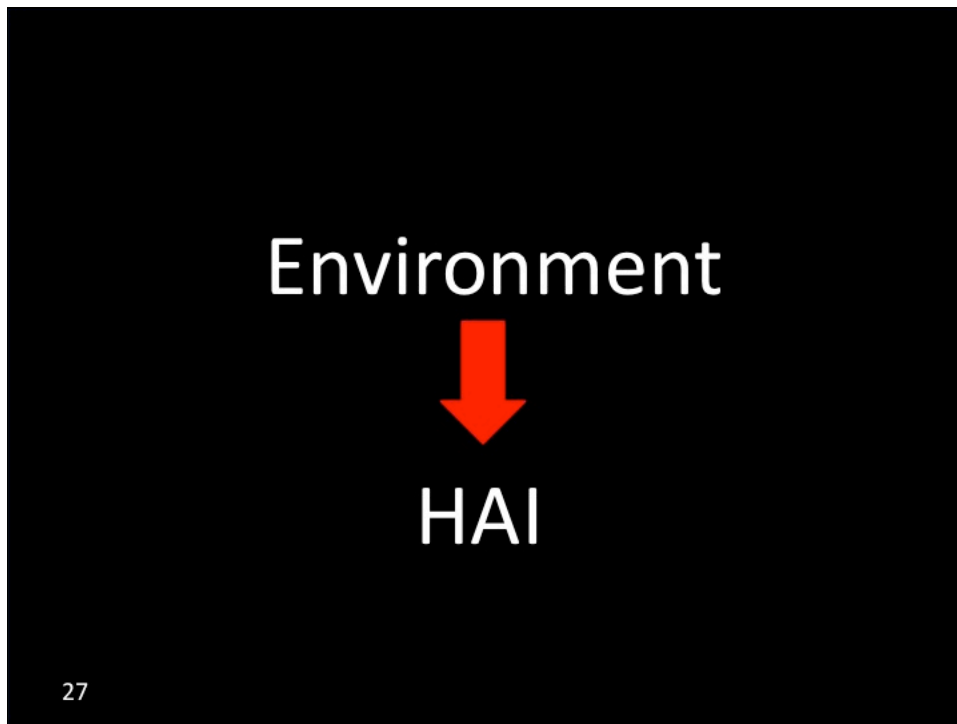
- Multi-modal approach of WHO can be highly effective:
 - Facilitate towards an optimal infrastructure
 - Compliance Measurements and Feedback
 - Education of HCW is underestimated
- Hospital-Leadership:
 - Full support
 - Personal commitment
 - Adequate Budget

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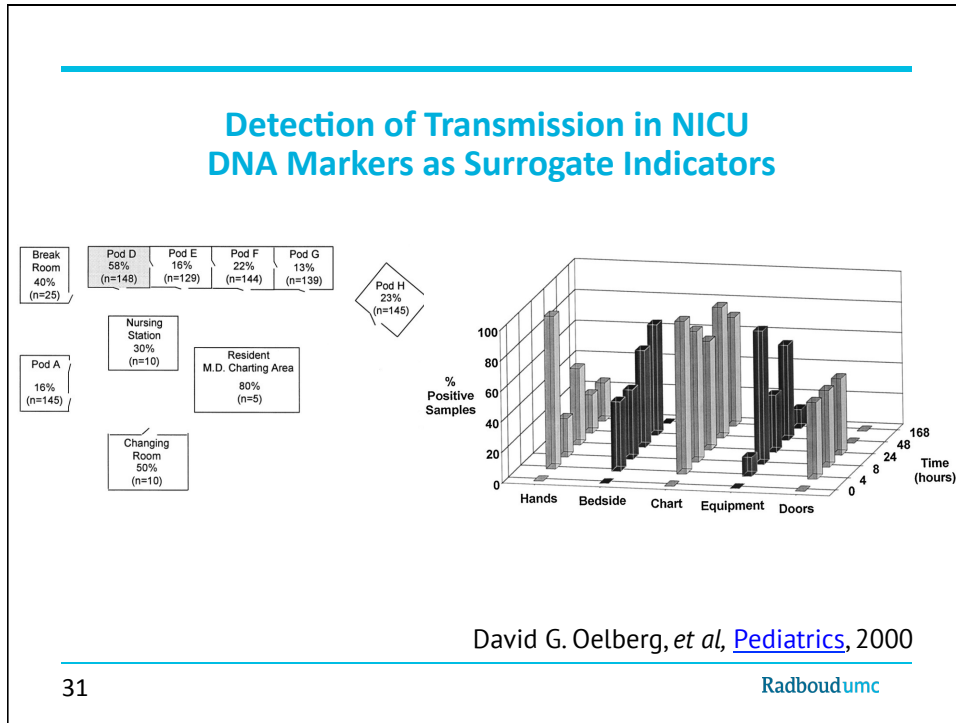
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Lessons from history



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

Epidemiology of Pseudomonas aeruginosa in a Burns Hospital: Surveillance by a Combined Typing System
 PAUL EDMONDS, RAYMOND B. BURNETT, BRUCE G. MACMILLAN
 Department of Environmental Health and Safety, Burn Institute, College of Medicine, University of Guelph, Ontario, Canada
 Submitted for publication 3 March 1972

Edmonds, *et al*, Applied Microbiology, 1972

PSEUDOMONAS IN SINKS, NOT TAPS
 Sinks.—We reported that sink traps are an important source of contamination with pseudomonas species in our respiratory/therapeutic intensive-therapy units. Dr. Constable and Dr. Thompson (March 31, p. 723) ask whether the water taps were responsible for the reappearance of pseudomonas in the sink traps after decontamination with an immersion heater.
 Cultures performed during the time of the reported study, as well as more recently, did not grow pseudomonas

Teres, *et al*, The Lancet, 1973

Hospital Practice
PSEUDOMONAS AERUGINOSA IN HOSPITAL SINKS
 G. A. J. AYLIFFE J. R. BARR
 B. J. COLLINS E. J. L. LOWERY
 S. W. B. NEWSOM
 Hospital Infection Research Laboratory, Summerfield Hospital, Birmingham 18, and Stree Woodland Memorial Laboratory, Farnborough Hospital

Ayliffe, *et al*, The Lancet, 1974

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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



¹N Engl J Med 2009; 360:2138-2141, may 2009

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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 **colonisation rate** :
$$\frac{\text{the number of primary positive microbiological results}}{1000 \text{ ICU admission days}}$$
 2. **Colonisation rate ratio:**
$$\frac{\text{colonisation rate post-intervention}}{\text{colonisation rate pre-intervention}}$$

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Results

June 2013 - May 2014

Pre-intervention

1351 patients
Median age 62 y [IQR 50-70]

intervention →

September 2014 - august 2015

Post-intervention

1307 patients
Median age 63 y [IQR 52-71]

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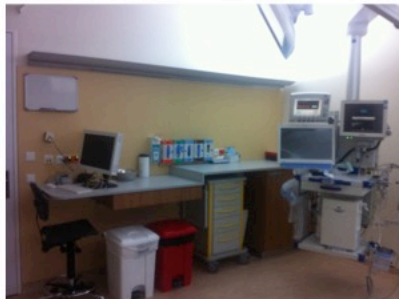
ICU-room pre-intervention



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ICU-room post-intervention

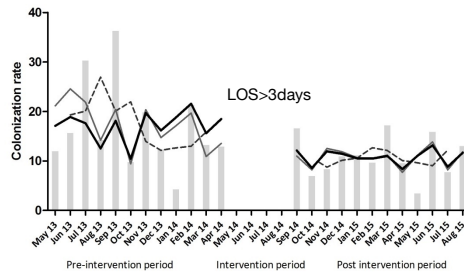


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Segmented regression analysis of the interrupted time series data



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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

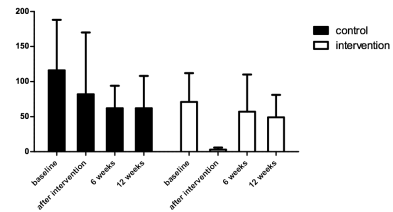
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Anti-bacterial coating of surfaces?



Nano-coating toetsenborden



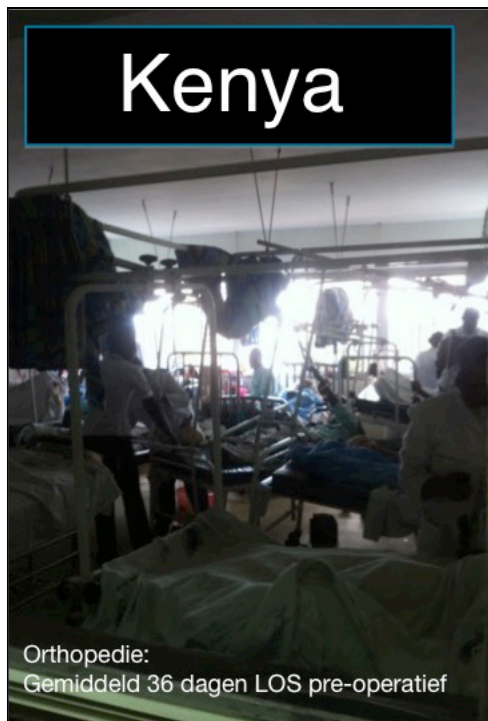
J.Hopman, *et al*, unpublished data

Cleaning and disinfection



Ghana

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Evidenced based medicine



Evidenced based cleaning?

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Journal of Hospital Infection (2009) 73, 378–385



Available online at www.sciencedirect.com



www.elsevierhealth.com/journals/jhin

REVIEW

The role of environmental cleaning in the control of hospital-acquired infection

S.J. Dancer*

Department of Microbiology, Hairmyres Hospital, East Kilbride, UK

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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CID 2006:42 June Hayden

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Reduction in Acquisition of Vancomycin-Resistant Enterococcus after Enforcement of Routine Environmental Cleaning Measures

Mary K. Hayden,¹ Marc J. M. Bonten,² Donald W. Blom,¹ Elizabeth A. Lyle,¹ David A. M. C. van de Vijver,² and Robert A. Weinstein^{1,2}

¹Rush University Medical Center and ²Stroger (Cook County) Hospital, Chicago, Illinois; and ³University Medical Center Utrecht, Utrecht, The Netherlands

Background. The role of environmental contamination in nosocomial cross-transmission of antibiotic-resistant bacteria has been unresolved. 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 (period 3), and a period of multimodal hand hygiene intervention (period 4). Mean proportions of positive results of cultures of environmental and hand samples obtained from patients' rooms were compared between periods.

Results. Mean proportions 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 ratio for acquiring VRE during periods 2–4 was 0.36 (95% confidence interval, 0.19–0.68); 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

Journal of Hospital Infection (2004) 56, 191–197

Available online at www.sciencedirect.com

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

S.W. Lemmen^{a,*}, H. Häfner^a, D. Zoldann^a, S. Stanzel^b, R. Lütticken^c

^aDepartment of Infection Control, University Hospital Aachen, 52057 Aachen, Germany
^bInstitute for Medical Statistics, University of Technology, 52074 Aachen, Germany
^cInstitute for Medical Microbiology, University Hospital Aachen, 52057 Aachen, Germany

Received 8 August 2003; accepted 3 December 2003

KEYWORDS Multi-resistant bacteria

Summary We prospectively studied the distribution of multi-resistant Gram-negative versus Gram-positive bacteria in the hospital inanimate environment. The environmental detection rate for MRSA or VRE was 24.7% compared with 4.9% for multi-resistant gramnegative bacteria.

precautions for close contact but without a single room seems sufficient. This benefits not only the patients, but also the hospital by removing some of the strain placed on already over-stretched resources.
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The environmental detection rate for MRSA or VRE was 24.7% compared with 4.9% for multi-resistant gramnegative bacteria

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BMC Infectious Diseases



Research article

Open Access

**How long do nosocomial pathogens persist on inanimate surfaces?
A systematic review**

Axel Kramer*¹, Ingeborg Schwebke² and Günter Kampf^{1,3}

Address: ¹Institut für Hygiene und Umweltmedizin, Ernst-Moritz-Arndt Universität, Greifswald, Germany, ²Robert-Koch Institut, Berlin, Germany and ³Bode Chemie GmbH & Co. KG, Scientific Affairs, Hamburg, Germany

Email: Axel Kramer* - kramer@uni-greifswald.de; Ingeborg Schwebke - schwebkei@rki.de; Günter Kampf - guenter.kampf@bode-chemie.de

* Corresponding author

“ 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.”

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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
- House keeping 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!!

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House keeping

- 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

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Journal of Hospital Infection 78 (2011) 178–181

Available online at www.sciencedirect.com

 **Journal of Hospital Infection** 

journal homepage: www.elsevierhealth.com/journals/jhin

Cleanliness audit of clinical surfaces and equipment: who cleans what?[☆]

R.E. Anderson^a, V. Young^a, M. Stewart^b, C. Robertson^c, S.J. Dancer^{b,*}

^aDepartment of Surgery, Hairmyres Hospital, East Kilbride, Lanarkshire, UK
^bDepartment of Microbiology, Hairmyres Hospital, East Kilbride, Lanarkshire, UK
^cDepartment of Statistics & Modelling Science, University of Strathclyde, Glasgow, UK

ARTICLE INFO

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Received 26 September 2010
Accepted 21 January 2011
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Available online 16 April 2011

Keywords:
ATP bioluminescence
Cleaning
Clinical environment

SUMMARY

Current guidelines recommend regular cleaning of clinical equipment. We monitored items on a surgical ward for predominant user, hand-touch frequency, cleaning responsibilities and measurement of organic soil. Equipment was assessed in triplicate against a cleanliness benchmark of 100 relative light units (RLU) using the Hygiene[®] ATP system. There were 44 items, of which 21 were cleaned by clinical support workers (CSWs), five by domestic staff; three by nurses, three by doctors, and 12 with no designated cleaning responsibility. Geometric mean RLU's ranged from 60 to 550/100 cm² for small items such as hand-held instruments.

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!

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Journal of Hospital Infection 77 (2011) 25–30



Finding a benchmark for monitoring hospital cleanliness

D. Mulvey^a, P. Redding^b, C. Robertson^c, C. Woodall^a, P. Kingsmore^d, D. Bedwell^d, S.J. Dancer^{e,*}

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^b Department of Microbiology, Southern General Hospital, Glasgow, UK

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^d Health Facilities Scotland, Glasgow, UK

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Bacterial culture



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Laboratory

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



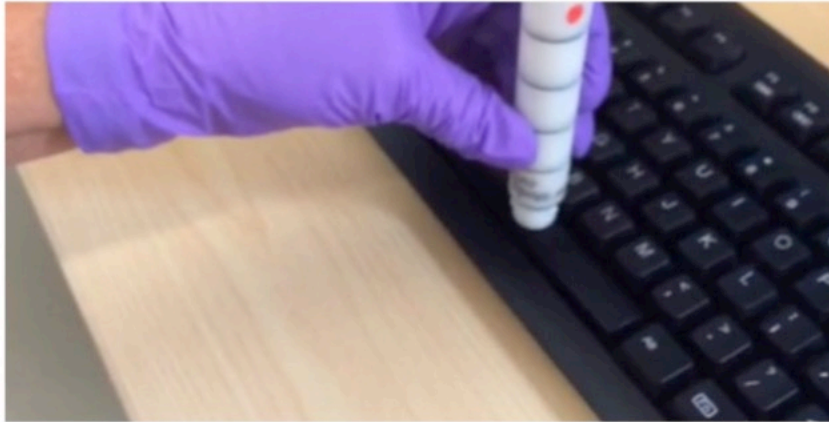
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Barriers and bridges to infection prevention and control: results of a qualitative case study of a Netherlands' surgical unit

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ABSTRACT

Objectives: The objectives of the study are to observe the overall work environment including infection prevention and control (IP&C) practices on the target surgical unit; to analyse the policies and procedures in the hospital and unit environments; to analyse the barriers and bridges to IP&C that practitioners identify in visual narratives of their unit environment and to collect monthly specific IP&C-related anonymised data.

Design: In this qualitative case study analysis, a socio-ecological approach on health systems informed the research design and provided a framework to better understand the complexity of implementing effective IP&C.

Setting: The study was conducted on a surgical unit at a Netherlands' hospital that reported successful reductions in the prevalence of targeted multidrug-resistant organisms.

Methods: Research methods included unit observations (n=3), review of relevant policies and procedures, five practitioner-led photo walkabouts of the unit (n=7), three photo elicitation focus groups with practitioners (n=13) and the review of related IP&C data.

Results: The findings indicate some conditions and processes present that may influence the low prevalence of multidrug-resistant organisms, including the 'search and destroy' active surveillance strategy.

ARTICLE SUMMARY

Article focus



- To observe the overall work environment including infection prevention and control (IP&C) practices on the target surgical unit;
- To critically review the policies and procedures aimed at the prevention and minimisation of multidrug-resistant organisms in the hospital and unit environments;
- To analyse the barriers and bridges to IP&C that practitioners identify in visual narratives of their unit environment and
- To collect monthly specific IP&C-related anonymised data.

Key messages

- The findings indicate some conditions and processes present that may influence the low prevalence of multidrug-resistant organisms, including:
- The 'search and destroy' active surveillance strategy; low occupancy rates
 - A centralised bed clearing system and
 - The presence of an active grass roots Hygiene in Practice group, which engages practitioners in several ongoing activities to promote IP&C on the units.

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Effect of surface coating and finish upon the cleanability of bed rails and the spread of *Staphylococcus aureus*

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KEYWORDS
Bacterial transfer

SUMMARY
Background: Bacterial reservoirs in the near-patient environment are likely vectors of healthcare-acquired infection.
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 soils. Aerobic colony counts and ATP bioluminescence were used to assess the efficacy of cleaning with microfibre cloths.
Conclusion: Organic soils affected bacterial transfer from all bed rails regardless of material or finish. Regular wiping with antibacterial wipes could be a cost-effective means of maintaining low numbers of bacteria near to the patient. To minimize the risk of cross-transmission, cleaning protocols should be validated to ensure effective removal of microbial and non-microbial surface contamination.
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Transfer from rail to fingertip ranged from 22%-38%

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Mechanical vs manual cleaning of hospital beds: a prospective intervention study

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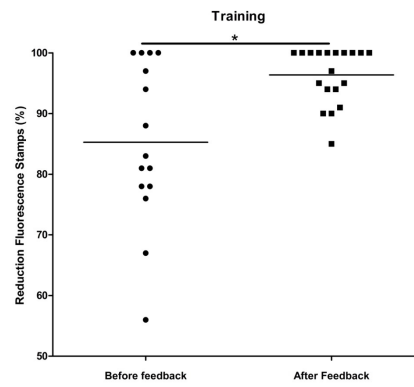
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Training of domestic service personnel

Fig.1



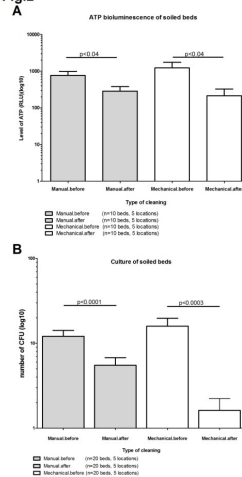
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Mechanical versus manual bed cleaning

Fig.2

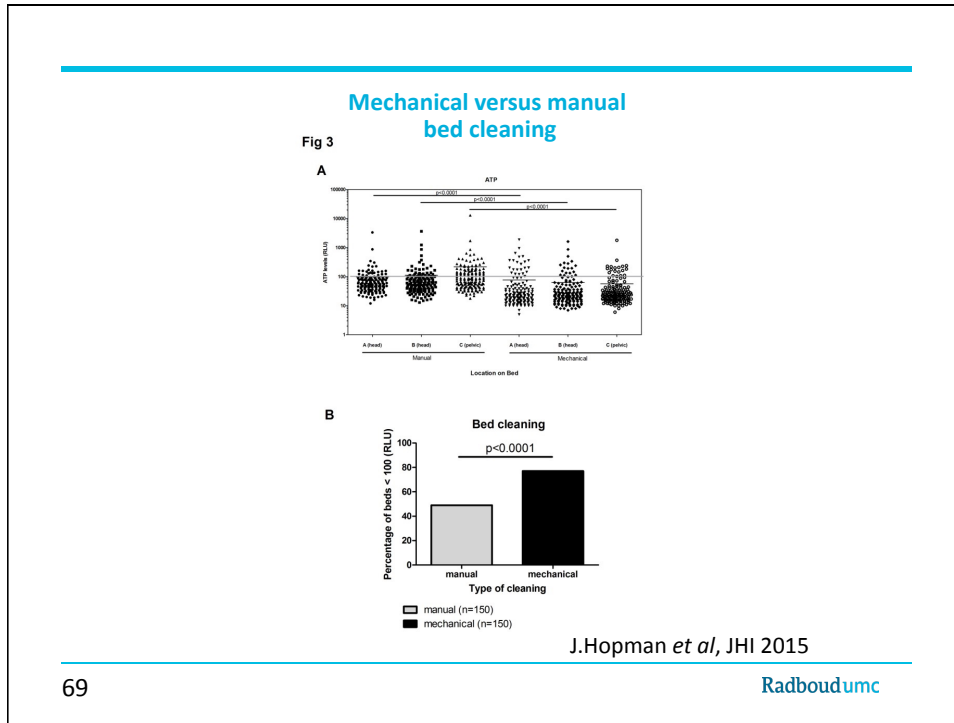


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Manual cleaning of hospital mattresses: an observational study comparing high- and low-resource settings

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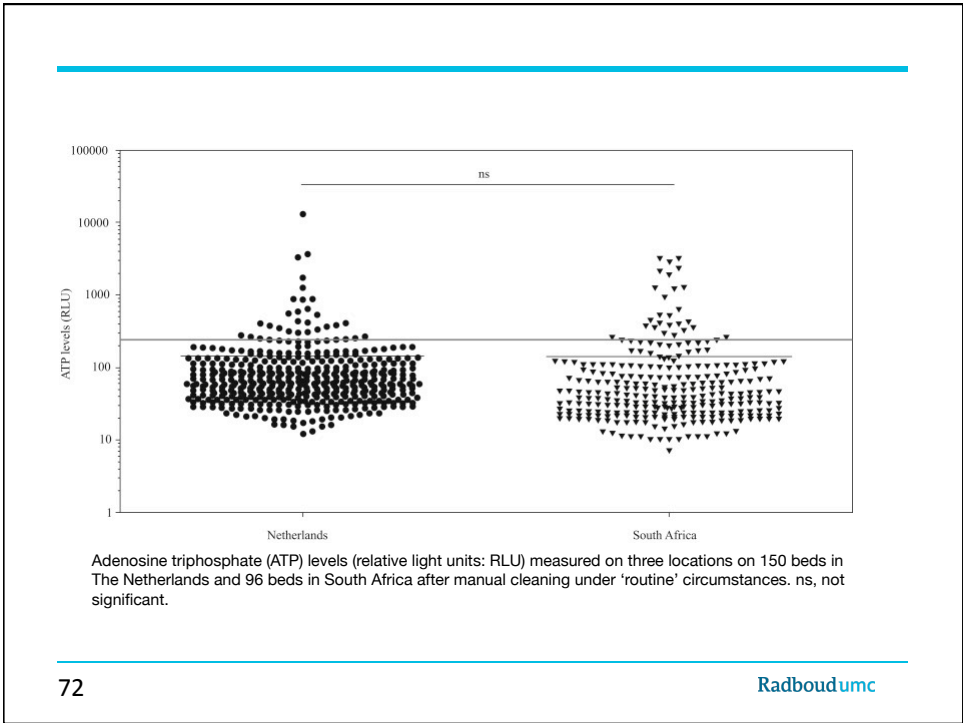
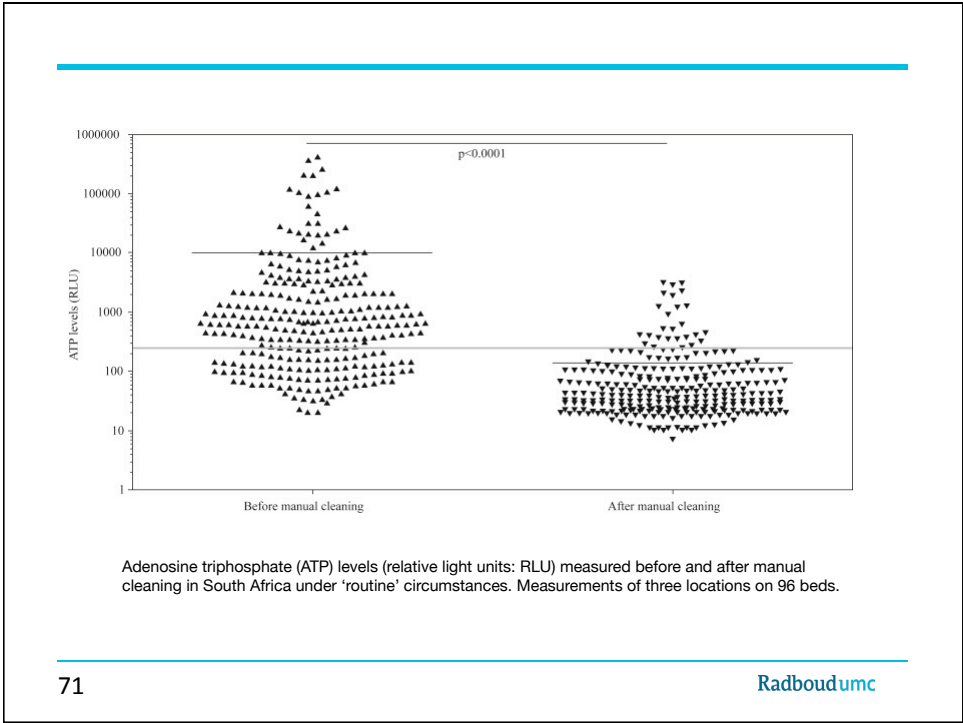
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J.Hopman, JHI 2015

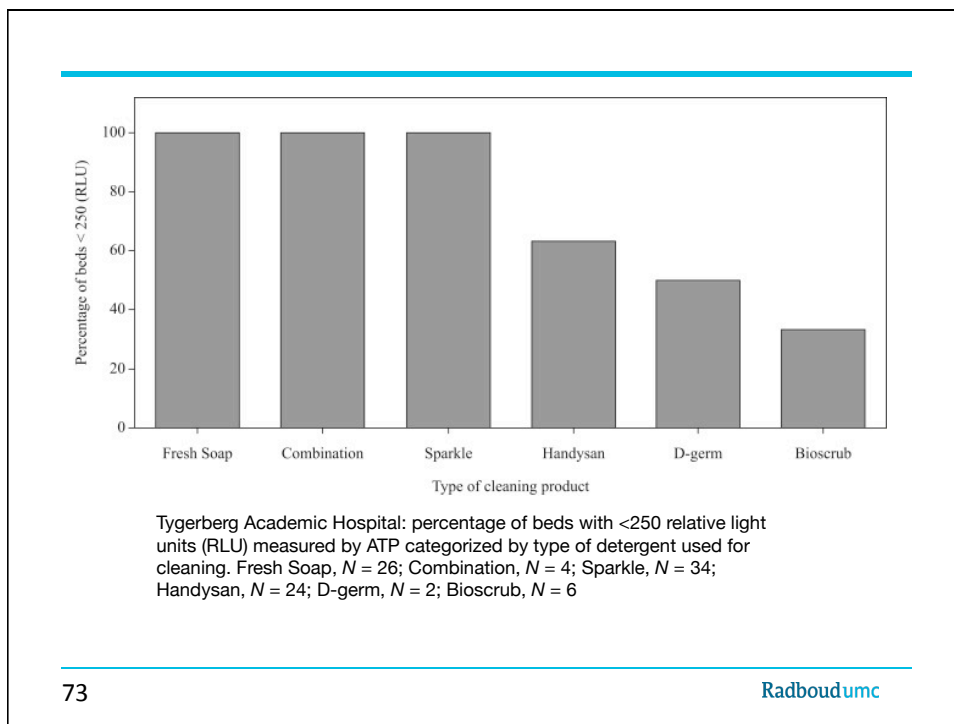
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Table I
Factors associated with adenosine triphosphate levels >250 RLU after cleaning (*N* = 96 beds)

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

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

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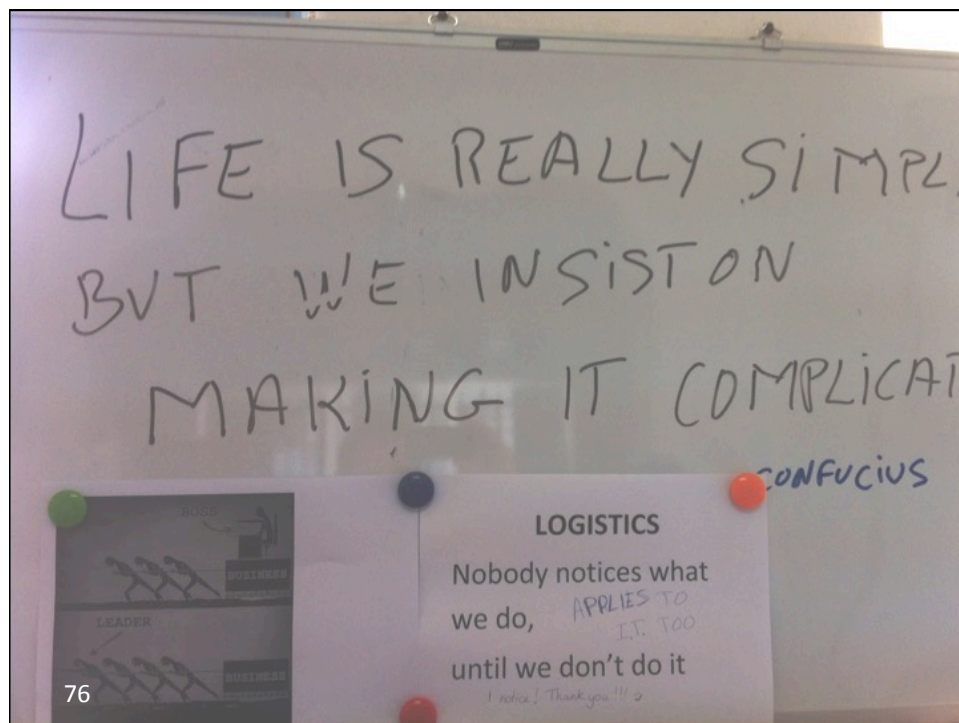
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Conclusions

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

Feedback of observations!



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Keep it empty!



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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)*

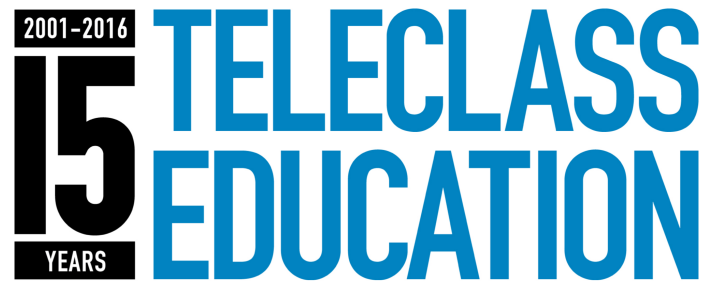
USING SCIENCE TO GUIDE HAND HYGIENE SURVEILLANCE AND IMPROVEMENT

Prof. Eli Perencevich, University of Iowa

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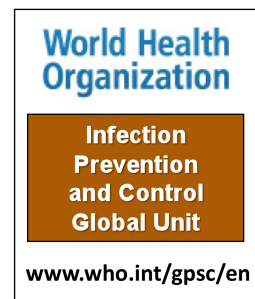
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