

Innovations and New Indicators in Hand Hygiene Monitoring

Dr. John Boyce, Yale University

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Innovation and New Indicators in Hand Hygiene Monitoring

John M. Boyce, MD
 Director, Hospital Epidemiology & Infection Control
 Yale-New Haven Hospital
 and
 Clinical Professor of Medicine
 Yale University School of Medicine

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Hosted by **Dr. Hugo Sax** WHO Patient Safety Agency
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www.webbertraining.com April 9, 2013

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Monitoring Hand Hygiene Performance

- Direct observational surveys are the gold standard method for measuring hand hygiene (HH) compliance
- Most widely recognized approach to observational surveys is to monitor hand hygiene opportunities, as outlined in the WHO's "5 Moments for Hand Hygiene"
 - Solid conceptual foundation
 - Identifies opportunities that should equate to transmission of pathogens
 - Has been validated and used in different countries/cultures
- Observational survey tools are available from WHO

Sax H et al. J Hosp Infect 2007;67:9
 Stewardson A & Pittet D ICHE 2011;32:1029

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Direct Observational Surveys

- Advantages of observational surveys
 - Provide most detailed information about hand hygiene (HH) practices
 - Only method that can detect compliance with all opportunities with varying risk of transmission (all 5 Moments for Hand Hygiene)
 - Can be used in all types of facilities with varying levels of resources
 - Only method that can assess HH technique used by HCWs
- Disadvantages
 - Time-consuming; can be difficult to observe in some situations
 - Provide data on only a very small percent of all HH opportunities
 - Results can be affected by Hawthorne effect
 - Non-standardized, making hospital comparisons problematic


Mayer J et al. ICHE 2011;32:59
 Stewardson A et al. J Hosp Infect 2011;77:358
 Steed C et al. AJIC 2011;39:19
 Boyce JM ICHE 2011;32:1016

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Options for Recording Observations

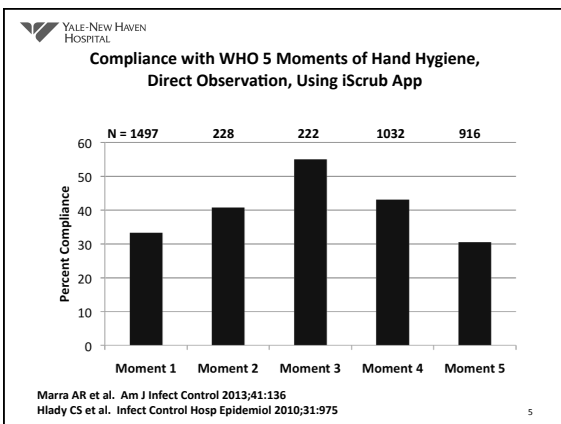
- iScrub app
 - Highly customizable
 - Oblivates the need for transcription
 - Record the WHO 5 Moments, or Room Entry & Exit
 - Observations are time and location stamped
 - Exported data can be opened in Excel
 - Free from App Store
- iPad applications are available for recording hand hygiene observations



Hlady CS et al. ICHE 2010;31:975

iScrub

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Electronic Hand Hygiene Monitoring Systems

- Electronic counting devices placed inside dispensers
- Door monitors (record room entry and exit (estimate Moments 1 and 4/5 opportunities) + dispenser counting devices)
- General electronic badge worn by HCP plus monitoring of room entry and exit (HCP group monitoring)
- Electronic badge system with each HCW assigned her/his badge (provides HCP-specific compliance rates)
- Video cameras installed in patient rooms or units with off-site real-time monitoring of compliance rates


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 **Electronic Counting Devices Placed in Hand Hygiene Dispensers (Product Consumption)**

- Electronic counting devices record each time a dispenser is accessed (HH event); often time- and date-stamped
- Counting devices have been used to study:
 - Frequency of use of manual vs touch-free dispensers
 - Relative frequency of use of hand sanitizer dispensers located in patient rooms vs hallways
 - Optimal location of in-room dispensers
 - Impact of interventions such as positive deviance
 - Effect on HH frequency of introducing new sanitizer
 - Correlation between frequency of dispenser use and HH compliance rates generated by observational surveys

Larson EL et al. Am J Crit Care 2005;14:304
 Boyce JM et al. ICHE 2009;30:1090; Marra AR et al. ICHE 2010;31:796
 Marra AR et al. ICHE 2010;31:12 Boyce JM ICHE 2011;32:1016
 Morgan DJ et al. Am J Infect Control 2012;40:955
 Helder OK et al. BMC Infect Dis 2012;12:248


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 **Automated Counting Devices vs Direct Observation for Measuring Hand Hygiene Performance**

- 30-week study in two intensive care units
 - 15-week baseline period
 - 15-week intervention period with HH promotion
 - Posters with HH compliance rates; visits by infection preventionists, training on WHO 5 Moments of HH
- Automated counting devices placed in alcohol hand rub and soap dispensers to determine hand hygiene events
- Direct observation by trained covert “secret shopper” observers who recorded compliance at room entry and exit

Morgan DJ et al. Am J Infect Control 2012;40:955


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 **Automated Counting Devices vs Direct Observation for Measuring Hand Hygiene Performance**

- 338 hours of direct observations of HH compliance, including 1783 room visits; days, nights and weekends
- 424,682 HH dispenser counts (> 14,000 HH events/week)
- Mean observed compliance was 26% on room entry and 48% on room exit
- Automated HH dispenser counts increased significantly during the intervention period in both ICUs ($p < 0.001$), but no significant change in compliance by direct observation

Morgan DJ et al. Am J Infect Control 2012;40:955


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 **Automated Counting Devices vs Direct Observation for Measuring Hand Hygiene Performance**

- Poor correlation between automated HH dispenser counts and results of direct observation, which has been noted in other studies
- Automated dispenser counts reflected changes in HH frequency during the intervention better than direct observation
- Disadvantages of counting devices include cost, inability to tell who is accessing dispensers (HCWs, visitors) and whether HH was performed at appropriate times during patient care
- Until newer technologies become available, a combination of automated counters + direct observation is a good option


Morgan DJ et al. Am J Infect Control 2012;40:955

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 **Advantages of Electronic Counting Devices Placed in Hand Hygiene Dispensers**

- Less time-consuming than observational surveys
- Can provide data on:
 - far more hand hygiene events than observational surveys
 - location and time of dispenser use
 - trends in hand hygiene frequency over time
 - impact of various interventions on hand hygiene frequency
- Avoid any Hawthorne effect
- Less expensive than electronic HH compliance monitoring systems that require door monitors or specialized badges

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 **Short-Comings of Electronic Counting Devices Placed in Hand Hygiene Dispensers**

- When used as the sole method of monitoring HH activity, electronic counting devices placed in dispensers are unable to do the following:
 - Distinguish between use by HCP vs patients/visitors
 - Identify type of HCP accessing the dispensers
 - Provide individual HCP-specific data on dispenser use
 - Determine if HH is performed at appropriate times during an episode of patient care
 - Determine the number of HH opportunities occurring
 - Establish HH compliance rates

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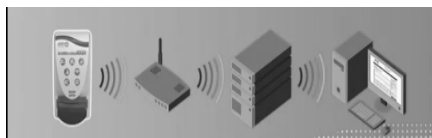
New Approach to Estimating Compliance Rates from Electronic Counting Devices in Dispensers

- WHO methods were used to observe 6,640 hand hygiene opportunities (HHOs) in 3 clinical areas in 2 types of hospitals
- Estimated number of HHOs: **30 to 179/pt-day** on inpatient wards, with significant differences between clinical areas and hospital types
- Developed a method for estimating benchmark HHOs, (number of HHOs/patient-day) for each clinical area and hospital type

Steed C et al. AJIC 2011;39:19 13

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New Approach to Estimating Compliance Rates from Electronic Counters in Dispensers



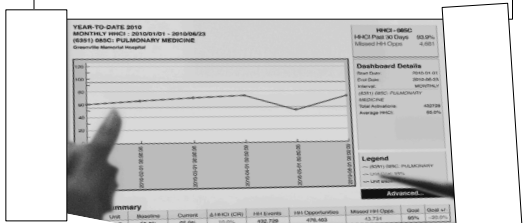
Electronic dispensers record each HH event → Wireless Data Transfer → Software on a server uses number of HH dispenser events and benchmarks for the expected number of HH opportunities for type of hospital unit and census to estimate HH compliance rates

Steed C et al. AJIC 2011;39:19 14

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New Approach to Estimating Compliance Rates from Electronic Counting Devices in Dispensers

System provides data on group performance; no data on individual HCP compliance



Hospital personnel can access estimated compliance rates via Web

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System Using Door Monitors and Electronic Dispensers to Assess Direct Observational Surveys

- Study of ~1400 HH opportunities in a clinic
 - Room entries & exits were recorded by infrared door monitor sensors and hand rub dispensers wirelessly transmitted data on HH events
 - 2 observers placed at different locations and at different times in clinic recorded room entries & exits by HCP and their use of hand rub dispensers
- Results obtained by the observers and automated system differed by 38%. Inconsistencies were largely related to:
 - Distance of the observer from the HH event
 - Busyness of the clinic (amount of traffic in the clinic)
 - more observer errors when clinic was very busy

Sharma D et al. Infect Control Hosp Epidemiol 2012;33:1259 16

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System Using Door Monitors and Electronic Dispensers to Assess Direct Observational Surveys

- Advantages
 - Provide data on HH events on room entry and exit
 - Proxy for WHO Moments 1, and 4 or 5
 - Less expensive than systems requiring HCP badges
 - Requires door monitors, but multiple sensors located throughout nursing unit are not necessary
- Disadvantages
 - Cannot determine if persons entering and exiting rooms are HCP, patients, or visitors (may over- or under-estimate HCP compliance)
 - If 2 HCP enter or exit room simultaneously, system may record the event as entry or exit of only one person

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Electronic HH Monitoring Systems With HCP Badges

- Sensors located in patient rooms (and sometimes in hallways outside patient) detect room entry and exit of HCP wearing special electronic badge
 - Record which HCW has entered or exited room
- Sensors located in HH dispensers record when a HCW has accessed the dispenser
- Data on room entry/exit and use of HH dispensers is sent wirelessly to a centralized computer with special software that interprets whether each HCW has performed HH upon entering and exiting the room
 - Interpreted as compliance or non-compliance

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RTLS Electronic Badge System

Room sensor (beacon) Sensor in Nursing Station

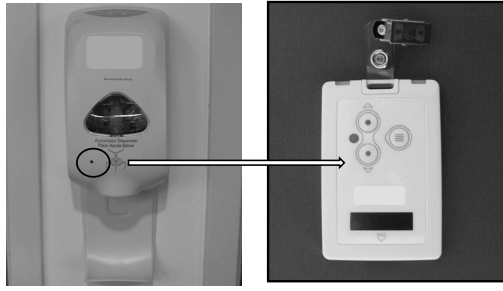


Sensors communicate with HH dispensers and HCP badges

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RTLS Electronic Badge System



Dispenser with wireless communication Electronic HCP badge

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Electronic HH Monitoring Systems With HCP Badges

- Portable wireless network programmable devices (motes) were developed to track room entry/exit by HCP wearing a badge, and use of hand hygiene products by HCP
- Sensitivity, specificity, (+) and (-) predictive values were determined based on trained observers
- Hand hygiene compliance defined as use of hand hygiene dispenser by HCP upon room entry & exit
- Results:
 - Sensitivity: 91 – 97%; Specificity: 100%
 - PPV: 100%; NPV: 96 – 99%
- Conclusion: practical and inexpensive system to determine hand hygiene compliance; provides data on individual HCP

Polgreen PM et al. ICHE 2010;31:1294

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Wireless Network of Devices (Motes) to Detect Healthcare Personnel Room Entry and Exit and Use of Hand Hygiene Dispensers



Badges Beacons Triggers Recorder

Polgreen PM Infect Control Hosp Epidemiol 2010;31:1294

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Use of Electronic Device Network to Assess Factors Affecting Observational Surveys

- Mobile electronic device network captured data on movement of 6 types of HCP in an ICU over a 2-week period
- Recorded entry and exit into patient rooms by HCP wearing electronic badges
- Identified 4 optimal line-of-sight locations where observers could theoretically view activity in most rooms
- Theoretical observation times of 1-15, 15-30, 30, and 60 min were considered in simulation models

Fries J et al. Infect Control Hosp Epidemiol 2012;33:689

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Use of Electronic Device Network to Assess Factors Affecting Observational Surveys

- 33,721 time-stamped HCW room entries and exits were recorded (each considered an opportunity for HH)
- The models found that if simulated observers had made observations over a 60-min period,
 - only 0.5% to 1.7% of HH opportunities would have been captured by direct observation of HCP
- Observation periods of 1-15 min provided the best estimates of HH compliance for the duration of the shift
- Conclusion: Placement of observers and length of observation periods are important

Fries J et al. Infect Control Hosp Epidemiol 2012;33:689

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Dedicated Electronic HH Monitoring System With HCP Badges

The Base Station
Centrally Located
Data Storage
Internet capable

The Room Sensor
Monitors Badge on Entry and Exit from the room

The Badge
Senses Alcohol on Hands

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Electronic Monitoring System Utilizing HCP Badges with Alcohol Sensor Technology

- Wireless sensors installed in 35-bed Orthopedic ward, HCP wore badges with alcohol sensors to detect HH events
- Baseline period with direct observations, followed by a 2-week intervention period using electronic badge system
- Hand hygiene compliance rates
 - Baseline period = 66%
 - Intervention period with electronic badge system = 93%
- 10/14 nurses felt all HCWs should wear the badge

Edmond MB et al. J Hosp Infect 2010;76:364

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Dedicated Electronic HH Monitoring System With HCP Badges

Hand hygiene station
detects alcohol-containing soap or handrub on HCW hands placed under unit

HCP badge
reminds HCW if hand hygiene not done upon approaching patient

Bed monitor
detects presence of HCW near patient's bed

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Electronic Monitoring System Utilizing Alcohol Sensor Technology

- A 6-month trial using electronic system with wall-mounted alcohol sensors, HCP badges, and bed and room beacons
- If HCP perform hand hygiene, badge turns green and HCP are classified as compliant
- If not, badge vibrates to remind HCP to perform HH
- System detected 26,032 episodes of HCP HH events, and 9,838 bed monitor interactions (HCP were in proximity of bed)
- HH compliance by doctors & nurses was maintained at > 90%, with a reported reduction in HAIs of 89%

Granado-Villar D et al. SHEA 2011, abstr 63

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Electronic Monitoring System Utilizing HCP Badges

- 3-month trial in a neurosurgical ICU of an electronic HH monitoring system with HCP badges
- 13,694 HH opportunities were recorded
- Electronically derived HH compliance rates were:
 - 21% for WHO Moment 1 (before touching patient)
 - 40% for WHO Moment 4 (after touching patient)
- Group monitoring (HCP shared badges) yielded lower HH compliance rates than HCP-specific monitoring (each HCW has his/her own badge)

Cheng VCC et al. BMC Infect Dis 2011;11:151

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Real-time Location System (RTLS) with Hand Hygiene Monitoring Application

- 10-month study with 6-month baseline period and 4-month study period
 - In SICU and general medical ward
 - Majority of nurses and a few other HCWs volunteered
 - HCP wore badges that recorded use of hand rub dispensers and room entry and exit using infrared signals
 - System estimated HH compliance for each volunteer
 - Observational surveys and education of volunteers was conducted before using the RTLS system
- Trained observers monitored the accuracy of the system

Boyce JM et al. IDWeek 2012

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Real-time Location System (RTLS) with Hand Hygiene Monitoring Application

- HH compliance on room entry increased in SICU ($p = 0.005$) and in the GMW ($p = 0.099$), but not during the study period
 - improvement occurred during the baseline period when nurses were educated about how the RTLS system would work
- HH compliance on room exit increased significantly ($p = 0.005$) on both units, but not during the study period
- RTLS system was not accurate in recording use of hand rub dispenser use by HCP, and had some problems with recording room entry and exits accurately
- Frustration with system inaccuracy adversely affected nurses perceptions of the system and affected HH compliance

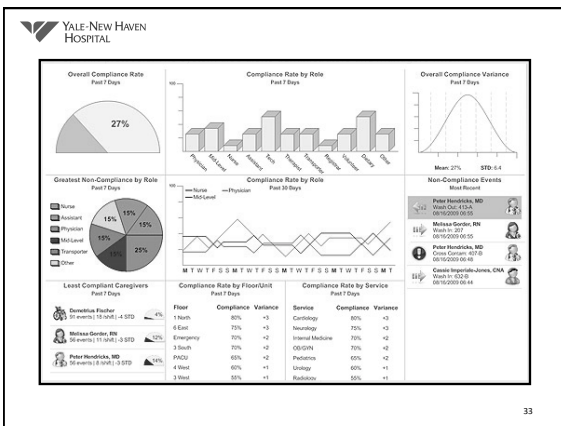
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Electronic HH Monitoring Systems with HCP Badge

- Advantages:
 - Provide data on HH events by HCP upon room entry/exit
 - If HCP share badges, estimates of HH compliance are provided for groups of HCP, by room, unit or service
 - If each HCW has her/his own badge, estimated HH compliance rates are generated for each HCP; can facilitate individual feedback
 - Robust data analysis software that provide real-time data on HH practices are available for such systems

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Electronic HH Monitoring Systems with HCP Badge

- Disadvantages of current systems based on room entry/exit
 - Data represent only proxies for HH before and after touching patient
 - Can't tell if HCP who entered room actually touched patient
 - Do not provide data on HH events related to Moments 2 and 3
 - Can't differentiate between Moments 4 & 5
 - Level of accuracy in estimating HH compliance rates not yet established for most systems
 - Acceptance of systems by HCP can be an important barrier
 - Impact on reduction of healthcare-associated infections not clear
 - Greater cost of additional infrastructure (including wireless system, multiple sensors, HCP badges, batteries) will make these systems unaffordable for hospitals with limited resources

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Can Automated Systems Provide Reasonable Estimates of Hand Hygiene Compliance Rates?

- 5577 HHOs were observed using WHO "My 5 Moments" methods by experienced observers
- Compliance rates were analyzed using 3 models

	My 5 Moments	Before & After Pt Contact	Before Pt Contact only
No. of HHOs	5577	3946	2149
Compliance rate	62%	61%	52%

- Moments 1, 4 & 5 accounted for 79% of all HH opportunities
- A Before & After approach (like automated systems) may possibly serve as surrogate marker for HH compliance

Stewardson A et al. J Hosp Infect 2011;77:358

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Real-Time Remote Video Monitoring of Hand Hygiene Practices

- Prospective study using real-time remote video monitoring of hand hygiene (HH) dispensers in ICU
 - Sensors detected room entries and exits
 - HCWs who were seen using dispensers on room entry and exit were classified as compliant
 - Off-site audit managers confirmed accuracy of findings
- 16-week period of video monitoring without feedback, 91 week period of real-time feedback
 - using electronic boards mounted in hallways
 - emails to supervisors every shift

Armellino D et al. Clin Infect Dis 2012;54:1


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 **Real-Time Remote Video Monitoring of Hand Hygiene Practices**


- HH rates increased from < 10% before feedback period, to 82% in the first 16 weeks of feedback, and were maintained for 75 weeks at 88%.
- **Conclusion:** remote video auditing + feedback produced significant and sustained improvement in HH compliance
- **Note:** Expense of system, acceptance by HCP, and concerns of potential legal liability may influence adoption of such systems

Armellino D et al. Clin Infect Dis 2012;54:1 37

 **Summary**

- Direct observational surveys still provide valuable data on HH compliance, and will continue to be useful for years to come
- Electronic counting devices that record use of HH dispensers can provide additional valuable information about HH patterns, responses to interventions, promotional campaigns, product changes
- Combining electronic counting devices in dispensers with validated benchmarks of HH opportunities can be used to estimate HH compliance rates

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 **Summary**

- **Electronic HH monitoring systems with HCP badges warrant further evaluation as a means of estimating HH compliance among HCP**
 - Can provide HCW-specific estimates of HH compliance that may be useful for individual feedback and increasing HCP accountability
 - Supplement data provided by direct observational surveys
- **Further studies are needed to establish**
 - Acceptance by HCP
 - Ability to accurately reflect compliance with 5 Moments for HH
 - Ability to improve HH compliance rates in a sustained manner
 - Their impact on healthcare-associated infection rates
 - Cost-effectiveness

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 **Thank you**

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2013 WHO Teleclass Schedule
Clean Care is Safer Care

February 6 Improving the Patient Safety Culture as a Successful Component of Infection Control <u>Strategies, Dr. B. Allegranzi</u>	August 7 Decontamination of High-Touch Environmental Surfaces in Healthcare: A Critical Look at Current Practices and Newer Approaches , Prof. S. Sattar
March 6 Patient Participation in Hand Hygiene Promotion and Improvement, Dr. Y. Longtin & Dr. M. McGuckin	September 3 Preventing Central Line-Associated Bloodstream Infections: The Matching Michigan Approach Applied in the USA and Other Countries , Prof. P. Pronovost
April 9 Innovation and New Indicators in Hand Hygiene Monitoring, Prof. J. Boyce	October 9 Implementing Infection Control Through a Patient Safety Partnership Approach in Africa, <u>J. Storr</u>
May 6 Special Lecture for 5 May, Prof. D. Pittet	November 11 Antimicrobial Resistance Issues Worldwide and the WHO Approach to Combat it, <u>Dr. C. Pessoa da Silva</u>
July 3 Risk Assessment and Priority Setting in Infection Control in Low to Middle Income Countries, Prof. N. Damani,	December 4 Control of Multi-Drug Resistant Organisms in the Nursing Home Setting, Prof. A. Voss

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