# NOVEL INTERVENTIONS FOR INFECTION CONTROL

CHARISSA BORJA-TABORA, MD FPPS, FPIDSP
Chair, Infection Prevention and Control Committee
Research Institute for Tropical Medicine

# Disclosure

- **I have no actual or potential conflict of interest in relation to this program/presentation.**
- I have received Research Grants from the following in the past 5 years:
  - Serum Statens Institute/Bill and Melinda Gates Foundation
  - CEMPRA/(BARDA)Biomedical Advanced Research and Development Authority
  - Takeda
  - Sequirus
  - Sanofi Pasteur
  - LG Biological Sciences
  - Glaxo SmithKline
  - Pfizer

- NOVEL INTERVENTIONS FOR INFECTION CONTROL
  - ENVIRONMENTAL HYGIENE
  - DISINFECTION AND STERILIZATION
  - HAND HYGIENE
  - PPE
  - SAFE INJECTON PRACTICES
  - ADMINISTRATIVE CONTROLS
    - DATA MINING
    - CHECKLIST

# NOVEL INTERVENTIONS…
# Environmental Hygiene

# Environmental Hygiene

- Technologies for Improving Cleaning and Disinfection of Environmental Surfaces
  - Manual cleaning and disinfection of environmental surfaces in healthcare facilities are essential elements of infection prevention programs
  - Because many factors make it difficult to achieve high rates of effective disinfection on a routine and sustained basis, continued efforts to improve the quality and consistency of traditional cleaning and disinfection practices are needed.
  - Given the many challenges in achieving desired levels of surface disinfection, adoption of modern technologies is indicated to supplement traditional methods

# Environmental Hygiene

- Optimal and careful cleaning and disinfection of environmental surfaces are essential elements of effective infection prevention programs
- Disinfectants should be used properly and appropriately to achieve the desired effects

## ISSUES

- Manual cleaning and disinfection is suboptimal
- Varying skill and performance of housekeepers
- Only 40-50% of areas that should be covered are cleaned
- Inadequate contact time in applying disinfectants
- Over dilution of disinfectants
- No monitoring of housekeeping practices

## NOVEL INTERVENTIONS…

# Environmental Hygiene

- New liquid surface disinfectants
- Improved methods for applying disinfectants
- Self-disinfecting surfaces
- Light-activated photosensitizers
- No-touch (automated) technologies

# Environmental Hygiene:
# NEW LIQUID SURFACE DISINFECTANTS

- New disinfectants that are currently available or under development include:
  - improved hydrogen peroxide liquid disinfectants
  - peracetic acid-hydrogen peroxide combination
  - electrolyzed water
  - cold atmospheric pressure plasma
  - polymeric guanidine
- Improved hydrogen peroxide disinfectants have been shown to be effective one-step cleaner/disinfectant agents that significantly reduce bacterial levels on surfaces
  - Study : 0.5 % (weight/volume) improved hydrogen peroxide was associated with fewer healthcare-associated infections when compared to an existing cleaning product
  - Improved hydrogen peroxide liquid disinfectants can also be used to reduce contamination by multidrug-resistant pathogens on soft surfaces such as bedside curtains
  - Several of the improved hydrogen peroxide disinfectants also have activity against norovirus surrogate viruses
  - These newer disinfectants have Environmental Protection Agency (EPA) safety rating of category IV (housekeepers do not need to wear any personal protective equipment while using these products).
- A new sporicidal disinfectant that contains both peracetic acid and hydrogen peroxide has been shown to reduce bacterial levels on surfaces to a greater degree than a quaternary ammonium disinfectant in one study, and reduced contamination by *C.difficile*, MRSA, and VRE as effectively as sodium hypochlorite in another study

# Environmental Hygiene:
# NEW LIQUID SURFACE DISINFECTANTS

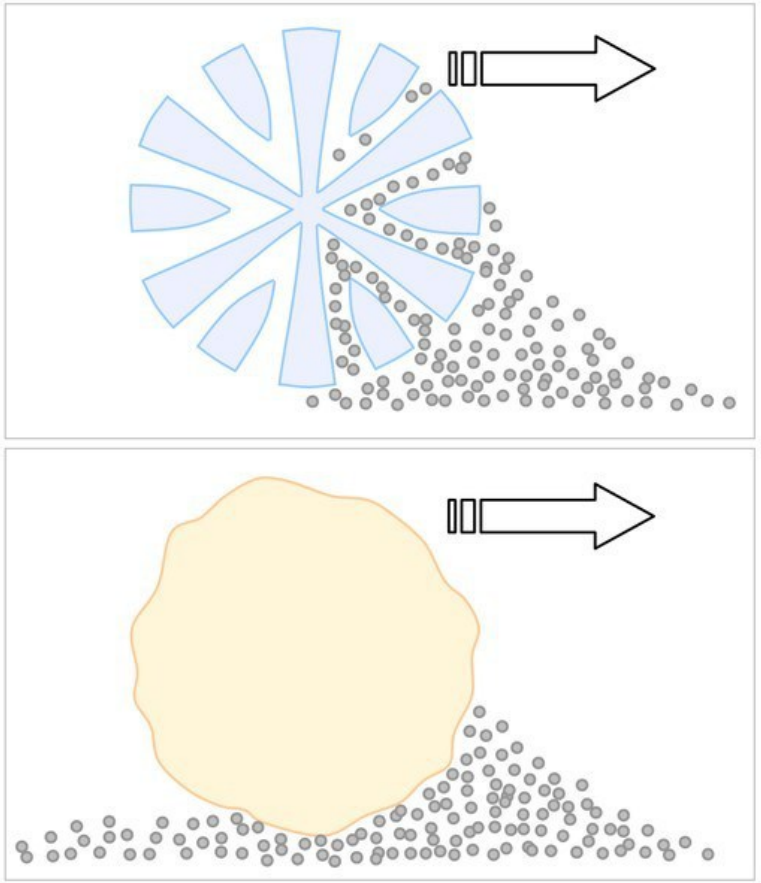
- Electrolyzed water (hypochlorous acid) disinfectant is produced by passing current through a solution of water and salt
  - Promising disinfectant
  - Shown to reduce bacterial levels on surfaces near patients to greater degree than a quaternary ammonium disinfectant in one study
  - In another study, an electrolyzed water disinfectant significantly reduced MRSA, VRE and *C. difficile* spores in in-vitro experiments, and significantly reduced aerobic bacteria and *C. difficile* spores when sprayed onto medical equipment
  - electrolyzed water effectively reduced the number of aerobic bacteria (including staphylococci) on near-patient surfaces
  - Electrolyzed water has the advantage of not leaving any toxic residues on surfaces

- Cold-air atmospheric pressure plasma systems
  - being investigated for possible use as surface disinfectants
  - In laboratory studies, the reactive oxygen species generated by these systems have bactericidal activity against a variety of pathogens, with variable activity against *C. difficile* spores
  - More experience with cold-air atmospheric pressure plasma systems is needed to determine the practicality, efficacy and safety of using such systems in hospital settings.
  - A novel nebulized solution of polymeric guanidine has been shown in one study to have antimicrobial activity against several healthcare-associated pathogens, and may warrant further investigation

# Environmental Hygiene:
# IMPROVED METHODS FOR APPLYING DISINFECTANTS

## MICROFIBERS

- Microfibers are densely constructed, polyester and polyamide (nylon) fibers, that are approximately 1/16 the thickness of a human hair.
- The positively charged microfibers attract dust (which has a negative charge) and are more absorbent than a conventional, cotton-loop mop.
- Microfiber materials also can be wet with disinfectants, such as quaternary ammonium compounds.
- In one study, the microfiber system tested demonstrated superior microbial removal compared with conventional string mops when used with a detergent cleaner (94% vs 68%).



## Environmental Hygiene:
## IMPROVED METHODS FOR APPLYING DISINFECTANTS

### MICROFIBERS

- The structure traps and retains the dirt and also absorbs liquids.
- Unlike cotton, microfiber leaves no lint
- Microfiber can be electrostatically charged for special purposes like filtration.

## Environmental Hygiene:
## IMPROVED METHODS FOR APPLYING DISINFECTANTS

- Electrostatic spraying has been used in the agricultural and automobile industry for decades
- Based on Coulomb's Law:
  - The magnitude of the electrostatic force of interaction between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distance between them. The force is along the straight line joining them
- Most Surfaces are neutral or negative

## Environmental Hygiene:
## IMPROVED METHODS FOR APPLYING DISINFECTANTS

- dispersed droplets spread out more evenly and seek out the negative (-) or neutrally charged surface - disinfectant is more targeted
- provides more consistent coverage
- less waste

# Environmental Hygiene:
# SELF DISINFECTINFG SURFACES

- STUDIES HAVE INDICATED THAT INADEQUATE CLEANING AND DISINFECTING OF SURFACES IS WIDESPREAD

- Creating "self-disinfecting surfaces" by coating surfaces with heavy metals such as
  - Copper
    - The antimicrobial activity of copper may be due primarily to its ability to form reactive oxygen radicals that damage nucleic acid and proteins
    - Impregnating equipment surfaces with copper alloys has been shown to reduce bacterial contamination of surfaces
    - A Study, coating several surfaces in hospital rooms with copper alloy was associated with reduction in incidence of HAIs

# Environmental Hygiene:
# SELF DISINFECTING SURFACES

- Creating "self-disinfecting surfaces" by coating surfaces with heavy metals
  - Silver
    - binds strongly with disulfide and sulfhydryl groups present in proteins of microbial cell walls, leading to cell death
    - Privacy curtains impregnated with silver have been shown to reduce or delay contamination of curtains with potential pathogens
    - applying to surfaces compounds that retain their antimicrobial activity for weeks or months has received some attention as a new strategy for disinfecting or preventing the growth of bacteria on surfaces in hospitals

# Environmental Hygiene:
# SELF DISINFECTINF SURFACES

- Organosilane compounds = surfactant plus an antimicrobial substance such as a quaternary ammonium moiety.
  - designed to minimize bacterial contamination of surfaces by maintaining their antimicrobial activity on surfaces for **weeks or months**
  - the ability of these compounds to prevent contamination of surfaces for prolonged time periods is unclear.
  - polyhexamethylene biguanide disinfectant was found to reduce bacterial levels on surfaces for at least 24 h after application in one study

## Environmental Hygiene:
## LIGHT ACTIVATED PHOTOSENSITIZERS

- Studies have explored the potential of applying of light-activated photosensitizers such as nanosized titanium dioxide to surfaces and using UV light to generate reactive oxygen species that can disinfect surfaces
- Activated titanium dioxide has been shown to have varying antimicrobial activity, with the relative susceptibility of agents against pathogens
- Research on the use of light-activated photosensitizers is in early stages, and much more information about the feasibility and safety of using this strategy is needed

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

- Aerosolized hydrogen peroxide
- Hydrogen peroxide vapor systems
- Gaseous ozone
- Chlorine dioxide
- Saturated steam systems
- Peracetic acid/hydrogen peroxide fogging
- Mobile continuous ultraviolet devices
- Pulsed-xenon light devices
- High-intensity narrow-spectrum (405 nm) light

# Environmental Hygiene:
# NO-TOUCH (AUTOMATED) TECHNOLOGIES

**Pulsed Xenon Light Devices**

**Hydrogen peroxide vapor generator**

**UV system devices**

**Aerosolized hydrogen peroxide**

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

# Hydrogen peroxide vapor

- "dry gas" vaporized hydrogen peroxide system that utilizes 30 % hydrogen peroxide
  - effective against a variety of pathogens, including *Mycobacterium tuberculosis, Mycoplasma, Acinetobacter, C. difficile, Bacillus anthracis*, viruses, and prions
- Long cycle times have made it difficult to implement this system in healthcare facilities
- Prospective, controlled trial performed (Passaretti et al) demonstrated significant reduction in the risk of acquiring multidrug-resistant organisms (MDROs), especially VRE
- used to decontaminate the packaging of unused medical supplies removed from isolation rooms,

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

# AEROSOLIZED HYDROGEN PEROXIDE

- 3 to7 % hydrogen peroxide
- Aerosols are injected into a room, followed by passive aeration.
- Studies:
  - reduce bacteria, generally a 4 log10 reduction of spores
  - associated with a reduction in *C. difficile* infection, and possible reduction of MRSA

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

- ULTRAVIOLET LIGHT DEVICES
  - Automated mobile ultraviolet light devices that continuously emit UV-C in the range of 254 nm
    - can be placed in patient rooms after patient discharge and terminal cleaning has been performed.
    - often reduce the VRE and MRSA by four or more log10, and C. difficile by 1–3
  - Advantages :
    - ease of use
    - minimal need for special training of environmental services personnel
    - unlike hydrogen peroxide vapor systems, the ability to utilize the devices without having to seal room vents or doors

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

- Pulsed-xenon device
  - emits light in the 200– 320 nm range
  - has been shown to significantly reduce pathogens in patient rooms

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

- High-intensity narrow-spectrum light
  - visible violet-blue light in the range of 405 nm has been
  - tested as a means of disinfecting air and surfaces and hospital rooms
  - technology targets intracellular porphyrins that absorb the light and produce reactive oxygen
  - one study, continuous HINS light showed a 27 to 75 % reduction in surface contamination by staphylococci compared to control areas
  - the light is visible, it is lethal to pathogens but is safe for use in the presence of patients and staff

## Environmental Hygiene:
## NO-TOUCH (AUTOMATED) TECHNOLOGIES

- PHOTOCATALYTIC DISINFECTION
  - An enclosed air purifying system designed for use by NASA
  - utilizes UV-activated titanium dioxide photocatalytic reactions to oxidize volatile organic compounds and airborne microorganisms
  - Since aerosolization of pathogens such as S. aureus and C. difficile during patient care activities is known
    - May reduce airborne bacteria that may settle onto environmental surfaces in patient rooms

- Manual cleaning and disinfection of environmental surfaces are essential elements of infection prevention programs
- Because many factors make it difficult to achieve high rates of effective disinfection continued efforts to improve the quality and consistency of traditional cleaning and disinfection practices are needed
- Given the many challenges in achieving desired levels of surface disinfection, adoption of modern technologies is indicated to supplement traditional methods
- As additional data become available, it is likely that newer liquid disinfectants and some no-touch room decontamination systems will be more widely adopted to supplement traditional cleaning and disinfection practices.

- Given the increasing interest in the above-mentioned new technologies:
  - Agency for Healthcare Research and Quality (AHRQ) recently commissioned an expert panel to review data regarding these modern technologies.
    - lack of comparative studies addressing the relative effectiveness of various cleaning, disinfecting and monitoring strategies,
    - future studies are needed that directly compare newer disinfecting and monitoring methods to one another and with traditional methods

## ATP (ADENOSINE TRIPHOSPHATE) BIOLUMINESCENCE ASSAY

- Adenosine triphosphate—ATP—is an energy molecule stored in all microorganisms and therefore an indicator of life
- Three steps of an ATP bioluminescence assay for monitoring cleanliness of surfaces:
  - Step 1: a special swab is used to sample the surface.
  - Step 2: the swab is placed in a reaction tube and shaken for 10–15 s.
  - Step 3: the reaction tube is placed in a luminometer and a result is reported as relative light units (RLUs).
  - The higher the RLU value, the greater the amount of ATP detected on the surface

# Environmental Hygiene:
# MONITORING

## ATP Bioluminescence Method

**Step 1**

Use special swab
to sample surface

**Step 2**

Place swab in
reaction tube

**Step 3**

Place tube in luminometer
Results: Relative Light Units

**It is a validation of cleaning**

# NOVEL INTERVENTIONS…
# Disinfection and Sterilization

# Disinfection and Sterilization
# WASHER DISINFECTOR

- An automatic unit designed to clean and thermally disinfect instruments.
- The unit uses a high-temperature cycle rather than a chemical bath.

# Disinfection and Sterilization
# WASHER DISINFECTOR

# Disinfection and Sterilization
# WASHER DISINFECTOR

- Safe
- Economical
  - Reduce personnel need
  - Reduced water and electrical consumption
  - Increase productivity time

# Disinfection and Sterilization
# PLASMA STERILIZATION

- Plasma is defined as an ionized (or energized) gas with an equal number of positively and negatively charged particles.
- Low-temperature plasmas, used in surface modification, cleaning, decontamination and sterilization applications, are ionized gases generated under deep vacuum (low-pressure) conditions.
- Operates within a vacuum chamber in which atmospheric gases have been introduced into the chamber typically evacuated below 0.1 Torr.

BENEFITS:

- Maximum safety for healthcare professionals, patients and the environment
  - by-products are non-toxic oxygen and water vapour
- Rapid turn around time
- **Low-temperature process provides gentle sterilization even for the most delicate instruments**
  - **longer instrument life and reduced cost of instrument repairs**
  - **sterilization of instruments such as general surgery instruments, rigid and flexible endoscopes, cameras, light cables, batteries, power drills and many others.**

# Disinfection and Sterilization
# AUTOCLAVE SHREDDER

- An Autoclave is a pressurized chamber used to sterilize medical waste, equipment and supplies by putting them through a high pressure, steam saturated process an approximately 15-20 minute cycle

- Loading
  - Hospital medical waste is loaded into the loading chamber through bin dumper.
- Pre-vacuum
  - As per program pre-vacuum process evacuate air and turned pressure inside to negative pressure at 0.09Mpa (13 psi) to ensures complete and effective sterilization.If pre-vacuum is not needed the prevacuum time can be adjusted as “0” min to skip this process.
- Shredding
  - The shredder begin to rotate and reverse at the same time to grind and crush waste into unrecognizable pieces which then fall into the sterilization chamber.
- Sterilization
  - Following the shredding process saturated steam is injected in and raise temperature up to 134 °C(273°F) & 0.22Mpa (32Psi) and continue sterilizing in 15 minutes to destroy all forms of microbial germs.
- Cooling and Drainage
  - To inject cold water into the sterilization chamber to decrease its temperature around 60°C and drain the condensate water accordingly.
- Post-Vacuum
  - At post-vacuum process is to remove the residual steam and moisture completely, thus the treated waste become dry and cold at end of the cycle.
- Recording
  - The autoclave system has automated recorder and monitor which can record the important data of the operation process and guarantee complete sterilization is archived.
- Unloading
  - The bottom door open and treated waste is unloaded automatically.

## Disinfection and Sterilization
## HYDROCLAVE

- The Hydroclave is essentially a double-walled (jacketed) cylindrical, pressurized vessel, horizontally mounted, with one or more side or top loading doors, and a smaller unloading door at the bottom.

## Disinfection and Sterilization
## HYDROCLAVE

- Sterilizes the waste utilizing steam, similar to an autoclave, but with much faster and much more even heat penetration.
- Hydrolyzes the organic components of the waste such as pathological material.
- Removes the water content (dehydrates) the waste.
- Breaks up the waste into small pieces of fragmented material.
- Reduces the waste substantially in weight and volume.

## Disinfection and Sterilization
## HYDROCLAVE

### STAGE ONE - LOADING

- The Hydroclave can process:
- Bagged waste, in ordinary bags.
- Sharps containers.
- Liquid containers.
- Cardboard containers.
- Metal objects.
- Pathological waste.

## Disinfection and Sterilization
## HYDROCLAVE

STAGE TWO - STERILIZING

- Powerful rotators mix the waste and breaks it into small pieces.
- Steam fills the double wall (jacket) of the vessel and heats the vessel interior.
- The liquid in the waste turns to steam.
- After 20 minutes the waste and liquids are sterile.

# Disinfection and Sterilization
# HYDROCLAVE

STAGE THREE - DEHYDRATION

- The vent is opened, the vessel de-pressurizes via a condenser, and sterile liquid drained into sanitary sewer.
- Steam heat and mixing continue until all the liquids are evaporated and the waste is dry.
- Guaranteed sterility of all waste particles!
- No pre-shredding of infectious waste necessary!
- No special waste bags or chemicals required!

## Disinfection and Sterilization
## HYDROCLAVE

STAGE FOUR - UNLOADING

- The unloading door is opened
- The mixer now rotates in the opposite direction, so angled blades on the mixer can push the waste out the unloading door.
- The dry sterile waste can be fine-shredded further or dropped in a waste disposal bin.
- The waste is now ready for safe disposal!

# Hydroclave vs Autoclave

## Hydroclave

- Low operating cost by recycling steam.
- No special bags required
- Treats wet or liquid loads easily
- Strong weight reduction
- Strong volume reduction
- Consistent high sterility

## Autoclave

- Higher operating cost,
- no steam recycling
- High temp/ bags req'd
- Cannot treat wet or liquid loads
- Weight increase
- No volume reduction
- Spotty sterility

# NOVEL INTERVENTIONS…
# Hand Hygiene

# Hand Hygiene

- 160 years after the publication of Ignaz Semmelwiess' study demonstrating the impact of hand hygiene (HH)
  - hospitals continue to struggle with suboptimal rates of compliance
  - despite widespread agreement that HH is the most important intervention for the prevention of infection

- The most common reasons given by healthcare workers (HCWs) for non-compliance:
  - insufficient time
  - work overload
  - lack of knowledge
  - scepticism about HH as a prevention method
  - inconvenient locations of sinks and soap dispensers
  - lack of incentives for HH compliance

## Hand Hygiene
## COMPLIANCE MONITORING DEVICES

- WHY MONITOR COMPLIANCE?
  - assess baseline compliance by health-care workers (HCWs),
  - provide feedback to health-care workers about defective practices as well as improvement,
  - evaluate the impact of promotion interventions, and
  - investigate outbreaks.

## Hand Hygiene
## COMPLIANCE MONITORING DEVICES

- How do we monitor compliance?
  - Direct Observation: Unobtrusive direct observation of hand hygiene practices by a trained observer is considered the gold standard for evaluating compliance
    - Hawthorne Effect:
      - ***individuals modify an aspect of their behavior in response to their awareness of being observed***
  - Electronic Handwash counters
  - Product Volume Measurement

PRODUCT UTILIZATION MEASUREMENT - USED AS A PROXY FOR DIRECT OBSERVATION FOR DETERMINING

(HAND HYGIENE) HH COMPLIANCE

- One reason for not finding a strict correlation between HH compliance measurement methods
  - patients and their families inside the rooms also use alcohol gel for HH
  - pushed the dispenser multiple times in a short time period (although the product will be dispensed on demand, only one episode of HH is recorded for every 2-s time period),
  - pushed the dispenser once suboptimally, resulting in a small dispensed volume

## Hand Hygiene
## COMPLIANCE MONITORING DEVICES: PRODUCT UTILIZATION DEVICES

- ELECTRONINC COUNTERS:
  - ADVANTAGES:
    - record continuously for 24 h per day
    - useful in counting dispenser activities
    - deliver rapid results without requiring the expenditure of many hours to obtain a small sample of observations
  - DISADVANTAGES
    - lack utility for determining the appropriateness of HH episodes by the user
    - cannot determine the quality of HH episodes

## Hand Hygiene
## COMPLIANCE MONITORING DEVICES: PRODUCT UTILIZATION DEVICES

- ELECTRONINC COUNTERS :
  - An effective tool to help measure and coach employee handwashing compliance
  - "beeps" when employees dispense soap to begin washing
  - "beeps" twice to signal they've washed for 20 seconds
  - counts each wash to help you monitor employee handwashing frequency

# RFID

**“use contextual-based movements of staff to determine if healthcare workers have washed their hands before and after patient care.”**

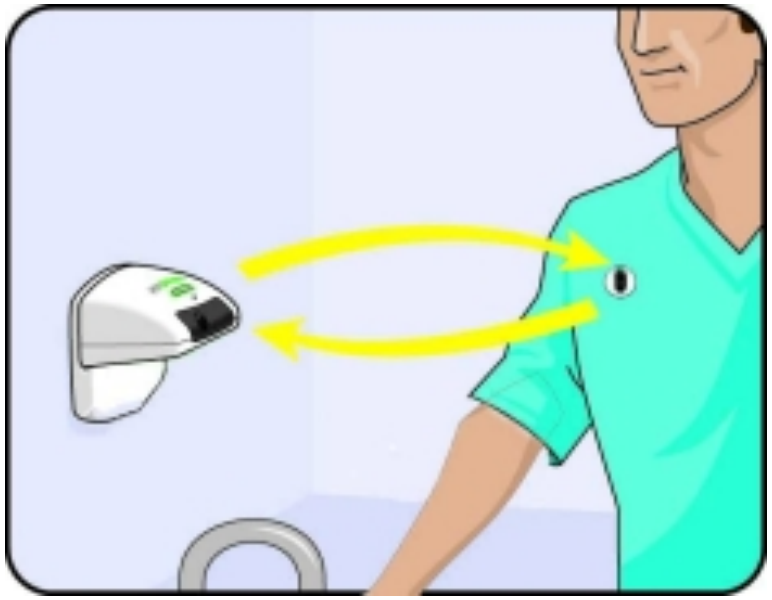
# RFID

- RFID readers are mounted on the ceiling/wall to rooms in which the dispensers are installed
- Staff members each wear RFID badge on a lanyard /attached to a lapel
- The unique ID number encoded to the badge's tag can be linked to that worker's own information if the employer wishes to track individuals
- When a staff member enters a room the reader captures that person's badge's tag ID number and forwards it to the software
- The software then expects that ID to be detected again at the hand-washing dispenser.

# Hand Hygiene
# RFID MONITORING DEVICES

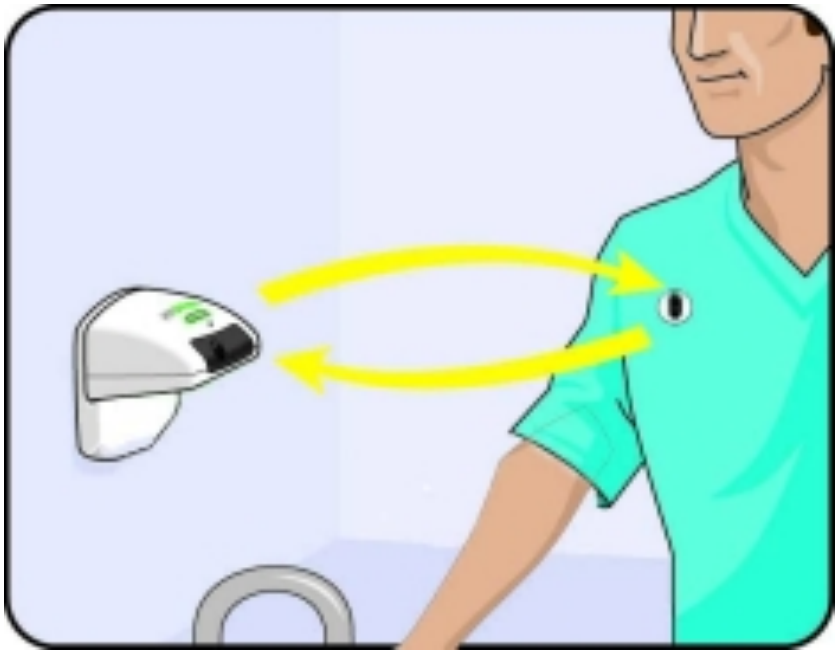
- The healthcare worker applies soap or gel to the hands.

# Hand Hygiene
# RFID MONITORING DEVICES



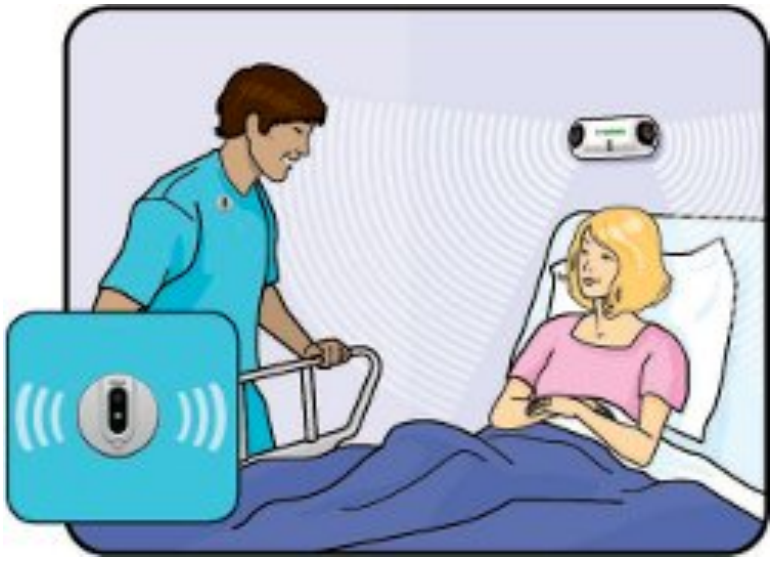
- When the sensor detects a hand hygiene event, the LED on top of the handwash sensor turns green and the badge blinks green.

  A wireless signal documents the healthcare worker ID, time and location and sends it to a database.



- When the sensor detects a hand hygiene event, the LED on top of the handwash sensor turns green and the badge blinks green

  A wireless signal documents the healthcare worker ID, time and location and sends it to a database



- While the healthcare worker takes care of the patient, the bed monitor recognizes that the badge is blinking green.

  Time and location of the interaction and HCW ID are also transmitted to the database.

  **If the badge is not green, the bed monitor knows that the healthcare worker has not washed and will vibrate to remind them to wash.**

- Data is recorded
- Document all hand hygiene events in the hospital 24 hours a day, 7 days a week
- Empower infection preventionists with accurate 24/7 real-time hand hygiene information

- RFID Hand Hygiene Advantages
  - Improves the safety of patient and provides enhanced quality of caution
  - Informs the administrators regarding non compliance
  - Cautions the caregivers of their non compliance; thereby gives them a chance to clean their hands before giving care
  - Used to find and detail the possible sources for transferring infection
  - Eases the implementation of policies with regards to hand hygiene

# 'You can lead a horse to water, but you can't make it drink'

1175 in Old English Homilies

# 'If the mountain will not come to Muhammad, then Muhammad must go to the mountain'

**Muhammad, as retold by Francis Bacon, in Essays, 1625: Mahomet calledd the Hill to come to him.**

- Alcohol gel dispenser is incorporated into the door handle
- Each person who uses the door handle receives sanitising gel
- Increased compliance rates by 700%.

# PPE

## GLOVES

- New and improved gloves are available for those in need of a 12-inch, powder-free, latex-free, exam glove.
- Comfortable, elastic, and durable
- Textured fingertips provide a grip that allows for complete control in both wet and dry environments
- Extended cuff provides extra protection to the wrist and lower forearm
- Tested for use with chemotherapy drugs, which makes these gloves the ideal choice when handling caustic and hazardous chemicals.

# What innovations and technologies are he or on the horizon?

- TEXTILE
  - "Wearable technologies such as radio frequency identification and biometrics
  - Hands-free wearables can monitor vitals along with exposure limits
  - The ability to track employees and measure their movements to help keep them SAFE

# What innovations and technologies are here or on the horizon?

- GLASSES
  - higher levels of anti-fog and scratch- resistant coatings
  - softer, more flexible frame options like urethane will increase comfort for the wearer
  - low- profile, lightweight, soft materials for better sealing, which will mimic traditional goggles
  - similar data that FitBit devices provide today like body temperature, environmental temperature, heart rate and activity level will be incorporated into wearable PPE

Being aware of a sudden spike in body temperature or heart rate of a worker will save lives

# Clothing

- Scrubs and lab coats integrated with a proprietary antimicrobial agent that protects fabrics from the damaging effects of microbial contamination.
- Apparel featuring long-lasting antimicrobial agent that protects fabrics from the effects of microbial contamination
  - technology integrates an antimicrobial agent that produces a chemical species known as hydroxyl radicals into every fiber of the product
  - provides an even distribution of the active ingredient while still keeping the fabric soft and pliable
  - hydroxyl radicals attack microorganisms along several parallel pathways - simultaneously degrading the cell's protective bio film, rupturing the cellular membrane and disrupting the biological processes within the cell, thereby killing the organism
- Because the agent bonds with the fabric in its raw state, the agent's efficacy can withstand the rigor of repeated laundering.

# APPLICATION

- Linens – duvet covers, sheets, pillowcases, towels, tablecloths, napkins
- Attire – staff uniforms, chef's coats, aprons
- Cleaning Supplies – rags, towels, sponges, mops

# Policies and Practices

DATA MINING

- Another way that hospitals are tackling the HAI problem
- SOFTWARE OR PROGRAMS, some of them proprietary, link to a hospital's data feed
  - identify patients with multidrug-resistant organisms or other infections
  - they can be isolated or target trends and associations of different infections within the facility
  - there is quicker notification of outbreaks and transmission

# Policies and Practices

- The Checklist: A Global Tool That Works
- At the core of many infection prevention strategies is an elegant and simple tool: the checklist.
  - The use of checklists in medicine is adopted from the aviation profession where checklists are routinely used for accident prevention
-

# Policies and Practices

BUNDLES that make use of a checklist

- CAUTI – Catheter-associated Urinary Tract Infection
- CLABSI – Central Line-associated Bloodstream Infections
- SSI – Surgical Site Infection
- VAP- Ventilator Associated Pneumonia

# Safe Injection Practices

- AUTODISABLE SYRINGE
  - Auto Disable syringe is a syringe that cannot be reused.
  - It incorporates a mechanism to automatically break or lock the plunger as the injection is being given to make the syringe inoperable for possibly being used for a second time.
- Retractable Syringe
- Needle caper

- Deciding what technologies to invest in should start with a good cost
- Hospitals need to determine the cost of the technology itself, the impact on workflow and how effective it is likely to be in decreasing infections.
- “Any time a facility is going to decide to implement new technology, they need to evaluate
  - what are their current infections,
  - what are the gaps
  - what is their performance
  - what do they need to work
  - what are the technologies out there that can help improve their performance that would justify the cost of adding new technologies

- .