

Health Care Nosocomial Infections

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NASA KSC

Disclosure

- No competing conflicts of interested
- Resources provided by CSIMPP/SPP

Warning

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Outline

- Definitions
- Magnitude of the problem and epidemiology
- Example and legislative context and intervention
- Knowledge base
- Points

Learning Objectives

- Understand the magnitude of the problem
- Discuss the relationships for development of HAI, and
- Recognize and apply the principles of antibiotic drug stewardship and infection control.

Magnitude of the Problem

Infection News

- Current recommendations for infection control among health care providers may not be adequate (Hospital Safety Insider, February 1, 2013)
- [refers to influenza precautions and use of fitted respirators]

Monitoring Effective Cleaning

- In the CDC guidelines for MDRO, it is recommended that hospitals "monitor cleaning performance to ensure consistent cleaning and disinfection of surfaces in close proximity to the patient..."
- To gauge the effectiveness of a cleaning program, most hospitals rely on visual inspection as a cleaning monitoring method which has been shown to be inadequate for ensuring proper cleaning has been performed.
- Better tools are available

Sensational News

March 29, 2013

“About 7,000 patients who visited a suburban Tulsa, Oklahoma, dentist in the past six years may have been exposed to HIV and hepatitis, health investigators say”

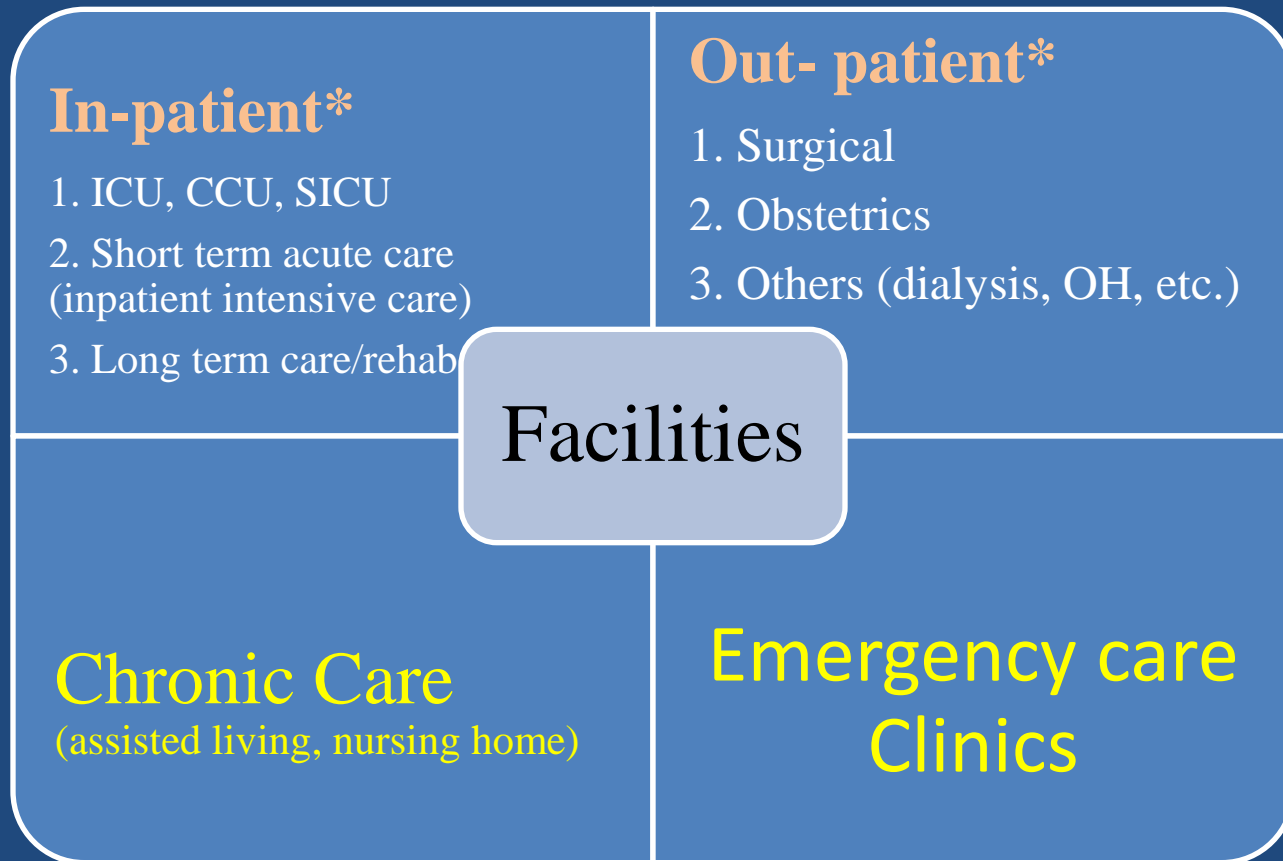
April 10, 2013

“Arkansas health officials on Tuesday recommended blood tests for about 100 young patients of a dentist who sedated them with drugs possibly contaminated with infectious material”

HAI

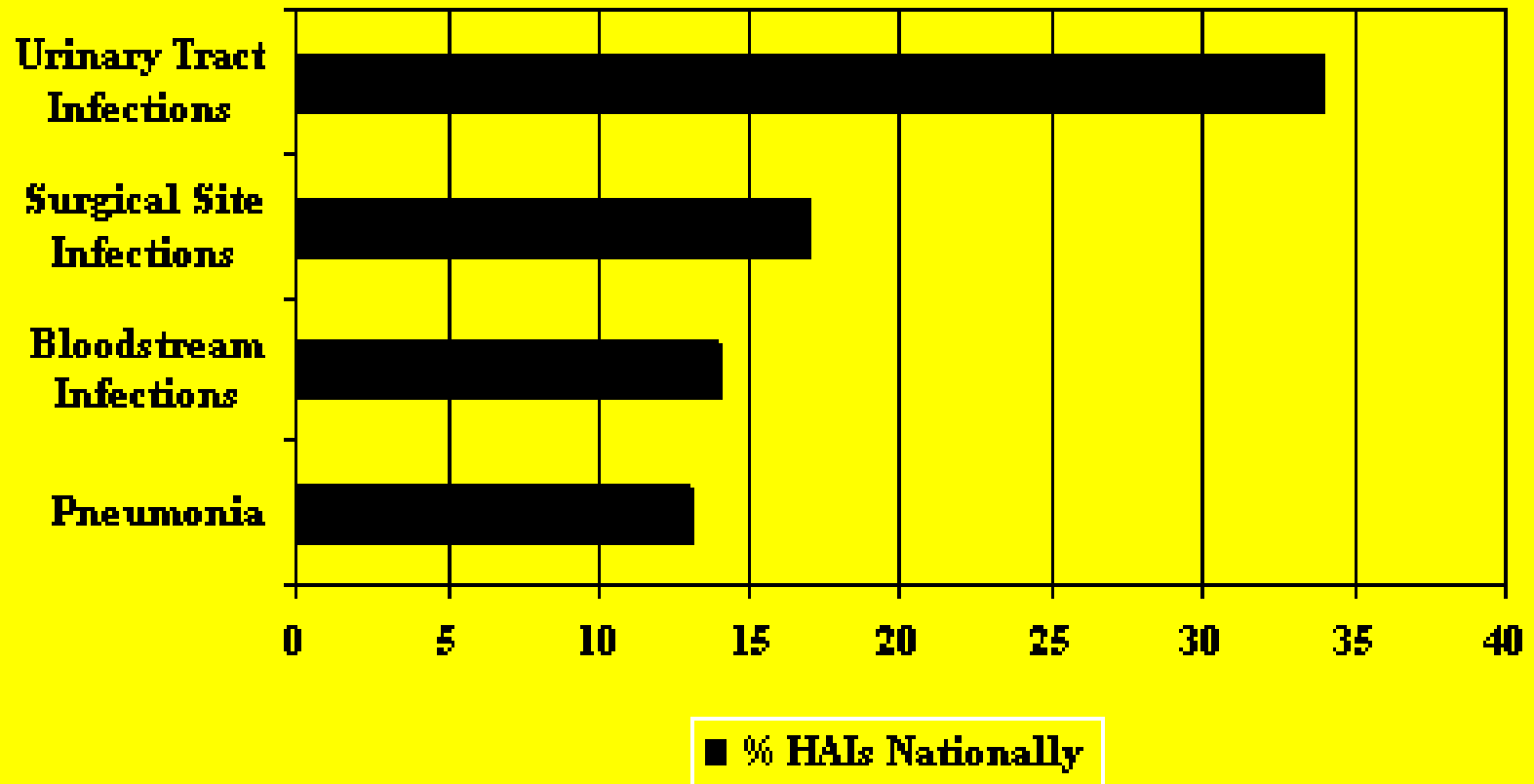
- **Refers to nosocomial infections acquired in health care settings, not diagnosed at the time of admission and apparent 48 to 72 hours after hospitalization**
- **Five to 10% of admitted patients at risk**
- **90,000 deaths**
- **USG cost \$ 4,5 billions**
- **Definitions**
 - Hospital associated infections
 - Health care acquired infections

Facilities of Interest (* of prime interest)



Categories

Leading Types of Healthcare-Associated Infections



Why Worry about HAI in OEH Practice?

- People live longer
- Workforce is getting older
- Chronic diseases becoming prevalent
- More procedures are performed on an outpatient basis
- Community acquired infections blend with health care nosocomial infections
- Poorly engineered buildings facilitate the spread of HAI
- Novel pathogens travel faster and further
- ***It is an avoidable/preventable safety problem***
- Health care costs, litigations and loss of public confidence

Reservoirs for *Clostridium difficile*

| Environment | Prevalence (%) |
|---|----------------|
| • Rivers | • 80 |
| • Community Swimming Pools | • 50 |
| • Lakes | • 47 |
| • Sea water | • 44 |
| • Soil | • 21 |
| • Hospitals | • 20 |
| • Dogs | • 10 |
| • Raw Vegetables | • 2 |
| • Main Tap (potable water faucets) | • 2 |
| • Private Residences (individual homes) | • 2 |
| • Cats | • 2 |

Special Concerns (HHS Area of Interest)

Pathogens

1. C diff.
2. MRSA

- C. diff. likely not to meet 2013 HHS target (9 more sensitive tests? Since 2009)
- Prevention and transmission control for C. diff. , MDRGN and VRE
- MRSA seems to be on target for 2013

Epidemiology

- Use of electronic tools (EHR)
- Transition from community/HAI and poor follow up in the post discharge period (readmissions)

Interventions

- Better understanding of effectiveness of interventions
- Importance and ease of implementation (compliance) of training

CDC 2011 report

- A 41 % reduction in Carbapenem resistant infections since 2008, up from the 32 percent reduction reported in 2010. Primarily (ICU), wards, and neonatal ICUs.
- CDC estimates that 12,400 central line-associated bloodstream infections occurred in 2011, costing one payer, the Centers for Medicare & Medicaid Services (CMS), approximately \$26,000 per infection.
- A 17 % reduction in SSI since 2008. Correlation with procedures is incomplete
- A 7 % reduction in CAUTI since 2009, While there were modest reductions in infections among patients in general wards, there was essentially no reduction in infections reported in critical care locations

OSHA, CDC, Joint Standards JCA

- Inadvertent exposures to environmental pathogens (e.g., *Aspergillus* spp. and *Legionella* spp.) or airborne pathogens (e.g., *Mycobacterium tuberculosis* and varicella-zoster virus) can result in adverse patient outcomes and cause illness among health-care workers.
- Environmental infection-control strategies and engineering controls can effectively prevent these infections.
- The incidence of HAI s and pseudo-outbreaks can be minimized by appropriate
 - 1) Use of cleaners and disinfectants;
 - 2) Maintenance of medical equipment (e.g., automated endoscope reprocessors or hydrotherapy equipment);
 - 3) Adherence to water-quality standards for hemodialysis, and to ventilation standards for specialized care environments (e.g., airborne infection isolation rooms, protective environments, or operating rooms); and prompt management of water intrusion into the facility.

Traditional OEH Standards

- Workplace
 - Food
 - Water
 - Blood (will use as an example here)
 - Air

Example of current legislations and safety recommendations

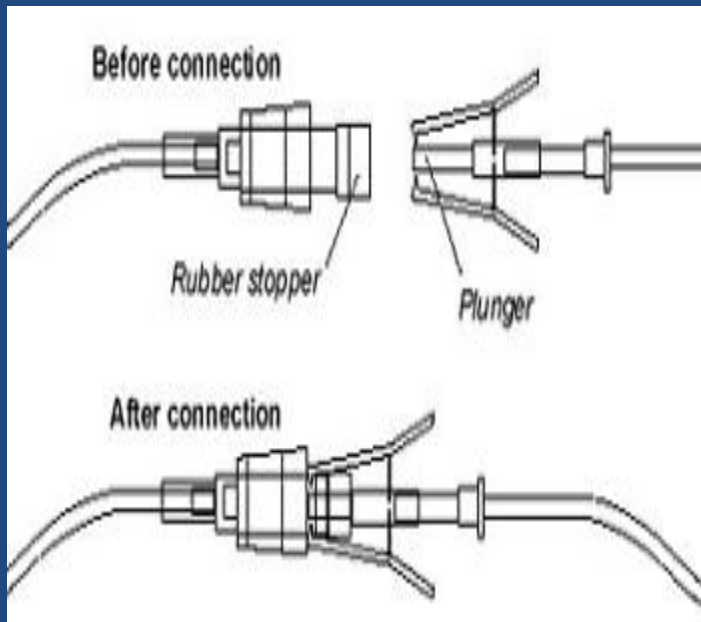
Laws

- OSHA “Needle stick Safety and Prevention Act”
 - Revised Blood borne Pathogens Standard [29 CFR 1910.1030], effective April 18, 2001
 - **Definitions** for blood borne pathogens, other potentially infectious materials (OPIM), and occupational exposure are found in 29 CFR 1910.1030(b).
 - Employers ensure that **hand washing** facilities be readily accessible, [29 CFR 1910.1030(d)(2)(iii)] and that employees wash their hands immediately or as soon as feasible after removal of gloves or other personal protective equipment [29 CFR 1910.1030(d)(2)(v)].
 - **Contaminated needles** and other contaminated sharps must not be bent, recapped, or removed except as noted in paragraphs 29 CFR 1910.1030(d)(2)(vii)(A) and (d)(2)(vii)(B). Shearing or breaking contaminated needles is prohibited. (Use of blunt sutures)
 - **Engineering and work practice controls** be used to eliminate or minimize exposures to blood and OPIM. [29 CFR 1910.1030(c), 29 CFR 1910.1030(d), and OSHA Directive CPL 02-02-069]
 - Appropriate **personal protective equipment** (PPE) be worn if blood or OPIM exposure is anticipated. [29 CFR 1910.1030(d)(3)] : **Gloves**[29 CFR 1910.1030(d)(3)(ix)]; **Masks** [29 CFR 1910.1030(d)(3)(x)]
 - **Post exposure** follow up and documentation [29 CFR 1910.1030(f)(3)].
 - Training procedures and post exposure investigations

Universal precautions

- Employer should implement universal precautions. [29 CFR 1910.1030(d)(1)]
 - Treat all blood and other potentially infectious materials with appropriate precautions.
 - Use gloves, masks, and gowns if blood or OPIM exposure is anticipated.
 - Use engineering and work practice controls to limit exposure.

Safer needles but not full proof



Emerging Hazards, Risks and Uncertainties (beyond AMDR)

Role of the Environment in HAI Transmission (Evidence)

- The link between environmental contamination and patient acquisition (Good)
- Patients admitted to rooms previously occupied by individuals infected or colonized with MRSA, VRE or *Acinetobacter baumannii* are at significant risk from previously contaminated sites (Good).

Role of the Environment in HAI Transmission (Evidence)

Health Care Worker [HCW]

- Contaminated environmental surfaces can contribute to the transmission of infectious pathogens (*Good*)
- Cleaning and disinfection high-touch surfaces has been suboptimal (*Excellent*).
- As Carling, et al. (2008) "*It has now been well documented that pathogens such as MSSA, MRSA and VRE, are readily transmitted from environmental surfaces to HCW hands.*"

Patient

- The link between environmental contamination and patient acquisition (*Good*)
- Patients admitted to rooms previously occupied by individuals infected or colonized with MRSA, VRE or *Acinetobacter baumannii* are at significant risk from previously contaminated sites (*Good*).

ENVIRONMENTAL CLEANING: MDR CONTROL?

- **Purpose**

- To assess the efficacy of environmental cleaning protocols for reduction of VRE and *C. difficile*

| | Baseline | Post-Routine | Post-Bleach |
|------------------------|----------------------|---------------------|--------------------|
| | <u>⊕ Cx</u> | <u>Cleaning</u> | <u>Cleaning</u> |
| VRE (N = 17) | 94% | 71% | 0 |
| | (p < .001) | | |
| C. diff (N = 9) | 100% | 78% | 11% |
| | (p = .03) | | |

... **Implications** ...

Infection Control

Drug Availability

- **Antibiotics**
 - Limited number in the development pipeline.
 - The average cost for each new drug is in the range of USD 70 to 2 billion.
 - Most of the antibiotic drugs entering the market are a modification of the already existing compounds.
 - There is an early resistance development for each new antibiotic entering the market
- **Vaccines**
 - Several in development and testing phases
 - Many do not reach large scale trials

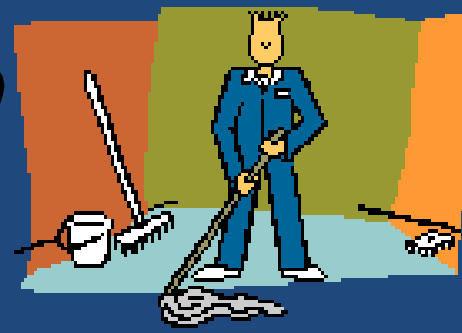
Control

- *Personal and environmental hygiene [refer to USG guidelines]*
- Administer antibiotics only when indicated (includes the use of topical antibiotics)
- Pathogen culture and sensitivity testing should guide therapy (MIC levels)
- Prescreening all patients on admission for carrier status is controversial
- Adherence to treatment protocols and guidelines
- Screening for travelers returning from suspected areas of high prevalence of AMDR

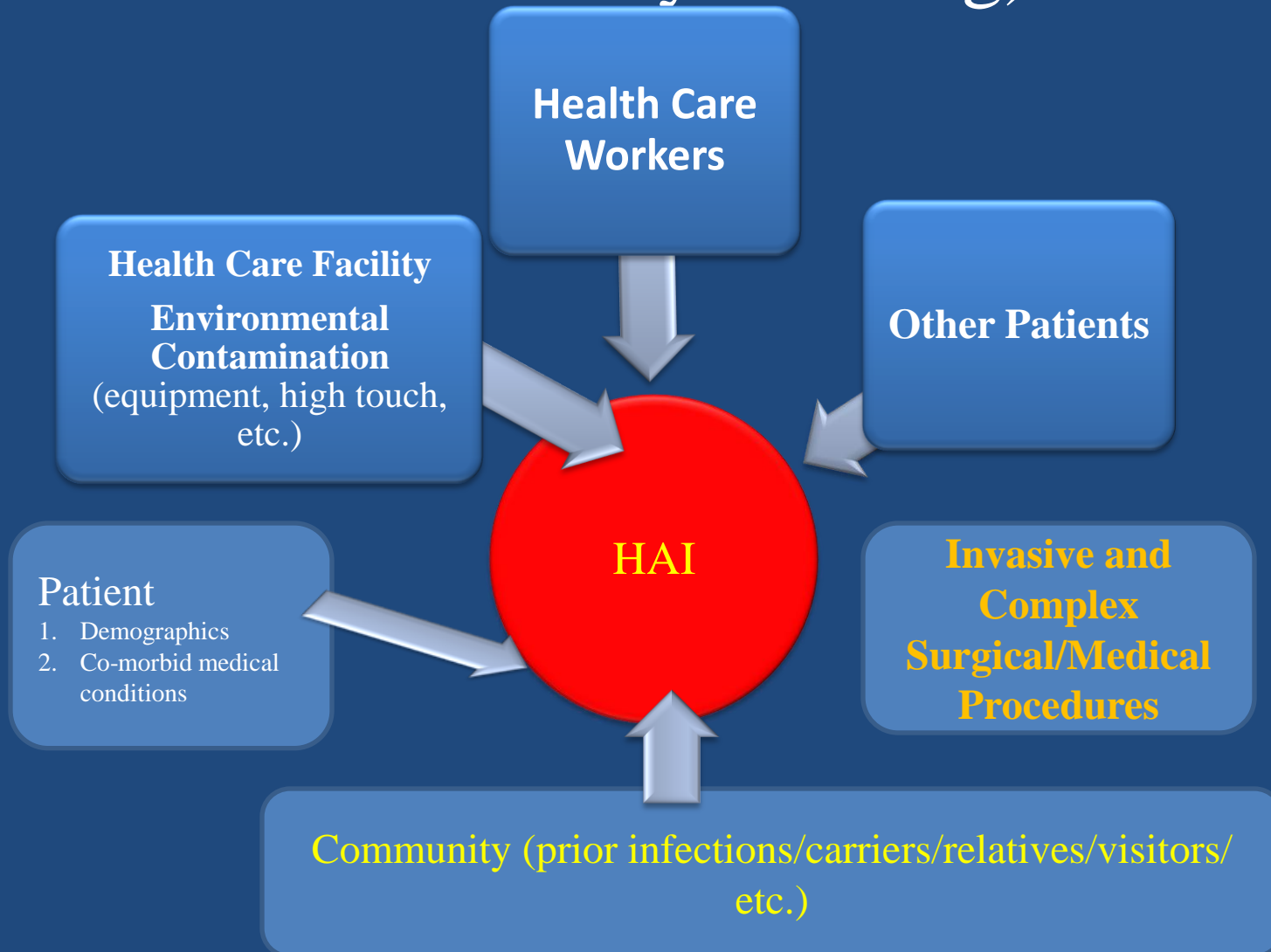
Categories of Environmental Surfaces

- **Two categories of environmental surfaces.**
 - Items That Need to Be Cleaned Frequently
 - Items that need to be cleaned frequently have a high degree of handling and risk of cross-transmission. These can include horizontal surfaces as well as “high touch” surfaces.:

Overlooked Culprits (Cross Contamination)



Possible Modes of HAI Acquisition (Need Priority Ranking)



Modeled Incidence and Percent Change for All Invasive Hospital-Onset and Healthcare- Associated, Community-Onset MRSA infections, 2005-2007

| <i>Year</i> | <i>Modeled incidence per 100,000 population</i> | <i>Modeled percent change from previous year</i> | <i>Total modeled percent change</i> | <i>P-value</i> |
|--|---|--|-------------------------------------|----------------|
| <i>Hospital-onset</i> | | | | |
| 2005 | 9.95 | | | |
| 2006 | 8.96 | -9.97% | | |
| 2007 | 8.24 | -8.08% | -17.2% | 0.01 |
| <i>Healthcare-associated, community-onset</i> | | | | |
| 2005 | 22.13 | | | |
| 2006 | 21.11 | -4.59% | | |
| 2007 | 19.70 | -6.71% | -11.0% | 0.04 |

Effectiveness of Interventions and Knowledge Gaps

HHS Current Evidence (qualitative rating)

- Association Factors
 - **Strong**
 - Lack of vaccines
 - Hygiene and hand washing
 - Seniors
 - Newborn/infants, especially perinatal
 - **Medium**
 - Antibiotic stewardship
 - Handling/preventing biofilm detection and prevention
 - Comorbid conditions [i.e. diabetes, metabolic, immunodeficiency]
 - **Weak**
 - Withholding reimbursements
 - **Unknown/Insufficient**
 - Environmental transmission and decontamination
 - Community

INFECTION PREVENTION: (FOUR) PILLARS

- De-populate the patient
- *De-populate the space
- *De-instrument the patient
- *De-escalate the ABX

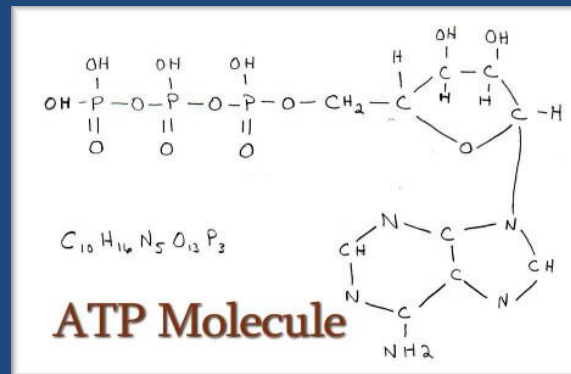
HIGH TOUCH AREAS

- Light Switches
- Sink Faucets
- Restroom Door Handle
- Toilet Flusher
- Bed Hand Rail
- Bed Side Table
- Shower Handle/ Rail
- Telephone
- Keyboards
- Remote Control
- Call Button



What is ATP?

- Adenosine triphosphate (ATP) is an enzyme that is present in all living cells, and an ATP monitoring system can detect the amount of organic matter that remains after cleaning an environmental surface, a medical device or a surgical instrument.



ATP based Clean-Trace System

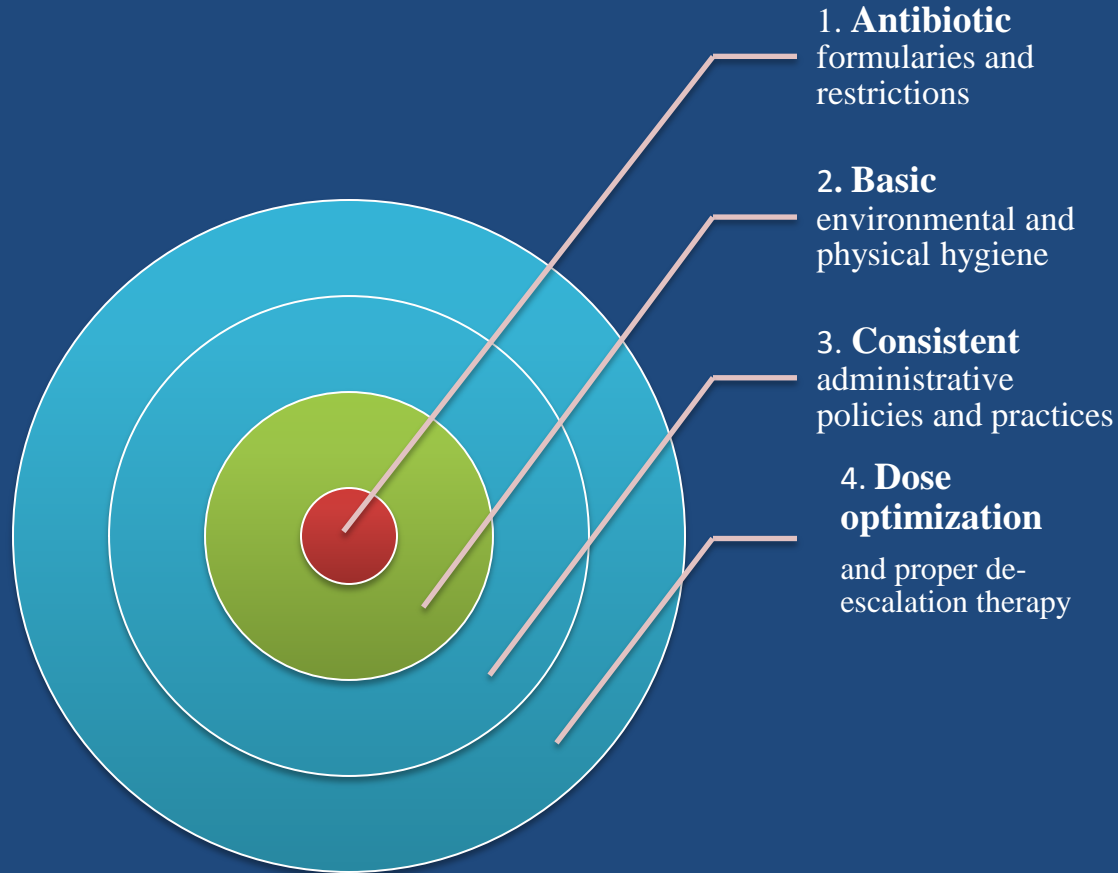
- Adenosine triphosphate (ATP) is an enzyme that is present in all living cells, and an ATP monitoring system can detect the amount of organic matter that remains after cleaning an environmental surface, a medical device or a surgical instrument.
- Using specially treated swabs, a specimen is collected from area in question.
- The swab is introduced into a hand held ATP bioluminescence registering device to determine if surfaces have been cleaned to an expectable level.
- Cost \$ 1,000-2,500



Portable PCRs

- Portable PCR systems introduced to the market in the early 2000s,
- In vitro diagnostics and point-of-care testing are two major applications.
- Problems: battery operated, accuracy, most weigh 50 lbs, cost \$10,000-\$150,000
- There are only a handful of vendors that sell handheld and portable PCR systems. Idaho Technology is among the biggest vendors. (Smiths Detection , Tetracore)
- Largest Markets
 - Security
 - Food
 - Diagnostics
 - Instrument Cost

The ABCD of Antibiotic Stewardship



Points to Remember

- About 70% of bacteria that cause infections in hospitals are resistant to at least one of the common antibiotics
- Some organisms are resistant to all approved antibiotics and must be treated with experimental and potentially toxic drugs
- Antibiotics are given to patients more often than called for in set guidelines
- Premature discontinuation or early interruption of antibiotic therapy help the spread of resistant strains (example: MDR-TB)
- Combination therapy with 2 antibiotics prevents the emergence of resistant strains in contrast to sequential antibiotic therapy
- Early initiation of antibiotics is among the most important factors for preventing the emergence of resistant strains
- Epidemiological studies to understand the relationship of prevalent community AMDR strains and nosocomial infections [surveillance]
- Environmental and personal hygiene

**Thank You for Your
Attention**

QUESTIONS?