Healthcare Infection Control Practices Advisory Committee

July 17-18, 2014
Centers for Disease Control and Prevention
Tom Harkin Global Communications Center (Building 19, Aud 3)
1600 Clifton Rd., NE, Atlanta, GA

Thursday July 17, 2014

Time	Topic	Purpose	Presider/Presenter
9:00	**Welcome and Introductions**	Information	Neil Fishman (HICPAC Chair) Jeff Hageman (DFO, HICPAC)
9:15	Guideline Status Updates • Surgical Site Infections • Neonatal Intensive Care Units	Information	Jeff Hageman (CDC)
9:45	1999 CDC SSI Guideline Recommendations	Information Discussion	TBD (HICPAC)
10:45	**Break**		
11:00	HICPAC Recommendations for Core Infection Prevention and Control Practices	Information Discussion	Gina Pugliese (HICPAC) Deborah Yokoe (HICPAC) Ruth Carrico (HICPAC
12:15	**Lunch**		
1:30	Outbreaks Related to the Use of Duodenscopes and Future Directions	Information Discussion	Alice Guh (DHQP, CDC)
2:30	Update on Catheter-associated Urinary Tract Infection Prevention and Surveillance	Information Discussion	Carolyn Gould (DHQP, CDC) TBD
3:15	Break		
3:35	Update on Catheter-associated Urinary Tract Infection Prevention and Surveillance		
4:30	Public Comment		
4:45	**Liaison/ Ex-officio Reports**		
5:00	**Adjourn**		

DRAFT

Friday July 18, 2014

Time	Topic	Purpose	Presider/Presenter
9:00	Advanced Laboratory Techniques for Prevention and Control of Healthcare-associated Infections	Information	L. Clifford McDonald (DHQP, CDC) David Henderson (NIH)
10:00	Improving Antibiotic Use Among Hospitalized Patients	Information Discussion	Arjun Srinivasan (DHQP, CDC)
10:45	Break		
11:00	TBD	Information	David Kuhar (DHQP, CDC)
11:30	Public Comment		
11:45	Summary and Wrap Up		
12:00	**Adjourn**		

DRAFT

Guideline Status: Surgical Site Infection, Neonatal Intensive Care Units, and Healthcare Personnel

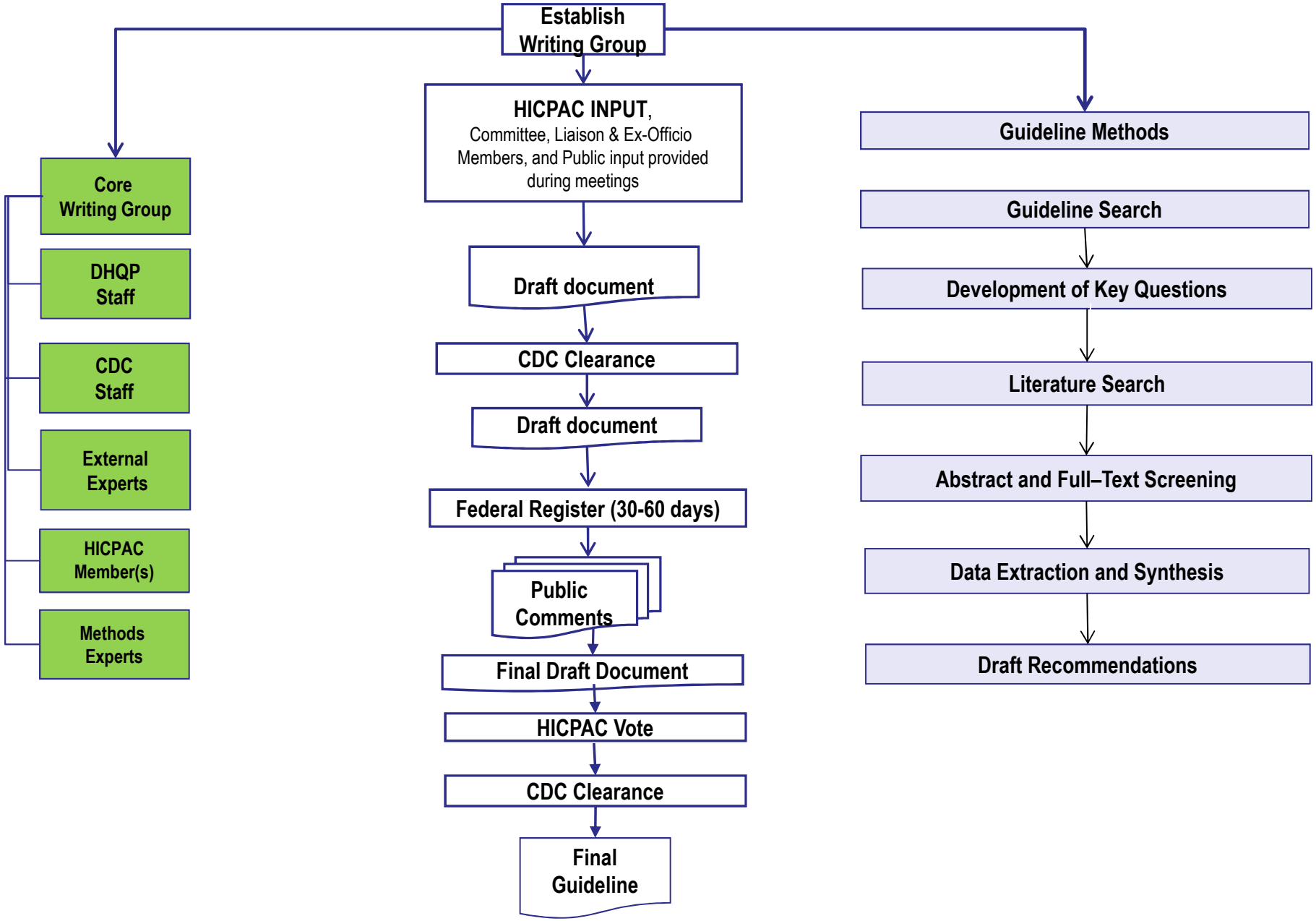
Jeff Hageman, MHS

Healthcare Infection Control Practices Advisory Committee Meeting

July 17, 2014

CDC
Centers for Disease Control and Prevention

Guideline Development Process



Draft SSI Guideline

- Draft developed
- Posted for Public Comment
  - Phase 1: Jan 29-Feb 28, 2014
    - 53 Commenters
  - Phase 2 : April 8-May 8, 2014
    - 5 commenters
  - Full narratives available on regulations.gov: (www.regulations.gov/#!docketDetail;D=CDC-2014-0003)

SSI Comments: Content-Specific

Categories of Comments

- Clarifications
  - Intent or wording
- Categorization
- New literature submitted/more recent evidence available

Content Areas

- Antimicrobial prophylaxis
- Antimicrobial coated sutures
- Antimicrobial dressings
- Antiseptic skin prep
- Antimicrobial sealant
- Antibiotic irrigation/ointment
- Glycemic control
- Intraop irrigation
- Normothermia
- Oxygenation
- Plastic adhesive drape
- Pre-op bathing

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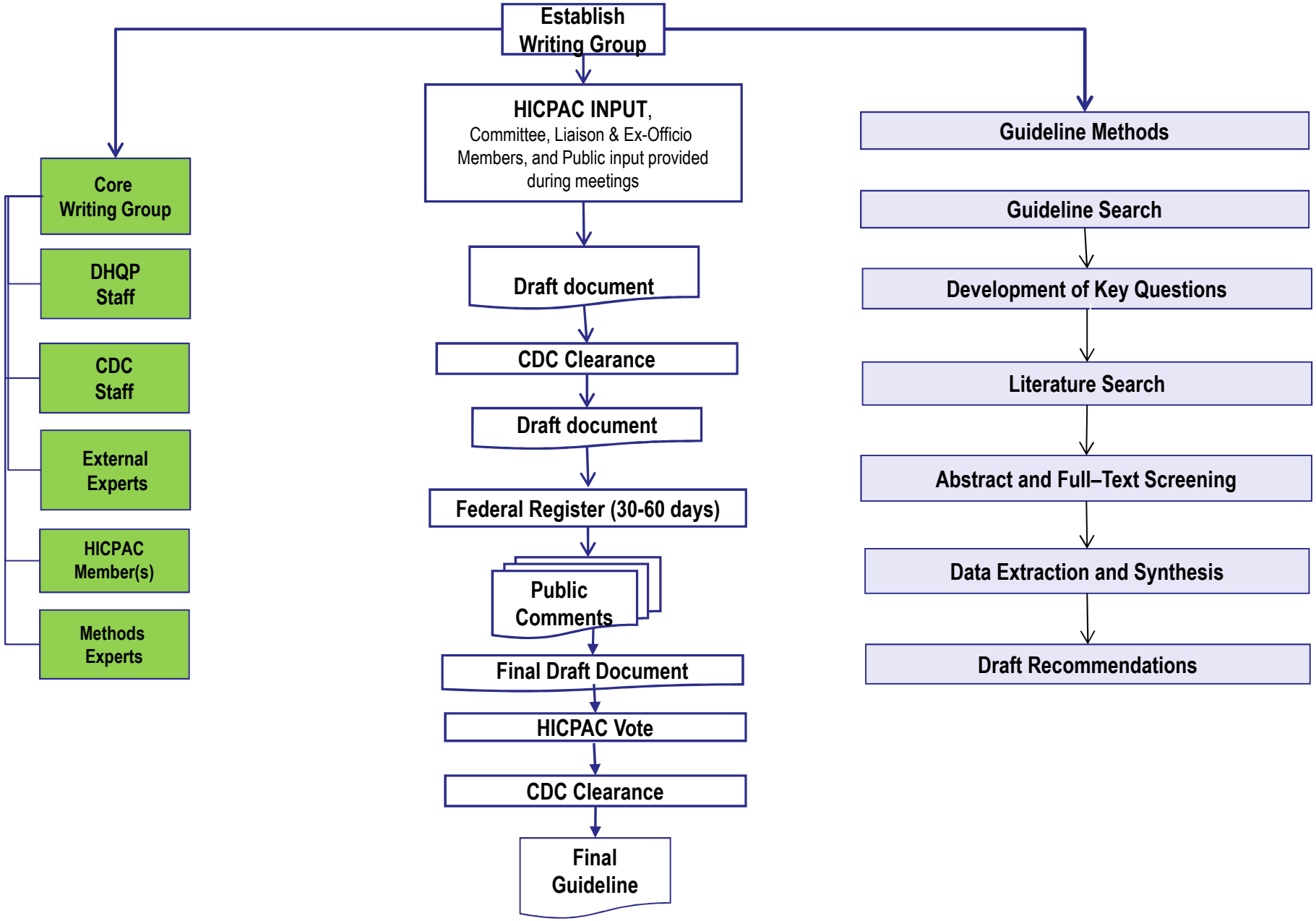


Updated Literature Search

- Searches were performed in MEDLINE, EMBASE, CINAHL, Cochrane Library.
- Previous search ended June 2011 (Core) and December 2011 (Ortho)
  - Searches were extended into 2014
- Abstracts reviewed: >500
- Full-text reviews: >90 (in-progress)
  - Antimicrobial prophylaxis (timing, dosing, duration, C-section timing)
  - Antimicrobial coated sutures
  - Antimicrobial dressings
  - Antimicrobial sealant
  - Antibiotic irrigation/ointment
  - Antiseptic skin prep
  - Oxygenation
  - Drapes
  - Pre-op bathing

SSI Next steps

- Extract studies into evidence tables
- GRADE evidence and update GRADE tables
  - Individual and aggregate
- Review and update draft recommendations
- Present draft recommendations to HICPAC
- 1999 SSI guideline recs
- No Recommendations

NICU Guideline

- Does not provide comprehensive infection control recommendations for all aspects of care provided in a NICU
- Pathogen specific areas
  - *Clostridium difficile*
  - Central-line associated bloodstream infections
  - *Methicillin-resistant Staphylococcus aureus*
  - Respiratory infections
- Implementation Guide

NICU Status

- Draft developed and reviewed by HICPAC
- Submitted to CDC clearance
- Updating literature search
  - Original search performed through Dec 2011
  - Search extended into 2014

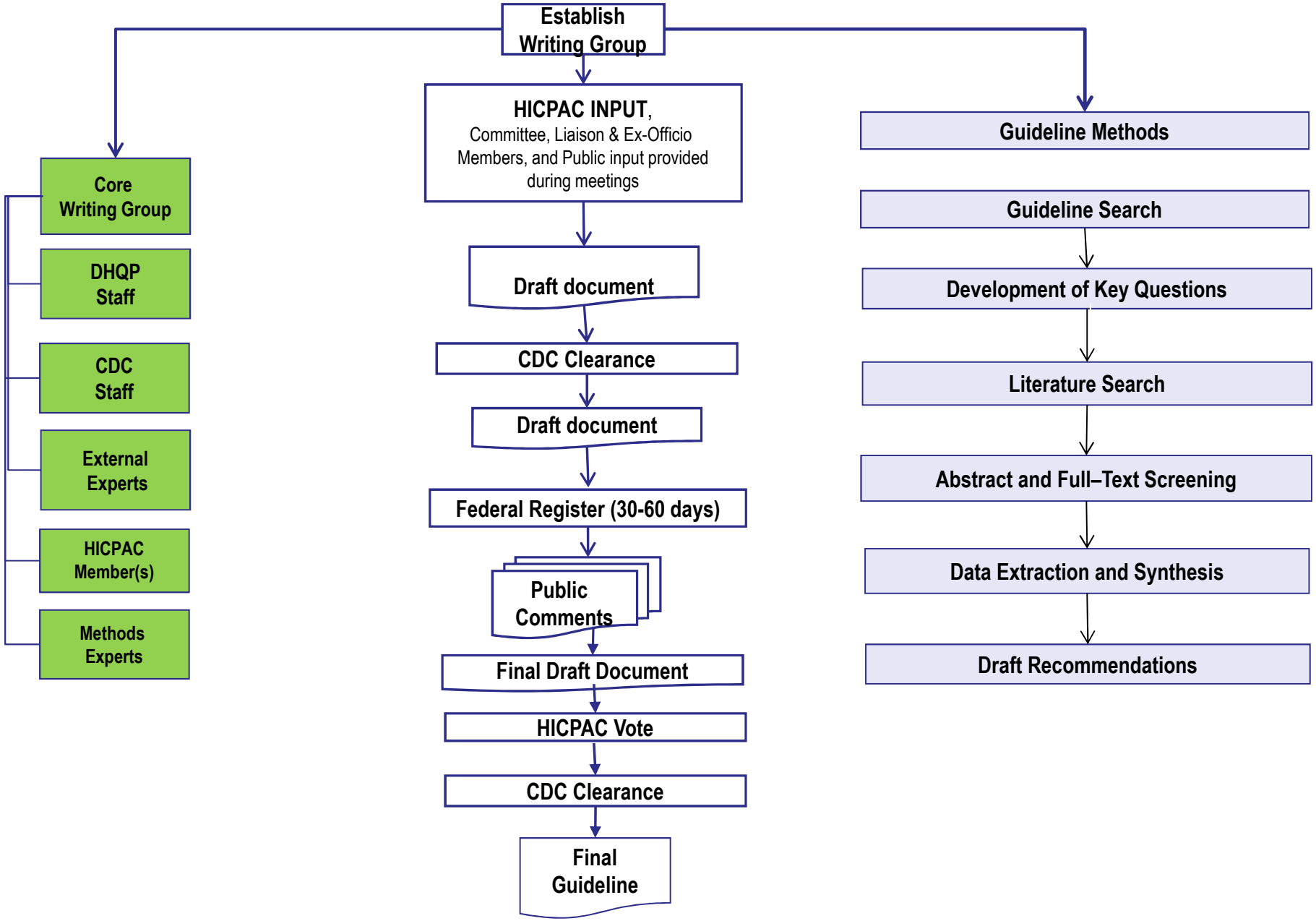
Updated Search Results

- CLABSI
  - Abstract review: 218 (in-progress)
- *C. difficile*
  - Abstracts reviewed: 41
  - Full-text review: 25 (in-progress)
- MRSA
  - Abstracts reviewed: 300
  - Full-text review: 48 (in-progress)
- Respiratory Pathogens
  - Abstracts reviewed: >180
  - Full-text review: 44 (in-progress)
    - RSV, Pertussis, Varicella

NICU Next Steps

- Complete abstract and full-text reviews
- Extract studies into evidence tables
- GRADE evidence and update GRADE tables
  - Individual and aggregate
- Review and update draft recommendations
- Public Comment

Guideline Development Process



Healthcare Personnel Guideline

- **Baseline Infrastructure and Routine Practices**
  - Infection Prevention Objectives for an Occupational Health Service
  - Elements of an Occupational Health Service for Infection Prevention
  - Draft reviewed at April HICPAC meeting
- **Specific Infectious Diseases**
- **Special Healthcare Personnel Populations**
  - Privacy & Related Issues, Pregnancy, Immunocompromised HCP, Laboratory Personnel, Emergency Response Employees, HCP with Disabilities, Personnel linked to Infectious Diseases Outbreaks, Travelling HCP

Core Writing Group Members

- David Kuhar (DHQP)
- Amanda Overholt (DHQP)
- Bradley King (NIOSH)
- Marie De Perio (NIOSH)
- Pathogen CDC Groups
- Mark Russi (ACOEM)
- David Weber (SHEA)
- Tammy Lundstrom
- Hilary Babcock (HICPAC)
- Ruth Carrico (HICPAC)
- Tom Talbot (HICPAC)
- Michael Tapper (HICPAC)

HCP Next Steps

- Reconvene core writing group
  - Finalize baseline infrastructure and routine practices
  - Begin infectious disease section

THANK YOU

For more information please contact Centers for Disease Control and Prevention

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E-mail: cdcinfo@cdc.gov Web: http://www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

1999 CDC SSI Prevention Recommendations

July 17, 2014

1999 CDC SSI Recommendations

- Reviewed issues not addressed in the SSI Guideline update
  - HICPAC Members
  - Subject matter experts
- Goal was to establish surgical core practices
  - Generally not supported by RCTs
  - Unlikely to be studied in the future
  - Maintain recommendations that are considered standard of care

Preparation of the Patient

Whenever possible, identify and treat all infections remote to the surgical site before elective Operation and postpone elective operations on patients with remote site infections until the infection has resolved.
Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation.
If hair is removed, remove immediately before the operation, preferably with electric clippers.
Encourage tobacco cessation. At minimum, instruct patients to abstain for at least 30 days before elective operation from smoking cigarettes, cigars, pipes, or any other form of tobacco consumption (e.g., chewing/dipping).
Thoroughly wash and clean at and around the incision site to remove gross contamination before performing antiseptic skin preparation.

Preparation of the Patient - Recommendations

Whenever possible, identify and treat all infections remote to the surgical site before elective Operation and postpone elective operations on patients with remote site infections until the infection has resolved.
Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation.
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Do not remove hair preoperatively unless the hair at or around the incision site will interfere with the operation. If hair removal is necessary, remove immediately before the operation, with clippers, and preferably outside of the operating room.
Encourage tobacco cessation for a minimum of at least 30 days before elective operation.
Thoroughly wash and clean at and around the incision site to remove gross contamination before performing antiseptic skin preparation.

Hand/Forearm Antisepsis

Keep nails short and do not wear artificial nails.
Perform a preoperative surgical scrub for at least 2 to 5 minutes using an appropriate antiseptic. Scrub the hands and forearms up to the elbows.
After performing the surgical scrub, keep hands up and away from the body (elbows in flexed position) so that water runs from the tips of the fingers toward the elbows. Dry hands with a sterile towel and don a sterile gown and gloves.

Hand/Forearm Antisepsis – Recommendations

- Covered in Hand Hygiene Guideline
- Somewhat antiquated given new alcohol-based surgical scrubs
- Recommend deleting this section

Management of Infected or Colonized Surgical Personnel

Educate and encourage surgical personnel who have signs and symptoms of a transmissible infectious illness to report conditions promptly to their supervisory and occupational health service personnel.
Develop well-defined policies concerning patient care responsibilities when personnel have potentially transmissible infectious conditions. These policies should govern (a) personnel responsibility in using the health service and reporting illness, (b) work restrictions, and (c) clearance to resume work after an illness that required work restriction. The policies also should identify persons who have the authority to remove personnel from duty.
Obtain appropriate cultures from, and exclude from duty, surgical personnel who have draining skin lesions until infection has been ruled out or personnel have received adequate therapy and infection has resolved.
Do not routinely exclude surgical personnel who are colonized with organisms such as S. aureus (nose, hands, or other body site) or group A Streptococcus, unless such personnel have been linked epidemiologically to dissemination of the organism in the healthcare setting.

Management of Infected or Colonized Surgical Personnel - Recommendations

- Covered in Core Practices Guideline
- Recommend deleting this section

Antimicrobial Prophylaxis

Before elective colorectal mechanically prepare the colon by use of enemas and cathartic agents. Administer nonabsorbable oral antimicrobial agents in divided doses on the day before the operation.
Do not routinely use vancomycin for antimicrobial prophylaxis.

Antimicrobial Prophylaxis - Recommendations

- Covered more extensively in other recent guidelines
- Should not address just two issues
- Recommend deleting this section

Ventilation

Maintain positive-pressure ventilation in the operating room with respect to the corridors and adjacent areas.
Maintain a minimum of 15 air changes per hour, of which at least 3 should be fresh air.
Filter all air, recirculated and fresh, through the appropriate filters per the American Institute of Architects' recommendations.
Introduce all air at the ceiling, and exhaust near the floor.
Do not use UV radiation in the operating room to prevent SSI.
Keep operating room doors closed except as needed for passage of equipment, personnel, and the patient.

Ventilation - Recommendations

- Covered in FGI Guidelines
- Maintain positive pressure ventilation in the operating room and adjoining spaces. Maintain the number of air exchanges, air flow patterns, temperature, humidity, location of vents, and use of filters in accordance with recommendations from the most recent version of the Facilities Guidelines Institute – Guidelines for Design and Construction of Hospitals and Outpatient Facilities (current version – 2014).

Cleaning and Disinfection of Environmental Surfaces

When visible soiling or contamination with blood or other body fluids of surfaces or equipment occurs during an operation, use an EPA-approved hospital disinfectant to clean the affected areas before the next operation.
Do not perform special cleaning or closing of operating rooms after contaminated or dirty operations. Category IB
Do not use tacky mats at the entrance to the operating room suite or individual operating rooms for infection control.

Cleaning and Disinfection of Environmental Surfaces - Recommendations

- Generally covered in Core Practices and Environmental Guidelines
- Recommend deleting #1 and 3
- Maintain:
  - Do not perform special cleaning or closing of operating rooms after contaminated or dirty operations.

Microbiological Sampling of the Environment

Do not perform routine environmental sampling of the operating room. Perform microbiologic sampling of operating room environmental surfaces or air only as part of an epidemiologic investigation.

Microbiological Sampling of the Environment

- Addressed in Environmental Guideline
- Recommend deleting this section

Sterilization of Surgical Instruments

Sterilize all surgical instruments according to published guidelines.
Perform flash sterilization only for patient care items that will be used immediately (e.g., to reprocess an inadvertently dropped instrument). Do not use flash sterilization for reasons of convenience, as an alternative to purchasing additional instrument sets, or to save time.

Sterilization of Surgical Instruments - Recommendations

- Maintain #1
- Immediate-use steam sterilization should never be used for reasons of convenience, as an alternative to purchasing additional instrument sets, or to save time. This practice should be reserved only for patient care items that will be used immediately in emergency situations when no other options are available (e.g., to reprocess an inadvertently dropped instrument).

Surgical Attire and Drapes

Wear a surgical mask that fully covers the mouth and nose when entering the operating room if an operation is about to begin or already under way, or if sterile instruments are exposed. Wear the mask throughout the operation.
Wear a cap or hood to fully cover hair on the head and face when entering the operating room.
Do not wear shoe covers for the prevention of SSI.
Wear sterile gloves if a scrubbed surgical team member. Put on gloves after donning a sterile gown.
Use surgical gowns and drapes that are effective barriers when wet (i.e., materials that resist liquid penetration).
Change scrub suits that are visibly soiled, contaminated, and/or penetrated by blood or other potentially infectious materials.

Surgical Attire and Drapes - Recommendations

Wear a surgical mask that fully covers the mouth and nose when entering the operating room if an operation is about to begin or already under way, or if sterile instruments are exposed. Wear the mask throughout the operation.	Wear a surgical mask that fully covers the mouth and nose when entering the operating room if an operation is about to begin or already under way, or if sterile instruments are exposed. Wear the mask throughout the operation.
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Change scrub suits that are visibly soiled, contaminated, and/or penetrated by blood or other potentially infectious materials.	Change scrub suits that are heavily soiled, contaminated, and/or penetrated by blood or other potentially infectious materials.

Asepsis and Surgical Technique

Adhere to principles of asepsis when placing intravascular devices (e.g., central venous catheters), spinal or epidural anesthesia catheters, or when dispensing and administering intravenous drugs.
Handle tissue gently, maintain effective hemostasis, minimize devitalized tissue and foreign bodies (i.e., sutures, charred tissues, necrotic debris), and eradicate dead space at the surgical site.
Use delayed primary skin closure or leave an incision open to heal by second intention if the surgeon considers the surgical site to be heavily contaminated (e.g., Class III and Class IV).
If drainage is necessary, use a closed suction drain. Place a drain through a separate incision distant from the operative incision. Remove the drain as soon as possible.

Aseptic and Surgical Technique - Recommendations

- Generalize first statement:
  - Adhere to principles of aseptic technique when performing all surgical procedures.
- Delete #2 and 3
- Maintain #4
  - If drainage is necessary, use a closed suction drain. Place a drain through a separate incision distant from the operative incision. Remove the drain as soon as possible.

Post-Operative Incision Care

Protect with a sterile dressing for 24-48 hours postoperatively an incision that has been closed primarily.
Wash hands before and after dressing changes and any contact with the surgical site.

Post-Operative Incision Care - Recommendations

- Reword #1:
  - Protect incisions that have been closed primarily with a sterile dressing for 24-48 hours post-operatively.
- Delete #2
  - Covered in Hand Hygiene Guidelines

Draft Core Practices for Infection Prevention: Minimum Expectations for Safe Care Across Healthcare Settings

HICPAC

July 17-18, 2014

Today's agenda

- Review goals and process
- Review final draft of core practices
- Finalize content
- Obtain HICPAC approval

Working Group

Chair: Ruth Carrico (HICPAC)
Co-chairs: Gina Pugliese (HICPAC) and Deborah Yokoe (HICPAC)
Members:

Kathleen Dunn and Susan Courage, PHAC
Neil Fishman, HICPAC
Jeff Hageman, CDC
Silvia Munoz-Price, America's Essential Hospitals
Joe Perz, CDC
Michael Anne Preas, APIC
Mark Rupp, SHEA
Sanjay Saint, Society of Hospital Medicine
Melissa Schaefer, CDC
Erin Stone, CDC
Rachel Stricof, CSTE

Guideline Review Assistance: Loretta Fauerbach

Goals

- Concisely describe a core set of infection prevention elements that are essential for healthcare that occurs in all settings, regardless of the level of care provided
- Ensure consistency and eliminate redundancy involved in listing and updating these standard practices for Centers for Disease Control and Prevention (CDC)/Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines.

Process

- Identified an initial list of core practices
- Reviewed current CDC and HICPAC guidelines
- Created a summary table
- Identified potential additions to the core practices list
- Presented and discussed draft core practices at previous HICPAC meetings.

Guidelines Reviewed

- Guideline for Infection Control in Healthcare Personnel, 1998
- Guideline for Prevention of Surgical Site Infection, 1999
- Guideline for Hand Hygiene in Health-Care Settings, 2002
- Guidelines for Prevention of Nosocomial Pneumonia, 2003
- Guidelines for Environmental Infection Control in Health-Care Facilities, 2003
- Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005
- Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006
- Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, 2007
- Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008
- Guidelines for Prevention of Catheter-Associated Urinary Tract Infection, 2009
- Guidance for Control of Infections with Carbapenem-Resistant or Carbapenemase-Producing Enterobacteriaceae in Acute Care Facilities, 2009
- Updated Norovirus Outbreak Management and Disease Prevention Guidelines 2011
- Updated Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011

Core Practice #1: Leadership support

1) Ensure that the governing body of the agency delivering healthcare is accountable for supporting the infection prevention activities that are relevant to the services provided and the patient populations cared for at the facility
2) Allocate appropriate resources, both human and material, to infection prevention activities to enable consistent, agile, and immediate response to infection risks
3) Empower and support positional authority to those responsible for the infection prevention activities to enable consistent, effective and immediate response to infection risks

Core Practice #2: Education and training of healthcare personnel on infection prevention

1) Include training specific to infection prevention as appropriate to job responsibilities
2) Develop processes to ensure that all healthcare personnel understand and are competent to perform their roles and responsibilities in a manner that will minimize the likelihood of infection

Core Practice #3: Patient, family, and caregiver education

1) Provide infection prevention education to patients, family members, and others included in the caregiving network, as appropriate

Core Practice #4: Performance monitoring and feedback

1) Monitor performance to enhance adherence to infection prevention best practices
2) Provide regular feedback of process and outcomes to staff performing the processes being monitored and to facility leadership

Core Practice #5: Standard Precautions

Use Standard Precautions to care for all patients in all settings. Standard Precautions include:

5a. Hand hygiene

5b. Use of personal protective equipment (e.g., gloves, gowns, face masks)

5c. Respiratory hygiene/cough etiquette

5d. Injection and medication safety

Core practice #5a: Hand hygiene

1) Require healthcare personnel to perform hand hygiene in accordance with Centers for Disease Control and Prevention (CDC) and HICPAC recommendations
2) Use an alcohol-based hand rub or an antimicrobial or non-antimicrobial soap for the following indications:
   - ✓ Before touching a patient
   - ✓ After touching a patient or the patient's immediate environment
   - ✓ After contact with blood, body fluids or excretions, and wound dressings
   - ✓ Before performing an aseptic task (e.g., placing an indwelling device, preparing an injection) or handling invasive medical devices
   - ✓ Before moving from a contaminated body site to a clean body site on the same patient
   - ✓ After glove removal
3) Ensure that healthcare personnel perform hand hygiene with soap and water (an antimicrobial or non-antimicrobial soap) when hands are visibly soiled

Core Practice #5b: Personal protective equipment

1) Educate all healthcare personnel on proper selection and use of personal protective equipment (PPE) including the following:
   - ✓ Wear gloves if likely to have contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment
   - ✓ Wear a gown to protect skin and clothing during procedures or activities where contact with blood or body fluids is anticipated
   - ✓ Wear mouth, nose and eye protection during procedures that are likely to generate splashes or sprays of blood, respiratory secretions, or other body fluids
   - ✓ Remove and discard PPE upon leaving the patient's room or area or completing a task that involves contact with excretions, secretions, blood or body fluids or contact with mucous membranes or non-intact skin.
2) Ensure that healthcare personnel have immediate access to and are able to select, put on, remove, and dispose of PPE in a manner that protects themselves, the patient, and others

Core Practice #5c: Respiratory hygiene and cough etiquette

1) Discourage visitors and healthcare personnel with symptoms of respiratory infection (e.g., fever and cough) from entering the healthcare facility
2) Help patients and essential visitors with symptoms of respiratory infection to contain their respiratory secretions by, for example, providing tissues and/or surgical masks and instructional signage or handouts at points of entry and throughout the facility
3) Separate patients with respiratory symptoms from other patients (e.g., place them into a separate examination room or as far from other patients as possible in the waiting room) as soon as possible after entry into the healthcare facility

Core Practice #5d: Injection and medication safety

1) Use aseptic technique when preparing and administering medications
2) Disinfect the access diaphragms of medication vials before inserting a device into the vial
3) Never administer medications from the same syringe to multiple patients, even if the needle is changed or the injection is administered through an intervening length of intravenous tubing
4) Do not reuse a syringe to enter a medication vial or solution
5) Do not administer medications in single-dose or single-use vials, ampules, or bags or bottles of intravenous solution to more than one patient
6) Do not use fluid infusion or administration sets (e.g., intravenous tubing) for more than one patient
7) Dedicate multidose vials to a single patient whenever possible. If multidose vials are used for more than one patient, restrict the medication vials to a centralized medication area and do not bring them into patient treatment areas (e.g., operating room, patient room/cubicle)
8) Dispose of used syringes and needles at the point of use in a sharps container that is closable, puncture-resistant, and leak- proof
9) Adhere to federal and state requirements for protection of healthcare personnel from exposure to bloodborne pathogens.

Core Practice #6: Transmission-based precautions

1) Implement additional precautions (i.e., Contact, Droplet, and/or Airborne Precautions) in situations where contact with the patient, their body fluids, or their environment presents a substantial transmission risk despite adherence to standard precautions

Core Practice #7: Preventing cross-contamination of supplies and equipment

1) Separate clean from soiled equipment in patient care areas and during patient care activities
2) Do not share patient care items between patients unless the items have been cleaned and disinfected between use and are labeled as appropriate for multiple patient use.
3) Store patient care supplies and equipment in clean storage spaces that minimize opportunities for contamination
4) Do not reuse or share between patients any items packaged or labeled as single patient use unless reprocessing of the item is FDA-approved
5) Store patient care items in areas that are free from conditions that may compromise the item (e.g., contact with water)

Core Practice #8: Environmental hygiene and disinfection/sterilization of equipment

1) Assign responsibility for routine cleaning and disinfection to appropriately trained healthcare personnel
2) Follow manufacturer's recommendations for use of cleaners and EPA-registered disinfectants (e.g., amount, dilution, contact time, safe use, and disposal)
3) Follow the equipment manufacturer's instructions to ensure that reusable medical equipment (e.g., blood glucose meters and other point-of-care devices, surgical instruments, endoscopes) is cleaned and appropriately reprocessed prior to use on another patient.

Core Practice #9: Invasive medical device

1) During each healthcare encounter, assess the medical necessity of any invasive medical device (e.g., vascular catheter, indwelling urinary catheter) in order to identify the earliest opportunity for safe removal.
2) Ensure that healthcare personnel adhere to recommended insertion and maintenance practices

Core Practice #10: Occupational health

1) Develop mechanisms that enable healthcare personnel to either receive immunizations or have documented immunity against vaccine-preventable diseases as recommended by the CDC's Advisory Committee on Immunization Practices (ACIP) and required by the U.S. Occupational Safety and Health Administration (OSHA)
2) Develop processes to encourage healthcare personnel to refrain from reporting to work when they develop signs or symptoms of acute infectious illness (e.g. fever, cough, diarrhea, vomiting, or draining skin lesions) to prevent spreading their infections to patients and other healthcare personnel
3) Develop systems to encourage healthcare personnel to report signs, symptoms, and diagnosed illnesses that may represent a risk to their patients, coworkers, and their communities to their supervisor or healthcare facility staff who are responsible for occupational health

Additional Questions?

- How often should HICPAC review core practices?
- What would trigger a re-evaluation of an existing core practice or inclusion of a new core practice?

Next Steps

- HICPAC working group will draft a white paper that includes summary of development process, importance of core practices, and implementation recommendations
- CDC will format and post core practice table on CDC's website. Summary white paper will link to the table.

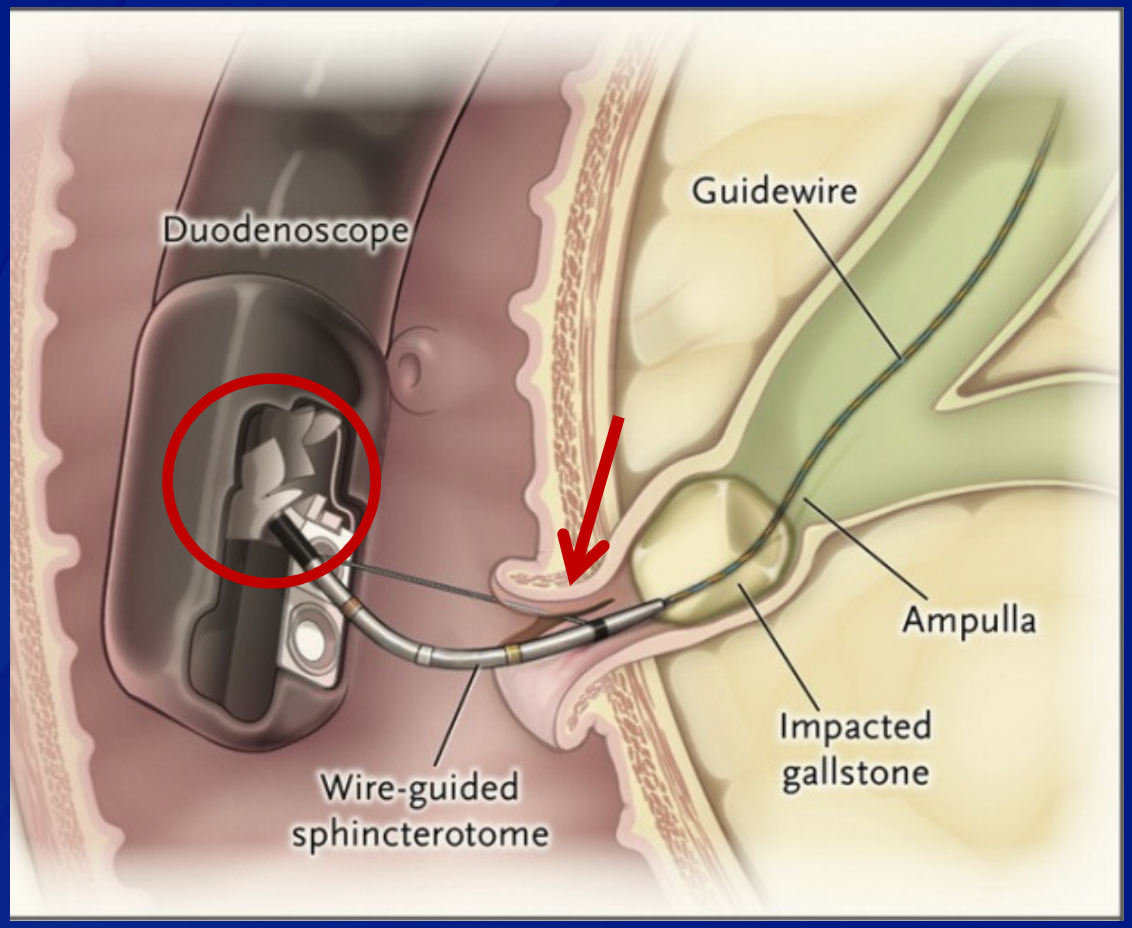
Outbreaks Related to the Use of Duodenoscopes and Future Directions

Alice Guh, MD, MPH

Division of Healthcare Quality Promotion
Centers for Disease Control and Prevention

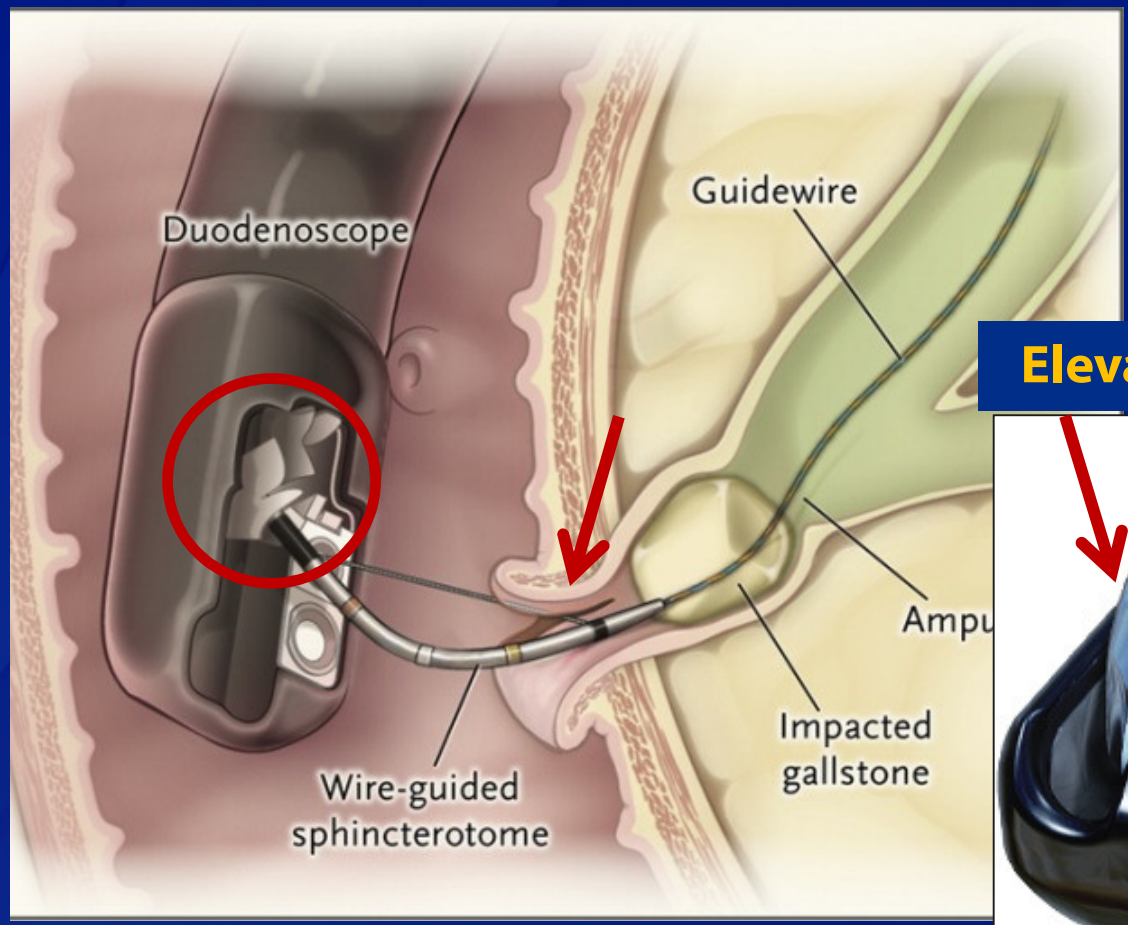
HICPAC Meeting
July 17, 2014

ERCP and Duodenoscopes



Fogel EL, Sherman S. N Engl J Med 2014;370:150-157.

ERCP and Duodenoscopes



Elevator Mechanism

Fogel EL, Sherman S. N Engl J Med 2014;370:150-157.

Duodenoscope Reprocessing

- **Considered semicritical device: manual cleaning followed by high-level disinfection***
  - Free of microbes except for spores
- **Current US guidelines do not recommend routine microbiologic surveillance of reprocessed duodenoscopes**
  - Routine culturing recommended in European, Australian, and New Zealand guidelines

*CDC/HICPAC Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008

Challenges with Duodenoscope Reprocessing

- **Elevator mechanism**
  - Intricate design makes it difficult to access all surfaces during manual cleaning
- **Unsealed elevator wire channel (older models)**
  - Flushing pressure not achieved by most automated endoscope reprocessors (AER); requires manual flushing*
  - Newer models have sealed elevator channel; no flushing required

*CDC/HICPAC Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008

Outbreaks Associated with ERCP

- **Bacterial outbreaks due to improperly reprocessed duodenoscopes have been well documented**
  - Lapses in recommended reprocessing procedures
  - Defective duodenoscope or problem with reprocessing equipment (e.g., AER)
- **In 2013, outbreak of carbapenem-resistant Enterobacteriaceae (CRE) reported in Illinois linked to ERCP**
  - No clear breaches in duodenoscope reprocessing identified

IL CRE Outbreak

Morbidity and Mortality Weekly Report

Notes from the Field

New Delhi Metallo-β-Lactamase–Producing *Escherichia coli* Associated with Endoscopic Retrograde Cholangiopancreatography — Illinois, 2013

Infections with carbapenem-resistant *Enterobacteriaceae*

were recovered from the terminal section (the elevator channel) of the device.[§] The *E. coli* isolate was highly related (>95%) to the outbreak strain by PFGE. Retrospective review and direct observation of endoscope reprocessing did not identify lapses in protocol. Previous studies have shown an association between ERCP endoscopes and transmission of multidrug-

- **6 of 8 patients with NDM-producing *Escherichia coli* treated at an IL hospital had ERCP**
- **Recovered NDM-producing *E. coli* and KPC-producing *Klebsiella pneumoniae* from the distal tip of implicated duodenoscope (post-reprocessing)**

IL CRE Outbreak: Duodenoscope Investigation

- **No clear breaches in reprocessing were identified by hospital staff, CDC field team, and manufacturer**
  - Certain products/items not specifically recommended by manufacturer but were marketed for or identical to products on manufacturer's compatible list:
    - Enzymatic detergent, high-level disinfectant (OPA), cleaning brushes
- **Hospital adhered to manufacturer's duodenoscope service schedule**
- **No defects of duodenoscope or improper functioning of AER identified by manufacturers**

IL CRE Outbreak: CRE Screening and Laboratory Testing

- **Patient notification for CRE screening**
  - 27 of 89 patients who returned for screening were positive for NDM-producing *E. coli*
- **Patient isolates and *E.coli* isolate from duodenoscope were highly related by PFGE (>92% similar)**
- **Testing of NDM-producing *E. coli* and KPC-producing *K. pneumoniae* isolates**
  - Metricide™ OPA Plus was effective – no survivors
  - Not more likely to form biofilm than other organisms

CDC unpublished data

CDC Response

- **February 2014: CDC organized conference call with key stakeholders and leading experts**
  - APIC (Association for Professionals in Infection Control and Epidemiology)
  - SHEA (Society for Healthcare Epidemiology of America)
  - ASGE (American Society for Gastrointestinal Endoscopy)
  - SGNA (Society of Gastroenterology Nurses and Associates)
  - AAMI (Association for the Advancement of Medical Instrumentation)
  - FDA (US Food and Drug Administration)

Purpose of call

- Review findings from CDC-led and other public health investigations of outbreaks related to duodenoscope use
- Identify challenges with duodenoscope reprocessing, including the adherence to recommended procedures and the procedures themselves
- Discuss approaches to addressing evidence gaps and improving reprocessing of duodenoscopes

Summary of Call

- **Extent of problem with duodenoscopes might be underestimated**
- **Failure of duodenoscope reprocessing due to unrecognized lapses and/or intrinsic issues with these types of endoscopes**
  - Inadequate cleaning or drying due to lack of appropriate training and/or regular review of practices
  - Lack of standardized/required preventive maintenance schedules
  - Design issues that may make cleaning difficult
  - No standardized process to assess cleaning has been validated

CDC Activities

- Continued discussion with stakeholders and leading experts
- Piloted a protocol for culturing duodenoscopes (primarily focused on elevator mechanism)
- Ongoing technical assistance to facilities and health departments
- Developing interim guidance for facilities that perform procedures with duodenoscopes

Draft Interim Guidance for Facilities that Use Duodenoscopes

Draft Interim Guidance

- Regularly review recommended duodenoscope reprocessing procedures
- Perform microbiologic surveillance of reprocessed duodenoscopes
- Repeat the reprocessing of any duodenoscope with positive cultures and further evaluate if persistently positive
- Inform patients of risk of bacterial transmission associated with duodenoscope procedures

These are draft recommendations and have not been formally disseminated by the Centers for Disease Control and Prevention and should not be construed to represent any agency determination or policy.

Review Recommended Duodenoscope Reprocessing Procedures

- Ensure personnel performing duodenoscope reprocessing are trained with competency verification
- Regularly review reprocessing procedures to ensure strict adherence to manufacturer instructions
- Ensure the elevator mechanism is thoroughly cleaned and visibly free of debris
- Ensure duodenoscope channels and elevator mechanism are thoroughly dried prior to storage

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Perform Microbiologic Surveillance of Reprocessed Duodenoscopes

- **Frequency of microbiologic surveillance**
  - Sampling after every reprocessing may not be feasible
  - Perform periodic microbiologic surveillance based on frequency of duodenoscope use
- **Culture at least the distal tip (where the elevator mechanism is located) and unsealed elevator wire channel (if applicable)**
- **Duodenoscopes do not need to be held from use while culture results are pending**
  - Clearly document all procedures subsequent to obtaining cultures

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Assessing Adequacy of Duodenoscope Reprocessing

- **Interpretation of results of post-reprocessing duodenoscope cultures**
  - No pathogenic bacteria should be detected (e.g., Enterobacteriaceae, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Enterococcus*)
  - >10 CFU of non-pathogenic bacteria (e.g., coagulase-negative staphylococci, *Bacillus* species) per distal tip or channel culture or repeated finding of positive cultures of non-pathogenic bacteria from the same duodenoscope (even if <10 CFU/distal tip or channel) might warrant evaluation
- **Use of non-culture methods**
  - Limited experience using ATP assays following manual cleaning
    - Requires more evidence before can be routinely recommended

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Remedial Actions for Reprocessed Duodenoscopes with Microbial Growth Detected

- **Suggest that reprocessed duodenoscopes that are found to have pathogenic bacteria or >10 CFU of non-pathogenic bacteria be reprocessed again**
  - Obtain cultures after repeat reprocessing
- **Hold off on using duodenoscope until repeat cultures are negative for pathogenic bacteria or have <10 CFU of non-pathogenic bacteria**
- **Review reprocessing procedures and evaluate for defects if cultures persistently positive**
  - Consider evaluation by duodenoscope manufacturer

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Patients Undergoing Duodenoscope Procedures

- **Current informed consent mentions risk of infection (assuming from patient's own flora)**
- **Suggest informing patients of small risk for patient-to-patient bacterial transmission**
  - Including rare possibility of transmission of multidrug-resistant organisms

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Thank you

For more information please contact Centers for Disease Control and Prevention

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

CAUTI Prevention & Surveillance Activities

Carolyn Gould, MD, MSCR

Division of Healthcare Quality Promotion
Centers for Disease Control and Prevention

HICPAC Meeting
July 17, 2014

Outline

- Current Status: National Data
- Targeted Assessment for Prevention
- Standardized Urinary Catheter Utilization Ratio
- Update on UTI Surveillance Definition Modifications

Catheter-associated Urinary Tract Infection (CAUTI)

- Department of Health and Human Services (HHS) has named reduction of CAUTI an Agency Priority Goal
  - Goal to reduce CAUTIs by 25% by 2014
  - National surveillance data indicate we are not on target to reach our goals

http://www.hhs.gov/ash/initiatives/hai/
Picture courtesy of CMS

http://www.cdc.gov/HAI/pdfs/progress-report/hai-progress-report.pdf

HEALTHCARE ASSOCIATED INFECTIONS PROGRESS

NATIONAL

Healthcare-associated infections (HAIs) are infections patients can get while receiving medical treatment in a healthcare facility. The standardized infection ratio (SIR) is a statistic used to track HAI prevention progress over time; lower SIRs indicate better progress. The infection data are collected through CDC's National Healthcare Safety Network (NHSN). HAI data gives healthcare facilities and public health agencies knowledge to design, implement, and evaluate HAI prevention efforts.

NATIONAL PROGRESS OVERVIEW	NATIONAL SIR	CHANGES IN INFECTION VS. NATIONAL BASELINE
Central Line-associated Bloodstream Infections (CLABSI)	0.56	↓ 44%
Catheter-associated Urinary Tract Infections (CAUTI)	1.03	↑ 3%
Surgical Site Infections, Colon Surgery (SSI)	0.80	↓ 20%
Surgical Site Infections, Abdominal Hysterectomy Surgery (SSI)	0.89	↓ 11%
Hospital-onset *Clostridium difficile* Infections	0.98	↓ 2%
Hospital-onset MRSA Bloodstream Infections	0.96	↓ 4%*

CAUTIs ↑ 3% HIGHER COMPARED TO NAT'L BASELINE

CATHETER-ASSOCIATED URINARY TRACT INFECTIONS

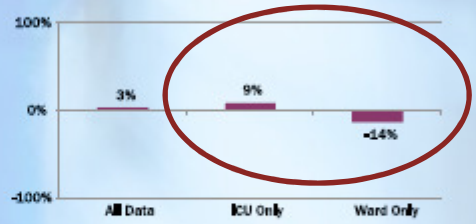
When a urinary catheter is not inserted correctly, not kept clean, or left in a patient for too long, germs can travel through the catheter and cause a catheter-associated urinary tract infection in the urinary system, which includes the bladder and kidneys.

US hospitals reported a significant increase in CAUTIs between 2011 and 2012.

3,597 hospitals across the nation reported CAUTI data in 2012.

13% 13% of hospitals have an SIR significantly worse than the national SIR of 1.03.

Changes in CAUTI vs. 2009 National Baseline



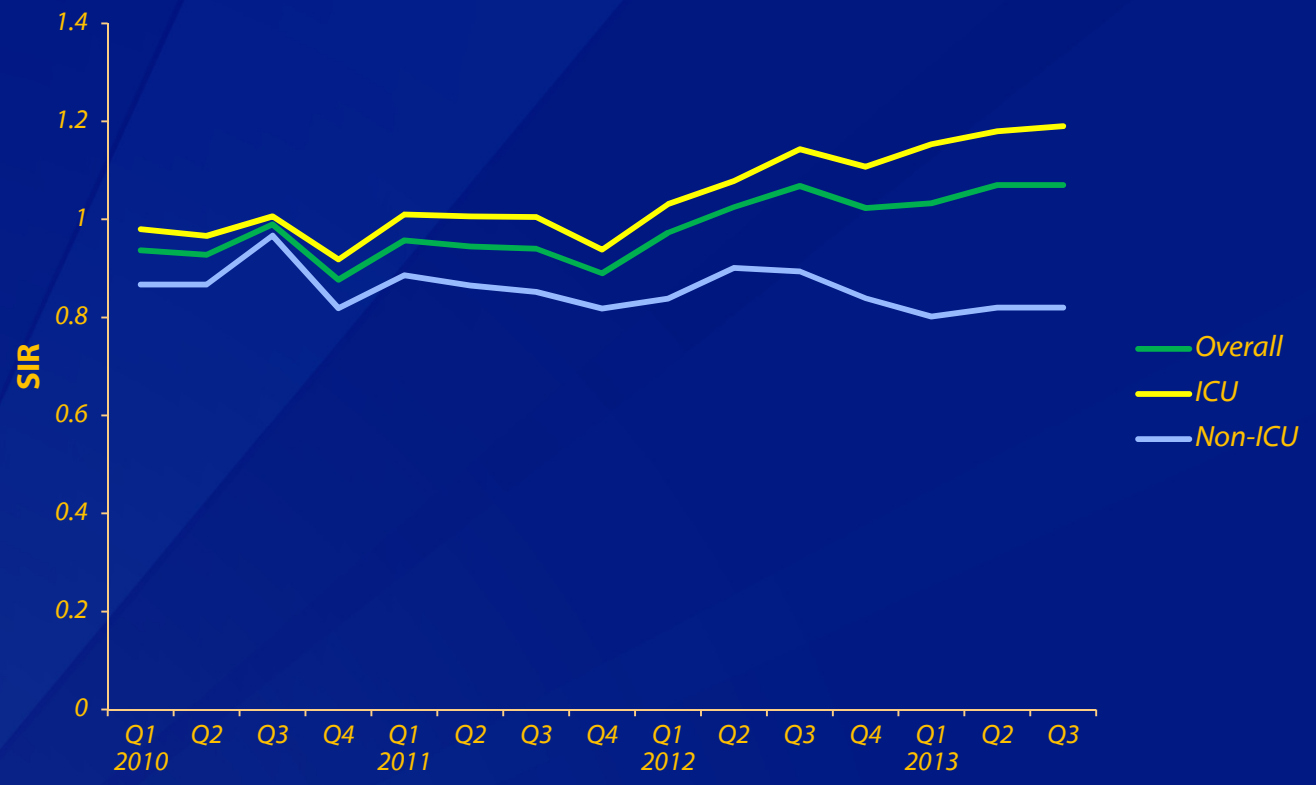
Learn how well your hospital prevents infections: www.medicare.gov/hospitalcompare

- 2012 HAI Progress Report: www.cdc.gov/hai/progress-report/
- Preventing HAIs: www.cdc.gov/hai
- NHSN: www.cdc.gov/nhsn

THIS REPORT IS BASED ON 2012 DATA, PUBLISHED MARCH 2014

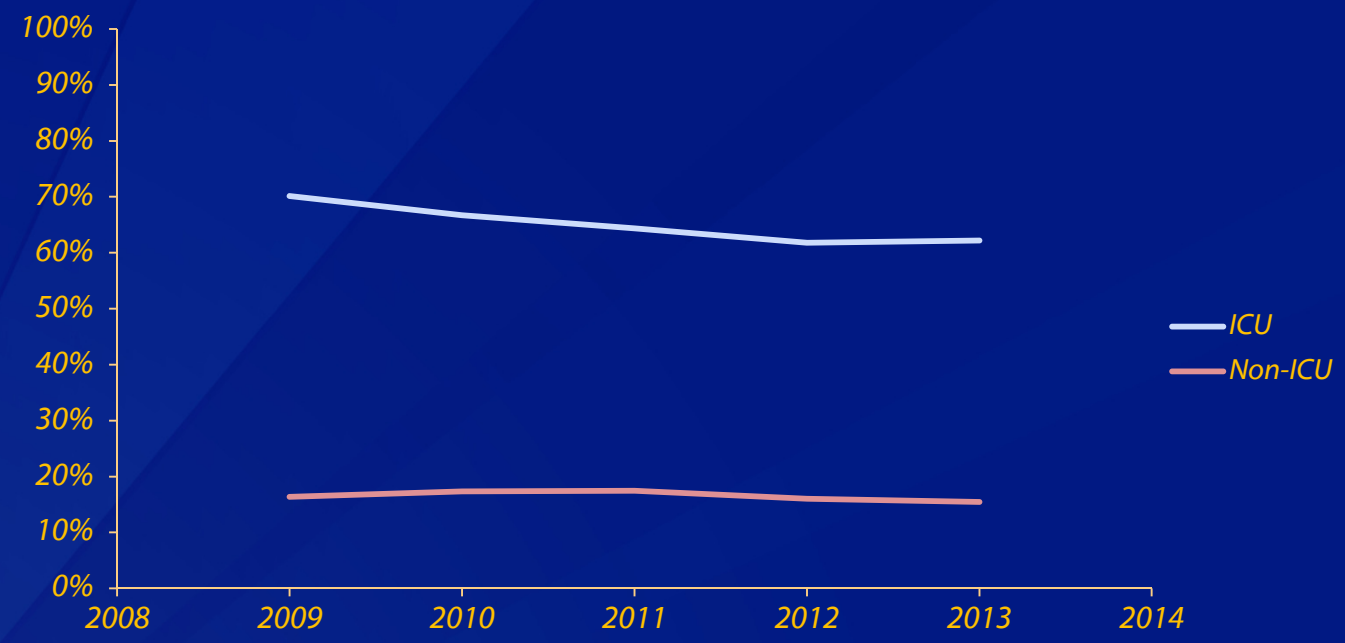
http://www.cdc.gov/HAI/pdfs/progress-report/hai-progress-report.pdf

National Data: Trends in CAUTI SIRs



2013 (Q1-Q4)			
Location Type	CAUTI (expected)	CAUTI (observed)	SIR
ICU	22100	26072	1.18
WARD+	10663	8558	0.80

National Data: Trends in Urinary Catheter Device Utilization Ratios (DUR)



2013 (Q1-Q4)			
Location Type	Ucath Days	Patient Days	DUR
ICU	11,241,580	18,837,644	60%
WARD+	6,169,303	35,824,729	17%

Using Data: Targeted Assessment for Prevention (TAP)

- TAP report ranks facilities by excess numbers of infections above a set benchmark defined at a national, state, or group level
- CDC is partnering with organizations to target prevention efforts toward facilities with highest excess numbers of infections
- TAP report function will be built into NHSN application in January 2015

NHSN Data for Action

NHSN Data
Over 4,700 hospitals currently reporting CAUTI data

Targeted assessment for prevention (TAP) strategy

Target hospitals with highest excess numbers of infections

Technical Assistance

- HENs
- QIOs
- CUSP
- Other partners

Cumulative Attributable Difference (CAD) = Excess Infections

- $\mathrm{CAD} = \mathrm{OBSERVED} - (\mathrm{EXPECTED} * \mathrm{SIR}_{\mathrm{target}})$
- Target SIR can be chosen based on goals of a group, state, organization, or national target
- A lower target SIR will create a larger excess number of infections

Courtesy of Minn Soe, CDC

CAD Example Calculation

Hospital A	Hospital B
$SIR = \frac{O}{E} = \frac{20}{10} = 2.0$	$SIR = \frac{O}{E} = \frac{8}{10} = 0.8$
$CAD = O - (E * SIR_{target})$	$CAD = O - (E * SIR_{target})$
$CAD_{HHS\ target} = 20 - (10 \times 0.75) = 12.5$	$CAD_{HHS\ target} = 8 - (10 \times 0.75) = 0.5$

Courtesy of Minn Soe and Jonathan Edwards, CDC

Sample CAUTI TAP Report: Facility Level

FACILITY RANK	ORGID	STATE	BEDS	NO.LOCATION (ICU,NON-ICU)	CAUTIS (ICU,NON-ICU)	DEVICE DAYS (ICU,NON-ICU)	DU% (ICU,NON-ICU)	CAD (ICU, NON-ICU)	SIR (ICU,NON-ICU)	ICU: TOTAL NO. PATHOGENS (% EC,YS,PA,KPO,FS,PM,ES)
1	001	AA	325	6(4,2)	42(34,8)	6861(5364,1497)	26(56,9)	22.9(17.8,5.2)	2.2(2.1,2.8)	37 (24, 14, 16, 8, 11, 0, 0)
2	002	AA	586	3(2,1)	73(70,3)	14292(13898,394)	48(70,4)	21.6(20.1,1.5)	1.4(1.4,2)	78 (27, 17, 10, 17, 12, 1, 0)
3	003	AA	471	3(2,1)	28(26,2)	6255(5880,375)	51(72,9)	15.6(15.1,0.6)	2.3(2.4,1.4)	28 (21, 36, 7, 7, 7, 0, 0)
4	004	AA	340	1(1,0)	36(36,.)	6760(6760,.)	84(84,.)	13(13,.)	1.6(1.6,.)	36 (36, 36, 8, 6, 0, 0, 0)
5	005	AA	646	4(4,0)	45(45,.)	11569(11569,.)	71(71,.)	12.2(12.2,.)	1.4(1.4,.)	45 (22, 31, 4, 9, 2, 2, 16)
6			469	16(7,9)	39(32,7)	14240(9989,4251)	24(55,10)	7.8(7.6,0.2)	1.3(1.3,1)	36 (19, 47, 3, 3, 11, 0, 0)
7			200	3(2,1)	14(12,2)	4408(4125,283)	40(61,7)	4.9(4,0.9)	1.5(1.5,1.9)	12 (42, 25, 25, 0, 0, 0, 0)
8			500	3(3,0)	13(13,.)	6322(6322,.)	59(59,.)	3.7(3.7,.)	1.4(1.4,.)	13 (23, 54, 0, 8, 0, 8, 8)
9			418	1(1,0)	12(12,.)	3614(3614,.)	81(81,.)	3.7(3.7,.)	1.4(1.4,.)	13 (38, 31, 8, 0, 0, 0, 8)
10			283	3(2,1)	9(8,1)	4690(3744,946)	36(63,14)	2.9(3.4,-0.5)	1.5(1.7,0.7)	9 (22, 22, 0, 11, 22, 0, 0)
11			258	3(2,1)	13(11,2)	7784(6588,1196)	44(63,16)	2.8(3.1,-0.3)	1.3(1.4,0.9)	11 (18, 9, 18, 0, 9, 0, 0)
12			200	3(2,1)	6(6,0)	3010(2590,420)	38(56,13)	2.2(2.8,-0.7)	1.6(1.9,.)	6 (0, 50, 0, 17, 17, 0, 0)

- Facilities are ranked by CAD in descending order
- Data separated by ICU vs. non ICU locations
- TAP report also includes data on device utilization and pathogens

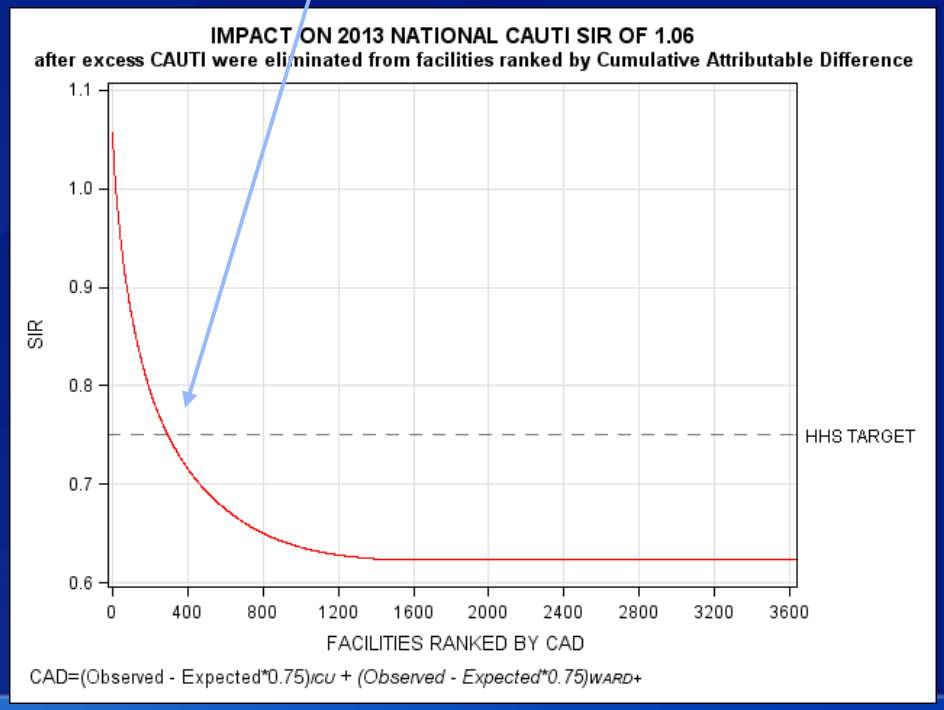
Sample CAUTI TAP Report: Unit Level

FACILITY		LOCATION								
FACILITY RANK	ORGID	LOCATION RANK*	LOCATION	CDC LOCATION TYPE	EVENT	DEVICE DAYS	DU	CAD	SIR	TOTAL NO. PATHOGENS (%EC,YS,PA,KPO,FS,PM,ES)
1	001	1	1073	IN:ACUTE:CC:B	14	1783	48%	6.2	1.78	16 (31, 6, 25, 13, 0, 0, 0)
		1	11001	IN:ACUTE:CC:S	10	1443	64%	6.2	2.66	10 (30, 10, 0, 10, 10, 0, 0)
		3	1004	IN:ACUTE:CC:M_PED	4	197	18%	3.8	.	5 (20, 0, 20, 0, 40, 0, 0)
		4	10011	IN:ACUTE:STEP	5	964	13%	3.2	2.72	5 (20, 80, 0, 0, 0, 0, 0)
		5	1012	IN:ACUTE:WARD:M	3	533	6%	2	2.96	4 (50, 0, 25, 0, 0, 0, 0)
		6	1002	IN:ACUTE:CC:M	6	1941	78%	1.5	1.34	6 (0, 50, 17, 0, 17, 0, 0)
2	002	1	POD	IN:ACUTE:CC:MS	24	5358	80%	11.7	1.94	26 (19, 31, 12, 12, 4, 4, 0)
		2	NSTU	IN:ACUTE:CC:NS	46	8540	65%	8.4	1.22	52 (31, 10, 10, 19, 15, 0, 0)
		3	N- REHA	IN:ACUTE:WARD:REHAB	3	394	4%	1.5	2.00	3 (0, 0, 33, 67, 0, 0, 0)
3	003	1	ICU	IN:ACUTE:CC:MS	19	4666	74%	13.4	3.39	21 (19, 48, 0, 10, 5, 0, 0)
		2	NCCU	IN:ACUTE:CC:NS	7	1214	64%	1.7	1.31	7 (29, 0, 29, 0, 14, 0, 0)
		3	REHAB	IN:ACUTE:WARD:REHAB	2	375	9%	0.6	1.40	2 (0, 0, 0, 50, 0, 50, 0)
4	004	1	ICU OSB	IN:ACUTE:CC:T	36	6760	84%	13	1.56	36 (36, 36, 8, 6, 0, 0, 0)
5	005	1	1A	IN:ACUTE:CC:MS	19	4729	75%	8.1	1.74	19 (21, 47, 0, 0, 0, 0, 11)
		2	2AB	IN:ACUTE:CC:T	12	1706	69%	6.2	2.06	12 (33, 17, 8, 8, 0, 0, 17)
		3	2CD	IN:ACUTE:CC:CT	4	2410	71%	-0.1	0.97	4 (0, 75, 0, 0, 25, 0, 0)
		4	1BD	IN:ACUTE:CC:NS	10	2724	65%	-2	0.83	10 (20, 0, 10, 30, 0, 10, 30)

- Reporting locations ranked within facilities

Hospitals to Target for CAUTI Prevention: Preliminary Analysis

2013 National CAUTI SIR = 1.057		# Facilities Reporting = 3,639	
	# Hospitals	# Excess CAUTIs	National SIR achieved if excess CAUTIs eliminated
# Hospitals above HHS target SIR (0.75)	1,578	14,206	0.62
# Hospitals to reach HHS target SIR (0.75)	281	9,884	0.75
# Hospitals to reach HHS target SIR (0.75) – ICU data only	492	9,884	0.75



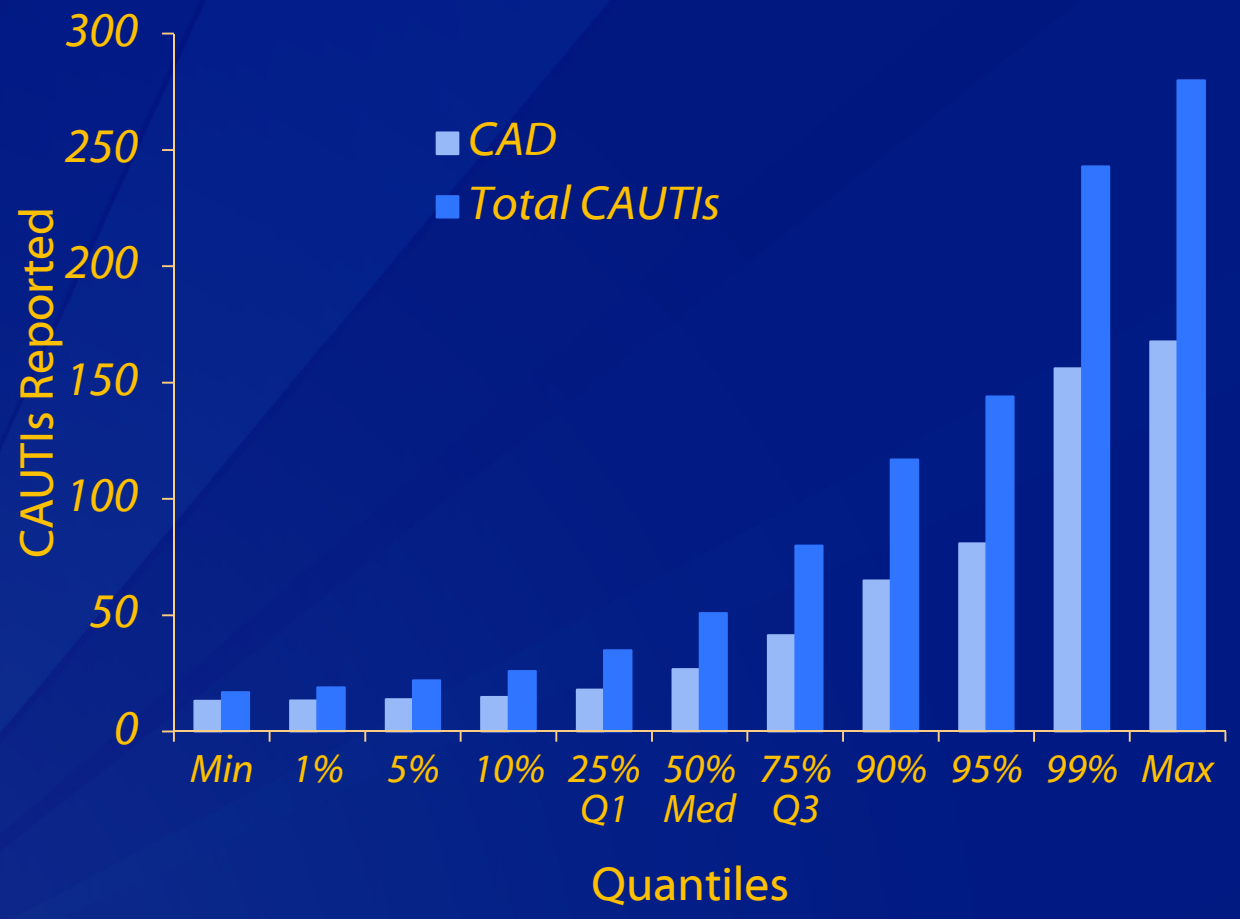
Data courtesy of Minn Soe, CDC

Demographics of 281 Hospitals (*Preliminary Analysis*)

Characteristic	N	Percent
General Hospital	281	100%
Med Type		
Graduate teaching	57	20.3%
Major teaching	153	54.5%
Non-teaching	67	23.8%
Undergraduate teaching	4	1.4%
Bed size		
≤ 200	13	4.6%
201-500	127	45.2%
501-1000	132	47.0%
> 1000	9	3.2%

Data courtesy of Minn Soe, CDC

Distribution of CAD Among 281 Hospitals (*Preliminary Analysis*)



Data courtesy of Minn Soe, CDC

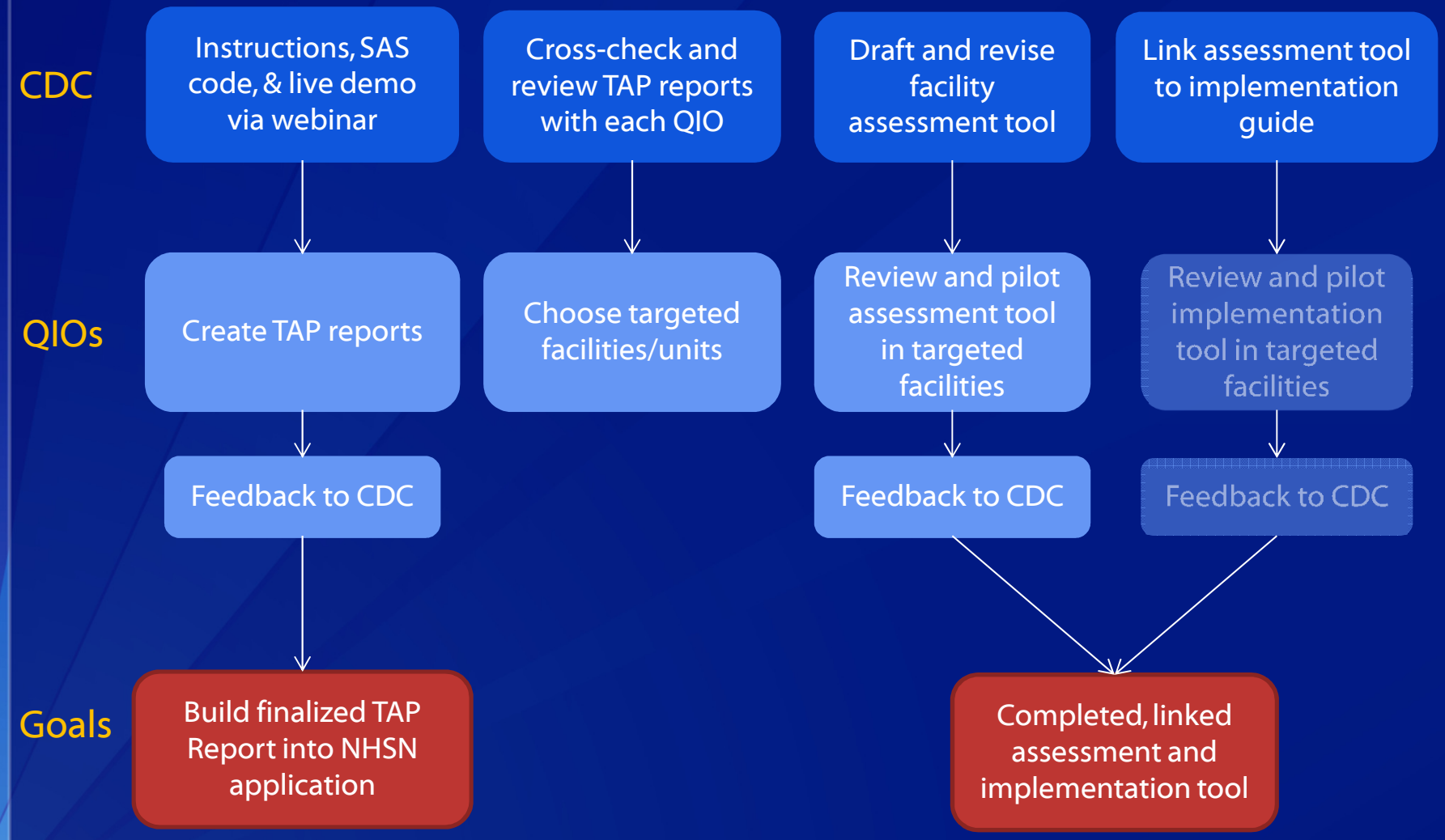
TAP Reports: Data for Action

- CDC is developing strategies to assist targeted hospitals with their prevention efforts
- Determining whether targeted hospitals are members of existing prevention collaboratives or quality improvement organizations (e.g., QIOs, HENs, HDs, CUSP, etc)
  - Reaching out directly to hospitals
  - Connecting those that aren't already connected
  - Assisting partners in targeting and implementing prevention
  - Assisting partners with recruitment efforts
- Exploring other potential partnerships and TAP
  - e.g., Accreditation organizations

Pilot of TAP Strategy with CMS Quality Improvement Organizations (QIOs)

- 7 participating QIOs
- 3 months (April – July 2014) during remaining 10th SOW
- Objectives:
  - Determine feasibility of QIOs creating TAP reports of their member hospitals (initially focused on CAUTI)
  - Pilot and refine tools to assess barriers to prevention in targeted hospitals

Pilot Process



Initial Facility Assessment Tool: Major CAUTI Domains

- General Infrastructure, capacity, and processes
  - Leadership
  - Training
  - Competency assessments
  - Audits & Feedback
- Appropriate indications for urinary catheter insertion
- Timely removal of urinary catheters
- Aseptic urinary catheter insertion
- Proper urinary catheter maintenance
- Preventing candiduria and detection of asymptomatic bacteriuria

Initial Facility Assessment Tool: Convergent Feedback from QIOs

- Interview > 1 respondent at each facility/unit
  - e.g., Director of IP, nurse/unit manager, physician representative, frontline staff/nurse
  - Reveals differences in awareness, knowledge, and perceptions
- Create an atmosphere of partnership (not punitive)
- Utilize frequency scales for response choices
- Clarify meaning of terms
  - e.g., "engage," "audit," "competency assessment"
- Lots of specific advice to help clarify language and improve the questions and flow

Qualitative Feedback from QIOs on TAP Pilot Experience

- Overall convergent themes
  - Improved sharing of resources and communication across sites and facilities
  - Prioritization of intervention and improvement opportunities
  - Enhanced targeting of educational gaps (improving facility as well as individual staff knowledge and awareness of practices and policies – "*teaching moments*")
    - Assessment was "*thought-provoking*" and "*an eye-opener*"
    - Pilot served as a "*real-time performance improvement*" effort and often led to specific actions by the hospitals ("*continuous tool for improvement - not just one point in time*")
      - One facility decided "*to target unit-specific educational opportunities during skills day*"

Additional Examples of Qualitative Feedback from QIOs on TAP Pilot Experience

- *"…allows the facility to target resources to units of need."*
- *"Many times during the assessment, the person being interviewed would stop to say, 'I don't know the answer to that. I will have to check into that.' So, it is helpful to get them thinking … to ascertain that they are indeed doing everything that they can to prevent CAUTIs…"*
- *"None of them really knew whether the people inserting catheters are doing it correctly. They thought they got that training in nursing school. They [identified through the assessment that they] have no method of ascertaining that at their facility…and they needed a method for verifying correct aseptic technique…"*
- *"It was very eye opening to do the assessment with three different people at the same hospital. Many of their answers were different for the same question…not everyone is on the same page at the same facility. Important to start dialog."*
- *"This experience and tool has allowed [the hospital] to see that they need to engage the physicians. They actually created a physician-led committee to oversee their CAUTI prevention efforts in addition to the IPs resulting in a decrease in CAUTIs from 23 to 2 over the last quarter…"*

Example of Implementation Tool: CDC Urinary Catheter Checklist

Urinary Catheter Checklist	Yes	No
Insertion		
Hand hygiene performed before and after insertion		
Catheter placed using aseptic technique and sterile equipment		
Catheter secured properly after insertion		
Catheter insertion and indication documented		
Maintenance		
Hand hygiene performed before and after manipulating catheter		
Catheter and collecting tubing are not disconnected (irrigation avoided)		
Urine bag emptied using aseptic technique		
Urine samples obtained aseptically (via needless port for small volume)		
Urine bag kept below level of bladder at all times		
Catheter tubing unobstructed and free of kinking		
Need for urinary catheters reviewed daily with prompt removal of unnecessary urinary catheters		

Goals for Expansion of TAP Strategy

- Work with CMS to expand TAP approach to additional QIOs in 11th SOW
- Develop similar assessment and implementation tools for CDI & CLABSI
  - An integrated, modular tool for all HAIs would be ideal
  - Maximize impact of site visits and allow for a more complete assessment
- Work with additional group users with access to data (e.g., HENs, state health departments)

Acknowledgments

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  - Dawn Sievert
  - Ronda Sinkowitz-Cochran
  - Minn Soe
  - Arjun Srinivasan
  - Abbigail Tumpey
  - Ellen Wan
  - Todd Weber
- CMS
  - Marge Cannon
  - Annese St. Louis
  - Jean Moody-Williams
- QIO NCC
  - Jennifer O'Hagan
  - Julie Myers
  - Cathy Maffry
- Participating QIOs and hospitals

Getting to the Source of the Problem: The Urinary Catheter

- 70-75% of healthcare-associated UTIs are associated with catheters (95% of UTIs in ICUs)
- Non-infectious complications common
  - Urethral strictures/erosion, hematuria, blockage
  - Discomfort/pain
  - Restriction of activities – "one-point restraint"
- Physicians frequently unaware

Burton DC, Edwards JR, Srinivasan A, et al. Infect Control Hosp Epidemiol 2011;32:748-56
Saint S, Lipsky BA, Baker PD, et al. J Am Geriatr Soc 1999;47:1453-7
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Saint S, Wiese J, Amory JK, et al. Am J Med 2000;109:476-80

Standardized Utilization Ratio (SUR) Metric: Indwelling Urinary Catheters

Alison S. Laufer, PhD

LT, United States Public Health Service
Division of Healthcare Quality Promotion
National Center for Emerging and Zoonotic Infectious Diseases

Healthcare Infection Control Practices Advisory Committee Meeting
July 17, 2014

DEVICE UTILIZATION RATIO (DUR)

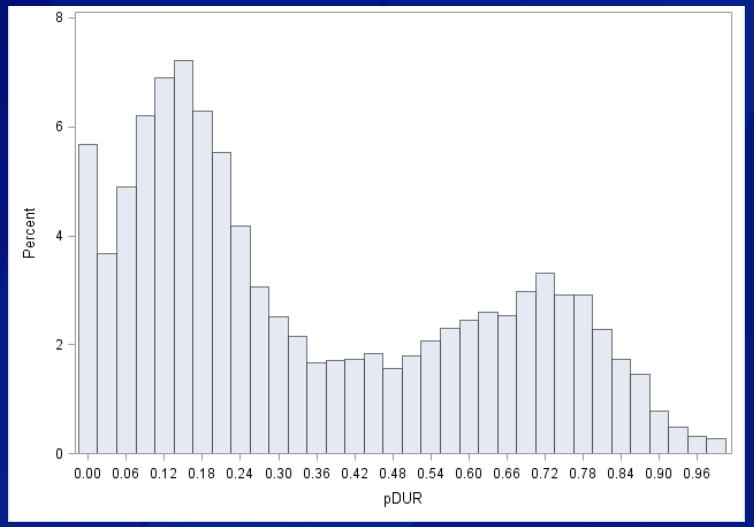
- Proportion of total patient-days where an indwelling urinary catheter was used

$$\text{DUR} = \frac{\text{\# Indwelling Urinary Catheter-Days}}{\text{\# Patient-Days}}$$

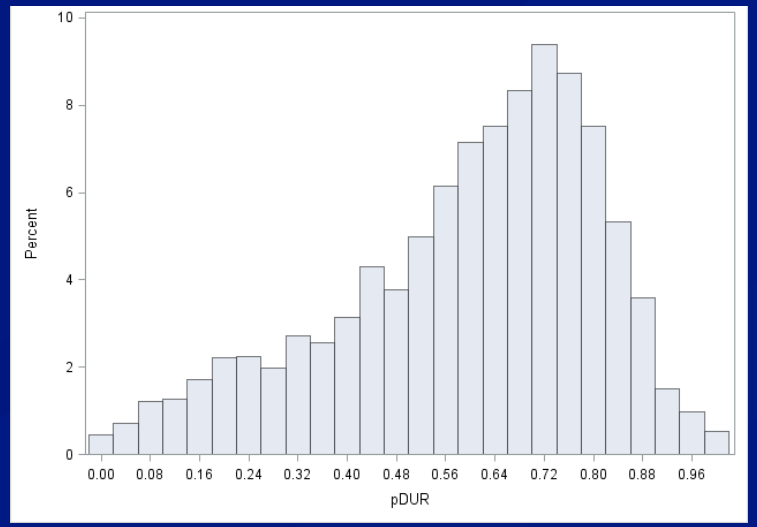
STANDARDIZED UTILIZATION RATIO (SUR)

- Help facilities target prevention efforts
- Prolonged catheterization
  - Main modifiable risk factor for CAUTI
- Standardized Utilization Ratio (SUR)
  - Model all location- and facility-level data collected by NHSN facilities
  - Summary measure
    - Comparative metric
  - Potential applications: use of other devices, antibiotics

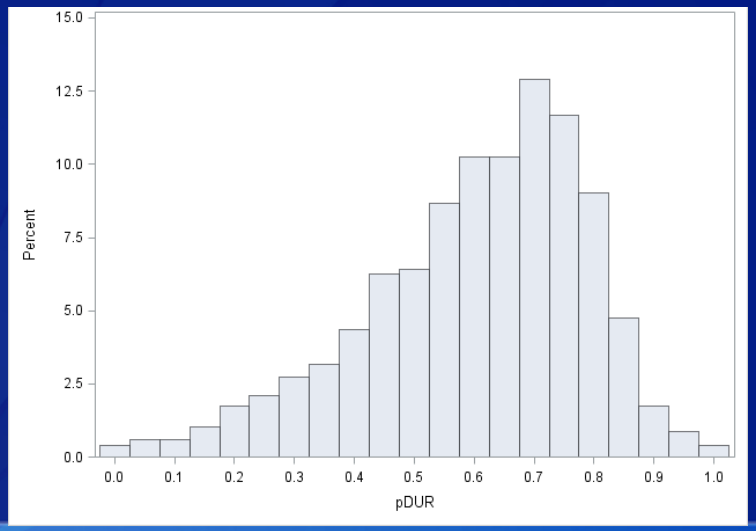
DISTRIBUTION OF CATHETER DUR, 2012



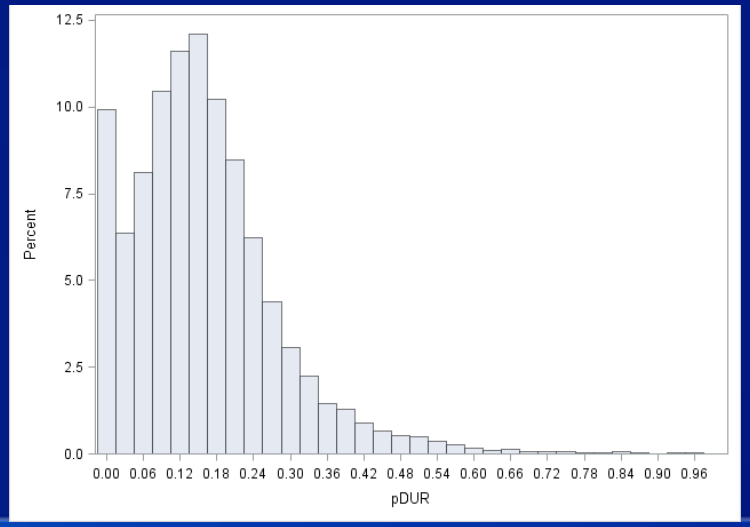
Overall



ICUs only



Medical-Surgical ICUs



Non-ICUs

ANALYSIS: VARIABLE SELECTION

- Variables already collected in NHSN for CAUTI
  - Location type (e.g., Surgical ICU, Medical Ward)
  - Medical school affiliation (Major, Graduate, Undergraduate, None)
  - Unit bedsize (Continuous number)
  - Facility bedsize (Continuous number)
  - Facility type (e.g., General, Orthopedic, Surgical)

ANALYSIS: MODEL SELECTION

- 2012 NHSN data
- Pooled DUR
- Most parsimonious model
- Calculate the standardized utilization ratio (SUR)

EXAMPLE CALCULATION

Location Type	Medical School Affiliation	Unit bedsize	Facility bedsize	Predicted DUR
Med/ Surg ICU	Major teaching	60	200	0.60

Predicted DUR	×	Total # Patient-days	=	Predicted # catheter-days	VS.	Observed # catheter-days
0.60		750		450		500

Unit SUR = Observed/Predicted = 1.11

LIMITATIONS

- Variables currently collected for risk-adjustment
- No patient-level data
- No data on
  - Number of insertions vs.
  - Duration of catheterization

MOVING FORWARD

- Submit to the National Quality Forum (NQF) for endorsement (2015)
- Include in future HAI Reports
- Incorporate SUR metric into NSHSN to enable facilities and groups to evaluate summarized catheter utilization
- Re-evaluate this metric in 2016

ACKNOWLEDGEMENTS

- Jonathan Edwards
- Carolyn Gould

- Facilities participating in NHSN

Thank you!

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone: 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
Visit: www.cdc.gov | Contact CDC at: 1-800-CDC-INFO or www.cdc.gov/info

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Update on CAUTI Surveillance Definitions

Recap: NHSN User Feedback and Concerns

- Clinical credibility
  - One study showed PPV 35% compared to ID consultant diagnosis
  - Inclusion of yeast and attribution of fever are biggest concerns
  - Lower microbial counts
- Application to special populations
- Laboratory variability in diagnostic practices
- Reporting requirements

F. Al-Qas Hanna et al. Am J Infect Control 2013,41:1173-7

CMS Quality Reporting Programs

- National CAUTI reporting
  - January 2012 – acute care hospital adult and pediatric ICUs
  - October 2012 – long-term acute care hospitals and inpatient rehabilitation facilities
  - January 2013 – PPS-exempt cancer hospitals
  - *(coming soon…)* January 2015 – acute care hospital adult and pediatric medical, surgical, and medical/surgical wards

Qualities of an Ideal Surveillance Definition

- **Definitions should be:**
  - Credible
  - Sensitive & specific – favoring specificity
  - Objective – minimizing need for interpretation/decision making
  - Easy to capture – ideally, amenable to electronic reporting
  - Minimal burden
  - Appropriate for current laboratory protocols – criteria should be applicable in most cases

CAUTI Definitional Review

- Began in February 2013
- Internal core working group
- External experts
  - Infection preventionists, hospital epidemiologists, microbiologists, infectious diseases physicians, state HAI program staff, facility representatives, CAUTI subject matter experts
- Targeted literature reviews
- Analysis of NHSN data
- Survey of clinical laboratories
- Feedback from HICPAC (June 2013)

Survey of Clinical Laboratories: Urine Culture Workup and Reporting Practices

- Process:
  - Survey developed and performed in collaboration with APIC
  - Electronically sent to all APIC members
  - Addressed to Laboratory Director
  - Assessed:
    - Protocols for urine culture work up
    - Criteria for pathogen identification
    - Methodology and use of urinalyses (U/A)
- 340 surveys completed

Major questions addressed (not all-inclusive)

1. Should inclusion of yeasts as urinary pathogens continue?
2. Should quantitative culture categories be modified?
3. Should clinical criteria be modified for special populations?
4. Should a UTI be reported on the basis of fever, even if another cause of fever is identified?
5. Should urinalysis continue to be included in UTI definitions?

Should inclusion of yeasts as urinary pathogens continue?

- Rare cause of UTI, but urinary catheter colonization common in some ICU populations
- Treatment of candiduria not associated with clinical benefit[1]
- Inclusion may encourage inappropriate antifungal prescribing
- Lack of clinical credibility leads to adjudication

1. Sobel et al. Clin Infect Dis 2000;30:19-24

Proportion of CAUTIs Reported to NHSN Attributed to Yeast, 2009-2013

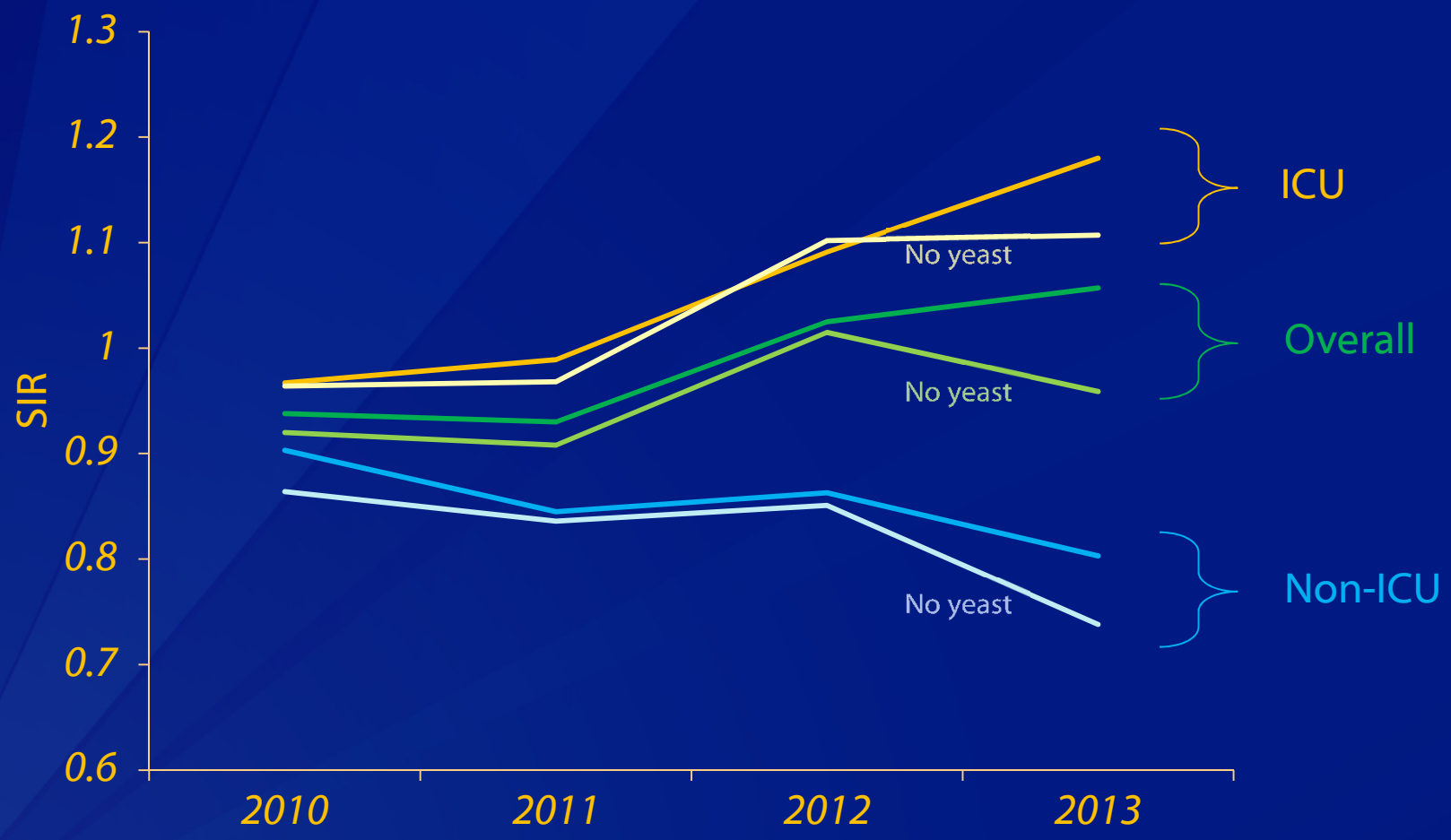
	SUTI 1 (n = 73,442)	SUTI 2 (n = 8,162)	ABUTI (n = 1,157)	Total (n = 82,761)
Yeast only	10,200 (13.9%)	1,948 (23.9%)	227 (19.6%)	12,375 (15.0%)

Potential reductions in UTI reporting with removal of yeast:

- CAUTI: 15%
  - ICU: 20%
  - Non-ICU: 9%

Non-CAUTIs: 2%

Temporal Analysis of CAUTI SIRs with and without Yeast* (2010-2013)



* Urine cultures with yeast as sole pathogen excluded

Laboratory Survey:

How does your laboratory report yeasts from a urine specimen from an indwelling catheter?

Quantitatively, always	168 (49%)
Quantitatively only when yeast is sole pathogen	82 (24%)
Semi-quantitatively	41 (12%)
Not quantified	36 (11%)
Other/missing	14 (4%)

Should Quantitative Culture Categories be Modified?

- Current categorizations:
  - ≥ 100,000 CFU/ml (SUTI 1)
  - ≥ 1000 and < 100,000 CFU/ml (SUTI 2)
- Problems:
  - Laboratory variation in quantitative reporting
  - Concern that lower colony counts less likely to represent true infection; however,
    - Low level bacteriuria progresses to ≥ 100K within 3 days[1]
    - Similar percentages of SUTI 1 (6.1%) vs. SUTI 2 (5.2%) reported to have secondary bacteremia in NHSN

1. Stark, Maki NEJM 1984;311:560-4

Laboratory Survey:

Which quantitative threshold does your laboratory use to determine whether organisms are definitively identified in a urine specimen with ≤ 2 organisms collected from an indwelling urinary catheter?

≥ 1,000 CFU/ml	49 (14%)
≥ 10,000 CFU/ml	166 (49%)
≥ 50,000 CFU/ml	39 (12%)
≥ 100,000 CFU/ml	49 (14%)
N/A	42 (12%)

Quantitative culture categories

Modify

Modify based on most common laboratory protocols

Variable

Remove lower colony count definition

Potential impacts: Reductions in UTI reporting

- CAUTI: 10%
- non-CAUTI: 7%

Use one category and lower threshold

26% of labs surveyed* did not work up pathogens with < 50,000 CFU/ml

*sample not necessarily representative

Should clinical criteria be modified for special populations?

- CAUTI may be under or over-reported in some patient populations
  - Elderly
  - Ventilated
  - Depressed level of consciousness
  - Spinal cord injury
  - Immunosuppressed

Special Populations: Spinal Cord Injury Patients

- Concern among rehabilitation and spinal cord injury (SCI) professionals about removal of indwelling catheters from SCI patients by hospitals to reduce CAUTI rates
  - Mistaking overflow incontinence for "volitional voiding"
  - Anecdotal cases of resulting renal dysfunction
- Advocating removal of SCI patients from CAUTI surveillance
- Potential problems
  - Defining populations and exclude their denominator days
  - Other populations with chronic urinary retention

Plans to Address Some Issues with Special Populations

- Potential to risk adjust CAUTI SIRs
  - Proportion of admissions with primary diagnosis of spinal cord dysfunction on Inpatient Rehabilitation Facility Annual Survey
- Addition of more signs/symptoms with some objectivity (from McGeer LTC definitions*)
  - Acute pain, swelling, or tenderness of testes, epididymis, or prostate
  - Purulent discharge from around catheter

* http://www.cdc.gov/nhsn/PDFs/LTC/LTCF-UTI-protocol_FINAL_8-24-2012.pdf

Should a UTI be Reported on the Basis of Fever, Even if Another Cause of Fever is Identified?

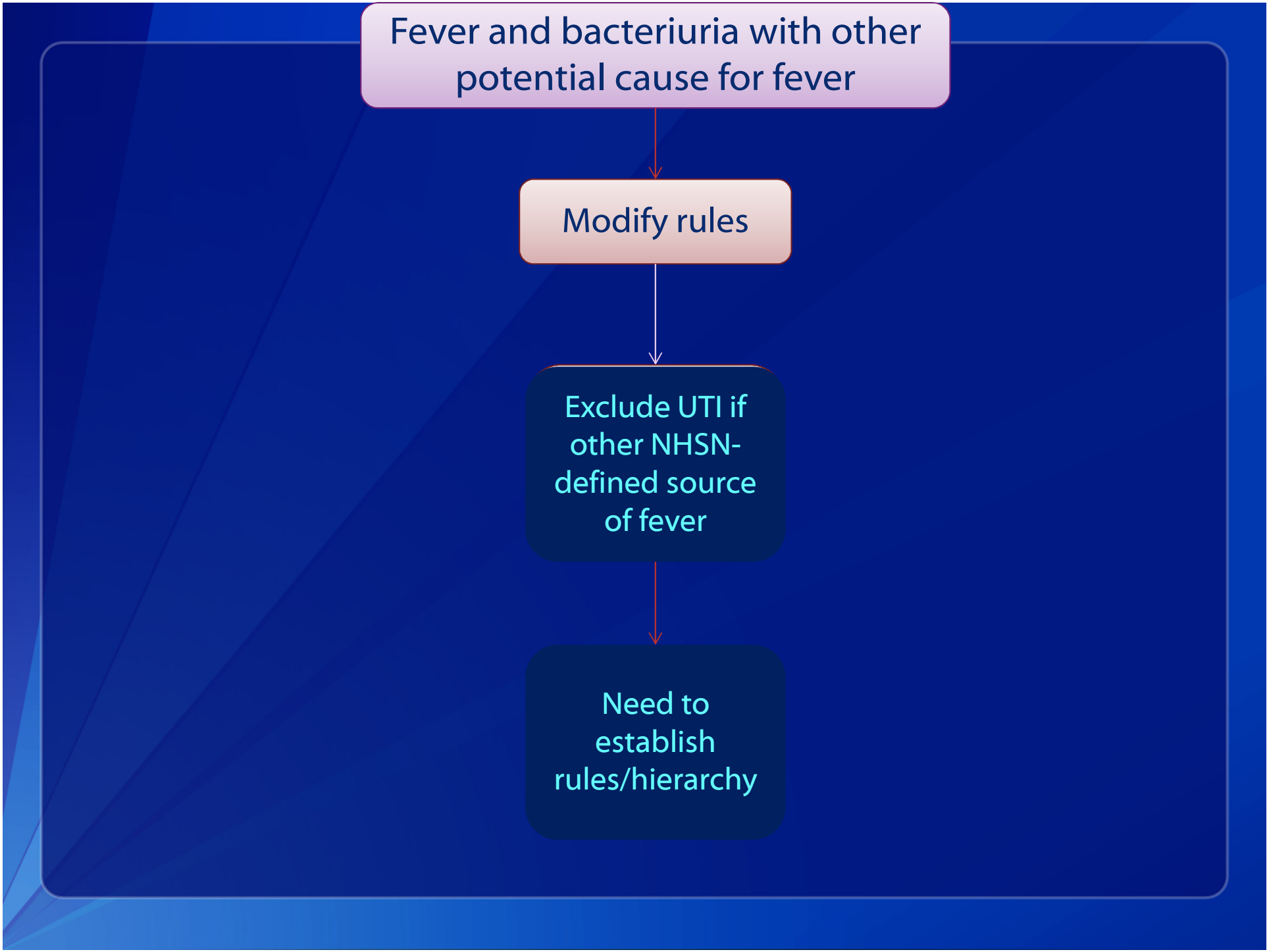
- Urinary tract-specific signs and symptoms are uncommon and poorly documented in patients with CAUTI
  - Clinical diagnosis of CAUTI often made on basis of non-specific signs/symptoms
- CAUTI surveillance usually relies on presence of fever
- To ensure objectivity, NHSN does not allow decisions on fever attribution
  - May lead to higher CAUTI rates in units with high prevalence of fever (e.g., neuro-ICUs)

Drekonja DM et al. Infect Control Hosp Epidemiol 2014;35:574-6.
Wald HL et al. Infect Control Hosp Epidemiol 2014;35:685-91.

NHSN Data: Frequency of Signs/Symptoms

	CAUTI		NCAUTI	
	SUTI 1 (n = 73,448)	SUTI 2 (n = 8162)	SUTI 1 (n = 10,117)	SUTI 2 (n = 810)
Fever	65,076 (88.6%)	7,372 (90.3%)	3,779 (37.3%)	306 (37.8%)
Fever alone*	62,934 (85.7%)	6,994 (85.7%)	3,396 (33.6%)	274 (33.8%)
SP tenderness	5,142 (7%)	446 (5.5%)	807 (8%)	67 (8.3%)
CVA pain/tenderness	2,115 (2.9%)	208 (2.5%)	373 (3.7%)	36 (4.4%)
Urgency†	3,006 (4.1%)	238 (2.9%)	2,553 (25.2%)	156 (19.3%)
Frequency†	3,450 (4.7%)	287 (3.5%)	4,032 (39.8%)	287 (35.4%)
Dysuria†	4,996 (6.8%)	430 (5.3%)	3,934 (38.9%)	308 (38%)

* Fever alone cannot be used for those > 65 who are not catheterized
† For CAUTI, symptom only applies if catheter no longer present when CAUTI identified


Fever and bacteriuria with other potential cause for fever
Modify rules
Exclude UTI if other NHSN-defined source of fever
Need to establish rules/hierarchy

Should Urinalysis Continue to be Included in UTI Definitions?

- Up to 70% of catheterized patients with bacteriuria have accompanying pyuria[1]
- Variability in laboratory reporting methods of pyuria
  - No standardized criteria for "positive"
- 2009 IDSA guideline indicates lack of utility of pyuria for differentiating CA-bacteriuria from CAUTI[2]
  - However, *absence* of pyuria suggests another diagnosis (if not neutropenic)

1. Nicolle LE. Int J Antimicrob Agents 2006;28S:S42-8
2. Hooton et al. Clin Infect Dis 2010;50:625-63

2009 IDSA Guideline for Diagnosis, Prevention, and Treatment of CAUTI

4. In the catheterized patient, pyuria is not diagnostic of CA-bacteriuria or CA-UTI (AII).

i. The presence, absence, or degree of pyuria should not be used to differentiate CA-ASB from CA-UTI (A-II).

ii. Pyuria accompanying CA-ASB should not be interpreted as an indication for antimicrobial treatment (A-II).

iii. The absence of pyuria in a symptomatic patient suggests a diagnosis other than CA-UTI (A-III).

Hooton et al. Clin Infect Dis 2010;50:625-63

Laboratory Survey:

Which, if any, of the following laboratory tests determine work-up of urine cultures (choose all that apply)?

Urinalysis WBC count	196 (58%)
Dipstick leukocyte esterase or nitrite	203 (60%)
None	96 (28%)
Other	49 (14%)

Can the Laboratory Play a Role in Improving the Pre-test Probability of the Urine Culture?

- Urine culturing practices may lead to over-diagnosis of CAUTI
  - In one VA hospital, 31% of urine cultures were ordered without an appropriate indication
  - Of the appropriate cultures, only 13% were ordered for urinary-specific symptoms
- Leads to significant unnecessary antibiotic use as well as over-reporting

Drekonja DM et al. Infect Control Hosp Epidemiol 2014;35:574-6.

Investigation of a Hospital with High CAUTI Rates in ICUs

- CDC and state health department investigation
- Among the findings, urine cultures frequently ordered without a clear indication
- 50 NHSN-defined CAUTIs evaluated
  - 18 (36%) attributed to *Candida* spp – most not treated
  - 8 (17%) were from patients with < 30 cc/hr urine output
  - 7 (14%) had suspicion of CAUTI reported in medical record
    - However, 21 (42%) were treated for UTI with antimicrobials

Epstein L, Laufer A, et. al. Successful Interventions to Reduce Unnecessary Urine Cultures in Intensive Care Units at a Tertiary Care Hospital, Baltimore, MD, 2011-2013. Oral abstract for presentation at ID Week 2014

Impact of a Urine Reflex Laboratory Protocol

- Hospital implemented a policy whereby the laboratory reflexes to a urinalysis first when a urine culture is ordered
- Urine culture only performed if >10 WBC/mm^3
- Post-intervention, urine culturing rates decreased by 67% and CAUTI rates decreased by 63% (interrupted time series analysis)
- No adverse events noted; more study needed on potential impacts

Epstein L, Laufer A, et. al. Successful Interventions to Reduce Unnecessary Urine Cultures in Intensive Care Units at a Tertiary Care Hospital, Baltimore, MD, 2011-2013. Oral abstract for presentation at ID Week 2014

Modifications are Interrelated

- Separation of yeasts from reported CAUTIs might make the fever issue less prominent
  - Similar strategy as separating mucosal barrier injury BSIs from CLABSIs
- Exclusion of UTI in absence of pyuria (at any colony count) might improve specificity, although unclear how much

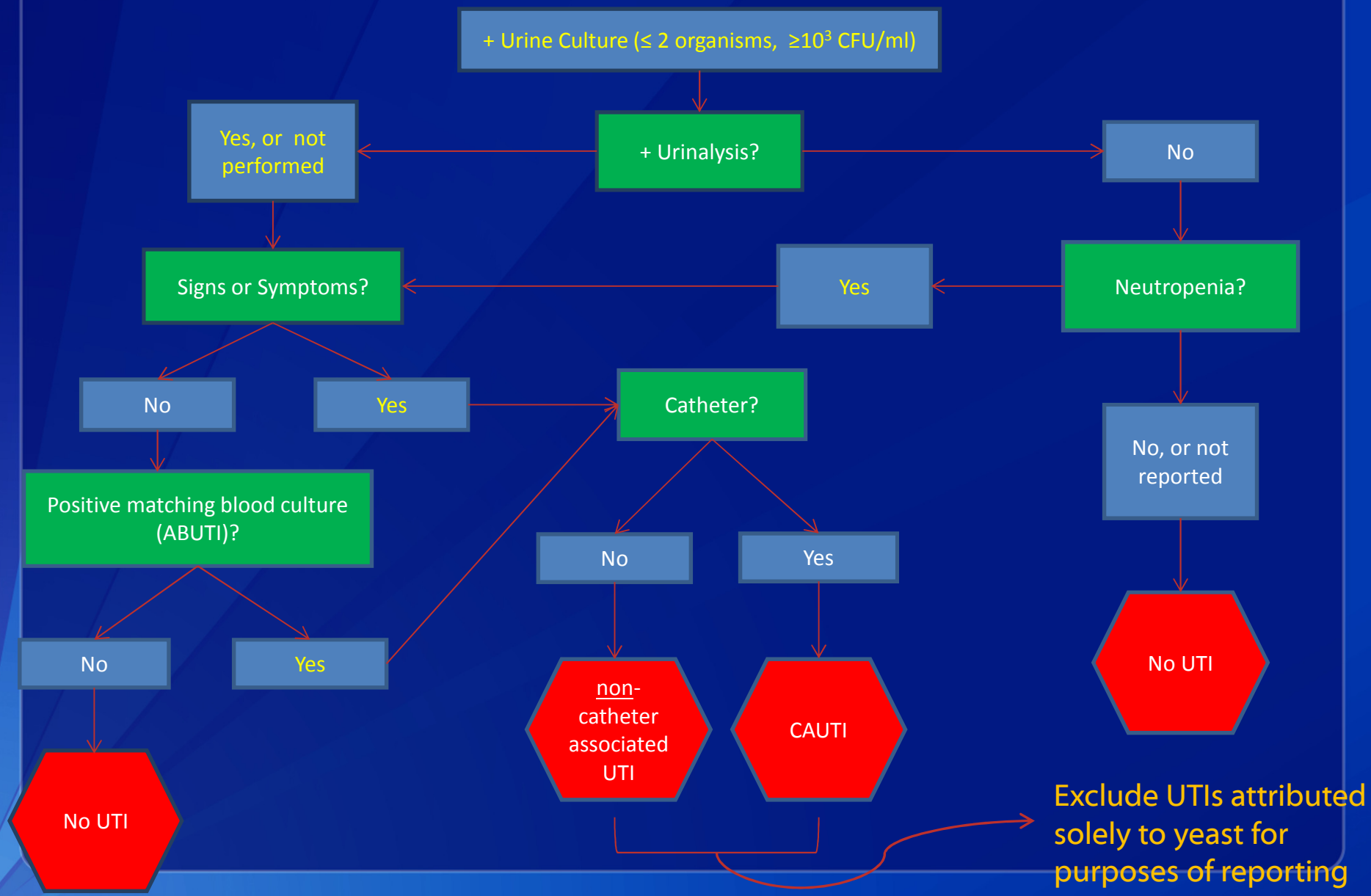
CAUTIs with Secondary BSI

NHSN Data Jan 2009-May 2013

	ICUs	Non-ICUs	Total
No Secondary BSI	*61,268 (93.3%)*	*38,757 (92.4%)*	*100,025 (93%)*
Secondary BSI	*4,420 (6.7%)*	*3,197 (7.6%)*	*7,617 (7.1%)*
Total	*65,688 (61%)*	*41954 (39%)*	*107,642*
Secondary BSI & Only Yeast	*828 (1.3%)*	*292 (0.7%)*	*1120 (1.0%)*

~ 15% of secondary BSIs may potentially be reclassified as CLABSIs if fungurias not classified as CAUTIs

Proposed UTI Definition Revision (Preliminary)



Exclude UTIs attributed solely to yeast for purposes of reporting

Modified from Kathy Allen-Bridson

Conclusions and Next Steps

- Modified UTI surveillance definition proposal currently under review
- More work needed to understand current laboratory practices for urine culturing/urinalyses
  - Standardization of laboratory practices would improve consistency of reporting across facilities
- Plan to continue to follow fungurias as a potential quality indicator

Acknowledgments – CAUTI definitions

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Carolyn Zollar – America Medical Rehabilitation Providers Association (AMRA)

CAUTI Lab Survey Experts
Steven Ewers – St. Francis Hospital
Deirdre Church – University of Calgary

CDC

Thank you!

Questions/Comments?

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Advanced Molecular Detection: Healthcare-acquired Infections and Antimicrobial Resistance

Brandi Limbago & Cliff McDonald

July 18, 2014
HICPAC Meeting

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

Priority Questions: Application of Advanced Molecular Approaches

- **Colonization**
  - How does asymptomatic colonization contribute to the development and expansion of MDRO?
  - Can we reliably detect asymptomatic colonization with MRDO?
- **Transmission**
  - Can molecular epidemiology inform our understanding of MDRO transmission (Patient-patient/ staff-patient/ environment-patient)?
  - What is the role of asymptomatically colonized patients?
  - Develop targeted interventions based on these data
- **Evolution**
  - Why are some MDRO expanding more rapidly than others?
- **Role of the microbiome in all of these areas**

Overview of AMD Projects

- **Outbreak Investigations**
  - CRE *E. coli*, *K. pneumoniae*
  - *M. wolinskyi*
  - CRE transmission among patients who received ERCP
- ***C. diffficile* Carriage, Transmission, Infection**
  - Long term care-Acute care colonization & transmission study
  - Acute care point prevalence, admission/ discharge study
- **Predicting CRE Transmission**
- **WGS of CC8 MRSA**
  - Evolution of CC8 lineage
  - Transplant-mediated transmission of highly clonal USA300.0114
- ***C. difficile* Environmental Isolates (Outpatient)**
- **Evolution KPC-producing *K. pneumoniae* ST258**
- **CRE with unknown resistance mechanisms**

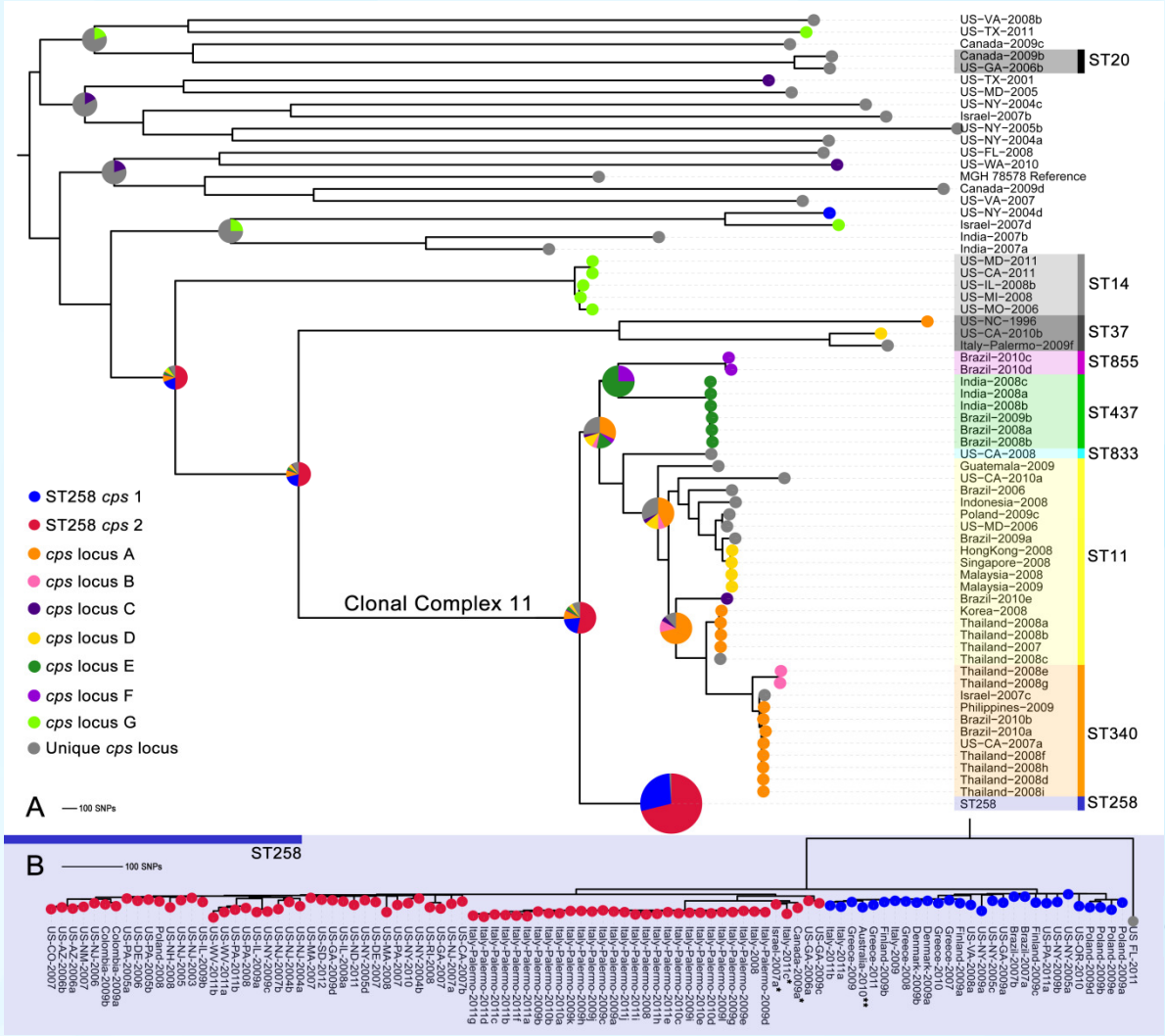
Evolution of ST258 *K. pneumoniae*

Evolution, Transmission

- **167 Isolates: U.S. (n=72) and other countries (n=95)**
  - ST258 and related isolates (esp. CC11) collected over 17 years
  - Both KPC+ and KPC- isolates
- **Assembly, SNP analysis, accessory genome analysis**
  - Illumina paired-end reads assembled against *K. pneumoniae* reference genomes
    - Novoalign for alignment
    - GATK for SNP detection
    - BEAST for time to most recent ancestor, evolutionary relationships
    - *In silico* plasmid analysis with PlasmidFinder
- **Highly clonal**
  - Divergence in capsule polysaccharide locus
  - Divergence in outer membrane profiles (OmpK35, OmpK37)

K. pneumoniae Maximum Parsimony

49,059 SNPs from 165 isolates

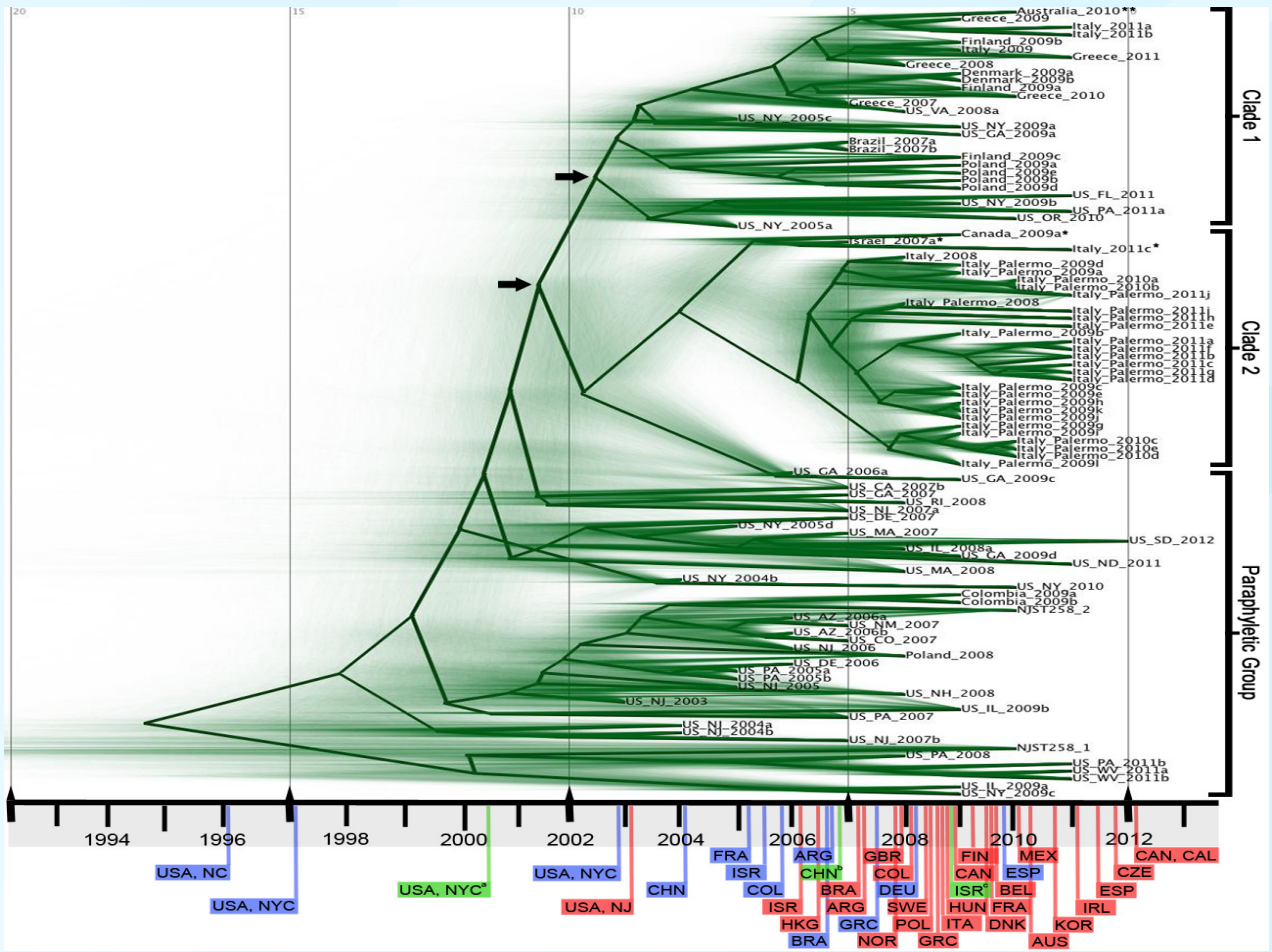


cps locus (capsule synthesis) is a primary point of divergence among groups

ST258, rotated & condensed

Kitchel, Bowers et al. *submitted*

BEAST analysis of ST258 Isolates



Time to most recent common ancestor: ~19 years ago (approx. 1995)
Mean mutation rate/ clock speed of 1.03 x10-6

Literature reports:
- KPC
- ST258

Kitchel, Bowers et al. *submitted*

C. difficile Surveillance in Acute Care

Transmission, Colonization

- **15 mo. QI project to decrease CDI in acute care setting**
- **Role of asymptomatically-colonized pts in transmission**
- **Culture-based surveillance**
  - Admission, transfer, discharge screening
  - Six point prevalence surveys (all adult inpatients, ~500/ day)
  - Document presence/ absence of symptoms
- **Intervention: Isolation for C. difficile-positive pts**
- **Strain typing for all Isolates**
  - First pass: PCR-ribotyping (~600 isolates)
  - Indistinguishable isolates: WGS and SNP analysis (~250 isolates?)

Collaboration with Chris Polage, UC Davis

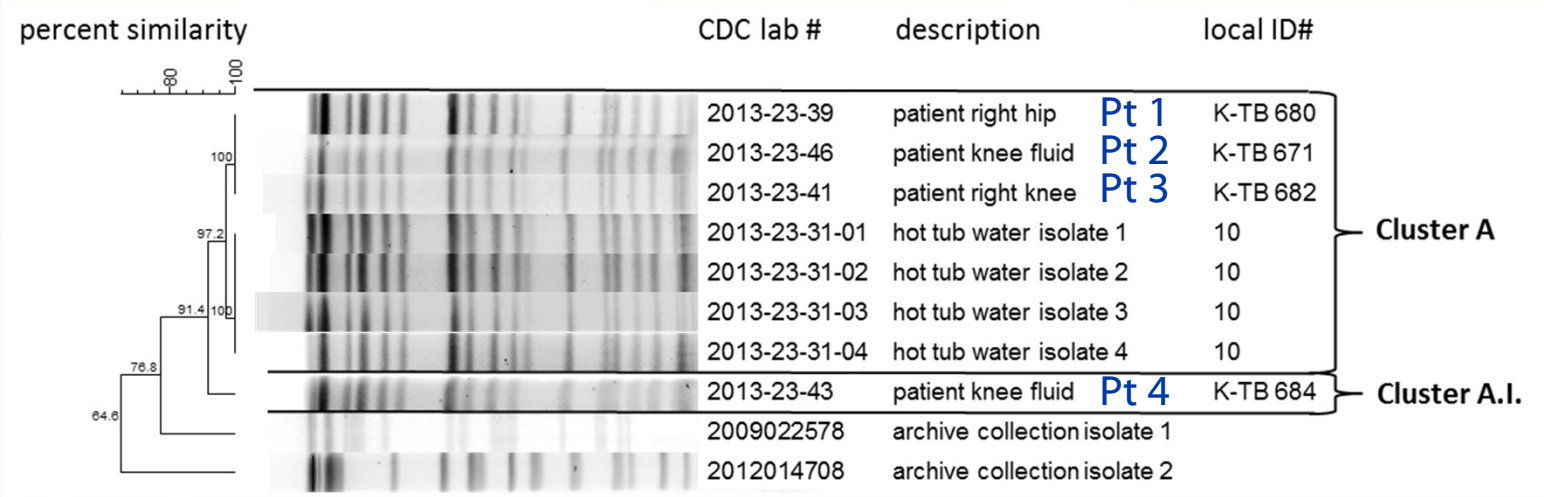
Investigation of *Mycobacterium wolinskyi* Surgical Site Infections

Transmission, Evolution, Colonization

- **Cluster of surgical site infections with M. wolinskyi identified at single facility over nine months**
  - Knee and hip surgeries
  - Several different surgeons, different clinics
  - Cultures from hospital environment were negative for *M. wolinskyi*
  - Single healthcare worker common among case patients
    - Had hot tub, but denied using it
    - *M. wolinskyi* recovered from cultures of HCW hot tub
- ***M. wolinskyi* is an uncommon pathogen**
  - Little known about its diversity or methods for characterization

PFGE of *M. wolinskyi*

Ase I



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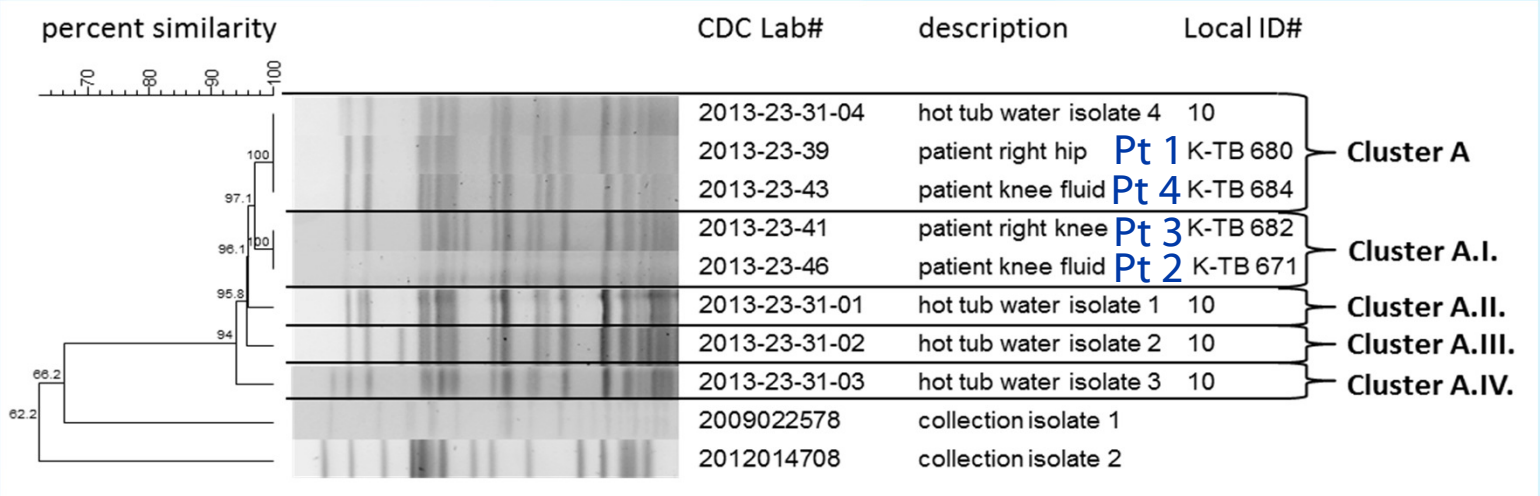
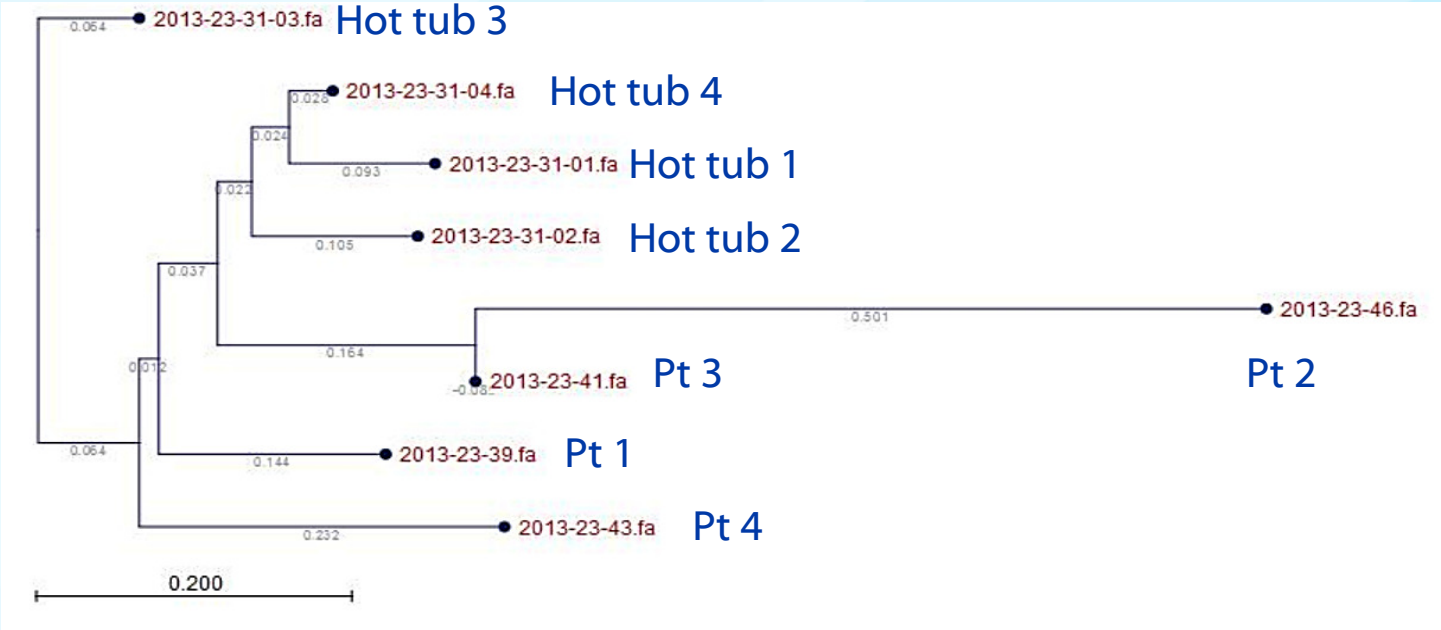


WGS SNP Analysis of *M. wolinskyi*

- **Unrooted SNP matrix alignment tree for *M. wolinskyi* isolates from this outbreak**



SNP per branch length

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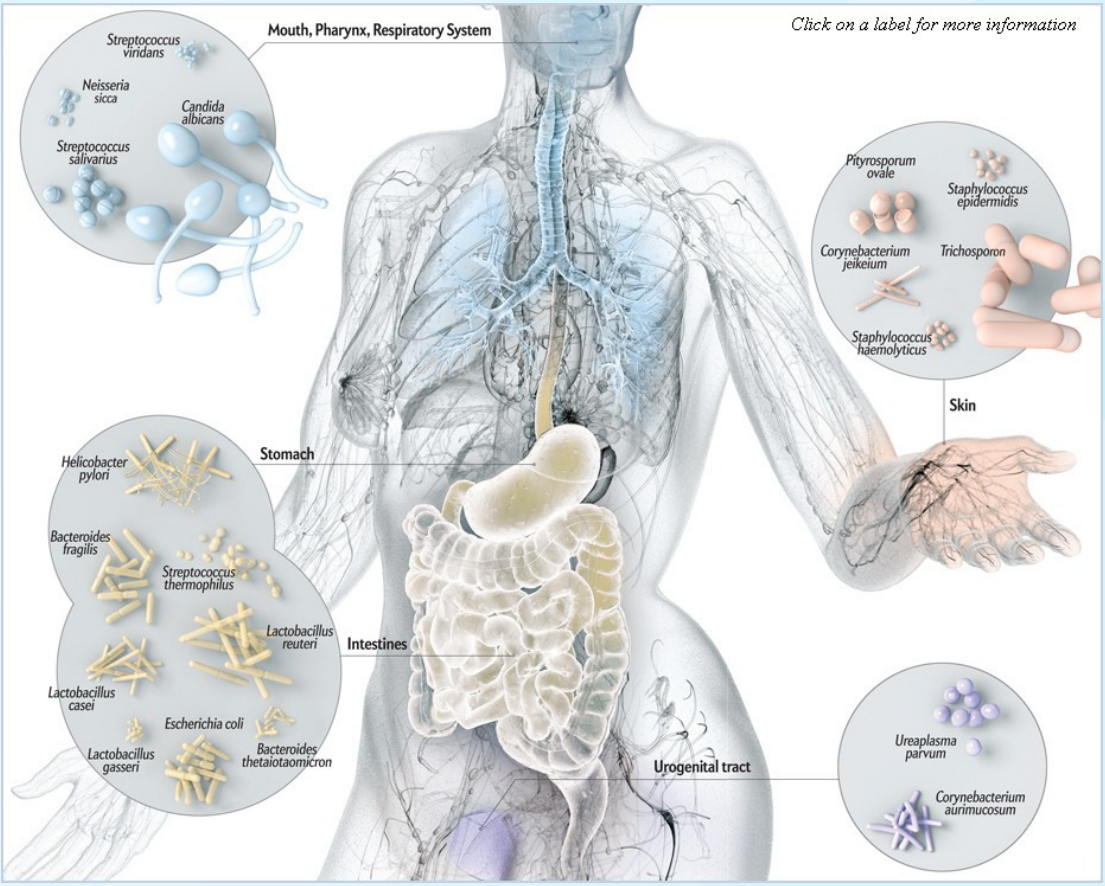
  - Alison Laufer
  - Cliff McDonald
  - Nimalie Stone

Priorities for Bridling the Human Microbiome to Control MDROs



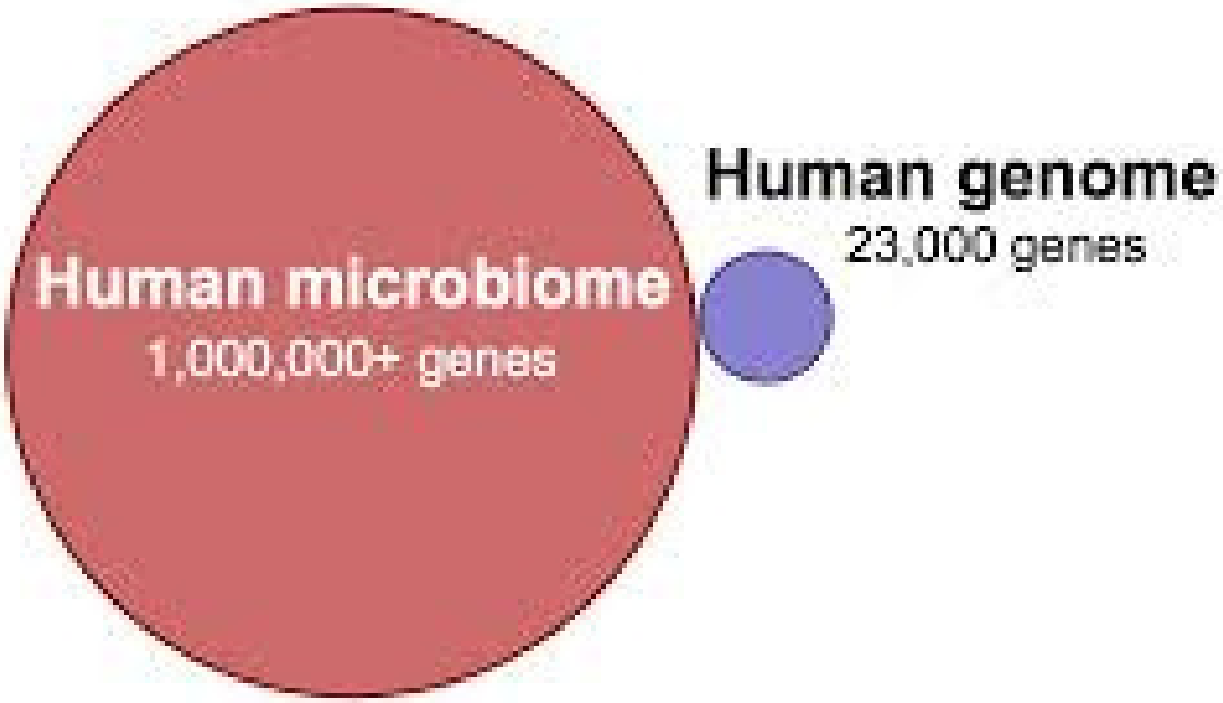
http://www.scientificamerican.com/article/microbiome-graphic-explore-human-microbiome/

Definitions

- **Microbiota - *microorganisms living in or on us***
- **Microbiome - *collective genome of the microorganisms***
- **The 'omics'**
  - Metagenomics-study of genetic material recovered directly from samples (environmental, animal, human)
  - Metabolomics-study of complete set of small-molecule metabolites
  - Proteomics-study of complete set of proteins produced or modified

Intestinal Microbiota

- 10^{14} microorganisms overall
- Only ~20% ever cultured in vitro
- 10^{4-5} species
- Increasing density
  - 10^{1} stomach
  - 10^{3} duodenum
  - 10^{4} jejunum
  - 10^{7} ileum
  - 10^{12} colon
- 10^{12} per gram of stool



http://mpkb.org/home/pathogenesis/microbiota

Key Premise

- The intact human microbiome is a primary host defense for preventing colonization, dominance, and infection with pathobionts
  - *Clostridium difficile*
  - Multidrug-resistant organisms (VRE, CRE, ESBLs, others)
- Mediated via:
  - Competition for food sources
  - Antibacterial substances
  - Triggering host antibacterial substances or immunity
  - Specific signaling

CDC Developing Microbiome Disruption Indices (MDI)

- Uses
  - Stage patient need for microbiome restoration
    - Monitor patients before, during, and after antibiotic therapy
    - Intervene when disruption reaches critical level or if colonization or dominance is detected
  - Characterize risk of specific antibiotics
    - Rating system to gauge relative risks of different agents
    - MDIs determined during approval process and included in package insert

Antibiotic Resistance Threat from Microbiome Disruption

What is the usual MDI seen with antimicrobial X?

Antibiotic disruption

Multidrug Resistant Organism*

Further Antibiotic disruption

Normal microbiome: Resistant to colonization

Disrupted microbiome: Susceptible to colonization

Colonization

Overgrowth and Dominance

Cross Transmission

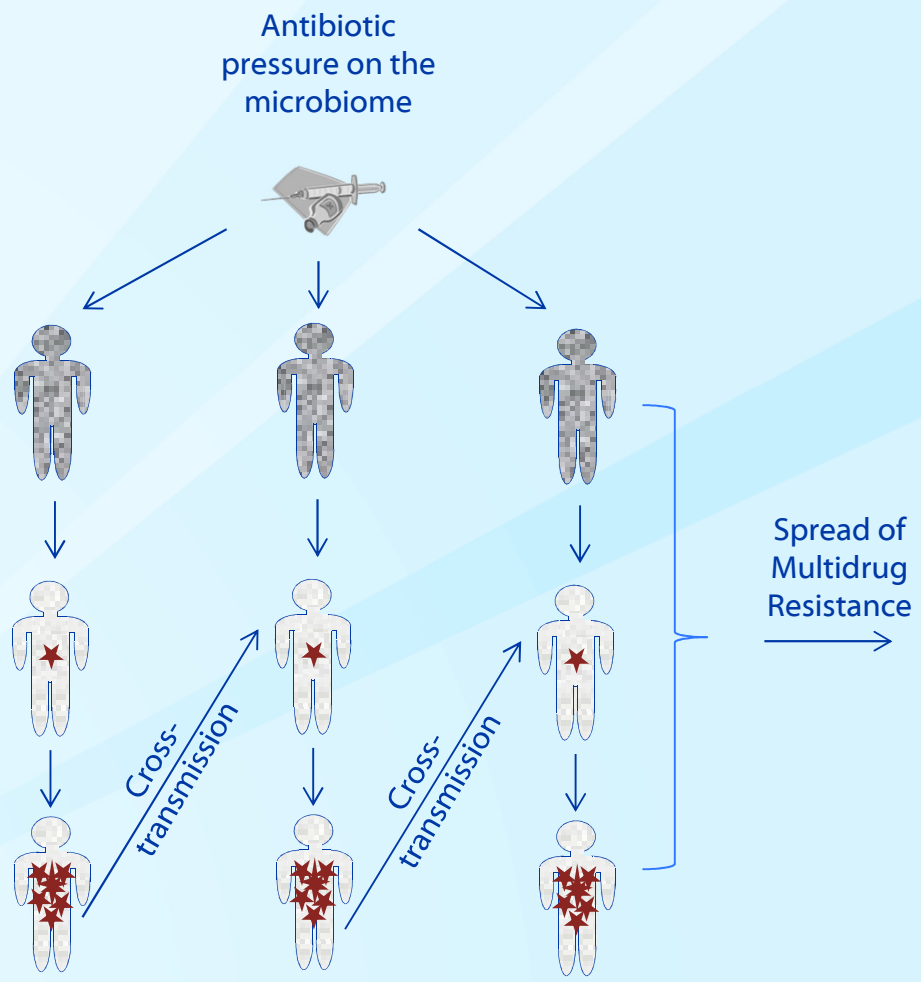
What is the MDI permissive for colonization?

What is the MDI that promotes dominance?

What is the cumulative MDI that leads to transmission?

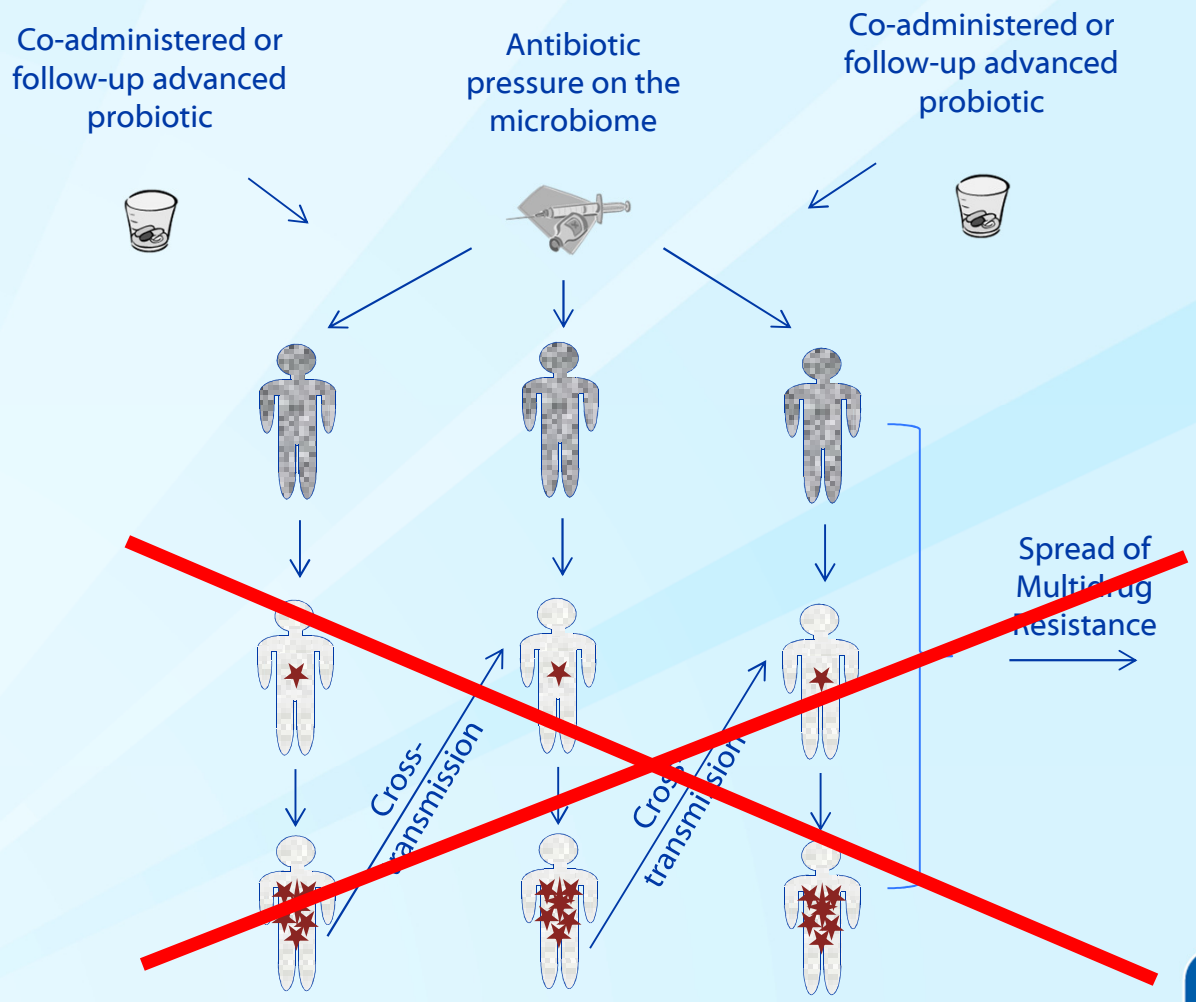
*Examples include carbapenem-resitstant enterobacteriaceae, vancomycin-restant enterococci, extended-spectrum beta-lactamase producing enterobacteriaceae. May also include transfer of genetic transfer of resistance determinants

Turning the Tide of Resistance in Healthcare



Refocused antibiotic stewardship: reducing transmission via reduced cumulative MDI?

Turning the Tide of Resistance in Healthcare



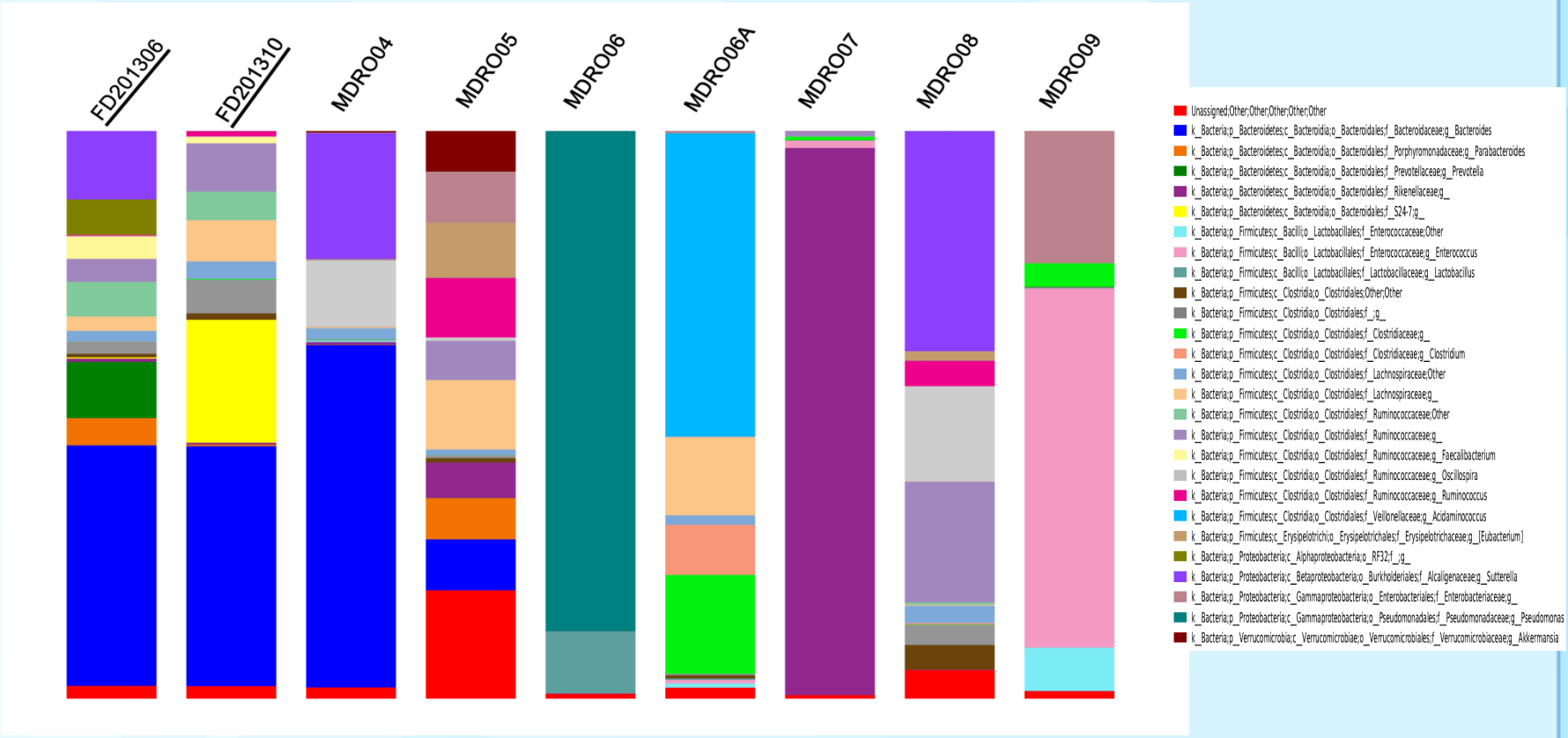
Understanding the Degree and Duration of Microbiome Disruption

- **Cross-sectional pilot with Emory in long-term acute care hospital (LTACH) inpatients**
  - Admission 'screening' for *C. difficile* infection, waste specimens
  - 16S ribosomal RNA encoding DNA amplification and sequencing
  - Association with antibiotic exposure histories and MDRO colonization
- **Washington University Prevention Epicenter human volunteer study**
  - 10 healthy volunteers
  - Stool sample collected at baseline
  - Antibiotic (amoxicillin/clavulanate) administration
  - 16S profiling before, after, and during resolution

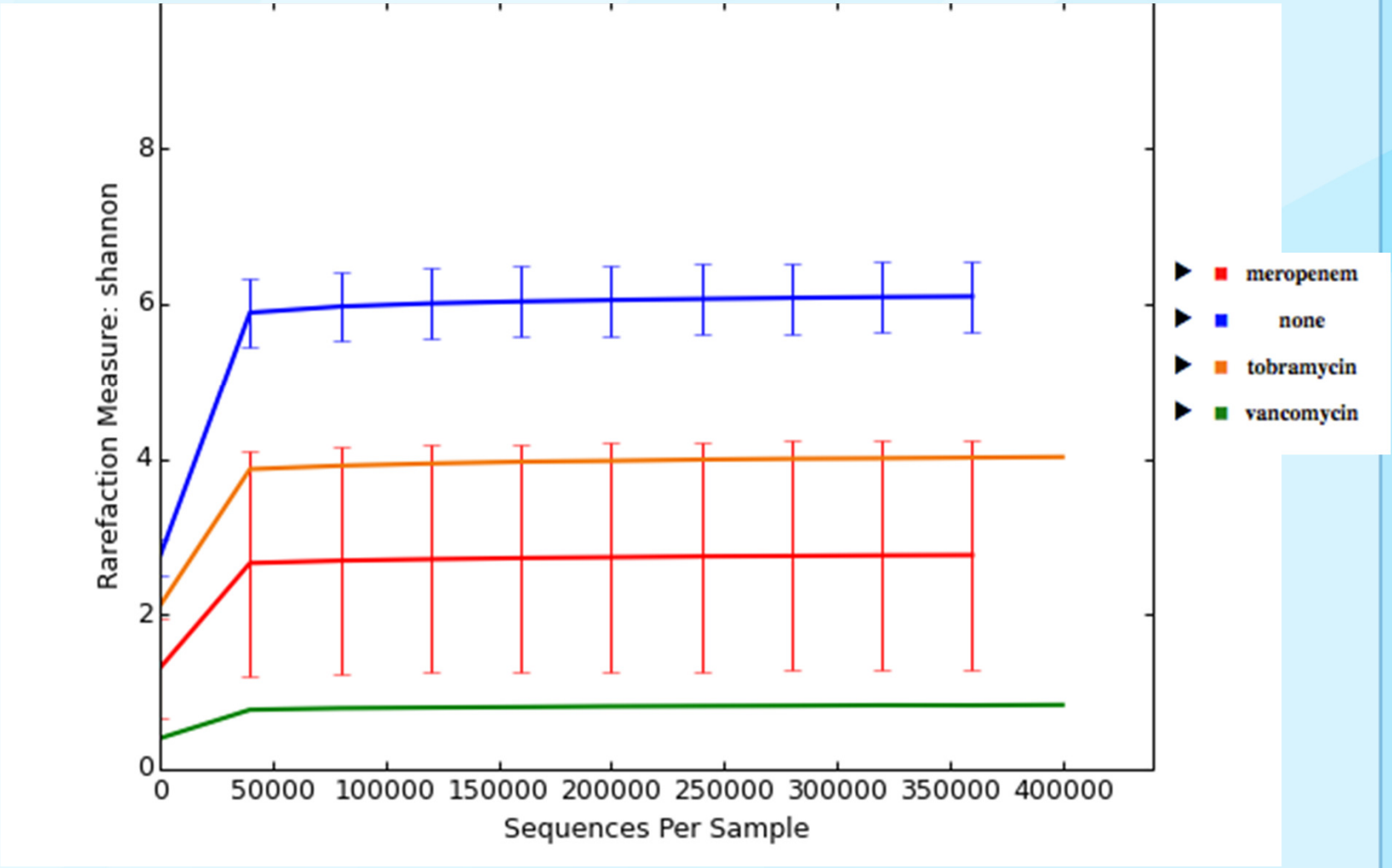
Cross-sectional Survey in Emory LTACH Patients

			Antibiotics 48 hours before stool collection		
SampleID	**Sex**	**Age**	**ABX name (1)**	**ABX name (2)**	**MDRO**
FD201306	M	20	None	None	None
FD201310	M	20	None	None	None
MDRO04	M	66	Tobramycin	None	None
MDOR05	F	71	None	None	None
MDOR06	M	69	Meropenem	Vancomycin	None
MDOR06A	M	69	Meropenem	Vancomycin	C.DIFF
MDRO07	M	57	Vancomycin	Levaquin	C.DIFF
MDRO08	F	54	None	None	None
MDOR09	F	75	Meropenem	Nitrofurantoin	VRE

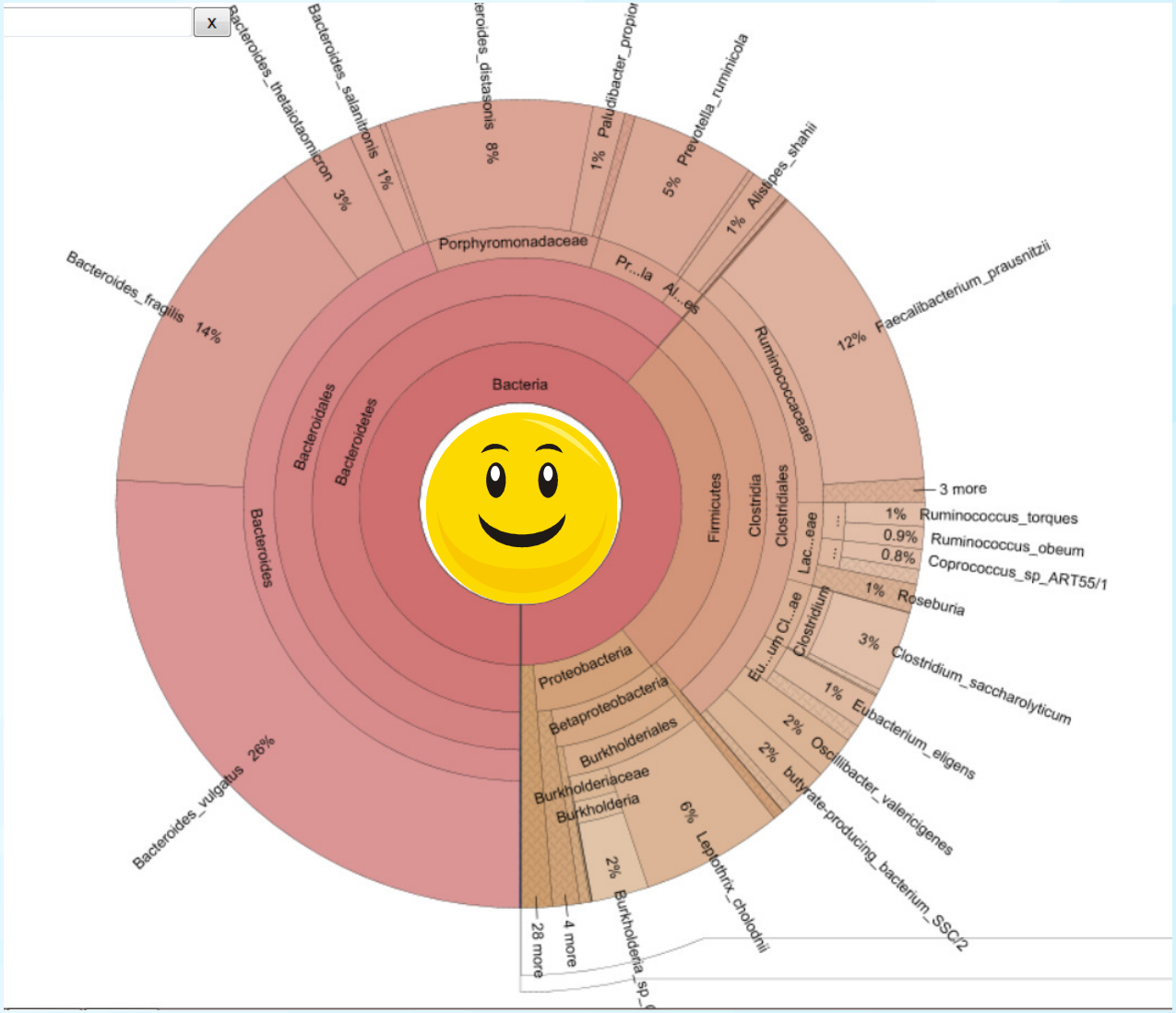
Loss of Bacteroidetes and Expansion of Proteobacteriae as an MDI Metric



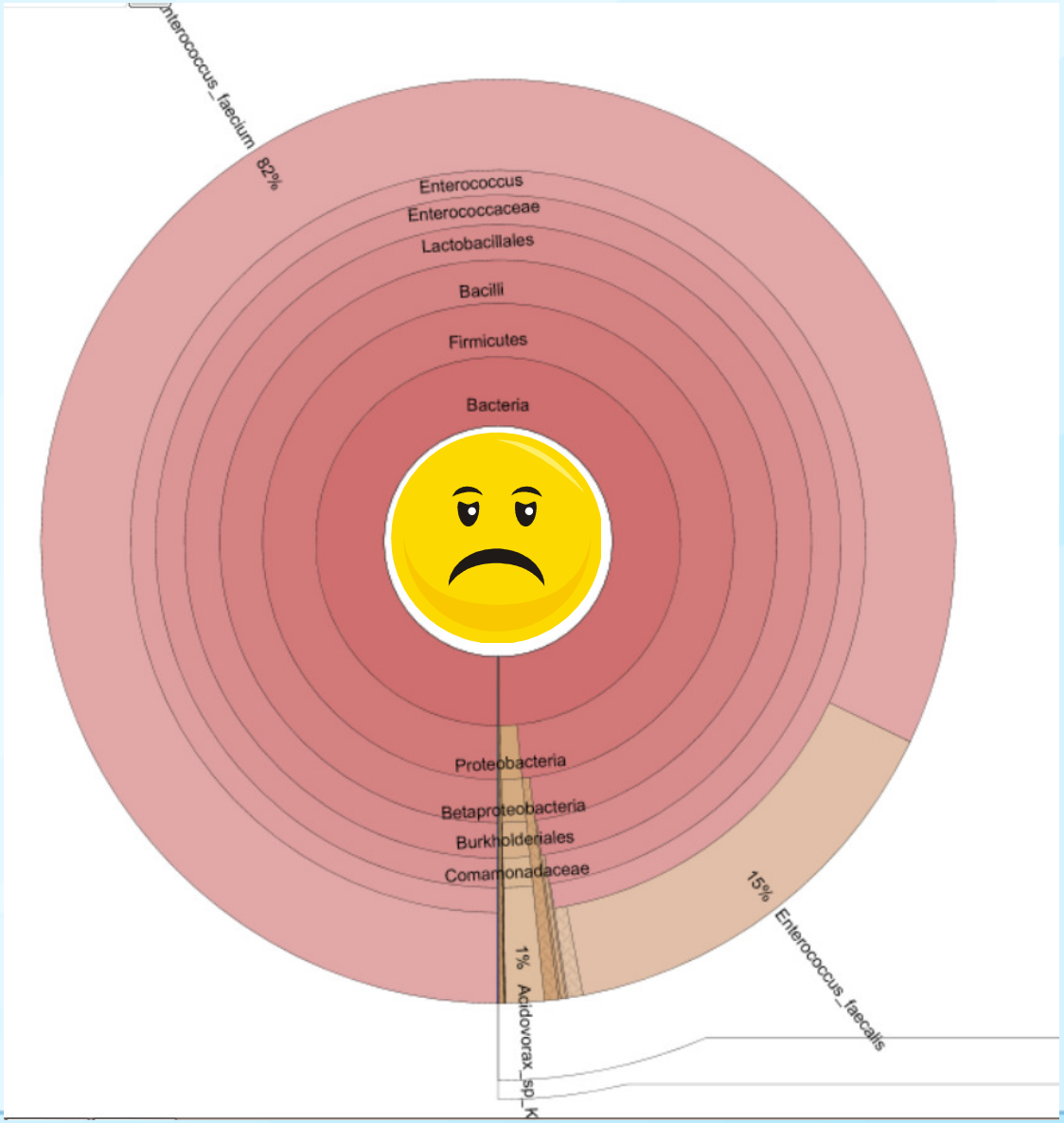
Another MDI Metric: Loss of Diversity as Measured by the Shannon Diversity Index



Here's Your Gut Microbiome…



…Here's Your Gut Microbiome on Antibiotics



16S ribosomal RNA-encoding DNA metagenomic analysis of the lower intestinal microbiota of a healthy individual living in the community without recent antibiotic exposure (panel A) and a patient in a long-term acute care hospital after repeated antibiotic exposures who has become colonized and dominated by VRE (panel B).

Understand the Natural History of Microbiome Disruption that Precedes MDRO Colonization and Dominance

- **Chicago Prevention Epicenter microbiome studies prior to and following CRE colonization**

- **Follow up pilot study with Emory collaborators**
  - Enroll patients on admission to LTACH
  - Collect serial stool specimens
  - Follow microbiome disruptions over time and their temporal relationship to antibiotics and MDRO colonization and dominance

Provide Proof of Concept: Microbiome Restoration to Ameliorate MDRO Dominance or Colonization and Improve the Resistome

- **Washington University Prevention Epicenter**
  - Auto-transplant subset of human volunteers with FMT following antibiotic administration
    - Investigational New Drug number obtained from FDA
    - Enrollment beginning by end of summer
  - Assess how the intestinal resistome shrinks
- **CDC has been in discussions with companies developing advanced probiotics that may ameliorate MDRO dominance or colonization**

Acknowledgements

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  - Washington University Prevention Epicenter
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  - Director of Clinical Microbiology Laboratory
  - Co-director of FMT program
  - Investigator on several FMT translational projects
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- **Mary Hayden, Vince Young, Robert Weinstein**
  - Chicago-Rush Prevention Epicenter

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Controlling Healthcare-Associated Spread of MDRO's – the Contribution of Whole Genome Sequencing

David K. Henderson, M.D.

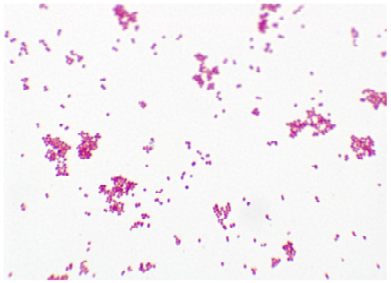
Tara N. Palmore, M.D.

July 17, 2014

Overview

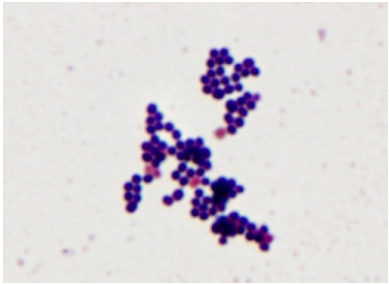
- MDROs – the problem
- Immunosuppressed patients
- Whole genome sequencing (WGS)
- Utility of WGS in characterizing transmission during our CRE outbreak at the Clinical Center
- Barriers and next steps

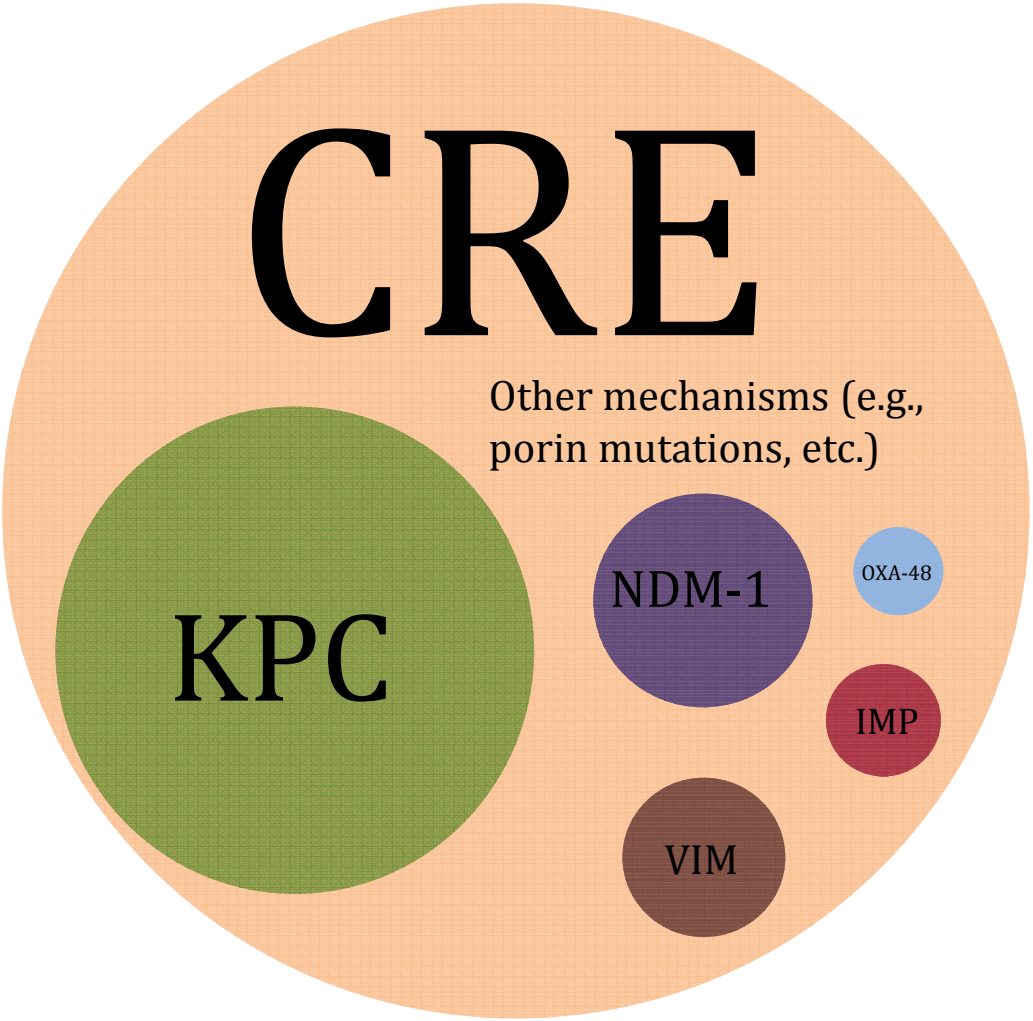
Multidrug-resistant hospital-acquired bacteria



Multidrug-resistant bacteria

- **Gram negative**
  - **CRE** (carbapenem-resistant *Enterobacteriaceae*)
  - ***Acinetobacter baumannii***
  - ***Pseudomonas aeruginosa***
  - **Others**
- **Gram positive**
  - **MRSA** (methicillin-resistant *Staphylococcus aureus*)
  - **VRE** (vancomycin-resistant enterococci)
  - **VISA/VRSA** (vancomycin-resistant *Staphylococcus aureus*)
  - **Others**



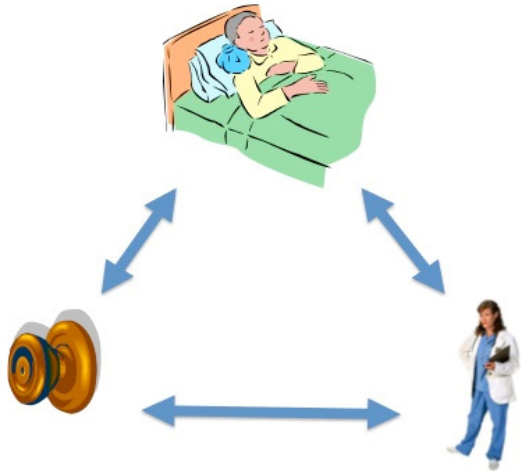


Klebsiella pneumoniae carbapenemase (KPC)
New Delhi metallo-β-lactamase 1 (NDM-1)
Verona Integron-Encoded metallo-β-lactamase (VIM)
Imipenemase metallo-β-lactamase (IMP)
OXA-48 carbapenemase (OXA-48)

Brooke Decker, M.D.

How are MDRO spread in healthcare?

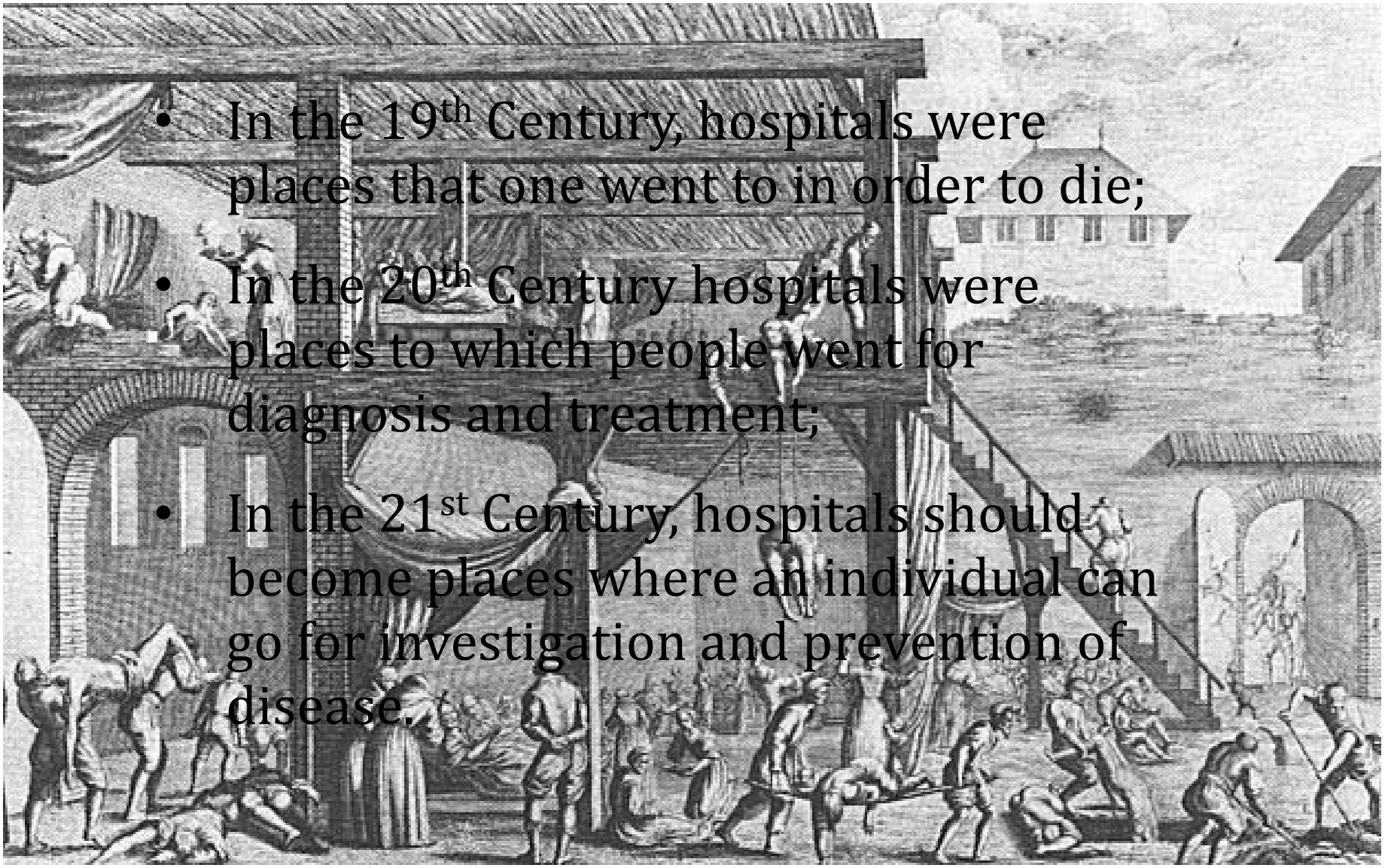
- No direct, ironclad data (diffuses accountability)
  - Hands of health care workers
  - Contaminated equipment
  - Other fomites
  - Environmental contamination
- Which routes of transmission occur most commonly?
- Where should prevention efforts be targeted?



MDROs have become an enormous problem, for hospitals treating seriously immunosuppressed patients

“Canaries in Coal Mines”

Historically hospitals were not the safest places



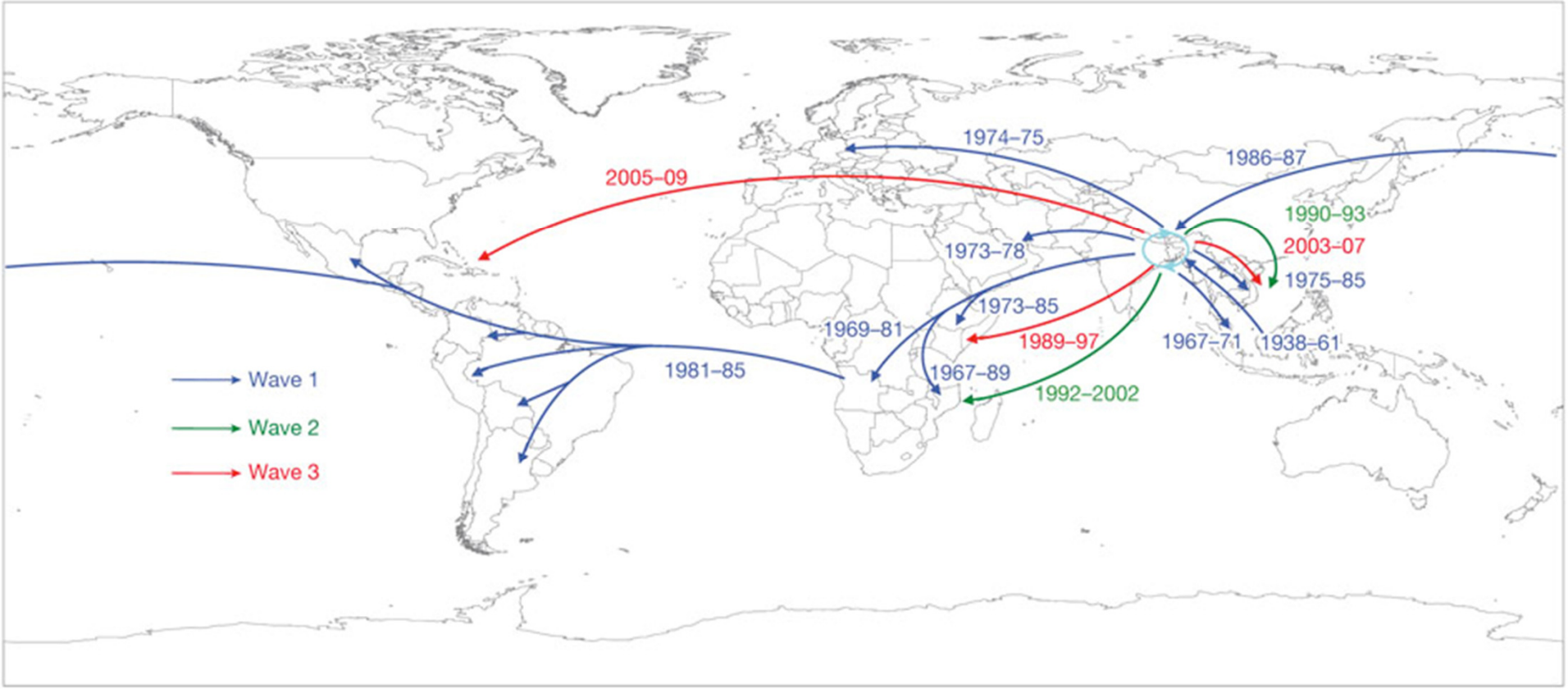
- In the 19th Century, hospitals were places that one went to in order to die;
- In the 20th Century hospitals were places to which people went for diagnosis and treatment;
- In the 21st Century, hospitals should become places where an individual can go for investigation and prevention of disease.

So…If pan-antimicrobial resistance is the problem, what is the solution?

Prevention!!!

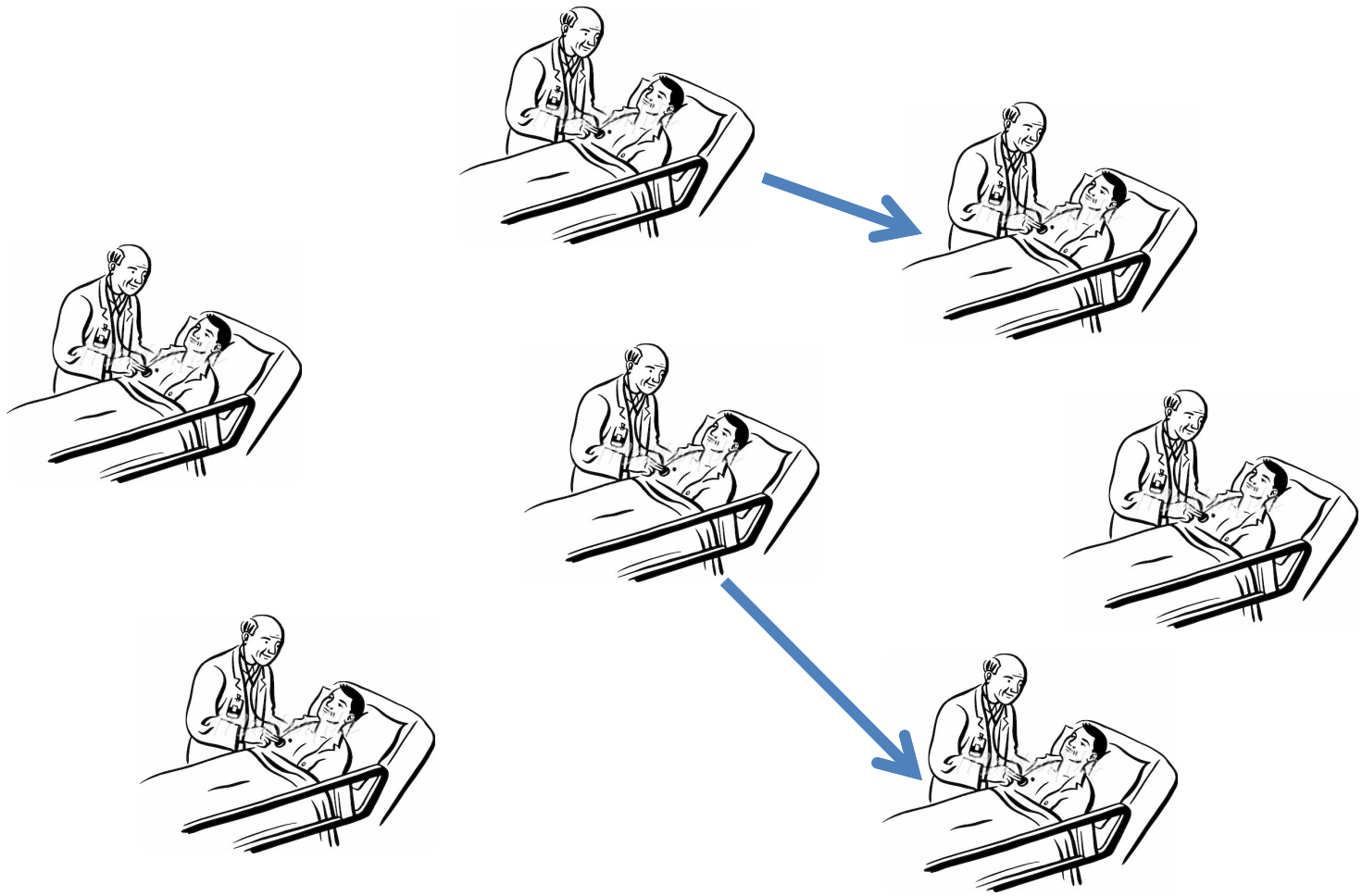
So, how might whole genome sequencing of MDRO's be of value to healthcare epidemiology?

Genome sequencing has proved effective in tracking world-wide dissemination of infectious diseases

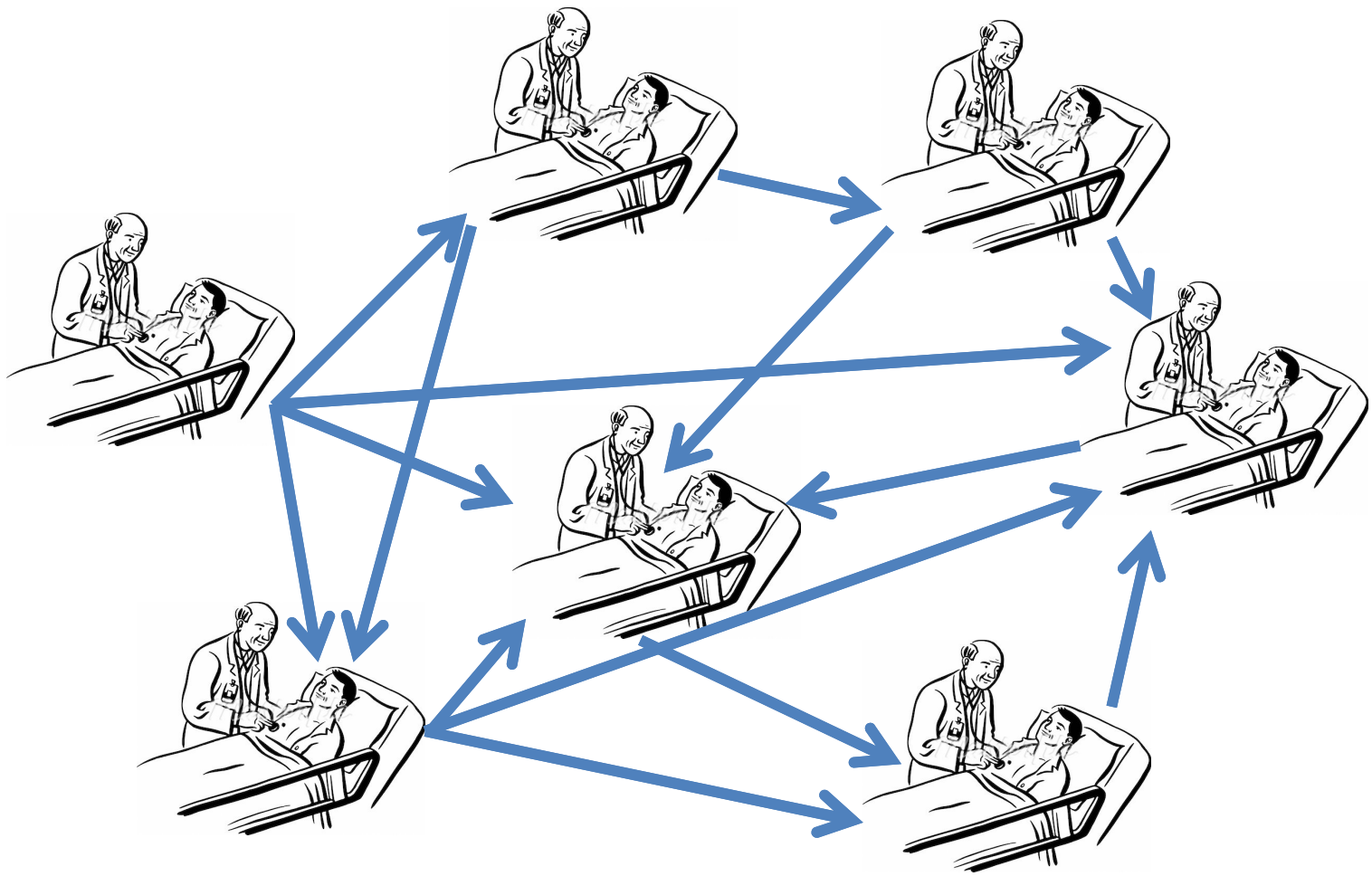


1. Mutreja, A. et al. Evidence for several waves of global transmission in the seventh cholera pandemic., Nature, 2011.
2. Chin, C.-S. *et al.* The Origin of the Haitian Cholera Outbreak Strain. *N Engl J Med*, 2011.

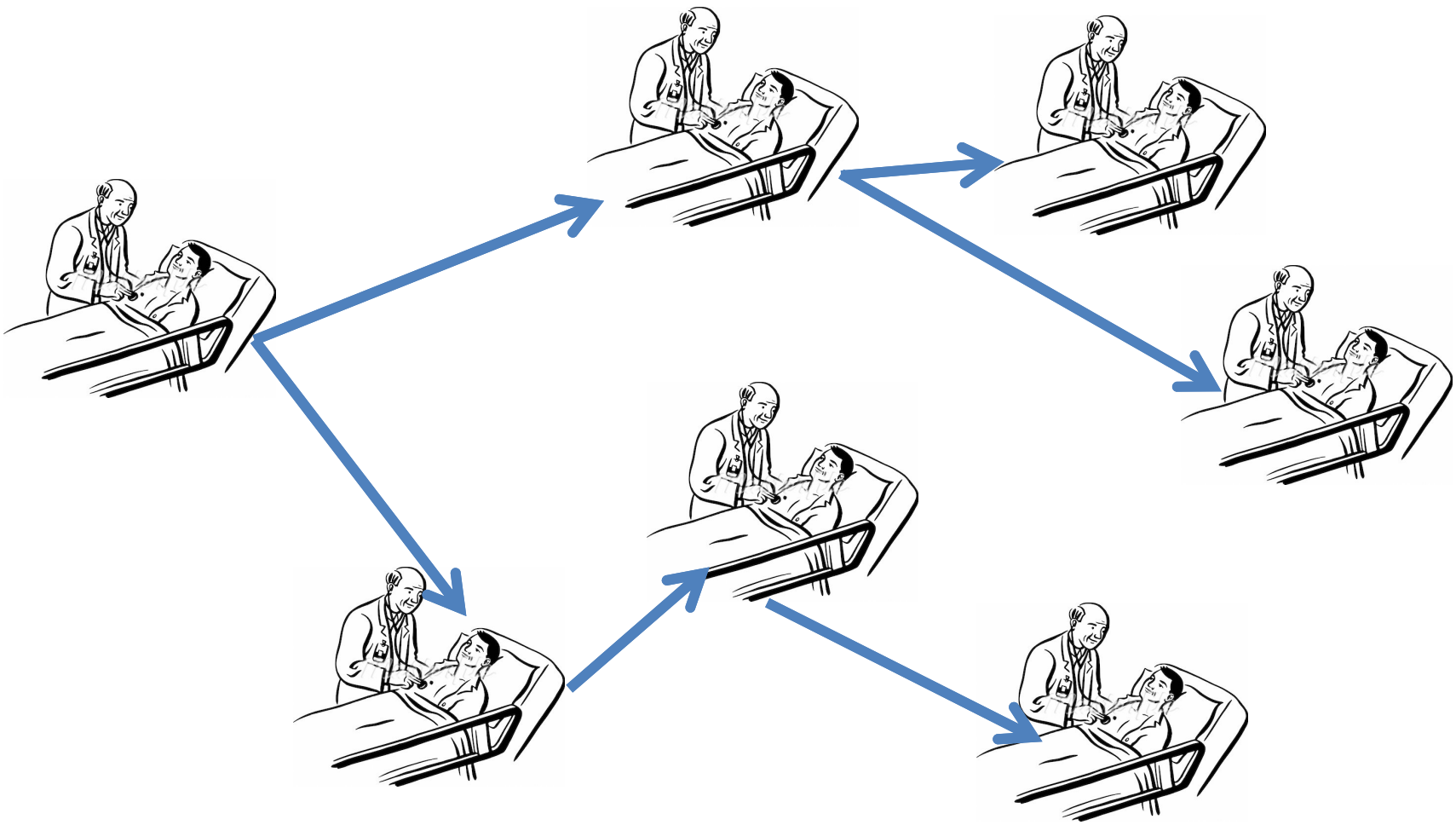
History-Taking and General Epidemiology



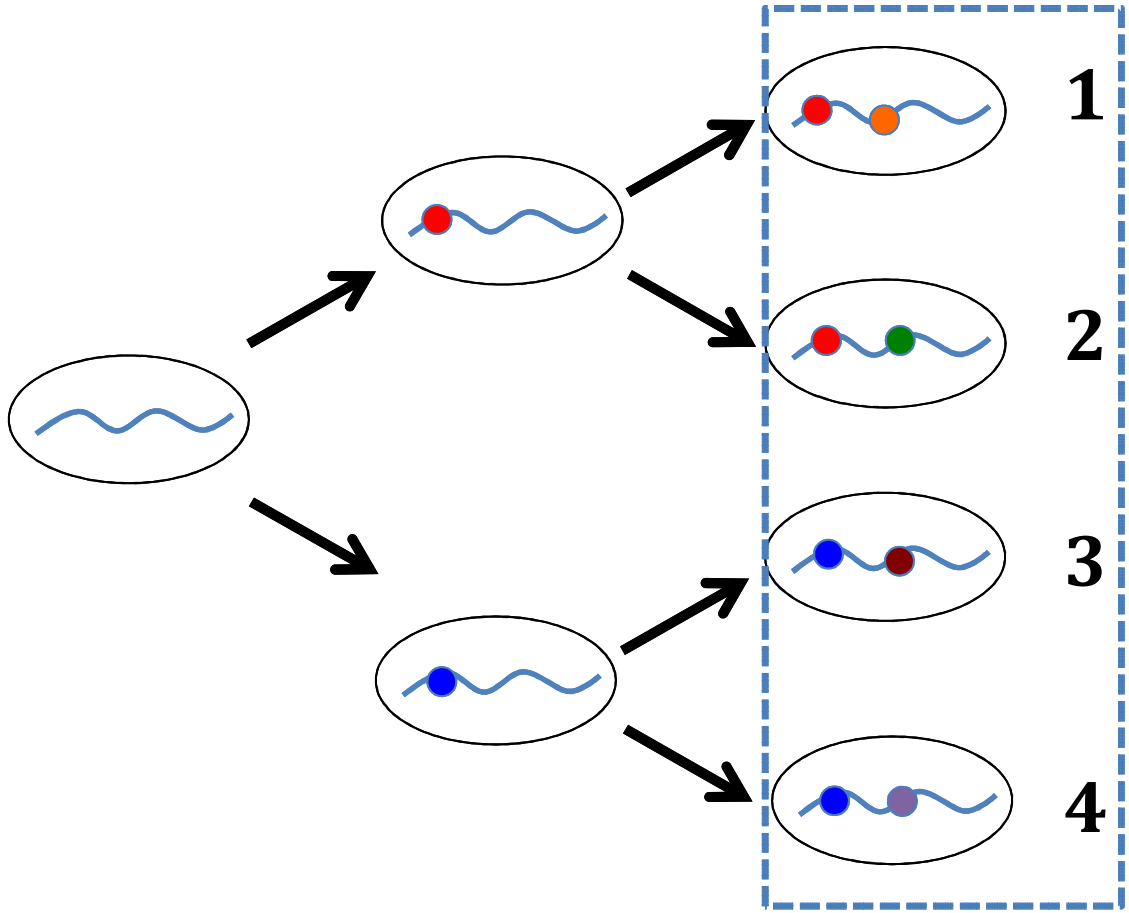
Shoe Leather Epidemiology



Whole Genome Sequencing Combined with Shoe Leather Epidemiology

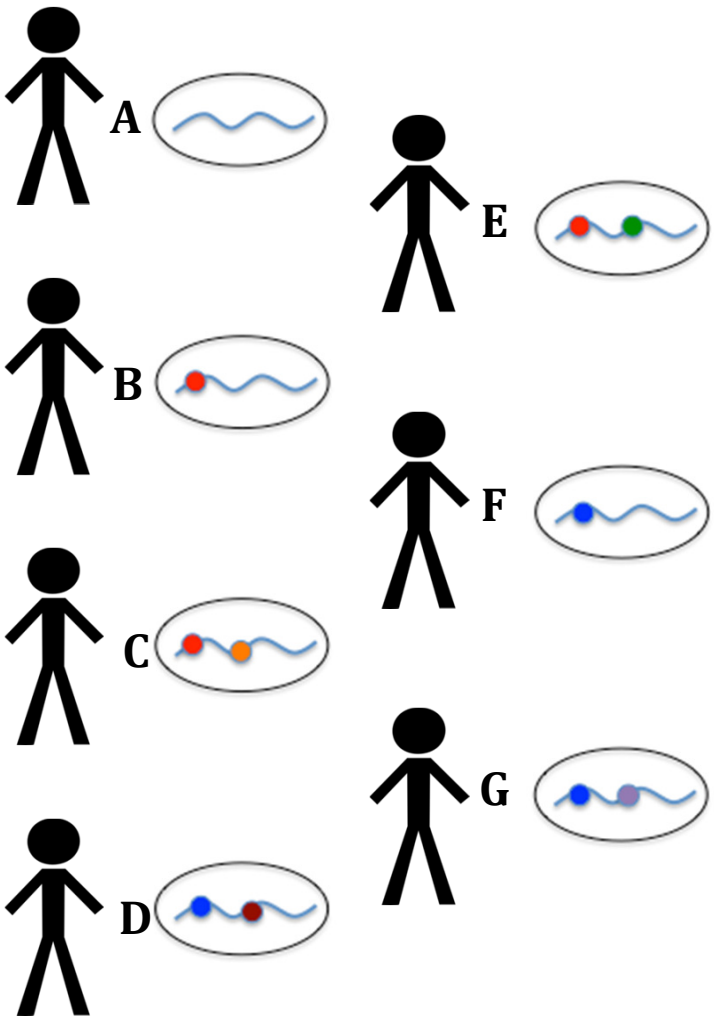


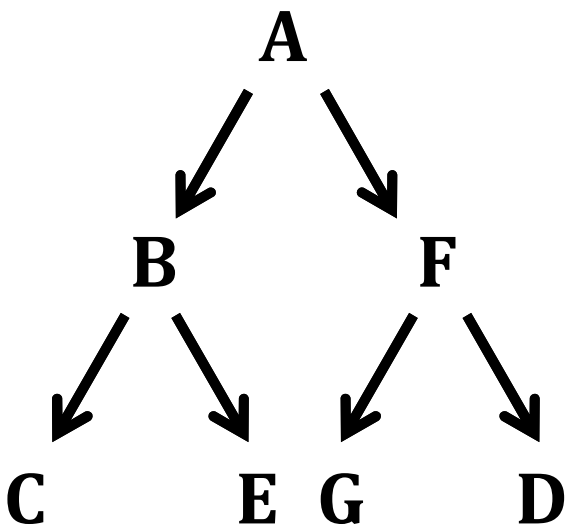
Differences in organism's genomes can be used to recreate their history



Evan Snitkin, Ph.D.

This same concept is what we hoped to use to track the spread of infectious disease





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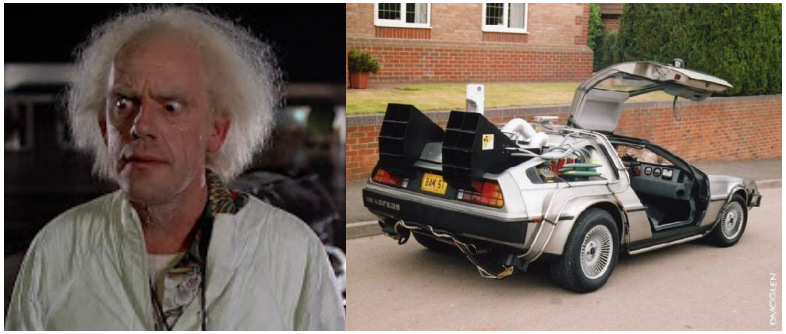
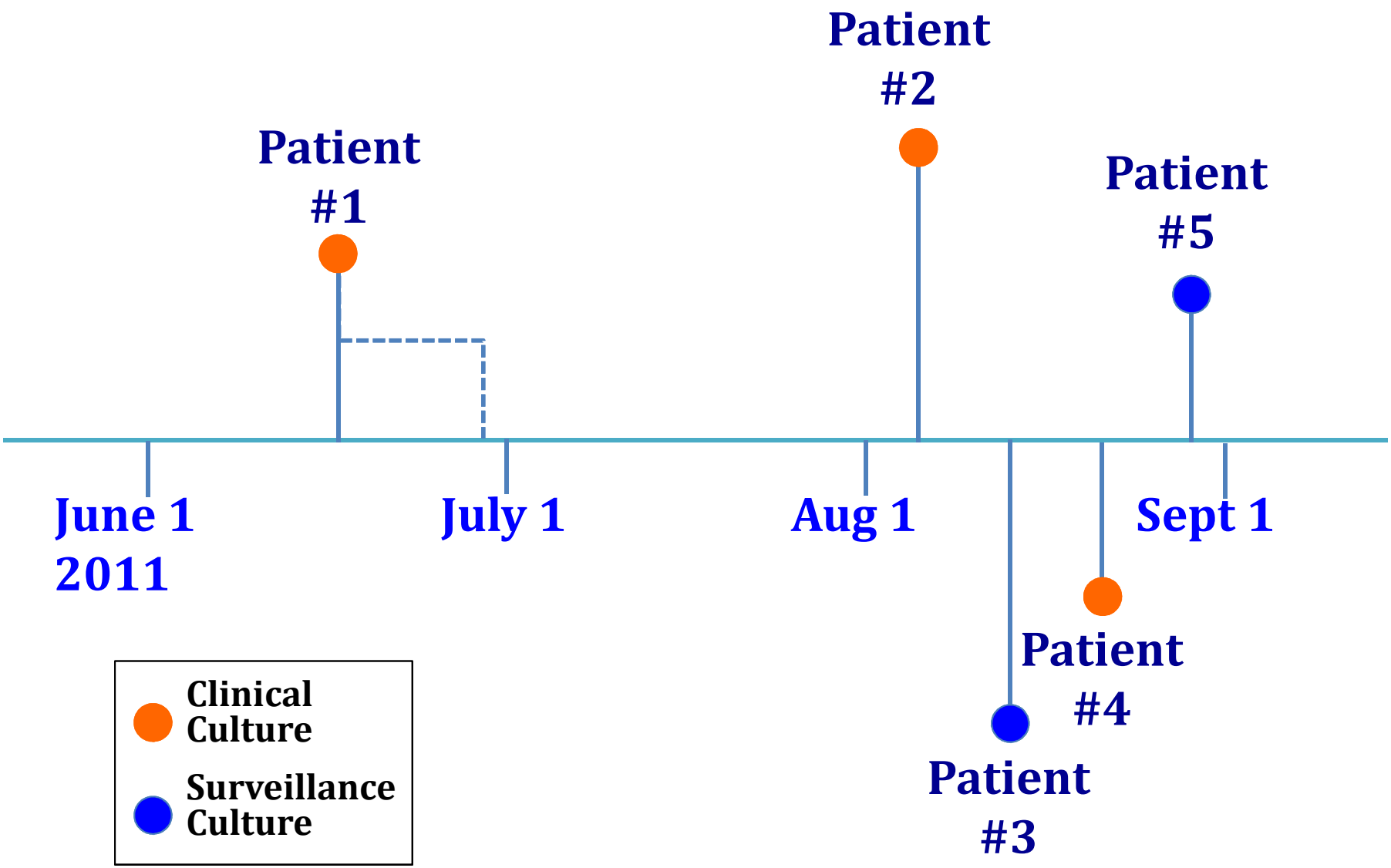
Back to the Future...



A patient known to be infected with a drug-resistant form of *K. pneumoniae* was admitted to the NIH Clinical Center on 13 June 2011. Enhanced isolation procedures were immediately implemented, and no spread of the bacteria was seen for the month she was in the hospital. Although all seemed well, a few weeks later on August 5th, a second patient was discovered to be infected with a similar pathogen, followed by a series of other patients identified as either infected or colonized –– about 1 per week to a total of 18 by the end of 2011. Seven people ultimately died as a result of CRE infection.

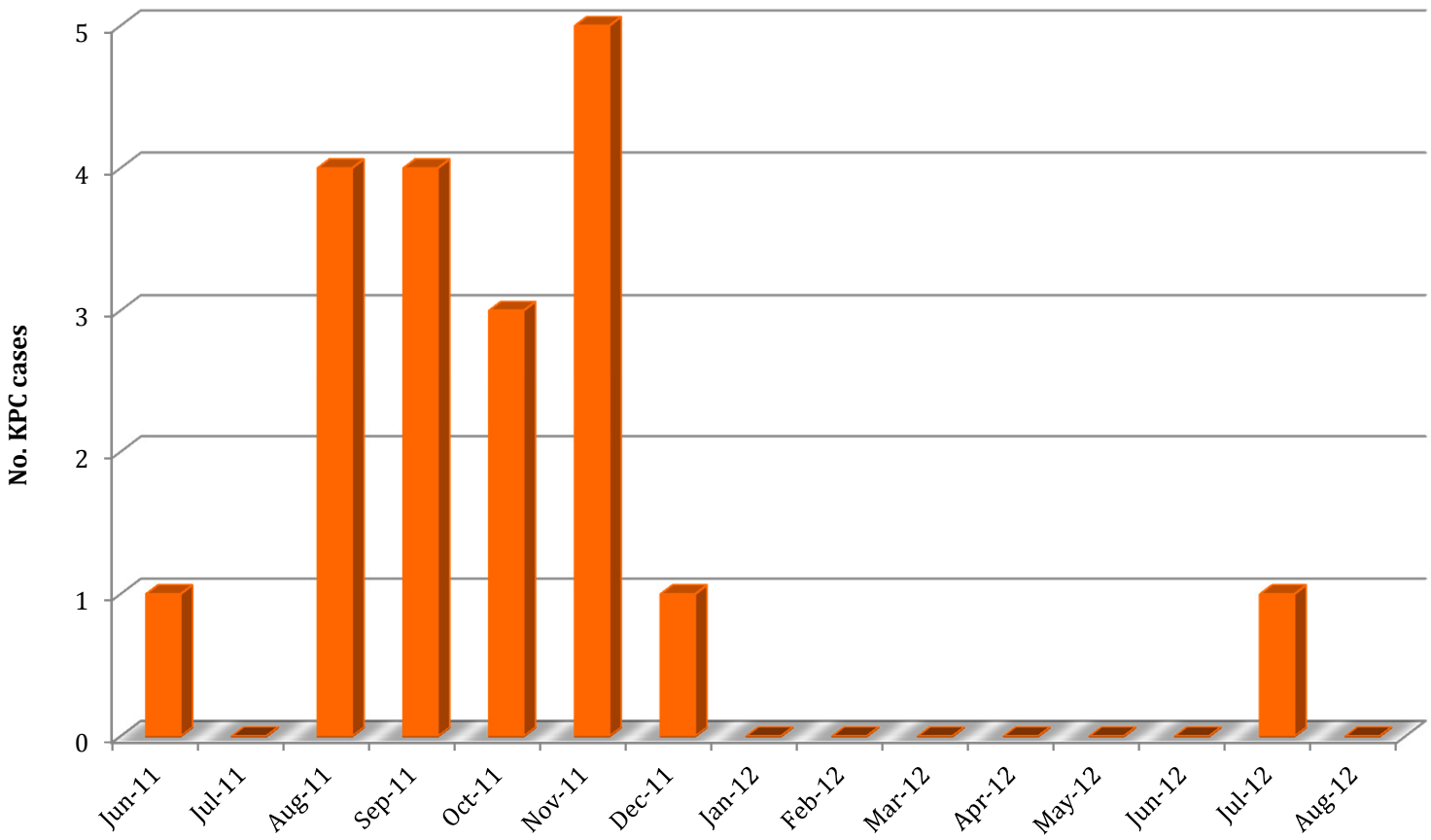
Initial KPC Cases: June 2011 – September 2011

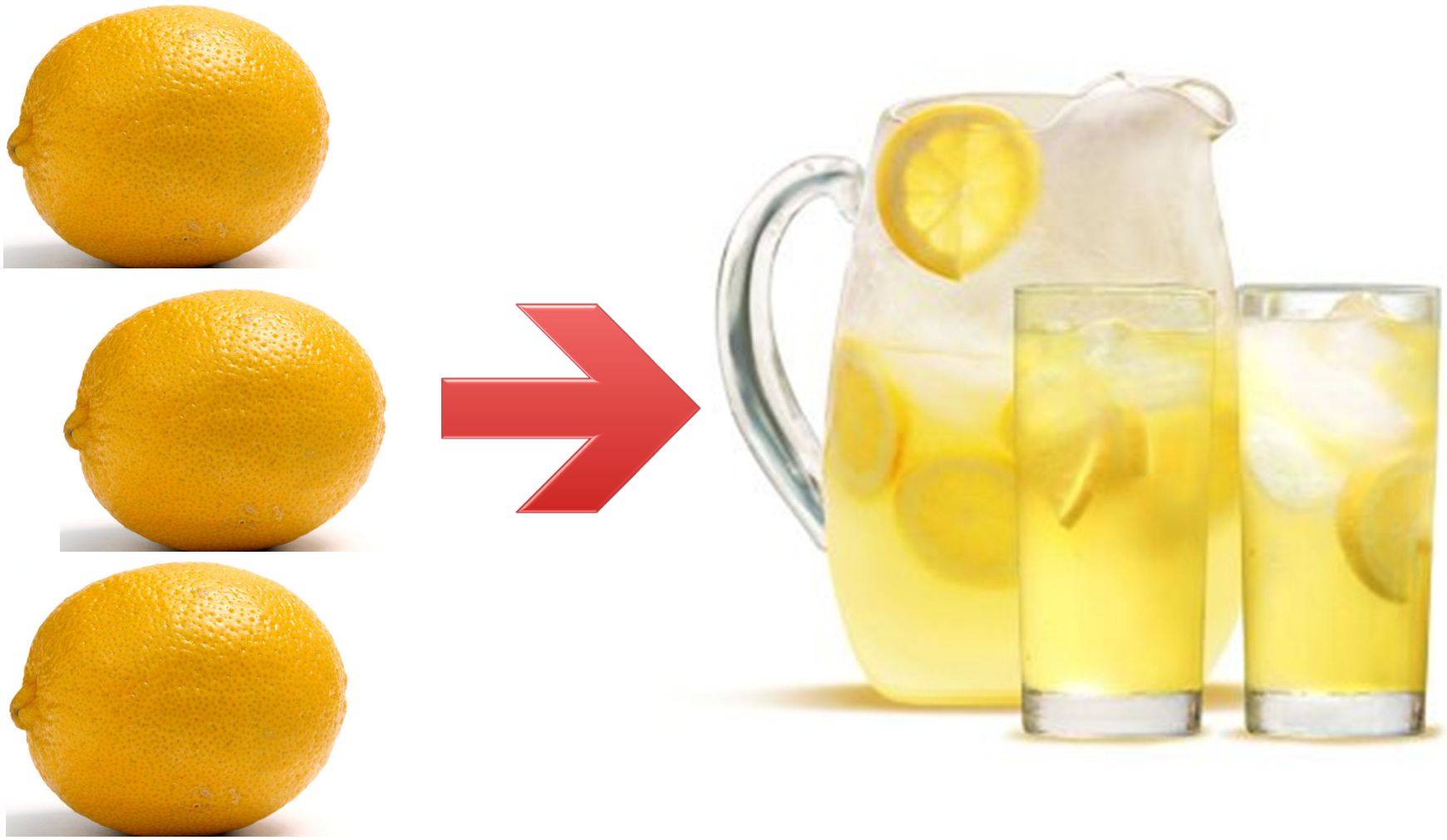


Characteristics of Clinical Center patients who acquired the outbreak strain

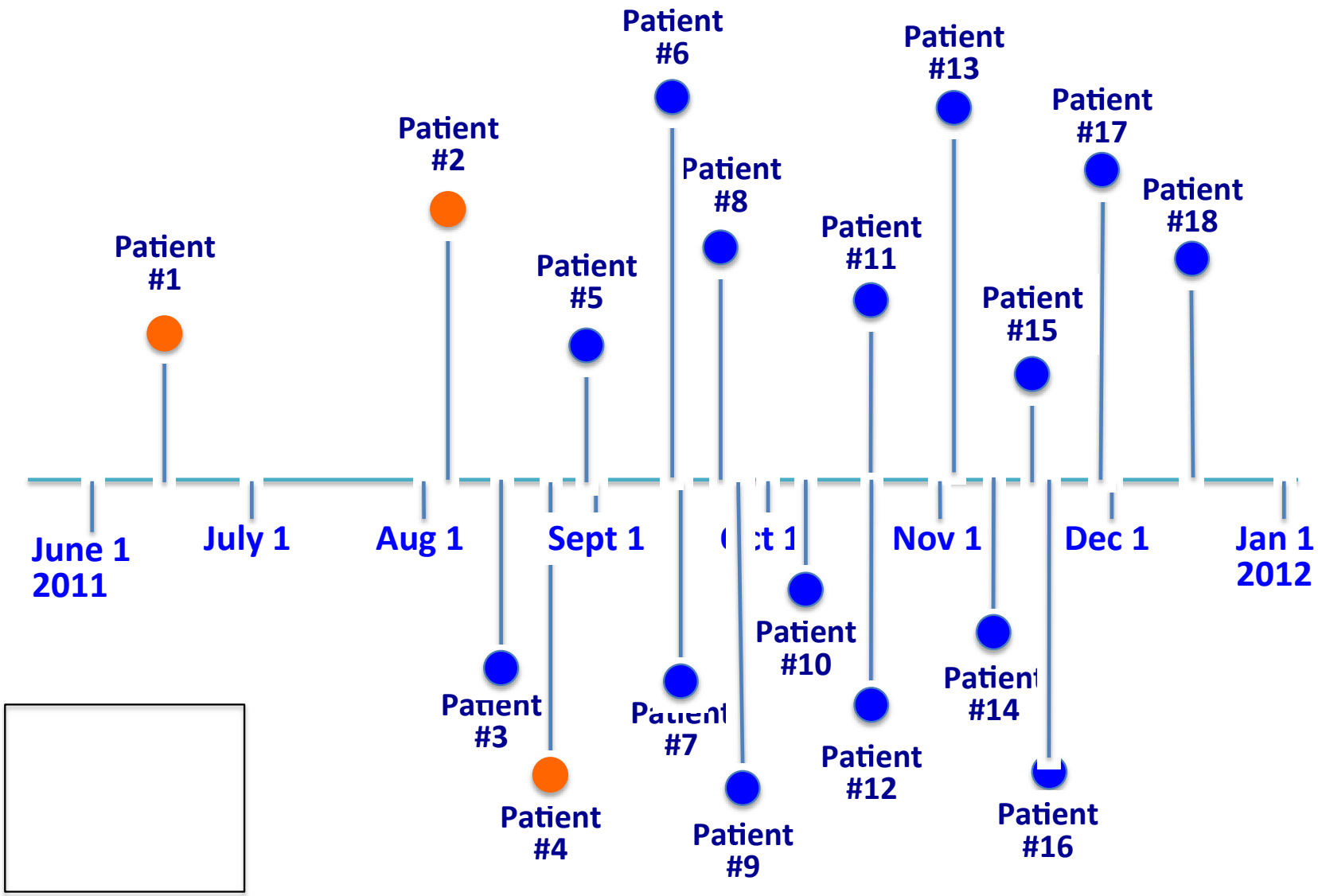
Demographic characteristics (18 pts)	
Median age (yrs)	44
Underlying malignancy	9
HSCT recipients	6
Outcome	
Only colonized with CRE	9
Developed CRE infection (bloodstream)	9
Died from CRE	7
Died from underlying condition	4

Epidemic curve of Clinical Center KPC-Klebsiella cases, 2011-12

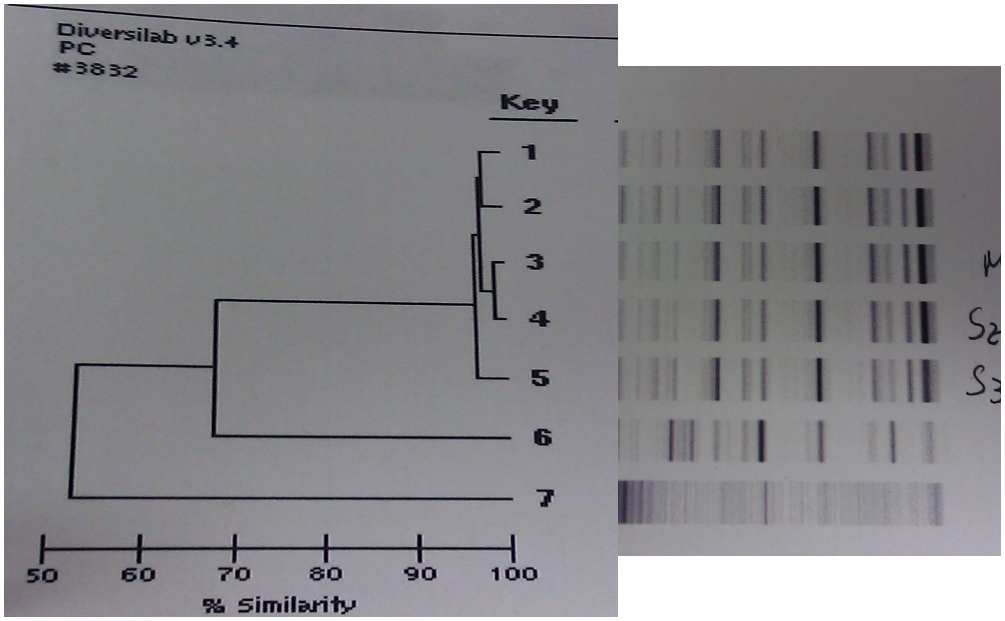




How can we begin to understand how this outbreak unfolded?

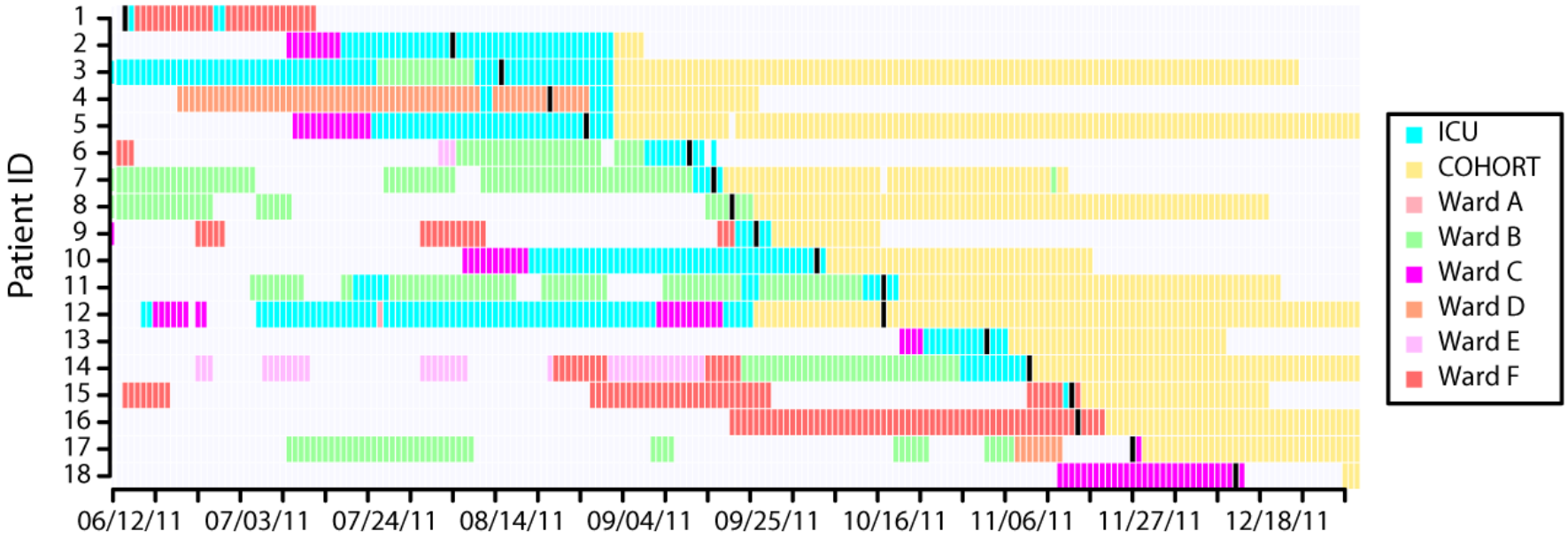


PFGE and Rep-PCR did not distinguish isolates

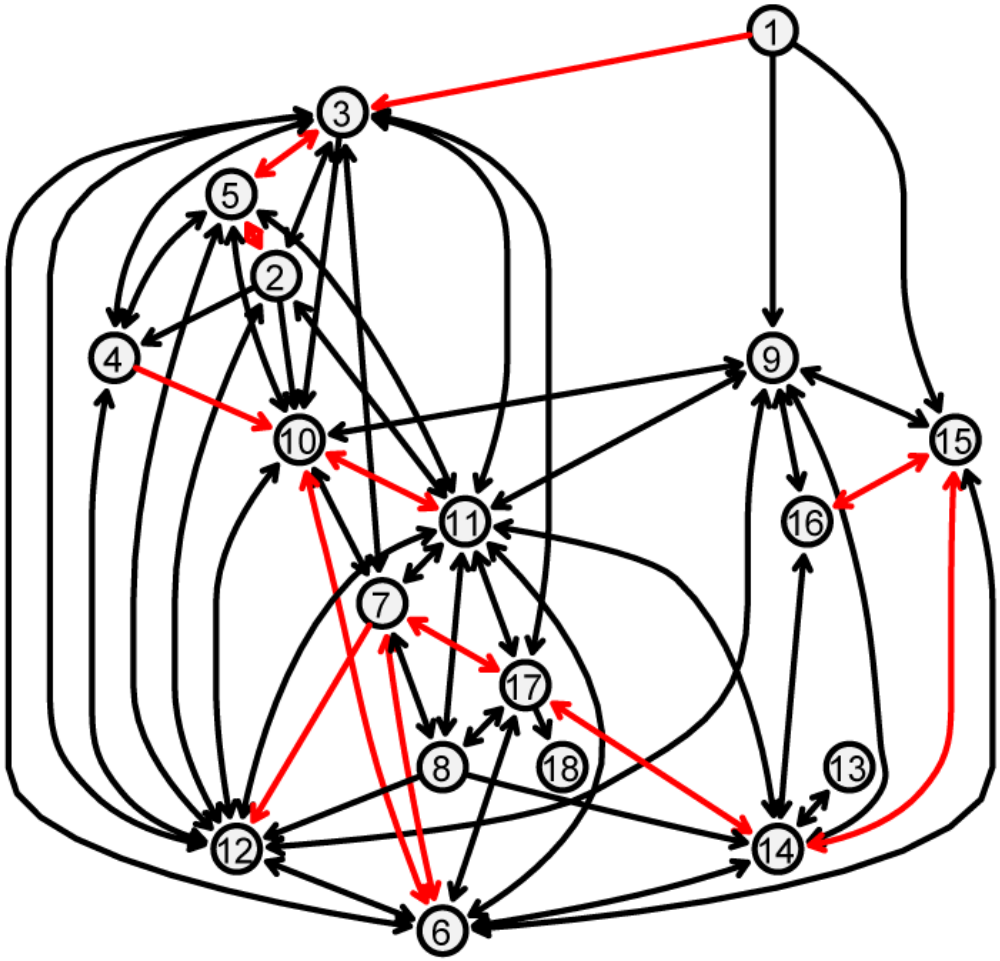


Anna Lau, Ph.D.

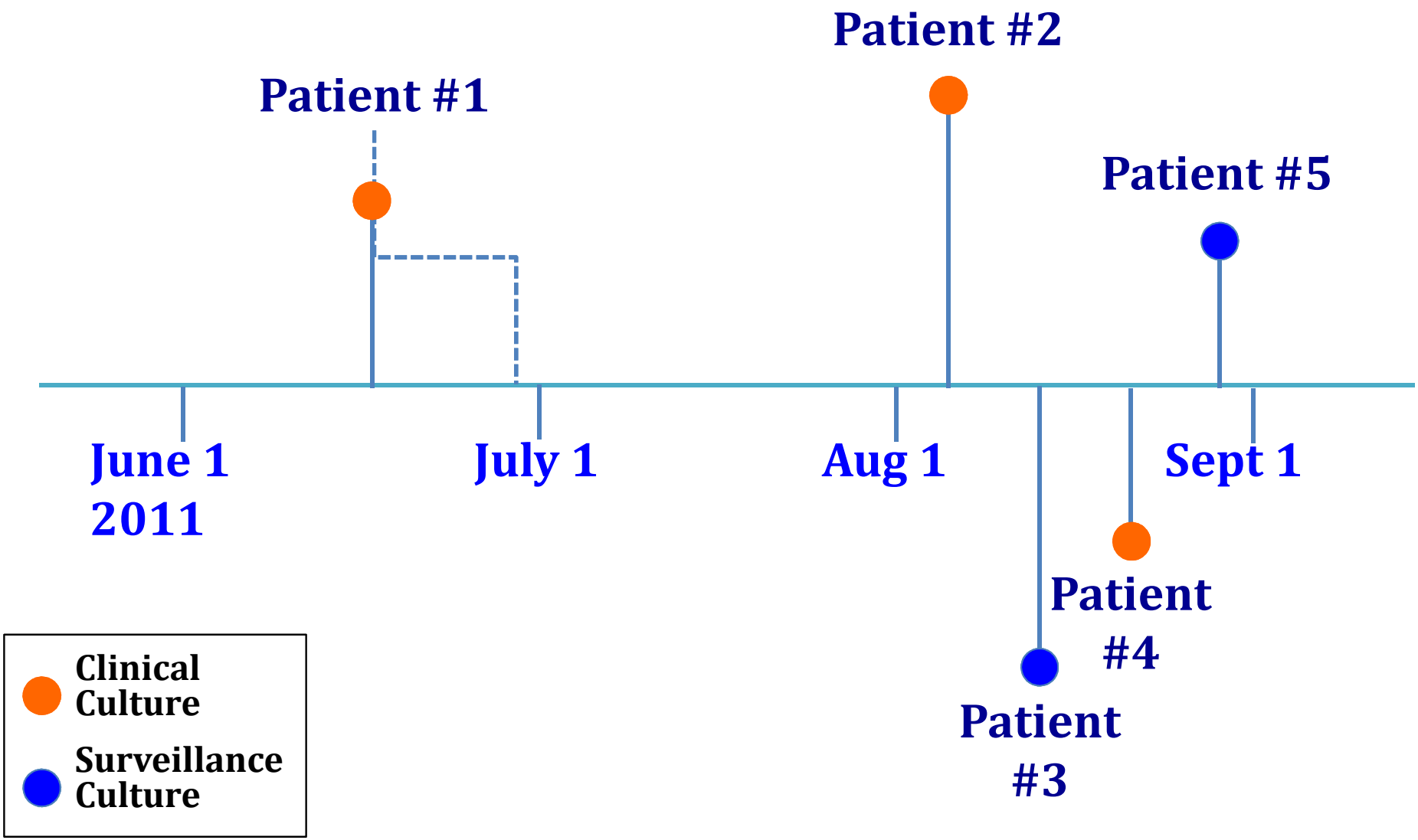
Can we use 'Shoe-Leather Epidemiology' (i.e., patient overlap) to reconstruct transmission?



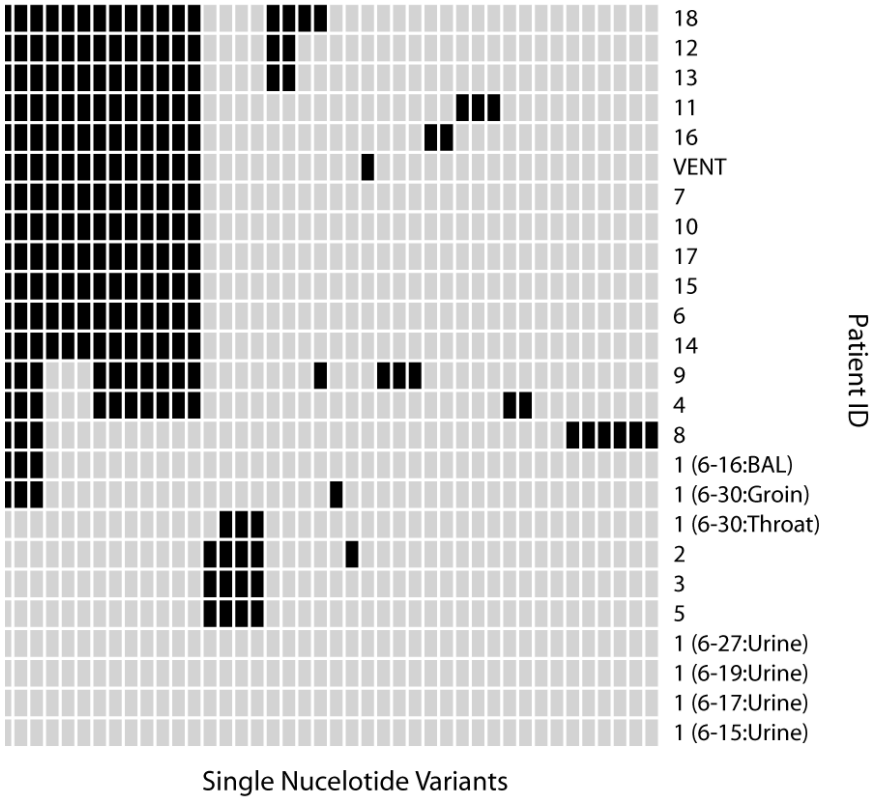
Patient overlap does not provide clear picture of how outbreak unfolded

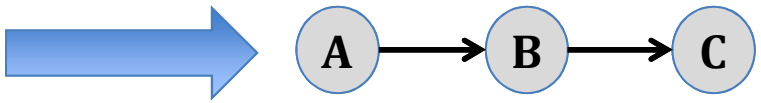


One major question – Does *Klebsiella* evolve fast enough to track spread over weeks?

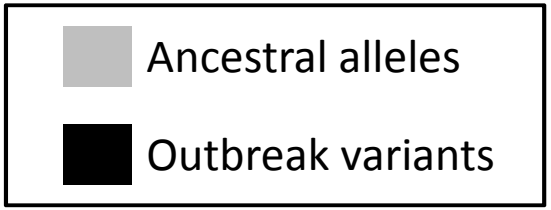


If variants clearly stratify patients into groups: Can we infer transmission paths from sequence variants?



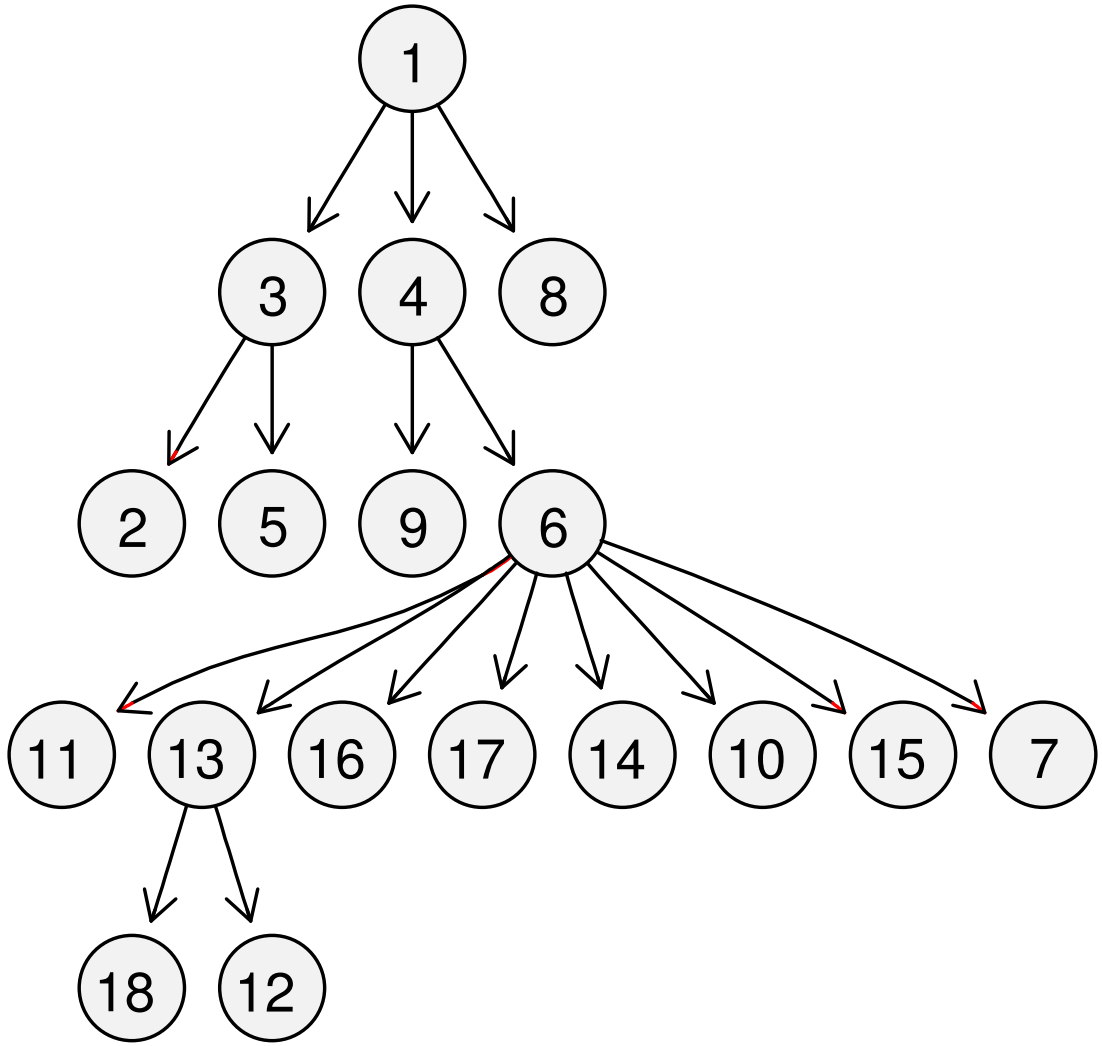


Transmission graph

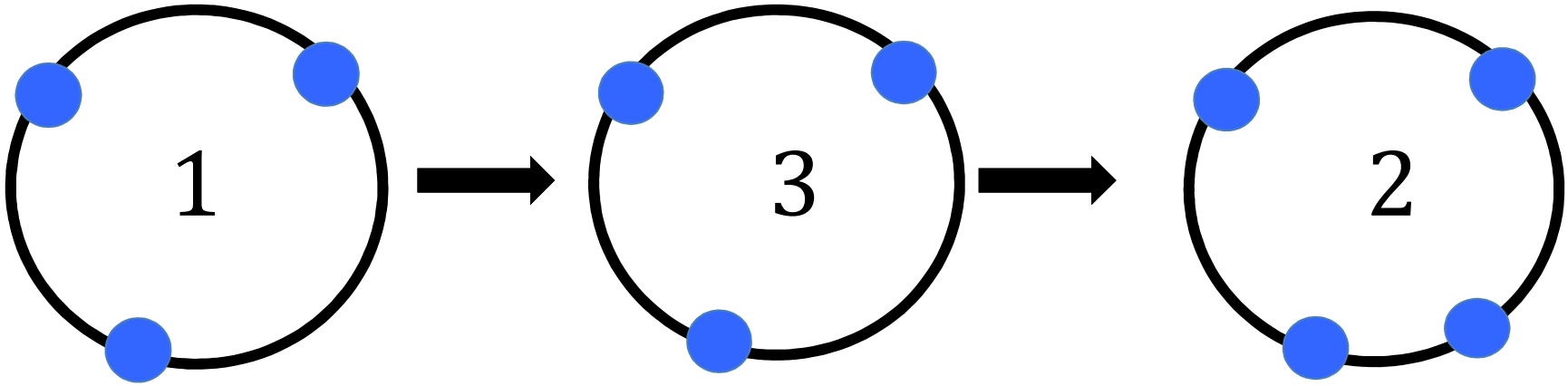


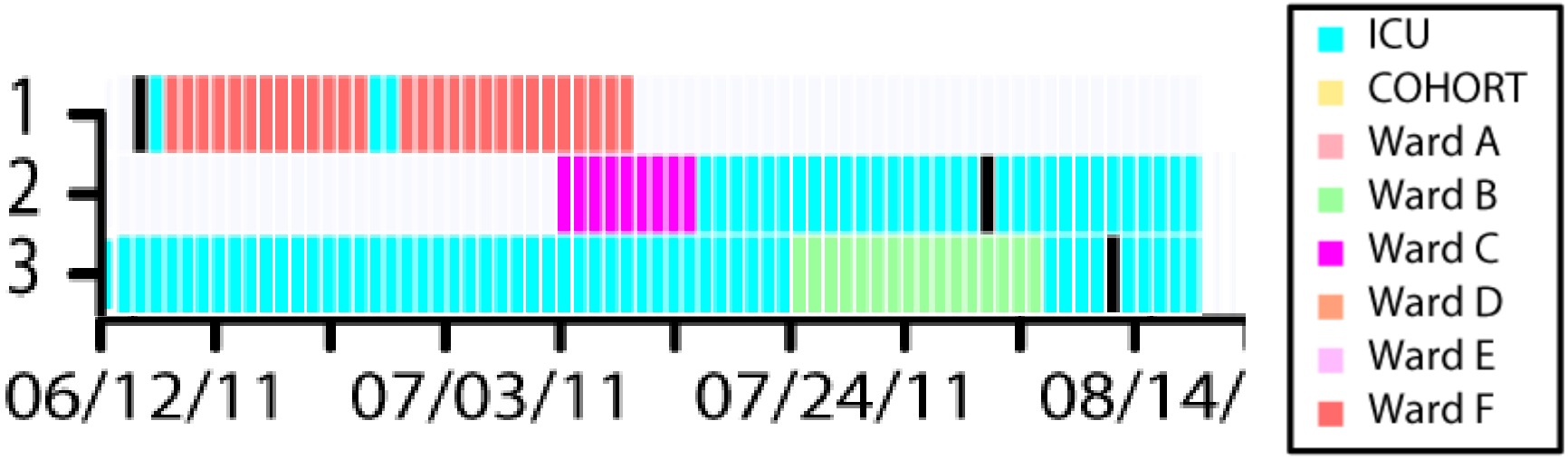
Evan Snitkin, Ph.D.

Transmission map based on basic epidemiology plus sequence variation



Chain of Transmission: Patient 1➔3➔2
Genetic and epidemiology data agree

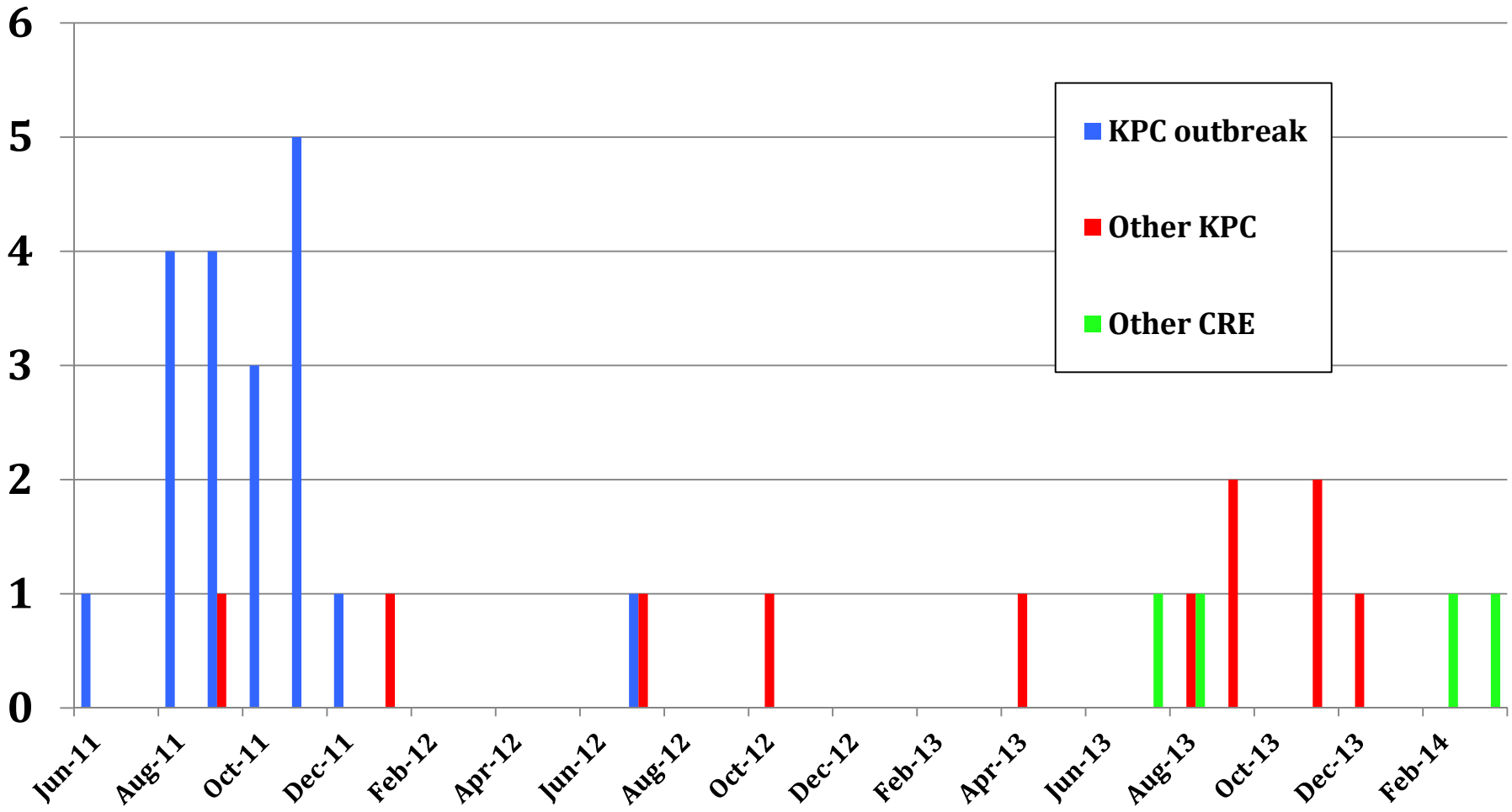




What did we learn from our outbreak?

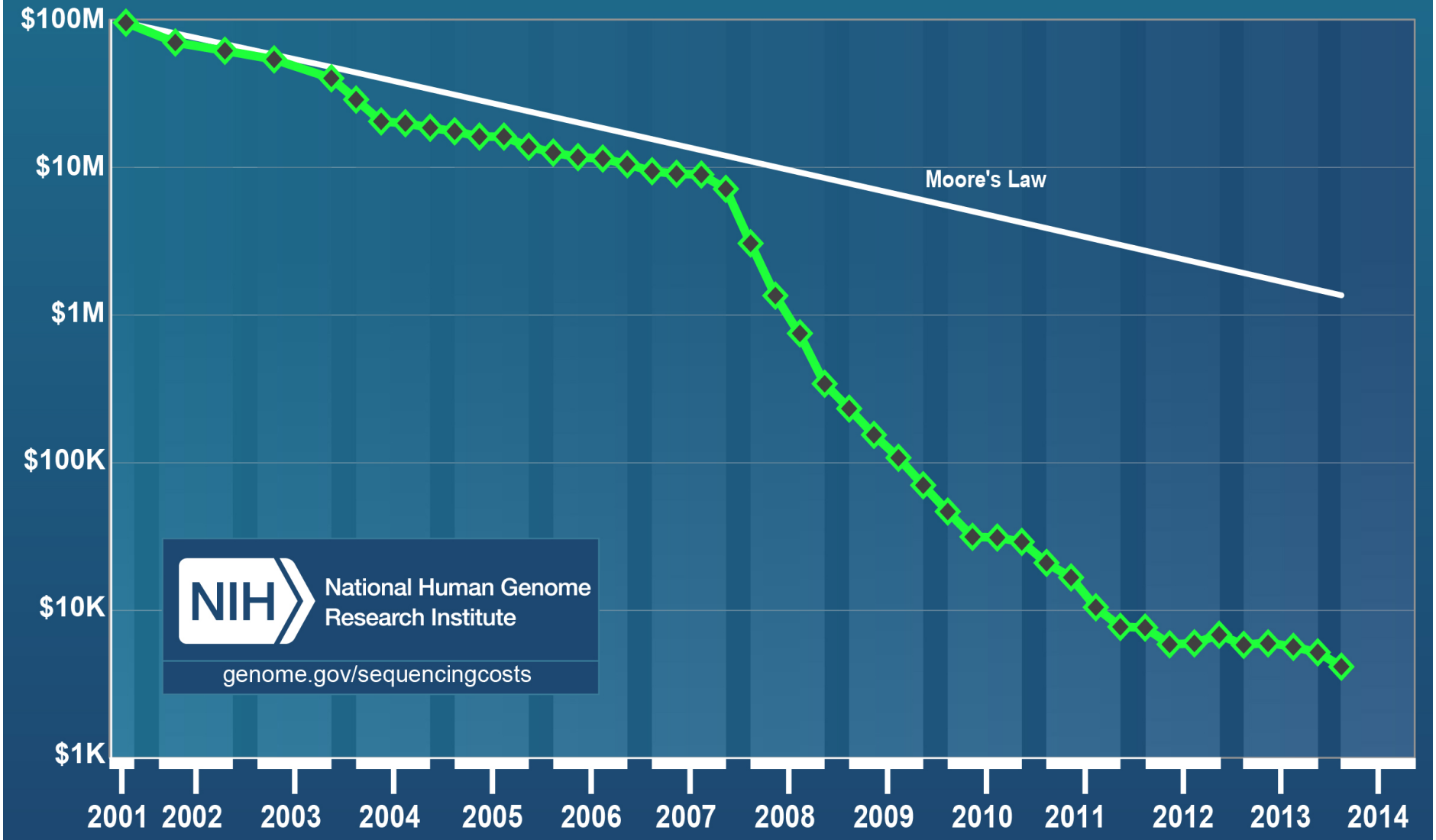
- The outbreak was clearly clonal, originating from patient 1;
- Klebsiella outbreaks can spread undetected from individuals who are silently colonized
- Rectal surveillance is critical for detection of silently colonized patients and stemming transmissions, though not sensitive enough;
- Genetic sequencing offers promise as a more sensitive fingerprinting technique and may provide a mechanism to investigate specific instances of transmission.

Results of CRE surveillance since 2011-12 KPC-*Klebsiella* outbreak



Barriers and Other Issues…

Cost of Whole Genome Sequencing for Human Specimens



What are the remaining issues?

- Cost
  - Decreasing rapidly as technology advances
  - Now between $50 and $100 per bacterial genome
- Within-patient genetic diversity
- Rate at which genomic evolution occurs
  - May vary by organism
  - May be influenced by other 'environmental factors'.
- Access
- Turnaround time

Next Steps?

- Employ WGS to evaluate plasmids carrying KPC (biology, ecology, and epidemiology).
- Use WGS to evaluate the nosocomial epidemiology of VRE.
- Use WGS in 'real-time' (especially in clusters), first to establish or disprove clonality; second to assess individual transmission events to try to ascertain definitively routes of transmission in order to tailor prevention efforts.

Infection Control/Healthcare Epidemiology in the Hospital is a Team Sport…

Acknowledgements

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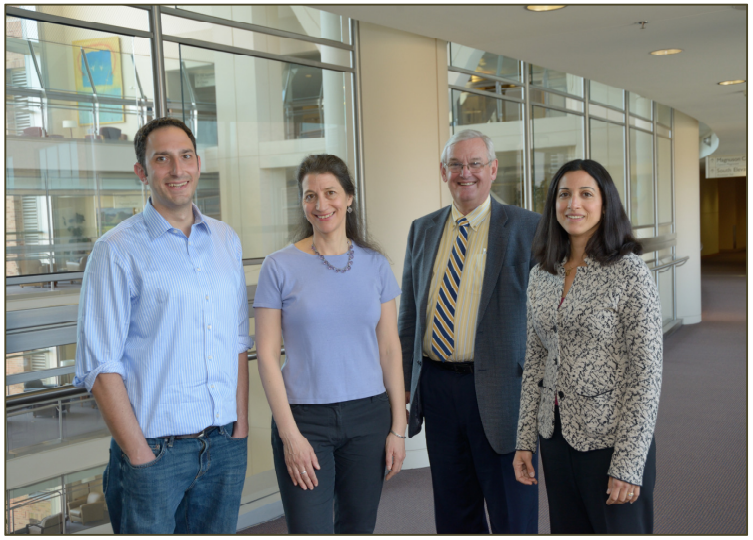
Julie Segre



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CDC Vitalsigns™

March 2014

Making Health Care Safer

Antibiotic Rx in Hospitals: Proceed with Caution

1 in 2

More than half of all hospital patients receive an antibiotic.

3x

Doctors in some hospitals prescribed 3 times as many antibiotics as doctors in other hospitals.

30%

Reducing the use of high-risk antibiotics by 30% can lower deadly diarrhea infections by 26%.

Antibiotics save lives, but poor prescribing practices are putting patients at unnecessary risk for preventable allergic reactions, super-resistant infections, and deadly diarrhea. Errors in prescribing decisions also contribute to antibiotic resistance, making these drugs less likely to work in the future.

To protect patients and preserve the power of antibiotics, hospital CEOs/medical officers can:

- Adopt an antibiotic stewardship program that includes, at a minimum, this checklist:
  1. Leadership commitment: Dedicate necessary human, financial, and IT resources.
  2. Accountability: Appoint a single leader responsible for program outcomes. Physicians have proven successful in this role.
  3. Drug expertise: Appoint a single pharmacist leader to support improved prescribing.
  4. Act: Take at least one prescribing improvement action, such as requiring reassessment within 48 hours, to check drug choice, dose, and duration.
  5. Track: Monitor prescribing and antibiotic resistance patterns.
  6. Report: Regularly report to staff prescribing and resistance patterns, and steps to improve.
  7. Educate: Offer education about antibiotic resistance and improving prescribing practices.
- Work with other health care facilities to prevent infections, transmission, and resistance.

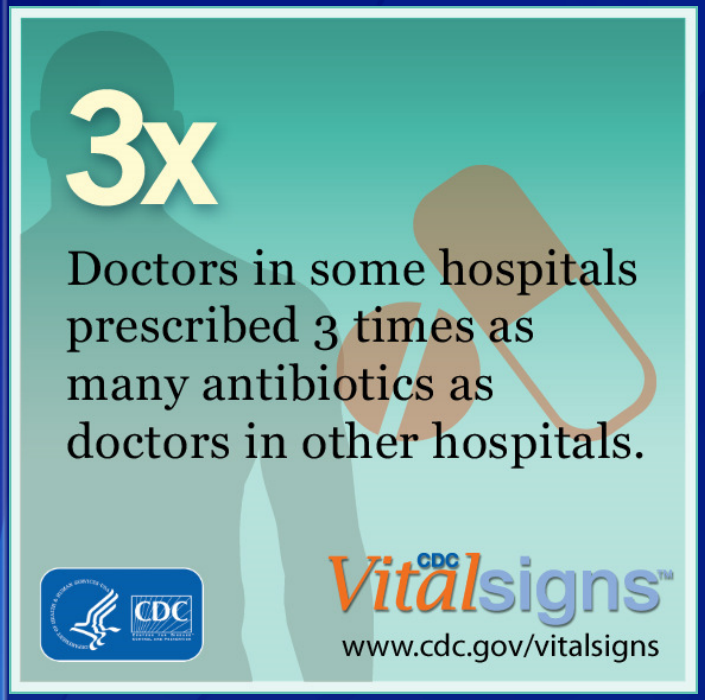
→ See page 4

Want to learn more? Visit www.cdc.gov/vitalsigns

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

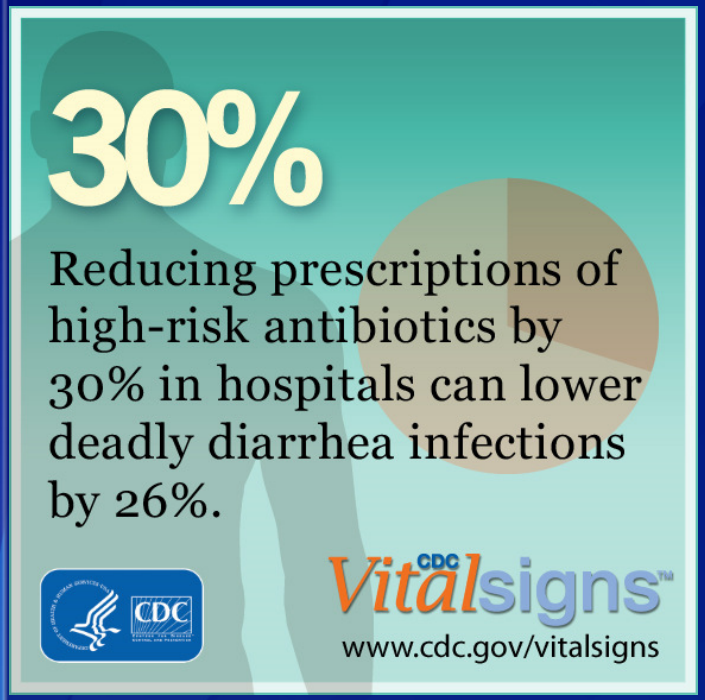
CDC

Prescribing Practices Vary, Errors Common



- More than half of all hospital patients receive an antibiotic
- Doctors in some hospitals prescribed 3 times as many antibiotics as doctors in other hospitals

Poor Prescribing Harms Patients



- Decreasing the use of antibiotics that most often lead to *C.difficile* infection by 30% could lead to 26% fewer of these infections
- Patients getting broad-spectrum antibiotics are up to 3x more likely to get another infection from an even more resistant germ

Assessment of Treatment of UTI in 36 Hospitals

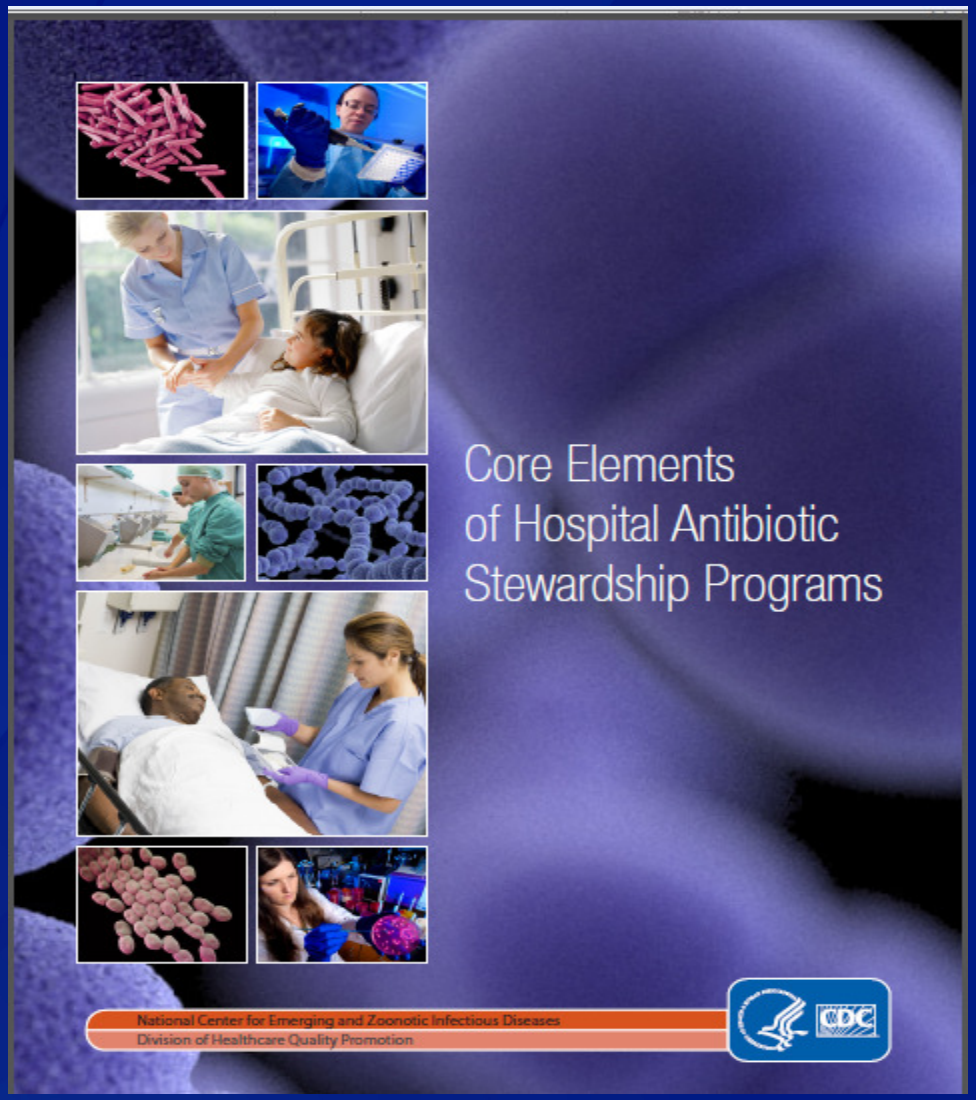
Treatment	No.	(%)
Patients treated for UTI present on admission, without indwelling catheter	**111**	**—**
Urine culture was not ordered, although standard practice before treatment	18	(16.2)
Urine culture was positive, but no documented symptoms were present	23	(20.7)
Urine culture was negative, and no documented symptoms were present	3	(2.7)
No. of patients with potential for improvement in prescribing	**44**	**(39.6)**

MMWR March 7, 2014 / 63(09);194-200

Assessment of Vancomycin Use in 36 Hospitals

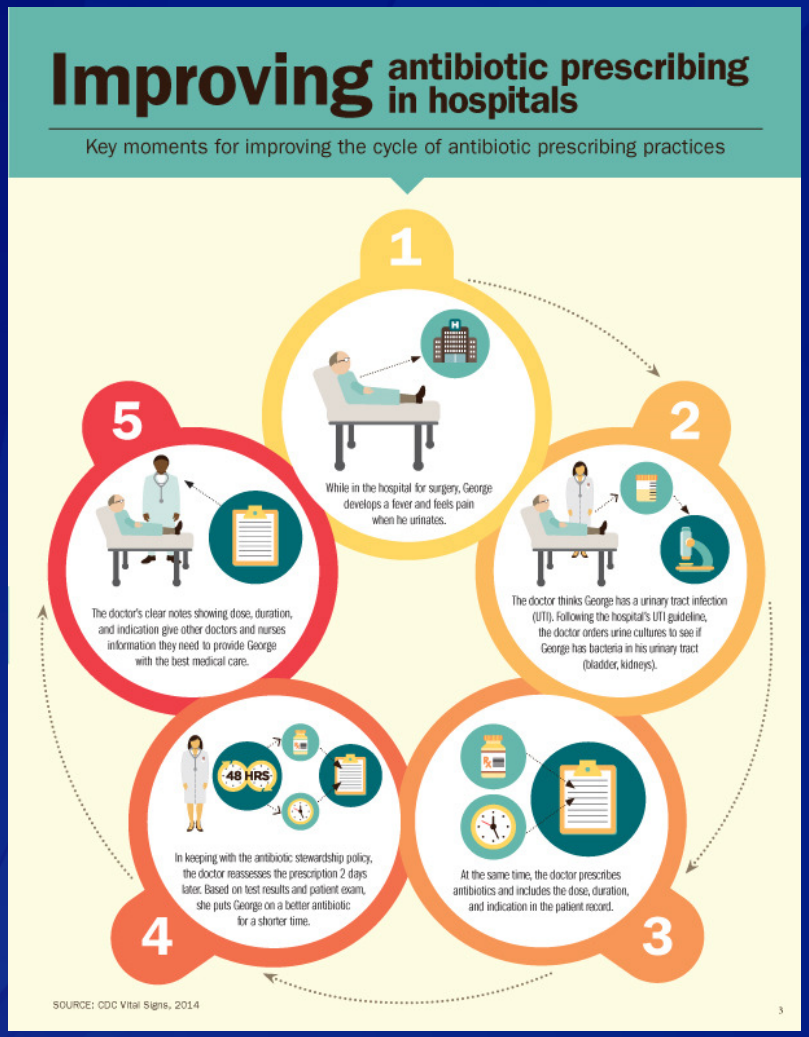
Patients treated with intravenous vancomycin	**185**	—
No diagnostic culture obtained around antibiotic initiation, although standard practice with most infections	17	(9.2)
Diagnostic culture showed no Gram-positive bacterial growth, but patient still treated for long duration (>3 days) (excludes presumed SSTI, which often can be culture negative)	40	(21.6)
Diagnostic culture grew only oxacillin-susceptible *Staphylococcus aureus*, but patient still treated for long duration (>3 days) (likely missed opportunity to switch antibiotic based on culture result)	9	(4.9)
No. of patients with potential for improvement in prescribing	66	(35.7)

MMWR March 7, 2014 / 63(09);194-200



http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.html

CDC Recommends All Hospitals Implement Antibiotic Stewardship Programs



- Leadership commitment
- Accountability
- Drug expertise
- Action
- Tracking
- Reporting
- Education

CDC Strategies to Measure and Improve Antibiotic Use in Hospitals

- Measure use and stewardship programs
  - Overall antibiotic use
  - Appropriate antibiotic use
  - Stewardship programs in US hospitals
- Improve Use
  - Education and promotion
  - Policies
- Innovate

CDC Approach to Measuring Antibiotic Use

- Broad (ideally national) assessments of aggregate use.
  - Proprietary data from drug distributors.
- Facility specific assessments of antibiotic administration data
  - NHSN AU option
- Detailed assessments of appropriate antibiotic use.
  - EIP antibiotic use assessment

National Measures of Use

- Continuing to analyze MarketScan data from ~300 hospitals.
  - Detailed information on antibiotic use that can be linked to patient specific data.
  - Plans to begin going beyond descriptions of frequencies of use to look at use in the context of patient level claims data.
- Discussing options to get data from drug distributors.

Facility Specific Use Measurement

- Antibiotic Use Option of NHSN
- Now more than 60 facilities enrolled.
- Starting to look at and think about types of summary reports that would be most useful at both the facility and national levels.
- Collaboration with a group of hospitals in IL through the iCHASE project.
  - Looking and AU data to both inform and assess interventions.

AU Option- Next Steps

- Beginning work on antibiotic use benchmarking.
- What's the most useful way to summarize data for benchmarking?
- How should we stratify and risk adjust data for benchmarking?
- Collaboration with Kaiser Permanente of Southern California.

Measure Appropriate Antibiotic Use in US Hospitals

- Emerging Infections Program pilot evaluation of appropriate antibiotic use was helpful in showing that appropriate use could be assessed in a standardized way across a large number of facilities.
- Working on an expanded version of this assessment in 2014-15:
  - More cases
  - More hospitals

Measure Appropriate Antibiotic Use in US Hospitals

- We also need to examine how appropriate use helps (or does not help) explain variations in overall use.
- We see big variations in use in facilities reporting into AU.
- We now need to start exploring what accounts for that variation.

Assessing Variations in Antibiotic Use

- Plans to partner with:
  - IL iCHASE collaborative (IL Health Dept)
  - Intermountain Healthcare
  - VA
- Working on exploring underlying factors associated with variations in antibiotic use and assessing relationship of appropriate therapy to overall use (do high users have more inappropriate use?)

Measure Antibiotic Use in US Hospitals

- Current efforts to measure overall and appropriate antibiotic use will inform our development a metric to submit to the National Quality Forum.
  - Seeking a metric based on the measure in the AU option- antibiotic days per 1000 patient days present.

Challenges With A Quality Measure on Antibiotic Use

- Will require good benchmarking to help facilities know if they are outliers.
- Being an "outlier" does not necessarily mean there is a problem.
- The measure would allow facilities to compare and might suggest areas where further review is warranted.

Measure Antibiotic Stewardship Programs in US Hospitals

- CDC seeking to add questions on Antibiotic Stewardship Programs to the annual facility survey of NHSN.
  - Would provide information from ~4000 hospitals reporting data to NHSN.
- Questions will be based on the items in the "Core Elements" documents.
  - Will provide some details on how the programs are being implemented, rather than mere presence of a program.

Improve Use- Education and Promotion

- CDC has defined core elements for stewardship programs in the US.
  - CDC working with ECDC (TATFAR collaboration) to help develop a US-EU document on core indicators for stewardship programs.
- Now working with partners to promote broad implementation of stewardship efforts in keeping with the core elements.

Improve Use- Partnership Examples

- American Hospital Association-
  - Joined CDC on the Vital Signs press conference to underscore their support for stewardship programs as a "Top 5" way to improve the appropriate utilization of medical resources.
  - Partnered with CDC, and several other groups, on a stewardship toolkit.
  - Partnering with CDC on a stewardship discussion with healthcare leaders.

Improve Use- Partnership Examples

- The Joint Commission
  - CDC co- leading the development of a "Targeted Solutions Tool" for *Clostridium difficile* that will feature stewardship as a key intervention.
- Partnership for Patients
  - CDC working to support activities of several hospital engagement networks that are working on *C. difficile* and stewardship.

Improve Use- Policies

- CDC continues to work with CMS to support and inform discussions on policy options to improve antibiotic use.

Improve Use- Policies

- Council of State and Territorial Epidemiologists recently passed a position statement that encourages state health departments to play an active role in antibiotic stewardship.
- ASTHO also working on a statement.
- CDC working to partner with them to help state and local health departments support and expand stewardship efforts.

Innovate

- CDC funding a multi-year project to do a multi-center assessment of post-prescription antibiotic reviews on a variety of outcomes.
- CDC partnered with Prevention Epicenters and Emerging Infections Program investigators to submit a letter of intent to PCORI on a large-scale stewardship intervention to reduce *C. difficile*.

Measure Overall Antibiotic Use in US Hospitals

- Collaboration with Kaiser Permanente of Southern California.
- They are starting a project to benchmark use in their facilities.
- They also are submitting data to AU.
- CDC partnering with them to look at various approaches to displaying and risk-adjusting their use data.

Measure Appropriate Antibiotic Use in US Hospitals

- Intermountain Healthcare is also exploring different ways of displaying and reporting antibiotic use data.
- For example, development of a "spectrum score" to give facilities a sense of how much of their antibiotic use is broad v. narrow.
- CDC interested in learning more about with them as well.

Measure Appropriate Antibiotic Use in US Hospitals

- The IL iCHASE collaborative has found substantial variation in antibiotic use among "similar" types of units in different hospitals.
- We now want to work with them to see if we can figure out at some of what explains that variation.
  - Better prescribing at lower use facilities?
  - Differences in patient mix?

Measure Appropriate Antibiotic Use in US Hospitals

- Intermountain Healthcare has also recently enrolled in the AU option and is noting similar variations in use among their facilities, many of which are small, community hospitals.
- CDC partnering with Intermountain on an effort to try and better understand what might explain the variations in use.

Measure Appropriate Antibiotic Use in US Hospitals

- Veterans Affairs (VA) Hospitals are currently enrolling in NHSN AU option.
- VA already has access to detailed use data from their hospitals (and detailed, patient level data).
- CDC and VA are partnering to assess how overall antibiotic use might reflect appropriate use.

Measure Appropriate Antibiotic Use in US Hospitals

- VA has manually collected data on appropriate antibiotic use from annual medication use evaluations.
- They plan to use that information to develop electronic measures of appropriate antibiotic use.
- Goal will be to apply the measures to AU data to see if there are correlations.
  - Is use more appropriate at facilities with lower use rates?

Infection Control Recommendations for Measles

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HICPAC Meeting
July 18, 2014

National Center for Immunization and Respiratory Diseases
National Center for Emerging and Zoonotic Infectious Diseases

Outline

- Background
- Vaccine
  - Recommendations for Healthcare Personnel (HCP)
  - Effectiveness
- Measles in healthcare settings
  - Transmission
  - Economic burden
- Vaccine failures
- Current recommendations
  - Unresolved issues regarding personal protective equipment (PPE)
- Proposed interim guidance

Measles Complications & Deaths

Diarrhea	8%
Otitis media	7- 9%
Pneumonia	1- 6%
Encephalitis	1-2 per 1,000 cases
Death	1-3 per 1,000 cases (2-15% in developing countries)
Subacute Sclerosing Panencephalitis (SSPE)	1 per 100,000 cases 7-10 years after measles

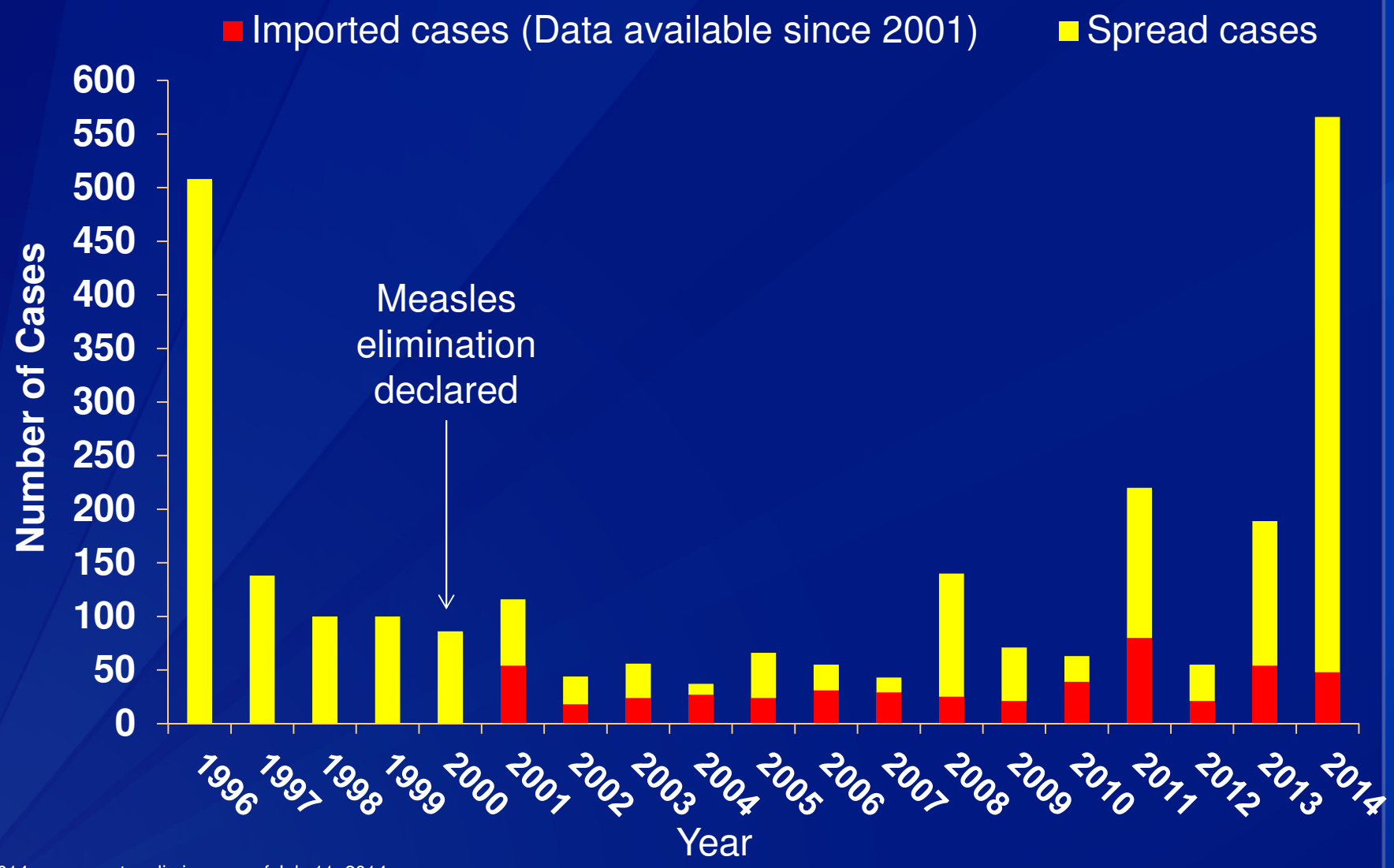
Measles Elimination in the U.S.

- Measles was declared eliminated* from the U.S in 2000 due to:
  - high two-dose vaccination coverage
  - improved measles control in the World Health Organization Region of the Americas
  - intensive and rapid public health responses to imported measles cases

- Even in an elimination era, imported cases and limited spread still occur

*Defined as interruption of continuous transmission lasting ≥12 months

Measles, United States, 1996-Present*



*2014 case count preliminary as of July 11, 2014

Immunization of Healthcare Personnel 2011: Recommendations of ACIP

- All healthcare personnel should have presumptive evidence of immunity to measles, which includes any of the following:
  - Written documentation of vaccination with 2 doses of live measles or MMR vaccine administered at least 28 days apart
  - Laboratory evidence of immunity
  - Laboratory confirmation of disease, or
  - Birth before 1957

Shefer A., et.al. 2011. Immunization of health-care personnel. *MMWR*. 60(7): 1-45.

Measles Vaccine Recommendations for Healthcare Personnel

Routine

- 2 doses (unless HCP have laboratory evidence of immunity, laboratory confirmation of disease, or birth before 1957)
- For unvaccinated personnel born before 1957 who lack laboratory evidence of measles immunity or laboratory confirmation of disease, healthcare facilities *should consider* vaccinating personnel with 2 doses of MMR vaccine at the appropriate interval.

Outbreaks

- 2 doses are recommended for all HCP who do not have other evidence of immunity (including those born before 1957)

2013 ACIP Recommendations at: http://www.cdc.gov/mmwr/pdf/rr/rr6204.pdf

Measles Vaccine Effectiveness

	Vaccine effectiveness
1 dose	~93%
2 doses	~97%

Factors Affecting Risk of Transmission

- Most contagious of the vaccine-preventable diseases
- Patients are infectious *4 days before* through 4 days after rash onset
- The virus can remain in the air for up to 2 hours after patient leaves area
- Intensity of exposure (i.e., dose of virus received) is an important risk factor for breakthrough infection
- Many U.S. healthcare providers have never seen measles
  - Often not considered in the differential diagnosis
  - Appropriate infection control measures are often not implemented (patients end up exposing others in the waiting room, the lab, etc.)

Measles in Healthcare Facilities

- Measles is a well-described nosocomial problem[1]
- Due to the severity of measles, infected persons are likely to seek medical care in primary health care, emergency departments, or hospital settings[1-4]
- The risk of acquiring measles is estimated to be 2 to 19 times higher for susceptible healthcare personnel than for the general population[5-7]

1. Fiebelkorn AP, Seward JF, Orenstein WA. A global perspective of vaccination of healthcare personnel against measles: systematic review. *Vaccine. 2013 (epub ahead of print).*
2. Atkinson WL, Markowitz LE, Adams NC, Seastrom GR. Transmission of measles in medical settings— United States, 1985–1989. *Am J Med.* 1991;91:320S–4S.
3. Davis R, Orenstein WA, Frank JA, et al. Transmission of measles in medical settings.*JAMA*1986;255:1295–8.
4. Sugerman DE, Barskey AE, Delea MG, et al. Measles outbreak in a highly vaccinated population, San Diego, 2008: role of the intentionally undervaccinated. *Pediatrics.* 2010; 125 (4):747-55.
5. Steingart KR, Tomas AR Dykewicz CA, Redd SC. Transmission of measles virus in healthcare settings during a communitywide outbreak. *Infect Control Hosp Epidemiol.* 1999; 20: 115-19.
6. Atkinson WL, Markowitz LE, Adams NC, Seastrom GR. Transmission of measles in medical settings–United States, 1985-1989. *Am J Med* 1991;91(3B):4S–320S.
7. Williams WW, Preblud SR, Reichelderfer PS, Hadler SC. Vaccines of impor-tance in the hospital setting. Problems and developments. *Infect Dis Clin North Am* 1989;3(4):701–22.

Measles Transmission in U.S. Healthcare Facilities, 2001- 2014*

Year	No. of measles cases transmitted in U.S. healthcare facilities	No. of healthcare provider(s) infected at work	Did healthcare provider(s) transmit measles to other patients or providers?	Vaccination status of infected healthcare provider(s)
2014*	13	7	No	3 had 2 doses, 3 unknown, 1 born before 1957
2013	6	3	No	1 vaccinated (2 doses), 1 had titers, 1unknown
2012	3	1	No	2-dose vaccinated
2011	15	4	No	All unvaccinated/ unknown
2010	1	1	No	2-dose vaccinated
2009	8	1	No	2-dose vaccinated
2008	14	1	Yes- infected 1 patient	Unknown
2001-2007	10	4	No	1 had 1 dose, 2 unvaccinated, 1 born before 1957
TOTAL	**70**	**22**	**Yes (2008)**	**Varied**

*2014 data through July 11, 2014

Economic Burden of Measles Outbreak Responses in U.S. Healthcare Facilities

Year	State	Number of cases at facility	Estimated costs incurred by healthcare facility to control spread of measles
2008	Illinois[1]	1	$19,000
2011	New York[2]	2	$63,000
2005	Indiana[3]	3	$113,000
2008	Arizona[4]	7 (at 2 hospitals)	$800,000

1. O'Donnell A, Lavin M, Bardowski L, Silkaitis C, Bolon M, Zembower T. Impact of a measles exposure in an emergency department. *Am J Infect Control* 2010;38(5):E2–41.
2. Helmecke MR, Elmendorf SL, Kent DL, et al. Measles investigation: a moving target. *Am J Infect Control* 2014; epub ahead of print.
3. Parker AA, Staggs W, Dayan GH, et al. Implications of a 2005 measles outbreak in Indiana for sustained elimination of measles in the United States. *N Engl J Med.* 2006. 355(5):447-55.
4. Chen SY, Anderson S, Kutty PK, et al. Health care-associated measles outbreak in the United States after an importation: challenges and economic impact. *J Infect Dis.* 2011; 203(11):1517-25.

Measles in Persons with Two-Dose MMR Vaccine Failure

- Often results in modified/inapparent measles (e.g., 2 case studies of modified measles in vaccinated physicians exposed to primary measles cases in 2009)

- Transmit less/ less infectious
  - Absence or reduced severity of respiratory symptoms, particularly a cough, may result in lower infectivity
  - Some previous reports have found no evidence that persons with modified/inapparent measles virus infections shed measles virus

- Nonetheless, measles transmission has been documented among two-dose MMR vaccine failures

1. Rota JS, Hickman CJ, Sowers SB, et al. Two case studies of modified measles in vaccinated physicians exposed to primary measles cases: high risk of infection but low risk of transmission. *J Infect Dis.* 2011; Suppl 1: S559-63.
2. Leviano FA, Papania MJ, Helfand RF, et al. Lack of evidence of measles virus shedding in people with inapparent measles virus infections. *J Infect Dis*. 2004; Supple 1: 189: S165-70.

Two-Dose MMR Vaccine Failures Who Transmitted Measles

Year	Location	No. of 2-dose vaccine failures who transmitted measles	No. of people they infected
2011	NYC[1]	1	4 (all had prior evidence of immunity: 2 were two-dose vaccinated, 2 had positive measles IgG antibodies)
2003	Pennsylvania[2]	2	Index patient transmitted to 5 others (including to 2 two-dose vaccinated persons) and one of the two-dose failures transmitted to two unvaccinated persons
1989	Finland[3]	Not stated (but two-dose transmission occurred)	Two-dose vaccinated and unvaccinated primary patients were equally contagious within families: attack rates among family members were 47% (9/19) and 43% (6/14), respectively
1986	Wisconsin[4]	1 (likely others during this outbreak, but paper did not specify)	Index patient transmitted to 13 previously vaccinated classmates

1. Rosen J, Rota JS, Hickman CJ, et al. Outbreak of measles among persons with prior evidence of immunity, New York City, 2011. *Clin Infect Dis.* 2014; 58(9): 1205-1210.
2. Yeung LF, Lurie P, Dayan G. A limited measles outbreak in a highly vaccinated US boarding school. *Pediatrics.* 2005; 116(6):1287-91.
3. Paunio M, Peltola H, Valle M, et al. Explosive school-based measles outbreak: intense exposure may have resulted in high risk even among revaccinees. *Am J Epidemiol.* 1998; 148(11): 1103-10.
4. Edmonson M, Addiss D, McPherson J, Berg J, Circo S, David J. Mild measles and secondary vaccine failure during a sustained outbreak in a highly vaccinated population. *JAMA* 1990;263:2467-71.

Immunization of Healthcare Personnel 2011: Recommendations of ACIP

- **Measles**
  - Airborne Infection Control Precautions
    - If an airborne-infection isolation room is not available, the patient should be placed in a private room with the door closed and be asked to wear a mask.
    - If possible, only staff with presumptive evidence of immunity should enter the room
    - Regardless of presumptive immunity status, all staff entering the room should use respiratory protection…(i.e., use of an N95 respirator…)
      - Because of the possibility, albeit low (~1%), of measles vaccine failure in HCP exposed to infected patients, all HCP should observe airborne precautions in caring for patients with measles.

Shefer A., et.al. 2011. MMWR. 60(7): 1-45

2007 Guidelines for Isolation Precautions

- **Appendix A**
  - Measles
    - Airborne Infection Control Precautions
      - Susceptible HCWs should not enter room if immune care providers are available
      - No recommendation for face protection for immune HCW;
      - No recommendation for type of face protection for susceptible HCWs, i.e., mask or respirator

Siegel JD, et al. 2007. http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf

2007 Guidelines for Isolation Precautions

- **Measles**
  - Use of PPE
    - No recommendation is made regarding the use of PPE for HCP who are presumed to be immune to measles (rubeola) (Unresolved)
    - No recommendation is made regarding the type of PPE (surgical mask or respirator) for susceptible HCP (Unresolved issue)
  - Respiratory protection
    - Although airborne precautions are recommended, there are no data upon which to base a recommendation for respiratory protection for susceptible personnel
      - Since the majority of HCP have natural or acquired immunity, only immune personnel generally care for measles patients
      - Although there is no evidence to suggest facemasks are inadequate for protection, for purposes of consistency and simplicity, or difficulties in ascertaining immunity, some facilities may require the use of respirators for entry into all AIIRs

Siegel JD, et al. 2007. http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf

Infection Control Practices for Measles May be Diverse and Potentially Inadequate

- **Anecdotes**
  - Some facilities indicate that neither susceptible HCP nor those with evidence of immunity to measles are wearing a facemask or respirator when entering the room of patients with known or suspected measles infections being managed in airborne isolation
- **2007 Isolation Precautions Guidelines**
  - "No recommendation…" for face protection for HCP or type of face protection for susceptible HCP may be interpreted as indicating a facemask or respirator isn't recommended

Rationale for Clarifying Recommended Personal Protective Equipment

- **Increased domestic measles activity**
  - Patients with measles often seek healthcare services
- **Highly contagious disease**
  - Infectious 4 days prior to onset of rash
- **Vaccine failures**
  - Rare transmissions are described despite presumptive evidence of immunity
- **Studies to determine the differential efficacy of PPE for measles are unlikely to be conducted**

Proposed Interim Guidance

- **Measles**
  - When entering the room of a patient with suspected or confirmed measles, healthcare personnel should wear respiratory protection at least as protective as a NIOSH-certified N-95 respirator, regardless of presumptive evidence of immunity to measles

Thank you!

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone: 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: http://www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.