Objectives of the Session

1. Identify how to apply a systems engineering approach to *C. difficile* prevention

2. Describe the complementary data collection approaches useful in characterizing *C. difficile* prevention efforts.

3. Examine the interprofessional aspects of *C. difficile* prevention
Complexity of *C. difficile* infection

Challenges to containment

- Uncertain incubation period
- Multiple reservoirs
- Environmental persistence
- High rates of recurrence
- Need for soap and water for hand hygiene
- Multidisciplinary approach to containment
- Need for both infection prevention protocols and antibiotic stewardship interventions

Fishbone diagram showing the complexity of CDI
Systems Perspective

An individual perspective may be narrow, underestimate the scope of the problem, may not be sufficient to recognize root causes and may make implementation of infection prevention for CDI challenging.

A systems perspective takes the whole picture into consideration from all relevant perspectives and stakeholders.

Breaks the problem down into its component parts.

Human Factors

- Misperceptions:
  - Fact #1: *Human factors is about designing systems that are resilient to unanticipated events.*
  - Fiction: *Human factors is about eliminating human error.*
  - Fact #2: *Human factors addresses problems by modifying the design of the system to better aid people.*
  - Fiction: *Human factors addresses problems by teaching people to modify their behaviour.*

The science of human factors: separating fact from fiction Alissa L Russ et al
https://qualitysafety.bmj.com/content/22/10/802
– Fact #3: Human factors work ranges from the individual to the organisational level.
– Fiction: Human factors is focused only on individuals.

– Fact #4: Human factors is a scientific discipline that requires years of training; most human factors professionals hold relevant graduate degrees.
– Fiction: Human factors consists of a limited set of principles that can be learnt during brief training.

– Fact #5: Human factors professionals are bound together by the common goal of improving design for human use, but represent different specialty areas and methodological skills sets.
– Fiction: Human factors scientists and engineers all have the same expertise.
Human Factors/Ergonomics

<table>
<thead>
<tr>
<th>HFE mechanisms</th>
<th>Objectives of system design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A work system that is not designed according to HFE design principles can create opportunities for errors and hazards (see table 2 for examples of design principles)</td>
<td>The objective of HFE-informed system design is to identify and remove system hazards from the design through maintenance phases.</td>
</tr>
<tr>
<td>2. Performance obstacles that exist in the work system can hinder clinicians’ ability to perform their work and deliver safe care</td>
<td>If some obstacles cannot be removed, for instance, because they are intrinsic to the job, then strategies should be designed to mitigate the impact of performance obstacles by enhancing other system elements (ie, balance theory of job design)</td>
</tr>
<tr>
<td>3. A work system that does not support resilience can produce circumstances where system operators may not be able to detect, adapt to, and/or recover from errors, hazards, disruptions and disturbances</td>
<td>Work systems should be designed to enhance resilience and support adaptability and flexibility in human work such as allowing problem or variance control at the source</td>
</tr>
<tr>
<td>4. Because system components interact to influence care processes and patient safety, HFE system design cannot focus on one element of work in isolation.</td>
<td>Whenever there is a change in the work system, one needs to consider how the change will affect the entire work system, and the entire system needs to be optimised or balanced</td>
</tr>
</tbody>
</table>

HFE mechanisms between system design and patient safety
HFE, human factors and ergonomics.

<table>
<thead>
<tr>
<th>Focus of HFE</th>
<th>Examples of HFE design principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical HFE</td>
<td>To minimise perception time, decision time, and manipulation time</td>
</tr>
<tr>
<td></td>
<td>To reduce or mitigate need for excessive physical exertion</td>
</tr>
<tr>
<td></td>
<td>To optimise opportunities for physical movement</td>
</tr>
<tr>
<td>Cognitive HFE</td>
<td>To ensure consistency of interface design</td>
</tr>
<tr>
<td></td>
<td>To match between technology and the user’s mental model</td>
</tr>
<tr>
<td></td>
<td>To minimise cognitive load</td>
</tr>
<tr>
<td></td>
<td>To allow for error detection and recovery</td>
</tr>
<tr>
<td></td>
<td>To provide feedback to users</td>
</tr>
<tr>
<td>Organisational HFE</td>
<td>To provide opportunities to workers to learn and develop new skills</td>
</tr>
<tr>
<td></td>
<td>To allow worker control over work system</td>
</tr>
<tr>
<td></td>
<td>To support worker access to social support</td>
</tr>
<tr>
<td></td>
<td>To involve users in system design</td>
</tr>
</tbody>
</table>

Examples of HFE design principles
HFE, human factors and ergonomics.

<table>
<thead>
<tr>
<th>Examples of HFE design principles</th>
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</table>

HFE mechanisms between system design and patient safety
HFE, human factors and ergonomics.

Human Factors and Ergonomics as a patient safety practice Pascale Carayon, Anping Xie, Sarah Kianfar
https://qualitysafety.bmj.com/content/23/3/196#block-system-main

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Clostridium difficile Prevention Using a Human Factors and Systems Engineering Approach
Prof. Nasia Safdar, University of Wisconsin-Madison
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![Diagram of work system, process, and outcomes with external environment, processes, and patient outcomes]

Table 2
Value of SEIPS model to healthcare.

<table>
<thead>
<tr>
<th>Characteristics of SEIPS model</th>
<th>Value to healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration of SPO model in SEIPS model</td>
<td>Healthcare professionals' familiarity with SPO model translating to adopting SEIPS model</td>
</tr>
<tr>
<td>Work system model</td>
<td>Broad focus, not just individual focus; support to develop wide set of solutions for redesigning system</td>
</tr>
<tr>
<td>Patient outcomes and employee/organizational outcomes</td>
<td>Benefits for both patients and healthcare workers</td>
</tr>
<tr>
<td><strong>Generic model</strong></td>
<td>Applicability to any healthcare domain and healthcare quality or patient safety problem</td>
</tr>
<tr>
<td>Person at the center of work system can be healthcare professional, patient, or team</td>
<td>Flexibility in applying model to various work systems and various people</td>
</tr>
<tr>
<td>Feedback loops from processes and outcomes, to work system</td>
<td>Emphasis on the need for healthcare organizations to monitor, consider, and take advantage of ongoing feedback</td>
</tr>
<tr>
<td>Process influenced by work system</td>
<td>Expanded view of process that integrates all work system elements</td>
</tr>
<tr>
<td>System interactions</td>
<td>Emphasis on systemic impact of organizational and sociotechnical changes</td>
</tr>
</tbody>
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Key interventions for CDI prevention - a CDI bundle

1) rapid, appropriate diagnostic testing for *C. difficile*

2) empiric isolation for patients with diarrhea and suspected CDI

3) contact isolation for patients with confirmed CDI

4) environmental decontamination of CDI patient rooms

5) full compliance with hand hygiene by all entering and leaving CDI patient rooms.

SEIPS model for CDI

Five Components

- Tools
- Technologies
- Environment
- People
- Organization
- Tasks
SEIPS for evaluation of *C difficile* bundle

- Tools and Technologies: Increased awareness of *C difficile* bundle
- Tasks: Empiric isolation, Contact isolation, Room cleaning, Hand hygiene
- People: Increased awareness and acceptance of bundle
- Organization: Increased participation of EVS
- Environment: Med-surg floors
- Adherence to bundle components: Assessment of barriers and facilitators

**SEIPS work system model**

**Process measures**

---

**SEIPS application to CDI**

- Create a process map to understand current practice and procedures
- Review of policies and procedures, signage, diagnostic testing procedure
- Supplement this data with focus groups/interviews of relevant groups
- Supplement with direct observations of PPE donning and doffing, room layout, PPE supplies.
Data collection

- Three homogenous focus groups convened – one each comprised of physicians, nurses and environmental services workers (EVS) – over a 4-week period.
- The physician focus group included 7 medicine residents and one attending physician
- The nursing focus group included 10 nurses from medical units with varying experience
- The EVS group included six participants with 2-30 years of experience from varying types of units (ICU, medical, surgical).

- Facilitated by a human factors engineer with significant experience in healthcare group facilitation.
- Participants received no financial remuneration for attending.
- Discussion was audio recorded for transcription by a professional service and subsequently coded by two researchers
Transcripts of the three focus groups were uploaded to Dedoose® web-based qualitative data analysis software.

Each excerpt was coded to three dimensions –
1) which of the five CDI bundle interventions the excerpt corresponded to
2) which of the five elements of the work system it related to
3) and 3) whether it was a work system barrier or facilitator.

An excerpt could be coded to multiple bundle interventions, multiple work system elements and be both a barrier and facilitator.

Person.

Nurses presented an issue associated with relying on others to inform them that a patient they care for has CDI. This becomes a problem when the expectation is not met. For example, CDI patient rooms must have a sign on the door informing the person entering the room to take additional precautions.

If the person responsible for posting the sign forgets or does not post the notice, hand hygiene and other CDI interventions may not appropriately occur.

[Nurse focus group: “Or if somebody forgets to put the sign up and it’s your patient ... you have no idea they were in isolation. That’s (not) always great.”]
Tools/technology.

All three groups noted sink interference posed by the excessive amount of equipment (and also people) in the patient room.

Pose sink access issues. [EVS focus group: “(There are) huge chairs and the patient sits in front of the sink. And then we can’t get to the sink to wash our hands. … Supplies in front of the sink … (cause) interference.”]

EVS staff commented on their positive and consistent use of pagers as a means of informing them that they will be cleaning a CDI patient room.

Organization.

The challenge of educating patients’ families regarding their need to comply with the CDI interventions was solely discussed by nurses who noted that changes in hand hygiene practice varied based on family member perceptions.

Physicians admitted the lack of clarity of the hand hygiene policy related to when, where, and how long hand washing should occur.

Other organization issues that were identified frequently related to role-specific policies solely relevant to a particular group. For example, EVS workers discussed significant issues related to training and staff turnover that had an impact on compliance with and understanding of the importance of hand hygiene. Institutional pressure to turnover room fast
Environment

Eight of the 52 total comments were related to sinks and were made by all three groups.

Consistent issues related to the number and location of the sinks.

[Nurse focus group: “We have to use the sinks in the hallway to wash our hands because you can’t get out of a C. diff room without recontaminating your hands after you’ve washed.”]

Tasks

Wet hands make gloving difficult

PPE when not anticipating touching patient or environment

Inconsistency in where used gowns are disposed

Inconsistency in where clean gowns are stored

Supply
### SEIPS Application to PPE

#### Person
- Type of healthcare worker
- Patient/visitor
- Knowledge/awareness
- Perception of risk given anticipated activity

#### Tools/technology
- PPE cumbersome
- Use of phone/iPAD in isolation rooms difficult

#### Tasks
- Bundling of cares
- Increases time
- Cleaning issues

### SEIPS Application to PPE

#### Environment
- Disposal
- Supplies
- Signage on door
- Stethoscope issues

#### Organization
- Policies
- Practice variation
- Leadership involvement

#### Facilitators
- Leadership engagement
- Consistency of messages
- Ease of availability and disposal

---

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SEIPS and interventions

• Create a list of barriers and select ones that are modifiable and have high impact
• Examples
  – Creation of new sinks
  – Consistency of messaging- pros and cons
  – Leadership support for EVS

Acknowledgments

Funding:
AHRQ
VA
PCORI
NIH
CDC
UW-Madison

References:
Barriers and facilitators to Clostridium difficile infection prevention: A nursing perspective.
What do visitors know and how do they feel about contact precautions?
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Prof. Nasia Safdar, University of Wisconsin-Madison  
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<th>Date</th>
<th>Event</th>
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<th>Location</th>
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<tbody>
<tr>
<td>February 5, 2019</td>
<td>ISSUES IN ANTIFUNGAL STEWARDSHIP: AN OPPORTUNITY THAT SHOULD NOT BE LOST</td>
<td>Dr. Ramasubramanian, The Capstone Clinic, Tamil Nadu, India</td>
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<tr>
<td>February 7, 2019</td>
<td>THE EFFECTIVENESS OF TUBERCULOSIS INFECTION CONTROL STRATEGY IN HIGH HIV/ TB-BURDEN SETTINGS</td>
<td>Dr. Eltony Mugomeri, Africa University in Zimbabwe</td>
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<td>February 13, 2019</td>
<td>THE INTRODUCTION OF RISK-BASED ASSESSMENT FOR THE MANAGEMENT OF ESBL-E PATIENTS IN ACUTE CARE</td>
<td>Julianne Munro, Clinical Nurse Specialist, Infection Prevention &amp; Control, Canterbury District Health Board, New Zealand</td>
<td></td>
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<td>February 14, 2019</td>
<td>THE FALLOUT OF FAKE NEWS IN INFECTION PREVENTION, AND WHY CONTEXT MATTERS</td>
<td>Prof. Didier Pittet, University of Geneva Hospitals, and Dr. Pierre Parneix, Hôpital Pellegrin, CHU de Bordeaux, France</td>
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