Hand Hygiene and Human Factors/Systems Engineering

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Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters

D.G. Maki MD, C.J. Alvarado MS, M. Ringer MS
Disclosures
2013

• Speaker – APIC National Meeting


• Retired – Living in Kona HI half of the year, spending way to much time with a 7 iron…FYI there are a lot of your fellow Canadians out there with me!
Real Disclose 2013:
What will not happen in our 45 minutes?

- You will not become a human factors engineering expert
- You will not get all of the answers today
Objectives

• Understand the Human Factors/Systems (HF/S) work model
• Evaluate the health care hand hygiene physical and organizational environment using HF/S principles
My goals

• Change the way you think about decisions regarding the design of, or changes to, anything at your facility

• My hope is that you will never be able to approach hand hygiene the same way again

• My hope is that you will never undertake an organizational, personnel, workflow, technology, or environmental change the same way again
Objectives of this talk

1. To identify new strategies in human factors engineering as it relates to hand hygiene, both physical environment and workflow issues.

2. To discuss considerations to improve sustainability, adapt to change in hand cleaning delivery methods and improve programs.
   - Participatory Ergonomics (Positive deviance)
   - Joint optimization

3. To discuss considerations and changes in human factors as care environments continue to evolve.
   - *SEIPS Model*
What is Human Factors/Systems Engineering?

- The study of how people interact physically and cognitively with the world around them, including environments, tools, processes, and procedures. It is “matching” the work system to the “person”.

- Should be simple right? Everyone is interested in preventing infections…to this end, our colleagues comply and do everything we suggest for hand hygiene!
How Our Colleagues Interpret Infection Prevention Policies and Procedures

“First, your return to shore was not part of our negotiations nor our agreement so I must do nothing. And secondly, you must be a pirate for the pirate's code to apply and you're not. And thirdly, the code is more what you'd call "guidelines" than actual rules. Welcome aboard the Black Pearl, Miss Turner.”

Captain Hector Barbossa
Pirates of the Caribbean - Curse of the Black Pearl
Current Reality of Average Infection Prevention Program

More isolation than integration and innovation

No learning systems dedicated to IP implementation science

Lack of authority to implement change
  - Irony: others are taking ownership of IP processes and we have no authority…who would have predicted that?

Poor understanding of economics of HAI

Disbelief that zero can be achieved

ICP is more “cop” than “coach”

Staff see IP measures such as hand hygiene as a distraction or interruption to what they perceive as their actual task
Understand the “System”

Large scale issues in sociotechnical systems

In IP we were trained to break down into parts…but in complex systems – like hand hygiene and health care delivery

**Relationships** between parts are far greater than the parts alone…

**Resilience**…resilience aligns with what is described as a “new view of human error” which sees humans in a system as a primary source of resilience in creating safety. The “old view” focuses more on the elimination of risk rather than, more realistically describing strategy that will circumscribe, cope and contain failure, as proposed by resilience
In a Complex System **Relationships** between parts are far greater than the parts alone...
Example

Termite hill

• Can’t be reduced to the termites
• Statistically emergent from termite
• By the way there is no CEO termite or CNO-VP patient services termite etc., just termites that all know their places and tasks in the system

THE TERMITES HAVE A SHARED MENTAL MODEL

We establish order and control through actions of a few top people in the organization – this may be the biggest factor holding back innovation and progress in our organizations
So what do we do? The prevailing infection prevention system paradigm:

Slide stolen from Matt Scanlon, MD
Problems with the anticipatory model
“Whac-a-Mole” is an Anticipatory Model

This is an anticipatory model – based on prediction of problems occurring again (lack of hand Hygiene)...in the exact same way!

You guess or try to “pattern match” (data) where the “mole will pop up”

But...what is the problem with this model
"FROM JERUSALEM TO JERICHO":
A STUDY OF SITUATIONAL AND DISPOSITIONAL VARIABLES IN HELPING BEHAVIOR

JOHN M. DARLEY 2 AND C. DANIEL BATSON

Princeton University

The influence of several situational and personality variables on helping behavior was examined in an emergency situation suggested by the parable of the Good Samaritan. People going between two buildings encountered a shabbily dressed person slumped by the side of the road. Subjects in a hurry to reach their destination were more likely to pass by without stopping. Some subjects were going to give a short talk on the parable of the Good Samaritan, others on a nonhelping relevant topic; this made no significant difference in the likelihood of their giving the victim help. Religious personality variables did not predict whether an individual would help the victim or not. However, if a subject did stop to offer help, the character of the helping response was related to his type of religiosity.
The Study
Princeton University Seminary Students

- \( \frac{1}{2} \) were told to present a sermon on the Good Samaritan; the other prepare a talk about seminary jobs

- They were told to go to one building then they changed the routes and building location just prior to leaving

- The two groups were divided again: One group was told to hurry they would be late; the others not to rush

- All groups’ routes had them come across a man slumped in a doorway who moaned and coughed as they passed…

- Outcomes: 1. All will stop, 2. Those studying Good Samaritan will stop, 3. Those who were less hurried would stop
1. Positive Deviance is an approach to behavioral and social change based on the observation that in any community, there are people whose uncommon but successful behaviors or strategies enable them to find better solutions to a problem than their peers, despite facing similar challenges and having no extra resources or knowledge than their peers.

2. Participatory Ergonomics programs seek to maximize the involvement of the workers in process based on the simple fact that a worker is an expert on his or her job.
Joint Optimization

• Because the social and technical elements must work together to accomplish tasks, work systems produce both physical products and social/psychological outcomes. The key issue is to design work so that the two parts yield positive outcomes; this is called joint optimization.

• Change supported by efforts in both the social and technical aspects of work seems more likely to be sustained
Most nights, unexpected contingencies unwound the tight choreography of the shift, diagrammed in hourly increments in the sprawling spreadsheets of patients' charts. I lurched from one task to the next, fulfilling all requirements, but little more.

For a while, the electronic thermometers we used were in short supply, and the shift started with a mad dash to nab one. We made a joke of it, but behind the laughs, I heard the clock ticking. Infection control slows down all movement: Hands must be washed before and after every contact with a patient, and fresh gown and gloves donned every time one enters a patient room, to be discarded when exiting. A thermometer or any other piece of equipment moved from one room to another must be cleaned, too.
In another country province far west of Ontario…

Health Minister Fred Horne says the hand-washing compliance rate in Alberta hospitals needs to be a lot better.

Horne made the comments after learning the hand-hygiene compliance rate in Auditor General Merwan Saher’s report Monday was 66 per cent.

The time factor is one thing Liberal Critic Dr. David Swann believes professionals could really use. He’s pointing the finger of blame at the Progressive Conservative government. “It is partly a function of oversight but being short-staffed and over-capacity of patients is a recipe for disaster and this government needs to make some changes here,”
The question we must ask is: Is Hand Hygiene the task? Or is it an interruption to what is perceived as the “real” task?

A task has inputs → throughputs → outputs

If it is a task, how can it be imbedded into other tasks and not remain a “stand alone task” with no clear and timely feedback?

Remember a “stand alone task” can be worked around…or NOT DONE
SEIPS - Systems Engineering Initiative for Patient Safety

Technology for Hand Hygiene

Adding technology may be like adding another team member, but one who does not speak the same language or share the same cultural assumptions. (Woods 1996)

That may lead to “technology surprises” - What is the technology doing now? Why is it doing that? What will it do next?
How will we use HFE?

- **Observational Task Analysis** of lower level providers based on the elements of the HFE work system model
- Look for Barriers and Enablers to hand hygiene and the Five Moments
- Surveys of users
- Focus groups of users
- Do your colleagues share the same Mental Model?
Hand Hygiene Agents

- Are they mounted on vertical surfaces free from clutter?
- Are they convenient to point of care?
- Are they near glove box holder?
- Can you see if they are full/empty?
- Are they blocked by other objects?
- Are within a comfortable reach (37-47 ins. from floor)?
- Soap dispenser near sink?
- Lotion dispenser near sink?
- Can you tell all the hand hygiene agents apart?
- Towel dispenser near sink? Are they regularly emptied?
- What other tasks are performed in the sink and surrounding area?
How Can I Help Identify the Agents?

Use color … but only in combination with other identification such as prominent lettering, dispenser shape, sound etc. Color is ALWAYS a secondary identifier.

How Can I Help Identify Locations for Agents?

Consider placement visibility, flexibility, accessibility and consistency…and if alcohol based fire safety

Digital actuation counters on products…not for hand hygiene data but rather location use

Post-It Notes color designated to soap, alcohol based hand rub (ABHR) and lotion. All employees have them and place them on a surface where a hand hygiene opportunity occurred but sink/agent was not easily accessible

Patient rooms available for dynamic placement of agents based on user feedback
Let’s Return to the Good Samaritan and the NYC Burn Nurse

Nurses always performed hand hygiene after removing gloves but not very compliant before donning gloves…why?

MDs more likely to perform hand hygiene upon leaving room than entering next patient room

Wet hands do not go into gloves.

Hands were wet with ABHR took TIME to dry and they wanted to get on to the “real task”

Products placed in inconvenient locations took TIME to find

Workflow patterns made sink and product locations different for RNs vs. MDs
Patient rooms available for dynamic placement of agents based on user feedback

Post-It Notes or stickers color designated to soap, alcohol based hand rub (ABHR) and lotion. All employees have them and place them on a surface where a hand hygiene opportunity occurred but sink/agent was not easily accessible.
Fig. 1 Workflow on room class 1. The thicker arrows denote more frequent flow. The star denotes the current location of the dispenser.

Fig. 3  Link analysis for the generic average workflow. The *thicker arrows* denote more frequent flow

What Can “We” Do?


- Single intervention (2% CHG disposable cloths) targeting source control lowered new acquisition of multi-resistant organisms (MRO), reduced MRO in environment and on healthcare workers hands
- The CHG was to reduce MRO on the patient but it becomes a “passive” healthcare hand and environmental hygiene agent – “chunking”
From: Chlorhexidine Gluconate to Cleanse Patients in a Medical Intensive Care Unit: The Effectiveness of Source Control to Reduce the Bioburden of Vancomycin-Resistant Enterococci


Table 2. Comparison of Vancomycin-Resistant Enterococci (VRE) Contamination on Health Care Workers' Hands During the 3 Study Periods

<table>
<thead>
<tr>
<th>Site Where Culture Specimen Was Obtained*</th>
<th>Study Period</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Soap and Water</td>
</tr>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>After exiting room of patient with VRE colonization</td>
<td>84</td>
</tr>
<tr>
<td>Common area of ICU</td>
<td>86</td>
</tr>
</tbody>
</table>

Abbreviation: ICU, medical intensive care unit.

*Each episode of health care worker hand sampling is the unit of analysis; there were 529 episodes.
†Log_{10} Colony-forming units from workers whose hand culture specimens were positive for VRE.
‡P = .01; determined by the χ² test, comparison with soap and water baths.
§P < .001; determined by Wilcoxon rank sum test, comparison with soap and water baths.
‖P = .07; determined by the χ² test, comparison with soap and water baths.

Figure Legend:
Comparison of Vancomycin-Resistant Enterococci (VRE) Contamination on Health Care Workers’ Hands During the 3 Study Periods.
From: Chlorhexidine Gluconate to Cleanse Patients in a Medical Intensive Care Unit: The Effectiveness of Source Control to Reduce the Bioburden of Vancomycin-Resistant Enterococci


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<th>Site Where Culture Specimen Was Obtained</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Soap and Water (n = 311)</td>
</tr>
<tr>
<td>Table</td>
<td>10 (3)</td>
</tr>
<tr>
<td>Bed rail</td>
<td>33 (11)</td>
</tr>
<tr>
<td>Pull sheet</td>
<td>63 (20)</td>
</tr>
</tbody>
</table>

*Each environmental culture acquired is included in the analysis. Data are presented as number (percentage). The same number of cultures were obtained for each environmental surface.

†*P* < .001 by Mantel-Haenszel summary χ² test; stratified by environmental surface; comparison with the soap and water period.

‡*P* = .02 by Mantel-Haenszel summary χ² test; stratified by environmental surface; comparison with the soap and water period.

Figure Legend:
Percentage of Environmental Surface Culture Specimens That Were Positive for Vancomycin-Resistant Enterococci During the 3 Study Periods*
From: Chlorhexidine Gluconate to Cleanse Patients in a Medical Intensive Care Unit: The Effectiveness of Source Control to Reduce the Bioburden of Vancomycin-Resistant Enterococci

Figure Legend:
Risk ratios for skin contamination and environmental or health care worker contamination by or patient acquisition of vancomycin-resistant enterococci (VRE). Comparison of soap and water baths to cleansing with either chlorhexidine or nonmedicated cloths. Summary risk ratios are displayed for the frequency of VRE contamination of patients' skin (inguinal and antecubital), environmental surfaces (bed rail, overbed table, or pull sheet), and workers' hands (culture specimens taken after exiting the room of a patient with VRE colonization or a common room in the medical intensive care unit). The point estimate and upper and lower bounds of the 95% confidence intervals are displayed.
Remember Semmelweis?

What is the model for the cause of puerperal fever?

Person
Task
Tools/Technology
Environment
Human Factors/Systems Task Analysis

societal/organization factors such as the infected patients’ socioeconomic class causes placement in the hospital vs. remaining home

physical environment factors such as water quality, patient bed linens, ventilation, and patient crowding

task factors such as difficult or extended labors requiring more physician/medical student attention than normal deliveries left to the midwives

tools and technology in use – comparing hospital and at home deliveries and the people involved in the delivery – physician, medical student, midwife, and patients.
OK you “know the answer” but do you? Semmelweis did and it was not just hand hygiene in years prior, incidence of puerperal fever had been equally low in both wings of the hospital with emergence of forensic pathology and the opening of the new Viena Institute of Anatomy, instructional autopsies came into academic fashion and were required of all physicians with patients that died in the hospital his analysis clearly describes a *latent error* in the system, placing the medical staff at the “sharp” of the infection transmission or medical error

The cause was one of advancement in medical technology – the Organization
"Knowing is not enough; we must apply. Willing is not enough; we must do."
— Goethe

...let’s not wait another 20+ years to accept the use of human factors and systems engineering in Infection Prevention...

Thank you for inviting me back to Toronto!
References:


