



## Creating Design Criteria for Hand Sanitizer Stations Using SEIPS

### Section I

#### *Background information*

Hand sanitizer stations had to be replaced at an academic medical center due to the unavailability of refills for the current product. Prior to purchase and implementation of new hand sanitizer stations, a human factors assessment was requested. This assessment provided initial insight into the usage, acceptance, and concerns of the new proposed hand sanitizer stations at an overall, systems level.

#### *Keywords*

Hand-Sanitizer, User Acceptance, Usability

#### *Submitted by*

Harsh Sanghavi, M.S.  
[hksanghavi@carilionclinic.org](mailto:hksanghavi@carilionclinic.org)  
(540) 514-1994

Matthew Jesso, M.A., AUXP  
[mnjesso@carilionclinic.org](mailto:mnjesso@carilionclinic.org)  
(540) 589-9413

<https://carilionclinic.org/human-factors#about-human-factors>  
<https://labs.vtc.vt.edu/parker/>

### Section II

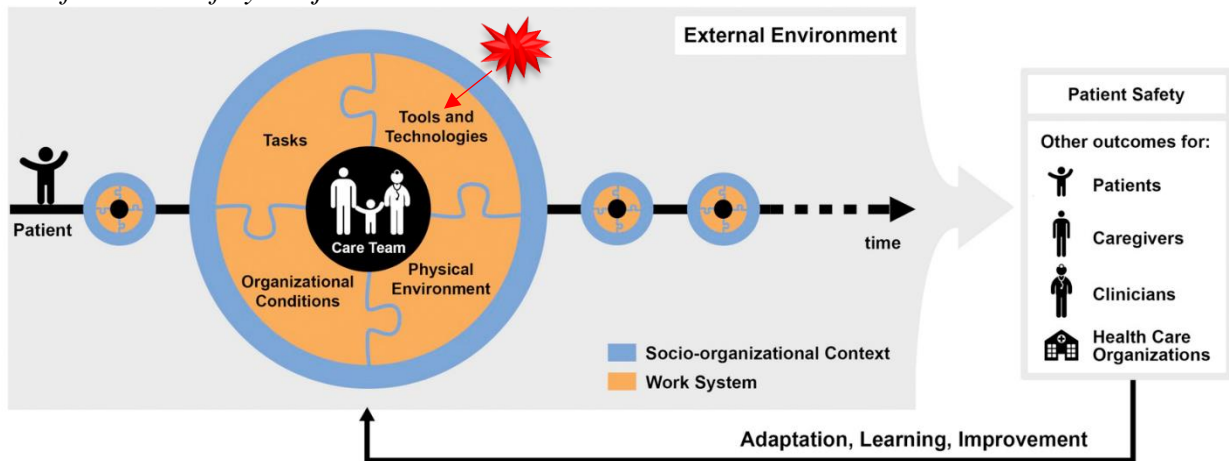
#### *Role of the ergonomists/human factors*

Two human factors (HF) engineers, in partnership with project management, were tasked by Materials Management and Infection Prevention to assess five potential replacement hand sanitizer stations. Changes in equipment design have potential for adjusting staff interactions. For a hand sanitizer station, changes in behavior may lead to less hand hygiene moments and possible hospital acquired infections. The individual assessments helped to define potential benefits and barriers for three end user groups (Nursing, Environmental Services, & Infection Prevention). HF engineers developed the methodology and design criteria, conducted assessments, compiled analysis and reports, and presented findings and recommendations to the stakeholders.

#### *Main area of intervention*

The hand sanitizer equipment (Tools & Technology) was changing due to the manufacturer discontinuing the model currently used throughout the hospital system.

## Aim of Patient Safety Project



A change in station design and sanitizing product (Tools & Technology) can be expected to have cascading effects on: Physicians and Nurses using the stations many times for a single patient encounter, Environmental services to stock and replace the cartridges (Care Team); the usage and replacement of cartridges (Tasks); the placement of stations, and storage of replacement cartridges on the unit (Physical Environment); the cost of purchasing from vendors with and without previous business relations (Organizational); the number of hospital acquired infections due to hand hygiene compliance (Patient).

Contracting Hospital: Carilion Clinic

Industry: Health Care and Quality & Patient Safety

### Section III

#### Method

The HF team conducted rapid assessments of five individual hand sanitizer stations and provided a report that highlighted initial impressions. Insights were arranged into a Systems Engineering Initiative for Patient Safety (SEIPS) framework to categorize recommendations from the other user groups. The SEIPS framework assisted in identifying how the product design influences several factors for the context of use in a hospital setting. We modified questions from the SEIPS framework to help us evaluate each hand sanitization station:

- Does this tool\device used to perform the task of hand sanitization increase or decrease the likelihood of safety events?
  - Ease of use
  - Visibility of station and remaining product
  - Ability to use safely without breaking
  - Risk of creating a slip hazard with excess sanitizer pooling on floor
- What in the physical environment can be sources of error or promote safety?
  - Width of device may be too wide to fit in all existing hand sanitizer locations
  - Color of sanitizer station is the same as the wall color

- What are the characteristics of the hand sanitization task in the person’s workflow that could contribute to safe or unsafe patient care?
  - The visibility of remaining product to know when to replace the cartridge
  - Can only give sanitizer if pushed (i.e. unidirectional) there needs to be two stations for staff entering and leaving patients’ room to follow “foam in, foam out” policy
  
- What are the characteristics of different persons performing the tasks or involved in the work?
  - Clinical staff constantly using hand sanitizer
    - May lead to dry hands & disuse
    - If the product leaves a film on hands it may be difficult to don and doff gloves
    - Environmental services keep replacement cartridges on their carts
      - If the weight of a replacement cartridge is too much there will be a need to restock their work cart on multiple runs

### *Results*

The distinct evaluation categories generated, helped present the benefits and flaws of each hand sanitization station relevant to each end-user. The SEIPS framework helped the HF team identify nine criteria that were later used to help end-users evaluate these hand sanitizer stations. These criteria (shown in Table 1) were identified as themes and were found to be recurring patterns in our evaluations.

	<b>Hand Sanitizer Station</b>				
<b>SEIPS</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>Physical Environment</b>	<i>"Forced to cup hand"</i>	<i>"Wall prevents hand from being fully open"</i>	<i>"Similar footprint of existing sanitizer holder"</i>	<i>"There may be areas in the hospitals where the width may be problematic"</i>	<i>"Storage of replacement plastic bags will take up twice as much space"</i>
<b>Tasks</b>	<i>"This design is a unidirectional push dispenser"</i>	<i>"Staff will most likely avoid using foam dispenser if one is placed only on the inside or outside of the room"</i>	<i>"Multidirectional Design"</i>	<i>"One push may not be enough to properly sanitize"</i>	<i>"Requires two hands to open plastic cover"</i>
<b>Tools/Technology</b>	<i>"Simple design is highly intuitive"</i>	<i>"Unclear when replacement needs to occur until hand sanitizer is not available"</i>	<i>"Possible waste of sanitizer so staff do not wait until bottle is empty"</i>	<i>"Has a clear viewing window to see the cartridge"</i>	<i>"Color of walls on unit floor may make stations blend in"</i>
	<i>"The button to depress is noticeable"</i>	<i>"Easy to open"</i>	<i>"Easy to replace- Bottle slides in and out of holder"</i>	<i>"can break easily"</i>	<i>"Has a clear viewing window to see the cartridge"</i>
<b>People</b>	Nursing EVS Infection Control	Nursing EVS Infection Control	Nursing EVS Infection Control	Nursing EVS Infection Control	Nursing EVS Infection Control

Table 1: HF SEIPS evaluation results with selected comments for each of Physical Environment, Tasks, Tools and People

The nine evaluation criteria (Table 2) were then used to help multiple end-user groups choose between the five different hand sanitizer stations.

<b>Criteria</b>	<b>Description</b>
Intuitiveness	Easiest to learn how to use
Visibility	Clarity of remaining fluid level
Ease of Use	Easiest to use and does not cause inconvenience
Feel	Liquid that feels pleasant to use
Odor	No obtrusive odor
Refill	Easy to refill
Package	Cartridge Safe and easy storage options
Durability	Durable to install and operate
Safety	Safety while use

Table 2: Criteria generated through analyzing data through a SEIPS perspective

Thereafter, two types of survey forms (forced decision and priority ranking) were constructed to collect feedback from each end-user group, the responses were then transcribed by the HF team into a decision matrix.

Three groups: Nursing, Environmental Services and Infection Control used each sanitizer station (Figure 1) and then completed the survey forms.



Figure 1: Hand Sanitization Stations

### Conclusion

Due to the SEIPS foundation to create the design criteria there were differences in the user groups design priorities as well as overall product preference. The results of the priority ranking in the first survey showed that Environmental services rated Visibility, Ease of Use, and Intuitiveness as their top three criteria. Infection prevention rated Safety, Ease of Use and Feel as their top three criteria, while Nursing rated Feel, Ease of Use and Odor as their top three criteria. Human Factors rated Safety, Durability and Feel as their top three criteria.

Results from the decision matrix scores generated from the surveys across all groups showed that out of all five sanitizer brands (A, B, C, D, and E), brand A was rated the best for infection control (*score = 9.7*), registered nurses (*score = 7*), and the human factors team (*score = 9.8*). The EVS team rated E highest (*score = 11.8*) followed by A.

### *Was the outcome evaluated following implementation?*

The implementation of the new hand sanitizer brand is scheduled for early 2022. Existing hospital infrastructure is currently in place to monitor the implementation and use of the new product. Hospital safety event reports are tracked and monitored by Quality and Patient Safety team members; Infection Prevention has scheduled hand hygiene compliance checks and hospital acquired infection reports to gauge the success of implementing new hand sanitizer stations.

### *Cost-Benefit Analysis*

Due to the discontinuation of the existing product, cost was a factor considered by stakeholders, post HF usability assessment. Reducing the number of products under consideration meant that stakeholders only had to meet with two vendors. In the end, our stakeholders moved forward with Product A over Product E, due to cost, implementation timeline, and previous business relationships with the vendor. The cost analysis considered the initial implementation cost (and timeline), the cost of initial product and availability, and cost to reorder product.

### *References*

- Carayon, P., Wooldridge, A., Hoonakker, P., Hundt, A. S., & Kelly, M. M. (2020). SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Applied ergonomics*, 84, 103033.
- Sanghavi H, Jesso M. Identifying Conflicting Priorities in Hand Sanitizers Among Different Clinical End-Users. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*. 2021;10(1):106-108. doi:10.1177/2327857921101105