Improving Hand Hygiene Monitoring and Compliance through Interaction Design: An Intersection of Design and Science

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Background

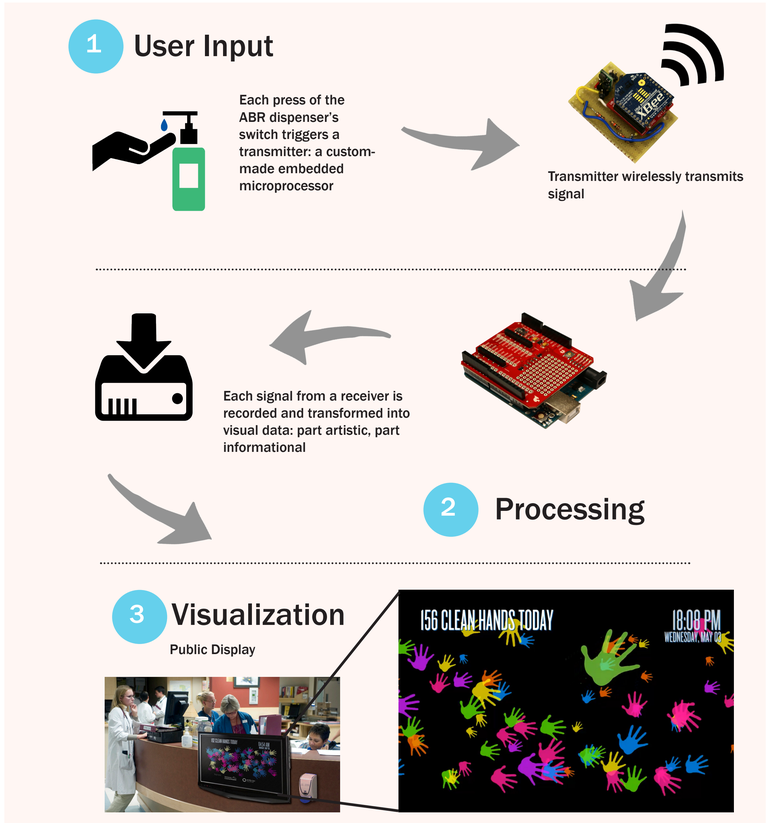
Hand hygiene compliance (HHC) is critical in the effort to reduce transmission of hospital acquired infections (HAI).

An innovative approach to improve HHC through interaction design (ID) was developed by Emily Carr University of Art + Design's Health Design Lab. Our team partnered with Emily Carr to develop and integrate interactive Alcohol Based Rub (ABR) dispensers at Foothills Medical Center, to empirically evaluate the impact of the technology on HHC.

Objectives

1. Evaluate the impact of the interactive ABR dispensers on frequency of use (FoU).
2. Evaluate the relationship FoU and audited HHC, the current assessment method.
3. Test scalability of this innovative and efficient approach to promoting HHC and decreasing HAI.

How Does the Interaction Design Work?



Study Design

A subset of ABR dispensers (n=29) on a four wing, 36 bed medical teaching unit were modified with hardware that allowed them to record FoU and transmit this data over personal area networks (PAN) to local servers. Each server was connected to a display terminal capable of visualizing dispenser frequency use. This FoU data was collected simultaneously with in-person audits.

Phase I
Data collection without ID intervention.

Phase II
ID intervention was introduced and frequency of use data was visualized on central displays, providing real-time feedback to unit staff and visitors.

Analysis
The relationship between audited compliance and FoU data was modelled through simple linear regression. A Student's t-test was used to compare FoU before and after the visualization of FoU data, with respect to peak and trough trends. Analyses were conducted using Microsoft Excel 2016.

Results

Data Transformation
FoU data from before and after the ID intervention were binned from 4 and 2 months, respectively, into hourly bins (time of day). The team was then able to calculate FoU differences across the hours of a day (Figure 1). HHC was calculated and binned using the in-person audit data. The team then used these HHC percentages to determine whether the ABR dispensers provided an accurate representation of ABR dispenser use (Figure 2).

Effect of Visualization
FoU per day with visualization was higher ($M = 4.08$, $SD = 1.89$) than with no visualization ($M = 3.35$, $SD = 2.09$), $t(22) = 1.72$, $p < 0.001$.

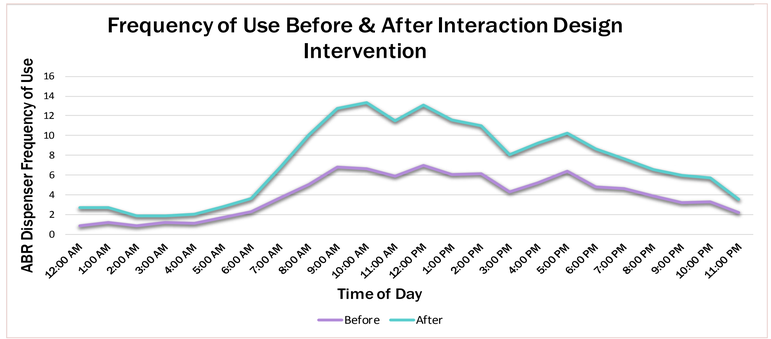


Figure 1. Data representing frequency of use of ABR dispensers among healthcare workers before and after the visual interaction design intervention was introduced.

Variance in Compliance
Frequency of use (FoU) predicted a significant proportion of variance in compliance $R^2 = 0.37$, $\beta = 7.51$, $t(125) = 8.54$, $p < 0.001$ (see Figure 2).

Innovative Interaction Design is the Future of Hand Hygiene!

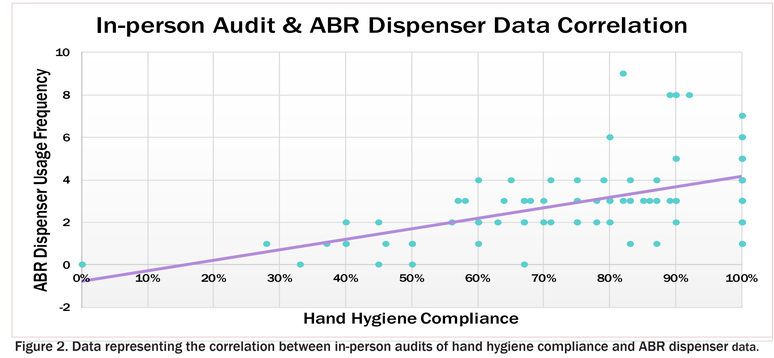


Figure 2. Data representing the correlation between in-person audits of hand hygiene compliance and ABR dispenser data.

Conclusions

Outcomes
Modified ABR dispensers give a fairly accurate representation of HHC and ID significantly improves overall HHC.

Qualitative Results
Healthcare worker (HCW) feedback indicated an increased motivation for HHC and often volunteered feedback for alternative ways to visualize the data, revealing the potential for the co-development of the ID.

Lessons Learned
The team identified barriers on a system level that included ownership and maintenance of the technology, in addition to finding limits to the sustainability of the hardware and software. During the project, the team discovered that the application reached a wider potential than originally thought, identified by IPC, environmental services, and external stakeholders.

Future Directions

Improve
Develop future iterations of technology and use knowledge to improve scaliblity with respect to manufacturing and reliability of the technology.

Disseminate
Open sourcing the hardware and software components allows other organizations to prototype their own interaction designs, and encourages a network of innovation through collaboration.

This technology demonstrates the potential to increase HHC as well as support more effective and efficient hospital practices. The hardware and software will be available under the Creative Commons license and the GPL- 3.0.

Freely available content includes:

- Software required for the interactive data visualization
- Hardware specifications, bill of materials, and PCB diagrams
- Functional instructions for development and installation

Visit: https://github.com/W21C/Interactive-Hand-Hygiene-Design