



# Investigation into the Cleaning Methods of Smartphones and Wearables from Infectious Contamination in a Patient Care Environment (I-SWIPE)

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## Study Objective

To determine if ultraviolet-C (UV-C) disinfection devices are more effective at eliminating bacteria on smartphones and wearables when compared to usual care.

## Introduction

As technology advances, many healthcare workers are using smartphones and wearable devices on a daily basis. These devices do not have a cleaning standard enforced to prevent the spread of bacteria. To date, there have not been any real-world trials which have examined bacterial elimination on devices such as smartphones and wearable technologies in a hospital setting.

Wearable devices such as smartwatches are not recommended. As per the Island Health Infection Prevention and Control Reference Guide, hand and wrist jewelry, rings or watches should be removed when providing patient care.

Cleaning of smartphone and wearable devices with a disinfecting wipe is recommended by Island Health policies. Unfortunately, approved disinfection products within Island Health are not recommended for use by smartphone manufacturers. Manufacturers recommend using a microfiber cloth.

As per the CleanSlate UV manufacturer, UV-C has been shown to significantly reduce the number of bacterial organisms on small items, but has not been investigated in real-world trials for disinfection of healthcare workers' smartphones and wearable devices.

## Outcome Measures

### Primary Outcome:

- Isolated bacteria on smartphones and wearable devices compared before and after use of UV-C disinfecting device

### Secondary Outcomes:

- Isolated bacteria on smartphones and wearable devices before use of UV-C disinfecting device, compared to isolated bacteria on hospital-provided identification (ID) badges
- Bacterial load in colony forming units (CFUs) of inoculated smartphones and wearable devices prior to disinfection with UV-C, compared to bacterial load after disinfection with UV-C

## Methods

Prospective, before-and-after study involving clinicians at the Royal Jubilee Hospital (RJH), Victoria General Hospital (VGH), and Campbell River General Hospital (CRG).  
 > CleanSlate UV was selected by Island Health, not by project investigators, for use during this project

### Questionnaires:

- Baseline - to determine smartphone and wearable use and cleaning habits
- Exit - to determine the ease of use and convenience of UV-C disinfection

### Swabs:

- Baseline swab of devices prior to UV-C deployment
- Participants used the UV-C device by placing their smartphones, smartwatches, Vocera® badges, and iPod Touch® devices (with the Vocera® Collaboration Suite installed) in the machine for 30 seconds at beginning and end of each shift
- Pre and post UV-C swabs taken on a pre-determined date

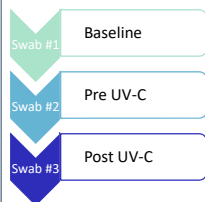


Figure 1: Swab Interval

### Inclusion and Exclusion Criteria

#### Inclusion Criteria:

- Included clinicians: hospitalists, nurses, pharmacists, physiotherapists, occupational therapists, and rehab assistants
- Clinicians who use smartphones, smartwatches, Vocera® badges and/or Vocera® Collaboration Suite during work within the hospital

#### Exclusion Criteria:

- Clinicians who use mobile phones other than smartphones
- Clinicians who worked ≤16 hours per week

### Inoculation:

- Pre and post UV-C swabs taken of inactive Island Health smartphones and Vocera® badges inoculated with specified bacteria

## Results

Table 1: Baseline Characteristics

Characteristics (Total Number of Participants; n = 153)					
	Profession	n (%)		Devices Used	n (%)
	Pharmacist	56 (36.7)		Smartphone	156 (74.6)
	Hospitalist	27 (17.6)		Smartwatch	21 (10.1)
	Nurse	68 (44.4)		Vocera® Badge	26 (12.4)
	PT/OT/RA	2 (1.3)		Vocera® Collaboration Suite/iPod Touch®	6 (2.9)

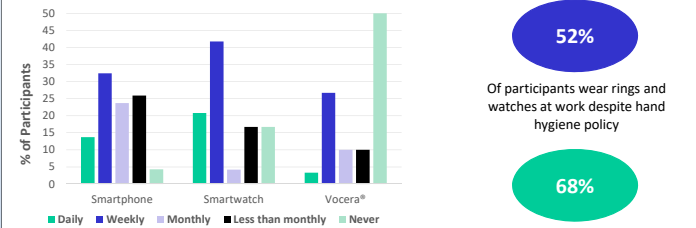


Figure 2: Baseline Frequency of Device Cleaning

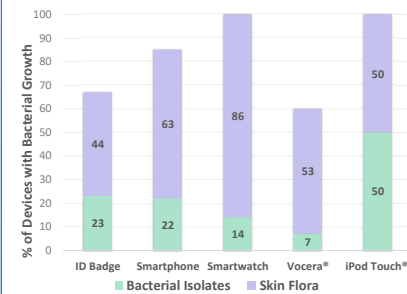


Figure 3: Percentage of Baseline Isolates (Prior to UV-C initiation)

### Primary Outcome

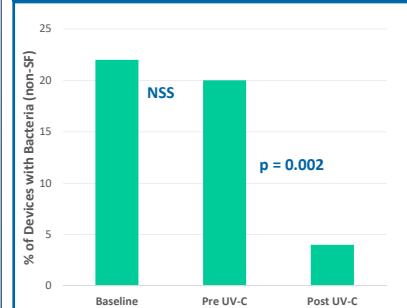


Figure 4: Percentage of Bacterial Isolates (non-skin flora [SF]) Pre and Post UV-C

Table 2: Total Bacterial Isolates

Bacteria Type	Pre UV-C	Post UV-C
Acinetobacter	3	0
Arthrobacter	1	0
Bacillus cereus	1	0
Coagulase Negative Staphylococcus	1	0
Coliform	5	0
Enterococcus	5	0
Ewingella	1	0
Gram negative bacilli (non-fermenting)	2	0
Klebsiella	2	0
Pantoea	46	1
Pseudomonas	5	1
Serratia	1	0
Sphingobacterium	1	0
Staphylococcus aureus	20	1

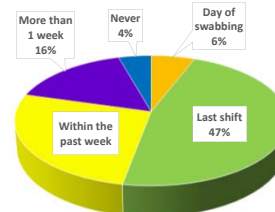


Figure 5: Last UV-C Use at Time of Swabbing

## Results (continued)

Table 3: Inoculated Bacterial Load Pre and Post UV-C

Secondary Outcome		
Bacteria Type	Pre UV-C*	Post UV-C
C. albicans	0-10	No growth
E. coli	50-100	No growth
E. coli (ESBL)	50-100	No growth
E. faecalis	50-100	No growth
E. faecalis (VRE)	10-50	No growth
K. pneumoniae (EBSL)	50-100	No growth
P. aeruginosa	10-50	No growth
S. aureus (MSSA)	50-100	No growth
S. aureus (MRSA)	10-50	No growth
S. pneumoniae	10-50	No growth



Figure 6: CleanSlate UV Disinfection Device

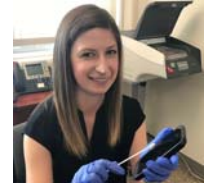
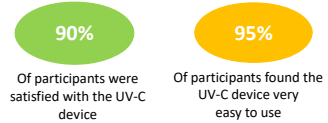


Figure 7: Device Swabbing by Investigator



## Discussion

- We assessed the efficacy of usual care by taking baseline swabs prior to implementing the twice daily UV-C disinfection. The percentage of devices with bacterial growth at baseline was similar to pre UV-C.
- The amount of bacteria that grew on each device was lower than anticipated. Potential reasons for this include:
  - The baseline questionnaire revealed that most participants cleaned their devices at least weekly
  - Island Health implements infection control parameters including a strict hand hygiene policy, regular audits in patient care areas for compliance, and tracking of quarterly infection rates
  - Royal Jubilee Hospital has many single bed rooms in an effort to decrease the spread of infection
- Vocera® Badges had less bacterial growth compared to the iPod Touch® with the Vocera® Collaboration Suite installed. Vocera® Badges are encompassed in an antibacterial coating (BioCote®), which could explain the lack of bacterial growth.
- Wearing of the hospital-provided ID Badge is mandatory for all clinicians. Approximately 23% of these badges had bacterial growth (other than skin flora) with usual cleaning. In contrast, watches had a lower rate of bacterial growth of 14%, but they are prohibited by the hand hygiene policy, while ID badges are not.
- Statistically significant decrease in bacterial isolates pre vs. post UV-C
- Smartphone cases with crevices that cannot be reached by UV-C is a potential reason for presence of bacteria post UV-C
- Bacterial load of prevalent hospital bacteria decreased to no growth post UV-C in our inoculation test within the lab.

## Conclusion

- The smartphones and wearable devices tested in our study were relatively clean, with the majority of devices only growing skin flora or having no bacterial growth
- UV-C appears to be more effective at eliminating bacteria on smartphones and wearable devices when compared to usual care
- UV-C may be a beneficial disinfection device to use in hospitals
- Further studies are needed to determine the interval at which UV-C should be used to prevent bacterial growth and spread

## Next Steps

- Recommend updating Island Health policies to support wearing of watches and disinfection using UV-C
- Inform a business case for new Island Health hospital builds to incorporate UV-C as a disinfection standard for smartphones and wearable devices
- Inform a business case for rollout of UV-C devices in all clinical areas within all hospitals across Vancouver Island