

Cell Phone Hygiene Initiative: Monitoring and Testing the Use of Cell Phones in the Restroom

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Background

Preventable medical errors are the third leading cause of death in the United States annually, accounting for 251,000 lives annually (Makary & Daniel, 2016). Healthcare-acquired infections (HAIs) account for nearly 40% of this population, costing the healthcare system \$28.4-33.8 billion each year.

Current efforts monitoring sources of HAI have set their focus on device-associated infections (i.e. central line, catheter, and ventilator-associated infections). Yet, in a recent Multistate Point-Prevalence Survey of Health Care-Associated Infections, device-associated HAI only accounted for 25.6% of instances detected (Magill et al., 2014). The rising prevalence of smartphone usage has also prompted researchers to target mobile phones as potential vectors for infectious transmission in healthcare. Although sophisticated applications may serve as valuable references to physicians and other healthcare professionals, these devices are easily contaminated and rarely disinfected (Chang et al., 2017; Gill, Kamath, & Gill, 2012; Jeske, Tiefertalder, Hohlieder, Hinterberger, & Benzer, 2007; Kotris, Drenjancevic, Talapko, & Bukovski, 2017; Mark et al., 2014; Ulger, Dilek, Esen, Sunbul, & Leblebicioglu, 2015). One potential area accounting for significant cellphone contamination is use in restrooms. Little empirical research has been conducted to investigate this proposition, however there are multiple non-peer reviewed sources demonstrating a rise in cellphone usage in restrooms. In a recent survey of 408 Americans, 61% of respondents used their phone in the restroom. This group admitted using their cell phone to check social media (92%), read text messages (49%), and answer phone calls (30%) (Rampton, 2014). There have been several additional reports of individuals admitting to cellphone use on the toilet as well, ranging from 61%-75% (Drewett, 2013; Kelly, 2012; Rampton, 2014).

Aim

Given the diverse microbial biogeography found in public restrooms, cellphone usage is an alarming health concern. The present study aims to provide the first empirical evidence linking restroom mobile phone usage to their contamination and subsequent role in HAIs. To do this, we first aim to survey both students and to establish a baseline for the growing population of individuals using their mobile phones in the restrooms. We will then aim to assess the degree of pathogenic contamination on subjects' cellphones using an ATP Luminometer



Methods

Data Collection

- The study aims to assess the cellphone hygiene habits of UNTHSC students, faculty, & staff. Using an interval sampling model, subjects using restrooms located on the 1st-4th floors of the MET Building between 12:00PM-1:00PM during the normal school week will be asked to participate in the survey. Student Investigators will administer informed consent & the survey tool using Qualtrics Survey Software on a school-issued laptop after subjects exit the restroom. A unique numerical identifier will be attached to each survey participant for the purpose of linking their responses with degree of cell phone contamination, but no personal identifying or protected health information will be collected from subjects. The distribution of surveys will be overseen by the principal investigator, Dr. Janet Jowitt. All collected data will be stored using a password protected log-in on Qualtrics Survey Software.
- While subjects are taking the survey, Student Investigators will use a standard cotton swab to systematically take a sample of potential pathogens on the subjects' cellphone. The swab will then be placed into an ATP Luminometer, which uses RLU's (relative light units) to quantify the biomass of living organisms on cellphones.

Survey Design & Validation

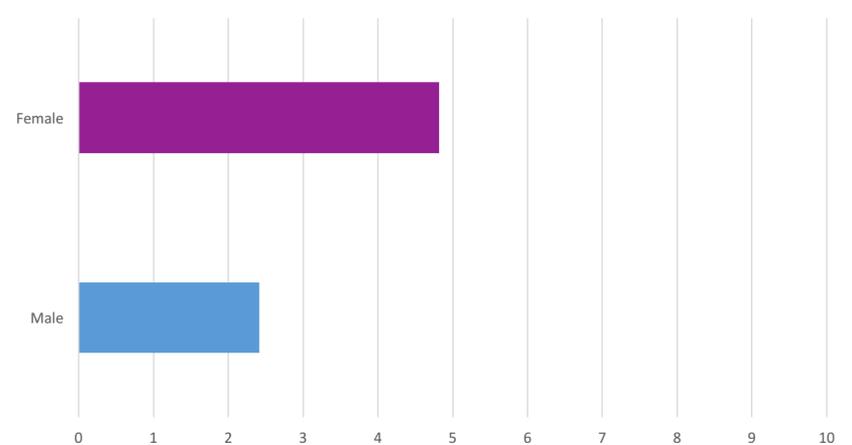
- Participants:** In this study, a test sample of graduate students from the University of North Texas Health Science Center were asked to report on their usage of cell phones in the restroom and cellphone hygiene. In total, data was collected from 68 participants (29 males; 39 females).
- Survey Design:** The survey designed for this study consisted of 9 self-report items. Responses were on a Likert-type scale, ranging from 1 = "Extremely Unlikely" to 10 = "Extremely Likely". All items were collaboratively generated by all investigators based upon literature review of cellphone usage in restrooms and cellphone hygiene.
- Factor Analysis:** Factorability of all 9 items were examined using well recognized criteria. Firstly, 8 of the 9 items correlated at least .3 with one or more other items, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.614, and Bartlett's test of sphericity was significant ($\chi^2(36) = 143.461, p < 0.001$). Thirdly, the 7 of the 9 diagonals of anti-image correlation matrix were over .5. Finally, all communalities were met or exceeded 0.3 (see Table 1), further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was deemed to be suitable with all 9 items.
- Principal Components Analysis:** Used to validate the quality and reliability of the North Texas Cellphone Contamination Survey. Initial eigenvalues indicated that the first three factors explained 38.8%, 24.1%, and 11.6% of the variance, respectively. The fourth, fifth, sixth, seventh, eighth, and ninth factors had eigenvalues less than one, and cumulatively only explained 25.6% of the variance. Given the 'leveling off' of eigenvalues on the Scree Plot after three factors, the three-factor solution was preferred. Next, a principal components analysis using an oblimin rotations was conducted, with three factors explaining 74.4% of the variance. All items in this analysis had primary loadings over 0.7. The factor loading matrix for this final solution is presented in Table 1.
- Internal Consistency:** Examined using Cronbach's alpha based on standardized items. All alpha values demonstrated moderate-to-highly reliability: 0.87 for Restroom Cellphone Usage (4 items), 0.84 for Post-Restroom Hand Hygiene (3 items), and 0.978 for Cellphone Hygiene (2 items). To evaluate internal consistency of items within the Cellphone Hygiene factor, it was necessary to recode the responses for "If you wash your phone, how likely are you to remove the case when doing so?" into intervals comparable to "How many times per week do you clean your cellphone". No substantial increases in alpha for any of the scales could have been achieved by eliminating more items.

Preliminary Results

Table 1. Summary of Cellphone Usage & Hygiene

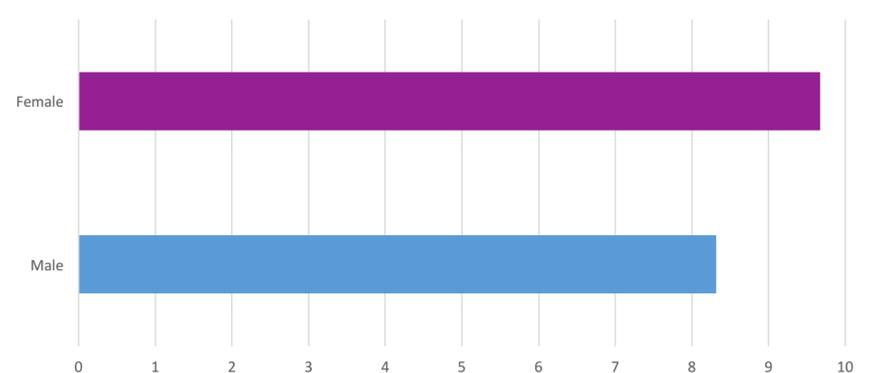
	N	Minimum	Maximum	Mean	Std. Deviation
On a scale from 0-10, how likely are you to use your phone while in the bathroom?	68	0	10	7.24	3.186
On a scale from 0-10, how likely are you to check social media while using restroom?	68	0	10	6.19	3.588
On a scale from 0-10, how likely are you to use your phone when defecating?	68	0	10	6.82	3.681
On a scale from 0-10, how likely are you to use your phone when urinating?	68	0	10	3.79	3.423
On a scale from 0-10, how likely are you to wash hands after using restroom?	67	2	10	9.42	1.361
On a scale from 0-10, how likely are you to wash your hands after defecating?	68	4	10	9.88	0.744
On a scale from 0-10, how likely are you to wash your hands after urinating?	68	1	10	9.09	1.891
If you wash your phone, how likely are you to remove the case when doing so?	28	0	10	4.18	3.175
How many times per week do you clean your cell phone?	69	1	4	1.49	0.656

On a scale from 0-10, how likely are you to use your phone when urinating?



On an independent t-test, females were significantly more likely to use their phone while urinating ($p < 0.01$)

On a scale from 0-10, how likely are you to wash your hands after urinating?



On an independent t-test, females were significantly more likely to wash their hands after urinating ($p < 0.01$)

Next Steps

Next, we intend to follow previously established protocols for demonstrating that bacteria can be aerosolized and contaminate nearby objects, and apply this principle to mobile phones contamination (Barker & Jones, 2005). We will also search potential hand-to-phone contamination prior to hand sanitization when the mobile phone is being put away. If we are able to empirically establish that restrooms may act as an index site for mobile phone contamination, we would seek to generate an infographic to educate healthcare workers on the risks associated with restroom cellphone usage, as well as explore possible avenues for cellphone decontamination in restrooms.

