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PTV research protocol Survey on hand hygiene, use of hightouch devices, and proper habits by health care workers for prevention of infectious risk.

Antonio Aprile, Giustino Morlino, Claudia Mosconi, Luca Guarente, Mariachiara Carestia, Francesca Pica, Patrizia De Filippis, Massimo Maurici, Leonardo Palombi

Submitted to: JMIR Research Protocols
on: May 11, 2024

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Abstract

Background: Care-Related Infections, are infectious diseases that occur in a care setting. The most important methods of prevention are hand hygiene and proper use of gloves and gowns. Recent literature points out that mobile devices being in contact with hands or potentially contaminated environments can promote an increased occurrence of HAIs.

Objective: The purpose of our study is, therefore, to analyze the correlation between the microbial population present on the handprints of health care professionals in the wards of the Tor Vergata Hospital in Rome, and the microorganisms present on the surfaces of workers' smartphones and tablets by searching for the main agents responsible for HAIs.

Methods: Sterile swabs will be used for identification of microbial flora to be taken on hands and smartphones of health workers and transported to the laboratory for culture analysis, performed according to current microbiological procedures. This type of investigation will have a quarterly periodicity to assess any changes in the microbial flora. At the same time, questionnaires will be administered and assigned a sequential number.

Results: Thirty health workers per quarter will be selected, for a total of 120 health workers and a total of 240 samples taken. For each sample, the following will be sought: Total bacterial load at 37°C (TBC 37°C) and at 22°C (TBC 22°C), of Coliforms/E.coli, Enterococci, Staphylococci, Acinetobacter, Klebsiella and pseudomonas and any antimicrobial resistance.

Conclusions: It will be important as a result of the study to promote proper education of the practitioners involved in the study on HAIs prevention. Clinical Trial: The protocol was properly evaluated and approved by the territorial ethics committee "Lazio Area 2" on March 21, 2024 with the code 76.24 CET2 utv_ptv

(JMIR Preprints 11/05/2024:60450)
DOI: https://doi.org/10.2196/preprints.60450

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Abstract

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Keywords: HAIs, Device, Hand Hygiene, Good Practice.

Introduction

Healthcare-Related Infections (HAIS), are infectious diseases that occur in a Healtcare setting, both hospital and all healthcare facilities (1). They are among the major complications related to care processes with prolonged hospital stay, aggravation of underlying pathology and long-term disability with consequent impact from clinical, social and economic perspectives (2). Moreover, it is estimated that HAIs are responsible for 16 million additional inpatient days, 37,000 deaths as a primary cause each year (3). The Italian law 81/08 emphasizes the important responsibility of management in order to reduce infectious risk, including in the proper provision and use of protective clothing (including hospital gowns) as well as remarking on the importance of avoiding

exposure of uniforms to the external environment (4). However, the document "Regional Hand Hygiene Intervention Plan" 2021, from the Lazio region, highlights handwashing as the most effective intervention for the prevention of HAIs, although it notes suboptimal adherence in care facilities to this correct practice (5). Another important prevention method concerns the correct use of gloves, which in no way replaces the need to wash hands; moreover, their incorrect use can increase the risk of pathogenic germ transmission from caregiver to patient or vice versa (6). In addition, over the past 10 years, there has been widespread use of smartphones in the workplace among healthcare workers (7, 8, 9). Mobile devices are always in contact with hands or potentially contaminated environments, and also due to the presence of a touch screen can convey the spread of infection and contamination (10, 11). Recent literature has highlighted the possibility that there may be a correlation between an increased prevalence of HAIs and the use of these devices where appropriate preventive measures, such as proper hand hygiene and disinfection of the cell phone surface, are lacking (12, 18). As evidence of this, several studies have shown that 58 percent of staff reported cleaning their phones once a day, at best (19), and that a range of 44 percent to 90 percent do not clean their devices at all (20). There are also early studies referring to Italy that would support the need to investigate this dynamic further, although they are limited to analyzing the phenomenon in individual departments (21, 23). The purpose of our study is, therefore, to analyze the correlation between the microbial population present on the handprints of health care professionals in the wards of the Tor Vergata Hospital in Rome, which will serve as a pilot for this experience, and the microorganisms present on the surfaces of workers' smartphones and tablets by searching for the main agents responsible for HAIs in order to promote the use of modern surveillance platforms for nosocomial Infections. This would allow for more accurate evaluation of all possible prophylaxis interventions.

The present study, conducted by the Department of Hygiene and Preventive Medicine of the Univestity of Rome Tor Vergata is part of the DARE project (Initiative "DARE - Digital Lifelong Prevention" Code: PNC_0000002 - CUP: B33C22001340002"), and specifically will contribute to the collection of data needed to carry out the activities of Pilot: 1: "Data mining and AI approaches to predict/prevent risk of Healthcare Associated Infections (HAIs)," under WP 3, Task 3. 1 (Digital Tools in children and aged frail subjects.).

Methods

Recruitment

Participants in the study will be selected by voluntary adherence from a population of healthcare workers, users of Hightouch devices, in the very high, high, and medium infectious risk departments of the Tor Vergata Polyclinic. Subjects who do not use a smartphone or tablet or who do not have them at the time of the study will be excluded in the sampling. The present study will last one year and sampling will be performed over the course of the 4 seasons, in the 'participating hospital 30 healthcare workers per quarter will be selected, for a total of 120 healthcare workers and a total of 240 samples taken; any Alert Microorganisms will be tested on each sample.

Privacy Policy

The following privacy policy will be administered to each recruited health professional:
"Dear Participant,
We wish to inform you that the GDPR (EU Regulation No. 2016/679) provides for the protection of individuals with regard to the processing of personal data.
According to the indicated regulation, such processing will be based on the principles of lawfulness, fairness and transparency, adequacy, relevance and limitation, accuracy and updating, non-

excessiveness and accountability.

Information on the processing of your data.

1. The data you provide will be processed for scientific research purposes, as part of the research project entitled "Survey on hand hygiene, use of high touch devices and correct habits by health care workers for the prevention of infectious risk."

2. The research is aimed at assessing the habits of health care workers regarding hand washing and the use of high touch devices in the work environment . To this end, participants will be swabbed on the surface of their hands and their device. Contextually, they will be asked to complete a paper questionnaire.

4. The data controller will implement appropriate technical and organizational measures to effectively implement data protection principles and protect the rights of data subjects.

5. The provision of data is optional, that is, it does not derive from a regulatory obligation, and any refusal to provide such data has no consequences. The provision of data for the purposes mentioned in point 1. is essential for the conduct of the study. Refusal to confer will not allow the Data Subject to participate in the study in question.

6. The data in question will not be communicated to other parties nor will it be disseminated except in anonymous and aggregate form."

To which consent may be granted or withheld as stated in the disclosure.

Questionnaire

The validated WHO questionnaire, translated in italian and adapted by the Lazio region, on hand hygiene will be administered to all participants to collect information on sociodemographic characteristics (age, gender, profession, and department of membership), to which will be added a short questionnaire with questions on the use of hightouch devices and PPE (gloves, gowns) in the workplace. Present attached. Personal and sensitive data of the subjects involved in the study will not be collected. Questionnaires can be found in the supplements section.

Sample collection and laboratory

Sample collection and laboratory analysis Sterile swabs will be used for the detection and identification of microbial flora to be taken on the hands and smartphones of health care workers. Samples will be taken, with timing compatible with the needs of the departments. The collected samples will be placed in the appropriate tubes and transported to the laboratory for culture analysis, which will be performed according to current microbiological procedures. This type of investigation will have a quarterly periodicity that may allow, thanks to seasonal differences in temperature and humidity, to assess any quantitative and qualitative changes in the microbial flora at different times of the year.

The analysis includes a quantitative and qualitative assessment, with the search for total bacterial count at 37°C (TBC 37°C) and at 22°C (TBC 22°C), of Coliforms/E.coli, Enterococci, Staphylococci, Gram-, Pseudomonas Aeruginosa and Mycetes. In addition, the isolated strains will be typed through standardized, miniaturized tunnels for biochemical 'API tests'. Sampling is carried out immediately after delivery of the completed questionnaire, using a swab and tube containing 2.5 cc of transport solution. Each questionnaire is assigned a sequential number, which is written on the

corresponding swab tube. The sampling procedure is the standard one for environmental surface sampling.

The swabs are transferred to the laboratory immediately after sampling and are then seeded as follows: for the determination of both TBC 37°C and 22°C, the bulk seeding technique is used with 500 µl per sample on plates of TSA(Tryptone Soy Agar) medium which are then placed in thermostat at 37°C/22°C for 48/72h; - 250 µl per sample are distributed and spatulated on a plate with Harlequin E. coli/Coliform chromogenic medium for the determination of E. coli and total coliforms; - 250 µl per sample are distributed and spatulated on a sterile Slanetz and Bartley agar plate for the determination of Enterococci;- 250 µl per sample are distributed and spatulated on a plate containing Baird Parker agar medium for the determination of Staphylococci; - 250 µl per sample are distributed and spatulated on a plate with MacConkey Agar medium for the determination of Gram-negative bacteria; - 250 µl per sample are distributed and spatulated on a plate with Cetrimide Agar base medium for the determination of Pseudomonas; - 250 µl per sample are distributed and spatulated on a plate with Sabouraud medium for the determination of mycetes (yeasts and micro fungi).All plates are then transferred to a thermostat at 37°C for 24 to 48 hours;

After the appropriate culture times, the plates are observed and a count of the colonies grown is made. The results obtained, expressed as CFU/dm^2 , are noted on a special form (Table 1) that includes: sample ID, date of sampling and any observations. In addition to a quantitative evaluation, a qualitative evaluation is carried out, based on the observation of colony morphology, and after selection of the different types, the identification of individual types is preceded by a specific miniaturized biochemical test "API test," following the procedure indicated by the manufacturer. Colonies in each treated plate will be screened for resistance by using broad-spectrum antibiotics: 10 µg ampicillin, 4 µg gentamicin and 5 µg chloramphenicol placed separately on Muller-Hinton agar plates and incubated in aerobiosis at 37°C for 18 hours.

Minimum inhibitory concentration (MIC) will be performed using the automatic ID/AST Vitek® 2 Compact instrument (Biomerieux) and Gram-positive and Gram-negative susceptibility test cards (AST-P577; AST-N117; Biomerieux, France).

The diffusion method according to Kirby-Bauer will be used for the antibiotics aztreonam, minocycline and levofloxacin. Breakpoints will be interpreted according to CLSI guidelines.(24)

sample	date	sample type	TBC 37°C	TBC 22°C	Acineto	E.Coli	Entero	Klebsiella	Stafilo	Pseudomonas
ID 1		Hands								
		Devices								
ID 2		Hands								
		Devices								
ID 3		Hands								

		Devices								
ID 4		Hands								
		Devices								
ID 5		Hands								
		Devices								
ID 6		Hands								
		Devices								
ID 7		Hands								
		Devices								
ID 8		Hands								
		Devices								
ID 9		Hands								
		Devices								
ID 10		Hands								
		Devices								

Table 1. Positivity of microorganisms in analyzed samples.

Data recording on computer medium.

The questionnaire responses, quantitative data from plate reading, annotations made on the sampling form and results of bacterial identifications will be recorded on Excel® Professional Plus 2016 (Italian language) worksheet.

Statistical Analysis

The descriptive statistical analysis will be used to describe the socio-demographic data of the sample and the answers to the questionnaires to determine the frequency of use and awareness of contamination of Hightouch Devices and PPE (Gloves, Gowns), subsequently, inferential investigations will be carried out between the socio-demographic data of the sample and the results from the microbiological swabs. The results for the descriptive section of the questionnaire will be expressed in terms of numbers and percentages; as for the quantitative microbiological results, these will be in terms of mean, standard deviation (SD), as well as median and interquartile range (IQR), as it is expected that the distribution of some variables will not be Gaussian-like. The microbiological results will be presented by stratifying against the questionnaire variables. For the qualitative analysis, we will construct a heatmap with the R software, for the construction of which the continuous variables will be transformed into dichotomous variables using a threshold of 100 CFU/dm2 as indicated in recent literature, so that dichotomous and continuous variables can be

compared on a single map.For the species under investigation, we will describe the frequency of occurrence. In order to graphically show the relationship between the questionnaire variables of interest and bacterial concentrations, "scatter plots" will be constructed expressing the bacterial concentrations on a logarithmic scale (lnCFU/dm2), color differentiating and constructing different confidence intervals in the graph according to the categorical variable (e.g. different cleaning methods, frequency of training, gender, etc.). Box-and-whisker graphs will also be constructed to show the distributions of HPC 37°C, HPC 22°C, and those for specific agents according to the above categorical variables. Quantitative analyses will be performed using SPSS ver. 22.0 (SPSS Inc. Chicago, IL, USA), verifying the normality of continuous variables by means of the Shapiro-Wilk test, and performing parametric (t-test) or non-parametric (Kruskal-Wallis) tests depending on the results of this analysis. Samples will be compared according to the following variables: gender, type of ward, cleaning frequency, cleaning method, type of telephone case, gown use. Subsequently, variables with a significance threshold of $p<0.2$ will be selected to run multiple linear regression models to describe the relationships between quantitative and categorical microbiological variables.

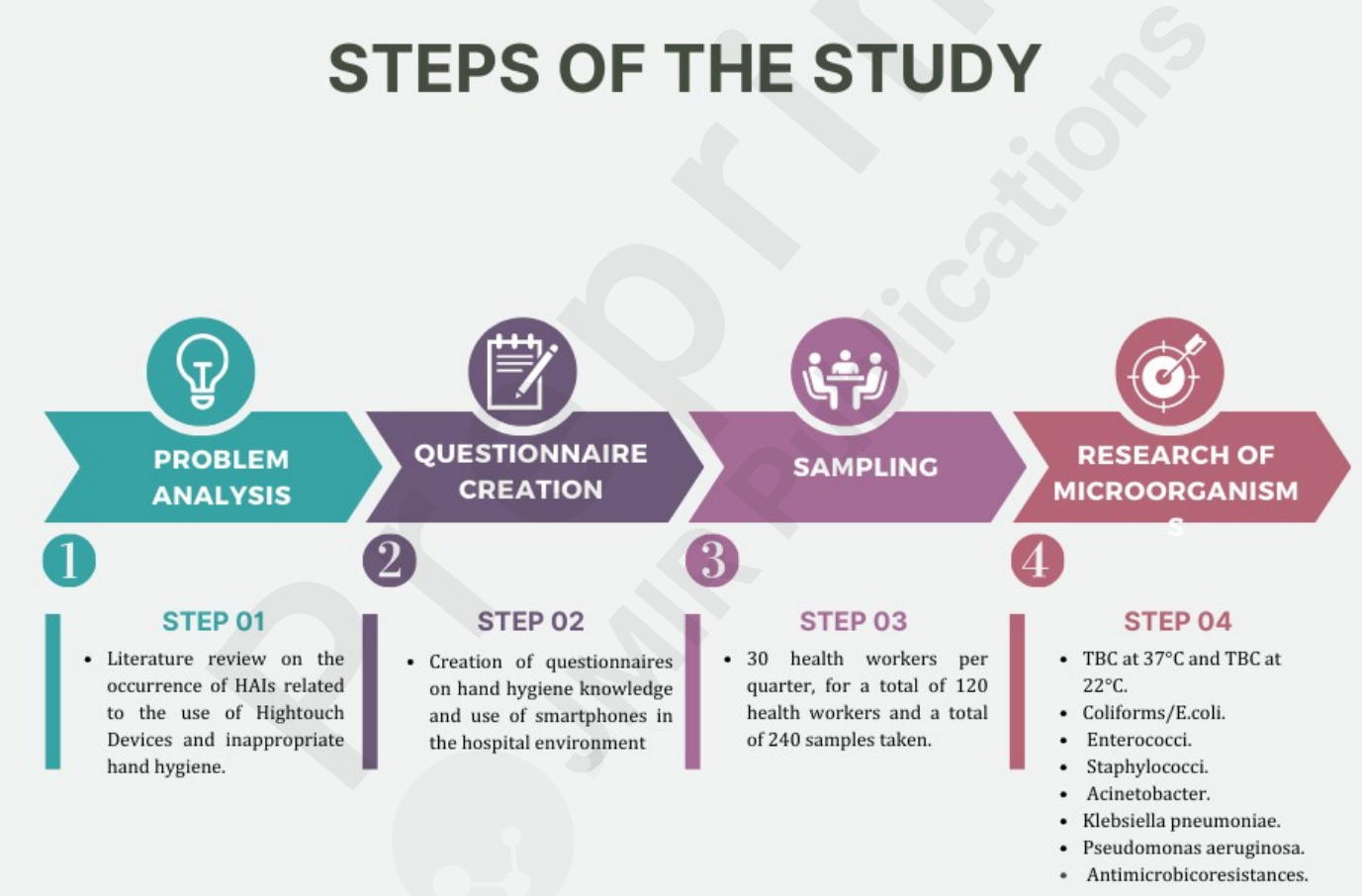

Figure 1. Steps of the study.

Results

Staff

Staff involved in the project will include nurses and prevention technicians who will be responsible for taking samples. Biologists and laboratory medicine residents will also be involved in the laboratory analyses in support of the teaching staff of the Department of Biomedicine and Prevention, Section of Hygiene and Preventive Medicine at Rome Tor Vergata. The physicians

specializing in hygiene and preventive medicine, will be in charge of collecting questionnaires and analyzing the collected data, supported by the teaching staff.

Cost

The present study is nonprofit. The main cost of the study will be for laboratory expenses, the burden of which will be covered with funds from the National Complementary Plan, Initiative "DARE - Digital Lifelong Prevention" Code: PNC_0000002 - CUP: B33C2200134000”and by the Department of Biomedicine and Prevention, Section of Hygiene and Preventive Medicine, University of Rome Tor Vergata along with the cost of administering questionnaires and collecting samples.

Publications

The results may be the subject of scientific publications in national and international journals, which will be carried out by the University of Rome Tor Vergata once the trial is over, even in the case of negative results that will be shared with the scientific community.

Conclusions

The purpose of the study is to emphasize the importance of proper hand hygiene combined with proper use during work practice of Hightouch devices and PPE, for the prevention of HAIs. It will be important at the follow-up of the study, to promote, in case the results highlight the presence of multiple Alert organisms, proper education of the staff of the departments involved in the study on the prevention of Care-Related Infections. Following this, new monitoring will be implemented for possible improvement in adherence to good practices in the prevention of care-related infections.

Acknowledgements

Conceptualization, L.P..; methodology, P.D.; software, M.M.; validation, G.M. and A.A.; investigation, L.G. and M.C.; resources, M.C. and C.M.; data curation, A.A. and G.M.; writing—original draft preparation, M.M., G.M., A.A and L.G.; writing—review and editing, M.C. , F.P. and M.M.; visualization, L.P. and P.D.; supervision, L.P., G.M. and A.A.; project administration, L.P.; funding acquisition, L.P. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Abbreviations

JMIR: Journal of Medical Internet Research
HAIs: Healthcare Associated Infections
PTV: Tor Vergata Polyclinic
WHO: World Health Organization
PPE: Personal Protective Device

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Supplementary

Questionnaire 1

Questionnaire of health care workers' attitudes on the use of Hightouch devices in the work environment

Question 1: What type of device do you use most in the workplace

☐Tablet ☐Smartphone ☐PC/ Laptop ☐Other

Question 2: How much do you use hightouch devices in the workplace ?

1 Not at all , 7 Very much

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Domanda 3: When you last cleaned your device's screen?

☐Never ☐Today ☐Last Week ☐Last Month ☐in the last year ☐More than a year ago

Question 4: What kind of covers do you use for your digital devices ?

☐Nothing ☐Glass ☐Plastic ☐Other

Domanda 5: Do you think that the use of a Hightouch device in the workplace may increase the possibility of spreading care-related infections?

1 Not at all 7 Very much

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Question 6: Have you ever worn scrubs outside the department? (possible multiple answer)

☐Never ☐In the toilet ☐ At the canteen ☐Outdoors ☐I use it normally

Question 7:When was the last time you replaced your gown.?

☐Never ☐Today ☐Last Week ☐Last Month ☐in the last year ☐More than a year ago

Question 8:How often do you wash your hands after removing your gloves?

1 Never 7 Always

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1	2	3	4	5	6	7
○	○	○	○	○	○	○

Question 9: Do you wear gloves when hand exposure to body fluids is expected?

1 Never 7 Always

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Question 10: Avoid wearing objects(rings,watches,bracelets, etc.) or using nail polish/gel or semi-permanent while using gloves ?

1 Never 7 Always

1	2	3	4	5	6	7
○	○	○	○	○	○	○

Questionnaire 2

WHO validated questionnaire, translated into Italian and adapted by the Lazio region, for health workers.

“Regional intervention plan on hand hygiene: Health worker perception questionnaire”

The questionnaire can be found among the attached documentation.

Supplementary Files

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