Quality Assessment of the *SureWash Pocket*® App for Hand Hygiene Compliance

Avaliação da qualidade do aplicativo *SureWash Pocket*® para adesão à higiene das mãos

Evaluación de la calidad de la aplicación *SureWash Pocket*® para la adherencia a la higiene de manos

Érica Baggio[1] , Juliano Bortolini[2] , Mara Regina Rosa Ribeiro[2] , Antônio César Ribeiro[2] , Richarlisson Borges De Morais[3] , Liliane Moretti Carneiro[1] , Odinéa Maria Amorim Batista[4] , Mayara Callado Silva Moura[4] , Tainá Evelin De Sousa[5] , Marilia Duarte Valim[1]

[1] Universidade do Estado de Mato Grosso, Programa de Pós-Graduação em Enfermagem. Mato Grosso (MT), Brasil.

[2] Universidade Federal de Mato Grosso, Programa de Pós-graduação em Enfermagem. Mato Grosso (MT), Brasil.

[3] Universidade Federal De Uberlândia, Minhas Gerais (MG), Brasil.

[4] Universidade Federal do Piauí, Programa de Pós-graduação em Enfermagem, Piauí (PI), Brasil

[5] Centro Universitário Brás Cubas, São Paulo (SP), Brasil.

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Corresponding Author:
Marília Duarte Valim
Address: Faculdade de Enfermagem (FAEn), Universidade Federal de Mato Grosso. Avenida Fernando Correa da Costa, 2367, Boa Esperança, ZIP Code: 78060-090, Cuiabá, Mato Grosso, Brasil
CEP: 78060-090
Phone: +55 (65) 99683-0505
E-mail: marilia.duarte.valim@gmail.com

ABSTRACT

Introduction: Mobile health applications, also known as mHealth, have emerged as tools to support hand hygiene compliance in clinical settings. This study aimed to evaluate the quality of the *SureWash Pocket*® application, designed to promote hand hygiene compliance among healthcare professionals. Design: This was a methodological study with a quantitative approach, conducted at a public teaching hospital in the Central-West region of Brazil in 2019. Ten healthcare professionals evaluated the application's quality using the Application Evaluation Scale (user version). Descriptive analyses included the calculation of mean scores and standard deviations for each section of the evaluation. Results: The *SureWash Pocket*® application achieved an average score of 4.11 in the quality domain, considered between good and excellent. The assessments of subjective quality and perceived impact were also positive, with averages of 3.27 and 3.93, respectively. These results suggest that the application is a promising tool for educational support. Implications: The evaluation suggests that *SureWash Pocket*® can contribute to the training and improvement of hand hygiene practices in high-demand clinical environments, serving as an effective and affordable alternative. Future research is recommended to explore the applicability of *SureWash Pocket*® across different contexts and professional groups.

DESCRIPTORS

Hospital infections. Hand hygiene. Mobile applications. Educational technology.

INTRODUCTION

Technological innovations have impacted various fields, with particular emphasis on health and education [1,2]. The rapid spread of internet access via mobile devices has driven the development of mobile health applications (mHealth apps), which have become incorporated into the daily routines of healthcare professionals, primarily through smartphones and tablets [3,4]. These applications have been frequently used to support healthcare delivery [5], but their use remains limited in the control and prevention of healthcare-associated infections (HAIs), particularly in promoting hand hygiene (HH) adherence [6].

The lack of regulation regarding content and the limited involvement of users in the development of these applications are important issues to consider in ensuring information security and the quality of the final product [5,7]. Experts in the field, software developers, and end users must work together in the development and evaluation of mHealth apps [8,9], establishing acceptable metrics to guide the processes of construction, implementation, and use of these applications [10,11].

Given the current landscape, digital devices emerge as complementary alternatives for the control and prevention of HAIs, as these infections remain a global public health challenge with significant morbidity and mortality rates [12]. However, strategies must be adopted to ensure the quality of technological implementation in the work environment. This includes evaluating the application by healthcare professionals to promote healthy behaviors and disseminate safe practices [13].

In response to the demand for effective and high-quality strategies, the *SureWash Pocket®* application presents itself as a promising tool. Incorporating elements of gamification into the learning method, *SureWash Pocket®* was developed based on international recommendations for improving HH technique in a more substantial and interactive manner, theoretically grounded in David Kolb's Experiential Learning Theory [6]. This application can be used as a complementary strategy for training healthcare professionals in infection control and prevention [6,14].

Although *SureWash Pocket®* has been adapted for Brazilian Portuguese [14], its quality has not yet been evaluated among Brazilian users. Unlike other mHealth tools related to HH [6], this application also stands out for its educational focus and its successful experiences in other countries and cultures, reinforcing its relevance to the Brazilian context [15-17].

Therefore, this study aimed to evaluate the quality of the *SureWash Pocket®* mobile health application as perceived by Brazilian healthcare professionals.

METHODS

This was a methodological, technological study with a quantitative approach, conducted between September and October 2019. The research was approved by the Research Ethics Committee of a public teaching and research hospital in the Central-West region of Brazil, under opinion CAAE: 75169317.0.0000.5541.

The *SureWash Pocket®* mobile health application, originally developed in English in Ireland, successfully underwent localization for Brazilian Portuguese and is available on the two major mobile app online stores, Apple App Store® (iOS) and Google Play Store® (Android), featuring a text interface adapted to the local language [14]. However, its quality had not yet been evaluated by Brazilian users, justifying this study, which builds upon previous research conducted by the authors [6,14].

In this study, the sample consisted of ten healthcare professionals: three nurses (RN), three nursing technicians (NT), two physicians (MD), and two physical therapists (PT), all working in critical and semi-critical hospital units, each with at least one year of experience. The sample size was based on literature recommendations for software usability evaluation, where a sample of eight participants is considered sufficient to identify approximately 80% of usability issues [18]. It is acknowledged that the sample size limits the generalizability of the results; nonetheless, it allows for an initial assessment of the usability quality of digital technologies applied to educational training [13]. Professionals from different specialties were included to investigate evaluations across diverse practice contexts, considering that varied professional backgrounds may influence technology assessments differently.

Eligibility criteria required that healthcare professionals own and use a smartphone compatible with either the iOS or Android operating systems and not be exclusively engaged in administrative functions. Selection was performed randomly by lottery based on a work schedule. Only one lottery per professional

category was needed, as the selected individuals met the pre-established inclusion criteria and agreed to participate in the study by signing an informed consent form.

During data collection, participants were instructed to use the application daily for a minimum period of two weeks, using individual login credentials. The research team monitored app usage through the Surewash.net platform, tracking compliance with usability requirements. In two cases of consecutive days without app access, reminders were sent via WhatsApp to check for any doubts that might be hindering app usage. After the reminder, the professionals reported no doubts and justified the lack of access due to high work demands. All participants subsequently fulfilled the requirement of using the app for two consecutive weeks.

After a 20-day interval from the initial contact, an individual meeting was scheduled with each participant to evaluate the *SureWash Pocket*® app using the Mobile App Rating Scale (MARS) – user version, validated for Brazilian Portuguese, which demonstrated an excellent level of internal consistency with a Cronbach's alpha coefficient of 0.91 [19]. This is a self-administered scale composed of 20 items designed to systematically classify and evaluate the quality of mHealth apps. The items are organized into two main domains: App Quality Ratings, which include four sections (A – Engagement, B – Functionality, C – Aesthetics, and D – Information), and Subjective Quality Ratings, which consist of one section (E – Subjective Quality). Additionally, the scale includes an App-Specific section (F), composed of six questions adapted according to the purpose of the app under evaluation, addressing the perceived impact in terms of knowledge, attitudes, and behavior change [13,19]. Each item is rated on a five-point Likert scale (1 = inadequate, 2 = poor, 3 = acceptable, 4 = good, and 5 = excellent). Data collected in this study were organized using Microsoft Excel® and analyzed through descriptive statistics, calculating the mean score and standard deviation (SD) for each section, as well as the mean total score for the App Quality Ratings dimension (sections A, B, C, and D). For the Perceived Impact items (section F), scores were also evaluated using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), with mean and SD calculations. For this study, a cutoff point of 3 was established as the minimum acceptability threshold, based on the original scale (13) and justified by the absence of a more specific benchmark for the hospital context. In addition, qualitative feedback from healthcare professionals was explored to enrich the analysis, presented in the results according to professional category, allowing verification of differences among professional backgrounds.

All selected healthcare professionals participated in the evaluation of the *SureWash Pocket*® mobile health application and completed the study.

RESULTS

Participant Characteristics

The study participants were predominantly female (n=8), with a mean age of 35 years, and accessed the application through their own personal cell phones, using either the iOS (n=6) or Android (n=4) operating systems. Only three participants were part of specific committees within the study hospital. Regarding professional qualifications, the majority of participants held a specialization degree (n=7), as shown in Table 1.

Table 1. Characteristics of the Evaluators of the *SureWash Pocket*® Mobile Health Application. Cuiabá, Mato Grosso, Brazil, 2019.

Professional Category	Work Sector	Age (years)	Highest Professional Qualification	Highest Professional Qualification	Committee Participation	Cell Phone Operating System
Nurse	Adult ICU*	31	Master's Degree in Nursing	Research and Evaluation Management		iOS**
Nurse	Medical Clinic	30	Specialist in Neonatal ICU	Transfusion Committee		Android
Nurse	Adult ICU	38	Specialist in Dermatology with an Emphasis on Wound Care		No	iOS
Nursing Technician (NT)***	Medical Clinic	30	Specialist in Innovative Business Management		No	Android
Nursing Technician (NT)	Medical Clinic	35	Bachelor's Degree in Biomedicine		No	iOS
Nursing Technician (NT)	Medical Clinic	35	Bachelor's Degree in Nursing		No	Android
Physician	Medical Clinic	31	Specialist in Internal Medicine		No	iOS
Physician	Neonatal ICU	62	Doctorate in Pediatrics	Mortality Review; Medical Record and Documentation Review/Regulations		iOS
Physical Therapist	Adult ICU	29	Specialist in Adult ICU		No	Android
Physical Therapist	Adult ICU	32	Master's Degree in Health Sciences		No	iOS

*ICU - Intensive Care Unit
** iOS - iPhone Operating System
*** NT - Nursing Technician

Evaluation of *SureWash Pocket*® by App Users

The mean EAA score for app quality was 4.11 (SD 0.43), classified as good to excellent quality. A complete description of the data is presented in Table 2.

Table 2. Scores from the User Version of the Mobile App Rating Scale for the *SureWash Pocket®* Application.

Professional Category	Sections of the Mobile App Rating Scale					App Subjective Quality	Perceived Impact
	App Quality						
	Engagement (A)	Functionality (B)	Aesthetics (C)	Information (D)	Mean (SD) ABCD	(E)	(F)
Nursing	3.2	4.5	4.67	4.25	4.15 (SD 0.66)	2.5	2.67
Nursing	4.2	4.25	5	4.25	4.42 (SD 0.38)	3.5	4.5
Nursing	3.2	3.75	4.67	4	3.9 (SD 0.61)	2	1.33
Nursing Technician (NT)	4	3.5	3.67	4.25	3.85 (SD 0.34)	3.5	5
Nursing Technician (NT)	3.6	4.5	4	4.75	4.21 (SD 0.51)	4.25	5
Nursing Technician (NT)	4.4	4.25	4.33	4.75	4.43 (SD 0.22)	4	5
Medicine	4.4	4.75	5	5	4.79 (SD 0.28)	3.75	5
Medicine	2.4	3.5	3.67	3.75	3.33 (SD 0.63)	3.25	3.83
Physical Therapy	4.4	3.75	4.33	5	4.37 (SD 0.51)	4	4.67
Physical Therapy	3	4.25	4.33	3	3.64 (SD 0.75)	2	2.33
Mean (SD)	3.68 (SD 0.71)	4.1 (SD 0.44)	4.37 (SD 0.48)	4.3 (SD 0.62)	4.11 (SD 0.43)	3.27 (SD 0.83)	3.93 (SD 1.35)

* Standard deviation
** NT - Nursing Technician

Regarding the app's subjective quality section, the score per healthcare professional ranged from poor to good, and this section had the lowest average score (mean 3.27; SD 0.83). It is important to highlight that this section showed moderate variability in the scores given by healthcare professionals, with 30% rating it as good quality (≥4.0) and another 30% rating it as poor quality (<3.0). Half of the participants (n=5) stated they would use the app 10 to 50 times over a 12-month period, and most (n=6) said they would recommend the app to individuals who could benefit from it, although the same number (n=6) indicated they would not pay for the app. The average star rating — comparable to the star ratings in online app stores — was 3.8, thus classified as satisfactory.

The perceived impact section showed greater variability when considering individual scores assigned by participants (mean 3.93; SD 1.35). The app may have a good impact on increasing awareness of correct technique and hand hygiene adherence, promoting attitudes aimed at improving correct technique and adherence, and motivating behavior change (mean 4.0). As a source of help and behavior change, it was rated as having an acceptable impact (mean 3.9). The lowest impact was related to knowledge (mean 3.8), as two healthcare professionals considered it inadequate, believing they already possessed the necessary knowledge on the topic.

User Feedback on the *SureWash Pocket®* Application

Participants' comments were grouped into positive experiences, negative experiences, and suggestions for improvement. The positive experiences reported by two participants, both nursing technicians, emphasized the importance of the topic and their understanding of the educational purpose of the *SureWash Pocket®* app:*"I found the app excellent; I only had difficulty when it came to washing the thumb" (NT, iOS);"In the last levels, 4 and 5, it gets very fast, requiring memorization of the technique, which makes the hand hygiene action simple and continuous. It was interactive training. It would also be interesting for guiding and training companions and patients, raising awareness and preventing future infections" (NT, Android).*

Regarding negative experiences, most comments were related to the speed of the more advanced levels (4 and 5): *"As the time decreases, you need to be faster, which makes it difficult to perform the technique correctly" (RN, iOS);"The execution speed for the steps could be slower" (MD, iOS);"In the last two levels, the focus is on agility rather than on the quality of hand hygiene" (PT, iOS).*

Additionally, two healthcare professionals — the same ones who considered the app inadequate for increasing knowledge about the correct technique and hand hygiene adherence — found the tool irrelevant for use by healthcare professionals, stating: *"Perhaps the app would be more interesting for undergraduate and technical course students; for professionals who already know the correct technique and have good habits, it ends up being irrelevant" (PT, iOS); "I don't believe it is advisable to encourage professionals to perform the hand hygiene technique quickly" (RN, iOS).*

Only four healthcare professionals suggested improvements for the app, including: providing instructions about the goal of each speed level in the app and/or increasing the time allowed to perform the hand hygiene steps in the final levels.

DISCUSSION

The results for the *SureWash Pocket®* app indicated acceptable to good quality across all evaluated sections, suggesting that it could be used as an innovative technological tool for multimodal educational intervention on hand hygiene (HH), with a globally comparable impact. A systematic review showed that the main factors influencing healthcare professionals' use of mobile health applications are related to individual, organizational, and contextual aspects, notably purpose and ease of use, technical components, design, cost, time, privacy, security, familiarity with technology, risk-benefit assessment, and interaction with colleagues, patients, and managers [20].

Studies conducted using the *SureWash* learning method have demonstrated the effectiveness of this technological strategy in improving healthcare professionals' HH technique [15,16]. A study conducted at a private hospital in Ireland found that compliance with the five moments of HH increased from 42% to 84% (p<0.0001) after 12 months of a multimodal intervention using SureWash. Regarding technique, the average approval rate rose from 52% before the educational intervention to 79% one year after the intervention (p<0.0001) [15].

The *SureWash Pocket®* app follows WHO recommendations for performing the HH technique [6]. However, recent studies evaluating HH technique have shown that most healthcare professionals do not execute all six recommended steps, and adherence tends to be higher when the simplified three-step technique is encouraged. The simplified HH technique has proven efficacy in reducing microbial load on hands and involves only three steps: covering all hand surfaces with the antiseptic; rotational rubbing of fingertips on the palm of each hand alternately; and rotational rubbing of both thumbs [21-23].

Additionally, it is recommended that HH with alcohol-based hand rubs should last between 20 to 30 seconds, and with soap and water between 40 to 60 seconds. It is important to reduce the time required to perform the technique without compromising its effectiveness, aiming to improve HH adherence in healthcare settings, as time pressure, workload, and inadequate infrastructure (such as inaccessible or distant sinks) are recognized barriers to compliance [24]. Given this, it may be more important to prioritize the quality of HH technique movements rather than just the duration, and to continue developing studies on the efficacy of the simplified three-step HH technique [23,25].

The main limitation of this study is that the *SureWash Pocket®* app is already patented and licensed by Glanta Ltd. (Dublin, Ireland), preventing the implementation of some suggestions made by users, particularly regarding the app's speed settings. Additionally, the small sample size and the potential

Hawthorne effect, where participants may temporarily improve their behavior due to awareness of being observed, limit the generalizability of the findings. Future studies with larger samples are recommended to evaluate the app's effectiveness in promoting correct technique and adherence to the five moments of HH among healthcare professionals, aiming to reduce HAI rates, particularly in critical care settings, and to contribute to the reduction of morbidity and mortality associated with these infections [7,9].

CONCLUSION

The *SureWash Pocket*® app, successfully localized for Brazilian Portuguese, was evaluated as having good to acceptable quality across all sections, with emphasis on the App Quality domain. User evaluation enables greater acceptance, use, and a better experience for the target audience, helping to achieve the app's intended goals.

Thus, the *SureWash Pocket*® app can be implemented as a complementary educational strategy in hospital training programs, integrated into multimodal programs of continuous and permanent education in healthcare services. This approach would ensure that all healthcare professionals have sufficient time to access the app and are adequately trained in its use. Additionally, it is essential to provide specific guidelines for the correct and safe use of the app, incorporate it into the training process, and maintain continuous monitoring of app usage, regular user feedback, and ongoing evaluation of its effectiveness and usability. Periodic reviews are also recommended to ensure the app remains appropriate for hospital contexts and meets the needs of healthcare professionals.

Furthermore, there is a need for longitudinal studies to assess the impact of *SureWash Pocket*® on clinical practice and proper HH adherence, providing more robust data on the app's effectiveness in sustainably maintaining these practices among healthcare professionals. These studies would offer a deeper understanding of its potential effects on patient safety and the control and prevention of HAIs.

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AUTHOR CONTRIBUTIONS

All authors contributed to the project's conception, data collection, analysis, and interpretation. There was active participation in the discussion of the results and in the writing of the article, as well as in the final review and approval of the version to be published. All authors agree with the accuracy and integrity of the information presented in the manuscript.

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ETHICS APPROVAL

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CONFLICT OF INTEREST

The authors declare no conflict of interest.