Prevalence of Microorganisms on the Surface of Healthcare Professionals' Cell Phones: Scoping Review

Prevalência de Microrganismos na Superfície de Aparelhos Celulares de Profissionais da Saúde: Revisão de Escopo

Prevalencia de Microorganismos en la Superficie de los Teléfonos Celulares Utilizados por Profesionales de la Salud: Revisión del Alcance

RESUMO

Objetivo: estimar a prevalência de contaminação microbiana na superfície de aparelhos celulares utilizados por profissionais de saúde e identificar os principais microrganismos isolados. **Metodologia:** Scoping Review segundo as diretrizes do Joanna Briggs Institute. A busca, realizada entre agosto e novembro de 2025 nas bases PubMed/MEDLINE, SciELO, BDENF e Google Scholar, incluiu estudos transversais de 2020 a 2025, em português, espanhol e inglês, envolvendo a obtenção de culturas microbianas da superfície de aparelhos celulares de profissionais de saúde. **Resultados:** Foram incluídos 13 estudos, que identificaram taxas de contaminação microbiana variando de 60% a 100% nos celulares de profissionais da saúde. Os microrganismos mais frequentes foram bactérias Gram-positivas e Gram-negativas associadas às infecções relacionadas à assistência à saúde, além da detecção de SARS-CoV-2 em alguns estudos. **Considerações Finais:** Os resultados mostram alta prevalência de contaminação microbiana em celulares de profissionais da saúde. Esses dispositivos atuam como fômites relevantes, reforçando a necessidade de sua desinfecção regular como parte das estratégias de prevenção e controle de infecções.

DESCRITORES: Smartphone; Profissionais da Saúde; Fômites; Contaminação de Equipamentos; Controle de Infecções.

ABSTRACT

Objective: To estimate the prevalence of microbial contamination on the surface of cell phones used by healthcare professionals and identify the main microorganisms isolated. **Methodology:** Scoping Review according to the guidelines of the Joanna Briggs Institute. The search, conducted between August and November 2025 in the PubMed/MEDLINE, SciELO, BDENF, and Google Scholar databases, included cross-sectional studies from 2020 to 2025, in Portuguese, Spanish, and English, involving the collection of microbial cultures from the surface of cell phones belonging to healthcare professionals. **Results:** Thirteen studies were included, which identified microbial contamination rates ranging from 60% to 100% on healthcare professionals' cell phones. The most frequent microorganisms were Gram-positive and Gram-negative bacteria associated with healthcare-related infections, in addition to the detection of SARS-CoV-2 in some studies. **Final Considerations:** The results show a high prevalence of microbial contamination on healthcare professionals' cell phones. These devices act as relevant fomites, reinforcing the need for their regular disinfection as **DESCRIPTORS:** Smartphone; Healthcare Professionals; Fomites; Equipment Contamination; Infection Control.

RESUMEN

Objetivo: elaborar un manual para familiares y visitantes de pacientes ingresados en la Unidad de Terapia Intensiva de un hospital público universitario. **Método:** estudio de diseño metodológico. La elaboración del producto constó de tres etapas: una revisión integradora de la literatura; la elaboración del manual y la validación del contenido por parte de especialistas. Fue aprobado por el comité de ética local, con el dictamen número 4.190.568. **Resultados:** las evidencias científicas demostradas en la síntesis de conocimientos se especificaron en el manual. La versión final del manual puede consultarse en el enlace: https://drive.google.com/file/d/1DDl6kKKblFTgAQAK49Jw_KAmmdI4Bvd8/view?usp=sharing. **Conclusión:** el manual elaborado en formato digital se construyó basándose en las evidencias científicas demostradas por la síntesis de conocimientos de la revisión integradora de la literatura. La aplicabilidad del manual permite una acogida humanizada a los visitantes y proporciona las condiciones para que el equipo sanitario ofrezca orientación presencial y virtual.

DESCRIPTORES: Humanización; Acogida; Familias; Unidad de Terapia Intensiva; Pandemia; Covid-19.

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INTRODUCTION

The use of cell phones as a tool to support professional activities has been steadily increasing, driven by technological expansion. Although this evolution has brought significant advantages in all sectors, it is also necessary to consider the negative effects of *smartphone* use in clinical practice. In the hospital setting, their handling can promote cross-contamination, contribute to the maintenance of healthcare-associated infections (HAIs), and increase the risk of spreading multidrug-resistant bacteria[(1,2)] .

The uncontrolled use of mobile devices contributes to an increased likelihood of cross-contamination, consequently impacting the incidence of hospital infections and causing an increase in hospitalization time and costs, making it a topic of relevance in the field of patient safety[(2,3)] . Current research emphasizes cell phones as fomites, increasing the risk of spreading nosocomial diseases, since the hygiene of these devices is often neglected[(4,5)]. More microorganisms can be found on a cell phone than on a toilet seat, the sole of a shoe, or a door handle[(6)].

In 2020, a review of 56 studies found that, on average, 68% of cell phones were contaminated with microorganisms, including antibiotic-resistant bacteria[(7)]. In the hospital environment, bacterial colonization on healthcare professionals' cell phones was associated with hand contamination, suggesting that devices may contribute to cross-contamination[8] . In addition, studies have shown that cell phones in hospital settings were often contaminated with serious pathogens, such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*, and *Acinetobacter sp*. - microorganisms associated with serious and difficult-to-treat infections[(7,9)]. Multidrug-resistant bacteria, with the potential to cause nosocomial infections, account for 40–70% of the contamination of healthcare professionals' cell phones[(10).]

Cell phones are widely used in clinical settings and can be colonized by potentially pathogenic bacteria, which can lead to the transmission of nosocomial infections[(8)]. These infections involve the cross-transmission of different pathogens—bacteria, viruses, or fungi—contained on the surfaces of devices, which can act as reservoirs[(6,11,12)]. Handling these devices with dirty hands and/or infrequent cleaning of equipment can aggravate health risks[(13)].

Cell phones act as "Trojan horse" devices that: (i) circumvent recommended hand hygiene practices; (ii) are likely linked to the spread of pathogens through cross-contamination transmission routes; and (iii) contribute to infections and hospitalizations in the global population due to nosocomial infections[(14)].

Given the above, the objective of this study is to estimate the prevalence of microbial contamination on the surface of cell phones used by healthcare professionals and to identify the main microorganisms isolated.

METHODOLOGY

This is *a Scoping Review* based on the recommendations of *the Joanna Briggs Institute - JBI Manual for Evidence Synthesis: Chapter 11: Scoping Reviews*[(15)] . The purpose of the scoping review is to address broad topics, gathering and synthesizing comprehensive scientific evidence, which enables the analysis of emerging evidence and the identification of knowledge gaps. In addition, it allows for the rigorous mapping, examination, and systematization of specific concepts and characteristics, delimiting the nature of a broad field of knowledge. This scoping review was registered in *the Open Science Framework* (OSF) and is available at: https://doi.org/10.17605/OSF.IO/CAESZ

The scoping review is conducted in five interrelated steps: (1) definition of the research question; (2) identification of relevant studies through a search strategy; (3) selection of studies; (4) mapping of data; and (5) synthesis and presentation of results[(15)].

The research was guided by the following question: what is the prevalence of contamination on the surfaces of healthcare professionals' cell phones and what are the main microorganisms isolated?

The search for relevant studies was conducted between August and November 2025 in the Virtual Health Library (VHL), the *PubMed/MEDLINE (National Library of Medicine)* databases*, SciELO Scientific Electronic Library Online (SciELO)*, and the Nursing Database (BDENF). Additionally, a complementary search for gray literature was conducted in *Google Scholar*.

The theoretical framework was constructed based on a combination of the terms presented in Table 1, using the Boolean operators “OR” to associate synonyms and “AND” to interrelate different concepts.

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Table 1 – Terms used to develop the search strategy.

Concept	DeCS / MeSH	Synonyms/free terms
Health professionals	Health Personnel Healthcare Workers	Health Professionals Medical Staff Healthcare Professionals
Cell Phones	Cell Phones Mobile Phones	Smartphone* Mobile Device* Cellular Phone*
Microbial contamination / microorganisms	Cross Infection Microbial Contamination Bacteria Fungi	Concept Health professionals Cell Phones Microbial contamination / microorganisms Prevalence and isolation
Prevalence and isolation	Prevalence Cultures	Frequency Isolation Microbial Culture Bacterial Isolates

Source: the authors, 2025.

Eligibility criteria: articles published in full; studies in Portuguese, Spanish, or English; publications between 2020 and 2025 (until November); primary studies with a cross-sectional design; investigations that performed microbial cultures of cell phone surfaces; and conducted with healthcare professionals.

Exclusion criteria: duplicate studies; literature reviews, editorials, letters to the editor, protocols, case reports, and qualitative studies; research that did not involve cell phones or did not perform microbial cultures; studies with a population not composed of healthcare professionals; and publications outside the established period or languages.

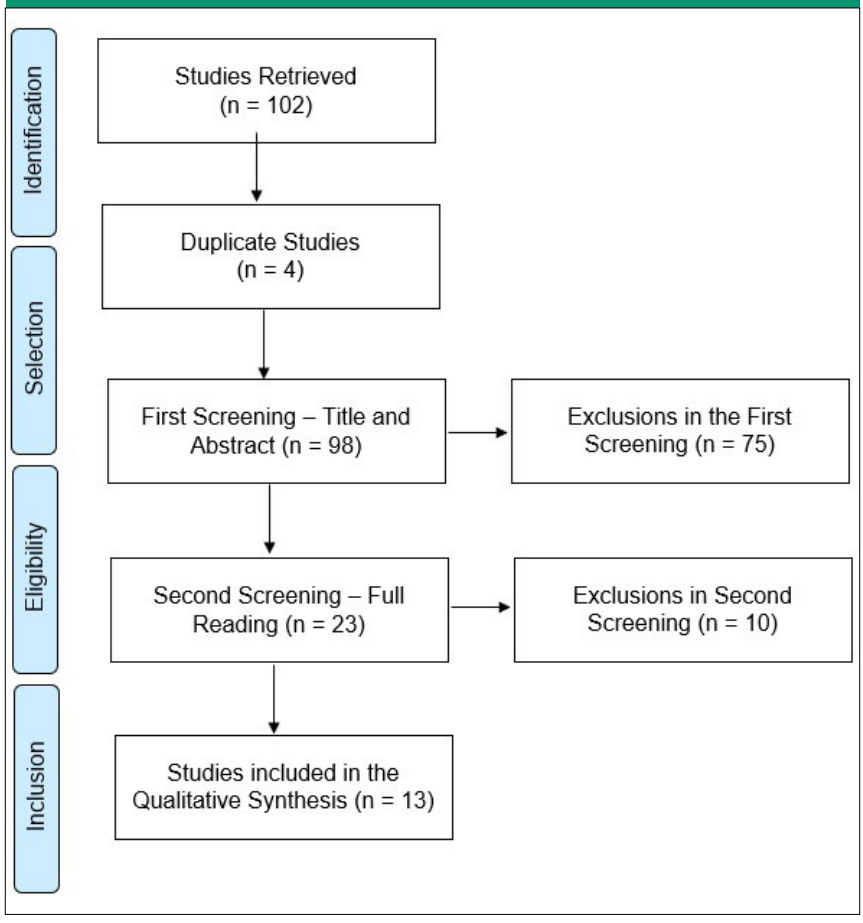
All retrieved studies were screened for eligibility by two independent reviewers according to the inclusion criteria. The selection process occurred in two stages: (i) evaluation of titles and abstracts; and (ii) full-text reading of potentially eligible texts, with recording of exclusion justifications.

The included studies underwent data mapping *(data charting)*, performed by two reviewers, covering bibliographic information (authors, year, country, and journal) and data related to the concept and context of the study (methodological characteristics and main findings). The mapped data were organized and presented through narrative synthesis, according to the objectives of the scoping review.

RESULTS

The search strategy retrieved 102 relevant studies. Using the previously established criteria, 13 studies comprised the sample of the present study. The selection process is detailed in Figure 1.

Figure 1- Flowchart of identification, selection, and inclusion/exclusion of studies.



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In the second stage of screening, 10 studies were excluded because they did not meet the eligibility criteria. Of these, two were literature reviews, five included populations that were not health professionals, two did not report the isolated microorganisms, and one was a letter to the editor. The data from the included studies are presented in Tables 2 and 3.

Table 2 - Narrative summary of the general characteristics of the studies.

Author/Year	Country	Title	Journal/ Database
Correa et al (2023)[16]	Brazil	Mobile phones of anesthesiologists as reservoirs of nosocomial bacteria in a quaternary teaching hospital: an observational study	Braz J Anesthesiol/ PubMed
Espinoza et al (2021)[17]	Brazil	Are mobile phones part of the chain of transmission of SARS-CoV-2 in hospital settings?	Rev. Inst. Med. trop. S. Paulo/ SciELO
Cabral et al (2021)[18]	Brazil	Contaminação de aparelhos celulares da equipe de enfermagem em unidade de terapia intensiva de um hospital público do noroeste paranaense	Arq. Ciênc. Saúde Unipar / Google Scholar
Mushabati et al (2021)[19]	Zambia	Bacterial contamination of mobile phones of healthcare workers at the University Teaching Hospital, Lusaka, Zambia	Infect Prev Pract/ Pubmed
Galdino Júnior et al (2022)[20]	Brazil	Biofilme em smartphones de profissionais da saúde: padrão de uso de descontaminação do aparelho	Rev. Eletr. Enferm/ SciELO
Yao et al (2022)[21]	China	Bacterial Colonization on Healthcare Workers' Mobile Phones and Hands in Municipal Hospitals of Chongqing, China: Cross-contamination and Associated Factors	J Epidemiol Glob Health / PubMed
Tannhäuse et al (2022)[22]	Germany	Bacterial contamination of the smartphones of healthcare workers in a German tertiary-care hospital before and during the COVID-19 pandemic	Am J Infect Control/ Pubmed
Kuriyama et al (2021)[23]	Japan	Prevalence of bacterial contamination of touchscreens and posterior surfaces of smartphones owned by healthcare workers: a cross-sectional study	BMC Infec. Dis/ PubMed
Elbarghathi et al. (2025)[24]	Libya	Mobile Phones and Multidrug Resistant Bacteria: A Growing Concern for Healthcare Workers	Libyan Med J / Google Scholar
Kuriyama et al (2021)[25]	Japan	A cross-sectional study on bacterial contamination on the touchscreens and posterior surfaces of smartphones of emergency department staff	J Eval Clin Pract/ Pubmed
Asfaw et al (2021)[26]	Ethiopia	High Rate of Bacterial Contamination on Healthcare Worker's Mobile Phone and Potential Role in Dissemination of Healthcare-Associated Infection at Debre Berhan Referral Hospital, North Shoa Zone, Ethiopia	Risk Manag Healthc Policy/ Pubmed
Qadi et al (2021)[27]	Palestine	Microbes on the Mobile Phones of Healthcare Workers in Palestine: Identification, Characterization, and Comparison	Can J Infect Dis Med Microbiol/ Pubmed
Al-Beeshi (2021)[28]	Saudi Arabia	The bacterial colonization of healthcare workers' mobile phones in a large tertiary care teaching hospital in Saudi Arabia	J Infect Dev Ctries/ Pubmed

Source: the authors, 2025

Table 3 - Narrative synthesis – main results identified

Author/ Year	Results	Isolated Microorganisms
Correa et al (2023)[16]	A total of 128 cell phones were examined, of which 86 showed bacterial contamination. Bacterial contamination was identified in 67.2% of anesthesiologists' cell phones.	Micrococcus spp
Espinoza et al (2021)[17]	Fifty people participated in the study. The percentage of cell phone contamination was not identified, with only qualitative results related to SARS-CoV-2 detection being presented.	SARS-CoV-2
Cabral et al (2021)[18]	Twenty-two employees participated in the study. The presence of microorganisms on the cell phones of nursing professionals in the ICU was 100%.	Staphylococcus aureus, Staphylococcus epidermidis, Klebsiella pneumoniae e Enterobacter spp
Mushabati et al (2021)[19]	Thirty-eight healthcare professionals participated in the study. Seventy-nine percent of the smartphones evaluated showed bacterial contamination	Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Staphylococcus haemolyticus, Escherichia vulneris, Escherichia coli e Klebsiella pneumoniae
Galdino Júnior et al (2022)[20]	Thirty-eight professionals participated in the study. Biofilm contamination was identified in 100% of the smartphone screen samples from healthcare professionals.	Bactérias Gram-negativas e Staphylococcus aureus

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Yao et al (2022)[21]	The study had 50 participants. 95.5% of phones were contaminated with bacteria	Staphylococcus epidermidis, Acinetobacter baumannii, Staphylococcus haemolyticus e Staphylococcus aureus.
Tannhäuse et al (2022)[22]	295 healthcare professionals participated. 99.3% of smartphones were contaminated.	SARS-CoV-2
Kuriyama et al (2021)[23]	The sample consisted of 12 healthcare professionals and their respective cell phones. About 60% of the smartphones used by healthcare professionals were contaminated.	Staphylococci (CoNS), Bacillus species e Taphylococcus aureus
Elbarghathi et al. (2025)[24]	Sixty samples were collected in three hospitals. The overall prevalence of contamination of cell phones was 84%.	Pseudomonas aeruginosa, Escherichia coli, Staphylococcus epidermidis, Klebsiella pneumoniae, Staphylococcus aureus
Kuriyama et al (2021)[25]	Forty smartphones belonging to healthcare professionals were analyzed. The contamination rate was 65% on the screen and 90% on the back surface.	Bacillus spp. e estafilococos coagulase-negativos
Asfaw et al (2021)[26]	Sixty-five healthcare professionals participated in the study. 100% of cell phones showed bacterial contamination. Eighty-four bacterial isolates were identified.	Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus spp., Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter spp., Enterobacter spp. cter spp., Enterobacter spp.
Qadi et al (2021)[27]	Three hundred individuals (200 healthcare professionals and 100 students) participated in the study. The contamination rate of cell phones was 87.5%.	Staphylococcus aureus, estafilococos coagulase-negativos, Enterobacteriaceae
Al-Beeshi (2021)[28]	130 cell phones belonging to healthcare professionals were analyzed. The contamination rate was 71.5% of the devices	Staphylococcus epidermidis, Micrococcus spp., Staphylococcus hominis, Bacillus spp., Staphylococcus aureus, Pseudomonas sp.

Source: the authors, 2025

The studies included in this scoping review reported the presence of different microorganisms on cell phones used by healthcare professionals, including Gram-positive bacteria, Gram-negative bacteria, and viruses.

Table 4 - Microorganisms identified on healthcare professionals' cell phones: distribution of Gram-positive and Gram-negative bacteria.

Classification	Microorganisms
Gram-positive bacteria	• Staphylococcus aureus • Staphylococcus epidermidis • Staphylococcus haemolyticus • Staphylococcus hominis • Coagulase-negative staphylococci (CoNS) • Micrococcus spp. • Bacillus spp. • Enterococcus spp
Gram-negative bacteria	• Escherichia coli • Escherichia vulneris • Klebsiella pneumoniae • Enterobacter spp. • Acinetobacter baumannii • Acinetobacter spp. • Pseudomonas aeruginosa • Pseudomonas spp

Source: the authors, 2025

The contamination rate of equipment ranged from 60% to 100% of the samples analyzed. Three studies reported 100% contamination[18,20,26]. Among Gram-positive bacteria, *Staphylococcus aureus, Staphylococcus epidermidis, coagulase-negative staphylococci (Staphylococcus haemolyticus, Staphylococcus hominis)*, as well as *Micrococcus spp., Bacillus spp., and Enterococcus spp*. were mainly observed.

In the Gram-negative bacteria group, species potentially associated with healthcare-related infections were identified, including *Escherichia coli, Klebsiella pneumoniae, Enterobacter spp., Acinetobacter spp*. (especially *Acinetobacter baumannii*) and *Pseudomonas spp*., especially *Pseudomonas aeruginosa*. Some studies reported the isolates only in aggregate form, as belonging to the *Enterobacte-*

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riaceae family.

In addition to bacteria, two studies also described the detection of *SARS-CoV-2* on cell phones, indicating the potential of these devices as fomites in viral transmission in healthcare settings.

DISCUSSION

Mobile devices have become indispensable accessories in clinical practice. They increase the quality of healthcare by providing rapid communication and easy access to laboratory test results, images, and patient records. At the same time, however, they can act as vectors for pathogenic microorganisms and, as such, represent a potential risk of hospital infection[(9)]. These devices can serve as reservoirs from which HAIs can spread to the hands of healthcare professionals and then to patients[(8)]. Although technological advances have brought significant advantages in all sectors, it is also necessary to consider the negative effects of *smartphone* use in healthcare settings[(2)].

Healthcare professionals' cell phones are fomites for potentially pathogenic and highly drug-resistant microorganisms, constituting an important route of cross-contamination due to the low frequency with which they are sanitized and the cyclical contamination of hands and face. The difficulty in accepting sanitization stems from the fear of damaging the device, lack of time, and the absence of clear visual protocols. Cell phones are rarely sanitized and are always in contact with the hands and different parts of the face, as well as with work surfaces, which facilitates the transmission of infections inside and outside the hospital environment[(2.32)].

Cell phones used by healthcare professionals show significant bacterial contamination, especially on the back surfaces, which makes accurate and effective disinfection difficult. This difficulty increases the chances of cross-contamination and subsequent problems after use.

In a recent report of a survey of healthcare professionals in an acute pediatric care setting in Australia, 56% (86/165) of respondents indicated that they use their cell phones in the bathroom, demonstrating the use of these devices in unhygienic environments[(33)].

One study evaluated microbial contamination on the surface of dental students' cell phones before and after disinfection with 70% alcohol. It was observed that, in samples collected without the use of alcohol wipes, the contamination rate was 81%, with an average count of 120,953 CFU/mL. After a single disinfection, microbial contamination was reduced to 21%, corresponding to 201 CFU/mL[34].

The presence of these microorganisms on cell phones and surfaces in the hospital environment is concerning, as it represents a risk of pathogen transfer to patients and spread in the community[29]. Although no causal relationship has been established, strong associations have been reported. Guidelines from hospital infection control committees are needed on restriction, care, and routine cleaning of cell phones, as well as further research. Efforts to limit patient exposure to microorganisms may be negated if cell phones are not regularly decontaminated.

One study evaluated the survival capacity of clinically relevant microorganisms present on cell phones and found that hospital pathogens—especially *Staphylococcus aureus* and other microorganisms associated with healthcare-associated infections (HAIs)—remained viable for prolonged periods, ranging from hours to days, on the surfaces of these devices[(37)]. Furthermore, evidence indicates that bacteria isolated from cell phones often exhibit multidrug resistance profiles[38].

Antimicrobial resistance is a major concern for human health. Worldwide, 4.95 million deaths are associated with bacterial resistance to antimicrobials. *E. coli, S. aureus, Klebsiella spp., Streptococcus spp., Acinetobacter spp.*, and *Pseudomonas spp.* are known to be the main pathogens causing deaths associated with resistance[((39))].

In addition to bacterial infections, fomites play a significant role in the transmission of various viruses and fungi[(40)]. However, this risk may be underestimated due to a restricted microbiological approach, since many studies prioritize bacterial identification and employ limited methodologies for the detection of non-bacterial microorganisms, which contributes to the underestimation of the biological impact associated with these devices[(41)].

It should be noted that culture-based methods alone drastically underestimate microbial diversity. This suggests that many studies (focused only on cultivable bacteria) have likely failed to detect fungi or microorganisms that are difficult to culture[(42)]. The methodology used in sample collection and processing can introduce unintended biases, since variables such as the type of *swab* used, transport time and conditions, and the selection of culture media significantly influence the recovery and detection of microorganisms, which may result in an underestimation of the microbial load present[(41,43)].

With the COVID-19 pandemic, there has been an increase in the use of digital devices, including cell phones, to access and record information in the healthcare setting. This can potentially increase the risk of contamination and transmission of microbial agents, including SARS-CoV-2[29]. Two included studies corroborate

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these data by reporting the detection of SARS CoV-2 on the surface of equipment[17,22] .

Although hand hygiene and cell phone use are not mutually exclusive, it is crucial to recognize the potential role of cell phones in the disease transmission cascade and take appropriate evidence-based measures. Cell phones should be considered relevant fomites, and the disinfection of mobile devices should be included in hospital infection control protocols (the "6th moment" of hand hygiene)[45].

Recent reviews continue to point out that low compliance with cell phone hygiene (estimated at between 8% and 13% of professionals) is a critical flaw. The biggest challenge lies in the absence of a standardized disinfection protocol in place in healthcare institutions, which requires the development of evidence-based guidelines[(46)]. Raising awareness among healthcare professionals about the transmission of microorganisms via cell phones is essential to improve hand and mobile device hygiene practices, reduce the risk of infection, and strengthen hospital infection control measures.

In addition, several studies indicate that one of the main barriers to the cleaning of cell phones by healthcare professionals is the fear of damaging the device, especially the screen and its sensitive components, a concept known as *"fear of* cleaning-related *device* damage." Professionals report uncertainty about applying liquids near charging ports and microphones, as well as concern about damage to the screen coating[((30,48))].

In this context, the disinfection of cell phones should be recognized as an essential component of infection prevention and control strategies and should occur as frequently as hand hygiene[((49))]. In this scenario, the use of ultraviolet C (UV-C) light stands out as a complementary technology with a high impact on reducing cross-contamination[((50))]. UV-C sanitizing devices can decontaminate devices in very short intervals, usually between 10 and 20 seconds, offering a fast, effective, and safe alternative. In addition to enhancing basic hygiene practices, this method can be integrated into the workflow of professionals, allowing for the simultaneous disinfection of cell phones during hand hygiene[36] .

The effectiveness of UV-C technology has been proven in field trials, where sanitization resulted in an average reduction in microbial contamination ranging from 84.4% to 93.6% in colony counts, validating it as a fast and efficient means of reducing the spread of microorganisms and complementing hand hygiene[((50))]. Additionally, this feature reduces uncertainty about damage to cell phones during conventional disinfection.

UV-C disinfection is presented not only as a quick alternative, but also as the most cost-effective intervention, with significant savings potential for hospitals over 10 years, when compared to relying exclusively on traditional hand hygiene protocols[((51))] .

FINAL CONSIDERATIONS

The results of this scoping review, obtained from a comprehensive search strategy, show that cell phones used by healthcare professionals have a high prevalence of microbial contamination, including multidrug-resistant bacteria and the SARS-CoV-2 virus. The wide diversity of microorganisms identified reinforces the role of *smartphones* as clinically relevant fomites, capable of contributing to the nosocomial transmission chain of pathogens.

The heterogeneity of the isolated microorganisms and the frequency of contamination observed—ranging from 60% to 100% in the samples analyzed—reinforce the need to incorporate the sanitization of mobile devices as an explicit component of institutional infection control strategies.

Therefore, adopting regular cell phone cleaning routines and integrating their disinfection into infection prevention and control practices is essential to reduce risks, strengthen patient safety, and minimize the spread of microorganisms in the clinical environment. In this context, it is recommended that healthcare institutions implement a multifaceted intervention, including education and training, aimed at significantly reducing the microbial load on portable devices, as well as policies for the rational use of these devices.

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