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Mobile phone hygiene practices in healthcare settings: A mapping review

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ABSTRACT

The aim of this review was to map the evidence related to knowledge, attitude, and hygiene practices of healthcare workers regarding mobile phones in a healthcare setting.

Methods

A comprehensive search across different scientific and health organization databases was conducted for all types of studies focusing on the aim. Primary outcomes included knowledge and attitude of mobile phone hygiene practices; and secondary outcomes are types of phone surface disinfectants and/ or protocols for phone use and disinfection.

Results

A comprehensive search yielded 646 articles. Following the criteria set for inclusion and using a 3-step screening process (titles, abstracts, and full text) for eligibility, a final number of 20 articles were included. Data were meticulously extracted independently by the two reviewers. Only 11 articles looked at knowledge and attitude, but most reviewed types of microbes harboured on mobile phones and related hygiene practices. Healthcare workers were aware of cross-contamination between hands and mobile phones, but disinfection compliance was substandard. Various surface disinfectants (70% alcohol-based solutions) were advised, and mediums included wipes/ swabs. Phone coverings (including cling wrap or plastic bags) are encouraged and limited mobile phone use in healthcare settings are advised.

Conclusion

Mobile phones are a necessity in healthcare settings. Researchers highlighted the importance of mobile phone disinfection as these devices are considered as a fomite. Evidence suggests the need for mobile use and disinfection protocols in all healthcare settings.

Keywords

Mobile phone; hygiene practices; mapping review; alcohol-based disinfectants; disinfectant media; phone coverings; mobile phone use protocol.

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Data availability statement
The datasets generated during and/or analysed during the current study are available from the corresponding authors on reasonable request. Data generated or analysed during this study are included in this published article.

ABSTRACT

Introduction

More than 5.07 billion people globally use mobile phones (MPs) daily. The use of these MPs has become an extension of the office and clinical practice for healthcare workers, including students. The mobile devices are one of the most highly touched surfaces, according to the Centres for Disease Control (CDC) and Prevention, and its use ranges from once every 15 minutes to once every two hours among healthcare workers.[1-2] The mobile devices act as the perfect substrate for colonisation of different microorganisms such as bacteria, fungi and the severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) virus. This allows these microbes to flourish, which then serves as a vehicle in the transmission of nosocomial infections due to direct contact with the hands, face or mouth. This not only indicates the importance of hand hygiene, but also daily MP hygiene to prevent cross-contamination and to avoid transmission of these microorganisms.[1,3-4]

In light of infectious disease outbreaks experienced globally, Coronavirus disease (Covid) and Monkeypox (MPox), the subjects of hygiene practices and infection control are most relevant today.[4-5] Covid, a respiratory infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and MPox, caused by the monkeypox virus (MPox), are both contagious and transmitted directly through close physical contact and via respiratory droplets, small and large, respectively.[4-6] It has also been established that transmission may occur via indirect contact with a contaminated environment or from inanimate surfaces that act as potential sources of infection.[4,5,7-10] A dental or oral health professional may be the first to observe any signs or symptoms of MPox.[5] With the Covid-19 pandemic experienced globally, MPs were regarded as a lifeline in terms of communication. It was used for daily communication at work to allow continuance of everyday activities, including for remote working and teaching and learning, especially at universities when it was advisable not to attend campuses.[10] Subsequently, MPs have been

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included as an essential medium of learning and teaching at educational institutions (medical and dental) and continue to play a valuable role in this setting.[7,10-11]

In the clinical teaching setting, portable devices, including MPs, are used for assessment purposes to record students' scores for related clinical work.[10]

Healthcare workers, including medical and dental students, require the use of a mobile device for a number of diverse situations: viewing health-related news, communication with colleagues, to peruse medical guidelines and drug interactions, checking adverse events and health research, for medical or dental photography and radiology, sharing of medical documents, and of particular importance during the Covid-19 pandemic was through conducting patient tele-consultations.[1,10,12] It was also recommended as a tracking device during the pandemic and advised by governments to use in alerting people of other Covid positive cases in their vicinity and so ensure the safety of all in the prevention and spread of infections.[12] Thus, it has become an essential part of our work and lifestyle and has proven to change and enhance the lives of those who use it. However, by holding these mobile devices, texting, making calls or reading from it in public along with sharing of phones, various microorganisms can be transferred onto its surfaces and across the different surfaces where it is used.[13] Thus, due to its continuous daily use, these mobile devices may, therefore, be considered as "hotspots" for carrying and transmission of these microorganisms, including the SARS-Cov-2.[4,8-9,13-14]

It is apparent that respiratory viruses such as Corona, Coxsackie, Influenza, MPox virus, SARS and Rhinovirus have been shown to persist on surfaces for a few days.[2,5] By touching infected surfaces such as MPs, then touching the eyes, nose and mouth, people may become infected. Evidence suggested that SARS-CoV-2 may remain viable for hours and/or even days on a variety of materials.[1-2,15] The presence of the coronavirus is known to be more stable on plastic and stainless steel than on copper and cardboard and may be detected for up to 72 hours on these surfaces.[15-16] As MPs are neither disposable nor washable, it is a reservoir for microbes and the more time spent with the device, the greater the chances of microbial cross-contamination.[12,15] Similarly, mobile devices are stored in pockets and handbags and are used in different locations eg the toilet, gym, while dining out, and within healthcare settings, allowing contamination and creating an environment for cross-infection. This naturally increases the chances of microbial growth and the spread of nosocomial infections to patients, colleagues, family and friends.[2,15]

Low compliance of hand hygiene and, similarly, infection prevention and device disinfection protocols are found to be poor among healthcare workers including those related to mobile phones.[7,9,12] Evidence suggests that most healthcare workers fail to disinfect and decontaminate their MPs even though they are aware that it can act as a reservoir for microbes.[12] It has been reported that only between 8-13% of healthcare workers clean their devices regularly and about 93.7% had bacterial contamination on their hands after using an MP.[2,12,17] This evidence emphasises the need for proper hand and MP hygiene practices and related clinical protocols.[2,12,17] As stated, healthcare workers are aware of the importance of following an MP hygiene and disinfection routine but what is lacking, however, is a standardised disinfection protocol within healthcare settings.[7,11-12,18] For greater impact among healthcare workers, an evidence-based MP usage policy and disinfection protocol must be established to ensure it becomes the norm in healthcare settings – especially those connected to educational institutions – for successful implementation.[7,12,14]

The review aims to map out the evidence related to knowledge, attitude and practices of staff and students regarding mobile phone use and hygiene practices in a healthcare setting, in light of infectious disease outbreaks.

The objectives of the study were:
1. To map out and/or categorise the studies/evidence related to knowledge, attitudes and practices of workers in a healthcare setting toward mobile phone hygiene practices.
2. To identify different measures (disinfectants and medium) of cleansing mobile phones among workers in a healthcare setting
3. To guide the development of evidence-based and standardised protocols for mobile phone use including hygiene and disinfection practices in healthcare settings.

The research question that was addressed is:
What is the knowledge, attitude and hygiene practices of healthcare workers towards mobile phone use in healthcare settings?

METHODOLOGY

The study design that was used for this review is that of mapping or evidence synthesis.[19] The criteria for this design are similar to other review types.[19] A comprehensive search was conducted for all studies focusing on knowledge, attitude and mobile phone hygiene practices in a healthcare setting.

Search criteria

Inclusion criteria

1. Nature of the research focus is on pre-, during and post-Covid and mobile phone hygiene practices in a healthcare setting.
   Knowledge and attitudes of healthcare workers related to mobile phone hygiene practices.
   Current practices and procedures including types of mobile phone hygienic materials/surface disinfectants used.
   Company recommendations for mobile phone surface hygiene or disinfecting.

The outcomes for the review include:

Primary:	Knowledge and attitude of mobile phone hygiene practices.
Secondary:	Types of mobile phone surface hygiene materials/disinfectants. Procedures or protocols for mobile phone use and/or disinfection.

2. Comparisons
   Different educational or healthcare settings
3. Time period: 2019/01/01-2024/06/30
4. Cultural and linguistic range: English
5. Types of study design
   - Case studies
   - Health Group Reports (WHO, FDI, ADA, CDC)
   - Randomised controlled studies and clinical trials
   - Observational studies
   - Systematic reviews
   - Qualitative research

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Exclusion criteria
Research related to public mobile phone use and disinfection not covered by this mapping review.

Sources
The following databases and scientific working group sites were searched for relevant publications: Medline, Science Direct, Scopus and WHO, FDI, CDC, AMA websites. Reference lists of pertinent studies related to mobile phone use and hygiene practices were screened for additional research.

The key terms and medical subject headings were combined using Boolean operators. An example of the search string that was used is as follows:[20]

(Mobile phone OR smart phone) AND (hygiene practices OR knowledge OR attitudes OR surface disinfectants) AND (hospitals OR health clinic) AND (literature reviews OR reviews OR observational OR clinical trials OR randomised controlled trials OR qualitative research OR systematic reviews) AND (2019/01/01-2024/06/30).

The search strategy had to be kept broad to allow the maximum number of articles to be accessed as the research for this topic was not considered a priority prior to the Covid pandemic. In addition, minor changes to it were allowed to accommodate the differing search engines or databases.[20]

Study selection
A study eligibility form was created to guide reviewers to select appropriate articles from the database searches independently (SK/QI).[21] The researchers then excluded the duplicate articles selected from different databases using Mendeley. Articles were initially screened according to the titles. Following this, the selected articles were screened independently by the two reviewers (SK/QI) for the different sections according to their abstracts as per the inclusion and exclusion criteria and using their expertise as dental practitioners in a healthcare setting. After screening titles and abstracts, the two reviewers met to view any discrepancies, which were resolved through discussion.[21]

The two researchers then independently reviewed the full text version of the selected studies, and consensus was reached through discussion to determine final inclusion. When agreement could not be reached between the two reviewers, a third person (also a dental practitioner) was adjudicated at all stages of screening. The number of articles selected and reasons for exclusion was documented at each stage.

Data extraction
An evidence map provides a broad overview of the specific data from each included study that researchers agree are of value. A data extraction form was developed by reviewers and the data from each full text article was extracted in a standardised manner and summarised in a template that included the following:

- Authors, year of publication, title and geographical location
- Study design
- Setting (hospital, clinical, theatres, medical and dental educational)
- Participants (sample size, sex, staff, students)
- Tool/s
- Outcomes/conclusion
- Key results related to knowledge, attitude, hygiene practices and procedures and/or surface hygiene materials or disinfectants used
- Mobile phone hygiene protocols used at a healthcare setting
- Additional notes (funding, conflict of interest)

Data analysis and synthesis
The search results are reported using a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart, and all included studies were further evaluated according to the data extraction criteria as set out above.[21-22] It was important and necessary to group articles for the mapping of included studies. The characteristics of the included studies is reported descriptively – eg publication date, geographical location and study design – and these are summarised in a table. The extracted data was interpreted to address the review question and the findings synthesised in a narrative review and mapped out on a table. The evidence synthesis or mapping using a high-level map visualising the type of disinfectants used on mobile phones in a healthcare setting was also completed. This paper is reported using the PRISMA checklist as guideline for reporting secondary research.[21-22]

Results
For this mapping review or evidence synthesis, the review was registered with the institutional ethics review board (BMREC Reg No: BM21/9/7).

After searching all relevant databases, 646 articles were obtained following criteria set for inclusion and using a three-step screening process (titles, abstracts and full text) for eligibility and a final number of 20 articles were included (Figure 1).[1-2,7,9,11,16-17,23-35] Data were meticulously and independently extracted by the two reviewers (SK and QI) focusing on the outcomes set for this review.

PRISMA FLOW:
The four categories for reporting the searches and final study inclusion were accurately followed:

a) Identification: The search was extended not just to health databases but also to health working groups and networks due to the paucity of information related to the topic.
b) From the screening, it was noticed that the record numbers were initially high but after measuring these against the inclusion criteria, it reduced substantially. This was an indication of how the searches could be very wide where the different search engines include all terms, even those not applying to the study or review.
c) The inclusion of eligibility criteria and using a well described form aided the process.
d) Thus, the final sample for this review (n=20) seems low but highlights the importance of setting proper inclusion criteria (Figure 1).

The articles included for this review were studies conducted in different healthcare settings (hospitals, clinics, surgical areas, theatres) with different cohorts of healthcare workers (medical students, doctors in different medical disciplines, allied professionals) and in different healthcare disciplines

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Prisma Flow Diagram

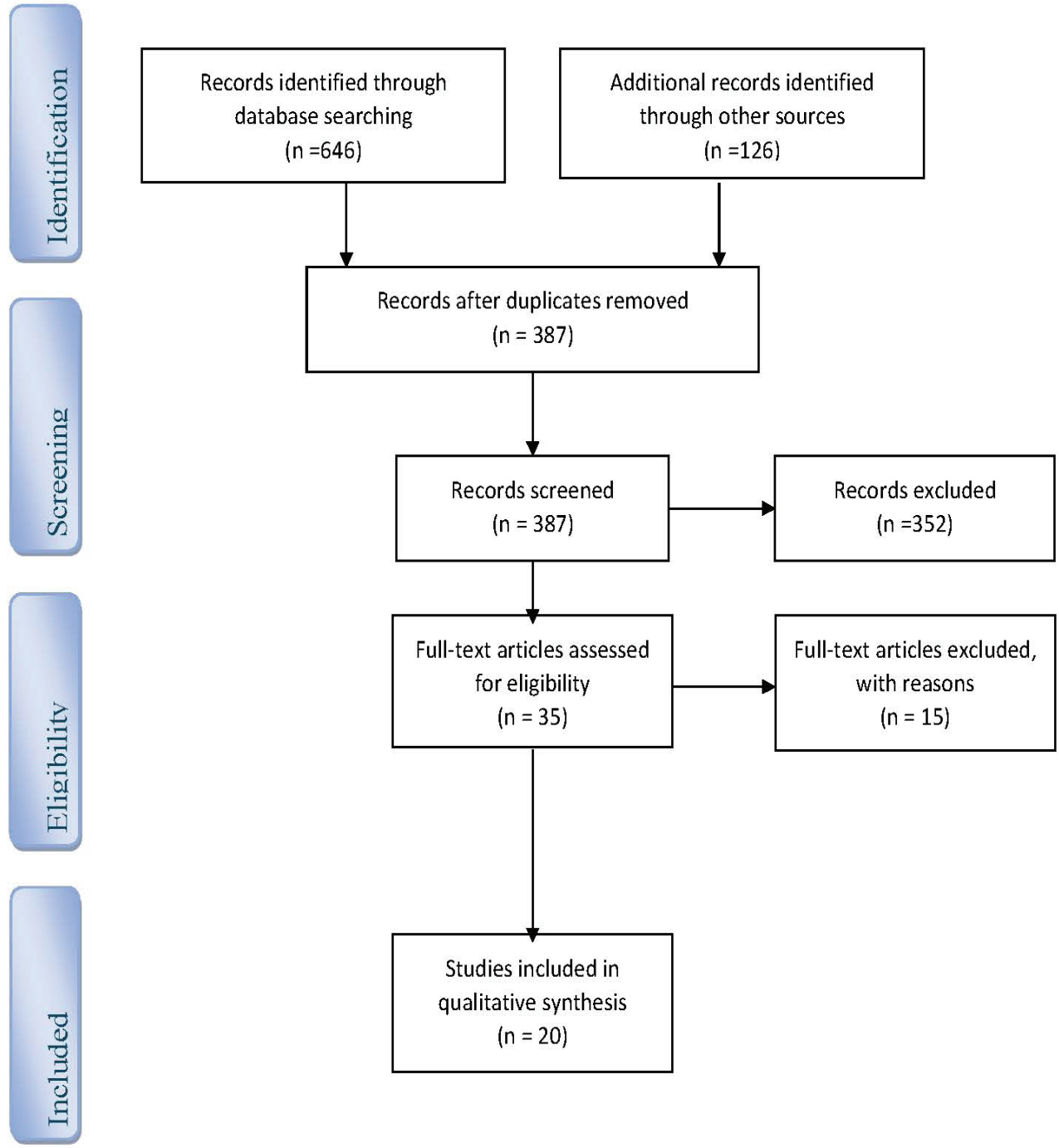

Figure 1. PRISMA FLOW Chart Indicating records for Mobile Phone Hygiene Practices

Characteristics of included studies (Table 1):
For this mapping review, the included studies used different study designs, sample size varied for the diverse group of parti cipants and the tool used was mostly a questionnaire, at times combined with swabbing of MPs.[2,7,11,25,27-31,33-34] Most participants included in these studies were questioned about their knowledge of MP hygiene practices.[1-2,7,25,27-30,33-35] Some studies extended their research objectives and included swabbing of MPs then analysed these for identification of microbes harboured on the devices.[11,28-31,33-34] Studies also looked at hygiene practices related to hands and MPs in the healthcare setting. In addition, researchers questioned participants about the MP disinfectants used to cleanse devices and whether it was sprayed, wiped or had covers. Thus, the outcomes varied across the studies (Table 1). In those studies where MP hygiene was elaborated upon, most suggested a concomitant hand hygiene protocol as a necessary and compulsory step due to suspicions of transference of microbes either way.[1,7,16-17,25,29,35]

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Table 1: Characteristics of included studies

CHARACTERISTICS OF INCLUDED STUDIES						
	Publication	Design	Sample	Tool	Outcomes	Conclusion
1.	**Panigrahi et al. 2020**	Commentary			Apple/Samsung suggest 70% alcohol use but not on MP openings	Restrict MP use. No evidence MP hygiene reduce microbes; Use MP covers/headphones. HH important
2.	**Robertson 2020**	Cross-sectional study	N=53 HC Workers (ICU)		Know/aware of HH and MP disinfection	MP contaminated with virus. MP transmission of SARSCoV
3.	**Kumar et al. 2021**	Cross-sectional study	N=66 HC Workers	Questionnaire	89.4% clean MP + adhere to HH	Restrict MP use; No evidence MP hygiene reduce microbial transmission. HH recommended. Increase MP hygiene. Standard guidelines
4.	**Gian Loreto D'Alo 2020**	Opinion	N=108		3% clean MP daily; hygiene practices to counteract spread of pathogens	SARS-CoV spread from environment and inanimate surfaces to people. Hygiene important to reduce spread of microbes
5.	**Michael et al. 2020**	Cross-sectional study	N=1100 Medical students	Questionnaire	78% cleaned MPs 93% aware of cleaning	An increase in knowledge show an increase in MP cleaning
6.	**Bhargava et al. 2020**	Systematic review	N=4 articles		Reduce MP use, sanitise MP; UV cabinets a priority; Use disposable cover	Restrict MP use in high-risk areas Maintain HH
7.	**Tladi et al. 2020**	Literature review			93.7% bacterial contamination on hands after MP use	Recommend MP disinfection HH can eliminate cross-contamination
8.	**Husain et al. 2021**	Cross-sectional study	N=110 Doctors		51%=compliant with HH; 55%=cleaned MP	Junior and female DRs more meticulous in MP hygiene and HH
9.	**Agarwal et al. 2021**	Cross-sectional study	N=956	Questionnaire Telephonic interviews	> 50% used MP; Majority sanitised MPs 50% HH compliant	Regular MP disinfection. Increase HH awareness Develop disinfection protocol
10.	**Sethy et al. 2020**	Commentary	HC Workers		MP Alcohol-base damages. Cling wrap can be sanitised and is waterproof	Avoid direct disinfectant and MP damage Use cling wrap over MP
11.	**Olsen et al. 2021**	2 Experimental trials	N=42 MP N=165 MP	Questionnaire	98% MPs were contaminated. 56% never cleaned MP	CleanPhone sanitiser reduce microbial growth. Use lint cloth and alcohol wipe on MP
12.	**Dubljanin et al. 2022**	Cross-sectional study	N=492 Medical students	Questionnaire MP swabs	MP use with increase fungal infection	Decrease MP clinical use Develop surveillance and prevention strategies Increase MP hygiene awareness Introduce standard protocol
13.	**Yao et al. 2022**	Cross-sectional study	N=111 HC Workers	Questionnaire MP swabs	95.5% bacterial frequency, Aware MPs need to be cleaned	Cross-contamination: MP/ hands Use MP cover Increase HH Develop MP -hygiene guidelines
14.	**Lubwama et al. 2021**	Cross- sectional study	N=79 Medical students	Questionnaire MP Swabs	Different microbes present/detected 83% gram positive; 34% MP hygiene compliant	Increased bacterial counts on MP Include MP hygiene in curriculum and policies

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15.	**Tannhauser et al. 2022**	Before/ After study	N=295 HC Workers	Questionnaire MP swabs	99% bacterial count Increased MP use, 96% aware of MP hygiene, But 50% cleaned MP	Bacterial cross-contamination MP to be disinfected An increased MP use, increase MP hygiene intensity
16.	**Maurici et al. 2023**	Cross-sectional study	N=83 HC students	Questionnaire MP swabs	Increased bacterial load 89% used MP 13% never clean MP	Bacteria stay on surfaces for long periods; behavioural characteristics of owner impact types and number of microbes on MP
17.	**Gala 2020**	Cross-sectional study	MP in plastic bag	MP wiped with 70% isopropyl	Use MP with plastic bag cover, use alcohol to clean covered surface	MP disinfection MP plastic cover allows use in clinics MP plastic cover is hygienic and disposable
18.	**Huffman et al. 2019**	Before/after prospective study	N=153 HC Workers	Questionnaire MP swabs: dry and after UV disinfection	Bacterial contamination: Prior UV=20% After UV=4%	MP cleaning/ hygiene UV effective in eliminating and reducing bacteria from MP UV device easy to use in clinics HH included
19.	**Qureshi et al. 2020**	Cross-sectional study	N=100 HC Workers	Questionnaire MP Swabs	93% contaminated with Staph 55% cleaned MPs (alcohol swab)	MP Hygiene practices. Replace cracked screens and covers
20.	**De Groote et al. 2022**	Systematic review	N=5425 Hospital staff/ HC Workers	PRISMA Guidelines	a) Microbes (Staph) b) Disinfectants Contaminated MPs are microbe vectors	Restrict MP use Risk of nosocomial infection MP and HH protocol (WHO)

KEY: MP=Mobile phone; HC=Healthcare; ICU=Intensive care unit; UV=Ultraviolet; HH= hand hygiene; PRISMA= Preferred Reporting Items for Systematic reviews and Meta-Analyses; WHO= World Health Organization

(1, 2, 7, 9, 11, 16-17, 23-35)

Table 1: Characteristics of included studies

(radiology, ICU, oncology, anaesthesiology, orthopaedic ward) (Table 1).[2, 21]

Outcomes of this review (Tables 1 and 2)

In terms of study designs, most were primary studies, for example cross-sectional studies (N=11), before and after studies (N=2), and one clinical trial has been reported on Table 1. There were secondary studies such as systematic reviews (N=2), a literature review and some commentaries (Table 1). Only 11 studies looked at knowledge and attitude, and most studies reviewed MP hygiene practices (Table 1). Differences in terms of knowledge, awareness and attitude towards infection control practices related to MPs have been reported to exist.[11] Healthcare workers as the participants across different spheres of health care had knowledge of MP hygiene practices and what these entail, including the different methods to achieve this, thus awareness was reported to be present (Table 1). Studies that investigated these aspects specifically recorded how they cleaned mobile phones, what they used to clean it with and what the consequence of not cleaning was.[1,7,16,26-27,32,34] In addition, many researchers swabbed MPs and then determined the type of microbes that are harboured on uncleaned phones.[11-12,28-34]

From the questionnaire studies and the responses received from the participants, it was reported that healthcare workers were aware of cross-contamination. From the research, it was reported that microbes present were mostly due to transference between hands and MP, thus emphasising hand hygiene.[7,16-17,23,29-30] It was also reported in one study that females disinfected MP more frequently than their male counterparts.[24] Thus, most studies emphasised the inclusion of a regular hand-hygiene protocol when using MPs in healthcare settings.[1,7,16-17,25,29,33,35] The exploration of different MP hygiene products such as disinfectants, MP coverings or screens as well alternatives to these such as UV disinfection or plastic and cling covers was further discussed in the included studies.[1-2,7,9,11,16-17,23-35]

Mapping of the disinfectants used and recommended in these included studies, including the MP coverings that some participants introduced, are reported in Table 2. A number of disinfectants are advised by researchers and MP companies, for example 70% alcohol-based solutions and alcohol swabs (Table 2).[1,5] The use of these disinfectants was not advised in isolation by medical researchers only; different companies had investigated this aspect and made certain recommendations of what could be used on MP surfaces for disinfection, especially during the Covid pandemic where users developed a heightened sense of clean surfaces.[1,5]

In addition, other researchers also introduced the using of different media on MPs such as alcohol-based and non-alcoholic wipes or swabs (Table 2). The type of coverings referred to in the studies and included in this review are MP covers or screens, cling wrap and plastic bags.[1-2,7,16,23,26,29,31-32,34] Other protocols referred to by some researchers include limiting or restricting MP use in healthcare settings, using headphones, disinfecting stations when entering and exiting healthcare settings and alternately making use of measures such as UV-disinfecting devices stationed in these settings.[1,7,16,26,28,32-33,35]

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Most participants and researchers recognised the importance of having MPs on them and using these in healthcare settings, even in theatres.[2,12] This meant alternative hygiene protocols to contain cross-contamination between hands and MPs that would allow continued use of these devices needed to be explored. These included having MP coverings which are disposable and that can be disinfected using readily available disinfectants in clinics.[1-2,6,23-24,26,29-30,32,34] As a result, having phone coverings such as MP screens, cling wrap or placing devices inside plastic bags that could then be disinfected were encouraged instead.[1-2,6,23-24,26,29-32,34] Moreover, this limited damage to devices.[23] Having considered all factors and clinical protocols, many studies included comments to limit or abstain from MP use in healthcare settings, when possible.[1,7,16,28,35] Many researchers also emphasised hand hygiene protocols recognising its importance in curbing transmission of microbes across different surfaces and settings, which many were conscientised to during the Covid-19 pandemic (Table 1).[1,7,12,15-17,25,29,33,35]

MEDIUM USED FOR MOBILE PHONE HYGIENE									
NO	AUTHOR, COUNTRY, (YEAR)	Disinfecting spray/ swab/ wipes/cloth	Alcohol swabs	70% Isopropyl alcohol wipes	Biocidal agents	Screen protector/ Plastic cover	UV Dis-infection	Cling wrap	(Head phones; Plastic bags)
1	Panigrahi et al. India (2020)								
2	Robertson S. Brazil (2020)								
3	Kumar et al. India (2021)								
4	Gian L. D'Alo et al. Italy (2020)								
5	Michael et al. Malaysia (2020)								
6	Bhargava et al. India (2020)								
7	Tladi et al. South Africa (2020)								
8	Husain et al. UK (2021)								
9	Agarwal et al. India (2021)								
10	Mitanjali et al. India (2020)								
11	Olsen et al. Australia (2021)								
12	Dubljanin et al. Serbia (2022)								
13	Yao et al. China (2022)								
14	Lubwama et al. Uganda (2021)								
15	Tannhauser et al. Germany (2022)								
16	Maurici et al. Italy (2023)								
17	Gala. UK (2020)								
18	Huffman et al. US (2019)								
19	Qureshi et al. Pakistan (2020)								
20	De Groote et al. Belgium (2022)								

Table 2: Mapping of types of mobile phone hygiene materials used

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After the data was extracted and analysed from the included studies, it became apparent that a gap existed across healthcare settings specifically pertaining to changes related to protocols due to the Covid-19 pandemic. For this research, particularly related to MPs, the absence of a disinfecting protocol or even a protocol allowing MP use in healthcare settings was identified by several researchers, acknowledging its importance.[7,11-12,25,28-29,35]

DISCUSSION

This mapping review addressed the aim of this study, and it highlights important aspects of mobile phone use in a healthcare setting. MPs have become a necessary addition to healthcare workers' daily tools used in clinics, theatres, hospital waiting rooms and when examining and treating patients. Thus, preventing or inhibiting its use while working in healthcare settings is not an option for many healthcare workers. What has transpired, though, is the extended consciousness post the Covid-19 pandemic of the transference of microbes from hands to devices and vice versa and the impact of this on health and wellbeing. Consequently, with most of the included studies for this review, hand hygiene was continuously emphasised.[1,7,16-17,25,29,33,35] This aspect of cross-contamination was not mentioned by Khan et al (2022) when examining MPs of students and staff in both aerosol and non-aerosol generating clinics.[12] Moreover, the increase in related research in the different settings and exploring different disinfectant media that could align with strict Covid-19 clinical protocols were also explored.

In 2021, there was estimated 7.1 billion users of MPs which is projected to increase to 7.49 billion in 2025. These devices are touched by hands averaging 2,000 times per day and are known to house micro-organisms which are easily transmissible.[31] MPs used in healthcare settings is favoured among healthcare workers and is expected to increase in the future with the various activities this cohort extend themselves to, including tele-consultations.[33]

MP hygiene practices in HC settings

Healthcare workers have adapted to using MPs as a work aid to increase the quality of care through accessing point of care tools, allowing better decision-making, thus aiding superior patient outcomes.[27] Usage of electronic devices amid patient care was reported to be 78.8% by healthcare workers.[7] It has also been reported that up to 88% of healthcare professionals use MPs in clinical practice which are contaminated with a spectrum of micro-organisms at an average contamination rate of 68%.[27] This was similar to a study conducted among dental health professionals (students and staff) where different types of microbes were found on MP surfaces.[12]

It is generally accepted that an increase in knowledge and/or awareness increases the likelihood of disinfecting MPs.[2,7,28] Michael (2020) found that undergraduate students with higher levels of knowledge were 2.15 times more likely to clean their mobile phones when compared to those with lower levels of knowledge.[2] It was also observed that MP contamination predisposed the hospital community to hospital acquired infections.[11] In addition, the behavioural characteristics of MPs users are highlighted, and this relates to where they use these devices without following any particular hygiene protocols.[12,16] For example, working in aerosol and non-aerosol generating clinics, carrying it in their handbags, visiting bathrooms and dining without cleaning these across the different platforms to prevent cross contamination.[12,16] However, it was reported that actions for infection prevention such as hand hygiene and disinfecting of MPs among healthcare workers are inadequate, even though they are knowledgeable about these practices.[7,12]

It is important to note, however, that compliance and considerations regarding hand hygiene practices have increased slightly during and post the Covid-19 pandemic, and even now with the current Mpox scare.[30] Although more efforts are required to ensure healthcare workers follow the steps of hand hygiene within the appropriate clinical spaces and at the correct times.[25,30] Researchers have advised that WHO hand hygiene posters should be displayed in handwashing areas and practical, easy handwashing methods should be circulated.[35-36] In addition, and for ensuring best practice across clinical platforms, regular monitoring and reinforcement should be rendered.[25] The use of social media platforms has been recommended to increase awareness of these practices.[11]
Infection Prevention and Control Canada and the WHO has recommended hand hygiene before and after use of MPs, but compliance is poor, as mentioned previously.[33,35] Lack of hygiene practices related to hand washing and MP disinfection can be attributed to forgetfulness, lack of time and reinforcement, inadequate awareness of standard disinfection practices and fear of damaging devices.[7] The most common excuse pertained to fear of damaging the device can be attributed to unawareness of the correct method of disinfection.[7]

Microbial analysis revealed that bacterium isolated from MPs and those on the hands of healthcare workers had similar antibiograms and biochemical profiles.[17,25] Low compliance with MP disinfection may potentially reduce effects of hand hygiene procedures as clean hands may become contaminated again by microorganisms on the device.[9,27] The rate of bacterial contamination of healthcare workers' hands increased by 93.7% after MP use.[2] Increased levels of contamination are associated with an increase in duration of mobile phone use.[2,29,33] Huffman et al (2020) found a low percentage of bacterial growth on MPs because of cleaning these devices regularly in conjunction with hand hygiene.[33] Thus, re-emphasising the importance of hand hygiene prior to and after using MPs in addition to regular disinfecting of these devices.

Banning/restricting MP use in healthcare settings has been observed as an option to prevent infections and cross-contamination.[29] The study by Yao et al (2022) discovered that this instruction was only obeyed by 2.8% of workers as 68% was in opposed to the banning of MPs in the workplace.[29] It is therefore important to rather improve MP disinfection awareness and hygiene practices as opposed to restricting its use. The positive uses of MPs across the different clinical spaces for guiding diagnoses and appropriate treatments have been reported often, thus the option of banning its use is rather unrealistic.[10-12]

MP disinfectants

To date, the best method for MP disinfection for continued use in clinical practice has not been explored and established.[33] To reduce the potential risk of microbial transmission via MPs in healthcare settings, various methods have been suggested. Decontamination with 70% alcohol decreases the rate of contamination from 47,6%-100%.[2] Alcohol wipes,

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used by some, can effectively eliminate bacteria and is often easily accessible by healthcare workers but have shown to not eliminate all micro-organisms found on MPs.[33] They are also not a recommendation by Apple and Samsung for use on their products.[1,33]

Qureshi, et al (2020) recommended MP hygiene to include the change of screen covers and replacement of cracked screens with additionally wiping the device with an alcohol swab to decrease contamination and transmission of micro-organisms.[34] This was because of their study revealing that MPs with cracked screens and covers were more likely be associated with microbial colonisation.[34] Less or no contamination was associated with appropriate cleaning of MPs within a 24-hour period, emphasising the timing of instituting such a cleansing protocol.[34]

A systematic review investigating MP contamination and decontamination found a reduction of microbes of more than 80% when using a disinfectant.[35] The disinfectant, 70% isopropyl alcohol, was the most commonly used decontaminant for MPs and was renowned for being superior to other disinfectants.[35] Other means of disinfecting MPs found to be quite effective included placing MPs in ultraviolet (UV) boxes, though this was not common practice.[33]

MP hygiene protocols

From the studies included in this review, containing one completed in the present context, the absence of an MP hygiene and disinfecting protocol was mentioned by several researchers.[7,11-12,25,28-29,35] None has officially been introduced following the recommendations from these studies, but by merging the evidence synthesised, it would not be impossible to formulate a guideline for such a much-needed protocol. Hence, an attempt to mention possible inclusions in a protocol for MP use and MP disinfection in the context of a healthcare setting will be outlined below, using the evidence presented in this review.

A) Mobile phone use protocol

Include posters to share the MP use policy of the healthcare setting. Place these posters in strategic visible clinical locations. Posters can also be shared via social media. Some of the features to be included in the MP use protocol include:[1,7,16,28,35]

- Avoid or restrict using MPs in healthcare settings, if possible.
- Avoid MP sharing between healthcare workers.
- Avoid MP sharing between healthcare worker and patient.
- Use headphones as an alternative when using MPs.
- Avoid MP use across different platforms (clinics, bathrooms, dining).
- Place MP in specially sealed spaces when not in use.
- Have regular audits for compliance based on healthcare MP use policy.[1,7,16,28,35]

B) Mobile phone disinfection protocol

Include posters to guide healthcare workers with MP hygiene techniques. Place these posters in strategic visible clinical locations in healthcare settings. Posters can also be shared via social media.

- Some of the features to be included in the MP hygiene protocol include: [1,9,17,23,25-27,29,32-35]
- Limit or restrict use of MP in healthcare settings, if possible.
- Wash hands according to handwashing protocol before use of MPs.
- Wipe MPs with recommended disinfectant before use.
- Implement regular MP cleaning within a 24-hour cycle.
- Wash hands according to handwashing protocol after use of MPs.
- Regular audit for compliance with this MP disinfection protocol.
- Clean MP while in switched off mode.
- Avoid moisture in openings of MPs.
- Do not spray disinfectant directly onto the surface of the MP.
- Place covering over the MP (plastic screens, hard cover, cling film, plastic bags).
- Spray disinfectant on MP cover or plastic bag or cling film.[1,9,17,23,25-27,29,32-35]

CONCLUSION

Evidence suggests there is a need for MP hygiene awareness and a demand for protocols regarding MP use and MP disinfection among healthcare workers in healthcare settings. Standard disinfection protocols of MPs in healthcare settings should be directly related to hand hygiene protocols stipulated by the WHO.

Clinical recommendations

MP use and disinfection protocols in healthcare settings are recommended and an attempt to describe such protocols are shared above. Educational campaigns to highlight issues with MP use, disinfection and transmission of disease can be extended to social media advertisements encouraging MP users, which would be ideal for students.[2] The addition of these protocols early in the dental/medical curriculum when students are exposed to other disinfection protocols is another suggestion.[11] Lastly, clear posters and signage regarding HH and MP use and disinfection must be placed in specific locations in clinical spaces.

Future research

Prior to the Covid-19 pandemic, research related to MP hygiene and disinfection was not a priority. However, post this global health catastrophe and the reports related to the current MPox infection, researchers realised the urgency and importance of conducting this type of research. Much of this can be directed to the education of MP use and hygiene in different settings. The efficacy of (and practicality of) using different methods of disinfection on MPs such as sprays, wipes and UV devices may be explored. In addition, addressing compliance following placement of visible protocols can be studied, too. Moreover, conducting research to highlight cross-contamination from medical staff to patients and vice versa is a priority, especially considering that the MPox infection is regarded as a public health emergency.[5] Another area that needs to be addressed is cross-contamination between different locations within the healthcare settings (clinic to bathroom to dining areas).

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