

## Authors

Sara Reis  
Universidade Católica Portuguesa,  
Portugal

Rita D Marques  
Escola Superior de Saúde da Cruz  
Vermelha Portuguesa, Centro de  
Investigação Interdisciplinar em Saúde

Patrícia Pontífice-Sousa  
PhD  
Universidade Católica Portuguesa,  
Centro de Investigação Interdisciplinar  
em Saúde

## Corresponding author

Sara Reis  
Universidade Católica Portuguesa,  
Portugal

# Impact of using personal mobile phones in the operating theatre: A scoping review

## Abstract

**Background:** Nowadays, mobile phones are an indispensable tool in multiple settings, particularly in the field of health care. Consequently, it is important to understand the impact of their use by health care professionals in the operating theatre – an environment that should be as ‘sterile’ as possible, to ensure patient safety.

**Purpose:** To map the available scientific evidence on the impact of the multidisciplinary team’s use of personal mobile phones in the operating theatre.

**Methods:** A scoping review was conducted, following the methodology recommended by the Joanna Briggs Institute. The bibliographic search was carried out in the ‘PubMed’ and ‘Web of Science’ databases and on the ‘EBSCOhost’ platform, employing the selected DeCS/MeSH descriptors. Additionally, relevant grey literature was searched, using Google Scholar and the ‘Repositórios Científicos de Acesso Aberto de Portugal’ (RCAAP) portal. The resulting articles underwent a selection process, which consisted of reading the respective title, abstract and full text. The review included works published in Portuguese, English and Spanish, without establishing a specific publication time frame.

**Results:** After applying the inclusion criteria, 15 articles were identified. The results were then organised, taking into account the inherent positive and negative aspects of using mobile phones in the context under study. The negative aspects included bacterial contamination of the devices and the occurrence of events that might distract the professionals. The positive aspects included the effectiveness of the devices to distract children and enable adequate care (e.g. during anaesthetic induction) and to improve professional knowledge and skills.

**Conclusion:** When considering the impact of using personal mobile phones in the operating theatre, we often focus on the positive aspects of that practice. Nevertheless, in 11 studies included in the present review, the reported negative effects were more significant than the positive ones. There is evidence that patient safety may be threatened in such situations, due to the risk of cross-infection and the potential for distraction of multidisciplinary team members.

**Keywords:** cell phone, mobile phone, smartphone, operating room, operating theatre, impact

All authors contributed to the study’s conception and design, to the data’s analysis and interpretation, and to the necessary critical revisions.

## Introduction

Since the development of the first mobile phone, there has been a substantial increase in the services provided by such devices and their potential to facilitate various aspects of our lives.<sup>1</sup> Mobile phones have become part of our daily routines and the field of health care is no exception. Numerous smartphone applications allow calculating medication doses and ventilation parameters, by simply inputting the patient's age, weight and gender. Using instant messaging applications, it is possible to obtain an opinion from a colleague, or a specialist, without having to write an e-mail; and x-rays and images can be readily shared, minimising response times. In addition, notes on patients, techniques and procedures can be easily taken, and that information can be saved in the mobile phone, to be just 'a click away'.<sup>2,3</sup> The benefits of mobile phones are also well known in the context of nursing care – they can be a considerably useful tool, facilitating access to information, saving time, promoting patient safety, improving the quality of the provided care and enhancing the nurses' confidence regarding their own performance.<sup>2,4</sup>

However, in recent years, some concerns have arisen with respect to health care professionals' use of personal mobile phones at work. Mobile phone use in health care provision has been extensively studied, with evidence suggesting possible repercussions for the professionals' level of vigilance, which may result in negative effects on patient safety.<sup>5</sup> In a scoping review, 55 per cent of the analysed studies reported that nurses used their personal mobile phones in the workplace mainly for private purposes. Moreover, nurses expressed their apprehension

regarding distractions related to mobile phones that occurred during care provision, also mentioning issues related to the patients' privacy and confidentiality.<sup>6</sup> In addition, the available literature points to a probable relationship between nosocomial infections and the use of mobile devices,<sup>1</sup> with the latter being considered a potential vehicle for microorganism transmission, given the lack of effective guidelines on adequate cleaning and disinfection procedures for such equipment.<sup>2,7</sup>

Despite the existence of some works about the use of mobile phones in health care provision and the implications of that practice, there are specific contexts which deserve special attention, namely the operating theatre. Operating theatres have been compared to the cockpits of commercial aeroplanes, from which electronic mobile devices have been banned (the so-called 'sterile cockpit rule'). Both are environments where critical moments occur, demanding the professionals' full attention and focus.<sup>8</sup> In an observational study on distractions within the operating theatre, 1020 events (32%) were associated with 'case irrelevant verbal communication' and smartphone use.<sup>9</sup> Furthermore, besides constituting a potential source of contamination, the use of mobile phones in such settings may influence the patients' perception regarding the received care, possibly leading them to consider they are not the centre of the professionals' attention.<sup>1</sup>

Given the need to clarify this issue, the following research question emerged: 'What is the impact of the multidisciplinary team's utilisation of personal mobile phones in the operating theatre?'

## Materials and methods

The present scoping review was carried out according to the recommendations of the Joanna Briggs Institute (JBI).<sup>10</sup> To form the research question, we employed the 'PCC' mnemonic ('population', 'concept' and 'context'). The study's population was multidisciplinary teams (nurses, anaesthesiologists, surgeons and perfusionists), its concept was the impact of using personal mobile phones, and its context was the operating theatre.

We sought relevant works, published in English, Portuguese or Spanish, without defining a specific publication time frame. To perform the bibliographic search, the following DeCS/MeSH descriptors were applied: 'cell phone', 'impact', 'mobile phone' and 'operating room'.

First, a preliminary search was conducted, in several electronic databases, to explore the topic under study. Afterwards, the main search was carried out, using the 'PubMed' and 'Web of Science' databases, and the 'EBSCOhost' platform (which comprised the following databases: CINAHL Complete, Cochrane Collection Plus, Nursing & Allied Health Collection: Expanded, MEDLINE® Complete and MedicLatina). In this second search, we employed the previously validated descriptors and the previously identified keywords, together with the Boolean operators 'AND' and 'OR'. Finally, a third search was performed, using Google Scholar and the 'Repositórios Científicos de Acesso Aberto de Portugal' (RCAAP) portal, to find relevant grey literature.

The reading of titles, abstracts and full-text versions was executed by two independent reviewers. Subsequently, an analysis of the included studies' bibliographic

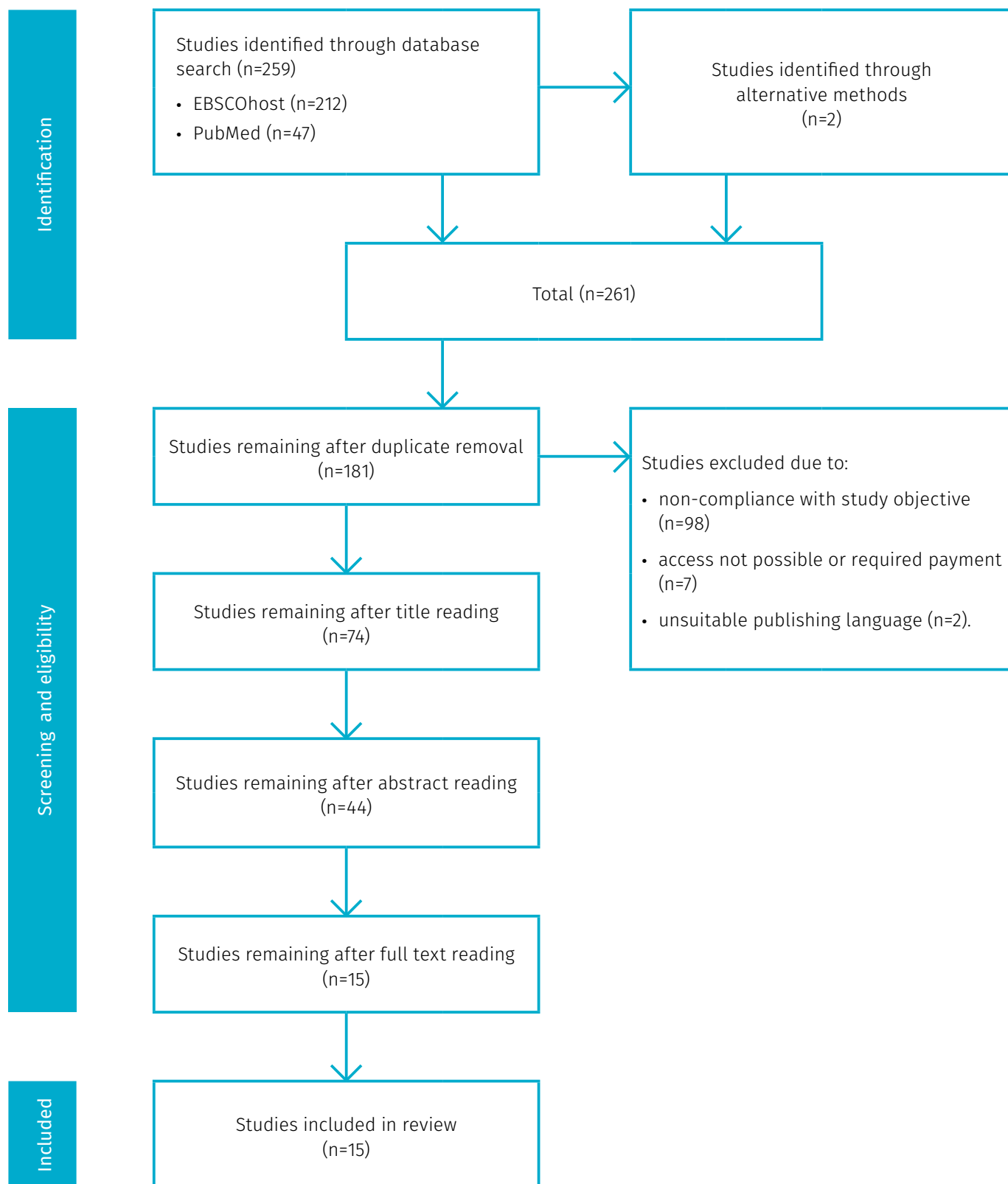


Figure 1: Flowchart of the study selection process (PRISMA flowchart, adapted from JBI Manual for Evidence Synthesis).

references was conducted, to identify additional relevant works. Next, the studies' methodological quality was assessed, employing the critical appraisal tools recommended by the JBI for the type of research in question.<sup>10</sup> This was followed by the results' extraction and discussion. Throughout the process, the opinion of a third reviewer was requested whenever disagreements occurred.

As shown in Figure 1, the main database search, in which the DeCS/MeSH descriptors were employed, produced an initial sample of 259 studies. The exploration of those studies' bibliographic references allowed identification of two additional articles. Conversely, no relevant works were found in the grey literature sources.

After duplicate removal (through automatic and manual methods), 181 articles were deemed suitable for analysis. A general assessment of the titles resulted in the exclusion of 98 studies that did not comply with the established objective. Of the remaining 83 works, two were excluded due to being published in languages other than Portuguese, English and Spanish, while seven were ruled out because their abstract or full-text version could not be accessed (either due to technical difficulties or to payment requirements). Thus, 74 articles were selected for further analysis, which consisted of reading abstracts and full-text versions. During this stage, various studies were eliminated, due to not answering the research question, describing an isolated case, or referring to a specific application used to monitor ventilatory or haemodynamic parameters. Reading abstracts resulted in the exclusion of 30 works, while reading full texts resulted in 29 works being excluded. Hence, the final sample included 15 articles.

## Results

The characteristics of the included studies are summarised in the supplemental material. Most of the included studies were published in the last five years – nine were conducted between 2017 and 2022, five between 2011 and 2016, and only one between 2006 and 2010. With respect to the countries of origin, three studies were from the United States of America (USA), two were from South Korea, two from Turkey and one each from Austria, Brazil, Canada, France, Iran, Israel, Pakistan and Taiwan.

Several types of research projects were identified – there were three exploratory quantitative studies, three quantitative studies, two randomised clinical trials, two observational cohort studies and one each of an observational study without a control group, a qualitative study based on focus group interviews, an observational mixed study, a retrospective quantitative study and a scoping review.

Analysis of the extracted data identified negative and positive impacts of using mobile phones in the operating theatre (see Figure 2). Table 1 summarises the impacts of mobile phones found in the fifteen included studies.

## Discussion

The results obtained in this review show a recent, but pressing, concern about the impact of mobile phone use in the operating theatre and a desire to thoroughly understand the phenomenon. Most of the included works are from the last five years, which is not surprising since the rapid evolution of mobile phone technology has created the need to further clarify the particularities of using such devices in health care practice.

Data analysis identified two negative impacts of using mobile phones in the operating theatre (risk of infection and risk of staff being distracted) and two positive impacts (anxiety reduction in child patients and improvement of staff knowledge and skills).

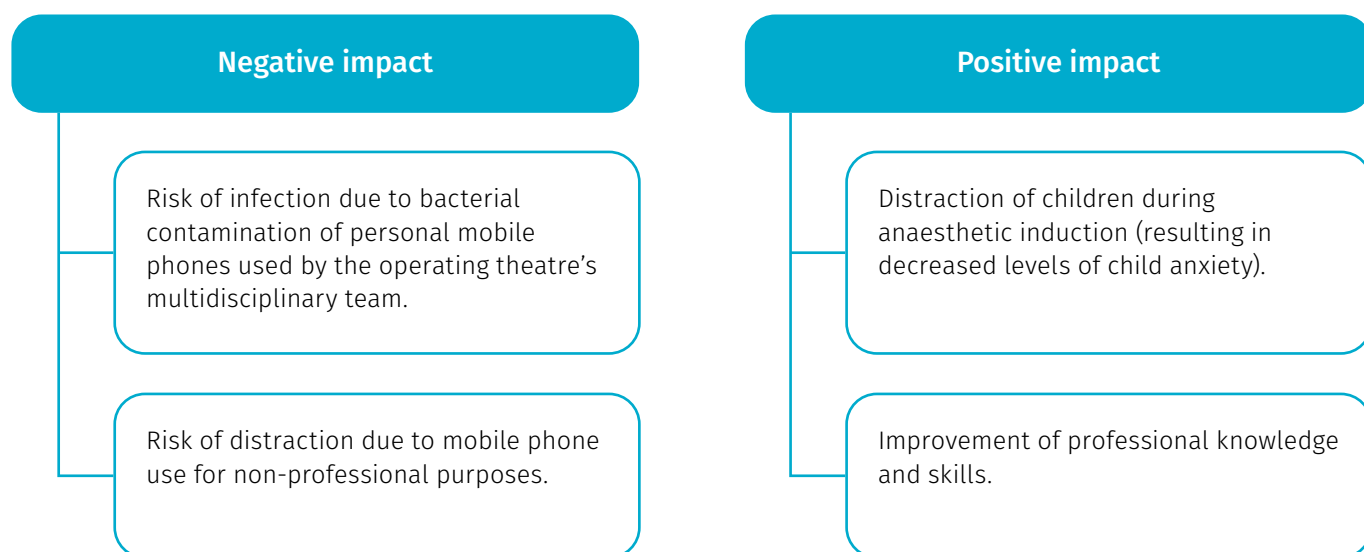
### Negative impacts – risks to patient safety

#### Mobile phone contamination and risk of patient infection

After analysing the six studies about mobile phone contamination in the operating theatre,<sup>7,12,15,19,21,24</sup> we found that personal mobile phones presented high levels of bacterial contamination. In five of the abovementioned works,<sup>7,12,19,21,24</sup> the reported contamination rates surpassed 80 per cent.

One study, aimed at establishing a relationship between the nasal colonisation of operating theatre professionals and the contamination of their mobile phones,<sup>7</sup> found that 94.3 per cent of the staff exhibited, simultaneously, the same bacteria on their mobile phones, on their hands and inside their nostrils.

On the other hand, a 2020 scoping review of the recommended practices for mobile phone sanitation in operating theatres revealed that the multidisciplinary team's mobile phones were colonised by pathogenic microorganisms, and that decontaminating the devices resulted in a significant decrease in their microbial load.<sup>13</sup> Similar findings were mentioned in three of the other included studies.<sup>7,12,21</sup> It was also found that operating theatre professionals were not in the habit of sanitising their mobile phones, lacking specific guidelines on disinfectants and on disinfection periodicity.<sup>12,21</sup>



**Figure 2: Categorisation of the obtained results, according to the impact of mobile phone use in the operating theatre**

**Table 1: Impact of the multidisciplinary team's use of personal mobile phones in the operating theatre**

| Study                          | Negative impact                                                 |                                                       | Positive impact                                            |                                    |
|--------------------------------|-----------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------|------------------------------------|
|                                | Risk of infection due to bacterial contamination of the devices | Risk of distraction affecting operating theatre staff | Decreased anxiety in children during anaesthetic induction | Development of professional skills |
| Avidan et al. <sup>14</sup>    |                                                                 | ✓                                                     |                                                            |                                    |
| Çelikoyar et al. <sup>16</sup> |                                                                 |                                                       |                                                            | ✓                                  |
| Chang et al. <sup>7</sup>      | ✓                                                               |                                                       |                                                            |                                    |
| Cohen et al. <sup>17</sup>     |                                                                 | ✓                                                     |                                                            |                                    |
| Cumino et al. <sup>18</sup>    |                                                                 |                                                       | ✓                                                          |                                    |
| Dowden et al. <sup>13</sup>    | ✓                                                               |                                                       |                                                            |                                    |
| Jeske et al. <sup>24</sup>     | ✓                                                               |                                                       |                                                            |                                    |
| Lee et al. <sup>22</sup>       |                                                                 |                                                       | ✓                                                          |                                    |
| Murgier et al. <sup>19</sup>   | ✓                                                               |                                                       |                                                            |                                    |
| Park et al. <sup>15</sup>      |                                                                 |                                                       |                                                            | ✓                                  |
| Pinar et al. <sup>20</sup>     |                                                                 | ✓                                                     |                                                            |                                    |
| Porter et al. <sup>11</sup>    |                                                                 | ✓                                                     |                                                            |                                    |
| Qureshi et al. <sup>12</sup>   | ✓                                                               |                                                       |                                                            |                                    |
| Shakir et al. <sup>21</sup>    | ✓                                                               |                                                       |                                                            |                                    |
| Smith et al. <sup>23</sup>     |                                                                 | ✓                                                     |                                                            |                                    |

The concern with bacterial contamination of mobile phones has also been a subject of interest in other settings, including in intensive care. In a scoping review on patient safety and mobile phone contamination in intensive care units (ICUs),<sup>25</sup> the included studies pointed to the devices' contamination with the bacteria present on the health care professionals' skin and nasal fossae. This indicates poor compliance with infection prevention and control measures of hand hygiene and object sanitation; and this, associated with a lack of standardised recommendations, contributes to the increase of nosocomial infections, compromising the safety of hospitalised patients.<sup>25</sup>

Another study of ICUs<sup>26</sup> identified the presence of methicillin-resistant *Staphylococcus aureus* (MRSA) in 11 per cent of the samples collected from health care professionals' mobile phones, warning that such devices may be a vehicle for the transmission of microorganisms to critically ill patients. Consequently, the authors stressed the importance of reinforcing hand hygiene in hospital settings and the need to further explore mobile phone sanitation options.<sup>26</sup>

To summarise, mobile phones are considered a significant source of bacterial contamination, particularly in operating theatres, ICUs and surgical wards; therefore, jeopardising patient safety. These devices are usually kept in pockets, or small bags – a practice that facilitates the spread of bacteria since such microorganisms only multiply at certain temperatures. The constant handling of mobile phones also contributes to the dissemination of microorganisms, as they transition from the user's hands to the equipment and vice versa. This phenomenon aids microbial

transmission to susceptible patients. Regular and adequate hand hygiene is the only measure capable of reducing the risk of bacterial contamination of mobile phones. Nonetheless, it should be combined with decontamination of the devices and/or frequent sanitation (using disinfectant wipes or 70% isopropyl alcohol).<sup>27</sup>

### Mobile phone use and risk of distraction

The five included studies about mobile phone usage habits in the operating theatre<sup>11,14,17,20,23</sup> reflect a need to identify the consequences to patient safety of the surgical team being distracted by such devices.

Two studies – conducted on Turkish anaesthesiology staff<sup>20</sup> and American perfusionists<sup>23</sup> – revealed participants' tendency to access their mobile phones during anaesthetic procedures (93.7%) and during extracorporeal circulation (ECC) procedures (55.6%). It was also found that 78.3 per cent of the perfusionists viewed mobile phone use as a hazardous practice, in terms of patient safety. In both studies, numerous participants stated having observed colleagues who were distracted by their mobile phones during work, although a high percentage believed that mobile phone use had never caused their own distraction in such circumstances.<sup>20,23</sup>

An observational quantitative study of 25 cardiac surgeries with ECC,<sup>17</sup> found that staff members spent approximately 1.5 minutes focused on their mobile phones, regardless of the surgical stage. An observational mixed study,<sup>14</sup> which was carried out to determine the number of phone calls taking place in the operating theatre, showed that 96 per cent of the incoming calls were answered, and that 15 per cent of the answered

calls resulted in distractions to the multidisciplinary team (mostly on the surgeon's part, when using their personal mobile phone).

Furthermore, three of the selected works<sup>11,20,23</sup> mention that participants worried about possible distractions which might endanger patient safety. In some cases, this specific concern was expressed by 80 per cent of the involved professionals.<sup>11,23</sup>

The understandable need to better comprehend this phenomenon, employing reliable tools, led to the development and validation of several questionnaires, one of which (that used by Porter et al.<sup>11</sup>) was analysed in the present review. Concurrently, we highlight the existence of a study that validates the psychometric qualities of a particular questionnaire, designed to quantify distractions related to mobile phones in the operating theatre.<sup>28</sup>

Mobile phone use in health care provision has already been extensively investigated. One study assessed nurses' perceptions of their own decreased professional performance due to mobile phone use,<sup>29</sup> with the following outcome: 42.5 per cent of participants believed that smartphones can be a serious distraction during work hours; 69.5 per cent considered that using personal mobile phones at work has, predominantly, a negative impact, despite presenting some benefits. In fact, 70.9 per cent of participants declared having observed negative effects, caused by distractions related to mobile phones, on their colleagues' professional performance, but only 7.4 per cent admitted that their own professional performance was, at some point, negatively affected by personal mobile phone use.<sup>29</sup> Such results are in line with the findings reported in some of the included



studies, suggesting that nurses may have an erroneous self-perception concerning this issue, since they seem to identify more easily their colleagues' deviant behaviour than their own.<sup>20,23</sup>

The distractions associated with mobile phone use can have severe consequences, regardless of the context, and the operating theatre is no exception.<sup>8</sup> Accordingly, the Association of periOperative Registered Nurses (AORN) considers that the undisciplined use of mobile phones in the operating theatre may jeopardise patient safety because it hinders care providers from focusing on the patient. AORN also mentions that the occurrence of distractions within the operating theatre can augment the incidence of adverse effects, increase procedure duration and lead to omissions.<sup>30</sup>

Conversely, in the article 'Smartphones in the operating room: Can perioperative nurses be trusted?',<sup>3</sup> the advantages of using mobile phones in the operating theatre are highlighted. Even so, the authors emphasise the importance of digital professionalism, with respect to deciding the appropriate moment for accessing the smartphone – a professional attribute that should be developed and adjusted.<sup>3</sup>

### **Positive impact: improvements in the quality of the care provided**

#### **Reduced levels of child anxiety during anaesthetic induction**

The present review included two studies in which researchers used mobile phones as part of a behavioural strategy to reduce child anxiety levels during anaesthetic induction.<sup>18,22</sup> This practice represents a beneficial use of mobile phones in the operating theatre.

The results of one of these studies,<sup>22</sup> conducted on 120 children, showed that patients undergoing anaesthetic induction exhibited fewer signs of anxiety when they were given a mobile phone containing age-appropriate material together with a small dose of midazolam. Likewise, another study,<sup>18</sup> carried out on 84 children, found that a combination of mobile phone-based distraction and written information (provided to the parents in a pamphlet) was an effective strategy to decrease child anxiety levels during anaesthetic induction. Moreover, the use of this combination increased the parents' satisfaction levels concerning that surgical stage.<sup>18</sup>

In fact, the use of mobile phones as a behavioural strategy and as a non-pharmacological intervention to reduce anxiety on the day of surgery has proven to be effective. Distraction is a widely applied tool in paediatrics. When mobile phones are employed to show videos, or provide games, the associated distraction reduces child anxiety and pain in surgical settings, and also has a positive effect on patients' families. Immersion in an interesting game is likely to decrease pre-operative anxiety in preschool children, as well as improve their performance and cooperation during anaesthetic induction, thus contributing to its success.<sup>31,32</sup>

#### **Improvement of professional knowledge and skills**

Two of the studies included in this review<sup>15,16</sup> reported advantageous use of mobile phones in the operating theatre to improve staff members' knowledge and skills. One of them addressed mobile phone use to store information on surgical procedures,<sup>15</sup> while the other investigated the use of such devices for open surgery recording.<sup>16</sup>

Nurses view mobile phones as a quick and easy way to access reliable content. Such devices allow performing searches on medication and diseases, which provide valuable information regarding patient diagnoses. Besides, the mobile phone can be used as a watch, timer or calculator. All the abovementioned functions increase nurses' availability for actual care provision.<sup>4,23</sup>

Nurses also mention other advantageous possibilities: keeping notes, organising schedules, programming reminders and accessing contacts and email accounts. They often emphasise that, while influencing patient safety, mobile phones facilitate their access to precise information, as well as to established standards and institutional documentation, thus improving their professional self-confidence.<sup>4</sup> In addition, mobile phone cameras are pointed out as an important tool in care provision, since they allow the sharing of relevant clinical information between colleagues, through photography or video.<sup>6</sup>

### **Conclusion**

This scoping review contributes to a deeper knowledge of the impact of personal mobile phone use in operating theatres. Some positive impacts were reported, namely the reduction of child anxiety levels during anaesthetic induction and the improvement of professional knowledge and skills. Nevertheless, the negative impacts predominate, with 11 (73.3%) of the included works highlighting the disadvantages of mobile phone use. Our findings indicate that bacterial contamination of mobile phones, together with a lack of decontamination routines, puts patients at risk of infection. Similarly, our findings indicate that

mobile phones are mostly being used for non-professional purposes in the context under investigation thus putting patient safety at risk from staff members being distracted when using their mobile phone.

In view of these findings, we believe that:

1. Further studies should be conducted to:
  - a. establish a cause-and-effect relationship between the bacterial contamination of staff members mobile phones and the occurrence of surgical site infections
  - b. develop institutional guidelines for mobile phone decontamination
  - c. determine how often staff members are actually distracted in the operating theatre, and to what extent those distractions affect patient safety.
2. The use of mobile devices inside the operating theatre should be restricted, with health service organisations and their teams being responsible for implementing this measure. Despite the fact that, ideally, mobile phones and other personal electronic devices should be kept outside of the operating theatre, banning them from the operating theatre is most likely not feasible; therefore, we suggest that operating theatre professionals keep their devices in silent mode, refrain from answering and making phone calls during surgical procedures and define a specific place (e.g., a box or cabinet) within the operating theatre where all mobile phones should be stored in order to prevent the devices 'circulation' through various areas of the room. With

respect to the regular cleaning and decontamination of mobile devices, we consider that clear rules should be established, according to the existing evidence (e.g., using wipes soaked in 70% isopropyl alcohol). Finally, the need for adequate hand hygiene, before and after using their personal mobile phone, should be impressed on all surgical staff.

In the absence of more specific guidelines, it is essential to cultivate awareness among operating theatre staff about the risks associated with using their personal mobile phones at key surgical moments and when close to patients, operating fields and members of the sterile team, and appeal to their common sense and professionalism.

## References

1. Venugopal A, Marya A, Vaid NR, Bowman SJ. The cell phone quandary [Internet]. *J World Fed Orthod*. 2022 [cited 2023 Jan 18];11(3):90–92. DOI: 10.1016/j.ejwf.2021.10.004
2. Attri J, Khetarpal R, Chatrath V, Kaur J. Concerns about usage of smartphones in operating room and critical care scenario [Internet]. *Saudi J Anaesth*. 2016 [cited 2023 Jan 18];10(1):87–94. DOI: 10.4103/1658-354X.169483
3. Armour T, Coffey E. Smartphones in the operating room: Can perioperative nurses be trusted? [Internet]. *J Periop Nurs*. 2020 [cited 2023 Jan 18];34(1):e27–e30. DOI: 10.26550/2209-1092.1114
4. Johansson P, Petersson G, Saveman B-I, Nilsson G. Experience of mobile devices in nursing practice [Internet]. *Vård i Norden*. 2012 [cited 2023 Jan 18];32(4):50–54. DOI: 10.1177/010740831203200411
5. Snoots LR, Wands BA. Use of personal electronic devices by nurse anesthetists and the effects on patient safety. *AANA J*. April 2016;84(2):114–119.
6. Jong A, Donelle L, Kerr M. Nurses' use of personal smartphone technology in the workplace: Scoping review [Internet]. *JMIR mHealth uHealth*. 2020 [cited 2023 Jan 18];8(11):e18774. DOI: 10.2196/18774
7. Chang C-H, Chen S-Y, Lu J-J, Chang C-J, Chang Y, Hsieh P-H. Nasal colonization and bacterial contamination of mobile phones carried by medical staff in the operating room [Internet]. *PLoS ONE*. 2017 [cited 2023 Jan 18];12(5):e0175811. DOI: 10.1371/journal.pone.0175811
8. Neves S, Soto RG. Distraction in the OR: Bells and whistles on silent mode [Internet]. *Int Anesthesiol Clin*. 2019 [cited 2023 Jan 18];57(3):62–67. DOI: 10.1097/AIA.0000000000000236
9. Van Harten A, Gooszen HG, Koksma JJ, Niessen TJH, Abma TA. An observational study of distractions in the operating theatre [Internet]. *Anaesthesia*. 2021 [cited 2023 Jan 18];76(3):346–356. DOI: 10.1111/anae.15217
10. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Chapter 11: Scoping reviews (2020 version). In: Aromataris E, Munn Z, editors. *JBIM manual for evidence synthesis* [Internet]. Joanna Briggs Institute. 2020 [cited 2023 Jan 18]. Available from: [synthesismanual.jbi.global](https://synthesismanual.jbi.global)
11. Porter SB, Renew JR, Paredes S, Roscher CR, Plevak MF, Yost KJ. Development, validation, and results of a survey of personal electronic device use among 299 anesthesia providers from a single institution [Internet]. *Anesth Analg*. 2022 [cited 2022 Aug 11];134(2):269–275. DOI: 10.1213/ANE.0000000000005708
12. Qureshi NQ, Mufarrih SH, Irfan S, Rashid RH, Zubairi AJ, Sadruddin A et al. Mobile phones in the orthopedic operating room: Microbial colonization and antimicrobial resistance [Internet]. *World J Orthop*. 2020 [cited 2022 Aug 11];11(5):252–264. DOI: 10.5312/wjo.v11.i5.252
13. Dowden A, Manson-Brick N, Martin W, McKerricher L, Wiebe M. Recommended cleaning practices for cell phones in the operating room: A modified scoping review [Internet]. *ORNAC J*. 2020 [cited 2022 Aug 11];38(2):15–20. Available from: [tinyurl.com/3pzb9ptn](https://tinyurl.com/3pzb9ptn)
14. Avidan A, Yacobi G, Weissman C, Levin PD. Cell phone calls in the operating theater and staff distractions: An observational study [Internet]. *J Patient Saf*. 2019 [cited 2022 Aug 11];15(4):e52–e55. DOI: 10.1097/PTS.0000000000000351
15. Park H, Lee S. International Nursing: Use of a commercially available smartphone application to solve information needs of orthopedic scrub nurses [Internet]. *Nurs Admin Q*. 2019 [cited 2022 Aug 11];43(4):337–350. DOI: 10.1097/NAQ.0000000000000366



16. Çelikoyar MM, Topsakal O, Gürbüz S. Mobile technology for recording surgical procedures [Internet]. *J Vis Commun Med*. 2019[cited 2022 Aug 11];42(3):120–125. DOI: 10.1080/17453054.2019.1612234
17. Cohen TN, Shappell SA, Reeves ST, Boquet AJ. Distracted doctoring: The role of personal electronic devices in the operating room [Internet]. *Perioper Care Oper Room Manag*. 2018[cited 2022 Aug 11];10:10–13. DOI: 10.1016/j.pcorm.2017.12.001
18. Cumino DO, Vieira JE, Lima LC, Stievan LP, Silva RAP, Mathias LAST. Smartphone-based behavioural intervention alleviates children's anxiety during anaesthesia induction: A randomised controlled trial [Internet]. *Eur J Anaesthesiol*. 2017[cited 2022 Aug 11];34(3):169–175. DOI: 10.1097/EJA.0000000000000589
19. Murgier J, Coste J-F, Cavaignac E, Bayle-Iniguez X, Chiron P, Bonneville P et al. Microbial flora on cell-phones in an orthopedic surgery room before and after decontamination [Internet]. *Orthop Traumatol: Surg Res*. 2016[cited 2022 Aug 11];102(8):1093–1096. DOI: 10.1016/j.otsr.2016.09.014
20. Pinar HU, Karaca O, Doğan R, Konuk ÜM. Smartphone use habits of anesthesia providers during anesthetized patient care: A survey from Turkey [Internet]. *BMC Anesthesiol*. 2016[cited 2022 Aug 11];16:88. DOI: 10.1186/s12871-016-0245-7
21. Shakir IA, Patel NH, Chamberland RR, Kaar SG. Investigation of cell phones as a potential source of bacterial contamination in the operating room [Internet]. *J Bone Joint Surg Am*. 2015 [cited 2023 January 18];97(3):225–231. Available from: [www.researchgate.net/publication/272398404\\_Investigation\\_of\\_Cell\\_Phones\\_as\\_a\\_Potential\\_Source\\_of\\_Bacterial\\_Contamination\\_in\\_the\\_Operating\\_Room](http://www.researchgate.net/publication/272398404_Investigation_of_Cell_Phones_as_a_Potential_Source_of_Bacterial_Contamination_in_the_Operating_Room)
22. Lee J-H, Jung H-K, Lee G-G, Kim H-Y, Park S-G, Woo S-C. Effect of behavioral intervention using smartphone application for preoperative anxiety in pediatric patients. *Korean J Anesthesiol*. 2013[cited 2022 Aug 11];65(6):508–518. DOI: 10.4097/kjae.2013.65.6.508
23. Smith T, Darling E, Searles B. 2010 Survey on cell phone use while performing cardiopulmonary bypass [Internet]. *Perfusion*. 2011[cited 2022 Aug 11];26(5):375–380. DOI: 10.1177/0267659111409969
24. Jeske H-C, Tiefenthaler W, Hohlrieder M, Hinterberger G, Benzer A. Bacterial contamination of anaesthetists' hands by personal mobile phone and fixed phone use in the operating theatre [Internet]. *Anaesthesia*. 2007[cited 2022 Aug 11];62(9):904–906. DOI: 10.1111/j.1365-2044.2007.05172.x
25. Moura FL, Moraes ÉB, Martins JD, Souza DF, Sanches MCO. Contaminação de celulares em unidades de terapia intensiva e a segurança do doente [Internet]. *Enferm Foco*. 2020[cited 2023 January 18];11(6):207–213. DOI: 10.21675/2357-707X.2020.v11.n6.3852
26. Santana-Padilla YG, Santana-Cabrera L, Dorta-Hung ME, Molina-Cabrillana MJ. Presence of microorganisms in mobile phones of intensive care staff at a hospital in Spain [Internet]. *Rev Peru Med Exp Salud Publica*. 2019[cited 2023 January 18];36(4):676–680. DOI: 10.17843/rpmesp.2019.364.4421
27. Shukla P, Khalid B, Yaqoob S, Ahmad S. Involvement of mobile phones as a source for nosocomial infections. *Asian J Med Sci*. 2021[cited 2023 January 18];12(7):126–129. DOI: 10.3126/ajms.v12i7.34788
28. Hasanshahi M, Rakhshan M, Fereidouni A, Moayedi SA, Torabizadeh C. Development and psychometric evaluation of a questionnaire for measuring distraction due to mobile phone use in operating rooms [Internet]. *J Periop Nurs*. 2022[cited 2023 January 18];35(2):e3–e13. DOI: 10.26550/2209-1092.1162
29. McBride D, LeVasseur SA, Li D. Nursing performance and mobile phone use: Are nurses aware of their performance decrements? [Internet]. *JMIR Hum Factors*. 2015[cited 2023 January 18];2(1):e6. DOI: 10.2196/humanfactors.4070
30. Association of periOperative Registered Nurses (AORN). AORN position statement on managing distractions and noise during perioperative patient care [Internet]. *AORN J*. 2014[cited 2023 January 18];99(1):22–26. DOI: 10.1016/j.aorn.2013.10.010
31. Li L, Ma J, Ma D, Zhou X. Smartphone interventions effect in pediatric subjects on the day of surgery: A meta-analysis [Internet]. *Front Surg*. 2021[cited 2023 January 18];8:1–7. DOI: 10.3389/fsurg.2021.759958
32. Gao X-L, Liu Y, Tian S, Zhang D-Q, Wu Q-P. Effect of interesting games on relief of preoperative anxiety in preschool children [Internet]. *Int J Nurs Sci*. 2014[cited 2023 January 18];1(1):89–92. DOI: 10.1016/j.ijnss.2014.02.002