# Residents' Smartphone use During The Conduct of Anesthesia: The Incidence and Impact on Anesthesia-Related Complications

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***Objective:*** *The aim of this study was to determine the rate of smartphone use by residents during the conduct of anesthesia, and their attitude towards smartphone use in clinical settings.*
***Material and Method:*** *The study consisted of two phases. The first, a disguised observation phase, used operating room nurses to record residents' use of smartphones every 15 to 30 minutes during anesthesia. Anesthesia-related complications were documented at a postoperative visit. The second phase comprised a survey of residents' attitudes to smartphone use and the clinical consequences of doing so while administering anesthesia.*
***Results:*** *Smartphones were used during 89 of the 250 anesthetics observed (35.6%). There was no relationship between the use of a smartphone and anesthesia-related complications. Fifty-three of 72 anesthesia residents responded to the questionnaire (73.6%). All owned a smartphone and all admitted to using a smartphone while administering an anesthetic. Most used their smartphone to access the Internet (96.2%, n = 51), including social networks (81.1%, n = 43). The majority felt positive towards smartphone use (94.3%, n = 50), particularly their educational value. A minority reported that smartphones distracted from patient care or impaired their interactions with colleagues.*
***Conclusion:*** *The rate of smartphone use among anesthesia residents in the operating room is high. Residents' awareness of the potential for distraction by smartphones during the conduct of anesthesia is low, and should be highlighted as part of their clinical clerkship.*

***Keywords:*** *Anesthesia conduction, Self-awareness, Cell phones, Handheld computers, Smartphone*

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Smartphones have become part of everyday life for many. A Time Magazine survey in 2012 reported that a substantial number of individuals admit to being addicted to smartphone use, particularly those aged 25 to 29. One in four people are reported to check their phone every 30 minutes, and one in five every 10 minutes[1]. Healthcare providers are increasingly using medical smartphone applications, and the availability of wireless connectivity in the hospital and the operating room (OR) means that there is almost unlimited access to the Internet. As smartphones become more affordable and battery life improves, they are increasingly widely available and accessible.

Smartphones allow access to online clinical educational material: there are many mobile applications for healthcare providers available for most operating systems[2]. Improving access to information is reported to enhance the quality of patient care and reduce the incidence of medical errors[3]. Smartphones also allow an online logbook of clinical activity to be maintained and can be used to evaluate clinical performance.

The potential for becoming distracted by smartphones is an issue for drivers. The Governors Highway Safety Association reported that 25% of automobile accidents in the United States occurred as a result of distraction while driving using a smartphone[4]. Moreover, a smartphone can cause distraction in workplace settings[5]. When performing a simple task, mobile phone communication and text messaging produce significant effects on working memory and recall[6]. Nevertheless, the distraction caused by smartphone use in clinical practice has not been extensively studied. A survey of cardiac perfusionists found that 55.6% admitted to using a

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mobile phone while administering cardiopulmonary bypass[7], despite 78.3% expressing concern that mobile phone use is a risk to patient safety. Gill et al have proposed that smartphones distract healthcare professionals from patient care[8]; however, the potential for distraction of anesthesiologists in the OR has not been examined.

The use of smartphones for communication between clinicians and nurses is acknowledged to increase collaborative working and the multitasking abilities of residents[9]. Smartphone communication is beneficial mostly for non-urgent manners, but the reduction in face-to-face communication may impair teamwork. This issue has been raised by nurses, who have recognized that relationships with doctors may become strained when conducted using electronic devices[10]. Some nurses prefer to email the doctors instead of making a phone call because they do not want to disturb them.

The anesthesiologist has almost unlimited access to their smartphone while working in the OR: they do not need to wear sterile gloves throughout the procedure and may have time to devote to other activities during the stable maintenance phase of anesthesia. Advances in monitoring and record-keeping technologies mean that the anesthesiologist may now spend less time completing records and charts, allowing more time to view a smartphone or mobile device.

There are no published data concerning the use of smartphones during the provision of anesthesia care. We have observed increasing use of smartphones among anesthesiologists. The purpose of this study was to observe smartphone habits of anesthesia residents during the conduct of anesthesia, and their attitude to these behaviors. We hypothesized that the incidence of smartphone use during anesthesia is higher than residents might appreciate.

## Material and Method

The study protocol was approved by the Institutional Review Board (Si 451/2013) and the need for informed consent was waived, as patient care was not affected. The study was conducted between September 2013 and September 2014 in the Department of Anesthesiology, Faculty of Medicine, Siriraj Hospital, which accommodates 72 residents in a 3-year anesthesia-training program.

The study consisted of two phases: an observation phase and a survey phase. The observation phase was conducted in orthopedic OR, neurosurgery OR and cardiothoracic surgical OR, to give a representative sample of short and long, regional and general, and straight forward and complex anesthetics. Smartphone use by residents during the conduct of anesthesia was observed by OR nurses every 15 to 30 minutes using a disguised technique. Use of the smartphone for anything other than a telephone conversation was recorded. The surgical specialty, operation, mode of anesthesia and the residents' experience were also documented. Anesthesia-related complications were assessed and recorded during a postoperative visit. We judged that observing 250 anesthetics based on an incidence of smartphone use of 80% would yield 95% confidence intervals (CI) <5%[8].

After completing the first phase of the study, a three-page questionnaire was distributed to all anesthesia residents in September 2014. The questionnaire comprised three sections, including questions about demographic characteristics, attitudes toward smartphone use during the conduct of anesthesia and experience of consequences or complications of smartphone use during the conduct of anesthesia.

### *Statistical analysis*

Statistical analysis was undertaken using SPSS (version 18; SPSS Inc., Chicago, IL). Comparisons of demographic data, observed smartphone use and questionnaire responses were made with the independent t-test, Mann Whitney U test or Pearson's Chi-squared test. Statistical significance was represented by a $p$-value <0.05, which was reported with a 95% CI. Adjusted analysis using binary logistic regression was performed to explore the relationships between observed smartphone use during the conduct of anesthesia and other parameters.

## Results

A total of 250 anesthetics were observed, the demographic data was shown in Table 1. Smartphone use was detected in 89 cases (35.6%). There were 10 anesthesia-related complications. Most were minor, such as minor lip or dental injury. In one case, however, the patient developed postoperative respiratory failure. In this case the resident had used a smartphone, but when analyzing there was no statistically significant relationship between use of smartphones and complications.

A Chi-square test of independence was calculated comparing the frequency of smartphone use

in male and female, level of training of anesthesia residents, operating units and types of anesthesia. A significant interaction was found in level of training, operating units and types of anesthesia [Chi-square (2) = 6.96 ($p$ = 0.03), Chi-square (2) = 54.13 ($p$<0.01) and Chi-square (1) = 11.25 ($p$<0.01) respectively]. First year residents were more likely to use smartphone than second and third year (Table 1). There were 38 observations of smartphone use (45.2%) during orthopedic surgery, 48 (55.8%) during neurosurgery, but only three (3.8%) during cardiothoracic surgery. Moreover, residents were found to use smartphone during regional anesthesia than general anesthesia (regional anesthesia 60%, general anesthesia 30.8%).

There were 84 (33.6%), 86 (34.4%) and 80 (32.0%) observations of anesthesia in orthopedic, neurosurgical and cardiothoracic ORs, respectively. The mean duration of anesthesia in the entire cohort was 211 minutes (±standard deviation 116 minutes). The mean durations of anesthesia were compared between operating theater specialties using one-way ANOVA revealed different mean anesthesia time, 160±76.9 minutes for orthopedic surgery; 284±136.4 minutes for neurosurgery and 188±88 minutes for cardiothoracic surgery (F = 32.9, $p$<0.01).

When comparing the observations of smartphone use and not use with independent t-test, the mean duration of anesthesia was significantly longer in cases in which smartphone use was observed (254±129 minutes versus 187±102 minutes in those cases in which smartphone use was not observed, t (246) = -4.5, $p$<0.01). Multivariate analysis using binary logistic regression identified that duration of surgery and surgical specialty significantly influenced smartphone use (Table 2).

Of the 72 anesthesia residents, 53 responded to the questionnaire (response rate 73.6%). The mean age of the respondents was 28.2±1.8 years old; nine were men (17.0%). All respondents owned a smartphone and all admitted that they had used them during the conduct of anesthesia.

The majority of respondents reported that they used their smartphone during the conduct of anesthesia to look at websites (96.2%, n = 51) and connect to social networks (81.1%, n = 43). Smartphones were also used to play games (13.2%, n = 7), read e-books (3.8%, n = 2), as a calculator (3.8%, n = 2), to make financial transactions (1.9%, n = 1) and to check operating schedules (1.9%, n = 1).

Responses to the questionnaires showed that 94.3% (n = 50) viewed smartphone use positively (Table 3). The same proportion responded that the smartphone was useful for educational purposes, but only 39.6% (n = 21) thought that smartphones helped improve quality of patient care. Indeed, almost half the respondents (47.2%, n = 25) thought that smartphone use impaired quality of the patient care and 64.2% (n = 34) felt that the risk of complications would increase when smartphones were used while taking care of the patient. More than two-thirds (67.9%,

**Table 1.** Characteristics of the 250 cases observed

| Characteristic | Number (proportion of entire cohort, %) | Smartphone use | | $p$-value |
|---|---|---|---|---|
| | | Yes | No | |
| Gender | | | | |
| Male | 70 (28.5) | 25 (35.7) | 45 (64.3) | |
| Female | 176 (71.5) | 63 (35.8) | 113 (64.2) | 0.99 |
| Level of training of anesthesiologist | | | | |
| Year 1 | 63 (25.8) | 30 (47.6) | 33 (52.4) | |
| Year 2 | 83 (34.0) | 22 (26.5) | 61 (73.5) | 0.03 |
| Year 3 | 98 (40.2) | 35 (35.7) | 63 (64.3) | |
| Operating theater | | | | |
| Orthopedic surgery | 84 (34.0) | 38 (45.2) | 46 (54.8) | |
| Neurosurgery | 86 (34.0) | 48 (55.8) | 38 (44.2) | <0.01 |
| Cardiothoracic surgery | 80 (32.0) | 3 (3.8) | 77 (96.3) | |
| Type of anesthesia | | | | |
| General | 211 (85.8) | 65 (30.8) | 146 (69.2) | |
| Regional | 35 (14.2) | 21 (60.0) | 14 (40.0) | <0.01 |

**Table 2.** Factors influencing smartphone use

| Factors | Smartphone use,n (%) | Odds ratio (95% confidence interval) | *p*-value |
|---|---|---|---|
| Duration of anesthesia | | | |
| ≤60 min | 2 (22.2) | 1 | <0.01 |
| 61–120 min | 7 14.3) | 0.6 (0.1–4.4) | 0.65 |
| 121–180 min | 25 (34.7) | 1.4 (0.2–9.2) | 0.70 |
| >180 min | 55 (46.6) | 3.9 (0.6–25.0) | 0.15 |
| Operating theater | | | |
| Cardiothoracic surgery | 3 | 1 | <0.01 |
| Orthopedic surgery | 38 | 15.7 (3.8–65.8) | <0.01 |
| Neurosurgery | 48 | 27.3 (7.7–96.9) | <0.01 |
| Level of training | | | |
| Year 1 | 30 | 1 | 0.91 |
| Year 2 | 22 | 1.1 (0.5–2.6) | 0.74 |
| Year 3 | 35 | 0.9 (0.4–2.1) | 0.90 |
| Type of anesthesia | | | |
| General anesthesia | 65 (30.8) | 1 | 0.34 |
| Regional anesthesia | 21 (60.0) | 3.8 (1.4–3.9) | 0.01 |

**Table 3.** Questionnaire findings, report the number and proportion of respondents who agreed or strongly agreed with the statement

| Question | Number (proportion of respondents, %) |
|---|---|
| Smartphone use is of benefit overall | 50 (94.3) |
| Using a smartphone helps with education | 50 (94.3) |
| Smartphones help improve the quality of patient care | 21 (39.6) |
| Smartphone use may decrease the quality of patient care | 25 (47.2) |
| Smartphone use increases the risk of morbidity and error | 34 (64.2) |
| Smartphone use may delay the detection of abnormalities in the patients by the anesthesiologist | 36 (67.9) |
| Smartphone use impairs my relationship with co-workers, for example the surgeon or nurses | 12 (22.6) |
| Smartphone use distracts me while taking care of the patient | 22 (41.5) |
| I am aware of my colleagues being distracted by smartphones while giving an anesthetic | 19 (35.8) |
| I have experienced a near-miss situation when using a smartphone while giving an anesthetic | 4 (7.5) |
| I have made an error when using a smartphone while giving an anesthetic | 2 (3.8) |
| I have experienced a delay in the detection of abnormalities when using a smartphone while giving an anesthetic | 20 (37.7) |

n = 36) believed that smartphone use could impair their ability to detect perioperative physiologic disturbance, and 37.7% reported that they had experienced this personally. A minority thought that smartphone use could be distracting while caring for patients (41.5%, n = 22), but that their interactions with colleagues were not affected (22.6%, n = 12). Two respondents (3.8%) reported that they had experienced an adverse event as a result of smartphone use, while four (7.5%) reported a near miss events.

## Discussion

We found that anesthesia residents used smartphones frequently while giving anesthetics. There were low levels of awareness of the drawbacks of smartphone use, such as distraction and impairment of relationships with colleagues; however, there was no statistical association between smartphone use and anesthesia-related complications.

All anesthesia residents in our institution that responded to the questionnaire own and use a

smartphone. There are no previous data regarding smartphone use in a broadly comparable population, but the age group of our anesthesia residents corresponds with that most likely to be addicted to their smartphone, 25 to 29 years old[1]. Smartphones have become fully integrated into daily life, and prohibiting smartphone use during work may not be the solution. Nonetheless, medical personnel should be fully aware of the potential for distraction and impairment of interactions with colleagues associated with smartphone use.

There was a low level of awareness among our residents of the potential for distraction by smartphone use during clinical work. Katz-Sidlow et al found that both residents and faculty members feel that smartphone use can be a serious distraction during ward rounds[11], with residents reporting they missed about one-third of information due to distraction by smartphones. To the best of our knowledge there is no evidence that smartphone use is associated with an increased incidence of adverse events or morbidity, or adversely influences patient outcome. Our study revealed most of anesthesia-related complications occurred were minor complications such as lip or dental injury, which was occurred during the intubation period when no one use smartphone anyway. One major complication was postoperative respiratory failure and found unrelated to smartphone use. However, this complication has very low incidence, this study might be underpowered to detect such a correlation.

The surgical specialty of the case strongly influenced smartphone use among our residents, who used their smartphones significantly less in the busy cardiothoracic OR. We also found that residents used their smartphones significantly more often during the maintenance phase of regional anesthesia cases compared with general anesthesia cases. Moreover, the use of smartphone was observed more in longer duration of anesthesia. This may be due to there were more available time to use smartphone during regional anesthesia as well as during lengthy maintenance anesthesia hours.

The majority (81.1%) of respondents admitted to using their smartphones to connect to social networks during work. Medical applications on smartphones may improve knowledge and patient safety, but distraction by games and social networks appears unavoidable. Use of social media influences behavior and can become addictive for some[12]. The problem is not only distraction, but there are numerous examples of healthcare practitioners behaving unprofessionally on social media, and breaches of patient confidentiality[9]. It is essential to improve residents' awareness of the potential complications that could arise as a result of social media use at work.

Nonetheless, our anesthesia residents did not feel that smartphone use affected their relationships with colleagues (41.5% disagreed with a statement that smartphones did so, with 35.8% neutral and 22.6% agreeing). They also did not believe that smartphones can distract them during clinical work (Disagree 24.5%, neutral 34% and agree 41.5%). Viale has proposed that face-to-face contact is the most important part of the relationships between doctors, medical personnel and patients[13]; it seems likely that face-to-face contact is impaired by mobile devices.

The limitations of this study include the relatively small size of the cohort recruited from a single center, which could limit its generalizability. Also, the generalizability to other generations, such as consultant anesthesiologists, is not known: further studies of smartphone use and consultant anesthesiologists' attitudes towards smartphones would be valuable. Moreover, the size of our sample means that we cannot draw meaningful conclusions about the relationship between smartphone use and anesthesia-related complications; studies in larger populations will be required to address this important issue.

In conclusion, the incidence of smartphone use by anesthesia residents during the conduct of anesthesia is high. All medical personnel should be aware of the potential for distraction by smartphones during clinical work.

**What is already known on this topic?**

Smartphones have integrated into daily life in this generation including healthcare providers. Distraction by smartphones is a recognized problem among drivers but not in healthcare providers.

**What this study adds?**

Rate of using smartphones during providing anesthesia is high among anesthesia residents while awareness of the drawback is low. Self-awareness of potential distraction by smartphone during clinical clerkship is important and need to be encouraged in all healthcare providers.

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**Potential conflicts of interest**

None.

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## การใช้สมาร์ทโฟนในแพทย์ประจำบ้านวิสัญญีระหว่างให้การระงับความรู้สึก

กษณา รักษมณี, บุศรา ศิริวันสาณฑ์, พิชยา ไวทยะวิญญู, อัครินทร์ นิมมานนิตย์

**วัตถุประสงค์:** เพื่อหาอัตราการใช้สมาร์ทโฟนระหว่างให้การระงับความรู้สึกของแพทย์ประจำบ้านวิสัญญี และทัศนคติต่อการใช้สมาร์ทโฟนขณะดูแลผู้ป่วย

**วัสดุและวิธีการ:** การศึกษาแบ่งเป็นสองระยะ ระยะแรกเป็นการสังเกตพฤติกรรมการใช้สมาร์ทโฟนของแพทย์ประจำบ้านในห้องผ่าตัด โดยบุคลากรที่แฝงตัวมาสังเกตทุก 15 ถึง 30 นาที ระหว่างให้การระงับความรู้สึกว่ามีพฤติกรรมการใช้สมาร์ทโฟนหรือไม่ และบันทึกภาวะแทรกซ้อนที่เกิดขึ้นด้วย ระยะที่สองใช้แบบสอบถามเพื่อศึกษาทัศนคติของแพทย์ประจำบ้านที่มีต่อการใช้สมาร์ทโฟน รวมถึงประสบการณ์การใช้สมาร์ทโฟนที่ส่งผลต่อการดูแลผู้ป่วย

**ผลการศึกษา:** จากการสังเกตพบแพทย์ประจำบ้านใช้สมาร์ทโฟนระหว่างระงับความรู้สึกในผู้ป่วย 89 รายจาก 250 ราย (ร้อยละ 35.6) ไม่พบความสัมพันธ์ของการใช้สมาร์ทโฟนและภาวะแทรกซ้อนทางวิสัญญีที่เกิดขึ้น ผลการตอบแบบสอบถาม มีแพทย์ประจำบ้าน 53 คนตอบจาก 72 คน (ร้อยละ 73.6) แพทย์ประจำบ้านทั้งหมดมีสมาร์ทโฟนอยู่ในครอบครองและ 100% ยอมรับว่าเคยใช้สมาร์ทโฟนขณะให้การระงับความรู้สึกผู้ป่วย จากการสอบถามพบว่าร้อยละ 96.2 (52 ราย) ใช้สมาร์ตโฟนเพื่อเชื่อมต่ออินเตอร์เน็ต ซึ่งรวมถึงการใช้เครือข่ายสังคม (ร้อยละ 81.1, n = 43) โดยส่วนใหญ่มีทัศนคติเชิงบวกเกี่ยวกับการใช้สมาร์ทโฟนโดยเฉพาะในแง่ของการหาความรู้เพิ่มเติม (ร้อยละ 94.3, n = 50) มีแพทย์ประจำบ้านส่วนน้อยรายงานการใช้สมาร์ทโฟนทำให้เสียสมาธิขณะดูแลผู้ป่วยและทำให้ปฏิสัมพันธ์กับเพื่อนร่วมงานลดลง

**สรุป:** พบอัตราการใช้สมาร์ตโฟนระหว่างให้การระงับความรู้สึกค่อนข้างสูงในขณะที่แพทย์ประจำบ้านมีความตระหนักน้อยมากเกี่ยวกับข้อเสียของสมาร์ทโฟนเช่นทำให้เสียสมาธิในการดูแลผู้ป่วย