

Smartphone and app usage amongst South African anaesthetic service providers

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Background: Mobile medical applications have evolved rapidly in the 21st century, making it easier for anaesthetic service providers to utilise these for work-related queries. However, there is no South African data available to determine if this technology is being utilised. The usage patterns of mobile medical health applications and the accessibility of this technology to a resource-limited environment, along with a focus on what apps South African anaesthetic service providers are using was assessed and quantified. Secondly, the favourability of a South African-based app and any possible barriers to entry were examined.

Methods: A prospective, contextual, descriptive study was conducted amongst anaesthetic service providers attending the 2018 South African Society of Anaesthesiologists National Congress in Cape Town. Two hundred and thirty-two (116 specialists and 116 registrars) surveys were completed voluntarily between 4 to 8 April 2018, and analysed.

Results: 100% of participants utilise smartphones for work-related queries. 169/232 (72%) participants favoured a South African-based app. Drug referencing and calculator functionality were the most frequently used mobile applications. Specialists were more likely to admit to nonprofessional use of smartphones in theatre. High data costs contribute to decreased usage amongst respondents.

Conclusions: A South African-based pharmacology app would be welcomed and utilised by the South African anaesthetic community. Smartphone and app usage patterns, as well as limitations to this technology usage in South Africa appear to reflect those seen worldwide. Poor internet connectivity and high data costs were limiting factors to technology utilisation.

Keywords: smartphone, app, anaesthesiology, drug referencing

Introduction

Traditionally, the medical community has been criticised for not using mobile technology devices as readily as other industries. However, there now appears to be a significant shift in this attitude, with doctors and medical students alike using at least one medical app regularly.¹⁻³ In some literature, up to half of the participants reported using their favourite work app daily.^{2,3}

Anaesthesiology as a field utilises pharmaceuticals with varying calculations. It, therefore, makes practical sense that anaesthetic service providers would be utilising this readily available technology as much as, or possibly even more, than other medical disciplines. Questions raised with regards to this assumption included whether quantification of app usage by medical professionals and particularly anaesthetic service providers exists; whether there are certain favoured apps that are used; if app usage is relevant to medical practice and also if there are any perceived or real negative effects of app and smartphone usage. There are very few South African-based apps for work-related queries. In fact, the apps being used currently are mostly American in origin and designed for the Apple iOS market.⁴ This may possibly be hindering the use of this technology by South African anaesthetic service providers.

The aim of this study was to determine the incidence of smartphone and medical app usage amongst South African anaesthetic service providers and to assess whether trends echo those seen in the rest of the world. Worldwide smartphone

ownership is persistently above 75%, with 80% of those users making use of smartphone apps. It is estimated that upwards of 70% of medical professionals worldwide utilise medical apps regularly, but little to no data is available from the African continent.^{5,6} The impact of mobile medical health applications in the lower- to middle-income countries versus those in the higher-income world and the accessibility of said technology to these resource-limited environments was assessed, with a particular focus on what apps South African anaesthetic service providers are favouring and the possible reasons for this. South African smartphone and app usage amongst medical practitioners and anaesthetic service providers is probably in line with trends in the developed world due to smartphone usage trends amongst the South African population which mirror those seen in the rest of the world,^{7,8} but there is little accurate data to substantiate this currently.

Methods

This prospective, contextual, descriptive study was conducted during the national congress of the South African Society of Anaesthetic service providers in April 2018, after approval was granted by the Human Research Ethics committee of Stellenbosch University (Approval number 0649).

Opt-in sampling was used for participant recruitment. Data was collected using a self-developed 12-point questionnaire. The questionnaire was administered by the principal investigator. Data collected included the participants' demographics, clinical

experience, reasons for using or not using a smartphone, preferred apps, and websites, as well as barriers to technology usage. Two population groups were selected: qualified specialists (working in both the private and public health sector) and the anaesthetic registrar population of South Africa. This population categorisation allowed for the assessment of any age-related congruity with regards to smartphone and app usage.^{3,6,9-11}

From the available data it was expected that at least 60% of the South African population would have a smartphone and be using apps.⁸ Using an expected prevalence of 60% for smartphone usage, the sample size required to have 9% precision with 95% confidence for this prevalence was calculated to be 114. Data from the completed questionnaires was captured on a structured spreadsheet. Incomplete questionnaires were excluded from the analysis. Percentages were rounded up to the nearest whole number and chi-squared statistical testing was used to ascertain the statistical significance of the data.

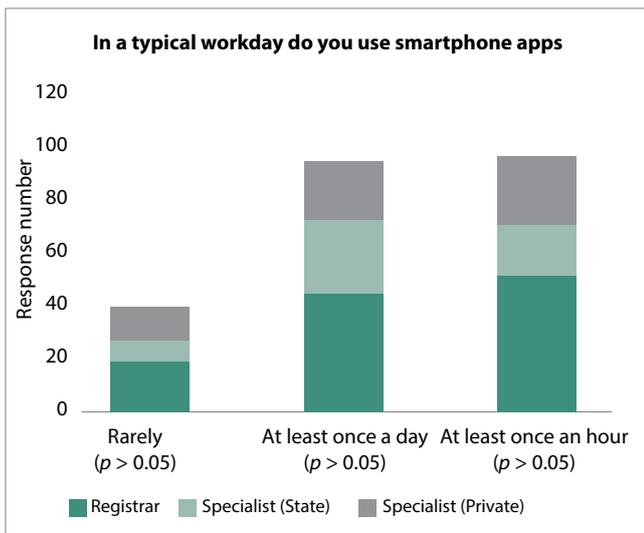


Figure 1: Smartphone app usage

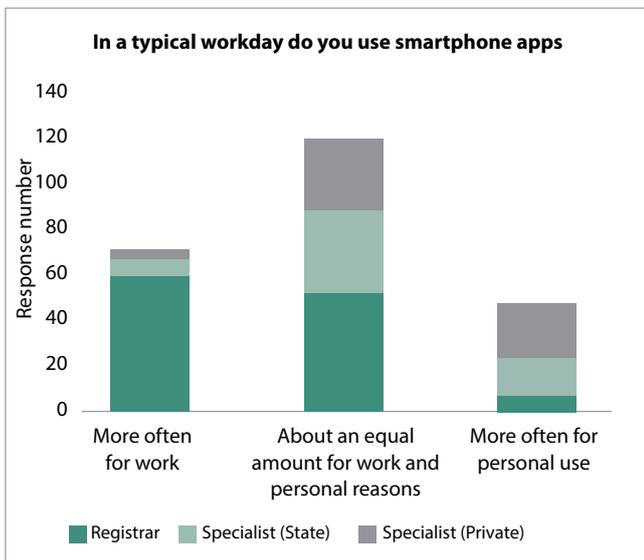


Figure 2: Professional versus personal use preference

Results

A total of 252 questionnaires were distributed of which 239 were returned. Seven of those returned questionnaires were incomplete (two registrars and five specialists) and excluded from the final data analysis. One hundred and sixteen registrars and 116 specialists (44 public sector and 72 private sector) completed the questionnaire. 100% of all participants reported owning and using a smartphone. 71% of specialists and 72% of registrars utilise Apple products.

The usage trends for smartphone and app usage are reflected in Figure 1 and Figure 2.

Specialists showed a preference for less apps and websites than registrars did (absolute ratio of 0.21 answers versus 0.62 for registrars).

A comparison of the specialists in the private and public sectors showed that 6/44 (14%) of public sector specialists use Pedistat compared to 1/72 (1%) of the private sector specialists ($p = 0.007$). There was no statistically significant difference in the use between state and private sector specialists for any other apps in this survey.

When asked about the activities performed on a smartphone in theatre, respondents were able to provide multiple responses to this question. The activities accounting for smartphone usage in theatre followed similar trends amongst registrars and specialists (Figure 3).

Other uses for smartphones in a theatre environment listed by participants were billing, entertaining paediatric patients during

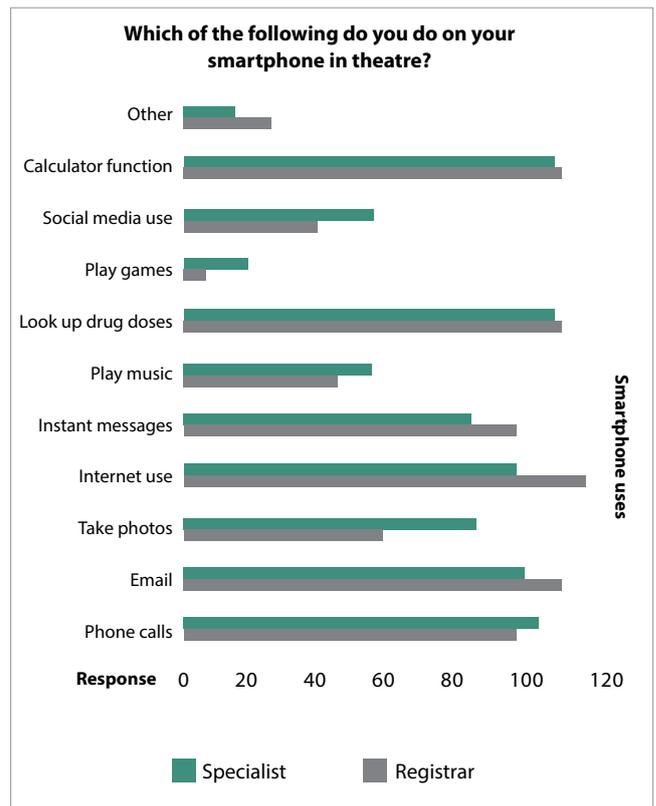
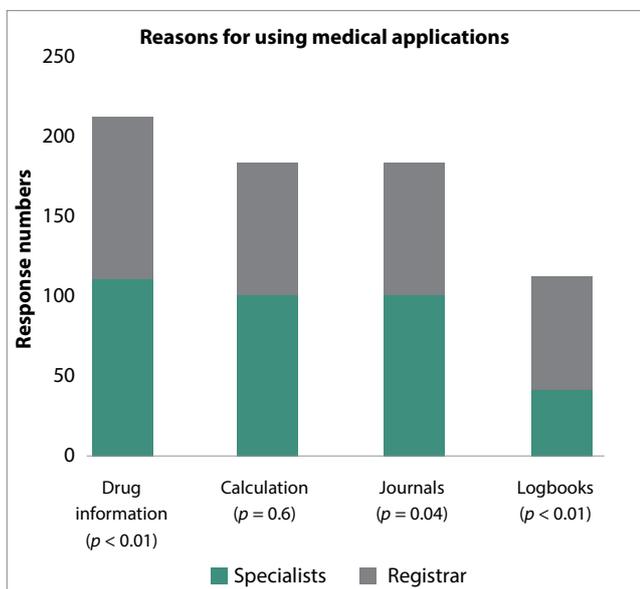


Figure 3: Reasons for smartphone use in theatre

Table I: Specialist smartphone use in theatre – public vs private sector

Smartphone functions used in the operating theatre	Public sector n = 44	Private sector n = 72	p-value
Make or receive phone calls	43 (98%)	59 (82%)	< 0.01
Send or receive emails	42 (95%)	56 (78%)	< 0.01
Taking photos	43 (98%)	41 (57%)	< 0.01
General internet use (other than for social media)	40 (91%)	56 (78%)	0.56
Send or receive instant messages and/or texts	42 (95%)	41 (57%)	0.02
Play music	19 (43%)	35 (49%)	< 0.01
Look up drug doses	43 (98%)	63 (88%)	0.17
Play games	3 (7%)	31 (43%)	0.56
Social media use	24 (55%)	30 (42%)	0.18
Use the calculator function for drug calculations	44 (100%)	63 (87%)	0.056
Other – checking drug trade names, billing, entertaining kids with induction, block techniques	8 (18%)	7 (9%)	0.18

**Figure 4:** Medical app usage

induction of anaesthesia and researching regional anaesthesia techniques.

The responses have been further subdivided into specialists working in the public vs private sector (Table I), highlighting the differences in smartphone use applications between specialists working in the two healthcare sectors.

The reasons for use of medical apps varied among survey respondents (Figure 4). Respondents were allowed more than one choice for this question.

The difference in the apps used between specialists in the public and private sectors is shown in Table II.

Table II: Specialist medical app usage – public versus private sector

	State sector n = 44	Private sector n = 72	p-value
Drug information	43 (98%)	63 (88%)	0.056
Calculations	42 (95%)	52 (72%)	$p < 0.01$
Journals	32 (73%)	29 (40%)	$p < 0.01$
Logbooks	21 (48%)	23 (32%)	0.08

Trends were similar for specialists and registrars with regards to reasons for not using smartphones at work (multiple answers were allowed in this section) (Figure 5). Expensive mobile data charges and irregular or no internet access are the major limiting factors to access (72% and 81% were responses for specialists and registrars respectively).

Possible smartphone addiction, infection risk, not wanting to appear unprofessional and distraction from patient care were cited as other reasons why practitioners might not favour using electronic devices in a theatre environment.

A further analysis of the specialist group indicated that issues related to internet connectivity were a significant factor influencing the decision to use medical apps in the operating theatre.

Availability of Wi-Fi was shown to be a limiting factor when all state sector employees (160/232) versus those in private (72/232) alone were compared ($p < 0.001$).

There was an overwhelmingly positive attitude towards having a South African app for drug referencing with 77% of registrars (90/116) and 68% (79/116) of specialists indicating that they would use an app with only five registrars out of all the respondents indicating that they would not use a South African-based app. 72% of all respondents would use a South African-based app ($n = 169, p = 0.006$).

Discussion

This is the first survey on medical app usage by anaesthetic service providers conducted in South Africa and is also the first of its kind to be done on the African continent. There are a few small

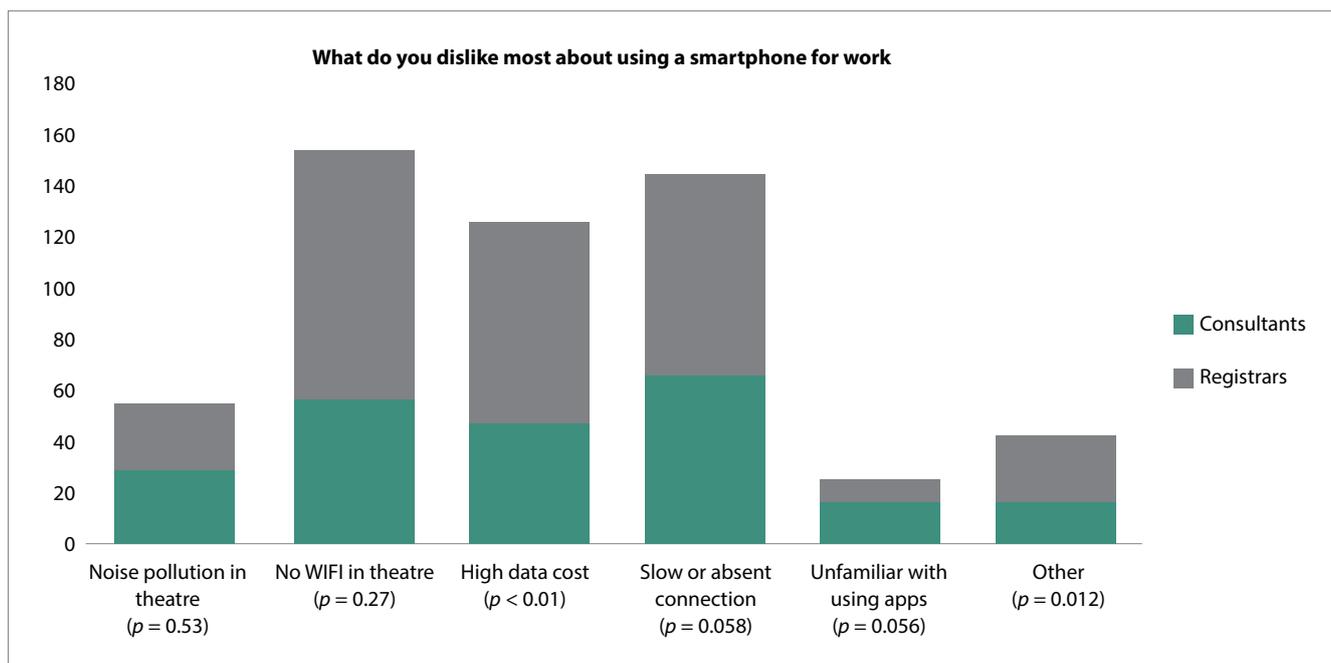


Figure 5: Barriers to entry for smartphone and app usage in theatre

international studies looking at similar data but currently most of the existing data looks at medical professionals in general and not at anaesthetic service providers in particular.^{2,6,9,11-15}

Worldwide smartphone ownership is persistently above 75%; with 80% of those users making use of smartphone apps. It is estimated that upwards of 70% of medical professionals worldwide utilise medical apps regularly, but little to no data is available from the African continent.^{2,5,12} As of January 2021, Apple reported that a staggering 1.6 million apps were available through the iTunes app store. Between 2011–2012 over 4 500 English language medical apps existed in the Apple store already, with a relatively equal proportion available for medical healthcare professionals and the public.¹⁶ Smartphone ownership (100%) and usage patterns in this survey mirror those seen around the world with a strong preference for Apple products ($n = 165$).^{3,4} Our results also support data from other worldwide surveys demonstrating the high ownership and usage rate of these tools by medical practitioners globally. This encompassed a wide spectrum of environments from Saudi Arabia to Uganda.¹⁷

Our study sample included South African anaesthesiology specialists and registrars of varying ages, and a varied geographical and socioeconomic spread. Gender has not been shown to have an influence on app usage patterns globally and we therefore did not collate this information.¹⁰

Age also did not seem to play a role with regards to smartphone and app usage in this survey, which corresponds well with the international literature. From as early as 2006, there has been disagreement in the literature as to whether the popularity of mobile device usage corresponds with age. It has always been assumed that usage correlates with younger age groups, but this does not seem to be the case internationally, and our results correspond with this.¹⁸ In this survey 97/116 (94%) registrars

reported using a smartphone app at least once a day with 93/116 (82%) specialists indicating the same. Smartphone usage frequency in this survey was not influenced by the healthcare sector that the respondents worked in or whether they were still trainees or not. This further underpins the evolving and widespread nature of mobile medical technology, as well as the relevance of medical apps and our use thereof.

There was a notable disparity amongst specialists and registrars with regards to their motivations for using smartphones, with only 12/116 (10%) specialists reporting usage mostly for work versus 58/116 (50%) registrars reporting mostly work-related usage ($p < 0.05$). This disparity does not translate to specialists in the public versus private sectors however ($p = 0.37$). These findings correspond well with international literature that indicates that younger colleagues fear the implication that using electronic devices may imply a lack of ability and professionalism.

In this survey, there was an increased app technology usage amongst the registrars and the choice of app was also in part dictated by the level of training, rather than age alone. A multiple answer model was used to assess website and app preference and absolute ratios indicated increased usage patterns for registrars versus specialists ($p < 0.05$). Statistical significance was shown for registrar versus specialist preference for the app Pedistat ($p < 0.01$). Pedistat is an app designed specifically for paediatric patients and provides drug doses, airway and fluid requirements based on both age and weight. It is unclear as to why this may have been favoured over other apps, but it could be that this allows for the verification of information and fact checking in a group of doctors who are still solidifying their core knowledge base. Also relevant to the apps in the survey was that they have some form of academic review with regards to their information. They could therefore possibly be assumed to be more accurate or reliable than other apps. Amongst specialists in

the two health sectors there was no statistical significance shown other than for the use of the app Pedistat, with more usage being reported amongst the private sector specialists. The popularity of the Pedistat app could imply several things. The app itself could be deemed to be well designed and easy to use. Secondly, with the highly individualised nature of paediatric anaesthesia, there is an increased risk for drug errors. This makes the use of an accurate mobile app particularly useful and relevant for this subset of patients.

The above speculation is further supported by the fact that the most popular apps amongst medical professionals are consistently those for medical drug referencing.^{19,20} The findings in this survey also further suggest the validity of the above with 65% of the specialists' and 54% of the registrars' responses indicating preferential use of smartphones for drug information and drug calculations (Figure 4). Registrars also reported more logbook use than specialists (76/329; 23% of overall registrar responses versus 61/332; 18% of overall specialist responses). This is appropriate for registrars particularly, as their final examination entry requirement includes the mandatory submission of a completed logbook upon completion of training.²¹

The use of smartphones for drug research in this survey predominated smartphone usage for work-related queries. Furthermore, specialists in the private sector used smartphone apps more for medical calculations than their public sector colleagues ($p = 0.001$). This could imply intensified vigilance with regards to drug dosing especially amongst more experienced personnel but was also likely linked to the solitary and time-constrained nature of private sector work. Private sector work does not necessarily allow for the same level of physical interaction with colleagues to discuss challenging cases or review drug doses, which tends to occur in the public health sector. It also calls for highly efficient patient turnover which requires quick and accurate drug calculations.

Mosa et al. demonstrated that 33% of nearly 3 000 physicians in their study reported making prescribing decisions based on smartphone information.^{3,22} What is interesting and also indeed somewhat worrying, is that some studies also show quite conclusively that users search for and evaluate the quality of information in a different way than is implicitly assumed by app authors.¹⁵ In other words, users do not always adequately assess the quality of information on the web and on apps but rather simply assume that it is accurate. The primary criteria for choice of app download by users, regardless of the reason for downloading the app (that is social versus professional use) appears to be pricing.²³

As recently as 2016, a review of pharmacology apps and websites was completed with a focus on opioid medications to specifically assess side-effects and incorrect data related to the prescribing of these drugs. Over 850 errors were identified between 2011–2013, and since the publication of that study only a third had been corrected. This once again highlights the need for standardised and verified online information, particularly with

regards to pharmacology referencing for medical practitioners. Thus far the vast majority of available medical apps remain without any form of regulation or safety checks internationally.⁵ No evidence of any existing South African legislation with regards to such regulation has been found to date.

This is relevant to the use of medical apps in South Africa, as the results of our survey echo what is being seen in the international literature with younger professionals becoming increasingly reliant on and exhibiting increasing preference for mobile medical technologies.

Smartphones are routinely used for communication purposes and offer many advantages including quick responses, the opportunity to text or email about non-urgent issues, increased communication, or consultation between members of a multi-disciplinary team, and increased communication about and with patients. While there was a statistical difference between registrars and specialists with regards to general internet use ($p < 0.01$), social media use ($p = 0.03$), playing games ($p < 0.01$) and taking photos in theatre ($p < 0.01$), overall usage trends correspond well with international studies for both groups.^{16,24} Amongst the specialists' cohort, a significant difference was demonstrated between public and private sector specialists for both professional and non-professional smartphone use. This is perhaps a further indicator of the mobile nature of private sector specialists' work and the increased usefulness that mobile medical technology has for this subset of colleagues.

As is consistent with international literature on smartphone use in the operating theatre, our survey respondents echoed that barriers to entry for smartphone usage included poor internet connectivity and high mobile data costs. Some apps can only be used with working internet connection and have no offline use facilities which has important implications for practitioners in rural areas or hospitals and particularly with regards to theatres with limited or no internet connection.²⁵ This becomes particularly relevant for Africa with studies done in Sudan, Uganda, and South Africa highlighting access to the internet as a major limiting factor for app usage in the developing world.^{12,26–28}

In 2016 it was noted that South African data costs are amongst the highest for any African or BRICS nation²⁹ and in 2017 a formal inquiry into the high data costs in South Africa was initiated by the Competition Commission,³⁰ which speaks to the significant stumbling block that high data costs pose with regards to mobile medical technology in South Africa. Trends were similar for specialists and registrars with regards to reasons for not using smartphones at work in this survey, with expensive mobile data charges and irregular or no internet access the major limiting factors to access ($p < 0.01$). When comparing all employees in the public sector vs private sector, Wi-Fi availability was also shown to be a significant factor limiting smartphone usage in theatre for those in the state sector ($p < 0.001$). A welcome reduction in mobile data charges is anticipated in South Africa due to the Competition Commission's Market Inquiry into mobile data usage and costs³⁰ and it is expected that this will significantly aid

the usage of mobile technology in the country. This may have a knock-on effect of increasing medical app use, particularly amongst anaesthetic care providers in the public health sector.

A limitation of this study was the sample size. There are approximately 1 000 anaesthesia providers in South Africa. A study sample size of 232 represents only 23.2% of the estimated anaesthesia provider population in South Africa. In addition, these providers were all recruited at the National Anaesthesiology Congress, and therefore may only represent a proportion of the population that may be more inclined to attend medical education programmes. The participants were recruited at the national congress in order to ensure that the response rate was higher than that which is usually achieved with electronic surveys.³¹

Conclusions

The use of mobile medical technology in the form of apps and smartphone usage amongst the medical community is growing and becoming increasingly relevant to medical practice. The available data regarding internet and app access in theatre has mostly originated from the developed world and, as such, did not assess or seek to address the limiting factors that are experienced by doctors from resource-limited countries and particularly by doctors working in Africa. While smartphone use appears to be expanding, barriers to access, such as limited internet access, high data costs, resource limitations, lack of familiarity with the technology and rural settings remain important factors within the African context.

This study determined the usage of smartphone apps amongst South African anaesthetic service providers and has demonstrated that usage patterns follow those seen in international literature. Expected barriers to entry were confirmed and strong favourability towards a South African app for pharmacology referencing has now been identified.

With the first formally quantified South African data on the use of smartphone apps by anaesthetic service providers in South Africa, we now have the data available to spur the development of focussed apps for the South African medical app market and to improve upon barriers to access for smartphone use amongst healthcare practitioners in the anaesthesiology and medical fields at large.

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Conflict of interest

There was no conflict of interest to disclose.

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Ethical approval

Approval for this study was granted by the Human Research Ethics committee of the Stellenbosch University (Approval number 0649).

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