

# Smart Device Use Among Resident Physicians at Stanford Hospital

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## Abstract

**Introduction:** A smart device refers to a cordless electronic device that is mobile, Internet-connected (e.g., via Wi-Fi), capable of voice and video communication, and web browsing. Although smart device usage is high by healthcare providers, little is known about the specific patient care-related tasks performed by physicians on these devices. The goal of this study was to measure the prevalence and types of uses of smart devices among residents in seven different specialties at Stanford University Hospital. This study is important because it can inform appropriate content and app development as well as issues around connectivity and security in smart devices.

**Methodology:** Stanford University housestaff in Anesthesia, Medicine, Surgery, Emergency Medicine, Pediatrics, Psychiatry, and Neurology were solicited by e-mail to participate in an online survey.

**Results:** Seventy-six of the 387 (20% response rate) eligible residents completed the survey. Ninety-seven percent own a smart phone, while 53% have a tablet. The two most common (60% of respondents) uses for the smart device were: 1) communication (e.g., paging, exchanging patient care-related text messages) and 2) obtaining pharmacy/medication-related information. The next most common uses were as a medical reference, textbook, or patient care-related study aid (45%), obtaining information on evidence-based medicine/treatment algorithms (34%), keeping up with medical literature (24%), viewing electronic medical records (16%), taking photos or capturing images/videos (13%), patient education (9%), and guidance for procedures (7%).

**Conclusions:** Residents surveyed are likely to own and use smart devices in delivering patient care. Common uses include communication among providers and accessing medication information. Understanding smart device usage by physicians will facilitate proper content and app development and providing connectivity and security.

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**Categories:** Medical Education, Miscellaneous

**Keywords:** smart device, education, physician education, patient education, smartphones, communication, residents, apps, ipad

## Introduction

A smart device is an electronic device that is cordless (unless while being charged), mobile (easily transportable), always connected (via Wi-Fi, 3G, 4G etc.) to the Internet, capable of voice and video communication, Internet browsing, and "geo-location" (for search purposes) [1]. Since clinical work is often conducted in multiple locations and requires communication and collaboration among health care professionals, any mobile technology that facilitates the transfer of information is desirable. Improved information access, communication, and clinical decision-making are potential benefits of mobile technologies.

Over the past few years, physicians have adopted smartphones and tablets at impressive rates. As one example, smartphone and tablet ownership among surgeons in the UK and continental Europe equaled 84% and 37%, respectively [2]. This is in part also due to downloadable applications, or "apps" [3]. Many specialty-specific uses exist [4-7]. A systematic review of 57 smartphone apps found that disease diagnosis, drug reference, and medical calculator applications were deemed to be most useful by healthcare professionals and medical or nursing students [8]. Smart devices can also aid with resident education, such as teaching neonatal intubation [9].

While it is known that smart devices usage is high in healthcare providers, little is known about the specific patient care-related tasks performed by physicians on these devices. The goal of this study was to measure the prevalence and types of uses of smart devices among residents in different specialties at Stanford University Hospital.

## Materials And Methods

### How to cite this article

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### Survey development and validation

A review of the literature on smart devices identified possible clinical uses. The online survey was developed in an iterative process (Figures 1-4). Content validity was provided by repetitive rounds of refinement of questions among the authors, through feedback from a pilot study with a convenience sample of eight residents and the aim to keep the time for survey completion under 10 minutes. A free response section was added to note other uses of their smart devices not specifically mentioned in survey.

Q1 What is your residency/specialty?

- ☐ Anesthesia (1)
- ☐ Medicine (2)
- ☐ Surgery (3)
- ☐ Emergency medicine (4)
- ☐ Pediatrics (5)
- ☐ Neurology (6)

Q2 Gender

- ☐ Male (1)
- ☐ Female (2)

Q3 Year in training/practice

- ☐ Intern (1)
- ☐ PGY 2 (2)
- ☐ PGY 3 (3)
- ☐ PGY 4 (4)
- ☐ PGY 5 (5)
- ☐ PGY 6+ (6)

Q5 Which smartphone(s) do you own?

- ☐ Iphone (1)
- ☐ Android device (2)
- ☐ Blackberry (3)
- ☐ Other (4)
- ☐ I don't own a smartphone (5)

**FIGURE 1: Copy of survey, page 1**

Q6 Which tablet device(s) do you own?

- ☐ Ipad (1)
- ☐ Android device (2)
- ☐ Blackberry (3)
- ☐ Other (4)
- ☐ I don't own a tablet (5)

**FIGURE 2: Copy of survey, page 2**

Q7 I use my smart device (smart phone/tablet):

	Rarely (never, or less than once per month) (1)	Sporadically (1-4 times per month) (2)	Occasionally (1 or multiple times per week) (3)	Frequently (daily) (4)	Very frequently (multiple times daily) (5)
To obtain pharmacy/medication information (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As a medical calculator (e.g. anion gap, MELD score etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To view electronic medical records/imaging studies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For communication (paging, texting, calling other care givers)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To take photos or capture images/videos (e.g. progression of cellulitis, surgical site infection, movement disorders etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As a medical reference/textbook/study aid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To obtain information on evidence-based medicine/ treatment algorithms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For patient education (e.g. use of anatomical images to describe disease & medical/surgical interventions)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To keep up with medical literature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For guidance through procedure techniques	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

FIGURE 3: Copy of survey, page 3

Q8 What else would you like to share about your use of smart devices in the healthcare setting?  
FREE TEXT

Q9 What medicine-related activity would you ideally perform with your device? What are some of the obstacles in achieving this goal?  
FREE TEXT

FIGURE 4: Copy of survey used, page 4

Survey deployment

The survey for this paper was generated using Qualtrics® Labs, Inc. Software, Version 35307 of the Qualtrics Research Suite Copyright © 2012. Software distributed the survey using an anonymous survey link. The

emailed request to participate in the online survey was sent on June 19, 2012 to Stanford University resident physician listservs in Anesthesia, Medicine, Surgery, Emergency Medicine, Pediatrics, Psychiatry, and Neurology.

## Results

Seventy-six (76) of the 387 (20% response rate) eligible residents (Table 1) completed the survey with 51% female (Table 2). Seventy-four (97%) respondents indicated owning a smartphone. The iPhone was most common (n=60, 79%) followed by Android (n=13, 17%) and Blackberry (n=2, 3%). Forty-one respondents (54%) own a tablet device. The iPad ranked as the most common tablet (n=33, 43%), followed by Android (n=6, 8%).

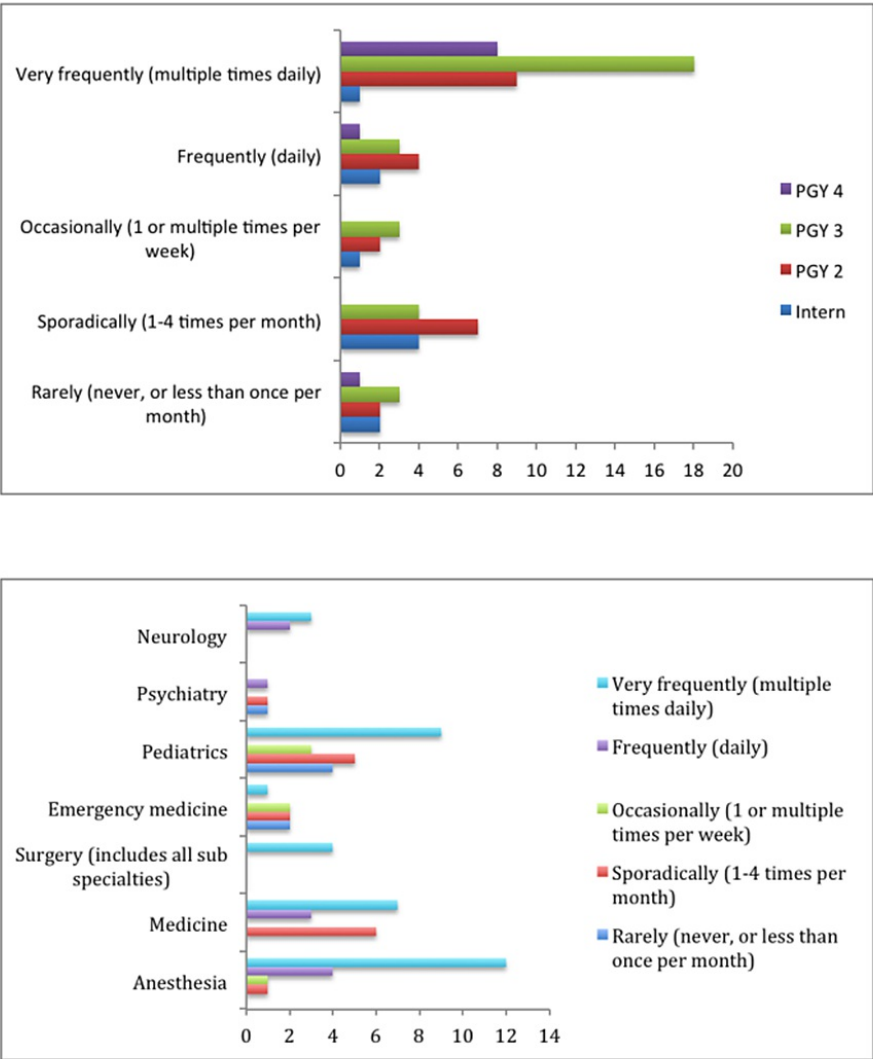
Specialty	Number of Responders	Number of Residents Eligible	% Response Rate
Anesthesia	18	72	25%
Medicine	16	112	14%
Surgery	4	25	16%
Emergency medicine	7	36	19%
Pediatrics	23	78	29%
Psychiatry	3	40	8%
Neurology	5	24	21%
Total	76	387	20%

**TABLE 1: Response rate by specialty**

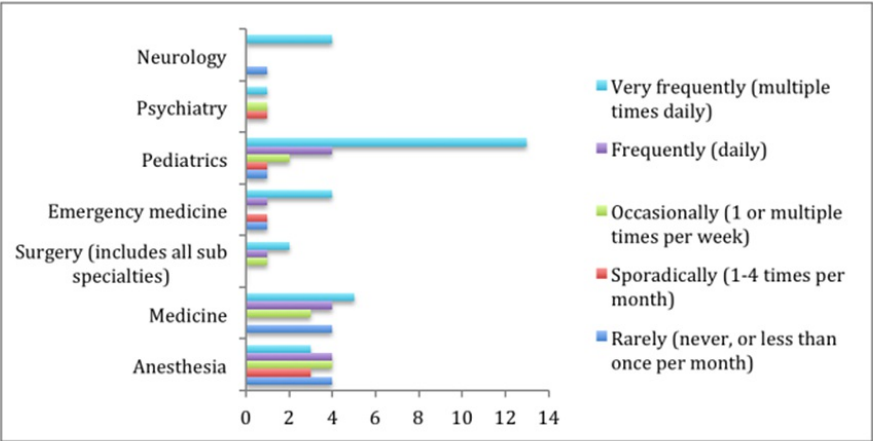
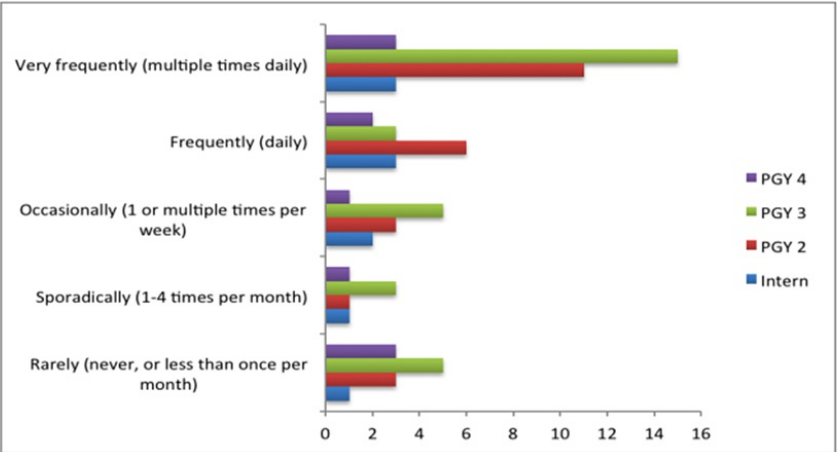
	Number of Responses (%)	
Female	51	(67%)
Level of Training		
Intern	10	(13%)
PGY 2	24	(32%)
PGY 3	32	(42%)
PGY 4	10	(13%)

**TABLE 2: Gender and level of training of respondents**

The two most common uses for the smart device were: 1) communication (e.g., paging, exchanging text messages, and calling other health care providers) and 2) obtaining pharmacy/medication-related information. Sixty percent (46 of 76) respondents indicated these uses as “Frequently” or “Very Frequently” (Figures 5, 6).

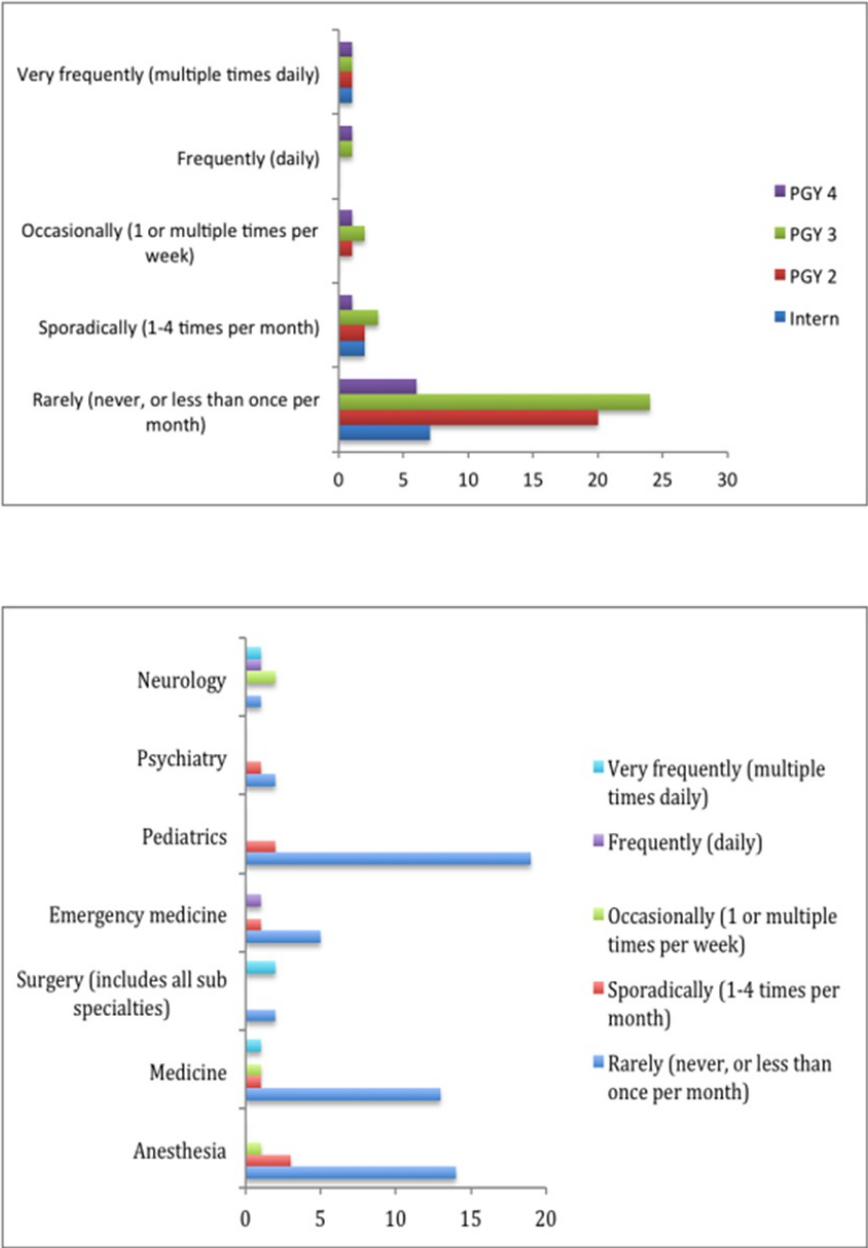


**FIGURE 5: Responses to “I use my smart device for communication (paging, texting, calling).”**



**FIGURE 6: Responses to “I use my smart device to obtain pharmacy/medication information.”**

Other common uses were as a medical reference, textbook, or study aid (45%), obtaining information on evidence-based medicine/treatment algorithms (34%) (Figure 7), keeping up with medical literature (24%), viewing electronic medical records (16%), taking photos or capturing images/videos (13%), patient education (9%), and guidance for procedures (7%).



**FIGURE 7: Responses to "I use my smart device to view EMR/imaging studies."**

When respondents were asked to share additional comments on smart device use (Table 3), access to electronic medical record was a common request. When respondents were asked what medicine-related activity they would ideally perform with their smart device (Table 4), 17 of the 30 (57%) indicated a desire to access an electronic medical record or participate in computerized order entry.



Free text responses to "What else would you like to share about your use of smart devices in the healthcare setting?"

I would use it to access electronic medical records if they were accessible via Android devices.

Using the iPad to chart and do orders when not near a computer has greatly improved my efficiency.

I would love to have the EMR on an ipad.

[A smart device is] easier to carry around than books.

I would use [a smart device] more if someone helped me load and figure out the programs. I would still hesitate to use it for patient medical information. Even secure emails are cumbersome.

Delivery of email to the device multiple times per day; use for maintenance of the GME requirements, i.e. logon to report duty hours, perform MEDHUB evaluations for the program and the faculty

I worry about physicians in the hospital typing in their smartphones in clinical areas. I worry it presents a distracted look to patients. MD more engaged with device than with people and care environment.

[I use my smart device] mostly to communicate with team members about whereabouts, patient updates (without PHI), etc. I also keep up with my classmates who are on different rotations by texting throughout the day. Makes rounding more interesting!

Remote access to electronic medical records [can be] very useful.

It's not absolutely necessary but definitely helps with efficiency

So incredibly helpful. [I] would love more patient education and procedure specific info.

Electronic records access would be very helpful. Better incorporation with hospital networks would make my work much easier.

[Academic] programs should order [as to receive a] bulk discount for ePocrates and similar [applications].

TABLE 3: Free text responses to "What else would you like to share about your use of smart devices in the healthcare setting?"

**What medicine-related activity would you ideally perform with your device (and any obstacles)?**

Reviewing patient records. Obstacles include slow access speed via encrypted intranet.

Internet access at affiliated hospitals.

Looking up patient info. [This is] too difficult to access info with phone. Obstacles include lack of development for android in a field where iPhone® is used more commonly.

Connect an ultrasound probe to the phone to view for TTE or A-line or nerve-guided blocks.

Study aid.

I would want more patient education apps.

Prerounding and rounding on an iPad®. Obstacles include not being allowed by HIPAA to put it on my iPad® and not being given an iPad® by work.

[I] worry about taking photos considering HIPAA but would be a very useful tool.

[Evidence-Based Medicine] search...that is fast (most searches need entry of a password and logging in each time is too time-consuming.)

Look up drug information on something like Lexi-Comp® and look up disease-specific information on something like UpToDate®, obstacles are cost of smartphone and of these services.

[Look up] antibiotic selection, medications, UpToDate®, PubMed, calculations. I do all this on the computers at work instead, because I don't know how to do it on my phone. Also, the iPhone® screen is small, so I would only use the phone if the regular computers were not available.

EMR access and ability to check the "in basket" of the EMR to read patient messages, staff messages. Obstacles are the compatibility with the add-ons or plug-ins that do not allow compatibility with the Kindle Fire®. I would have used that on inpatient rounds to have open the Epic® EMR and be able to make instant orders and modifications as well as use it to page people while on rounds.

**TABLE 4: What medicine-related activity would you ideally perform with your device (and any obstacles)?**

## Discussion

The ability to obtain the right information at the right place and time is vital for hospital-based physicians, such as the residents surveyed. The majority of our survey population was in Pediatrics (30%), Anesthesia (24%), and Medicine (21%) with 74% being PGY2 and PGY3. Overall, the data suggests that approximately 97% of Stanford resident physicians own and use smart devices in delivering patient care, of which the iPhone was the most popular (79%). The two most common uses for the smart devices were communication with other providers and accessing medication information. Patient education is not currently a common use for smart devices across any of the seven specialties surveyed. However, there is interest and an unmet need to have smart device access to the electronic medical record. Understanding smart device usage by physicians will facilitate providing proper content, connectivity, and security.

### Communication among providers

Alphanumeric paging is a common way of communicating with care team members within a hospital. Although it can be a time-consuming practice to manually filter, manage, and prioritize communications, this paging method is considered more reliable than the cellular network at many facilities, especially within large medical centers, such as Stanford Hospital. More interactive communication, such as two-way paging, creates fewer disruptions and uses less time [10]. The similarity between two-way paging and text messaging may permit this benefit to translate to smart devices. A single, integrated communication device for the hospital physician is likely preferred compared to multiple non-integrated devices. We did not separate calling, paging and texting in our survey questions. Future studies, therefore, will need to better assess the relative frequency of each respective activity. One unresolved issue is how smart device use and separation of professional and personal life will develop.

### Medication/pharmacy checks/medical calculator

Another common use for smart devices was to obtain pharmacy or medication dosing information, such as available, via apps such as Epocrates®. The ability to verify dosage regimens may potentially reduce

medication dosage errors. For example, the use of drug calculator on smartphones for dosing was more accurate and faster, with prescribers more confident in their calculations, than use of the British National Formulary for Children [11].

Although not enough residents in each specialty responded to determine differences in smart device use between specialties, it is noteworthy that the proportion of residents who indicated they used their devices either “Frequently” or “Very Frequently” for pharmacy or medication-dosing information varied: Neurology (80%), Surgery (75%), Pediatrics (73%), Emergency Medicine (71%), Internal Medicine (58%), Psychiatry (33%), and Anesthesia (33%). This may be evidence that each specialty has different uses for smart devices due to differences in tasks and workflow.

## Electronic medical records

The most common requested unmet need for smart devices by respondents was the ability to view electronic medical record data and to write orders electronically. Mobile-enabled computerized physician order entry on physician’s smart device has the potential to streamline workflow and decrease response time. There are other mobile offerings within the hospital enterprise, such as computers on wheels. However, concerns exist regarding their bulk and their lack of mobility compared to smart devices. Physicians may benefit from receiving on their smart device immediate, automatic alerts of new laboratory and imaging studies. This delivery system may be preferable to manually logging in to a computer terminal to view results.

In our survey study, the use of smart devices to view electronic medical records was low across all specialties. Using smart devices to view electronic medical records is logistically complicated. Smartphones have smaller screens, which may not be amenable to easy navigation and data entry into electronic medical records or viewing high-resolution images. Smartphones may be more suitable for push notification of patient clinical status. While tablets may be better suited for viewing images, obstacles remain to order entry and clinical encounter documentation. Most of the tablets only have touch screen interfaces. In our survey, resident physicians indicated that the process of installing our electronic medical record in smart devices is complicated and the EMR application’s functionality is unreliable.

## Patient education

Residents in this study indicated a desire to use smart devices to engage and educate patients. We found that surgical residents, more than any other surveyed specialty, used smart devices for patient education. The ability to have an interactive and portable source of information, images and videos may be especially valuable for explaining medical and surgical procedures to patients.

## Physician education & evidence-based medicine

Making high quality evidence-based medicine readily available to the physician-in-training may help improve patient care [12]. In our survey, smart device use for evidence-based medicine happened sporadically or occasionally. Some respondents indicated that they would like their training programs to offer discounted access to educational material.

## Images and video

Although the use of smart devices to capture images and videos was low across all specialties, residents expressed a desire for secure image and video transmission of patient disease between smart devices. The computing power and speed of current smart devices makes image and video transmission feasible [13]. Capturing and sharing patient photos can be useful for obtaining opinions from medical colleagues regarding a patient’s disease status. This may be analogous to telemedicine for chronic disease care, rural medicine, and international health [14]. Smart devices, such as the iPhone and iPad, have built-in video conferencing features that enable real-time collaboration between physicians. For instance, at the Southern Arizona Limb Salvage Alliance, the iPad FaceTime feature was used for real-time collaboration between surgeons caring for a patient with limb-threatening infection [15]. Recording images of superficial infections, wounds, or incisions can be an objective tool to measure wound healing or disease progression. Respondents indicated that HIPAA regulations as well as privacy concerns limited their use of smart devices for such purposes. Other limitations include the need for a hospital-wide wireless network to provide seamless coverage, and a HIPAA-compatible framework for the use of patient data on personal wireless devices.

## Apps

Smartphones and tablets are changing the ways in which physicians deliver healthcare. This is also true for consumer health as there are novel uses for smartphones. These include apps for personal management of health, such as for preventing exercise-induced glycemic imbalance in diabetic patients [16], cuff-less blood pressure measurement [17], and accessing a web-based e-Diary for self-monitoring of symptoms by patients with sickle cell disease. How these personal medical apps will become integrated into medical care deserves further study.

Medical app development for smart devices needs to consider risks of breaches of patient confidentiality, conflicts of interests and malfunctioning clinical decision-making [18]. The benefits of smart device use, however, could be undermined if distraction from direct patient care becomes problematic [19]. A respondent described his or her concern about how health care users might interpret a more device-centered health care setting, "...I worry it presents a distracted look to patients as medical doctor is more engaged with device than with people and care environment." One recent study found smartphones were used during rounds for patient care (85% residents, 48% faculty), reading/responding to personal texts/e-mails (37% residents, 12% faculty), and other non-patient care uses (15% residents, 0% faculty) [20]. Nineteen percent of residents and 12% of attendings believed they had missed important information because of distraction from smartphones. Policies on smartphone use may need to be established.

## Conclusions

Residents surveyed are likely to own and use smart devices in delivering patient care. Common uses include communication among providers and accessing medication information. Understanding smart device usage by physicians will facilitate proper content and app development and providing connectivity and security. It may not be possible to extrapolate our results to the entire population of residents at Stanford, or at outside institutions. This is due to the fact that our sample was non-random, and thus, the results are subject to responder bias. However, the high use of smart devices is consistent with other studies.

## Additional Information

### Disclosures

**Human subjects:** Consent was obtained by all participants in this study. The Stanford University Institutional Review Board issued approval N/A. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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