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Mobile Tablet Use among Academic Physicians and Trainees

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Abstract

The rapid adoption rate and integration of mobile technology (tablet computing devices and smartphones) by physicians is reshaping the current clinical landscape. These devices have sparked an evolution in a variety of arenas, including educational media dissemination, remote patient data access and point of care applications. Quantifying usage patterns of clinical applications of mobile technology is of interest to understand how these technologies are shaping current clinical care. A digital survey examining mobile tablet and associated application usage was administered via email to all ACGME training programs. Data regarding respondent specialty, level of training, and habits of tablet usage were collected and analyzed. 40 % of respondents used a tablet, of which the iPad was the most popular. Nearly half of the tablet owners reported using the tablet in clinical settings; the most commonly used application types were point of care and electronic medical record access. Increased level of training was associated with decreased support for mobile computing improving physician capabilities and patient interactions. There was strong and consistent desire for institutional support of mobile computing and integration of mobile computing technology into medical education. While many physicians are currently purchasing mobile devices, often without institutional support, successful integration of these devices into the clinical setting is still developing. Potential reasons behind the low adoption rate may include interference of technology in doctor-patient interactions or the lack of appropriate applications available for download. However, the results convincingly demonstrate that physicians recognize a potential utility in mobile computing, indicated by their desire for institutional support and integration of mobile technology into medical education. It is likely that the use of tablet computers in clinical practice will expand in the future. Thus, we believe medical

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institutions, providers, educators, and developers should collaborate in ways that enhance the efficacy, reliability, and safety of integrating these devices into daily medical practice.

Keywords

Tablet; Technology; Mobile computing; mHealth

Introduction

Recent advances in mobile devices and wireless technology have ushered in a new era of medicine, dubbed “mHealth,” characterized by the integration of mobile devices into the practice of medicine [1, 2]. One of the most noticeable shifts has been in the form of smart phones and tablet computers used as adjunct diagnostic devices, decision support, and treatment tools. The trend towards integrating technology into medical settings is not new, and has previously been examined with regard to computers [3], personal digital assistant devices [4, 5], electronic medical records [6, 7], and handheld computers [8]. Most recently, the prevalence of smart phone use among medical providers has been evaluated [9], but no study has yet explored how medical providers within the United States are adopting and using tablet devices in the context of patient care.

Current tablet computers have their roots in the early evolving pen-computing technology of the 1980–1990s [10], but few models made it to final production for the consumer market. In January of 2010 Apple® evolved the tablet computer with the introduction of the iPad [11], a device with compact size, versatility, a robust application marketplace and refined touch interface display [12]. These enhancements allowed the iPad to capture almost 70 % of the tablet market share within 1 year of launch to consumers [13]; the iPad still maintains a 61 % share of the US tablet market 2 years later [14]. The greatest competition to the iPad device and platform is currently Google’s Android operating system which runs on many devices created by Google, Samsung, Hewlett Packard, and others. With their high-speed processors, large displays, immense storage capability and wireless data access, tablet computers are becoming the preferred mobile devices for advanced aspects of clinical medicine, such as electronic medical record access and complex bedside treatment algorithms.

The subject of tablet computers in medical practice has recently exploded in the peer-review literature, with current publications emphasizing the benefits of these clinical adjuncts [15–18]. In addition, the past 18 months have witnessed over 70 peer-review publications on the subject of the iPad tablet device alone, with the rate of publication increasing at an exponential pace. Existing studies have emphasized the iPad’s efficacy as a communication tool, educational tool, reference source and educational resource for both patients and providers [8, 19–21]. Furthermore, recent survey results have demonstrated a positive patient perception of physicians who use tablet computers in the clinical setting regardless of patient age, race, gender or income [22].

Specific assessments of tablet use in the clinical setting have also recently begun to appear in the literature. One such study demonstrated that the high resolution display of the iPad

performed equally to conventional desktop LCD monitors in preliminary interpretation of emergent CT brain exams after minor modifications were made to the iPad's zoom function capabilities [23]. Sterile tablet computers have been successfully utilized in the operating room by neurosurgeons as a substitution to expensive commercial intraoperative imaging equipment for image guidance during tumor resection procedures [24]. Another recent publication found Internal Medicine residents felt subjectively more efficient on the wards when they were provided with iPad tablets loaded with the hospital electronic medical record access program. This study also showed inpatient admission orders were placed more efficiently after iPad use was implemented by residents throughout the hospital [18].

However, while the increased use of tablet computers within the hospital is apparent to many providers, the prevalence, functionality, and challenges to mobile device integration have yet to be examined. Our group previously published a study examining and reporting the prevalence of smart phone use among medical providers in the United States [9]. The purpose of this study was to perform a similar prospective, nationwide email survey evaluating the use of tablet computers, their applications, and their challenges among physicians at medical centers recognized by the Accreditation Council for Graduate Medical Education (ACGME). We hypothesized that tablet computers are being used by a majority of providers at all levels of training and that a desire exists among providers for greater wireless integration and mobile functionality.

Methods

Data were collected from a national survey of all ACGME-accredited residency and fellowship programs using a previously described methodology [9]. Briefly, institutional review board approval was obtained to distribute an online survey (Appendix A) to query physician usage patterns of mobile technology devices. Program directors from all ACGME sites were contacted via email requesting that they forward the survey to their faculty members, fellows and residents. In total, 6,134 individual emails were sent to a total of 685 institutions. Two additional follow-up emails were sent as reminders to increase response rate. Responses for this study were anonymously and electronically collected over a three-week period in December 2011. Data were segmented based on respondent specialty and the following levels of training: resident, fellow, faculty with fewer than 5 years of practice, faculty with 5–15 years of practice, and faculty with greater than 15 years of practice. Survey responses included 30 different department types and 118 program types across 678 institutions.

A free response section was provided for respondents to list the mobile applications they find most useful in clinical practice. Several entries represented applications with similar utility (drug reference, electronic medical record applications, point of care applications, etc.) that were combined into categories for final data analysis. Point of care applications included drug references (Epocrates, Hopkins antibiotic guide, Sanford guide, Merck index), medical calculators, ICD-9 applications and medical translators. Primary resources included continuing medical education entries (Up-To-Date, Medscape, Skyscape, etc.) textbooks and medical journals.

Data are reported as percentages [95 % confidence interval]. Confidence intervals were calculated using the modified Wald method [25]. Chi-squared tests for independence were used to examine associations between various survey parameters, the strengths of which were quantified using Cramer's V.

Results

A total of 2,942 responses were collected. Resident trainees accounted for 1,457 responses (50 %), fellowship level trainees accounted for 513 responses (17 %) and attending level physicians accounted for 972 responses (33 %). Survey respondents represented 28 different specialties. Pediatrics (12 %), Orthopedic Surgery (11 %), Family Medicine (11 %), Internal Medicine (9 %) and Emergency Medicine (9 %) were the specialties with the highest number of survey responses. Overall, 40 % [38 %, 42 %] of all respondents owned a tablet computer, and 45 % [42 %, 48 %] of tablet owners endorsed using their device in the clinical setting. The majority (86 %) of tablet-owning respondents of our survey utilized the iPad device. Other prevalent tablets used by respondents included Android OS running devices such as the Samsung® Galaxy tablet (8 %), Windows tablet devices (3 %) and BlackBerry tablets (1 %).

Respondents indicated that 56 % [56 %, 59 %] of the surveyed institutions supported mobile technology use at the time of survey; however, 96 % [94 %, 97 %] of tablet owners and 92 % [91 %, 93 %] of non-tablet owners felt their institution *should* support tablet integration in their hospitals and clinics (Table 1). When asked whether mobile technology "makes [you] a better physician" there was a decreasing trend for positive responses relative to level of training: 85 % [83 %, 86 %] of residents, 80 % [77 %, 83 %] of fellows, 70 % [64 %, 76 %] of faculty physicians less than 5 years from completion of training, 67 % [61 %, 72 %] of physicians with between 5 years and 15 years of faculty experience and 61 % [56 %, 65 %] of physicians with greater than 15 years of faculty level experience supported the statement (Fig. 1). Chi-squared test of independence demonstrated that training level and support of this statement are not independent; χ^2 (8, N=2,880)=142, p<0.0001, V=0.16. Similarly, there was a decreasing trend of support with increased training level for the statement "the use of mobile technology improves patient interactions" in respondents who denied use of tablet computers in the clinical setting. However, the respondents who do use a tablet computer in the clinical setting support the idea that the device improves patient interactions at a consistent rate (69 % [65 %, 73 %], without a clear trend corresponding to experience level (χ^2 (4, N=518)=8.01, p=0.09). Respondents across all levels of training also overwhelmingly supported tablet integration into medical education (71–78 % support across all levels of training; 74 % [72 %, 76 %] overall). Chi-squared demonstrates that the training level and support of integration of mobile/table training into clinical education are not independent but the association is a very small effect; χ^2 (8, N=2,878)=18.8, p=0.02, V=0.06.

When categorized by groups, primary resource apps used in clinical practice accounted for 40 % of all responses. Point of care (29 %) and electronic medical record access (14 %) categories also accounted for a high percentage of responses. Survey respondents listed 58 discrete applications that were currently being used in clinical practice. Epocrates, a drug reference utility and calculator, was the most commonly listed application currently being

used (15 % of all responses) followed by electronic medical record access (14 %), journal applications (12 %), Medscape (7 %) and continuing medical education applications (7 %) (Fig. 2). Textbooks and references were rated as the most useful types of tablet applications by survey respondents (17 %) followed by general medical knowledge apps (12 %), residency exam and board study material (11 %), techniques and guides (11 %) and classifications/treatment algorithms (10 %) (Fig. 3).

Discussion

The purpose of this study was to census physicians with all levels of experience in ACGME recognized training centers to understand how tablet computers are currently being utilized in the clinical setting. Although we initially hypothesized that a majority of providers are using tablets in the clinical setting, our results demonstrate that a high percentage (40 %) of physicians currently own mobile tablet computing devices and 86 % of those are iPads. In addition, 74 % of respondents support the integration of mobile technology into medication education and 94 % believe hospitals should support wireless technology. This rapid adoption rate suggests that the prevalence of tablet use will likely constitute a majority of American physicians in the near future, and when combined with the strong support for mobile integration and education, clearly demonstrates providers believe mobile technology is not simply a passing trend. Reasons for the rapid acceptance rate likely include the relatively low startup and maintenance cost of the device and the appealing functional extension of the tablet computer into personal applications such as social networking or entertainment genres. This new technology has the potential to shift the way medicine is practiced in the future.

While Apple® is the only producer of the iPad, any company with the capability of producing hardware that can support the Android operating system can produce an Android tablet. The other major difference between the two systems is the manner in which applications are made available to consumers. iPad applications are only available through a single distribution channel that is controlled by Apple® and all applications must be reviewed and approved by Apple® before being made available to the public. In contrast, any developer can create and release an Android application without undergoing a review process. These differences may have important implications regarding the reliability and security of apps and the information they contain. However, we must emphasize that neither app “review” process evaluates the validity of app content, which has patient care and patient safety implications when medical decisions are determined as a result of the information provided. The number of tablet owners who use their device in clinical practice (45 %) was lower than we expected considering the numerous medical applications available and the strong desire for support among this population. One possibility that might explain the low adoption rate is that many tablet-owning physicians may desire more applications to be created. Conceivably, these tablet-owning physicians might think that current medical applications do not meet their needs and require further supplementation, validation or improvement before integrating them into clinical practice. Another possibility is that physicians may not be familiar with currently available medical applications for their device.

Both tablet-owning and non-tablet owning physicians view the tablet computer as a useful educational utility and endorse integration of the device into clinical practice and medical education. The category of textbooks and references was felt to be the most useful subdivision of applications available for tablet computers by survey respondents. Several characteristics of tablet computers, such as large displays and the innate ability to function as an electronic text reader, allow effective use of textbooks, journals, and reference applications. This functionality is enhanced by the fact that an increasing number of medical journals and textbooks have shifted towards tablet platforms to allow seamless integration and reference directly from these devices.

In contrast to the overall supportive results favoring tablet integration, we also found that more experienced practitioners were less likely to believe tablet computers create better physicians or improve patient-physician interactions. These results can potentially be explained by previous studies in psychology literature investigating generational differences in the adoption rate of new technology [26]. It has previously been shown that younger generations have been exposed to technology from an early age and a large percentage of their education has utilized technological media. Therefore, the younger physicians exhibit favorable attitudes toward innovative technology, resulting in its rapid adoption. In contrast, physicians practicing for over 15 years are less likely to be familiar with digital technologies, thereby making them less comfortable utilizing technological devices as a primary source of education and productivity. Rather, they have become proficient in data gathering through non-technological mediums such as paper journals and textbooks. Studies have determined the initial adoption of technology by older generations is likely influenced by social norms [26]. In other words, new technology is initially utilized simply because it is popular in the workplace among their colleagues. It is not until the device is used for some time in practice that experienced practitioners recognize its full potential. These differences could explain our finding that less trained (and presumably younger) physicians are more rapidly adopting tablet technology into clinical practice than their more experienced counterparts.

The preferred role of the tablet computer in clinical practice can be inferred based on the most frequently used applications reported by our respondents. Primary resource applications were the most popular group of free response applications reported followed by access to electronic medical records and point of care applications. In contrast to previous smart phone study results [9], access to electronic medical records was one of the most frequently reported uses of the tablet computer. We speculate that tablet computers are preferred over smart phones for EMR access primarily as a result of the large displays and a greater number of integrated EMR platforms.

When examined individually, Epocrates was the most frequently reported (15 %) medical application used on the tablet computer. While the popularity of Epocrates is not surprising due to its established reputation and early entry into the personal computing market, this is far short of the 79 % reported use of similar drug compendiums on smart phone devices [9]. The smaller size of a smart phone relative to a tablet computer likely explains this difference. A compact smart phone is certainly more convenient than a tablet computer for quick access to drug information. Additionally, drug reference applications do not require

the tablet's high-resolution display, fast processor speeds or ergonomic user controls for ideal functionality.

One major limitation of this study is the scope of the population surveyed. The survey was sent only to physicians practicing in ACGME approved academic medical centers and does not necessarily represent the viewpoint of all physicians practicing in the United States. In addition, because of the inherent nature of email surveys, we were unable to control for selection bias. Our results may be skewed toward physicians with favorable opinions regarding tablet computing in the clinical setting. Furthermore, there is no reliable way to calculate survey response rate when email is used as a survey distribution channel since the number of emails that were received and discarded is unknown. Based on our sample size of 2,942 respondents among all academic physicans and trainees, our survey represents only a small percentage of all potential respondents and may not be representative of the intended population. However, we note that this survey methodology has been previously described and published [9]. Lastly, our survey results were obtained prior to the release of the newest iteration of Apple's popular iPad (March, 2012). As a result, our data does not represent the presumed growth of tablet utilization that accompanies the release of an improved product to the consumer market.

This study is the first to examine the use of mobile tablet devices among practicing physicians and trainees at ACGME institutions. These results convincingly demonstrate a shift towards the use of tablets in many aspects of clinical care, specifically electronic medical record access and educational resource applications. There is a strong desire for increased institutional support and expanded applications for the tablet computing platform. The positive responses from current tablet users imply that the user base is likely to expand. Thus, we believe that medical institutions, providers, educators, and developers should collaborate in ways that enhance the efficacy, reliability, and safety of integrating these devices into daily medical practice.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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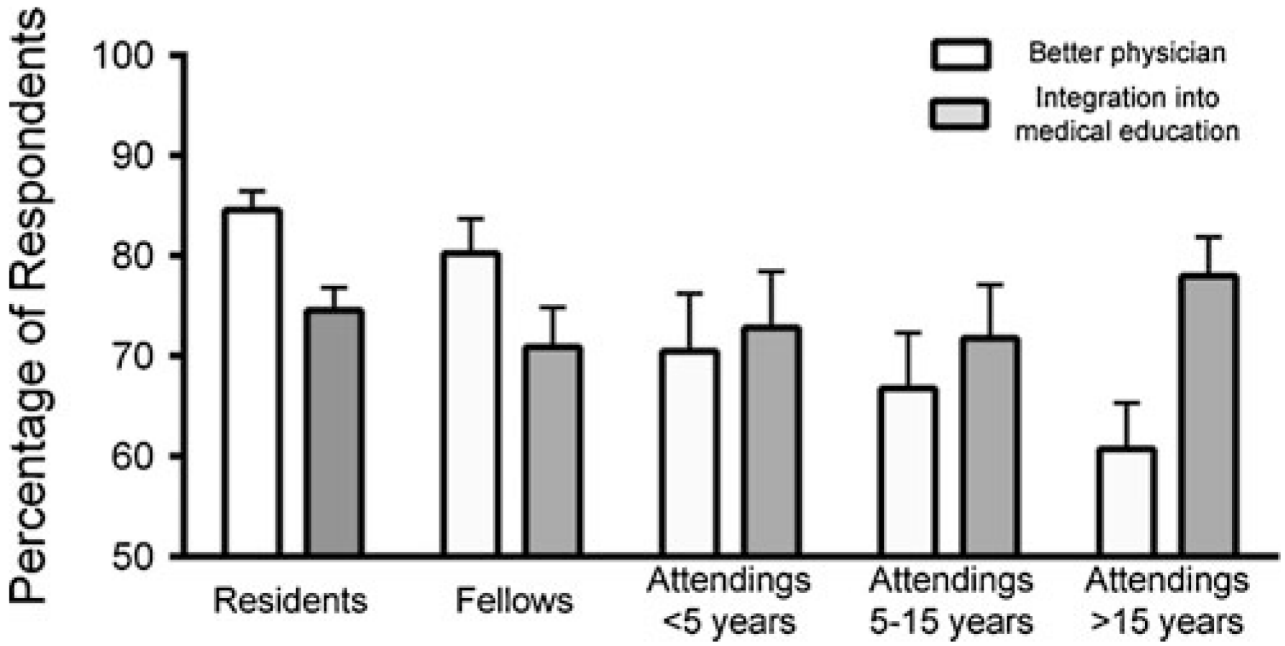

Fig. 1.

Percentage of respondents that feel tablet use makes them a better physician (*white*) vs. percentage that support tablet integration into medical education (*gray*) across the survey population. *Error bars* represent 95 % confidence intervals. The y-axis has been expanded to better illustrate the range of responses. Note the declining trend in those who believe that tablets make them a better physician with increasing training level, in contrast with the relatively consistent response that tablet use should be integrated into medical education

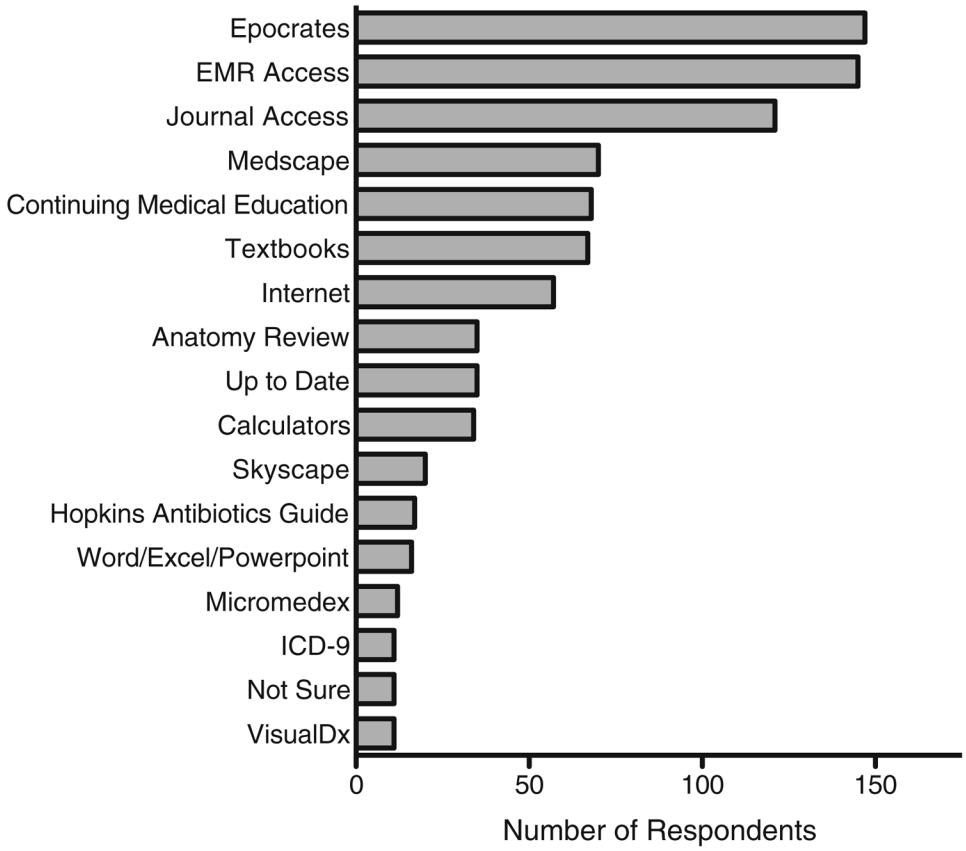

Fig. 2.

Individual tablet applications currently used in clinical practice that were rated the most useful by respondents. Note that primary resource applications were the most commonly used, followed by electronic medical records and point of care applications. These data differed notably from usage patterns in smartphone users [9]

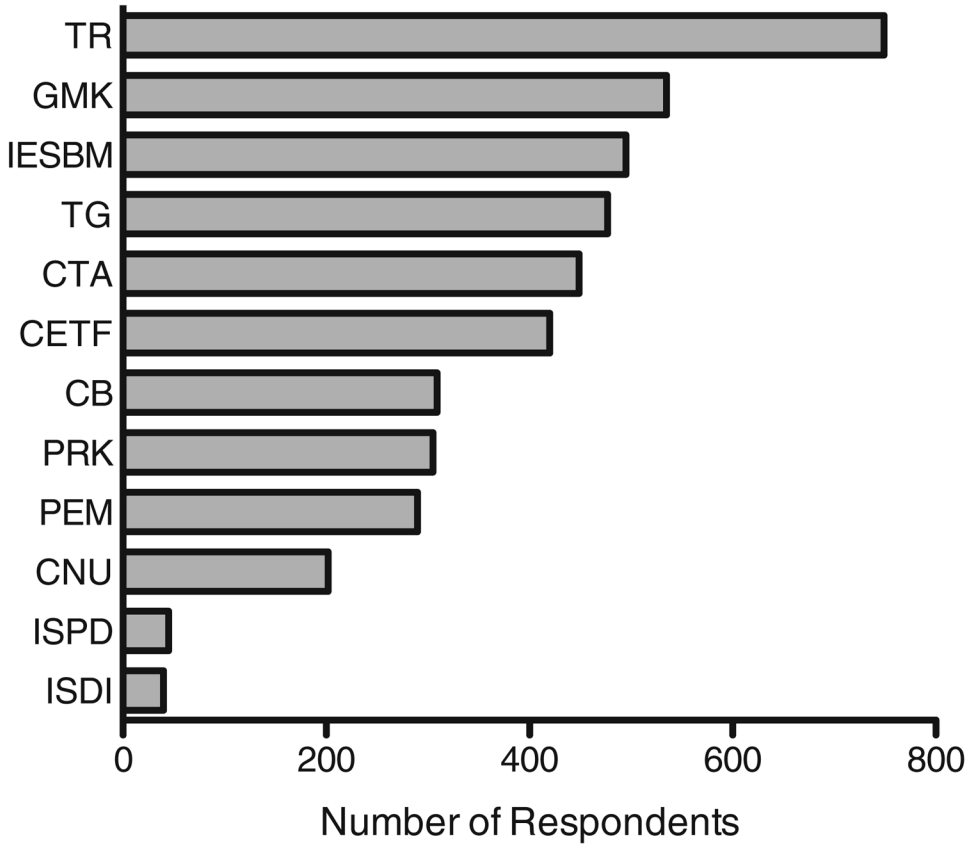

Fig. 3.

Depiction of the tablet application category rated most useful by survey respondents. TR-textbooks/reference, GMK-general medical knowledge, IEBSM-in-training exam/board study material, TG-techniques/guides, CTA-classifications/treatment algorithms, CETF-clinical exam tests & findings, CB-coding & billing, PRK-patient record keeping, PEM-patient education materials, CNU-current news/updates, ISPD-industry-sponsored product information, ISDI-industry-sponsored device information

Table 1

Current tablet computer ownership and rate of clinical utilization across the survey population

Level of training	Tablet owners (%)	Currently use device in clinical setting (%)
Resident	36	19
Fellow	34	13
Faculty <5 years	41	14
Faculty 5–15 years	58	19
Faculty>15 years	45	19