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Use and Perceived Benefits of Mobile Devices by Physicians in Preventing Adverse Drug Events in the Nursing Home

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Abstract

Objective—Although mobile devices equipped with drug reference software may help prevent adverse drug events (ADEs) in the nursing home (NH) by providing medication information at the point-of-care, little is known about their use and perceived benefits. The goal of this study was to conduct a survey of a nationally representative sample of NH physicians to quantify the use and perceived benefits of mobile devices in preventing ADEs in the NH setting.

Design/Setting/Participants—We surveyed physicians who attended the 2010 the AMDA Annual Symposium about their use of mobile devices and beliefs about the effectiveness of drug reference software in preventing ADEs.

Results—The overall net valid response rate was 70% (558/800) with 42% (236/558) using mobile devices to assist with prescribing in the NH. Physicians with 15 years clinical experience were 67% more likely to be mobile device users, compared to those with >15 years of clinical experience (odds ratio=1.68; 95% confidence interval=1.17-2.41; $p=0.005$). For those who used a

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mobile device to assist with prescribing, almost all (98%) reported performing an average of one or more drug look-ups per day, performed an average of 1-2 lookups per day for potential drug-drug interactions (DDIs), and most (88%) believed that drug reference software had helped to prevent at least one potential ADE in the preceding four-week period.

Conclusions—The proportion of NH physicians who use mobile devices with drug reference software, while significant, is lower than in other clinical environments. Our results suggest that NH physicians who use mobile devices equipped with drug reference software believe they are helpful for reducing ADEs. Further research is needed to better characterize the facilitators and barriers to adoption of the technology in the NH and its precise impact on NH ADEs.

Keywords

Nursing homes; handheld computers; mobile devices; smartphones; m-Health; Adverse drug events; drug-drug interactions

INTRODUCTION

An adverse drug event (ADE) is defined by the Institute of Medicine (IOM) as an injury resulting from a medical intervention related to a drug.¹ The most clinically significant and costly medication-related problems in nursing homes (NHs), ADEs are associated with an estimated 93,000 deaths a year and as much as \$4 billion of excess healthcare expenditures.²⁻⁴ Data on ADEs in the NH suggest that about half are preventable.⁵ The majority of preventable ADEs (59-68%) are associated with prescribing errors, often a result of insufficient knowledge about appropriate medication prescribing and drug-drug interactions (DDIs).^{5,6}

Despite the frequency, cost and clinical significance of ADEs in NHs, use of health information technology (HIT) to prevent or mitigate their occurrence has been quite limited in this clinical setting.⁷ HIT to reduce ADEs include electronic health records (EHRs), computerized provider order entry (CPOE), and clinical decision support (CDS) systems. Studies assessing the barriers to the implementation and use of these technologies in the NH setting have concluded that the costs of implementing and maintaining HIT systems are shared by multiple stakeholders, but are unlikely to be fully aligned with potential benefits.^{8,9} Other barriers include difficulties in finding HIT products that meet the needs of the NH, insufficient evidence that HIT will have a positive impact on quality of care, concerns about operational inefficiencies (e.g., alert burden), and shortcomings in the hardware and/or technical support necessary for to accessing and using electronic data.¹⁰⁻¹²

Mobile devices, such as personal digital assistants (PDAs), handheld computers, and smartphones, represent a potentially attractive alternative solution to prevent or mitigate ADEs without requiring extensive investment in software and hardware infrastructure. Such devices can provide access to a wide variety of drug reference software that provide information about medication selection, dosing, drug-drug interactions and other safety concerns.¹³⁻¹⁶ Studies of the use of mobile device-based drug reference software in the ambulatory setting suggest that it can improve access to drug information¹⁷ and prevent ADEs,¹⁸ but systems can vary in scope, completeness, and ease of use.^{19,20} A systematic

review found that between 45-85% of clinicians use mobile devices in a variety of clinical settings outside of NHs.²¹ Unfortunately, the generalizability of these findings to the NH setting might be limited. Thus, the goal of this study was to conduct a survey of a nationally representative sample of NH physicians to quantify the use and perceived benefits of mobile devices in preventing ADEs in the NH setting.

METHODS

Participants

Potentially eligible participants included 1,061 NH physician attendees of the 33rd Annual American Medical Directors Association (AMDA) Conference, held in March of 2010 in Long Beach, California. Physicians were selected as the target audience based on their medical-legal responsibility for all medication prescribing in the NH setting.

Survey Development

We developed a paper survey in order to gather information regarding the use and perceived benefit of mobile devices with drug reference software in preventing ADEs in the NH setting. Components of the survey discussed in this paper include two sections (“current use of medication references on mobile devices” and “demographic information”) containing a total of 13 multiple choice questions, which were adapted (with permission) from an earlier survey developed by Rothschild *et al.*¹⁸ Relevant questions discussed: 1) ownership, use, and experience with a mobile device for assistance with prescribing; 2) hardware/software (i.e. operating system used and drug reference software (s) employed); 3) frequency of drug reference software use associated with drug look-ups in the prior 4-week period; 4) perceived impact on DDI prevention; and 5) perceived impact on ADE prevention. Additional questions not discussed in this paper assessed respondents’ attitudes regarding ADE alerting.

Survey Distribution

Following University of Pittsburgh institutional review board approval, the survey was distributed to a total of 800 physicians. Respondents who returned a completed survey were given a complimentary AMDA Clinical Practice Guideline (CPG). These nationally-reviewed and AMDA-endorsed interdisciplinary CPGs provided attendees with a substantial incentive (i.e., \$15 equivalent) to complete the survey.

Data analysis

Completed surveys were transferred from paper to a Microsoft ACCESS database for analysis, with dual data entry of all responses to ensure accuracy. We used frequencies and percentages to summarize survey responses, and two-way contingency tables with chi-square tests to examine overall associations between mobile device ownership/use for prescribing and physician demographics. If a statistically significant overall association was found between a physician characteristic and mobile device use, we fit a logistic regression model with mobile device use as the response variable, and multiple categorical definitions of the physician characteristic to identify those specific levels that are associated with increased likelihood of mobile device use, as measured by odds ratios and their 95%

confidence intervals. Criterion for statistical significance was set at $p < 0.05$. SAS[®] version 9.2 (SAS Institute, Inc., Cary, North Carolina) was used for all statistical analyses.

RESULTS

Survey Participants

A total of 800 surveys were distributed; 565 completed surveys were returned, for a 71% response rate. Of these, seven surveys were excluded because we were not able to verify that the respondents were physicians, resulting in a 70% net valid response rate. Fewer than 5% of the completed survey had missing data, with no identifiable pattern of missing responses among the items. The results that follow are derived from the 558 completed physician surveys.

Most respondents were male (69%). Almost all of the physicians (90%) were doctors of allopathic medicine (Table 1). The majority completed an internal medicine residency program (56%), approximately one-third (34%) completed a fellowship in geriatric medicine, and the majority had been practicing clinical medicine for >15 years (58%). Most (57%) respondents reported spending at least 25% of their clinical time providing care in the NH, with more than two-thirds practicing in 2 NHs (69%), over half (53%) had CMD certification, and almost all (99%) reported providing medical direction in at least one NH.

Mobile Device Use

Less than half (42%) of the respondents indicated that they owned and used a mobile device for assisting with prescribing in the NH. Of this sub-group, the majority (52%) indicated that they had used mobile devices for 5+ years and less than 5% used 2 mobile devices to assist with prescribing. The three most commonly used mobile device platforms were Palm (31%), iPhone (30%), and Blackberry (25%) (Figure 1).

There was a significant negative association between duration of practicing clinical medicine and mobile device use, with those who recently completed their clinical training showing greater use ($\chi^2=12.4$; $df=3$; $p=0.0061$). Specifically, those with 15 years clinical experience were 67% more likely to be mobile device users, compared to those with >15 years of clinical experience (odds ratio=1.68; 95% confidence interval=1.17-2.41; $p=0.005$). There was also a significant association between proportion of time spent in the NH setting and mobile device use ($\chi^2=9.2$; $df=3$; $p=0.027$). Respondents spending 26-50% of their clinical time in the NH were 64% more likely to be mobile device users compared to those spending the majority of their time in the NH (odds ratio=1.64; 95% confidence interval=1.03-2.60; $p=0.038$). There were no other significant associations between the demographic factors and device use.

Drug Reference Software Use and Benefit

The vast majority (89%) of physicians who reported using a mobile device for prescribing assistance relied on the Epocrates Rx drug reference software, followed by Tarascon Pocket Pharmacopeia 9%, and Lexi Drugs 6%. More than 15% of the clinicians who used drug reference software indicated that they used more than one product: 31 respondents (14%)

selected two, and seven (3%) selected three. Almost all (98%) of the respondents who used mobile devices for prescribing assistance indicated that they used drug reference software on average daily in the previous four weeks, with three-quarters (75%) reporting an average of 3 or more look-ups daily (Table 2). The vast majority of respondents (94%) who used mobile devices perceived that drug reference software on a mobile device helped them to assess an average of one or more potential DDIs per day over the preceding four-week period. Similarly, most (88%) perceived that mobile device drug reference software resulted in safer patient care by preventing one or more potential ADE in the previous four-weeks (Figure 2).

DISCUSSION

To the best of our knowledge, this is the first nationally representative survey of mobile device and drug reference software use among NH physicians. An important finding is that only 42% of respondents indicated that they owned and used a mobile device for prescription assistance. This rate of adoption of mobile devices for assistance with prescribing in the NH is somewhat lower than what would be expected based on previous studies. Surveys of physicians in other clinical environments have found mobile device adoption rates of up to 86%^{21,22} with access to drug references consistently among the leading uses.^{21,23,24}

Similar to physicians in non-NH settings,^{21,25} younger NH physicians are more likely to use mobile devices, as are physicians who spend relatively less clinical time in the NH setting. These findings suggest that drug reference software available on mobile devices might be of particular value for physicians with less experience prescribing for the geriatric patient. Another, possibly complementary explanation is that younger physicians may be more familiar with mobile devices and have already integrated them into their workflow. In either case, more research is needed on potential facilitators and barriers to mobile device use in NHs. Unreliable Internet access and device breakage issues were barriers reported in a case study of health information technology in NHs.¹² Improved adoption of mobile devices among NH physicians is likely to be achieved by increased attention to practitioner needs and preferences, organizational constraints, physical and workplace environments, consideration of prescribing challenges particular to older people,²⁶ and other factors that define NH medical care.²⁷

The overwhelming majority of physicians (98%) that reported using mobile devices to assist with prescribing used them quite frequently. Physicians reported performing an average of 1-2 unique drug information lookups per day, with 43% indicating an average of six or more unique drug lookups per day. Potential DDIs are a major safety concern in the NH with multiple studies showing an association between exposure to drugs with a known interaction and ADEs including hospitalization.^{6,28,29} This study finds that drug reference software on mobile devices is being used often to address this concern. Nearly all physicians using a mobile device (94%) reported performing an average of 1-2 lookups per day for potential DDIs. Reported frequencies of ADE avoidance were particularly striking, with 89% of respondents indicating that the use of mobile drug reference software helped prevent at least one ADEs in the preceding month. The importance and potential cost of ADEs in the NH

make these responses particularly encouraging.²⁻⁴ However, more rigorous measurement is needed to provide an accurate count of such events.

Redundancy in both hardware and software was a factor for a small subset of respondents, with 5% indicating the use of more than one device and 16% indicating the use of multiple software packages for help in prescribing. Although our study does not provide insight into these trends, we speculate that some clinicians may feel that they need multiple devices and software packages to effectively meet all of their clinical and professional needs.

Information quality may be a factor as drug references can vary widely in scope, accuracy, and coverage.^{19,20,30-34} These variations have led some researchers to suggest that clinicians use multiple references to overcome the deficiencies of any single product.^{33,35} Further examination of these usage patterns might inform improvements that would reduce burdens associated with managing multiple devices and software tools.

The limitations of this study include the study population, the use of self-reported measures, and potential biases in the respondent population. Most of the NH physicians attending the AMDA Annual Symposium are medical directors and might not be representative of NH physicians in general. Other types of clinicians that either prescribe (e.g., nurse practitioners or physician assistants), make prescribing recommendations (e.g., consultant pharmacists), or administer medications (e.g., nurses and medication technicians) were not included in this survey. Studies that compared self-reported usage patterns of handheld clinical decision support systems to device-collected activity logs have found that respondent estimates may be inaccurate¹⁸ and possibly inflated. Some studies of clinical uses of mobile devices have seen a form of technology-affinity effect, with positive attitudes toward the technology, changes in practice, and changes in outcomes associated primarily with clinicians who were more active users of technology.^{36,37} Utilization rates may be lower for less enthusiastic practitioners. Finally, the results of this study may differ over time, as mobile device use amongst physicians has increased and the operating systems running on these devices has changed considerably since the survey was administered.²² However, recent data suggest that there has been little change in the number of physicians that use clinical applications on mobile devices and that largely the same pharmacopeial software is being used.¹⁶

CONCLUSION

The proportion of NH physicians who use a mobile device with drug reference software, while significant, is lower than in other clinical environments. NH physicians who have integrated a mobile device into their prescribing workflow perceive that the technology improves medication safety. Further research involving a broader range of NH clinicians (e.g., nurses, nurse practitioners, and consultant pharmacists) is needed to better characterize the facilitators and barriers to adoption of the technology in the NH, and to determine the precise impact of the technology on NH ADEs.

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Figure 1. Mobile device platforms used by nursing home physicians

Figure 2. Perceived number of adverse drug events (ADEs) prevented using mobile devices with drug reference software during the previous four weeks

Table 1**Physician and Practice Characteristics of Survey Respondents**

<u>Characteristic</u>	<u>No.</u>	<u>%</u>
Gender		
Male	384	69%
Medical School Training		
Allopathic physicians (MD)	504	90%
Residency Training*		
Internal medicine	310	56%
Family medicine	214	38%
Currently a resident/fellow	21	4%
Fellowship Training*		
Geriatrics fellowship	192	34%
Number of Years Practicing Medicine		
1 to 5 years	61	11%
6 to 10 years	61	11%
11 to 15 years	72	13%
16 to 20 years	68	12%
21 to 25 years	97	17%
>25 years	161	29%
Still in training	36	6%
Percentage of clinical time in the NH		
<10%	59	11%
10-25%	175	31%
26-50%	139	25%
51-75%	72	13%
>75%	108	19%
Number of NHs where clinical care is provided		
0	7	1%
1	166	30%
2-5	296	53%
>5	88	16%

NH= nursing home

* Residency and Fellowship training responses add up to more or less than 100% due to multiple responses and omitted responses, respectively.

Table 2

Average daily frequency of unique drug lookups using mobile medication reference(s) during the preceding 4 weeks

<u>Daily Instances</u>	<u>Drug Lookups</u>		<u>Drug-Drug Interaction Identification</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
0	4	2	15	6
1-2	55	23	102	43
3-5	75	32	54	23
6-10	48	20	33	14
11-15	23	10	11	5
>15	30	13	20	9
Total	236	100	236	100