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ORIGINAL PAPER

The Use of Information Technologies Among Rural and Urban Physicians in Florida

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Abstract This study examines rural–urban differences in the use of various information technologies (IT) applications by physicians in the ambulatory setting. Findings suggest that no differences exist between rural and urban physicians with respect to the use of a computer (77.4 vs 81.4; p=.144) or with the availability of an Internet connection (95.0 vs 96.5; p=.249) in the office. However, rural physicians were significantly less likely than urban doctors to indicate using e-mail with patients (7.9 vs 17.2%; p<.001) and slightly less likely to use a personal digital assistant (PDA) (32.3 vs 37.9; p=.091). Rural doctors were significantly less likely to indicate routinely using an electronic health records (EHR) system (17.6 vs 24.1; p=.020). EHR differences between rural and urban physicians were not significant (p=.124) in multivariate analyses and were explained away by practice size (p<.001) and practice type (p=.015). Most barriers to EHR did not differ between rural and urban physicians. However, rural physicians more commonly cited barriers associated with temporary disruptions to productivity or disruptions in access to records when computers systems fail. In sum, EHR use and patient e-mailing is less common in rural areas. While much of this variability can be explained by rural practice characteristics, these findings illustrate the need for further efforts to identify and alleviate barriers and encourage health IT adoption in rural areas.

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Introduction

Information technologies (IT) are an important ingredient in achieving healthcare quality [1] and have been associated with numerous benefits. [2–7] Research has suggested that rural areas typically lag behind their urban counterparts with respect to adoption of IT. [8–10] However, most previous studies of IT adoption have focused on hospitals [11–13] and not the ambulatory setting where the majority of rural care is received.

Similar to the hospital setting, the use of IT is associated with positive outcomes in the ambulatory setting as well. [14–16] Technologies that are gaining popularity such as personal digital assistants (PDAs), doctor–patient e-mailing, and electronic health records (EHR), all promise to improve efficiencies, boost patient-centeredness, reduce errors, and save costs. However, despite the growing literature on general use of IT in the outpatient setting [17–22] little is known about rural adoption of such technologies and whether it differs from urban areas.

The current study is an sub-analysis of a large scale survey of IT use among ambulatory physician practices in Florida. [23–25] Specifically, we examine rural–urban differences in computer and Internet availability, the presence of a practice website, the use of PDAs and EHRs, and the use of e-mail between physicians and patients. Moreover, we explore potential factors associated with using these quality enhancing technologies in the rural setting. Lastly, we examine barriers to EHR and adoption intentions among rural and urban physicians in Florida.

Methods

A survey instrument was developed and administered to a large sample of physicians (N=14,921) practicing in ambulatory settings in Florida. The survey instrument asked doctors to indicate whether or not they used a variety of IT applications in their office practice. Those that indicated the use of one or more IT application were further asked related questions regarding that use. Prior to completing the survey instrument, individual questions were cognitively tested for face and content validity with a panel of physicians.

Next, the most recent list of all physicians (allopathic and osteopathic) with a clear and active medical license was obtained, in August 2004, from the State Department of Health (DOH). The DOH maintains this list, which includes practice address, for licensure purposes. Those with a practice address outside of Florida were excluded. A cover letter and questionnaire was then mailed, in the spring of 2005, to every primary care physician (family medicine, internal medicine, pediatrics, and obstetrics and gynecology) as well as a 25% stratified random sample of other specialists from the DOH list. Because the focus of this study was the ambulatory setting, physicians that do not traditionally practice in this setting (e.g., radiologists, pathologists, anesthesiologists, and emergency physicians) were excluded. The cover letter indicated the purpose of the study and encouraged individual physicians to participate. After the first mailing, a number of surveys were returned as undeliverable primarily because of unknown or changed addresses or incorrect practice location. Numerous efforts were made to obtain updated mailing information, and questionnaires were re-mailed to those individuals still practicing in Florida.

Each questionnaire was tracked by a six digit identifying code. After 4 weeks, nonresponders were mailed a second letter and questionnaire to reiterate our interest in their participation. Those physicians, who indicated by phone or mail, that they were no longer actively treating patients (i.e., retirement, or other reasons) were excluded. Completed questionnaires were returned by physicians via business-reply paid postage. Data was entered into a computer database and was subjected to data verification and cross-check methodologies.

To be as inclusive as possible, rurality was assessed using any one of the following three criteria; (1) the 33 statutorily-designated rural counties in Florida, (2) physicians practicing in rural areas of nonrural counties as designated by the Rural Urban Commuting Area (RUCA) codes [26] and, (3) the current Health Resources and Services Administration list of defined Florida rural areas.

To examine differences between rural and urban physicians, we cross-tabulated survey results regarding usage of various IT applications (e.g., EHR, PDA, e-mail). In these instances, the chi-square test was utilized to determine differences between groups. Moreover, since the configuration of typical rural practices differ from urban practices with respect to size, multispecialty affiliation, etc., we sought to identify which specific factors, if any, explained the differences in rural and urban IT utilization rates, when they existed. To do so, we utilized binary logistic regression models that incorporated various explanatory variables including practice size (measured as number of physicians employed there), type of medical training (primary care vs other), practice type (single vs multispecialty), physician race, and gender. This method allowed us to determine which variables accounted for the observed differences between rural and urban physicians with respect to IT adoption. All analyses were conducted in SPSS version 13.0 and significance was considered at the $p<.05$ level. Lastly, the project was approved by the university institutional review board.

Results

Overall, 4,203 surveys were returned which represented a 28.2% participation rate. There were 3,950 (94.2%) urban and 245 (5.8%) rural physician respondents. Rural physicians responded at a slightly higher rate (32.3 vs 28.0%, p=.014). Demographic and practice characteristics of rural and urban physician respondents are displayed in Table 1. Briefly, rural and urban physicians did not differ with respect to age. The majority of physicians were Caucasian (68.4%), male (75.9%), and worked in a single specialty practice (66.3%). A great number of respondents were in either solo (30.9%) practice or had 2–9 physicians in their group (54.2%). An additional 9.7% and 5.2% were in groups of 10–49, or greater than 50, physicians respectively. As expected, rural physicians were significantly more likely to report practicing in small or solo practices.

Computer and internet availability

The availability of information technologies among rural and urban physicians' practices in Florida is displayed in Table 2. No differences existed between rural and urban physicians with respect to the use of a computer (77.4% vs 81.4%; p=.144) or with the availability of an Internet connection (95.0% vs 96.5%; p=.249) at their office practice location. Moreover, no differences existed with the method of Internet connection used; dial-up (13.5% vs 12.0%; p=.564), broadband (83.7% vs 85.5%; p=.520), or wireless network (9.6% vs 11.2%; p=.490) between rural and urban physicians. However, urban physicians were more likely to indicate that their practice had an Internet website available to their patients (20.6% vs 43.8%; $p<.001$).

Table 1 Demographic and practice characteristics of rural and urban physician respondents

	Rural (*N*=245)	Urban (*N*=3950)	*P* value
Practice size (mean)			
No. of physician per practice	4.18	14.7	0.008
Practice size (distribution)			
Solo practice	113 (47.7%)	1,110 (29.8%)	
2–9 physicians	111 (46.8%)	2038 (54.7%)	
10–49 physicians	12 (5.1%)	372 (10.0%)	
50 or greater physicians	1 (0.4%)	205 (5.5%)	<0.001
Training			
Primary care	153 (63.2%)	1,982 (51.0%)	
Other specialty	89 (36.8%)	1,904 (49.0%)	<0.001
Practice Type			
Single specialty	165 (92.7%)	2,543 (85.2%)	
Multispecialty	13 (7.3%)	443 (14.8%)	0.005
Age			
Less than 40 years	33 (18.6%)	450 (15.8%)	
41–50 years	67 (37.9%)	1,060 (37.2%)	
51–60 years	47 (26.6%)	883 (31.0%)	
61 years or greater	30 (16.9%)	455 (16.0%)	0.565
Gender			
Male	155 (76.7%)	2,320 (75.9%)	
Female	47 (23.3%)	736 (24.1%)	0.793

Chi square analysis, or independent sample *t*-test as appropriate, were used to calculate the *P* values. Where applicable, numbers may not add up to 100% due to rounding

When specifically examining computer functions used by rural and urban physicians, very little differences existed. For example, no differences were noted between rural and urban doctors with respect to using a computer to schedule and register patients, charge capture, claims submission, access to drug and other reference material, and electronic order entry. However, rural physicians were less likely to use their office based computer for dictation purposes (20.5% vs 30.1%; p=.002).

E-mail use between physicians and patients

E-mail use with nonpatients was common, and did not differ, among both rural (59.0%) and urban (63.3%) physicians. However, rural physicians were less likely than urban doctors to indicate using e-mail with their patients (7.9% vs 17.2%; p<.001) (see Table 2). Specifically, physicians of Asian descent, who in our sample were more likely to be in rural areas, were less likely to indicate using e-mail to communicate with their patients (OR=0.28, 95% CI=0.16–0.49). In fact, in multivariate analysis of e-mail use, rural–urban differences were not significant with the above univariate findings and were explained completely by the physician race variable (p<.001).

Table 2 The availability of information technologies among rural and urban physicians' practices in Florida

	Rural (*N*=245)	Urban (*N*=3950)	*P* value
Information technology available			
Office-based computer	175 (77.4%)	3,054 (81.4%)	0.144
Internet access	211 (95%)	3,606 (96.5%)	0.249
Dial-up connection only	24 (13.5%)	381 (12%)	0.564
High-speed connection	149 (83.7%)	2,704 (85.5%)	0.520
E-mail with patients	19 (7.9%)	670 (17.2%)	<0.001
Practice has a website	49 (20.6%)	1,708 (43.8%)	<0.001
PDA	74 (32.3%)	1,408 (37.9%)	0.091

Fisher's exact test was used to calculate the *P* values.

Personal digital assistants

Compared to their urban counterparts, rural physicians were less likely to own a PDA (44.1% vs 51.3%; p=.028). However, even though PDA usage within the scope of medical practice among rural physicians was less common, the difference was not statistically significant (32.3% vs 37.9%; p=.091). Additionally, no differences in PDA functions (i.e., drug references, checks for medication interactions, calendar and organizer functions, etc.) used by rural and urban physicians were noted.

Electronic health records

Rural physicians were significantly less likely to indicate routinely using an EHR system at their office practice location (17.6% vs 24.1%; p=.020) (see Table 3).

Table 3 Trends in the use of EHR among rural and urban physicians' practices in Florida

	Rural (N=245)	Urban (N=3950)	P value
Current EHR utilization	43 (17.6%)	951 (24.1%)	0.020
Among current EHR users, time since system installation			
0–2 years	14 (35.0%)	231 (26.3%)	
3–5 years	15 (37.5%)	264 (30.0%)	
6+ years	11 (27.5%)	384 (43.7%)	0.127
Are non-EHR users considering adoption?			
Yes, very soon (within 1 year)	22 (14.4%)	487 (21.2%)	
Yes, but not within the next year	47 (30.7%)	794 (34.5%)	
No, not currently considering EHR	84 (54.9%)	1,018 (44.3%)	0.025

Chi square analysis, or Fisher's exact test as appropriate, were used to calculated P values. Where applicable, numbers may not add up to 100% due to rounding

Moreover, rural physicians with an EHR reported having their system in place for slightly less time, on average (4.92 vs 5.83 years; p=.203). In multivariate analysis, differences between rural and urban physicians were not significant (p=.124) for EHR use. The only significant predictors, which explained away the rural–urban differences, were practice size (p<.001) and practice type (p=.015). Specifically, physicians in large and in multi-specialty practices were more likely to adopt EHR regardless of location.

Among EHR users, rural physicians did not differ significantly from their urban counterparts with respect to most of the specific functions their systems contained. For example, no differences existed with respect to any of the functions that the Institute of Medicine [27] recommends should be present in an EHR system. The only exception was that rural doctors were less likely to have electronic connections to pharmacy info (21.8% vs 35.9%; p=.033) via their EHR system.

When asked about future EHR adoption intentions, rural physicians differed from their urban colleagues (see Table 3). Specifically, rural physicians were less likely to indicate an intention to adopt an EHR system within the next 1 year (14.4% vs 21.2%; p=.025) and more likely to suggest that they are not currently considering the adoption of an EHR system at all (54.9% vs 44.3% p=.025).

Barriers to EHR

Physicians that did not indicate currently using an EHR system were asked about their barriers to the adoption of this technology. The results comparing rural and urban physicians on their barriers to EHR systems are presented in Table 4. Generally, rural and urban physicians did not

Table 4 Percent rural and urban physicians in Florida rating each potential barrier to EHR adoption as a "major barrier"

Potential barrier to EHR adoption	Rural (%)	Urban (%)	P value
Financial			
Upfront cost of hardware/software are too high	65.9	63.2	0.263
Ongoing maintenance costs would be too high	47.2	44.9	0.305
Inadequate return on investment	44.9	43.5	0.392
Productivity			
Entering data into computer can be cumbersome	52.8	48.6	0.159
Lack of time to acquire, implement such a system	50.0	44.9	0.105
EHR may slow me down	34.5	33.5	0.429
Temporary loss of productivity and/or revenue during EHR system implementation phase	38.4	31.1	0.027
No time to learn how to use such a system	26.0	23.4	0.240
Disrupts workflow and/or office's physical layout to accommodate going to a computerized system	30.1	28.8	0.387
The system would be difficult to use	18.4	18.0	0.482
Technical			
Lack of uniform data standards within the industry	41.6	44.1	0.280
Temporary loss of access to patient records if computer crashes or power fails	46.6	39.3	0.034
Products available do not meet my needs	25.6	26.8	0.401
Me and/or my staff don't have any technical knowledge	16.4	12.7	0.102
Patients			
Privacy/confidentiality concerns	26.9	21.0	0.046
Patient resistance or not wanting their physicians to use EHR	6.9	6.8	0.514

Fischer's exact test was used to calculate the P values

differ on the most common barriers reported including financial barriers, productivity barriers, and some technical barriers. However, rural physicians rated several barriers more frequently than their urban counterparts. For example, rural physicians were more likely to indicate as a barrier the *temporary loss of productivity and/or revenue during EHR system implementation phase* (34.8% vs 31.1%; p=.027). Moreover, rural physicians were more likely to select as a barrier the potential *temporary loss of access to patient records if computer crashes or power fails* (46.6% vs 39.3%; p=.034). Lastly, rural physicians we more likely to consider *privacy/confidentiality concerns* as a major barrier to EHR adoption compared to urban physicians (26.9% vs 21.0%; p=.046).

Discussion

In the present study, we identify several differences between rural and urban physicians with respect to IT use in their office practice. Most notably, rural doctors were less likely to use both e-mail and EHR. However, being in a rural location had less to do with these trends than did the greater likelihood of urban physicians being in larger and multispecialty groups – both of which are associated with increased available resources and subsequent IT use. [17, 22] Even though practice size and multispecialty affiliation explained most of the differences between rural and urban physicians, the fact remains that those in rural areas are less likely to use important quality enhancing technologies.

Specifically, patients visiting their rural physician are less likely to see an EHR being used to enhance their care. Moreover, physicians in rural areas were less likely to indicate a future intention to adopt an EHR system. Among all physicians, financial barriers ranked high as impediments to EHR adoption. Financial barriers are particularly pronounced for rural physicians because they typically practice in single-specialty, solo or small groups which traditionally lack the necessary resources needed for successful EHR implementation. Given their financial vulnerability and more isolated locations, rural physicians were more likely than their urban counterparts to consider temporary losses in productivity during the EHR implementation phase, and potential loss of access to records when computers fail, as major barriers. More work specifically alleviating these barriers, which appear to disproportionately affect rural physicians are needed.

The findings of our work also suggest that rural patients are less likely to communicate with their physician via e-mail. However, based on the data we present, it is unclear whether or not the e-mail trend reflects a decreased demand among rural patients or the characteristics of rural physicians in their practice setting. Research suggests that when used properly, e-mail with physicians can enhance the quality of healthcare. [28, 29] A better understanding of e-mail use between physicians and patients in rural areas is warranted.

Given that rural physicians were less likely to use important information technologies in their medical practice, if steps are not taken to alleviate their adoption barriers, the digital divide between rural and urban doctors is likely to widen. Nevertheless, on a positive note, we found that rural physicians who are utilizing EHRs are doing so in a manner similar, both in tenure and functionality, to their urban counterparts.

The interpretation of the data we present should be done in light of our research limitations. First, our study utilized a cross-sectional design and achieved a modest response rate to the survey. However, after employing various common techniques used to determine response bias, we failed to detect any. The results of those analyses have been published elsewhere. [30] Second, our study examined IT use at the physician level, and not the practice level. It is possible that several physicians, working in the same medical practice, responded to our survey. Thus, our conclusions are most generalizable to individual physicians rather than the practices that employ them. Lastly, our study was based in one state where the medico-legal and competitive climate may differ from other locations. Therefore, generalizability of our study to geographic locations outside of Florida should be done with caution.

The Institute of Medicine's national vision for the future of healthcare will require the use of IT by all clinical providers. [1, 27] Additionally, the success of emerging local initiatives such as regional health information organizations [31] will depend on whether all physicians, including rural doctors, have electronically available clinical information. Given the importance of health IT to the future of both national and local health quality initiatives, future studies should continue to focus on rural physicians' IT use.

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