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Demographic Trends in Consumer E-Health Adoption: Analysis of NCI HINTS 2003 and 2005 National Surveys

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ABSTRACT

It has become common for healthcare providers to offer e-health services to patients and other consumers. Experts suggest these services are desired by users, and this has been confirmed generally through empirical research. However, most empirical studies of e-health adoption have focused on demographically homogeneous populations and have been implemented through cross-sectional designs. This study applies data from two administrations of the Health Information National Trends Survey (HINTS) conducted by the U.S. National Cancer Institute to develop an analysis of adoption trends that crosses time (2003-2005) and also addresses effects of gender, age, socio-economic status, and race/ethnicity on e-health use. The analysis is further developed to distinguish differences in adoption of informational e-health services vs. transactional e-health services. Key findings of the analysis are that e-health use is increasing but usage is much higher for informational than for transactional uses. Informational e-health use is found to be significantly associated with gender, age, and race/ethnicity demographics. Transactional e-health use is significantly associated only with race/ethnicity and gender measures.

Keywords (Required)

Healthcare, health-IS, IT adoption and use, gender, race/ethnicity, age, socio-economic status, income.

INTRODUCTION

During the past decade, healthcare providers have begun to offer a wide variety of e-health services to patients and other consumers. These include informational services such as online access to encyclopedic health information and personal health records (Masys, Baker, Butros, and Cowles, 2002) as well as transactional services including electronic billing and payment (Altinkemer, De, and Ozdemir, 2006), computer-mediated communication with physicians and clinical staff (Wilson, 2003), interaction with peers and mentors in online support groups (Zrebiec and Jacobson, 2001), and public health reporting (Järvinen, 2009). It is important for providers to understand at what level their e-health services are adopted by consumers in general, and this issue has been studied by a number of researchers (e.g., Fox and Rainie, 2000; Klein, 2007; Wilson and Lankton, 2004; Winkelman, Leonard, and Rossos, 2005). However, the present study is based upon the observation that it is also necessary to understand how trends in adoption may be influenced by demographic factors. Understanding the role that demographics play in adoption can help identify whether e-health investments are adequately supporting population subgroups who may have special needs and perspectives. Several aspects of this issue have been investigated in prior studies as discussed below, however, this is the first study we are aware of that assesses a comprehensive set of demographic factors and their effects on use of multiple e-health services utilizing randomized national surveys administered at multiple times.

BACKGROUND AND RESEARCH QUESTIONS

This study utilizes data from two administrations of the Health Information National Trends Survey (HINTS) conducted by the U.S. National Cancer Institute. HINTS is a nationally representative sample of U.S. households that targets residents of age 18 and above and intentionally oversamples participants who self-identify as Black and Hispanic race/ethnicity. In this paper we expand upon previously reported descriptive findings from the 2003-2005 HINTS administrations (Rutten et al., 2007) to analyze both direct and interactive effects of e-health adoption trends across dimensions of time (2003-2005), gender, age, socio-economic status, and race/ethnicity. A further contribution of our research design is to distinguish

differences between adoption of informational e-health services vs. transactional e-health services. In the following sections we survey the background literature to develop research questions relating to each demographic dimension of the study.

Gender

Although men dominated use of the Internet in its early days, the proportion of women and men now online is roughly equivalent (Fallows, 2005). However, relative usage by gender depends heavily on contextual factors (Dholakia, 2006). Men continue to use the Internet more to find news, weather and sports information (Fallows, 2005). Yet Kim and Forsythe (2008) report no difference between genders in adoption of online shopping application while Wilson and Lankton (2004) note that women comprise nearly 80% of users who volunteered to participate in their study of e-health adoption. In addition, different factors appear to be important in driving information technology (IT) use by women vs. men (Ahuja and Thatcher, 2005; Venkatesh and Morris, 2000). These findings suggest that between-gender differences may be important in predicting use of various e-health services, however, we did not find any prior studies that focus on this issue. This situation prompts our first research question.

What U.S. trends in e-health use are associated with gender?

Age

Compared to adolescent and early adult usage rates, use of the internet for both informational and transactional activities tends to be lower in elderly populations (Fox and Madden, 2005). This situation is exacerbated among the elderly by lack of access and low awareness of services that are available via the Internet (Hill, Beynon-Davies, and Williams, 2008). As a group, older adults have heightened need for both health information (Wicks, 2004) and health services (CDC, 2005), and many of these needs can be fulfilled through the Internet. As time passes it is predictable that Internet usage by older adults will increase as a function of generational changes; a Kaiser (2005) survey reports that the proportion of 50-64 year-olds who have gone online is more than twice as high as among those 65 and older. Yet most studies of the impact of age on Internet usage implement cross-sectional designs which do not directly inform trend analysis, and there is relatively little research addressing age-related trends in e-health use. The need to clarify the role of age in e-health adoption prompts our second research question.

What U.S. trends in e-health use are associated with age?

Socio-Economic Status

Until recently, the correlation between socio-economic status and Internet use was considered to derive exclusively from the ability to pay for access (DiMaggio, Hargittai, Celeste, and Shafer, 2004). However, recent studies indicate that a variety of factors related to socio-economic status affect Internet use beyond the simple ability to pay and that these factors differ categorically between persons of low and high socio-economic status (Bonfadelli, 2002; Hseih, Rai, and Keil, 2008). Thus, socio-economic demographics are of increasing interest to e-service researchers in general. Current research reports that e-health access rates are much lower for low-status than for mid-to-upper status groupings (Dart, 2008). However, it is not clear from cross-sectional designs, such as the Dart study, whether this difference is static or is part of a changing trend. The desire to inform this issue leads to our third research question.

What U.S. trends in e-health use are associated with socio-economic status?

Race/Ethnicity

Minority groups currently represent over a third of the U.S. population and will cumulatively account for more than half the population by 2050 if current trends continue (U.S. Census Bureau, 2004). The relatively few empirical studies that address differences in technology adoption driven by race/ethnicity report equivocal findings. Compared to Whites, a lower percentage of Blacks and Hispanics utilize home computers and the Internet (Dupagne and Salwen, 2005; Albert and Jacobs, 2008), yet these minority groups are significantly more innovative than Whites in television use, e.g., through researching new programming and subscribing to digital cable (Albert and Jacobs, 2008). Although the prior research indicates that a distinct digital divide exists between Whites and minorities (Norris, 2001), we did not find any empirical studies that address recent trends in e-health use by these groups. Thus, we address this issue in our fourth research question.

What U.S. trends in e-health use are associated with race and ethnicity?

Interactive Trends

Where studies of a single demographic factor are limited to assessing main effects on one or more dependent factors, the comprehensive design of the present study also supports investigation of interactive effects. We were not able to find prior

research on interactive effects of race/ethnicity, gender, age, or socio-economic status on use of e-health services over time, and this lack of prior findings prompts the inclusion of this final research question in our study.

What interactions between time and demographic factors characterize U.S. trends in e-health use?

RESEARCH METHOD

This study uses data from the Health Information National Trends Survey (HINTS), conducted in 2003 and 2005 by the National Cancer Institute. The survey applies a national probability sampling methodology to assess U.S. residents' knowledge and perceptions regarding cancer information and other issues surrounding healthcare (Davis, Park, Covell, Rizzo, and Cantor, 2005). HINTS is directed toward documenting changing patterns in use of health information (especially relating to cancer), identifying health communication trends, assessing how cancer risks are perceived, and testing theories relating to health communication (HINTS, 2008). The present study utilizes a subset of HINTS data relating to respondents' use of the Internet for healthcare purposes and demographic data.

HINTS data were collected by telephone interviews and online questionnaires. The 2003 HINTS data were collected between October 2002 and April 2003, and 2005 HINTS data were collected between February and August of 2005. List-assisted, random digit samples of all telephone exchanges in the U.S. were used to develop a nationally representative sample of households. Residents of age 18 and above were recruited to participate in the survey, with intentional oversampling of residents who were self-identified as Black or Hispanic. A total of 6369 individuals completed the HINTS 2003 survey (33% overall response rate), and 5586 completed the HINTS 2005 survey (21% overall response rate). For our study, we eliminated data from non-Internet users, from individuals who did not complete e-health use measures, and from race/ethnicity categories that did not include sufficient numbers of respondents to support analysis. This resulted in a study sample of 4089 with 2433 responses from the 2003 survey and 1656 from the 2005 survey.

Demographic Measures

Independent variables in our research design consist of four demographic factors (gender, age, income level, and race/ethnicity) assessed in 2003 and 2005. All measures are categorical. Gender is measured as male vs. female. Age is grouped at two levels—18 to 64 vs. 65 or over—based upon prior research indicating that Internet use patterns differ categorically between these age groups (Fox and Madden, 2005). Income level is grouped at two levels—less than or equal to $25,000 vs. greater than $25,000—based upon prior research indicating that Internet use patterns differ primarily between low- and mid-levels of socio-economic status (Bonfadelli, 2002; Hseih, Rai, and Keil, 2008). Race/ethnicity is grouped into Hispanic, White, or Black categories based upon respondents' self-report. Response rates in other race/ethnicity categories were too low to support effective analysis, thus respondents in these categories were not included in the present study. The number of responses for each demographic measure used in the analysis is shown in Table 1.

	Number of Responses	Percent
Gender		
Male	2,275	39%
Female	3,568	61%
Age		
18 – 64	3518	88%
65 +	471	12%
Income Level		
<= 25,000	902	23%
25,000 +	3000	77%
Race/Ethnicity		
Hispanic	335	9%
White	3136	80%
Black	432	11%

Table 1. Demographic Measures

E-Health Use Measures

E-health use is calculated as the proportion of services in a predefined set that participants report having used during the prior 12 month period. The rationale for counting the number of different behaviors is based upon the premise that higher counts represent more extensive utilization of the Internet across the studied population (Wilson, Dobrzykowski, and Cazier, 2008). We categorize these as *informational use*, in which the Internet is used to acquire health information for oneself or others, and *transactional use,* in which the Internet is used to complete a transaction, consisting of buying a health product online, participating in an online support group, or communicating electronically with one's doctor or clinic. In the subsets of Internet users we analyzed, the overall informational e-health use rate was 49% in 2003 and 59% in 2005. The overall transactional use rate was 6.6% in 2003 and 9.4% in 2005. Figures 1 and 2 show the changes in proportions of each studied group in respondents' use of informational and transactional e-health.

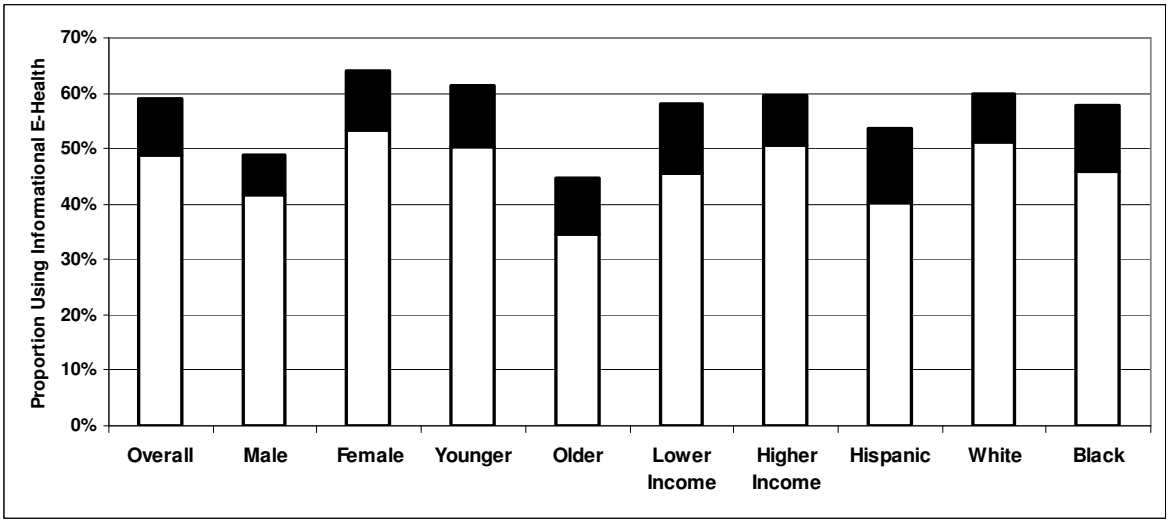

Figure 1. Cumulative Proportions of Demographic Groups Using Informational E-Health
(Black portion indicates increase from 2003 to 2005 surveys)

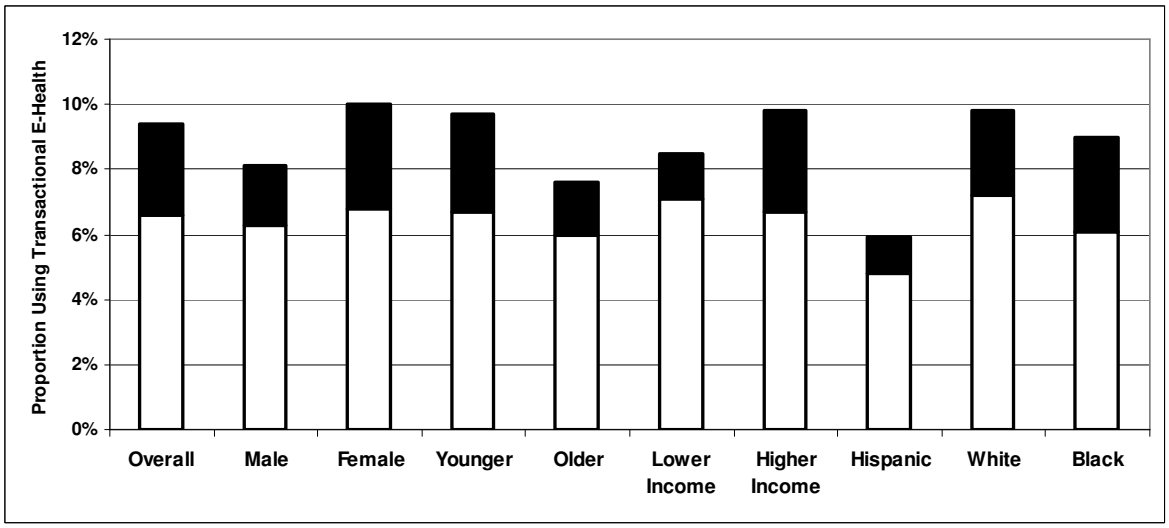

Figure 2. Cumulative Proportions of Demographic Groups Using Transactional E-Health
(Black portion indicates increase from 2003 to 2005 surveys)

DATA ANALYSIS AND RESULTS

We examined our research questions using MANOVA in order to assess overall e-health use as well as distinct aspects of informational and transactional e-health uses. Our MANOVA was run through SAS GLM using Type III sum of squares and incorporating replicate weights as recommended by the National Cancer Institute for conducting multi-year analysis with HINTS data (Rizzo et al., 2008). The dependent variables are correlated ($r = .234$, $p < .01$), however, the correlation is well within the range that can be handled effectively by MANOVA (Maxwell, 2001). With large sample sizes, as in the present study, MANOVA also is robust to effects of unbalanced cell sizes (Tabachnick and Fidell, 2001). The independent variables are between-subject measures representing the four demographic variables and survey year (2003 or 2005).

Our research questions focus on identifying trends in e-health use that are related to demographic factors. In addition to studying main effects, we propose to assess interactions between demographic factors and year of survey. Correspondingly, we specified a custom MANOVA model that includes main effects terms for year and four demographic factors (gender, age, income level, and race/ethnicity) and terms for two-way interactions between year and each of the demographic factors.

The results indicate that there is a significant overall increase in e-health use between 2003 and 2005 and that this effect is primarily driven by an increase in informational uses. All demographic factors except income have main effects on informational use of e-health, and an interaction between income and year appears in the multivariate results. This interaction arises from significantly larger gains in informational use between 2003 and 2005 among lower-income participants.

For transactional use, only the gender and race/ethnicity demographic factor are significantly associated with changes over time. Females made larger gains in transactional use than males between 2003 and 2005. Post hoc analysis showed that White respondents use informational e-health at higher rates than Hispanic (Scheffe test, $p = .0068$) or Black respondents (Scheffe test, $p = .0018$), and Hispanics use transactional e-health less than White (Scheffe test, $p = .0004$) or Black respondents (Scheffe test, $p = .0201$). No significant interactive effects are found between year and any of the studied demographic factors on the transaction use measure.

	Multivariate Results		**Univariate Results**			
			Informational Use		**Transactional Use**	
Factor	***F***	**Sig.**	***F***	**Sig.**	***F***	**Sig.**
Year (2003 vs. 2005)	14.21	< .0001	28.03	< .0001	3.16	ns
Gender	63.82	< .0001	127.59	< .0001	4.86	.0275
Age	18.30	< .0001	36.58	< .0001	2.12	ns
Income	.00	ns	0.00	ns	.00	ns
Race/Ethnicity	8.10	<. 0001	10.31	<. 0001	7.92	.0004
Year * Gender	1.79	ns	.98	ns	3.21	ns
Year * Age	.17	ns	.19	ns	.08	ns
Year * Income	9.34	<. 0001	16.77	<. 0001	.21	ns
Year * Race/Ethnicity	1.65	ns	1.05	ns	1.64	ns

Table 2. Significant Results of Analysis

DISCUSSION

Our first four research questions relate to U.S. trends in e-health use by gender, age, income level, and race/ethnicity. We find all these factors have significant direct or interactive effects on use of one or more types of e-health services. Prior research in general Internet use has been equivocal regarding gender. In the case of e-health services, we find that use by women clearly predominates use by men. Consistent with prior research, we find that younger people use e-health more than those who are older, however, this effect was significant only for informational e-health use. Race/ethnicity also is an important predictor in our findings, but the results differ for informational vs. transactional e-health use. Whites use informational e-health services at a significantly higher rate than Blacks or Hispanics whereas Hispanics use transactional e-health at a lower rate than either Whites or Blacks. Although income did not exert any direct effect on e-health use, our results indicate lower-income groups are "catching up" to the rest of the population in informational usage rates.

It is important to reiterate that the majority of the demographic factors we studied did not interact with survey year, indicating that increases in use have been relatively consistent across demographic groups over the two-year period of the study. Yet it

may be premature to rule out such effects. Potentially, a two-year period is not of sufficient length to detect significant demographic trends, even using well-designed, large-scale, and representative surveys such as HINTS. The NCI administered a third survey in 2007 and will publish results in 2009, and we encourage future research to investigate further whether interactions appear when the 2007 data are added to the current data set.

Our findings indicate that male, elderly, and minority populations, especially Hispanics, are comparatively underserved by e-health, yet overall use by all these groups increased significantly between 2003 and 2005. In the following sections, we discuss the practical and research implications of these findings.

Practical Implications for Informational E-Health

By 2003, our findings indicate that more than half of U.S. Internet users had searched for health information for themselves and others. During the following two years, this proportion increased to approximately 59%. Our findings indicate that informational e-health has become a mainstream Internet service across each of the demographic dimensions that we analyzed. This observation implies that healthcare providers can benefit in key ways by expanding their delivery of informational e-health services whether directed toward specific demographic groups or across all demographics. First, e-health can speed delivery of information. Because the Internet is nearly always accessible, e-health is uniquely capable of eliminating delays in providing information about health conditions and clinical services. Second, e-health can deepen the informative value of health information. Because only negligible incremental distribution costs are associated with reproducing Internet content, unlike printed documents e-health services can inexpensively deliver in-depth analyses, voluminous illustrations, videos, and audiovisual materials that can increase understanding and improve retention of knowledge by recipients. Third, low distribution costs also enable e-health to cost-effectively increase the exposure of healthcare providers beyond their core patient groups and allow them to reach underserved communities, such as the elderly, who have heightened need for health information and services (Wicks, 2004; CDC, 2005).

Practical Implications for Transactional E-Health

Where use of informational e-health has become mainstream, less than 10% of 2005 HINTS respondents had used e-health during the prior 12 months to conduct the transactions we studied: buying a health product online, participating in an online support group, or communicating electronically with one's doctor or clinic. We do note that proportional growth in transactional e-health use between 2003 and 2005 substantially outstripped growth in informational use (42% vs. 21% increase) although this effect was not significant in the context of our MANOVA analysis ($p = .0755$). Observed growth rates were similarly strong across demographic measures, with the notable exception of Hispanics. In follow-up analysis, we find 89% of HINTS respondents who used transactional e-health also report using informational e-health. This analysis suggests that informational e-health provides a gateway experience that can lead users to experiment with transactional e-health services.

These findings also imply that significant potential exists for successful diffusion of existing transactional e-health services, such as online prescription refills, appointment scheduling, and communication (Altinkemer, et al., 2006; Wilson, 2003) as well as development of new e-health services, such as online health monitoring and access to lab results. However, success will depend in large part on the ubiquity and quality of services that healthcare providers actually deploy. Unlike informational e-health which can be obtained through a generic supplier, such as WebMD, transactional e-health typically requires tight integration with the individual's own healthcare provider.

So far, healthcare providers have been slow to innovate transactional e-health services. Although the overall healthcare sector is beginning to overcome its lagging investment in IT (HIMSS Analytics, 2007), much of the new investment is being targeted toward "back office" IT, such as electronic medical record (EMR) and computer physician order entry (CPOE) systems. Relatively little funding currently is being targeted toward providing e-health to patients. As a consequence, transactional e-health currently fails to provide many of the services patients want, such as integration of personal health records with the healthcare provider's EMR (Wilson, 2009). Patients have alternatives to conducting their health transactions online, and they will not use e-health services that are difficult to understand and use (Lankton and Wilson, 2007) or provide functions of marginal utility (Payton and Brennan, 1999).

Similar to informational e-health, transactional e-health offers substantial potential to improve healthcare delivery while cutting or containing costs. Our findings suggest that interest in transactional e-health is increasing in the U.S., and providing innovative transactional services could deliver considerable competitive advantages to healthcare providers.

Implications for E-Health Research

The generic term *e-health* has diversified to cover such a wide range of intra- and inter-organizational applications that it has become easy to ignore uses of e-health by patients and other consumers outside of healthcare organizations (Wilson, 2008).

Yet our findings indicate that informational e-health is used at least once a year by nearly 60% of Internet users in the U.S., and use of transactional e-health appears to be increasing. We argue these findings substantiate a need for increased study of existing consumer-oriented e-health services, especially to quantify capabilities and economic impacts. There is further need for forward-looking research intended to identify best practices for design and administration of consumer-oriented e-health. E-health is qualitatively different from most other online services, in the same manner as healthcare is distinct from other business organizations. Thus it is important to conduct specialized studies within the e-health domain in order to augment the broader e-services literature as well as to provide specific guidance to e-health practitioners.

CONCLUSION

We proposed at the beginning of this paper that it is necessary to implement comprehensive research designs across time in order to understand the effects of demographic factors on e-health adoption. Availability of the HINTS 2003 and 2005 surveys made this effort possible. We find that disparities exist across demographic dimensions, yet e-health use increased for all groups between 2003 and 2005. These are reassuring results that reinforce our call for health-IS researchers to give more attention to the study of patient-oriented e-health services.

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