Letters

RESEARCH LETTER

Trends in Seniors' Use of Digital Health Technology in the United States, 2011-2014

The sickest, most expensive, and fastest growing segment of the US population are seniors 65 years and older.[1] Digital health technology has been advocated as a solution to improve health care quality, cost, and safety. However, little is known about digital health use among seniors.

Methods | The Partners HealthCare Human Research Committee exempted this study from review. The National Health and Aging Trends Study (NHATS) is an annual in-home, computer-assisted, longitudinal, nationally representative survey of community-dwelling Medicare beneficiaries 65 years and older drawn from the Medicare enrollment database through a complex sampling design.[2] Each year, NHATS asks the same respondents about everyday (nonhealth) technology use and 4 digital health modalities: use of the internet to fill prescrip-

Table. Characteristics of Community-Dwelling Medicare Beneficiaries by Digital Health Technology Use in the United States, 2011

	All Seniors, % (95% CI)[a] (n = 7609)	Digital Health Modalities Used, % (95% CI)[a,b]		Any Use of Digital Health, OR (95% CI)[c]
		None (n = 6391)	Any (n = 1216)	
Age, mean (95% CI), y	75.3 (75.1-75.5)	76.1 (75.9-76.4)	72.1 (71.8-72.4)	0.93 (0.92-0.94)
Women	56.6 (55.2-58)	58.2 (56.7-59.7)	50.7 (47.6-53.7)	0.87 (0.65-1.16)
Race/ethnicity[d]				
White	80.5 (78.8-82.2)	77.8 (75.7-79.8)	90.8 (89.0-92.6)	Reference
Black	8.1 (7.3-8.9)	9.4 (8.3-10.4)	3.5 (2.8-4.1)	0.50 (0.36-0.68)
Latino	6.7 (5.7-7.8)	7.8 (6.6-9.1)	2.7 (1.6-3.8)	0.50 (0.29-0.85)
Other	4.6 (3.6-5.6)	5.1 (3.9-6.2)	3.0 (1.7-4.2)	0.45 (0.22-0.94)
Marital status				
Married or partnered	57.0 (55.5-58.4)	52.7 (51.2-54.3)	72.7 (70.0-75.4)	Reference
Divorced or separated	12.2 (11.4-13.1)	12.9 (11.8-14)	9.8 (8.2-11.5)	0.71 (0.55-0.92)
Widowed	27.1 (25.8-28.3)	30.3 (28.9-31.8)	15.0 (12.8-17.1)	0.90 (0.68-1.18)
Never married	3.7 (3.1-4.3)	4.0 (3.4-4.7)	2.5 (1.3-3.8)	0.70 (0.36-1.35)
Education				
<High school	21.8 (20.0-23.5)	26.7 (24.7-28.6)	3.7 (2.5-4.9)	Reference
High school graduate	27.6 (26.3-28.9)	30.7 (29.4-32)	16.3 (14.1-18.6)	2.61 (1.66-4.08)
Some college or trade school	26.2 (25.0-27.4)	24.6 (23.3-25.9)	32.2 (29.5-34.9)	4.55 (3.04-6.81)
College graduate	13.0 (11.7-14.4)	10.2 (9.1-11.3)	23.7 (20.8-26.6)	6.95 (4.49-10.77)
>College	11.3 (9.9-12.8)	7.9 (6.8-8.9)	24.1 (20.9-27.3)	9.57 (6.22-14.71)
Annual income, $				
<15 000	21.1 (19.5-22.6)	24.7 (23.0-26.5)	7.3 (5.6-9.0)	Reference
15 000-29 999	24.9 (23.4-26.4)	28.5 (27.1-29.8)	11.6 (9.5-13.8)	0.94 (0.63-1.42)
30 000-44 999	17.4 (16.4-18.4)	17.6 (16.5-18.7)	16.5 (14.1-18.9)	1.44 (1.02-2.04)
45 000-60 000	11.0 (10.1-11.9)	10.1 (9.1-11.1)	14.5 (12.8-16.1)	1.58 (1.10-2.25)
>60 000	25.6 (23.8-27.5)	19.1 (17.6-20.5)	50.1 (46.7-53.6)	2.06 (1.41-3.01)
Self-reported health				
Excellent	14.8 (13.7-15.9)	13.2 (12.2-14.2)	20.7 (18.3-23.0)	Reference
Very good	29.5 (28.3-30.8)	27.0 (25.8-28.3)	38.7 (35.9-41.5)	1.07 (0.87-1.30)
Good	30.7 (29.4-32.0)	31.9 (30.4-33.3)	26.2 (23.5-28.9)	0.81 (0.59-1.10)
Fair	18.4 (17.2-19.5)	20.3 (19-21.5)	11.3 (9.3-13.3)	0.91 (0.60-1.40)
Poor	6.7 (5.9-7.5)	7.7 (6.8-8.5)	3.1 (2.1-4.2)	0.47 (0.22-0.998)
Cigarette smoker[e]	13.0 (12.1-14)	12.3 (11.3-13.3)	15.7 (13.3-18.1)	1.45 (1.08-1.93)[f]
Dementia[g]	6.1 (5.5-6.7)	7.5 (6.8-8.2)	M	0.84 (0.38-1.86)[f]
Depression[h]	14.6 (13.3-15.8)	16.3 (14.9-17.7)	8.1 (5.9-10.2)	0.95 (0.65-1.38)[f]
Takes medications	90.7 (89.7-91.6)	89.9 (88.9-90.9)	93.5 (91.8-95.2)	1.94 (1.32-2.85)[f]
Comorbidity count, mean (95% CI)	3.0 (3.0-3.1)	3.1 (3.0-3.1)	2.9 (2.8-3.0)	1.13 (1.06-1.21)[i]
ADLs, mean (95% CI)[j]	5.6 (5.6-5.7)	5.6 (5.6-5.6)	5.9 (5.8-5.9)	0.99 (0.75-1.31)[i]
IADLs, mean (95% CI)[j]	7.6 (7.5-7.6)	7.5 (7.5-7.6)	7.8 (7.7-7.8)	1.05 (0.96-1.15)[i]
SPPB, mean (95% CI)[j]	6.7 (6.6-6.8)	6.3 (6.1-6.4)	8.2 (8.0-8.3)	1.04 (1.00-1.08)[i]
Grip strength, mean (95% CI), kg	26.5 (26.1-26.9)	25.6 (25.2-26.1)	29.3 (28.7-30.0)	0.99 (0.98-1.01)[i]
Hospitalizations, mean (95% CI), No.	0.4 (0.3-0.4)	0.4 (0.3-0.4)	0.3 (0.2-0.3)	1.07 (0.94-1.23)[i]

Abbreviations: ADLs, activities of daily living; IADLs, instrumental activities of daily living; M, masked (cell based on fewer than 5 individuals); OR, odds ratio; SPPB, Short Physical Performance Battery.

[a] No. represents the unweighted survey participants. Percentages represent the weighted prevalence. Percentages may not sum to 100 due to rounding.

[b] Modalities include digitally fill prescriptions, contact a clinician, handle insurance matters, or obtain health condition information. The comparison between None and Any was *P* value less than .01 for all, except comorbidity count (*P* = .046).

[c] For brevity, we do not show the variable census region, although it is included in the multivariable model.

[d] Self-reported from options provided in the survey.

[e] Current or within the past 20 years.

[f] Referent is the converse.

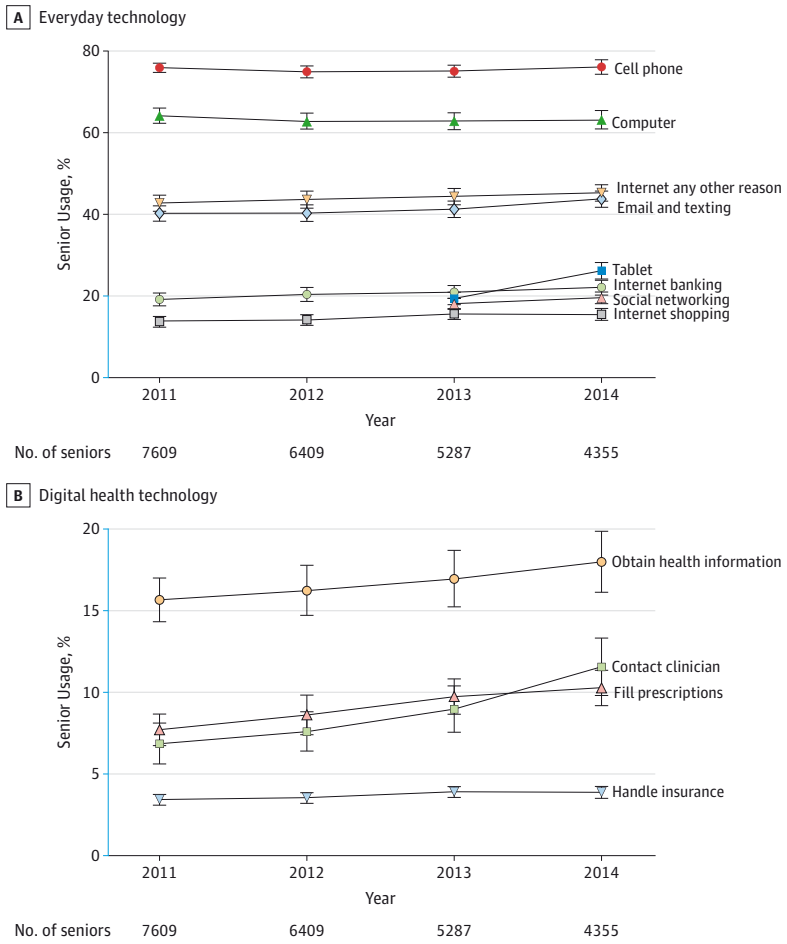
[g] Possible or probable by self- and family-report, then supplemented by the 8-item Interview to Differentiate Aging and Dementia.

[h] A score of 3 or more on Patient Health Questionnaire 2.

[i] Respectively, units are per comorbidity, per activity, per activity, per point, per 1 kg, and per admission.

[j] ADLs include 6 items; the IADLs, 8 items; the SPPB, 12 items.

Figure. Changes in US Seniors' Technology Use, 2011-2014



The y-axis scale shown in blue indicates range from 0% to 20%. Tablet and social network sites questions were asked only in 2013 through 2014. Error bars indicate 95% CIs of the weighted percentages. *P* values for trends: cell phone (.17), computer (.11), internet and online for any other reason (<.001), email and texting (<.001), internet banking (<.001), tablet (<.001), social network sites (.006), internet shopping (.003), obtain health condition information (.002), fill prescriptions (<.001), contact a clinician (<.001), and handle insurance matters (.065). Cumulative attrition between 2011 and 2014 was due to death (n = 1430) and loss to follow-up (n = 1824).

tions, contact a clinician, address insurance matters, and research health conditions.

For this study, we included participants in 2011 (response rate, 71%) who were followed yearly until 2014. We examined everyday and digital health use and variables associated with digital health use using logistic regression, adjusting for all characteristics in the **Table**, the complex survey design, repeated measures, nonresponse, and missing data.

We analyzed trends over time with the trend test. We considered 2-sided *P* values less than .05 to be significant. We performed all analyses with SAS (SAS Institute), version 9.4.

Results | In 2011, the mean age of the 7609 participants was 75 years (SD, 7.4); 57% were women (Table). Although 76% of seniors used cell phones and 64% computers, fewer used internet (43%) and email and texting (40%). Less than 20% used internet banking, internet shopping, social network sites (2013 data), and tablets (2013 data). Fewer seniors used digital health technology: 16% obtained health information, 8% filled prescriptions, 7% contacted clinicians, and 5% handled insurance online.

In 2011, variables associated with less use of any digital health were older age; black, Latino, and other race/ethnicity; divorce; and poor health (Table). Variables associated with greater use included college education, higher annual income, taking medications, and more comorbidities.

By 2014, 1430 participants had died and 1824 were lost to follow-up, leaving 4355 seniors (57%). Although cell phone and computer use were stable, small statistically significant increases were noted in other everyday technologies (**Figure**). Use of 3 of 4 digital health technologies increased. The proportion of seniors who used any digital health increased from 21% in 2011 to 25% in 2014 (difference, 4% [95% CI, 3% to 5%]; $P < .01$). In 2011, 1.1% used all 4 modalities compared with 1.8% in 2014 (difference, 0.7% [95% CI, 0.1% to 1.3%]; $P = .02$). From 2011 to 2014, 14% (95% CI, 13% to 15%) of seniors increased the number of modalities used; 10% (95% CI, 9% to 11%) decreased their use.

Discussion | Seniors used digital health at low rates with only modest increases from 2011 through 2014. To our knowledge, this is the first nationally representative study to examine trends in seniors' digital health use, although a study in Northern California found higher patient portal use than the clinician contact rate in this study.[3]

Seniors' use of everyday technology was below that of the general population (approximately 90% use the internet and

own cell phones; 60% search for health information),[4] but similar to other studies of older adults, except for the finding of racial and socioeconomic differences.[4,5] Relying on everyday technology or generic internet use rates to estimate digital health use may be misleading. For example, although 63% used a computer and 43% used the internet, only 10% filled prescriptions online.

Limitations include that NHATS is a closed cohort with inception in 2011; more recent cohorts may be different. Many survey participants were lost to follow-up or died, although there were not large changes in sample characteristics. Data were only available over 4 years.

Digital health is not reaching most seniors and is associated with socioeconomic disparities, raising concern about its ability to improve quality, cost, and safety of their health care. Future innovations should focus on usability, adherence, and scalability to improve the reach and effectiveness of digital health for seniors.

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Author Contributions: Dr Levine had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: All authors.
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1. Centers for Medicare & Medicaid Services. National health expenditure fact-sheet. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NHE-Fact-Sheet.html. Accessed October 24, 2015.

2. National Health and Aging Trends Study. NHATS data collection procedures. http://www.nhats.org/. Accessed October 30, 2015.

3. Gordon NP, Hornbrook MC. Differences in access to and preferences for using patient portals and other ehealth technologies based on race, ethnicity, and age. *J Med Internet Res*. 2016;18(3):e50.

4. Fox S, Duggan M. Health online 2013. http://www.pewinternet.org/2013/01/15/health-online-2013/. Accessed June 24, 2016.

5. Greysen SR, Chin Garcia C, Sudore RL, Cenzer IS, Covinsky KE. Functional impairment and internet use among older adults. *JAMA Intern Med*. 2014;174(7):1188-1190.

6. Care Innovations. Older populations have adopted technology for health. http://www.careinnovations.com/wp-content/uploads/filebase/Older-Populations-Adopt-Health-Technology.pdf. Accessed January 12, 2016.

COMMENT & RESPONSE

Metallic vs Plastic Stents for Benign Biliary Strictures

To the Editor Dr Coté and colleagues[1] conducted a randomized trial that showed that fully covered metallic stents were not inferior to multiple plastic stents in achieving resolution of certain types of benign biliary strictures.

Multiple progressive plastic stenting to treat postoperative bile duct strictures was introduced in 2001[2] and has been widely adopted worldwide.[3,4] The progressive stretching of the fibrotic biliary stricture with an increasing number of plastic stents maintains good results after more than 10 years of follow-up.[5] The main limitation of this method is the need for repeated endoscopic interventions to replace the stents and increase their number, which leads to higher costs and requires good adherence from patients. Removable fully covered self-expanding metallic stents represent an appealing alternative because only 2 endoscopic retrograde cholangiopancreatography procedures, one to implant the stent and one to remove it, are theoretically required.

However, only a minority of patients with benign biliary strictures are good candidates for metallic stenting. Most patients with benign biliary strictures have a postcholecystectomy injury, which is seldom amenable to metallic stenting for 2 reasons: the stricture is often located close to the main hepatic confluence, and the bile duct below the stricture is usually of normal caliber. Only 4 of 112 patients (3.6%) randomized in the study by Coté and colleagues[1] had "other postoperative injuries," whereas the majority had anastomotic strictures after orthotopic liver transplantation and chronic pancreatitis. The study by Coté and colleagues[1] therefore concerned only a limited, well-selected subset of patients with benign biliary strictures.

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Conflict of Interest Disclosures: The author has completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and reported having received grants from Medtronic, Olympus, Cook Medical, and Boston Scientific.

1. Coté GA, Slivka A, Tarnasky P, et al. Effect of covered metallic stents compared with plastic stents on benign biliary stricture resolution: a randomized clinical trial. *JAMA*. 2016;315(12):1250-1257.

2. Costamagna G, Pandolfi M, Mutignani M, Spada C, Perri V. Long-term results of endoscopic management of postoperative bile duct strictures with increasing numbers of stents. *Gastrointest Endosc*. 2001;54(2):162-168.

3. Draganov P, Hoffman B, Marsh W, Cotton P, Cunningham J. Long-term outcome in patients with benign biliary strictures treated endoscopically with multiple stents. *Gastrointest Endosc*. 2002;55(6):680-686.

4. Dumonceau JM, Tringali A, Blero D, et al. Biliary stenting: indications, choice of stents and results. *Endoscopy*. 2012;44(3):277-298.

5. Costamagna G, Tringali A, Mutignani M, et al. Endotherapy of postoperative biliary strictures with multiple stents. *Gastrointest Endosc*. 2010;72(3):551-557.

In Reply I agree with Dr Costamagna that currently available designs for fully covered, self-expandable metallic stents limit their utility to patients in whom the stricture is below