Use of a Shared Medical Record With Secure Messaging by Older Patients With Diabetes

WILLIAM G. WEPPNER, MD, MPH[1]
JAMES D. RALSTON, MD, MPH[2]
THOMAS D. KOEPSELL, MD, MPH[3]
LOU C. GROTHAUS, MS[2]
ROBERT J. REID, MD, PHD[2]
LUESA JORDAN, BA[2]
ERIC B. LARSON, MD, MPH[2]

OBJECTIVE — Evaluate use of a web-based shared medical record (SMR) between older patients with diabetes and providers.

RESEARCH DESIGN AND METHODS — This was a retrospective cohort study. Health records and SMR use patterns of 6,185 enrollees aged ≥65 years with diabetes were analyzed from implementation of a SMR in August 2003 through December 2007. We analyzed baseline predictors of age, sex, distance from clinic, socioeconomic status, insulin use, morbidity, and associated primary care provider's (PCP) secure messaging use on patients' initial and subsequent use of the SMR. Changes in morbidity, PCP, or diabetes treatment were evaluated for impact on outcomes.

RESULTS — A total of 32.2% of enrollees used the SMR; median rate was 1.02 user-days/month. Numbers of users and rate of use continued to increase. In adjusted analyses, likelihood of SMR use was associated with younger age, male sex, and higher socioeconomic status neighborhood, as well as clinical characteristics of overall morbidity and assigned PCP's use of secure messaging. Initial SMR use was more likely within 3 months of an increase in morbidity (hazard ratio 1.61, 95% CI 1.28–2.01) and within 1 month of changing to a PCP with higher use (3.02, 1.66–5.51).

CONCLUSIONS — Four years after implementation, one-third of older individuals with diabetes had used the web-based SMR. Higher morbidity predicted initial and continued use of SMR services. Providers' use of the communication feature was associated with higher likelihood of SMR engagement by their patients. Web-based SMRs may be an effective form of non–visit-based health care for older individuals with diabetes.

Diabetes Care **33:2314–2319, 2010**

Websites providing secure access to electronic medical records shared between patients and providers represent a new form of online health services. Such shared medical records (SMRs) allow patients to view personal electronic health information, send secure electronic messages to care teams, and use online services such as appointment scheduling and medication refills. Similar to "integrated personal health records" that have been promoted as facilitating engagement in care, SMRs allow systems to share patient-centered information between patients and care providers (1). They have the potential to empower patients, support chronic disease self-management, and move beyond care based on episodic, in-person, and often discontinuous visits (2,3). Early evidence suggests high levels of patient satisfaction with web-based SMRs (4,5), reduced in-person visits (6), and improved clinical outcomes (7–10).

Questions remain, however, about the role of the SMR in the care of older individuals who may be less able or interested in using online health services (11). Because older individuals are more likely to have chronic conditions that require intensive coordination and management, increasing use in this group remains an important challenge for implementation of Internet-based patient-centered medical records. In our literature review, we have not identified a study evaluating the predictors of use for online services such as SMRs in a Medicare-aged population.

This article describes the characteristics predictive of initial and continued use of SMRs in a longitudinal cohort of patients with diabetes aged ≥65 years, following implementation of a SMR. Based on previous studies, we hypothesized that younger age, female sex, and higher neighborhood socioeconomic status (SES) level would be predictive of SMR use (4,6,12). We also hypothesized that the SMR features related to communication, medication refills, and information would be useful to individuals with characteristics of higher morbidity, insulin use, greater distance between home and primary care clinic, and having a primary care provider (PCP) with a higher average level of use of the SMR's secure messaging feature.

RESEARCH DESIGN AND METHODS

— We performed a retrospective cohort analysis of SMR website use linked to administrative health data at Group Health Cooperative (GHC), a mixed-model health delivery system. GHC provides health insurance and comprehensive care to ~500,000 residents in the northwestern U.S. In 20 clinics operated by GHC, patients choose a PCP who guides and coordinates their care. Beginning August 2003, patients enrolled in these clinics were able to access their SMR via the MyGroupHealth patient website, which was linked to the ambulatory electronic medical record (EpicCare, Verona, WI). A detailed description of the implementation and use of the patient website was reported previously (4). In brief, the SMR features implemented included the following: secure messaging with health care providers; requesting medication re-

From the [1]Department of Medicine, University of Washington, Seattle, Washington; the [2]Group Health Research Institute, Seattle, Washington; and the [3]Department of Epidemiology, University of Washington, Seattle, Washington.
Corresponding author: William G. Weppner, wweppner@u.washington.edu.
Received 11 June 2010 and accepted 15 August 2010. Published ahead of print at http://care.diabetesjournals.org on 25 August 2010. DOI: 10.2337/dc10-1124.

fills and in-person appointments; and viewing test results, after-visit summaries, medical problem lists, allergies, and immunizations. During our study period, GHC physicians were expected to use the SMR to communicate with patients via secure messaging. Documentation of messages, after-visit summaries, and test results were available to patients and GHC health care providers via the shared electronic medical record. To help ensure information security, patients were required to verify their identity before using these features.

Participants included 6,185 individuals aged ≥65 years continually enrolled during the study period who were identified at GHC as having diabetes for at least 1 year before the implementation of the SMR (August 2003); they were followed to the end of the observation period (December 2007), or death. Study procedures were approved by the GHC institutional review board.

Outcomes were initial and subsequent use of the SMR. We defined initial SMR use as the date of the first use of at least one of the eight SMR features during the study period, following initial registration and subsequent postal verification. Initial use of SMR was treated as a binary outcome. Rates of continued SMR use were measured as the number of days/month in which patients used any of the listed features, accounting for censoring due to death.

Predictors were measured in the following manner. Administrative data provided age at baseline and sex. Neighborhood SES status was derived from the zip code for each patient in combination with census block information on median education and income levels derived from the 2000 U.S. census (13,14). Distance to the clinic was calculated between the patient's home address and clinic location of the PCP; we chose a distance ≥27 km from the clinic to approximate ≥30 min of traveling time. We used the Johns Hopkins Adjusted Clinical Groups case mix system to measure each individual's overall morbidity burden (15–18). This algorithm groups ICD-9 codes by similar expected amounts of care, taking into account acute and chronic conditions. Based on age, sex, and ICD-9 codes identified over the previous 12 months, Adjusted Clinical Groups software assigns a level of overall morbidity between 1 (none) and 6 (very high). Enrollees using insulin were identified using pharmacy data. The PCP's use of the SMR communication feature was measured as the proportion of secure messaging exchanges (or "threads"), divided by the number of threads plus the total number of in-person visits each PCP had with his or her panel in the same period (19).

We treated age as categories (65–69, 70–74, and ≥75 years). Sex, driving distance >30 min, and low neighborhood SES were treated as binary variables. We grouped Adjusted Clinical Groups levels into three morbidity categories: "very high," "high," or "moderate and lower." The PCP's proportion of secure messaging was treated as a group-linear variable, using deciles of use (e.g., 0–10%, 11–20%, etc., up to 100%).

Variables were generated as baseline and changing characteristics. We calculated baseline variables on 1 August 2003. For time-varying clinical characteristics of morbidity category, insulin use, and assigned PCP, we calculated a baseline measure and then determined if and when each enrollee changed status. Insulin use and assigned PCP were tracked each month; for overall morbidity, we calculated change variables each quarter. To emphasize larger morbidity changes, we designated morbidity change if the enrollee moved from "moderate or lower" to a "high" or "very high" morbidity level. Insulin initiation was determined when the first prescription for insulin was filled. Change to a PCP with a higher rate of secure messaging was indicated if *1*) the patient changed PCP and *2*) the new PCP's rate was at least 10 percentage points higher than the previous PCP.

We selected a Cox proportional hazard analysis with robust standard errors to examine the relationship of baseline predictors and time to initial SMR use. After unadjusted analyses for each predictor, we fit an adjusted model with all of the above predictors. To evaluate the effect of changing clinical variables over time, we used an alternate Cox model and added time-dependent covariates updated each month (secure messaging, insulin use) or quarter (morbidity category). To assess whether the effect of worsening morbidity, starting insulin, or a change to a PCP with higher messaging was temporary or lasting, we fit a series of models where the effect of change was allowed to last varying lengths of time: 1 month, 3 months, 6 months, and lastly from the time of the change to the end of the study period.

To examine rates of SMR use among ever-users, we compared rates of use after initial use (days of SMR use/month) among various subgroups determined by the predictors. We then fit a multivariate model with similar covariates as used in the base Cox model to compare adjusted rates of use. To account for overdispersion of count data, we used a negative binomial regression model with robust standard errors. Variables were reviewed for missingness. We performed sensitivity analyses to assess the effect of excluding participants who died during the study and tested proportional hazards assumptions for the base Cox model. All analyses were run on Stata IC version 10.1 (College Station, TX). $P < 0.05$ was considered statistically significant.

RESULTS — Of 7,076 potential study subjects identified at the beginning of the study period, 694 (9.8%) were excluded because of enrollment interruptions and 197 (2.8%) because they switched to PCPs outside of the Group Health integrated system. A total of 6,185 enrollees (87.4%) met inclusion criteria and were followed for an average of 2.86 years before first SMR use or censoring, for a total of 17,688 patient-years of observation.

Of the 6,185 participants, 1,990 (32.2%) used the SMR during the study period. The age range among SMR users was 65–101 years. Additional characteristics are presented in Table 1. Among SMR users, mean rate of use was 1.37 days of SMR use/month, with a median of 1.02 monthly user-days. In order, the most frequently used SMR services were as follows: clinical test results reviews, medication refill requests, and secure messages. Averaged over the entire study period, the number of unique monthly users was 77, 73, and 43 per 1,000 participants, respectively. Use of these features appeared to continue to increase over the observation period (Fig. 1).

Unadjusted analyses indicated that younger age, male sex, living in a higher SES neighborhood, and PCP level of secure messaging were associated with patients' initial SMR use (Table 2). These relationships persisted in an adjusted analysis. Higher morbidity was associated with higher likelihood of initial SMR use compared with moderate or lower morbidity in the adjusted analyses.

Models looking at change over time revealed additional relationships between clinical characteristics and initial SMR use (Table 3). Older patients had a three times higher rate of signing up for and using the SMR within the same

Table 1—*Characteristics of study cohort during study period**

Total number of enrollees	6,185 (100.0)
Enrollees who used shared medical record	1,990 (32.2)
Age at baseline [mean years ± SD (range)]	75.2 ± 6.73 (65–101)
65–69	1,539 (24.9)
70–74	1,550 (25.1)
≥75	3,096 (50.1)
Female	3,150 (50.9)
Low neighborhood SES status†	1,500 (26.8)
>30 min driving time from clinic‡	400 (7.2)
Morbidity category at baseline§	
Low or very low	236 (3.8)
Moderate	2,676 (43.3)
High	1,764 (28.5)
Very high	1,509 (24.4)
PCP's percent of encounters via secure messaging [mean ± SD (range)]¶	18.5 ± 8.1 (1.3–49.5)
Insulin use at baseline	1,792 (29.0)
Change during study period	
From "moderate or lower" to "high" or "very high" morbidity	2,402 (38.8)
To new PCP with 10% higher level use of secure messaging¶	815 (13.2)
From oral or diet therapy to insulin	1,143 (18.5)
Died during study period	1,621 (26.2)

Data are *n* (%) unless otherwise stated. *Study period was defined as introduction of SMR (1 August 2003) to end of available data (31 December 2007); values calculated as of beginning of study period unless otherwise noted. †Calculated using 2000 U.S. Census data and address from January 2005; number missing 582 (9.4%). ‡Based on distance between residence and primary clinic >27 linear kilometers as of January 2005; number missing 592 (9.6%). §Based on Johns Hopkins Associated Clinical Groups Resource Utilization Bands. ¶Defined as number of secure messaging threads by PCP divided by PCP's total outpatient encounters plus secure messaging threads, averaged over study period; number missing 86 (1.4%). All other measures missing <1%.

month of changing to a provider with a higher level of secure messaging use (hazard ratio 3.02, 95% CI 1.66–5.51); increased rates were seen within 3 and 6 months of such a change. Similarly, patients who had increasing morbidity were 60% more likely to sign up and use the SMR within 3 months of change (hazard ratio 1.60, 95% CI 1.28–2.01); an increase was seen at 6 months and any time subsequent to change.

Higher morbidity also had an association with the rate of continued SMR use in the adjusted analysis. Compared with moderate or lower morbidity, individuals with high morbidity had a 30% higher rate of ongoing use (rate ratio 1.30, 95% CI 1.16–1.45, $P < 0.001$), and individuals with very high morbidity had 21% higher use (rate ratio 1.21, 95% CI 1.07–1.37, $P = 0.003$). By level of clinical need, this meant that people with high morbidity accessed the SMR 1.53 days/month, enrollees with highest morbidity did so 1.43 days/month, and those with moderate or lower morbidity used it 1.25 days/month.

Sensitivity analyses comparing methods for dealing with ties, exclusion of variables missing >1.5% of values, and exclusion of individuals dying during the study had negligible impact on overall findings. Tests for proportional hazards over time indicated that associations between initial SMR use and sex, age, distance from clinic, and neighborhood SES status changed slightly over the study period.

CONCLUSIONS — In this study of older patients with diabetes, approximately one-third of patients used services offered in an online SMR. Patients' initial use was related to baseline morbidity, as well as their baseline PCPs' use of the secure messaging feature. Increasing morbidity or change to a PCP with higher level of use had a temporal relationship with patient's initial use of the SMR. Among users, the rate of subsequent SMR access was slightly more than 1 day of use

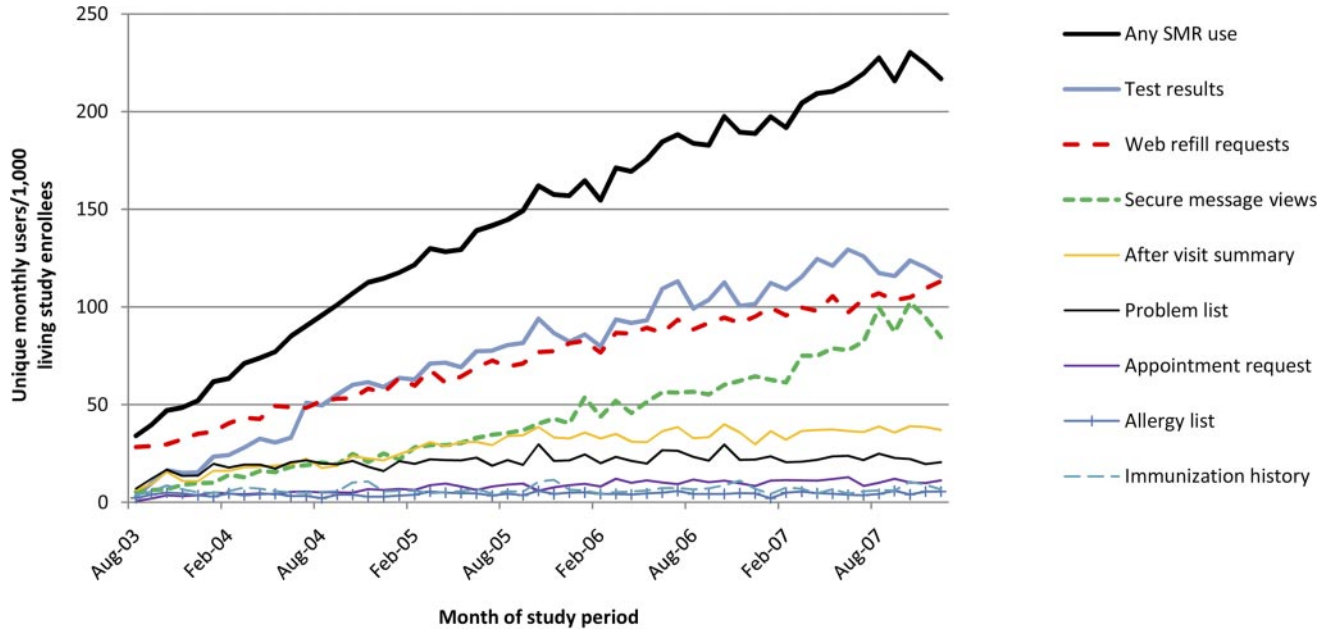

Figure 1—*Use of individual features of the MyGroupHealth shared medical record website by participants during study period. Rates are for unique monthly users who accessed each service listed, per 1,000 study enrollees alive during the given month.*

Table 2—*Predictors of initial shared medical record use during study period using Cox proportional hazards model with baseline variables*

Baseline predictor	Unadjusted HR of SMR use*	Adjusted HR of SMR use†
Age category (years)		
65–69	Ref.	Ref.
70–74	0.77 (0.69–0.86)	0.76 (0.68–0.85)
≥75	0.55 (0.50–0.62)	0.57 (0.51–0.63)
Female sex	0.71 (0.65–0.78)	0.72 (0.66–0.79)
Low neighborhood SES	0.77 (0.69–0.85)	0.80 (0.72–0.89)
>30 min distance from clinic	1.21 (1.04–1.42)	1.13 (0.96–1.33)
Overall morbidity		
Moderate or lower	Ref.	Ref.
High	1.06 (0.96–1.18)	1.12 (1.01–1.25)
Very high	1.04 (0.93–1.17)	1.15 (1.02–1.29)
PCP use of secure messaging (10% difference)	1.10 (1.04–1.15)	1.12 (1.06–1.19)
Insulin use	1.04 (0.94–1.15)	1.00 (0.91–1.11)

Data are hazard ratios (95% CI). Hazard ratio compares rate of initial use (number of initial users per day) relative to reference group. *One model for each variable. †Adjusted model includes all variables in table (n = 5,500). HR, hazard ratio.

per month; higher rates of use were seen in patients with higher baseline morbidity. Four and a half years after the initial implementation, there was no evidence of a plateau of first-time users or number of repeat uses.

Our study was limited to observations of a specific patient group within GHC using a single type of SMR; thus, generalization is limited. It is important to note that SMR was implemented in a health care system in which providers were salaried, with administrative support and modest incentives for use of secure messaging. As in any observational study, unmeasured confounding is possible. We were unable to directly measure individual health literacy, education, or Internet access; this would have strong influence on the ability to use web-based SMRs. Other information on English proficiency, ethnicity, and race variables were lacking. However, because the Medicare-aged GHC population tends to be predominantly white nonimmigrants, adjustment for these would not likely change overall findings, but may limit generalizability. We were unable to identify if users were patients themselves, or caregivers with SMR access. Given the important role of caregivers in the older populations, it may be important to address this question in subsequent research.

Patients were more likely to sign up and use services offered by SMRs based on morbidity level. Although not large in magnitude, the association between morbidity and SMR use was robust; baseline morbidity predicted increased initial use and continued rates of use throughout the entire study period of almost four and a half years. This reinforces similar relationships seen in studies of patient use of online health services (6,20) and extends this to an older population of potential users with chronic conditions. Patients who developed higher morbidity were more likely to sign up and use the SMR closer to the time at which the morbidity appeared to worsen. A tangible example of this was demonstrated in patients beginning insulin. This result suggests that services such as secure messaging, lab results, and medication refills offered by the SMR may be useful to patients facing transitions to more intensive disease management, even in this older population.

In our study, level of secure messaging use by a patient's provider was associated with that patient's likelihood of initial SMR use, but not the rate of continued use. We felt that a provider's overall level of secure messaging may serve as a proxy for his or her overall use and endorsement of the SMR; such an endorsement would encourage patient use. We were not able to analyze provider level factors, such as age, sex, or panel characteristics. However, we felt that significant unmeasured provider or panel level effects were less likely, given the strong association with SMR use seen in patient who changed to a new provider with a higher level of use. Although it may be that patients who changed to new providers were more likely to use the SMR for other reasons (e.g., they felt more empowered in general, and thus more likely to make provider changes and engage SMR use), it is likely that the early interaction between patients and a higher-using provider may have triggered patient interest. Discussion during initial visits may have provided an opportunity to discuss online resources.

It is interesting that we did not see higher levels of continued SMR use in patients with providers who were higher-level users of secure messaging. This result suggests that provider's endorsement may be important for initial patient engagement in the SMR, but subsequent

Table 3—*Relationship between change in clinical status and subsequent initial use of shared medical record using alternate Cox time varying proportional hazards models*

	Hazard ratio for SMR use in same month of change	Hazard ratio for SMR use within 3 months of change	Hazard ratio for SMR use within 6 months of change	Hazard ratio for SMR use any time after change
Change to higher morbidity level*	NA	1.60 (1.28–2.01)	1.38 (1.14–1.66)	1.20 (1.05–1.38)
Change to PCP with higher level secure messaging use†	3.02 (1.66–5.51)	1.56 (1.10–2.24)	1.44 (1.09–1.90)	1.13 (0.95–1.36)
Change to begin insulin therapy‡	1.95 (1.15–3.30)	1.67 (1.03–2.70)	1.47 (1.01–2.16)	1.15 (0.91–1.46)

Data are hazard ratios (95% CI). n = 5,500; each outcome was adjusted for all variables listed, as well as age, sex, neighborhood SES, estimated driving distance from clinic, and baseline morbidity, insulin use, and PCP level of SMR. All time periods include initial month or quarter of change. *From moderate or lower morbidity to high or very high morbidity. †To PCP with >10% higher average secure messaging use during study period. ‡From diet control or oral therapy.

use is more likely to be based on morbidity and other individual patient characteristics. This may be important for encouraging patient use of online communication services. Although patients have expressed an interested in online health services (21,22), provider engagement may be difficult because of concerns of increased workload, responsibilities, and reimbursement issues (23). However, recently, several insurers have begun to reimburse for online consultations, with a designated billing code (CPT 99444) (24). Systems seeking to implement such changes need to acknowledge additional pressures on workflow, identify reimbursement and productivity measures, and collaborate with providers to address these constraints.

We were interested to see that males were more likely to sign up and continue to use the SMR; this is the opposite of conclusions from other large studies (6,20). Our finding is likely based on the effect of the older age-group that we studied; looking at the subgroup of older patients in the Kaiser Permanente study mentioned (6), we found that women over age 65 years in this study had a similar likelihood of use as we found in our study. Women ≥65 years old may simply prefer to seek health care in person or via telephone, or it may be that men may have more familiarity with the Internet from recent employment. Or, it may be that older males are more likely to have caregivers that sign up to use the online health services on their behalf.

The question of whether those most in need for health care services actually receive them is of great interest to health providers and policymakers. Findings in our study suggest that web-based SMRs may provide features that are useful to patients with higher and increasing morbidity and that endorsement and use by their providers is an important factor in motivating engagement.

For providers and systems seeking to engage older patients in care through SMRs, our findings highlight potential areas of focus. Efforts to encourage physicians to use SMR features may increase initial patient engagement. Enhanced opportunities for patients to sign up for SMRs during times of increased need for care may help them to engage in these services. Providing features that are useful to patients with chronic disease and higher morbidity may be important to promote adoption, including the ability to view laboratory results, obtain medication refills, and engage in secure messaging with health care providers. Finally, continued study is needed to evaluate longer-term effects of SMRs on disease self-management, patient and physician perceptions of SMRs, as well as impacts on utilization and outcomes related to use.

Acknowledgments— Funding for this study was via a grant from the Agency for Healthcare Research and Quality (R01 H5016759-01; James Ralston, principal investigator). Additional support was provided via a Health Resources and Services Administration T-32 Institutional Ruth L. Kirschstein National Research Service Award grant (T32 HP10002).

No potential conflicts of interest relevant to this article were reported.

W.G.W., J.D.R., L.C.G., and L.J. researched data. W.G.W. wrote the manuscript. W.G.W., J.D.R., T.D.K., L.C.G., R.J.R., and E.B.L. reviewed/edited the manuscript and contributed to discussion.

Preliminary results related to this study were presented at the Society of General Internal Medicine 32nd Annual Meeting, 13–16 May 2009.

The authors would like to acknowledge Gwen Schweitzer, Group Health Research Institute, for assistance with this study.

References

1. Tang PC, Lee TH. Your doctor's office or the Internet? Two paths to personal health records. N Engl J Med 2009;360:1276–1278
2. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC, National Academy Press, 2001
3. Groves T, Wagner EH. High quality care for people with chronic diseases. BMJ 2005;330:609–610
4. Ralston JD, Carrell D, Reid R, Anderson M, Moran M, Hereford J. Patient web services integrated with a shared medical record: patient use and satisfaction. J Am Med Inform Assoc 2007;14:798–806
5. Hassol A, Walker JM, Kidder D, Rokita K, Young D, Pierdon S, Deitz D, Kuck S, Ortiz E. Patient experiences and attitudes about access to a patient electronic health care record and linked web messaging. J Am Med Inform Assoc 2004;11:505–513
6. Zhou YY, Garrido T, Chin HL, Wiesenthal AM, Liang LL. Patient access to an electronic health record with secure messaging: impact on primary care utilization. Am J Manag Care 2007;13:418–424
7. Green BB, Cook AJ, Ralston JD, Fishman PA, Catz SL, Carlson J, Carrell D, Tyll L, Larson EB, Thompson RS. Effectiveness of home blood pressure monitoring, Web communication, and pharmacist care on hypertension control: a randomized controlled trial. JAMA 2008;299:2857–2867
8. Ralston JD, Hirsch IB, Hoath J, Mullen M, Cheadle AD, Goldberg HI. Web-based Collaborative Care for Type 2 Diabetes: a Pilot Randomized Trial. Diabetes Care 2009;32(2):234–239
9. Harris LT, Haneuse SJ, Martin DP, Ralston JD. Diabetes quality of care and outpatient utilization associated with electronic patient-provider messaging: a cross-sectional analysis. Diabetes Care 2009;32:1182–1187
10. McCarrier KP, Ralston JD, Hirsch IB, Lewis G, Martin DP, Zimmerman FJ, Goldberg HI. Web-based collaborative care for type 1 diabetes: a pilot randomized trial. Diabetes Technol Ther 2009;11:211–217
11. Kahn JS, Aulakh V, Bosworth A. What it takes: characteristics of the ideal personal health record. Health Aff 2009;28:369–376
12. Weingart SN, Rind D, Tofias Z, Sands DZ. Who uses the patient Internet portal? The PatientSite experience. J Am Med Inform Assoc 2006;13:91–95
13. Hsu J, Huang J, Kinsman J, Fireman B, Miller R, Selby J, Ortiz E. Use of e-Health services between 1999 and 2002: a growing digital divide. J Am Med Inform Assoc 2005;12:164–71
14. Braveman PA, Cubbin C, Egerter S, Chideya S, Marchi KS, Metzler M, Posner S. Socioeconomic status in health research: one size does not fit all. JAMA 2005;294:2879–2888
15. Starfield B, Weiner J, Mumford L, Steinwachs D. Ambulatory care groups: a categorization of diagnoses for research and management. Health Serv Res 1991;26:53–74
16. Weiner JP, Starfield BH, Steinwachs DM, Mumford LM. Development and application of a population-oriented measure of ambulatory care case-mix. Med Care 1991;29:452–472
17. Weiner JP, Dobson A, Maxwell SL, Coleman K, Starfield B, Anderson GF. Risk-adjusted Medicare capitation rates using ambulatory and inpatient diagnoses. Health Care Financ Rev 1996;17:77–99
18. Clinical Groups (ACG) Assignment Software (Version 8.1 for Windows) [program]. Baltimore, MD, Johns Hopkins University, 2008
19. Messages, Strands and Threads: Measuring Electronic Patient-Provider Messaging. Washington, DC, American Medical Informatics Association Annual Session, 2005
20. Ralston JD, Rutter CM, Carrell D, Hecht J, Rubanowice D, Simon GE. Patient use of secure electronic messaging within a shared

medical record: a cross-sectional study. J Gen Intern Med 2009;24:349–355
21. Silvestre A-L, Sue VM, Allen JY. If you build it, will they come? The Kaiser Permanente model of online health care. Health Aff 2009;28:334–344
22. Lake Research Partners and American Viewpoint. *Connecting Americans to Their Health Care: Empowered Consumers, Personal Health Records and Emerging Technologies*. Markle Foundation, New York, 2006
23. Delbanco T, Sands DZ. Electrons in flight: e-mail between doctors and patients. N Engl J Med 2004;350:1705–1707
24. Berthold J. Using e-mail in practice is e-asy, but exercise care. ACP Internist June 2010:8