

Grant Final Report

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Patient Readiness to Use Internet Health Resources

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Structured Abstract

Purpose: To develop a measure for the readiness of people with chronic conditions to use internet health resources, examine its predictive validity, and characterize portal users with chronic conditions.

Scope: Self-management is an important component of chronic disease management. Interactive online interventions might engage and support patients to better self-manage. But these tools can only help if patients are ready to use them. Characterizing the readiness of potential users may help researchers investigating these web-based applications.

Methods: Item development and generation from focus groups, key informants, and the literature and existing scales. Factor analysis to determine factor structure and final items. Examination of predictive validity for enrollment in a patient portal and search capabilities. Characterization of portal users with respect to health characteristics and behaviors.

Results: The final Patient Readiness to Engage in Health Information Technology (PRE-HIT) instrument had 28 items that sorted into 8 factors with associated Cronbach's alpha: 1) Health Information Need (0.84), 2) Computer/Internet Experience (0.87), 3) Computer Anxiety (0.82), 4) Preferred Mode of Interaction (0.73), 5) Relationship with Doctor (0.65), 6) Cell Phone Expertise (0.75), 7) Internet Privacy (0.71), and 8) No News is Good News (0.57). Test-retest reliability for the 8 subscales ranged from (0.60 to 0.85). For adult patients with chronic conditions, PRE-HIT score significantly associated with patient portal enrollment, as well as declining to enroll. No difference was detected between users and non-users of the patient portal with respect to health behaviors and status such as smoking, being overweight, and hazardous alcohol consumption.

Key Words: measurement issues/instrument development; health information management; chronic disease

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Final Report

Purpose

As a K08 Career Development Award, there were dual purposes of Career Development and Research Activities. The overall purpose of the award was to better understand patient behavior around internet health activities, with a focus on those with chronic conditions. Specifically, we developed a measure for the readiness of people with chronic conditions to use internet health resources, and then examined its predictive validity and characteristics of portal users and non-users. The Career Development Activities and Research Activities were both aimed at this better understanding of patient internet behavior.

Career Development Activities

- 1) Acquire expertise in scale development.
- 2) Develop an understanding of the intersection of information and learning in health applications, focusing on both the human and technological dimensions.
- 3) Gain scientific and career guidance from local collaborators, advisors, and consultants.
- 4) Acquire leadership skills.
- 5) Training in the responsible conduct of research.

Career Development activities will be discussed in the Results section of this report.

Research Activities

Aim 1: To develop a measure of the readiness (aptitude + desire) of patients with chronic conditions attending primary care clinics to use web-based health resources.

This Aim included several activities:

1. *Item development and scale creation.* In developing the measure, we will examine dimensions of health literacy, computer ability, motivation, and issues of privacy and trust. Our objective is to develop a measure to identify the ambulatory chronically ill patient's readiness to use online health information.
2. *Feasibility testing* of the measure.
3. Two examinations of the instrument's predictive validity.

- a. *Measures of patient enrollment* in a new interactive web-based patient portal (health-e), using quantitative measures of resource use within the system.
- b. *Direct observation of predicted patient users* in the Information Experience Lab, an on-campus usability lab that is equipped with Morae software to examine how users interact with software systems. Morae will record users' mouse movement and clicks, screens visited, and concomitant audio and video of their "thinking aloud" while they use the IQ Health software.

Aim 2: To determine how the frequency and type of use of web-based health resources are associated with improvements in clinical measures for patients with Type 2 Diabetes.

Scope

Background

Consumers are turning more to the internet for health information.¹ Online and mobile health interventions to aid lifestyle change and chronic condition self-management are proliferating.²⁻⁴ However, important "digital divides" such as age, education, and rural residence still exist and may limit consumer use of these tools.⁵ Concerns about data security, privacy, and lack of motivation may also limit use.⁶ Researchers and developers of online and mobile tools for patients may want to assess not only the skills of prospective target populations, but also their motivations and concerns, which can be encapsulated in the term "readiness". Researchers would benefit from an instrument that characterized their research participants' likelihood of using technology applications.

There has been previous instrument development in this area. Norman and Skinner developed a 10-item scale, the eHealth Literacy Scale (eHEALS), to measure the eHealth literacy concept. The scale prompts participants to evaluate their own abilities to search for, use, and evaluate health resources on the internet.^{7,8} Although this was an important first attempt to measure the concept of eHealth Literacy, it has several limitations. First, the researchers developed the scale with a youthful sample ranging in age from 13 to 21 years. No data exist on its performance in older adults, which is an important limitation, considering that internet and computer skills will likely differ between these two populations. Additionally, a Dutch version of the eHEALS failed to predict internet health use.⁹ Lastly, an instrument that goes beyond literacy to measure readiness may be more useful to researchers.

Self-management is an important component of chronic disease management and it is thought that interactive online interventions might engage and support patients to better self-manage.¹⁰ But these tools can only help if patients are ready to use them. Therefore, we developed and tested an instrument designed to go beyond basic eHealth Literacy and computer skills to measure a readiness to use internet resources to access health information. Unlike the eHEALS, we included concepts such as information needs, motivations, privacy concerns, and preferred source of information. Also, we particularly focused on patients with chronic conditions as they tend to be older, a factor associated with decreased internet use.⁵ Focusing on

those with chronic conditions is important because many of the health information technology interventions are being developed for people with chronic conditions.

Context, Setting and Participants

As planned, the research design capitalized on existing infrastructure and mentoring support from Dr. David Mehr and complemented his work within the context of his AHRQ-funded evaluation of Health Information Technology (HIT) to improve ambulatory chronic disease care (Mehr, R18HS017035). One subject of that evaluation was a new electronic health resource for patients, health-e (originally called IQ Health), a web-based portal for patients to securely message their healthcare providers and view parts of their electronic medical record. Developed by the Cerner Corporation, this component of MU Healthcare's HIT was being implemented as the initial K08 application was submitted.

In Dr. Mehr's project, one Aim evaluated the effectiveness and changes associated with the patient portal, including in-home medication reconciliation. A question raised by this Aim was, "Who can access this information?", and perhaps more important, "Who *will* access this information?" which became the focus of this K08 project. The work complemented Dr. Mehr's study with an examination of the capability and motivation of those with chronic conditions to use internet-based health information resources.

Study participants were patients age 18 years and older with the chronic conditions of diabetes, hypertension, heart disease, or heart failure. Patients were all ambulatory patients attending one of 6 family medicine clinics of the Department of Family and Community Medicine at the University of Missouri (MU). Patients were recruited from the waiting room of the clinic. The research assistant made efforts to approach every person in the waiting room and made no assumptions about eligibility or experience using internet/computers. We limited participants to those who primarily spoke English. The same recruitment method was used for all phases of the instrument development.

For the validation of the instrument, inclusion criteria were broadened to any chronic condition, but the recruitment methods otherwise remained the same. In addition, for the validation sample, we collected data from the medical record, with the patient's written consent, about health e use, lifestyle factors and risks, and clinical outcomes. The MU Health Sciences Institutional Review Board approved all phases of this study.

Methods

Study Design

The major activity of the project was instrument development and validation. We used focus groups, key informants, and review of existing scales for item generation. We created 98 candidate items. The candidate items were reduced to 53 items based on best practices for item construction.^{11,12} After cognitive interviewing to further refine items, we gave the 53-item questionnaire to 200 patients with at least one chronic condition. We then explored the properties of these items and their factor structure using exploratory factor analysis. We

examined test-retest reliability of the instrument in one-quarter of the sample at 3 months. Following the initial instrument development, we collected data from a second validation sample and for the Aim 2 activities.

Data Sources/Collection

In Table 1 we present the number of participants in each phase of the instrument development and validation study, along with the number of items that were presented to those participants. All participants are aged 18 and older patients of an ambulatory clinic with a chronic condition, as described in the Context, Setting and Participants section, above.

Table 1. Instrument development activities

Activity	Participants	Items
Focus Groups to Identify Domains	16	---
Literature Review of Existing Scales	---	---
Initial Item Writing Based on Identified Domains	---	98
Choosing Best Items Based on Best Practices	---	53
Feasibility Testing/Cognitive Interviewing	21	53
Instrument Development Sample	200	53
Test-Retest Reliability	45	53
Final Instrument	---	28
Instrument Validation Sample	234	28
Direct Observation of Searching	14/234	28
Aim 2: Health Behaviors and Portal Use	234	28

Instrument Validation Activities

The recruitment method for these 234 patients was the same as for the original sample of 200 patients. We inflated sample size to account for the increased demands of confirmatory factor analysis and predictive validity.¹³

Predictive Validity: Health-e Use. Among the Validation sample, health-e use was ascertained from the medical record and characterized as categories “Not Invited”, “Invitation Sent” (but not accepted), “Enrolled”, or “Declined”. Health-e status was ascertained on the day before patients took the PRE-HIT Instrument, as eligible patients were identified the day prior to their potential enrollment. We used the Kruskal-Wallis test, a nonparametric alternative to the standard one-way analysis of variance, to compare the four health-e status groups with respect to mean PRE-HIT score.

Predictive Validity: Direct Observation of Searching. A subset of 14 of the 234 participants in the previous evaluation of the PRE-HIT instrument and who had diabetes were contacted to participate in a study of observation of search behaviors. We estimated sample size based on usual practices for usability studies, including our previous experience with this method.¹⁴ Participants were asked to complete four increasingly difficult internet searches for information about diabetes. Participants were video recorded with simultaneous computer screen capture of websites visited in response to the search prompts in the study. The search prompts were:

- Using this computer, can you find basic information about diabetes?
- Suppose you would like to find out information that would help you understand more about foot problems if you have diabetes. Can you find information about foot problems in diabetes?
- Using the computer, can you find the goal blood pressure for a person with diabetes?
- Suppose you got sick and weren't eating. Can you find information about how to take your diabetes medicine during that time?

We used Morae software to record and analyze the sessions,¹⁵ which took place in the Information Experience Lab, a usability testing facility in the MU School of Information Science and Learning Technologies, College of Education. Time for each search was ascertained from the recording. Each participant was also rated by an experienced usability graduate research assistant on their searching abilities based on the following rubric:

Level 0: Unable to search the internet, could not approach or complete the tasks.

Level 1: Significant difficulty, e.g., trouble getting to search screen, trouble with basic hardware functions (e.g. double click).

Level 2: Able to search but with some difficulty, gets snagged by ads, not differentiating quality of information, poor search workflow.

Level 3: Searches with confidence and goes right to highest quality resources, differentiates between .org, .gov, and .com.

The usability graduate research assistant was unaware of the participants' PRE-HIT scores. We compared PRE-HIT Score for expert vs. novice users. We also examined the relationship of PRE-HIT score to search time.

Aim 2: Examination of Health Behaviors and Portal Use

We had proposed to examine the effect of portal usage on clinical outcomes among patients with diabetes. Since the submission of the proposal, this has been examined several times by several groups of investigators.¹⁶⁻²² One of the caveats of these examinations is that it is difficult

to separate unmeasured confounders when examining the effect of portal use on clinical outcomes in diabetes. Given that this area had already been addressed in much the same way that we had planned to address it, and that this approach had known limitations that had become apparent over time, we turned our attention to a more unique and potentially fruitful question, “Given the potential role of patient portals to assist lifestyle change to improve health, is there differential use of patient portals among people in need of lifestyle change?” For example, if a group designed a patient portal application to assist with smoking cessation, do the developers need to be concerned that smokers are less likely than non-smokers to use a patient portal?

Patients were the same participants with one or more chronic conditions as those used for the validation sample. Patients were asked in general how they would rate their health, including possible responses of excellent, very good, good, fair, and poor. They were also asked if they considered themselves overweight, if they were a current every day smoker, and on how many occasions in the past 30 days they had consumed 5 or more (males) or 4 or more (females) drinks of alcohol. We compared those enrolled in the patient portal to those not enrolled using Fisher’s exact test to examine in separate analyses proportions who considered themselves in “fair” or “poor” health, overweight, a current every day smoker, or who had reported 5 (4 for women) drinks or more a day on 1 or more days in the last 30 days.

Results

Career Development Activities

- 1) Acquire expertise in scale development: Dr. Koopman completed a graduate psychology course in psychometrics at MU. She also benefitted from education and mentoring from Dr. Greg Petroski during the process of scale creation and validation.
- 2) Develop an understanding of the intersection of information and learning in health applications, focusing on both the human and technological dimensions: Dr. Koopman completed four graduate courses in MU’s School of Information Science and Learning Technologies, College of Education, including Human Information Behavior, Human-Computer Interaction, Diffusion of Educational Innovations, and Needs Assessment for Instructional Systems Design. She also benefitted from educational activities and networking at the American Medical Informatics Association and North American Primary Care Research Group Annual Meetings, including presentation of results. The award also supported Dr. Koopman to attend a 5-day Human Factors Engineering course at the University of Wisconsin entitled “Systems Engineering Initiative for Patient Safety.” She was also invited to the inaugural 2013 I-PrACTISE conference at the University of Wisconsin, an AHRQ-funded small conference to examine human factors engineering to improve ambulatory primary care.
- 3) Gain scientific and career guidance from local collaborators, advisors, and consultants: The career development award allowed Dr. Koopman to develop collaborative relationships with many investigators at MU. She has or has had active collaborations with other investigators within the School of Medicine, and with investigators in the

School of Nursing, School of Engineering, School of Information Science and Learning Technologies (College of Education), School of Health Professions, School of Journalism, and the MU Informatics Institute.

- 4) Acquire leadership skills: Dr. Koopman benefitted from formal mentoring sessions with Dr. Linda Headrick, a Professor of Internal Medicine and the MU School of Medicine’s Senior Associate Dean for Education. They addressed leadership topics using a quality improvement approach, with observation and feedback on key leadership skills. As planned, Dr. Koopman also attended the Association of American Medical College’s Mid-Career Women’s Faculty Professional Development Conference, after being endorsed by the School of Medicine Interim Dean. The Interim Dean also recommended Dr. Koopman for MU’s year-long Leadership Development Program, which trains faculty from all four of MU’s campuses. Dr. Koopman completed this longitudinal leadership curriculum in Year 5.

- 5) Training in the responsible conduct of research: Dr. Koopman attended frequent MU School of Medicine seminars on a variety of topics related to the responsible conduct of research throughout the five years of the study, including seminars on informed consent, electronic data security, and ethics in translational research. She also attended research ethics activities at national conferences that she attended.

Research Activities

Instrument Development. Two hundred participants with chronic conditions completed the 53-item questionnaire plus demographic questions. The mean age of the sample was 54 years (s.d. 14 years) with a range of 20–86 years. Other demographic characteristics of the sample are detailed in the PRE-HIT manuscript.²³

Of the original 53 items, 28 items were retained which sorted into 8 factors in the Exploratory Factor Analysis. The content experts on our team were easily able to name the factors based on underlying concepts, supporting construct validity. Each item has responses “Strongly Disagree”, “Disagree”, “Agree” and “Strongly Agree”. The items and Cronbach’s alpha for each of the 8 factors are listed in Table 2. Test-retest reliability for the 8 subscales ranged from 0.60 to 0.85. A scree plot of Eigen values revealed a higher order structure with 4 factors each clustering into 2 meta-factors, Barriers and Facilitators. Barrier factors were CA, RWD, IPC, and NNGN while Facilitator factors were HIN, CIEE, PMI, and CPE (Table 2). These also have good construct validity. The final instrument is available free of charge from Dr. Koopman (koopmanr@health.missouri.edu).

Table 2: Items and Cronbach’s Alpha for the 8 factors

Health Information Need - HIN (0.84)
If I went on the internet, I would use it to look up things so that I wouldn’t worry about them anymore.
If I went on the internet, I would use it to look up information about herbals and/or supplements.
If I went on the internet I would use it to look up symptoms.
If I went on the internet I would use it to search for information about my health.

If I went on the internet I would use the internet to find information about medications.
Computer/Internet Experience, Expertise – CIEE (0.87)
If I went on the computer, I would be able to figure out most computer problems that I might run into.
If I went on the computer, I would have access to the internet.
If I went on the internet, I would find using the internet to be easy.
If I went on the internet, I would find using email to be easy.
Computer Anxiety – CA (0.82)
If I went on the computer, I would find using it to be frustrating.
If I went on the internet, I would get frustrated with the amount of information I found about health on the internet.
If I went on the internet, I would find searching for information on the internet would be stressful.
If I went on the internet, I would find sorting through information on the internet to be too time consuming.
Preferred Mode of Interaction – PMI (0.73)
Looking up health concerns on the internet is more convenient for me than contacting a doctor's office.
I prefer calling my doctor's office to emailing them.
I email my doctor.
I trust the internet as a source for health information.
Looking up information online about medications is easier than asking my doctor.
Relationship with Doctor – RWD (0.65)
I let my doctor handle the details of my health.
Doctors are my most trusted source of health information.
When I have a health concern, my first step is to contact my doctor's office.
Cell Phone Expertise – CPE (0.75)
I go online using my cell phone.
I use my cell phone to text people almost every day.
Internet Privacy Concerns – IPC (0.71)
If I went on the internet, I would be very concerned about giving any personal information.
If I went on the internet, I would be concerned it would lead to invasions of my privacy.
No News is Good News - NNGN (0.57)
People today want to know too much about their health.
Regarding my health, I agree with the statement "No news is good news."
I am concerned about what I might find if I look up health issues on the internet.

Validation Studies

Health-e Status was collected from the 234 patients in the validation sample. Number and percent of participants for each health-e status are shown in Table 3, with the mean PRE-HIT scores for each group. As might be expected, those who were enrolled in the patient portal had

the highest scores, while those who had an invitation sent had scores closest to those who were enrolled, and those who declined had the lowest scores.

Table 3: Health-e Enrollment and PRE-HIT Scores

Status	Number (%)	Mean PRE-HIT Score
Declined	35 (15%)	57.9
Not Invited	85 (36%)	65.6
Invitation Sent	51 (22%)	69.5
Enrolled	63 (27%)	73.8

The Kruskal-Wallis test, a nonparametric alternative to the standard one-way analysis of variance was used to compare the four Health-e status groups with respect to the PRE-HIT score. The overall test was significant with $p < 0.0001$ and so pairwise comparisons were carried out to identify which groups differed. The significance levels for those comparisons are contained in Table 4. Almost all health-e status groups differ significantly from each other in their PRE-HIT score.

Table 4: Significance Levels for Pairwise Comparisons of PRE-HIT Scores by Health-e Enrollment Status

Health-e Status	Declined	Not Invited	Invitation Sent	Enrolled
Declined	----	0.004	0.0001	0.0001
Not Invited		----	0.182	0.0005
Invitation Sent			----	0.015
Enrolled				----

Fourteen patients with diabetes and a range of PRE-HIT scores participated in the Information Experience Laboratory usability study. Participant search ability was evaluated by a graduate research assistant skilled at assessing human-computer interaction using the rubric specified in the methods section. The graduate research assistant was unaware of the PRE-HIT scores of the participants. There were no significant differences in PRE-HIT scores between groups with different search abilities (Table 5). There was also no significant relationship between PRE-HIT score and time to complete four internet searches about diabetes.

Table 5: Observed Search Ability and PRE-HIT Score

Search Ability	Number (%)	Mean PRE-HIT Score
Unable to search	2 (14%)	58.0
Novice	2 (14%)	75.5
Intermediate	7 (50%)	64.5
Expert	3 (21%)	79.3

Aim 2: Health Behavior and Portal Use

We examined portal enrollment among those with different health behaviors including self-rated “overweight” current smoking, and self-reported hazardous drinking defined as one or more episode in the past 30 days of drinking 5 or more (males) or 4 or more (females) alcoholic drinks consecutively. Results of this examination are shown in **Table 6**. Comparing those enrolled and not enrolled using Fisher’s exact test, there were no significant differences in the proportion of patients with each health behavior or status.

Table 6: Portal Enrollment and Health Status and Behaviors

	Percent Enrolled (n=63)	Percent Not Enrolled (n=171)
Fair or Poor Self-Rated Health	28.6	38.6
Overweight	68.3	65.5
Current Smoker	15.9	21.6
Hazardous Drinking	9.5	5.3

Discussion

The PRE-HIT instrument is a valid instrument to measure likelihood of using health information technology resources among patients with chronic conditions. It addresses using information technology both to search for information and to communicate with the health care team. The instrument demonstrated good test-retest reliability. Its 8 subscales have good construct validity and robust factor loadings. The 8 subscales clustered into 2 larger meta-factors, “Facilitators” and “Barriers”, again, with good construct validity.

There is a good match of the items and factors to the themes identified in the focus groups, reflecting good coverage of the identified domains. Domains and factors include not just measures of computer and internet ability and media literacy that have been addressed by previous instruments, but also user preference for mode of interaction and motivation and desire to search for information.

The PRE-HIT instrument builds upon groundwork laid by the eHEALS.⁷ While the eHEALS was developed in a young population, the PRE-HIT was developed with older adults with chronic conditions. This is a key demographic target of online and mobile health and lifestyle self-management tools. The PRE-HIT instrument also goes beyond the computer skills and media literacy components of the eHEALS to examine factors such as motivation, information needs, privacy concerns, and user preference for mode of interaction.^{7,24-30} The PRE-HIT instrument will likely be better suited to assess readiness among older adults with chronic conditions. This may help to bridge the gap in predicting use that was found with a Dutch examination of the predictive validity of the eHEALS.⁹

The validation study examining the relationship between PRE-HIT score and enrollment in the health-e patient web portal showed very good predictive validity for the instrument. The PRE-HIT instrument was designed to be able to identify those likely to enroll in and use electronic health resources, and particularly patient portals, and it performed quite well in this task. The instrument performed less well in the validation study looking at search ability within patients with diabetes. Perhaps this is because this task addresses primarily the computer ability component of the PRE-HIT, which is essentially only one of its eight subscales.

The Aim 2 study examining portal enrollment and health behaviors failed to show a difference between users and non-users of the patient portal with respect to health behaviors and health status. Moreover, some of these had a greater proportion of patients among those enrolled (overweight, hazardous drinking) and some had a greater proportion among those not enrolled (smoking, fair or poor health status), suggesting that there is no true difference. This is important because we can expect that those with unhealthy behaviors that we might want to address using web-based resources or a patient portal can be expected to be enrolled in patient portals to essentially the same degree as the general population.

Limitations

This series of studies was conducted in 6 ambulatory primary care clinics, but a single regional location. However there are some factors that nevertheless favor the studies' generalizability. Women are over-represented in the sample, which likely reflects our strategy of recruiting from our clinic waiting rooms; women make up substantially more than half of all ambulatory care visits, especially as age increases.³¹ Women are also the most frequent users of the internet as a health information source, perhaps resulting from their frequent roles as caretakers for children and aging parents.^{32,33} The percentages of each race in our development sample are similar to the percentages in the United States population, which should aid generalizability.³⁴ However, Latino ethnicity is under-represented in our sample, so this may be an area for future examination.

We limited items to English language and enrolled only participants who spoke English as their primary language. Many of the measure's domains (e.g. trust, privacy issues) may have a cultural context far beyond a simple translation and back translation of items. Validating this work for use in other languages and cultures would likely need to examine this cultural context and cultural specificity, in addition to a linguistic translation. Translation and validation in languages other than English is a potential area for future work.

While some factors had a very robust Cronbach's alpha, others were more toward the low end of acceptable alpha levels. Cronbach's alpha is very sensitive to the number of items in a factor, and we made the decision to keep the item number small to minimize potential burden on future research participants, perhaps with implications for each factor's alpha level.³⁵ These studies also did not establish a "cut-off" level for investigators enrolling patients in studies of web-based applications, although the mean PRE-HIT score for enrollment in the patient portal may inform this choice for researchers using the PRE-HIT.

Significance

Frequently those who are developing and testing new internet and technology based interventions need to enroll patients to test these tools. However, a recurring question is who to enroll, and how to know if the participant is capable of using the technology, and also if they are likely to use it. The PRE-HIT instrument can help researchers choose appropriate test participants. It can also be used to assess a user's readiness to use the technology and can therefore assist researchers in their statistical analyses evaluating these tools, especially in analyses examining use.

The PRE-HIT instrument is largely suited for addressing computer, internet, and mobile technology use. As technologies evolve, the instrument may need to be modified to address different ways of using technology to improve and inform personal health.

While it would be unrealistic to expect the 28 item PRE-HIT instrument to be used in clinical practice, this validated tool will be a great aid to researchers who are examining emerging technologies to assist patients with lifestyle change and chronic disease self-management. Currently, it is difficult to determine who to enroll in studies of these technologies and also difficult to characterize the sample beyond simple demographic information. The PRE-HIT instrument will allow investigators to enroll based on specified criteria and to better describe their sample and analyze their results. In the three months since the manuscript describing the development of PRE-HIT was published, Dr. Koopman has had several requests to use the instrument from an international assortment of researchers, one of whom seeks to translate the instrument into Dutch.²³

Career Development Outcomes

- Dr. Koopman was promoted to Associate Professor with Tenure in the School of Medicine at the University of Missouri in 2011. She was also invited to join the Faculty of the MU College of Graduate Studies in 2009 and accepted a Courtesy Joint Appointment in MU's Sinclair School of Nursing in 2014.
- Because of her work with patient portals and EHRs, she was awarded the MU School of Medicine's prestigious Dorsett L. Spurgeon Distinguished Medical Research Award in 2010.
- During the course of this K08 award, she published 23 manuscripts of original research and 2 invited manuscripts about health information technology.
- She served on the editorial board of *Family Medicine* and was an Associate Editor for *BMC Family Practice*. She served as guest editor for a 2010 *Family Medicine* special issue on Health Information Technology.
- She has served as a study section member for AHRQ's Health Information Technology Research (HITR) Study Section, 2011-2015. She also served as an ad hoc reviewer on the previous Healthcare Technology and Decision Sciences (HCTDS) Study Section in 2010 and 2011 and on an AHRQ Special Emphasis Panel in 2010. In 2014, she served on a HIT-related combined NSF- NIH Review Panel.
- The MU School of Medicine Interim Dean appointed Dr. Koopman as the School's designated representative to the AAMC Group on Women in Medicine and Science. He also asked her to co-lead the development of a formal mentoring program for School of Medicine as a whole. Dr. Koopman is also leading the Executive Council of a new Women in Medicine and Medical Science Society at the School of Medicine. She is the group's founder and Dr. Headrick continues to mentor her in her leadership activities.

- Dr. Mehr continues as Dr. Koopman's research mentor, with continued twice monthly meetings.

Grants Funded as Principal Investigator

How Does a 30 Inch Screen Affect Patient Centered Care?

Principal Investigator

Joint Grant Awards Program Research Award

American Academy of Family Physicians Foundation 9/1/2012 – 8/31/2013

Grants Submitted as Principal Investigator

- 1R21HS021881-01 Filling the Online Void: How Consumers Search for a Physician, submitted to AHRQ in response to RFA in 2012, Not Funded
- 1R01HS023328-01 GRANT11506412 Optimizing Display of Blood Pressure Data to Support Clinical Decision Making, submitted to AHRQ in response to PA 11-198 in November 2013, scored in the 35th percentile, resubmitting in July 2014

Grants Funded as Co-Investigator

Technology to Automatically Detect Early Signs of Illness in Senior Housing

PI: Marilyn J Rantz, RN, PhD

Role: Co-Investigator

National Institute of Nursing Research (NINR) 5/16/2013 – 3/31/2016

R01NR014255

EHR Style Guide

PI: Jeffrey L. Belden, MD

Role: Co-Investigator

SHARP-C, Office of the National Coordinator for Health IT

California Health Care Foundation 7/1/2013-9/1/2014

Information Overload: Creating a More Readable Electronic Health Record (EHR) Model

PI: Jeffrey L. Belden, MD

Role: Co-Investigator

Mizzou Advantage Grant 2/15/2011-12/31/2013

References

1. Fox, S. Pew Internet: health. Washington, DC: Pew Internet and American Life Project, 2012. Last updated 3-1-2012. Accessed on 3-13-2012 at: <<http://pewinternet.org/commentary/2011/november/pew-internet-health.aspx>>.
2. McMahon GT, Gomes HE, Hickson HS, et al. Web-based care management in patients with poorly controlled diabetes. *Diabetes Care* 2005;28(7):1624-9.
3. Allen M, Iezzoni LI, Huang A, et al. Improving

- patient-clinician communication about chronic conditions: description of an internet-based nurse E-coach intervention. *Nurs Res* 2008;57(2):107-12.
4. Lorig KR, Ritter PL, Laurent DD, et al. Internet-based chronic disease self-management: a randomized trial. *Med Care* 2006;44(11):964-71.
 5. Kruse RL, Koopman RJ, Wakefield BJ, et al. Internet use by primary care patients: where is the digital divide? *Fam Med* 2012;44(5):342-7.
 6. Malhotra NK, Kim SS, Agarwal J. Internet users' information privacy concerns (IUIPC): The construct, the scale, and a causal model. *Inf Syst Res* 2004;15(4):336-55.
 7. Norman CD, Skinner HA. eHEALS: the eHealth Literacy Scale. *J Med Internet Res* 2006;8(4):e27.
 8. Norman CD, Skinner HA. eHealth literacy: essential skills for consumer health in a networked world. *J Med Internet Res* 2006;8(2):e9.
 9. van der Vaart R, van Deursen AJ, Drossaert CH, et al. Does the eHealth Literacy Scale (eHEALS) measure what it intends to measure? Validation of a Dutch version of the eHEALS in two adult populations. *J Med Internet Res* 2011;13(4):e86.
 10. Wagner EH, Austin BT, Davis C, et al. Improving chronic illness care: translating evidence into action. *Health Aff (Millwood)* 2001;20(6):64-78.
 11. Streiner DL, Norman GR. Devising the items. In: *Health measurement scales: a practical guide to their development and use*. 2nd ed. Oxford ; New York: Oxford University Press; 1995. p. 15-27.
 12. Streiner DL, Norman GR. Selecting the items. In: *Health measurement scales: a practical guide to their development and use*. 2nd ed. Oxford ; New York: Oxford University Press; 1995. p. 54-68.
 13. Mundfrom DJ, Shaw DG, Tian LK. Minimum sample size recommendations for conducting factor analyses. *Int J Test* 2005;5(2):159-68.
 14. Koopman RJ, Kochendorfer KM, Moore JL, et al. A diabetes dashboard and physician efficiency and accuracy in accessing data needed for high-quality diabetes care. *Ann Fam Med* 2011;9(5):398-405.
 15. *Morae software, version 2.0.1*. Okemos, MI: TechSmith Corporation; 2007.
 16. Sarkar U, Karter AJ, Liu JY, et al. The literacy divide: health literacy and the use of an internet-based patient portal in an integrated health system-results from the diabetes study of northern California (DISTANCE). *J Health Commun* 2010;15(Suppl 2):186-96.
 17. Cho AH, Arar NH, Edelman DE, et al. Do diabetic veterans use the Internet? Self-reported usage, skills, and interest in using My HealtheVet Web portal. *Telemed J E Health* 2010;16(5):595-602.
 18. Osborn CY, Mayberry LS, Wallston KA, et al. Understanding patient portal use: implications for medication management. *J Med Internet Res* 2013;15(7):e133.
 19. Ronda MC, Dijkhorst-Oei LT, Gorter KJ, et al. Differences between diabetes patients who are interested or not in the use of a patient Web portal. *Diabetes Technol Ther* 2013;15(7):556-63.
 20. Wade-Vuturo AE, Mayberry LS, Osborn CY. Secure messaging and diabetes management: experiences and perspectives of patient portal users. *J Am Med Assoc* 2013;20(3):519-25.
 21. Lau M, Campbell H, Tang T, et al. Impact of patient use of an online patient portal on diabetes outcomes. *Can J Diabetes* 2014;38(1):17-21.
 22. Cotter AP, Durant N, Agne AA, et al. Internet interventions to support lifestyle modification for diabetes management: a systematic review of the evidence. *J Diabetes Complications* 2014;28(2):243-51.
 23. Koopman RJ, Petroski GF, Canfield SM, et al. Development of the PRE-HIT instrument: patient readiness to engage in health information technology. *BMC Fam Pract* 2014;15:18.
 24. Czaja SJ, Charness N, Fisk AD, et al. Factors predicting the use of technology: findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychol Aging* 2006;21(2):333-52.
 25. Brodie M, Flournoy RE, Altman DE, et al. Health information, the Internet, and the digital divide. *Health Aff (Millwood)* 2000;19(6):255-65.
 26. Pelletier AL, Sutton GR, Walker RR. Are your patients ready for electronic communication? *Fam Pract Manag* 2007;14(9):25-6.
 27. Bunz U, Curry C, Voon W. Perceived versus actual computer-email-web fluency. *Comput Human Behav* 2007;23(5):2321-44.
 28. Bunz U. The Computer-Email-Web (CEW) Fluency Scale--development and validation. *Int J Hum Comput Interact* 2004;17(4):479-506.
 29. Smith B, Caputi P, Rawstorne P. The development of

- a measure of subjective computer experience. *Comput Human Behav* 2007;23(1):127-45.
30. Yaghmaie F. Development of a scale for measuring user computer experience. *J Res Nurs* 2007;12(2):185-90.
 31. National Ambulatory Medical Care Survey: 2010 summary tables. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Health Statistics, 2011. Last updated 1-22-2013. Accessed on 12-30-2013 at: <http://www.cdc.gov/nchs/data/ahcd/namcs_summary/2010_namcs_web_tables.pdf>.
 32. Rice RE. Influences, usage, and outcomes of Internet health information searching: multivariate results from the Pew surveys. *Int J Med Inform* 2006;75(1):8-28.
 33. Houston TK, Allison JJ. Users of Internet health information: differences by health status. *J Med Internet Res* 2002;4(2):E7.
 34. USA QuickFacts from the US Census. Washington, DC: United States Census Bureau, 2012. Last updated 12-17-2013. Accessed on 12-30-2013 at: <<http://quickfacts.census.gov/qfd/states/00000.html>>.
 35. CRONBACH LJ, WARRINGTON WG. Time-limit tests: estimating their reliability and degree of speeding. *Psychometrika* 1951;16(2):167-88.

List of Publications and Products

Instrument

PRE-HIT: Patient Readiness to Engage in Health Information Technology

The key product of the study is a validated instrument, the PRE-HIT, available free of charge from Dr. Koopman upon request koopmanr@health.missouri.edu and included as an appendix after the references.

Publications

Koopman RJ, Petroski GF, Canfield SM, Stuppy JA, Mehr DR. Development of the PRE-HIT instrument: Patient Readiness to Engage in Health Information Technology. *BMC Family Practice*, 2014, 15:18 doi:10.1186/1471-2296-15-18.

Koopman RJ. Health Information Technology Evaluation and Education: Finding Our Way. *Family Medicine* 2010;42:312-313.

Wakefield DS, Mehr DR, Keplinger LE, Canfield SM, Gopidi R, Wakefield BJ, Koopman RJ, Belden JL, Kruse RL, Kochendorfer KM. Issues and Questions to Consider in Implementing Secure Electronic Patient-Provider Web Portal Communications Systems International Journal of Medical Informatics. *International Journal of Medical Informatics*, 2010;79:469-477.

Washington KT, Meadows SE, Elliott SG, Koopman RJ. Information Needs of Informal Caregivers of Older Adults with Chronic Health Conditions. *Patient Education & Counseling*, 2011;83(1):37-44.

Koopman RJ, Kochendorfer KM, Moore JL, Mehr DR, Wakefield DS, Yadamuren B, Coberly JS, Kruse RL, Wakefield BJ, Belden JL. A diabetes dashboard and physician efficiency and accuracy in accessing data needed for high-quality diabetes care. *Ann Fam Med* 2011;9(5):398-405.

Wakefield DS, Kruse RL, Wakefield BJ, Koopman RJ, Keplinger LE, Canfield SM, Mehr DR. Consistency of patient preferences about a secure internet-based patient communications portal: contemplating, enrolling, and using. *Am J Med Qual* 2012; 27(6): 493 – 501. doi:10.1177/1062860611436246

Kruse RL, Koopman RJ, Wakefield BJ, Wakefield DS, Keplinger LE, Canfield SM, Mehr DR. Internet use by primary care patients: where is the digital divide? *Fam Med* 2012;44(5):342-7.

Keplinger LE, Koopman RJ, Mehr DR, Kruse RL, Wakefield DS, Wakefield BJ, Canfield SM. Patient portal implementation: resident and attending physician attitudes. *Family Medicine*, 2013;45(5):335-40.

Wakefield BJ, Koopman RJ, Keplinger LE, Bomar M, Bernt B, Johanning JL, Kruse RL, Davis JW, Wakefield DS, Mehr DR. Effect of home telemonitoring on glycemic and blood pressure control in primary care clinic patients with diabetes. *Telemedicine and eHealth*, 2014;20(3)199-205.

Koopman RJ, Wakefield BJ, Johanning JL, Keplinger LE, Kruse RL, Bomar M, Bernt B, Wakefield DS, Mehr DR. Implementing home blood-glucose and blood-pressure telemonitoring in primary care practices for patients with diabetes: Lessons learned. *Telemedicine and eHealth*, 2014;20(3)253-60.

Presentations

Stuppy JA, Koopman RJ, Mehr DR, Campbell JD, Canfield SM, Shigaki CL. Patient Readiness to Use the Internet. AMWA National Conference Student Poster Presentation. Arlington VA, March 2010. (Poster presentation by Summer Medical Student Julie Stuppy detailing our focus group work for item development.)

Koopman RJ, Petroski G, Canfield SM, Mehr DR. Development of the PRE-HIT Instrument: Patient Readiness to Engage in Health Information Technology. North American Primary Care Research Group Annual Meeting. New Orleans, LA, November 2012.

Appendix: PRE-HIT Instrument

Attached is the PRE-HIT Instrument.

The instrument was designed to be self-administered but can also be given verbally.

Scoring

Score 1 for Strongly Disagree, 2 for Disagree, 3 for Agree, 4 for Strongly Agree for all items except items 1-4, 6, 7, 9, 15, and 19-23, which are reverse scored 4 for Strongly Disagree, 3 for Disagree, 2 for Agree, 1 for Strongly Agree.

Reference

Koopman RJ, Petroski GF, Canfield SM, Stuppy JA, Mehr DR. Development of the PRE-HIT instrument: Patient Readiness to Engage in Health Information Technology. *BMC Family Practice*, 2014, 15:18 doi:10.1186/1471-2296-15-18

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March 2014

Date _____ ID _____

Please check <input checked="" type="checkbox"/> how much you agree with the following statements:	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I let my doctor handle the details of my health.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. People today want to know too much about their health.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Regarding my health, I agree with the statement "No news is good news."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Doctors are my most trusted source of health information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I trust the internet as a source for health information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I am concerned about what I might find if I look up health issues on the internet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. When I have a health concern, my first step is to contact my doctor's office.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Looking up health concerns on the internet is more convenient for me than contacting a doctor's office.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I prefer calling my doctor's office to emailing them.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I would email my doctor because it is easier than having an office visit.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Looking up information online about medications is easier than asking my doctor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I go online using my cell phone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I use my cell phone to text people almost every day.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. If I went on the computer, I would be able to figure out most problems that I might run into.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. If I went on the computer, I would find using it to be frustrating.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. If I went on the computer, I would have access to the internet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please check <input checked="" type="checkbox"/> how much you agree with the following statements:	Strongly Disagree	Disagree	Agree	Strongly Agree
17. If I went on the internet, I would find using it to be easy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. If I went on the internet, I would find using email to be easy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. If I went on the internet, I would be very concerned about giving any personal information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. If I went on the internet, I would be concerned it would lead to invasions of my privacy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. If I went on the internet, I would get frustrated with the amount of information I found about health.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. If I went on the internet, I would find searching for information would be stressful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. If I went on the internet, I would find sorting through information to be too time consuming.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. If I went on the internet, I would use it to look up things so that I wouldn't worry about them anymore.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. If I went on the internet, I would use it to look up information about herbals and/or supplements.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. If I went on the internet, I would use it to look up symptoms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. If I went on the internet, I would use it to search for information about my health.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. If I went on the internet, I would use it to find information about medications.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>