Wellness for Older Adults: Usability and Benefits of TeleHealth Monitoring

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Abstract

This study was conducted to determine the usability and benefits of telehealth in the older adult population. Eighteen residents in an assisted living facility were selected to participate in a pilot to study the effects of telehealth monitoring. Participants were engaged weekly with a new feature or health benefit of the remote healthcare system monitoring their vital signs. Results of the study concluded that the participants were receptive to the technology and sought to continue monitoring their health and wellness. Moreover, the older adults were able to learn the technology in a few sessions of training.

Keywords: aging population chronic disease management, e-health, gerontechnology, health management, home monitoring health records, remote monitoring, quality of health care, usability testing

I. Introduction

According to the Centers for Medicare & Medicaid Services (CMS) (2012), growth projections for U.S. health spending is estimated at 5.8% from 2012-2022. Healthcare costs continue to rise, and is projected to grow 1% faster than the Gross Domestic Product (GDP) (CMS, 2012;Olsen, Saunders et al. 2010). This has resulted in healthcare access disparity with nearly 48 million Americans without health insurance in 2012 (United States Bureau of the Census, 2013). There are numerous factors that are driving healthcare cost changes; including the aging population and longer life expectancy.

II. Literature Review

Most of the U.S. senior population is reported to suffer from multiple chronic conditions, i.e., hypertension, coronary hypertension, coronary, heart disease, stroke, diabetes, cancer, arthritis, hepatitis, weak or failing kidneys, chronic obstructive pulmonary disease, or current asthma (Ward & Schiller, 2013). Other factors include the shift from acute care to chronic care (Nahm and Mack, 2013). However, "Today, the system is largely impersonal and reactive; we typically visit a doctor when an illness or accident has already occurred. In the years to come, healthcare will become far more personalized, and will focus more on prevention" (Castaldo, 2010). Use of telehealth technology has been shown to be very effective for monitoring large numbers of patients with chronic disease conditions with personalized care plans (Polisena, 2009).

Telehealth provides a comprehensive array of interventions based on the regular gathering of data points, conceivably inspiring healthy diet and exercise (Bashshur, Shannon, et al., 2009). The telehealth is one of many growing healthcare service delivery market. Vital Care was established when it became evident there was a need to implement cost-effective solutions for health and wellness care delivery that would be personalized to individual needs in their own living settings. The company's solutions ensure that patients stay healthy, follow their designed care plans, and avoid costly hospital readmissions and emergency room (ER) visits. Using advanced, portable, consumer friendly telehealth technology, healthcare providers can

interact with their remote-location patients as often as necessary, and implement a customizable regimen to match each patient's individual needs. The innovative telehealth software running on commercial tablets is simple to operate for patients with no prior computer experience. These Wi-Fi or 4G enabled cellular tablets relay vital sign measurements, personalized daily questions, medication reminders, and clinical advice immediately through encrypted and Health Insurance Portability and Accountability Act (HIPAA) compliant messaging from secure servers. The patient is connected anywhere, and at anytime to a healthcare provider.

III. BACKGROUND

As part of a service-learning course entitled, *Intergenerational Computing,* students choose a term project, primarily based on current needs of community partners. Vital Care Services was one of many community partners offering projects to the class. Vital Care chose to explore older adult usability with their telehealth products by launching a pre-pilot study. Some objectives of the research included the acceptance of technology by the older adults, as well as their ability to learn the procedures for the vital sign readings. Students voluntarily selected this community partner for their project. Students in the *Intergenerational Computing* class choose a community partner from a variety of nursing homes, assisted living, independent living, adult day care, and senior centers to conduct weekly customized computer literacy training sessions with the self-selected paired older adults. For this telehealth project, the choice dwelling arrangement was assisted living because of convenience and economically feasibility. The telehealth set of Bluetooth enabled hardware is under $1000, therefore placed strategically in a common recreation area for the assisted living facilities proves far less expensive than purchasing one set for each senior apartment. Assisted living residents volunteered to partake in the weekly program to collect vital sign data. The targeted population consisted of those over the age of 65.

IV. TELEHEALTH

Telehealth is defined as the use of technology (audio, video, telecommunications, and informatics) to provide health services to isolated populations (Gantenbein, 2011; Strode, et al., 1999). Telehealth is a time efficient and cost-reducing form of health care access (Polisena, 2009). It is capable of storing older adult patient records, monitoring health and vital signs, and connecting patients and doctors by video. When seeking care in institutional settings such as doctors' offices, clinics and hospitals become burdensome; telehealth can be an effective tool for meeting patient and health care provider needs remotely. Older adults who need care typically are required to travel to see their physician to retrieve health readings. As older adults get older, they may find it difficult to travel to their health care provider. With telehealth technology, these vital recordings can be completed at a patient's home, and readings can be monitored remotely by a healthcare professional. In addition, a physician or nurse monitors patient data and if readings are beyond the normal threshold, immediate intervention is made. With telehealth, seniors are able to lower transportation costs of frequent doctor visits, which can get expensive over time (Castaldo, 2011). In many cases, it is also burdensome for seniors to leave their living setting due to deteriorating physical ailments. Advances in telehealth can help older adults maintain their independence and age in place in their homes (Belden, 2006).

As technology has improved over time, the possible health benefits for healthcare have increased. The use of advanced technology to deliver healthcare at a distance has the potential to be one of the defining medical revolutions of the 21st century. With the unwieldy U.S. healthcare system under scrutiny, telehealth can be one of the solutions for increasing access and, at the same time, decreasing the cost of healthcare delivery.

V. Research Questions

In this pilot telehealth study, research questions focused primarily on the older adults' ability to utilize the telehealth hardware, as well as the older adults to accept the technology to help improve their quality of life. Can older adults learn how to use the telehealth equipment to collect data on their vital signs? Are older adults willing to embrace technology to improve their quality of life? What fonts, colors, buttons, etc. work the most efficiently?

VI. PROJECT SUMMARY

Vital Care Services provided assisted living residents with a chance to experience telehealth monitoring on a weekly basis in conjunction with an *Intergenerational Computing* course offered at Pace University, New York. A telehealth team of four undergraduate students from the course were identified and trained in telehealth technology. Day 1 was the assisted living orientation, which was utilized as an opportunity to gain an audience with multiple residents with the help of the student team. At the conclusion of the registration process, there were a total of eighteen residents enrolled in the program that participated in weekly screenings.

As part of the service-learning course curriculum, each older adult would meet once a week with his or her student to learn about consumer technology. As an added learning experience, Vital Care Services set up a kiosk in the billiards room to educate the participants of healthcare technology and to take health readings weekly. For seven weeks the older adults would spend about 5 minutes learning how to use telehealth technology to take vital sign readings, i.e., blood oxygen levels, blood pressure, and weight. Initially, the residents enrolled in the program were somewhat timid about using the telehealth monitor (tablet), which many have never thought of using before. Each week the telehealth student team members were patient with the older adults and taught them how to input their username and password to log on to their personal account within the application. From there the students guided the older adults to take their vital signs. First they took their blood oxygen levels. After inserting their finger into the Sp02 device and waiting a few seconds, the monitor would instantaneously transmit the readings via Bluetooth wireless technology to the telehealth tablet and clinical web portal. This reading also would be provided audibly and visually to the patient. Next, the senior would take their blood pressure readings, which were also transmitted wirelessly to the tablet. Lastly, the older adult would step on a scale to record their weight on the telehealth tablet wirelessly.

During the second week, the residents were introduced to viewing their collected data. The telehealth team showed them how it was graphed inside the program for easy comparability of weekly readings. This became a weekly routine and allowed them to discover any change in their readings. A common learning curve issue amongst most of the residents enrolled was how to understand the touch sensitivity of the tablet in their ability to type their username and password as well as how to touch specific areas in an effort to guide themselves through the steps of the screening process. As the weeks went on, residents enrolled showed that they had overcome this issue with ease of practice and a more in-depth explanation of the touch sensitivity of the tablet to make the signing in process much smoother. As the residents progressed in using the technology, more features of the Vital Care Program were introduced. First was the medicine reminder application, which can help individuals who are forgetful about taking the numerous pills they take on a daily basis. Secondly, a few follow up questions were placed after the usual screening process to get a more accurate depiction on any changes in normal living for each individual resident.

By growing more accustomed to the technology presented to them, the residents were much quicker in grasping the new features. During the last few weeks of doing health screenings, there was immense progress made by each enrolled senior resident. Some were able to make their way through the health screening process with no assistance from students. The fact that the technology was easy to use by residents, once they got past a small learning curve, helped reinforce how simple the process was. Also the impact of taking their readings on a weekly basis allowed some enrolled residents to discover issues that they did not previously know about, such as high blood pressure. The residents wanted to understand their readings, as well as how to keep them on relatively good levels. In the end, residents were questioning whether Vital Care's service would be available long term so that they could continue to have their readings monitored and so that they could have a better understanding of individual health. As a final part of the project residents were asked to partake in a testimonial video which many happily obliged.

VII . Data Analysis

Figure 1 shows blood pressure and daily questions historical data for Patient A. The study was for a total of seven weeks, and the figure displays data collected which prompted intervention and treatment. These health readings were crucial in assisting Patient A in monitoring her health and

wellness. Although she was on medication to manage her hypertension, the team was concerned when her blood pressure reading was 179 mmHg/97 mmHg. In order to ensure the accuracy of this elevated blood pressure, the team took the reading again a few minutes later. The result was very similar at 174 systolic/87 diastolic; therefore the team verified that this was high priority information and advised Patient A that she should contact her doctor immediately. Before she went, the team ended her health data collection with personalized daily questions. The software flagged YES responses to "Are you more tired than usual?" and "Do you generally feel worse than usual today?" as part of the decision to recommend Patient A to visit the doctor.

Figure 1

Below are Patient A's comments on her medical intervention:

"I had been taking pills and I had been feeling bad, nauseous, and not good at all. What it was, I don't know, but I knew something was terribly wrong. I went to my doctor and I told him what was happening, and we decided a pill [undisclosed] I had been taking was keeping my pressure very high, making me feel awful, nauseous, dizzy, and it was affecting my walking even. I had no strength to walk. He took my pressure and he got the same reading that you did. He took me off the pill slowly and I started to feel better in time. Because of what was happening here made me aware of what was happening to myself, which was very important because my pressure was going up. My reading yesterday was 140/80, which was a lot less. I thank you very much."

Patient A showed that early knowledge of her high blood pressure and responsive clinical attention was vital in improving health. The team later found that another root cause of this condition that neither her doctor or Patient A knew about was that she was prescribed to two hypertension medications, which have adverse effects. Between Vital Care Services, Patient A, and the resident doctor, the team concluded that this could have been a chief reason for her health problem.

When the team took her readings a week later, it saw her blood pressure decrease by 25 mmHg systolic and 12 mmHg diastolic. Also, her general health improvement was reflected on her daily questions. She feels confident in using the technology to check her health readings and clearly sees the benefit in potentially saving her life.

"I'm 87 years old and technology does scare me, but I feel that I can do it and I will do it."

Patient B is not your typical 94 years old. She moves around without a walker or wheel chair and even takes dance classes to stay active. Patient R decided to enroll in our telehealth study because she wanted to learn more about technology and how it could benefit her health and wellness. For eight weeks her vital signs were monitored including, but not limited to, blood oxygen, blood pressure, and weight.

Figure 2

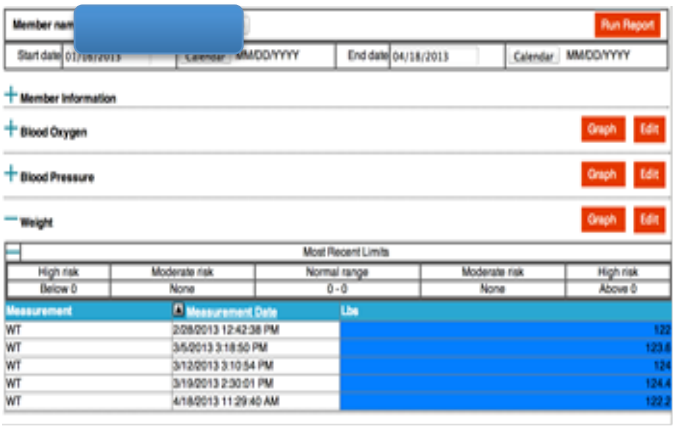

Figure 2 above shows Patient B's weight trends. After four weeks in a row of minor weight gain, she decided to opt out of taking weight readings until the last week of the study. The purpose of this was to see her weight difference with added awareness to diet and exercise.

Patient B found weight to be the most important data because she only weighed herself when she went to a doctor's office. Patient B stated to the team:

"When you go to the doctor… The first thing you do before you get checked out, you say… Please weigh me! And when you see that you're gaining weight, you know you're doing something wrong. Either you are having too much fat, or too much of sugar. Don't wait until you get up to 5 pounds. Because 5 pounds is very hard. So this makes you aware of your body. It's wonderful to know how you are doing before it gets too late. You got to exercise and watch what you eat. Having telehealth services here has been wonderful. They keep you alive! I don't know where we would be if we didn't have you guys around here. The technology is wonderful. There's more pain about things. It's so easy. Everything is so easily done for you. No one wants to go, and we're not in a hurry. I have grandchildren that I want to see. Everyone is better taken care of these days using technology. That's how we can live over 90!"

To supplement the findings from the above two cases, an analysis of variance (ANOVA) test for the whole sample was conducted on those involved in the weekly examinations of blood oxygen level, weight, blood pressure, and pulse. Following is the summary of sample statistics (Table 1).

Table 1. Summary Statistics

Measurement	Mean	St.Dev.	Obs
Oxygen Level	95.55	3.08	52
Weight (LBS)	128.78	19.31	44
BP Systolic	141.96	19.46	52
BP Diastolic	86.25	12.43	52
Pulse	69.36	10.83	52

The measurement was done for seven weeks for a total of fourteen subjects who consistently participated in the weekly examination. The sample statistics are based on various measurements (e.g., oxygen level) done during the first and last three weeks for those fourteen subjects who did measurements for at least three weeks. The total number of observations is fifty two: each subject was measured for various tests more than once, up to six times at the most. We do not use an individual as a unit of analysis because it reduces the number of data points significantly (about one half). Although each individual doesn't contribute to the same number of data points during the first and last three weeks, the numbers of the data points for the two time periods are not significantly different (e.g., 23 versus 29 for oxygen level and 7 versus 9 for oxygen level below 95—refer to Table 2).

Table 2. ANOVA Results

Measurement	Weeks	Obs	Mean	F
Oxygen Level	First 3 Weeks	23	95.47	.028
	Last 3 Weeks	29	95.61	
Oxygen Level Below 95[1]	First 3 Weeks	7	92.57	4.095*
	Last 3 Weeks	9	94.72	
Weight (LBS)	First 3 Weeks	19	131.71	.762
	Last 3 Weeks	25	126.56	
BP Systolic	First 3 Weeks	23	139.36	.731
	Last 3 Weeks	29	144.02	
BP Diastolic	First 3 Weeks	23	86.01	.015
	Last 3 Weeks	29	86.44	
Pulse	First 3 Weeks	23	69.80	.067
	Last 3 Weeks	29	69.01	

[1] The range for the normal oxygen level is 95-100.
* $p < .10$

The ANOVA analysis is done by comparing the measurement means for the two time periods mentioned above (Table 2). The results show that there were no significant differences in our measurements in general, such as blood oxygen level, weight, blood pressure, and pulse, for the two time periods. One reason might be that the examinations were done during a short period of seven weeks spanning just two months. Another reason might be that the sample size is small—fourteen subjects might be not enough for a sample to generate statistically significant results. For example, the weight loss of 5 pounds (from 131.71 pounds to 126.56 pounds) seems substantial, but the result shows that it is not statistically significant. Another reason might be that on average, subjects were in a good health condition in the beginning (except in the case of Patient A), and with health monitoring services, they could keep such a good health condition for the seven-week experiment period. One notable exception is the

results for the subjects with the oxygen level below 95, which show that their oxygen level has improved from 92.57 to 94.72.

VIII. CONCLUSION

Assisted living older adults were naturally hesitant about their adaptability to learn new technology. Some believed that they were incapable of learning how to use it. Since this particular assisted living facility has a primary care physician available on location, many patients are accustomed to walk-ins for treatment. Therefore, the introduction of modern telehealthcare remote patient monitoring was difficult to understand.

Having a student teach the technology was important for the participants to learn. Without this, it would make the process very difficult. For some older adults, seeing their younger generation tutor was something they looked forward to weekly. It took several weeks to focus on patiently teaching them what telehealth is, the benefits, and basic touch-screen fundamentals. The team found that the participants had a need for guided audio-visual directions from the telehealth monitor. Vital Care enhanced this feature and it proved very helpful for those participants who have sensory impairments. Patient C commented: "I have a visual handicap. As a result, the first time I used the little machine, the letters were too small; when I mentioned that, immediately you guys took over and made them larger so the next time I used it, it was better. The technology is simple. All you do is to listen to the voices and press the buttons."

After two weeks of initial assistance, all the participants knew exactly what they were doing and what information was being recorded. Coming to the kiosk every week to take health readings became a part of the older adults' weekly routine for almost all the seniors. Every week the seniors remembered where to go and what to do because it was the same day at the same time.

The impact that this technology had on their lives varied by each individual case. Some participants witnessed the acute care interventions such as Patient A, while others like Patient R benefitted from post-acute care monitoring her weight. For some others, benefits ranged from potential health risks to peace of mind and increased confidence in using technology. Knowing that they would be able to monitor their own health without the direct assistance from a doctor or nurse gave them a greater sense of empowerment and independence, a feeling that can often be lost in an assisted living facility.

By simply taking five minutes out of their week, the telehealth program was beneficial to all patients, but in different ways. The key difference was not the ability for them to learn the technology or experience the benefits, but rather the risk level of the patient. Vital Care Telehealth solutions were designed to service the diverse needs of the aging population. When evaluating health data analytics, patients saw either stable or unstable readings; patients with stable readings had the peace of mind of this new healthcare accessibility tool and those with unstable readings sought appropriate medical attention. In this case study, Vital Care Services technology proved to be a user-friendly solution that improves health outcomes and increases the quality of care.

A future research study which recently received funding will include 120+ older adults. These older adults will reside in assisted living facilities, as well as commute to senior centers in New York City looking at effects of telehealth at different levels of social-economic status.

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