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Impact Of A PDA-Based Patient-Centered Communication Intervention On Charted Medical Outcomes Of Breast Cancer Patients

Christine Dierker

Ohio State University

Abstract

Effective communication between doctors and patients has been shown to lead to increased patient satisfaction (Stiles, 1979; Treadway, 1983), better adherence to medical recommendations (Cegala, 2000), and enhanced health outcomes (Stewart, 1999). This study tested the feasibility and effectiveness of a patient-centered communication system designed to improve communication between women undergoing chemotherapy treatment for breast cancer and their physicians. Fifty women at one of two study sites were recruited for the study and randomized into either the intervention or control arms. Baseline and post-treatment data were collected for both groups, but only the intervention participants utilized the intervention tool during treatment. Intervention participants were asked use a PDA to complete weekly symptom profiles assessing pain, fatigue, and depression and watch communication skills training videos tailored to symptom severity and race prior to each medical visit. If scores on an inventory crossed a high severity threshold, an alarm message would pop up on the PDA requesting that the patient contact her physician's office to discuss the problematic symptom. The PDA recorded the overall symptom scores, the frequency of alarm triggering, and the frequency of video activation. Participants' medical charts were also reviewed for details concerning each treatment and medical visit. Results showed that the frequency of depression video clicks was significantly associated with increased discussion about depression. The number of alarm triggers significantly influenced the occurrence of both a discussion of depression and a behavioral recommendation from the physician to the patient about her depression. In addition, the overall depression sum was a reliable predictor of the physician making a behavioral recommendation for treatment of the patient's depression symptoms.

Overall, the use of the intervention tool showed the ability to increase communication concerning chemotherapy-related depression symptoms between breast cancer patients and their physicians and has promising potential in overcoming barriers in patient-physician communication.

Impact Of A PDA-Based Patient-Centered Communication Intervention On Charted Medical Outcomes Of Breast Cancer Patients

Communication has long been considered one of the most pivotal aspects of the patient-physician relationship. Improvements in the communication between patients and physicians not only leads to increased satisfaction (Stiles, 1979;Treadway, 1983) and decreased anxiety (Martinali, 2000) on the part of the patient, but also better compliance with the medical recommendations made by the physician, such as behavioral treatments and follow-up appointments (Cegala, 2000) and enhanced health outcomes (Stewart, 1999). Kaplan (1989) found that poorer communication between patients and physicians, as exemplified by the minimal exchange of information and affect between patients and physicians, was consistently associated with both a decreased sense of control for the patient and also poorer control of diabetes and hypertension as compared to those who communicated better.

Communication Interventions

Because of the traditional dominance of physicians in the patient-physician relationship, many past interventions designed to improve patient-physician communication have targeted the physician. More recently, however, researchers have begun focusing on the other half of the patient-physician relationship through interventions that target the patient (Post, 2002). In their review, Post and colleagues categorized patient-centered communication interventions as high intensive, moderate intensive, or low intensive, based on the length of the intervention, the use of personnel, and estimated cost (Post, 2002). Low-intensity interventions often involve little time on the part of the patient, have a relatively low cost for the investigator and do not require any personnel. In one low-intensity intervention patients were provided with an

educational leaflet in the waiting room prior to the medical appointment that encouraged more open lines of communication with the physician (Frederikson, 1995).

Moderate- and high-intensity interventions, on the other hand, require significantly more time and financial resources and may involve personnel. In previous studies, several high-intensity interventions involved a 10- to 30-minute communication skills training session with a research assistant prior to the medical appointment (Roter, 1977; Greenfield, 1985; Greenfield, 1988; Kaplan, 1989; Cegala, 2001). The focus of the training sessions varied; some emphasized only enhanced patient question-asking (Roter, 1977) while others encouraged increased question-asking on the part of the patient and provided techniques for negotiating medical decisions (Greenfield, 1985; Greenfield, 1988; Kaplan 1989). Another study applied a high-intensity intervention that focused on increasing the exchange of information during the medical visit by having a trained health educator meet with the patient before his or her appointment with the physician and providing the patient techniques for presenting information to and obtaining information from the physician (McGee, 1998). Most studies involving the use of personnel in patient communication skills training also utilized either a workbook (Cegala, 2001) or the patient's medical record (Greenfield, 1985; Greenfield, 1988; Kaplan, 1989) to provide a direction for the training session. Moderate-intensity communication interventions involved a number of different strategies for enhancing patients' communication skills. Two common approaches involved modeling optimal communication skills via video (Anderson, 1987; Lewis, 1991) or teaching through a written medium, such as a workbook or handout (Cegala, 2000).

Intervention Evaluation

The effectiveness of most high- and moderate-intensity interventions aimed at improving the communication between patients and physicians has been evaluated based on patient-related outcomes. Post, Cegala, and Miser (2002) conducted a review of eight high- or moderate-intensity patient-centered communication interventions from 1975 to 2000 and found that the most prevalent communication variable studied was question-asking on the part of the patient, one of many patient behaviors typically used to evaluate communication interventions. The patient's level of satisfaction and sense of control were also frequently targeted as variables to assess the impact of interventions (Post, 2002). Other patient-related variables include patient involvement, affect, recall of information and knowledge of disease, compliance with medical treatment, and health outcomes (Post, 2002).

Very little attention has been given to the effect of high- and moderate-intensity patient-focused communication interventions on charted medical outcomes. In Harrington and colleagues' systematic review of patient communication interventions from 1966 to 2001, none of the twenty-five qualified studies used charted medical outcomes to measure the process of communication during the medical visit (Harrington, 2004). In fact, the majority of studies utilized interaction analyses, specifically either audiotaping or videotaping of medical visits; several other studies assessed the process of communication using questionnaires administered to the patient, physician, or both (Harrington, 2004). Using only subjective measures, such as surveys and questionnaires, to assess the impact of communication interventions on medical visits has been considered problematic, as subjective measures and behavioral measures have been shown to correlate poorly (Harrington, 2004). Although interaction analyses, audiotaping and videotaping, have been shown to be less biased than

subjective perceptions in characterizing the process of communication during the medical visit, these technologies can be very costly and may render some studies unfeasible. Charted medical outcomes offer another avenue to evaluate the process of communication during the medical visit, and yet very few, if any, studies evaluating communication interventions have included this valuable and very inexpensive tool in their evaluation measures. Although some may argue that charted medical outcomes, like questionnaires, may introduce unnecessary bias into the evaluation of interventions, the potential for charted medical outcomes in evaluating communication interventions still warrants some attention before being dismissed and may prove to be an extremely reliable tool in accurately characterizing the process of communication during medical visits.

Technology-Based Interventions

Furthermore, as medicine continues to be changed dramatically in the twenty-first century by technology, patient-centered communication interventions have concordantly begun emerging that incorporate the use of technology in symptom-monitoring and communication skills training. Paper-based symptom assessment measures can often be difficult to implement and the results cumbersome to analyze in a timely manner in a clinical setting; technological applications offer potential solutions for overcoming the practical barriers of paper-based communication intervention techniques (Fortner, 2003). For example, the Cancer Care Monitor (CCM) was designed to screen high-frequency cancer-related symptoms and assess overall symptom severity and quality of life in cancer patients. Its ability to assess the physical, psychological, and functional status of cancer patients has been shown to be both reliable and valid (Fortner, 2003). Another communication intervention employed tablet PC

technology, known as the PACE (Patient Assessment, Care, and Education) System, to document symptom assessment rates of cancer patients by physicians with and without the use of the tool; results demonstrated that the assessment of chemotherapy-related symptoms significantly increased after implementation of the system (Mark, 2008).

Interventions Targeting Depression Outcomes

In the 21st century, depression is becoming an increasingly prevalent and costly mental disorder, affecting approximately 1 out of every 4 U.S. adults (Schwenk, 2004). Despite this prevalence, depression remains underrecognized and undertreated, and recent research has focused on how to achieve more effective treatment of depression (Schwenk, 2004). Epstein (2007) found that the quality of care for depression increases when patients take a more active role in their healthcare. Clever (2006) found similar results, demonstrating also that patients who engaged in shared decision-making about their depression experienced better health outcomes. These findings suggest that communication interventions should support shared decision-making and encourage patients to take a more active role in their healthcare (Clever, 2006; Epstein, 2007). However, very little attention has been given to the development of communication interventions that specifically target depression. Most interventions that have focused on the improvement of patient-physician communication concerning depression have simultaneously investigated other chemotherapy-related symptoms such as pain and fatigue. One such study utilized tablet PC technology to increase physician assessment rates of chemotherapy-related pain, fatigue, and depression (Mark, 2008). The results were promising, showing that the intervention most significantly improved assessment of depression,

suggesting that interventions specific to communication about depression have promising potential in improving the treatment of depression (Mark, 2008).

Objective

The current study was set within a larger experimental design to develop and test the feasibility of an innovative patient-centered communication intervention that incorporated the use of a personal digital assistant (PDA) to improve communication between patients and healthcare professionals. To our knowledge, this was the first patient-centered communication intervention of this intensity to utilize PDA technology. The target population included women diagnosed with breast cancer and who were undergoing chemotherapy treatment, since effective patient-clinician communication is essential to the management of the physical and psychological symptoms associated with the diagnosis and treatment of cancer (Baker, 2001). Specifically, the symptoms of pain, fatigue, and depression were targeted for assessment, as these were recently cited by the National Institute of Health as the most common under-assessed and under-treated symptoms in cancer patients undergoing chemotherapy treatment (Patrick *et. al.*, 2003).

The current study focused specifically on the physician and clinician response to this high-to-moderate intensity patient-centered communication intervention by investigating the impact of the intervention on charted medical outcomes. Medical records provide a quantitative, physician-related variable with which to measure the clinician response to patient-centered interventions. The study hypothesis is that specific components of the communication intervention will be associated with a) patient-physician discussion of

depression symptoms; b) behavioral recommendations to treat this symptom; and c) medication prescriptions to treat this symptom.

Methods

Procedures

Eligibility and Accrual. Participants were initially recruited by a nurse, nurse practitioner, or physician at one of two oncology clinics at an academic medical center in the Midwest. Eligible patients were considered those who were at least 18 years of age and diagnosed with clinical or pathological stages I-III breast cancer. All participants were receiving adjuvant chemotherapy for the first time as an outpatient at one of the two study sites. Patients were excluded if they were diagnosed with stage IV breast cancer or had a previously diagnosed uncontrolled major illness, major neuromuscular disease, or uncontrolled psychiatric disorder that would have potentially confounded the assessment of chemotherapy-related side effects or use of the self-assessment tool. Other exclusion criteria included a patient's inability to read by self-report, legal blindness, or classification within a special population group such as prisoners or the mentally disabled. Once patients were identified as eligible, they were approached by a nurse, nurse practitioner, or physician during their regularly scheduled medical appointment and given a brief introduction to the study. If the patient expressed interest in participating, she was either approached by the research assistant immediately following the medical clearance visit or contacted via telephone shortly thereafter to explain the study in further detail and answer any questions. Written, informed consent was obtained either immediately following this verbal discussion, at another time scheduled at the patient's

convenience before beginning chemotherapy treatment, or directly prior to the patient's initial chemotherapy treatment.

Randomization. After participants were consented to the study, they were stratified by the duration of their primary chemotherapy treatment regimen (≤ 12 weeks vs. > 12 weeks) and then randomized to one of two study conditions—control versus intervention. Given the small sample size of the pilot study, it was important to achieve a relatively equal distribution of the pain, depression and fatigue outcomes between the control and intervention groups; stratification by duration of treatment gave the research team a neutral variable that is closely related to the outcomes and upon which they could match intervention and control participants. Control participants received care as usual while those randomized to the intervention arm were given the intervention, which involved weekly symptom self-monitoring on the PDA and the viewing of communication skills training videos prior to each chemotherapy treatment.

Assessment. Baseline data on all participants were collected prior to the initiation of chemotherapy treatment. Immediately following consent and randomization and prior to the first chemotherapy treatment, participants were asked to complete a written pre-treatment questionnaire divided into several sections. The questionnaire assessed a variety of measures, including demographics, the participants' current perception of their health, their attitude toward cancer, relationship distress, and their experience in using computers and PDA's. Participants were also asked to complete a similar post-treatment questionnaire after completion of chemotherapy treatment. In addition to these written questionnaires, all participants were asked to complete a series of baseline symptom inventories assessing pain,

fatigue, and depression prior to the initiation of chemotherapy treatment. The Brief Pain Inventory (BPI) (Daut *et. al.*, 1983; Cleeland, 1989), Center for Epidemiologic Studies – Depression (CES-D) (Radloff, 1977), and Fatigue Symptom Inventory (FSI) (Hann *et. al.*, 1998) were used to assess the severity of pain, depression, and fatigue, respectively. All inventories were completed on a PDA. Intervention participants were also asked to complete these inventories once per week throughout the course of treatment for symptom monitoring.

Participants

Based on previous studies that utilized the BPI, CES-D, and/or FSI to assess pain, fatigue, and depression, respectively, it was determined that 25 subjects per study arm would be required to detect a difference in symptom severity between the baseline and final assessments for the overarching study. Therefore, 60 eligible patients were accrued into the study so that 50 patients would complete the study in order to achieve an 83% retention rate. African American patients were specifically targeted to accrue a minimum 15% minority representation in the study. The current study focused on the 27 participants randomized to the intervention group.

Measures

Symptom monitoring. Although pain, fatigue, and depression inventories were all completed on a weekly basis by intervention participants throughout the duration of chemotherapy treatment, outcomes related to depression symptoms are the focus of the current study. The CES-D is a 20-item instrument created by the Center for Epidemiological Studies commonly used to assess the severity of depression (Radloff, 1977). Each response is scaled from 0 to 3, and total scores range from 0 to 60 (Radloff, 1977). A cut-off score of 16 on

the CES-D is typically used to identify cases of depression (Boyd, 1982); this score was consequently chosen as the threshold to prompt a communication skills training video about depression.

PDA. A patient communication system was designed and integrated into the PDA's used by intervention participants for the duration of their chemotherapy treatment. The system contained two integrated components: 1) patient monitoring of pain, fatigue, and depression; and 2) tailored patient communication training. Intervention participants, upon completion of a symptom inventory, received immediate feedback regarding the severity of the symptom for the corresponding completed inventory in the form of a bar graph. Bar graphs for each symptom depicted the participant's symptom profile, or average score for each symptom computed from the corresponding symptom inventory and the change in that average over time since the beginning of chemotherapy treatment. These symptom profiles were also downloaded and printed out by the research assistant to be placed on each intervention participant's medical chart prior to each medical visit. On the day prior to each visit for chemotherapy treatment, the participant received a summary of the average score on each of the symptom inventories in the form of a bar graph followed by triggering of a tailored, video-based communication training program. The PDA was programmed both to evaluate each participant's symptom data as well as trigger the appropriate communication training module. Use of a PDA enabled the research team to record the number of times the participant clicked on each training module to initiate the program. In addition to triggering the appropriate tailored video, the PDA was also programmed to display an alert message if the participant's pain, fatigue, or depression level crossed a severity threshold. For depression, a CES-D score of

32 or higher triggered a message to encourage participants to contact their physician for help with depression. The PDA automatically recorded the frequency with which these alert messages were triggered.

Chart review. Near the endpoint of the study and when the majority of participants had already completed chemotherapy, all participants' medical charts were reviewed by a trained research assistant. For each clinic visit, the research assistant recorded a general rating of functional status (ECOG rating); the presence or absence of a rating for each symptom; the presence or absence of a note concerning a discussion of and/or behavioral recommendation for each symptom; presence or absence of the prescription of medication for each symptom, and referrals to a specialist for further treatment of each symptom. Details about each chemotherapy treatment were also recorded, including the agent received, dosage of each agent received, and dose intensity. The hemoglobin count, administration of any erythropoiesis-stimulating agents, and number of blood units received during each treatment were recorded. Finally, details concerning any hospitalization that occurred throughout the course of treatment was abstracted from the medical chart and recorded by the research assistant. The current study focuses only on the presence or absence of a note concerning a discussion of, behavioral recommendation about, and prescription of medication for the treatment of depression symptoms. The criteria for a behavioral recommendation included recommendations to change certain behaviors such as work schedules or sleep patterns, recommendations to address stress such as aromatherapy, recommendations for exercise, recommendations regarding diet and diet supplementation, and recommendations regarding relationships such as joining support groups or socializing more.

Data Analysis

Fisher's exact tests were used to test the association between the number of depression video clicks and the occurrence of a discussion of, behavioral recommendation about, or medication prescribed for depression symptoms and also between the number of times an alarm was triggered for the depression self-assessment and the occurrence of a discussion of, behavioral recommendation about, or medication prescribed for depression. Random-effects logistic regression was used to test the association between the number of depression video clicks, the severity of depression (depression sum), and both variables together (the multivariable analysis) to predict the physician's behavioral recommendation for the patient concerning depression. The random-effects regression was chosen to account for inter- and intra-individual variability.

Results

Between each of the two study sites, five physicians referred a total of 93 patients, only 78 of whom were eligible for participation (Figure 1). Sixty of these eligible patients consented to participate in the study, and of these 60 participants, the target 50 successfully completed endpoint data (Figure 1).

Table 1 describes the demographic characteristics of participants. Of the 50 participants who completed endpoint data, 27 were randomized into the intervention group and utilized the PDA patient communication system throughout the duration of their chemotherapy treatment. The table compares the characteristics between patients in the control group versus those in the intervention group; however, this study focused exclusively on the intervention group, specifically the ability of the certain components in the PDA patient

communication system to influence charted medical outcomes. The average intervention participant age was approximately 50 (±10.7) years old. Seventy-eight percent were Caucasian with the other remaining 22% African American, and 21% were married. All intervention participants at least held a high school diploma and 33% held as high as a graduate degree. Sixty percent were employed full-time, with the remaining 40% of participants working part-time, retired, unemployed, or disabled. Intervention participants held a variety of occupations, with the most (42%) being categorized as major professionals. Most who were employed worked 40 hours per week and 32% of these had an annual household income of ≥$100,000. More than half (52%) were granted medical leave from their employer for their condition. Thirty-four percent of intervention participants had 1 dependent and 27% had 2; 31%, however, did not report any dependents. No intervention participants reported smoking cigarettes while more than half (52%) reported currently drinking alcohol. Ninety-two percent use a computer more than once per week and only 44% reported using a PDA more than once a week.

Table 2 describes the clinical characteristics of participants. Thirty-seven percent of intervention participants were post-menopausal at the time of consent and 44% received mastectomies. Only 11% were diagnosed with stage III breast cancer and 70% of the participants had cancer that was estrogen-receptor positive while 63% of cancers were progesterone-receptor positive. Eighty-one percent of the cancer histology for intervention participants was characterized as either invasive ductal, lobular, or mucinous. Twenty-six percent were diagnosed with depression at the time of consent, with only 15% having a

previous pain diagnosis and only 4% with a fatigue diagnosis. The median frequency of clinic visits was every 6 days and the median frequency of treatments every 7 days.

Tables 3 through 6 show the association between certain components of the PDA communication intervention system and charted medical outcomes indicating a discussion of, behavioral recommendation about, and prescription of medication for the treatment of depression symptoms. The number of depression video clicks was significantly associated with a depression discussion during the medical visit between the patient and physician or nurse practitioner (Table 3, p-value = 0.019). In addition, there was significant association between the triggering of a depression alarm and a depression discussion (p-value < 0.001) and between the triggering of a depression alarm and a behavioral recommendation from the physician to the patient concerning the depression symptoms (p-value = 0.039). There was no significant correlation between the depression video clicks or the depression alarm triggers and the prescription of depression medication by the healthcare professional (Table 3).

Tables 4 and 5 provide a summary of the data utilized to conduct the Fisher's exact test analyses to determine whether there was a significant association between each charted medical outcome and the depression video clicks and alarm triggers, respectively. The analysis for each charted medical outcome was conducted in two ways, first with a count analysis and secondly using a dichotomous method. The count analysis looked at the association between the total number of times an intervention participant clicked on a depression video or viewed an alarm throughout the course of treatment and each charted medical outcome, while the dichotomous method only used video and alarm variable data indicating whether a participant did or did not click on a video or view an alarm at all throughout treatment. Both analyses

indicated the same general pattern of significance between each variable and charted medical outcome with the exception of the association between a depression discussion and depression video clicks. In this instance, the count analysis did not show an association between the occurrence of the depression discussion and the number of times a participant clicked on a depression video, whereas the dichotomous analysis did show significance (Table 4).

The depression score, indicating the severity of depression symptoms as self-assessed by the patient, was significantly associated with the physician or nurse practitioner making a behavioral recommendation to the patient concerning her depression symptoms (Table 4, *p*-value = 0.026). There was not a significant association between the occurrence of this behavioral recommendation and the number of depression video clicks (*p*-value = 0.137). When the regression for the outcome, behavioral recommendation for depression by the physician, was run with both variables, the number of depression video clicks and the depression score, the depression score was still the only variable that showed a significant association with the outcome, indicating that the two variables have no bearing on one another (*p*-value = 0.024). The odds of a behavioral recommendation for depression increased by 59% for each additional time the patient clicked the depression video (odds ratio = 1.59), while each unit increase in the depression score only increased the odds of a behavioral recommendation for depression by 15% (odds ratio = 1.15).

Discussion

Communication has long been considered one of the keystones of the physician-patient relationship, leading to increased patient satisfaction (Stiles, 1979), better compliance with medical recommendations (Cegala, 2000), and enhanced health outcomes (Stewart, 1999).

This is especially true for cancer patients, since effective patient-physician communication in this setting is absolutely critical to the management of the many physical and psychological symptoms associated with the diagnosis and treatment of cancer. This paper specifically investigates the clinician response to a PDA-based patient-centered communication system by examining the effect of the intervention on charted medical outcomes of breast cancer patients.

Overall, the study demonstrated that the use of the intervention tool was a reliable predictor of the occurrence of two phenomena as documented on the medical chart: 1) the physician and participant having a discussion about depression during the medical visit; and 2) the physician making a behavioral recommendation to the participant for treatment of her depression symptoms. More specifically, the number of times a patient clicked on a video training her to effectively communicate to her physician about her symptoms significantly increased the probability that a discussion about depression took place during the medical visit (Table 3). The number of depression video clicks is presumably indicative of the frequency of communication skills training about depression. Watching these videos perhaps increased the confidence the participant had in her ability to communicate to her physician, the assurance she had that her depression symptoms were relevant, and the storage in her memory of the presence of these symptoms, all leading to a greater probability that she would initiate a discussion with her physician regarding her depression symptoms.

The triggering of an alarm prompting a participant to immediately contact her physician regarding her depression symptoms significantly increased both the chance that a depression discussion would take place and that the physician would make a behavioral recommendation

to the participant concerning her depression (Table 3). These alarms emphasized the severity and veracity of the participant's depression symptoms and may have led her to initiate a discussion with her physician to seek help for the treatment of these problems. At the same time, the physician was made aware of the severity of the participant's depression symptoms due to the bar graph that was placed on the participant's medical chart immediately preceding the medical visit. Therefore, the physician, in addition to the patient, may also have been more inclined to initiate a depression discussion and to make a behavioral recommendation to the patient for treatment of the symptoms.

Finally, a higher depression score on the CES-D scale was associated with an increased probability that the physician would make a behavioral recommendation to the participant concerning her depression symptoms (Table 4). Like the alarm triggers, a higher depression sum presumably led to an increased awareness by both the participant and the physician of the severity of the participant's depression symptoms. The physician, therefore, may have been more likely to make a behavioral recommendation to treat the symptoms, while the participant may have been more likely to actively seek help from her physician. Although the logistic regression did not indicate an association between depression video clicks and the physician making a behavioral recommendation about depression, both the small sample size and comparatively large degree of variability in video click counts most likely resulted in the inability of the regression analysis to detect a relationship between the variable and outcome, suggesting that the relationship between these two variables should be further investigated with a larger sample size.

Despite the promising results showing the intervention tool's ability to effectively increase the communication concerning depression symptoms between breast cancer chemotherapy patients and clinicians, the study must be viewed in light of its limitations. The primary limitation of the study is the small sample size, with only 27 patients that used the intervention tool throughout the course of treatment. A larger sample size with the same variability would better isolate the intervention effects on outcome measures. The small sample size had the most significant effect on the analyses of the relationship between the video clicks and each charted medical outcome, potentially underestimating the effect of the video clicks in the intervention due to the large degree of variability in the video clicks within such a comparatively small sample size. Additionally, the study only included patients referred from five physicians located at two clinical sites. The results do not test for variability between physicians and may or may not be generalizable to both other oncology clinics and other physicians. In addition, different physicians may have very different medical charting practices, and the absence of a note in the medical chart documenting a discussion or behavioral recommendation regarding depression does not necessarily mean that a discussion did not take place. Documentation in the medical chart by the physician does a poor job of fully characterizing a discussion about depression, giving little indication of the depth and nature of the discussion. Moreover, documentation in this way only captures the clinician's perception of the depression discussion when a discussion implies participation by both parties, the physician and the patient. Finally, the results rely on the assumption that participants viewed the entire communication skills training video upon clicking on the link to activate the video; distractions or lack of time could have prevented a participant from watching the video despite activating it.

There are many questions that have been left unanswered and that should be addressed in future research with a larger sample size. One of the major limitations of the study was the use of medical chart documentation to characterize the effect of the intervention on measured outcomes, specifically the occurrence of a discussion about depression and the physician's response to the patient's behavioral changes caused by the intervention Future research can overcome this limitation and better characterize how the intervention influenced the medical visit through the use of audio or video tape to get a fuller picture of what is occurring during the medical visit. Additionally, the burden of this type of communication skills training should be assessed and how best to balance the need for greater patient communication skills training and the burden on the patient in terms of time and financial resources, especially when employing this type of technology.

Overall, this PDA-based patient communication system has promising potential for improving the communication between women undergoing chemotherapy treatment for breast cancer and their physicians, as least concerning depression symptoms. The use of tailored video-based communication skills training seems to be effective in prompting a discussion between patients and their physicians about depression symptoms. Furthermore, periodic symptom monitoring by the patient seems to help the patient better communicate her depression symptoms to her physician, eliciting a behavioral recommendation concerning those symptoms. As the use of technology in healthcare continues to grow, the improvement of this system and its future integration into chemotherapy treatment for cancer patients shows promise in helping to overcome past barriers to patient-physician communication, both in cancer patients and in other patients dealing with chronic problems. Furthermore, the financial

benefits of utilizing this type of technology to help manage depression and other chronic conditions may far outweigh its relatively high financial burden, making the argument that PDA's should be used in healthcare. Technology may hold the key to the restoration of effective patient-physician communication, the most pivotal aspect of the patient-physician relationship, and greatly improve both the quality of care delivered to patients and patient health outcomes across all fields of medicine.

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Table 1: Patient Demographics

Characteristic	Intervention
Count, N	27
Age, Mean (Std Dev)	49.5 (10.7)
Race, N (%)	
White	21 (77.8)
African American	6 (22.2)
Marital Status, N (%)	
Married	21 (77.8)
Divorced/Separated	3 (11.1)
Single w/ Partner	2 (7.4)
Single w/o Partner	1 (3.7)
Widowed	0 (0)
Education, N (%)	
Some HS	0 (0)
HS Diploma/GED	4 (14.8)
Some College	5 (18.5)
Associate degree	6 (22.2)
College degree	3 (11.1)
Some graduate school	0 (0)
Graduate degree	9 (33.3)
Employment, N (%)	
Full time	16 (59.3)
Part time	3 (11.1)
Retired	4 (14.8)
Disabled	1 (3.7)
Unemployed	3 (11.1)
Occupation category, N (%)	
Major Professional	11 (42.3)
Minor Professional	2 (7.7)
Administrative Professional	2 (7.7)
Assist. Manager/Clerical	1 (3.9)
Skilled crafts person	3 (11.5)
Semi-skilled operatively	1 (3.9)
Homemaker	6 (23.1)
Hours worked/week, median (IQR)	40 (25-48)
Household Income, N (%)	
< $20,000	3 (12.0)
$20,000 to $39,999	2 (8.0)
$40,000 to 59,999	2 (8.0)
$60,000 to $79,999	6 (24.0)
$80,000 to $99,999	4 (16.0)
≥$100,000	8 (32.0)
Granted Med Leave, N (%)	
No	4 (16.0)
Yes	13 (52.0)
N/A	8 (32.0)
Number of Dependents, N (%)	
0	8 (30.8)
1	9 (34.6)
2	7 (26.9)
3	0 (0)
4	1 (3.9)
5	1 (3.9)
Currently Smoke Cigarettes, N (%) Yes	0 (0.0)
Currently Drink Alcohol, N (%) Yes	14 (51.9)
Computer use ≥ 1/week, N (%)	23 (92.0)
PDA use ≥ 1/week, N (%)	4 (44.4)

Table 2: Clinical characteristics

Characteristic	Control	Treatment	Total	*p*-value[1]
Count, N	23	27	50	
ECOG, % ones	4.8	0.0	2.1	0.447
Menopausal status, % post	52.2	37.0	44.0	0.393
Surgery type, % mastectomy	73.9	44.4	58.0	0.047
Estrogen receptor status, % positive	78.3	70.4	74.0	0.747
Progesterone receptor status, % positive	78.3	63.0	70.0	0.355
Stage of disease, % IIIA/IIIB/IIIC	21.7	11.1	16.0	0.444
Number positive lymph nodes, median (IQR)	1 (0-2)	1 (0-1)	1 (1-2)	0.089
Histology, % Invasive ductal, lobular, or mucinous	82.6	81.5	82.0	0.999
Tumor size, median (IQR)	2.4 (1.5-3.5)	2.2 (1.5-3.5)	2.3 (1.5-3.5)	0.822
Depression diagnosis, % yes	13.0	25.9	20.0	0.308
Pain diagnosis, % yes	17.4	14.8	16.0	0.999
Fatigue diagnosis, % yes	4.4	3.7	4.0	0.999
Frequency of clinic visits, median (IQR)	8 (6-8)	6 (4-7)	7 (4-8)	0.034
Frequency of treatments, median (IQR)	8 (6-9)	7 (4-8)	8 (5-8)	0.345

[1] Percentage *p*-values are based on Fisher's exact test and medians are based on Wilcoxon rank-sum test. IQR is interquartile range

Table 3: Treatment Subjects Analysis of Clicked Videos and Alarm Triggers

PDA Action	Variable	Symptom	Clinic visit	p-value[1]
Video clicked	Count	Depression	Discussion	0.096
Video clicked	Count	Depression	Recommendation	0.155
Video clicked	Count	Depression	Medication	0.269
Video clicked	Dichotomous	Depression	Discussion	0.019
Video clicked	Dichotomous	Depression	Recommendation	0.177
Video clicked	Dichotomous	Depression	Medication	0.431
Alarm triggered	Count	Depression	Discussion	< 0.001
Alarm triggered	Count	Depression	Recommendation	0.038
Alarm triggered	Count	Depression	Medication	0.828
Alarm triggered	Dichotomous	Depression	Discussion	< 0.001
Alarm triggered	Dichotomous	Depression	Recommendation	0.038
Alarm triggered	Dichotomous	Depression	Medication	0.999

[1] *p*-value based on Fisher's exact test

Table 4: Depression Discussion, Recommendation, and Medication Analysis of Depression Video Clicks

Count of video clicks	**No Discussion [N = 135]**	**Discussion [N = 25]**	***p*-value[1]**
0	72.6%	48.0%	0.096
1	16.3%	32.0%	
2	5.9%	12.0%	
3	3.0%	8.0%	
4	0.7%	0.0%	
5	1.5%	0.0%	
Count of video clicks	**No Recommendation [N = 155]**	**Recommendation [N = 5]**	***p*-value**
0	69.7%	40.0%	0.155
1	18.7%	20.0%	
2	6.5%	20.0%	
3	3.25%	20.0%	
4	0.75%	0.0%	
5	1.3%	0.0%	
Count of video clicks	**No Medication [N = 120]**	**Medication [N = 40]**	***p*-value**
0	66.7%	75.0%	0.269
1	20.8%	12.5%	
2	5.0%	12.5%	
3	5.0%	0.0%	
4	0.8%	0.0%	
5	1.7%	0.0%	
Video Clicked	**No Discussion [N = 135]**	**Discussion [N = 25]**	***p*-value**
No	72.6%	48.0%	0.019
Yes	27.4%	52.0%	
Video Clicked	**No recommendation [N = 155]**	**Recommendation [N = 5]**	***p*-value**
No	69.7%	40.0%	0.177
Yes	30.3%	60.0%	
Video Clicked	**No Medication [N = 120]**	**Medication [N = 40]**	***p*-value**
No	66.7%	75.0%	0.431
Yes	33.3%	25.0%	

[1] *p*-value based on Fisher's exact test

Table 5: Depression Discussion, Recommendation, and Medication Analysis of Depression Alarm Triggers

Count of alarm triggers	**No Discussion [N = 135]**	**Discussion [N = 25]**	***p*-value[1]**
0	97.0%	72.0%	< 0.001
1	3.0%	20.0%	
2	0.0%	8.0%	
Count of alarm triggers	**No Recommendation [N = 155]**	**Recommendation [N = 5]**	***p*-value**
0	94.2%	60.0%	0.038
1	4.5%	40.0%	
2	1.3%	0.0%	
Count of alarm triggers	**No Medication [N = 120]**	**Medication [N = 40]**	***p*-value**
0	93.3%	92.5%	0.828
1	5.0%	7.5%	
2	1.7%	0.0%	
Alarm Triggered	**No Discussion [N = 135]**	**Discussion [N = 25]**	***p*-value**
No	97.0%	72.0%	< 0.001
Yes	3.0%	28.0%	
Alarm Triggered	**No recommendation [N = 155]**	**Recommendation [N = 5]**	***p*-value**
No	94.2%	60.0%	0.038
Yes	5.8%	40.0%	
Alarm Triggered	**No Medication [N = 120]**	**Medication [N = 40]**	***p*-value**
No	93.3%	92.5%	0.999
Yes	6.7%	7.5%	

[1] *p*-value based on Fisher's exact test

Table 6: Random-Effects Logistic Regression Results

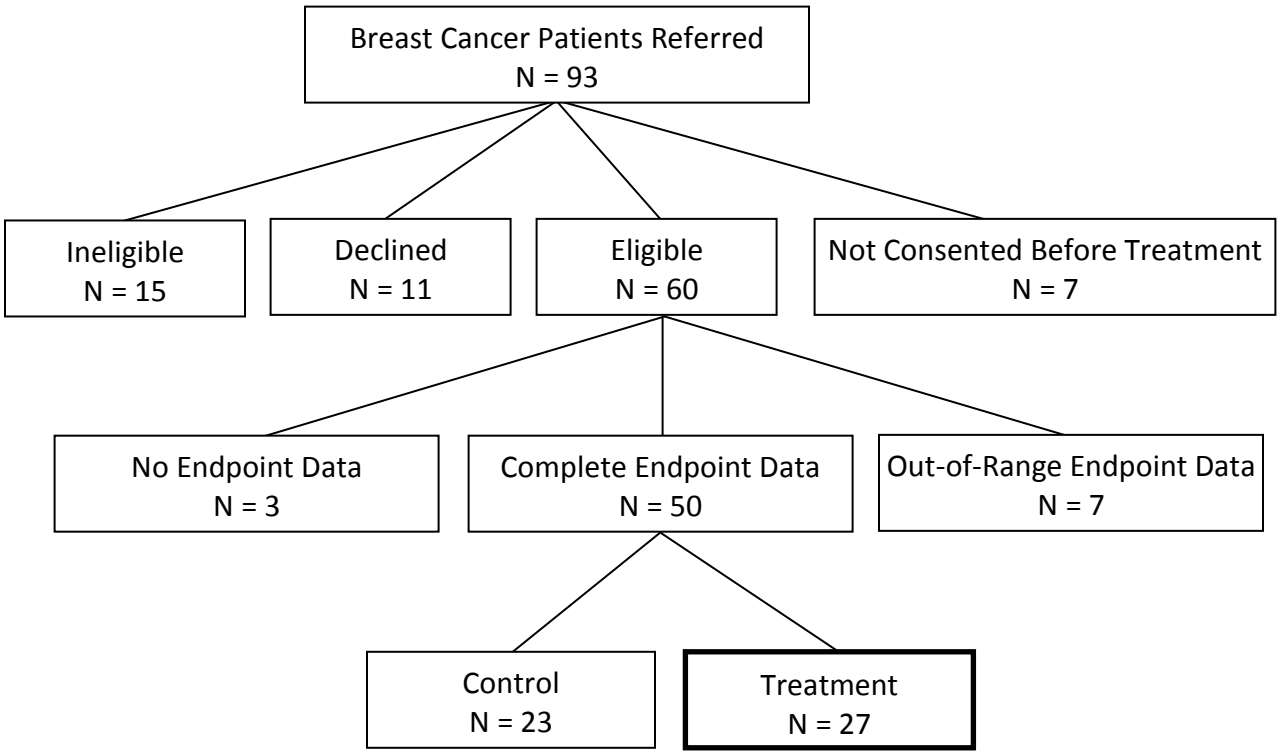
Outcome[1]	**Predictors**	**Odds Ratio**[2]	***p*-value**
Behavioral recommendation for depression (yes/no)	Number of depression video clicks	1.59	0.137
	Depression score	1.15	0.026
	Number of depression video clicks	1.67	0.104
	Depression score	1.17	0.024

[1]Random-effects logistic regression was used since a subject's observations are repeated over the clinic visits. Thus the within subject and between subject variance is used to estimate the correct standard error used to test the odds ratio.

[2]Odds ratio is for a one unit increase in the predictor variable

Figure Caption

Figure 1: Diagram of Included Participants


Breast Cancer Patients Referred
N = 93
Ineligible
N = 15
Declined
N = 11
Eligible
N = 60
Not Consented Before Treatment
N = 7
No Endpoint Data
N = 3
Complete Endpoint Data
N = 50
Out-of-Range Endpoint Data
N = 7
Control
N = 23
Treatment
N = 27