Feasibility of Using Technology to Disseminate Evidence to Rural Nurses and Improve Patient Outcomes

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abstract

Background: Rural African American women receive less frequent mammography screening and die of breast cancer at a higher rate than is seen in the general population. To overcome this disparity, it is necessary to assist rural providers in their efforts to influence women to obtain screening.

Method: This study examined the feasibility of using distance education to disseminate knowledge about timely and appropriate mammography screening to rural nurses, using patient outcome data to evaluate the effectiveness of this intervention.

Results: Overall, there was a decline in referrals and mammography screening, but the intervention group centers showed a smaller decline after the educational intervention than did the control group.

Conclusion: The findings show the effect of dissemination of information and the feasibility of using patient outcome data for educational evaluation. Neighboring academic health centers and nursing schools should include in their mission the provision of educational programs for relatively isolated rural nurses.

J Contin Educ Nurs 2010;41(1):25-32.

Breast cancer is the most common cancer (excluding skin cancer) and the second most common cause of cancer-related death in women in the United States, with an estimated 178,480 new cases of invasive disease and 40,460 deaths in 2007 (American Cancer Society, 2007a). More than 19,240 new cases of breast cancer were diagnosed among African Americans in 2005 (American Cancer Society, 2005b). The incidence rate is approximately 17% higher in White women than in African American women older than 40 years, but mortality rates for African American women are higher (American Cancer Society, 2005b). The disparity may be explained by comorbidities and tumors that are more aggressive and less responsive to treatment. However, later stage at diagnosis, perhaps as a result of lower rates of screening mammography, likely accounts for some of the racial disparity. Numerous studies have documented racial differences in screening rates (Barton, 2006; Breen & Kessler, 1994; Burns et al., 1996; Hirschman, Whitman, & Ansell, 2007; Makuc, Breen, & Freid, 1999). In 1987, only 29.0% of African American women 40 years and older reported the use of mammography screening for breast cancer within the last 2 years. In 2000, this percentage had increased to 66.7%, but it was still lower than the rate among White women (American Cancer Society, 2003). A recent study suggested that although African American women may undergo mammography, they might not be following regular screening guidelines (Hirschman et al., 2007).

Women with family incomes below the poverty level are less likely to receive a mammogram (American Can-

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The authors disclose that they have no significant financial interests in any product or class of products discussed directly or indirectly in this activity. This research was supported in part by NIH-NINR grant P20NR009009, Rural Health Care Research Center, University of Virginia, School of Nursing.

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doi:10.3928/00220124-20091222-08

cer Society, 2005a). In 2006, 24% of African Americans were living in poverty in the United States (DeNavas-Walt, Proctor, & Smith, 2006). The poverty rate for Black women (26.5%) was more than twice that for non-Hispanic White women (Institute for Women's Policy Research, 2005). Further, in 2003, 21% of African Americans were uninsured, 25% were covered by Medicaid, and only 49% were covered by an employer-sponsored insurance plan (Lillie-Blanton & Hoffman, 2005). Women who have less than a high school education and are uninsured are least likely to report having had a recent mammogram, and rural residence has also been found to lower the rate of mammography screening (American Cancer Society, 2007b; Hall, Jamison, Coughlin, & Uhler, 2004). Women in rural areas have been found to have higher rates of breast cancer and late-stage disease than women in nonrural areas (Flynn et al., 1997; Larson & Correa-de-Araujo, 2006; Liff, Chow, & Greenberg, 1991; Powell et al., 2005). Among African American women, those 50 years and older are disproportionately represented in the population of poor and uninsured in the United States. These women have been a difficult population to reach through conventional breast cancer intervention programs (Forte, 1995).

Possible explanations for the less frequent use of mammography screening by rural women include greater distance to medical facilities, less accessibility of services, and lack of or inadequate health insurance coverage (Coughlin, Thompson, Hall, Logan, & Uhler, 2002). Physician recommendation, known to positively influence mammogram use, has been reported to differ significantly between urban and rural women, and this could reflect the lack of a consistent primary caregiver for rural, poor women (Carr et al., 1996; Hall, Uhler, Coughlin, & Miller, 2002). In a study of Appalachian women, advanced age, lower income, lower education level, and not having seen a doctor within the previous year all were correlated with lower mammography screening rates (Hall et al., 2002).

Numerous studies have evaluated various methods to promote the use of mammography, with varying levels of success (Andersen, Hager, Su, & Urban, 2002; Champion et al., 2003). Earp et al. (2002) showed that lay health advisors could be trained to provide education and support to a rural population to increase the mammography screening rate. That intervention led to a 6% increase countywide, with an 11% increase among low-income women.

Rural nurses trying to stay current with evidence-based care may be isolated from continuing education opportunities and may have few available health care libraries and resources. Although technology is available to bridge this gap, little is known about how to use technology to provide information to busy nurses working in rural settings, and even less is known about whether providing information on a particular evidence-based practice would translate into improved patient outcomes.

In the current study, the authors sought to determine a feasible and acceptable way to disseminate information about evidence-based practice for one target condition: mammography screening. The current study could provide information about how to develop similar educational programs for the rural nurse who may be working in an area with few educational opportunities. Further, the study sought to determine whether patient outcomes can be changed based on nurses' education and practice and also whether these outcomes can be evaluated at a distance. This information will contribute to the development of a model of distance education for rural nurses and to the use of patient outcomes to evaluate the effect of nurses' increased knowledge.

Tele-health and web-based distance learning methods have been found to be useful in the dissemination of evidence-based information to nurses in rural practice (Atack & Rankin, 2002; Bernhardt, Runyan, Bou-Saada, & Felter, 2003; Olade, 2004; Olson, Stedman-Smith, & Fredrickson, 2005). Using an education program based on the curriculum developed by Earp et al. (2002), the current study used distance learning methods to prepare nurses who work with a vulnerable population of rural women to advise these women about mammography screening. Mammography screening is especially well suited for this pilot study in that a measure of effectiveness can be determined through the collection and analysis of patient outcome data.

METHODS

Study Population

Twenty-eight community health centers (CHCs) in rural areas of Virginia with an African American population of at least 25% were contacted and invited to participate in the pilot study. Eight center administrators agreed to participate, and the centers were randomized into control and intervention groups. Of the eight participating centers, one CHC employed eight nurses, whereas most of the other centers employed one or two nurses. At the CHCs that agreed to participate, all registered nurses and licensed practical nurses were contacted and asked to participate via a mailing sent to the center director. A total of 19 nurses agreed to participate and returned informed consent forms to the principal investigator; subsequently, 2 nurses dropped out. Centers were asked to abstract medical records and provide de-

identified patient data as a condition of their participation, and CHCs received $1,000 after data submission. The institutional review board of the University of Virginia approved the study. Nurses in both the control and intervention groups were given an examination on general breast cancer knowledge pre- and postintervention, and intervention group nurses were asked to complete a technology evaluation survey after each educational session. Of the eight CHCs that agreed to participate in the pilot study, four were randomly assigned to engage in the educational program. A total of 13 nurses, comprising the total nursing staff of the eight CHCs, agreed to participate and completed demographic surveys. Four nurses were randomized to the control group.

The study sample included the first 50 charts of patients seen in the CHC from May 2004 through October 2005 who met the study criteria. Eligible patients were women between 51 and 64 years, African American or White, Medicaid recipients, or uninsured. The age range of 51 to 64 years was chosen for two reasons: in Virginia, all women older than 50 years who are covered by Medicaid are entitled to annual screening mammograms. The upper limit of the age range was set at 64 years to exclude women covered by Medicare, because Medicare coverage would limit the investigators' ability to make assumptions about income. Patients who had a history of breast cancer in the last 3 years or who had abnormal findings on mammography within the last year were excluded. Data collection was completed by February 2006. De-identified data from 266 charts were provided. An econometric model of analysis was used to determine the differences in rates of patients receiving referrals and screening mammograms from the centers before and after the educational program. Correlated probit models were specified that allowed for CHC- and person-specific random effects, and they were estimated with simulated maximum likelihood methods. The model allowed for random effects, because if random effects were present, their existence would cause estimates to be inconsistent. The estimate of sigma, the standard deviation of the person-specific error, as seen in Table 3, implies a correlation of 4.6% among the errors before and after the intervention, suggesting that it was appropriate to allow for random effects. Once such random effects are found, simulated maximum likelihood has very good estimation properties.

Intervention

The educational program consisted of four sessions. Based on the curriculum of Earp et al. (2002), the study used web-based and videoconferencing distance learning methods to introduce and reinforce nurses' knowledge about breast cancer screening and diagnosis. The curriculum included a review of screening guidelines and a discussion of reasons why women choose not to undergo mammography, along with suggestions on how to encourage appropriate compliance with guidelines.

RESULTS

Use of Technology

All nurses participating in the intervention viewed slides, interacted with experts (a surgical oncologist and a women's health nurse practitioner), and participated in videoconferencing sessions. To participate in the web-based sessions, nurses needed to log on to the Blackboard learning platform, read the text, and respond to the forum discussion, which was meant to further explicate the material presented. Only 2 of the 13 nurses logged on, and just 1 of these 2 nurses posted a response to the forum discussion. Therefore, the rest of the nurses did not avail themselves of the curricular material available on this platform. The nurses' satisfaction with the technology used in the educational program was evaluated with a nine-question survey using a five-point Likert-type scale. Eleven responses were received after the videoconference sessions, and nine nurses evaluated the Blackboard sessions, although it was apparent that not all of these participants had actually accessed the program. Student *t* tests showed no significant differences between the nurses' satisfaction with videoconferencing compared with Blackboard sessions; responses indicated agreement with questions such as "It was convenient for me to participate in this session."

To evaluate the nurses' knowledge of breast cancer diagnosis and screening, a 30-question survey was given to the intervention group and control group nurses before and after the educational program. The four control group nurses submitted three pretests and three posttests, which provided too small a sample for analysis. In the intervention group, 16 pretests and 10 posttests were submitted (the two nurses who dropped out did so after completing the pretests). Improvement was noted on 71% of the questions; the number of correct responses ranged from 7% to 65%. These results show that the nurses who participated in the educational intervention could answer questions about breast cancer more accurately after the intervention, so participating in the educational program increased their level of knowledge about breast cancer in general.

Center-Level Data

The data collected from the centers included the percentage of African American and uninsured patients in the center population as well as the rate of referral and

TABLE 1

CHARACTERISTICS OF PATIENTS TREATED IN COMMUNITY HEALTH CENTERS RECEIVING DISTANCE TECHNOLOGY INTERVENTION AND COMPARISON GROUP OF PATIENTS TREATED IN COMMUNITY HEALTH CENTERS

	Total		Intervention Group CHCs		Control Group CHCs		
Description (Symbol[a])	***N***	**%**	***N***	**%**	***N***	**%**	***t* Test**
Percent African American patients (R)	160	60	79	59.3	81	60.9	-0.09
Percent Medicaid patients (I)	109	41	77	57.9	32	24.1	1.28*
Percent uninsured patients (U)	157	59	56	42.0	101	75.9	-1.16*
Percent preintervention referrals (Y_{i0})	49	18	28	21.1	21	17.2	0.835*
Percent preintervention screenings (Z_{i0})	41	15	23	17.3	18	14.7	0.352
Percent postintervention referrals (Y_{i1})	44	18	26	22.2	18	14.7	0.449
Percent postintervention screenings (Z_{i1})	36	15	22	16.5	14	10.5	0.420

Note. CHC = community health center. [a]Symbol is used to represent a particular variable in the econometric model. *Significant ($p \leq .10$).

TABLE 2

PERCENTAGE OF PATIENTS RECEIVING REFERRALS AND SCREENINGS IN INTERVENTION AND CONTROL GROUP CLINICS PRE- AND POSTINTERVENTION

	Preintervention Referral Rate	Postintervention Referral Rate	Change in Rate	Preintervention Screening Rate	Postintervention Screening Rate	Change in Rate
Intervention						
CHC1	18	15	-3	9	6	-3
CHC2	3	0	-3	3	0	-3
CHC3	18	7	-11	15	3	-12
CHC4	41	79	+38	41	79	+38
Total change		+21		+20		
Control						
CHC5	31	24	-7	31	24	-7
CHC6	0	10	+10	0	0	0
CHC7	21	19	-2	14	17	+3
CHC8	16	7	-9	12	7	-5
Total change		-8		-9		

Note. CHC = community health center.

screening mammography both before and after the educational intervention for both the intervention and the control group centers. In addition to patient data, center-level data on control variables were collected to control for various characteristics of the CHCs that might affect mammography referrals and screening rates. These data included the distance to the nearest mammography facility, the availability of a free transportation system, and the use of a reminder system. The intervention group centers were located an average of 22.5 miles from the nearest mammography facility, whereas the control group centers were 22.7 miles from the nearest mammography center. All of the centers were in counties considered more than 50% rural according to the U.S. Department of Agriculture system for judging rurality (U.S. Department of Agriculture, 2003).

Previous studies found free transportation and the use of a reminder system to be related to improved rates of cancer screening (Curry, Byers, & Hewitt, 2003). Only one of the control group centers in this study indicated that free transportation was available to patients of the CHC, but this service was restricted to the Medicaid

TABLE 3

COMPARISON OF PERCENTAGE OF PATIENTS RECEIVING REFERRALS OR MAMMOGRAMS WHEN DUE, BEFORE AND AFTER INTERVENTION (*N* = 266)

	Referral for Mammography		Receipt of Mammography	
Variable	**Estimate**	***SE***	**Estimate**	***SE***
Intervention group				
CHC1	0.742*	0.233	1.185*	0.275
CHC2[a]				
CHC3	0.744*	0.296	0.898*	0.317
CHC4	-0.604	0.468	-0.610	0.503
Control group				
CHC5	0.503*	0.217	0.418**	0.232
CHC6	1.616*	0.293	4.800	
CHC7	0.762*	0.220	0.928*	0.236
CHC8	1.101*	0.263	1.115*	0.288
African American patient	0.093	0.164	0.200	0.188
Medicaid patient	0.173	0.197	0.122	0.212
Intervention	0.409*	0.197	0.339**	0.209
Sigma	0.220	0.396	0.529	0.427

Note. CHC = community health center. [a]One intervention community health center was not included in the model because of the lack of variation in receipt of referrals and examinations. *Significant ($p \leqslant .10$). **Significant ($p \leqslant .05$).

population. The intervention centers did not indicate that free transportation was available. Two of the control group centers and one intervention group center indicated the use of a patient reminder system. Additionally, the only CHC with a mobile mammography service was a control group center.

The presence of a Breast and Cervical Cancer Early Detection Program (BCCEDP) mammography site may have affected the patient-level findings. BCCEDP, a program of the Centers for Disease Control and Prevention, was begun in 1990 to improve access to screening and diagnostic services for low-income uninsured women. Since 1991, approximately 4 million screenings have been performed for more than 1.75 million women (Centers for Disease Control and Prevention, 2007; Tangka et al., 2006). From 2005 to 2006, there were 23 enrollment sites across the state of Virginia and a network of approximately 250 facilities that provided mammography for enrolled women. Centers that refer women to a BCCEDP site do not receive mammography reports to include in their charts (V. Burnette, Coordinator, Pittsylvania-Danville Health District, personal communication, April 28, 2006). Therefore, in centers located in counties with a BCCEDP program site, many uninsured patients may have been referred to that site and received screening services there, resulting in missing data. One of the intervention group centers and two of the control group centers were located in counties with no program provider. One control group center and one intervention group center had two program sites in the county. Both of these centers reported very low rates of pre- and postintervention referral and screening, and both had very high percentages of uninsured patients: 72% in the intervention group center and 66% in the control group center.

Patient-Level Data

Table 1 shows descriptive data for the patient cases submitted. The population of Medicaid recipients was greater in the intervention group, as was the percentage of patients with preintervention mammography referrals, although not significantly. The preintervention rate of actual mammography screenings was not significantly greater in the intervention group.

Table 2 shows the percentage of patients receiving referrals and screenings in the intervention and control group centers pre- and postintervention. Only one of the intervention group centers and one of the control group centers reported an increase in the referral rate from pre- to postintervention. One intervention group center re-

ported an increase of 38%, and one control group center reported a referral rate increase of 10% postintervention. The average decline in referral rates at the three intervention group centers that reported lower postintervention rates was 5.6%. Three control group centers reported a decline in referral rates that averaged 6%.

Table 3 shows the results of econometric modeling. This model was used to identify differences in rates of patients receiving referrals and screening mammograms related to race. One of the intervention group centers, CHC2, previously described as having a high percentage of uninsured patients (78%) and a location in a county with two BCCEDP enrollment sites, was noted to have a very low rate of referrals and screenings. Inclusion of this intervention group center in the model was problematic because of the lack of variation, so it was excluded from the analysis. The effect of the intervention on the value of obtaining a referral and an examination was statistically significant at the 5% level, which implies large effects on behavior. These results show a positive effect on postintervention rates in the intervention group centers, and if no other change in CHC procedure occurred, this finding would indicate that the nurses' increased knowledge of breast cancer screening had an effect on their patients being screened. In this model, being African American increased the value of obtaining a referral (relative to not obtaining a referral) by a small amount; however, the estimate was not statistically significant.

These results suggest that patient outcome data provide a feasible measure of the dissemination of educational information in that, if no other change has been made in the way patients are seen in the clinic, it can be expected that the nurses used their increased understanding of the appropriate use of mammography screening to counsel or encourage patients about the need for timely mammography screening. This would result in a positive effect on postintervention rates in the intervention group centers, as was found in this analysis.

DISCUSSION

A number of studies have used lay advisors or trusted local women to teach and advise African American women or women of other racial or ethnic minorities about cancer and cancer prevention (Earp et al., 2002; Mock, Nguyen, Nguyen, Bui-Tong, & McPhee, 2006; Paskett et al., 2006). The current study was unique in that it used patient outcome data to evaluate the dissemination of education. Researchers found that patient outcome data provided a useful measure of the dissemination of education. The education program resulted in a small but positive increase in the likelihood of African American women receiving a referral for screening as well as actual mammography screening.

The value of continuing education for nurses in rural practice is clear. Professional isolation has been linked to geographic isolation and has been identified as a source of role strain for rural nurses (Bushy, 2007). The lack of resources or an immediately available professional network can be overwhelming for isolated providers. The use of technology to enable rural providers to remain current and in contact with a tertiary medical center for advice and consultation is valuable in enhancing the translation of research into practice.

Historically, evaluation of the effectiveness of continuing education with respect to learning new skills or changing behavior has been limited to data on the satisfaction of nurses' experience in participating and has not focused on the incorporation of new skills into practice or outcome indicators (Blair & Ramones, n.d.). Although the current study included an assessment of changes in nurses' knowledge, the primary means of evaluating the effectiveness of the program was an outcomes analysis of the patient population. The use of patient outcome measures is an effective method of determining whether practice has been changed by the spread of information on the evidence of best practices.

Limitations

The pilot study had several limitations that should inform future efforts to use distance learning for continuing education. The study collected data over a short period postintervention (6 months), but this may not have been long enough to show an outcome reflecting the development of new skills or a change in practice. The nurses who participated in the educational program did not self-select, and the researchers did not ask about the nurses' educational priorities. Therefore, the nurses' interest in advocating for breast cancer screening in the patient care setting was not assessed. Furthermore, the program was presented via distance learning, and even with the best use of distance learning, the challenges of maintaining learner motivation and commitment without face-to-face contact are great. Researchers did not have a complete view of the nurses' comfort level with technology. Although most of the nurses said that they had a computer with Internet access at home, their skill and comfort with the computer and the Internet was not assessed. As stated previously, the nurses had little interaction with the web-based portion of the program, so content was not well used by this group of learners. Additionally, organizational factors that might have precluded the development of a new patient education role were not evaluated.

key points

Jerome-D'Emilia, B., Merwin, E., Stern, S. (2010). **Feasibility of Using Technology to Disseminate Evidence to Rural Nurses and Improve Patient Outcomes.** *The Journal of Continuing Education in Nursing, 41*(1), 25-32.

1. Rural African American women are not receiving mammography screening as frequently as they should be, and their breast cancer mortality rate is higher than that of the general population of women.
2. Registered nurses working in rural community health centers are well situated to advise their patients of the need for timely mammography screening.
3. Web-based distance learning is useful for updating rural nurses on evidence-based practices that are relevant to their patient population.

Limitations may also have existed in the data collection processes and in the data themselves. First, centers with a large number of uninsured patients in a county where at least one BCCDEP site is located may have a mammography rate that is lower than would be expected, even for this underserved population. Second, reliance on centers to provide patient data does not allow evaluation of the quality of the CHC database, and it is possible that screening and referral dates may have been missed. In subsequent studies, it would be advisable either to conduct medical records review or to engage in primary data collection.

Recommendations for Future Research

Although it is imperative that academic health centers continue disseminating research findings and translating these findings into useful practice tools, future studies should follow from nurse-identified educational needs and recruit rural nurses more directly. Evaluating the outcomes of education is challenging, which is why these outcomes are reported so rarely in the literature. Nevertheless, outcomes provide a meaningful assessment of educational effectiveness.

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