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County-level Poverty and Barriers to Breast and Cervical Cancer Screening in a Health Education and Patient Navigation Program for Rural and Border Texas Residents

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Abstract

Purpose: The study examined the impact of (1) county-level poverty rates and (2) patient navigation on breast and cervical cancer screening outcomes for women in rural and border counties in Texas reporting barriers to screening.

Methods: Univariate analyses described the distribution and screening prevalence rates in the sample, while a series of random intercept logistic regression models analyzed mammogram (N=2,326 women aged 40+) and Papanicolaou (Pap; N=2,959 women aged 21–64) screening separately.

Results: Mammogram and Pap screening prevalence rates were highest among women who were aged 40–64, Spanish-speaking Latinas, lower educated, attending cancer education events because of the cost of the screenings, patient navigation recipients, living in the south region of Texas, and in counties with high poverty. Although models indicated significant variability in screening rates by county, county-level poverty was only significantly associated with odds of getting Pap screening in adjusted models. Not receiving patient navigation vs. receiving it was associated with lower odds for both mammogram (OR: 0.51, CI: 0.38–0.70) and Pap (OR: 0.69, CI: 0.50–0.94) screenings.

Conclusions: County-level variation in screening rates exist for both mammogram and Pap tests and should be considered in the development and implementation of screening interventions in rural and border areas. However, other factors beyond poverty levels may explain the variation.

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Keywords

health disparities; cancer screening; patient navigation; health education

Introduction

Women in rural counties with high poverty rates screen for breast cancer at much lower rates than their urban counterparts, and these differences are compounded for women of color when compared to urban and non-Latina white (NLW) residents [1–3]. Rural women's lower screening rates compared to urban residents' rates may, in turn, contribute to later stage diagnoses and higher mortality rates for both cancer sites [4, 5]. Studies of residents living in the Texas-Mexico border region reflect similar findings with lower breast and cervical cancer screening and higher cancer-related mortality in lower socioeconomic status (SES) areas compared to higher SES areas with additional variation by race/ethnicity favoring NLW women [2, 6]. Other findings reported limited clinical capacity, cost, lack of government funding sources, limited to knowledge of the healthcare system, low health literacy, work-related issues, transportation, and legal status as barriers to screening in Texas border counties [7].

The border region in Texas encompasses 32 counties of which 27 are designated rural and are characterized by average poverty rates for adults over 29% compared to just 16% in all US rural counties [8–10]. Most adult residents of these counties are Latinos (88%), some with limited English proficiency (32%) with a large proportion of uninsured (46%) and a high rate of adults without a high school diploma (33%) [9]. In addition, the top five counties with the highest adult poverty rates in Texas are designated as both rural and border, and only three of the ten counties with the highest adult poverty rates are designated as urban [11]. In contrast, only three of the counties in Texas with the lowest poverty rates are designated as rural and all are non-border [11]. Data comparing screening rates among rural counties are limited; however, the higher poverty rates and unique barriers to care faced by border populations suggest an even greater disadvantage for these residents.

Patient navigation (PN) was developed to address social determinants of health that impact screening uptake and supportive care across the cancer continuum [12–14]. Studies of PN have found generally positive findings to increase breast and cervical cancer screening rates among different populations [15]; however, few have examined the adaptation and implementation of PN to increase breast and cervical cancer screening among rural and border populations [16].

To address this gap, the following analysis examined the impact of county-level poverty rates on screening outcomes for participants attending cancer education events and reporting a barrier to screening. This paper aims to (1) identify variation in screening rates by county and poverty level and (2) examine the impact of PN services to identify and connect individuals residing in rural and border counties to clinical screening for breast and cervical cancer.

Methods

Intervention

In 2012, the Texas Agrilife Extension Service established *Friend to Friend plus Patient Navigation* (FTF+PN) with grant funds from the Cancer Prevention Research Institute of Texas (CPRIT) to increase breast and cervical cancer screening among women aged 40+ who may be disabled, self-employed, and/or have limited English proficiency residing in 76 un-/underserved rural and border counties. Grant funds paid for clinical services and employed four trained, lay patient navigators that joined an established team of four regional cancer specialists to follow-up with program participants and provide transportation or other ancillary services that addressed barriers that might prevent women from screening. Patient navigators and regional cancer specialists worked in four regional teams where they organized bilingual, culturally sensitive cancer education incorporating local cancer care professionals and survivors from the community.

Participants were recruited into the education program through a variety of community outreach efforts. Fliers were circulated in areas where the women were likely to see them, such as doctors' offices, groceries, laundromats, etc. Local health care providers also referred their patients in need of screening services to the program staff. The patient navigators and regional cancer specialists invited women to attend the events at churches, community gatherings, health fairs, and other public venues. Women who attended the event were entered into a drawing for a "door prize" awarded at the end of the event to incentivize participation.

The evidence-based education program known as a "pink party" informed women about the need for timely breast and cervical cancer screening based on American Cancer Society (ACS) guidelines for breast and cervical cancer at the time recommending annual mammograms for women aged 40–54 and biannual mammograms for those aged 55+ with average risk of breast cancer and Papanicolaou (Pap) tests every 3 years for women aged 21–29 and every 5 years for women aged 30–64 [17–19]. Items measuring screening knowledge and screening history in pre- and post-test surveys used in this program had previously been examined in a randomized control trial [20]. Relevant questions from the pretest included demographic and barrier items as well as separate mammogram and Pap test items for the following: 1) how often should someone your age get screened? (every year, every 2 years, every 3 years, not needed, not sure); 2) when was your last screening? (within the last year, within the last 2–3 years, more than 3 years ago, not sure, never screened); 3) when do you plan on getting your next screening? (within the next year, within the next 2 years, within the next 3 years, not needed, not sure); and 4) what was the main reason you came to this program? (needed help paying for tests, came with a friend/family member, a family history of cancer, doctor/nurse told me I needed the tests, to find out more about tests, other). The screening related questions were asked again in the post-test with the option to leave their contact information for a follow-up questionnaire. Women attending the party were offered help getting screened at the end of the event using PN services to assist them with payment, transportation, or other barriers that might prevent them from screening.

Participants who provided contact information at any point during the intervention received follow-up interviews to assess their screening outcomes.

Data Source

The analysis combines the proportion of adults living at or below the federal poverty level (FPL) for each county with individual-level variables from FTF+PN participants who attended the FTF and reported at least one barrier to screening. FTF+PN was implemented in 36 rural and border counties during 2012, and the following year saw an additional 23 counties served. In 2014, 5 more counties received the intervention for the first time. Finally, 7 novel counties were included in the program in 2015 and 5 more in 2016. Based on availability and demand, some counties had multiple parties within the same year and some held additional parties in subsequent years. In total, FTF+PN operated in 76 unique counties within four administrative regions and held over 180 separate FTF events from 2012 to 2016. This project considers counties as rural, frontier, or border based on U.S. Census definitions of metropolitan and non-metropolitan areas that correspond to rural and urban categories [8]. In addition, border and non-border designations are based on the La Paz Agreement of 1983 between the U.S. and Mexico defining counties that are within 100 kilometers of the U.S./Mexico border as “border counties” [8].

The individual-level data include responses to pre- and post-test surveys from FTF+PN participants during events and follow-up surveys of screening behavior from March 1, 2012 to November 5, 2016, totaling N=7,450 unique observations. The analytic sample first excluded women who had not received follow-up (n=1,451) as their screening status could not be determined. Women who did not report barriers to screening (n=1,667) were also excluded. In addition, 96 respondents reporting multiple or other racial/ethnic categories, women who identified as American Indian or Native American (n=29), Asian, Asian-American, or Pacific Islander (n=30), were excluded due to small sample sizes. Latinas were divided into two groups based on their language preference at home; therefore, those that spoke something different than English or Spanish (n=6) or missing this variable (n=50) were removed. Surveys with missing age (n=95) and education level (n=189) were excluded. Finally, 545 participants who had attended repeated events were excluded for a total of N=3,292 included in the analytic sample. The Institutional Review Board (IRB) of The University of Texas at Austin reviewed and approved (FWA # 00002030) the proposed study prior to analysis.

Measures

Individual-level dependent variables.—The dependent variable consists of FTF+PN follow-up participants’ receipt of a mammogram and/or Pap screening based on self-report, dichotomized as yes or no. During follow-up interviews, participants reported their date of screening for a mammogram and/or Pap test as evidence of receipt of cancer screening. If program funds provided for screening, this date was also confirmed with the provider at the time of payment. However, not all cases were paid through grant funding if, for example, women had insurance that covered the cost of the screening but needed assistance in another form, such as transportation. For the mammogram outcome, only women aged 40+ were included in the analysis based on ACS recommendations for an analytic sample of N=2,326.

The Pap screening outcome sample was similarly reduced to women aged 21–64 based on ACS recommendations for a total of N=2,959 participants.

Individual-level independent variables.—Respondents provided demographic data including age (determined from their year of birth), race/ethnicity (non-Latina black [NLB], Latina, and NLW) primary language use at home, and education level (did not complete high school, high school graduate, or some college or more). Primary language use at home was defined as those who spoke English only, Spanish only, or English and Spanish equally. This variable was used to differentiate English speaking Latina (ESL) women from Spanish speaking Latina (SSL) women. Participants indicated if cost was the main reason for attending FTF, and their patient navigation status was recorded during follow-up interviews. Both of these items were reverse coded to highlight the impact of cost and participation in PN on screening completion. The posttest captured potential barriers to screening with options including worry about cost, transportation, not having time, problems with child/elder care, nervousness about testing, bad experiences getting care, testing not offered where they live, not knowing where to go, problems getting through the application process for assistance programs, or another reason. This variable was used to select those who reported a barrier to screening while excluding women who did not report any barrier from the analysis.

County-level poverty.—The U.S. Census Bureau supplied aggregated data from the 2014 American Community Survey for county-level measure of poverty [11]. Percentages of the adult county population aged 18+ who lived below the federal poverty level (FPL) comprised the area SES measure, which served as the main independent variable of interest. This variable was divided into tertiles including counties with less than 14.2% of adults below the FPL (low), counties with 14.2% to less than 19.5% of adults below the FPL (medium), and counties with 19.5% or more of adults below the FPL (high). Thus, this measure assesses FTF+PN participants' screening behavior relative to their residential location. The region variable reflected the program's administrative organization in the state (North, South, East, and West).

Statistical Analysis

Univariate statistics described the distribution of the sample and prevalence rates of mammogram and Pap screening by the independent variables. The primary statistical analyses consisted of multilevel logistic regression models using PROC GLIMMIX in SAS 9.4 (SAS Institute Inc., Cary, NC). A series of regression models analyze mammogram and Pap screening completion separately using random intercept models with individual and county level data. First, an intercept only model was used to calculate between-county variance. Then, fixed effects including age, race/ethnicity/language, education level, and program region were added to the model. The next models include not attending FTF due to cost of screening and PN participation. The county-level poverty ranking was added as the final model.

Results

Univariate Analyses

Results from the univariate analyses showed that mammogram and Pap screening prevalence rates were highest among women aged 40–64, SSL, and lower educated women (Table 1). Over 41% of women with barriers did not attend the education intervention due to the cost of screening, and 26% of the sample chose not to participate in PN. Residents of counties with more than 19.5% of adults living in poverty represented the largest portion of the sample and had the highest screening prevalence rates for both tests at 62.3% for mammogram screening and 56.2% for Pap screening. Similarly, the South region experienced the highest prevalence rates for both screenings and represented the largest portion of the sample. Mammogram screening prevalence rates were highest for women aged 40–64 years (56.4%), SSL women (66.4%), and those who did not achieve a high school education (64.6%). Compared to those who did not attend FTF due to the cost of a mammogram, screening prevalence rates were nearly 30% higher for women who needed help paying for their mammogram. Similarly, mammogram screening prevalence rates were more than double for PN recipients at 63.6% compared to non-intervention respondents.

Pap screening prevalence rates observed similar trends for SSL women, who experienced more than double the rates of NLW women at 61.1%. Lower educated women had higher prevalence rates for Pap screening at 59.3% compared to those with some college or more who only had a prevalence rate of 32.5%. Differences in prevalence rates were even more pronounced for Pap screening comparing women who attended due to cost and participated in PN. Women who attended due to the cost of screening had more than double the prevalence rates of screening at 59.8% compared to those who did not attend due to cost, while women who participated in PN had more than triple the rates at 56.5% compared to their counterparts.

Multivariate Analyses

Null models first calculated the pseudo inter-correlation coefficient (ICC) for both screenings. For mammogram screening, the pseudo $\text{ICC}=\frac{0.96}{0.96+3.29}=23\%$ [21]. For Pap screening, the pseudo $\text{ICC}=\frac{1.37}{1.37+3.29}=29\%$. Table 2 reported the results of the subsequent regression models for mammogram screening. Model 1 analyzed demographic variables including age, race/ethnicity/language categories, education level, and program region. In the first model, NLB (OR: 0.56, CI: 0.34–0.92) and ESL (OR: 0.64, CI: 0.44–0.92) women reporting a barrier to screening both experienced lower odds of screening with a mammogram compared to NLW women. Women in the South region (OR: 2.29, CI: 1.12–4.68) compared with the North also had higher odds of receiving a mammogram. This model also observed significant variability in mammogram screening rates at the county level (down from 0.96 to 0.66). Age and education level were not significant. In Model 2, the adjusted model revealed that women with barriers who were not concerned about cost (OR: 0.71, CI: 0.56–0.90) and who did not participate in PN (OR: 0.51, CI: 0.38–0.70) also experienced lower odds of getting screened. Again, significant county-level variability was present in this model (0.46), and fit statistics indicated the addition of these variables as

an improvement from the previous model. Finally, the last model included the county-level poverty variable which did not contribute any new findings from the previous one. Results continued to indicate significant county-level variability (0.44) but with worse model fit. Also, NLB (OR: 0.57; CI: 0.34–0.94) and ESL (OR: 0.55; CI: 0.38–0.81) women continued to experience lower odds of mammogram screening compared to NLW women in this adjusted model.

The first Pap screening model found that education played a significant role (Table 3); those with less than a high school education (OR: 1.29, CI: 1.01–1.64) and high school graduates (OR: 1.29, CI: 1.02–1.63) experiencing higher odds than college educated women. Women in the South compared with the North region (OR: 4.03; CI: 1.87–8.70) also had higher odds of receiving a mammogram. In Model 2, women with barriers not attending FTF due to the cost of screening (OR: 0.56, CI: 0.45–0.69) and not being a PN participant (OR: 0.70, CI: 0.51–0.96) had lower odds of receiving a Pap screening. Once again, significant variability was observed at the county level (0.62, down from 0.79 in Model 1), and fit statistics indicated an improved model with the addition of the two variables. Women who did not attend FTF due to the cost of screening (OR: 0.56, CI: 0.45–0.69) and were not PN participants (OR: 0.69, CI: 0.50–0.94) continued to experience lower odds of Pap screening in the next model. Residents of the South region (OR: 4.27; CI: 2.11–8.65) compared with the North and from counties with the lowest poverty levels (OR: 2.16, CI: 1.13–4.13) compared with the highest levels had higher odds of receiving a Pap test. County-level variability remained significant (0.59, compared to 0.62 in Model 2), and model fit statistics slightly improved with the addition of the county-level poverty variable.

Discussion

The findings from this study affirm PN as an effective method to increase screening uptake for both breast and cervical cancer. Mitigating financial barriers to care facilitated significant gains in screening rates among women with barriers to screening. PN factors directly into this finding as patient navigators facilitated payment for screening services and served other needs, such as transportation. Thus, PN practice in rural and border areas provides a responsive approach to bridge gaps between health care systems and residents in need of cancer care services.

Individual level variables indicated areas of programmatic success consistent with research supporting screening uptake in diverse, lower SES populations. For example, providing cancer education and supportive services directly impacts cancer screening uptake for lower educated women by increasing perceived susceptibility and providing access to screening services through programs designed to mitigate this barrier [22, 23]. Increased access to health care and no cost screenings provided by the Affordable Care Act has also increased screening for lower educated individuals [24]. Further, individual factors such as fatalism, religiosity, gender roles, and linguistic and cultural provider competence may impact screening uptake in ways not assessed in this study [22, 25, 26].

However, county-level poverty only explained variation in Pap screening uptake. Despite significant county-level variability, county-level poverty did not explain variation in

mammogram screening compared to other studies demonstrating the screening advantage for higher SES areas [2]. Despite their variation, the counties are high poverty in general, leading to less variation from county-to-county compared to higher SES, urban counties.

Broad implementation of sustainable PN programs faces many challenges. First, PN services require funding from non-traditional sources as these services are not usually covered by health insurance further straining resource limited safety net providers already struggling with reduced payments for reimbursable services [27]. Rural hospitals also contend with rapidly increasing closures due to financial shortfalls further risking access to care among socioeconomically disadvantaged and racially/ethnically diverse communities such as those in rural and border areas of Texas [28]. While accreditation standards reflect the evidence base supporting PN by benchmarking best practices in cancer care, only institutions with the capacity to absorb the additional cost of PN can adhere to this level of care. Furthermore, shortages in cancer care professionals, rising treatment costs, and higher incidence rates of cancers among an expanding and aging population pose even greater challenges to health care systems required to respond with innovative practices while struggling to maintain their current capacity [29].

Despite PN's focus on the navigator as the primary means of intervening with patients, PN has also been described as a system of care involving both professionals in the cancer care community and outside the bounds of a health care institution [14]. As a result, the various individuals involved in PN and cancer care must understand their role as a part of PN to achieve the best outcomes for individual patients and the population. Interprofessional education for all health providers offers a means to enhance clinical practice areas addressing psychosocial contributions to health and wellbeing [30].

Limitations

While this study attempted to include multilevel factors influencing screening behavior, other elements may also account for differences in screening by residential location, race/ethnicity/language, and other measures. Program implementation protocols varied by region so that patient navigators and regional cancer specialists could adapt to local conditions. Consequently, these differences may affect screening and participation rates in ways not assessed in this study as noted by the outcomes in the South region. At the time of the analysis, follow-up interviews had not been conducted on all intervention participants leading to possible bias in the results (Appendix 1). Follow-up procedures varied from region to region leading to differences in follow-up screening rates. For example, the South region's additional patient navigator adding to their capacity to perform follow-up interviews at higher rates than the other regions. Also, participants from year 1 had a much longer timeframe to receive follow-up compared to participants in later years. Consequently, these practical limitations may have affected the results of the study.

Conclusion

Women with known societal barriers face multifaceted challenges to screening for breast and cervical cancer often leading to negative outcomes for the un-/underserved. Programs such as FTF+PN offer education and firsthand assistance for women to overcome these barriers

to preventative care. This help extends to communities in need such as higher poverty counties in rural and border areas that benefit from these services. Variation in screening uptake among counties may also be informed by future qualitative investigations assessing individual and community factors not assessed in this study. To conclude, screening decisions are impacted by both individual and contextual factors that distinguish screening behavior among varying groups of women, and both should be considered in the design and implementation of interventions aiming to improve health outcomes for un-/underserved groups.

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Appendix 1

Chi square tests comparing the proportions of Friend to Friend + Patient Navigation participants without follow-up interviews to participants with follow-up interviews reporting barriers to screening (n=4,743), 3/1/12–11/5/16

Variable	No follow-up (n, %)	Follow-up (n, %)	*P*
Total	1,451	3,292	
Age			
21–39 years	271, 19.7	929, 28.5	<.0001
40–64 years	657, 47.9	2,030, 62.4	
65+ years	445, 32.4	296,9.1	
Race/ethnicity/language (%)			
Non-Latina Black	101,7.2	133,4.0	<.0001
English Speaking Latina	100, 7.2	450, 13.7	
Spanish Speaking Latina	252, 18.0	1,826, 55.5	
Non-Latina White	945, 67.6	882, 26.8	
Education level (%)			
Did not complete high school	168, 12.0	1,264, 38.4	<.0001
High school graduate or GED	370, 26.5	911,27.7	
Some college or more	858,61.5	1,116,33.9	
Region			
North	492,33.9	736, 22.4	<.0001
East	543, 37.4	447, 13.6	
West	236, 16.3	422, 12.8	
South	180,9.7	1,686, 90.4	

Variable	No follow-up (n, %)	Follow-up (n, %)	*P*
Attended FTF due to cost of screening	194, 13.4	1,939, 58.9	<.0001
Did not attend FTF due to cost of screening	1,257, 86.6	1,352,41.1	<.0001
% county residents living in poverty			
1st tertile, <14.2	363,25.0	635, 19.3	<.0001
2nd tertile, 14.2-<19.5	461,31.8	649, 19.7	
3rd tertile, 19.5+	627,43.2	2,007,61.0	

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Table 1

Sample distribution, mammogram, and Papanicolaou (Pap) screening prevalence rates of Friend to Friend + Patient Navigation follow-up respondents reporting one or more barriers to screening, 3/1/12–11/5/16

Variable	Full sample (%)	Mammogram (% yes)	Pap (% yes)
	N=3,292	N=2326	N=2,959
Age			
21–39 years	28.5	-	46.8
40–64 years	62.4	56.4	48.4
65+ years	9.1	34.1	-
Race/ethnicity/language			
Non-Latina Black	4.0	34.6	26.0
English Speaking Latina	13.7	39.1	35.9
Spanish Speaking Latina	55.5	66.4	61.1
Non-Latina White	26.8	39.0	25.8
Education level			
Did not complete high school	38.4	64.6	59.3
High school graduate or GED	27.7	52.4	49.1
Some college or more	33.9	41.3	32.5
Region			
North	22.4	32.7	20.0
East	13.6	43.9	27.7
West	12.8	44.1	30.5
South	51.2	68.6	67.7
Did not attend FTF due to cost of screening	41.1	36.2	27.5
Attended FTF due to cost of screening	58.9	65.6	59.8
Not a patient navigation recipient	25.5	25.6	16.3
Patient navigation recipient	74.5	63.6	56.5
% county residents living in poverty			
1^{st} tertile, <14.2	19.3	41.5	39.0
2^{nd} tertile, 14.2-<19.5	19.7	37.5	28.8
3^{rd} tertile, 19.5+	61.0	62.3	56.2

Table 2

Mammogram screening models for Friend to Friend + Patient Navigation follow-up respondents aged 40+ reporting a barrier to screening (N=2,326), 3/1/12–11/5/16

	Model 1		Model 2		Model 3	
Fixed effects	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**
Age						
40–64 years	ref.		ref.		ref.	
65+ years	0.75	0.56–1.01	0.94	0.69–1.27	0.93	0.69–1.27
Race/ethnicity/language						
Non-Latina Black	0.56***	0.34–0.92	0.57**	0.35–0.94	0.57**	0.34–0.94
English Speaking Latina	0.64***	0.44–0.92	0.57**	0.39–0.82	0.55**	0.38–0.81
Spanish Speaking Latina	1.11	0.80–1.53	0.94	0.67–1.30	0.92	0.66–1.28
Non-Latina White	ref.		ref.		ref.	
Education level						
Did not complete high school	1.31	1.00–1.71	1.19	0.91–1.56	1.19	0.91–1.56
High school graduate or GED	1.17	0.91–1.49	1.08	0.84–1.39	1.09	0.85–1.40
Some college or more	ref.		ref		ref.	
Region						
North	ref.		ref.		ref.	
East	1.71	0.88–3.32	1.45	0.81–2.61	1.39	0.77–2.51
West	1.24	0.68–2.25	1.18	0.69–2.01	1.25	0.72–2.19
South	2.29*	1.12–4.68	1.95*	1.04–3.64	1.85	0.99–3.48
Reason for attending FTF						
Not due to cost of screening			0.71**	0.56–0.90	0.71**	0.56–0.90
Due to cost of screening			ref.		ref.	
Patient navigation participant						
No			0.51***	0.38–0.70	0.51***	0.38–0.70
Yes			ref.		ref.	
% county residents living in poverty						
1st tertile, <14.2					0.80	0.45–1.41
2nd tertile, 14.2-<19.5					0.83	0.50–1.39

	Model 1		Model 2		Model 3	
Fixed effects	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**
3rd tertile, 19.5+					ref.	
Error variance (estimate, standard error)						
County (Level 2)	0.66(0.18)***		0.46(0.14)***		0.44(0.14)***	
Fit statistics						
−2 log likelihood (−2LL)	2,775.56		2,736.50		2,735.75	
Δ −2LL (Δ degrees of freedom)			39.06 (2)	*P*<0.0001	1.16(1)	*P*=0.28
AIC	2,797.56		2,762.50		2,765.75	
BIC	2,822.76		2,792.27		2,800.11	

* *P* < .05,

** *P* < .01,

*** *P* < .001

Table 3

Papanicolaou (Pap) screening models for Friend to Friend + Patient Navigation follow-up respondents aged 21–64 reporting a barrier to screening (N=2,959), 3/1/12–11/5/16

	Model 1		Model 2		Model 3	
Fixed effects	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**
Age						
21–39 years	ref.		ref.		ref.	
40–64 years	1.17	0.97–1.41	1.13	0.93–1.36	1.13	0.94–1.37
Race/ethnicity/language						
Non-Latina Black	0.60	0.34–1.04	0.61	0.35–1.07	0.62	0.35–1.09
English Speaking Latina	0.74	0.52–1.06	0.69 *	0.48–0.99	0.72	0.50–1.03
Spanish Speaking Latina	1.09	0.80–1.50	0.97	0.71–1.34	1.01	0.73–1.39
Non-Latina White	ref.		ref.		ref.	
Education level						
Did not complete high school	1.29 *	1.01–1.64	1.18	0.92–1.50	1.17	0.92–1.50
High school graduate or GED	1.29 *	1.02–1.63	1.18	0.93–1.50	1.17	0.92–1.49
Some college or more	ref.		ref.		ref.	
Region						
North	ref.		ref.		ref.	
East	1.64	0.81–3.33	1.40	0.73–2.69	1.65	0.85–3.17
West	0.97	0.51–1.87	0.90	0.49–1.65	0.73	0.39–1.36
South	4.03 **	1.87–8.70	3.58 ***	1.77–7.26	4.27 ***	2.11–8.65
Reason for attending FTF						
Not due to cost of screening			0.56 ***	0.45–0.69	0.56 ***	0.45–0.69
Due to cost of screening			ref.		ref.	
Patient navigation participant						
No			0.70 *	0.51–0.96	0.69 *	0.50–0.94
Yes			ref.		ref.	
% county residents living in poverty						
1st tertile,<14.2					2.16 *	1.13–4.13

	Model 1		Model 2		Model 3	
Fixed effects	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**
2nd tertile, 14.2-<19.5					1.31	0.73–2.35
3rd tertile, 19.5+					ref.	
Error variance (estimate, standard error)						
County (Level 2)	0.79(0.21)***		0.62(0.18)***		0.59(0.17)***	
Fit statistics						
−2 log likelihood (−2LL)	3,257.77		3,213.83		3,208.33	
Δ −2LL (A degrees of freedom)			43.94(2)	*P*<0.0001	5.50(1)	*P*=0.02
AIC	3,279.77		3,239.83		3,238.33	
BIC	3,305.26		3,269.95		3,273.09	

*$P < .05$,

**$P < .01$,

***$P < .001$