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As I write to you all from the 2014 TPHA Annual Education Conference in Corpus Christi. Much of my time, and even more of our Executive Director, Terri Pali’s time has been consumed with attending to the details of conducting a large and varied meeting. I am excited by the speakers and sessions we will offer at the AEC. I hope that by the time you read this, you will have lasting memories of stimulating discussions and timely presentations that leave you better equipped to address the challenges of improving the public’s health in Texas.

Many TPHA members have worked tirelessly throughout the year to attend to the business of TPHA. As I prepare to hand the gavel to next year’s president, Jim Swan, I want to highlight some of TPHA’s noteworthy accomplishments.

First, the Executive Board and Governing Council approved a strategy for responding to requests to support legislation, grant proposals, and other issues, usually on short notice. With guidelines in place, TPHA is now able to respond quickly and add our voice to important conversations about legislative priorities or to help like-minded organizations apply for funding.

Second, TPHA teamed up with the Texas Public Health Coalition and its member organizations to advocate for Texas legislation to promote public health and with some notable successes, including the passage of appropriation bills that will fund the Texas Department of State Health Services for vaccinations and tobacco-cessation programs and to the Texas Education Agency for assessing children’s fitness. TPHA will continue to support TPHC’s efforts towards legislation focusing on increasing vaccinations, helping Texans be physically active and eating healthy diets, avoiding tobacco, and preventing cancer.

Our third arena of activity was our efforts, spearheaded by past president Kaye Reynolds, to prepare local health departments to acquire the necessary knowledge and skills to obtain voluntary national accreditation through the Public Health Accreditation Board. With support from the American Public Health Association, Texas Association of Local Health Officials, Texas Public Health Training Center and the University of North Texas Health Science Center, we held our second Accreditation Workshop in May 2013 focusing on Performance Management and Quality Improvement and Documentation. Several sessions on accreditation are being held during our TPHA AEC. These include a session on Culturally and Linguistically Appropriate Services (CLAS) Standards as well as NEW Public Health Accreditation Board Education Version 1.5 – Domains, Standards and Measures. This summer, TPHA will host a webinar on workforce development (PHAB Standard 8). Please visit our website often for more information, www.texaspha.org.

And finally, to address our mission of providing educational support to public health providers, TPHA was awarded funds from APHA to partner with the Austin/Travis County Health and Human Services department to host a webinar to promote successful projects funded by federal Community Transformation Grants. Dr. Phil Huang, Medical Director and Health Authority of ATCHHS, spoke about effective strategies for enacting tobacco-free worksite campus policies. The webinar was well attended and was available to a national audience following the live webinar.

Much of our efforts this past year have gone towards preparing for the AEC. The Planning Committee developed and piloted a new system for abstract submissions that resulted in more peer-reviewed oral and poster presentations than ever. We have speakers coming from more than 20 counties in Texas and from two countries outside the US. Besides all the work the Local Arrangements Committee has done to host our AEC, they also facilitated our TPHA Fellows Project (coordinated by Bobby Schmidt), which engaged Corpus Christi elementary, middle, and high school students in a competition to illustrate or write about public health in Texas. The winners of the competition will be displayed and recognized at the AEC.

I am inspired to see so many people working to make TPHA a strong and vibrant organization. My special thanks go to Terri Pali for her patience and steady and expert administrative skills this year. As I leave office, I look forward to continuing to serve TPHA and to encouraging more people to join TPHA and members to work towards accomplishing our valuable mission.
start this presidential year undergoing medical treatment that will allow me to communicate only electronically for a couple of months or so. Oh well, when one is on a five-year leadership track, one cannot always plan one’s illness to fit a convenient schedule.

We speak every year of the challenges to public health and to the health of the population of Texas. This year is certainly no exception. Public health has its own perspectives on promoting the health of the public, perspectives that often clash with prevailing attitudes, politics, and historical trends. In particular, public health sees humans as both unique individuals and among the most social of beings. We hold to values celebrating both individual autonomy and the needs of the community. We thus see health and illness as stemming from varied sources: individual responsibility, social determinants, and environmental conditions. We consequently promote health to individuals, undertake population-health campaigns, act to prevent and to counter threats to health and safety, plan programs at all levels to benefit the health of Texans, and advocate policy that will likewise do so. And we build our public health knowledge base and infrastructure through research and evaluation, education and training, planning, leadership, and administration. As a dedicated, applied field, we are pragmatic, seeking to use the tools that come to hand to accomplish our goals; but we are also proactive and strive to improve those tools and develop new ones. And although we are a small association facing such major issues, we know we are part of a much-greater public health and public service community, with which we must continue and strengthen partnership. Thus, some of the tasks we set for ourselves as TPHA may appear small and inconsequential set against the major challenges that face the health of Texans; but these tasks are essential to our working with the wider community fighting to ensure a healthy Texas.

Partnership is essential to public health. The Association partners with state and local departments and organizations. For example, we have been quite active in sponsoring workshops for local health department accreditation. We work with a variety of public health-related organizations in sponsoring special conferences, including regional public health training conferences. And we of course work with networks of public health organizations and activists to promote healthy lifestyles, particularly physical activity and good nutrition; tobacco-free living; chronic-disease prevention; vaccinations; efforts against environmental hazards; access to healthcare and nutritional resources; and so on.

So, here are challenges I give to any and all of us: help plan for next year’s annual education conference by joining the program planning committee. The committee holds its first meeting onsite at the conclusion of each annual conference but can be joined at any time, just send an email of your intentions to txpha@aol.com; get involved with other committees and groups working to build the association (for example, the Membership Committee) or undertaking tasks important to the association (for example, the Legislation, Policy, and Government Affairs Committee); become active in a section that works in an area of your interest and expertise; consider taking leadership of the association, whether through section or committee leadership or through commitment to being a governing counselor for the association as a whole.

Active membership is the lifeblood of the Association. We have made great strides in this regard, in particular building a large, active, and vibrant Student Section, bringing in new lifeblood. This means not just encouraging individual students to join and be involved, but also creating active partnerships with higher education programs in the diversity of disciplines that contribute to public health. It also involves willingness to mentor the wonderful students who come to our association.

I am proud to be a founding member of our newest section, Aging and Public Health. Although still a small section, in the past year it has organized itself as an active group that has joined other sections in sponsoring our own juried paper sessions at this conference, remaking our pre-existing aging track into opportunities of practitioners, academics, and students to present juried papers. In this, we are but one of several sections that have taken this step with this year’s conference.

And for some of you, I issue a particular challenge to consider undertaking leadership in the association. I refer to what I have been known to call the “sucker track”: a five-year leadership commitment through second vice-president, first vice-president, president-elect, president, and past-president. It is a long trail to follow but one that allows for considerable personal growth, while building experienced leadership for the association. Eligibility is open to elected fellows of the Association, activists with at least five years’ membership. That means that you can all be fully eligible in five years or less, so think ahead!

I don’t say that participation is easy, or always fun; but it is rewarding. And it can be eased. For example, most of our work, including committee and governing work, can be undertaken via email, telephone conferencing, and Skype. Hey, consider in coming months when I am immunosuppressed, so unable to attend meetings in person, I plan to be an active president via Skype and other electronic means. The bottom line: if you want to be involved, that involvement will be accommodated.

Thank you for all for attending our recent conference, for the work you do to promote the health of Texas, and let’s see each other again at next years’ conference in the Austin area.

Commissioner’s Comments
A Focus on Women’s Health
David L. Lakey, M.D.
Commissioner, Texas Department of State Health Services

Take a moment to think about the women in your life. They are our mothers, grandmothers, daughters and sisters, and Texas is now better positioned to help ensure women have access to the health care they need – whether that’s during pregnancy, in between pregnancies or to avoid unintended pregnancies.

Despite previous reductions in family planning funds, Texas has multiple funding streams that are helping DSHS, local health departments and other providers restore women’s health services across the state. The focus is now on comprehensive care that addresses not only contraception but also disease prevention and overall health.

There is a renewed interest among state leaders and real hope for women that Texas is working to ensure it has the capacity to provide preventive health care and family planning to low-income women.

One of the biggest boosts we received during the last legislative session was $100 million in additional funds for the next two years to expand our Primary Health Care program. The expansion has allowed us to increase access to essential comprehensive women’s health care services in Texas. Texas also continues to offer women’s health services through the department’s Family Planning program, funded with $43 million in state dollars this biennium, and the Texas Women’s Health program administered by the Texas Health and Human Services Commission.
The expansion to our Primary Health Care program will serve about 170,000 low-income women per year and covers a range of services including family planning and health screenings. We recently awarded more than $45 million in new state funding to more than 50 agencies – from hospital districts to local health departments – across the state to expand access to low-cost women’s health services. Funds also will be available to these providers for 2015. Many of the agencies operate multiple clinics – with a total of more than 200 clinic sites statewide. More than 60 percent of the women served will receive family planning services.

As part of the expansion, services include mammograms, pelvic examinations, STD screening and treatment, immunizations, prenatal medical and dental services, sterilizations, contraceptives, health screenings and other services. To be eligible for the program, women must be 18 years of age or older and at or below 200 percent of the Federal Poverty Level.

Looking ahead, we’ll be watching the data to determine the impacts of our efforts and whether women are able to access the services they need. We must make sure this substantial investment makes a difference. The Senate Health and Human Services Committee is conducting an interim study of access and women’s health services, and HHSC has named a women’s health coordinator to help oversee women’s health services across the agencies.

The health of our mothers, sisters and daughters shapes the health of our families. We’re providing women greater access to a broader range of health services in Texas. These dollars will help women receive the family planning and other basic services they need to be healthy.

**Buckyball Magnet Ingestions: Small Objects That Can Cause Big Problems**

Mathias B. Forrester

Texas Department of State Health Services, Austin, Texas

Ingestion of foreign bodies is a common clinical problem, particularly among children. The preponderance of these ingestions do not require medical intervention. However, one type of foreign body of particular concern are magnets. A single magnet usually will progress through the gastrointestinal tract and be expelled from the body without any problems. However, if multiple magnets or a single magnet with a piece of metal are ingested together, the pieces can be attracted to one another. If a part of the gastrointestinal tract is caught between these pieces, they may result in obstruction, perforation, fistula formation, necrosis, and even death.

An analysis of data from the National Electronic Injury Surveillance System (NEISS) estimated that over 16,000 children less than 18 years in age were seen at emergency departments for possible magnetic ingestion during 2002-2011. Almost half of the patients were less than five years in age. The rate increased 8.5-fold during this time period. In particular, over the last few years there appears to has been an increase in the ingestion of multiple magnets.

One particular type of magnet are high-powered buckyball magnets. These magnets are small and round, about five millimeters in diameter. They are usually sold in sets and can be attached to one another to create patterns and shapes. They are intended to be desk toys and stress relievers for adults. About three million sets of buckyballs and the related buckycubes have been sold in the United States since 2010.

The United States Consumer Product Safety Commission (CPSC) has documented 54 reports of children and adolescents ingesting these magnets, and all but one required medical interventions. As a result, on April 12, 2013, the CPSC, along with six retail companies, announced the voluntary recall of all buckyball magnets sold by these retailers.

Ingestions of foreign bodies may be reported to poison centers. By the end of 2013, twenty buckyball magnet ingestions have been reported to Texas poison centers. Three of the ingestions occurred in 2010, nine in 2011, six in 2012, and two in 2013. Nine of the ingestions were reported to involve one buckyball magnet, six involved two magnets, three involved three magnets, one involved “multiple” magnets, and one involved an unknown number of magnets. The mean patient age was 10.5 years (range 1-22 years); five patients were 1-5 years, seven patients were 6-12 years, seven patients were 13-19 years, and one patient was 22 years. Ten of the patients were male and ten were female. Nineteen of the ingestions were unintentional and one intentional (ingested “for fun”). Sixteen of the ingestions occurred at the patient’s own residence, two at school, one at another residence, and one at an unspecified site. Nine of the patients were managed on site, four were already at/en route to a healthcare facility, five were referred to a healthcare facility, and two were managed at an unspecified site. The medical outcome was no effect, moderate effect, not followed judged nontoxic, not followed minimal effects, and unable to follow potentially toxic. The adverse clinical effects, reported in one case each, were: abdominal pain, headache, X-ray findings, and unspecified. The reported treatments were dilution, irrigation, food/snack, other emetic, and unspecified.

The Texas poison center information suggests that many of the buckyball magnet ingestions that may be reported to healthcare providers will involve only a single buckyball magnet and are not expected to result in serious outcomes. However, since serious problems can occur, particularly with ingestion of multiple buckyball magnets, care should be taken when managing the patient. Algorithms are available that can assist healthcare providers in the management of magnet ingestions.

**REFERENCES**

Rodenticides and other rodent control products are a mixed group of chemicals that are among the most toxic substances commonly found in homes.\(^1\) During 2011, 88,853 rodenticide exposures were reported to United States poison centers; at least 17 persons exposed to rodenticides died. Of the total rodenticide exposures, at least 43% involved children age five years or less.\(^2\)

Rodent control products have a wide range of toxicities to humans.\(^1\) One type of product are glue traps. These strips or trays are comprised of cardboard or plastic coated with a strong natural or synthetic adhesive. A scent is added to the adhesive or a bait placed on the trap to attract rodents. Glue traps are primarily used for indoor rodent control. If a pet or other non-target animal or person accidentally comes into contact with a glue trap, they can be released from the trap by applying vegetable oil and gently working them free from the trap. Although generally considered non-toxic to humans, parents and other caregivers may become concerned if a young child comes in contact with a glue trap.

A total of 431 rodent glue trap exposures among patients age five years or less were reported to Texas poison centers during 2000-2013. Only three of the exposures involved other substances in addition to the glue trap. The distribution by patient age was 19.5% less than one year, 37.1% one year, 10.7% three years, 6.3% four years, 3.2% five years, and 2.1% exact age unknown; 54.5% of the patients were male. The exposure occurred by dermal contact alone in 45.2% of the exposures, ingestion alone in 39.2%, dermal contact and ingestion in 14.2%, dermal and eye contact in 0.7%, dermal and eye contact and ingestion in 0.2%, and unspecified route in 0.5%. The preponderance (91.6%) of the exposures occurred at the child's own residence, 3.9% at another residence, 2.3% at school, 0.9% at a public area, and 1.2% at other or unspecified locations.

With respect to patient management site, 95.1% were managed on site (outside of a healthcare facility), 4.2% were already at or en route to a healthcare facility when the poison center was contacted, and 0.7% were managed at an unspecified site. The poison centers did not refer any of the patients to a healthcare facility. In 98.4% of the cases, the exposures were not considered to be serious, in 0.9% the exposures were considered to be potentially serious, and in 0.7% the symptoms were not considered related to the glue trap.

Few specific adverse clinical effects were reported in these exposures, the most common of which was erythema, reported in eight exposures. Vomiting was reported in five exposures and diarrhea and dermal pain in two each. Clinical effects reported in a single case each were bullae, nausea, fever, ocular irritation, red eye, and bleeding. The most common management of the exposure was dilution or washing reported in 84.0% of the cases. Other treatments were food or snack (n=9), antibiotics (n=2), and antihistamines (n=1).

Thus, of the over 400 glue trap exposures among young children reported to Texas poison centers during the past 14 years, one-year-olds seemed particularly likely to be involved in these exposures. And although dermal contact was the most frequent route of exposure, ingestion occurred in over half of the exposures. As expected, these exposures tended to not be serious and could be successfully managed at home by dilution or washing. However, if a child has come into contact with a glue trap, concerned parents or other caregivers can contact their local poison center at 1-800-222-1222 for assistance.

REFERENCES
Regional and Racial/Ethnic Differences in the Association between Perceptions of Dietary Practices, Eating Habits, and Obesity among Texas Adolescents

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ABSTRACT

Purpose: Adolescent obesity is now of critical concern for Texas, as the statewide prevalence is higher than the National prevalence. The purpose of this study is to evaluate the association of perceptions of dietary practices, eating habits, weight-loss behaviors and overweight/obesity among adolescents in three Health Service Regions (HSRs) in Texas.

Methods: Our study utilized data from eighth and eleventh grade adolescents (n=3,837) who participated in the 2004-2005 School Physical Activity and Nutrition (SPAN) study. Weighted multinomial logistic regression evaluated the association of eating habits, perceptions of dietary practices, and weight-loss behaviors on adolescents’ weight status (overweight or obese compared with normal/underweight), by demographic-specific subpopulations and adjusting for race/ethnicity, gender, grade and/or HSR.

Results: Approximately one third of adolescents were overweight (17.2%) or obese (17.1%). Associated factors for obesity among Texas adolescents included: (a) not meeting recommendations for dairy consumption (in African American adolescents as compared with Hispanics and White/other); and (b) perceiving eating habits as “less healthy than peers” (among Hispanic and White/other adolescents as compared with African American adolescents).

Conclusions: Interesting differences arise across race/ethnicity categories and regions when evaluating the influence of perceived eating habits relative to peers on weight status. These findings highlight the importance of considering the socio-cultural context of health outcomes and health-related behaviors among adolescents. We propose that health educators should: (a) approach eating habits and nutrition education with cultural competency; and (b) continue to encourage adolescents to meet the recommendations for dairy consumption daily. Moreover, policymakers should consider the influence of perceived social norms on eating habits and weight status among adolescents.

INTRODUCTION

Childhood obesity is now a significant public health crisis. Approximately 6 million (18.1%) U.S. children aged 12-19 are obese; the prevalence in Texas is higher than the National estimates. Childhood obesity is associated with immediate adverse effects, including body dissatisfaction, low self-esteem, and depression, as well as morbidity and mortality due to cardiovascular disease and Type II diabetes. The role of nutrition and physical activity on obesity prevention has been well-documented. However, social/cognitive factors have not been extensively studied and the influence of health-related behaviors and perceived social norms on weight status could be important for reducing the prevalence of childhood obesity.

Adolescents are encouraged to consume three or more servings of dairy and five or more combined servings of fruits and vegetables each day. Research has indicated that adolescents who consume the lowest levels of dairy have increased odds of being obese compared with adolescents who consume the highest levels; the association between fruits and vegetables intakes is unclear. Similarly, it is recommended that adolescents consume breakfast each day in order to maintain a healthy weight.

Perceived social norms are often associated with weight status, and eating habits among adolescents. Shifting perceived social norms of weight have resulted in overweight adolescents’ inability to accurately identify themselves as such. Perceived social norms are associated with both healthy eating habits (e.g. fruit/vegetable consumption) and unhealthy eating habits (e.g. soft drink consumption). Research has also indicated that weight-loss behaviors associate with weight status, irrespective of race/ethnicity.

METHODS

Study Design and Participants

The SPAN study was designed to provide representative estimates of childhood obesity, health-related behaviors and perceptions of dietary practices at both the region and state level. A full description of the SPAN study design is available elsewhere. Briefly, the SPAN survey is a validated questionnaire composed of questions on demographics, self-reported height and weight, dietary recall, health-related behaviors and perceptions of dietary practices. Following survey completion, each adolescent’s height and weight is measured by a health professional.

Our study examined data from eighth and eleventh grade adolescents from HSR 2/3 (n=1,747), HSR 4/5N (n=1,094), and HSR 6/5S (n=996), representing a population of 145,905, 24,067 and 130,863 adolescents, respectively. The final sample size (n=3,837) represents a population of 300,385 adolescents.

Although data were available from all eight HSRs, we examined these regions for three distinct reasons. First, Texas is the second most populous state in the U.S. and features many socio-cultural settings. Despite differences in adolescents’ obesity prevalence across HSRs, few studies are evaluated at the regional level. Second, the HSRs selected for this study contain two of the largest Metropolitan Statistical Areas (MSAs) in the U.S. The third region, HSR 4/5N, covers East Texas counties and borders these regions; it is included

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in our analyses to draw comparisons. Finally, a report from the 2004-2005 SPAN study noted differences in obesity among eighth grade adolescents in HSRs 2/3, 4/5N and 6/5S (prevalence of 23%, 33%, and 14%, respectively).31

Treatment of Variables
Demographic variables collected include gender, grade, HSR and race/ethnicity. Self-reports of race/ethnicity were collapsed into ‘African American’, ‘Hispanic’, or ‘White/other’ due to the sample size requirements of the study design.2 Using the CDC growth-for-age charts,30 weight status was categorized into: underweight/normal (<85th percentile), overweight (≥85th percentile to <95th percentile) and obese (≥95th percentile).

Eating habits were assessed through self-reports of foods consumed on the previous day, with a possible range of ‘none’, ‘1 time’, ‘2 times’ or ‘3 or more times’. This method is an appropriate proxy for servings, as research asserts that adolescents interpret number of times as number of servings.31 Adolescents were asked to identify the number of times they consumed: (a) any kind of cheese, cheese spread, or cheese sauce, (b) any kind of milk, and (c) any kind of yogurt or cottage cheese. Using the guidelines to consume three or more servings daily,12 composite scores of dairy consumption were dichotomized into ‘met recommendations’ and ‘did not meet recommendations’.

One question asked adolescents to identify the number of times in which they consumed any kind of fruit, not including juice; this question represented fruit consumption. One question asked adolescents to identify the number of times in which they consumed any kind of vegetable, including all cooked and uncooked vegetables, salads, and boiled, baked and mashed potatoes but not including French fries or chips; this question represented vegetable consumption. These variables were combined to create a fruit/vegetable consumption variable, ranging from 0 to 6+ times the previous day. Using the guidelines to consume five or more servings of fruits/vegetables daily,12 composite scores of fruit/vegetable consumption were dichotomized into ‘met recommendations’ and ‘did not meet recommendations’.

One question assessed breakfast consumption by asking adolescents to comment on how frequently they ate or drank something for breakfast. This variable was dichotomized into ‘met recommendations’ and ‘did not meet recommendations’ to eat breakfast everyday.15

Adolescents were asked to rate their dietary practices as ‘much healthier than those of most people my age’, ‘somewhat healthier…’, ‘about the same’, ‘somewhat less healthy…’, or ‘much less healthy…’. Perception of dietary practices was collapsed into ‘healthier than peers’, ‘about the same’ or ‘less healthy than peers’. Weight-loss behaviors was measured by asking adolescents to identify if they were currently trying to lose weight; a response of ‘yes’ was recoded as ‘currently trying to lose weight’ and a response of ‘no’ was recoded as ‘not trying to lose weight’.

Statistical Analysis
In order to account for the multistage sampling design, SPAN probability weights for the HSR were incorporated into all analyses. Due to violation of the goodness-of-fit assumption,32 multinomial models were implemented in place of ordinal models. Multinomial logistic regression models evaluated the association of eating habits, perceptions of dietary practices, and weight-loss behaviors on adolescents’ weight status for each of the following subpopulations: (a) for each gender, while adjusting for race/ethnicity, grade and HSR; (b) for each racial/ethnic group, while adjusting for gender, grade and HSR; and (c) for each HSR, while adjusting for gender, grade and race/ethnicity. A type I error level was set a priori at 0.05. Results were presented in terms of adjusted odds ratios (AORs) and 95% confidence intervals (CIs). Analyses were performed using Stata, v. 11 (StataCorp LP, College Station, Texas)

Ethical Considerations
The SPAN study received Institutional Review Board (IRB) approval through the University of Texas Health Science Center at Houston, the Texas Department of State Health Services and each participating school district.3 Informal written consent/assent was obtained from parents and participating adolescents, respectively. Approval for the present study was granted through The University of Texas at Tyler’s IRB committee.

RESULTS
Overall, race/ethnic proportions were 17.7% African American, 24.4% Hispanic and 57.9% White/other (Table 1). Approximately one third of adolescents were overweight (17.2%) or obese (17.1%). The sample was evenly distributed between boys and girls. The average age was 13.8 among eighth grade adolescents and 16.7 among eleventh grade adolescents. Approximately half of adolescents in eighth and eleventh grade did meet the recommendations for dairy consumption and only 4.4% of (95% CI:3.1-5.7) adolescents met the recommendations for fruit/vegetable consumption.

Multinomial Logistic Regression
Tables 2-4 show adjusted odds ratios and equivalent 95% CIs for the association of eating habits, weight-related behaviors and perceptions of dietary practices on weight status, by demographic-specific subpopulation analyses and adjusting for race/ethnicity, gender, grade and/or HSR.

African American adolescents who did not meet the recommendations for dairy have an AOR of 3.23 for being obese (95% CI:1.33-8.30) compared with normal/underweight African American adolescents who did meet the recommendations, after adjusting for gender, grade and HSR (Table 2). Hispanic adolescents who identified their eating habits as ‘less healthy than peers’ had increased odds for being obese compared to normal/underweight Hispanic adolescents who identified their diet as ‘healthier than peers’ after adjusting for gender, grade and HSR. This association was also observed among White/other adolescents.

Girls who identified their eating habits as ‘less healthy than peers’ had increased odds for being obese (AOR:2.98, 95% CI:1.34-6.64) compared to normal/underweight girls who identified their eating habits as ‘healthier than peers’, after adjusting for race/ethnicity, grade and HSR (Table 3). Boys who did not meet the recommendations to eat breakfast regularly had an AOR of .48 for being obese (95% CI:0.28-0.82) as compared with normal/underweight boys, after adjusting for race/ethnicity, grade and HSR.

HSR 2/3 adolescents who identified their eating habits as ‘less healthy than peers’ had increased odds for being obese compared to normal/underweight HSR 2/3 adolescents who identified their eating habits as ‘healthier than peers’, after adjusting for race/ethnicity, grade and HSR (Table 4). This association was also observed among HSR 4/5N adolescents.

Across all demographic-specific subpopulations, adolescents who were ‘currently trying to lose weight’ had increased odds for being obese.

DISCUSSION
Three factors associate with an increased odds for obesity among adolescents: (a) not meeting recommendations for dairy consumption
(among African American adolescents as compared with Hispanics and White/other), (b) perceiving eating habits as ‘less healthy than peers’ (among Hispanic and White/other adolescents as compared with African Americans), and (c) weight-loss behaviors (all race/ethnic groups). These findings contribute to the limited body of knowledge of racial/ethnic differences in eating habits and perceived social norms and its influence on adolescent obesity.

Interesting differences arise between race/ethnic groups when evaluating the influence of perceptions of dietary practices on weight status. We observed that obesity among Hispanic and White/other adolescents is influenced by perceptions of dietary practices. Other studies suggest that perceived social norms vary considerably across groups. Most often, economical (availability/access), personal preferences, environmental (school/home) or cultural factors can account for these differences. Similarly, these differences exist between HSRs, further supporting the importance of considering the socio-cultural context of health-related behaviors and outcomes among adolescents.

Consistent with results from our study, previous research indicates that high levels of weight-loss attempts and inaccurate perception of weight are common among adolescents across race/ethnic groups. Approximately half of obese adolescents in this study describe their weight status. We observed that obesity among Hispanic and White/other adolescents is influenced by perceptions of dietary practices. Other studies suggest that perceived social norms vary considerably across groups. Most often, economical (availability/access), personal preferences, environmental (school/home) or cultural factors can account for these differences. Similarly, these differences exist between HSRs, further supporting the importance of considering the socio-cultural context of health-related behaviors and outcomes among adolescents.

We did not observe an association between meeting the recommendations for fruit/vegetable consumption and weight status; other studies support this finding. Previous literature has shown that not consuming breakfast regularly is associated with obesity among adolescents, yet our study implies the opposite. We are cautious in this finding because we did adjust for physical activity, a behavior that independently associates with weight status.

**Strengths and Limitations**

Strengths of our study include the study design, use of a validated, reliable questionnaire, and analytic techniques. Additionally, our sample is representative of the populations of interest; the demographic mix is similar to the 2010 US Census report and the Texas Education Agency student enrollment in these HSRs. Sampling weights and survey design features were applied to limit the inferences from the Project EAT Study. J Adolesc Health. 2011;48:373–378. doi:10.1016/j.jadohealth.2010.07.022.

**Implications and Contributions**

Educators should: (a) approach eating habits and nutrition education with cultural competency; and (b) continue to encourage adolescents to meet the recommendations for dairy consumption daily. Moreover, policymakers should consider the influence of perceived social norms on eating habits and weight status among adolescents.

**Acknowledgements:**

Dr. Adriana Pérez was supported by the Michael & Susan Dell Foundation [Grant 8075] during the writing of this manuscript.

**REFERENCES**


http://www.cdc.gov/pcd/issues/2007/06_0061.htm


Table 1. Weighted Estimates of Demographic Characteristics of Eighth and Eleventh Grade Adolescents in Three Texas Health Service Regions 2/3, 4/5N & 6/5S, 2004-2005 SPAN study, n=3,837a

<table>
<thead>
<tr>
<th>Totala (n)</th>
<th>Weighted Proportions % (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade</strong></td>
<td></td>
</tr>
<tr>
<td>Eighth</td>
<td>2,115</td>
</tr>
<tr>
<td>Eleventh</td>
<td>1,722</td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td></td>
</tr>
<tr>
<td>2/3</td>
<td>1,747</td>
</tr>
<tr>
<td>4/5N</td>
<td>1,094</td>
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<tr>
<td>6/5S</td>
<td>996</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,901</td>
</tr>
<tr>
<td>Female</td>
<td>1,936</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>704</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1,138</td>
</tr>
<tr>
<td>White/other</td>
<td>1,995</td>
</tr>
<tr>
<td><strong>Perception of weight status</strong></td>
<td></td>
</tr>
<tr>
<td>Too little</td>
<td>578</td>
</tr>
<tr>
<td>Just right</td>
<td>2,057</td>
</tr>
<tr>
<td>Too much</td>
<td>1,170</td>
</tr>
<tr>
<td><strong>Perception of dietary practices</strong></td>
<td></td>
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<tr>
<td>Healthier than peers</td>
<td>1,130</td>
</tr>
<tr>
<td>About the same as peers</td>
<td>1,953</td>
</tr>
<tr>
<td>Less healthy than peers</td>
<td>533</td>
</tr>
<tr>
<td><strong>Weight-loss behavior</strong></td>
<td></td>
</tr>
<tr>
<td>Not trying to lose weight</td>
<td>2,282</td>
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<tr>
<td>Currently trying to lose weight</td>
<td>1,545</td>
</tr>
<tr>
<td><strong>Breakfast consumption</strong></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1,501</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
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</tr>
<tr>
<td><strong>Dairy consumption</strong></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>2,190</td>
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<tr>
<td>Did not meet recommendations</td>
<td>1,599</td>
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<tr>
<td><strong>Fruit/vegetable consumption</strong></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>177</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>3,622</td>
</tr>
<tr>
<td><strong>Weight status</strong></td>
<td></td>
</tr>
<tr>
<td>Underweight/normal</td>
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<tr>
<td>Overweight</td>
<td>661</td>
</tr>
<tr>
<td>Obese</td>
<td>656</td>
</tr>
</tbody>
</table>

Abbreviation: CI, confidence interval.

a n represents the sample size. The total estimated student population using the sampling weights is N=300,835

b White/other category includes non-Hispanic white, Asian, Pacific Islander, Native American, and “other.”

c Met recommendations to eat breakfast daily include definition here to facilitate reading to readers.

d Recommended dairy intake defined as 3 or more daily servings.

e Recommended fruit/vegetable intake defined as 5 or more daily servings.

f Weight status by gender and age: underweight/normal (<85th percentile), overweight (≥85th percentile to <95th percentile) and obese (≥95th percentile).

<table>
<thead>
<tr>
<th>Perception of dietary practices</th>
<th>African American, AORs (95% CIs)</th>
<th>Hispanic, AORs (95% CIs)</th>
<th>White/other, AORs (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overweight</td>
<td>Obese</td>
<td>Overweight</td>
</tr>
<tr>
<td>Healthier than peers</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>About the same as peers</td>
<td>0.55 (0.24, 1.26)</td>
<td>0.97 (0.40, 2.36)</td>
<td>0.91 (0.47, 1.77)</td>
</tr>
<tr>
<td>Less healthy than peers</td>
<td>1.25 (0.34, 4.65)</td>
<td>1.07 (0.30, 3.86)</td>
<td>0.59 (0.22, 1.63)</td>
</tr>
<tr>
<td>Weight-loss behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not trying to lose weight</td>
<td>2.31 (0.87, 6.15)</td>
<td>7.84 (3.21, 19.14)</td>
<td>2.10 (1.13, 3.90)</td>
</tr>
<tr>
<td>Currently trying to lose weight</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Breakfast consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.12 (0.51, 2.50)</td>
<td>0.73 (0.32, 1.65)</td>
<td>1.14 (0.59, 2.22)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>1.45 (0.57, 3.70)</td>
<td>3.32 (1.33, 8.30)</td>
<td>0.98 (0.51, 1.88)</td>
</tr>
<tr>
<td>Dairy consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.24 (0.66, 2.32)</td>
<td>1.60 (0.95, 2.68)</td>
<td>0.93 (0.56, 1.55)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>1.24 (0.66, 2.32)</td>
<td>1.60 (0.95, 2.68)</td>
<td>0.93 (0.56, 1.55)</td>
</tr>
<tr>
<td>Fruit/vegetable consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.41 (0.79, 2.51)</td>
<td>0.48 (0.28, 0.82)</td>
<td>1.25 (0.71, 2.22)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>1.18 (0.69, 2.02)</td>
<td>1.18 (0.69, 2.02)</td>
<td>1.18 (0.69, 2.02)</td>
</tr>
</tbody>
</table>

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.


<table>
<thead>
<tr>
<th>Perception of dietary practices</th>
<th>Boys, AORs (95% CIs)</th>
<th>Girls, AORs (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overweight</td>
<td>Obese</td>
</tr>
<tr>
<td>Healthier than peers</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>About the same as peers</td>
<td>0.52 (0.28, 0.94)</td>
<td>1.22 (0.67, 2.24)</td>
</tr>
<tr>
<td>Less healthy than peers</td>
<td>0.66 (0.28, 1.56)</td>
<td>1.71 (0.77, 3.81)</td>
</tr>
<tr>
<td>Weight-loss behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not trying to lose weight</td>
<td>3.09 (1.63, 5.83)</td>
<td>5.58 (2.86, 10.88)</td>
</tr>
<tr>
<td>Currently trying to lose weight</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Breakfast consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.41 (0.79, 2.51)</td>
<td>0.48 (0.28, 0.82)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>1.24 (0.66, 2.32)</td>
<td>1.60 (0.95, 2.68)</td>
</tr>
<tr>
<td>Dairy consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.41 (0.79, 2.51)</td>
<td>0.48 (0.28, 0.82)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>1.24 (0.66, 2.32)</td>
<td>1.60 (0.95, 2.68)</td>
</tr>
<tr>
<td>Fruit/vegetable consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>0.67 (0.21, 2.17)</td>
<td>1.26 (0.37, 4.31)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td>0.67 (0.21, 2.17)</td>
<td>1.26 (0.37, 4.31)</td>
</tr>
</tbody>
</table>

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

* AORs and 95% CIs estimated from weighted multinomial logistic regression, adjusting for gender, grade and HSR.
* An example of how to interpret the AOR for overweight with respect to the reference category (normal/underweight) is as follows: Boys who perceived their eating habits as “healthier than peers” have an AOR of 1.18 for being overweight (95% CI: 0.69, 2.02) compared with normal/underweight boys who perceived their eating habits as “healthier than peers”, after adjusting for race/ethnicity, grade and HSR.
* An example of how to interpret the AOR for obesity with respect to the reference category (normal/underweight) is as follows: Girls who perceived their eating habits as “healthier than peers” have an AOR of 0.56 for being obese (95% CI: 0.16, 2.77) compared with normal/underweight girls who perceived their eating habits as “healthier than peers”, after adjusting for race/ethnicity, grade and HSR.

<table>
<thead>
<tr>
<th>Perception of dietary practices</th>
<th>HSR 2/3, AORs (95% CIs)</th>
<th>HSR 4/5N, AORs (95% CIs)</th>
<th>HSR 6/5S, AORs (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overweight</td>
<td>Obese</td>
<td>Overweight</td>
</tr>
<tr>
<td>Healthier than peers</td>
<td>0.62 (0.41, 0.94)</td>
<td>1.40 (0.90, 2.18)</td>
<td>0.68 (0.37, 1.25)</td>
</tr>
<tr>
<td>Less healthy than peers</td>
<td>0.74 (0.36, 1.52)</td>
<td>2.26 (1.21, 4.22)</td>
<td>0.70 (0.29, 1.69)</td>
</tr>
<tr>
<td>Weight-loss behavior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not currently trying to lose weight</td>
<td>2.27 (1.48, 3.47)b</td>
<td>2.62 (1.69, 4.06)b</td>
<td>2.37 (1.16, 4.83)</td>
</tr>
<tr>
<td>Currently trying to lose weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakfast consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.05 (0.69, 1.59)</td>
<td>0.91 (0.63, 1.31)</td>
<td>1.46 (0.78, 2.70)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Dairy consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.28 (0.82, 2.00)</td>
<td>1.24 (0.83, 1.86)</td>
<td>1.14 (0.64, 2.05)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Fruit/vegetable consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met recommendations</td>
<td>1.05 (0.43, 2.56)</td>
<td>0.70 (0.32, 1.21)</td>
<td>1.26 (0.33, 4.84)</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AOR, adjusted odds ratio, CI, confidence interval.

AORs and 95% CIs estimated from weighted multinomial logistic regression, adjusting for gender, grade and HSR.

An example of how to interpret the AOR for overweight with respect to the reference category (normal/underweight) is as follows: HSR 2/3 adolescents who identified that they were "currently trying to lose weight" have an AOR of 2.27 for being overweight (95% CI: 1.48-4.37) compared with normal/underweight HSR 2/3 adolescents who identified that they were "not trying to lose weight", after adjusting for race/ethnicity, grade and gender.

An example of how to interpret the AOR for obesity with respect to the reference category (normal/underweight) is as follows: HSR 2/3 adolescents who identified that they were "currently trying to lose weight" have an AOR of 2.62 for being obese (95% CI: 1.69-4.06) compared with normal/underweight HSR 2/3 adolescents who identified that they were “not trying to lose weight”, after adjusting for race/ethnicity, grade and gender.

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Texas A&M Health Science Center School of Public Health celebrates!
* April 4: Guided tours of walking trails in downtown Bryan, Texas
* April 7-11: Student public health posters on display
* April 7: Campus blood drive & Brazos Valley Mayoral proclamation of NPHW
* April 8: 11th Annual Student Conference Scholarship Golf Tournament
* April 9: Lunch & Learn followed at 4PM with Student Public Health Poster Awards
* April 10, Noon -1 PM Luncheon, Dean’s Lecture Series, “Relieving Pain in the Brazos Valley: A State and Local Partnership Approach” and expert panel discussion
* April 11: Lunch & Learn, “Texas Census Research Data Center: Opportunities for Research Using Restricted Data.”
* April 12: Habitat for Humanity volunteer event and Annual Student Gala.

More information online at [http://www.srph.tamhsc.edu/nphweek/](http://www.srph.tamhsc.edu/nphweek/)
A Comparison of Health Outcomes Between Three Counties in the Houston Metropolitan Area: Harris County, Fort Bend County and Brazoria County

Hafeez U. Rehman, MD, MPH, CPH
Epidemiologist Specialist, Bureau of Epidemiology, Houston Department of Health and Human Services, Houston TX

ABSTRACT
The three counties, Harris, Fort Bend and Brazoria, within the Houston Metropolitan Area are studied for disparities in health outcomes and health factors. Disparities in health may be related to race/ethnicity, socioeconomic factors or overall demographic factors. The County Health Ranking and Roadmaps Data is analyzed to compare the health disparities between the three counties. County Health Ranking and Roadmaps used a number of noteworthy data sources to describe the health outcomes and health factors of all the counties within each state. The demographic and health care data of the three counties selected are compared to determine the health disparities between them. Health outcome and health factor measures rated higher for the Fort Bend and Brazoria counties in contrast to the Harris County. A number of measures like HIV prevalence, infant and child mortality, number of uninsured adults and children, poor physical and mental health days, adult obesity, excessive drinking, sexually transmitted infections, and teen birth showed higher trends in Harris County than the Fort Bend and Brazoria Counties. Harris County ranked much lower for overall health outcomes and factors within the state of Texas. Although the three counties compared, share a similar geographic location and resources, wide distinction in health outcomes and factors are observed among them. The variation can be associated to socioeconomic and racial/ethnic diversity between them. Higher health care costs are not affordable to the communities uniformly and a good resolution to end health disparities would be to offer affordable health insurance across the state.

INTRODUCTION
The Harris County, Fort Bend County and Brazoria County border each other and make the most of the Houston Metropolitan Area, which is the fifth largest metro area in U.S. City of Houston lies mainly within the Harris County with portions in adjacent counties. The Houston Metropolitan Area is one of the fastest growing areas in the nation with Harris County growing by 20 percent and Fort Bend by 65 percent between the years 2000 to 2010. Although the three counties are located in the same geographic region and have similar available resources, there are sizeable differences in health outcomes among them. Disparities in health outcomes by race and ethnicity remain one of the most persistent, costly, and challenging public health issues in Texas. Texas is one of the five geographical areas with the highest concentration of minority population the other four being California, New Mexico, Hawaii and District of Columbia (2). Texas has shifted to a majority-minority population with 55% of its population classified as minority. The three counties studied have a distinct racial distribution, and racial/ethnic differences are reported to be a factor in health disparities within the U.S. Social class or socioeconomic status generally measured by income and education has also documented associations with health outcomes. It has also been studied how socio-economic status and race/ethnicity are involved mutually and individually to health outcomes. Although the state of Texas has led to improvements in the overall health of its population, widespread health disparities persist among the counties which may be implicated to economic inequalities. The purpose of this article is to compare and comprehend the disparities in health factors and health outcomes of the three counties within the state of Texas and to elucidate the differences among them associated to the demographic variations. If the factors identified are improved, then it can make the communities healthier places to live and work.

METHODS
The 2013 County Health Rankings and Roadmaps data is analyzed because it compiled the rankings using county-level measures from a variety of national and state data sources. The County Health Rankings and Roadmaps Program is a collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute. The purpose of the County Health Rankings is to compare the County health outcomes and health factors within each of the state. County Health Rankings are estimated based on national data sources, including Behavioral Risk Factor Surveillance System (BRFSS) data from the Centers for Disease Control and Prevention (CDC). The BRFSS data is used from 2005-2011 for the 2013 County Health Rankings across the nation. The other data sources used are: Dartmouth Atlas of Health Care from Centers for Medicare and Medicaid Services (CMS), National Vital Statistics System (NVSS), National Diabetes Surveillance System, National Center for HIV/AIDS, Viral Hepatitis, STD and TB Prevention, American Community Survey, CDC Wonder Environmental Data, County Business Patterns, Health Resources and Service Administration, U.S. Census, Small Area Health Insurance Estimates, Small Area Income and Poverty Estimates, Federal Bureau of Investigation, Uniform Crime Reporting, and U.S. Department of Agriculture, Food Environment Atlas.

Each of the measures from different data set was first standardized. Weighted sums of these standardized measures were used to rank counties within a state. Counties ranked highest relative to other counties within the state were considered to be healthiest. The county ranks were determined by calculating eight summary scores: Overall Health Outcomes, Mortality, Morbidity, Overall Health Factors, Health Behaviors, Clinical Care, Social and Economic Factors, and Physical Environment.

The health ranking data of the three counties Harris, Fort Bend, and Brazoria are compared to describe the health outcome and health factors disparities among them by examining their socio-demographic distribution. The ranks of the three counties are looked in the County Health Rankings and Roadmaps within the state of Texas.

The state of Texas is selected on the County Health Rankings and Roadmaps website and the three counties of interest are studied within Texas. The website lets you select the counties of interest and compare the health outcomes and health factors between them. No specific statistical tests are performed because of the unavailability of the actual databases used by the County Health Rankings and Roadmaps. The comparisons of the three counties between themselves and with the State of Texas are made using the rates and percentages calculated by the County Health Rankings and Roadmaps.

RESULTS
The three counties are compared among themselves and with the state of Texas for demographics, social and economic factors, and physical environment (Table 1). Harris County is not only the largest county by population of the three compared but also in Texas where more than 40% of the population is Hispanic compared to 28% and 24% in Brazoria and Fort Bend counties respectively. Harris County has the lowest percentage of non-Hispanic White population (33%)
compared to 52% in Brazoria and 36% in Fort Bend. In terms of race/ethnicity, Fort Bend is the most diverse county, compared to Harris and Brazoria. Only 1% of the Harris County is rural in contrast to Brazoria 23% and Fort Bend 8%. The median household income is lower in Harris County in comparison to the Fort Bend and Brazoria Counties. Housing costs are slightly higher in Harris County than the other two counties. Social and economic factors’ comparison indicates lower rates of high school graduation and college education in Harris County versus Fort Bend and Brazoria Counties. Unemployment rate is notably lower in Fort Bend County than the Brazoria and Harris Counties. Children in poverty, children in single-parent households, and violent crime rate are noticeably higher in Harris County than the other two counties. Inadequate social support is slightly less in Fort Bend County in comparison to the other two counties. Homicide rate and the percentage of children eligible for free lunch are higher in Harris County, but the motor vehicle crash death rate is considerably higher in Brazoria County. Comparing the clinical care in the three counties, more people are uninsured for healthcare in Harris County than the Fort Bend and Brazoria Counties. Although there are more physicians per population available in Brazoria and Fort Bend Counties in contrast to Harris County, there is less number of dentists per population in these two counties. Diabetic and mammography screening are slightly higher in Fort Bend County than the other two counties. Preventable hospital stays are higher in Brazoria County than the other two counties. Looking at the health care indicators among the three counties, ratio of mental health care providers to population is far better in Harris County in comparison to the other two counties. At the same time, number of uninsured adults, uninsured children, and those who could not see a doctor due to cost is also high in Harris County than the other two counties.

The Health Outcomes and Health Factors are compared in Table 2. Health outcomes indicate HIV rate more than 5 times higher in Harris County against Brazoria County. Infant and child mortality is also higher in Harris County versus Fort Bend and Brazoria Counties. Premature age-adjusted mortality is relatively lower in Fort Bend County than the other two counties. Health outcomes such as poor or fair health and poor physical and mental days are reported to be higher in Harris County versus Fort Bend and Brazoria counties. Health Factors compared included health behaviors, clinical care, and health care. Health behaviors such as adult smoking and physical inactivity are higher in Brazoria County than the other two counties. Adult obesity and excessive drinking are higher in Harris County compared to the other two counties. Sexually transmitted infections and the teen birth rates are also higher in Harris County, but the motor vehicle crash death rate is considerably higher in Brazoria County. Comparing the clinical care in the three counties, more people are uninsured for healthcare in Harris County than the Fort Bend and Brazoria Counties. Although there are more physicians per population available in Brazoria and Fort Bend Counties in contrast to Harris County, there is less number of dentists per population in these two counties. Diabetic and mammography screening are slightly higher in Fort Bend County than the other two counties. Preventable hospital stays are higher in Brazoria County than the other two counties. Looking at the health care indicators among the three counties, ratio of mental health care providers to population is far better in Harris County in comparison to the other two counties. At the same time, number of uninsured adults, uninsured children, and those who could not see a doctor due to cost is also high in Harris County than the other two counties.
days, adult obesity, excessive drinking, sexually transmitted infections, and teen birth clearly indicate higher trends in Harris County than the other two counties. These differences in health outcome and health factors between the three counties can also be confirmed from the Health Fact Profile 2009 report of the Center for Health Statistics, Texas Department of State Health Services. Harris County is the largest county by population while Fort Bend County ranks 10th and Brazoria 15th within the state of Texas. Ninety nine percent of the Harris County is urban while Brazoria is 76 percent and Fort Bend 94 percent urban. The three counties studied are ethnically diverse and have increased dramatically in diversity between the years 2000 and 2010. The diverse race/ethnicity distribution of the three counties could be accounted to the disparity in health outcomes and health factors, but remarkable differences are reported in level of education and income within the racial/ethnic groups. Therefore, the main ground for health disparities in these counties could be significant differences in socio-economic factors. Looking at the socio-economic factors like median household income, high housing costs and children eligible for free lunch, Harris county rates lower than the other two counties. A number of studies have demonstrated socio-

Table 3 features the rankings of the three counties studied with respect to the health outcome and health factor measures. A total of 232 counties’ data is reported and included in rankings out of 254 counties in Texas. The overall health outcome measure ranks Fort Bend County 13, Brazoria 32, and Harris 70 within the state of Texas. Likewise, overall health factor measure ranks Fort Bend County 5, Brazoria County 23, and Harris County 132 within the state of Texas. The three counties are also ranked by the sub health outcomes and sub health factors detailed in Table 3.

**DISCUSSION**

The overall health outcome and overall health factor rankings of the three counties studied show higher ranks for Fort Bend and Brazoria against Harris County which means those two counties are considered healthier than the Harris County within the state of Texas. As observed in the results, Harris County has a number of health outcome and health factor measures radically different than the other two counties. HIV prevalence, infant and child mortality, number of uninsured adults and children, poor physical and mental health

<table>
<thead>
<tr>
<th>HEALTH OUTCOMES</th>
<th>Harris</th>
<th>Brazoria</th>
<th>Fort Bend</th>
<th>Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV prevalence rate*</td>
<td>577</td>
<td>119</td>
<td>137</td>
<td>311</td>
</tr>
<tr>
<td>Premature age-adjusted mortality rate*</td>
<td>351</td>
<td>345</td>
<td>240</td>
<td>352</td>
</tr>
<tr>
<td>Infant mortality rate*</td>
<td>643</td>
<td>556</td>
<td>459</td>
<td>642</td>
</tr>
<tr>
<td>Child mortality rate*</td>
<td>62</td>
<td>54</td>
<td>37</td>
<td>58</td>
</tr>
<tr>
<td>Premature death rate* (years before age 75)</td>
<td>6,995</td>
<td>6,795</td>
<td>4,584</td>
<td>6,928</td>
</tr>
<tr>
<td>Low birth weight (less than 2,500 g)</td>
<td>8.6%</td>
<td>8.3%</td>
<td>8.8%</td>
<td>8.4%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>8%</td>
<td>10%</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Poor or fair health</td>
<td>18%</td>
<td>12%</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Poor physical health days/month</td>
<td>3.6</td>
<td>3.0</td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Poor mental health days/month</td>
<td>3.1</td>
<td>2.9</td>
<td>2.7</td>
<td>3.3</td>
</tr>
</tbody>
</table>

**HEALTH FACTORS**

**Health Behaviors**

<table>
<thead>
<tr>
<th></th>
<th>Harris</th>
<th>Brazoria</th>
<th>Fort Bend</th>
<th>Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult smoking</td>
<td>16%</td>
<td>18%</td>
<td>10%</td>
<td>18%</td>
</tr>
<tr>
<td>Adult obesity</td>
<td>29%</td>
<td>27%</td>
<td>26%</td>
<td>29%</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>23%</td>
<td>26%</td>
<td>21%</td>
<td>25%</td>
</tr>
<tr>
<td>Excessive drinking</td>
<td>17%</td>
<td>12%</td>
<td>12%</td>
<td>16%</td>
</tr>
<tr>
<td>Motor vehicle crash death rate*</td>
<td>12</td>
<td>18</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Sexually transmitted infections rate*</td>
<td>545</td>
<td>343</td>
<td>244</td>
<td>476</td>
</tr>
<tr>
<td>Teen birth rate per 1,000 females 15-19 years</td>
<td>60</td>
<td>52</td>
<td>26</td>
<td>60</td>
</tr>
</tbody>
</table>

**Clinical Care**

<table>
<thead>
<tr>
<th></th>
<th>Primary care physicians</th>
<th>Dentists</th>
<th>Preventable hospital stays per 1,000 Medicare enrollees</th>
<th>Diabetic screening</th>
<th>Mammography screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harris</td>
<td>1,806:1</td>
<td>1,581:1</td>
<td>2,791:1</td>
<td>81%</td>
<td>59%</td>
</tr>
<tr>
<td>Brazoria</td>
<td>1,523:1</td>
<td>2,540:1</td>
<td>1</td>
<td>5%</td>
<td>63%</td>
</tr>
<tr>
<td>Fort Bend</td>
<td>1,766:1</td>
<td>2,200:1</td>
<td>7</td>
<td>85%</td>
<td>61%</td>
</tr>
<tr>
<td>Texas</td>
<td>2,483:1</td>
<td>2,178:1</td>
<td>72</td>
<td>82%</td>
<td>61%</td>
</tr>
</tbody>
</table>

**Health Care**

<table>
<thead>
<tr>
<th></th>
<th>Mental health providers</th>
<th>Health care costs (Price-adjusted Medicare spending per enrollee)</th>
<th>Uninsured adults</th>
<th>Uninsured children</th>
<th>Could not see doctor due to cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harris</td>
<td>3,430:1</td>
<td>$11,903</td>
<td>35%</td>
<td>35%</td>
<td>21%</td>
</tr>
<tr>
<td>Brazoria</td>
<td>6,169:1</td>
<td>$11,147</td>
<td>25%</td>
<td>14%</td>
<td>13%</td>
</tr>
<tr>
<td>Fort Bend</td>
<td>4,883:1</td>
<td>$11,328</td>
<td>23%</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>Texas</td>
<td>4,374:1</td>
<td>$11,088</td>
<td>23%</td>
<td>15%</td>
<td>19%</td>
</tr>
</tbody>
</table>

* Per 100,000
economic status, measured by income and education, influence a series of health outcomes, including mortality, heart diseases, arthritis, asthma, diabetes, and disability in children, adolescents, and young and old adults\textsuperscript{11-14}. The factors like school and college education and children in poverty are also broadly dissimilar among counties with Harris County showing lower education rates and higher number of children in poverty. The disease risk is accounted to individual behaviors, such as physical inactivity, smoking, diet, condom use, and other risk behaviors but most of these behaviors are also related to the education, awareness, and access to information which are again associated with socio-economic factors. Access to healthcare is getting costlier day by day and the higher healthcare costs may account for the disparities in three counties.

The differences observed in health outcomes and health factors between the counties can be addressed by increasing the access to healthcare and utilization of services to the community as a whole. The core issue of unequal resource distribution that leads to socio-economic disparity can be addressed by effective policy development and financial redistribution. One way of undertaking it is to lower the costs of health insurance to be affordable to every individual in community irrespective of the socio-economic status. Access to healthcare is getting costlier day by day and the higher healthcare costs may account for the disparities in three counties.

The differences observed in health outcomes and health factors between the counties can be addressed by increasing the access to healthcare and utilization of services to the community as a whole. The core issue of unequal resource distribution that leads to socio-economic disparity can be addressed by effective policy development and financial redistribution. One way of undertaking it is to lower the costs of health insurance to be affordable to every individual in community irrespective of the socio-economic status. The availability of health insurance to each class of society can help access to healthcare services for everyone. It can help achieve the long term goal of health for all and end to health disparities.

REFERENCES

Differences in Environmental Perceptions, Physical Activity, and Weight Status among Rural and Urban Residents in Texas

Allison Ottenbacher, PhD1; Roderick Harrison, PhD2; Marcus Martin, PhD2; Eddilisa Martin, PharmD2; Thomas James, PhD2; Kim Linnear, MPA1; Avani Parikh, MPH1; Patricia Moore, PhD3; Kathryn Cardarelli, PhD1

1University of North Texas Health Science Center, Texas Prevention Institute
22M Research Services, LLC
3Texas Department of State Health Services

ABSTRACT

Purpose: The objective of this study was to distinguish the effects of rural vs. urban residence from those of race-ethnicity, education, and income, in the environmental perceptions, physical activity and weight status of respondents in rural and urban counties in Texas.

Methods: The data are from a survey conducted in three rural and three urban counties participating in Transforming Texas in 2012.

Findings: Residents of rural counties had less favorable environmental perceptions, lower rates of physical activity, and higher rates of obesity, than residents of urban counties. Rural rates of physical activity, but not of obesity, were lower than urban rates after controlling for demographic confounders.

Conclusions: Health professionals must acknowledge the differences between individuals living in different environments to develop more effective health promotion strategies.

INTRODUCTION

The environment, particularly the built environment (sidewalks, trails, recreational facilities, traffic), may limit physical activities in some communities, contributing to the rise in obesity. In a systematic review of 169 publications focusing on the built environment, 89% of the analyses indicated a positive association between the built environment and physical activity or obesity.1 Another systematic review of 47 publications found that the availability of physical activity equipment, connectivity of trails, and the availability, accessibility, and convenience of recreational facilities were positively associated with physical activity.2

The Census Bureau defines urban areas, urbanized areas and urban clusters, based on population and density within census blocks and block groups.3 By default, rural is defined as any area that is not classified as urban. In 2005-2008 Nutritional Health and Nutritional Examination Survey (NHANES) data, rural residents were more likely than urban residents to be obese (39.6% vs. 33.4%), Non-Hispanic White (86.3% vs. 65.1%), and report lower income.4 2000 BRFSS data showed an increased odds of being physically inactive in the most rural areas, compared to the most urban categories (OR: 1.46, 95% CI: 1.23-1.66).5 Given the higher rates of obesity and physical inactivity in rural areas, modifying the built environment may represent an important step towards encouraging healthy behaviors among residents.

According to the 2012 America’s Health Rankings, Texas ranked 40th in overall health and poorly on measures of obesity (40th) and physical activity (39th).6 Understanding some of the barriers to ameliorating these conditions depends, in part, on identifying how rural-urban residence, in contrast to the greater prevalence of disadvantaged populations, contributes to these low rankings. This study examined: (1) demographic characteristics, (2) environmental perceptions of sidewalks and trails, and (3) physical activity and obesity, among residents of urban and rural counties in Texas. The study objective was to identify associations between rural vs. urban residence and environmental perceptions, behavior, and weight status, while adjusting for other factors that influence these relationships, namely race, education, and income.

METHODS

Counties included in this cross-sectional study were participating in Transforming Texas, the largest grantee of the U.S. Department of Health and Human Services’ Community Transformation Grant.7 Adults at least 18 years of age, residing in the 6 counties of Lubbock, Hale, Jim Wells, Willacy, Webb, and McLennan, were contacted by telephone and asked to complete the Adult Targeted Surveillance Survey (ATSS), which was originally developed by Research Triangle International as a telephone survey using modules from the BRFSS and NHANES. The ATSS was administered by the University of North Texas Survey Research Center from September 2012 through November 2012. The study protocol was approved by UNT and the UNT Health Science Center Institutional Review Boards. All participants provided informed consent. Hale, Jim Wells, and Willacy were combined to estimate “rural” distributions, while Lubbock, Webb, and McLennan counties were combined to represent “urban.” The urban / rural categorizations were provided by the Texas Department of State Health Services, based on census definitions.3

Demographic characteristics included age, gender, race/ethnicity, income level, education, employment status, and marital status. The main outcome variables of this study were environmental perceptions, physical activity behavior, and weight status. Survey questions regarding environmental perceptions were: “There are sidewalks on most streets in my neighborhood;” “The sidewalks in my neighborhood are well maintained;” “When I am walking on a sidewalk in my neighborhood, there are parked cars between me and the road;” “There is a grass or dirt strip that separates the streets from the sidewalks in my neighborhood;” and “There are bicycle or pedestrian trails in or near my neighborhood that are easy to get to.” Response options for environmental survey questions included; ‘strongly agree,’ ‘somewhat agree,’ ‘somewhat disagree,’ ‘strongly disagree,’ and there are ‘no sidewalks.’ Responses were dichotomized to reflect those who disagree, or reported that sidewalks weren’t present, vs. those who agreed (strongly or somewhat). Physical activity was measured by: “During the past month, did you participate in any physical activities or exercise such as running, calisthenics, golf, gardening, or walking for exercise?” Responses were classified as ‘yes,’ vs. ‘no’ or ‘don’t know.’ Participants were also asked to self-report their weight and height, which were used to calculate a body mass index, which was then placed in the corresponding category of underweight (<18.5), normal (18.5≤BMI<25.0), overweight (25.0≤BMI<30.0), or obese (BMI>30.0). For the analyses we combined underweight and normal, vs. overweight and obese.

Weighted percentages were calculated for demographic variables, environmental perceptions, participation in physical activity, and body mass index categories. Chi-square tests and adjusted logistic regression models evaluated the association between rural vs. urban status and environmental perceptions, physical activity, and weight status. All analyses were conducted in SAS 9.2.

RESULTS

In total, 2,330 surveys were completed: 1,248 from a landline contact number and 1,082 from cellular lines. A total of 385 surveys were...
completed in Jim Wells, Lubbock, McLennan, and Willacy Counties, 387 in Hale County, and 403 in Webb County. The cooperation rate, which is the percentage of people who completed the survey when they were reached on the phone, was 21.7% for landline and 16.5% for cell phone.

Missing values on demographic variables were imputed using a hot-deck procedure. The distribution of ages, gender, employment status, and marital status were similar in rural and urban counties (see Table 1). Significant differences between rural and urban counties were observed in race/ethnicity, education, and income.

Fewer rural than urban residents agreed that sidewalks and trails are available (p < 0.01), are well-maintained (p < 0.01), and easily accessible (p = 0.01) in their neighborhood (see Table 2). Both rural (32%) and urban (40%) respondents were least likely to agree with the statement that “There are bicycle or pedestrian trails in or near my neighborhood that are easy to get to” (p = 0.01). Only 37% of rural residents agreed that “There are sidewalks on most streets in my neighborhood,” compared to 64% of urban residents (p < 0.01). Urban residents (76%) were more likely to report participation in physical activity than rural residents (69%, p = 0.005). Rural residents (73%) were significantly more likely to be overweight or obese than urban residents (65%, p = 0.005).

After adjusting for race, education, and income, rural/urban status was significantly associated with environmental perceptions and physical activity, but not with obesity. The odds of being physically active were significantly lower for residents of rural counties than of urban counties, even after controlling for race/ethnicity, education, and income (OR: 0.66, 95% CI: 0.50-0.88) (see Table 3).

**DISCUSSION**

Rural residents perceive an environment with fewer accessible sidewalks and trails, and report lower rates of health promoting behaviors. Lower education and income, and a higher proportion of minorities, may contribute to the poorer health outcomes. However, once these demographic differences are controlled, rural residents still have lower odds of participation in physical activity than urban residents. This finding is important, as physical inactivity is a major contributor to chronic disease. After controlling for these differences, rural vs. urban residence does not affect rates of obesity, suggesting that physical activity related to occupations may counter-balance the likelihood of engaging in formal physical exercise.

Despite the evidence that a well-structured environment can promote formal physical activity, occupations or other activities in rural areas may counter-balance the differences. Barriers to environmental and policy change in rural areas include small population size, lack of time or education, the culture and priorities of the communities, and lack of support from leadership. However, the daily activities associated with rural living may provide comparable physical exercise to the activities in which urban residents are more likely to engage.

This study was limited by self-report, and restricted to residents of Texas. Zip code, which could have provided greater detail, was not required for the survey, thus we weren’t able to conduct more focused analyses. Rural and urban environments in other areas of the country may exhibit different patterns.

The state of Texas is a prime example of how health determinants, behaviors, and outcomes can differ between rural and urban counties,
Table 2. Environmental perceptions, physical activity, and weight status among residents in urban and rural Texas counties.

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Urban</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (weighted %)</td>
<td>n weighted %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are sidewalks on most of the streets in my neighborhood(^a)</td>
<td>(395) 37%</td>
<td>(706) 64%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>The sidewalks in my neighborhood are well maintained (paved, even, and not a lot of cracks)(^a)</td>
<td>(360) 53%</td>
<td>(649) 67%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>When I am walking on a sidewalk in my neighborhood, there are parked cars between me and the road(^a)</td>
<td>(332) 53%</td>
<td>(502) 60%</td>
<td>0.04</td>
</tr>
<tr>
<td>There is a grass or dirt strip that separates the streets from the sidewalks in my neighborhood(^a)</td>
<td>(332) 59%</td>
<td>(480) 56%</td>
<td>0.45</td>
</tr>
<tr>
<td>There are bicycle or pedestrian trails in or near my neighborhood that are easy to get to(^a)</td>
<td>(330) 32%</td>
<td>(443) 40%</td>
<td>0.01</td>
</tr>
<tr>
<td>Participation in physical activity in the past month</td>
<td>(811) 69%</td>
<td>(878) 76%</td>
<td>0.005</td>
</tr>
<tr>
<td>Overweight or obese</td>
<td>(766) 73%</td>
<td>(719) 65%</td>
<td>0.005</td>
</tr>
</tbody>
</table>

\(^a\) Percentage who somewhat or strongly agree

Table 3. The association between rural / urban residence and self-reported physical activity.

<table>
<thead>
<tr>
<th></th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>0.66 (0.50 – 0.88)</td>
</tr>
<tr>
<td>Urban</td>
<td>Ref</td>
</tr>
<tr>
<td>Race / ethnicity</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>Ref</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.63 (1.08 – 2.47)</td>
</tr>
<tr>
<td>Other</td>
<td>1.05 (0.55 – 2.00)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Less than high school diploma</td>
<td>0.42 (0.23 – 0.76)</td>
</tr>
<tr>
<td>12 years or GED</td>
<td>0.64 (0.38 – 1.05)</td>
</tr>
<tr>
<td>Some college</td>
<td>0.65 (0.40 – 1.07)</td>
</tr>
<tr>
<td>College 4 years or more</td>
<td>Ref</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>Less than $20,000</td>
<td>0.64 (0.36 – 1.15)</td>
</tr>
<tr>
<td>$20,000 to $34,999</td>
<td>0.74 (0.41 – 1.34)</td>
</tr>
<tr>
<td>$35,000 to $74,999</td>
<td>0.78 (0.46 – 1.33)</td>
</tr>
<tr>
<td>$75,000 or more</td>
<td>Ref</td>
</tr>
</tbody>
</table>

and these results make a significant contribution to the Community Transformation Grant. Rural environments present unique barriers to developing healthy communities, and may benefit from collaboration and partnership with regional or national programs to supplement their limited resources.3 Health professionals must acknowledge the differences between individuals living in different environments to develop more effective health promotion strategies for each community, with the ultimate goal of preventing chronic disease.

**Funding**

The Texas Department of State Health Services was awarded the Public Prevention Health Fund: Community Transformation Grant by the Centers for Disease Control and Prevention under grant number CDC-RFA-DP11-1103PPHF11 to implement Transforming Texas.

**REFERENCES**


ABSTRACT
Objective: Home observation reveals factors that are highly relevant to children’s health and development, but no standardized tool currently exists that is both brief enough for widespread application and detailed enough to capture a broad spectrum of environmental concerns. The purpose of this study was to begin developing a brief, easily administered home observation tool that could identify sentinel indicators of unhealthy homes with minimum burden to study participants.

Methods: Investigators developed a new dwelling unit observation (DUO) tool based on review of existing home assessment tools and subjective selection of items that were easy to administer, highly informative, and possibly indicative of more extensive environmental concerns. The new DUO was pilot tested in a sample of 18 homes that varied widely in value and location within a Texas county.

Results: The most outstanding sentinel observations indicating potentially unhealthy conditions, all of which occurred with a frequency of one in 18 dwellings, included a roach infestation, structural disrepair, extremely unclean indoor surfaces, poor access to services (18 miles from the nearest grocery store), and close proximity to an agricultural field. Sentinel air quality measurements obtained with 15-minute readings on handheld sensors included elevated carbon monoxide (CO) and carbon dioxide (CO2) in a home with poor ventilation and elevated particulates (PM 2.5) in a home with indoor tobacco smoking.

Conclusions: Using the DUO, data collectors without any specialized training were able to record the most important environmental factors related to health and simple air quality measurements in a matter of minutes. Sentinel indicators of unhealthy conditions can trigger more detailed evaluations, limiting such evaluations to homes that are most likely to have a problem.

BACKGROUND
The home, or dwelling unit, has a significant impact on health and well-being. Characteristics contributing to good health include adequate space for the number of occupants, good ventilation, good repair, and control of pests. Older homes are more likely than newer homes to have hazardous materials such as asbestos, lead-based paint, or residues from pesticides that are now banned. Indoor air pollution can irritate the airways, increase the risk of cardiovascular disease, and contribute to general malaise. The quality of indoor air is particularly important in places like Texas, where people spend more time indoors than average during the summer due to excessive heat and outdoor pests.

Because many commonly used home assessment tools require hours to administer and generate large amounts of data, a simpler tool focused on sentinel indicators offers many practical advantages. The purpose of this study was to develop a brief, easily administered home observation tool that could identify sentinel indicators of unhealthy homes with minimum burden to study participants, primarily in the context of the National Children’s Study (NCS). The first home assessments in the NCS took days to complete using an intricate environmental sampling protocol and highly trained technicians. Since NCS cannot possibly measure every contaminant in every participant’s home, a screening tool to select homes for extensive environmental sampling would limit more intricate sampling to homes with sentinel indicators on initial screening.

A “sentinel indicator” in epidemiological studies is an early sign, usually an illness or injury, that reflects a potential health hazard for the exposed population. For instance, a canary’s illness after entering a coal mine has been used as a sentinel indicator of toxic gas. In this study, a sentinel indicator refers to a housing condition picked up on screening that may indicate more widespread concerns about the home. In terms of screening homes for sentinel indicators, the goal was to develop a tool that could be completed in 30 minutes or less by data collectors with no specialized training. The tool relies on observations rather than asking questions of participants, which reduces participant burden. The homes with sentinel indicators are candidates for more intense data collection, while those homes without any such indicators can be characterized only by the screening tool.

This study was a pilot project conducted in a rural Texas area for the NCS, a prospective cohort study of a diverse, nationally representative group of children from before birth through age 21 years. Although the dwelling unit observation (DUO) tool was developed for NCS, it could be used as a screening tool in other longitudinal health studies, with or without children in the home.

Population and Methods
A Development of the Dwelling Unit Observation (DUO) Tool
The DUO was based on a review of several existing tools, including NCS legacy tools, the Canadian Healthy Infant Longitudinal Development (CHILD) Study environmental assessment tools, other home assessment tools from Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the Agency for Toxic Substances and Disease Registry (ATSDR), the Home Observation for Measurement of the Environment (HOME) tool, which has been widely used in children’s health research for 40 years, the National Environmental Education Foundation (NEEF)’s pediatric environmental history questionnaire, the 2011 Enterprise Green Communities Checklist, and housing related publications from National Institute of Environmental Health Sciences (NIEHS) funded Centers for Children’s Environmental Health and Disease Prevention, Research.

Initially, over 100 items from the NCS legacy tools (Structural Visual Observations or SVO and Dwelling Unit Visual Observations or DUVO) and Canadian tool (CHILD Environmental Assessment) were listed by row on an Excel spreadsheet in the following categories: neighborhood contaminant sources, structural visual observations, indoor ventilation, sources of combustion, pets and pests, safety, cleanliness and clutter, and social observations. The items were included on the DUO only if both informative value and ease of collection were subjectively ranked as “high” by the investigators. The initial list was reduced from over 100 to 43 items. Examples of items that were deleted at this stage were observations about humidifiers, air cleaners, and door seals. As investigators reviewed additional home assessment instruments, the strategy switched to selecting items of interest rather listing every item and eliminating those with low informative value or ease of collection. Extant data, social observations, and digital photographs were not included in the NCS legacy or Canadian instruments but were added to the DUO for their high
informative value and ease of collection. Extant data include items such as air quality index, weather, proximity to pollutant sources, access to services, and real estate appraisal value.\textsuperscript{21}

B. Selection of Sensors for Air Quality Measurements

The indoor air measurements in the initial NCS protocol required large, expensive air pumps that were left running in the participant’s home over a number of hours. The DUO protocol was much simpler, involving 15-minute readings with hand-held devices. The sensors used for this pilot study were selected for convenience, as they were purchased for other studies and available to investigators at no additional cost. The sound meter (Quest Technologies Model 2900) was used to monitor sound levels inside and outside the home. The TSI Q-Trak measures temperature, humidity, carbon monoxide (CO), and carbon dioxide (CO\textsubscript{2}) using a small hand-held device with a probe attached and costs less than $1,000. All monitors were calibrated before use. Average CO levels in homes without gas stoves vary from 0.5 to 5 parts per million (ppm),\textsuperscript{22} and no health effects are expected in adults unless CO exceeds 25 ppm for more than an hour;\textsuperscript{23} nonetheless, small elevations of CO may reflect poorly ventilated combustion by-products and trigger additional tests. CO\textsubscript{2} is generally not considered a health hazard, but increasing levels are associated with stuffiness indoors due to lack of fresh, outdoor air.\textsuperscript{24} A probe for total volatile organic carbons (VOCs) is available with the Q-Trak but was not used for this pilot study. The TSI SidePak is “a miniature battery operated laser photometer that measures air borne particle mass concentration in units of milligram per cubic meter,”\textsuperscript{46} according to the product brochure, and weighs 16 ounces. It also costs less than $1,000. These sensors require about thirty minutes of training to use properly. Recalibration between homes takes a few minutes and can be done on the road. The hand-held sensors are not meant to replace more extensive air monitoring but rather to identify homes with initial elevations of CO\textsubscript{2}, CO, or particulates for more extensive air monitoring in follow up evaluations.

C. Complete DUO Tool

The final DUO tool has five sections: extant data, outdoor observations, real-time air and sound measurements, and Global Positioning System (GPS) coordinates. A few area observations, or abbreviated systematic social observations, such as presence of abandoned buildings and litter are also included.\textsuperscript{25} See Table 1 for a summary of items included on the DUO field tool. The complete tool can be obtained from the authors.

D. Enrollment of Participants

The study team invited 27 families with young children living in a predominantly rural area of Texas to participate in the study by letter and phone. The study team knew all the invited families from participation in other studies. About 65%, or 18/27, of those who received invitation letters actually participated in the study. No one refused to participate, but some potential participants could not be reached. This was a non-random, convenience sample for the purpose of field-testing a new home observation tool. Despite the potential selection bias of this approach, the sample contained a broad range of homes in terms of appraisal value, state of repair, and location within the county (see Table 2, Extant Data).

E. Field Testing the DUO Tool

The field-testing phase started with training the data collection team, which included two investigators, two research nurses, and two data collectors. Investigators developed an illustrated training manual detailing how to interpret each answer choice on the DUO. Training consisted of four hours of reviewing the manual item by item, followed by implementing the DUO for practice at the homes of two volunteers. Recruitment and data collection procedures were approved by Battelle Memorial Institute institutional review board (IRB) for human subjects’ protection. Data collection was completed over a one-week period in late July 2012. An average of four team members (two field staff and two investigators) evaluated each

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**Table 1: Observations included on the dwelling unit observation (DUO) field tool**

<table>
<thead>
<tr>
<th>Summary of Items Included on the DUO Field Tool</th>
<th>Number of Items Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Outside the Dwelling</td>
<td></td>
</tr>
<tr>
<td>A. Geographic Coordinates</td>
<td>1</td>
</tr>
<tr>
<td>B. Photos</td>
<td>3</td>
</tr>
<tr>
<td>C. Sources of Contaminants</td>
<td>6</td>
</tr>
<tr>
<td>D. Structural Visual Observations</td>
<td>5</td>
</tr>
<tr>
<td>E. Abbreviated Systematic Social Observations</td>
<td>6</td>
</tr>
<tr>
<td>Subtotal / Outside the Dwelling</td>
<td>21</td>
</tr>
<tr>
<td>II. Inside the Dwelling</td>
<td></td>
</tr>
<tr>
<td>A. General Information</td>
<td>7</td>
</tr>
<tr>
<td>B. Ventilation Assessment</td>
<td>9</td>
</tr>
<tr>
<td>C. Combustion Sources</td>
<td>6</td>
</tr>
<tr>
<td>D. Flooring</td>
<td>3</td>
</tr>
<tr>
<td>E. Pets, Pests, and Mold</td>
<td>7</td>
</tr>
<tr>
<td>Subtotal / Inside the Dwelling</td>
<td>32</td>
</tr>
<tr>
<td>III. Both Outside and Inside the Dwelling</td>
<td></td>
</tr>
<tr>
<td>F. Noise</td>
<td>2</td>
</tr>
<tr>
<td>G. Air Measurements</td>
<td>6</td>
</tr>
<tr>
<td>Subtotal / Both Outside and Inside the Dwelling</td>
<td>8</td>
</tr>
<tr>
<td>Total Number of Items</td>
<td>61</td>
</tr>
</tbody>
</table>
were pleasant and cooperative and seemed to enjoy interacting with the investigators. One participant asked us not to look in her bedroom. Overall, study participants were usually available at the scheduled time, or the team had the wrong address. One participant agreed to participate but did not show up at the time of the pilot study, so the team needed to reschedule the visit. In some instances, no one was home at the time of the pilot study. This included extreme outdoor heat (average high temperature = 102 degrees F during the week of data collection), which impacted all the observations. The consistency of responses (reliability) between pairs, including the two investigators, the two data collectors, within team investigator and data collector, and across team investigator and data collector was equivalent. In other words, the two investigators disagreed with each other as frequently as they disagreed with the data collectors. The data collectors disagreed with each other about as frequently as they disagreed with the investigators. Agreement was generally best on extremes. For instance, all four raters agreed on identifying a severe roach infestation as a pest problem. Reliability was not as good on more subtle items such as whether a couple of dead crickets indicated a pest problem. Since disagreement on subtle items is insignificant for this screening tool, reliability could be enhanced by reducing answer choices on some items such as presence of pests to two choices: none to few pests (applies to 95% of homes) or unusually severe infestation (seen to this degree in only about 5% of homes).

B. Feasibility, Acceptability, and Cost of DUO Overall

The DUO took about 30 minutes to complete, which is much less than the several hours required for the initial NCS home assessment with environmental sampling or the HUD Healthy Home assessment. Since the DUO protocol required 15 minutes of air monitoring both inside and outside the home, it could not be completed in less than 30 minutes. The observations generally took less time than the air measurements. The size of the home was less important than the home’s condition in terms of the time required to make observations. For instance, if the indoor environment had chipping paint and a crack in the ceiling, the observers took several minutes to rate the severity of indoor disrepair. In some instances, no one was home at the scheduled time, or the team had the wrong address. One participant asked us not to look in her bedroom. Overall, study participants were pleasant and cooperative and seemed to enjoy interacting with the study team.

While the development cost of the DUO was high, the marginal cost of implementing the DUO within the NCS infrastructure that existed at the time of the pilot study was relatively low. This included scheduling participants (average of three calls to 27 prospective participants over several weeks), scheduling data collectors (who were already trained and cleared for human subjects research), and conducting the training for the DUO. The implementation cost within the NCS infrastructure, not including development, supplies, or indirect cost, was about $8,000 for labor for 18 home assessments (four people working full time on this project for two weeks at an average salary of $1,000 per week) for the pilot study. The labor cost for two data collectors to conduct the DUO would be about $4,000 for 18 homes, or about $222 per home, including travel time between homes.

C. Section 1: Extant Data

Extant environmental and assessment data from Texas Department of Transportation (TxDOT), Tiger Roads, United States Department of Agriculture (USDA) Cropland layers, ToxMap, Google Earth, Google Maps, WalkScore, weather from the National Weather Service, census data for population density, and county tax appraisals provided some general information about each home (see Table 2). The most prominent potential health risk identified with extant data included extreme outdoor heat (average high temperature = 102 degrees F during the week of data collection), which impacted all the homes in the study. The extent sentinel indicators of a potentially unhealthy environment included remote location, low value, and proximity to an agricultural field. A rural home (population density = 9 in census block, walk score = 0) had poor access to services such as grocery stores (nearest grocery store = 18 miles). One home had a tax appraisal value < $15,000 due to disrepair and posed a safety hazard to residents. Finally, one home was next to an alfalfa field identified with USDA cropland layers, which could be a risk factor for agricultural pesticides or run-off.

In some instances, the GPS measurement at the door was more accurate than the coordinates obtained by entering the street address into Google Earth. Differences such as those illustrated in Figure 1 could be quite important for measuring proximity to pollutant sources. In these homes, the Google Earth coordinates placed the homes within 300 meters of a major highway, which is a risk factor for cardiovascular effects from air pollution. The actual coordinates, taken with a Trimble Juno SB Handheld, placed the homes outside the radius of expected health effects from living near the highway.
D. Section 2: Outdoor Observations
The data collection team observed the area around the home, potential pollutant sources, type of structure, and state of repair from outside the home, including taking three high resolution digital photos of the dwelling unit and the homes down the street. The type of structure included eleven single family dwelling units and seven multi-family dwelling units, some of which were subsidized. All 18 dwellings were single level (no basements or stairs). Most had attached garages and brick exteriors. The homes reflected a wide range of dwelling unit types, from small apartments to spacious new brick homes with in-ground swimming pools. The exteriors varied widely from immaculate to severe disrepair. The subsidized dwellings appeared to be structurally sound and actively maintained. The only sentinel indicator identified from outdoor observation was severe disrepair in the privately owned home valued at <$15,000 by tax appraisal data.

E. Section 3: Indoor Observations
Interior observations included cleanliness, occupant density, ventilation, combustion sources, floor type, furry pets, pests, and signs of mold.26 Judging from observation alone, the homes had no more than two occupants per bedroom, indicating that over-crowded living conditions did not occur in this sample. Most homes were tightly sealed to conserve energy, and occupants were staying indoors with the air conditioning running due to the excessive heat of the Texas summer. The HVAC systems did not bring in any outdoor air, and exhaust fans in the kitchens and bathrooms were of variable quality. A small amount of mold was occasionally visible, typically around the shower base, but no patches exceeding one inch in diameter. Gas appliances were common. As anticipated, most homes in this study (16/18) had central, ducted, forced air cooling systems, and some (2/18) had only window units for cooling. Most homes had carpet and furry pets indoors.

Sentinel indicators of a potentially unhealthy indoor environment included a pest infestation and unclean surfaces. One of 18 dwellings had a strong pungent odor upon entry and multiple roach sightings during the home visit, indicating a severe roach infestation. A different home, only one of the 18 visited, had a build-up of grime on all surfaces and was universally classified as “unclean” by all observers.

F. Section 4: Real Time Air and Sound Measurements
The sensors detected several sentinel indicators of poor indoor air quality. One dwelling unit had higher levels of both CO (4.2 ppm) and CO2 (2300 ppm) than the others (see Table 3). The American Society of Heating, Refrigeration & Air Conditioning Engineers (ASHRAE) CO2 level of concern for CO2 is 1000 ppm, reflecting poor ventilation, and five of twelve homes tested exceeded this level. One of the 18 dwellings had much higher PM2.5 than the others (see Table 4). This was a rural home with obvious indicators of tobacco smoking indoors such as ashtrays with cigarette butts. In addition, this home did not have a central HVAC system.

There was no significant difference in outdoor PM 2.5 between any of the 18 dwellings, regardless of proximity to highways. The sound level measurements were in a similar range both inside and outside for all dwellings.

DISCUSSION
As a screening instrument to identify sentinel indicators of unhealthy homes, the DUO was successful in identifying the most salient health risks in the home environment and triggers for additional testing. Furthermore, the DUO field evaluation was acceptable to participants, feasible to administer with minimum training, and cost effective, using widely available hand held instruments for air measurements. The most outstanding sentinel indicators from extant data and observations included a low density area, associated with lack of services;27 a low value home, associated with disrepair; proximity to an agricultural field, associated with run-off; grimy surfaces indoors, associated with incidental ingestion of toxic substances and a disorderly home;28 and a roach infestation, associated with increased risk of allergies and asthma.29 Easily obtained air quality measurements that could trigger additional testing included elevated CO and CO2 in a poorly ventilated home and elevated particulates in a home with indoor tobacco smoking.

Table 3: Inter-Rater Reliability on Key Items

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Fleiss’ Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling Unit Type (five choices)</td>
<td>0.67</td>
</tr>
<tr>
<td>Clutter Indoors (three categories)</td>
<td>0.48</td>
</tr>
<tr>
<td>Pests (yes or no)</td>
<td>0.48</td>
</tr>
<tr>
<td>Close to Major Highway (yes or no)</td>
<td>0.44</td>
</tr>
<tr>
<td>Forced Air, Central HVAC (yes or no)</td>
<td>0.35</td>
</tr>
<tr>
<td>Cleanliness Indoors (yes or no)</td>
<td>0.31</td>
</tr>
<tr>
<td>Outside Disrepair (three categories)</td>
<td>0.26</td>
</tr>
<tr>
<td>Mold (yes or no)</td>
<td>0.11</td>
</tr>
<tr>
<td>Indoor Disrepair (three categories)</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Interpretation: Kappa of “1” indicates perfect agreement. Kappa below 0.3 indicates that agreement on the item was inadequate, and the wording of the item and/or training in collecting the data needs improvement.
Table 4: Air Quality Measurements from Sensors

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Outlier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide - Outdoor</td>
<td>18</td>
<td>0.5-1.0</td>
<td>0.7</td>
<td>0.8</td>
<td>none</td>
</tr>
<tr>
<td>Carbon Monoxide – Indoor*</td>
<td>18</td>
<td>0.2-4.1</td>
<td>0.7</td>
<td>0.7</td>
<td>4.1**</td>
</tr>
<tr>
<td>Carbon Dioxide – Outdoor</td>
<td>18</td>
<td>400-440</td>
<td>420</td>
<td>420</td>
<td>none</td>
</tr>
<tr>
<td>Carbon Dioxide – Indoor*</td>
<td>18</td>
<td>600-2200</td>
<td>700</td>
<td>1009</td>
<td>2200**</td>
</tr>
<tr>
<td>PM 2.5 – Outdoor*</td>
<td>18</td>
<td>5-12</td>
<td>7</td>
<td>11</td>
<td>none</td>
</tr>
<tr>
<td>PM 2.5 – Indoor***</td>
<td>18</td>
<td>10-70</td>
<td>12</td>
<td>9</td>
<td>70</td>
</tr>
</tbody>
</table>

*American Society of Heating, Refrigeration & Air Conditioning Engineers (ASHRAE), carbon monoxide Level of concern indoors = 9 ppm; ASHRAE carbon dioxide level of concern = 1000 ppm (not for the carbon dioxide itself but as a surrogate for other bioeffluents or odors); Environmental Protection Agency’s National Ambient Air Quality Standards list 15 μg/m³ as the annual limit and 65 μg/m³ as the 24-hour limit for PM2.5 in outdoor air.

**The highest carbon monoxide and highest carbon dioxide occurred in the same home.

***Actual measurements divided by 3 to correct for tobacco smoke particle size, as determined by calibration experiments comparing the SidePak to pump-and-filter gravimetric methods30

Figure 1: Geographical coordinates of residence by entering address into Google Earth vs. taking an actual measurement at the home. The crosses reflect the actual address as measured with a Trimble Juno S8 Handheld device, while the dots reflect the geographical coordinates obtained by entering the address into Google Earth. The dots (false location) are close enough to a major highway to be a health concern, while the crosses (real location) are not.
The air measurements are good examples of how sentinel indicators can serve as "dwelling canaries." The elevated CO alludes to potentially higher values when gas appliances are in use. This measurement came from a public housing unit that had natural gas appliances and recent tightening of the building envelope to conserve energy, which contributed to both the CO and CO2 elevations. If resources were available, sentinel indicators such as these could trigger more detailed dwelling inspections such as gas appliance performance, combustion gas generation, and venting before the problem becomes a health risk to the occupants. Elevated PM 2.5 in another home could trigger a follow-up study of particulate air pollution over a longer period of time with documentation of occupant activities to help identify the extent and source of exposure.

The DUO tool is still in the development phase and not ready for use in other studies. Additional studies of content, validity, reliability, and seasonality could strengthen the DUO field tool. Comparison to longer assessments (HUD or EPA) might identify items for inclusion or deletion from the DUO. Funding was not available to conduct the longer assessments in the field alongside the DUO. Long-term air quality measurements, as well as professional inspections for mold, pests, and disrepair in a sample of DUO assessed homes, would also help establish the DUO’s validity compared to professional measurements. A few items on the DUO, such as degree of mold and indoor disrepair, had poor inter-observer reliability and need refinement in phrasing along with additional training. Finally, the DUO should be repeated in the winter when use of gas furnaces is prevalent, and the risk of combustion byproducts such as CO in indoor air increases.

Acknowledgement

Many thanks to Karen Tucker, operations manager, and the Battelle field office staff for their contributions to this study.

REFERENCES

8. The Canadian Healthy Infant Longitudinal Development (CHILD) Study (2009), Environmental Assessment_RA, Q17ENVRA3M v.2009M12D01 and Prenatal Home Environment self-administered questionnaire, Q9HEN-V18WK v.2010M09D30. (Note: Proprietary tools provided to investigators as a professional courtesy).
Evaluating a De-Centralized Regional Delivery System for Breast Cancer Screening and Patient Navigation for the Rural Underserved

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ABSTRACT

Providing breast cancer screening services in rural areas is challenging due to the fractured nature of healthcare delivery systems and complex reimbursement mechanisms that create barriers to access for the under- and uninsured. Interventions that reduce structural barriers to mammography, like patient navigation programs, are effective and recommended, especially for minority and underserved women. Although the literature on rural healthcare is significant, the field lacks studies of adaptive service delivery models and rigorous evaluation of evidence-based programs that facilitate routine screening and appropriate follow-up across large geographic areas.

Objectives: To better understand how to implement a decentralized regional delivery “hub & spoke” model for rural breast cancer screening and patient navigation, we have designed a rigorous, structured, multi-level and mixed-methods evaluation based on Glasgow’s RE-AIM model (Reach, Effectiveness, Adoption, Implementation, and Maintenance).

Methods and Design: The program is comprised of three core components: 1) Outreach to underserved women by partnering with county organizations; 2) Navigation to guide patients through screening and appropriate follow-up; and 3) Centralized Reimbursement to coordinate funding for screening services through a central contract with Medicaid Breast and Cervical Cancer Services (BCCS). Using Glasgow’s RE-AIM model, we will: 1) assess which counties have the resources and capacity to implement outreach and/or navigation components, 2) train partners in each county on how to implement components, and 3) monitor process and outcome measures in each county at regular intervals, providing booster training when needed.

Discussion: This evaluation strategy will elucidate how the heterogeneity of rural county infrastructure impacts decentralized service delivery as a navigation program expands. In addition to increasing breast cancer screening access, our model improves and maintains time to diagnostic resolution and facilitates timely referral to local cancer treatment services. We offer this evaluation approach as an exemplar for scientific methods to evaluate the translation of evidence-based federal policy into sustainable health services delivery in a rural setting.

Key Words: breast cancer, patient navigation, rural, health services delivery, multi-level evaluation, mixed-methods, RE-AIM

BACKGROUND

Breast cancer screening and follow-up is complicated, but, if navigated correctly, promises to significantly reduce mortality and morbidity. Mammograms are effective in reducing breast cancer mortality1-3 and several entities - the US Preventive Services Task Force, American Cancer Society, American College of Radiology – recommend them.4,6 Mammography interventions can also increase screening, while timely follow-up of screening identifies cancers at earlier stages and thereby decreases breast cancer mortality.4,6 However, these mortality benefits can only be achieved when women receive regular screening according to national guidelines and obtain efficient follow-up for abnormal mammograms.8 To this end, public and private providers, advocates, and funders have created numerous programs to encourage women to receive regular screening and timely follow-up. For under- and uninsured women in the US, the Congress mandated the Centers for Disease Control and Prevention (CDC) create the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), a federal state-administered partnership to maximize access to this type of care. The NBCCEDP has reduced mortality among under- and uninsured low-income women across the country by funding state agencies to reimburse clinical prevention services rendered by local state contractors.7 In Texas, the CDC prevention partnership is known as Texas Medicaid Breast and Cervical Cancer Services (BCCS). Unfortunately, provision of these services has been suboptimal in many rural areas. States with large rural populations, like Texas, continue to face considerable burdens for cancer care delivery in rural communities.

Why is breast cancer service delivery suboptimal in rural parts of the country? Some of the reasons stem from more general challenges that rural communities face in obtaining and delivering healthcare. The healthcare infrastructure in many rural communities is underdeveloped such that rural residents cannot readily obtain optimal care from local providers or technology needed for screening and follow-up. While rural communities boast many small businesses and self-employed individuals, residents of non-metropolitan areas report higher rates of poverty and lack of insurance, which greatly reduce financial access to available cancer prevention services.9,10 With less developed infrastructure and fewer financing mechanisms than metropolitan areas, rural residents also have greater difficulty receiving care coordination. Potential providers face significant non-reimbursable, administrative costs involved in successfully applying to become a state BCCS contractor that can then receive reimbursement for indigent screening services through the state-federal partnership. Consequently, many rural providers that otherwise might be able to provide breast cancer screening services cannot provide the initial administrative investment needed to qualify as a BCCS-approved contractor. Although BCCS is a state-wide program, in 2010 only one third of the counties in Texas have a BCCS provider (Figure 1). Furthermore, even where rural communities have the appropriate services and access mechanisms in place, many underserved in these areas lack awareness of the services available to them. All told, rural residents face restricted access to health services, higher costs, fewer providers, limited transportation options, and inadequate or under-utilized infrastructure.11-13 The field lacks studies of adaptive service delivery models and rigorous evaluation of evidence-based programs serving rural regions that facilitate routine screening and appropriate follow-up, especially for underserved and disadvantaged groups.14,15

Rural breast cancer screening

Access and delivery challenges make breast cancer a critical public health problem for rural communities. While rural communities do not demonstrate greater incidence and mortality rates than urban populations, rural communities on average are older and have lower rates of mammography.16-19 Rural residents with cancer tend to be diagnosed at more advanced stages2 while experiencing reduced access to state-of-the-art technology.20-22 As a result, rural residency is a strong predictor for lack of mammography. Among rural counties in our region of North Texas, for example, breast cancer is the leading incident cancer diagnosis among women, where many counties report notably higher age-adjusted breast cancer rates.21,23 Breast cancer is a burden for both rural communities and the public health...
programs attempting to serve them. With financial and structural obstacles impeding the provision of care, designing delivery models to provide rural women with routine, guideline-recommended screening and follow-up presents an enormous challenge.\textsuperscript{24}

Navigation along a continuum of screening and preventive care works best when the various services in that continuum are part of the same system of care. Integrated private systems, like Kaiser Permanente or Group Health, accomplish integration by coordinating both care and coverage within their system through unified ownership and management.\textsuperscript{25-27} Absent these integrated systems, private providers and insurers have emulated vertical integration through virtual system integration or “virtual integration.” Spurred by the demise of unmanaged indemnity insurance and the rise of the health maintenance organizations (HMOs), preferred provider organizations (PPOs), integrated medical groups (IMOs), and individual practice associations (IPAs), virtual networks have emerged across the country since the 1990s wherein providers are “capable of bearing capitation risk for tens to hundreds of thousands of patients …[through] complex ownership and contractual relationships with hospitals and outside specialists” in a virtual system of integrated delivery.\textsuperscript{27}

Medicaid and, to a lesser extent, other federal-state programs have sought to create analogous networks for low-income and uninsured populations. Some safety-net systems, like the Dallas County-funded Parkland Health & Hospital System, have created integrated public systems through their own HMOs or county-sponsored medical assistance plans, where public ownership and the creative use of public and private reimbursement mechanisms imitates the vertical integration and service coordination achieved in private systems.\textsuperscript{28,29} Rural systems have not seen comparable success, however, largely because many rural communities lack the large employer-base for insurance-driven delivery networks, and most rural counties are unable to support robust public health infrastructure. The Breast Screening & Patient Navigation (BSPAN) program fills that gap by establishing the Moncrief Cancer Institute (Moncrief) as the hub of a virtually-integrated care group. As a BCCS contractor, Moncrief establishes contractual relationships with local providers along the breast cancer screening and follow-up care continuum, reimbursing them at Medicare rates while using nurse-driven telephone navigation to address patient barriers to screening completion and follow-up.\textsuperscript{17,30} This vertical integration allows BSPAN to retain programmatic flexibility: it protects the legal autonomy of Moncrief and local providers while adjusting to local county contexts that differ with respect to the types of organizations available to partner with Moncrief.\textsuperscript{31}

**Original screening program**

To address the needs of rural counties in North Texas, Moncrief Cancer Institute (Moncrief), a community-based not-for-profit, created a BSPAN program in five rural counties - Denton, Wise, Parker, Hood, Johnson - surrounding Tarrant County, Texas (Figure 2). BSPAN deploys oncology-certified nurse-driven screening and follow-up navigation and provides centralized reimbursement as a Texas BCCS provider.\textsuperscript{23} The Moncrief program is comprised of three components: 1) Outreach to underserved women by partnering with local county organizations; 2) Navigation to guide patients through screening and appropriate follow-up; and 3) Centralized Reimbursement to coordinate funding for screening and follow-up services through the Texas BCCS contract, additional state grant funding, and local philanthropic support. These components reduce geographic and financial barriers for women who need screening mammograms as well as those who report symptoms and thus do not qualify for screening programs.

Moncrief utilized patient navigation because it is an evidence-based intervention. National Cancer Institute-funded studies indicate that patient navigation reduces the time from abnormal finding to diagnosis in various cancers.\textsuperscript{22,24} While “patient navigation” facilitates timeliness of care, multiple varieties of the model exist. Within breast cancer screening alone, for example, patient navigation services differ by scope of services navigated, setting of the care involved, qualifications of navigators deployed, and effectiveness of the programs utilized.\textsuperscript{35-37} With BSPAN, Moncrief compensated for the unique service conditions of the North Texas setting by adapting patient navigation strategies to underserved, rural communities: telephone-based access to oncology-certified nurse navigators and a network of county-based local providers address the lack of provider infrastructure in the rural context,\textsuperscript{23} while centralized reimbursement through the Moncrief BCCS contract circumvents the problem that limited financial liquidity often poses to rural providers otherwise interested in providing care to under- and uninsured women. BCCS funding itself removed financial barriers associated with access to screening for rural uninsured.\textsuperscript{38} An outreach team, led by a social worker and oncology nurse manager, identifies and assesses potential county organizations then develops partnerships to create a county-based network both to target underserved women and to provide clin-
ical services in each local county. To address rural distances, BSPAN deploys trained, bilingual oncology-certified registered nurse navigators working over the telephone to guide women through each of the multiple steps to guideline-based follow-up and care, decreasing time to clinical diagnosis and subsequent treatment. The navigator team provides initial education and counseling for screening and appointment scheduling as well as follow-up and treatment as necessary for those with abnormal findings. Importantly, the program incorporates patient financial review and manages the cascade of provider reimbursement to create an integrated navigation process, resulting in fewer patients lost to follow-up and more cancers found at early, treatable stages. In summary, Moncrief’s original BSPAN design adapted patient navigation to address the problem of service integration in rural communities.

**Methods and design**

We have published outcomes of the initial program design; BSPAN is successful when Moncrief provides guideline-based care through the full program (all three components) to a rural county. This success has led 12 adjoining counties to invite Moncrief to expand their services into their underserved communities. However, the complexity of providing all the resources necessary to implement all three program components restricted Moncrief’s ability to expand the program to other rural counties in the region; Moncrief requested we consult with them to expand the program, now BSPAN2, and collect the data necessary to understand how best to allocate program resources to better support sustainability across the expanded catchment area.

**Aims**

To implement a sustainable expansion of the original BSPAN (five counties) to an additional 12 counties covering approximately 14,000 square miles, we adapted the program to increase community engagement and practical distribution of resources based on county capacity. To increase the program reach and sustainability, we will systematically evolve and expand to a hub-and-spoke model that enables counties (the spokes) to assume responsibility for one or two of the components while Moncrief (acting as the hub) continues to provide centralized financial review and reimbursement. We will prospectively identify those counties that have the necessary programmatic capacity and then test whether implementation of the program tailored to a county’s capacity and local needs can lead to equivalent program success in an additional 12 rural counties (BSPAN2 total = 17 counties).

In this protocol, we describe how we will implement and evaluate BSPAN2, the adapted model, in our rural region of North Texas. We describe the means by which we will assess county capacity, standardize our navigation algorithm, train our staff, and monitor implementation effectiveness, using a mixed-methods evaluation process modeled on Glasgow’s RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework for rigorous evaluation. We expect that the outcomes generated by the implementation of this protocol will lead to a model that can be disseminated to other rural communities across the country.

**Setting and participants**

- 17 rural and underserved counties in North Texas
- Estimated 74,000 under- and uninsured women >40 years across 14,000 square miles
- Multiple county partner organizations (community non-profits, clinics and provider organizations, county health departments, etc.)

**Assessing county capacity**

We will develop a Readiness Assessment Criteria (RAC) tool to gauge county capacity and readiness for BSPAN2 program implementation. We will define capacity in terms of the ability and potential of county partners to a) partner with Moncrief and other organizations; b) provide some or all components of this evidence-based intervention; as well as c) change and adapt in order to implement interventions to improve the quality of care in their community. County capacity “affects not only the potential of organizations for uptake in the sense of adopting health interventions and entering into partnerships, but also the ways in which these are implemented in practice and whether they can be sustained.”

Strategies for community capacity assessment and coalition building are diverse. Implementation researchers face multiple challenges in convening stakeholders with diverse “expectations, goals, and incentives for collaboration.” Consequently, we will implement a rudimentary social network recruitment strategy patterned after Valente’s social-network thresholds model, identifying champions within county social and care delivery networks to influence organizational agenda setting. We will assess local and contextual barriers to the embedding of new practices and the forging of new service coalitions; such barriers may stem from previous inter-organization history or from larger social, political, and organizational dynamics within county communities. Accordingly, we will design and implement the RAC tool as a relational and iterative tool that builds trust, fosters community, and highlights the value for stakeholders: maximized benefits and minimized drawbacks resulting from collaboration that can accrue to their organization and community at large.

Our outreach team will operate at multiple levels, with our hub leadership (e.g. medical director) addressing county opinion leaders and prominent gatekeepers while our program providers (e.g., navigation and outreach managers) engage the front line staff in a deliberative engagement process (Figures 3, 4). We design this multi-level and multi-step engagement process to foster institutionalization of the evidence-based program and to encourage inter-organizational collaboration while minimizing concerns community stakeholders may have about loss of practice autonomy and insufficient coalition resources.

Based on preliminary research and literature review, we will assess “readiness” using both qualitative and quantitative criteria. The measures will include quantitative structural capacities of each county, including: baseline breast cancer screening capabilities; funding/reimbursement resources; pre-existing and potential linkages among service providers; existence of a key institution with appropriate service capacity; information technology and financial reporting infrastructure; and baseline capacity of appropriately trained health providers. The measures will also include qualitative “social capital” capacities, including the support of county leadership for such a program; the presence of provider “champions” to launch, implement, and sustain such a program; and the ability of community stakeholders at various stages along the screening outreach and navigation process to collaborate for programmatic success.

The RAC tool will be a multi-step instrument that involves both hub and spoke in gathering the quantitative and qualitative data (Figure 3) to gauge multiple dimensions of county resources and infrastructure relevant to adopting BSPAN2 program components. For example, positive markers for outreach capacity will include multiple local media outlets, an active Chamber of Commerce, and numerous examples of community cohesiveness like religious congregation activities serving the indigent. Positive markers for navigation capacity will include actual medical facilities, local leadership culture in the form of a supportive hospital executive, articulated vision for strategic collaboration, use of collaborative data, and staff recognition of these priorities. The RAC will also indirectly identify key actors (at
private practices, local hospitals, or free-standing facilities) who can facilitate streamlined implementation of centralized reimbursement processes. We will evaluate the effectiveness of the RAC to gauge county capacity based on the actual outcomes for individual patients on screening completion in light of county capacity and BSPAN2 program implementation.

The RAC tool consists of both multiple-choice and open-ended survey questions that probe a county’s capacity to implement outreach and navigation. Surveys are completed by both hub and potential spokes at three designated points during the preparation to launch (Figure 3). The hub conducts an initial survey of overall county resources, a survey of each partner’s specific resources, and a final assessment of the county’s collective capacity based upon hub evaluation of multiple partners in that county. Each partner organization, or spoke, completes an initial survey of its own capacity, a second survey in response to the hub’s initial assessment, and a third survey three months after launch that revisits organizational readiness-for-change. County partners launch screening event activities prior to an initial screening event. All surveys are administered online using REDCap software.62 The data are downloaded by the hub at key points to assess and inform partners of the proposed plan for partnership and are reviewed by members of the research team to monitor and evaluate the hub’s implementation of the protocol.

Database for patient registration and navigation
We will develop a database to standardize our navigation algorithm. The initial five-county BSPAN program used a customized version of the Oncolog Breast Outcomes data management system (Manasquan, NJ) to record all patient information and screening and diagnostic mammogram results and to generate screening reminders to patients. Information on co-morbid conditions, prior breast history, and genetic and gynecologic histories was also documented. Oncolog was used to document phone contacts, clinic visits, referrals, and other steps in the navigation protocol. For the BSPAN2 expansion, we will develop a customized internet-based application that provides step-wise, controlled data entry. This will standardize the registration, screening, and clinical follow-up process, facilitating consistent data capture at the hub and spokes. We have previously developed and successfully implemented similar interface applications in other projects funded by the Cancer Prevention Research Institute of Texas (CPRIT) as well as federal agencies.63

This database application will meet both HIPAA (Health Insurance Portability and Accountability Act) privacy requirements and Texas Medicaid BCBS standards for secure data transfer for patient tracking, financial review, and reimbursement processes. Core data elements for tracking patient navigation programs include eligibility (age, race/ethnicity, language preference, time since last screen); mode (in-person, on-phone, number of encounters, time spent per person, overall caseload per week, number of navigators with same patient); and time period of follow-up for outcome measure (three, six, or 12 months vs. specific age).64 Our data system records three telephone attempts and sends a certified letter to the last patient-reported address to determine loss to follow-up rates. We will continue to track our performance as we extend comprehensive screening and appropriate follow-up beyond the original five to 12 new rural counties.
Training modules
Longitudinal program quality will require that we provide county partners with solid initial and ongoing training and support. We will begin by training county partners how to implement the necessary program components according to their capacity levels. We will expand our BSPAN2 staffing from seven to 15 full-time equivalents (1.4 FTE per county from 1.1. FTE) to support the appropriate training modules as we launch, in a step-wise manner, the program components with our new county partners. The outreach training modules will enable county partners to: identify local champions; coordinate with county infrastructure; and identify and maximize local media channels to reach underserved women. Staff will train county partners to register patients, determine initial eligibility status, and schedule clinical breast exams. The navigation training modules will enable county partners to provide counseling and case management; coordinate referrals to the appropriate local providers; and collect and enter clinical and process data using the internet-based application. Owing to the financial constraints mentioned above, BSPAN2 will retain responsibility for the Centralized Reimbursement component in all target counties, regardless of county capacity. However, to ensure BCCS reimbursement for screening, diagnostic, and treatment costs, staff will train partners to use the navigation database to comply with Medicaid BCCS measures and eligibility metrics.

Monitoring and evaluation
We will evaluate 1) the implementation of BSPAN2’s hub-and-spoke model across a range of rural county contexts and 2) the program’s impact on the breast cancer screening process and outcome measures. Glasgow’s RE-AIM model (described below) will guide our evaluation process, and will focus on program implementation and impact at both the participant and county partner (spoke) levels. To conduct this multi-level evaluation, we will employ a combination of quantitative methods (abstraction from the patient navigation database) and qualitative methods (interviews with county partners and participants and structured observation during site visits), integrating these data to inform our analysis and create a more robust evaluation.

Evaluation strategy: RE-AIM model
Researchers have successfully used Glasgow’s RE-AIM model to assess similar screening and health promotion programs. RE-AIM specifies five dimensions to determine program impact — 1) Reach into the target population, 2) Effectiveness, 3) Adoption by program partners, 4) consistent Implementation, and 5) Maintenance of its effects among program participants and partners. By including both individual and organizational levels in the framework, RE-AIM enables investigation of whether program implementation has an impact on one level but not the other. Assessment of both levels is essential to determine in which contexts a program will work. Table 1 describes the BSPAN2 evaluation strategy with respect to the RE-AIM dimensions, two levels (participant and county), evaluation questions, measures, and data collection method. Constrained by a three-year grant award, the Implementation dimension refers to expansion and scaling-up of hub activities. True maintenance is a time-dependent dimension more appropriately examined at least six or more months beyond initial implementation (adoption), ideally after the last intervention contact; that is not possible here. Conceptually, however, the ability of the hub and/or spoke to “maintain” a practice, for example, screening procedures remains useful as an interim process measure, albeit within the timeframe of our implementation.

Mixed methods
Our mixed-methods approach directly responds to Glasgow et al.’s recommendation that implementation studies based on the RE-AIM model assess performance both within and across the five dimensions. We have designed our database to facilitate collection of both quantitative process and outcome measures. Reports of quantitative data will be generated monthly and quarterly to systematically inform qualitative data collection. Two qualitative methods will be deployed — semi-structured interviews with participants and county partners and structured observations during visits at county sites. We will use a convergent data analytic approach to connect the quantitative and qualitative data collected (see also Table 1- Measures & Data Collection Method).

The program expansion incorporated evaluation from the outset, and a discrete cost analysis of the evaluation component itself is beyond the scope of the grant award. Derivative analyses are planned to explicate the cost strategy not only of the expansion evaluation but of the BCCS leveraging strategy for the hub-and-spoke model overall, which will have significant implications for dissemination to other jurisdictions.

Measures
The BSPAN2 program follows Texas Medicaid BCCS guidelines as stipulated by the CDC’s NBCCEDP national requirements. To guide selection of process and outcomes measures at the participant level, we are also informed by Taplin and colleagues’ conceptual framework of the cancer screening process. Notably, breast cancer screening facilitates earlier detection and lowers mortality only when the full process is completed; it is not just about getting a mammogram. Key steps in the multi-step process are risk assessment, detection, diagnosis, and treatment. For some women, the process only involves getting a clinical breast exam and a screening mammogram; for other women with symptoms or those who are referred because of an abnormal test result, the process will require a full diagnostic evaluation and treatment if cancer is diagnosed.

Level 1- Participant
Quantitative. At the participant level, we will use the database to monitor a variety of process and outcome measures with respect to the Reach and Effectiveness dimensions (Table 1). For example, process measures capturing Reach include: number of women who respond to our outreach activities by calling our toll-free navigation telephone, number of women who receive one or more tests/procedures, and number of women lost to follow-up. A critical component of Reach is determining the appropriate denominator; for our program, the denominator will be based on the 2010 Census estimates of the number of uninsured women in each county. This denominator will be used to calculate the percentage of under- and uninsured women who participated in BSPAN2. To further assess Reach, we will also compare sociodemographic characteristics between BSPAN2 participants and county census data.

We will measure the Effectiveness dimension as the percentage of women who complete the screening process. For those with an abnormal screening test result, we will also track the percentage that complete diagnostic evaluation (e.g., diagnostic mammogram, biopsy, etc.). The database is date-driven, thereby enabling us to assess timely delivery of care such as average number of days to diagnostic resolution.

Qualitative. At the participant level, “exit interviews” conducted with a sample of participants who complete the mammography screening process will enable us to assess the Reach and Effectiveness dimensions qualitatively. The interviews will assess participant perspectives with respect to each component of the BSPAN2 program (outreach, navigation, patient financial review), as well as how these attitudes and experiences shape feelings about breast cancer prevention overall. The evaluation team will conduct 30-minute interviews in either English or Spanish, according to the participant’s perspectives.
### Table 1. Evaluation Questions, Measures, Data Collection Methods for Participant and County Partner Levels by Re-AIM Dimension

<table>
<thead>
<tr>
<th>Level</th>
<th>Selected Evaluation Question</th>
<th>Measures &amp; Data Collection Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reach</strong></td>
<td></td>
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<tr>
<td>Participant</td>
<td>How many women have been served?</td>
<td>Using the database, calculate—</td>
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<tr>
<td></td>
<td>What percent of uninsured women participated in BSPAN (based on each county’s 2010 Census estimate for the denominator)?</td>
<td>Process measures—</td>
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<td></td>
<td>What percent of those served received their 1st or baseline mammogram?</td>
<td>- # calls to toll-free navigation telephone</td>
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<td></td>
<td>Are sociodemographic characteristics of participants similar to the target population (per 2010 Census)?</td>
<td>- # never screened women (baseline: asymptomatic, symptomatic)</td>
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<td></td>
<td>Use of qualitative methods to understand reach and/or recruitment</td>
<td>- # and length of navigation calls per participant</td>
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<td></td>
<td></td>
<td>Outcome measures—</td>
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<tr>
<td></td>
<td></td>
<td>- % women in county who received 1 or more test/procedures (based on 2010 census denominator of women 40+ who are uninsured)</td>
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<tr>
<td></td>
<td></td>
<td>- % women served who had never had a mammogram (BCCS)</td>
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<tr>
<td></td>
<td></td>
<td>- Compare sociodemographics between BSPAN participants and census data</td>
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<tr>
<td><strong>Effectiveness</strong></td>
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<td></td>
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<tr>
<td>Participant</td>
<td>What is the impact of program on screening rates? <em>(CDC NBCCEDP recommendations; Texas BCCS)</em></td>
<td>(Database)</td>
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<td>How did navigated participants perceive the program— useful, credible, and sensitive to needs?</td>
<td>% women who completed screening process</td>
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<td></td>
<td>% CBE within 60 days of screening mammogram (BCCS)</td>
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<td></td>
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<td># and stage of cancers detected</td>
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<tr>
<td></td>
<td></td>
<td>Among women with abnormal screening mammogram or CBE:</td>
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<td></td>
<td></td>
<td>- % women who completed follow-up process</td>
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<td></td>
<td></td>
<td>- Average # days to diagnostic resolution</td>
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<td></td>
<td></td>
<td>% women lost to follow up among all touched by BSPAN program (Measure of attrition)</td>
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<tr>
<td></td>
<td>Interviews of subsample of women completing and not-completing</td>
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<tr>
<td>County</td>
<td>Are eligible agents willing to initiate program?</td>
<td>Percent of organizations approached agreeing to participate</td>
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<tr>
<td></td>
<td>Do county partners accept/agree with RAC assessment?</td>
<td>Site visits and Interviews with county partner to assess attitudes toward:</td>
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<td></td>
<td>Do they feel prepared to implement program components and use the BSPAN database?</td>
<td>1) RAC assessment;</td>
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<td>2) training and support for program components and database</td>
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<tr>
<td><strong>Adoption</strong></td>
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<tr>
<td>County</td>
<td>Is each county using all available outreach channels?</td>
<td>Using the database, calculate monthly rates of</td>
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<td></td>
<td>Does county follow navigation protocol?</td>
<td>- # of promotional messages placed in various channels per month</td>
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<td>Do rates indicate booster training is needed?</td>
<td>- Types of channels for outreach activities,</td>
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<td>Is county team aware of changes in county resources, local champions, add'l partners?</td>
<td>- # cases with appropriate documentation of navigation contacts</td>
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<td></td>
<td>Use of qualitative methods to understand implementation</td>
<td>- Measuring navigation protocol adherence</td>
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<td>Email communication between hub and county partners (request for clarification, notification of change in infrastructure, staff turnover)</td>
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*BSPAN, Breast Screening & Patient Navigation program; BCCS, Texas Breast & Cervical Services; CDC NBCCEDP, Centers for Disease Control & Prevention National Breast & Cervical Cancer Early Detection Program; CBE, clinical breast exam; RAC, readiness assessment criteria tool.*

preference, and will inquire about language concordance – a key factor in obtaining cancer screening. Participants will stratified by asymptomatic/symptomatic, race/ethnicity (Hispanic, White, Black), insurance status (yes/no), language (English or Spanish), cancer-positive/negative, and navigation completed vs. refused or lost to follow-up for a total of 100 interviews; participants will receive a $20 honorarium.

**Level 2 – County Partner Organization**
Quantitative. At the county level, we will use the database to monitor outcome measures with respect to the Adoption and Implementation dimensions (Table 1). While all of our county partners have expressed interest in joining BSPAN2, we will not determine organizational participation within counties until we complete the RAC assessment of county capacity and readiness. As with other RE-AIM studies, BSPAN2 measures Adoption by comparing the number of organizations approached to those who agree to participate. To monitor Implementation, we have designed the BSPAN2 database to enable meaningful use of patient health information. Our database will capture complete and accurate information on all elements of the navigation protocol as well as the entire breast cancer screening process including documentation of test/procedure results provided by primary care providers, mammography facilities, and hospitals and surgical facilities providing biopsies. The database will gener-
ate monthly reports to the hub to help Moncrief monitor the county partners’ patient volume as a reflection of the following: a) use of the full range of outreach channels to raise women’s awareness of the BSPAN2 program, b) appropriate documentation of navigation activities, and c) accurate allocation for billing and reimbursement.

Qualitative. To gauge Implementation qualitatively, we will engage in both structured observation and semi-structured interviews with county partner organizations. To gauge Adoption, we will audio-record training sessions conducted by hub staff with their county partners. Audits will enable us to track the progress of the program components as laid out in the training manuals.

We anticipate being in the field over a period of approximately six months, thus four weeks per county, based on time since launch. We approximate: Week 1 – interviews with clinicians and key staff of community groups identified by the Outreach Coordinator; Week 2 – interviews with patients identified through the database; Week 3 – additional interviews with staff and patients based upon emergent themes from Weeks 1 and 2; Week 4 – analysis, summary report, and development of plan for booster trainings.

Structured observation. Investigators will conduct site visits to shadow BSPAN2 program staff and county partners in activities such as outreach events, team meetings, counseling and navigation sessions, pathology lab reporting, and screening test distribution and test return. Our past experience demonstrates we can conduct such observation with little to no change in clinical process behavior. We will draw from techniques of participant-observation, a well-developed methodology that lends itself to organization and process analyses in community settings.

This systematic method combines quiet observation with informal discussions and involvement in the daily work of program staff in county partner organizations.

Site visits will reveal the accuracy with which each program component was implemented (fidelity) and adaptations that might reflect local organizational culture and county partner protocols, e.g., “work-arounds” related to the screening process. Investigators will inquire about changes in procedure, roles, and responsibilities and solicit opinions about interactions between BSPAN2 program components, various partner organizations, and local providers. For example, investigators will compare the formal versus informal means that a county partner might employ to control the number of screenings scheduled when patient demand is higher than anticipated.

County partner interviews. Interviews of key county actors who facilitate mammography screening (e.g., result reporting, appointment making, reviewing referrals) will allow us to clarify observations, explore members’ opinions regarding their role in increasing access and patient care, and gain insight into observed behavior, local practice structure, and protocols. We will interview three to four selected leaders and liaisons (e.g., public health official, hospital executives, financial services and information technology infrastructure staff) per county. Interviews will each last 45-60 minutes over one or two sessions as needed; participants will receive a $20 honorarium. In recruiting care team members for interviews, we will be careful to not disrupt BSPAN2 screening operations. A total of 24 interviews will be conducted with county partners: two staff and four leaders each in two high- and two medium-capacity counties. We will document the official role of individual actors as he or she understands it and note whether they are opinion leaders that initiate or resist change in the mammography screening process. These interviews will provide perspective on organizational history, practice patterns, and quality improvement initiatives and will contextualize data collected from site visits.

**Analysis plan**

Quantitative Analysis. Descriptive statistics will be calculated for the process and outcome variables described under Measures. Chi square tests will be used to compare BSPAN2 participants with county census data on sociodemographic characteristics.

Qualitative Analysis. We will make notes during participant observations at site visits and transcribe the patient and organizational partner interviews. We will then enter this text together with all email correspondence and other documented communications between the hub and county partner organizations into an NVivo 9.0 (QSR International, AUS) database. The investigators will review and analyze these data using an inductive, text-driven approach to thematic content analysis. We will identify patterns and recurring themes using line-by-line coding to compare and contrast qualitative data.

Our initial open codes will generate axial coding categories that we will refine into more abstract thematic codes and validate against other theoretical constructs, for example, in organizational behavior. To address inter-rater reliability, the team will systematically review coding agreement and resolve discrepancies through consensus.

Convergent Analysis. At both the participant and county partner levels, we will enumerate qualitative thematic codes (identified through our qualitative analysis) and connect them to the quantitative data generated from the database. At the participant level, we expect that our qualitative data will identify independent variables assessing issues related to delivery of the navigation protocol such as how women enter the breast cancer screening process (e.g., asymptomatic women seeking access to screening vs. symptomatic women seeking diagnostic evaluation). We will examine whether these independent variables are differentially associated with timely delivery of care. At the county partner level, we will enumerate themes identified during participant observation and semi-structured interviews, such as fidelity to the navigation protocol, and then quantitatively evaluate how those variables influence key process outcomes (e.g., complete vs. incomplete navigation; days from intake to file closure).

**Study status**

The University of Texas Southwestern Medical Center Institutional Review Board (IRB) and Simmons Cancer Center Protocol Review & Monitoring Committee approved the protocol (STU 022012-009). Project implementation and evaluation is underway. County partner organizations have been recruited, capacity assessed, and partner staff trained; data collection is ongoing.

**DISCUSSION**

We build on initial CPRIT funding for the original BSPAN to implement a hub-and-spoke regional delivery model that centralizes BCCS reimbursement and tailors the provision of breast health services to individual county capacity. We propose this systematic evaluation to demonstrate the effectiveness of a capacity-tailored model and gather data necessary to facilitate future dissemination of our hub-and-spoke model in order to enable rural counties elsewhere to leverage national funding streams. We hope our success in North Texas can be used to advance rural programs for breast cancer screening and appropriate follow-up services across the US.

After conducting this evaluation, BSPAN2 will be able to disseminate the training modules for the outreach and navigation program components. We will be able to disseminate our county capacity RAC tool to enable similarly situated not-for-profit organizations to determine how local players are best able to partner with a central hub to improve breast cancer and screening follow-up services. We will be able also to disseminate the BSPAN2 internet-based database application for patient tracking, financial review, and screening
reimbursement. We will be positioned to offer “Train the Trainer” education and support. Our evaluation will document how local county spokes most efficiently interact with the BSPAN2 central hub to operate a decentralized regional delivery model. For example, we will know the appropriate number of education booster sessions necessary to sustain efficient programs. We also will be able to describe key qualifications of program component trainers, i.e., the ideal composition of skills and experience necessary to sustain a centralized regional delivery model. Importantly, we can explicate the cost-assessment and step-by-step procedures required for a community-based organization or provider seeking to acquire a Texas BCCS contract for reimbursement of guideline-based screening and clinical follow-up services.

Potential limitations
A significant limitation of our model is also a fundamental strength, namely the central role of clinical service financing through our provider contract with Texas BCCS under the broader CDC initiative for the under-and uninsured. At this time, Texas and 20 other states have opted not to undertake the Medicaid expansion tied to the implementation of the federal Patient Protection and Affordable Care Act. Consequently, there is uncertainty about what form state BCCS programs may take, although contracts could simply devolve to state Medicaid.90 Whether the primary payor is BCCS, Medicaid, Medicare, or federal or local state health exchange, the need for reimbursement management will remain. Moreover, the need for outreach and patient navigation infrastructure within rural counties will certainly persist.21 Prevention service reimbursement represents a fundamental challenge to the question of sustainability. While our data may be able to demonstrate how hub-spoke partnerships may best maintain this delivery model, issues of sustainability depend on funding externalities driven by state and federal funding that are themselves in flux.60

An additional limitation is the inability to continuously observe the process of training and implementing the BSPAN2 components in all county partner sites. While we will sample across high, medium, and low capacity counties, we will observe particular events only by chance. We address this limitation by including questions in our interviews that elicit retrospective accounts from key informants of experiences during the training, implementation, and operation of the BSPAN2 program components. In addition, documentary evidence (e.g., invoices, training plans, e-mail communications) will be collected from county partners to 1) help characterize the organizational culture, structure, and protocols (policy framework) associated with comprehensive mammography and appropriate follow-up; 2) examine training and monitoring processes leading to successful adoption and continued implementation; 3) explore means by which practice changes occur; 4) evaluate consequences of internal and external procedural change on the mammography screening process; and 5) compare across the selected counties to identify best practices in BSPAN2 adoption and implementation.84 Longer term assessment of program maintenance is constrained by the budgetary limits of grant support; however, our evaluation metrics and reporting infrastructure can be used to continue program monitoring. Overall, program maintenance also depends on the sustainability of the patchwork of federal, state, and local philanthropic funds needed to underwrite cancer prevention services as well as clinical navigation and follow-up.92

Community demand for breast cancer screening and clinical follow-up services motivated the decision to expand the original Moncrief program to 17 rural and underserved counties. Accordingly, our BSPAN2 model hinges on assessing the capacity of local county partners (the spokes) to assume responsibility for different components of the program. However, this protocol does not attend equally to the capacity of an organization, like Moncrief, to evolve and adapt (as a central hub) to serve as the central coordinator of program services across multiple partners. We will need to build on the evaluation infrastructure of BSPAN2 to assess the capacity to form and serve as a central hub, including a robust cost analysis, if we are to fully understand the sustainability and replicability of our hub-and-spoke design. Future efforts will need to determine the key indicators, processes, and contextual factors to standardize a successful blueprint for how other organizations might follow Moncrief in the effort to foster regional infrastructure to sustain rural cancer screening in their respective communities.

CONCLUSIONS
In this paper, we propose a comprehensive protocol to evolve and evaluate a hub-and-spoke model for the de-centralized regional delivery of breast cancer screening and patient navigation services for rural underserved women. The protocol specifically addresses key outcomes in capacity-building across a multi-county network as well as the timely provision of screening and diagnostic services. The mixed-methods approach presented is broadly applicable to the evaluation of regional community partnerships not only in cancer prevention but also public health programs seeking to connect rural patients to prevention services.

Competing Interests
The authors declare that they have no competing interests.

Authors’ contributions
SJI, JAT, SCL together developed the mixed-methods design, determined outcome measures, overall protocol, and wrote this manuscript. TVM helped revise and edit the manuscript, providing coordination and assistance with figures and tables. KEA conceived and led development of the initial five-county BSPAN program and obtained initial program funding. SCL conceived the BSPAN2 expansion design and obtained funding to implement the protocol. All authors read and approved the final manuscript.

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The 90th Annual Texas Public Health Association Education Conference was a tremendous learning experience for nearly 300 public health practitioners and students. TPHA extends its deepest gratitude to all who gave of their time, funding and expertise to make our annual event a true success. Many thanks to: the TPHA planning and local arrangements committees; student volunteers; our continuing education team and all who donated goods and services.

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