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Sexually transmitted infection screening and positivity in pregnant women living in areas with high social vulnerability indices.

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Abstract

Pregnant women living in rural areas of the United States are not equitably served by healthcare systems and may be disproportionately affected by sexually transmitted infections (STIs). We examined the impact of location of pregnancy care on STI screening and positivity in a statewide health system. Pregnant women seeking care within a statewide health system during 2021-2022 were categorized by location of care at either the main university hospital (urban) or regional (rural) hospitals. We assessed STI screening and positivity for chlamydia, gonorrhea, and trichomoniasis within each setting and by the social vulnerability index (SVI) assigned to the person's census tract (high ≥ 0.75 versus low <0.75). We identified 12,921 unique pregnancy episodes: 9,051 (70%) within the university hospital and 3,870 (30%) in regional hospitals. The mean census tract SVI among all women was 0.54 (SD 0.29), and 29% of pregnant women resided in areas with a high SVI. Women in care at a regional hospital were more likely to reside in areas with a high SVI compared to the university hospital (41% vs. 23%). In total, 75% of pregnant women were screened for any STI (9,727/12,921). Compared to university hospitals, STI screening rates during pregnancy were lower (77% vs 70%) and STI positivity during pregnancy was higher in regional hospitals [chlamydia (3.9% vs 6.4%), gonorrhea (0.6% vs 1.3%), and

trichomoniasis (4.6% vs 8%)). In a statewide health system, pregnancy care provided in rural regional hospitals was associated with lower STI screening rates and higher STI positivity.

Short Summary

Location of care and high social vulnerability were associated with decreased STI screening and increased STI positivity among pregnant people seeking care from a statewide healthcare system.

Keywords

chlamydia; gonorrhea; pregnancy; surveillance; social vulnerability

Introduction

Between 2018 and 2021, chlamydia and gonorrhea infections increased in the U.S. Racial or ethnic minority groups are disproportionately affected by these sexually transmitted infections (STIs).¹ Furthermore, women in rural communities, especially adolescents, may be disproportionately affected by chlamydia and gonorrhea infections.² The area in which women live affects their health and mortality.^{3,4} In the U.S., the areas with highest social deprivation are located in the South and have higher proportions of Black and rural residents.^{3,5} U.S. racial and ethnic minority groups are more likely to reside in areas disproportionately affected by poor housing, crime, noise, pollution, stress, and reduced services including healthcare.^{5,6} Residence within neighborhoods with higher deprivation indices has been associated with high rates of STIs and adverse pregnancy outcomes.^{7,8} Furthermore, women residing in rural communities within the U.S. have reduced access to reproductive health services, including STI screening and prenatal care, compared to those residing in metropolitan areas.⁹

Approximately one-third of South Carolinians reside in rural counties and, according to Medicaid, are more likely to have medical care for chlamydia and gonorrhea compared to those in urban counties.¹⁰ The hospital system is with a large university medical center located in an urban center. Smaller regional hospitals that are mostly located in rural communities were acquired by the health system between 2019 and 2021, and some deliver obstetric outpatient and inpatient services. Rural residents, who may be disproportionately affected by STIs,¹⁰ are more likely to seek pregnancy care at these regional hospitals within their communities.⁹

The CDC recommends chlamydia and gonorrhea screening for all pregnant women 24 years old and younger and for any woman older than 24 years who is considered at increased risk.¹¹ Because a large fraction of pregnant women are screened, they are a potential sentinel population for surveillance for chlamydia and gonorrhea. The CDC does not have any specific recommendations for trichomoniasis screening during pregnancy, however symptomatic pregnant women should be tested (11). We previously found that approximately 67% of pregnant women were screened for chlamydia, gonorrhea, or trichomoniasis in the university hospital and 7.7% were positive for at least one of these STIs.¹² We suspect geography may impact STI screening and positivity rates. The primary

aim of this study was to determine potential differences in STI screening and positivity in a sentinel population of pregnant women receiving care in a university medical center compared to those receiving pregnancy care in regional hospitals within a single statewide hospital system. Our secondary aim was to determine the impact of living in areas with high levels of social vulnerability on STI screening and positivity during pregnancy in both settings.

Methods

This observational study of a cohort of pregnant women seeking care within an urban, university medical center and affiliated regional hospitals was approved by the university Institutional Review Board (Pro00106414). Using the EPIC© (Verona, WI) Clarity application within the electronic health record (EHR), we identified women with an active pregnancy episode seeking any pregnancy-related care between January 1, 2021, and December 31, 2022. Pregnancy episodes bundle all pregnancy-related care visit (outpatient and inpatient) documentation, laboratory tests, and imaging within the EHR. Additional details about pregnancy episodes and the methodology used for surveillance of chlamydia, gonorrhea, and trichomoniasis positivity during pregnancy have been described previously.¹³ In the event women received care for more than one pregnancy during the study period, each unique pregnancy episode(s) was eligible for inclusion in this study. The following variables were abstracted from the EHR using Structured Query Language script: hospital where care was received, date of last menstrual period (LMP), age, primary insurer, self-reported ethnicity and race, estimated date of delivery (EDD), results of the first chlamydia, gonorrhea, trichomoniasis nucleic acid test (NAAT) collected during a pregnancy episode, specimen collection date, zip code, county, and home address. The data abstraction did not include the NAAT specimen source (cervix, vaginal, urine). All NAATs were received and processed by the MUSC laboratory.

To assign neighborhood contextual data, individuals' addresses were geocoded with ArcGIS Pro version 3.1 (Environmental Systems Research Institute, Redlands, CA). Next, spatial overlay analysis was used to identify and assign each person's residential census tract. Rural census tracts were defined according to the 2020 US Census results.^{14,15} Census tract codes were then used to assign CDC's 2020 Social Vulnerability Index (SVI) score to each individual patient.¹⁶ The SVI was initially designed to identify communities that are more likely to need additional support for an emergency such as severe weather, disease outbreaks, or chemical exposures.¹⁷ However, SVI has subsequently been used to assess community access to health care and disease burden for a variety of conditions, including HIV.^{3,5,7,18} The SVI is created using 16 variables from the 5-year American Community Survey (ACS) that are based on four social themes: socioeconomic status, household characteristics, racial and ethnicity minority status, and housing type and transportation.¹⁷ The SVI characterizes neighborhood vulnerability by using a national percentile-ranked score that ranges from 0 to 1, with higher scores indicating higher levels of area-level social vulnerability. For this analysis, residing in an area with high social vulnerability was classified as living in a census tract with an $SVI \geq 0.75$.

We calculated the proportion of pregnant women seeking care in the health system who were screened for an STI. Among those screened, we determined the proportion testing positive for any STI (chlamydia, gonorrhea, and/or trichomoniasis) in total and by census tract. We mapped screening and diagnosis rates by census tract to visually compare the geographical distribution of these outcomes with census tract SVI. Census tracts with fewer than five women were censored to avoid skewing representation for that geographic location. Pregnancy episodes were categorized by the location where pregnancy-related care was received: university or regional hospitals. Bivariate analyses were used to compare differences by location of care in patient age group (≤ 25 years versus >25 years), race (White, Black, Other), Hispanic or Latina ethnicity, insurer (public, private/military, other), delivery at any health system hospital (university and regional hospitals), STI screening, STI positivity, and the SVI assigned to the patient's census tract of residence (high [≥ 0.75] versus low/moderate [<0.74]). Military and private insurers were combined as a single categorical variable because they reimburse obstetric care as a global package regardless of the number of pregnancy visits or patient complexity. We presumed global reimbursement may influence provider behavior as it relates to screening during prenatal care.

Results

During the study period, 12,921 unique pregnancy episodes were eligible for inclusion in the analysis: 6,442 (50%) in 2021 and 6,479 (50%) in 2022. Most pregnancy episodes (9,051, 70%) were within the university hospital and 3,870 (30%) occurred in regional hospitals. Age and SVI were normally distributed. The mean age of women receiving pregnancy care was 28.4 years (SD 6.3 years). The mean SVI of patients' census tract of residence was 0.54 (SD 0.29), with 3,718 (29 %) pregnant women living in a census tract with a high SVI (scoring ≥ 0.75). Residing in a census tract with a high SVI was more common among pregnant women seeking care from regional hospitals compared to those seeking care at the university hospital (41.4% vs 23.4%). Compared to pregnant women seeking care at the main university hospital, a higher proportion of pregnant women seeking care at regional hospitals were ≤ 25 years of age, Hispanic or Latina, self-identified as Black race, and had a public insurer (Table 1).

Pregnant women included in our analysis lived in 44 out of 46 (96%) counties and 746 out of 1,103 (68%) census tracts in the state.¹⁹ Over half (55%) of women lived in the three counties surrounding the university hospital (Berkeley, Charleston, and Dorchester). Figure 1a represents SVI distribution across the state. Areas of high SVI are disproportionately located on the eastern side of the state and where the health system hospitals in this analysis are located. Among the 407 (55%) census tracts with at least five pregnant women receiving pregnancy care within the health system, 104 (25.5%) had a high SVI (Figure 1a).

Most women were screened for an STI during pregnancy (9,727, 75%). The median STI screening rate by census tract was 75% (range 0-100%). Census tracts with the highest screening rates among pregnant patients were typically concentrated near a hospital (Figure 1b). We observed a small but statistically significant difference in the percentage of women screened for an STI by the SVI where they reside (high SVI 76.5% versus low SVI 74.8%, $p = 0.04$). Women who were screened for an STI during pregnancy were more often: ≤ 25

years old (77.2% vs. 74.3% screened, $p=0.0004$), self-reported Black race (78.9% screened vs. 73.7% [white] and 74.1% [other], $p<0.0001$), receiving pregnancy care at the university hospital (77.4% vs. 70.4% screened, $p<0.0001$), and delivering an infant within the health system during the study period (80.7% vs. 70.5% screened, $p<0.0001$). For all demographic and clinical factors assessed, pregnant women seeking care at the university hospital were more likely to be screened for an STI compared to those seeking care from a regional hospital (Table 2).

In 2021, there was no difference in the percentage of women who were screened for an STI during pregnancy at the university hospital and regional centers ($p = 0.24$), with 3,483/4,553 (76.5%) screened in the university network compared to 1,419/1,889 (75.1%) screened in the regional network. However, in 2022 pregnant women were more likely to be screened for an STI in the university hospital system [3,520/ 4,498 (78.3%)] compared to those at regional centers [1305/1981 (65.9%), $p < 0.0001$].

Of those screened, 8.1% were positive for any STI (785/ 9,727); 4.5% (406/ 9,096) of women tested positive for chlamydia, 5.4% (385/ 7,099) tested positive for trichomoniasis, and 0.8% (75/ 9,472) tested positive for gonorrhea (Table 3). When compared to women residing in areas with a low SVI, women residing in areas with a high SVI score were more likely to test positive for chlamydia (7.3% vs 3.3%), gonorrhea (1.5% vs 0.5%), and trichomoniasis (9.0% vs 3.9%) (Table 3). Pregnant women more likely to have a positive chlamydia, gonorrhea, or trichomoniasis test during pregnancy were ≤ 25 years old, self-identified as Black, had public insurance, and received care in a regional hospital (Table 3). Among the census tracts with at least 5 pregnant health system patients, the median STI positivity rate was 6% (range 0-100%). Median STI positivity was higher in census tracts with a high SVI compared to those with a low SVI (11% versus 4%, $p<0.0001$) (Figure 1c).

Discussion

Women receiving pregnancy care in regional hospitals were less likely to be screened for STIs than those seeking care at a university hospital, but they were more likely to test positive for an STI. Most regional hospitals in the health system are in rural communities and serve populations living in areas with high social vulnerability. Our analysis supports previous findings that pregnant women who are at risk for STIs in rural communities have less access to STI screening, even when they have access to other prenatal care.¹⁰ It is possible that providers of pregnant women do not always adhere to STI screening recommendations. Pinto et al suggest that rural providers are less likely to screen for STIs due to the misconception that young women are not sexually active and STIs are not a health issue in rural areas. Additionally, young women in small communities may not seek sexual health care due to concern for loss of privacy or mistrust in the healthcare system.² Young women are most at risk for unplanned pregnancy and would benefit from STI screening and treatment to reduce the risk of STI-related complications of pregnancy.² To improve STI care in rural communities, regional medical centers might consider increased provider education and expanded access to resources for STI screening and treatment.

Rural communities in our state are more likely than urban areas to have a high SVI.¹⁰ Women receiving pregnancy care in regional hospitals, who live in rural areas, were more likely to reside in areas with a high SVI compared to women receiving care at the urban university medical center. Our findings are consistent with previous reports that living in areas with high deprivation indices are associated with poor health outcomes, including STIs and HIV⁷ and suggest that the SVI where a patient lives may be a useful metric for identifying communities at risk for STI positivity. Census-based deprivation indices such as SVI are valuable analytic tools for monitoring trends in healthcare inequity and directing the allocation of resources to reduce disparities.^{3,6,18} Providers within socially vulnerable communities might benefit from additional STI education to increase screening, particularly in pregnant women, to adhere to national recommendations.

SVI attempts to quantify the social conditions in a community and can be used to help guide public health initiatives aimed at addressing health inequities and social determinants of health.²⁰ Using the SVI assigned to a patient's residence as a marker for individual-level health outcomes has limitations. First, SVI of residence is calculated from census data.¹⁷ SVI calculated by zip code and census tract may not accurately reflect the SVI of a patient's "neighborhood". Additionally, racial and ethnic minorities may be more likely to be census non-responders.⁴ The mechanism by which SVI contributes to poor health outcomes involves social and structural factors that cannot be easily measured in a retrospective study of information captured in medical records.^{20,21} Census data evaluates where people live, not necessarily where they work and play, and may not be reflective of factors currently influencing a neighborhood.¹⁷ Current social determinants of health such as education, family structure, income, and built environment may not be accurately captured in census-based analyses. As electronic health records capture more individual level characteristics that may impact health in real time, there may be opportunities to supplement census-based measures that assess social vulnerability.^{7,22}

According to the American College of Obstetricians and Gynecologists, prenatal care guidelines and CDC STI treatment guidelines, pregnant women 25 years old and younger and older women at risk should be screened for chlamydia and those at risk should be screened for gonorrhea during pregnancy.^{11,23,24} We observed that only 77% of pregnant women at the university hospital and 70% seeking care at regional hospitals were screened for a STI. Within each setting, there was likely further variation in screening practices at the clinic or provider level that we did not have the ability to assess in this analysis. These differences in screening practices have implications for using EHR from the entire health system as a sentinel population to assess chlamydia, gonorrhea, and trichomoniasis positivity. Sentinel populations should be well-defined subsets of the general population.²⁵ Both testing practices and the population screened need to be consistent so that trends over time are more likely to reflect trends in the general population.²⁶ Several regional hospitals were acquired in 2021 by the hospital system under analysis which likely contributed to the observed reduction in the proportion of patients screened in regional hospitals from 75.1% in 2021 to 65.9% in 2022. When large hospital systems acquire smaller, regional hospitals, both screening practices among the recently added provider groups and the characteristics of the underlying population served may change. These changes must be considered when defining sentinel populations and interpreting trends in positivity.

In this analysis, we could not assess the reasons why patients were not screened for STIs. It is possible that patients who were not screened were more likely to refuse this service due to mistrust of the healthcare system. This may be particularly true in rural communities where high proportions of people avoid seeking recommended health care.²⁷ It is also possible that providers, particularly in rural settings, are more likely to screen patients they perceive to be at risk for STIs. This selection bias may at least partially explain the higher positivity rates we observed for patients living in rural areas. In both the university and regional hospital settings in our analysis, young, Black patients were more likely to be screened for STIs during pregnancy than other demographics. Our findings correspond with previous reports that this population is more often screened for STIs in ambulatory care settings and during pregnancy.^{24,28} This suggests that young, Black women might be more likely to be selected for STI screening based solely on their race.²⁹ Implementing universal chlamydia screening in pregnant women could eliminate the potential for race and ethnicity to influence provider practices.²⁴

Conclusion

Based on our analysis, STI screening during pregnancy varied by hospital location, despite national recommendations for universal screening. Regional hospitals that serve rural populations who are more likely to experience social and economic disparities were less likely to screen pregnant women for an STI. Additional provider training and structural changes to the EHR to promote STI testing during pregnancy may be needed to implement universal screening, particularly in settings that serve women living in rural areas and may be more at risk for STIs.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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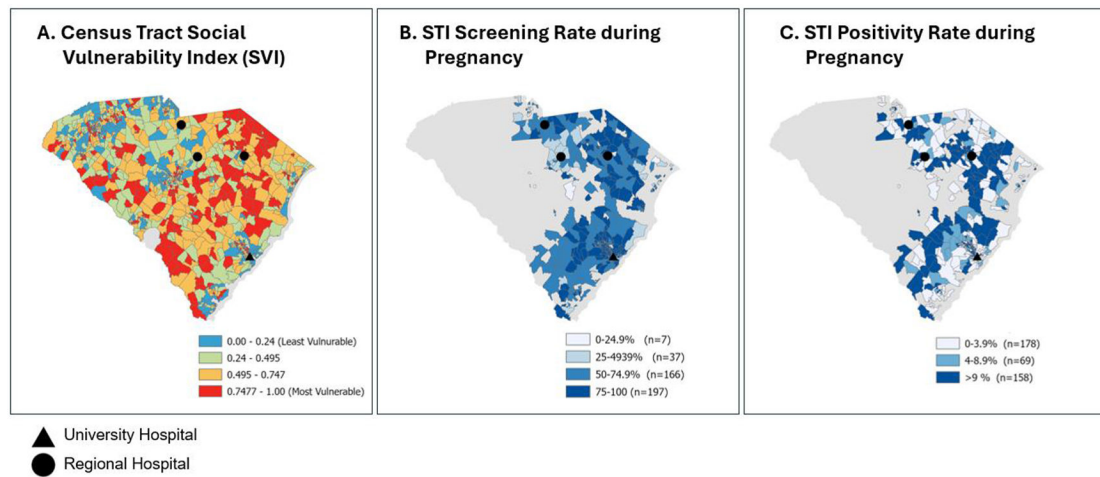


Figure 1.

Census-Tract Social Vulnerability Index (SVI), STI Screening Rates, and STI Positivity Rates, South Carolina

Panel (a) illustrates census tract measures for overall social vulnerability obtained from CDC's 2020 Social Vulnerability Index (SVI) across South Carolina, including census tracts outside of the health system network. Darker red shades highlight areas with the greatest vulnerability and areas shaded blue are the least vulnerable; Panel (b) maps the spatial distribution of sexually transmitted infections (STI) screening rates for participants residing in census tracts in the study catchment areas between January 1, 2021 and December 31, 2022. Darker blue shades highlight areas with the highest screening rates during our study period; and Panel (c) presents the spatial distribution of positive STI screenings for census tracts in the catchment area. Please note that panels b and c suppressed census tracts with fewer than five patients.

Table 1.

Characteristics of women receiving prenatal care by hospital location, 2021-2022

	University (n=9051) N (%)	Regional (n=3870) N (%)
Age		
≤25 years	2510 (27.7%)	1824 (47.1%)
>25 years	6541 (72.3%)	2046 (52.9%)
Race		
Black	2890 (32.3%)	1777 (46.7%)
White	4837 (54.1%)	1699 (44.7%)
Other	1215 (13.6%)	326 (8.6%)
Ethnicity		
Hispanic/Latina	952 (10.8%)	269 (7.2%)
Non-Hispanic/Non-Latina	7887 (89.2%)	3461 (92.8%)
Insurer		
Public	2501 (27.6%)	1638 (42.3%)
Private/ military	6214 (68.7%)	2132 (55.1%)
None	336 (3.7%)	100 (2.6%)
Social Vulnerability Index		
High (≥ 0.75)	2118 (23.4%)	1600 (41.4%)
Low (< 0.75)	6923 (76.6%)	2269 (58.6%)
Delivery in Health System		
Yes	4126 (45.6%)	1923 (49.7%)
No	4925 (54.4%)	1947 (50.3%)

Missing data are not displayed.

Table 2.

Proportion of women screened for any STI during pregnancy care by hospital location, 2021-2022

	Total N (%)	University N (%)	Regional N (%)^a
Total screened	9727/12921 (75.3%)	7003/9051 (77.3%)	2724/3870 (70.4%)
Age			
≤ 25 years	3344/4334 (77.2%)	2018/2510 (80.4%)	1326/1824 (72.7%)
>25 years	6383/8587 (74.3%)	4985/6541 (76.2%)	1398/2046 (68.3%)
Race			
Black	3684/4667 (78.9%)	2345/2890 (81.1%)	1339/1777 (75.4%)
White	4819/6536 (73.7%)	3655/4837 (75.6%)	1164/1699 (68.5%)
Other	1142/1541 (74.1%)	957/1215 (78.8%)	185/326 (56.8%)
Ethnicity			
Hispanic/Latina	921/1221 (75.4%)	773/952 (81.2%)	148/269 (55.0%)
Non-Hispanic/Non-Latina	8619/11348 (76.0%)	6126/7887 (77.7%)	2493/3461 (72.0%)
Insurer			
Public	3168/4139 (76.5%)	1991/2501 (79.6%)	1177/1638 (71.9%)
Private/ military	6334/8346 (75.9%)	4827/6214 (77.7%)	1507/2132 (70.7%)
None ^b	225/436 (51.6%)	185/336 (55.1%)	40/100 (40.0%)
Social Vulnerability Index			
High (≥ 0.75)	2845/3718 (76.5%)	1691/2118 (79.8%)	1154/1600 (72.1%)
Low (< 0.75)	6873/9192 (74.8%)	5304/6923 (76.6%)	1569/2269 (69.2%)
Delivery in Health System			
Yes	4884/6049 (80.7%)	3413/4126 (82.7%)	1471/1923 (76.5%)
No	4843/6872 (70.5%)	3590/4925 (72.9%)	1253/1947 (64.4%)

^aPercentages shown in table represent the percentage of each subgroup that were screened.^b $p = 0.008$, all other $p < 0.0001$. The p -values represent comparisons of the percent screened at university versus regional hospitals using Pearson's χ^2 test.

Table 3.

Positivity rates for chlamydia, gonorrhea, or trichomoniasis during pregnancy by patient characteristic, 2021-2022

	Chlamydia		Gonorrhea		Trichomoniasis	
	Tested, n	Positive, n (%)	Tested, n	Positive, n (%)	Tested, n	Positive, n (%)
Total	9096	406 (4.5%)	9472	75 (0.8%)	7099	385 (5.4%)
Age						
≤ 25 years	3003	305 (10.2%) *	3219	57 (1.8%) *	2439	174 (7.1%) *
>25 years	6093	101 (1.7%)	6253	18 (0.3%)	4660	211 (4.5%)
Race						
Black	3410	276 (8.1%) *	3551	58 (1.6%) *	2909	313 (10.8%) *
White	4531	74 (1.6%)	4714	13 (0.3%)	3286	51 (1.6%)
Other	1083	55 (5.1%) *	1129	3 (0.3%)	857	18 (2.1%)
Ethnicity						
Hispanic/Latina	870	43 (4.9%)	912	2 (0.2%) *	703	15 (2.1%) *
Non-Hispanic/Non-Latina	8057	357 (4.4%)	8379	73 (0.9%)	6274	362 (5.8%)
Insurer						
Public	2890	199 (6.9%) *	3070	37 (1.2%) *	2372	198 (8.4%) *
Private/ military	5997	199 (3.3%)	6185	36 (0.6%)	4568	180 (3.9%)
None	209	8 (3.8%)	217	2 (0.9%)	159	7 (4.4%)
SVI **						
High (≥ 0.75)	2579	189 (7.3%) *	2733	40 (1.5%) *	2143	193 (9.0%) *
Low (< 0.75)	6509	217 (3.3%)	6730	35 (0.5%)	4951	192 (3.9%)
Location						
University	6968	269 (3.9%) *	6977	43 (0.6%) *	5404	250 (4.6%) *
Regional	2128	137 (6.4%)	2495	32 (1.3%)	1695	135 (8.0%)
Delivery **						
Yes	4527	222 (4.9%)	4722	45 (1.0%)	3247	200 (6.2%) *
No	4569	184 (4.0%)	4750	30 (0.6%)	3852	185 (4.8%)

* $p < 0.05$. Pearson's χ^2 tests were used to assess differences in positivity within each demographic by disease. Reference groups for race is "White" and reference group for insurer is "private/military".

** SVI, social vulnerability index. Delivery, within statewide health system.