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The Front-Line Health Care Workers in Schools: Health Equity, the Distribution of School Nurses, and Student Access

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Abstract

Objective: To determine whether the disparities in access to care observed within pediatric populations along the lines of race/ethnicity, socio-economic status, and geography are mirrored in student access to school nursing services.

Method: Using school district employment records we linked 1,346 nurses to 1,141,495 students working in 296 districts within Washington state in the 2019-2020 school year. We constructed a measure of access (the student-to-nurse ratio) as the log transform of the total number of nursing full time equivalents divided by the total student enrollment within the district, and regressed these against a district's racial/ethnic composition, a measure of socio-economic status (percent eligible for Free-or-Reduced-Price-Lunch), and geography i.e. how urban vs rural.

Results: A 1% percent increase in the student population that is Black is associated with a 3.7% reduction in the student-to-nurse ratio, while a 1% increase in the percent of students eligible for Free-or-Reduced-Price-Lunch is associated with a 1.1% increase in the student-to-nurse ratio. Relative to urban districts, rural districts have higher student-to-nurse ratios, but due to the sorting of students to districts by race/ethnicity, when controlling for race/ethnicity results are insignificant.

Conclusions: Disparities in access to school nursing services mirror access gaps for pediatric care along socio-economic status and geography. The increased number of nurses working in school districts with more racial/ethnic minority students may play a protective role and partially ameliorate access gaps for these students observed in pediatric primary care.

Policy Implications: We provide a framework for how states, absent of centralized data collection on the school nursing workforce, can use existing employment and licensing data to understand where school nurses work, and who has access to them. States should develop their school nurse workforce data in order to aid in resource allocation decisions. To address disparities in access for poorer districts, a reconsideration of state funding formulas that overly rely on local education dollars for school health services may be warranted.

1. Introduction

Healthcare and education leaders have long overlooked school health services, but in recent years, emphasis on school accountability measures has driven school leaders and policy makers to begin addressing upstream factors of academic underperformance, including students' health needs (Lear, 2007). And the intersection of healthcare and education has never been so readily apparent as it is today in the wake of the COVID-19 pandemic. This shift in thinking has coincided with a significant reduction in inequality in access to care for pediatric populations over the last 20 years. For instance, the proportion of pediatric patients reporting no usual source of care has declined by 50% (Larson, Cull, Raicine, & Olson, 2016). Despite these gains, substantial racial, socio-economic, and geographic disparities in access to childhood healthcare services persist.

A limited body of research suggests that disparities in access to pediatric care could be partially addressed by school nurses, especially for racial and ethnic minorities and students from low socioeconomic backgrounds (Fleming, 2011). School nurses increase access to care by providing free healthcare without the need for appointments, transportation, fees, or insurance, and students can see the nurse without a referral (Fleming, 2011; Holmes et al., 2016). They provide ease of access to care where students spend 1/5 of their waking hours; in schools. School nurses are often the only school personnel with any formal medical training (NASN, 2017). More specifically, they are trained to be experts in infection control, pediatric health, population health, health promotion and care coordination. They are responsible for maintaining a healthy school environment through school health policies and interventions (Holmes et al., 2016; McDonald, 2020; NASN, 2017).

Yet data on the school nurse workforce has been limited. Existing evidence suggests that many public schools (18%), do not have access to any paid nursing support (Willgerodt, Brock, & Maughan, 2018). The lack of data on school nurses tied to students has made it difficult to ascertain how school nurses are distributed, which student populations they serve, and whether or not access to health services in schools are equitably distributed. To our knowledge, there is no literature leveraging a census of state-wide school nursing data on which types of students have access to school nurses; we provide a first look at the differences in school nurse availability by students' race/ethnicity, socio-economic status (SES), and geographic location. We fill this gap in the literature using data from Washington State, and further outline a novel method for how states, absent of centralized school health service databases, can build school nurse workforce data from readily accessible and standardized data sources.

2. Background

School nurses play a key role in managing students' health (Baisch, Lundeen, & Murphy 2011) and aid in addressing gaps in access to care (Fleming, 2011). Yet there is limited research on how and for whom school nurses might address these gaps. To contextualize and understand how nurses might address access gaps, it is informative to review some of the broader healthcare literature on where the provision of traditional pediatric services has been known to fall short (e.g., access gaps by race/ethnicity, socio-economic status, and geography).

Even with significant decreases in the childhood uninsured rate from 2000 to 2014, Hispanic children are still 2.3 times more likely to be uninsured than their White peers (Larson, Cull, Racine, & Olson, 2016). Moreover, after controlling for family income and insurance coverage, children of color are more likely to have no consistent source of medical care and are more likely to have not seen a primary care provider in the last year (Flores & Tomany-Korman, 2008). Latino and Black children are 77% and 99% more likely to have no usual source of care relative to their White peers (Flores & Tomany-Korman, 2008).

Similarly, across the distribution of family income children of poorer families are more likely to have no usual source of care (Black, Benson, 2018), and children of near-poor families are 2.5 times more likely to be uninsured than their non-poor peers (Larson et al., 2016). Children of poorer families are less likely to access recommended preventative care than their peers of wealthier families (Abdus & Seldon, 2013), and poorer communities are more likely to live further from pediatric sub-specialist providers (Mayer, 2008).

The geographic availability of care presents further challenges for equitable pediatric access. Relative to children living in urban communities, children living in rural counties must overcome additional barriers to access care; they have fewer primary care pediatricians per capita (Shipman et al., 2011), live further away from specialists (Mayer, 2008), have higher hospitalization rates for ambulatory care sensitive conditions (Laditka, Laditka, & Probst, 2009), and these access gaps may be compounded by other risk factors, such as race/ethnicity (Caldwell et al., 2016). Students attending schools in rural communities are more than two times as likely to have no paid school nurses working in them (Wilgerodt et al., 2018), however, this rate does not take into account the differences in total populations between rural and urban communities.

Despite the large literature on disparities in access to pediatric primary care, we know very little on whether or not such disparities exist in school health services. And, documented disparities in primary care access may not provide much insight into potential disparities in the education system. School health services and providers are under different legal requirements and often have different funding streams (Johnson, 2017), potentially negating many of the mechanism that drive disparities in pediatric primary care.

A limited body of research suggests that a point where many traditionally disadvantaged students get care is through school nursing services. Fleming (2011) found that, conditional on a school having a nurse, Black students made up 40% of visits, but accounted for 24% of the student body. Similarly, Latino students made up 16% of visits, but 11% of the student population, and poor students accounted for 57% of visits, but only 41% of the student population. Anyon et al. (2013) suggest that higher risk factors associated with students of color and the limited availability of quality health services in their communities could contribute to these higher utilization rates, but they also find that measures of health risk factors do not completely explain the difference in utilization.

Some of the services that students may be utilizing through school nursing services include clinical care, health education, care coordination across different healthcare delivery systems, care management, and assessing their behavioral and mental health (Holmes et al., 2016; NASN, 2016). School nurses also track student health data, provide population health management, prepare for health emergencies, monitor vaccinations rates, conduct disease surveillance, and provide leadership on school health policy (Holmes et al., 2016; NASN, 2016).

School nurses can address disparities in care by providing these services free of charge without the need for appointments, transportation, fees, or insurance, and students can see nurses without a referral (Fleming, 2011; Holmes et al., 2016). Knopf et al. (2016) and Johnson (2017) argue that School-Based Health Centers and school nurses remove health related obstacles to educational attainment, increase health equity, and increase access to care for traditionally disadvantaged populations. School nurses may act as a liaison to a student’s medical home by coordinating across systems of care (Holmes et al., 2016) thereby reducing the need for parents to take time off of work. And low-income parents are less likely to have paid sick or vacation time, and less able to use paid time off for their children's' primary care visits (Richman, Johnson, & Buxbaum, 2006). Over three school years nurses in 78 school districts in Massachusetts performed over a million medical procedures, many of which if not performed at school would have had to be conducted off campus (Wang et al., 2014).

However, school nurses can only address disparities in access to care if they are employed where there is need. To that end, obtaining updated national level data on the distribution of school nurses are challenging, given the infrequency with which data are collected, and the lack of a dedicated data infrastructure. What is available tends to either rely on voluntary reporting and participation, doesn't link the data to students, or doesn't adjust school level findings for total student enrollment.

Prior federal data on the school nurse workforce collected in the 2015-2016 school year via the *National Teacher and Principal Survey* asked a single question: whether a nurse is working full or part-time at the school. According to the survey findings, more nurses work in urban, suburban, and town schools relative to rural schools, in elementary schools, and in wealthier schools (Spiegelman, 2020). However, these findings were not adjusted for total student enrollment at the reporting schools.

More recent data collected from a nationally representative survey of school nurses indicates that 18% of public schools in the US do not have access to paid nursing services, and that many schools rely on volunteers to provide health services (Willgerodt et al., 2018). Rural, compared to urban schools are more likely to have no school nurse (23.5% and 10.3%, respectively). School nurses tend to work in more than one school (56%), and in elementary schools. These data provide a national snapshot of the school nurse workforce, but, importantly are not linked to the student populations they serve.

Maughan (2009) constructed state-by-state student-to-nurse ratios for all 50 states by contacting state representatives. State representatives reported using a variety of different methods and data sources to construct their student-to-nurse ratios. However, Maughan notes that approximately half of states had no "systematic reporting program to collect data [on school nurses] from all districts or schools." Furthermore, the data that was collected often used different discretized measures of the nursing workforce (e.g., does at least one nurse work part time at a school). And, lastly, the majority of state contacts indicated that the data on school nurses represented "guesstimates", rather than high quality systematically collected data.

Arguably the best up-to-date information on the national school nurse workforce is from the National Association of School Nurses, which collects data on staffing, chronic conditions, absenteeism, and health clinic visits (known as the *National School Health Data Set: Every Student Counts)*. The goals of *Every Student Counts* are to provide data to inform policy, identify best practices, and better understand pediatric health (NASN, 2019a). The *Every Student Counts* initiative uses a uniform data set with standardized reporting procedures and provides a data infrastructure for school nurses to report their data (Maughan, Johnson, & Bergren, 2018). However, the initiative notes that participation is voluntary and, as such, the data are "not generalizable" (NASN, 2019b). For instance, school nurses with lower caseloads and thus more flexibility in their schedules may be more likely to participate, ultimately skewing results.

Given the role school nurses play in keeping children and youth healthy in school (Baisch, Lundeen, & Murphy, 2011), and that at the national level (as well as for many states) there is not systemic data collection, it is imperative that we have an understanding how school nurses are distributed and whom they serve. The substantial resource investments by federal, state, and local governments into school health services without corresponding research or an understanding of the system has led some researchers to call school health services the "Hidden Healthcare System" (Lear, 2007). To our knowledge, there is no literature on which types of schools and/or student groups have access to school nurses; we provide a first look at the differences in school nurse availability by students' race/ethnicity, SES, and geographic location. We fill this gap in the literature using data from Washington State, and provide a roadmap to build a data infrastructure for states without a centralized data collection system on the school nursing workforce.

3. Study Data

3.1 School Nurses

This study utilizes administrative data from primarily three sources: the Washington State Office of Superintendent of Public Instruction (OSPI), the Washington State Department of Health (DOH), and the U.S. Census Bureau. The OSPI data includes detailed staffing records for public school employees via the S-275 personnel database. The S-275 provides annual information regarding each employee (or contractor), including their individual paid assignments during a given year, their role and activities, their full time equivalent (FTE) for each assignment, which buildings or districts those assignments are associated with, in addition to a variety of other pertinent staffing information.

Nurses working in Washington's schools fall under two designations; certified Educational Staff Associate (ESA) nurses and classified nurses. ESA nurses are required to have a registered nurse (RN) license, be bachelors prepared, and possess three years of school nursing experience or complete coursework specific to school nursing.[1] Licensed Practical Nurses (LPNs), RNs, and Advanced Registered Nurse Practitioners (ARNPs) who do not meet these requirements can work in schools as classified nurses.[2] In this way, ESA nurses may be considered more highly credentialed to work in schools than classified nursing staff, and outside of this data section we will henceforth refer to ESA nurses as Highly Credentialed nurses.

Using the OSPI S-275 data we can clearly identify ESA nurses by the activity and duty codes they are assigned, however, identifying classified nurses is not as clear. To identify classified nurses, we first identified all individuals providing healthcare services (by their assigned activity) in roles titled “Professional”, “Technical”, “Aide”, “Contract Educational Staff Associate”, and “Other Support Personnel.” From the 2000-2001 to 2019-2020 school year this composed a pool of 7,768 potential classified nurses. We then merged this pool to the Washington State Department of Health (DOH) Health Care Provider Credential data to identify individuals with LPN, RN, and ARNP licenses.[3] Those individuals were coded as classified nurses. To validate our identification strategy of classified nurses during the 2019-2020 school year, we looked up nurses and their positions in the staff directories, health services webpages, and student handbooks for each of the 296 Washington school districts.

To validate nursing roles in prior school years, we matched ESA nurses in each year to the DOH credentialing data. Using the S-275 we know the exact number of nurses working as

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[1] ESA requirements as of August 27, 2020. Retrieved from https://www.k12.wa.us/certification/educational-staff-associate-certificates/esa-first-time-applicant/school-nurse

[2] The state's largest school district, Seattle Public Schools, distinguishes the role of the classified nurse as providing more direct care compared to the ESA nurse, while the ESA nurse will participate more in care management and planning, and coordinating care with other healthcare professionals. However, in practice for many nurses and districts the roles are determined by caseload and student population, among other things. The last study of the school nursing workforce in Washington state from 1997, found that 70% of nurse FTEs were ESA certified nurse assignments (DuBois, & Chaw, 1997). We confirm this 70-30 split between ESA certified and classified nurse FTE for the first year of our study, the 2000-2001 school year.

[3] DOH and OSPI data were merged on first, last, and middle names, and birth year. After 2015, year of birth is not consistently recorded in the Washington education workforce data.

ESA certified nurses in each year, and that they must have at least an RN license to practice. In other words, they must also have an RN license in the DOH credentialing data. However, due to name changes, spelling errors, and missing data match rates between the two datasets are not 100%. Across the 20-year period of study the match rate averaged 67%, with matches improving over time. For classified nurses prior to the 2019-2020 school year we adjusted our estimates of classified nurse FTEs by the annual match rate between DOH data and ESA credentialed nurses.[4, 5]

3.2 Districts and Students

Annual district, school and student data are publicly available through the Washington State Data Report Cards. The Report Cards include school-level student enrollment data on total school enrollment, enrollment by race and ethnicity, by gender, by Free-or-Reduced-Price-Lunch (FRPL) eligibility, and by English-Language-Learners participation. In keeping with education literature, we utilize FRPL eligibility as a proxy for SES. The 2018-2019 Report Cards also report the percent of students passing state standardized tests.[6] To calculate district level percentages of student demographics, we aggregate school level enrollment variables to the

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[4] For example, if we match and observe 100 FTEs for classified nurses in a given year and have a match rate between the DOH data and ESA nurses of 70% our estimate of classified nurse FTEs would be 100 / 0.7 = 143.

[5] In some instances, conglomerations of districts employ nurses in organizations known as Educational Service Districts (ESDs) through the School Nurse Corp program (SNC). There are 9 ESDs that cover and serve the entirety of the state. The SNC began in 1999 following a 1997 report that found students in smaller and more rural districts disproportionately lack access to nursing resources, and the SNC was intended to help address this gap (DuBois, & Chaw, 1997; OSPI, n.d.). Nursing services provided through ESDs and the SNC are listed in the S-275 at the ESD level and cannot be linked directly to individual districts. To handle this, we apportion ESD nurse FTE to their nested districts where no nurses were paid at the district level by student special education enrollment. In total during the 2019-2020 school year there were 24.2 nurse FTEs provided by ESDs. Four districts with an average enrollment of 9.25 students were not linked to nurses in the S-275 nor had any students enrolled in special education and thus received no SNC nurse FTEs via our apportionment rule. These districts are dropped from our regression analyses.

[6] State standardized test passing rates in math are not available for 2019-2020 due to school closures, and thus, we utilize the 2018-19 school year test performance of each district. For small districts, that do not report passing rates, we take the first non-missing observation from the 2017-18 or 2016-17 school years. If those are missing, we then used chained multiple imputations for the remaining 31 districts, whose average enrollment was 52 students. Due to the strong correlation between math and reading scores we include only math test scores in our regression models.

district level and divide the variables by the total district enrollment. We merge this data to the S-275 data using unique district IDs.

To ascertain whether potential differences in school nurses at the district level track differences in access to healthcare in the general population, we leverage the Health Resources & Services Administration's (HRSA) Medically Underserved Area (MUA) data. MUAs are geographic areas that HRSA has deemed have an undersupply of primary care services for the population. We merge these MUAs to geographic data on school districts and construct an indicator for whether or not the majority of the district (>50%) lies within a MUA.

Lastly, we merge the analytic dataset to the most recent year (2018-19) of the Education Demographic and Geographic Estimates (EDGE) dataset maintained by the National Center For Education Statistics (NCES) in partnership with the US Census Bureau. The EDGE data contains information on the urbanicity i.e. how urban vs rural a district is. A district can be located in one of four types of areas: urban, suburban, town, or rural.

The resulting analytic dataset allows us to track Washington's school nurse workforce during the 2000-01 to 2019-20 school years, and to evaluate the distribution of school nurses across a range of district and student types. The final analytic dataset yields 19,709 nurse-year observations for the 20 years of study. For the most recent school year, 2019-2020, we observed 1,346 nurses working 978 FTEs linked to 296 districts with 1,141,495 students.

4. Methods

We utilize student-to-nurse ratios as our dependent variable in all analyses, because these ratios may be thought of as one measure of a nurse's caseload, and as a measure of a student's access to nursing resources. Indeed, student-to-nurse ratios are strongly correlated with states' inputs into student support services i.e. support services funding per pupil (Maughan, 2009).

Student-to-nurse ratios are constructed as the district level total student enrollment divided by nurse FTE at the district. For a nurse working in Washington schools 1 FTE is considered to be working 180 days at 8 hours a day.

Overall, the district level student-to-nurse ratio has a positively skewed distribution centered around the median of 1,565, but with a long tail towards higher student-to-nurse ratios.[7] We take the natural log of the ratio to get an approximately normal distribution and use this transformed variable in all analyses described here. School nurses often work in multiple schools and cannot be reliably linked to individual schools, we therefore focus on district level analyses and weight all analyses by total enrollment at the district level. We focus on the 2019-2020 school year for our correlation and regression analyses, because we were best able to validate this year of data against district directories, and for prior years limit our analyses to aggregate trends in the nursing workforce.

To compare the distribution of school nurses to student demographics, we first look at the Pearson Correlation coefficients between the student-to-nurse ratio and selected student demographics (race/ethnicity and FRPL status), i.e. the relationship between selected student demographics and the student-to-nurse ratio unadjusted for other covariates. We perform a Sidak correction for testing the statistical significance of the correlation coefficients to account for multiple hypotheses tests. We perform Student's t-tests of the student-to-nurse ratios between urban districts and suburban, town, and rural districts. Lastly, we conducted a one-way ANOVA test of the student-to-nurse ratios by urbanicity. These results are presented in Table 2 and are discussed in the results section below.

[7] From Table 1, the state-wide student-to-nurse ratio is significantly less than the district level median student-to-nurse ratio. As we show, this discrepancy is due to larger districts having lower student-to-nurse ratios than smaller districts.

To get estimates of the relationship between race/ethnicity, SES, and urbanicity and the student-to-nurse ratio conditional on other district characteristics we utilize an Ordinary-Least-Squares regression framework. That is, we regress the student-to-nurse ratio at the district level for the 2019-2020 school year against a range of student demographic and other district characteristics to assess how the spread of the school nurse workforce differs across different district types. This regression model is depicted in Equation (1) below.

$$(1)\quad ln(y_d) = \beta_1 X_d + \beta_2 Z_d + \Theta_d + \pi_d + \varepsilon_d$$

In Equation (1) $ln(y_d)$ is the natural log transformation of district *d's* student-to-nurse ratio y_d. X_d is a vector of the percentage of the student population by race/ethnicity and eligibility for FRPL at the district level. Z_d is a vector of controls including the percent of the student population that is female, participating in Special Education, that is an English-Language-Learner, and passing the state-wide standardized math test. In some specifications we add Θ_d, a vector of fixed effects for the urbanicity of the district, and π_d, an indicator for whether the district was located in a MUA. ε_d is the error term. All regressions are weighted by district total enrollment.

5. Results

5.1 Time Trends in the Nursing Workforce

We begin by exploring time trends in the nursing workforce. Figure 1 plots the state-wide student-to-nurse ratio from the 2000-2001 to 2019-2020 school year by different measures of student or district characteristics; race/ethnicity, SES, and geography. In panel A we plot just the state-wide ratios. The dashed line represents the national goal from Healthy People 2020 of having one school nurse to every 750 students (DHHS, 2010). In the 2000-2001 school year there were 625 school nurse FTEs and by the 2019-2020 school year the number of FTEs was 978. The student-to-nurse ratio has been on a slow, steady decline from approximately 1,605 in the 2000-2001 school year to 1173 in the 2019-2020 school year.

In panel B, we plot the student-to-nurse ratio by the race/ethnicity of districts over the past 20 years. Specifically, we calculate the percent of the district that is non-White and create quartiles in each year. We add the total enrollment and total nurse FTE within each quartile and year to get a quartile-by-year student-to-nurse ratio. The top quartile has the highest percentage of its student body that is non-White, and the bottom quartile has the lowest percentage of its student body that is non-White.

In panel C we plot student-to-nurse ratios by student participation in FRPL. Similarly, in each year we get the percentage of a district's student population that is FRPL eligible for each district and group them into quartiles. Next we calculate the student-to-nurse ratio for each quartile. The "Top Quartile" line includes districts with the highest percentage of their student population being FRPL eligible, while the "Bottom Quartile" group has the lowest percentage of FRPL eligible students.

Finally, in panel D, we disaggregated our results based on the urbanicity of the school districts. Panel D reveals that the gap in student-to-nurse ratios between rural and town districts compared to urban and suburban districts narrowed substantially over the past 20 years. For instance, the average student-to-nurse ratio was 33% higher for rural and town districts than urban and suburban districts in the 2000-2001 through 2002-2003 school years, while for the 2017-18 through 2019-2020 school years the ratio was only 10% higher.

5.2 2019-2020 Descriptive Statistics

Table 1 provides summary statistics for the school nurse workforce and student population they served in the 2019-20 school year. Columns 2-4 in Table 1 disaggregate the statewide results, Column 1, and Panel A provides data on the nursing workforce, while panel B provides data on students.

Across the state, there were 978 nursing FTEs with considerable variation by urbanicity. State-wide 59% of the FTEs were from highly credentialed nurses. Urban areas had a higher proportion of highly credentialed nurses working there, 74%, while 38% of the nursing workforce in rural areas was highly credentialed. The statewide student-to-nurse-ratio was 1,173, with the lowest ratio being in urban areas. The average nurse is working 0.73 FTEs in nursing roles, with highly credentialed nurses working 0.86 FTEs.[8] In all types of districts, the nursing workforce tends to be predominantly white, female, and approximately 50 years of age on average.

In panel B, we present the demographic data of students across the state and by urbanicity. Non-white students are more likely to be in urban school districts representing 50.9% of the student population, compared to rural districts (36%). 45% of the student population is eligible for FRPL, 11.7% are English-Language-Learners, and 14.5% participate in Special Education. Finally, in panel B we report the percentage of students enrolled in districts within MUAs. Statewide 42.5% of students go to schools in MUAs, but significant variation exists between types of school districts. 32.6% of students in urban areas compared 66.7% of students in town areas attend school in MUAs.

[8] Nurses may work in a non-nursing role, such as instruction. In the 2019-2020 school year the average nurses' non-nursing FTE was 0.021.

In Figure 2 we plot the student-to-nurse ratio for districts in the 2019-2020 school year with the MUAs overlaid, which are indicated with hash marks. Figure 2 clearly shows that there is significant variation in the student-to-nurse ratio across the state. However, from Figure 2 or Table 1, it is difficult to say what exactly is most associated with the differences in the student-to-nurse ratios. To investigate this more closely, we turn to our district level correlation and regression analyses.

5.3 2019-2020 District Level Correlation Analysis

In Panel A of Table 2, we present Pearson's Correlation coefficients between a district's racial/ethnicity and SES composition, and the log of the district's student-to-nurse-ratio. The student-to-nurse ratio can be thought of as a rough approximation of a nurse's caseload, so positive and significant correlations indicate that these types of districts have higher caseloads. In column (1) we present statewide results, and in columns (2) through (5) we disaggregate these results by urbanicity. Results from Table 2 are unadjusted correlations. In other words, they do not control for other characteristics of districts, such as the percent of the student population participating in Special Education.

In the state-wide results, the percentage of the student body that is Black, Native Hawaiian or Other Pacific Islander, or Multi-Racial is negatively associated with the student-to-nurse ratio. That is, per capita there are more nurses in districts with higher percentages of these student populations. The percent of the student body that is eligible for FRPL is positively associated with higher student-to-nurse ratios, but is not statistically significant. As we move across columns (2) through (5), the statistically significant associations in column (1) appear to be driven by lower student-to-nurse ratios in urban districts for these student groups, however, only the percent of the student population that is Black is statistically significant. Given the stability or larger magnitudes for the correlations on Native Hawaiian or Other Pacific Islander and Multi-Racial in urban districts, we interpret this as due to a loss of power when restricting the sample to individual urbanicity types.

In panel B, we present the student-to-nurse ratios state-wide and by urbanicity. We conducted a one-way ANOVA test on the student-to-nurse ratio across urbanicity; the F-statistic was 7.94 with an associated p-value of less than 0.001. These results indicate that student-to-nurse ratios differ by urbanicity. Furthermore, we test whether districts in suburban, town, and rural districts have statistically significant different student-to-nurse ratios than urban districts. In all cases, Student's t-test reveals statistically different student-to-nurse ratios.

5.4 2019-2020 District Level Regressions

In Table 3 we present the results from Ordinary-Least Squares regression analyses depicted in Equation 1. The outcome variable, the student-to-nurse ratio, has been log transformed. Exponentiated coefficients can be interpreted as the percent change in the outcome for a one unit increase in the independent variable.

Starting in Column 1, districts with a higher percent of FRPL eligible students had higher student-to-nurse ratios than otherwise comparable districts. Districts with a higher percentage of Black, Hispanic, or Native Hawaiian or Other Pacific Islander students had lower student-to-nurse ratios. To test whether or not these associations are driven by differences in where students live, we include urbanicity fixed effects in Column 2. Now student-to-nurse ratios are compared by demographics within the same urbanicity setting. All findings from Column 1 remain unchanged. The base category of urbanicity is urban districts, therefore, coefficients on the urbanicity fixed effects should be interpreted as changes in the student-to-nurse ratios relative to urban districts. Suburban, town, and rural districts have higher student-to-nurse ratios than urban districts, but are imprecisely estimated and not statistically significant.

Nonetheless, the magnitudes on the gap between urban and rural districts is quite large. For instance, the student-to-nurse ratio increases by 16.6% ($e^{0.1536}$) when going from a demographically similar urban district to a rural district. Further investigation reveals that the coefficients are insignificant because race/ethnicity is highly correlated with urbanicity, that is, students sort into different geographic types of districts by race and ethnicity. When we rerun our regression results omitting race and ethnicity, but maintain all other controls, the magnitude of the coefficients on town and rural districts is 110% and 122% larger and statistically significant.

In Column 3 we replace the urbanicity fixed effects with an indicator for whether or not the district was located in a MUA. While the coefficient is positive indicating higher student-to-nurse ratios in these districts, it is insignificant. To test whether or not the student-to-nurse ratio unadjusted for other covariates is different in MUAs vs. non-MUAs we conducted a two-sided Student's t-test comparing the means of the log of the student-to-nurse ratio. We find no evidence of difference between MUA and non-MUA districts.[9] We include three sets of robustness checks in Appendices A, B, and C.

6. **Discussion**

By conducting these analyses, we aim to provide a template for how state agencies can understand the current state and historical trends of their school nursing workforce. We show the importance of understanding these trends by illustrating how the distribution of school nurses can compound or mediate disparities in access to care using data from Washington state. As

[9] With alpha set at 0.05 the test yields a t-statistic of -0.67 and a corresponding p-value of 0.506.

leaders and policy makers make decisions on resource allocation, findings from this study can provide a historical context and a foundation from which to guide decision-making.

Over the past 20 years in Washington state, the rise in the number of nursing FTEs outpaced the rise in student enrollment, resulting in a steady decline in the student-to-nurse ratio. This growth in nursing FTEs was primarily driven by less highly credentialed nurses (classified nurses), with highly credentialed nurse (ESA) FTE growing by 42% compared to 81% for less highly credentialed nurse FTE.

Importantly, this decline in the student-to-nurse ratio over the past 20 years has coincided with an expansion of the role of school nursing. For instance, state and federal laws have reinforced the role that the education system, and subsequently school nurses, play in managing the care of students with severe disabilities and chronic diseases to ensure access to public education (Cedar Rapids Community School District v. Garret F, 1999).[10] Moreover, the number of students with acute and chronic conditions, developmental disabilities, behavioral issues and the complexity of care for those conditions have all increased (Boyle et al., 2011; Van Cleave, Gortmaker, & Perrin, 2010). Over a 12-year period the prevalence of students with chronic health conditions doubled, rising from 12.8% in 1994 to 26.6% in 2006 (Van Cleave, Gortmaker, & Perrin, 2010). The higher prevalence rate of chronic conditions, new regulatory environment, and increasing complexity of school nurse responsibilities likely contributed to the hiring of more school nurses, and thus the decline in the student-to-nurse ratio.

Our work confirms prior findings that more school nurses, per capita, are located in urban districts than rural districts (Willgerodt et al., 2018). We further extend this knowledge by documenting that the gap in nursing resources between urban and suburban districts compared to

[10] Also compare, for instance, the content of Chapter 28A.210 RCW on HEALTH—SCREENING AND REQUIREMENTS between 1999 and 2020; i.e. fewer than 5 provisions to over 40.

rural and town districts has also substantially narrowed. This may be due to a number of factors, for example an increase in state regulations in the 2000s requiring supportive services, which in turn forced more consistent staffing across districts or an increase in chronic conditions in general, necessitating more school nurses in rural areas to provide care. However, this is beyond the scope of this paper and we leave this for future investigations. Given that rural school nurses are more likely to work in multiple schools and spend time driving between them (Willgerodt et al., 2018), the gap reported here may underestimate the true gap in the nurse FTE available to care for students. Regardless, more work is needed to better understand the gap between urban and rural access to school nursing services.

Somewhat surprising is that the distribution of school nurses does not always track other trends in healthcare access for the pediatric or general population as a whole. More specifically, Black and Latino adults are less likely to have healthcare insurance and less likely to utilize healthcare services (Chen, Vargas-Bustamante, Mortensen, & Ortega, 2016). However, we show that in both our raw correlations and regression adjusted results Black students are more likely to attend districts with more nurses per capita. This is particularly true in urban districts. Our unadjusted correlations and regression results for Latino students are mixed with a null finding on the correlations, and a negative and statistically significant coefficient in the regression results. When we rerun our regression model omitting the two highest correlated variables to percent Hispanic, percent FRPL eligible and percent ELL, we replicate the null findings on the correlation analyses. This suggests that for two districts with similar SES and percent of English-Language-Learners, the district with a higher percent of Hispanic students is more likely to have more school nurses per capita. We also find consistent results that districts with more Native Hawaiian or Other Pacific Islander students have lower student-to-nurse ratios, and mixed evidence on districts with a higher percentage of Multi-Racial students. Broadly, in Washington state districts with more students of color tend to have lower student-to-nurse ratios. This may reflect hiring to meet an increased utilization in these districts because students of color have a higher prevalence rate for some chronic health conditions (Berry, Bloom, Foley, & Palfrey, 2010).

These results are from cross-district estimates of access to school health services. Fleming (2011) reported that within schools with school nurses, ethnic minority children were more likely to access school nursing services compared to White children. Taken together our findings plus Fleming's (2011) suggest that school nurses help the most vulnerable student populations by addressing barriers to student care, for example, by increasing accessibility and availability (Fleming, 2011). In this way, school nurses may serve as a protective factor for students of color.

On the other hand, we find that the distribution of school nurses tracks access gaps by SES in the general population. That is, districts with a higher percent of FRPL eligible students have less access to nursing resources, although this gap is only statistically significant in our regression adjusted results. To determine whether SES is an independent predictor of the student-to-nurse ratio from race, we omitted our race and ethnicity variables and reran our regression results with all other controls. FRPL eligibility remained a statistically significant predictor of the student-to-nurse ratio, but the magnitude of the coefficient has been reduced by 45%, suggesting that the correlation between race/ethnicity and SES (McIntosh, Moss, Nunn, & Shambaugh, 2020) does not fully explain access gaps by SES .

These results may be a consequence of how nursing services are funded. Nationally, 76% of nurses are primarily funded through local dollars (Willgerodt et al., 2018). We estimate that in

Washington approximately 2/3rds of nurse FTEs are funded by local dollars and 1/3 by State or Federal monies.[11] It is not surprising then to find that lower income districts, as measured by the proportion of students eligible for FRPL, that likely have fewer local dollars employ fewer nurses per student. Will (2020) estimates that nationally to staff one nurse at each school (the current recommendations of the National Academy of Sciences, Engineering, and Medicine (NASEM) and the American Academy of Pediatrics) could cost the prototypical school district an additional $400,000 per year. Disproportionate access to school nurses by income is problematic given that children of lower-SES families have a higher prevalence of disabling chronic conditions (Spencer, Blackburn, & Read, 2015). And, given that State and local budgets are being negatively impacted by the pandemic, these trends may be exacerbated. Addressing these substantial resource demands requires an understanding of where resources are distributed, and where to place additional limited nursing resources.

Understanding the variation in nursing resources by student demographics provides a glimpse of one aspect of access to care but does not illuminate how accessible culturally competent care is. We find that the school nurse work force is much whiter (90%) and more female (97%) than the student population they serve. For comparison, 47.3% of the student population is non-white. This may present a barrier to achieving health equity, as researchers have argued that increasing the diversity of the nursing workforce supports culturally competent care, increases patient-provider trust, and racial/ethnic language concordance, among other

[11] Nurses are primarily funded through the "Basic Education" funding formula and Special Education dollars (~95%), although a number of other small funding sources exist. Per Washington's Basic Education funding formula, the State provides funds for one nurse for every 5699 students, which for the 2019-2020 school year worked out to be 201 FTEs (RCW 28A.150.260). We calculate the total FTEs provided through all other funding sources, including Special Education, and theses 201 FTEs as the number of FTEs funded through State of Federal dollars. This represents an upper bound on the number FTEs funded through the State of Federal government, as it is likely that local dollars could be funneled through some of the smaller funding sources. The remaining FTEs not funded by the State through the "Basic Education" program are assumed to be local dollars.

things (Williams et al., 2014). While to our knowledge no research exists on the association between the diversity of the school nursing workforce and student health outcomes, parallels in the education environment exist. Students who racially match their teachers tend to perform better on statewide-standardized tests than their unmatched peers (Villegas, & Irvine, 2010).

We argue that these results need not be confined to Washington state. That is, state-level administrative data containing basic information surrounding the number of nurses, the hours they work, and the student populations they serve likely already exists. State education systems typically maintain employment information on all school district employees. Employment records should collect data automatically in a standardized manner on the census of school nurses. These employment records may identify some or all school nurses by their assigned roles, activities, or pay scale. When they do not identify school nurses directly, employment records can be matched against publicly available state-specific Department of Health healthcare provider licensing data. Together these data along with nationally available Common Core education data, which maintains school level data on race/ethnicity and socio-economic status, can answer important questions surrounding who has access to school health services. Given that school health services operate under a different regulatory environment and different funding mechanisms, a priori it is unclear the extent to which known existing disparities in access to pediatric primary care apply to school health services.

There are an estimated 132,000 school nurses across the country providing a wide variety health services to students (Wilgerodt et al., 2018); building an understanding of this hidden healthcare system (Lear, 2007) could provide an insight into potential avenues to increase student attainment and better health outcomes. And, we argue the paucity of data on the school nurse workforce can likely be addressed by pre-existing administrative data. After doing so, we found that in Washington the distribution of school nurses has the potential to bolster access to health services for some traditionally disadvantaged students, while for others the disparities in care parallel disparities in access to pediatric primary care.

7. Limitations

The student-to-nurse ratio captures only one aspect of a student's ability to access care at school. For instance, student-to-nurse ratios may not accurately capture a nurse's workload (Combe et al., 2015), which may substantively limit the availability and quality of care nurses can provide. As mentioned above, it does not capture the prevalence of chronic health conditions nor increased responsibilities school nurses have taken on due to regulatory changes. Future work should include controls for the prevalence of chronic health conditions and/or developmental disabilities, so that observed differences in access to care are conditional on the same level of health conditions. For example, other literature finds that Black students have a higher prevalence of some chronic health conditions (Berry et al., 2010). Without controlling directly for chronic health conditions, we do not know whether the increased access to school nurses is "keeping up" with the greater need of particular student populations.

On the other hand, prior literature documents a higher prevalence of developmental disabilities for low socio-economic children (Boyle et al., 2011). In this context, not controlling for health conditions biases estimates of the access gap towards zero, that is, our estimate of the gap is conservative without this additional control. To create finer measures of nursing workload and how they relate to student outcomes, better data tying students, their medical conditions and care requirements, and their outcomes to nursing sensitive metrics are needed (Jameson, Anderson, & Endsley, 2020). Such data should include measures of expected standards of practices, detailed data on care coordination, and a school nurse's community health responsibilities (Jameson et al., 2020).

It is important that states assess their own student populations and health services as results from Washington state may not generalize. Washington is a large western state with many rural areas. The urbanicity findings may not generalize to geographically different states. Additionally, the student population of Washington is Whiter, more Asian, more Pacific Islander, and more Multi-racial, and less Black and Hispanic than the nation as a whole (NCES, 2019). Findings on race/ethnicity may only generalize to states with similar racial compositions. However, we view the findings on FRPL eligibility as more likely to hold for two reasons. First, the 2015-2016 *National Teacher and Principal Survey* found that lower socio-economic schools were less likely to employ a school nurse full time. Second, the reliance on local education dollars to fund school nursing positions in both Washington and nationally indicates that the likely mechanism driving this disparity in access is present nationally.

Lastly, while we used multiple data sources to identify one type of nursing staff, classified staff, this likely undercounts classified nursing staff. Any potential undercounting, we believe represents a relatively small portion of the school nurse workforce. Classified nurses represent the minority of school nurse FTEs (DuBois & Chaw, 1997), and leveraging both DOH licensing data and district directories should capture the majority of these nurses.

8. **Conclusion**

The ways in which school nurses reduce barriers to care are well documented in the literature. School nurses provide no cost, referral free, and appointment free care without the need for transportation. In a given school, school nurses often provide care to traditionally disadvantaged ethnic minority populations (Fleming, 2011). Yet, little national or state data exist on whom school nurses serve. In this study, we provide a roadmap for how states can use existing administrative data to explore which students have access to school nurses, with the intent that states tailor the provision of nursing resources to the communities in need of them most.

The different legal requirements and funding streams that support school nurses are likely responsible for the differences in access to care observed in school health services relative to general pediatric primary care. Specifically, students of color are more likely to attend school districts with more school nurses per capita. However, rural and lower socio-economic school districts have fewer school nurses per student. School nurses have and will continue to be a valuable resource for communities providing health education and connecting students and their families to other healthcare services (Green, & Reffel, 2009). What's more is that school nurses may serve a protective role insulating students of color against disparities in healthcare access. States could consider expanding school nurse access in rural and poorer communities, if they want to narrow gaps in access to school health services. This could be of particular importance during the pandemic, as low socioeconomic communities and communities of color are being disproportionately affected by COVID-19. Future research should investigate the extent to which the distribution of school nurses impacts student health outcomes, for instance, COVID-19 infection rates.

Figures

Figure 1: State-wide Student-to-Nurse Ratios by Disparity Measures: 2000-2001 to 2019-2020

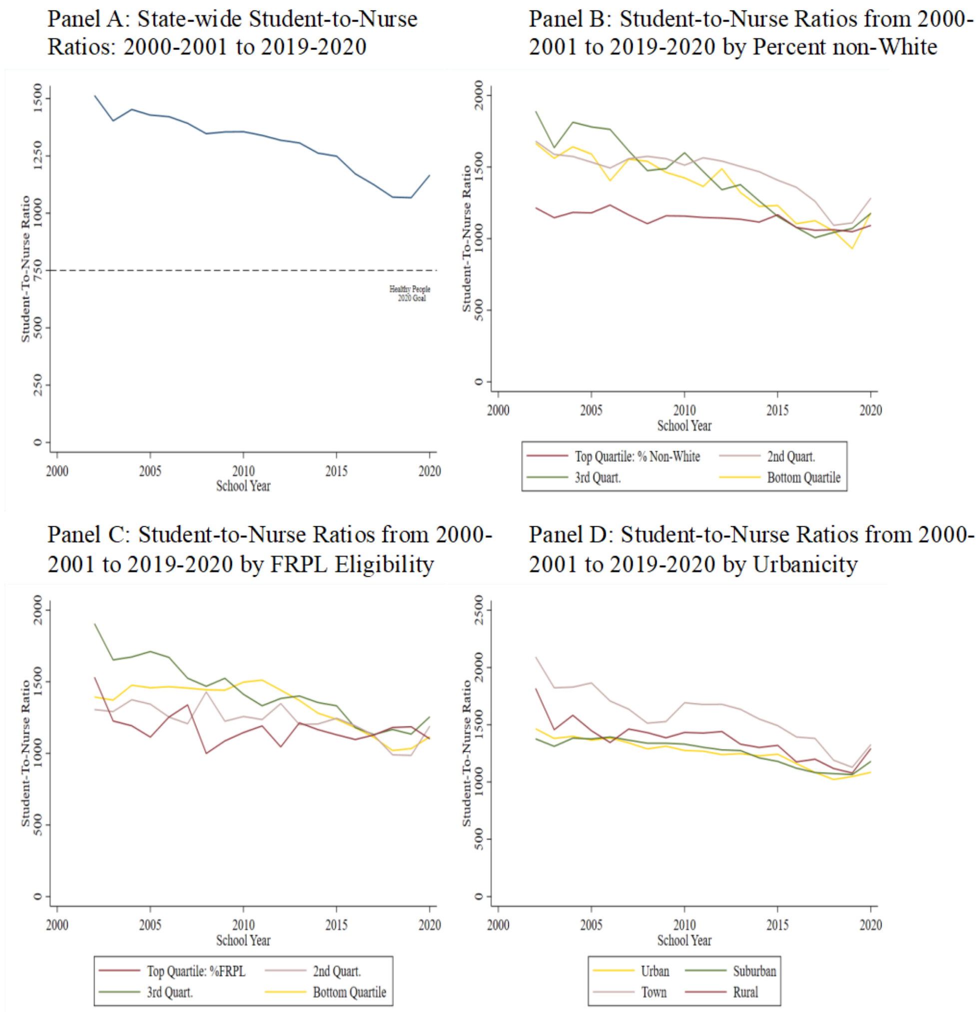
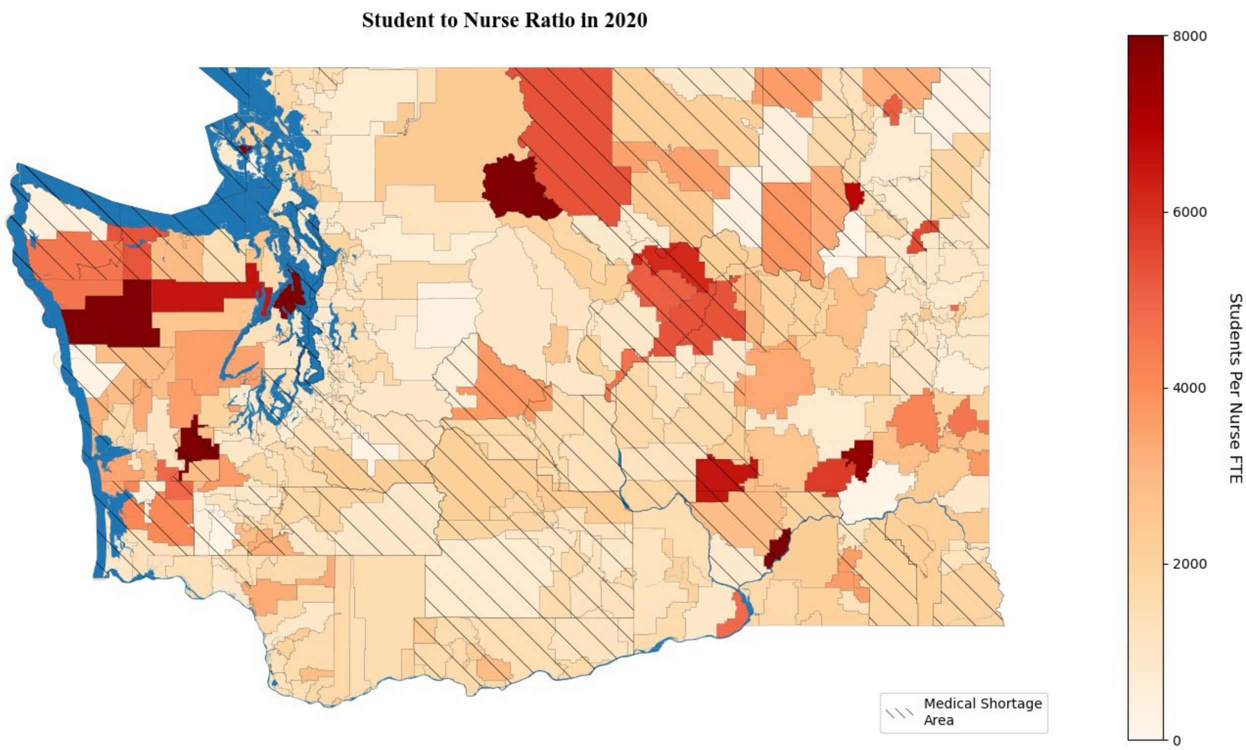


Figure 2: 2019-2020 School District Student-to-Nurse ratios and Medically Underserved Areas



Tables

Table 1: Summary Statistics of the Nursing Workforce and Student Population for the 2019-2020 School Year

Panel A: Nursing Workforce	Statewide	Urban	Suburban	Town	Rural
Nurse FTE (total)	978	403.9	391.9	114.9	67.3
Proportion Highly Credentialed	0.587	0.735	0.484	0.550	0.364
Students to Nurse Ratio	1172.7	1,086.9	1,181.2	1,327.7	1,293.0
Nurse FTE (mean)	0.723	0.783	0.705	0.711	0.564
Highly Credentialed (mean)	0.864	0.86	0.861	0.917	0.822
Mean Age*	49.66	50.10	48.70	49.38	53.41
Percent					
Female	0.972	0.975	0.976	0.974	0.938
American Indian or Alaska Native	0.005	0.002	0.006	0	0.017
Asian/Pacific Islander	0.038	0.047	0.044	0.013	0.008
Black	0.017	0.022	0.019	0.003	0.004
Hispanic	0.041	0.033	0.033	0.072	0.064
White	0.9	0.896	0.898	0.913	0.907
Number of Nurses**	1346	516	556	162	119
Panel B: Student Demographics					
Percent					
American Indian or Alaska Native	0.011	0.006	0.008	0.022	0.039
Asian	0.080	0.095	0.1	0.018	0.01
Black	0.044	0.063	0.043	0.012	0.006
Hispanic	0.240	0.234	0.211	0.341	0.25
Native Hawaiian or Other Pacific Islander	0.012	0.015	0.013	0.003	0.002
Two or More Races	0.086	0.095	0.094	0.051	0.053
White	0.527	0.491	0.531	0.553	0.64
Free-or-Reduced-Price Lunch Eligible	0.454	0.482	0.378	0.553	0.547
English Language Learners	0.117	0.127	0.106	0.129	0.108
With Disabilities	0.145	0.145	0.14	0.154	0.15
Students in MUA	0.425	0.326	0.421	0.667	0.524
Total Enrollment	1141495	439016	462902	152558	87019

Notes:

* Year of birth taken from DOH data and represents a subsample of nurses

** 7 nurses work across urbanicity settings, so the sum across urbanicity is 7 higher than the state-wide count

Table 2: Unadjusted Relationships Between Student-to-Nurse ratios and Race/Ethnicity, SES, and Urbanicity

Panel A: Pearson Correlation Coefficients between the Student-to-Nurse Ratio and Unadjusted Demographic Characteristics

	Statewide	Urban	Suburban	Town	Rural
Percent					
American Indian or Alaska Native	0.097	-0.0429	0.3798	0.1154	-0.1099
Asian	-0.127	-0.1341	0.0336	-0.2586	-0.1637
Black	-0.4094***	-0.6733**	-0.2982	0.0936	-0.0053
Hispanic	0.086	0.2566	-0.21	0.1445	0.0783
Native Hawaiian or Other Pacific Islander	-0.2442***	-0.2718	-0.2097	-0.0992	0.1051
Two or More Races	-0.2334**	-0.4613	-0.0173	-0.0247	0.0301
White	0.129	0.1964	0.2275	-0.1582	-0.0303
Free-or-Reduced-Price Lunch Eligible	0.057	0.0781	-0.1607	0.308	0.0358

Panel B: Student-To-Nurse Ratio By Urbanicity Relative to Urban Districts

	Statewide	Urban	Suburban	Town	Rural
Student-To-Nurse Ratio	1172.7	1086.9	1181.2***	1327.7**	1293***

Notes : Student-to-Nurse ratios have been log transformed for Panels A and B to get an approximately normal distribution. For ease of interpretation untransformed ratios are reported in panel B. All analyses are weighted by total enrollment. A Sidak correction has been applied in panel A to correct for multiple hypthesis tests. A one way ANOVA test of the student-to-nurse ratio across urbanicity yeilds a F-statistic of 7.94 and a p-value of less than 0.001. p-value: +p <=0.1, *p<=0.05, **p<=0.001, ***p<=0.001

Table 3: Regressions of Student-to-Nurse ratios on Student Demographic Data

	(1)	(2)	(3)
Percent			
American Indian or Alaska Native	-0.0045	-0.0082	-0.0054
	(0.007)	(0.007)	(0.007)
Asian	0.0013	0.0021	0.0016
	(0.004)	(0.004)	(0.004)
Black	-0.0383***	-0.0378***	-0.0411***
	(0.008)	(0.008)	(0.009)
Hispanic	-0.0075*	-0.0083*	-0.0084*
	(0.004)	(0.004)	(0.004)
Native Hawaiian or Other Pacific Islander	-0.0639*	-0.0649*	-0.0595*
	(0.026)	(0.027)	(0.027)
Two or More Races	0.0117	0.0155	0.011
	(0.009)	(0.010)	(0.009)
Free-or-Reduced-Price Lunch Eligible	0.0111***	0.0115***	0.0110***
	(0.003)	(0.003)	(0.003)
Urbanicity			
Suburban		0.0882	
		(0.053)	
Town		0.1251	
		(0.078)	
Rural		0.1536	
		(0.096)	
MUA			0.0465
			(0.051)
Districts	292	292	292

Notes: District level regressions of natural log transformed student-to-nurse ratios on student demographic data, urbanicity, and Medically Underserved Areas (MUAs) with analytic weights at the student enrollment level. All Models include controls for the percent of the student population that is female, participating in Special Education, an English-Language-Learner, and the percent of the district passing state standardized math tests. p-value: +p <=0.1, *p<=0.05, **p<=0.001, ***p<=0.001

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Appendix A: Regression Models without ESD Nurse FTE

As a robustness check we omit the 107 districts with only ESD nurse FTE allocation and rerun our models. These districts account for 4.4% of the student population and are primarily (87%) located in rural settings. As such, results are qualitatively similar with the exception of the higher student-to-nurse ratio finding in rural settings. In the robustness check, the sign on the finding for rural districts flips, but with a large standard error, which comports with many rural districts being dropped from this analysis.

	(1)	(2)	(3)
Percent			
American Indian or Alaska Native	-0.0108	-0.0124	-0.0119
	(0.010)	(0.010)	(0.010)
Asian	0.002	0.0022	0.0024
	(0.005)	(0.005)	(0.005)
Black	-0.0413***	-0.0411***	-0.0444***
	(0.009)	(0.010)	(0.010)
Hispanic	-0.0052	-0.0069	-0.0063
	(0.004)	(0.004)	(0.004)
Native Hawaiian or Other Pacific Islander	-0.0525+	-0.0612+	-0.0478
	(0.030)	(0.032)	(0.031)
Two or More Races	0.0195+	0.0200+	0.0187+
	(0.011)	(0.011)	(0.011)
Free-or-Reduced-Price Lunch Eligible	0.0080*	0.0097**	0.0080*
	(0.003)	(0.003)	(0.003)
Urbanicity			
Suburban		0.0768	
		(0.062)	
Town		0.08	
		(0.092)	
Rural		-0.0685	
		(0.129)	
MUA			0.051
			(0.060)
Districts	189	189	189

Notes: District level regressions of natural log transformed student-to-nurse ratios on student demographic data, urbanicity, and HRSA shortage areas with analytic weights at the student enrollment level. ESD nurse FTE has been removed from the regressions. p-value: +p <=0.1, *p<=0.05, **p<=0.001, ***p<=0.001

Appendix B: Regression of Total FTE on Student Demographics and Total Enrollment

While the dependent variable, the student-to-nurse ratio, represents a measure of a student's ability to access health services, an alternate measurement of access is the total number of nurse FTEs in a district, where total enrollment is included as a control. We run models of the log of total nurse FTE regressed against the student covariates in our main model plus a cubic in total enrollment. The rationale behind these models is to allow health services staffing policies to vary non-linearly by district size. For example, health services likely have both fixed and variable costs. Larger districts, where fixed costs likely comprise less of the total health services budget, may staff nurses differently from smaller districts. These models are better suited to compare large districts to large districts, and smaller districts to smaller districts.

The results depicted on the next page are generated from the following model:

$$(2) \quad ln(Total\, Fte_d) = \beta_1 X_d + \Theta_d + \mu_d + \varepsilon_d$$

Equation (2) is similar to Equation (1), but replaces the dependent variable from Equation (1), the student-to-nurse ratio, with the total nursing FTEs in district *d.* Equation (2) adds μ_d to Equation (1) and is a cubic in total enrollment at district *d.*

If our main models differ from this robustness check it would indicate that student demographics correlated with total enrollment are capturing the non-linear relationship between enrollment and nurse FTE in our main models. The first three columns from this robust check confirm the findings from our main models. However, at the end of the day what we care about is the ability of students to access nursing services regardless of the size of the district, and as such we prefer the student-to-nurse ratio as a measure of this.

	(1)	(2)	(3)
Percent			
American Indian or Alaska Native	-0.0067	-0.0042	-0.0053
	(0.009)	(0.009)	(0.009)
Asian	-0.0047	-0.0063	-0.005
	(0.005)	(0.005)	(0.005)
Black	0.0310*	0.0303*	0.0346**
	(0.012)	(0.012)	(0.013)
Hispanic	0.0091*	0.0072	0.0109*
	(0.005)	(0.005)	(0.005)
Native Hawaiian or Other Pacific Islander	0.0482	0.0537	0.0444
	(0.036)	(0.035)	(0.036)
Two or More Races	-0.0001	-0.0005	0.0011
	(0.012)	(0.011)	(0.012)
Free-or-Reduced-Price Lunch Eligible	-0.0145***	-0.0150***	-0.0144***
	(0.003)	(0.004)	(0.003)
Urbanicity			
Suburban		-0.0806	
		(0.066)	
Town		0.0345	
		(0.110)	
Rural		-0.5603***	
		(0.144)	
MUA			-0.0794
			(0.063)
Total Enrollment Per 100 Students	0.0342***	0.0307***	0.0339***
	(0.002)	(0.002)	(0.002)
(Total Enrollment Per 100 Students)^2	-0.0001***	-0.0001***	-0.0001***
	(0.000)	(0.000)	(0.000)
(Total Enrollment Per 100 Students)^3	0.0000***	0.0000***	0.0000***
	(0.000)	(0.000)	(0.000)
Districts	292	292	292

Notes: District level regressions of natural log transformed district total nurse FTEs on student demographic data, urbanicity, HRSA shortages areas, and a cubic in total enrollment with analytic weights at the student enrollment level. p-value: +p <=0.1, *p<=0.05, **p<=0.001, ***p<=0.001

Appendix C: Regressions Omitting one or two of the following variables: Percent Black, Percent FRPL Eligible, and Percent with Disabilities

Given concerns about heterogeneity between student achievement, FRPL eligibility, and communities of color (Domina et al., 2018), we rerun models omitting one racial category or FRPL eligibility to test coefficient stability. In particular, we rerun models in Columns 1 and 2 omitting FRPL eligibility, percent Black, FRPL eligibility and percent with disabilities, or percent Black and percent with disabilities. In no model does the findings for either FRPL eligibility or percent Black change, indicating that the findings are not driven by shared variation between these variables. Results are available on the following page.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Percent										
Black	-0.0383***	-0.0346***		-0.0378***	-0.0351***		-0.0347***		-0.0354***	
	(0.008)	(0.008)		(0.008)	(0.008)		(0.008)		(0.008)	
Free-or-Reduced-Price	0.0111***		0.0098***	0.0115***		0.0105***		0.0070**		0.0074**
Lunch Eligible	(0.003)		(0.003)	(0.003)		(0.003)		(0.002)		(0.003)
With Disabilities	-0.0261+	-0.0008	-0.0332*	-0.0276*	-0.0028	-0.0344*				
	(0.014)	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)				
Urbanicity										
Suburban				0.0882	0.0209	0.1021+			0.0214	0.0899
				(0.054)	(0.053)	(0.056)			(0.052)	(0.056)
Town				0.1251	0.1401+	0.1132			0.1382+	0.097
				(0.078)	(0.081)	(0.081)			(0.080)	(0.082)
Rural				0.1536	0.2122*	0.1678+			0.2123*	0.1848+
				(0.096)	(0.098)	(0.100)			(0.098)	(0.100)
Districts	292	292	292	292	292	292	292	292	292	292

Notes: District level regressions of natural log transformed student-to-nurse ratios on student demographic data and urbanicity with analytic weights at the student enrollment level. All non-listed student demographic variables from the main models are used in columns 1-10, but omitted in this robustness check to highlight the coefficients of interest: percent Black, percent FRPL, and the percent of students with disabilities. p-value: +p <=0.1, *p<=0.05, **p<=0.001, ***p<=0.001