Does the National Health Service Corps Help Underserved Areas?

**Background and Aims**

Medically underserved areas are communities with a high levels of unmet healthcare needs, often secondary to insufficient access to primary care physicians. Several loan repayment and subsidized training programs for primary care practitioners have been instituted to increase physician supply to underserved areas, including the National Health Service Corps (NHSC) through the Department of Health and Human Services (National Health Service Corps Scholarship Program, 2003). The NHSC grants primary care physicians up to $50,000 in medical school loan forgiveness in exchange for two years of service in a medically underserved area, however, the effectiveness of the program in improving patient health has not been evaluated. The aim of this analysis is to determine whether participation in the NHSC reduces area-level all-cause and disease-specific mortality (herein, simply ‘mortality’).

**Method**

Data for this study come from three sources: one, the Area Health Resource Files (US Department of Health and Human Services, 2014) for the ratio of primary care physicians-to-population; two, the Centers for Disease Control Wide-ranging Online Data for Epidemiologic Research (CDC WONDER) (Centers for Disease Control and Prevention, 1995) for infant mortality rates, low birthweight rates, a and crude all-cause, cancer, and heart disease mortality rates; and three, the American Community Survey (ACS) (U.S. Census Bureau; American Community Survey, 2014) for population estimates, age demographics, and poverty and unemployment rates. Briefly, the Area Health Resource Files are a compilation of 50 separate health service and economic datasets provided by the American Medical Association, American Hospital Association, and Bureau of Health Workforce. Files are updated annually to monitor health service worker supply, regional demand for specific medical procedures (e.g. elective surgery, orthodontia), and costs of care. Among the provided indicators is a census of all physicians licensed in the U.S., disaggregated by county of practice and medical specialty. CDC WONDER is an online query system maintained by the National Center for Health Statistics that allows users to generate area- and period-level natality and mortality data from linkage to birth records and the National Death Index (> 90% of all deaths are accounted for in any given year) for all U.S. counties between 1999 and 2016. Area-level mortality rates are provided for the 57 leading causes of death as determined by ICD-10 codes on death certificates, although rates are suppressed for regions with fewer than 10 deaths from a specific cause. Finally, the ACS is an ongoing, nationally representative, multistage probability sample conducted by the U.S. Census Bureau as a supplement to the decennial census. Roughly 0.6% of the U.S. population is sampled for the ACS in any given year, and, because the Census Bureau contacts respondents multiple time to encourage participation, the response rate in 2014 was 96.7% (Torrieri, 2014). The ACS includes census-tract level demographics including estimates of population by age and race/ethnicity, poverty, unemployment, and educational attainment.

*Index of Medical Underservice Scoring*

A county’s eligibility to participate in the NHSC is determined by the index of medical underservice score, which quantifies an area’s degree of physician shortage relative to healthcare needs. Scores are typically generated automatically by the Health Resource and Service Administration from Area Health Resource Files, CDC WONDER, and Census data, with all scores of 62 or below eligible for NHSC participation. While historic data on county eligibility are publicly available, index of medical underservice scores are only provided for counties currently eligible for the NHSC (i.e. in 2019; 2020 eligibility has not yet been determined). To obtain index of medical underservice scores for earlier years, I regenerate scores for each county in the U.S. using historic data and the Health Resource and Service Administration scoring guidelines (U.S. Department of Health and Human Services, 2015). Scores are calculated as the weighted sum of a county’s primary care physician-to-population ratio, percentage of residents age 65 or older, percentage of population at or below the federal poverty level, and infant mortality rate or, in instances where infant mortality rates were suppressed due to small sample sizes, rates of low birthweight. All score subcomponents are based on five-year averages to prevent substantial annual variation in program eligibility for treated counties (i.e. the averages of 2009-2014 components were used to calculate 2014 scores), and counties with qualifying scores automatically retain eligibility for two years following designation, regardless of subsequent scores. Though the NHSC has been in operation since the late 1970s, the current index of medical underservice scoring criteria were first implemented in 2014 such that all potential carry-overs from 2012/2013 to 2014 were disallowed. Thus, unlike for earlier periods, a county’s NHSC participation in 2014 is based strictly on its 2014 score rather than any one of its 2012, 2013, and 2014 scores. Table 1 provides a more detailed description of scoring criteria and weighting procedures.

*Treatment Assignment*

Let be a dichotomous variable denoting the eligibility of county *i* to participate in the NHSC in 2014 (with 0 = ineligible, 1 = eligible), denote the index of medical underservice score in 2014, and (1 = treated, 0 = control) denote actual participation in 2014. is a deterministic function of such that:

Due to budget constraints, not all eligible counties receive NHSC funding; however, no ineligible counties receive funding. Therefore, is a probabilistic function of eligibility for counties below the cutoff, and deterministic for counties above:

The one exception to this rule is that state governors may grant exemptions for ineligible rural counties with demonstrated primary care shortages to receive funding for rural health clinics. The application process for exemption is long and requires extensive administrative oversight, with few requests ultimately being approved; in 2014 a total of five counties were exempted, all of which I exclude from further analyses. As shown in Table 2, derived treatment assignment according to simulated scores adhered to known participation and eligibility rules, with zero counties above the cutoff participating and approximately two-thirds of those below participating.

*Model Specification*

such that the average treatment effect of on age-standardized mortality rate can be estimated as \_\_\_. I estimate local average treatment effects at multiple bandwidths use the Imbens and Kalyanarman approach to select the optimal bandwidth for estimation of the local average treatment effect (Imbens & Kalyanaraman, 2012), and additionally present results based on bandwidths one-half or double the optimal size.

For the purposes of precision, I present both unadjusted estimates and estimates adjusted for county-level adult obesity and smoking rates, percentage of adults without health insurance, and unemployment rate. I do not weight observations for population size in primary analyses because I am interested in county-level, rather than individual-level, effects.

*Sensitivity Analyses*

To assess potential manipulation of the running variable , I check for discontinuity in the density of observations just above and below the cutoff score (McCrary, 2008). I also perform placebo tests, using \_\_\_\_\_\_ as alternative outcomes, and using a range of different (false) cutoff values of to estimate local average treatment effects at different points along the running variable.

References

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**Table 1.** Description of index of medical underservice score subcomponents and weighting.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Infant Mortality1** | | **Percent Over 652** | | **Primary Care Ratio3** | | **Percent in Poverty4** | |
| **Maximum Value** | **Score** | **Maximum Value** | **Score** | **Maximum Value** | **Score** | **Maximum Value** | **Score** |
| ≤8 | 26.0 | ≤7 | 20.2 | ≤0.05 | 0.0 | ≤0.1 | 25.1 |
| ≤9 | 25.6 | ≤8 | 20.1 | ≤0.10 | 0.5 | ≤1 | 24.6 |
| ≤10 | 24.8 | ≤9 | 19.9 | ≤0.15 | 1.5 | ≤4 | 23.7 |
| ≤11 | 24.0 | ≤10 | 19.8 | ≤0.20 | 2.8 | ≤6 | 22.8 |
| ≤12 | 23.2 | ≤11 | 19.6 | ≤0.25 | 4.1 | ≤8 | 21.9 |
| ≤13 | 22.4 | ≤12 | 19.4 | ≤0.30 | 5.7 | ≤10 | 21.0 |
| ≤14 | 20.5 | ≤13 | 19.1 | ≤0.35 | 7.3 | ≤12 | 20.0 |
| ≤15 | 20.5 | ≤14 | 18.9 | ≤0.40 | 9.0 | ≤14 | 18.7 |
| ≤16 | 19.5 | ≤15 | 18.7 | ≤0.45 | 10.7 | ≤16 | 17.4 |
| ≤17 | 18.5 | ≤16 | 17.8 | ≤0.50 | 12.6 | ≤18 | 16.2 |
| ≤18 | 17.5 | ≤17 | 16.1 | ≤0.55 | 14.8 | ≤20 | 14.9 |
| ≤19 | 16.4 | ≤18 | 14.4 | ≤0.60 | 16.9 | ≤22 | 13.6 |
| ≤20 | 15.3 | ≤19 | 12.8 | ≤0.65 | 19.1 | ≤24 | 12.2 |
| ≤21 | 14.2 | ≤20 | 11.2 | ≤0.70 | 20.7 | ≤26 | 10.9 |
| ≤22 | 13.1 | ≤21 | 9.8 | ≤0.75 | 21.9 | ≤28 | 9.3 |
| ≤23 | 11.9 | ≤22 | 8.9 | ≤0.80 | 23.1 | ≤30 | 7.8 |
| ≤24 | 10.8 | ≤23 | 8.0 | ≤0.85 | 24.3 | ≤32 | 6.6 |
| ≤25 | 9.6 | ≤24 | 7.0 | ≤0.90 | 25.3 | ≤34 | 5.6 |
| ≤26 | 8.5 | ≤25 | 6.1 | ≤0.95 | 25.9 | ≤36 | 4.7 |
| ≤27 | 7.3 | ≤26 | 5.1 | ≤1.00 | 26.6 | ≤38 | 3.4 |
| ≤28 | 6.1 | ≤27 | 4.0 | ≤1.05 | 27.2 | ≤40 | 2.1 |
| ≤29 | 5.4 | ≤28 | 2.8 | ≤1.10 | 27.7 | ≤42 | 1.3 |
| ≤30 | 5.0 | ≤29 | 1.7 | ≤1.15 | 28.0 | ≤44 | 1.0 |
| ≤31 | 4.7 | ≤30 | 0.6 | ≤1.20 | 28.3 | ≤46 | 0.7 |
| ≤32 | 4.3 | >30 | 0.0 | ≤1.25 | 28.6 | ≤48 | 0.4 |
| ≤33 | 4.0 | -- | -- | >1.25 | 28.7 | >48 | 0.1 |
| ≤34 | 3.6 | -- | -- | -- | -- | -- | -- |
| ≤35 | 3.3 | -- | -- | -- | -- | -- | -- |
| ≤36 | 3.0 | -- | -- | -- | -- | -- | -- |
| ≤37 | 2.6 | -- | -- | -- | -- | -- | -- |
| ≤39 | 2.0 | -- | -- | -- | -- | -- | -- |
| ≤41 | 1.4 | -- | -- | -- | -- | -- | -- |
| ≤43 | 0.8 | -- | -- | -- | -- | -- | -- |
| >43 | 0.2 | -- | -- | -- | -- | -- | -- |
| 1. Infant mortality rate (or low birthweight rate in lieu of mortality) come from CDC WONDER and | | | | | | | |
| are defined as total infant deaths per 1000 live births or total infants born weighting < 5.5 lbs per | | | | | | | |
| 100 live births. | |  |  |  |  |  |  |
| 2. Percentage of elderly residents comes from the American Community Survey, and includes all | | | | | | | |
| non-institutionalized adults aged 65 or older living in the county. | | | | | |  |  |
| 3. Primary Care to Population Ratio comes from the Area Health Resource Files and equals | | | | | | | |
| total full-time equivalent non-federally employed primary care providers employed in non-research, | | | | | | | |
| patient care roles divided per 1000 population. | | | |  |  |  |  |
| 4. Poverty rate comes from the American Community Survey and is defined as percentage | | | | | | | |
| of population living households with annual incomes at or below the federal poverty level. | | | | | | | |

Table 2.