Background

The surgical workforce plays a critical role ensuring access to high quality, affordable surgical care.

Prior studies examined surgeons without considering anesthesiologists and obstetricians that constitute key components of the surgical workforce.

The Lancet Commission on Global Surgery (LCOGS) identifies surgeons, anesthesiologist, and obstetrician workforce density as a core indicator of surgical capacity with a recommendation of 20-40 SAO/100,000 population as the minimum standard to ensure quality surgical coverage.

The United States, like many high income countries, far exceeds the LCoGS minimum recommendation from a national standpoint, but a granular look at accessible SAO density for subsets of the population has not been measured.

Although studies have shown that up to 30% of all US counties have deficiencies in the number of surgeons, it is not clear how these deficiencies impact surgical outcomes which are more closely related to referral systems rather than the county level.

Hospital Referral Regions (HRRs), which are geographic units of analysis that were developed by the Dartmouth Atlas of Health Care to characterize referral patterns to tertiary care centers, more appropriately represent the use of surgical services and the distribution of SAO providers.

Objective and Methods

Objective

I sought to define the SAO density of US healthcare referral regions and the ratio of surgeons:anesthesiologists:obstetricians, determine the association between SAO density and mortality for common emergency general surgery and obstetric conditions among HRRs, and characterize the correlation between SAO density and Health Professional Shortage Areas (HPSAs).

Data Sources

Counts of practicing surgeons, anesthesiologists, obstetricians, operating rooms, and total deaths were obtained from the Health Resources and Services Administration’s 2018-2019 Area Health Resources Files (AHRF) by county.

Surgical and obstetric emergency mortality was defined based on ICD9 codes identified by Shafi et al that represent emergent surgical (ESG) and EOG codes defined by the World Health Organization that represent emergent obstetric deaths.

All codes were searched in the CDC WONDER database, which aggregates deaths by county based on cause of death by county.

Population level demographic data by US Census block group was obtained from the US American Community Survey (ACS) estimates for 2017.

Shapefiles for counties and block groups were obtained from the United States Census Bureau, and shapefiles for Hospital Referral Regions were obtained from the Dartmouth Institute for Health Policy and Clinical Practice.

Aggregation

Counts of providers, operating rooms, and deaths were aggregated up to the HRR level using a county-to-HRR crosswalk. Counties were attributed in whole or in part to HRRs according to the amount of area bounded by each HRR.

Surgeon, Anesthesiologist, and Obstetrician (SAO) density was defined as the number of practicing surgeons, anesthesiologists, obstetricians, and obstetric specialists per 100,000 population.

Analysis

The independent association between SAO density and surgical mortality was modeled using quintile regression in RStudio, adjusting for number of operating rooms, number of operations, percentage of population living in poverty, median household income, percent uninsured, and percent of population living in health professional shortage areas.

The independent association between SAO density and the percentage of population living in medically underserved regions was determined using linear regression for HRRs.

US Surgical Workforce

The national SAO density was 91.1863 SAO/100,000 population (see Figure 1 for geospatial representation of SAO density by HRR). All HRRs met the Lancet Commission on Global Surgery SAO minimum density target of 20 SAO/100,000. 97.7% of HRRs exceeded the target of 20-40 SAO/100,000 (see Figure 5).

Surgical Deliverly

The mean mortality rate was 37.88/100,000 (see Figure 2 for geospatial representation of death rate by HRR).

Across all quintiles, the percent of medically underserved population (HPSA designation) was not significantly associated with SAO density (see Figure 6 – lack of statistical significance indicates no association).

Surgeons constituted 71.2% of SAO density nationally (see Figure 4).

Results

Discussion

Increased SAO density is associated with decreased surgical mortality.

HPSA designation is not a good predictor of SAO density.

Geographic analysis shows that US meets LCoGS targets at national level, but that disparities in SAO distribution can be seen upon regional analysis.

Creation of a "surgically underserved" designation akin to HPSA should be explored in order to maximize reduction in surgically-amenable deaths.

One important limitation of this work is that not all ICD9 codes outlined by Shafi et al were available from the CDC WONDER database, though the codes that were available seemed to span the breadth of general surgery practice.

A significant strength is that SAO density has never previously been studied at a regional level in a high-income country like the United States and the relationship between SAO density and surgical mortality has not been described.