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Modeling Minimum Thresholds for Surgery, Anesthesia, and Obstetrics Specialist Workforce Densities for 2019

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Introduction

- Previous studies noted a desired density of 20-40 surgery, anesthesia, and obstetric (SAO) specialists per 100,000 to reduce maternal mortality rates (MMR).
- However, MMR is neither specific to surgical systems nor does it account for wide-ranging diseases and population groups impacted by the SAO workforce. Further, cadre-specific density thresholds are missing.
- In this analysis, we provide cadre-specific SAO density thresholds based on surgical healthcare access and quality (HAQ) index that comprehensively captures surgical care.

Discussion & Conclusion

- To our knowledge, this is the first global analysis presenting cadre-specific minimum thresholds for SAO specialist density.
- Majority countries fall below the thresholds.
- Previously World Federation of Society of Anesthesiologist calculated minimum thresholds for Anesthetist to be 4.
- Our results are slightly higher than 4 and 20 for Anesthetists and SAO respectively.
- These findings are vital for national surgical planning and directing investments for scaling up adequate training capacity, especially in the Global South.

Materials and Methods

Data Sources and Variables:
- SAO workforce density per 100,000 people (past years):LCoGS data (194 countries; 1999-2014) Physician density per 100,000 people: Institute for Health Metrics and Evaluation (IHME) (204 countries;1990-2019)

PAP density Calculations:

$$\frac{SAO}{Physician} Ratio = \frac{Year\ specific\ SAO\ density\ (per\ 100{,}000)}{Year\ specific\ Projected\ Physician\ Density\ (per\ 100{,}000)}$$

$$2019\ SAO\ Density\ (per\ 100{,}000) = 2019\ Projected\ Physician\ Density\ (per\ 100{,}000) * \frac{SAO}{Physician} Ratio$$
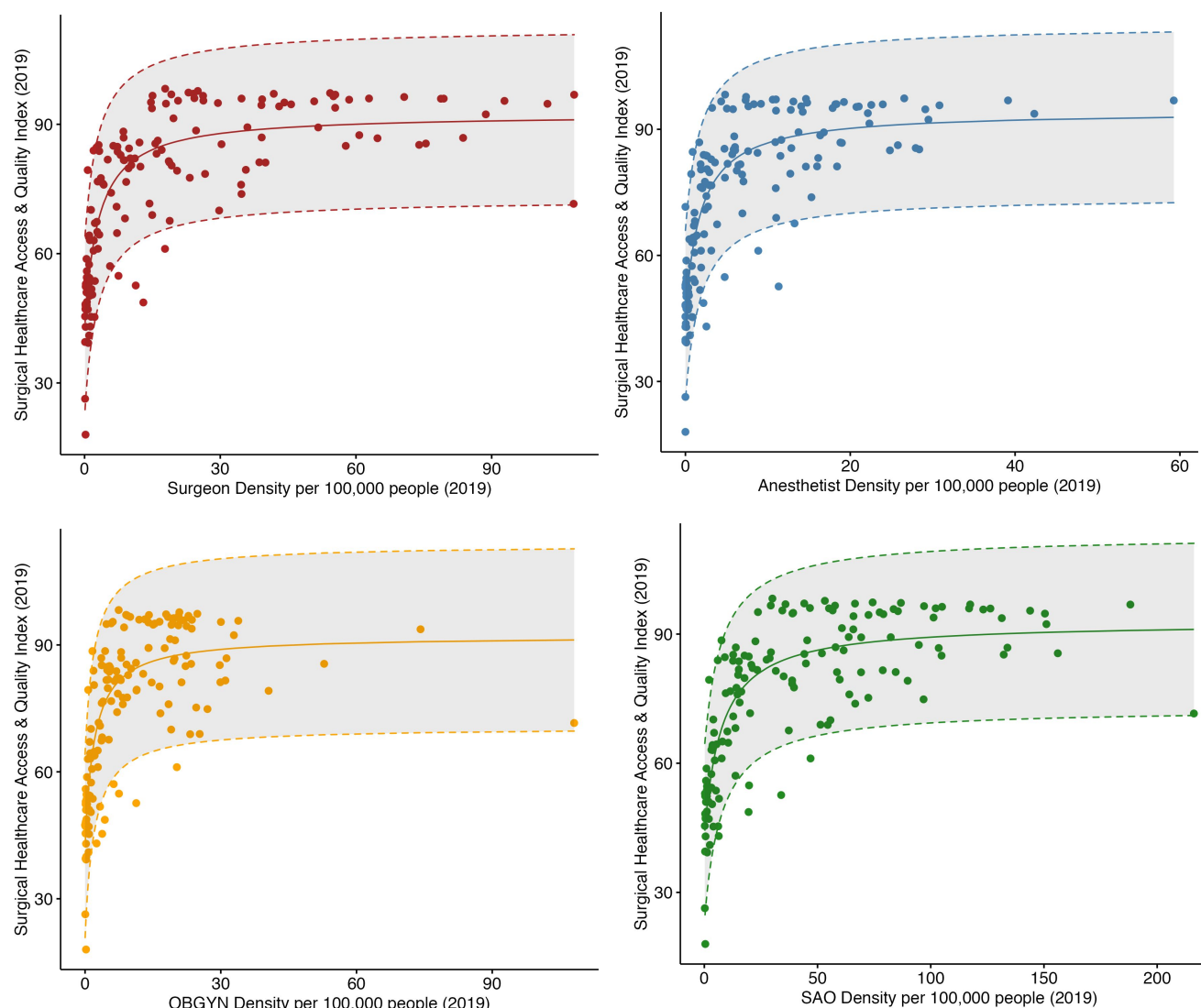
- Validation using data by Bouchard et al (20 countries, 2019).

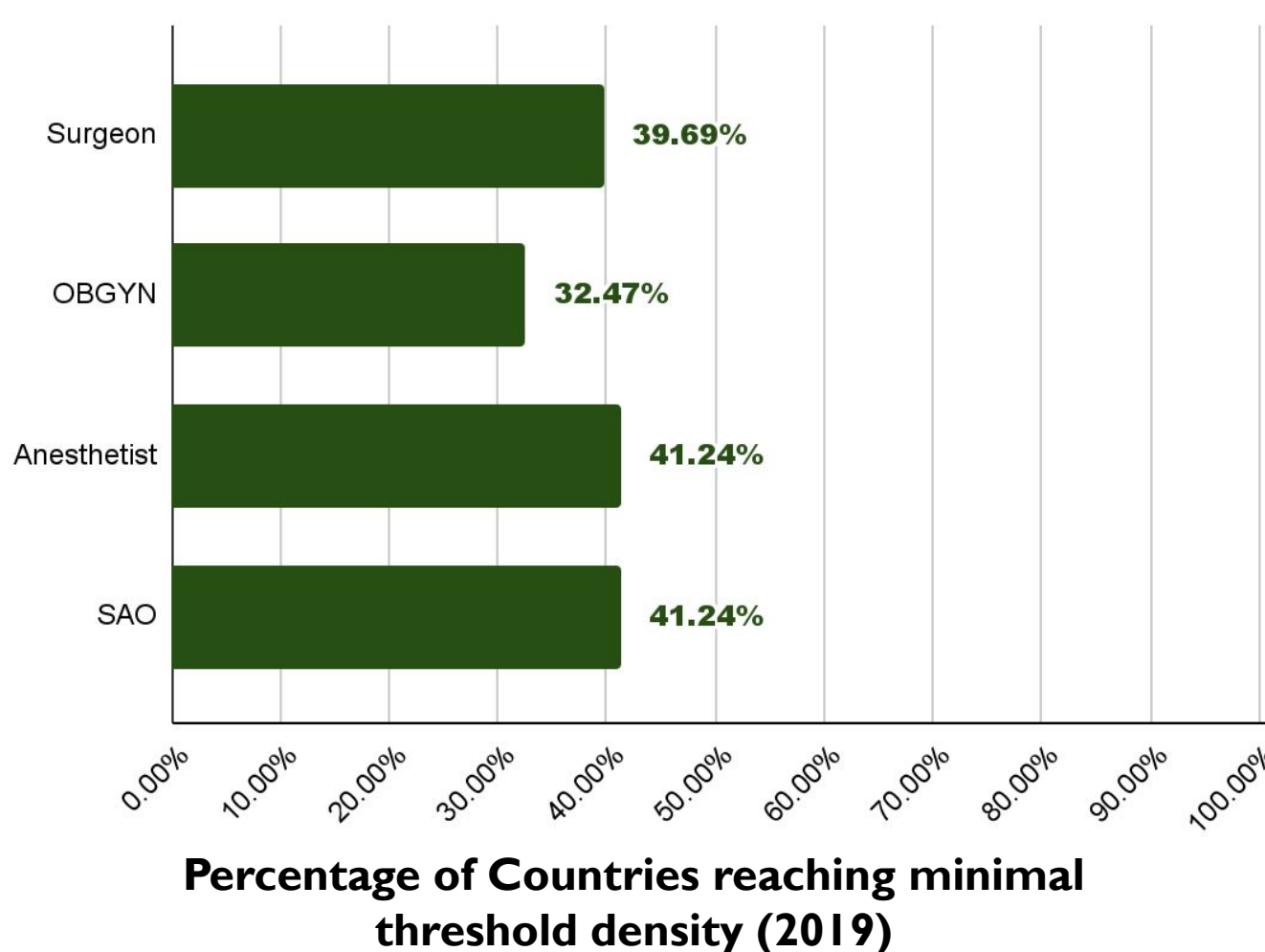**Minimum Density Threshold Calculation:**
- Outcome: Surgical healthcare access and quality (HAQ) index (2019) - a scaled (0-100, with 100 being best) composite of fourteen surgically treatable diseases with preventable mortality.
- The relationship between the four densities (S, A, O, and SAO) and surgical HAQ inspected using scatter plot
- Nonlinear least squares used to estimate the best-fit three-parameter Michaelis-Menten equation curve for the relationship.

$$f(x, (c, d, e)) = c + \frac{\{d-c\}}{\{1 + \frac{e}{x}\}}$$

- Four models were considered for the explanatory variables: surgeon density, anesthetist density, obstetrician density, and SAO density.
- Minimum thresholds - Workforce densities corresponding to the median surgical HAQ index (76.85).
- We also estimated thresholds for achieving surgical HAQ of 85 and 90 as aspirational targets.
- Analysis and visualizations were performed in R (RStudio Version 1.3.1056).

References

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Results

Cadre	Surgical HAQ >= 76.8	Surgical HAQ >= 85	Surgical HAQ >= 90
Surgeon	9.81 (4.69, 14.93)	16.75 (8.01, 25.48)	26.60 (12.73, 40.48)
OBGYN	6.72 (3.44, 10.00)	11.48 (5.88, 17.08)	18.23 (9.33, 27.13)
Anesthetist	6.06 (3.51, 8.62)	10.35 (6.00, 14.71)	16.44 (9.52, 23.36)
SAO	24.90 (13.03, 36.78)	42.52 (22.24, 62.80)	67.54 (35.32, 99.75)

Percentage of Countries reaching minimal threshold density (2019)

- Surgeon: 39.69%
- OBGYN: 32.47%
- Anesthetist: 41.24%
- SAO: 41.24%