

Project Proposal: Optimizing Primary Care Physician Distribution Using Matching Algorithms and Population Health Analytics

1. Problem Statement

Rural America faces critical primary care physician shortages (per HPSA scores) while urban areas experience resource saturation. Current National Resident Matching Program (NRMP) algorithms prioritize individual preferences over population health needs, exacerbating geographic health disparities (Roth & Peranson, 1999). This project proposes a data-driven matching mechanism integrating epidemiological demand forecasting with stability-preserving allocation rules.

2. Objectives

1. Develop a two-sided matching system incorporating:
 - Health demand metrics from NHANES
 - Physician preference constraints
2. Quantify potential improvements in:
 - Chronic disease management capacity (Diabetes focus)
 - Physician retention rates in underserved areas

3. Methodology

Phase 1: Demand Modeling

Source: NHANES 2017-2018 (Python nhanes package)

Methods:

1. Age-standardized diabetes prevalence mapping
2. Logistic regression forecasting

Phase 2: Modified Matching Algorithm

Adapt kidney exchange stability concepts:

Match score = $0.6 \times \text{Regional Disease Burden} + 0.4 \times \text{Physician Preference}$

Dynamic HPSA-like priority weights

Benchmark against NRMP baseline

Phase 3: Policy Simulation

Output metrics:

1. Avoidable hospitalizations (Cost savings)
2. Physician-to-population ratios

Tools: Python matching library + Plotly dashboards

4. Expected Outcomes

- First application of kidney exchange stability concepts to physician geographic allocation
- Open-source algorithm implementation
- Data integration & epidemiological modeling, wrangling and statistical standardization
- Interactive plotly choropleth and bar-chart dashboards
- Adjustable priority weights to bridge ml with real-world health-policy analytics.
- Simulations of policy impact & avoidable hospitalizations

5. This project operationalizes Arrow's (1963) seminal work on healthcare as a "failed market" by:

Quantifying welfare losses from pure preference-based matching

Demonstrating how operations research can repair market failures