

Notice of submission: This protocol was finalized and uploaded to GitHub on May 24, 2020

## **Driving times to Psychiatrists in the United States**

### Methods and Statistical Analysis Plan

#### Summary:

**Purpose:** The purpose of this study is to estimate the population-weighted mean driving time in the United States (US) from census block group mean centers of population to the closest psychiatrist practice location and to compare how this varies in urban and rural areas.

**Primary outcome:** The driving time will be calculated from each ‘mean center of population’ (MCP) of each US Census block group (within the 50 states and District of Columbia) to the closest psychiatrist (identified by any psychiatrist practice locations listed in the National Provider Identifier database). A weighted mean of these driving times will be calculated, with the population of each census block group as weightings; this weighted mean is the primary outcome. The “closest” psychiatrist to an MCP will be defined as the psychiatrist with the shortest driving time from that location (see further details below). This weighted mean driving time will be compared between urban and rural regions (see definition below).

#### Data sources:

**Census block groups:** A public data file containing the population of and geographic coordinates of the mean center of population (MCP) of each census block group from the 2010 US Census was downloaded from : <https://www.census.gov/geographies/reference-files/2010/geo/2010-centers-population.html>. Also included in the file was Federal Information Processing System (FIPS) code for the census tract and corresponding county/county-equivalent entity and state. Census block groups and accompanying information from United States territories were removed.

**Psychiatrist addresses:** The National Provider Identifier (NPI) database will be used to identify addresses of psychiatrists. This is a publicly available downloadable file of all NPI records in the United States ([http://download.cms.gov/nppes/NPI\\_Files.html](http://download.cms.gov/nppes/NPI_Files.html)). Psychiatrists will be identified through taxonomy codes reflecting the following specializations within the “Psychiatry and Neurology” classification: Addiction Medicine, Addiction Psychiatry, Child & Adolescent Psychiatry, Forensic Psychiatry, Geriatric Psychiatry, Psychiatry, or Psychosomatic Medicine,. All primary and secondary practice locations will be used as addresses.

**Urban-rural definitions:** The Rural-Urban Commuting Area Codes (RUCA) will be used to define urban and rural regions according to the following definition (<https://depts.washington.edu/uwruca/ruca-uses.php>):

**Urban:** 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, and 10.1

**Rural:** 4.0, 4.2, 5.0, 5.2, 6.0, 6.1, 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 10.0, 10.2, 10.3, 10.4, 10.5, and 10.6

#### Geocoding:

Addresses will be batch geocoded using ArcGIS with StreetMaps Premium Locators. Psychiatrist practice location addresses that are not matched on batch geocoding will be excluded.

#### Determination of “closest” psychiatrist address:

For the geographic coordinates of the mean center of population of each census block group, the “point-to-point” distances to all psychiatrist business addresses in the United States will be calculated using the Haversine formula. The Haversine formula determines the great-circle distance between two points, assuming a spherical globe. The list of ten nearest psychiatrist practice location addresses, for each mean center of population, as measured by great-circle distance will be created for each census block group MCP.

For each of the ten nearest psychiatrist addresses, the driving time and driving distances will be calculated using the ArcGIS Network Analyst (OD Distance Matrix) with StreetMaps Premium using historical average driving speeds. The address with the lowest driving time from each MCP will be used as the “closest” psychiatrist for a census block group.

#### Statistical plan

Analyses will be conducted in R or another accepted statistical program.

#### Primary analysis:

The purpose of this study is to estimate the population-weighted mean one-way driving time by to the closest psychiatrist practice location for residents in the United States. The primary analysis will test whether the population-weighted mean one-way driving time by to the closest psychiatrist practice location (primary outcome) is different between urban and rural regions in the United States. The primary outcome will be calculated in a two-step process: First, the driving time from the MCP of each census block group within the 50 states and District of Columbia (obtained from the US Census Bureau) to the closest psychiatrist practice location will be calculated. Second, a weighted mean of the MCP to psychiatrist driving times will be calculated, using the population of the census block group as the weight. The “closest” psychiatrist to an MCP will be based on the psychiatrist practice location with the shortest driving time from the MCP.

The tested hypothesis is that the weighted mean of driving times to the closest psychiatrist practice location will be longer in rural areas than urban areas. A weighted two-sample t-test will be used to compare urban and rural population-weighted mean driving times.

Additional analyses: Driving times will additionally be calculated by county and state. Driving distances and costs associated with driving (e.g. based on IRS estimates of variable cost of driving and based on fuel costs) will be calculated.

**Declaration at the time of upload of the protocol:**

At the time of uploading the protocol, the following have been conducted:

- The project has been determined not to be human subjects research by the Stanford Institutional Review Board.
- Python code has been developed and tested
- A previous analysis comparing the closest OTP and pharmacies by driving times to census tract mean centers of population has been completed
- The NPI database and census block group MCP files have previously been downloaded

Robert Andrew Kleinman, MD

Resident in Psychiatry

Stanford University School of Medicine

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