

Mapping Provider Availability Using Public Licensure and Population Data: A Feasibility Study of a GIS-Based Approach to Workforce Planning

Madeline Ratoza, Rupal M Patel, Julia Chevan, Wayne Brewer, Katy Mitchell

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Madeline Ratoza¹ PT, DPT, PhD; Rupal M Patel² PT, PhD; Julia Chevan³ PT, DPT, PhD, MPH; Wayne Brewer² PT, PhD, MPH; Katy Mitchell⁴ PT, PhD

¹6705 Walebridge Ln University of St. Augustine for Health Sciences Austin US

²Texas Woman's University Houston US

³Springfield College Springfield US

⁴Texas Woman's University Denton US

Corresponding Author:

Madeline Ratoza PT, DPT, PhD

6705 Walebridge Ln

University of St. Augustine for Health Sciences

5401 La Crosse Ave

Austin

US

Abstract

Background: Access to rehabilitation services is a critical, yet an understudied, dimension of health equity. Among the six domains of access, provider availability, defined as the presence of sufficient providers to meet population needs, is particularly underexplored in rehabilitation professions such as physical and occupational therapy. Current data reporting often lacks the geographic granularity required for effective workforce planning.

Objective: The purpose of this study was to demonstrate the feasibility of mapping rehabilitation provider availability at the census tract level using Geographic Information Systems (GIS), integrating public licensure and population data to inform equitable workforce planning.

Methods: A descriptive, cross-sectional study was conducted using publicly available state licensure data for physical and occupational therapists and demographic data from the American Community Survey. Residential provider addresses were geocoded and matched to 2020 census tracts. Provider-to-population ratios were calculated and mapped using choropleth and bivariate mapping techniques. Descriptive and inferential statistics were used to compare sociodemographic characteristics between areas with high and low provider availability.

Results: Provider availability varied widely across census tracts in Texas, with population-to-provider ratios ranging from 4 to 11,147 individuals per provider. Bivariate maps highlighted census tracts where high disability prevalence intersected with low provider availability, identifying areas of high need.

Conclusions: This GIS-based study offers a novel, and feasible approach to mapping rehabilitation provider availability. The methodology enables small-area spatial analysis and can be adapted for use across other health professions and geographic regions. Findings support its utility in health equity research and workforce policy development aimed at improving access to care.

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Original Manuscript

Feasibility Study

Madeline Ratoza, PT, DPT, PhD
University of St. Augustine for Health Sciences
mratoza@usa.edu

Rupal M Patel, PT, PhD
Texas Woman's University

Julia Chevan, PT, DPT, PhD, MPH
Springfield College

Wayne Brewer, PT, PhD, MPH
Texas Woman's University

Katy Mitchell, PT, PhD
Texas Woman's University

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Keywords:

Geographic Information Systems; Rehabilitation Workforce; Health Workforce; Spatial Analysis; Provider Availability; Workforce Planning; Health Services Accessibility; Public Health; Census

Tract; Spatial Epidemiology; Cross-Sectional Studies; Health Services Research

Introduction

Access to Rehabilitation as a Social Determinant of Health

Access to healthcare is a key social determinant of health that directly influences outcomes across populations.[1-6] Within rehabilitation professions such as physical therapy (PT) and occupational therapy (OT), access is shaped by a combination of system-level and individual-level factors.[7,8] The concept of access has been widely studied and is frequently organized around the Penchansky and Thomas' Theory of Access, which outlines six interrelated dimensions: availability, accessibility, accommodation, affordability, acceptability, and awareness.[7,8]

Availability of Providers as a Dimension of Access

The dimension of availability, in particular of the rehabilitation therapy (PT and OT) providers, is an under examined component of access. We define availability in this instance as the extent to which a sufficient rehabilitation workforce is geographically and operationally present to meet population needs. While each dimension of the Theory of Access contributes to a full understanding of access, this study focuses specifically on rehabilitation therapy providers' availability, defined as the presence of adequate personnel, equipment, and resources to deliver care.

Rehabilitation providers, particularly those in outpatient settings, deliver care through multiple visits across an episode of care, making provider availability a central concern in ensuring consistent, effective treatment.[9] However, there is no standardized methodology for assessing and visualizing workforce availability across geographic regions. In contrast, disciplines such as primary care medicine and behavioral health use established designations, such as Health Professional Shortage Areas (HPSAs) and Medically Underserved Areas/Populations (MUAs/MUPs), to identify and respond to gaps in provider supply[10-12] that translate into reduced access.

HPSAs are unique for primary care, dentistry, mental health, and maternity care. They offer a way to calculate and score a region to designate it as having a shortage of providers for a group of people in a defined geographic area.[12-14] These models use population-to-provider ratios and incorporate community-level indicators of need, such as poverty rates or infant mortality. No comparable designation framework exists for PT and OT services.[13]

Need for Standardized Method

Existing data sources on rehabilitation workforce availability, such as licensure registries maintained by state health agencies, are typically reported at the larger geographic county level and lack integration with indicators of population health or need.[15-17] These data often include provider demographics but omit characteristics of the corresponding population or geography, making it difficult to assess whether the distribution of providers is equitable or aligned with public health needs. Furthermore, current data systems do not support the small-area geographic analysis necessary for local workforce planning or resource allocation. Census tracts, which are smaller statistical subdivisions averaging 4,000 residents, offer a valuable unit of analysis for this type of inquiry.[18] Census tracts are updated by local governments prior to each decennial census as part of the Census Bureau's Participant Statistical Area Program, but may be delineated by the federal Census Bureau directly in the event that local or state governments decline to participate.[19] By aligning provider data to census tract geographies and linking those data to demographic and socioeconomic indicators, researchers and policymakers can gain a more precise understanding of where rehabilitation services may be lacking—and for whom.

Geospatial Methods in Rehabilitation Research

Geographic Information Systems (GIS) provide a powerful tool to evaluate healthcare access by combining location-based data with population characteristics and social indicators.[20-23] Prior studies have used GIS to assess rehabilitation access in urban and rural contexts, revealing disparities in proximity to care, travel time, and service availability in relation to population health needs.[24-28] However, these studies have typically focused on either small metropolitan areas or broad, aggregated regions and have not offered standardized, reproducible methods for data collection, integration, and analysis at a smaller geographic scale. There is a growing need for research that documents transparent, scalable approaches to workforce mapping in rehabilitation. These methods would enable researchers, public agencies, and advocacy organizations to systematically evaluate workforce equity and support data-driven planning for underserved communities.

Objective of This Study

The objective of this study is to describe the feasibility of a GIS-based methodology to assess the availability of rehabilitation providers at the census tract level. This approach involves integrating licensure data with demographic datasets, geocoding provider locations, and linking them to area-level indicators of population need. By outlining each step, from data acquisition and cleaning to spatial analysis and visualization, this feasibility study is designed to support future research, workforce planning, and equity-focused policy development in rehabilitation.

Methods

Study Design

This is a descriptive, cross-sectional observational study designed to evaluate the availability of rehabilitation providers across census tracts using geographic information systems (GIS). The primary objective is to calculate and compare population-to-provider ratios at the census tract level and examine how these ratios relate to sociodemographic characteristics of each tract. The study methodology integrates publicly available licensure and demographic datasets with spatial mapping techniques to enable small-area workforce analysis.

Determining Setting, Context, and Geographical Unit of Measurement

When conducting Geographic Information Systems (GIS)-based analyses of workforce availability, researchers should consider the geographic and demographic context of the region under study. Factors such as land area, population density, and urban-rural distribution shape both the delivery and interpretation of health services and provider access.

Aggregated geographic units like counties or ZIP codes, while commonly used, can mask meaningful local variation in provider availability and introduce misclassification bias. ZIP codes, for example, often group together heterogeneous populations by combining areas of affluence with areas of poverty, which can distort analyses of access and need.[29] In contrast, census tracts, which typically include populations of 1,200 to 8,000 people and are designed to be socioeconomically homogenous, provide a more precise basis for equitable spatial analysis.[19]

The use of small-area units like census tracts requires detailed data on provider location and population characteristics. The methodology in this study is designed to support census tract-level analysis when such data are available. Ultimately, GIS-based access assessments must balance granularity and feasibility to generate meaningful, context-sensitive insights.

Ethical Approval

This study method utilized secondary, de-identified data from publicly available sources, including licensure databases and census-based demographic datasets. No identifiable private information was disclosed and no direct interaction with human subjects occurred. Prior to implementation, the study was approved by the Institutional Review Board (IRB) at Texas Woman's University as exempt status under 45 CFR §46.104(d) since the research involved publicly available or non-identifiable data. IRB approval was obtained before conducting data analysis. All data was de-identified prior to data cleaning and analysis.

Data Sources

This study integrated information from two primary data sources: (1) state-level licensure data for rehabilitation professionals and (2) population and demographic data from the U.S. Census Bureau's American Community Survey (ACS). For this study, we used Texas as the example state in the analysis.

Licensure Data

Licensure data was obtained from the relevant state licensing agency or board (e.g., Executive Council of Physical Therapy and Occupational Therapy Examiners) through publicly available open records requests in Texas. Licensure data could also be obtained by official mailing list purchases, depending on state-specific procedures. These datasets typically include provider information such as residential mailing address (including street, city, state, and ZIP code), license type, issue and expiration dates, and basic demographic characteristics such as gender and ethnicity, where available. Personally identifiable information (e.g., name, license number) were excluded or removed prior to analysis. Provider addresses were used for spatial analysis, and all data were stored and processed in a deidentified format.

Population Data

Demographic and population data were sourced from the U.S. Census Bureau's 2020 American Community Survey (ACS), a publicly available dataset providing census tract-level estimates for population size and characteristics such as race, ethnicity, age, disability status, insurance coverage, and income. These data were downloaded as geodatabase files for integration with GIS software (e.g., ArcGIS Pro, Esri).

These two data sources were used to calculate population-to-provider ratios and assess workforce availability at the census tract level. Table 1 outlines the data sources and key variables.

Table 1: Data Sources

Data Source	Access Information	Key Variables Extracted	Notes
State Licensure Data	Varies by state; example from Texas: Open Records Request.[30]	Address, license type, issue/expiration dates, gender, ethnicity (if	Deidentified prior to spatial analysis

		available)	
American Community Survey (ACS)	Census Website[31]	Population, race/ethnicity, poverty status, disability, insurance coverage, by census tract	2020 5-year estimates

Data Aggregation and Cleaning

After obtaining licensure and demographic data, a multi-step cleaning and aggregation process was conducted to ensure accurate spatial representation of the rehabilitation workforce.

Licensure Data Cleaning and Inclusion Criteria

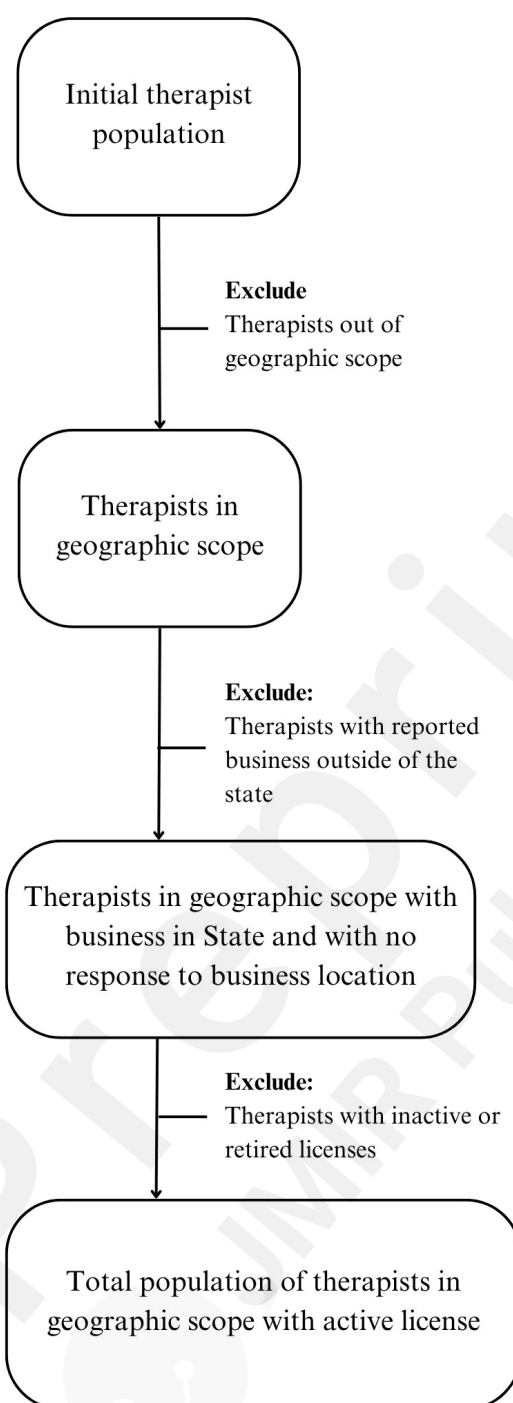
Licensure datasets typically include all actively licensed rehabilitation professionals within a state or jurisdiction, including individuals practicing via interstate licensure compacts and those residing out of state. To ensure an accurate geographic representation of providers residing and working within the region of interest (Texas) the dataset was filtered based on the following criteria:

1. Inclusion of individuals with an in-state residential address.
2. Exclusion of licensees reporting only out-of-state addresses or inactive/retired licensure status.
3. Retention of individuals with in-state residential addresses but missing workplace address data, with acknowledgment of potential uncertainty regarding employment status.
4. Manual review and correction of ambiguous or mislabeled geographic entries, such as addresses geocoded incorrectly or entries containing missing street-level information.

Figure 1 illustrates the selection and cleaning process, including inclusion/exclusion steps for licensure data.

Filtering and cleaning procedures were conducted using R (version 4.3.1 or higher; The R Foundation for Statistical Computing) within RStudio (Posit Software, PBC). Code used for data cleaning is documented is available in the Supplementary Materials.

Figure 1: Licensure cleaning process



Software

All geospatial procedures were conducted using ArcGIS Pro version 3.3 (Esri), a geographic information system platform that allows for spatial data visualization, management, and analysis. Data cleaning and preprocessing was completed in R Studio prior to import into ArcGIS.

Demographic and Census Data Cleaning

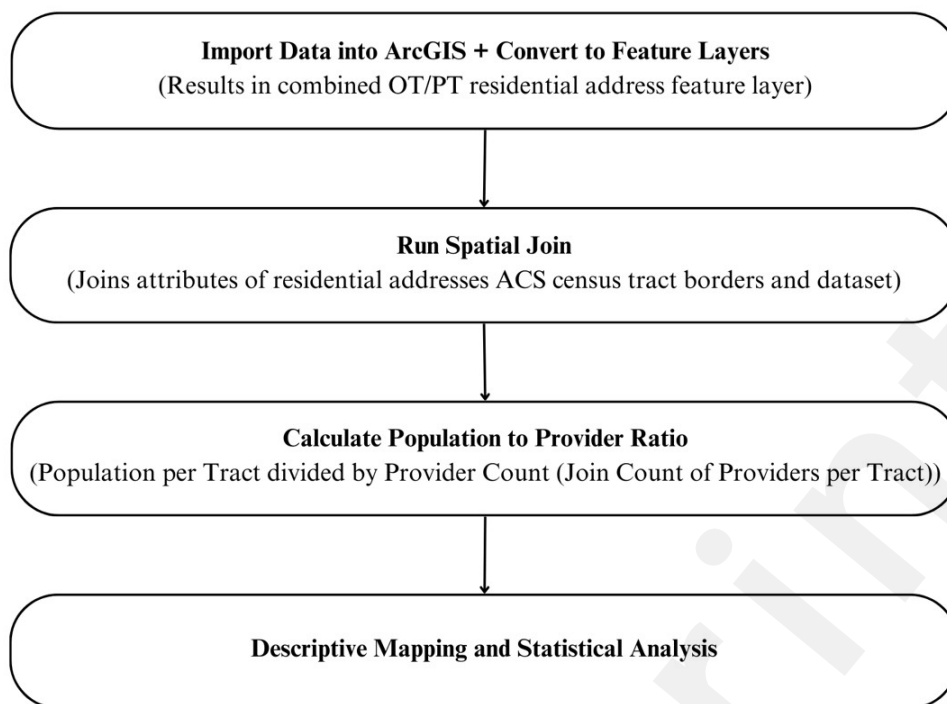
Census tract-level data from the American Community Survey (ACS) were filtered to match the

relevant geographic units used for licensure data aggregation. Relevant demographic variables (e.g., population size, poverty rate, disability prevalence, insurance coverage) were cleaned and formatted to allow for merging with provider datasets using census tract-level geographic identifiers.

Geospatial Analysis Methods

In ArcGIS, for the purpose of visualization and analysis, the first step is to create a feature layer, which is a collection of similar geographic features that are grouped together.[32] Thus, feature layers were created for individual PT and OT datasets. These were combined into one feature layer with both PT and OT data that were utilized for analysis. Next, an ArcGIS geoprocessing tool called a spatial join that joins attributes from one feature to another based on the spatial relationship was added for data management. This spatial join was conducted for the combined PT and OT feature layer to match each provider spatially to the census tract in which their residential address was located. The join count resulting from this spatial join represents the number of providers residing in each of the 6,896 census tracts from the 2020 census. Then, this dataset was merged with 2020 census tracts that included over 70 ACS demographic variables.[33] The process for uploading, preparing and using the data within ArcGIS is described in Figure 2. Full code for geocoding and spatial joins is included in Supplementary Materials.

Figure 2: Process for importing residential data for use in calculating and visualizing the data within ArcGIS.



Calculating Population to Provider Ratio

To calculate the population to provider ratio, a basic calculation of demand over supply was used. The population in the census tract, or the measure of the demand for services (d_i), was divided by the provider join count or the number of PTs and OTs residing in the census tract (p_i).

$$\frac{d_i}{p_i}$$

Additional adjustments were made to mitigate several problems. First, for census tracts where the population is zero, the ratio becomes zero, which suggests there are zero providers for a population. To adjust for this, in the case where the population is zero, the provider count was returned as “null,” so that these regions would not be considered in the calculations. The second problem relates to the provider count being in the denominator of this equation. In the case that the provider count is zero, the resulting calculation would be “null,” which would suggest that any census tract with a population and zero providers would not be calculated. To adjust for this, any census tract with a population greater than zero and a provider count of zero was set to return a value of “1” for provider count. In the case where neither of these situations occurred, the original value for the join count was used. These adjustments were made within ArcGIS using a Python Code Block and are included in the Supplementary Materials.

Next, using the adjusted provider count, the population to provider ratio was calculated by creating a new field and calculating that field by dividing the total population per census tract by the adjusted join count.

Descriptive Mapping

The population to provider ratios across census tracts was investigated using descriptive statistics and choropleth and bivariate maps. A choropleth map is a thematic map in which areas are styled to represent the variation of a single variable. A bivariate map displays two variables using variations in colors or symbols where each variable is assigned a different graded color scheme in a 3x3 table that is included in the top right hand corner of the bivariate maps.[34,35] A graduated color

choropleth map was created to visually analyze the distribution of the population to provider ratio across the state of Texas by quintiles. Then, bivariate choropleth maps were created to visually describe the relationship between population to provider ratio and the percent disability in each census tract as defined by the ACS. Bivariate choropleth maps allow for the visualization of the specific areas that may be most in need of providers based on specific population demographics.

Statistical Analyses

Descriptive statistics were used to describe the variability in population to provider ratio across all census tracts within the state of Texas, and inferential statistics were used to understand if there were significant differences between population demographics in areas with high or low provider availability. To run inferential statistics, first high and low provider availability were operationally defined. The first quintile was operationally termed “High Provider Availability,” and the fifth quintile was operationally termed “Low Provider Availability.” Then, a comparison of the first to the fifth quintiles of population to provider ratio was made. The first quintile represents census tracts where there are between 4 and 457 individuals per provider, and the fifth quintile represents census tracts where there are between 2,940 and 11,147 individuals per provider. This is a relative rather than an absolute comparison as there is currently no set standard for the ideal supply of rehabilitation providers, hence, the method followed in this study is similar to that of Brown et. al. [36] Comparing the highest and lowest quintiles to each other allows for the ability to assess factors that may be related to this large degree of difference in provider availability.

Within ArcGIS,[37] census tracts that fell into the first and fifth quintiles were assigned a label of either “1” or “5” using the calculate field function within the geodatabase attribute table. The code block for this calculation is available in the Supplementary Materials. The attribute table was exported from ArcGIS to the local desktop using the “Table to Excel” function within the Geoprocessing pane. The data was then uploaded into R Studio. Inferential statistics were computed within R Studio to calculate and produce sums, tables, chi-square, and Cramér's V statistics. The code to generate these statistics are included in the Supplementary Materials. A chi-square goodness of fit test is appropriate for comparing demographics between two groups because it assesses whether the observed frequency distribution of categorical variables (e.g., race, ethnicity) in one group matches the expected distribution based on the other group. This test is ideal when the data are nominal or ordinal and helps to determine if any differences in demographic composition between the groups are statistically significant or due to random chance.[38,39] A priori power analysis for chi-square goodness-of-fit was conducted prior to analysis.

Measures of Feasibility

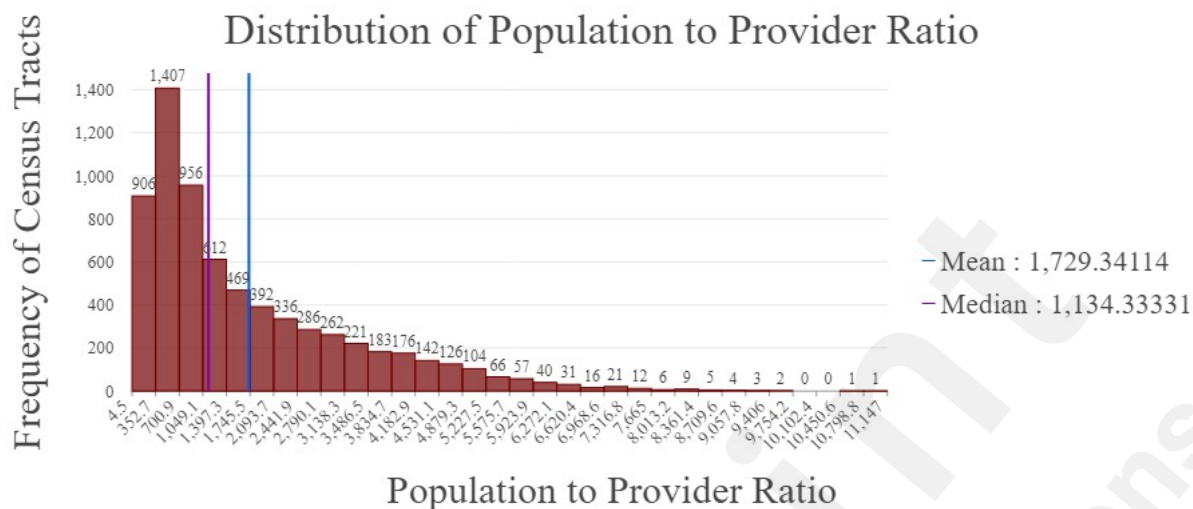
The following measures of feasibility were assessed throughout the study: ability to obtain licensure data and the percent of providers included after cleaning, the time and resources needed to clean and geocode the data, the percent of provider addresses that were successfully geocoded, the ability to merge licensure data with ACS data, the percent of census tracts that were matched, the feasibility of the geospatial analysis methods, and the relevance of the results to workforce planning and replication.

Results

The population to provider ratio per census varied significantly across the state of Texas with the mean value of 1,729 individuals per one provider and a range of 4 individuals per provider to 11,147 individuals per provider. The census tract with the smallest population count to providers was census tract 313102, which is in the Texas Medical Center Area of Houston. This census tract had 4 individuals per one provider. In contrast, the census tracts with the largest population count to providers were census tracts 002100 and 012000. These census tracts are in Lubbock and just east of

Dallas, respectively and had between 11,147 and 10,510 individuals per one provider, respectively. The distribution of population to provider ratios across the state of Texas is depicted in Figure 3.

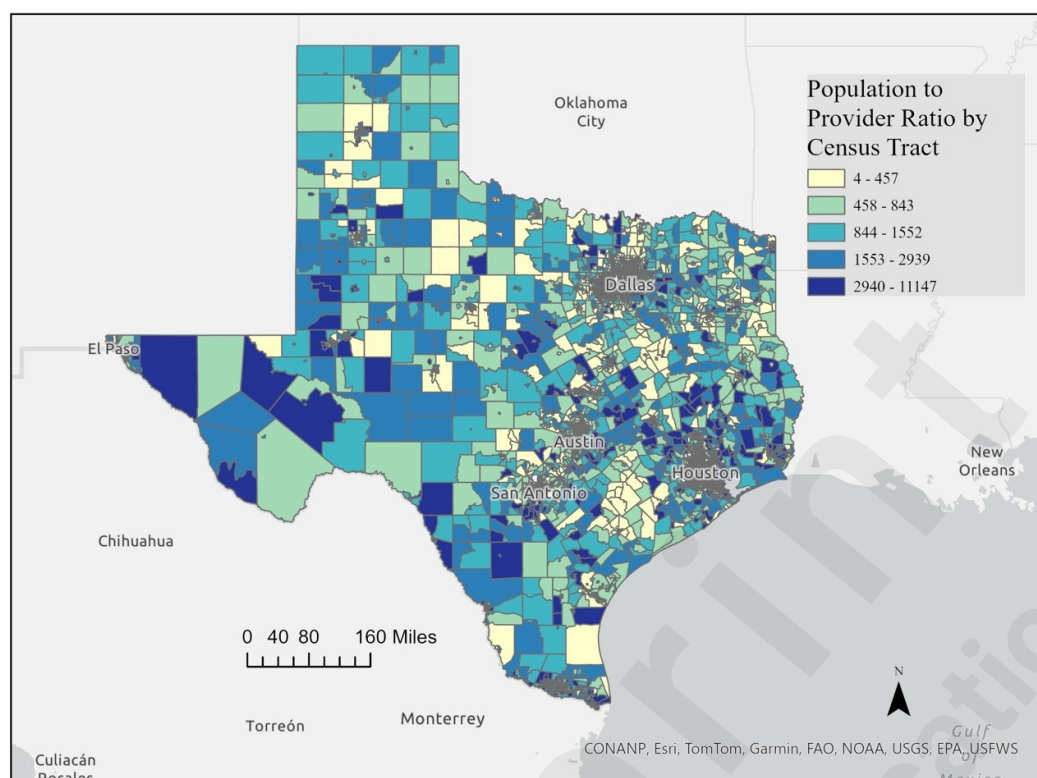
Figure 3: Distribution of Population to Provider Ratio



Graduated color choropleth maps (quintiles)

Graduated color choropleth maps demonstrate the distribution of the population to provider ratios across all census tracts in the state of Texas. Graduated colors within these maps are representative of the five quintiles of availability of providers with yellow representing the highest availability of providers (the lowest population count per provider) and dark blue representing the lowest availability of providers (the highest population count per provider). Figure 4 shows the distribution of population to provider ratios in the state of Texas. Dark blue shaded census tracts are seen on the map throughout the state but are more obvious in certain regions.

Figure 4: Texas Census Tracts by Quintile of Ratio of Population to Rehabilitation Provider

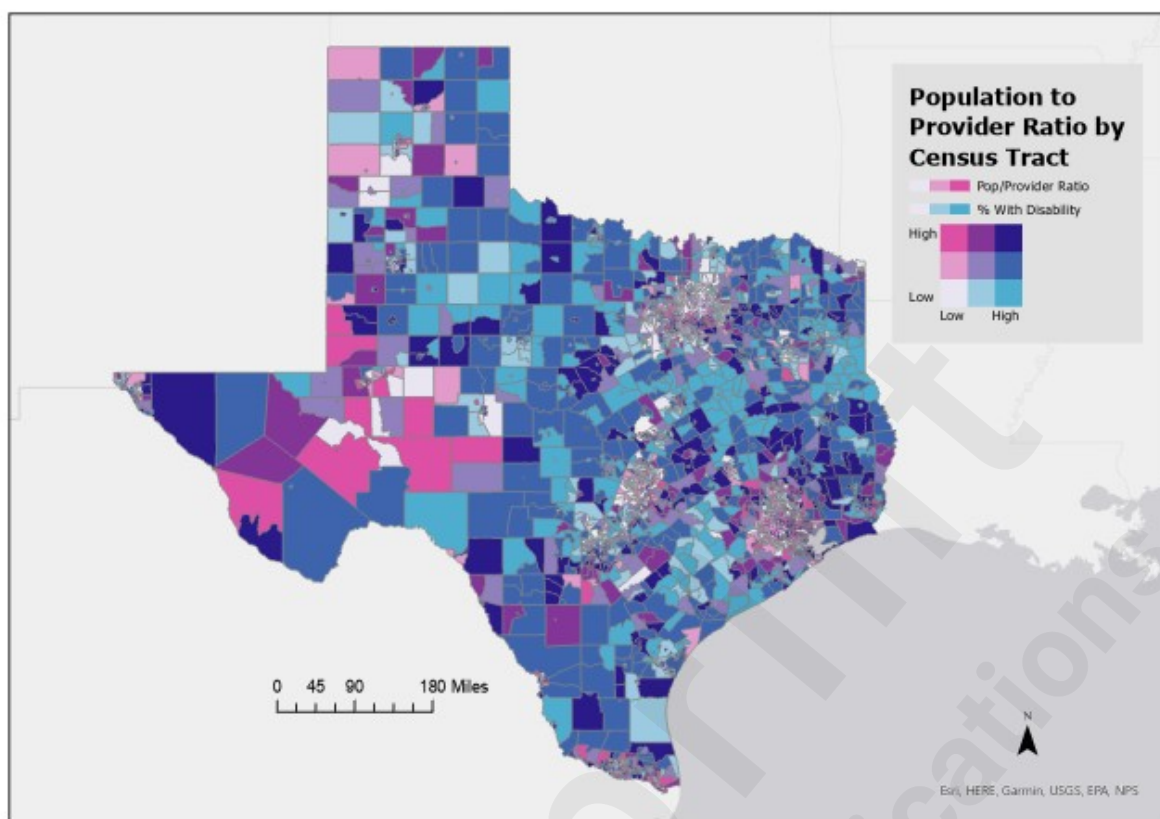


Bivariate Choropleth Maps

Bivariate choropleth maps demonstrate the variability of population to provider ratio overlaid with the percent disability, percent minority, and percent of the population below the poverty level within each census tract, and these overlays and color variations are illustrated using a 3 x 3 table within the figure. Bivariate choropleth maps allow for the visualization of the specific areas that may be most in need of providers based on specific population demographics. A census tract with a high population to provider ratio and high prevalence of either disability, minority, or population in poverty is denoted using the darkest color tone. These darker color areas represent census tracts where high need and low provider count per population coexist.

The American Community Survey (ACS) has six survey questions related to disability including: hearing disability, vision disability, cognitive difficulty, ambulatory difficulty, self-care disability, and independent living difficulty.[40] If respondents answer yes to any of these questions, they are considered to have a disability. As shown in Figure 5, the bivariate choropleth map combining prevalence of disability and the population-to-provider ratio highlights census tracts where low provider availability aligns with a relatively high prevalence of disability, identifying areas of potential service gaps and heightened need.

Figure 5: Bivariate choropleth map by quintile of the ratio of population to rehabilitation provider to percentage of disability within each census tract in Texas



Feasibility

Feasibility was assessed throughout each phase of the methods including data acquisition, data processing, descriptive mapping, and statistical analysis. Table 2 illustrates the measures of feasibility assessed in this study.

Table 2: Feasibility Results

Domain	Indicator	Results
Data Acquisition	Ability to obtain licensure data; % of licensed providers included after cleaning	Licensure data was purchased and accessible in 2022; 28,613 PTs (88% of initial entries) and 16,501 OTs (87% of initial entries) were retained after cleaning.

Data Processing	Time and resources needed to clean and geocode data	Data cleaning required manual review of address inconsistencies and development of flowcharts/ R code. Processing took ~4 weeks of graduate assistant time with regular oversight by investigators.
Geocoding Success	% of provider addresses successfully geocoded	Nearly all addresses were successfully geocoded; only 9 PT and 5 OT addresses (<0.05% of total entries) were excluded because they could not be verified.
Data Integration	Ability to merge licensure data with ACS data; % of tracts matched	Provider data (28,613 PTs and 16,501 OTs) were successfully matched to 6,896 Texas census tracts and merged with 70+ ACS variables with no unmatched tracts.
Analysis Feasibility	Ability to generate population-to-provider ratios, maps, and bivariate overlays	Ratios were calculated across all tracts; maps and overlays were successfully created using ArcGIS. Analyses were replicable using shared R code and ArcGIS workflows.
Acceptability/Utility	Relevance for workforce planning; potential for replication	Methods allowed visualization of geographic disparities in provider availability. The workflows (R scripts, flow diagrams, verification steps) are reproducible and adaptable to other states and health professions, though feasibility will depend on state-specific licensure access rules.

Discussion

Rationale for Method Selection

Geographic Information Systems (GIS) provide a robust platform for understanding disparities in

health workforce distribution by integrating provider data with demographic characteristics across small geographic units such as census tracts. Unlike traditional approaches that rely on zip codes or counties, which often obscure within-area variation, GIS enables high-resolution visualization and spatial analysis. This is especially valuable when seeking health equity and informed workforce planning.

GIS also facilitates advanced mapping techniques, including bivariate mapping, which allows for the simultaneous visualization of two variables, such as provider availability and population-level indicators of need. This methodological advancement provides a deeper understanding of where disparities exist and which populations are most affected.

This was the first study to investigate the distribution of population to provider ratios for OT and PT providers within a large and diverse state (Texas) using GIS technology. The results contribute to understanding the variability in population to rehabilitation provider ratio, distribution of providers by census tract, and the ratio of population to rehabilitation provider to percentage of disability within each census tract in Texas. The results illustrate the feasibility of using a GIS-Based protocol for workforce planning.

The protocol described in this paper offers several methodological strengths that enhance its rigor, adaptability, and relevance to workforce planning. First, the approach is highly replicable; the step-by-step procedures, along with the inclusion of code in the supplementary materials, are intentional so that the methods can be applied in a variety of geographic contexts or across different health professions. This transparency supports reproducibility and scalability in future research. Second, the novel method emphasizes high geographic resolution by conducting analyses at the census tract level. This finer scale allows for a more precise identification of geographic disparities than approaches that rely on broader units such as counties or zip codes,[19,29] offering a more detailed understanding of provider availability. Finally, the methods of this study are grounded in interdisciplinary collaboration, drawing on expertise from geospatial science, health services research, and clinical rehabilitation. This cross-sector engagement strengthens the methodological approach and ensures that it is both technically sound and grounded in the practical realities of healthcare delivery and workforce needs.

Limitations

This study design includes several limitations. First, it focuses exclusively on availability, one domain within the Penchansky and Thomas Theory of Access, and does not account for realized access (the actual entry of a patient into the healthcare system)[41] or outcomes. The use of residential address as a proxy for provider practice location introduces potential misclassification, and the population-to-provider ratio does not capture factors like transportation infrastructure, health insurance coverage, or service capacity.

Additionally, the observational nature of the analysis precludes causal inferences about relationships between availability and health disparities. This study also prioritizes comparison of high and low availability areas using quintiles, which may not account for regional variations in land mass, population density, or local health systems.

Finally, publicly available licensure and census data are subject to reporting errors and definitional inconsistencies. These data limitations should be acknowledged in future research and addressed, where possible, by improved workforce data infrastructure.

Future Applications

The methods used in this study are adaptable and scalable for use in other professions (e.g., speech-language pathology, behavioral health) and other geographic regions. Future studies could integrate clinic location data, travel-time analyses, or patient-level outcomes to provide a more complete understanding of access to care. The integration of GIS into national workforce planning tools could support more equitable distribution of health services.

This methodology may also be used to advocate for inclusion of rehabilitation providers in federal incentive programs such as the National Health Service Corps. Additionally, future work can explore spatial equity in relation to workforce diversity, assessing whether providers from minoritized backgrounds are equitably distributed in communities most in need. Recent workforce projections have highlighted the lack of precise practice location and individual-level demographic data as a limitation in modeling physical therapist supply and distribution.[42] The ability to obtain licensure data and process and clean the data along with the successful linkage across datasets support the feasibility of applying this GIS-based approach for workforce planning in rehabilitation.

Conclusion

This study outlines a novel and replicable GIS-based approach for assessing rehabilitation provider availability through integration of licensure and demographic data that is feasible to use in a diverse and large state, Texas. By enabling high-resolution spatial analysis, the methodology supports more equitable workforce planning and provides a platform for examining geographic disparities in provider availability. The approach is designed to inform future research, policy development, and advocacy efforts aimed at advancing health equity in rehabilitation access across diverse populations and regions.

Acknowledgements

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Conflicts of Interest

Not Applicable

Funding Statement

This project was supported by the CoHSTAR Pilot Study Grant. Funding was allocated for data acquisition, software licensing, and research assistant time. Additional resources may be required for broader implementation or extension of the methodology across other provider types or states. No commercial or private interests are involved in the design or intended dissemination of this study.

Data Availability

The data that support the findings of this study are available from publicly available datasets included in this study and through the Executive Council of Physical Therapy and Occupational

Therapy Examiners. Restrictions apply to the availability of the data from the Executive Council of Physical Therapy and Occupational Therapy Examiners, which were used under license for the current study, and so are not publicly available. Data may be available from the authors upon reasonable request and with permission of the Executive Council of Physical Therapy and Occupational Therapy Examiners.

Abbreviations

GIS: Geographic Information Systems

PT: Physical Therapy

OT: Occupational Therapy

HPSA: Health Professional Shortage Areas

MUAs: Medically Underserved Areas

MUPs: Medically Underserved Populations

IRB: Institutional Review Board

ACS: American Community Survey

Mutimedia Appendices

Appendix 1: R code for cleaning PT licensure data

Appendix 2: R code for cleaning OT licensure data

Appendix 3: Python code for block for ArcGIS reclassifications

Appendix 4: R code for descriptive statistics

Appendix 5: Data dictionaries

Appendix 6: Supplementary materials index

References

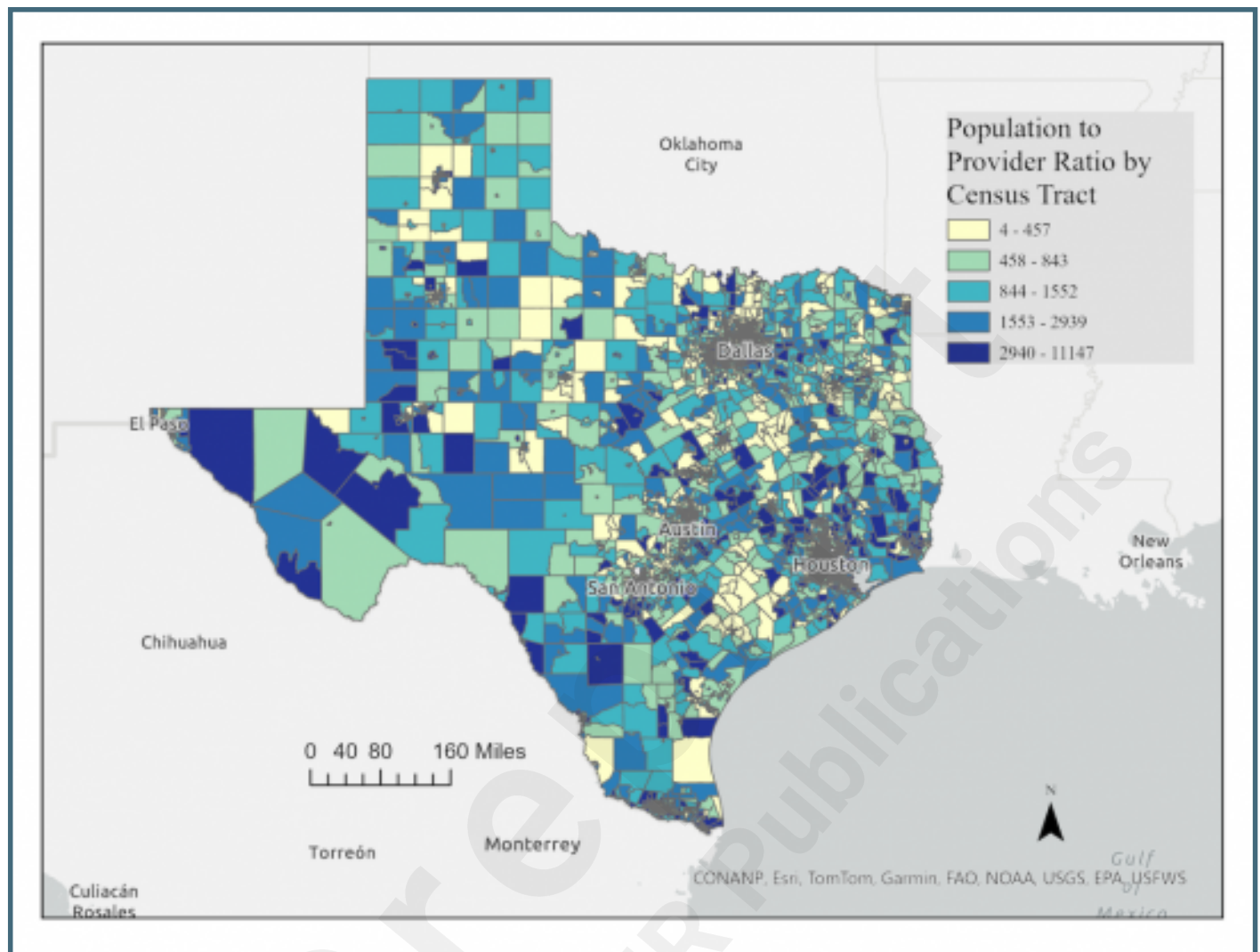
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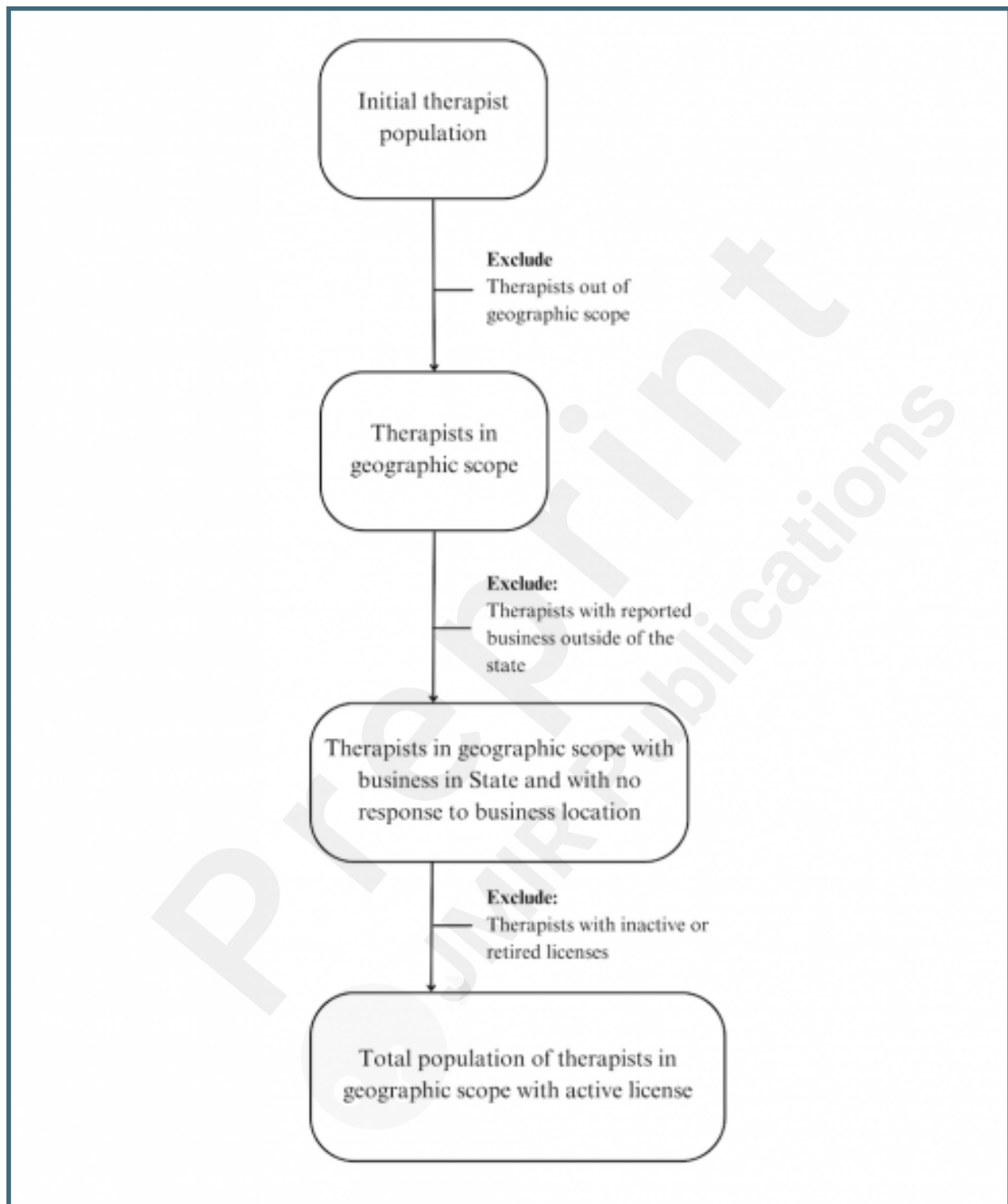
Supplementary Files

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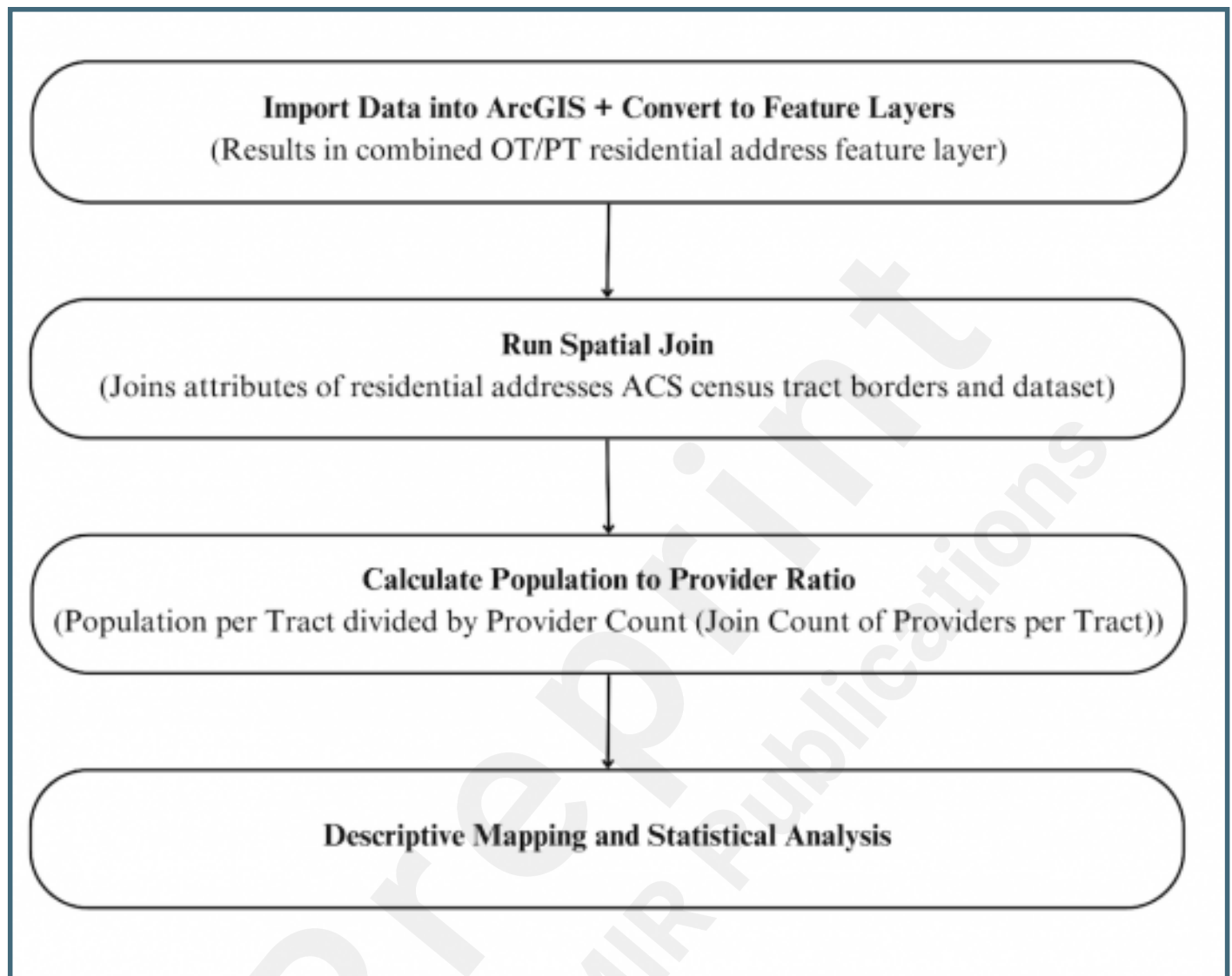


Figures

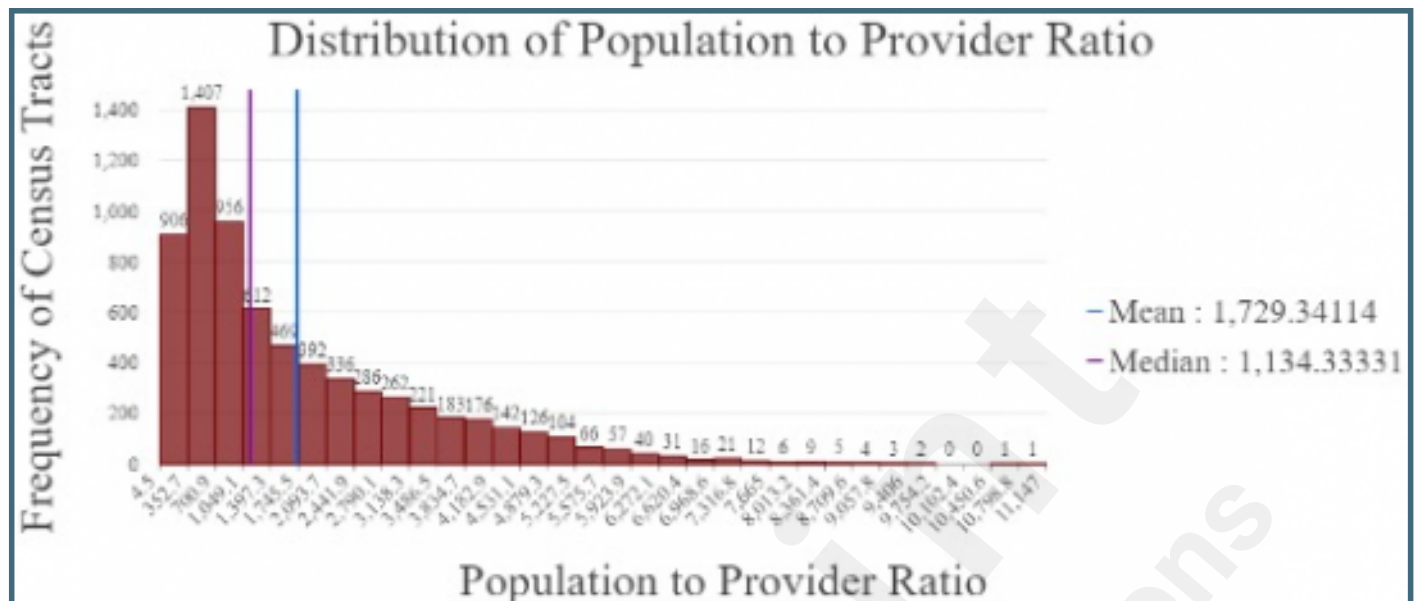
Licensure cleaning process.



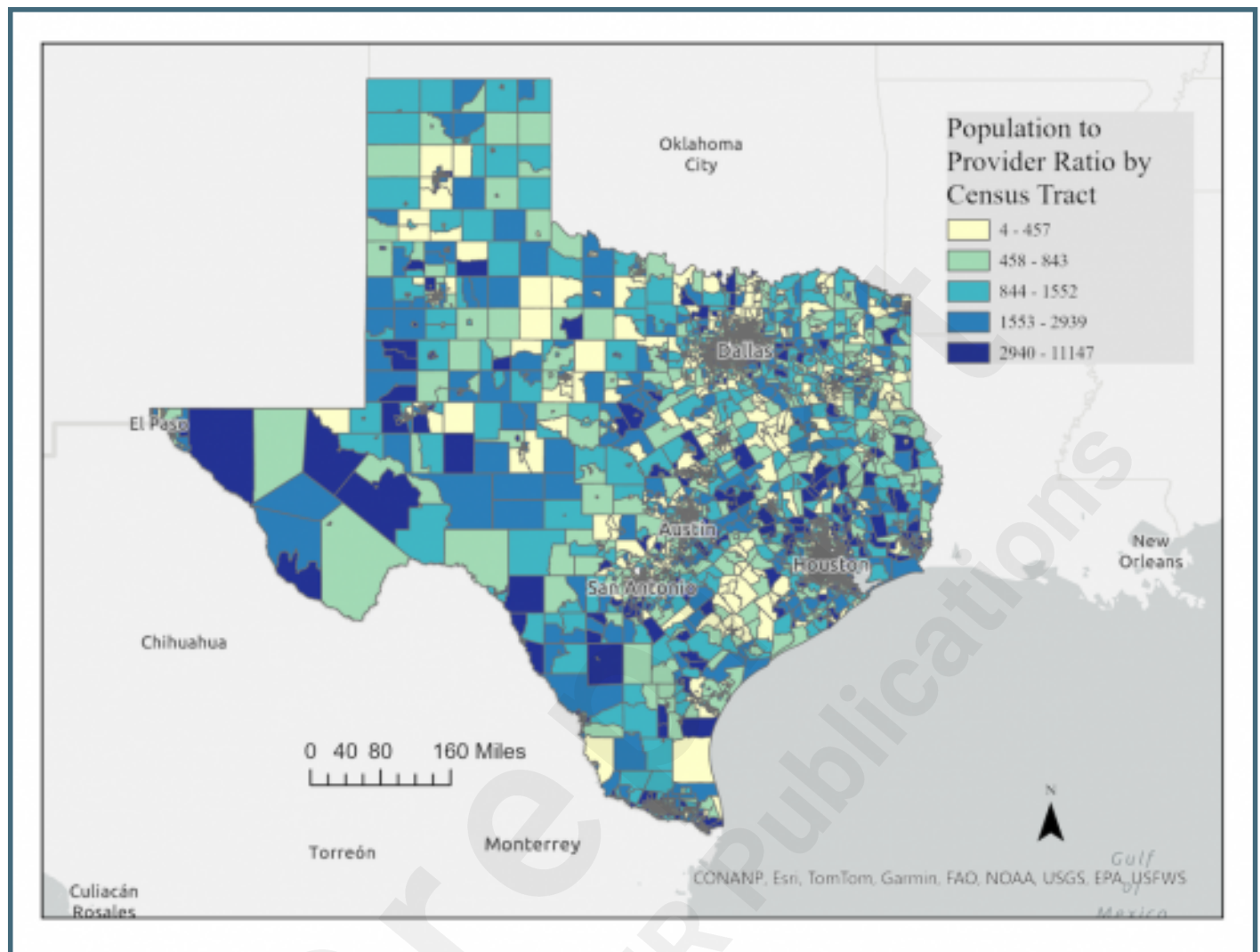
Process for importing residential data for use in calculating and visualizing the data within ArcGIS.



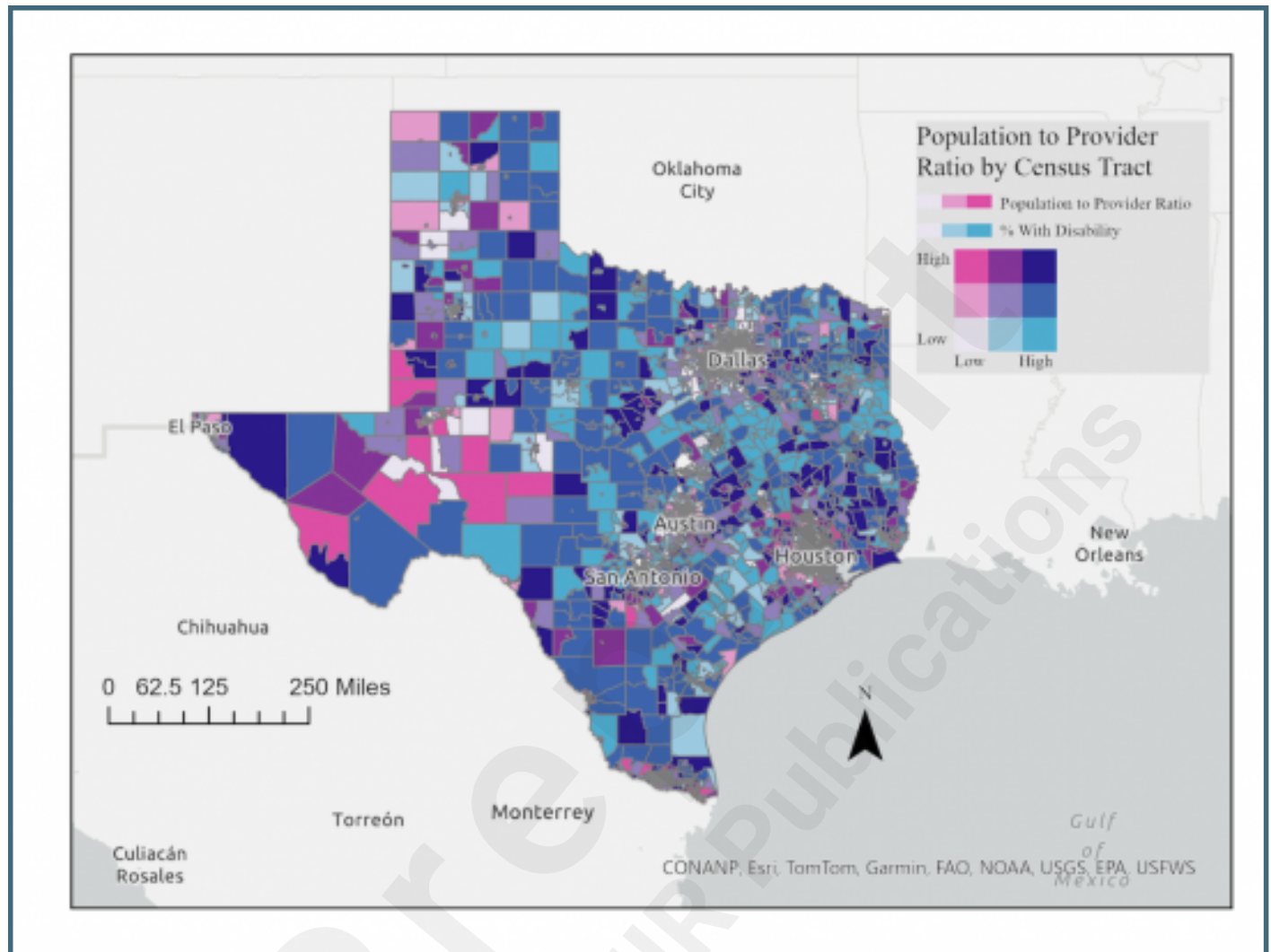
Distribution of Population to Provider Ratio.



Texas Census Tracts by Quintile of Ratio of Population to Rehabilitation Provider.



Bivariate choropleth map by quintile of the ratio of population to rehabilitation provider to percentage of disability within each census tract in Texas.



Multimedia Appendixes

R code for cleaning Texas PT licensure data, creating subsets for spatial and statistical analysis.

URL: <http://asset.jmir.pub/assets/ed19f6108d3bc61aeb6f62ec88341db5.pdf>

R code for cleaning Texas OT licensure data, creating subsets for spatial and statistical analysis.

URL: <http://asset.jmir.pub/assets/45d28b2f06d19039f53a3ea5939346e8.pdf>

Python code block for ArcGIS Pro to reclassify join counts to avoid divide-by-zero errors in provider ratios.

URL: <http://asset.jmir.pub/assets/72824bbb4f1dfb51f65db8dd4743fd77.pdf>

R code for calculating descriptive statistics and chi-square analyses on population-to-provider ratios.

URL: <http://asset.jmir.pub/assets/9c0c8bb3163550ff62f25e8dba94433c.pdf>

Data dictionaries for all datasets used in the study, defining variables and example values.

URL: <http://asset.jmir.pub/assets/4335c1805f9f092e288673769277622c.xlsx>

IRB approval letter from Texas Woman's University for this research protocol.

URL: <http://asset.jmir.pub/assets/c88a1d476c7f2d4c6847f548189052ff.pdf>