

The Use of Geographic Information Systems (GIS) to Inform Behavioral Health Care

Two Case Studies

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For the

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Contents

- The Use of Geographic Information Systems (GIS) to Inform Behavioral Health Care 4
 - Introduction 5
 - Initial Survey of States 5
 - Case Studies 6
- Oklahoma 7
 - Introduction 8
 - GIS Projects and Products 8
 - Maps of Behavioral Health Services by State Legislative District 8
 - Map of Clients Affected by Tornado 9
 - Maps of Community Mental Health Center (CMHC) Boundaries 10
 - Other Maps and GIS Products 12
 - Collaboration with Other State Agencies and External Partners 13
 - Software and Tools Used 13
 - Initial and Ongoing Funding for GIS Initiatives 13
 - Challenges Faced 13
- Washington 15
 - Introduction 16
 - GIS Projects and Products 16
 - Community Outcomes and Risk Evaluation (CORE) Information System 16
 - Client Proximity to Services 18
 - Other GIS Initiatives 19
 - Collaboration with Other State Agencies and External Partners 20
 - Software and Tools Used 20
 - Initial and Ongoing Funding for GIS Initiatives 20
 - Challenges Faced 20

The Use of Geographic Information Systems (GIS) to Inform Behavioral Health Care

Introduction

Data are not just in databases. Most data can be linked to a location in your community and state. Accessing this spatial aspect of data can provide novel insight into your system and how well it is serving clients.

For example: Can your clients access services? What parts of the state are “service deserts” and do not have access to important behavioral health services? If you are opening a new program, how do you know where to locate it so that it will serve the greatest number of people? Your clients and providers are all located in specific places and how the

Geographic information systems (GIS) link data to location through the creation of spatial databases. In the context of behavioral healthcare, spatial databases may include any client, provider, or community data as long as there is way to associate a location with the data. Common ways to associate locations with data include addresses, ZIP code areas, administrative boundaries (such as neighborhoods, city limits, school districts, counties, etc.), as well as, of course, latitude and longitude.

Most commonly, GIS practitioners use these spatial databases to create maps of the topic in question. However, these spatial databases can also be used to calculate distances between clients and services (as Washington has done) and hotspots (like Oklahoma’s opioid hotspot map profiled later in this document).

Initial Survey of States

In early 2019, NRI asked State Mental Health Planners whether their state uses GIS to inform behavioral health care. Twenty five states and territories responded, of which 12 indicated that they did use GIS to inform care.

The most common uses of GIS that states mentioned included:

- Mapping service need and potential gaps in availability
- Mapping service utilization
- Mapping hotspots of opioid use
- Drive-time analyses to measure service accessibility
- Mapping the reach of telepsychiatry

Of this sampling of state uses, only the first two were mentioned by multiple states. Beyond that core, uses of GIS were varied and did not overlap across states.

Although this survey included responses from less than half of states and territories, it still indicated that many states and territories are using GIS, although maybe more than half are not. Thus many states have yet to benefit from the use of GIS. As indicated by the wide variety of possible uses for GIS across the 12 states that responded, states currently using GIS to inform behavioral healthcare may still find new use cases for GIS.

Case Studies

In summer 2019, NRI performed semi-structured interviews of contacts from the behavioral health agencies in Oklahoma and Washington about how they use GIS to inform planning and decision making. These interviews lasted one hour and included questions about:

- The reasons why the state began to use GIS
- Who in the state uses GIS
- What GIS technologies the state uses
- Examples of GIS products produced by the state that have had an impact
- Who the users of the states GIS products are and how the state distributes or promotes the products to them
- How the state has collaborated with other state agencies and external partners
- How the state funds its GIS initiatives
- Challenges faced by the state in the implementation of their GIS initiatives

The following two case studies are the result of those interviews.

Oklahoma

Introduction

This case study of the use of geographic information systems (GIS) by Oklahoma's State Behavioral Health Agency (SBHA) is based on an interview with Ray Bottger, Ph.D., Senior Data Analyst at the Oklahoma Department of Mental Health and Substance Abuse Services (ODMHSAS). This interview lasted 90 minutes and queried Dr. Bottger about specific uses of GIS within Oklahoma as well as overall funding sources for GIS initiatives, technology used, and partnerships across state government related to GIS initiatives in the SMHA.

ODMHSAS has graciously allowed us to include examples of several of their maps. They have reviewed the maps to ensure that they do not contain sensitive information. All maps in this document belong to ODMHSAS.

GIS Projects and Products

ODMHSAS's use of GIS began in 2003 as part of a state grant-funded initiative to unify data systems between the SBHA and the Medicaid agency. ODMHSAS sought the advice of the state GIS council, which recommended getting ESRI ArcGIS. The director of the research division at ODMHSAS was interested in developing an agency ability to produce GIS products and helped push through the initiative.

Dr. Bottger is the primary user of GIS within ODMHSAS. Two epidemiologists in the prevention division also use GIS.

Maps of Behavioral Health Services by State Legislative District

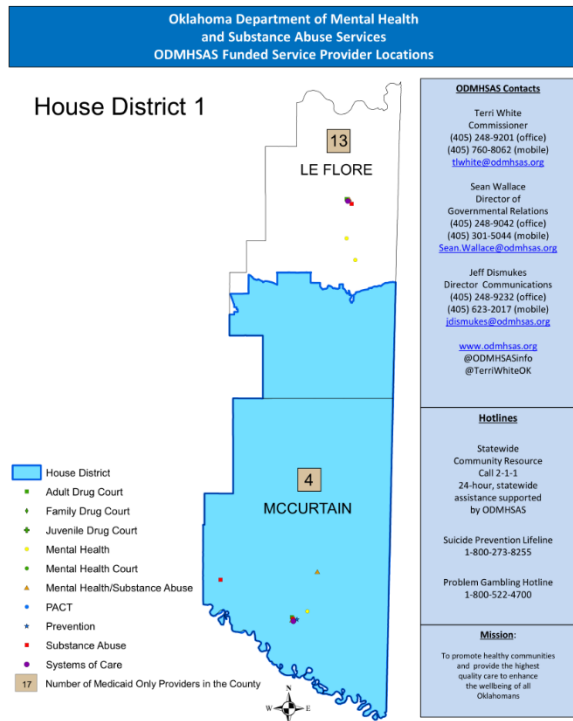
One of the earliest uses of GIS, since 2005, was the creation of a set of maps that showed all behavioral health providers and services in each state house and senate district. At the district level, it included contact information for each behavioral health agency as well as some basic facts about the number of people served in each district. (See Figure 1)

The creation of provider maps by state legislative district began as an educational tool to aid newly elected state legislators to understand better the extent and variety of behavioral health services within their districts. Over time, the maps have become the go-to directory of behavioral health services for each legislator.

ODMHSAS originally intended to update these maps every two years, after a new legislature was elected. However, due to the utility of this product, ODMHSAS has begun to update these maps every year. Legislators use the map to understand the number of people served by ODMHSAS in their districts. ODMHSAS also believes legislators use the maps to look up what services to direct constituents that call asking for help.

Using the data in these maps, ODMHSAS can also project how many people in each legislative district will lose access to services if the ODMHSAS budget is cut by a given amount.

Figure 1



Oklahoma Department of Mental Health and Substance Abuse Services
Service Provider Locations for House District 1

Representative Johnny Tadlock

Service Type/Service Provider	Address	City	Telephone
Adult Drug Court			
✓ McCurtain Adult Drug Court	14 NE Meritt Luther King Ave	Idabel	(580) 285-5777
✓ LeFlore/Leflore/Haskell Adult Drug Court	110 Front Street	Poteau	(918) 647-4535
Mental Health			
✓ Meadow Brook Residential Care Facility LLC	21222 Meadow Lane	Hoopa	(518) 625-2509
✓ Carl Albert CMHC	2000 E Linton Rd	Idabel	(580) 285-9639
Mental Health/Substance Abuse			
✓ Carl Albert CMHC	511 E 2nd St	Heavener	(918) 653-7718
✓ SequoiaCare of Oklahoma	411 S Central Ave	Idabel	(580) 285-5045
✓ SequoiaCare of Oklahoma	401 N Church St Suite F	Poteau	(918) 645-1482
✓ SequoiaCare of Oklahoma	100 N Broadway St	Broken Bow	(580) 584-3079
Prevention			
✓ Forest Grove Public Schools	1941 Forest Grove Rd	Garvin	(580) 786-5681
Substance Abuse			
✓ Farmers Council On Alcoholism	104 NE Ave A	Idabel	(580) 285-2207
✓ Valiant House LLC	300 N Dairor St	Willard	(580) 853-7031
The Oaks Rehabilitative Services Center	204 W Wall St Suite A	Poteau	(918) 647-2155
Systems of Care			
✓ McCurtain County Systems of Care	411 S Central Ave	Idabel	(580) 285-3530
✓ LeFlore County Systems of Care	401 S Church St	Poteau	(580) 285-2830
# of people served in FY18 from District: 2,608			
<small>✓ Indicates service provider located in ZIP code of district</small>			

Oklahoma Department of Mental Health and Substance Abuse Services

Recovery is Reality in Oklahoma

These maps are disseminated by ODMHSAS’s legislative liaison who delivers the maps to the legislative offices.

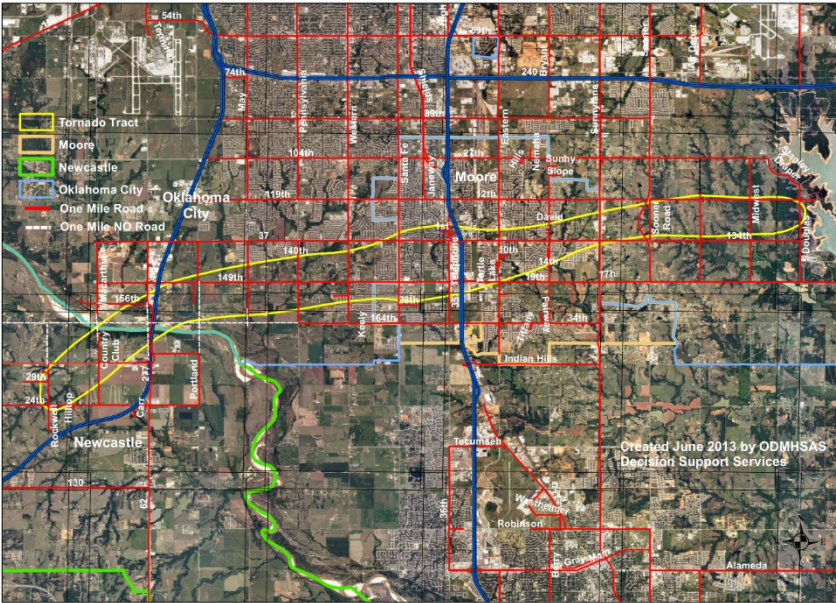
Map of Clients Affected by Tornado

The state has also used its GIS abilities to produce tools for agency staff after a natural disaster. On May 20, 2013, a powerful tornado struck the city of Moore in Central Oklahoma. ODMHSAS needed to be able to determine which of their consumers had been directly affected by the tornado. A map was produced showing a radar image of the tornado track, provided free-of-charge by a local company. Another company provided aerial photographs of the area. ODMHSAS then extracted clients from their database whose ZIP code was overlapped by the tornado track. After geocoding these clients they chose those clients whose residence was in the tornado track or who lived within one quarter mile of the track.

“ODMHSAS produced a large wall map of the entire affected area as well as smaller maps given to field staff to perform wellness checks on the affected clients along with other individuals that were affected by the tornado.”

Figure 2

May 2013 Moore Tornado With Mile Roads and Photos

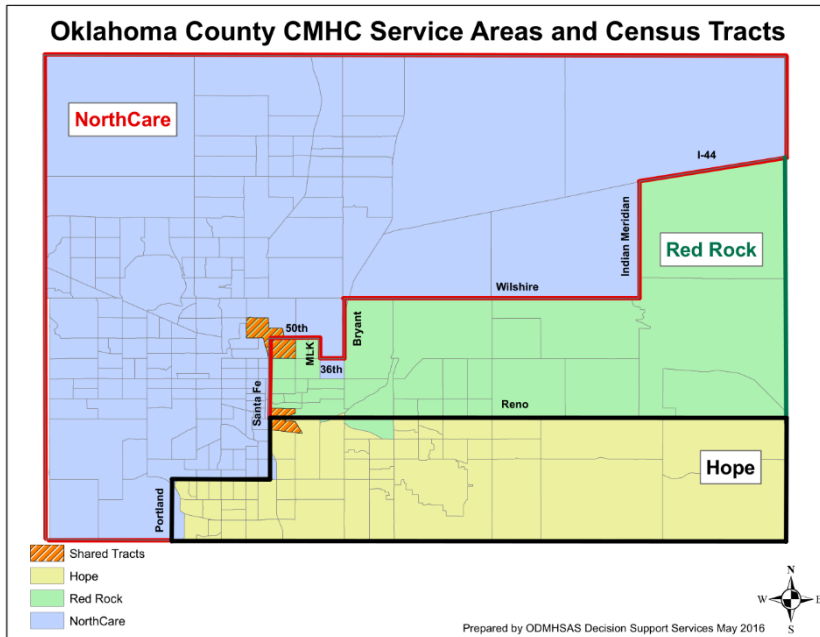


One version of the map (see Figure 2) shows the areas affected by the tornado, this map could be shared. Another version of the map included ODMHSAS client residences and was just used internally. Small maps with client locations were disseminated to agency field staff. Additionally, a version of the map just showing the path of the tornado was more broadly disseminated within ODMHSAS.

Maps of Community Mental Health Center (CMHC) Boundaries

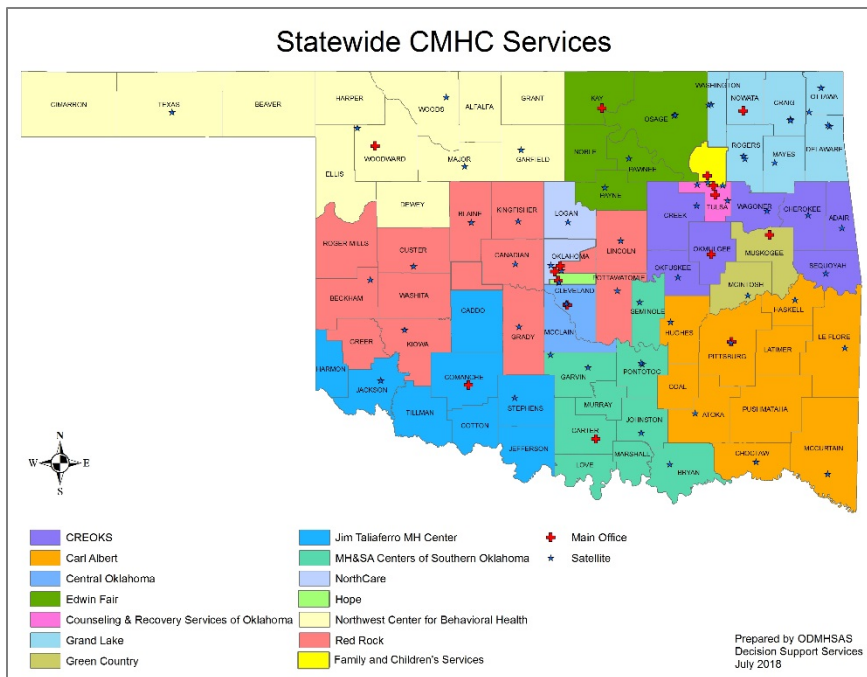
ODMHSAS has also produced maps of the CMHC boundaries within Oklahoma and Tulsa counties (locations of Oklahoma City and Tulsa, respectively). These are by far the most populous counties in the state. These maps serve to help local providers and policymakers understand in which CMHC a given community or neighborhood is located. ODMHSAS produced these maps after a request from program staff in the two counties. Figure 3 shows the map for Oklahoma County.

Figure 3



In addition ODMHSAS has produced a statewide map of CMHC boundaries, which includes the locations of main and satellite offices for each CMHC. (Figure 4)

Figure 4

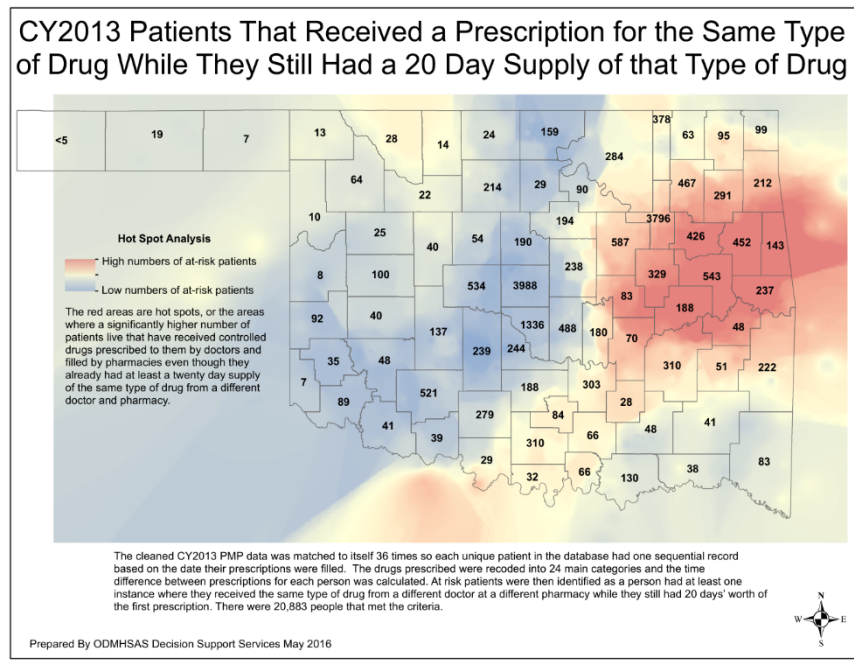


Other Maps and GIS Products

ODMHSAS produced map of all driving under the influence (DUI) schools in the state with a 35-mile buffer drawn around them. Internal staff requested this map because of a state law that requires all parts of the state to have access to a DUI school, defined as being within 35 miles of a residence. This map showed that in parts of western Oklahoma, in particular the Panhandle, some areas did not meet the mandated distance criterion. Due to this map, the state negotiated with DUI schools in Texas and Kansas that were located within 35 miles of the areas in question.

While many maps begin as requests from agency staff, ODMHSAS created a state hotspot map of opioid prescriptions being filled when exploratory data analysis of the state prescription database revealed that overuse of opioids was concentrated in specific parts of the state. The map looked at prescriptions received by patients who already had at least a twenty day supply of opioids. These patients were determined to be at-risk of an opioid abuse disorder. ODMHSAS produced the map at three levels: one displaying at-risk patients, one displaying doctors writing these prescriptions, and one displaying these prescriptions filled by pharmacies. This map has been used internally to determine where best to perform interventions. ODMHSAS has also presented it at conferences as well as to the Oklahoma Board of Medical Licensure and Supervision. (See Figure 5)

Figure 5



ODMHSAS has made maps of tobacco retailers by Census tract since 2007. These maps were made to aid in the completion of the coverage study of tobacco retailers that the Substance Abuse Block Grant (SABG) requires be performed every 3-5 years. The maps draw their data from an ESRI ArcPad form that ODMHSAS field technicians fill out on a hand held GPS unit in a given retail location when they ask to see the license. This form allows the field technician to geocode the location, as well as include pictures

of the location. These locations are then mapped. Several unlicensed tobacco retailers have been discovered during the coverage studies.

ODMHSAS has also made maps showing where alcohol can be purchased before and after a change in state law. This drew upon data from the state tax commission. One version of the map was put on ArcGIS Online and therefore is now publicly available. The online map also included a map layer on automobile accidents on state roads prepared by the Oklahoma Highway Safety Office.

Collaboration with Other State Agencies and External Partners

The original impetus to use GIS was part of the larger system change involving the combination of the SBHA with the state Medicaid agency. As part of that effort, ODMHSAS sought advice from other state agencies, which, among other things, advised ODMHSAS to talk with the state GIS council, an inter-agency advisory council. The State Department of Conservation maintains this council, which provides technical assistance to all state agencies working on GIS initiatives.

The University of Oklahoma has also been a source of support. During the summer, state employees had the opportunity to take certain short courses at the university for free. Two employees from ODMHSAS have taken GIS courses from the university.

Software and Tools Used

ODMHSAS uses ESRI ArcGIS for all their GIS initiatives. They use ArcGIS to geocode addresses, combine collected geographic data with externally provided shapefiles (such as the tornado track provided by the company Weather Decision Technologies or the US Census Bureau) as well as to overlay shapefiles on top of aerial photographs.

ODMHSAS also has a license for ESRI's Spatial Analyst, which allows them to calculate geographic buffers and other complex distance calculations. However, as this software is expensive, they only have one license, which means it must be switched between users as needed, slightly lessening its utility.

Finally, ODMHSAS has Tableau, which can be used for map-making and distribution.

Initial and Ongoing Funding for GIS Initiatives

Initial funding to purchase one license of ESRI ArcGIS was from a larger state grant whose goal was to combine the data systems of the SBHA and the state Medicaid agency. A second license was purchased later for the department epidemiologists. Ongoing costs are around \$6,000 per year and are covered by ODMHSAS.

Challenges Faced

ODMHSAS faces three primary types of challenge when performing their GIS activities. The first relates to the data available to GIS initiatives, the second relates to the difficulty of retaining staff capable of using ArcGIS, and the third challenge relates to the software itself.

Often, ODMHSAS produces a map or GIS product upon request. The data which would be necessary to make the map may not be collected or is not available for ODMHSAS to use. One example of this was a

request for a map that would include arrest data. In Oklahoma, this data is often held locally and can only be acquired by working out a data sharing agreement with every locality or by purchasing the data from each locality. Thus, the GIS products that ODMHSAS is able to produce are limited by data availability, although the requestor may provide the data for the map. In addition, some of the addresses which are used in communities and by ODMHSAS in other contexts are not able to be geocoded in ArcGIS as they are non-traditional addresses.

ODMHSAS is currently working to educate agency staff about its GIS capabilities as, due to turnover, some staff may be unaware. In addition, they plan on working to improve the knowledge of agency staff who wish to request GIS products better to understand what types of data are available or would be required.

The second challenge relates to the difficulty of retaining staff who are experienced and confident using ArcGIS. ESRI ArcGIS and Spatial Analyst are powerful but complex software systems that can seem opaque and unintuitive to those who have not been trained to use them. Oklahoma has previously located training opportunities for staff, sometimes at great expense, but these staff often leave. Similarly, a staff member received extensive training in ArcGIS and then did not use the software for several years, by which time the staff member's ability to use the software had atrophied.

Finally, the third challenge relates to ArcGIS. The software is expensive. ODMHSAS has two licenses for ArcGIS and only one license for Spatial Analyst. This means that the agency sometimes must switch the software licenses between people as needed, taking up time. ODMHSAS staff finds that updates to ArcGIS often contain many software bugs initially and they thus will wait to update to a new release only until it has been out long enough to be patched.

Washington

Introduction

This case study of the use of GIS by Washington's SMHA is based on an interview with Alice Huber, PhD and Barbara Lucenko, PhD. Dr. Huber is the Deputy Director of the Research and Data Analysis Division (RDA) of Washington State's Department of Social and Health Services (DSHS) and Dr. Lucenko is an office chief for program research and evaluation in the same division. The interview lasted approximately 60 minutes and queried Drs. Huber and Lucenko about specific uses of GIS within Washington as well as overall funding sources for GIS initiatives, technology used, and partnerships across state government related to GIS initiatives in the SMHA.

RDA has graciously allowed us to include examples of several of their maps. They have reviewed the maps to ensure that they do not contain sensitive information. All maps in this document belong to RDA and the State of Washington.

GIS Projects and Products

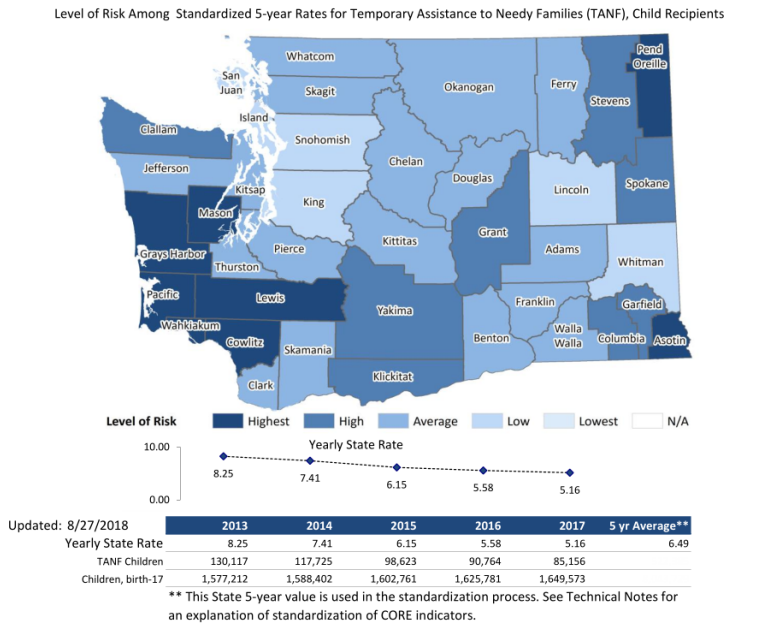
All uses of GIS by Washington State's Department of Social and Health Services (DSHS) are performed by the internal Research and Data Analysis Division (RDA). RDA began the use of GIS to inform mental health planning and decision making in the early 1990s. At that time, RDA was constructing a new client services data system and from the beginning the director of RDA, who was trained as a geographer, wished to include a GIS component in this system. RDA is able to integrate mapping and GIS capabilities into many products as the department-wide Client Services Database includes mappable address information.

Community Outcomes and Risk Evaluation (CORE) Information System

One of RDA's longest and most widely used GIS projects is the Community Outcomes and Risk Evaluation (CORE) Information System. This system was designed to be a map of factors related to substance use among adolescents. The original system was funded by a large SAMHSA grant, which supported the development of measures by the University of Washington Social Development Research Group. It has since evolved to be more inclusive of all factors and community resources related to both substance use and mental health. It now includes data about housing, schools, arrests, domestic violence offenses, substance use related measures, and mental health risk.

CORE includes population level data, not DSHS client level data, due to client confidentiality concerns. However, some of the population level data is aggregated from client level data from hospital data systems and school success records. All data are deidentified. CORE is intended to provide insight at a community level. As the definition of a community can be difficult to delineate, CORE aggregates data to different levels including legislative districts, counties, city/town boundaries, neighborhoods, and by school district. Although CORE originally was aggregated at only the county level (that was the geographic level of the original prevention funding), some of the other boundaries have been found to be better proxies for communities.

Figure 6



Note: The children (age birth-17) participating in Aid to Families (AFDC/TANF) programs in the fiscal year, per 100 children (age birth-17). The population used is for the calendar year which ends the fiscal period. Suppression code definitions are explained in Technical Notes. Fiscal years run from July 1 - June 30 and are designated by the ending year value.

State Source: Department of Social and Health Services, Research and Data Analysis, Automated Client Eligibility System and Warrant Roll.
Population Estimates: Washington State Office of Financial Management, Forecasting Division

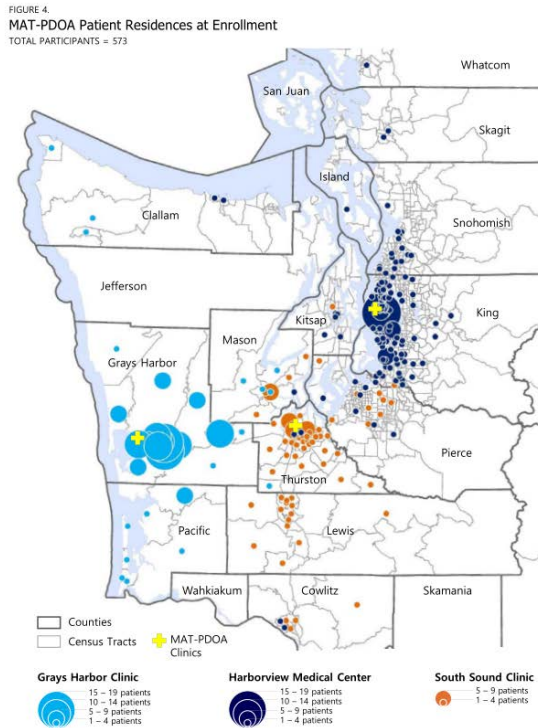
RDA releases many of the products of CORE to the public. They also produce data books given to each community (funded to receive state substance abuse prevention and mental health promotion money). These contain data from healthy-use surveys from schools, which have very tight privacy requirements. Thus the community data books are not released to the public.

To disseminate CORE more widely, in 2017 RDA made the reports available to the public at several levels of geography (accessible [here](#).) This data dashboard shows prevalence rates of behavioral health treatment needs and outcomes, including involvement with criminal justice system, homelessness, emergency room use, among other items. The dashboard includes reports using the data, maps to provide quick comparison across counties as well as a library of data, and geographic layers that can be downloaded. The CORE dashboard “has quite a bit of real estate on” the RDA website. They send out announcements within the state when they release a new report or map or when they add to the library of data and geographic layers.

The decision to create a public-facing report site was driven as much by efficiency and convenience for RDA as by a larger plan for data dissemination. Counties make use of the CORE library to acquire the data they need for required reports and local analytical needs. Making the reports public also makes it much easier for researchers to access, understand and use the data. It obviates the need for researchers to go through a data request process for publicly available data elements, which can take up significant state time.

RDA and other parts of DSHS use CORE to make decisions about what services to provide. They also use CORE to know how better to respond to an emergency, such as the opioid epidemic, as it allows policy-makers to visualize the problem. CORE is useful for helping legislators understand behavioral health service provision throughout the state.

Figure 7



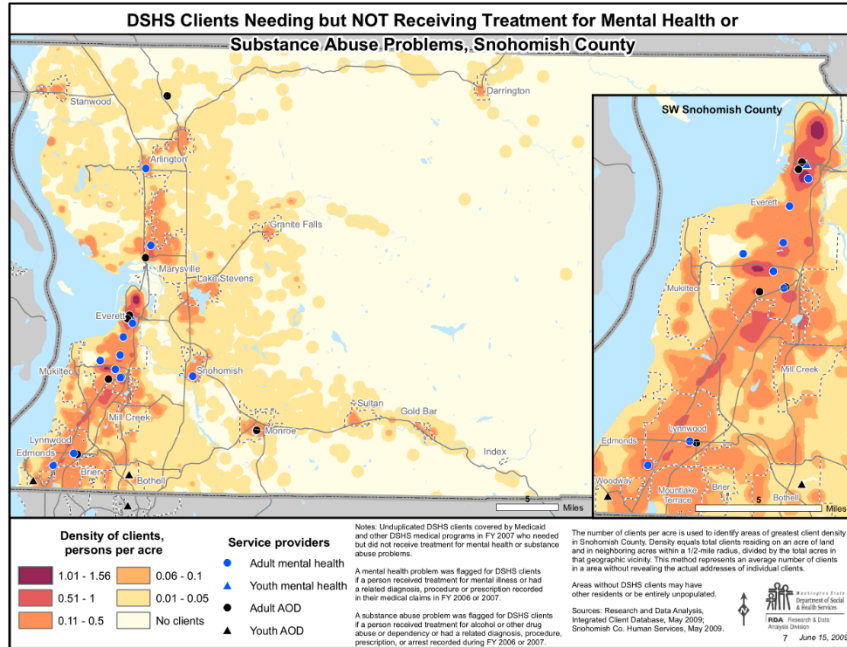
Client Proximity to Services

RDA has also created a data system that more explicitly examines the proximal relation between where clients live and where services are located and why clients in a particular area are not receiving the services indicated by their needs. This includes a calculation of driving time to available services relative to where clients live who have a need for that service or an estimated need for that service.

This data system includes data from the behavioral health system as well as Medicaid claims and encounters data. They are able to link addresses across system, which allows them to unduplicate the data. This data system can then be used for determining where the greatest need is and where to most effectively locate new offices or services. Finally, they are able to use this data system to locate clients who are vulnerable or in need due to a natural disaster, such as a wildfire, or other emergency. In order to be able to use this system for these different purposes RDA needed to negotiate data sharing agreements that were challenging to complete due to the inclusion of data from multiple agencies

without a history of sharing data. They worked out these data sharing agreements ahead of time so that the system would be ready to go in the event of an emergency.

Figure 8



A further use of this system has been to look for fraud, in which a client uses an EBT card at a location so far from their residence as to seem improbable, or that a particular store sells a significant amount of merchandise to individuals very distant from the location.

This data system is primarily used by program administrators or leads at state agencies who are looking at how better to reach their service population. For example, they may use this system if they have a requirement to reach a particular number of people for a new service and are seeking how best to accomplish that.

Other GIS Initiatives

Other RDA GIS initiatives include a research report about the child welfare system that examined risk among children for future abuse, neglect, and involvement with Children Protection Services. The report included maps to give the partner agency a quick view of risk across the state, including the absolute number of cases and their rates in different parts of the state. They have been able to release some parts of the report, while other report sections have had to remain internal due to privacy concerns.

Another RDA GIS initiative is a map of sex-offenders in the community to ensure they are not living near child-care facilities or other vulnerable populations.

Finally, RDA is working on a GIS database that can distinguish between what services providers are licensed to provide and what services providers are actually providing. This initiative could make it

easier to determine where clients throughout the state can go for help. In addition, as different providers vary based on cost structure, this database could help the state better understand the costs facing clients throughout the state.

Collaboration with Other State Agencies and External Partners

RDA is inherently a collaborative entity as all of its work is done in collaboration with state agency partners and its funding also flows through state agency partners. This structure was created in the early 1990s when the state recognized that there were many siloed data systems and that it needed a single entity that could negotiate access to data across state agencies. While RDA is housed in DSHS, they do work with other departments, including the state Medicaid agency and the Department of Children, Youth, and Families. Within DSHS, RDA works not only with the SMHA, but also the Developmental Disabilities Administration, and the Division of Vocational Rehabilitation.

Software and Tools Used

RDA primarily uses ESRI's ArcGIS for their GIS initiatives.

Within RDA 7-8 staff members actively use ArcGIS to create products, several of whom are expert users. About 100 people across the agencies that RDA works with have ArcMap to use maps interactively. They regularly provide hands-on training across state agencies for people to learn how to do basic mapping and how to understand the principles of mapping. The latter training helps agency staff make more effective requests for mapping help from RDA.

Initial and Ongoing Funding for GIS Initiatives

As mentioned, funds for RDA flow through their state agency partners as the latter are their customers. Each year they have to justify the value they bring to the state and the cost of their ArcGIS licenses. The trainings they provide agency staff drive interest among their partners, who then become stronger supporters of the more advanced GIS initiatives RDA performs. Thus, partner agency staff who have a more sophisticated understanding of GIS and its capabilities help to ensure the sustainability of RDA's GIS initiatives.

Challenges Faced

One challenge they face is in balancing the ability to use the latest features in ESRI ArcGIS with the bugs and security concerns that often accompany the most recent version of the software. RDA has to ensure that any updates to ArcGIS meet their security requirements given that they can include PHI in some maps. This has prevented them from always using the latest versions/features, until some of the bugs are resolved.

Another challenge involves the cost of the ArcGIS licenses and training. Every year RDA has to justify why they have so many licenses and how they bring value to the state. Since RDA's customers are state agencies, the more value they see in the use of ArcGIS, the less difficult it is to justify the continued expense. While RDA does not have the funds to send employees to in-person ArcGIS training, they have found the online tutorials to be quite good.