Comprehensive Assessment of Post-Acute Care Resources for Trauma Patients

Ohio EMS Research Grant

Northern Ohio Trauma System

Principal Investigator: Jeffrey A. Claridge, MD, MS, FACS

Report by: Olivia Houck, MPH, CPH

Introduction

Post-acute care following a traumatic injury is an important factor in maximizing recovery. According to 2017 data from the State of Ohio, 13,829 patients—23.7% of all trauma patients in Ohio for the year—were discharged from the trauma center to a skilled nursing or inpatient rehabilitation facility. Therefore, there is clearly a need in Ohio to ensure that these patients have optimal access to the proper post-acute care resources.

This project will seek to explore trends of distribution of trauma centers and post-acute care resources in the State of Ohio, and potentially underserved areas for each. This will be accomplished through two aims: 1) to conduct a Needs-Based Assessment of Trauma Systems, by region, for the entire State, and 2) to collect available data on post-acute care resources to conduct a similar assessment of post-acute resources relative to the community in need.

Contents

Executive Summary

This project involved looking at distribution of trauma centers and post-acute care facilities across the State of Ohio. We sought to identify any underserved geographic areas, using publicly available facility and population data and data requested from the State of Ohio Trauma Acute Care Registry.

To assess trauma centers, we utilized the Needs-Based Assessment of Trauma Systems tool, developed by the American College of Surgeons. We performed this assessment at the region level, utilizing the Ohio Homeland Security Regions. Factors included in the NBATS assessment are population of the geographical area, median transport time for the area, number of severely injured patients seen in non-trauma centers, current number of Level I trauma centers, and number of severely injured patients seen in existing Level I and II trauma centers. The tool assigns points based on values for each of these items, and the final result, recommending a certain number of new trauma centers or no new trauma centers, is based on the final number of points.

To assess post-acute care facilities, we mapped existing hospital-based and non-hospital-based facilities. For hospital-based facilities, we mapped the distance around each facility to determine potentially underserved areas. Data on non-hospital-based facilities was less concrete, so we mapped these facilities over the number of patients who were discharged to a skilled nursing facility or inpatient rehabilitation. Then, we mapped all facilities over the ratio of patients to facilities, and over the county uninsured rate.

All of these approaches suggested similar potentially underserved areas, particularly in the south central and southeast portions of the State, in both trauma centers and post-acute care facilities. However, existing data on post-acute care facilities, specifically with regards to pinpointing capacity to serve trauma patients, is piecemeal and sometimes lacking in the necessary granularity of data.

Future work expanding on this project may include re-creating the trauma center needs assessment with the NBATS 2, when available, and working at the State level to develop better sources of data on post-acute facilities and bed capacity.

Investigators

Dr. Jeffrey A. Claridge, MD, MS, FACS (PI): Dr. Jeffrey Claridge serves as the Director of Trauma for MetroHealth Medical Center. Through 2018, he served at Medical Director of the Northern Ohio Trauma System (NOTS) and now serves as on the NOTS Advisory Board as Treasurer. He also currently Chairs the Ohio Committee on Trauma. Given his leadership roles at many levels, and his extensive research history (including research using State data), Dr. Claridge has been in a prime position to provide vision and direction for this project, as well as to bring on board other physicians from around the State to offer their own expertise.

Olivia C. Houck, MPH, CPH (co-investigator): Ms. Houck is the Regional Data Specialist for the Northern Ohio Trauma System. She is responsible for maintaining the regional trauma registry, coordinating between trauma center registrars for consistent data collection, data region-level data analysis. She has interest in and experience with mapping in Tableau software, with an emphasis on visual storytelling to show relationships between different health topics.

Study-Specific Aims

This project has two aims related to the assessment of resources related to both acute trauma care and an in-depth evaluation of post-acute resources in Ohio:

Aim #1: Perform a Needs-Based Assessment of Trauma Systems (NBATS) of each trauma service area (TSA) in Ohio, utilizing data from the state data base and other data sources. This would also be used to evaluate the current regions across the state.

Aim #2: Utilizing data from Aim #1 and additional data on post-acute facilities, conduct an additional needs-based assessment of post-acute trauma facilities across the state, by region. This will be accomplished in two parts:

Aim #2a: Evaluate the current practice patterns of post-acute care and discharge practices to determine practice disparities and general benchmarks of disposition with a specific focus on post-acute care disposition.

Aim #2b: Assess the current post-acute facilities in relation to location of trauma centers and traumatic injuries and compare to areas of discharge disparity.

Literature Review

To help address community need for trauma centers, the American College of Surgeons developed the Needs-Based Assessment for Trauma Systems. In 2015, the American College of Surgeons (ACS) convened a conference to reach consensus on the Needs-Based Assessment of Trauma Systems (NBATS) tool and "the principle that trauma center designation within a regional trauma system should be based upon the needs of the population served [1].

This tool has subsequently been applied in peer-reviewed research in California, showing a trend of often higher-than-existing estimates for rural areas and lower-than-existing estimates for urban areas [2]. Understanding such service patterns is important, as adding more trauma centers to an adequately served region may reduce cost-efficiency of the system as a whole [3].

The literature on the role of post-acute care in recovery of the trauma patient is still sparse, though improving in recent years. Skilled nursing facilities (SNFs) have been found to be associated with adverse events and mortality [4]. While the association between SNFs and adverse events has become more understood, patients are being increasingly discharged to SNFs. Inpatient rehabilitation facilities (INFs) may offer a better alternative, as it is associated with improved outcomes in the form of a higher likelihood of eventual discharge to home and increased functionality [5].A similar trend involving significantly improved functionality has also been demonstrated in stroke patients [6].

Also in examining stroke patients, uninsured individuals, racial minorities, women, and people of a lower socioeconomic status have all been found to be less likely to receive intensive post-acute care, such as treatment they would receive in an IRF, rather than less intensive treatment in a SNF. Extrapolating from the above-mentioned literature on outcomes in SNFs vs IRFs, this may suggest that these individuals may be more prone to worse outcomes due to their lessened access to intensive post-acute care [7].

Current Status of the Topic in Ohio

At the time of this analysis, there were 17 Level I trauma centers (4 of which are pediatric), 24 Level II trauma centers (7 of which are pediatric), and 25 Level III trauma centers. In 2017, the year for which this project included data, there were 31,023 patients seen at Level I trauma centers, 12,623 seen at Level II trauma centers, and 7,101 seen at Level III trauma centers [8]. According to data requested from the Ohio Trauma Acute Care Registry, 13,829 of these patients were discharged from the trauma center to a skilled nursing or inpatient rehabilitation facility.

Issues & Considerations (Legislative & Regulatory)

A key issue behind this grant can be tied into the potential need for a lead trauma agency that can help regulate the number of trauma centers and/or post-acute facilities in a given area. This type of data can provide useful information for creating rules to designate new trauma centers and/or post-acute care facilities. The data will show supportive evidence of need in some areas and oversaturation in others.

Approach and Findings – Aim 1

I. Needs-Based Assessment of Trauma Systems (NBATS) Methodology

The NBATS tool was developed by the American College of Surgeons Committee on Trauma. It is a 6-question tool that is designed to recommend a number of trauma centers that should be located within a trauma service area (TSA). The tool can be found in Appendix A: ACS NBATS Tool. For the purposes of this assessment, a TSA was defined as an Ohio Department of Homeland Security planning region.

Data for this assessment was compiled through a combination on publicly-available sources and data requested from the State of Ohio Trauma and Acute Care Registry. Data sources for each section of the tool are explained further in each section below.

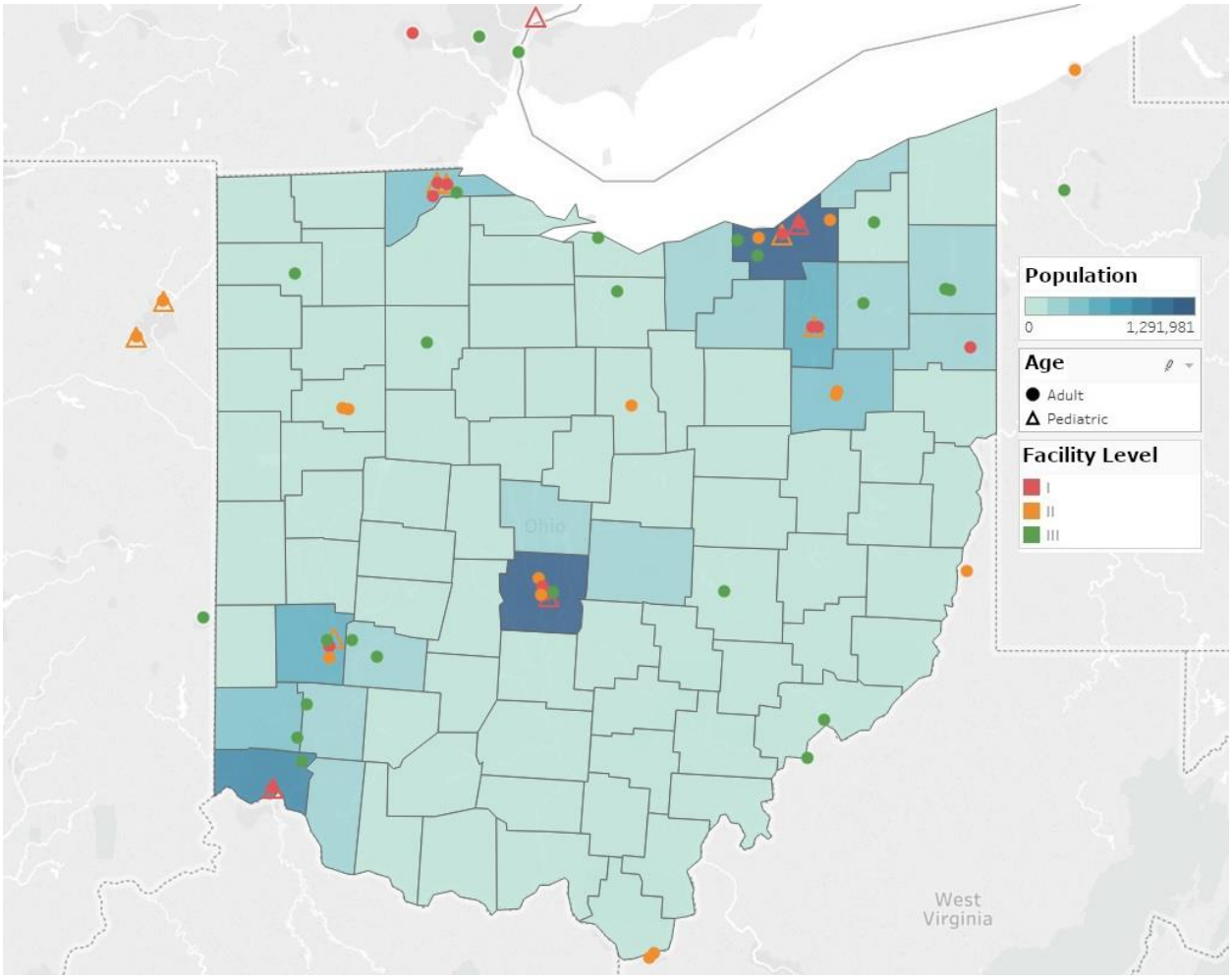

Figure 1. Trauma Centers in Ohio and Neighboring States with County Populations

A. Population

The NBATS Tool defined assessment of population as listed below:

a. Total TSA population of less than 600,000 received 2 points

b. Total TSA population of 600,000–1,200,000 received 4 points

c. Total TSA population of 1,200,000–1,800,000 received 6 points

d. Total TSA population of 1,800,000–2,400,000 received 8 points

e. Total TSA population of greater than 2,400,000 received 10 points

Data source: To determine the TSA population, the most recent (2017) estimate of population from the United States Census Bureau was referenced for each county in Ohio, and then added together to find the population of each region.

Region	Population	NBATS Points
1 (Northwest)	1,237,544	6
2 (Northeast)	1,979,118	8
3 (West Central)	1,163,553	4
4 (Central)	2,309,671	8
5 (Northeast Central)	2,241,565	8
6 (Southwest)	1,783,804	6
7 (Southeast Central)	471,450	2
8 (Southeast)	414,869	2

B. Median Transport Time

The NBATS Tool defined assessment of median transport time (combined air and ground-scene only, no transfer) as listed below:

a. Median transport time of less than 10 minutes received 0 points

b. Median transport time of 10–20 minutes receives 1 point

c. Median transport time of 21–30 minutes receives 2 points

d. Median transport time of 31–40 minutes receives 3 points

e. Median transport time of greater than 41 minutes receives 4 points

Data source: Median transport time data was obtained from the State of Ohio Department of EMS, using the state trauma registry. Each median provided is the median time for all trauma patients who were taken to a facility within each region.

Region	Median Transport Time	NBATS Points
1 (Northwest)	15 minutes	1
2 (Northeast)	14 minutes	1
3 (West Central)	16 minutes	1
4 (Central)	16 minutes	1
5 (Northeast Central)	17 minutes	1
6 (Southwest)	16 minutes	1
7 (Southeast Central)	18 minutes	1
8 (Southeast)	18 minutes	1

C. Lead Agency/System Stakeholder/Community Support

Since this assessment is not looking into the need for the creation of a new trauma center in a specific area, but rather to capture a general picture of trauma services in the State of Ohio, this section was not utilized. For this section, all regions were given a score of 0. For reference, this section is scored as listed below:

- *Lead agency support for a trauma center (if none exist) or an additional trauma center in the TSA – 5 points*
- *Trauma System Advisory Committee (or equivalent body) statement of support for a trauma center (if none exist) or an additional trauma center in the TSA – 5 points*
- *Community support demonstrated by letters of support from 25–50% of city and county governing bodies within the TSA – 1 point*
- *Community support demonstrated by letters of support from over 50% of city and county governing bodies within the TSA – 2 points*

D. Severely injured patients (ISS > 15) discharged from acute care facilities not designated as Level I, II, or III trauma centers

The NBATS Tool defined assessment of severely injured patients (ISS > 15) discharged from non-trauma acute care facilities as listed below:

a. Discharges of 0-200 severely injured patients receives 0 points

b. Discharges of 201–400 severely injured patients receives 1 point

c. Discharges of 401–600 severely injured patients receives 2 points

d. Discharges of 601–800 severely injured patients receives 3 points

e. Discharges of greater than 800 severely injured patients receives 4 points

Data source: The number of severely injured patients discharged from non-trauma facilities was obtained from the State of Ohio Department of EMS, using the state trauma registry.

Region	Patients	NBATS Points
1 (Northwest)	29	0
2 (Northeast)	23	0
3 (Northwest Central)	39	0
4 (Central)	8	0
5 (Northeast Central)	19	0
6 (Southwest)	144	0
7 (Southeast Central)	4	0
8 (Southeast)	58	0

E. Level I trauma centers

This section accounts for the numbers of Level I, II, and III trauma centers within the region. Points were assigned as listed below:

a. For the existence of each verified Level I trauma center already in the TSA assign 1 negative point

b. For the existence of each verified Level II trauma center already in the TSA assign 1 negative point

c. For the existence of each verified Level III trauma center already in the TSA assign 0.5 negative points

Data source: Number of trauma centers was obtained from the Ohio Designated Trauma Centers Map on the Ohio EMS Website [9] in October 2018. Trauma centers that were designated after that time are not included in this analysis.

Region	# Level I's	# Level II's	# Level III's	NBATS Points
1 (Northwest)	3	4	5	-9.5
2 (Northeast)	3	3	3	-7.5
3 (Northwest Central)	0	2	3	-3.5
4 (Central)	3	2	1	-5.5
5 (Northeast Central)	3	4	3	-8.5
6 (Southwest)	2	0	3	-3.5
7 (Southeast Central)	0	0	0	0
8 (Southeast)	0	0	2	-1

F. Numbers of severely injured patients (ISS > 15) seen in trauma centers (Level I and II) already in the TSA

This section compares the expected number of high-ISS patients (based on the number of existing Level I and II trauma centers in the region) and the actual number if high-ISS patients seen at Level I and II trauma centers. This section is scored as listed below:

500 x (# of Level I and Level II centers in the TSA) = _____

a. If the TSA has more than 500 severely injured patients above the expected number assign 2 points

b. If the TSA has 0-500 severely injured patients above the expected number assign 1 point

c. If the TSA has 0-500 fewer severely injury patients than the expected number assign 1 negative point

d. If the TSA has more than 500 fewer severely injured patients than the expected number assign 2 negative points

Region	Expected Patients	Actual Patients	NBATS Points
1 (Northwest)	3,500	687	-2
2 (Northeast)	3,000	1,016	-2
3 (Northwest Central)	1,000	796	-1
4 (Central)	2,500	1,624	-2
5 (Northeast Central)	3,500	1,147	-2
6 (Southwest)	1,000	930	-1
7 (Southeast Central)	0	0	0
8 (Southeast)	0	0	0

II. Needs-Based Assessment of Trauma Systems (NBATS) Results

The final score of the NBATS assessment is determined by simply adding the points for each section. A summary of scoring by each region can be found in Appendix B: NBATS Results by Region.

The following scoring system shall be used to allocate trauma centers within the TSAs:

- *TSAs with scores of 5 points or less shall be allocated 1 trauma center*
- *TSAs with scores of 6-10 points shall be allocated 2 trauma centers*
- *TSAs with score of 11-15 points shall be allocated 3 trauma centers*
- *TSAs with scores of 16-20 points shall be allocated 4 trauma centers*

Region	NBATS Score	Current TCs*	Additional TCs* Needed
1 (Northwest)	-4.5	7	0
2 (Northeast)	-0.5	6	0
3 (Northwest Central)	0.5	2	1
4 (Central)	1.5	5	1
5 (Northeast Central)	-1.5	7	0
6 (Southwest)	2.5	2	1
7 (Southeast Central)	3	0	1
8 (Southeast)	2	0	1
*Level I and II trauma centers			

Analysis of Findings

This assessment suggests that Region 3 (Northwest Central), Region 4 (Central), Region 6 (Southwest), Region 7 (Southeast Central), and Region 8 (Southeast) could all potentially benefit from an additional level I or II trauma center, based on their current need and capacity.

However, a major limitation of this assessment is determining the geographic area in question. For this assessment, need was examined at the region level. This places relatively arbitrary lines that don't necessarily factor in to decision-making with actual trauma patients who may be near those borders. In collaborative discussion during presentation of these NBATS results, it was suggested that Region 4 (Central) specifically may benefit from doing their own, more granular assessment. Their recommendation for an additional trauma center may be erroneous if they have a lot of population in the eastern side of their region who can more easily access trauma centers in Region 3 (Northwest Central) than the trauma centers in Columbus.

Consequently, this may have an impact on Region 3's results as well. While this assessment offers a good starting point, individual counties or trauma regions/systems may benefit from replicating these assessments with their own geographic service areas.

The ACS is currently developing second version of the NBATS that also incorporates advanced mapping and drive time analysis. For future study, it would be recommended to replicate this assessment when this new tool is available.

Approach and Findings – Aim 2

In this aim, we are seeking to assess distribution of post-acute care resources across the state of Ohio, identify any underserved areas, and compare these to areas that are underserved by trauma centers.

I. Hospital-Based Post-Acute Care

We sought to access hospital-based programs, as these programs would be more likely to have more specialized resources, and likely be better able to provide continuity of care to the patient (i.e. the patient receiving post-acute care within the same facility where they were treated for their initial injury). Further, we wanted to assess areas far away from such facilities, as ideally patients would be receiving care close to their own communities where loved ones could easily visit them.

Data on hospital-based post-acute facilities was obtained from the Ohio Department of Health's Directory of Registered Hospitals [10]. Bed numbers were collected for skilled nursing, physical rehabilitation, and long-term acute care. Facility, facility location, bed type, and bed numbers was compiled for every hospital in Ohio that provided one of these three types of care. This data provided the below map: Dots represent facilities, and the size of the dot represents the number of beds. The color of dots represents the type of facility. Blue denotes long-term acute care, yellow denotes rehabilitation, and red denotes skilled nursing.

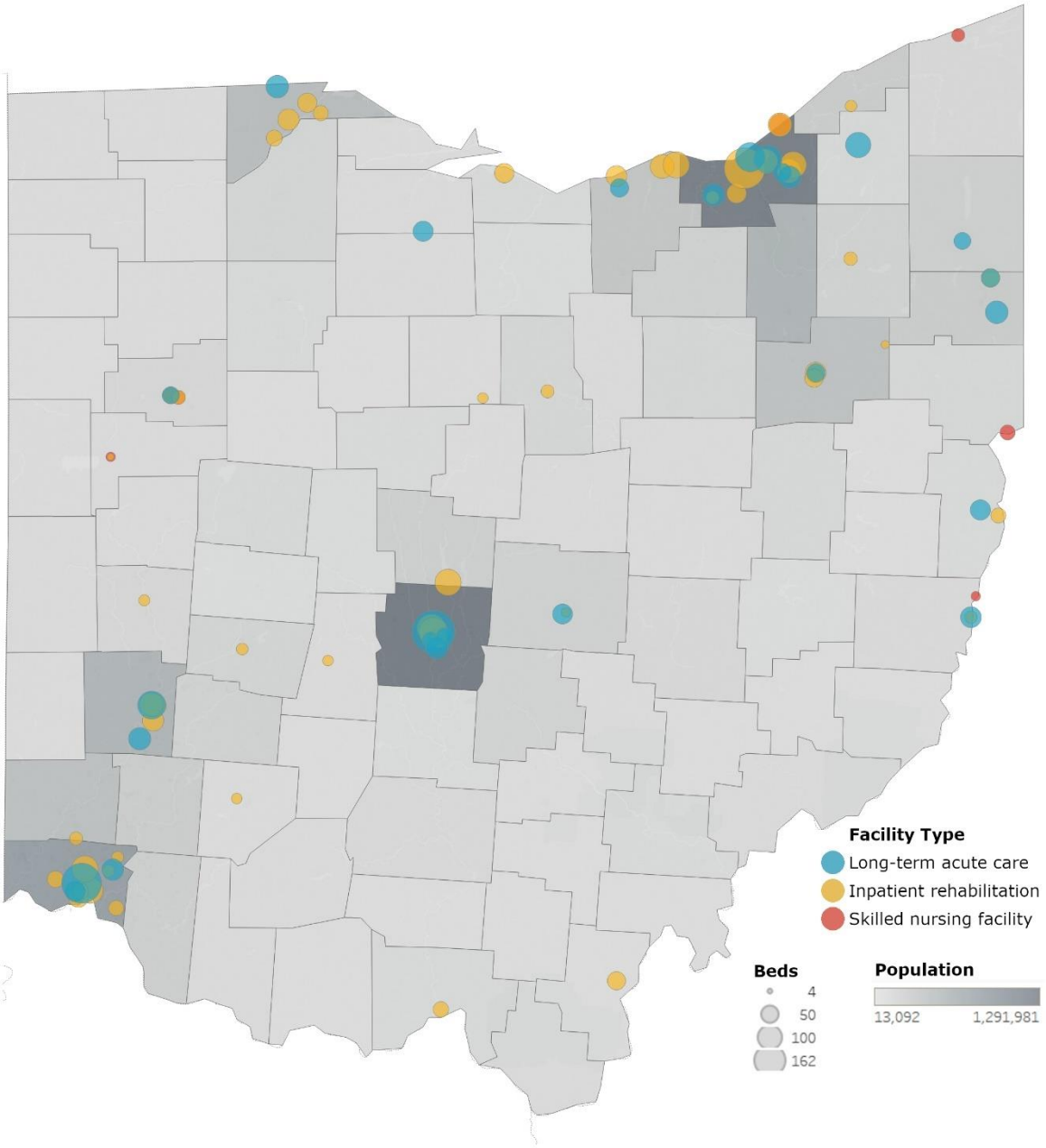

Figure 2. Hospital-Based Post-Acute Care Facilities by Type and Beds with County Population

15- and 25-mile radii were then superimposed on this map, allowing us to identify areas that were between 15-25 miles away from one of these facilities (yellow), and over 25 miles away (red).

This gave us the below map, showing large swaths of the northwest, southeast, and southeast central parts of the State that are a long distance from a hospital-based program.

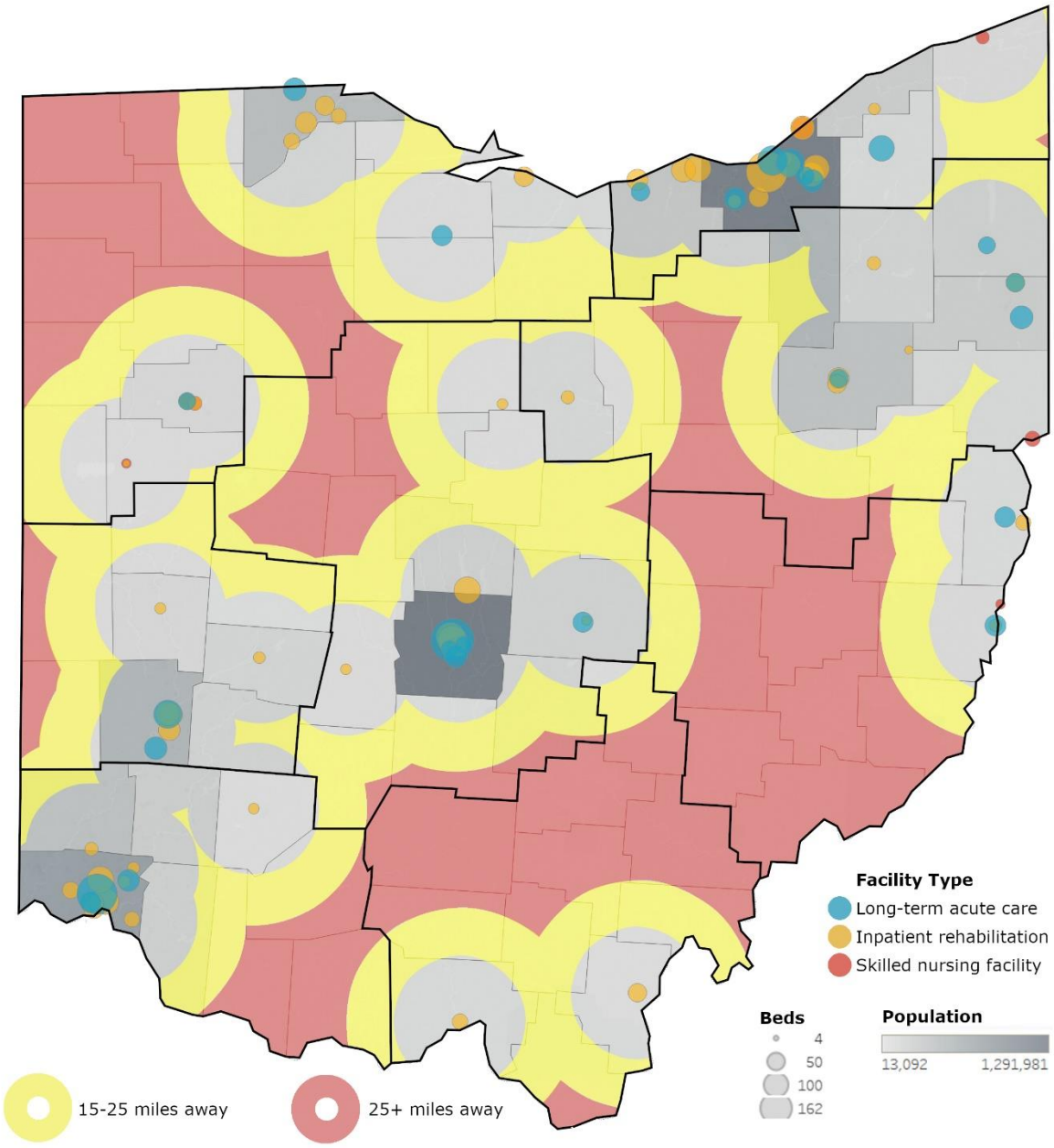

Figure 3. Hospital-Based Post-Acute Facilities by Type, Beds, and Radii with County Population

We then assessed the surface area of each county that fell into one of these yellow or red areas, which were then aggregated into regions. Table 1 shows percentage of land area in each region that is over 15 or over 25 miles away from a hospital-based post-acute facility. Highlighted in red are any regions that had values greater than the State as a whole.

	% of land area > 15mi from hospital-based post-acute care facility (yellow + red)	% of land area > 25mi from hospital-based post-acute care facility (red)
Region 1	63.6%	30.8%
Region 2	19.7%	0.2%
Region 3	42.2%	8.8%
Region 4	62.0%	19.3%
Region 5	45.1%	13.9%
Region 6	50.3%	22.8%
Region 7	82.3%	50.4%
Region 8	84.5%	66.2%
State	**59.7%**	**28.6%**

Table 1. Percentage of Land Area Greater than 15 or 25 miles from Hospital-Based Post-Acute Facility

The county most well-served by hospital-based post-acute facilities is Region 2 (Northeast), with 19.7% of the region being over 15 miles away from a facility, and only 0.2% of the region being more than 25 miles away. The county most underserved by hospital-based post-acute facilities is region 8 (southeast) with 84.5% of the region being over 15 miles away from a facility, and 66.2% being more than 25 miles away.

There are a couple caveats to this assessment. First, we did not include facilities across state lines. While there may be facilities just across state lines that provide these services, we performed this assessment on the assumption that, for insurance purposes, patients would seek more long-term post-acute care within their home state, even if they were treated at an out-of-state trauma center. Second, this assessment looks only at radius from each facility, and not drive time. Radius

can serve and a general indicator of drive time, but this is not always the case, particularly in the rural areas where roads are more sparse.

II. Non-Hospital-Based Post-Acute Care

Assessing non-hospital-based post-acute facilities and services is a much more difficult task. A list of nursing homes, which market skilled nursing and rehabilitative services, can be obtained from the Ohio Department of Health website. However, few of these facilities are dedicated to individuals recovering from severe traumatic injury. Many are senior living facilities who offer some form a skilled nursing and rehabilitation services, some of which do dedicate space for individuals of all ages who have recently left the hospital.

A list of 947 nursing homes was obtained from the Ohio Department of Health's Public Apps website [11]. One was eliminated because it was closed by the Ohio Department of Health in 2017. Eight were eliminated because the name of the facility designated them as an Alzheimer's care facility. This left a list of 938 non-hospital-based nursing facilities, 10 of which had a facility name that designated them as a post-acute center.

Bed information on these more mixed facilities is difficult, if not impossible, to parse. A total number of beds for the facility is provided, but there is no distinction between "senior living" beds and any space that may be dedicated specifically to post-acute skilled nursing care and/or rehabilitation. To examine distribution of potential even resources, we mapped these facilities over population by County in Ohio.

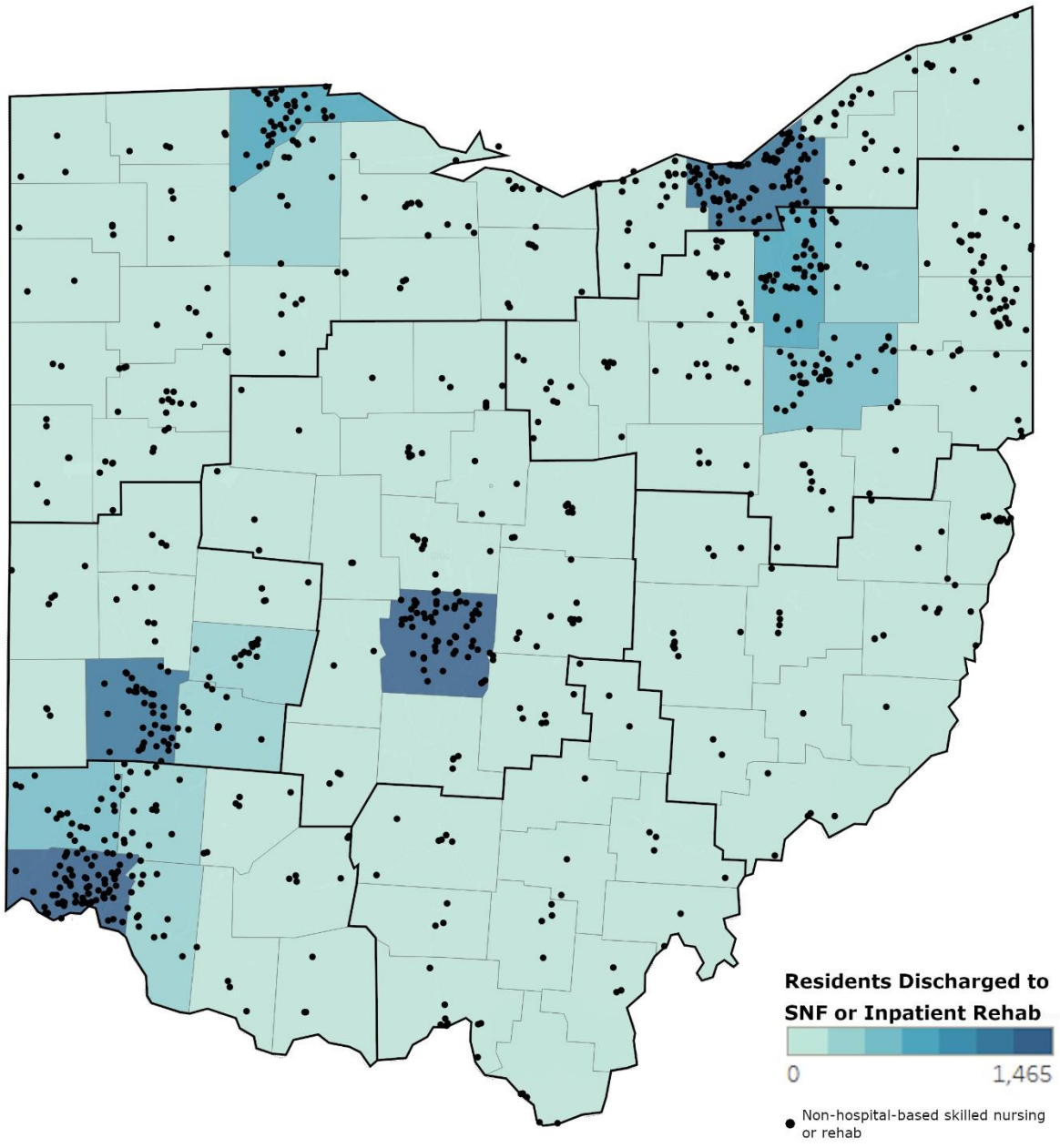

Figure 4. Non-Hospital-Based Post-Acute Facilities and County Residents Discharged to Skilled Nursing Facility or Inpatient Rehabilitation

III. Hospital-Based and Non-Hospital-Based Post-Acute Care Facilities

Next, in an effort to quantify the service coverage by county in lieu of specific bed data from non-hospital-based facilities, we calculated the patient-to-facility ratio for each county. The number

of patients discharged to “skilled nursing facility” or “inpatient rehabilitation” by patient home county was requests from the State of Ohio Department of EMS State Trauma Registry. This number of patients for each county was divided by the number of post-acute facility of any type in the county. Counties that appear darker in the map have more patients who are discharged to SNF or rehab and comparatively fewer facilities to accommodate those patients. While not a precise measure, this ratio can help us compare counties.

In some cases, patients are likely going to post-acute care facilities in neighboring counties. For example, Portage County in northeast Ohio has a high number of patients relative to the number of in-county facilities, but patients do have quite a bit more options in neighboring Summit County, which has a much lower patient-to-facility ratio. Ottawa and Greene Counties are similar.

It is possible that, based on this measure, Region 6 (Southwest) may also be underserved, despite its large number of facilities. The patient-to-facility ratio in much of Regions 6 and 3 are consistently higher, unlike the previously-mentioned scenario with a high-ratio county bordering a lower-ratio county with many facilities. Currently, there is simply not enough available data on number and types of beds to draw a conclusion, but this area of the state likely merits further examination.

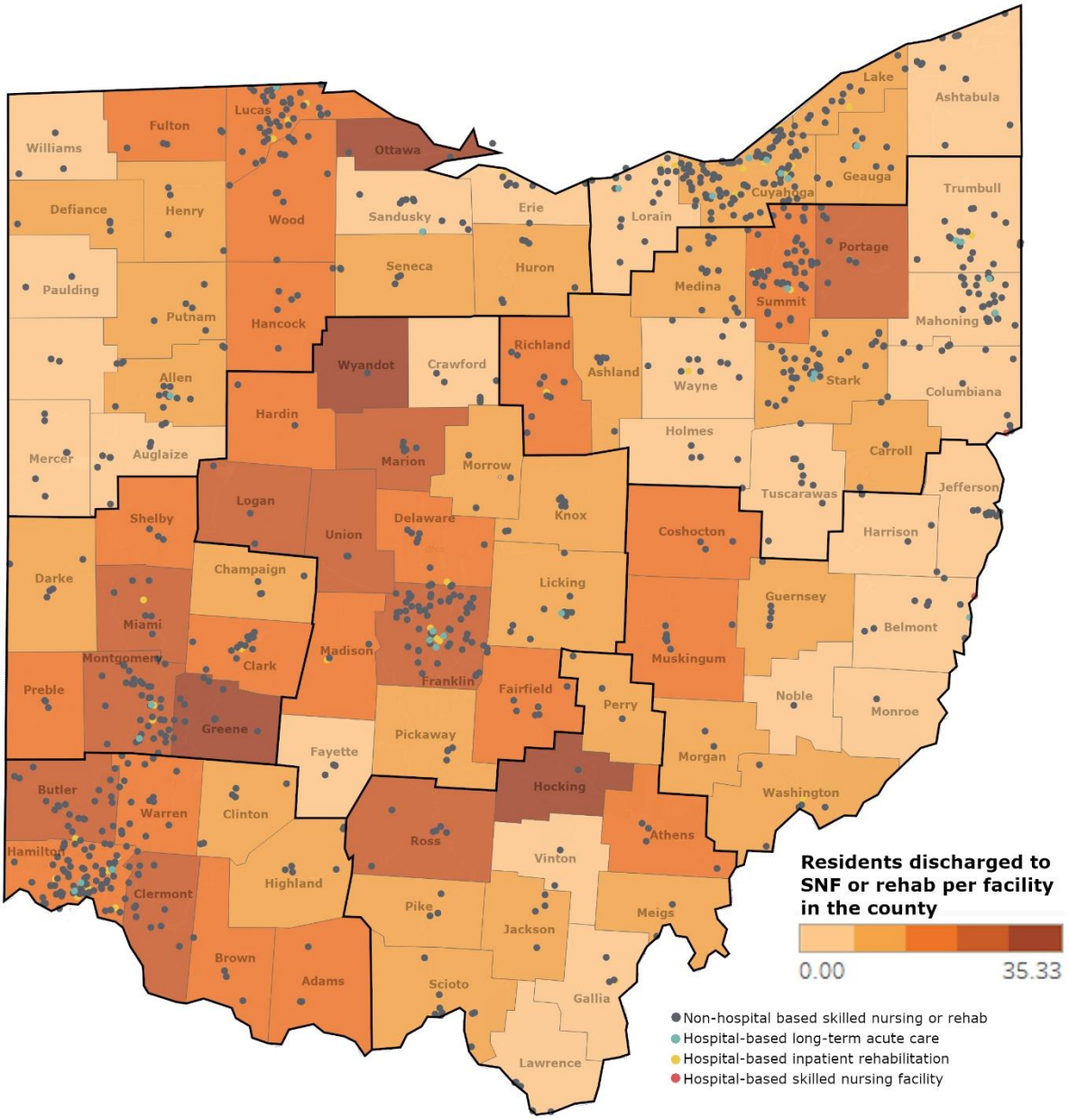

Figure 5. All Post-Acute Facilities and Ratio of Residents Discharged to SNF or Rehab per Facility in the County

Due to previous literature that found an association between uninsured status and less access to intensive post-acute care in stroke patients [6], we also superimposed these facilities on top of County uninsured rates, as reported by the 2019 County Health Rankings report [12], utilizing 2016

data [13]. This shows that geographic areas with a higher rate of uninsured individuals also tend to be further from hospital-based post-acute care and have fewer non-hospital-based facilities in the county. (Of note, Holmes County was an outlier, with a 20% uninsured rate reported. However, the rest of the counties in Ohio were between 4% and %9. Therefore, to make the relationship between the rest of the counties more visible, Holmes County is shaded as if it were an 8%-9% county.)

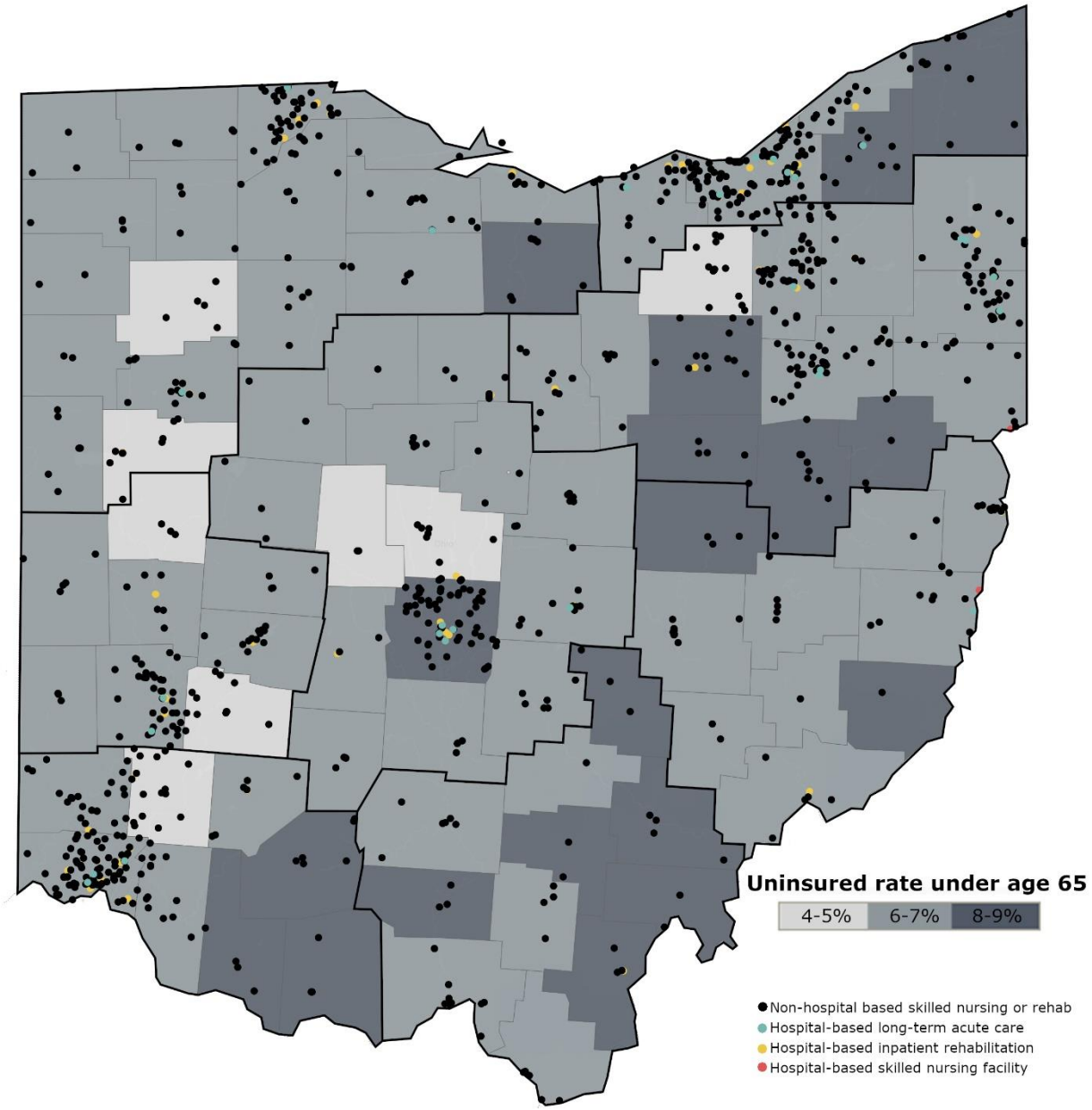

Figure 6. All Facilities and County Uninsured Rate

Analysis of Findings

With the currently available data, we were able to identify that Ohio Regions 1 (Northwest), 7 (Southeast Central), and 8 (Southeast) may be underserved in their proximity to hospital-based post-acute care facilities. Patients who live in these areas are likely receiving care far from home, limiting their ability to have support from family and friends via regular visitation. We were also able to identify counties that had a lower density of post-acute facilities relative to the number of patients who live in that county who were discharged to a post-acute facility.

Further, bed availability data for non-hospital-based facilities is extremely limited. There is no system of designating which nursing facilities are equipped to provide skilled nursing or rehabilitation care to trauma patients, or what degree of severity of injuries they can handle.

However, the trends that we have been able to identify may be of particular interest with regards to uninsured individuals in Ohio. Prior literature on post-acute care for stroke patients has found that uninsured status is often associated with a less-intensive level of post-acute care.

Conclusions

When looking at the two study aims together, common trends in underserved areas emerge. Regions 7 and 8 (Southeast Central and Southeast) were suggested to be underserved in both trauma centers and hospital-based post-acute care facilities. Both types of healthcare resources were disproportionately concentrated in densely populated areas. Between the time that the NBATS assessment of trauma centers was conducted and the writing of this final report, three new trauma centers are seeking provisional status and three have obtained provisional status. Only two of these facilities are in regions that this project's NBATS analysis showed could benefit from an additional trauma center. This suggests a need for increased oversight and/or a requirement to demonstrate community need to open a new facility.

With regards to post-acute facilities, stronger data collection is necessary to draw more specific conclusions. No single list exists of facilities, both hospital-based or non-hospital based, that are equipped to provide skilled nursing or rehabilitation services to trauma patients, particularly those recovering from severe injury. Further, granular bed number data on mixed-use facilities is not available. For example, one senior living facility specified on their website that they had a certain number of beds in their facility dedicated toward post-acute inpatient rehabilitation, not necessarily geared toward seniors. However, short of seeing this information on the facility's website (which few facilities post publicly), there is not a publicly-available list where one can find the number of post-acute beds separate from all beds that a facility has. This was one area where non-hospital-based programs diverged from hospital-based programs, where the Ohio Hospital Association lists how many beds a hospital has dedicated to each type of care.

Recommendations

Aim #1: Perform a Needs-Based Assessment of Trauma Systems (NBATS) of each trauma service area (TSA) in Ohio, utilizing data from the state data base and other data sources. This would also be used to evaluate the current regions across the state.

Recommendation 1: Based on the findings from Aim 1, we recommend that a community-needs-driven approach to trauma center placement be adopted in the State of Ohio. The data suggests that some areas remain potentially under-served, while areas that already have adequate trauma coverage put up additional trauma centers.

Recommendation 2: There are limitations to this current iteration of the NBATS tool, including not incorporating drive time information. There is a second version of this tool in development that will be more robust in its assessment. This iteration is still in development by ACS researchers. We recommend that either the State of Ohio participate in beta testing for the tool, or conduct an additional assessment with the same tool when it becomes available.

Aim #2: Utilizing data from Aim #1 and additional data on post-acute facilities, conduct an additional needs-based assessment of post-acute trauma facilities across the state, by region.

Recommendation 1: Based on the findings from Aim 2, we would first recommend that the State seek to compile a list of facilities, both hospital-based and non-hospital-based, that have the ability to provide post-acute care to trauma patients. Currently, the publicly-available list of 947 nursing homes does not provide enough information to be able to tell which facilities are more geared toward senior living, which are truly post-acute facilities, and which are a mixture of both. In the latte case, there is currently no way to differentiate how many beds within one facility are dedicated to each use.

Recommendation 2: Even based upon the data that is currently available, trends consistently emerge suggesting that trauma patients in the Southeast and Southeast Central regions of the State may have an inadequately low number of options for post-acute care. These regions may be well-served by an in-depth assessment of these areas specifically. Additional post-acute facilities in these areas may be of benefit to these communities.

References

[1] Trauma Systems Evaluation and Planning Committee, "Needs Based Assessment of Trauma Systems (NBATS) Tool," in *Needs-Based Trauma Center Designation Consensus Conference*, Chicago, IL, 2015.

[2] Uribe-Leitz T, Esquivel MM, Knowlton LM, et al, "The American College of Surgeons (ACS) Needs-Based Assessment of Trauma Systems (NBATS): Estimates for the State of California," *Journal of Trauma and Acute Care Surgery,* vol. 82, no. 5, pp. 861-866, 2017.

[3] Tepas JJ, Kerwin AJ, Ra JH, "Unregulated proliferation of trauma centers undermines cost efficiency of population-based injury control," *Journal of Trauma and Acute Care Surgery,* vol. 76, no. 3, pp. 576-581, 2014.

[4] Davidson GH, Hamlat CA, Rivara FP, et al, "Long-Term Survival of Adult Trauma Patients," *Journal of the American Medeical Association,* vol. 305, no. 10, pp. 1001-1007, 2011.

[5] Nehra D, Nixon ZA, Lengenfelder C, et al, "Acute Rehabilitation after Trauma: Does it Really Matter?," *Journal of the American College of Surgeons,* vol. 223, no. 6, pp. 755-763, 2016.

[6] Chan L, Sandel ME, Jette AM, et al, "Does Postacute Care Site Matter? A Longitudinal Study Assessing Functional Recovery After a Stroke," *Archives of Physical Medicine and Rehabilitation,* vol. 94, no. 4, pp. 622-629, 2013.

[7] Freburger JK, Holmes GM, Ku LE, et al, "Disparities in Postacute Rehabilition Care for Stroke: An Analysis of the State of Inpaties Databases," *Archives of Physical Medicine and Rehabilitation,* vol. 92, no. 8, pp. 1220-1229, 2011.

[8] Ohio Department of Public Safety Division of Emergency Mediacl Services, "Ohio Trauma Registry Annual Report 2017," 2018.

[9] Ohio Division of Emergency Medical Services, "Trauma System," 17 September 2018. [Online]. Available: https://www.ems.ohio.gov/links/ems_trauma_center_map.pdf. [Accessed October 2018].

[10] Ohio Department of Health, "Directory of Registered Hosiptals," [Online]. Available: http://publicapps.odh.ohio.gov/eid/reports/Report_Output_RS.aspx. [Accessed 24 July 2018].

[11] Ohio Department of Health, "Health Care Provider Report & Information Extract," [Online]. Available: http://publicapps.odh.ohio.gov/EID/reports/EID_Report_Criteria.aspx. [Accessed 2019 09 09].

[12] County Health Rankings & Roadmaps, "Uninsured," 2019. [Online]. Available: https://www.countyhealthrankings.org/app/ohio/2019/measure/factors/85/data. [Accessed 12 09 2019].

[13] County Health Rankings & Roadmaps, "Ohio Health Factors - Uninsured," Robert Wood Johnson Foundation, 2019. [Online]. Available: https://www.countyhealthrankings.org/app/ohio/2019/measure/factors/85/data. [Accessed 5 September 2019].

Appendix A: ACS NBATS Tool

1. Population
    a. Total TSA population of less than 600,000 received 2 points
    b. Total TSA population of 600,000–1,200,000 received 4 points
    c. Total TSA population of 1,200,000–1,800,000 received 6 points
    d. Total TSA population of 1,800,000–2,400,000 received 8 points
    e. Total TSA population of greater than 2,400,000 received 10 points

Points Assigned: _____

2. Median Transport Times (combined air and ground–scene only no transfer)
    a. Median transport time of less than 10 minutes received 0 points
    b. Median transport time of 10–20 minutes receives 1 point
    c. Median transport time of 21–30 minutes receives 2 points
    d. Median transport time of 31–40 minutes receives 3 points
    e. Median transport time of greater than 41 minutes receives 4 points

Points Assigned: _____

3. Lead Agency/System Stakeholder/Community Support

Lead agency support for a trauma center (if none exist) or an additional trauma center in the TSA – 5 points

Trauma System Advisory Committee (or equivalent body) statement of support for a trauma center (if none exist) or an additional trauma center in the TSA – 5 points

Community support demonstrated by letters of support from 25–50% of city and county governing bodies within the TSA – 1 point

Community support demonstrated by letters of support from over 50% of city and county governing bodies within the TSA – 2 points

Points Assigned: _____

4. Severely injured patients (ISS > 15) discharged from acute care facilities not designated as Level I, II, or III trauma centers.
    a. Discharges of 0-200 severely injured patients receives 0 points
    b. Discharges of 201–400 severely injured patients receives 1 point
    c. Discharges of 401–600 severely injured patients receives 2 points
    d. Discharges of 601–800 severely injured patients receives 3 points
    e. Discharges of greater than 800 severely injured patients receives 4 points

Points Assigned: _____

5. Level I Trauma Centers

a. For the existence of each verified Level I trauma center already in the TSA assign 1 negative point
b. For the existence of each verified Level II trauma center already in the TSA assign 1 negative point
c. For the existence of each verified Level III trauma center already in the TSA assign 0.5 negative points

Points Assigned: _____

6. Numbers of severely injured patients (ISS > 15) seen in trauma centers (Level I and II) already in the TSA

The expected number of high-ISS patients is calculated as:

500 x (# of Level I and Level II centers in the TSA) = _____

a. If the TSA has more than 500 severely injured patients above the expected number assign 2 points
b. If the TSA has 0-500 severely injured patients above the expected number assign 1 point
c. If the TSA has 0-500 fewer severely injury patients than the expected number assign 1 negative point
d. If the TSA has more than 500 fewer severely injured patients than the expected number assign 2 negative points

Points Assigned: _____

The following scoring system shall be used to allocate trauma centers within the TSAs:
•TSAs with scores of 5 points or less shall be allocated 1 trauma center
•TSAs with scores of 6-10 points shall be allocated 2 trauma centers
•TSAs with score of 11-15 points shall be allocated 3 trauma centers
•TSAs with scores of 16-20 points shall be allocated 4 trauma centers

If the number of trauma centers allocated by the model is greater than the existing number of trauma centers in the TSA, efforts should be undertaken to recruit and designate additional trauma centers.

If the number of trauma centers allocated by the model is greater than the number allocated by the model, the lead agency should not designate additional trauma centers in the TSA.

Appendix B: NBATS Results by Region

Needs-Based Assessment of Trauma Systems (NBATS) Results

The final score of the NBATS assessment is determined by simply adding the points for each section.

The following scoring system shall be used to allocate trauma centers within the TSAs:

- *TSAs with scores of 5 points or less shall be allocated 1 trauma center*
- *TSAs with scores of 6-10 points shall be allocated 2 trauma centers*
- *TSAs with score of 11-15 points shall be allocated 3 trauma centers*
- *TSAs with scores of 16-20 points shall be allocated 4 trauma centers*

Region	NBATS Score	Current TCs*	Additional TCs* Needed
1 (Northwest)	-4.5	7	0
2 (Northeast)	-0.5	6	0
3 (Northwest Central)	0.5	2	1
4 (Central)	1.5	5	1
5 (Northeast Central)	-1.5	7	0
6 (Southwest)	2.5	2	1
7 (Southeast Central)	3	0	1
8 (Southeast)	2	0	1
*Level I and II trauma centers			

A. No new trauma centers needed:

This NBATS assessment found that no new trauma centers were needed in the following regions: 1 (Northwest), 2 (Northeast), 5 (Northeast Central), 6 (Southwest).

1. **Region 1 – Northwest:** Region 1 has an estimated population of 1,237,544 and currently contains three (3) Level I, four (4) Level II, and five (5) Level III trauma centers. Based on this capacity, the number of severely injured patients (ISS > 15) expected to be seen in Level I or II trauma centers is 3,500. According to data from the State of Ohio trauma registry, the actual number of severely injured patients was 687.

   Region 1's final NBATS score was -4.5, suggesting no community need for additional trauma centers and potentially points to an over-saturation of trauma resources.

Figure 2. Ohio Homeland Security Region 1. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

2. **Region 2 – Northeast:** Region 2 has an estimated population of 1,979,118 and currently contains three (3) Level I, three (3) Level II, and three (3) Level III trauma centers. Based on this capacity, the number of severely injured patients (ISS > 15) expected to be seen in Level I or II trauma centers is 3,000. According to data from the State of Ohio trauma registry, the actual number of severely injured patients was 1,016.

   Region 2's final NBATS score was -0.5, suggesting no community need for additional trauma centers.

Figure 3. Ohio Homeland Security Region 2. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

3. **Region 5 – Northeast Central:** Region 5 has an estimated population of 2,241,565 and currently contains three (3), Level I, four (4) Level II, and three (3) Level III trauma centers. Based on this capacity, the number of severely injured patients (ISS > 15) expected to be seen in Level I or II trauma centers is 3,500. According to data from the State of Ohio trauma registry, the actual number of severely injured patients seen was 1,147.

   Region 5's final NBATS score was -1.5, suggesting no community need for additional trauma centers.

Figure 4. Ohio Homeland Security Region 5. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

B. New trauma centers needed:

This NBATS assessment found that new trauma centers are needed in the following regions: 3 (Northwest Central), 4 (Central), 7 (Southeast Central), and 8 (Southeast).

1. **Region 3 – Northwest Central:** Region 3 has an estimated population of 1,163,553 and currently contains no (0) Level I, two (2) Level II, and three (3) Level III trauma centers. Based on this capacity, the number of severely injured patients (ISS > 15) expected to be seen in Level I or II trauma centers is 1,000. According to data from the State of Ohio trauma registry, the actual number of severely injured patients was 796.

   Region 3's final NBATS score was 0.5, suggesting a community need for one (1) additional trauma center.

Figure 6. Ohio Homeland Security Region 3. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

2. **Region 4 – Central:** Region 4 has an estimated population of 2,309,671 and currently contains three (3) Level I, two (2) Level II, and one (1) Level III trauma center. Based on this capacity, the number of severely injured patients (ISS > 15) expected to be seen in Level I or II trauma centers

is 2,500. According to data from the State of Ohio trauma registry, the actual number of severely injured patients was 1,624.

Region 4's final NBATS score was 1.5, suggesting a community need for one (1) additional trauma center.

Figure 7. Ohio Homeland Security Region 4. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

3. **Region 6 – Southwest:** Region 6 has an estimated population of 1,783,804 and currently contains three (3) Level I, two (2) Level II, and three (3) Level III trauma centers. Based on this capacity, the number of severely injured patients (ISS > 15) expected to be seen in Level I or II trauma centers is 2,500. According to data from the State of Ohio trauma registry, the actual number of severely injured patients was 930.

   Region 6's final NBATS score was 2.5, suggesting a community need for one additional trauma center.

Figure 5. Ohio Homeland Security Region 6. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

4. **Region 7 – Southeast Central:** Region 7 has an estimated population of 471,450 and current contains no (0) Level I, II, or III trauma centers. Therefore, there were no expected or actual patients seen in Level I or II trauma centers.

   Region 7's final NBATS score was 3, suggesting a community need for one (1) trauma center.

Figure 8. Ohio Homeland Security Region 7. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx

5. **Region 8 – Southeast:** Region 8 has an estimated population of 414,869 and currently contains no (0) Level I or II, and two (2) Level III trauma centers. Therefore, there were no expected or actual patients seen in Level I or II trauma centers.

   Region 8's final NBATS score was 2, suggesting a community need for one (1) trauma center.

Figure 9. Ohio Homeland Security Region 8. Adapted from "Region Map". State of Ohio. 2015, July 1. Retrieved from https://www.ems.ohio.gov/medicaldirection-rpab.aspx