Working Age Stroke in Minnesota

Introduction

Stroke is often associated with old age, but while the risk of stroke is higher among the elderly, stroke can occur at any age. Strokes in younger adults are a particular concern because they may prevent individuals from working, caring for their families, carrying out activities of daily living, and have significant health consequences. When strokes occur at younger ages, survivors spend more years living with the complications of stroke, including increased risk of recurrent strokes.

Key Findings

- 29% of adult stroke patients in the Minnesota Stroke Registry (MSR) from 2018-2024 were working age (18-64).
- Average age at stroke varies by patient sex and race/ethnicity:
    - Male stroke patients are younger, on average, than female patients.
    - Black/African American, American Indian/Alaskan Native, Asian, and Hispanic/Latino stroke patients are younger, on average, than white patients.
- Working age stroke patients have high rates of stroke risk factors, such as hypertension, diabetes, smoking, and history of stroke
- Working age stroke patients are more likely to arrive to the hospital via private transportation and less likely to arrive via ambulance.
    - Arriving via private transportation leads to longer wait times between hospital arrival and diagnostic imaging, and between arrival and treatment - two key factors in stroke outcomes and recovery.
    - Working age adults who arrive via ambulance have similar imaging and treatment times as older adults.
- Strokes among younger adults can be disabling: 40% of working age adults had a moderate or severe disability immediately after their stroke.
- Most working age stroke patients are discharged directly to their homes, but 26% spend some time in a skilled nursing facility, in-patient rehab facility, or long-term care facility after their hospital stay.

Data Source

This report uses data from the Minnesota Stroke Registry (MSR), a statewide registry of acute stroke patient quality of care data managed by the Minnesota Department of Health (MDH). All acute treatment hospitals in Minnesota are required to submit case-level stroke patient data to the MSR. Data is collected using a manual chart abstraction process where patient medical records are reviewed to identify stroke-specific information, and this information is manually entered into the MSR by hospital-based chart abstractors. The primary purpose of the MSR is to provide hospitals with a platform to monitor and improve the quality of care they provide to stroke patients. Data from the MSR is also used to inform statewide quality improvement efforts coordinated by MDH. The MSR is not a formal stroke surveillance system and thus is not used to calculate stroke prevalence, incidence, mortality, or hospitalization rates. Nevertheless, the depth and breadth of MSR data can provide important insights into trends and outcomes for stroke patients across Minnesota.

Key Terms

Stroke: The MSR includes data on acute ischemic stroke (AIS), subarachnoid hemorrhage (SAH), intracerebral hemorrhage (ICH), transient ischemic attack (TIA), and stroke not otherwise specified (SNS). Acute ischemic strokes occur when a clot cuts off blood flow to the brain. Hemorrhagic strokes occur when a blood vessel ruptures in the brain (ICH) or in the space between the brain and the surrounding membranes (SAH). TIAs, sometimes called “mini strokes”, occur when blood flow to the brain is temporarily disrupted.

Working Age: “Working age” is defined as age 18-64 years in this report. While we recognize that many adults continue working after age 65, 65 is a useful cut-off to categorize those that are likely still in the midst of their primary working years versus those who may be retired.

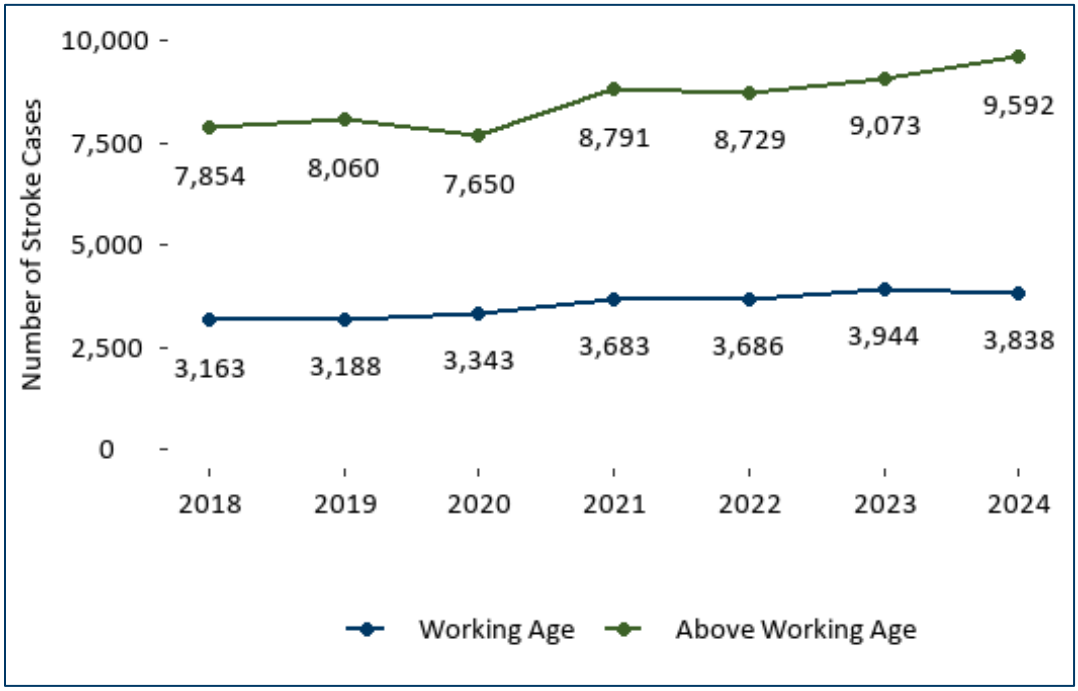
Analysis

We analyzed data from the Minnesota Stroke Registry (MSR) to quantify and characterize stroke among working-age adults. MSR data was downloaded for adult patients discharged from Minnesota hospitals between 2018 and 2024. Patients under age 18 were excluded from analysis, as were patients for whom age was not recorded. Patients without a confirmed final diagnosis of stroke were also excluded. Frequencies and descriptive statistics were calculated in R. Results are displayed as proportions of cases in the MSR and include cases admitted from 2018-2024, unless otherwise noted. Stroke incidence, prevalence, hospitalization and mortality rates were not calculated due to limitations of the MSR described above. Please visit the MDH Cardiovascular Health Data Dashboards for current and historical stroke hospitalization and mortality rates for Minnesota.

Working Age Strokes

Overall, 29.4% of stroke patients in the MSR from 2018-2024 were working age (18-64 years old). The number of working-age strokes in the MSR has increased from 3,163 in 2018 to 3,838 in 2024 (Figure 1, Table 1). Strokes among adults over age 65 increased from 7,854 to 9,592 over the same time period.

Figure 1: Working Age and Above Working Age Strokes by Year



Stroke Patient Age

The average age of stroke patients in the MSR from 2018-2024 was 71.6. Average age among working-age adults was 53.7, while the average above-working-age stroke patient was 79. Figure 2 shows the proportion of all adult stroke cases in the MSR by age range (Table 2). Approximately half (50.5%) of strokes in the MSR occur in adults aged 65-84. 24.6% occurred in adults aged 45-64, 20.1% in those above 85, and only 4.8% in those aged 18-44. The majority of working age stroke patients were 55-64 years old (Figure 3, Table 3). 26.4% were 45-54 and 16.2% were 18-44.

Figure 2: Strokes by Age Group

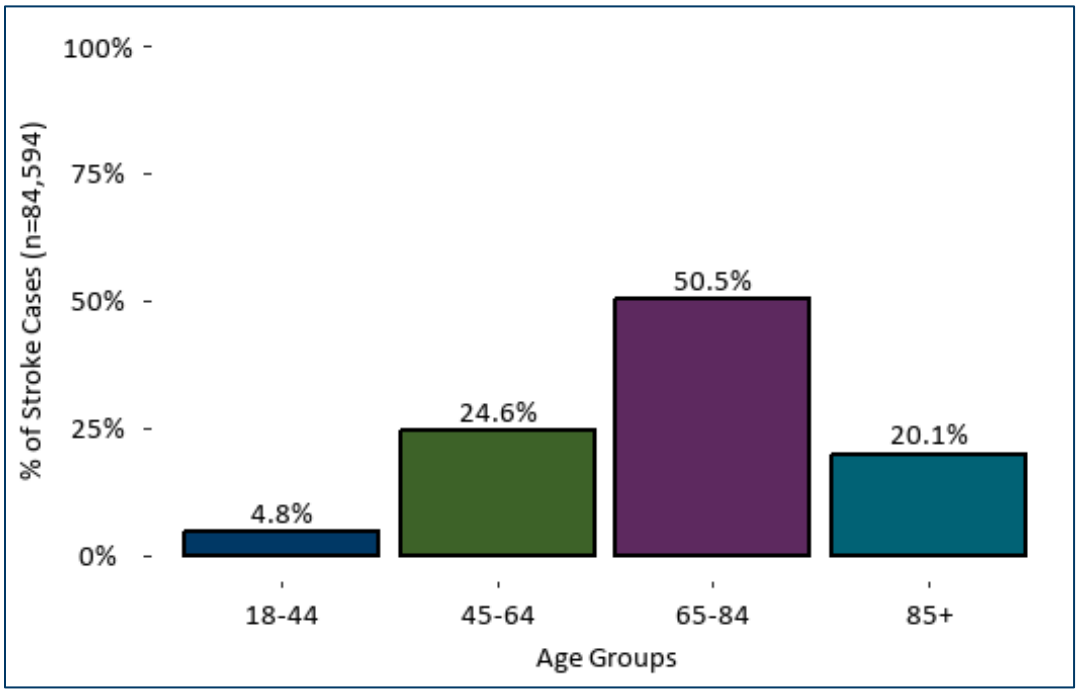
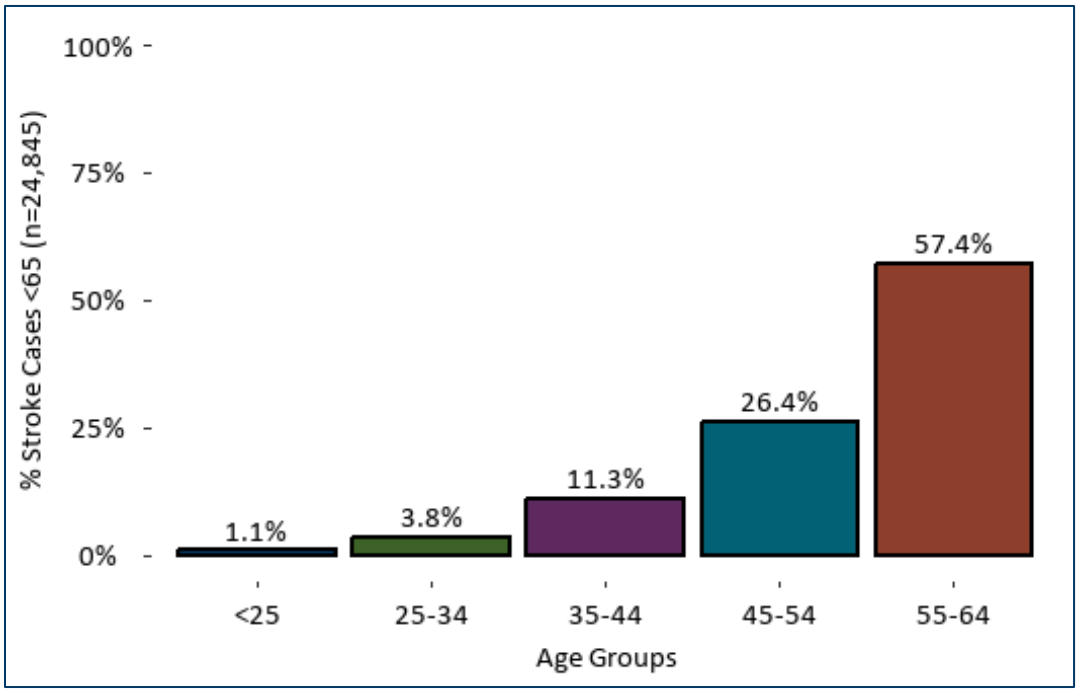


Figure 3: Working Age Strokes by Age Group



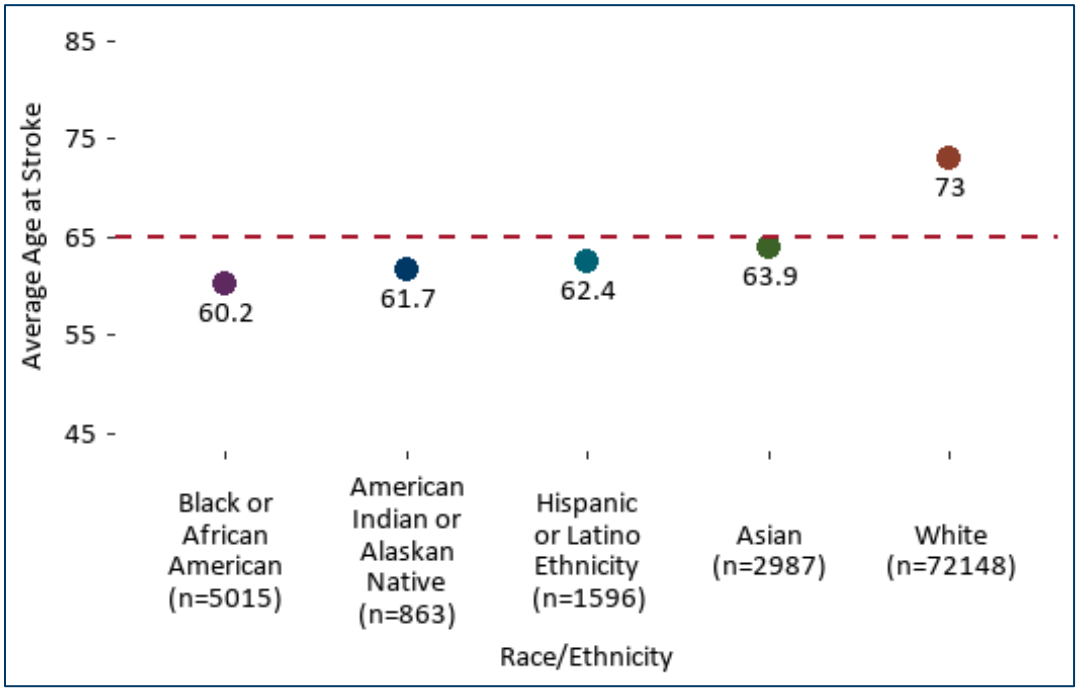
Sex

Men and women tend to experience stroke at different ages. Average age at stroke for female patients was 73.6, compared to 69.6 for male stroke patients. More men are experiencing stroke during their working years than women. 33.9% of male stroke patients in the MSR were under age 65, compared to 24.7% of female stroke patients (Table 4).

Race and Ethnicity

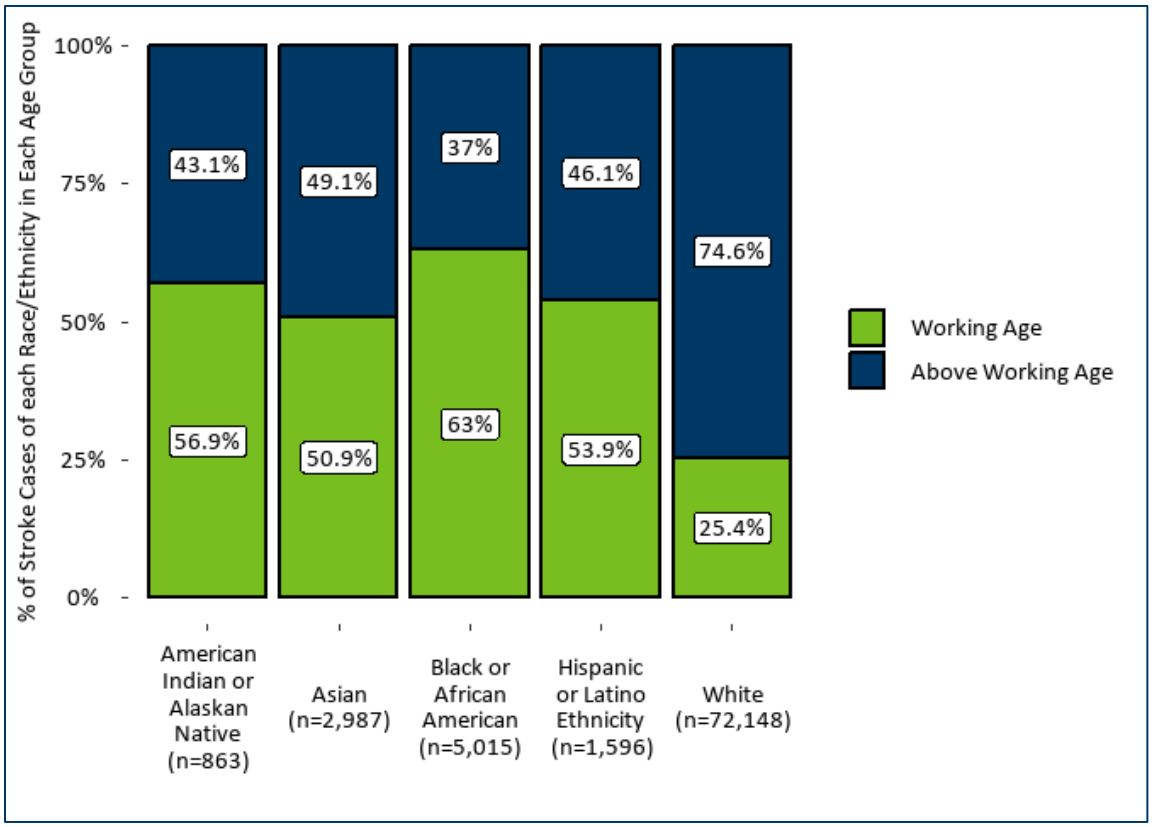
The average age of stroke patients also varies by race and ethnicity. Black, American Indian, Asian, and Hispanic stroke patients are all younger, on average, than white stroke patients. For instance, Black stroke patients in the MSR are 60.2 on average, 12.8 years younger than the average white stroke patient. This is due in part to the age and race/ethnicity composition of Minnesota's overall population. Only 8% of older adults in Minnesota are Black, Indigenous, and people of color, compared to 23% of working age adults.[i,ii] However, the difference in average age at stroke also likely reflects disparities in stroke and stroke risk factors.

Figure 4: Average Age at Stroke by Race/Ethnicity



Black, American Indian, Asian, and Hispanic stroke patients are more likely to experience stroke during their working years. About one-quarter of white stroke patients in the MSR were <65, compared to 50.9% of Asian stroke patients, 53.9% of Hispanic stroke patients, 56.9% of American Indian stroke patients, and 63% of Black stroke patients (Figure 5, Table 6).

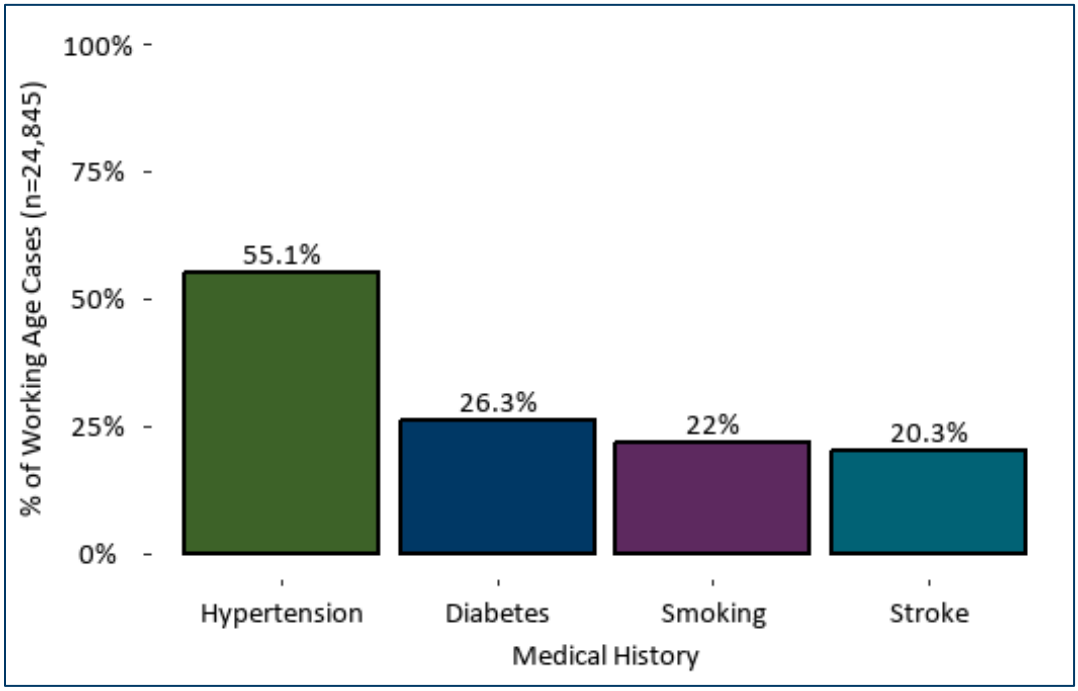
Figure 5: Working Age vs Above Working Age Strokes by Race/Ethnicity



Stroke Risk Factors

Most strokes can be prevented by managing risk factors such as hypertension, diabetes, smoking, and physical inactivity. The MSR documents whether stroke patients had a known history of several stroke risk factors before their stroke. These include hypertension, diabetes, a history of smoking, and prior stroke.

Figure 6: Stroke Risk Factors Among Working Age Stroke Patients



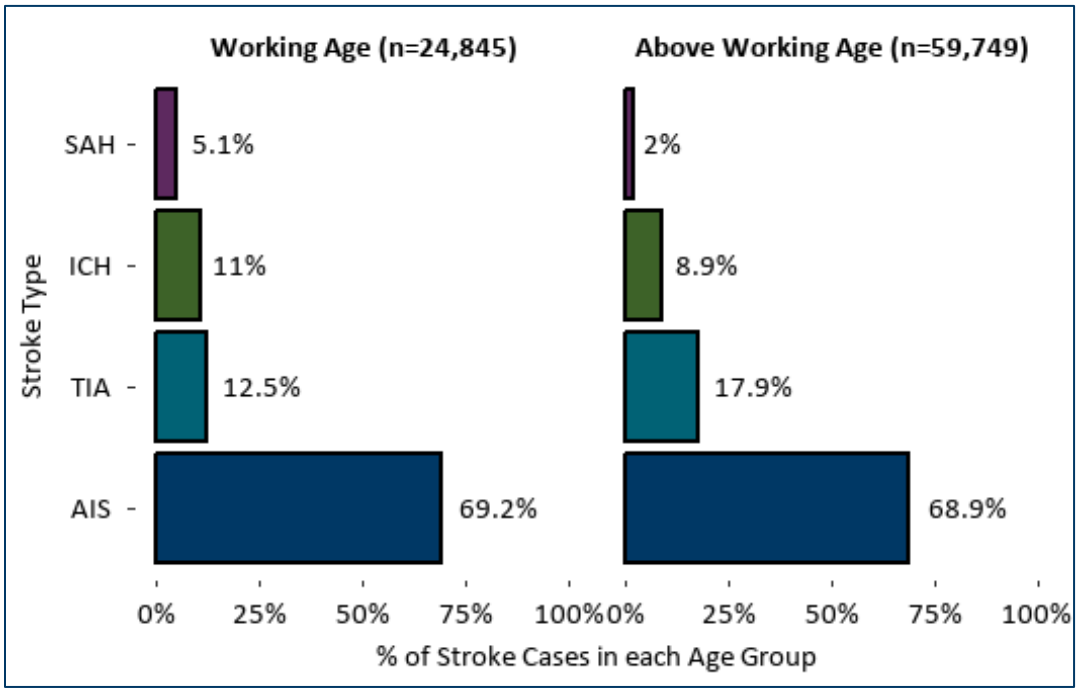
Note: Percentages total more than 100% because patients may have multiple conditions.

Stroke risk factors are common among working age stroke patients. 55.1% of working-age stroke patients had a documented history of hypertension, 26.3% had a history of diabetes, and 20.3% had a history of previous stroke (Figure 6, Table 7). 22% had a history of smoking, defined in the MSR as smoking at least one cigarette in the last year. These rates are considerably higher than those seen in the general working-age population. While the MSR does not directly capture new diagnoses of hypertension made after stroke, it does contain data on whether patients were discharged on an antihypertensive medication. Patients with no documented history of hypertension who were discharged on an antihypertensive may have had previously undiagnosed hypertension. Among working-age stroke patients who did not have a documented history of hypertension before their stroke,18.7% were prescribed an antihypertensive at discharge, suggesting previously undiagnosed or undocumented hypertension. Rates of pre-existing risk factors for stroke among working-age stroke patients underlines the importance of stroke awareness and education messaging for this age group. Individuals with these risk factors should be educated about stroke signs and symptoms, and the relationship between chronic conditions and stroke risk, regardless of age.

Stroke Type

Most working age and above working age stroke patients experienced acute ischemic strokes (AIS). Much smaller proportions experienced transient ischemic attacks (TIAs), intracerebral hemorrhages (ICH) and subarachnoid hemorrhages (SAH). Fewer working age stroke patients experienced TIAs compared to older adults, but a higher proportion of working age stroke patients had ICHs and SAHs (Figure 7, Table 8).

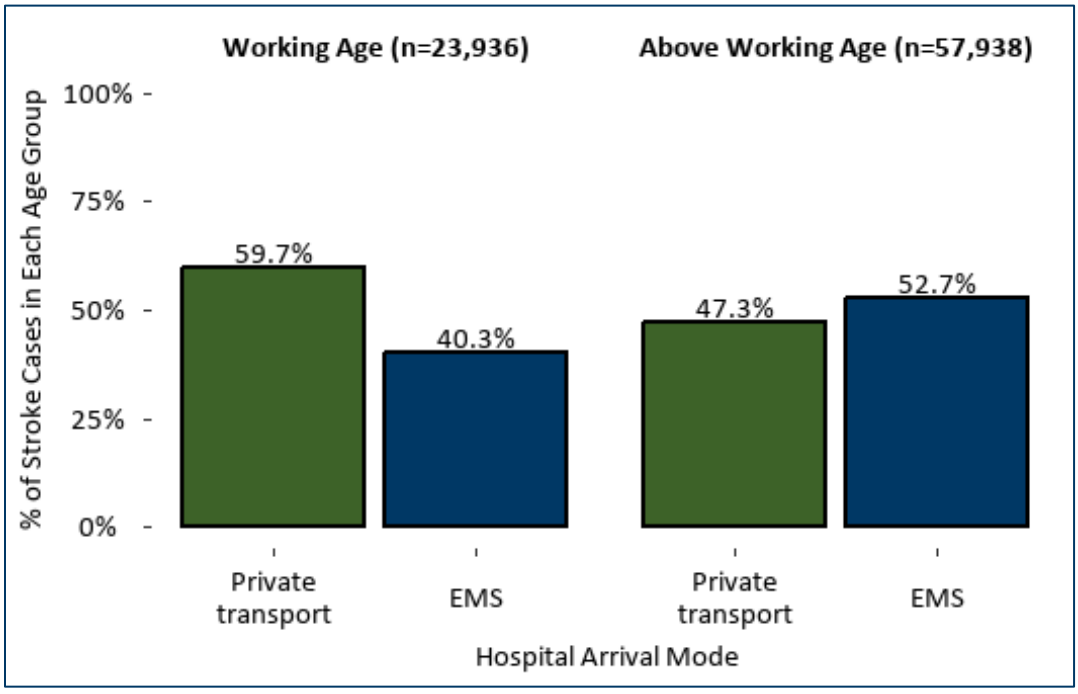
Figure 7: Types of Stroke Among Working Age and Above Working Age Patients



Hospital Arrival Mode

Mode of arrival to the hospital is an important factor in stroke treatment rates and outcomes. When stroke patients arrive via EMS, hospitals may be pre-notified of an in-coming, suspected stroke and able to more quickly activate stroke teams. Individuals of all ages are strongly encouraged to dial 911 when stroke signs and symptoms are discovered, rather than relying on private transport. Working-age adults are less likely to arrive to the hospital via EMS (Figure 8, Table 9). 40.3% of working-age adults in the MSR arrived via EMS, compared to 52.7% of those above working age.

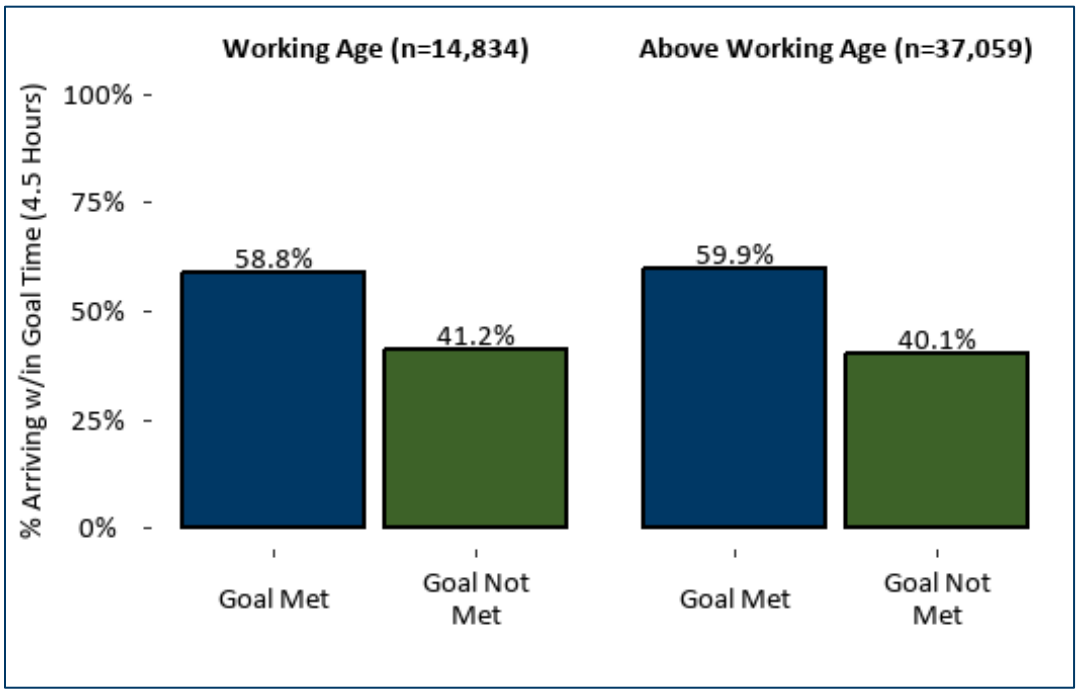
Figure 8: Hospital Arrival Mode Among Working Age and Above Working Age Patients



Hospital Arrival Time

Time between onset of stroke symptoms and arrival to the hospital is a critical factor in stroke outcomes, because "time lost is brain lost." Ideally, patients with stroke signs and symptoms would arrive to the hospital within four and a half hours of their "last known well" (LKW) time (the last time they were known to not have symptoms of stroke). Patients experiencing ischemic stroke that meet the eligibility criteria and arrive within 4.5 hours can receive IV thrombolytics, while those that arrive outside that "treatment window" may not be eligible for IV treatment. Working age and above working age adults were about equally likely to arrive to the hospital within 4.5 hours of their LKW (Figure 9, Table 10).

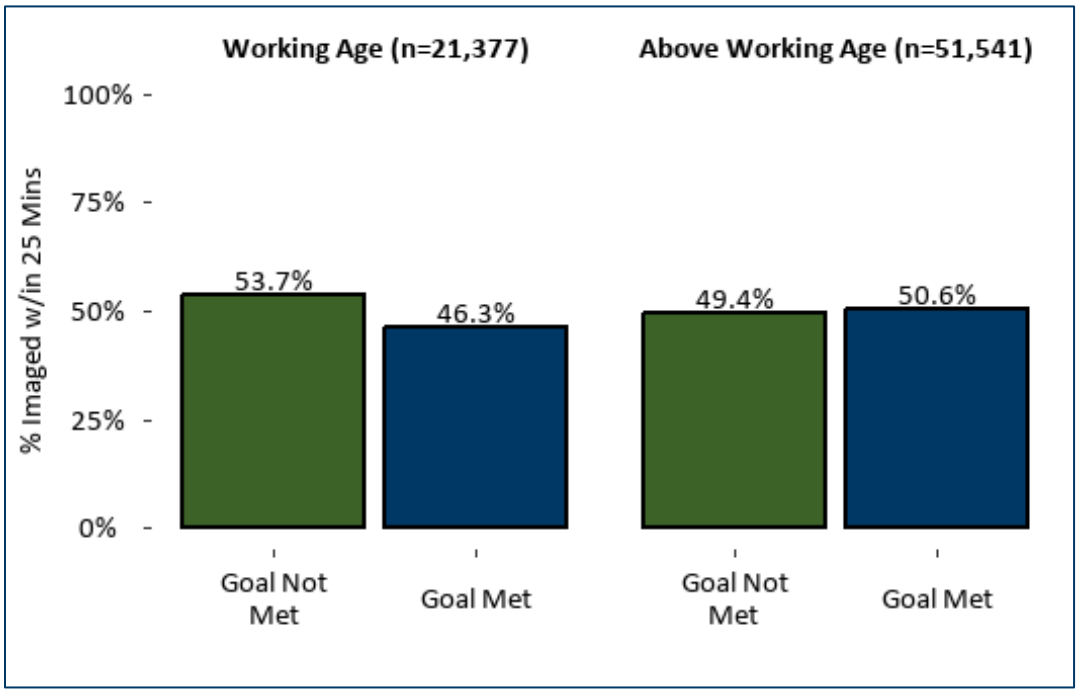
Figure 9: Hospital Arrival within 4.5 Hours Among Working Age and Above Working Age Patients



Hospital Arrival to Imaging Time

The time between hospital arrival and imaging is another important interval in stroke patient care. Hospitals aim to perform imaging on suspected stroke patients within 25 minutes of arrival. Working age adults were slightly less likely to receive imaging within 25 minutes than older adults (Figure 10, Table 11).

Figure 10: Imaging within 25 Minutes of Hospital Arrival Among Working Age and Above Working Age Patients



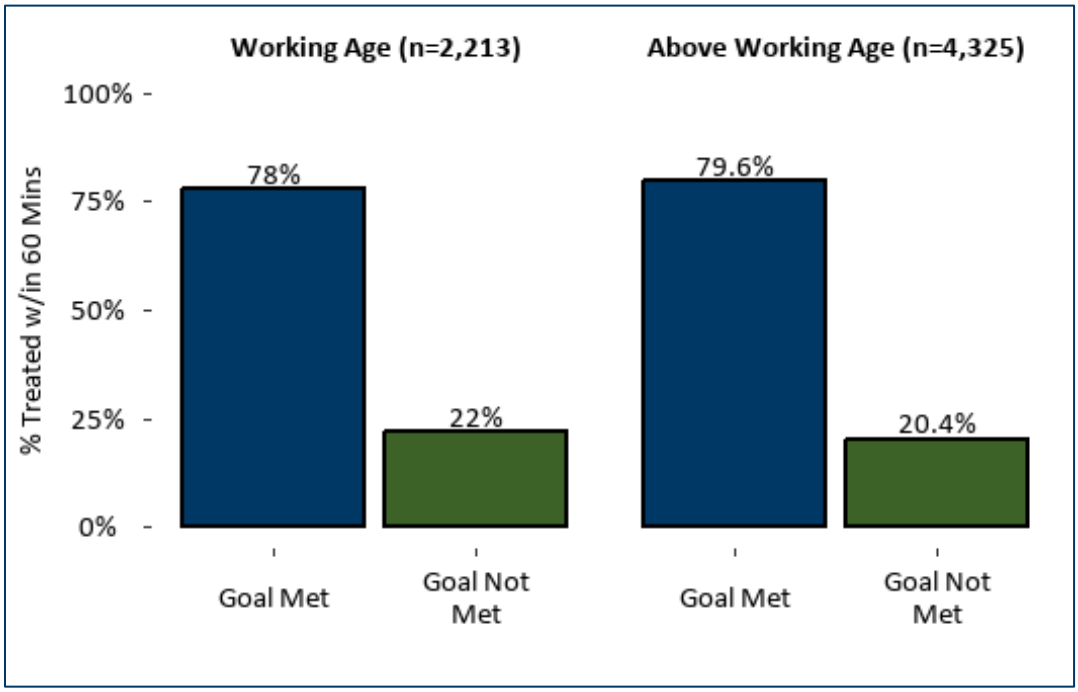
Age, Arrival Mode, and Door to Imaging

The difference in door-to-imaging time between working age and older adults is likely due to differences in hospital arrival mode. When working age adults arrive via EMS, they have a median door-to-imaging time of 17 minutes, compared to a median 33-minute door-to-imaging time for working age adults who arrive via private transportation. There is no difference in median door to imaging times between working age and above working age adults that arrive via EMS, as older adults have a median 16-minute door-to-imaging time when arriving via EMS (compared to 17 minutes for working age adults).

Hospital Arrival to Treatment Time

Time between hospital arrival and treatment is a critical stroke quality of care measure. The current goal is for eligible stroke patients to receive treatment with IV thrombolytic medication, the standard of care for AIS, within 60 minutes of hospital arrival. 78% of working age stroke patients met this goal, as did 79.6% of older patients (Figure 11, Table 12). There is less difference in door-to-needle times between working age and above working age adults than there is in door-to-imaging time, which suggests that once working age adults have been imaged, there are typically no delays to treatment that could be attributable to age.

Figure 11: IV Thrombolytic Treatment within 60 Minutes of Hospital Arrival Among Working Age and Above Working Age Patients



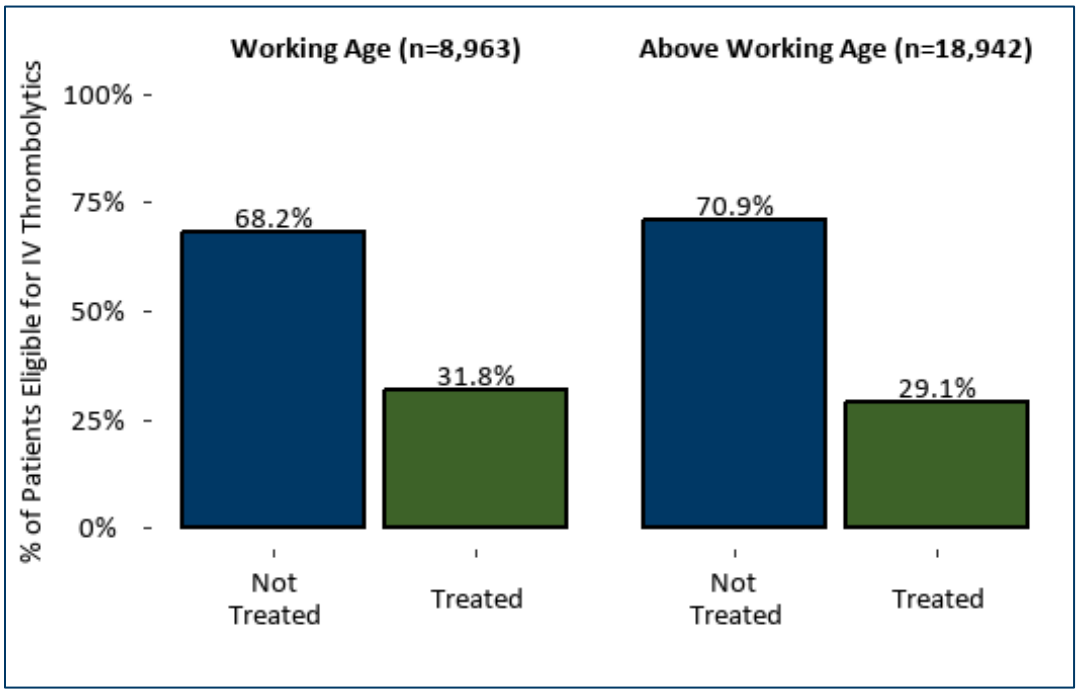
Age, Arrival Mode, and Door to Needle

Arriving to the hospital via EMS reduces door-to-needle time for both working age and above working age adults. Working age adults who arrive via EMS had a median door-to-needle time of 40 minutes, compared to 51 minutes for those who arrive via private transportation. Older adults arriving via private transportation also had a median 51-minute door-to-needle time, while those that arrive via EMS had a 42-minute median door-to-needle time.

Treatment with IV Thrombolytics

Intravenous (IV) thrombolytics are medications that help to remove blockages and restore blood flow to the brain. This helps to prevent further brain damage and improves the likelihood of recovery from stroke. IV thrombolytic treatment for stroke is time sensitive and only available for a small percentage of patients that present to the hospital quickly (typically within 4.5 hours). A higher proportion of eligible working age adults received IV thrombolytic treatment compared to older adults (Figure 12, Table 13).

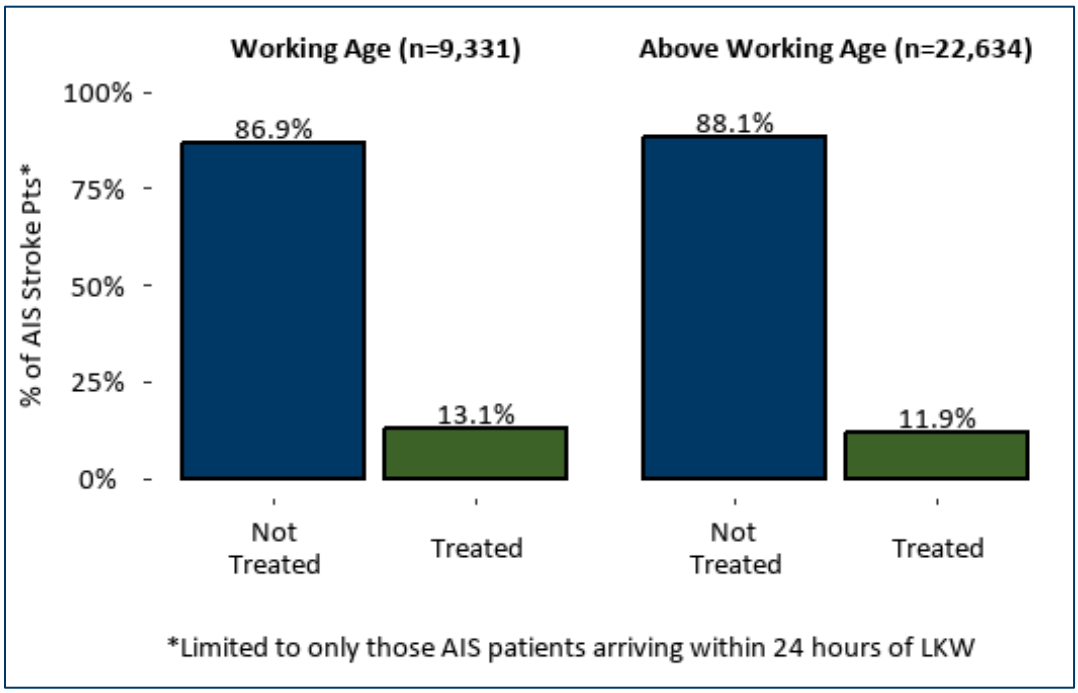
Figure 12: IV Thrombolytic Treatment Among Eligible Working Age and Above Working Age Patients



Treatment with Mechanical Thrombectomy

Endovascular clot removal, or thrombectomy treatment for stroke, is the standard of care for AIS patients with large vessel blockages who arrive to the hospital within 24 hours of last known well (and other considerations based off advanced imaging). The MSR does not include sufficient details on imaging results to determine how many patients are eligible for mechanical thrombectomy. However, we can determine what percentage of AIS patients who arrive within 24 hours of LKW receive mechanical thrombectomy. Working age patients who meet this criteria are slightly more likely than older adults to receive mechanical thrombectomy (Figure 13, Table 14).

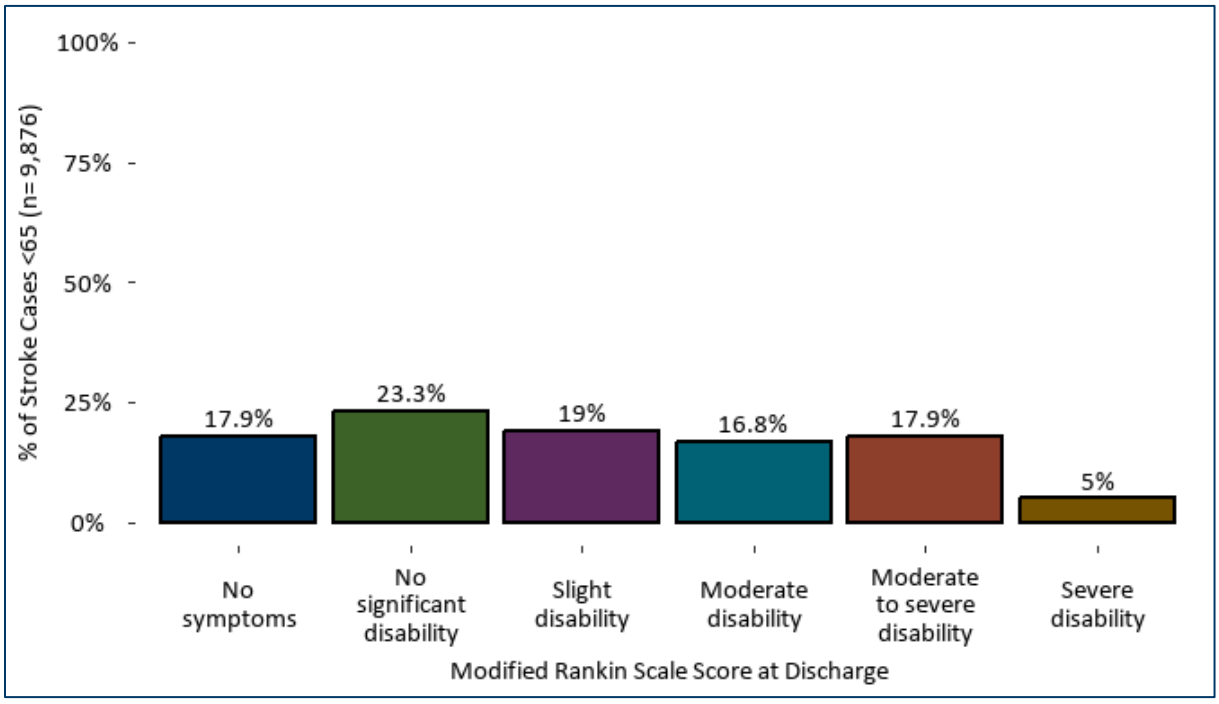
Figure 13: Mechanical Thrombectomy Treatment Among Eligible Working Age and Above Working Age Patients



Disability After Stroke

The Modified Rankin Scale (mRS) assesses a patient's level of disability after stroke. The MSR includes stroke survivor's mRS score at the time of their hospital discharge. 41.2% of working age stroke patients did not have symptoms or significant disability as a result of their stroke (at time of discharge), but 39.7% were left with a moderate to severe disability (Figure 14, Table 15).

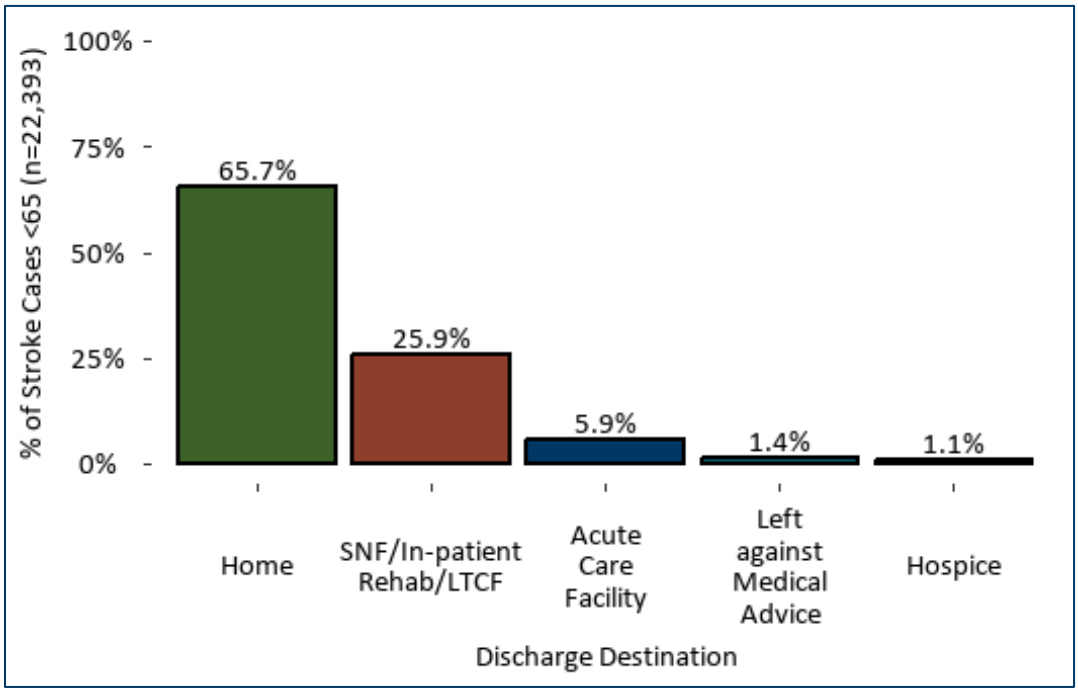
Figure 14: Post-Stroke Disability Status Among Working Age Stroke Survivors



Hospital Discharge Destination

Most working age stroke patients are discharged directly to their homes after their hospital stay. Patients discharged home may require additional out-patient rehabilitation services or in-home care, depending on the impacts of their stroke. 25.9% of working age stroke patients were discharged to a skilled nursing facility, in-patient rehab facility, or long-term care facility after their hospital stay (Figure 15, Table 16).

Figure 15: Discharge Destination Among Working Age Stroke Survivors



Conclusion

Stroke can occur at any age. Each year, about 29.4% of strokes in Minnesota are in adults under age 65. Men are more likely to experience strokes during their working years than women, as are Black, American Indian, Asian, and Hispanic individuals. Many stroke patients under age 65 have a history of stroke risk factors, such as hypertension, diabetes, and smoking. Managing these risk factors is important for individuals of all ages. Recognizing signs and symptoms of stroke, and calling 9-1-1, are also critically important to improve stroke outcomes. Effective treatment is available for stroke and many patients experience full recoveries. Stroke can be disabling, however, for patients of any age. Arriving to the hospital via ambulance can speed up treatment times, which can improve outcomes. Remember **BE FAST**:

B – Balance loss. Does the person have sudden loss of balance or coordination?

E – Eyesight changes. Is eyesight suddenly blurred or double? Is there a sudden loss of vision?

F – Face drooping. Does one side of the face droop or is it numb? Ask the person to smile.

A – Arm weakness. Is one arm weak or numb? Ask the person to raise both arms. Does one arm drift downward?

S – Speech difficulty. Is speech slurred, are they unable to speak, or are they are they hard to understand?

T – Terrible headache. Time to call 9-1-1. If the person shows ANY of these symptoms, even if the symptoms go away, call 9-1-1.

More information about stroke and the Minnesota Stroke Program is available on the MDH Stroke Program website.

Appendix: Tables

Table 1: Working Age Stroke Cases by Year

Year	Working Age	Above Working Age	Total
2018	3,163 (28.7%)	7,854 (71.3%)	11,017 (100.0%)
2019	3,188 (28.3%)	8,060 (71.7%)	11,248 (100.0%)
2020	3,343 (30.4%)	7,650 (69.6%)	10,993 (100.0%)
2021	3,683 (29.5%)	8,791 (70.5%)	12,474 (100.0%)
2022	3,686 (29.7%)	8,729 (70.3%)	12,415 (100.0%)
2023	3,944 (30.3%)	9,073 (69.7%)	13,017 (100.0%)
2024	3,838 (28.6%)	9,592 (71.4%)	13,430 (100.0%)

Table 2: Stroke Patients by Age Group

Age Group	Count	Percent
18-44	4027	4.8%
45-64	20818	24.6%
65-84	42744	50.5%
85+	17005	20.1%

Table 3: Age Groups Among Working Age Stroke Patients

Age Group	Count	Percent
<25	282	1.1%
25-34	948	3.8%
35-44	2,797	11.3%
45-54	6,567	26.4%
55-64	14,251	57.4%

Table 4: Working Age vs Above Working Age by Gender

Gender	Working Age	Above Working Age	Total
Female	10,278 (24.7%)	31,340 (75.3%)	41,618 (100.0%)
Male	14,544 (33.9%)	28,358 (66.1%)	42,902 (100.0%)

Table 5: Average Age by Race/Ethnicity

Race/Ethnicity	Mean	SD	N
American Indian or Alaskan Native	61.69	14.02	863
Asian	63.86	14.63	2,987
Black or African American	60.17	14.27	5,015
Hispanic or Latino Ethnicity	62.42	15.79	1,596
White	72.97	13.91	72,148

Table 6: Working Age vs Above Working Age by Race/Ethnicity

Race	Working Age	Above Working Age	Total
American Indian or Alaskan Native	491 (56.9%)	372 (43.1%)	863 (100.0%)
Asian	1,519 (50.9%)	1,468 (49.1%)	2,987 (100.0%)
Black or African American	3,161 (63.0%)	1,854 (37.0%)	5,015 (100.0%)
Hispanic or Latino Ethnicity	861 (53.9%)	735 (46.1%)	1,596 (100.0%)
White	18,315 (25.4%)	53,833 (74.6%)	72,148 (100.0%)

Table 7: Working Age Stroke Patients Medical History

Medical History	Count	Percent
Diabetes	6544	26.3%
Hypertension	13695	55.1%
Smoking	5478	22.0%
Stroke	5053	20.3%

Table 8: Stroke Type for Working Age and Above Working Age Patients

Stroke Type	Working Age	Above Working Age	Total
AIS	17,205 (29.5%)	41,145 (70.5%)	58,350 (100.0%)
ICH	2,742 (34.0%)	5,330 (66.0%)	8,072 (100.0%)
SAH	1,268 (51.0%)	1,219 (49.0%)	2,487 (100.0%)
SNS	534 (28.3%)	1,354 (71.7%)	1,888 (100.0%)
TIA	3,096 (22.4%)	10,701 (77.6%)	13,797 (100.0%)

Table 9: Hospital Arrival Mode by Working Age

Arrival Mode	Working Age	Above Working Age	Total
EMS	9,654 (24.0%)	30,505 (76.0%)	40,159 (100.0%)
Private transport	14,282 (34.2%)	27,433 (65.8%)	41,715 (100.0%)

Table 10: Stroke Patients Meeting LKW to Arrival Time Goal by Working Age

LKW to Arrival Time Goal (4.5 Hours)	Working Age	Above Working Age	Total
Goal Met	8,717 (28.2%)	22,216 (71.8%)	30,933 (100.0%)
Goal Not Met	6,117 (29.2%)	14,843 (70.8%)	20,960 (100.0%)

Table 11: Stroke Patients Meeting Door to Image Time Goal by Working Age

Door to Needle Time Goal (25 minutes)	Working Age	Above Working Age	Total
Goal Met	9,888 (27.5%)	26,075 (72.5%)	35,963 (100.0%)
Goal Not Met	11,489 (31.1%)	25,466 (68.9%)	36,955 (100.0%)

Table 12: Stroke Patients Meeting Door to Needle Time Goal by Working Age

Door to Needle Time Goal (60 minutes)	Working Age	Above Working Age	Total
Goal Met	1,727 (33.4%)	3,441 (66.6%)	5,168 (100.0%)
Goal Not Met	486 (35.5%)	884 (64.5%)	1,370 (100.0%)

Table 13: Stroke Patients Treated with IV Thrombolytics by Working Age

Treated with IV Thrombolytics	Working Age	Above Working Age	Total		
Not Treated	6,111 (31.3%)	13,429 (68.7%)	19,540 (100.0%)		
Treated			2,852 (34.1%)	5,513 (65.9%)	8,365 (100.0%)

Table 14: Stroke Patients Treated with Mechanical Thrombectomy by Working Age

Treated with Mechanical Thrombectomy	Working Age	Above Working Age	Total
Not Treated	8,111 (28.9%)	19,941 (71.1%)	28,052 (100.0%)
Treated	1,220 (31.2%)	2,693 (68.8%)	3,913 (100.0%)

Table 15: MRS at Discharge Among Working Age Stroke Patients

MRS at Discharge	Count	Percent
No symptoms	1770	17.9
No significant disability	2305	23.3
Slight disability	1876	19.0
Moderate disability	1662	16.8
Moderate to severe disability	1771	17.9
Severe disability	492	5.0

Table 16: Discharge Destination for Working Age Stroke Patients

Discharge Destination	Working Age	Above Working Age	Total
Acute Care Facility	1,329 (35.0%)	2,465 (65.0%)	3,794 (100.0%)
Home	14,715 (36.7%)	25,327 (63.3%)	40,042 (100.0%)
Hospice	246 (8.0%)	2,828 (92.0%)	3,074 (100.0%)
Left against Medical Advice	304 (66.4%)	154 (33.6%)	458 (100.0%)
SNF/In-patient Rehab/LTCF	5,799 (23.6%)	18,730 (76.4%)	24,529 (100.0%)

[i] Minnesota Compass. *Working-age adults Ages 18-64*. https://www.mncompass.org/topics/demographics/age/working-age-adults

[ii] Minnesota Compass. *Older Adults Ages 65+.* https://www.mncompass.org/older-adults