

## NEUROLOGICAL DISABILITY AMONG ADULTS WITH ACUTE STROKE

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### Abstract

**Background:** Neurological disability, also known as a neurological disorder, is simply described as an impairment in a person's nervous system that affects their bodily or mental functions. **Aim:** To investigate stroke-related disability in hospitalized patients during the 13-month period (January 2022 to January 2023). **Methods:** The present study was a descriptive as well as a comparative study. Target parameters were collected from medical documentation that was generated during patient treatment. Was compared the baseline frequency of neurological disability expressed as neurological deficit associated with acute stroke in hospitalized patients. **Results:** For the specified period, a total of 205 patients, as acute stroke cases were diagnosed, 104 (50.73%) males and 101 (49.27%) women. Acute ischemic stroke was the first most common cause of stroke, account for 81.95% of hospital admission for stroke, while acute hemorrhagic stroke was the second most common cause of stroke, account for 18.05%. The most frequent neurological deficit was left-sided hemiplegia 59/205 (28.78%), right-sided hemiparesis in the second order 52/205 (25.36%) and, in third order was right-sided hemiplegia 44/205 (21.46%). The three neurological deficits with the lowest frequency were: sensory-motor dysphasia 38/205 (18.54%), left-sided hemiparesis 35/205 (17.07%) and sensory-motor aphasia in 24/205 (11.71%) of cases. **Conclusion:** Regarding the baseline frequency of neurological deficit, the medical model of disability was prevalent. We think there is a need for a comprehensive format for neurological disabilities assessment, which will also include the three main components of the definition of disability from WHO (2001): impairments, activity limitations and participation limitations.

*Keywords:* stroke, ischemic, hemorrhagic, neurological disability

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### Introduction

Neurological disabilities include a wide range of neurological disorders that are medically defined as disorders that affect the nervous system. Depending on where the damage takes place, damage can result in a range of symptoms such as paralysis, muscle weakness, poor coordination, loss of sensation, seizures, confusion, pain and altered levels of consciousness.

Most authors claim that a person can acquire a physical disability for a variety of reasons, e.g., serious accidents, brain injuries, infections, diseases and as a side effect of other medical disorders and conditions, such as a stroke, an example of a major cause of long-term disability (Perin et al., 2022; Campbell et al., 2019; Roth et al., 2018; O'Donnell et al., 2016).

Whereas neurological disability, also known as a neurological disorder, is simply described as an impairment in a person's nervous system that affects their bodily and/or mental functions, strokes as neurological diseases except that they are the leading cause of disability they are the second leading cause of death worldwide, after cardiovascular diseases, while the number of stroke-related long-term disabilities increased tremendously in recent years (Campbell et al., 2019; Roth et al., 2018).

Acute stroke with a focal neurological injury of sudden onset, lasting more than twenty-four hours, of vascular origin is a clinical syndrome that can be classified into two main subtypes: ischemic and hemorrhagic stroke (Campbell et al., 2019).

Ischemic stroke occurs when the brain is not supplied with enough blood, either as a result of closing the arteries that supply the brain with blood and makes up a greater proportion of most

of the stroke cases. For example, about 85% (Roth et al., 2018), 87% (Tsao et al., 2023) or 88% (Campbell et al., 2019) are ischemic stroke, while the other, smaller percentage belongs to hemorrhagic stroke, which provokes bleeding in the subarachnoid space or intracerebral parenchyma (Campbell et al., 2019).

There is data that in half of stroke survivors age 65 and older, a physical disability also known as a loss of physical capacity is a substantial and long-term condition affecting one or more parts of that person's body that impairs and limits their physical functioning, mobility, stamina, or dexterity (Tsao et al., 2023).

Meanwhile, the experience of each person with a disability is unique and multidimensional, therefore the approach to it must be inclusive or holistic. Such an approach is in the World Health Organization (WHO) definition of disability (2001), because recently the approach to health, illness and disability has changed taking into account the recommendations for human rights, especially for the category of persons with disabilities (Narayan & John, 2017).

Based on the knowledge that the majority of stroke patients suffered from neurological disability and their disability presents the greatest risk of impacting the patients' daily functioning and quality of life (Kamberi, 2004; Kamberi & Kruja, 2006), the aim was by comparing the frequency of neurological disability according to the type of strokes, to determine when co-occurring disability is important as a clinical characteristic variable for the focus of this study and whether these data can provide more of the much-needed information on where to focus to improve the health of stroke survivors with disabilities across the lifespan.

## **Materials and methods**

*2.1. Data source and participants:* One-month follow-up was conducted among survivors from a hospitalized-based cohort of 205 enrolled patients with acute stroke included in the previous study so the methodology used is described in detail in that study (Kamberi, 2023).

In brief, a prospective, hospital-based study was undertaken from January 1, 2022, to January 31, 2023, in department of neurology in Clinical Hospital Tetovo, a secondary care referral center for neurological disorders in Lower Pollog, the Republic of North Macedonia.

For the specified period, the neurologic status of stroke survivors who had a confirmed diagnosis of a first stroke (of either type of stroke: ischemic or hemorrhagic), with a focal neurologic injury of sudden onset lasting longer than more than twenty-four hours, of presumed vascular origin was followed to determine when concurrent disability is relevant as a clinical characteristic variable for the focus of this study and whether these data may provide more information on that where to focus to improve stroke survivors' health and lifelong disabilities. The first stroke was documented using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10), codes for ischemic stroke, intracerebral hemorrhage, and stroke not otherwise specified (ICD-10\_2016\_Vol2\_PRINT.pdf).

Also, we checked final diagnoses in medical records against the attached ICD-10 code at discharge of 205 patients admitted for ischemic stroke and for hemorrhagic stroke.

The presence of neurological disabilities was defined by presence of a neurological deficit.

The prevalence of ischemic and hemorrhagic stroke survivors in hospitalized patients aged  $\geq 18$  years was defined as the number of those survivors divided by the total number of stroke survivors.

The primary outcome was cumulative all-cause disability after first stroke at the end of follow-up, stratified by stroke subtype in 30-day survivors. The secondary outcome was the prevalence rate of co-disability based on neurological deficits calculated as a percentage of different functional categories. Data on other variables, age, gender and length of stay were complete for all patients in the previous study (Kamberi, 2023).

Follow-up after first stroke was defined as time to first outpatient visit or end of follow-up, whichever occurred first. Neurological disability was defined as neurological deficit occurring within 30 days after the first acute stroke. For the analysis of the rate of neurological disability, only survivors within these 30 days were included. Deaths are not included.

2.2. *Statistical analyses:* We calculated the number and distribution of neurological deficit symptoms for each individual hospitalized stroke patient from date of acute stroke to the date of first ambulatory visit or end of follow-up, whichever occurred first. Frequencies of neurological deficit symptoms were compared between ischemic stroke survivors and hemorrhagic stroke survivors using X<sup>2</sup> (Chi-square) test [<https://www.graphpad.com/quickcalcs/contingency2/>].

The prevalence rates of co-disability on the basis of the neurological deficits were calculated as a percentage of the observed different functional categories after stroke (e.g., mobility as walking/climbing, problem solving as medical condition-comorbidity or dependence) in the group of patients with acute ischemic stroke, as a group with disabilities who experienced more neurological symptoms.

Two-sided P values of .05 were considered statistically significant.

## Results

One-month follow-up was conducted among survivors from a hospitalized-based cohort of 205 enrolled patients included in the previous study so the cohort follow-up showed the same frequency of neurological deficit (for 30 days) as at stroke onset.

The distribution of neurological deficit symptoms in hospitalized stroke survivors during the 13-month period (January 2022 to January 2023) was calculated as neurological disability for survivors of the first group (patients with AIS) and for survivors of the second group (patients with AHS).

The characteristics of causes of neurological disabilities according to the presence of symptoms of neurological deficit by a stroke type have been shown in Table 1.

**Table 1.** Target variables collected from study groups and their statistical analysis

SND*, n (%)	Survivors with AIS (n = 168)	Survivors with AHS (n = 37)	p**
Sensory-motor aphasia	22 (13.09)	2 (5.41)	0.3008
Sensory-motor dysphasia	37 (22.01)	1 (2.70)	0.0123
Right-sided hemiparesis	49 (29.17)	3 (8.11)	0.0140
Left-sided hemiparesis	31 (18.45)	4 (10.81)	0.3805
Right-sided hemiplegia	38 (22.62)	6 (16.22)	0.5237
Left-sided hemiplegia	40 (23.81)	19 (51.35)	0.0016

\*SND -symptoms of neurological deficit at stroke event

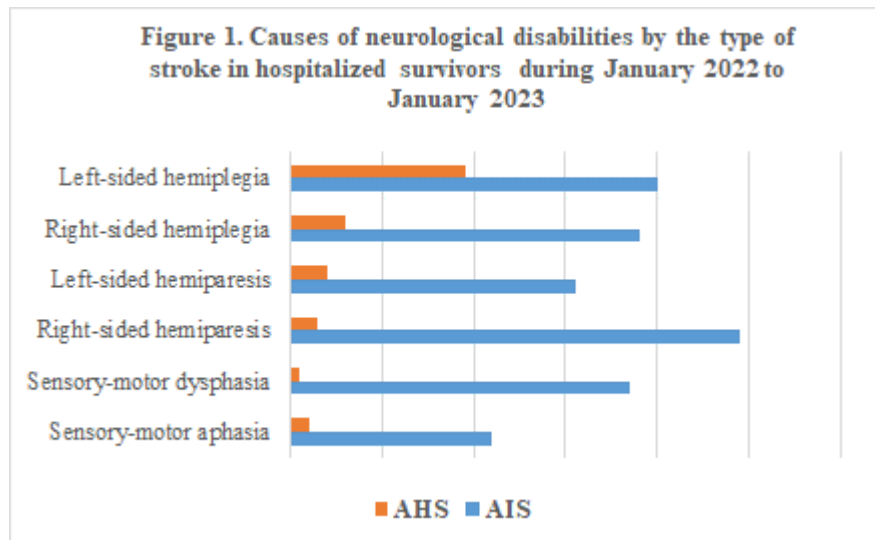
\*\* X<sup>2</sup> (Chi-square) <https://www.graphpad.com/quickcalcs/contingency2/Test>

As illustrated in Table 1, AIS (81.95%) was the most common cause of neurological disabilities in hospitalized stroke survivors, followed by AHS (18.05%). Compared to patients with AIS, patients with AHS had higher percent of left-sided hemiplegia (51.35% vs. 23.81%).

Left-sided hemiplegia 59/205 (28.78%), right-sided hemiparesis 52/205 (25.36%) and right-sided hemiplegia 44/205 (21.46%) were also common causes of neurological disabilities in hospitalized stroke survivors, followed by sensory-motor dysphasia 38/205 (18.54%), left-sided hemiparesis 35/205 (17.07%) and sensory-motor aphasia in 24/205 (11.71%).

Ischemic stroke survivors were found to have statistically significant differences in terms of proportion of right-sided hemiparesis, right-sided hemiplegia and left-sided hemiplegia. The proportion of sensory-motor aphasia, sensory-motor dsphasia and left-sided hemiparesis were not found to be statistically different between survivors of the first group and for survivors of the second group.

The number and distribution of neurological deficit symptoms in hospitalized stroke survivors over the 13-month period differed by stroke type, as shown in Figure 1.

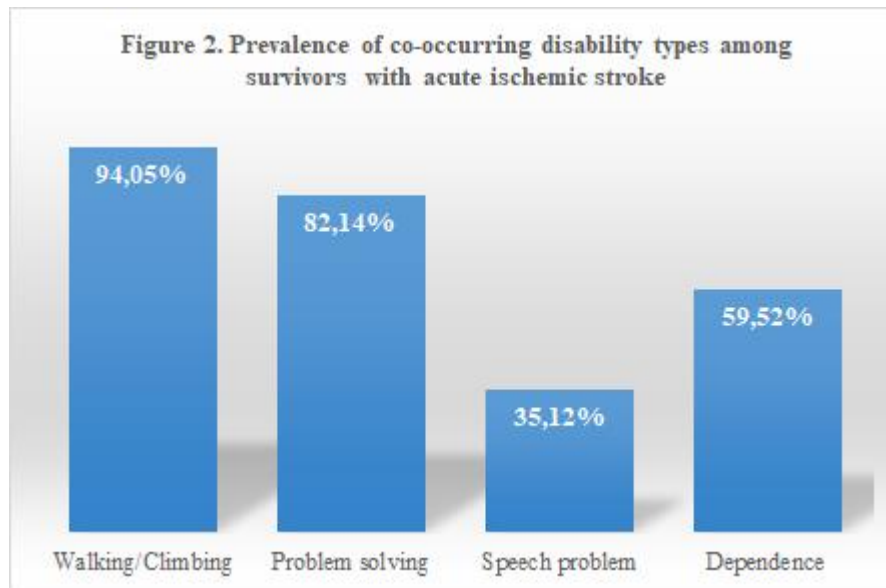


As illustrated in Figure 1, in survivors with acute ischemic stroke, according to the frequency in the first order it was right-sided hemiparesis, in the second order left-sided hemiplegia and in the third order right-sided hemiplegia, while in survivors with hemorrhagic stroke, according to the frequency in the first order it was left-sided hemiplegia, in the second order right-sided hemiplegia and in the third order was left-sided hemiparesis.

As seen from the obtained results, prevalence of neurological disability among survivors with AIS was higher compared to survivors with AHS. Site of neurologic symptoms also varied with disability status. Among the included adults who were 10-day survivors of their first stroke, the risk of disability in those with ischemic stroke compared with those with hemorrhagic stroke remained elevated one month later.

To disaggregate disability into different functional categories (e.g., mobility as walking/climbing, problem solving as medical condition-comorbidity, speech problem or dependence) the next important step was to routinely analyze the data by disability status to determine when co-occurring disability is important as a clinical characteristic variable for the focus of this study and whether these data can provide more of the much-needed information on where to focus to improve the health of stroke survivors with disabilities across the lifespan. Prevalence rates of co-disability were calculated as a percentage of different functional categories in the group of survivors with ischemic stroke, a group with disabilities who experienced more neurological symptoms.

In survivors with acute ischemic stroke, according to the prevalence of co-occurring disability types calculated as a percentage of different functional categories in the group of survivors with ischemic stroke in the first order it was walking/climbing, in the second order problem solving and in the third order dependence as shown in Figure 2.



As illustrated in Figure 2, in survivors with acute ischemic stroke all co-occurring disability types according to the frequency of different functional categories have a possible cumulative impact on current and maybe in future life experiences.

## Discussion

As shown in the some study, stroke itself was the most common cause of disabilities (Perin et al., 2022; Campbell et al., 2019; Roth et al., 2018; O'Donnell et al., 2016). Compared with other studies, the results of this study report that the medical model is present and also show that the characteristics of hospitalized stroke patients, including the reason for hospitalization and the distribution of neurological disability after stroke. We aimed to extend current knowledge.

Acute stroke is associated with poorer functional outcomes (Fluck et al., 2022) and previous studies have variably documented patient functional characteristics (Farooq et al., 2008), stroke severity (Ben-Shabat et al., 2023; Cumbler et al., 2015), functional status and patient-reported outcome (Jönsson et al., 2014).

The Barthel index to assess functional status and the modified Rankin scale to assess the degree of disability (Jönsson et al., 2014) were not used, but disability status was used because it is as great or greater a risk for unintentional injury than age, sex or gender, race, or education (Brophy et al., 2008).

Results from our sample showed that the influence of neurological deficit symptoms on disability after ischemic stroke is clear and the magnitude of disability among ischemic stroke survivors is substantial compared to the disability after hemorrhagic stroke. When compared to ischemic and hemorrhagic strokes, ischemic stroke cases were significantly more disabled in all neurological deficit symptoms studied. In this hospitalized cohort, more ischemic stroke cases experienced initial disability after stroke and were more disabled during hospital treatment than hemorrhagic stroke cases.

In an elderly cohort, more women experienced initial strokes and were more disabled at 6 months post-stroke than men, however, older age at stroke onset, not gender or stroke subtype, was associated with greater disability (Kelly-Hayes et al., 2003).

Here, for data on preventing long-term disability after stroke we compare in detail the distribution of neurological symptoms and neurological disability outcomes in patients with AIS and AHS which means that the results of the study reflect a standard medical approach to thinking about disability that involves seeing it as a problem that exists in a person's body

(medical model of disability), indeed with an emphasis on the consequence (social model of disability), as Goering (2015). claims, that “individual is thought to have need for treatment or care to correct the disability, to approximate normal functioning, or perhaps as a last resort, to help the individual adapt and learn to function despite the disability”.

Similar stroke prevalence in a medium-sized Swedish municipality (Appelros et al., 2021). this study indicates that 30-days stroke survivors are mostly dependent in daily activities because recovery of neurological function did not occur and as Appelros claims with his colleagues (Appelros et al., 2021) because many stroke patients survive with functional disability for years, stroke prevalence is a fundamental measure of stroke's impact on society.

According to the data of Centers for Disease Control and Prevention (CDC) (2013). the majority of Americans people with disabilities are younger than 65 years, and one third are ages 44 to 65 years, which are the prime years for contributing to the workforce, whereas according to (Tsao et al., 2023), stroke itself was the most common cause of disabilities and half of stroke survivors age 65 and older have limited physical functioning.

Some authors report that many stroke survivors live with different cause of disabilities and medical problems in the community (Ju et al., 2022) so stroke remains the leading cause of death (Ekker et al., 2019) and disability worldwide, despite continuous advances in treatment methods (Benjamin et al., 2019).

There are authors (Jiménez et al., 2002) who see the International Classification of Functioning, Disability and Health (ICF) as a new international model for describing and measuring health and disability, where according to Rauch et al. (2008) disability is a comprehensive biopsychosocial concept consisting of impairments, activity limitations, and participation restrictions.

Regarding the baseline frequency of neurological deficit at participants in this cohort, the medical model of disability was prevalent. Also, at this sample of stroke patients, the health condition resulting from the cumulative impact of the neurological deficits (“a person’s functional limitation or impairment”) at the present is likely to reflect the consequences of the neurological deficits in the future as quoted by Krahn et al. (2015) as might a life course perspective that recognizes that the environment influences the ability to be healthy and function effectively in society, and that health disparities reflect disparities that go beyond genetics and personal choice, or in impairments, activity limitations and participation limitations participation, which also included as components of the definition of disability from WHO (2001), or for example, like Kristin Kirschner (2001), sees disability studies as a way to help implement a more biopsychosocial model of medicine and address the troubling legacy of disability medicine and bioethics.

From one sided, adults with stroke are at increased risk for disability so from targeted stroke prevention programs may benefit adults, but from targeted rehabilitation programs may benefit adults to prevent long-term disability (Krahn et al., 2015).

From the other sided, during hospitalization there is sufficient time to collect sufficient data for rehabilitation planning for persons with disabilities, but what is available indicates that this is a particularly vulnerable time for this population. For example, in our sample during hospitalization, 94.05% of ischemic stroke patients had a mobility disability or 59.52% were dependent on the care of another person these experiences of disabilities contribute to unhealthier lifestyle behaviors and poorer mental health, creating a cycle of more chronic conditions, poorer health, and increasing functional limitations as Krahn claims with colleagues (2015).

Today we come across more terms and concepts that have been used, or are being used, referring to people with disabilities such as: defect, invalid, handicap, somatopsychic impairment, abnormality, difficulties in social integration, obstacles in psychophysical development, developmental obstacles, people with special needs, etc. (Dadić et al., 2018). Also, according

to Dadić et al. (2018) the word invalidity (disability) is of Latin origin (“invalidus”), but it has a negative connotation and in different countries there are different definitions of the term invalidity (disability) which creates dilemmas and problems for people with disabilities, whereas the concept of people with disabilities is clear and visible, because many used it, but rarely fully understand it.

In the International Classification of Functioning Disability and Health (ICF) framework, for adults (2001) and for children and youth (2007) quoted according to Krahn et al. (2015): “disability is used as an umbrella term to include bodily impairments, activity limitations, or participation restrictions that relate to a health condition”. In this perspective, general categories of functional impairment based on the ICF taxonomy and representing aspects of functioning addressed in rehabilitation therapies can be used by therapists (Resnik, 2013).

According to Iezzoni et al. (2008) in the United States, the ICF model is the most accepted model of disability in public health, but its adoption has been slow and according to Krahn et al. (2015), they claim that this happens probably because “the ICF is based on a model of social participation, and not on the medical model that is still predominant in the United States”.

It is known that population in the EU is older than that of the WHO European region (western, central, and eastern Europe) and even older than the global population, suggesting that it might be particularly vulnerable to an increasing burden of age-related neurological disorders (Deuschl et al., 2020).

Murray et al. (2012) says that stroke rank in the top 50 causes of disability-adjusted life years (DALYs). From this point of view, numerous studies confirmed neurological symptoms and signs as being important predictors of neurological disability because many neurological conditions may result in long-term disability (Nehra et al., 2020).

From term “invalidity” of Latin origin (Dadić et al., 2018) and/or “handicap” originating from the English “hand in cap” and the idea of “functioning” in the 2001 International Classification of Functioning, Disability and Health to the phrase “disabled person” can be seen as definitions vary. However, the definition given by the United Nations (UN) a joint reference has been made.

According to The Rights of Persons with Disabilities Act, 2016, “Person with disability” means a person with long term physical, mental, intellectual or sensory impairment which, in interaction with barriers, is prevented from participating fully and effectively in society, equally with others (Narayan & John, 2017) so within the context of The Rights of Persons with Disabilities when referring to persons with disabilities, one should choose words that reflect dignity and respect and use language that describes the person's disability without defining the individual's disability as his or her disability

Goering (2015) says that disability is commonly viewed as a problem that exists in a person's body and requires medical treatment, but the social model of disability, identifies disability as a disadvantage resulting from a lack of fit between a body and its social environment.

As Goering (2015) remarks “People with disabilities often express frustration when they are met with pitying attitudes or incredulity if they speak about anything positive related to living with their conditions” and “For many people with disabilities, the main disadvantage they experience does not stem directly from their bodies, but rather from their unwelcome reception in the world, in terms of how physical structures, institutional norms, and social attitudes exclude and/or denigrate them”.

From the point of view of Krahn et al. (2015) “defining inequalities is complex, so in this context, there is general agreement that health disparities refer to differences in health outcomes at the population level, that these differences are linked to a history of social, economic, or environmental disadvantages, and that these differences are regarded as avoidable”.

According to WHO (2006) patients with neurological disorders often require significant social and economic support because of physical, cognitive, and psychosocial limitations.

Within the context of disability, the protection of patients' rights is seen from several perspectives (Horodovenko et al., 2018) as the invalidity of contracts in the field of medical services as a way to protect the rights of the patient (Tashian, 2021).

Guidelines for management of ischemic stroke and transient ischemic attack (2008) emphasizes that it is already known that the consequences of stroke, patients carry throughout their lives and they have a great impact on their way of life but also on their family members.

On the other hand, according to Feigin et al. (2020): “the burden of deaths and disability caused by neurological disorders is increasingly being recognized as a global public health challenge, and this burden is set to rise during the next few decades”.

This means that access to real health care for many patients with neurological disabilities will be difficult, and this represents an additional challenge in the health system that requires greater commitment from decision makers, increased social and professional awareness

## Conclusion

In this small unselected cohort, the distribution of neurological deficit symptoms in hospitalized stroke survivors over the 13-month period differed by stroke type and experience of stroke-related disability (e.g., impaired speech, limited physical abilities, weakness or paralysis of a limb on one side of the body, difficulty grasping or holding things, and a slowed ability to communicate) suggest that neurological disability was present as the medical model of disability in the cases.

Also, the results of this study indicate that 30-days stroke survivors are mostly dependent in daily activities because recovery of neurological function did not occur and when it is known that many stroke patients survive with functional disability for years, neurological disability prevalence is a fundamental measure of stroke's impact on society.

We think there is a need for a comprehensive format for neurological disabilities assessment, which will also include the three main components of the definition of disability from WHO (2001): impairments, activity limitations and participation limitations, whereas the approach to the three main models that elaborate the problem of disability (medical, social and biopsychosocial model of disability) would be more purposeful.

In addition, within this small cohort, it was possible to analyze specific causes of a physical disability in more detail than previous studies, with information available on subtypes of strokes. Previous studies have presented this only for patients with ischemic stroke and not for patients with intracerebral hemorrhage, and causes of a physical disability were limited to recurrent stroke, other cardiovascular disease, malignancies, and other causes.

Although our sample is small, this detailed analysis of underlying differences in neurological disability characteristics between patients with AIS or AHS and adverse outcomes provides further insight into understanding the poorer outcomes associated with AIS.

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