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Driving inclusivity: design needs in autonomous vehicles for people with epilepsy

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Abstract: In this study, the transportation needs of people with epilepsy are considered, specifically in regard to the development of autonomous vehicles. People with epilepsy who are unable to achieve control of their seizures are not typically able to safely operate a motor vehicle, and are unable to be licenced drivers, and it is logical to believe that autonomous vehicles would be a benefit to them. However, the specific needs that people with epilepsy may have with respect to autonomous vehicles have not been examined. In this work, interviews with people with epilepsy and medical professionals involved in the treatment of epilepsy were conducted, with the goal of understanding the ways in which lower levels of autonomy might allow people with epilepsy to safely operate a motor vehicle as well as what design features might be needed in fully autonomous (Level 4 or Level 5, those which do not require human intervention) vehicles. As a result of this work, a roadmap of possible technological innovations and research directions is presented, with the intention of providing solutions to various challenges faced by people with epilepsy in their access to transportation.

Keywords: autonomous vehicles, epilepsy, transportation accessibility, mobility independence, inclusive design

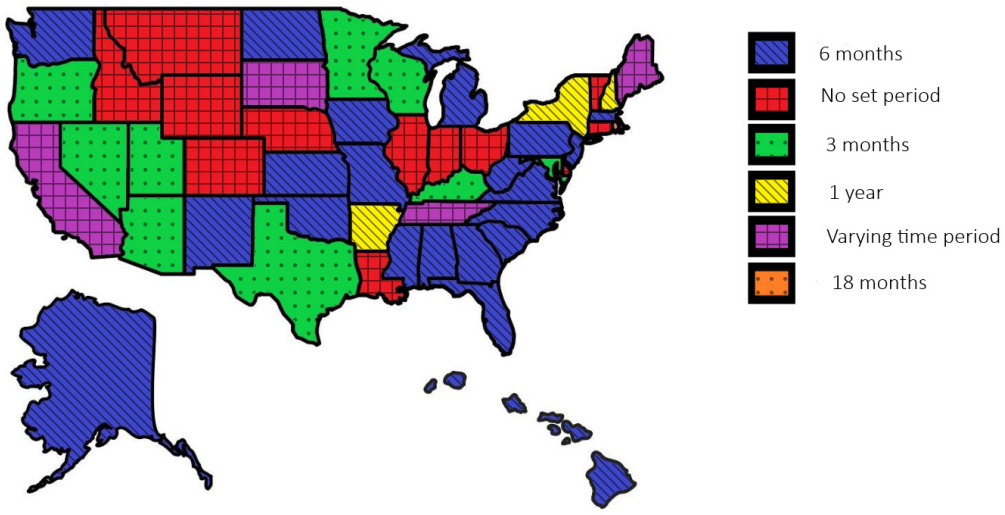
1. Introduction

One of the benefits of developing autonomous vehicles is that they have the potential to expand access to transportation to those who currently are unable to drive. This inability to drive may stem from a number of different causes, including disability status. Many disabilities can impact a person's ability to safely operate a vehicle; in this study, the needs of people with epilepsy are considered. People with epilepsy who are actively having seizures are typically unable to get a driver's licence, and it is acknowledged that they are not able to drive safely due to the risks of a seizure happening while they are driving. There are variations in how long someone must be seizure-free in order to be licenced to drive; data taken from the Epilepsy Foundation website (epilepsy.com/lifestyle/driving-and-transportation/laws) indicates that while some states have no set time period, those that do typically require six months without seizures. Some require as little as three months, while others require a year or more, with Rhode Island as the outlier with a requirement of 18 months. Figure 1 shows the variations in state requirements.

A number of studies have been conducted relative to epilepsy and driving, with the goal of understanding some of the associated risks; some of these studies also included other medical issues as well, as in a study in 1991 where it was found that drivers with either epilepsy or diabetes have an increased risk of traffic accidents (Hansotia & Broste, 1991). Similarly, a study by Hasegawa, Kumagai, and Kaji found that of 72 drivers with epilepsy, 18 of them experienced one

or more automobile accidents (Hasegawa, Kumagai, & Kaji, 1991). Later work conducted in 1996 looked at the risks of accidents for people with epilepsy behind the wheel, and discussed the risk of injury related to policies on how long someone must be seizure free in order to drive (Taylor, Chadwick, & Johnson, 1996). Another study in 1996, conducted in the United Arab Emirates where there were no rules on epilepsy and driving at the time, found that there was a significantly higher risk of property damage for accidents that occurred due to drivers having epileptic seizures (Bener, Murdoch, Achan, Karama, & Sztriha, 1996). Further studies continue to examine the risk of seizure-related accidents, e.g., (Tomson, Beghi, Sundqvist, & Johannessen, 2004), but not all showed the same results; work by Kwon et al. in 2011 found that people with epilepsy were not more likely to have motor vehicle accidents than the general population of drivers (Kwon, et al., 2011). Further work, conducted in 2019, found that of 658 drivers with epilepsy, 19 had seizures while driving, and 16 of those seizures resulted in accidents (Inamasu, Nakatsukasa, & Tomiyasu, 2019).

Figure 1: State Requirements: Seizure-Free Periods to Drive



Note: Map Outline from https://gisgeography.com/wp-content/uploads/2023/12/United-States-Country-Outline.jpg

Work by Sultan and Thomas presented results of a small study, in which eight people with epilepsy or their carers participated in semi-structured focus groups (Sultan & Thomas, 2020). This work, while closely aligned with the study reported in this paper, focused exclusively on the possibility of fully autonomous vehicles. Some of its findings included the devastating impacts of being unable to drive, concerns over the technology, the stigma associated with epilepsy, and the possible improvements in disease management if the concern over driving eligibility were removed. Another recent work by Ziyad and Ziyad specifically focused on the integration of emergency rapid response technology into vehicles to provide a response to epileptic seizures (Ziyad & Ziyad, 2021). This work focused on wearable medical devices that would communicate with a car's control system.

It is noted that the overwhelming majority of the literature on epilepsy and driving has been published in journals related to the medical field, not in the automotive literature. Much of it is descriptive, yielding useful information on the risks of driving for people with epilepsy and the impact of not being able to drive. Some studies, such as the work by Ziyad and Ziyad, propose technological solutions to some of the problems that are identified in other work. However, no comprehensive set of research directions or design concepts has been set forth to provide an agenda for researchers, engineers, and automotive designers.

In addressing this gap, this work is grounded in the broader context of accessibility and inclusive design. The Universal Design principles articulated by Connell et al. (Connell, et al., n.d.) emphasize equitable use, perceptible information, and tolerance for error, offering a structured framework for understanding how autonomous vehicles can support people with diverse abilities, including those with epilepsy. Furthermore, the focus on social participation and equity, as established by Tauke (Tauke, 2019), aligns with the objective of this study, which is to ultimately promote the full inclusion of people with epilepsy in society through ensuring that they have access to reliable transportation. By situating the findings of this study within these established frameworks, this work highlights not only the technical but also the inclusive-design significance of developing autonomous vehicles that expand mobility options for people with epilepsy.

2. Methodology

Data was gathered through semi-structured interviews and focus groups with people with epilepsy and health care professionals involved in the treatment of epilepsy. The study protocol and consent form were approved by the Kettering University Institutional Review Board (IRB). At the beginning of each interview or focus group, participants were asked if they had any questions or concerns about the consent form or the study in general.

For people with epilepsy, the following questions were used to frame the discussion:

- Tell me about how you handle transportation. Are you able to drive, or do you have someone else drive you? Is public transit an option?
- How accessible do you feel transportation is to you? Do you sometimes have to forego going places you want to because of transportation?
- In what ways, specifically, does epilepsy impact your ability to drive or use other forms of transportation?
- What would an ideal transportation solution look like to you?
- (Optional question for parents of children with epilepsy) What concerns do you have about the safety of your child/children with epilepsy in the car?

For health care professionals, the following questions were used to frame the discussion:

- Thinking about your patients with epilepsy, how much of a problem is transportation for them? What challenges do they face due to epilepsy with either driving or public transportation?
- What kinds of transportation solutions would work with the average patient? What would be necessary for the worst case scenario?
- What types of actions should an autonomous vehicle take if someone in it has an epileptic seizure? Are there actions an autonomous vehicle might take that would trigger seizures in some patients?
- If a vehicle was to have a system to detect a driver or passenger who had a seizure, how might this work? What could it detect that would indicate a seizure was taking place?

In discussing levels of autonomy and vehicle capabilities, the framework developed by SAE International was used, in which there are five levels of autonomy, in addition to a “Level 0”, which indicates no autonomy at all. These five levels of autonomy are (SAE International, 2021):

- Level 1: The driver must be constantly supervising the car, but may engage driver support for either steering or speed control.
- Level 2: The driver must be constantly supervising the car, but more than one driver support feature may be used, such as lane centring and adaptive cruise control.
- Level 3: The car can drive itself in some circumstances, but when the driver assistance features request to return control to the driver, the driver must take control.
- Level 4: The car can drive itself and the driver does not need to take control, but the vehicle may have a limited operational domain, outside of which it cannot operate autonomously.
- Level 5: The car can drive itself and the driver does not need to take control, without restrictions on where and when the vehicle can operate autonomously.

The levels of autonomy were familiar to some participants in the study; the health care professionals participating in the study were generally familiar with them, while some of the people with epilepsy were familiar and some were not.

Participants were recruited by the Epilepsy Foundation of Michigan, which publicised the research study to their contacts. The Foundation sent an email invitation to all community members who had reached out in the past two years looking for information or assistance related to transportation. The Foundation also invited members who participated with their Call & Connect groups, placed information on the Foundation website, and posted on social media. The Foundation ensured that all participants received a link to the electronic consent form prior to interviews and focus groups and set up the Zoom sessions. A staff member from the Foundation was present on the Zoom sessions in order to introduce the participants to the researcher, provide technical support if needed, and take notes to supplement the researcher's notes. Participants were placed in a focus group or individual interview based on their individual preference.

A total of 25 people participated in the study. Four were health care professionals, one was a parent of a child with epilepsy, and the remaining 20 were people with epilepsy. The criterion used to determine when sufficient participants had been recruited was saturation, which is a well-accepted criterion for qualitative work (Kielmann, 2012). The population was split almost equally between men and women. Due to the sensitivity of discussing medical issues, the need for respecting participants' privacy, and the specifics of the approved Institutional Review Board (IRB) protocol, detailed demographic data was not collected. Out of the 20 people with epilepsy, two of them currently were able to drive; the remaining participants among those 20 either did not drive, or did not disclose whether they were able to drive. Three of those participants reported that they had their first known seizure while driving, resulting in an accident. The participants came from multiple areas of the state of Michigan, and therefore while the geographic range was relatively small, it covered both urban and rural areas. Given the prevailing climate of the state, difficulties due to the typical weather in different seasons were inherent in the participants' experiences.

Of the 25 participants in the study, seven participated in two different focus groups, with one group of five and one of two, and the remaining 18 opted for individual interviews. Additionally, five participants confirmed attendance but did not attend their scheduled interviews; follow-up to see if they wished to reschedule was handled by the Epilepsy Foundation of Michigan staff.

Interview time slots were scheduled for one hour, although very few interviews took the full hour. Typical interviews lasted between 30 and 45 minutes. Focus groups were scheduled for a time slot of an hour and a half, and took approximately one hour in both cases.

The data was analysed using standard methods for qualitative data analysis. Specifically, techniques of descriptive coding (also known as topic coding) were used to identify the key topics that were brought up in the interviews and focus groups (Saldaña, 2021). Thematic analysis was conducted to identify the key recurring elements in participants' experiences (DeJonckheere, Vaughn, James, & Schondelmeyer, 2024).

3. Results

Analysis of the interview and focus-group data identified several major themes: (1) transportation constraints and vulnerability; (2) impacts of transportation barriers on daily life; (3) perceptions of autonomous and semi-autonomous vehicles; (4) desired features for accessible vehicle design; and (5) expectations and preferences for seizure-response and detection systems. These themes reflect consistent patterns that emerged across participants' accounts and align with established approaches to qualitative descriptive and thematic analysis. In addition to these key themes, participants were interested in the technical question of how seizures could be detected by vehicles, as well as the effects of surgery to prevent seizures; this has been grouped into a section on technical and medical considerations.

3.1. Theme 1: Transportation Constraints and Vulnerability

Participants described substantial limitations in their ability to travel independently, citing barriers across public transit, ride-share services, bicycling, and informal support networks. For most participants, public transit was not always a feasible option due to its availability, schedule, and consistency; however, some participants also reported concerns over how a bus driver or other passengers might react to a seizure. In addition, one health care professional reported that he knew of a case where someone having a seizure had been burned on the electric rail of a commuter train, as well as cases of robbery or sexual assault when someone was unconscious due to a seizure. Another participant reported an unfriendly ride-share driver, possibly due to their epilepsy, as there is a noted stigma attached to the disorder, as reported by the health care professionals in the study and in the literature (Jacoby & Austin, 2007); (Çamcı, Yakar, Oğuz, & Erdoğan, 2025). Other forms of transportation, aside from personal vehicles and public transit, that people with epilepsy reported using are shown in Table 1. It was noted, however, that using Uber alone could be an issue for some people, due to the possibility of having a seizure in the vehicle and the driver not knowing what to do, and that using a bicycle is not necessarily an option during the winter, and could be dangerous for some, due to the nature and frequency of seizures.

Table 1. Forms of Transportation Used Aside from Personal Driving or Public Transportation

Type of Transportation	Frequency
Depend on family or friends	8
Ride-share such as Uber or Lyft	4
Bicycle	3

Taken together, these findings illustrate the ongoing dependence many participants experience on others for essential mobility, and they underscore the importance of transportation accessibility as a prerequisite for participation in employment, education, medical care, and social activities.

3.2. Theme 2: Impacts of Transportation Barriers on Daily Life

Participants with epilepsy reported significant issues with transportation to a variety of places and events, and health care professionals reported seeing the same issues among their patients. One health care professional reported that transportation was the single biggest social problem caused by their patients' epilepsy. Lack of transportation impacted the ability to access medical treatment, maintain stable employment, spend time with family and friends, and participate in ordinary activities of daily living, such as going to the store. The most commonly cited transportation issues concerned employment, followed by medical appointments, shopping, recreation, and social activities with friends. One participant reported being ``medically retired'', in part due to transportation issues; another stated that she would like to join a writers' group, but had no way to get there. Yet another worked as a disk jockey (DJ), and spent much of his income from gigs on transportation; he also was unable to take jobs that came up at the last minute, due to the need to plan transportation in advance. Another participant wanted to attend college, and was concerned both with a residential experience, due to the possibility of having seizures without their existing support structure, and with commuting to school due to the difficulties of transportation. One health care professional also noted that the Epilepsy Foundation has many programmes to provide support for the community, but some members of that community are only able to participate in virtual events due to transportation needs.

These accounts collectively highlight the substantial equity gap created when transportation systems are not designed for users with conditions such as epilepsy, reinforcing the relevance of inclusive-design approaches that emphasize equitable use and flexibility.

3.3. Theme 3: Perceptions of Autonomous and Semi-Autonomous Vehicles

Participants were generally enthusiastic about the idea of autonomous vehicles; however, some had safety concerns and one participant in particular was strongly opposed to autonomous vehicles, feeling that their ability to operate safely is far in the future; this aligned with results seen by Sultan and Thomas (Sultan & Thomas, 2020). The idea of a semi-autonomous vehicle, which would take over from the driver in the event of a medical emergency, was seen as a more immediately attainable option. The safety concerns raised by the participants were typical of those that most people seem to have about autonomous vehicles, including how it would recognize pedestrians, whether it would follow traffic rules, and how it would be tested to ensure safety. Some participants in the study were engineers themselves, and they talked extensively about the design decisions involved in autonomous vehicles, testing protocols, and related issues. Several expressed the wish to participate in future work that might result in vehicles that would be appropriate for people with epilepsy. These responses point to a complex intersection of trust, perceived risk, and desired control, elements that are central to accessibility-focused human-autonomy teaming and inclusive technology adoption.

3.4. Theme 4: Desired Features for Accessible Vehicle Design

When participants were asked what their ideal transportation scenario would look like, several issues were raised, beginning with the cost of transportation. Even when options like Uber and

Lyft were feasible in other ways, the cost could at times be prohibitive, particularly given challenges maintaining stable employment. Participants emphasized features consistent with Universal Design principles, such as perceptible information, flexibility in use, and low physical or cognitive effort.

Most participants would find a shared vehicle to be an acceptable option, but one did specifically say that they wanted to own their own vehicle, with whatever level of autonomy would allow them to operate it independently. This might be connected to another concern, that of the hours of availability. Participants felt that something that was available with a reasonably short notice over a wide range of hours, including outside of business hours, was essential. The ability to interact with a vehicle via app or by calling for it from a home phone was also desirable. Other concerns included carseats, for those with children, and the ability to safely accommodate dogs, including service dogs. The ability to have the vehicle monitored by a dispatcher, as with some autonomous vehicles currently being tested was discussed; one such example is Waymo (Cummings, Li, Seth, & Seong, 2021). This was seen as a positive feature by some people, particularly if they were to have a seizure in the vehicle. Some of the other issues that were raised in regard to ideal transportation solutions were a secure place to keep medication, addressing sensitivity to noise, and the ability to block flashing lights for someone with photo-sensitive epilepsy. It was also noted that stress may trigger seizures in some people, and therefore having a level of trust in the vehicle is crucial.

In their interactions with a vehicle, participants generally felt that some kind of a display similar to those that now exist would be desirable. In most cases, they wanted a touch-screen interface, although some people would prefer a voice-activated system. It was also felt that communications should be customisable, depending on individual preferences for type and frequency of communications. These desired features reflect common inclusive-design considerations related to sensory accessibility, cognitive load, and compatibility with diverse user needs.

3.5. Theme 5: Vehicle Actions in the Event of a Seizure

There were extensive discussions on what a vehicle - whether fully autonomous or with the limited autonomy of taking control in an emergency - should do if a seizure occurred in the vehicle. Some participants had definite opinions on what should happen, while others could foresee different scenarios where different actions might be desirable; in some cases, participants thought a hierarchy of actions might be best, depending on factors such as how long a seizure was going on. This aligns with the views reported by Sultan and Thomas, wherein it was stated that "Participants could not agree on whether they would like the car to continue its journey or come to a safe stop in the event of the seizure." (Sultan & Thomas, 2020) The various actions mentioned by participants in this study are shown in Table 2; due to these different scenarios, the total number of responses is greater than the number of participants.

The most frequent action desired was to pull over and summon medical assistance; however, some participants definitely did not want this, unless a seizure was unusual in some way. There was also a debate over the desirability of locking doors; the discussion centred on whether that was more likely to keep a person safe, in the event that they were disoriented by the seizure and attempted to leave the vehicle and walk away, or whether it would be a hazard since it would prevent emergency personnel from reaching the person. The consensus was that some form of a profile should be created, which the vehicle would have access to, and which would contain critical information for that particular person. This aligns with the accessibility-driven approach

of emphasizing flexible, adaptable design that allows the system to match user needs, rather than imposing a one-size-fits-all architecture.

Table 2. Desired Vehicle Actions in the Event of a Seizure

Vehicle Action	Frequency
Pull over to the side of the road	18
Call a doctor, hospital, or EMTs	8
Call a designated friend or family member	7
Just wait for the seizure to end	3
It depends on the seizure type	3
Lock the vehicle doors	2

3.6. Technical and Medical Considerations: Seizure Detection and Effects of Surgery

Another topic of discussion was the question of how a vehicle could detect that a seizure was taking place. This presents a number of challenges, given the range of different types of seizures that could occur. Some of the ideas that were suggested included some form of helmet or device in the car's headrest that could detect brain wave activity and thereby send a signal to the car, devices to check a person's heart rate and pulse, or devices to detect violent muscle contractions or unexpected actions such as sudden braking or acceleration commands. There were also extensive discussions on the range of medical devices such as various types of vagus nerve stimulation devices (VNS) and responsive neurostimulation systems (RNS). One specific implantable device, the NeuroPace system, was mentioned (Kumar, Jandial, & Levy, 2025). Wearable devices to warn of seizures were also called out, with Empatica specifically being mentioned (Rukasha, Woolley, & Collins, 2020). There were many suggestions for ways to interface these devices with a vehicle, with the natural concern that privacy could be an issue and that HIPAA regulations could be a complication. Overall, participants enthusiastically offered ideas for how various types of seizures might be detected. In the case of people with epilepsy, these were generally based on their own personal experiences; health care professionals considered the question more broadly, as they saw a wide range of different types of seizures. These ideas reflect an intuitive recognition of the need for multimodal detection systems grounded in perceptible information and tolerance-for-error principles, critical to ensuring safety without overburdening the user.

An additional topic that emerged was the impact of surgery, which can stop seizures in some people, on the ability to drive safely. One person with epilepsy reported that after having surgery to stop their seizures, they experienced slowed reactions and some forms of cognitive issues, which impacted driving. Furthermore, one of the health care professionals mentioned that in some cases, if a person has surgery to stop seizures, their visual field of view is impacted, which makes it difficult or impossible to drive safely due to the inability to see enough of the surrounding environment. These findings suggest that autonomous and semi-autonomous vehicles may support not only those with active seizures but also individuals with postoperative impairments, expanding the scope of accessibility considerations in vehicle design.

4. Discussion

The results of this study highlight several interconnected challenges faced by people with epilepsy in accessing transportation. These challenges add to the existing literature on epilepsy and transportation. Prior work has discussed both real and perceived risks that can arise from people with epilepsy driving vehicles, as well as the impact of transportation limitations on quality of life (Hansotia & Broste, 1991; Hasegawa, Kumagai, & Kaji, 1991; Inamasu, Nakatsukasa, & Tomiyasu, 2019). The findings of this study reinforce those observations, but also provide additional insight into the cumulative impact of limited transportation access, including employment barriers, reduced independence, and difficulty participating in ordinary activities.

The experiences reported by participants also align with previous research on stigma and safety concerns beyond those of a possible vehicle accident. As seen in earlier work (Çamcı, Yakar, Oğuz, & Erdoğan, 2025; Jacoby & Austin, 2007), stigma associated with epilepsy continues to impact people's interactions with others, including transportation providers, and contributes to feelings of vulnerability in transportation as well as other settings, and is reflected in broader discussions of inclusive design (Tauke, 2019). The perspectives from health care professionals further affirm that transportation is a central life issue for people with epilepsy.

In discussing autonomous and semi-autonomous vehicles, participants expressed a range of views similar to those identified by Sultan and Thomas (Sultan & Thomas, 2020), including optimism about future benefits and hesitation regarding safety, technological reliability, and trust. However, this study adds further insight by showing how participants conceptualize autonomy through the lens of their own seizure types, support networks, medical histories, and comfort with technology. The emphasis on personalized action plans, flexible system behaviours, and multimodal detection reflects a more detailed set of expectations than what has been previously reported. These concerns enrich the discussion of human-autonomy teaming and system behaviour that is found in other areas of the autonomous vehicle literature (Cummings, Li, Seth, & Seong, 2021; Mai, Daveron, Julius, & Mishra, 2025), and align with accessibility-focused autonomous vehicle work showing how different populations think about trust and usability (Brinkley, Posadas, Woodward, & Gilbert, 2017).

These findings also connect directly to broader principles of accessibility and inclusive design, particularly Universal Design. Participants' desires for customisable communication, reduced sensory overload, safe emergency protocols, and flexible interaction modes align closely with principles such as perceptible information, flexibility in use, and tolerance for error. This connection suggests that autonomous vehicle development should not treat accessibility as an accommodation added late in the process but rather as a foundational design criterion.

The discussions surrounding seizure detection highlight an emerging and relatively under-addressed area in the literature. While prior work (Ziyad & Ziyad, 2021) has explored IoT-based seizure response systems, participants in this study went beyond existing proposals by envisioning multimodal, individualized detection frameworks integrated directly into vehicles and interoperable with medical devices, personal preferences, and privacy requirements. This also intersects with research on implantable devices such as the NeuroPace RNS (Kumar, Jandial, & Levy, 2025), which was mentioned by several participants. Their suggestions point toward future

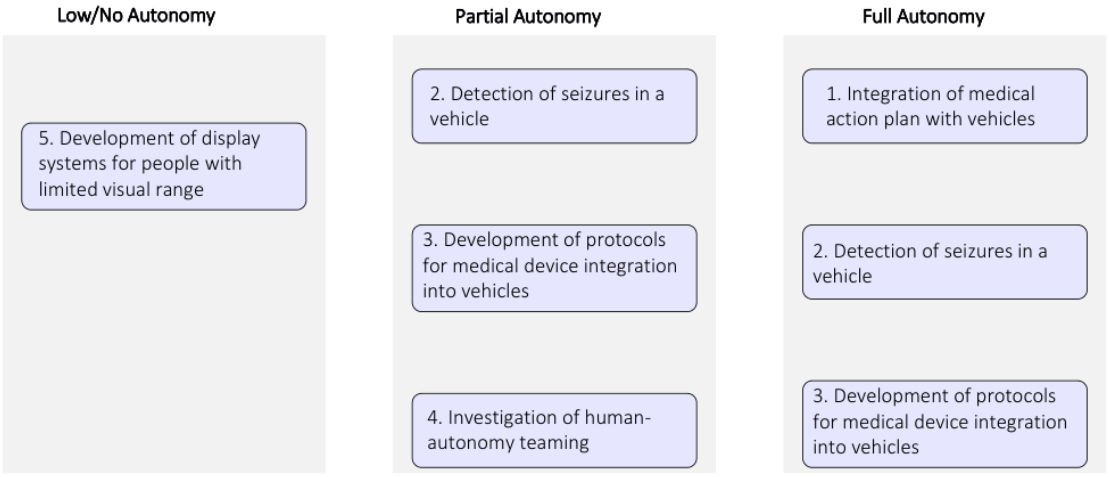
research on technical feasibility, safety thresholds, false-positive and false-negative tolerances, and regulatory considerations.

Finally, this study contributes new insight into how factors such as postoperative visual limitations or cognitive aftereffects influence driving ability and may create additional accessibility needs beyond seizure control alone. This expands the conversation about epilepsy and driving to include those whose seizures are medically managed but who still face significant barriers to safe vehicle operation. The results of this study, therefore, point to the urgent need to pursue a technical research agenda that centers the human experience, respects the varying needs of people with epilepsy, and focuses on both long-range and short-range research and development projects that can improve lives. Such an agenda is set forth in the Roadmap of Future Work, in the hopes that it will serve as a call to action to researchers working on the development of autonomous vehicles.

5. Roadmap of Future Work

The primary purpose of this study was not to itself advance autonomous vehicle technology, but to identify research and development challenges that could lead to vehicles that could provide mobility to people with epilepsy. Based on the results of the study, several avenues for future research are set forth here. The basic areas covered in this roadmap are shown in Figure 2. Each of the five areas is categorised by whether it applies to full autonomy, partial autonomy, or low/no autonomy. In addition, all areas of the roadmap should incorporate safety and system vulnerability; a full discussion of these issues is beyond the scope of this paper, but should be the subject of extensive future work.

Figure 2: Conceptual Framework: Research Roadmap by Level of Vehicle Autonomy



5.1. Integration of Medical Action Plan with Vehicles

The actions that vehicles should take when a driver or passenger has an epileptic seizure vary depending on the person and the circumstances. Therefore, one promising avenue for development is the creation of a vehicle system that would incorporate a medical action plan. Such a system would need to include input to determine whether a seizure was taking place, incorporate data to determine whether it was a ``typical" seizure for the person or not, and implement a hierarchy of actions based on the medical action plan. This plan could include escalation based on the length of the seizure, and have contingencies based on the inability to

reach primary contacts. Such a system could be expanded beyond the scope of people with epilepsy to include a variety of other medical conditions or disorders. The plan could also evolve or vary as vehicles gain increasing levels of autonomy.

5.2. Detection of Seizures in the Vehicle

In order to trigger a vehicle to take over from a driver and/or to execute a medical action plan, the vehicle must be able to reliably detect seizures. One key question to ask in this overall area of research is the proper balance between false positives and false negatives. Given the relative consequences, reducing false negatives at the expense of accepting more false positives is likely to be desirable. In this case, the vehicle could prompt the person to respond; if they did not respond, or indicated that there was a seizure occurring, then the vehicle could take appropriate action.

One key question that arises is the amount of time required in order to determine that a seizure is taking place. If the time period between a seizure's start and its detection is too long, an accident may have already occurred, particularly if the seizure involves sudden jerking movements that cause unexpected hard braking or high acceleration. The specific conditions in which such a system might be safe and feasible need to be investigated, in order to determine the operational design domain of a vehicle designed to operate safely when a driver has a seizure.

5.3. Development of Protocols for Medical Device Integration

Many discussions of seizure detection included existing medical devices used by some people with epilepsy. This also aligns with the work reported by Ziyad and Ziyad, which made use of these devices (Ziyad & Ziyad, 2021). Therefore, one promising avenue for development would be the creation of standard software protocols for communication between medical devices and vehicles. Such a protocol would need to implement robust cybersecurity that would also be HIPAA-compliant. Standards would need to be developed and adopted, and given the global reach of both the medical device and automotive industries, these standards would need to be agreed upon by multiple international organizations. Therefore, while there is a definite technical component to this work, it will also involve multiple standard-setting organizations and has public policy implications that must be considered.

5.4. Investigation of Human-Autonomy Teaming

If a vehicle is being actively driven by a human and needs to take over in the event of a medical incident, this takeover should be done in such a way that it does not produce dangerous or abrupt behaviour. Furthermore, if there is a false positive and the vehicle begins to take over when it should not, the conflict between the human driver and the autonomous system should be such that it does not cause the vehicle to take actions that would be hazardous. There are already efforts to study human-autonomy teaming, some involving vehicle steering such as work by Mai (Mai, Daveron, Julius, & Mishra, 2025); there is also literature on human-autonomy teaming in a wide variety of other environments, including collaborative robots (Vincentini, 2021) and in the field of psychology (Lappi & Mole, 2018); (Lyons, Sycara, Lew, & Capiola, 2021).

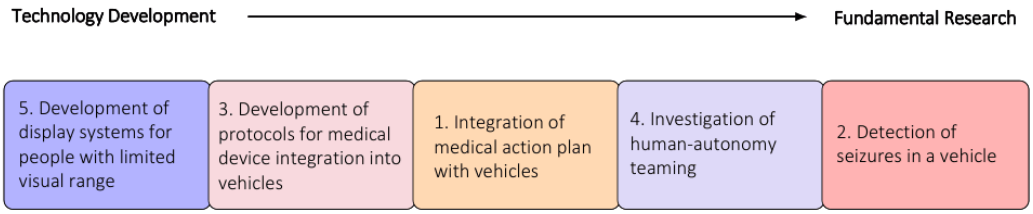
5.5. Development of Display Systems for Limited Visual Range

The potential for autonomous vehicles to benefit people with blindness or limited vision is well known (Brinkley, Posadas, Woodward, & Gilbert, 2017). The situation for people who have had

surgery to stop seizure activity, however, is slightly different from typical cases of blindness, as the person in question may have normal vision within a range. In particular, a system incorporating multiple cameras and a suitable display on the dashboard may provide sufficient information for a person to be able to safely drive using that display. The design of such a system is much more an issue of development than of research, as a wide variety of cameras and displays are readily available. However, researchers in human-machine interaction or cognitive psychology may find that there is significant scope for research projects.

These five areas vary in their level of technology readiness, with some being primarily development projects and others requiring more fundamental research, as shown in Figure 3.

Figure 3: Continuum of Research Needs: From Technology Development to Fundamental Research



6. Conclusions

The work conducted in this study has identified a number of ways in which vehicles can be designed in order to better accommodate people with epilepsy, who typically experience significant challenges with transportation. Future work can and should be done, in order to gather more data on these challenges and their solutions, and to refine the roadmap. This work can include additional interviews and focus groups as well as surveys focusing on specific options and their benefits.

It is noted that the challenges of mobility for people with epilepsy are not purely technical; there are also issues of public policy, economics, insurance, and legal aspects that need to be considered. Such considerations are beyond the scope of this specific paper, but should also be pursued as part of future work. Finally, future work should include development of these and other technologies which would provide options for people with epilepsy, in order for them to fully participate in work, education, social activities, and other activities of daily life that are currently challenging to access.

The broader significance of this research is that it begins to articulate a design agenda for autonomous vehicles that responds directly to the lived experiences of people with epilepsy and supports their full participation in mobility systems. As autonomous vehicle technologies continue to evolve, grounding their development in inclusive design principles will be essential to ensuring that the resulting systems expand, rather than limit, equitable access to transportation. Furthermore, in addition to addressing the specific transportation barriers faced by people with epilepsy, this work reinforces the importance of approaching autonomous vehicle development through the lens of accessibility and inclusive design, highlighting how such a framework can guide engineers, policymakers, and researchers toward solutions that are not only technologically feasible but also inherently more inclusive. Such an approach can and should be used to consider a wide variety of other accessibility needs that people may have.

7. Acknowledgement

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Statement on the Use of AI in the Writing Process. In this paper, AI tools were used for final editing and refinement; specifically, they were used to identify issues with inconsistent wording and unclear statements, and to detect differences between UK and US spellings of various words. In the case of unclear statements, the AI tool suggested new language, which was then edited heavily before being incorporated into the manuscript.

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