Ageing Road Users – Identifying Research Priorities

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Abstract

The TAC on behalf of the Victorian road safety partners undertook a project to identify opportunities for research into ageing road users. The information will provide the Victorian road safety partners with an understanding of existing research, policy and programs aimed at road trauma of ageing road users.

The components of the project included:
- analysis of current data on ageing road user trauma – by age group, gender and road user type
- a literature review on existing ageing road user safety research
- identification of emerging road safety issues for ageing road users
- identification of research priorities for consideration by the Victorian partners.

A significant consultation process was undertaken with a broad range of stakeholders from the road safety, academic, health, ageing, mobility and other relevant sectors. This paper describes the project, key findings and recommendations for the Victorian Road safety partners in terms of identifying research opportunities to inform programs and policies that aim to reduce road related trauma for an ageing population.

1. Introduction

The number of older people who are injured on our roads, predominantly as vehicle occupants or pedestrians will grow in coming years as the population ages. The TAC, on behalf of the Victorian road safety partners, has undertaken a review of the key issues facing older road users. The investigation involved conducting a literature review of recent older road user research, reviewing relevant older road user programs and policies, and consulting with a range of stakeholders to gain an understanding of their views and priorities for future research and action relating to older road users.

In terms of preventing future older road user crashes, the safe system framework has been adopted, which aims to have safer people, in safer cars, in safer environments. Each of the pillars of the safe system, in relation to older road users is discussed.

Understanding older road user crashes

People aged 75 and over will represent 12% of the population by 2051, up from 6% in 2011. In Victoria between 2008-2012 drivers aged 75yrs+ accounted for 13% driver deaths, and 8% serious injuries. In the same period, pedestrians aged 65yrs+ accounted for 34% pedestrian deaths.

Of the older drivers killed:
- 71 % were male
- 15% were not wearing a seatbelt
- 55% occurred in rural areas
- All were licensed and none had a BAC of 0.05 or above.

Of the older pedestrians killed:

- 57% were male
- 78% of fatal crashes occurred in Metro Melbourne
- 45% were aged 85 or over.

Older people are predominantly injured or killed as pedestrians, drivers and passengers. Australian research (Langford et al, 2010; Koppel et al, 2011; King et al, 2011) has found that the types of crashes older people are more likely to be involved in as drivers are:

- crashes at intersections, especially turning into oncoming traffic
- multiple vehicle crashes
- low speed rather than high speed crashes
- failure to yield or give way crashes.

They are far less likely than other drivers to be involved in:

- speed related crashes
- drink or drug driving crashes
- high speed, run off road crashes
- head-on over taking crashes.

An in-depth study of fatal older driver crashes in Sweden also found an over representation of older drivers in intersection crashes, but reported that one in five drivers died of natural causes (such as heart attack or stroke while driving) prior to the crash occurring (Skyving et al, 2009).

Older pedestrian crashes are more likely to occur in built up areas, and differ from other pedestrian crashes in that they are more likely to occur mid-block and older pedestrians are often hit on the far side (that is half way across the road), rather than the near side (that is having just stepped onto the road) (Oxley et al, 1997).

Older people are far more likely to be fatally injured in crashes than other road users (Evans, 2004). The injury severity levels of the crashes they are involved in is higher, due to their increased fragility and frailty.

Increased fragility and frailty are both associated with old age. Fragility is the likelihood of sustaining a greater level of injury for a given amount of force and is caused by reductions in bone density, declines in bone area and changes in bone morphology/geometry that makes the bones more likely to break (Kent, 2009). Fragility was found to be a significant factor in explaining the increased risk of death among older people when involved in a crash (Li et al, 2003).

Frailty refers to a person's ability to recover from disease or injury. The physical components of frailty are weakness, muscle atrophy, weight loss, physical incapacity and slowed movement (Heppenstall et al, 2009). People who are frail are at significantly higher risk of death from injury compared with people who are not frail. It should be noted that there is considerable variability among older people in terms of their frailty. Rockwood et al (2011) found that 22% of people aged 65yrs and over are frail and 44% of those aged 85 and older are frail.

Health and ageing

Determining which older people may be more at risk of crash involvement both as a driver and as a pedestrian is a critical question. What is known from the research is that with increasing age, comes a range of declines, which may impact on safety. The age related declines that may impact on driving relate to:

- psychomotor skills – which include slower reaction times, reduced flexibility and declining muscle strength
- visual skills – declining static and dynamic visual acuity, sensitivity to light, glare recovery, and contrast sensitivity
- cognitive skills – decreased performance on divided attention tasks, slower information processing speed and spatial cognition which makes navigating more difficult.

While these conditions all decline with age, and may affect performance as a driver or road user, the onset, severity and progression of these declines vary enormously from individual to individual. In some situations this may be compounded by the presence of one or more pre-existing diseases or conditions. Some medical conditions or diseases increase in prevalence with age and some of these can impair a person's ability to drive safely. Some of the most common diseases among older people include:

- Dementia: which affects a person's memory, attention, decision making, planning, reactions, vision and sensory processing and is an irreversible condition that necessitates stopping driving as the disease progress. The incidence of dementia in Australia is forecast to double by 2030 (Alzheimer's Australia Victoria, 2013).
- Parkinson's disease: which causes sufferers to have poorer cognition, contrast sensitivity, reaction time and increased sleepiness, which in advanced stages can require a sufferer to stop driving.
- Eye diseases: cataract is the most common eye disorder associated with ageing, but can be corrected. Macular degeneration effects up to 3% of people aged 55 and over. It is a progressive and irreversible condition that leads to significant vision loss (Charlton et al, 2010).
- Strokes: affect a person's vision, their cognitive processing and their upper and lower body strength, all of which can impair their ability to drive safely (Perrier et al, 2010).

Each of these disease categories have been found to impact on an individual's ability to drive to some extent (AustRoads, 2012). However, just a diagnosis of one or more of these conditions does not necessarily mean a person will be unsafe to drive. Research has indicated that even for diseases that are known to impair driving, such as dementia, people in the early stages of this disease are not necessarily unsafe to drive (Eby et al, 2012).

In addition, many people are living with undiagnosed age related diseases. It is estimated that as many as 50% of early stage cases of dementia in the community go undetected, and it takes 1.9 years on average for a diagnosis from when a family member notices symptoms (Phillips et al, 2011). People with a disease who are undiagnosed represent a significant concern as they will not be receiving any treatment or be assessed and may be driving when they are not safe to do so.

Another area of concern is the impact on an individual's safety as a road user when they have multiple conditions or diseases. The Australian Institute of Health and Welfare estimate that 34% of people who

are aged over 65yrs have two or more disabilities and the incidence of multiple morbidity increases with advancing age (AIHW, 2009).

A large proportion of older people are often taking one or more medications (NSPAC, 2012). However, the impact of prescribed medication, especially combinations of medications taken for multiple health conditions, has not been specifically studied among a large scale population of older people (Cooper et al, 2011).

The majority of the research published to date has focused on the impact that these and other disorders have on a person's ability to drive safely. Far less is known about how common age related declines and diseases impact on a person's safety as a pedestrian. With the increased incidence of these disorders, and the vulnerability of pedestrians, such research is needed.

A greater understanding of which older people are involved in crashes (as drivers and as pedestrians), including what is their crash and violation history, medical history, diagnoses and medications, would provide valuable information to guide health professionals and road safety agencies about older road user crash involvement.

2. Preventing future crashes - Safer People

The main ways in which older people can be safer road users is if they adopt safe or safer behaviours when using the roads. The vast majority of older people are generally law abiding road users, as demonstrated by the low level of infringements they incur. On the whole, drink driving, speeding and other high risk behaviours are uncommon. The areas of behaviour that have emerged as issues to be focused on for older road users include:

- wearing seatbelts
- adopting safer pedestrian behaviours
- being aware of when to limit or stop driving in some situations (self-awareness and self-regulation)
- deciding when it is time to stop driving (driving cessation).

Seatbelt wearing

While seatbelt wearing rates across the Australian population are very high, it appears that some older people are not always wearing seatbelts. This is evident from the crash data, with 15% of fatally injured older drivers over the last five years in Victoria not wearing a seatbelt.

It appears a small number of older people are not wearing seatbelts on some trips. Research has found that some older people find seatbelts uncomfortable or have difficulty twisting to reach them and difficulties fastening them (Levi et al, 2008). It is not known whether physical limitations or other reasons are barriers to seatbelt wearing.

Given the risks associated with failure to wear a seatbelt, the reasons for non-use of seatbelts among older Victorians should be explored further.

Safer Pedestrian Behaviour

Research (Oxley et al, 2005) indicates that older people's pedestrian behaviour can differ from young people in that they are more likely to:

- prefer to cross at signalised intersections and use footpaths

- not allow an adequate safety margin when crossing in front of oncoming traffic
- use the shortest and possibly least safe route possibly due to reduced physical mobility
- have a false sense of security based on an assumption that drivers will stop for them
- be unable to complete road crossing in the time allowed by the pedestrian lights.

However, most of this behaviour is thought to be due to compensatory due to physical declines or concerns about falling. Observational studies of pedestrian behaviour indicate that older adults are more careful, cautious and law-abiding pedestrians than younger adults (Oxley et al, 2005).

Garrard (2013) summarises that the over-representation of older pedestrians in crashes is generally attributed to factors associated with functional decline (reduced sensory, visual, perceptual and cognitive abilities), complex environmental demands (eg. crossing multi-lane roads), and increased frailty in the event of a collision.

Self-awareness and self-regulation

As people age, many of them change how, when and where they drive. Older drivers tend to avoid night driving, poor weather, high traffic times, urban areas and highways (Nauman et al, 2011).

To address the question of why some older people self-regulate and others don't, Oxley et al (2003) found that the factors that impact self-regulation include:

- awareness of health declines and the impact this may have on driving
- support from family, friends and health professionals to self-regulate
- having access to alternative transport
- personality factors.

Other research has shown that women are more willing to self-regulate than men, but often they avoid driving in situations that they find stressful or that make them uncomfortable, rather than situations that are necessarily less safe (D'Ambrosio et al, 2007). Baldock et al (2006) found that older drivers who self-regulated did not perform any worse than older drivers who did not self-regulate on driving tests.

Nevertheless, self-regulation of driving so that unsafe situations are avoided while people maintain their mobility and independence is a useful strategy. A better understanding of self-regulatory behaviours among older people and whether it is possible to encourage and enhance self-regulated driving and whether this would reduce crash risk are key questions that will need to be addressed in the future.

Driving cessation

How individual older drivers determine whether they are fit to drive seems to be based on the medical advice they receive. Medical advice and declining vision are predominantly given by older drivers as reasons why they stop driving (D'Ambrosio et al, 2007). In fact, poor vision is the most commonly cited reason older people give for regulating or stopping driving (Dellinger et al, 2001).

Many older people report taking medical advice and stop driving, however, the decision to stop driving can be influenced by a range of factors including:

- perceived mobility/transport options
- financial situation

- influence of friends and family.

Driving cessation is often associated with increased depressive symptoms, increased isolation, and a reduced quality of life (Eby & Molnar, 2012). However, many people do stop successfully, and some pre-planning and involvement in the decision making process can help reduce the negative outcomes associated with driving cessation (Musselwhite & Shergold, 2013).

Very little is known about the driving cessation process or the shift to alternative transport. Considering the ageing population, it is important to more fully understand factors that influence driving cessation decisions and the effects those decisions have on older drivers. Such information may help to develop strategies to support this process.

Assessing fitness to drive

A large amount of research has been undertaken over many years in trying to develop accurate ways of testing the functional abilities of older drivers, either to be used as assessment tools by health professionals or as part screening tests for licensing systems. However, it has been incredibly difficult to develop such a tool and at this stage, there are no screening tests that can accurately assess driving safety (King, 2011; Chaudhary et al, 2013).

It should be noted that determining whether screening tests to assess an individual's risk of subsequent crash involvement is very difficult. Some researchers have questioned whether it is in fact possible to determine whether a test is predictive as most at-risk drivers never have crashes as crashes on an individual level are rare and multi-determined (Hakamies-Blomqvist, 2006).

Licensing systems

A re-occurring question in much of the older driver research pertains to whether licensing systems can be modified to help reduce older road user crash involvement, in particular some form of age based testing.

After reviewing research from around the world, there is no research evidence to suggest that other licensing systems will be more effective at reducing older driver crash involvement than Victoria's current licence system.

Despite its popularity with the public and some opinion leaders, periodic age based testing has been conclusively shown to be an ineffective road safety measure. In summary, the research indicates the following.

- Chronological age per se seems to be a very weak predictor of safe driving performance (Siren et al, 2013).

- Age based testing or screening of the whole population of older drivers over a certain age does not reduce crash involvement. This is regardless of whether the testing involves on-road tests, vision tests and/or more regular licence renewals (Grabowski, 2004).

- A recently published review of the different driver licensing policies in 27 European countries concluded that licensing policies are not evidence based and tests that are commonly used to assess

the fitness to drive show very low correlations with crash rates (Siren et al, 2013).

- A recent review of the crash rates in five Canadian provinces with different licensing requirements found that the states with the more stringent licensing system had no fewer crashes than other states (Tay, 2012).

- This concurs with earlier Australian research that off-road screening tests of fitness to drive cannot be justified for all drivers reaching a threshold age (Langford, 2008).

More importantly, several studies have shown that introducing forms of age based testing can lead to overall increases in older road user death and injury. Several studies have demonstrated that as a result of the avoidance of licence screening, the net effect is that more older people are injured or killed as they are using unprotected forms of transport, like walking rather than driving (Siren & Meng, 2012).

Enhancing the current system

The vast majority of people make the decision to stop driving without any involvement of the licensing system. Most currently rely on advice from health professionals, especially eye specialists, GP's, occupational therapists and family and friends to reduce or cease driving when they need to. Enhancing how people make these decisions and the quality of advice that they receive is fundamental to good decisions being made about driving.

Health professionals play an important role in advising older people about their safety as a driver and road user in general. They also have an important role in the medical review process. However, many physicians report that they are uncomfortable making fitness-to-drive recommendations and that they lack the necessary information to do so (Sims et al, 2012).

Increasing the knowledge and skills of health professionals to accurately advise older people about their functional ability to drive safely is an area that needs to be the focus of increased efforts in the future.

Family members are often the first people to become aware that a person's functional abilities may have declined to the point where they are not safe to drive in all conditions. Research shows that the concerns of family members are often well-founded and they are quite accurate in assessing their relatives driving ability (O'Connor et al, 2010).

Ensuring that family members can readily get information about how to help an older relative, how the licensing system works and also how to support any reduction in driving and driving cessation is important and this information needs to be provided in a range of mediums and be widely available.

How well informed drivers of all ages are especially older people, about issues related to health, driving, licensing and options to consider in terms of reducing or stopping driving is not well understood at present. Determining this will help to guide health promotion and awareness efforts designed to improve older road user safety.

Two recently developed self-screening instruments have been developed in the US. The Driving Decisions Workbook (Eby et al, 2003) and the AAA Roadwise Review are both evidence based self-assessment tools. Both instruments are intended to provide drivers with information about changes in their driving abilities that occur with ageing, and make recommendations about driving compensation

and remediation strategies to extend safe driving, as well as whether further health evaluations might be needed. These tools may provide an effective means of raising awareness among older people.

3. Preventing future crashes - Safer Vehicles

Given the fragility of older people, travelling in a safe vehicle is more important for older people than any other age group.

Older people tend to get injured in crashes differently from other age groups. Older vehicle occupants are considerably more likely to suffer thoracic or chest injuries than younger people (Koppel et al, 2011). Due to these injuries and the fact that many older people have poorer rates of recovery due to their frailty, older people are more likely to die from chest injuries than younger people (Kent et al, 2005). Existing seatbelt systems in frontal crashes, and the intrusion from vehicle doors in side impact crashes seem to be the main causes of injury to older occupants (Morris et al, 2003).

While past advances in vehicle crashworthiness have assisted older vehicle occupants as well as younger ones, the focus of recent research has been on developing seatbelt systems that can be more protective to older people. Some recent work has trialed four point harnesses and inflatable seatbelts which are showing some promise in reducing the level of injury to older occupants (Eby & Molnar, 2012).

Intelligent transport systems

Some intelligent transport systems have the potential to assist older people. Designing and testing new systems for older users will be important, as current research into navigational systems has shown that older people do use ITS applications differently to younger people and take longer to learn how to use the technology (Eby & Molnar, 2009). However this may not be so for future generations of older people who will have more experience with in-vehicle devices and technology. The main considerations with ITS applications for older people are that they should not increase the cognitive workload for the older driver, are easy to use and affordable and do not have unintended consequences in terms of unsafe behaviours.

Specific applications that have the potential to assist older people include:

- *Forward collision warning* – these systems use radar information to determine the changes in distance to forward objects and warn a driver if a collision is likely. These are regarded as helpful for older drivers in negotiating intersections. In general these systems have been shown to be easy to use and had some safety benefit for older drivers (Eby & Monar, 2012).

- *Time gap assistance* – a device that assists drivers turn across traffic at an uncontrolled intersection and has been shown to assist older drivers select gaps in traffic (Gelau et al, 2011).

- *Night vision enhancement* - these systems help to detect objects using infrared cameras and are currently available in some high end vehicles. The safety outcomes are not conclusive at this stage, but some testing has shown that the systems are relatively easy to use and do not increase workload too much (Eby & Molnar, 2012).

- *Blindspot systems* – these systems are designed to make a driver aware of any vehicle in their blindspot. These systems are available in some new model vehicles and potentially as after-market adaptations. These may be helpful for older people who have limited head and neck movement. The safety effects have not been evaluated for older people, but some research shows that these systems are acceptable to older people (Chun et al, 2013).

While several ITS applications have great potential to assist older people, how willing older people will be to take up these applications, now and in the future, is uncertain. It is also unknown which of these ITS applications represent the areas of greatest assistance to older road users and which ones should be further evaluated and promoted for greater use in future cohorts of older drivers.

Buying a safe vehicle

A key road safety strategy is to encourage all people to buy the safest new or used car they can afford. This is particularly pertinent for older people. Research has shown that safety is considered important to older people when buying a car, but so are other factors, such as price, reliability and running costs (Zhan et al, 2013).

Some local research found that older people lack knowledge about some safety features and how they work (Koppel et al, 2005) and this is similar to more recent Canadian findings (Shaw et al, 2010). More information about the incentives and barriers among older people to enable safe vehicle choice would be helpful in developing strategies to encourage this.

The American Automobile Association (AAA) hosts a very comprehensive website for older road users. One component of the website is an interactive vehicle selection program called "Smart Features for Older Drivers". It describes the type of vehicle features that are helpful for older people with certain conditions. It also has a feature where the user can select a range of vehicle features and the program will prepare a list of vehicles that have these features and also provide information on the price of those vehicles and their fuel economy.

4. Preventing future crashes - Safer Environments

The potential safety benefits of creating safer road infrastructure for older road users has been well documented, as has the fact that such improvements would also lead to safety improvements for the entire population (King et al, 2011).

Creating safer intersections

A detailed review of infrastructure for older road users was undertaken as part of an AustRoads project (Fildes et al, 2004). This and other research (Baldock & McLean, 2005) recommend improvements to intersections that include:

- improvements in unrestricted sight distance
- improved traffic control
- improved intersection definition
- measures to improve gap selection – such as the use and design of roundabouts.

Ensuring that these improvements are systematically included in road design and as part of blackspot and other infrastructure programs is of critical importance.

Safer pedestrian infrastructure

Given the very high number of older pedestrian crashes and the ageing population, improving pedestrian infrastructure will be paramount. TAC crash data shows that older pedestrians tend to be involved in crashes that occur mid-block, and predominantly on urban roads (with either 50km/h or 60km/h) speed limits.

A number of measures have been shown to reduce the incidence of pedestrian crashes. These include:

- Reducing travel speeds – lowering speed limits and introducing traffic calming infrastructure has led to significant reduction in pedestrian injuries in Europe. Reducing speed limits to 30km/h in high pedestrian areas has led to very significant declines injuries in London (Steinbach et al, 2010).

- As people age their walking speed declines to the extent that those aged over 85 years are significantly slower than those aged 60 years and current walk phases are too short for many older people (Romero-Ortuno et al, 2010).

- Designing pedestrian priority or shared zones whereby vehicles, bicycles and pedestrians all share the road space are more common in Europe and may potentially have a positive effect on pedestrian safety and have been implemented in a few local streets in Melbourne (Bunn, 2003).

Improving the road system to cater for an ageing population

King et al (2011) commented that the overall road environment standards are designed for the needs of the young, healthy and "average". Making changes to the road environment to better meet the needs of older people would also assist all road users. These improvements include:

- improving the conspicuity of traffic signals and signage
- improving the placement of traffic signage
- more clearly defined vehicle paths
- improved lane-turn channelization
- greater delineation of roadway edges
- improved lighting, especially at intersections.

Moving from research to implementation

While there is a considerable amount of research to suggest what improvements could be made to the road environment, implementing these changes or improvements on a systemic basis seems to be harder to achieve. One way to encourage this may be to evaluate the success of various measures that have been implemented.

One possibility is to determine what we can learn from past infrastructure improvement programs, such as the Safer Roads Infrastructure Program (SRIP) and the Victorian Accident Blackspot Program. It has been suggested that there is likely to be enough data from these programs to be analysed by age group and road user category.

Undertaking trials or demonstration projects at a local level that could be evaluated to determine the effectiveness of pedestrian infrastructure improvements may also be effective. This infrastructure should include trialing and assessing the outcomes of reduced speed limits (30km/h) and traffic calming

in selected areas, as well as the potential of designated older pedestrian routes or pedestrian priority zones.

A number of Australian councils are beginning to embrace the WHO Aged Friendly Cities Guide. The aim of the guide is to outline key ways in which a community can become more aged friendly and it addresses topics such as social infrastructure, housing, employment, social inclusion as well as transport (WHO, 2007). Given the interest in adopting this framework among councils, this presents an opportunity to work with Local Government Areas to encourage the implementation of age friendly improvements to road and pedestrian infrastructure.

5. Conclusions

Utilising the safe system philosophy, recommendations for research and other initiatives to create safer people, safer vehicles and safer environments were identified.

Creating safe older road users requires a greater understanding of the crash risk associated with various health conditions and better mechanisms for ensuring that older people, their families and their health professionals can identify when a person is at higher risk and can employ a range of measures try to reduce that risk.

To achieve this, far more effort is needed in:

- understanding which older road users may be at greater risk as a driver and as a pedestrian
- ensuring health professionals have the knowledge to be able to determine a person's safety risks as a road user and take appropriate measures to address these
- providing support and encouragement to older people and their families to encourage effective self-regulation of driving and if necessary to cease driving and utilise other forms of transport safely.

Travelling in a safe vehicle is one of the most effective measures an older person can take to ensure their safety. As people age their fragility increases, meaning that they are far more likely to sustain serious or fatal injuries in crashes than younger vehicle occupants. The current focus needs to be on ensuring that older people choose the safest vehicle they can afford. In future years, vehicle technology may provide some assistance to older drivers, but these applications need to be tested to ensure that they produce the desired safety outcomes.

Creating safer roads for older drivers requires reducing the complexity of intersections, improving conspicuity, and creating infrastructure that simplifies driving manoeuvres. Safer environments for older pedestrians will be particularly important in future years as the population ages and the number of older pedestrians increases. Slower travel speeds, safer crossing points and better infrastructure in areas of high pedestrian activity need to be priority areas.

Creating a safe system for older road users is a shared responsibility involving not only road safety agencies, but a range of other key groups including, local government, health professional groups, health promotion and aged care specialists.

Possibilities for future research

- Determining how common age related declines and diseases impact on a person's safety as a pedestrian.

- A greater understanding of which older people are involved in crashes (as drivers and as pedestrians), including what is their crash and violation history, medical history, diagnoses and medications.

- The reasons for non-use of seatbelts among older Victorians should be explored further.

- A better understanding of self-regulatory behaviours of older people and whether it is possible to effectively encourage and enhance self-regulatory driving among older people.

- Exploring the factors that influence driving cessation decisions and the effects those decisions have on older drivers.

- Exploring how informed older people are about issues related to health, driving, licensing and reducing or stopping driving will help to guide health promotion and awareness efforts that could improve older road user safety.

- Undertake an analysis of the findings of SRIP funded improvements by age group to ascertain what impact these infrastructure improvements have had on older driver and pedestrian crashes.

- Undertaking trials or demonstration projects to determine the effectiveness of older pedestrian safety measures – potentially targeting those areas adopting the WHO ageing cities approach.

- Develop a better understanding of the injury patterns among older people and what the protective influences of vehicle size, design and safety features are for older vehicle occupants.

- Designing the testing crashworthiness features, especially seatbelt systems, based on adult anthropometry and performance.

- Determine what are the motivators and barriers among older people to safe vehicle choice.

- Review which ITS features are likely to be more beneficial to older people now and for future cohorts.

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