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Why public health should embrace the autonomous car

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As the fleet of 56 Google self-driving cars clocks up 1.5 million miles (about 2.5 million kilometres) around the United States,[1] the rest of the world is gearing up for the advent of autonomous vehicles (AVs). Substantial investments are being made by both industry (primarily automotive and technology companies) and governments to achieve the enhancements in design and infrastructure that are required to permit large-scale implementation.[2,3] Cars are already being produced with a range of autonomous features including cruise control and assisted parking, braking, and lane-keeping.[3,4] These features are precursors to the full automation that is expected to ultimately typify private, public and commercial vehicles.[4,5]

The move to automation is occurring rapidly. In Australia, the first autonomous bus will be trialled by the RAC in Western Australia in 2016, and the Australian Driverless Vehicle Initiative has published a timeline that anticipates progressive prototype testing and regulatory changes for the rest of this decade to pave the way for subsequent adoption of AVs by the general public.[6] In her 2016 State Opening of Parliament speech, the Queen announced that in the coming year the UK will be "at the forefront of technology for new forms of transport, including autonomous and electric vehicles".[7] In the US, it is forecast that 75% of cars will be fully automated by 2040.[8] Although AV usage will initially reflect the current dominant arrangement of private car ownership, the 'end game' is a fleet system that involves individuals summoning a vehicle when it is needed and releasing it to the fleet at the end of the trip so it is available for other users.[3,9]

The disruptive technological advancements associated with the advent of AVs may be overshadowed by the enormous social changes that will accompany a transition to a world in which humans relinquish control of their vehicles to artificial intelligence.[10,11] The focus of this commentary is on the health-related outcomes that are likely to result from these impending changes. While various issues need to be resolved prior to full implementation (especially those related to liability and insurance),[12] the forecast positive outcomes are wide in scope and extensive in potential benefits for individuals and society as a whole. These anticipated benefits are discussed below under the categories of accident prevention, climate change, and achieving a more inclusive society through mobility enhancement and improved access.

Accident prevention

The World Health Organization[13,14] estimates that 1.25 million people die in road accidents every year and more than 20 million are injured globally. Mortality rates are especially high among males (who account for three-quarters of all road deaths) and those aged 15-29 years (for whom road accidents are the leading cause of death).[13,14] Each year in Australia, around 1,200 people die in road accidents and another 34,000 are hospitalised with injuries.[15,16] According to World Health Organization estimates, road accidents cost developed nations such as Australia around 2% of their GDP[13] (about $18 billion).

Almost all (93%) road accidents are attributed to human error.[4] Common causes include speeding, drink-driving, and distracted driving.[14] AVs can be programmed to obey speed limits, and with 360 vision and faster reaction times they are likely to all but eradicate road accidents resulting from human error.[4] As a result, moving to full vehicle automation has the potential to avoid around 90% of accidents,[4] which translates to a saving of more than $16 billion per year and the freeing up of thousands of beds in hospitals and rehabilitation facilities. The benefits from accident prevention alone therefore provide justification for considering the role of public health in advocating for and facilitating rapid migration to AVs. If the saved expenditure could be redirected to strategies designed to optimise other aspects of health (e.g. used to fund efforts to cure cancer and reduce obesity), the potential for national health improvements is even more substantial.

Climate change

AVs have multiple pathways for reducing the effects of vehicles on the environment. In the first instance, fuel usage per vehicle is expected to be substantially reduced due to less acceleration and deceleration and more efficient intersection use.[4] The maximum benefit will be achieved when vehicles are able to communicate with each other to allow smaller between-vehicle gaps and smoother lane-changing, thereby reducing "traffic-destabilising shockwave propagation" and minimising fuel and brake usage.[4,9] Once high levels of automation have been achieved, estimates of fuel use reductions range from 25% to 80%.[4,10]

A second major source of environmental benefit relates to the parallel trend of electric vehicles (EVs). EVs contribute less to global warming than conventional vehicles and are an important part of future efforts to reduce the environmental impacts of transport systems.[17] It is expected that AVs and EVs will coincide given their complementary focus on efficiency and their shared reliance on route planning.[9] The cost of car batteries is falling rapidly, making EVs increasingly cost-effective over time.[18] EVs are on the cusp of mass adoption,[19] increasing the likelihood that the AVs of the future will also be EVs.[9]

A third potential benefit will be the reduction in raw materials, processing, and transportation required to manufacture and distribute vehicles. Given the amount of time most cars spend parked, it is estimated that one shared AV can replace 11 traditional vehicles.[20] The reduced number of total vehicles required will also dramatically reduce the amount of parking space required.[4] Finally, the traffic-flow-smoothing effects of AVs may almost double freeway capacity,[4] reducing pressure for additional roads and road-widening, leaving more space for cyclists, trees, and nature strips.

A more inclusive society

The United Nations encourages countries to achieve optimal access and mobility for all members of society, regardless of age, ability, or income.[21] The current transport situation in Australia – dominated by private cars (18 million cars are registered in Australia)[22] and suboptimal public transportation – increases the vulnerability of groups that are excluded from car ownership. These groups include those who lack the financial resources to buy and operate a car ,and the disabled and the elderly who are unable to cope with

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the physical and/or cognitive demands of driving.[23,24]

AVs are recognised as a mechanism for achieving a more inclusive society by providing transportation options for those who are unable to drive conventional cars.[3-5] The ability of AVs to increase the mobility of those who are unable to use public transport constitutes a potential means of reducing dependence and isolation, conditions that are associated with higher levels of comorbidity and mortality.[25] This outcome is highly desirable and aligned with the Australian Productivity Commission's call for strong action to avoid the predicted enormous social and economic costs of population ageing.[26]

Further social benefits of AVs relate to enhanced quality of life across the population. Driving time can be used for productive or leisure pursuits,[5,27] which can assist with time management, especially for those residing long distances from their place of work. Further, the ability of AVs to take themselves to more peripheral areas for parking and recharging will free up prime city spaces currently dedicated to parking that can be used for walking precincts, park areas, and other community-focused purposes.[4,5]

Possible unintended consequences

As with all major societal changes, there are likely to be unintended negative consequences of the transition to full vehicle automation. The convenience and inclusivity of AVs could result in an increase in the total number of kilometres travelled, placing upward pressure on congestion, fuel usage, and emissions.[4,5] This could be exacerbated by increasing urban sprawl facilitated by the availability of personal transport options that allow travellers to engage in work and leisure pursuits while in transit.[28,29] Further, the transition process will involve a period of AVs and conventional vehicles sharing the road,[5] which could present difficulties for drivers accustomed to using eye contact and courtesy as driving strategies.[3] Finally, AVs could represent a drastic reduction in the number of organs available for transplants.[29]

Despite these potential problems, forecasts are for AVs to produce an overall highly positive effect on accident-related deaths and injuries, road capacity, global warming, and social inclusion.[4,29] Governments have the challenge of harnessing the benefits of AVs while minimising negative unintended consequences. This will entail close monitoring of trends and implementing policies designed to maximise the positive outcomes. The public health sector can play an important role in this process.

A proposed role for public health

The successful transition to AVs can be assisted by the public health sector's expertise in research and evidence-based advocacy. In the first instance, much greater research is needed in the form of health economic analyses of the short-, medium-, and long-term implications of AV use under various scenarios.[3] These scenarios include rapid versus incremental adoption and continuing private ownership versus migration to a fleet system. Policy decisions relating to efforts to manage the AV evolution need to be informed by detailed analyses of the implications for individuals' transportation behaviours and any subsequent health outcomes (e.g. sedentary time and steps taken).

Second, if the gains on offer from AVs are to be maximised, the transition period needs to be as brief as possible, which can be facilitated through research into (1) the barriers and enablers of adoption and (2) the development of programs designed to enhance AV-related awareness and understanding among both policy makers and the general public. While some work in this area has commenced internationally,[30] almost nothing is known about Australians' likely reactions and adoption patterns. Of interest would be the identification of effective messaging approaches that focus on aspects of AV use that would be of most relevance to different groups of drivers (e.g. some people may be most concerned about emission reduction while others may value guilt-free texting while travelling or relief from the stress of manoeuvring through congested traffic). Understanding the motivations of different consumer segments will permit targeted approaches to communicating with these groups to enhance adoption rates. In particular, identifying, testing, and implementing messages that encourage AV sharing will be a critical element of strategies designed to hasten the successful transition to full automation in the context of a communal AV fleet.[5] Strategies will also be needed to minimise any reduction in physical activity resulting from the door-to-door transportation offered by AVs.[4] Such strategies will need to take account of the lifestyle behaviours that evolve in response to AVs and how they can be modified through various approaches (e.g. health promotion and behavioural economics).

In terms of advocacy, public health representatives can encourage government action to increase the availability and affordability of AVs while discouraging the use of conventional vehicles to accelerate adoption and realise the potential economic and social benefits.[27] In addition, it is likely to be necessary to provide a counterpoint to the resistance that will be inevitably mounted by the industries and agencies that will be adversely affected by the advent of AVs. Examples include the taxi industry, crash repairs workshops, and government bodies that rely on income from car registration and parking fees.[29] Such resistance will necessitate active responses and proactive information dissemination from public health to ensure decision makers and the general public appreciate the broader societal implications of AVs.

A brave new world of autonomous transportation is coming that is likely to result in huge changes to our social and physical environments. These changes have the potential to provide substantial health benefits for Australians. The public health sector has an important role to play in realising the opportunities posed by these changes and ensuring that any adverse outcomes are minimised.

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