

# Survey of health and licensing policies for taxi drivers in Singapore, Hong Kong and Australia: a perspective from evidence on older drivers

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## ABSTRACT

**Introduction:** With an ageing population, policy makers need to balance active ageing needs with older driver safety. In 2009, a survey of licensing policies for taxi drivers in Singapore, Hong Kong and Australia was undertaken for an evidence-based review of policies.

**Methods:** Licensing requirements collected using semi-structured questionnaires were compared descriptively and with evidence from licensing policies on older drivers.

**Results:** All the regions used medical certifications with vision screening. The frequency of medical certification varied according to the renewal cycle and age. Medical guidelines on fitness to drive were available in Australia and Singapore. Legislation for self-reporting of medical conditions by drivers existed in Australia and Hong Kong. Legislation for reporting at-risk drivers by doctors was limited to two Australian states. There were differences in the minimum age and driving experience criteria, the use of practical training, written and English tests, age-based screening, mandatory retirement age, refresher courses, off- and on-road tests.

**Conclusion:** Medical screening for at-risk drivers remains crucial. Age-based mandatory retirement policy at 73 years in Singapore is contrary to evidence-based practice. The lack of legislation for self-reporting of illness by drivers, the high minimum age criteria and therapy driving assessments for healthy taxi drivers are also unique to Singapore. There was stricter age-based relicensing from the age of 65 years in some Australian states and in Singapore. Continuing education for doctors, multi-tier screening for at-risk drivers and licensing policy changes are indicated.

**Keywords:** driver, evidence, health policy, licensing, medical guidelines

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## INTRODUCTION

In 2006, a new health and licensing policy was introduced in Singapore for 70-year-old taxi drivers, which allowed the extension of the working life of healthy drivers to 73 years.<sup>(1)</sup> This is consistent with calls for employers and governments to activate appropriate policies that promote active ageing for healthy older workers.<sup>(2,3)</sup> Active ageing aims to optimise the quality of life of individuals through the provision of opportunities for health, participation and security that match their needs, desires and capacities.<sup>(3)</sup> At the same time, there have been concerns regarding licensing policies that claim to manage the safety of older drivers with an impetus for evidence-based review of licensing policies.<sup>(4,5)</sup> Licensing policies associated with meeting the task demands and longer hours of driving are generally more stringent for professional drivers (e.g. those for taxis, buses and heavy vehicles) than those for ordinary drivers.<sup>(6-8)</sup> However, there is limited literature on the licensing policies of professional drivers compared to those of older ordinary drivers. To address this issue, a brief literature review of licensing policies on older drivers was conducted, followed by a survey of health and licensing policies for taxi drivers in the Asia Pacific region, in order to create an initial resource base for useful comparison among countries.

Driving is a complex task that involves the performance of a range of visual, physical, cognitive and perceptual functions in a dynamic traffic situation. Drivers may suffer from reduced driving capabilities with the onset of new medical conditions, due to medication or from normal age-related decline in functional abilities. Assessments and effective monitoring systems need to be in place in licensing policies so as to identify at-risk drivers to ensure public safety. Reported strategies include a shorter renewal cycle and stricter

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licensing criteria, with vision tests, in-person renewal, driving tests, legislation on reporting and indirect reports from concerned family members.<sup>(5,9)</sup> Licensing policies are crucial in defining the responsibilities of the various stakeholders in determining the fitness to drive. However, there are few studies investigating the effectiveness of licensing policies for older drivers,<sup>(10)</sup> or the impact of licensing policies on the community engagement and participation of older adults.<sup>(11)</sup>

Health screening has been a traditional step in the identification of at-risk drivers<sup>(5)</sup> in licensing policies. However, outside of routine compulsory health screenings, self-reporting of any change in the drivers' medical conditions to the licensing authority varies, depending on their awareness, willingness to report<sup>(9)</sup> and the legislative requirements. Guidelines on fitness to drive are available as resources for doctors in some regions like Canada,<sup>(12)</sup> the United States (US),<sup>(13)</sup> Europe,<sup>(7)</sup> Australia<sup>(6)</sup> and Singapore.<sup>(8)</sup> Drivers with medical conditions, e.g. diabetes mellitus, neurological conditions, musculoskeletal impairment, epilepsy, cardiovascular disease, depression, dementia, obstructive sleep apnoea, have a moderately increased crash risk.<sup>(14,15)</sup> The risk increases with the combined effect of multiple medical conditions and prescribed medications with age.<sup>(10,14)</sup> As there is wide variability in the functional impact on driving skills,<sup>(9,14)</sup> many older drivers with these medical conditions would still be considered fit to drive.<sup>(15)</sup> Some medical conditions have clear driving fitness criteria imposed by legal requirements, e.g. vision and epilepsy, as in the Singapore Medical Association Guidelines on Fitness to Drive.<sup>(8)</sup> In complex situations, when the functional implications on driving are unclear, doctors need to know that medical and off-road tests alone do not accurately predict the driving performance.<sup>(4,10,16)</sup> The ideal standard is still an on-road driving test for at-risk drivers, with or without adaptations.<sup>(9,14,17)</sup> Snook and Cohen have recommended specialised occupational therapists and driving rehabilitation specialists as the best assessors of driving performance for this.<sup>(5)</sup>

Older drivers are reported to have a higher rate of serious injury and death per distance travelled compared to those of other age groups.<sup>(18,19)</sup> However, recent studies argue that the high fatality rate in older people is associated more with their frailty than any age-related functional risks in driving.<sup>(4)</sup> Motor vehicle crashes by older drivers are not a significant threat to road users other than the drivers themselves because of their frailty.<sup>(18)</sup> It has been found that in Europe, people aged 65 and older are at a greater risk of death as a pedestrian or

when using alternative modes of unprotected transport, e.g. mopeds, bicycles.<sup>(20)</sup> It is also known that the cessation of driving for older drivers in the US<sup>(21,22)</sup> and Australia<sup>(23,24)</sup> leads to depression and reduced quality of life among them for a considerable period of time. Older retired drivers are also reported to be at a higher risk for subsequent nursing home placement.<sup>(25)</sup> Overall, these studies suggest that both crashes and premature or unnecessary driving cessation can result in undesirable outcomes and costs for the driver as well as for the society.

Licensing policies for older drivers differ in Europe,<sup>(17)</sup> the US<sup>(9)</sup> and Australia.<sup>(26)</sup> While existing policies and procedures are largely ineffective in identifying high-risk older drivers,<sup>(10)</sup> in-person renewal and vision testing in the US, and driving restrictions in Canada are reportedly effective in reducing traffic crashes, violations and related fatalities.<sup>(11)</sup> In-person renewal allows trained licensing staff to screen for signs of functional decline, such as assisted mobility, tremor or disorientation, when the driver presents at the licensing office.<sup>(9)</sup> However, there is inconclusive evidence to support the current vision testing of visual acuity and visual field as the sole basis for licensing decisions. It is recommended that assessments for vision impairments should be in the context of the driver's overall health and other functional driving abilities.<sup>(27)</sup> Restrictions on driving using conditional licensing require the driver to go for more regular medical certification, or limits driving to a certain time of the day or a certain geographical location.<sup>(5)</sup> Although conditional licensing has been recommended as a better option to overly strict licensing options based on a pass or fail basis,<sup>(5,11,14)</sup> there is still a lack of evidence from limited studies to support it in terms of safety limitations and effectiveness in licensing policy.<sup>(19)</sup>

Although numerous clinic-based or off-road tests have been developed and used in driving assessments, none of them are useful for licensing decisions at this time, as they lack the precision to predict future at-fault crash risk.<sup>(16,28,29)</sup> The best available off-road tests that have shown a reduction of at-fault crash risk in both retrospective and prospective studies are Useful Field of Vision (UFOV) and MaryPODS.<sup>(16)</sup> These tests have a reported relative risk ratio of about two. A relative risk is the probability of a driver with a poor test outcome being in a crash compared to a driver with a good test outcome. Based on calculations on the existing crash risk database in Australia, Langford provided evidence on the inaccuracy of these tests to predict crash risk even with a hypothetical 20-fold increase in the

relative risk ratio. It would still result in an unjustified large proportion (98%) of drivers losing their licenses unnecessarily. Instead, these tests were recommended to be more useful in a pre-selected cohort of at-risk drivers to generate a threefold outcome, i.e. pass, fail or borderline performance indicating the need for further assessment.<sup>(16)</sup> The current lack of validity in off-road tests does not warrant their sole use for licensing decisions.<sup>(5,14)</sup>

Despite the increase in literature on older drivers, the results from research studies have yet to be translated into most of the existing licensing policies.<sup>(4)</sup> At present, in-person renewal is the best available evidence-based assessment option in licensing policy to reduce crash risk for older drivers.<sup>(14)</sup> Considerable research in close collaboration with licensing authorities is still required in order to refine assessment procedures, improve test validity and implement effective, balanced and fair licensing policies.<sup>(5)</sup> Identifying medically at-risk drivers is a more cost-effective measure than wide population-based testing.<sup>(10,26)</sup> Some innovative licensing systems in the US (e.g. California<sup>(9)</sup> and Maryland<sup>(30)</sup>) and in Australia<sup>(26)</sup> restrict screening to possibly identified at-risk drivers referred by doctors, the police, family and health authorities, and/or use of a threefold driving outcome.<sup>(16)</sup> There is strong state-of-the-art evidence to replace population-wide, age-based assessments with a multi-tier approach in screening to identify at-risk drivers of all ages, followed by individualised functional capacity assessments.<sup>(4,10,14,26)</sup> The challenge for licensing policy-makers is to review existing policies in the light of new evidence from research studies while considering societal needs.

## METHODS

Approval for this study was obtained from the University of Queensland Ethics Review Board. All licensing authorities in the states of Australia and the surrounding countries in the Asia Pacific region were potential participants. In order to be included, the licensing authorities must have official addresses readily available from the internet. A total of 24 regions were identified as potential participants. They were Western Australia (WA), Northern Territory (NT), Queensland, New South Wales (NSW), Victoria, South Australia (SA), Australian Capital Territory (ACT), Tasmania, New Zealand, Singapore, India, Sri Lanka, Bangladesh, West Pakistan, Thailand, Malaysia, Indonesia, Brunei, South Korea, North Korea, Japan, Taiwan, Hong Kong and the Philippines.

A semi-structured, 30-item questionnaire was

developed from a literature review, using existing information on licensing authority websites and through consultation with both national and international driving researcher email lists in Australia, the US and Canada. The questionnaire was reviewed by two of the authors, both of whom were experienced drivers who were also familiar with driving cessation research and practices. Data were collected on the initial and renewal licensing requirements and processes, the availability of medical guidelines on fitness to drive, the frequency of medical certification, legislations on reporting and authority for licensing decisions.

Participant information sheets that explained the purpose of the survey and copies of questionnaires were sent out to licensing authorities via email or post. Participants were invited to complete the questionnaire either online or to return it by email, facsimile or post. Consent to participate was implied by the completion and return of the survey. The questionnaire was available online from the beginning of February to the end of March 2009. Follow-up contact was made after a fortnight if no initial response was received. Questionnaires were re-sent, if required. Participants were contacted by email and phone at the completion of data collection if clarification to the responses was required. Information was also obtained from the relevant websites of Australian states for participants who did not respond directly. A descriptive comparative analysis of the data was undertaken.

## RESULTS

Respondent countries were Hong Kong, Singapore and Australia. In Australia, licensing authorities in NSW, Queensland, SA, WA, Tasmania and ACT responded directly to the questionnaire. The licensing authority in the Australian state of NT responded by directing the researchers to its website to obtain the relevant information. As there was no response from the state of Victoria, the information was sought from its respective websites. The total number of participating regions in this study was therefore deemed to be ten. This included participants in the eight regions who responded directly to the questionnaire and the two regions whose information was accessed via their individual websites. Information from all these ten regions was descriptively analysed for the purpose of this study. In all the regions, the licensing process for professional taxi drivers differed from that for private drivers.

The minimum age criterion for starting taxi driving was 19–30 years. In Australia, it ranged from 19 years of age in SA and NT to the minimum age of 20 years in

NSW, WA, ACT, Queensland and Tasmania. Singapore had the highest minimum age of 30 years. Hong Kong reported a minimum age of 21 years. No maximum age limit existed for taxi drivers in Australia and Hong Kong. In Singapore, taxi drivers had a maximal age limit of 73 years, provided they pass a medical examination and a specified driving test at 70 years of age. The ACT required that taxi drivers aged  $\geq 70$  years pass an annual driving test and medical examination to retain their licences.

The minimum driving experience required was 0–3 years. Singapore and the Australian states of NSW, WA and Victoria required a minimum of one year of driving experience. Hong Kong and the Australian states of Queensland and ACT required a minimum of three years of driving experience. NT in Australia required a minimum of two years of driving experience, while Tasmania required a minimum driving experience of 2–3 years. These driving experiences were with unrestricted private driver licences, often without suspension or disqualifications. SA reported that it was considering changing its minimum driving experience from none to one year.

The main evaluation methods used during the initial licensing process were a medical certification that is different from a private driver licence (except in Hong Kong), a written examination (except in NT), a practical training test (except in Singapore and Hong Kong) and an English language test (except in Hong Kong and the Australian states of NT and ACT). Hong Kong reported using one evaluation method only, i.e. a written examination. Singapore reported that an English test was required only if there were no educational certificates to show a basic level of English reading and verbal skills. A minimum of one year of continuous contribution to the compulsory national medical savings scheme (Medisave) was mandatory in Singapore. This medical scheme is available for payment of specified medical expenses, e.g. hospitalisation and certain medical follow-ups by taxi drivers or for their family.

In the relicensing process, the renewal cycle was 1–10 years. Tasmania and the ACT had the shortest renewal cycle – annually. SA had a renewal cycle every two years. NSW and NT in Australia and Singapore had renewal cycles every three years. Queensland and WA had a renewal cycle every five years. The Australian state of Victoria had renewal cycles every year or every three years. Hong Kong had the longest renewal cycle at every ten years, which was shortened to every 1–3 years after the age of 70 years.

All regions required medical certification for license

renewal. In Australia, doctors could access the national resource, *Assessing Fitness to Drive 2003*, using the internet ([www.austroads.com.au](http://www.austroads.com.au)). In Singapore, doctors were required to purchase the handbook, *Medical Guidelines on Fitness to Drive 1997*, from the Singapore Medical Association, or access it on the internet.<sup>(8)</sup> These medical guidelines reportedly cover medical conditions like vision and physical impairment, stroke, Parkinson's disease, heart disease, dementia and others. The medical guidelines for taxi drivers were reported to be of higher standards than those for private drivers. Australia and Singapore reported that vision testing was included in the routine medical certification process. All Australian states (except for the ACT) and Singapore reported that any doctor could do the medical certification. The ACT, however, required a designated doctor. SA required that the length of the patient-doctor relationship be reported on the medical form. Mandatory reporting requirement for health professionals existed only in the Australian states of NT and in SA, outside the routine medical certification process. There was no such legislation for doctors in other Australian states and in Singapore. Hong Kong did not report any medical guidelines or respond to the question on vision testing and legislative requirement on doctors.

Taxi drivers were legislated to self-report permanent or long-term illnesses to the licensing authority regardless of age, by all Australian states. This information was made known in various ways either on the license application forms, driving licenses or medical certification forms. The time frame for self-reporting reportedly ranged from immediate to within seven days. There was no legislation for self-reporting of illness in Singapore. Drivers were reportedly encouraged to do so voluntarily, but the information was not made explicit on any forms.

Table I summarises the following types of evaluation used in relicensing: frequency of medical certification, on-road driving, off-road test, refresher course and in-person renewal. The frequency of medical certification varied according to the renewal cycle and the age of the driver. Additional health screenings may be triggered by licensing authorities outside of the renewal cycle and specified age following reports by drivers or others.

Age-based on-road driving test was used in Tasmania, the ACT and Singapore. On-road driving tests were reportedly outsourced to other transport agencies by licensing authorities in Tasmania and the ACT. The on-road driving tests were conducted by specialised driving assessor occupational therapists with driving instructors in Singapore. All these three respondents

**Table I. Relicensing process of taxi drivers in Australia, Hong Kong and Singapore.**

Area	Medical certification	Age-based medical certification	Age-based on-road test	Off-road skills	Refresher courses	In-person renewal
New South Wales	Every 3 years	Annually at $\geq 60$ years	Nil	Nil	Nil	Nil
Queensland	Every 5 years	Annually at $\geq 75$ years	Nil	Nil	Nil	Yes
South Australia	Every 5 years	Nil	Nil	Nil	Nil	Yes
Western Australia	Every 5 years	Nil	Nil		Half a day every 2 years by outsourced training providers	Yes
Tasmania	Every 3 years	Annually at $\geq 65$ years	At 65 and 70 years; annually, at $\geq 75$ years by outsourced transport agency	Nil	Nil	Yes
Australia Capital Territory	Annually	Nil	Annually at $\geq 70$ years by outsourced taxi agency	Nil	Nil	Yes
Northern Territory	Every 5 years	Nil	Nil	Nil	Nil	Optional
Victoria	Every 3 years	Annually at $\geq 60$ years	Nil	Nil	Nil	Yes
Hong Kong	Nil	At 70 years only	Nil	Nil	Nil	No response
Singapore	Every 3 years until 49 years of age	Every 3 years at age 30–49 years; every 2 years at age 50–64 years; annually at age 65–73 years	At 70 years, if opt to renew until 73 years, by driving assessor therapists	At 70 years, if opt to renew licence	Every 6 years by Taxi Academy or taxi companies	Optional

reported that driving reassessments were allowed upon failure. Although NSW did not have any age-based on-road tests, the privilege of on-road reassessment was reportedly not allowed for at-risk drivers who fail the test in the relicensing process.

Refresher taxi driver courses were reported by WA and Singapore. In WA, a half-a-day refresher course was required every two years. In Singapore, it was required every six years. Both countries reported the use of designated training agencies. In Singapore, the theory course was conducted by taxi companies or by the Singapore Taxi Academy, which was part of the local licensing authority. In WA, the educational course content was designed by the licensing authority but outsourced to a training agency. Its contents reportedly covered a range of professional driver issues like fatigue management, personal security and being a tourist guide.

Off-road tests were reported only in Singapore for 70-year-old taxi drivers who wished to renew their licences after passing the medical certification. It was administered by a specialised driving assessor occupational therapist. In-person renewal was reported by all Australian states except in NSW, and was an optional process in NT. In Singapore, in-person

renewal was an optional process, as taxi drivers could also renew indirectly via post or taxi-operator firms. In-person renewal was not reported in Hong Kong. In SA, the independent review board Passenger Transport Standards Committee was also used to consider the fitness of any taxi driver in question. Queensland required evidence of work entitlement in the relicensing process, while Singapore required up-to-date contributions to the national medical scheme, i.e. Medisave. All licensing authorities could make the decision to withdraw any taxi licences.

## DISCUSSION

The aim of this survey was to review the licensing policies for taxi drivers in Singapore, Hong Kong and Australia. The results indicate that licensing policies can range from a simple system with a few screening checks at renewal, as in the case of Hong Kong to a more complex system with regular renewal cycles and health and/or age-triggered policies in other regions. Hong Kong reported just two modes of screening in the relicensing process, i.e. medical certification at 70 years of age and shortening of the renewal cycle after age 70 years from ten years to every 2–3 years. In contrast, more regular medical certification cycles of 1–5 years

were found in Australia and Singapore. Shortening of the renewal cycle at the upper age range has been reported to have minimal effect in reducing overall crash and fatality rates for older drivers.<sup>(10)</sup> Given the moderate association of some medical conditions with impact on driving skills,<sup>(15)</sup> linking the shorter renewal cycle with health screening may enhance the existing screening process.

The medical screening of fitness to drive can be undertaken by any doctor in all of the regions, except in the ACT. Concerns have been raised regarding the existing training and self-reported comfort levels of doctors to competently assess fitness to drive in a clinic-based assessment.<sup>(5,9,10,31)</sup> Driving is a sensitive issue, the loss of which can be traumatising to the driver, affecting the doctor-patient relationship.<sup>(13)</sup> Ethical dilemmas related to patient-doctor confidentiality for at-risk drivers may arise.<sup>(10,31,32)</sup> According to Austroads, Australian doctors in the course of treatment of patients are to encourage drivers to self-report using a copy of the Medical Condition Notification Form.<sup>(6)</sup> Although mandatory reporting is required by doctors in SA and NT, professional indemnity is provided for discretionary reporting by doctors in other Australian states if a driver fails to heed medical advice or counselling, and is likely to endanger the public.<sup>(6)</sup> In Singapore, there is no system of mandatory obligation of doctors to report,<sup>(8)</sup> or the use of any formal written medical condition notification form to notify the licensing authority.

With the reliance of current licensing policies on medical screening, it is imperative that ongoing education of doctors and improvements to the existing systems of alerting at-risk drivers be made a priority.<sup>(5,10,31)</sup> The use of designated doctors with prior training on driving-related matters is one way to maintain the standard of screening for medical fitness to drive. SA required that the length of the doctor-patient relationship be made explicit in the medical certification process. This can be advantageous to ensure a thorough proper medical history record of the driver. It may also curb the risk of frequent changes of doctor by at-risk drivers to get a more favourable medical report. This strategy and the prescribed use of a medical condition notification form to encourage self-reporting by drivers in the course of treatment can be useful in regions where there is an absence of compulsory reporting of illness by the driver, as in Singapore.

An accredited online educational programme for general practitioners has reportedly been developed in Australia.<sup>(6)</sup> This may counteract the problems of distance and the lack of adequately trained doctors on driving matters. Presently, the medical guidelines to

drive in Australia<sup>(33)</sup> and Singapore are being updated to ensure consistency with current medical knowledge, with inputs from licensing authorities. Unlike during the past, when medical guidelines were developed from expert panel consensus, there is now growing medical evidence for the influence of chronic illness on driving performance.<sup>(32)</sup> Ongoing updates for doctors with international benchmarking to meet local needs and improved publicity of resources (e.g. the medical fitness to drive and a referral system to specialised occupational therapists when required) are recommended.

This survey showed a variation between Australia and Singapore in the availability of conditional licensing. There has been a long-standing use of conditional licensing in Australia, even for professional drivers to assist in their employability without compromising road safety.<sup>(6)</sup> Such conditional licenses include the wearing of corrective lenses when driving, modified vehicles, taking the prescribed medication and a medical certificate before the next renewal.<sup>(34)</sup> In Singapore, the wearing of any new corrective lenses is required to pass the health screening for driving, but it is not a feature of conditional licensing locally. Professional drivers in Singapore may be exempted from driving temporarily subject to later medical reviews or therapy driving assessments, but the licensing authority is not involved, as in Australia. This increases the moral ethical dilemma of healthcare professionals in Singapore if drivers themselves do not heed medical advice or fail to inform their employers in the absence of adequate professional indemnity to empower reporting by healthcare professionals. Restrictions on driving, in terms of the time and location of driving and the use of shorter renewal cycle with more frequent medical certification, are practised in Australia. However, the only type of conditional licensing available in Singapore is that for modified vehicles for drivers with disabilities and the prescribed use of an automatic transmission car for an amputee taxi driver. It appears there could be a need in Singapore to monitor and strengthen the compliance of professional drivers to medical advice outside of compulsory medical certification checks in the absence of legislation for self-reporting by drivers and reporting by healthcare professionals. In view of the limited studies on conditional licensing,<sup>(19)</sup> future Australian studies can yield evidence for comparisons with North America and Europe.

Bohensky et al highlighted that as previous studies did not control the effect of in-person renewal, there is inconclusive evidence for linking specific visual functions and impairment with crash risk. Older drivers

are known to underperform during visual testing. Setting benchmarks or performance thresholds on selected visual tests remains questionable, and visual acuity and visual field assessments do not adequately explain unsafe driving performance.<sup>(27)</sup> This survey highlights the current practice of using vision testing as a routine part of the medical certification process, rather than the sole criterion of licensing decision. This is consistent with the current recommendation to assess visual-related impairment in the context of the driver's overall health and other functional abilities,<sup>(27)</sup> given that driving is a multidimensional task involving the integration of visual, cognitive and psychomotor skills.<sup>(29)</sup> However, further detail about the components of vision testing used may be required, as it was not explored in this survey. According to Bohensky et al, measures of visual acuity and visual field are commonly used internationally.<sup>(27)</sup> With the lack of evidence to support its link with crash risk, there is scope to enhance vision screening with useful field of vision,<sup>(35)</sup> glare sensitivity,<sup>(36)</sup> contrast sensitivity<sup>(37)</sup> and motion sensitivity.<sup>(29)</sup>

It is known that younger drivers, male more than female, are at-risk drivers in terms of crash rate statistics compared to those of other age groups.<sup>(19)</sup> This is due to alcohol consumption, failure to use seat belts or safety devices, speeding, inattentiveness and poor judgement on speed for weather and road conditions.<sup>(32)</sup> Studies from driver education and graduated driver licensing have convincingly demonstrated that driving experience may be more important than maturity as contributing factors toward crash risk.<sup>(38)</sup> Experienced drivers have more knowledge in terms of judgement, quality and range of driving skills to respond to heightened crash risk situations compared to those with limited driving exposure. In the survey, most of the respondents with a minimum age criteria of about 20 years had an average minimum driving experience of three years. SA reported changing its criteria of no driving experience to one year of experience. This is consistent with the current evidence for improved driving safety. Singapore reported a minimum age of 30 years and at least one year of driving experience in order to be eligible to apply for a taxi driver license. The literature suggests that if required, the situation in Singapore can be changed by matching a lowering of the high minimum age criteria with increased minimum years of driving experience.

During its renewal cycle, WA and Singapore require taxi drivers to undergo information-based refresher courses by designated training providers every two and six years, respectively. While these regions use

designated transport agencies to run refresher courses, a theory-based style was reported in the instructional style in Singapore compared to a participatory workshop in WA. Older drivers may become nervous in theory-based classroom learning. An active adult learning engagement process that provides a sense of responsibility and ownership of new learning material to maximise motivation for behavioural change<sup>(39)</sup> may be more conducive for older drivers to benefit from driver refresher courses. Driver refresher courses show promise in improving driving knowledge, new traffic laws, defensive driving techniques and changing bad driving habits, e.g. checking blind spots and following vehicle distance. However, little is known about the effectiveness of driver refresher courses and their impact on actual crash risk.<sup>(40)</sup> Future comparative studies could explore the optimal instructional environment for effective driver refresher courses. Nonetheless, the current use of refresher courses can provide a further indirect means to screen for at-risk drivers if course providers are trained, as per in-person renewal to identify visual signs of possible functional impairments, e.g. inability to walk unassisted, excessive tremors or involuntary movements and obvious disorientation. This can be in addition to a check on medical history and medication usage.<sup>(9)</sup> This additional screening strategy at driver refresher courses can be especially relevant in regions where the renewal and medical certification cycle is long, as in Hong Kong.

A considerable number of older ordinary drivers aged 65 years and above self-regulate their driving behaviour by driving shorter hours or driving only in good weather, during non-peak hours and in familiar surroundings<sup>(18)</sup> to compensate for their reduced confidence and driving ability. While the prevalence of self-regulation is not known in taxi drivers, it is possible that older taxi drivers who are reluctant to retire totally may self-regulate their driving. Current literature has emphasised that licensing authorities should not rely on effective self-regulation by drivers,<sup>(41,42)</sup> as drivers do not know when to stop driving appropriately before a critical driving incident occurs.<sup>(43,44)</sup> Given the new evidence that at-risk older drivers are those who drive infrequently in relatively short distances on local streets with complex traffic situations,<sup>(18)</sup> it may be useful to enhance the existing health screening systems with self-screening tools, especially for taxi drivers in urban regions, e.g. Singapore, Hong Kong and metropolitan areas in Australian states.

Self-screening tools assist in the identification of at-risk driving behaviours in a non-threatening manner

and prompt drivers to seek further consultation.<sup>(9)</sup> A range of self-screening tools have been developed in the US for older drivers, with some evidence to support the use of self-screening tools like the Driving Decisions Workbook<sup>(45)</sup> or its web-based version,<sup>(46)</sup> or other computer-based self screening versions.<sup>(47)</sup> While the usefulness of such tools is limited to cognitively intact and compliant drivers,<sup>(9)</sup> there is potential to use them at taxi driver refresher courses, during in-person renewal, through the website or through public education leaflets as part of a public policy driving safety awareness programme. Future prospective evaluation studies on its effectiveness are still warranted.<sup>(9)</sup>

The licensing policy in Singapore is unique in its screening for a certain level of compulsory medical savings, i.e. Medisave, as one of the prerequisites to hold a valid taxi licence. Taxi drivers in Singapore are self-employed and are thus solely responsible for their own retirement funds. There is a strong emphasis in the current government policy on the personal responsibility of the individual and immediate family to meet their own financial needs in retirement.<sup>(48)</sup> This check on Medisave contributions by the licensing authority reflects the government policy to ensure a basic level of contribution to meet future medical expenses for the taxi driver and his immediate family. Another distinctive feature in Singapore is the apparent lack of legislative requirement for both self-reporting and reporting of at-risk drivers by doctors compared to other regions. The licensing policy in Singapore appears to lean more toward age-based licensing and more frequent medical certification with age criteria to manage its taxi drivers. For example, only 30-year-olds are eligible to apply for a taxi license compared to the age range of 19–21 years in other regions. It also maintains a mandatory retirement age at 70 or 73 years for older taxi drivers, unlike in other regions. Given the evidence of the negative effects of driving cessation on health and quality of life,<sup>(21,22,24)</sup> it may be imperative to explore the impact on health and well-being with mandatory retirement for healthy taxi drivers, retirement planning or driving cessation programmes like the UQDRIVE<sup>(23)</sup> to improve the outcomes for retired older taxi drivers in Singapore. Age-based mandatory retirement for healthy taxi drivers does not concur with the recent promotion of active ageing in Singapore,<sup>(49)</sup> and is therefore in need of policy review.

Interestingly, Singapore is the only region to use specialised occupational therapists to screen medically fit taxi drivers at 70 years of age in off-road and on-road tests for licence renewal. This service is only used

in the Australian counterparts for identified at-risk drivers.<sup>(26)</sup> The cost and funding for in-depth functional assessments and resources of specialist services can be an issue.<sup>(9,19)</sup> In the US, such barriers are being negotiated with insurance companies and relevant healthcare associations.<sup>(9)</sup> In Singapore, 70-year-old taxi drivers self-funded all license renewal costs. An affordable costing for the specialised occupational therapy service was taken into consideration during the licensing policy change. The therapy assessment for older taxi drivers in Singapore was designed to be quicker, more comprehensive and cheaper than the routine in-depth assessments for medically at-risk drivers.

It is unclear whether specialist driving assessor occupational therapist assessments are required for medically fit taxi drivers in Singapore. Tasmania and the ACT reported the use of staff from transport agencies without health qualifications, and not occupational therapists, for their age-based on-road tests of older taxi drivers aged 65 and 70 years and above, respectively. At the same time, there are reported concerns in on-road testing, e.g. the lack of standardisation for scoring procedure,<sup>(9)</sup> the distinction between normal or catastrophic types of errors,<sup>(19)</sup> and content validity in terms of complexity of manoeuvres to identify at-risk performance in experienced drivers.<sup>(10)</sup> The comparative validity of the type of on-road tests used in Singapore, Tasmania and the ACT requires further investigation. It is unclear if the on-road tests similar to those for ordinary drivers are adequate for taxi driver assessments compared to simulated real-world taxi driver test by designated transport operators, as reported for initial licensing in WA. Nonetheless, passing the on-road tests in Singapore is the main criterion for licensing renewal for 70-year-old taxi drivers, although off-road screening tests are also administered. This is consistent with studies that have recommended against using off-road tests as the sole criterion for licensing decision.<sup>(16)</sup> However, given the inefficient means of age-based screening to identify at-risk drivers,<sup>(14)</sup> and the limited studies on cost-benefit analysis of various screening protocols<sup>(11)</sup> and evaluations of on-road tests,<sup>(19)</sup> ongoing reviews of service demands against the latest evidence for licensing policies and cost-effectiveness of services are indicated.

A limitation to this study was the lack of response from other countries in the Asia Pacific region. This could have been due to language barriers in countries where English is not the main language. There is also the risk of misunderstanding of some terms used or reported in the survey by respondents, especially from non-English-speaking regions or by the researcher,



unless identified and clarified. Another limitation is the reliance on websites to obtain data for the Australian states of Victoria and NT. The methodology can be improved in future studies by face-to-face interviews conducted by identified local collaborators. It is possible that some responses were underreported due to inadequate knowledge, misunderstandings or pressured time frame.

There is a need to review the existing age-based licensing policies for healthy low-risk taxi drivers, especially in terms of the mandatory age limit, to match with the active ageing policy and to strengthen the existing systems of identifying at-risk drivers, which rely heavily on health screening to multilevel systems. The various stakeholders who need to review their policies include licensing authorities and health professionals. The strategies for licensing authorities include: replacing the mandatory age-based retirement policy with health-based driving fitness policy; the use of in-person renewal at licensing offices when medical certification is infrequent; the use of legislation for self-reporting of illness by drivers outside their medical certification cycles and for professional immunity to health professionals to report at-risk drivers who ignore medical advice; raising public awareness on age-, health- and functional-related driving issues with ways to alert at-risk drivers to authorities by concerned family members or the public; and exploring the cost-effectiveness of various screening protocols and the use of driving self-screening tools at home, in collaboration with employers and at driver refresher courses.

The strategies for health professionals include: benchmarking the medical certification process with certified training of doctors on driving; publicity of any new Medical Fitness to Drive Guidelines; referrals of at-risk drivers to functional driving assessment by specialised occupational therapists; stating the length of the doctor-driver relationship at medical certification; using a medical notification form to encourage self-reporting of drivers to the authorities; enhancing existing vision tests with UFOV, glare, contrast and motion sensitivity tests; ongoing programme evaluations of driving assessments, validity of off-road and on-road tests; and exploring the need for professional driver retirement programme to improve health outcomes.

More local and international comparative studies among various stakeholders on safety statistics, health and well-being outcomes for taxi drivers and other professional drivers, e.g. bus and heavy vehicle drivers, are warranted.

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