

# Analysis of fatal unintentional drowning in Australia 2008–2020: implications for the Australian Water Safety Strategy

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**D**rowning is a significant public health issue in Australia and a leading cause of mortality and morbidity.<sup>1</sup> Every year an average of 283 people die from unintentional drowning,<sup>2</sup> with fatalities costing the Australian economy \$1.24 billion annually.<sup>3</sup> For each unintentional drowning fatality in Australia, a further three people are hospitalised due to non-fatal drowning.<sup>4</sup> This ratio is highest among children under the age of five, with eight hospitalisations for each death.<sup>4</sup>

In 2014, the World Health Organization (WHO) described drowning as a serious and neglected public health threat<sup>5</sup> and called for the coordination of drowning prevention efforts with those of other sectors and agendas, and for the development of national water safety plans. The Australian Water Safety Council (AWSC) and the Australian Water Safety Strategy (AWSS) have been highlighted as exemplars in subsequent WHO technical guidance.<sup>6</sup>

The AWSC was formed in 1998 by peak water safety bodies Royal Life Saving Society – Australia and Surf Life Saving Australia, alongside other national non-government organisations with interests in swimming, boating and water safety.<sup>7</sup> The AWSC's establishment was supported by the Federal Government and prompted by research which estimated the national fatal drowning rate to be 1.44 per 100,000 population in 1997, with the highest rates found in children under five (4.60 per 100,000).<sup>8</sup> The AWSC acts as a consultative forum to encourage collaboration; it develops and monitors a

## Abstract

**Objective:** To examine temporal trends in drowning in Australia against targets set in the Australian Water Safety Strategy (AWSS) 2008–2020 and to inform the development of the next iteration of the Strategy.

**Methods:** A national analysis of unintentional fatal drowning rates per 100,000 population over 16 years (2004/05–2019/20) was conducted. Baseline rates (three-year average 2004/05–2006/07) were compared to the current three-year average (2017/18–2019/20) by sex, age group, drowning location and jurisdiction.

**Results:** The overall rate of unintentional fatal drowning during the period decreased by 28%. Substantial reductions were observed in children 0–4 years (-63%) and 5–14 years (-56%). Progress has been less pronounced among people aged 75 years and over (-11%) and 15–24-year-olds (-14%). All locations and jurisdictions recorded reductions, aside from rocks (+46%).

**Conclusions:** Although the strategy fell short of its aspirational target of a 50% reduction in drowning by the year 2020, this target was exceeded in key age groups, including children.

**Implications for public health:** The AWSS is a powerful tool to align drowning prevention sector actions to agreed objectives. Forthcoming strategies must take into consideration demographic and social change, areas where limited progress has been made and the latest evidence to guide future priorities.

**Key words:** drowning, epidemiology, injury prevention, policy, strategy

national water safety plan; and it facilitates workshops to create action plans for key drowning prevention issues.

The AWSC developed the first National Water Safety Plan (NWSP) in 1998 with a stated purpose of fostering cooperation and commitment in the fight against drowning.<sup>9</sup> The NWSP 1998 focused on: water safety research; management of aquatic locations; water safety education; and the targeting of key drowning demographics. This plan was updated in 2004<sup>10</sup> following further research and workshops with key stakeholders.

In 2008, the Plan was replaced by the AWSS, which proposed an aspirational target of reducing drowning deaths by 50% by 2020.<sup>11</sup> This target was intended as a focal point for advocacy, as well as being an indicator that flowed through a new drowning prevention framework. This framework was structured in three priority areas: 'life stages' – an acknowledgement that drowning risk changes throughout the life course; 'key locations' – which allowed for a more traditional lifesaving approach and focus on risk management and other strategies specific

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to water bodies; and finally, 'key drowning challenges' – which created a structure for issues considered to be emergent or that required specific focus of groups not yet engaged or identified in the previous plan. The AWSS then aligned goals and objectives to each area, often prioritising further research to address knowledge gaps as well as new initiatives, as evidenced in rivers<sup>12</sup> and older people.<sup>13</sup>

Two subsequent iterations of the strategy were published in 2012 (spanning 2012–15)<sup>14</sup> and 2016 (spanning 2016–20)<sup>15</sup> following a process of review that included a consideration of evidence, stakeholder workshops, redrafting and consultation. Table 1 shows the evolution of the priority areas and goals in each iteration. In most cases, changes to the goals reflected consideration of new research or stakeholder-recommended adjustments in the prioritisation of life stages, or were triggered by key events. These included the Queensland Floods in 2011 that resulted in 33 flood-related deaths, seven of which

resulted from swimming, wading or diving into floodwaters, and a similar number from driving in vehicles on flooded roads and crossings.<sup>16</sup>

Throughout the 2019/20 financial year, the AWSC reviewed progress, evaluated actions and has been developing a new iteration of the Strategy. Essential to that process, was an assessment of progress against the aspirational target of reducing drowning by 50% by 2020 – overall, and in each area of the AWSS 2008–2020. This study details the findings of an examination of temporal trends in fatal unintentional drowning in Australia.

### Methods

This study is a national, retrospective, total population analysis of fatal unintentional drowning rates in Australia using the Royal Life Saving National Fatal Drowning Database (the Database).<sup>17</sup> The Database collates a range of demographic, circumstantial and risk factor variables for each case of fatal unintentional drowning in Australia.<sup>18</sup>

Data are drawn primarily from the National Coronial Information System (NCIS).<sup>19</sup> Additional data sources such as year-round media monitoring,<sup>20</sup> police reports and lifesaving club reports are used to create a triangulation method. This approach minimises the reliance on International Classification of Diseases (ICD) codes, which have been shown to underreport fatal drowning.<sup>21</sup> The completeness of case capture is high due to the triangulation method and the use of a variety of search methodologies to identify drowning cases within the NCIS. The quality of inputs into the Database is also high, given the reconciliation of cases against the NCIS. Complete variables for a case rely upon those data being available in the NCIS. To limit potential underreporting for some drowning risk factors (such as alcohol and medical conditions), this study focused on sex, age group, drowning location and state or territory of drowning incident, which have a high rate of accuracy.

The study baseline was derived from a three-year average of fatal drowning data in

**Table 1: Evolution of the Australian Water Safety Strategy Framework (AWSS) 2008 –2020**

	2008	2012	2016	Focus	Rationale for changes 2008 - 2020	
PRIORITY AREA 1: Key Life Stages	Children	Children	Children	- adult supervision	Expanded to 0-14 following research showing large gaps in swimming skills in primary school aged children, and with support of swimming industry. Non-fatal added as overarching focus in 2016-2020 largely due to impacts on children.	
	0-4yrs	0-14yrs	0-14yrs	- pool fencing regulations - impacts of non-fatal drowning - promoting swimming and water safety education		
	Men and alcohol	Young people 15-24	Young people 15-24	- further research - lifesaving skill development - awareness campaigns		Alcohol and drugs prioritised in new goal in key challenge. Age group thought to be too broad, hence refinement to focus on 15-24 years. Thought to be start of risk-taking behaviours.
	Old people 55 yrs and above	People aged above 55 yrs	People aged above 65 yrs	- healthy active ageing - campaigns targeting health issues		Focus due to research. Terminology and age groups adjusted, following contradictory stakeholder feedback.
	-	-	Males aged 25-64	- healthy active ageing - campaigns targeting health issues	Focus due to research. Terminology and age groups adjusted, following contradictory stakeholder feedback.	
PRIORITY AREA 2: High Risk Locations	Surf beaches	Surf beaches	Coastal waters	- strengthening and expansion of lifesaving, lifeguarding service delivery - awareness campaigns - rock fishing interventions	Beaches 2nd ranked location. Stakeholder feedback subsequently broadened to coastal waters to incorporate ocean and rocks.	
	Rural and remote	Inland waterways	Inland waterways	- awareness campaigns risk management, further research	New research tightened focus on inland waterways.	
	Home pools	Aquatic industry	Aquatic industry	- building capacity and strengthening workforce - linking to health and social benefits - risk management	Home pool focus duplicated in children. Aquatic industry capacity building added as contribution to wider community knowledge and skills.	
PRIORITY AREA 3: Key Challenges	High risk activities	Watercraft and recreational activities	Boating, watercraft and recreational activity	- lifejacket laws and enforcement - boat licensing systems - awareness campaigns, weather warnings	New research promoted refinement to boating and watercraft. Symposia enhanced partnership with boating and watercraft sector.	
	High risk populations	High risk populations	High risk populations	- further research - skill development - community development - awareness campaigns	Focus on Aboriginal and Torres Strait Islander peoples, Culturally and linguistically diverse (CALD) people and tourists, populations consistent throughout, understanding and focus deepening in 2016 – 2020.	
	Extreme weather	Extreme weather	Impact of disaster and extreme weather	- public awareness - further research - hazard identification	Focus on flooding due in part to Brisbane Floods and Queensland cyclone season in 2011.	
	-	Alcohol and drugs	Alcohol and drug related	- campaigns - further research	Added as new goal in 2012 due to new research, stakeholder feedback.	

the Australian financial years immediately preceding the release of the first AWSS in 2008 (2004/05 to 2006/07 [henceforth referred to as the baseline average]), and a current comparison was derived from the most recent three-year average of fatal drowning data from 2017/18 to 2019/20 (henceforth referred to as the current average). Drowning rates per 100,000 population were calculated using population data from the Australian Bureau of Statistics. Population data for total, sex, location and state or territory were calculated using the population for December of the financial year (i.e. 2004/05 uses December 2004 population data).<sup>22</sup> Due to data availability, population data by age group are taken from June.<sup>23</sup>

Rates and 95% confidence intervals were estimated using exact Poisson methods. Reductions in rates in 2017/18–2019/20 relative to 2004/05–2006/07 were estimated using Poisson regression.

Ethical approval for this study was received from the Victorian Government Department of Justice and Community Safety (CF/07/13729; CF/10/25057, CF/13/19798; CF/19/25126).

### Results

Between the baseline average and the current average, the overall rate of unintentional fatal drowning in Australia decreased from 1.40 per 100,000 population to 1.00 (a reduction

of 28.2%). A higher reduction between the baseline average and the current average was seen among females (-37.2%) compared to males (-25.2%); see Table 2.

Children under the age of five recorded the highest rate of drowning at baseline (2.66). This position was replaced by the 65–74 years and 75+ years age groups at the current average (1.44, respectively). The largest reductions in fatal unintentional drowning were observed among children aged 0–4 years (-62.6%) and 5–14 years (-55.7%). The rate of drowning has been most resistant to change in the 75+ years age group (-10.5%), the 15–24 years age group (-13.5%) and among the 65–74 years age group (-18.0%); see Table 2.

	Average drowning deaths – baseline (2004/05–2006/07)	Drowning rate - baseline (2004/05–2006/07)	95% confidence interval	Average drowning deaths – current (2017/18–2019/20)	Drowning rate - current (2017/18–2019/20)	95% confidence interval	Percentage change in drowning rate (%) <sup>+</sup>	95% confidence interval (%) <sup>+</sup>
<b>Total</b>	284	1.40	1.30 to 1.49	252	1.00	0.93 to 1.08	28.2	20.8% to 34.9%
<b>Sex</b>								
Male	213	2.11	1.95 to 2.28	197	1.58	1.45 to 1.71	25.2	16.3% to 33.1%
Female	71	0.69	0.60 to 0.79	55	0.43	0.37 to 0.51	37.2	23.0% to 48.8%
<b>Age group</b>								
0-4 years	35	2.66	2.17 to 3.22	16	1.00	0.73 to 1.32	62.6	47.2% to 73.5%
5-14 years	16	0.60	0.45 to 0.80	8	0.27	0.17 to 0.39	55.7	28.3% to 72.6%
15-24 years	34	1.21	0.98 to 1.46	34	1.04	0.85 to 1.27	13.5	-13.8% to 34.3%
25-34 years	42	1.48	1.23 to 1.76	38	1.01	0.83 to 1.21	31.8	12.2% to 47.1%
35-44 years	41	1.34	1.12 to 1.60	35	1.06	0.87 to 1.29	20.8	-2.8% to 38.9%
45-54 years	40	1.40	1.16 to 1.68	34	1.06	0.87 to 1.29	24.2	1.3% to 41.8%
55-64 years	30	1.36	1.09 to 1.67	31	1.07	0.87 to 1.31	20.9	-5.6% to 40.7%
65-74 years	25	1.76	1.38 to 2.21	32	1.44	1.17 to 1.76	18.0	-11.1% to 39.4%
75+ years	20	1.61	1.23 to 2.06	24	1.44	1.13 to 1.81	10.5	-25.7% to 36.3%
<b>Location of drowning incident</b>								
Bathtub / Spa Bath	23	0.11	0.09 to 0.14	13	0.05	0.04 to 0.07	53.2	30.9% to 68.3%
Beach	49	0.24	0.20 to 0.28	54	0.21	0.18 to 0.25	11.5	-10.7% to 29.2%
Lake / Dam	24	0.12	0.09 to 0.15	25	0.10	0.08 to 0.12	18.1	-13.2% to 40.7%
Ocean / Harbour	48	0.24	0.20 to 0.28	36	0.14	0.12 to 0.17	38.8	21.6% to 52.3%
River / Creek	76	0.37	0.33 to 0.43	62	0.25	0.21 to 0.28	34.1	20.0% to 45.7%
Rocks	12	0.06	0.04 to 0.08	22	0.09	0.07 to 0.11	-46.3	-118.6% to 2.1%
Swimming Pool	41	0.20	0.17 to 0.24	31	0.12	0.10 to 0.15	38.3	19.2% to 52.8%
Other <sup>*</sup>	10	0.05	0.03 to 0.07	8	0.03	0.02 to 0.05	32.7	-14.5% to 60.4%
<b>Jurisdiction of drowning incident</b>								
Australian Capital Territory (ACT)	NP	0.60	0.22 to 1.30	NP	0.47	0.17 to 1.03	21.0	-145.1% to 74.5%
New South Wales (NSW)	105	1.57	1.40 to 1.75	88	1.10	0.97 to 1.24	30.0	17.6% to 40.6%
Northern Territory (NT)	7	3.37	2.09 to 5.16	7	2.98	1.87 to 4.52	11.6	-60.7% to 51.4%
Queensland (QLD)	68	1.72	1.50 to 1.98	61	1.21	1.04 to 1.40	29.9	14.5% to 42.6%
South Australia (SA)	19	1.21	0.91 to 1.57	14	0.78	0.56 to 1.06	35.1	2.9% to 56.6%
Tasmania (TAS)	10	1.98	1.33 to 2.84	7	1.25	0.77 to 1.94	36.7	-12.0% to 64.2%
Victoria (VIC)	43	0.86	0.71 to 1.02	43	0.66	0.55 to 0.79	22.3	0.9% to 39.1%
Western Australia (WA)	30	1.46	1.17 to 1.80	30	1.15	0.92 to 1.41	21.2	-5.6% to 41.2%

Notes:  
<sup>\*</sup> Other includes three unknown location cases from the 2017/18-2019/20 average. NP= Not Presented.  
<sup>+</sup> Results are presented in terms of percentage reduction. Negative reductions indicate a relative increase in rates.

The highest location-based drowning rates were rivers and creeks (baseline average 0.37; current average 0.25), followed by beaches (baseline average 0.24; current average 0.21). The largest reductions in drowning were observed in bathtubs and spa baths (-53.2%) and oceans and harbours (-38.8%). Rocks were the only location to record an increase in drowning over the study period (+46.3%); see Table 2.

The highest state and territory rates were found in the Northern Territory (NT) showing a baseline average of 3.37 per 100,000 residents and a current average of 2.98 per 100,000 residents. The lowest rates were found in the Australian Capital Territory (ACT) showing a baseline average of 0.60 per 100,000 residents and a current average of 0.47 per 100,000 residents. Tasmania (-36.7%) and South Australia (-35.1%) recording the largest reductions. No state or territory recorded an increase in drowning deaths over the study period (Table 2).

## Discussion

Unintentional drowning is a preventable cause of public health-related harm and is associated with a significant social and economic burden.<sup>3,4</sup> As a means of addressing the high drowning toll in Australia in the mid-1990s, the AWSS was established. Key to its role is the development and monitoring of a national water safety plan, which serves as a powerful tool for advocacy and aligning efforts of the sector. Successive strategy planning processes have been informed by an analysis of long-term drowning patterns.<sup>8,13</sup> This study aimed to explore temporal trends in fatal drowning rates to inform the development of future iterations of the strategy. The following discussion explores the results in the context of the AWSS key priority areas focusing on life stages and high drowning locations, as well as discussing limitations and areas for future improvements in monitoring water safety outcomes.

### Priority Area 1: Taking a life stages approach

Children aged under five are the age group most at risk of drowning in Australia<sup>4</sup> and, as such, have been a key focus of water safety policy, advocacy, programs and research.<sup>24</sup> At baseline, children aged 0–4 years had the highest unintentional fatal drowning rate (2.66 per 100,000). Consequently, the

AWSS 2008–2020 outlined an agreed focus on: promoting active adult supervision; strengthening pool fencing legislation and enforcement; promotion of water familiarisation lessons; and cardiopulmonary resuscitation (CPR) training for parents.<sup>11,14,15</sup> Further research specifically on the impacts of non-fatal drowning and supervision practices was also called for. Pleasingly, the highest reductions in the drowning rate in the current average (-62.6%) were seen among this age group. The continuation of current measures, as well as innovation to explore new strategies, will be required if child drowning rates are to move significantly closer to zero.<sup>25</sup> Future AWSS must ensure a focus on families of children known to be at higher risk of drowning, such as low socioeconomic families, those residing in regional and remote Australia, and Aboriginal and Torres Strait Islander and migrant populations.<sup>12,26,27</sup> Consultation has also reinforced a need to focus prevention measures on the developmental stages of children aged 0–4 years. The impacts of social determinants of health such as income security, housing, education and family size and supervision capacity need further consideration.

As with many other types of injury-related harm,<sup>28</sup> males continued to be overrepresented in fatal unintentional drowning statistics in Australia. This differential in fatal drowning rates between males and females has widened across the period analysed, from males drowning at a rate of 3.05 times that of females at baseline, to 3.67 times the drowning rate of females during the current period. This overrepresentation has been hard to address, with greater progress in reducing drowning rates seen among females (-37.2%) than males (-25.2%). A range of factors influence drowning risk among males, including alcohol consumption, differing exposure to water and participation in aquatic-related activities and lower likelihood to wear a lifejacket.<sup>29–31</sup> The AWSS has focused on males, initially combined with the issue of alcohol-related drowning in 2008, changing to young people 15–24 years in order to target risk-taking in later years, and then in a large cohort of males aged 25–64 from 2016. Future iterations of the AWSS should continue to encourage a focus on improving safety among males participating in aquatic activities, with a focus on addressing a range of risk-taking behaviours and the psychological motivations underpinning these.

The comparatively smaller reductions in drowning rates among people aged 65 years and older is of concern. Similar to many developed countries, Australia has an ageing population.<sup>32</sup> The AWSS focused evidence that retirement is associated with positive lifestyle changes, including increased physical activity.<sup>33</sup> This results in prolonged participation and exposure to aquatic recreational activities, including swimming, and combined with lifestyle-related health conditions can increase drowning risk.<sup>34</sup> Projected increases in the older age population, as well as study results showing that this age group has overtaken children under five to have the highest rate of drowning, require greater and more systematic approaches to reducing drowning risk among older people. Greater alignment with the healthy ageing and falls prevention sectors would further the dual focus of promoting aquatic recreation, while also encouraging safe behaviours to reduce injury.

### Priority Area 2: Addressing high-risk locations

Place or location-based analysis of drowning data is a common approach reflected in drowning studies. While international studies usually reflect ICD-10 coding for 'place of occurrence', the Royal Life Saving National Fatal Drowning Database applies nine potential locations or places of occurrence for drowning events. This more disaggregated location data and associated insights allowed the AWSS to prioritise 'High-Risk Locations' across: inland waterways (inclusive of rivers, lakes, dams); coastal waters (inclusive of beaches, the ocean and bays, and coastal rocks); and swimming pools and aquatic centres.

The focus on inland waterways has entailed national public awareness campaigns 'Respect the River' and 'Don't let your mates drink and drown', flood safety research<sup>12</sup> and various campaigns, and risk management at recreation areas on rivers and creeks and at lakes and dams. Risk approaches include safety regulations including signage and enforcement of laws including alcohol consumption while boating. The study shows a 34.1% reduction in drowning at rivers/creeks and an 18.1% reduction at lakes/dams. Rivers/creeks show the highest rate of drowning (current period 0.25), which reinforces the importance of a continued focus on inland waterways. With respect to lakes/dams, partnerships with water

authorities, other water and landowners and regional communities may be beneficial.<sup>35</sup>

Coastal environments have had a significant focus in water safety efforts including campaigns focused on safety at non-patrolled beaches, multiple studies investigating beach hazards,<sup>36,37</sup> exposure<sup>38,39</sup> and safety signage,<sup>40</sup> coastal lifeguarding services and volunteers, largely provided through the Surf Life Saving movement. Given the proportion of boating and watercraft fatalities<sup>41</sup> in coastal environments, continued focus on legislation and promotion of lifejacket use is warranted. Lifejacket use is recommended as one strategy to reduce rock fishing-related fatalities, including one legislated approach at fatality black spots in the state of NSW.<sup>42</sup> Implementation must overcome attitudes of rock fishers towards lifejackets and reducing personal risk.<sup>43</sup>

The study shows a reduction at beaches (11.5%), and oceans/harbours (38.8%). This shows good progress in both environments, particularly when increases in reported visitation at beaches are considered.<sup>44</sup> Rocks (inland rocks and rocky foreshores) were the only drowning location to record an increase (+46.3%). Although drowning rates are low (0.09 at the current time point), this proportional increase points to a concerning trend including reports of falls assumed to be related to social media phenomena, including the taking of Instagram photographs at hazardous locations.<sup>45</sup>

The third area of this priority area targeted swimming pools and aquatic centres, the latter taking the approach to reinforce safety legislation and regulations, and to focus on the wider health, social and community benefits of public swimming pools.<sup>46</sup> Drowning in swimming pools reduced by 38.3% during the study period, although further analysis attributes this to a reduction in children drowning in home swimming pools, with consistently low rates of drowning in public swimming pools.

Locations not directly reflected in the AWSS included bathtubs/spa baths which displayed the highest reduction seen in fatal drowning between baseline and current averages (-53.2%). Given the significant drowning risk in bathtubs for children under one year of age,<sup>47</sup> this achievement is likely to be partly driven by the significant reduction in drowning among the 0–4 years age group. This includes consumer law-related legislative change regarding product safety labelling of baby baths and bath aids,<sup>48</sup> as well as

increased public awareness of the importance of active adult supervision whenever children are in the bath. However, drowning deaths among older people in the bathtub continue to occur, with risk impacted by living alone, medical conditions, the interplay of multiple medications and falls in the bath.<sup>34</sup> Preventing bathtub-related drowning among this age group will require the AWSS to prioritise the aforementioned focus on preventing drowning among older people in Australia.

### *Jurisdictional achievements in reducing fatal drowning*

This study explored achievements in drowning reduction on a jurisdictional basis. The highest reductions in drowning rates were seen in Tasmania (36.7%), South Australia (35.1%) and New South Wales (30.0%). Although short of the 50% target, these reductions are significant and may reflect initiatives including the introduction and strengthening of pool fencing legislation and associated enforcement regimes. This intervention contributed to a halving of the child drowning rate in swimming pools in Queensland in the five years after its implementation.<sup>24</sup> Similarly, Tasmania has had legislation mandating lifejacket wear on vessels <6m in length since prior to the baseline period (2001)<sup>41</sup> and NSW has introduced legislation aimed at ensuring rock fishers wear lifejackets at high-risk locations.<sup>42</sup> After the ACT, Victoria had the lowest drowning rate at baseline (0.80 per 100,000) which has lowered further to (0.66; -22.3%) at the current time point. This may be in part due to legislative changes to mandate lifejacket use on small vessels, which were found to have had a significant impact in reducing drowning deaths post-implementation.<sup>49</sup> Victoria also has a unique model of legislating responses to coronial recommendations, which may also be impacting drowning risk in the state.<sup>50</sup>

The rate of drowning in the NT remains extremely high, 2.98 at the current time point, recording only an 11.6% reduction across the study period. The NT experiences elevated rates of injury-related mortality and morbidity,<sup>51</sup> including drowning, due to geographical remoteness, high rates of socioeconomic disadvantage and high rates of injury among Aboriginal and Torres Strait Islander peoples. As such, strategies to reduce drowning in the NT must address underlying inequities.

The next iteration of the AWSS must continue to consider state and territory-based differences in drowning risk and identify areas of improvement with respect to preventing drowning. Engagement with key stakeholders in the form of relevant state and territory government departments, regulators and drowning prevention advocates must form part of a cohesive plan to reduce drowning at the jurisdictional level.

### *Implications for public health*

Drowning disproportionately impacts young children where the greatest health losses are attributed. Drowning attracts the highest economic burden with respect to paediatric trauma treatment costs<sup>52</sup> and high mortality risk within 30 days of hospitalisation for paediatric patients when compared to other injury mechanisms.<sup>53</sup> Across the general population, drowning is also a preventable cause of public health-related harm. Therefore, the prioritisation of – and investment in – prevention initiatives should be a priority for federal and state and territory governments. While this study indicates that support in the form of funding, legislative change and advertising may have contributed to significant reductions in drowning over the period, most notably in the reduction of drowning among young children, there is more to be done. As the current AWSS 2008–2020 nears completion, this study has signposted several areas of focus, including a need to refocus drowning prevention efforts among older people in light of an ageing population<sup>32</sup> and at-risk populations where behaviour change is needed. While forecasts of overseas tourism, migration and international student patterns will need to be revised, taking the medium- and long-term impacts of the COVID-19 pandemic into consideration, factoring changes in populations at risk of drowning over time must be considered in future approaches. Given how valuable the AWSS is as an advocacy tool, it is also important to consider the language used to communicate key issues and trends. Future iterations of the AWSS will need to utilise drowning rates for scientific validity, while also maintaining the use of simple numbers and percentages to enable information to be easily shared with policymakers and practitioners (Table 3).

Drowning is a multi-sectoral issue; thus, a strategy is a powerful tool for focusing effort and energy of various sectors, as

well as providing goals against which to benchmark progress. Future iterations of the AWSS should strengthen alignment with injury prevention and preventative health plans. Careful reflection may lead to the development of a longer-term AWSS, noting the importance of regular reviews to ensure the sector remains committed and motivated. Similarly, the AWSS must highlight the intersection between drowning risk (and prevention) and other public health agendas such as the impacts of climate change<sup>54</sup> on flood risk and the role of swimming as both a drowning prevention strategy and a tool to address childhood obesity,<sup>55</sup> as just two examples. There may also be value in quantifying investment and achievements in fatal drowning reductions compared to those of other injury issues (such as road traffic injury) across a similar time period as a tool for advocating for increased investment in drowning prevention.

### Strengths and limitations

This study makes a valuable contribution to the literature by comparing progress in reducing drowning against the goals of a national water safety plan. The use of coronial data in a data triangulation approach leads to rich demographic and causal information to inform drowning prevention efforts. The use of fatal drowning rates also more accurately reflects the population demographic shifts occurring over the study period (Table 3). However, there are several

limitations. In the absence of exposure data, Australian population figures were used to calculate drowning rates (Table 3). A more accurate calculation would use visitation and participation data to revise rates based on exposure (Table 3). Future studies should investigate the feasibility of collating visitation figures by type of aquatic location. Another limitation is that some variables may change pending the outcome of ongoing coronial investigations. Closed cases are not subject to change and, as at 12 October 2020 when data were analysed, 85.9% of cases were closed. Despite the exhaustive methods used, it is possible that not all cases of unintentional fatal drowning in Australia during the study period were identified. Similarly, not all data may be available for a case within the NCIS, however, the variables chosen for analysis within this study had an extremely high rate of data completeness. The study does not include intentional drowning or analysis of non-fatal drowning rates.

### Conclusion

Drowning is an issue of public health concern. Despite successes, most notably among young children, there is more to be done to reduce drowning risk. Future iterations of the AWSS must consider consolidating this progress and focusing on emerging groups likely to be at risk. Drowning is a multi-sectoral issue and, as such, the AWSS has

coalesced action around evidence-informed goals. It is hoped that drowning rates continue to reduce with future strategies.

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**Table 3: Summary of lessons learned in the process of developing the AWSS 2008–2020.**

Domain	Lessons
<b>Vision</b> To reduce drowning by 50% by 2020	Served as a powerful advocacy tool, provided a very visible narrative, supported the alignment of the sector towards a common goal, and attracted media attention. However, it created some confusion about measurement (population rate or number), and was perceived as unattainable, or unrealistic by some. Overall, the benefits are thought to outweigh the negatives, and an aspirational framing of the intent of the strategy should be explored.
<b>Timeframe</b> AWSS set 12-year targets and was published in three overlapping four-year increments	Three separate plans (related) allowed for adjustments. However, increased resources were required to review and redevelop strategy, and the process was prone to change and influence due to stakeholder priorities. Four-year increments were often too short to measure change. Overall, a long-term period with a stronger sense of long-term outcomes, and planned review points may provide for a hybrid approach.
<b>Forecasting trends</b> Anticipating the impacts of social and economic change	The AWSS underestimated the impacts on drowning by factors including demographic change, urban development, changes in tourism patterns, weather. An environmental scan should be incorporated into strategy development to identify all projected changes and their potential impacts on achievement of the goals.
<b>Measurement</b> Use of numbers over rates	Numbers are more easily understood by the public, media, and non-public health audiences. However, rates are a more accurate way to measure progress as they factor in demographic shifts such as an aging population or increased migration. Future iterations of the strategy must strike a balance between the two.
<b>Measurement</b> Exposure data	Data on exposure to aquatic locations and participation in aquatic activities is limited. Crude drowning rates per 100,000 population by drowning location or activity prior to drowning are useful in the absence of better denominator data. An area of future research priority.
<b>Alignment</b> With other plans	The AWSS achieved strong alignment with AWSC member plans, and some state water safety plans. However, further alignment to other health (i.e. Injury prevention) and industry plans (i.e. Tourism) is recommended.

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