

Researching Pool Safety Strategies

DNB311 | ID Studio 7: Capstone

Topic: Design for Pool Safety



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Abstract

This report aims to identify the key causes leading to drowning incidents as well as stakeholder attitudes and beliefs around pool safety. Secondary research reveals that swimming ability and knowledge is severely lacking in all age demographics. Swim education funding and the subsequent cost of lessons was cited as a major barrier preventing young Australians from extending their swimming ability. Secondary research and conducted interviews revealed that active prevention against drowning is preferred and subsequently much more successful than a product that only plays a passive role in drowning prevention. It has been identified from these findings that the design solution must be primarily targeted towards parents with young children. The design solution must be reasonably affordable and more importantly reliable at actively preventing accidental water entry. Where possible, the design should still appeal to as wide a range of stakeholders as reasonably practicable.

Section 1

Introduction

Swimming is one of Australia's most cherished past-times, thanks to the water bound country's vast coastlines. The ongoing swimming culture is supported by school facilities providing swimming lessons to ensure younger generations are well informed to be safe and smart around the water. Despite this, drowning unfortunately remains the leading cause of mortality for children under 4 years of age in Australia (Abbassi et al., 2024). Extending to ages 1 through 14, drowning is the second leading cause of accidental injury mortality, behind motor vehicle accidents. This clearly indicates that there are significant barriers in protecting children from dangerous pool scenarios. The lack of supervision is one of the biggest contributors to drowning incidents.

Drowning is responsible for approximately 7% of all injury deaths and is ranked the third leading cause of accidental-injury-related death by the World Health Organisation (World Health Organization, 2024). It is also found that most child drownings occurring in swimming pools (Abbassi et al., 2024). This differs from adolescent and adult drownings, which are much more common in natural water bodies (Denny et al., 2021).

Globally, an estimated 230,000 people lose their lives to drowning each year. Drowning is threat to individuals of all age groups, especially young children 0-4 as they are still developing fundamental gross motor skills. Intoxicated swimmers and those over 65 are also at significant risk due to diminished physical ability and reaction to dangerous situations. The aim of this report is to identify gaps in drowning prevention practices and how products can promote swim safety.

Background

There are two primary categories for outdoor swimming pools, those being permanent pools and inflatable pools. Both types of pools need to follow strict fencing laws in Queensland. In Queensland, laws define a swimming pool as any structure that can be filled with water deeper than 300mm and is intended for people to enter the water (QBCC, 2021). The entire perimeter of water must be enclosed by fencing or walls at least 1200mm tall (Figure 1). There must be no climbable objects near the fence, and the gate lock should close and lock by itself (Figure 2). A temporary fence may be installed if there is no fencing around the pool. The temporary fence is allowed to be rented for 3 months before it needs to be inspected by the certifier or pool safety inspector, with written permission for further use.

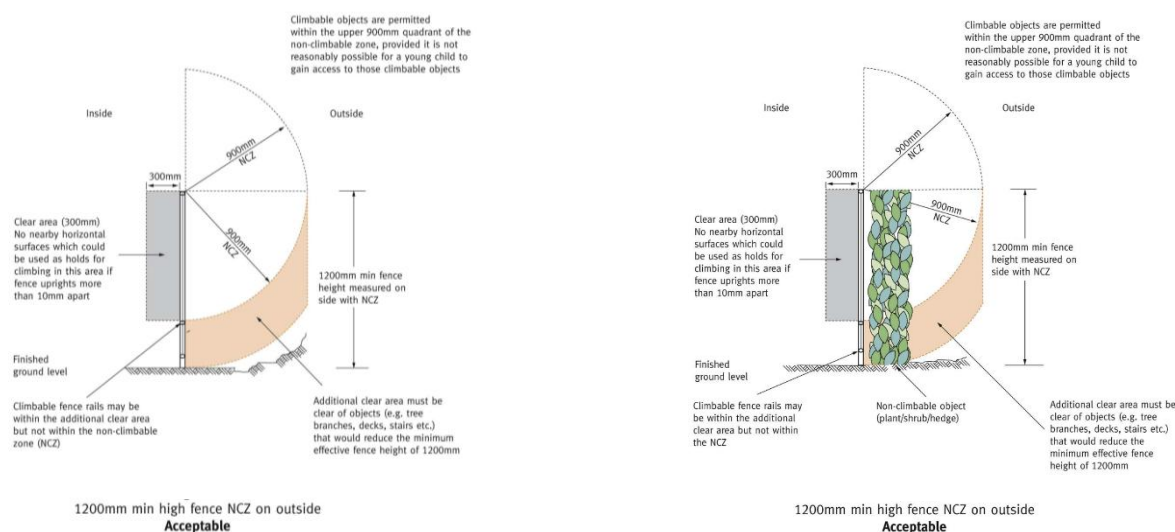


Figure 1: *Examples of Acceptable Pool Fencing Construction in Queensland* (Queensland Government Department of Housing and Public Works, 2012)

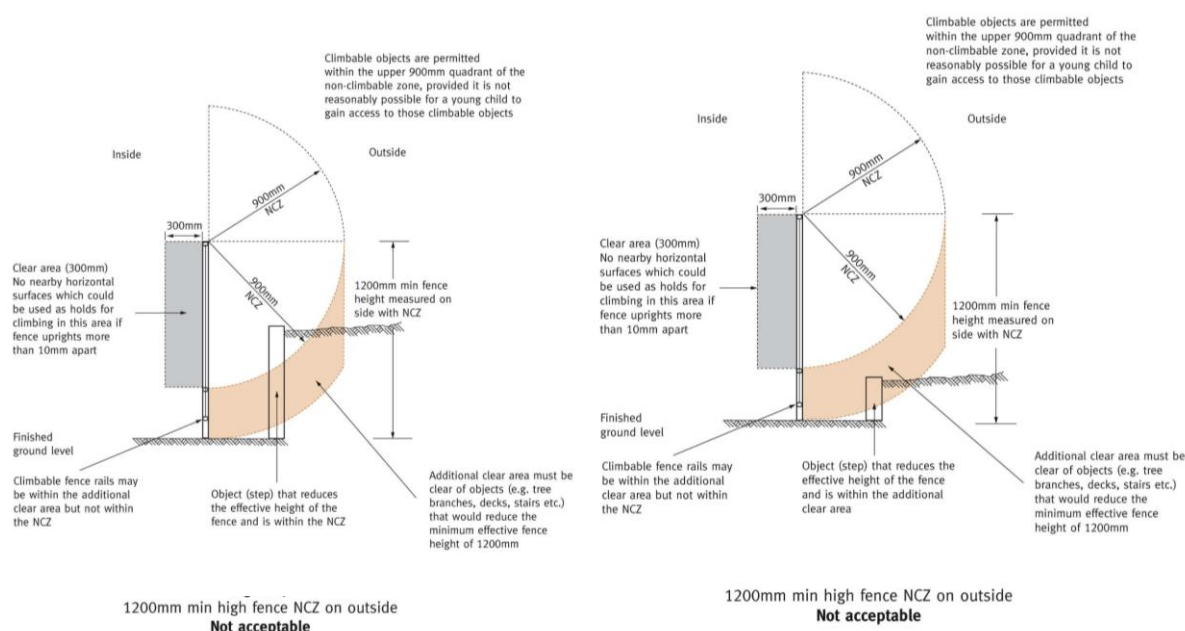


Figure 2: *Examples of Not Acceptable Pool Fencing Construction in Queensland* (Queensland Government Department of Housing and Public Works, 2012)

This issue is prevalent as inflatable pools are seen as temporary and that fencing seems like an unnecessary cost if it is only going to be relevant for a few months of the year. Most people are hesitant to empty the water when not in use as it is wasteful.

Studies reveal that when government inspections were mandated for pool fencing, compliance rose from 50% to 97% (Weerdenburg et al., 2006). These strict pool fencing laws are not reflected in most countries abroad. American fences are rarely inspected, and fencing laws only apply to new pools or if there is a child living in the residence (Denny et al., 2021).

Slipping and falling into the pool is a very big risk that factors into fatal drownings. In Australia, 78% of fatal drownings involve a fall (Australian Water Safety Council, 2021). If a fall is involved, the victim is most likely not expecting to enter the water, which can make them more panicked. Drowning victims are in significant danger without supervision as they are quickly silenced under the water. In a state of panic, drowning victims respond by attempting to keep their head out of the water, grabbing onto what they can. If a rescuer is inexperienced, they may be pushed down by the drowning victim, which can lead to two people having their lives in danger. When people are rescuing someone from the water, understanding the best methods as well as dangerous approaches is imperative for a successful and safe rescue.

A common misconception is that drowning is only defined as such in the event of death (Figure 3). Drowning is defined when respiration is impaired due to submersion in liquid. In Australia, three non-fatal incidents occur for every fatal drowning (Brander et al., 2023). Statistics are scarce on non-fatal drownings as incidents are rarely shared. However, reports have indicated that 35.6% of non-fatal incidents occurred in swimming pools.

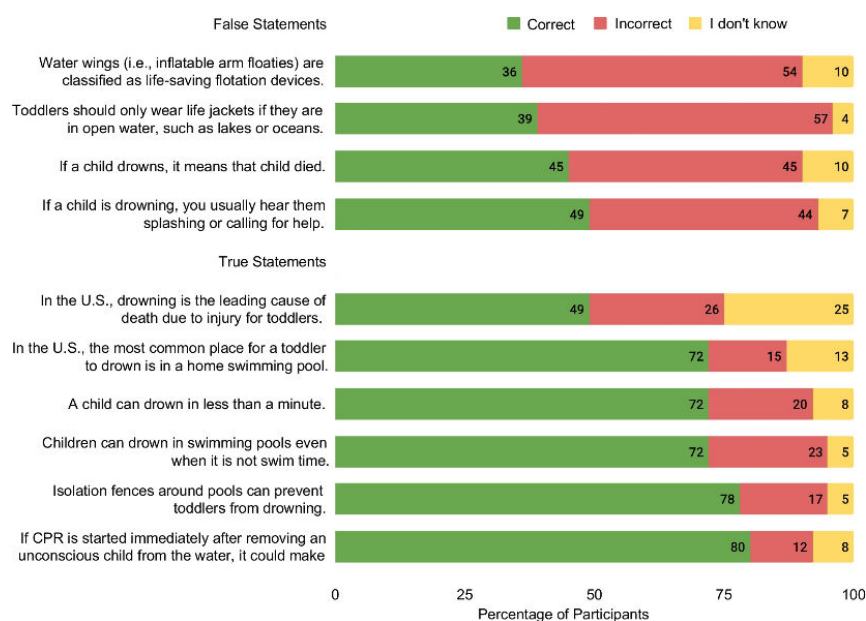


Figure 3: Participant answer selections on true/false water safety knowledge statements (based on the results of 650 parents/caregivers of 1–4-year-olds) (Johnson & Lawson, 2023)

Benchmarking

With swim safety being such a universal concern, many products exist to keep people safe in the water. Three specific product types were analysed in benchmarking. These include pool alarms, wearable safety devices and rescue flotation devices. A range of products designed for pool use and natural waters were analysed as they are all closely related to water safety.

It was quite challenging to find pool alarms that are readily available for purchase. Most alarms were found for sale on the specific brand's website or via Amazon. They were surprisingly seldom available at pool stores or general stores where such items may be found. Identified pool alarms on the market can be categorised in one of three sub-categories, as there are installed pool alarms, floating pool alarms and camera alarms. Installed alarms are screwed into the ground and have a motion sensor that sits in the water. People have cited in reviews of found products that the alarm is quite sensitive and can falsely set off as quickly as a week after normal water evaporation (Figure 4).

Image	Name	Retail Price	Important Notes:	Link
	SwamCam Pool Alarm	\$771.65AUD	One of the most expensive pool alarms on the market, also highly effective and reliable. Uses a camera to detect people walking in front of it. Design is wired which limits use, for most people it needs to be placed facing out a window indoors.	SwamCam Camera Pool Alarm System with Built-In WiFi Repeater - SwamCam
	INNOTIVO Wireless Battery-Powered Pool Alarm System	RRP: \$214.00AUD Sale: \$64.95AUD	Cheaper entry-level pool alarm. Must be installed into the ground beside the pool. Round device with infrared sensor needs to be able to detect the main unit from afar to sound the alarm. Battery powered, lasts around 18 months.	INNOTIVO Wireless Battery-Powered Pool Alarm System - need1.com.au
	Lifebuoy BCone System	\$695.00AUD	Floats in the water. It is heavy and hard to tamper with. Could potentially be improved by doubling as a floatation rescue device, as the current shape is hard to grab when wet. Connects via an app to remotely control alarm settings.	BCone System Lifebuoy

	Blue Wave Poolwatch Pool Alarm	\$342.50AUD	Must be installed into the ground beside the pool. Very sensitive, to the point that naturally lowering pool depth can set it off. No way to remotely stop the alarm, which can be frustrating. Reviews cite battery corrosion with salt water, which can pose a safety hazard.	Blue Wave Poolwatch Pool Alarm System - Walmart.com
	PoolEye Immersion Mountable Pool Alarm	\$182.96AUD	Cheaper entry-level pool alarm. Must be installed into the ground beside the pool. Reviews are mixed, with some claiming it sets off randomly	PoolEye Immersion Mountable Pool Alarm Compatible with Inground & Aboveground Pools ASTM-Compliant, Water Motion Sensor Advanced Technology Dual Protection, Poolside and in-Home Sirens, Multicolor : Amazon.com.au: Garden
	Pool Patrol PA-30 Pool Alarm	\$470.00AUD	Sensitivity can be adjusted, which is a welcome feature. Floats in the water. Small compact design makes it useful on the go.	Pool Patrol PA-30 Pool Alarm : Amazon.com.au: Garden

Figure 4: Pool Alarm Benchmarking Analysis (Own work)

Floating pool alarms demand a higher price point, although reception is a lot more positive. Reviews cite that floating alarms tend to be much more reliable at setting off when someone enters the water. The SwanCam Pool Alarm takes a different approach and instead uses a camera to detect human activity. It is functionally similar to a security camera. Through benchmarking, there were no portable pool alarms under the \$500.00AUD range (Figure 5). There could be serious potential in the market for an affordable pool alarm that can be taken on the go.



Figure 5: Pool Alarm Benchmarking Comparing Price against Portability (Own work)

As for wearable devices, bracelet alarms were most common, especially for the pool environment. Four of these devices were analysed in benchmarking (Figure 6). As was true with the pool alarms, the more expensive options were of higher quality. However, there are significant flaws in the bracelet concept, as it will only work if a child is wearing it in the first place. It would be difficult for many to wear one for extended periods of time, and the parent needs to make the conscious effort to ensure the child is always wearing the bracelet. As observed in research, fatal drownings are much more likely when water entry is unexpected. Hence, these devices cannot always observe the danger of water entry which makes them flawed as safety measures.

Image	Name	Retail Price	Important Notes:	Link
	Safety Turtle 2.0	Between \$225.00 and \$300.00AUD	DISCONTINUED for unknown reasons. If the wristband gets wet, it will instantly send a radio signal to the Base Station. The product is permanently sealed and ruggedly built to withstand child's play. Can be seen as a disadvantage, if the battery stops the device is defunct. Only alarms when fully submerged in water (spraying will not alarm). One base station can support an unlimited number of wristbands (or collar attachments for pets).	New Safety Turtle 2.0 Pool Alarm FAQs - DIYControls Blog Safety Turtle Alarm – kids - Safety Store Australia
	Water Patrol Child Guard	\$180.00AUD	It has a wireless range of up to 60m in open surrounds and the receiver runs of both mains power and a rechargeable battery.	Water Patrol Child Guard - wireless anti-drowning electronic device
	LunaSafe Pool/Boat Wearable Transmitter	\$307.00AUD	Extremely compact, wear on wrist, life jacket or in pocket. Battery lasts approximately 5 years. Includes carabiner for attachment to a life vest and a Velcro strap for pets. Transmits up to 150ft Multiple buying options, 4 pack comes with a carry case making it suitable for on-the-go usage. Works on 3 days of charge.	Water Activated Transmitter & Receiver Alarm - Lunasea Lighting

	AMB Water Alarm Set	\$375.00AUD	The bracelet uses a standard flat battery (3V type CR 2032) which can be changed using the screwdriver provided. To ensure water resistance, it is recommended for a professional to replace the battery.	Water alarm set for toddlers playing by the water
	Kingii Single Package	RRP: \$122.88AUD Sale: \$107.50AUD	Technically counts as a lifesaving wearable. The bracelet releases the replaceable CO2 cartridge and inflates the inflatable when submerged underwater. Ideally used out in the ocean, when boating for instance. It is reusable up to 50 times.	Single package (1 Kingii wearable + 1 cartridge) - Kingii International
	M-16 Manual Inflatable Belt Pack	\$185.00AUD	Pull the cord to eject and inflate a lifejacket built-in to the pack. The user simply pulls a strap on the jacket over their head. Also comes with a permanently attached rescue whistle that cannot be lost. Adjustable body belt; front buckle closure. Protective cover uses durable nylon fabric. 75 Newtons of buoyancy.	Shop M-16 Inflatable Belt Pack Reliable Manual PFD – Onyx Outdoor

Figure 6: *Wearable Device Benchmarking Analysis* (Own work)

Inflatable wearables provide a more active safety measure to water entry. The Kingii bracelet inflates immediately when submerged in water, which is perfect for unexpected entry. The M-16 Belt instead requires a cord to be pulled if the wearer needs a lifejacket. Whilst intended for use in natural waters, these devices provide good learning points as to how active safety measures are more reliable than passive ones like the bracelet alarms.

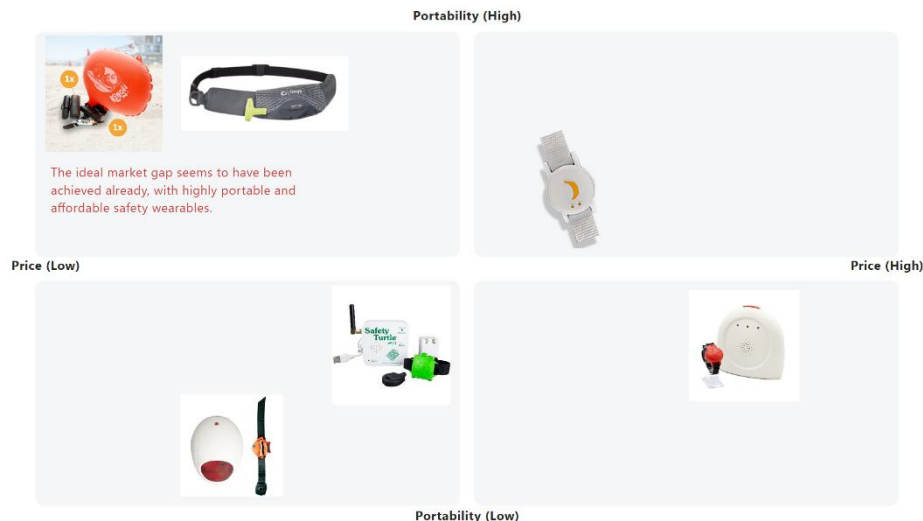


Figure 7: *Pool Alarm Benchmarking Comparing Price against Portability* (Own work)

There are a great variety of products that already exist for the purpose of preventing drowning incidents (Figures 5 and 7). The effectiveness of each is highly dependant on how they are used. In most instances, products with a higher retail price are more reliably functional. This was especially apparent with the pool alarms. It was also found while there are numerous bracelet alarms on the market, the concept in of itself is inherently flawed. The inflatable wearables differ in that they do not need electricity, instead utilising CO2 cartridges. The inflatable wearables would prove much more reliable as there are fewer points of potential failure that the bracelets have (batteries dying, sensor issues, etc.). Analysing these products effectively scopes the current market by highlighting the strengths and weaknesses of each concept.

Section 2

Research

Supervision is by far the most effective measure to ensure children's safety in the water. Reports have observed that parental and caregiver supervision is severely lacking in certain conditions. One study reported that 449 children observed, children aged 6-10 years were significantly less likely to be provided with ideal supervision (26%) compared to younger children aged 0-5 years (62%) (Costello et al., 2020). Within the same report, it was discovered that not one caregiver observed ideal supervision if they were using their phone. Some parents are actively concerned about diverting attention and will leave their phone out of reach whilst supervising their children (Dunn et al., 2024).

One study claims that participation in formal swimming lessons was associated with an 88% reduction in the risk of drowning in the 1- to 4-year-old children, although numerical estimates are imprecise (Brenner et al., 2009). Regardless, it is clear from this sample that getting young children 1-4 at least familiar with the pool and a few essential swimming skills significantly reduces the risk of drowning incidents occurring.

Entrapment hazards also pose a significant risk in younger children, as they are much smaller than teenagers and adults. It is estimated that 70% of pool suction entrapment victims are children (Hnatov, 2014). This can very quickly turn into a drowning incident as a child will not have the same knowledge or strength as an adult would to pull and free themselves from the suction vent. To mitigate these risks, pool suction covers are available to cover the wide-open suction hole (Figure 8). These are very effective as they do not impact pool filtration in any negative way. However, this is a product that people must buy separately. Some may be unaware of



Figure 8: *Pool Suction Cover Contents Distributed by Company 'Spa Electrics' (Aquaneo, 2025)*

the cover, while others may not see it as a worthwhile purchase. In America, reports have found that only 15% have installed antivortex drain covers in their pools or spas (Denny et al., 2021).

The Australian Royal Life Saving Society have a suggested list of swimming skills that children should be able to reach at important developmental milestones (Royal Life Saving Australia, 2020). Unfortunately, a significant percentage of Australian youth are unable to reach significant swimming goals at recommended ages of development. Reports show that nearly half of all year 6 students cannot swim 50 metres and tread water for 2 minutes (Larsen et al., 2025).

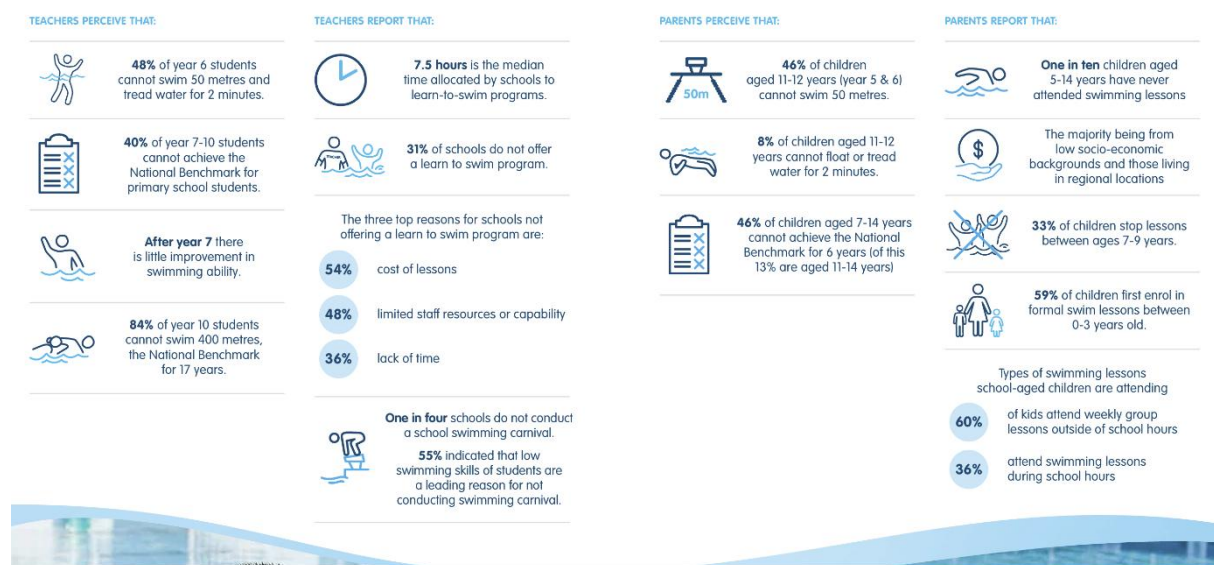


Figure 9: Key Insights: Status of Children's Swimming and Water Safety Skills (Larsen et al., 2025).

This is especially concerning as teachers also perceive that there is little improvement in swimming ability once starting high school. Consequently, 84% of year 10 students cannot swim 400 metres, which is much lower than the 50% that is recommended. One significant barrier in meeting these goals is that 31% of Australian schools do not offer swimming lessons. The leading causes of this derive from cost constraints. Conducted observations have further shown that it is much harder to build swimming skills at a later age (Devine et al., 2025). It is evident that swimming skills need to be taught in childhood (under 10) for people to grow as proficient swimmers.

From the research conducted, sources corroborate that lack of parental supervision is a major contributor to child drowning incidents. Alongside this, failure to organise continual swimming lessons throughout childhood will hinder future swimming ability.

Analysis and Findings

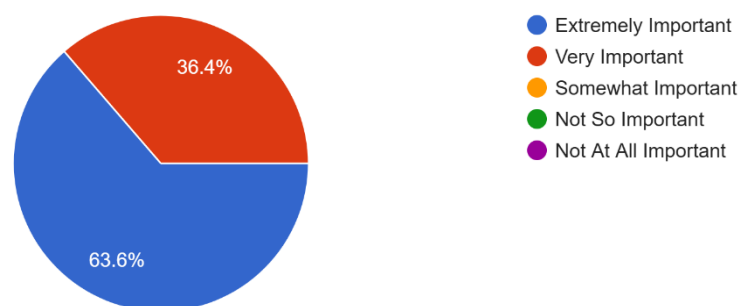
Understanding the biggest limitations towards swim safety, first-hand accounts and perceptions around the topic were sought out. Quantitative and qualitative data were corroborated through an online survey and three over-the-phone interviews.

The survey was targeted at parents who, at one point, had a pool at their home whilst having children under 18 living there. I intend for this to be my primary target audience for the design solution. The survey allowed me to gather responses from people who still have children living at home as well as reflective accounts. The survey was made of 20 multiple choice options and 4 short response questions.

Respondents were all between 35-64 years of age. Nine respondents were female and two were male. Respondents agreed that learning to swim proficiently was an important life skill.

How important do you think it is to learn how to swim proficiently as a general life skill?

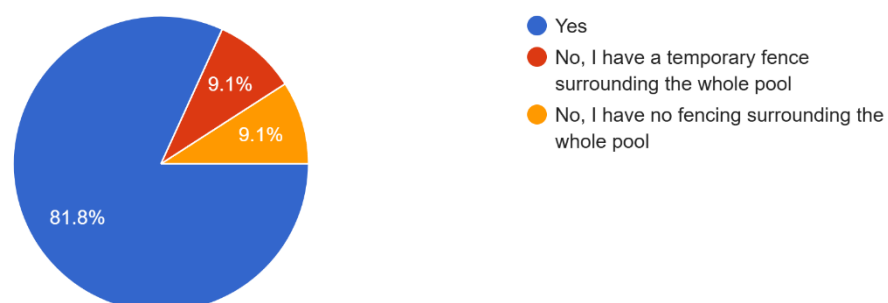
11 responses



Most participants had a permanent fence surrounding their pool, aside from two people who had a temporary fence and no fencing respectively.

Is there a permanent fence installed surrounding your pool?

11 responses

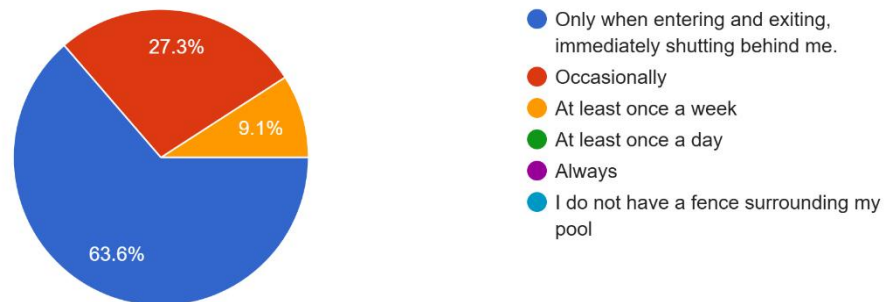


Pool fence gates are closely monitored by most, excluding the individual without a fence. This does conflict with their response to the previous question but can be interpreted in a

couple of ways. They may have fencing around part of their pool; they may be referring to another door to access the pool or they may have misinterpreted the question.

How often do you leave a pool fence door open?

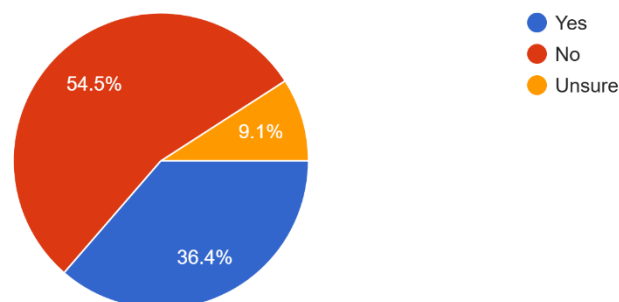
11 responses



5 out of 11 of participants noted that they have climbable objects near their pool.

Is there any furniture, tall trees or other climbable objects near your pool fence?

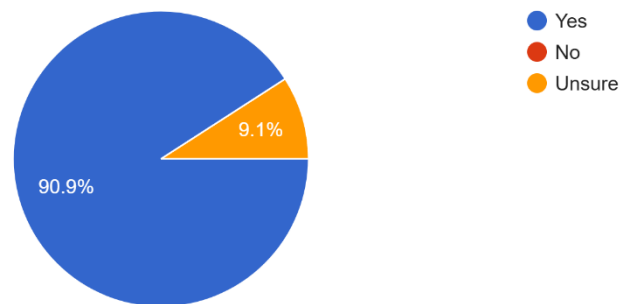
11 responses



Despite this, most claim that their pool meets their council's regulations. The one exception is the participant with a temporary fence. This raises concern when more participants noted that they had climbable objects near their fence. In fairness, participants may live in areas where council regulations are not as strict. As location was not tracked in this survey, there is no way to be certain.

Do you know if your pool meets your council's regulations?

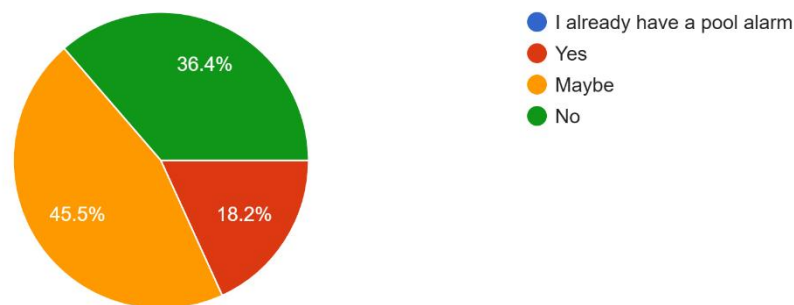
11 responses



Inspired from the benchmarking research, participants were asked if they would ever consider installing an audible pool alarm. The idea did not seem too receptive among participants, especially as none had a pool alarm already installed.

Would you ever consider installing a audible pool alarm?

11 responses



5 participants preferred the fence alarm, and there was an even split interest between static and floating pool alarms. The fence alarm was more popular as it acts as a pre-emptive safety measure. Nobody preferred the wearable bracelet alarm, likely because it is highly inconvenient to have a child wear a bracelet for extended periods of time.

7 out of 11 participants have visited a pool with questionable safety standards. Those who have visited an unsafe pool were much more put off by pools that lack fencing rather than those who were not fazed by it. Most pools with questionable safety were observed at another person's house.

Fencing was by far the most problematic safety approach ignored. Climbable objects were also observed in two instances.

Interviews were conducted via phone calls after receiving consent forms back via email. Three interviews were conducted, each with a different stakeholder group with valuable insights on pool safety.

Participant 1 (Lifeguard):

A beach lifeguard with seven years of ongoing professional experience.

Participant 2 (Parent):

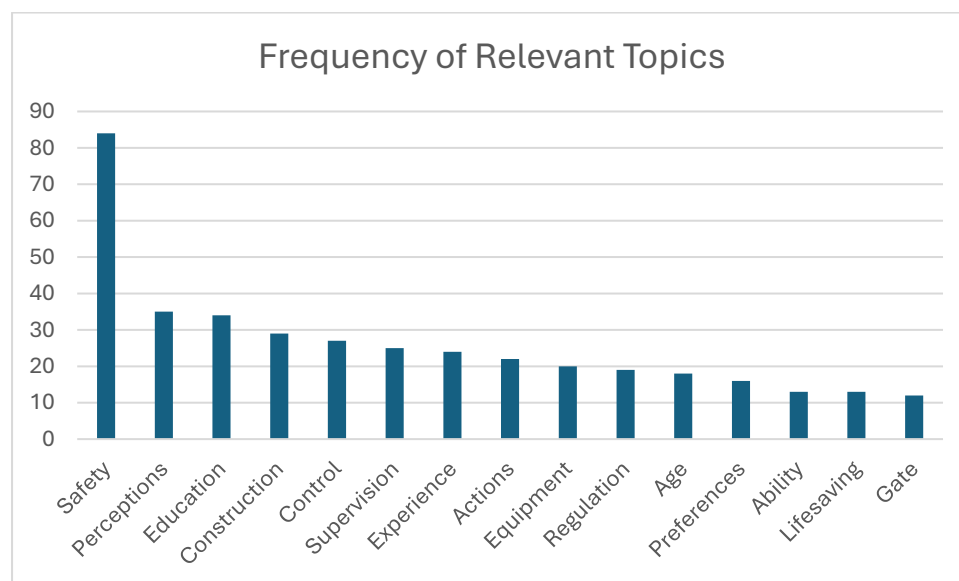
A parent who owned a pool when their children were in early primary school.

Participant 3 (Pool Builder):

A construction worker who had prior experience installing pools in residential homes.

Interviews were conducted in a semi-structured format with a range of targeted and shared questions. The interviews aimed to interpret perceptions about water safety more thoroughly than the initial survey.

Between the three interviews, common topics brought up included supervision, education and age. Construction was frequently brought up with the pool builder and control (controlling the beach, safety of pool environment, etc.) was mostly brought up by the lifeguard and parent.



Swim education was a frequent point of discussion among all interviews. It was agreed upon that keeping up swimming education from infancy to adulthood is greatly beneficial. Interviewees brought up the concept of age when swimming ability was discussed, often noting that whilst infants are in most danger of fatal drowning, everybody can be at risk in the wrong circumstances. Interviewees often cited issues with the current approach to swimming education. Criticisms included cost of lessons, a lack of streamlined curriculum between locations and rural swim schools shutting due to a lack of funding. All interviewees

stressed how important it was to have reliable supervision in the water. Everyone shared an incident where someone was in danger in the water. Drowning victims with someone watching them always led to quick safety, whereas those who were unseen ended up in a worse situation.

Interviewee preferences and perceptions about different aspects of pool safety were also monitored. Individual perceptions popped up twice as often as preferences. This was helpful as it uncovered beliefs around pool safety that different stakeholders believe. Some of these were true whilst others were false. It was important to hear about these aspects to better understand what people think about pool safety, how they may be invested in a new design solution and what they think needs to change.

Below are some key findings from each interview:

Lifeguard:

'From a lifeguard, lifesaver point of view, it's best to assume the worst and then let more qualified people make a decision from there.'

'There's lots of new initiatives they're trying to start up. I know that, like in Tally Creek, for example, they've got one of the rescue tubes permanently mounted and accessible to anyone who needs it, anytime.'

Parent:

'Kids learn in a bit of a clinical environment, in a pool, everything's predictable. And even to have a couple lessons a term out in the bay would be good.'

'When I'm in the backyard, I don't carry my phone with me. [I'd] prefer an audible alarm of some sort.'

'There's councils that can't afford to keep pools renovated and maintained. And yet, there's a lot of waterways. But I'm just thinking regional areas, having gone travelling recently, there's a lot of pools, pools that are just closing. There's a lot of kids missing out on swimming lessons'

Pool Builder:

'They had an extended sort of period of [shallow water steps], so that if you'd walk into the pool, you weren't going to then slide into the pool.'

'Most pools have got now, have got good safety guidelines around them, yeah? The issue with pools is simply around just monitoring children at the end of the day.'

'The issue we've got, is just that sheer price of people getting kids taught how to swim.'

Section 3

Discussion

Secondary research revealed that poor supervision was the most egregious factor to drowning incidents occurring. This was corroborated with primary research as identified in the surveys and interviews. Sources found that installing fencing around a pool proves highly successful in preventing potential drowning incidents. It was also observed that swimming knowledge and ability is below average for a vast majority of people at all ages. This typically stems from concluding swimming lessons too early, starting too late and placing false assumptions in swimming ability.

To reach out to participants, the survey was exchanged through word-of-mouth and posted on online platforms including Instagram and Reddit on r/surveyexchange. The survey received 11 responses in total. The biggest limitation with surveying is that I could only get responses from those who were aware of the survey. I distributed the survey to numerous popular online spaces and specific survey groups but failed to garner serious traction. A wider range of responses would have demonstrated more common opinions between survey takers. Respondents also had a very positive attitude towards swim safety as an important life skill. Every participant noted that their child had partaken in swimming lessons. It would have been beneficial to hear perspectives from parents who may not value swimming as highly to interpret how they could be targeted in the concept product's marketing. It would also have been helpful to hear from parents who were unable to take their child to lessons to understand their thoughts and perspectives around the issue.

I took the opportunity to reach out to additional stakeholder groups for interviewing to gather deeper insights from a wider range of people. This was useful as it allowed me to understand different takes about pool safety in more detail.

Design Implications

Secondary research proves that infants and toddlers are at highest risk of facing a drowning incident, due to lack of swimming experience and developing gross motor skills. Creating a device that can prevent drownings will be most effective if it is targeted towards protecting this demographic from accidental entry. Designs that actively prevent entry will prove more reliable and effective than passive interventions. For example, a gate can physically prevent children from entering the pool area, whereas a pool alarm only sounds an alarm when the child is already in the water. Based on these findings, parents of young children should be targeted as primary stakeholders for the design solution.

Interviewees also brought up that people at all ages are still at risk of drowning, no matter how strong they think their swimming ability is. Research papers have shown that tourists are

at high risk on beach waters and that a vast majority of adult drownings involved the use of illicit substances (Brander et al., 2023) (Daw et al., 2022). Where possible, it would also prove beneficial to also appeal to a wider range of demographics to ensure the product has wide-spread reach

Interviewees often cited that the high cost of swimming lessons as of current is detrimental to supporting swim safety to younger generations. In Australia, it has been observed that 54% of schools that do not offer a swimming program due to cost concerns (Larsen et al., 2025). One interviewee also cited in their experience that rural swimming centres are also shutting down due to a lack of funding, which has created a negative economic loop. These findings suggest that a design solution to promote pool safety will only be as effective as it is affordable.

Conclusion

The primary and secondary research conducted clearly highlighted common concerns and issues with swim safety measures. Common issues included a lack of supervision, economic barriers to swim education and consequent struggling of swimming ability. An unsupervised pool is a severe risk that leads as a primary factor in fatal drownings in children. This suggests that there is opportunity to introduce a device that enhances passive supervision or prevents accidental entry into the water. Secondary research and conducted interviews have revealed that active prevention against drowning is preferred and subsequently much more successful than a product that only plays a passive role in drowning prevention. It has been identified from these findings that the design solution must be primarily targeted towards parents with young children. The design solution must be reasonably affordable and more importantly reliable at actively preventing accidental water entry. Where possible, the design should still appeal to as wide a range of stakeholders as reasonably practicable. The primary and secondary research conducted in this report has synthesised the biggest concerns around pool safety. The insights from this report will be highly beneficial to create a concept design that promotes pool safety that will appeal to a wide and relevant audience.

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