QISU collects and analyses data from emergency department injury presentations on behalf of Queensland Health. Participating hospitals represent three distinct areas of Queensland.

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INJURY BULLETIN

Domestic Pool Immersion in Queensland Children under 5 years of age

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Summary

- It is estimated that 50 Queensland toddlers present to emergency departments each year following an immersion in a domestic pool.
- The peak age for domestic pool immersion is 1 to 2 years of age.
- Nearly three quarters of children who present following an immersion event are admitted to hospital.
- The annual number of toddler deaths due to immersion in domestic pools has fallen significantly since the introduction of pool fencing legislation in Queensland.
- The majority of toddlers who drown, do so in domestic pools that are non-compliant with current pool fencing requirements.

Introduction

Drowning is the process of experiencing respiratory impairment resulting from submersion or immersion in liquid. Drowning remains the single leading cause of death from all causes for Queensland toddlers aged 1-4 years (1) and the leading cause of injury death nationally for children aged under 5 years. (2) The majority of drowning deaths for children aged 1-4 years in Queensland occur in domestic swimming pools.(1,3,4,5). Pool fencing legislation for domestic swimming pools was introduced in Queensland In 1991. (6) The legislation requires a barrier to be erected to restrict unintended toddler access to a domestic pool. Under current legislation, the requirement to fence a domestic pool is dependent on the age, type and specifications of the pool.

There has been a significant reduction in annual toddler immersion deaths in Queensland since pool fencing legislation was introduced. This issue of The Injury Bulletin re-examines domestic pool immersion in young children in Queensland.

Method

The QISU database was searched for the nine year period 1999 to 2007 for all immersion in children aged under 5 years. Data was analyzed according to the type and location of the immersion. Pool immersions were classified according to the location of the pool (domestic, public, resort etc). QISU data is collected from participating Queensland emergency departments representing approximately one quarter of the state population.

Recent death data was accessed from the Commission for Children and Young People and Child Guardian Annual Reports. (1,4,5) Death data for 1983 to 2004 was accessed from the QISU drowning database (3).

Results

Death Data

The total number of toddler immersion deaths in Queensland (under 5 years) has fallen significantly from an average of 23 per annum pre pool fencing legislation (1983-1991) to 14 per annum post legislation (1992 to 2004). In the same time period, the average number of domestic pool related deaths has halved from 13 per annum to 7 per annum. During is time the population of Queensland children under 5 years has increased 21.5% and the number of domestic pools has tripled.

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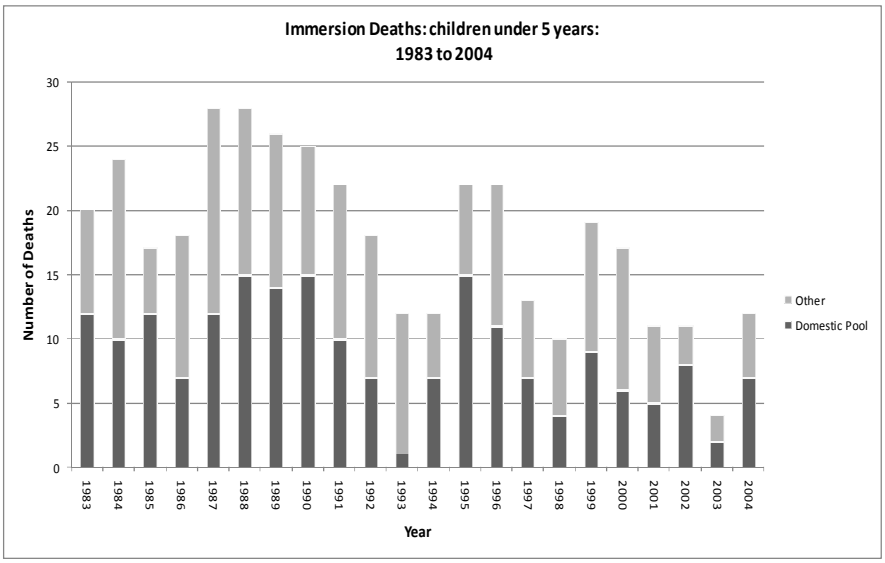


Graph 1: Immersion deaths in Queensland for children under 5 years of age: domestic pool compared to other fatal drowning by year.

The number of immersion deaths for children under 5 years of age in Queensland for the period June 2004 to July 2007 is presented below (note the data for June 2004 to December 2004 overlaps with the graph above. (1,4,5) The average number of immersion deaths in this period is 16, and the average number in domestic pools is 7.

Year	Total Drowning	Non Pool	Domestic Pool Requiring a barrier	Wading Pools not req. a barrier	Public/ Other
2004-05	14	5	8	0	1
2005-06	19	11	6	1	1
2006-07	14	7	5	1	1
Total	47	23	19	2	3

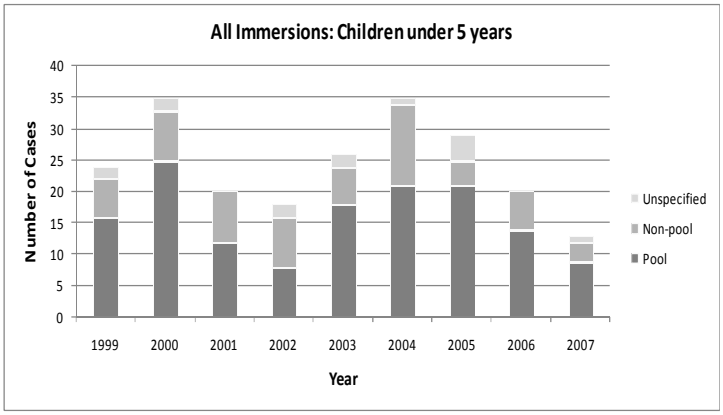
Table 1: Immersion deaths in Queensland for children under 5 years of age: June 2004 to July 2007: data displayed according to pool type and requirement for pool fencing.

The proportion of immersion deaths under 5 years of age in domestic pools has fallen over the 25 year period dropping from 51% (107/208) pre legislation (1983-1991) to 45% (21/47) post legislation (2004-2007) in a period where the hazard due to exposure to domestic pools has significantly increased.

Of the 21 domestic pool immersion deaths (June 2004 to July 2007), 2 occurred in portable wading pools that do not require pool fencing under current legislation.

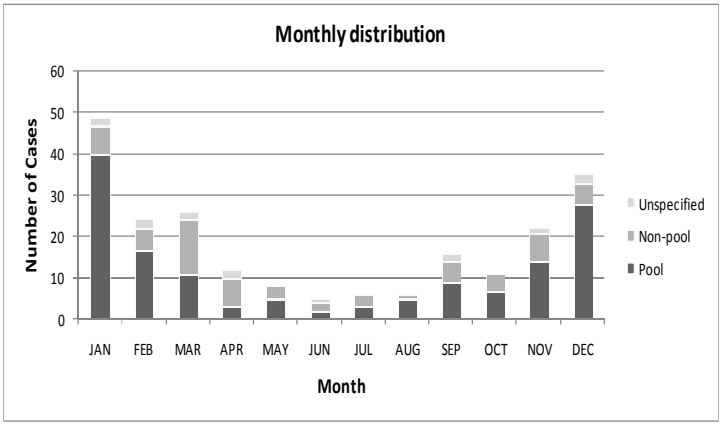
QISU data:

Searching the QISU database revealed 220 cases of immersion related injury during the study period for children under 5 years of age. QISU data is collected by hospitals representing approximately one quarter of the state population. We estimate that during the study period, 880 children under the age of 5 years presented with immersion related injuries (approximately 100 children per year). The majority of immersion injuries in children under 5 years of age were related to swimming pools (144/220 or 65%). (Graph 2) Half (109/220) of all the immersion events occurred in domestic swimming pools. The remainder of immersion injuries were due to incidents occurring in baths (44/220 or 20%) and a variety of other water hazards (buckets, ponds, tanks, dams, rivers, beach, sea). In 14 cases, the immersion occurred at an unspecified location. The number of immersions varies from year to year, with an average of 24 per year; 16 of these pool related incidents and 12 domestic pool related incidents.



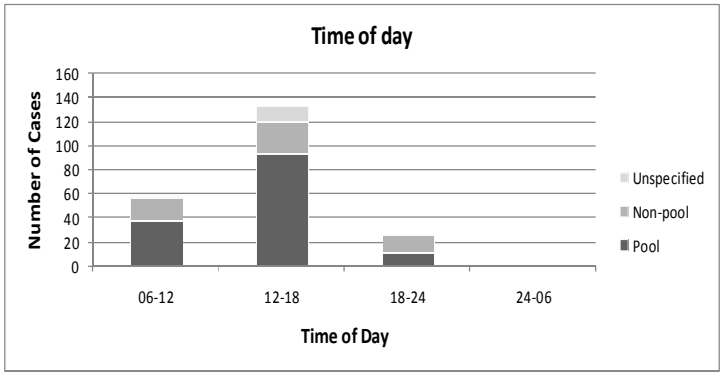
Graph 2: Immersion injuries in children under 5 years of age by year and water hazard.

Immersion injury varies significantly according to season, with the peak number of immersions occurring in January, and 49% (108/220) of all immersion injuries occurring in the summer months (December to February). (Graph 3) Pool related immersions predominate in the summer months, accounting for 79% of all immersions between December and February, with 65% of summer immersions occurring in domestic pools.



Graph 3: Immersion injuries in children under the age of 5 years by month and water hazard.

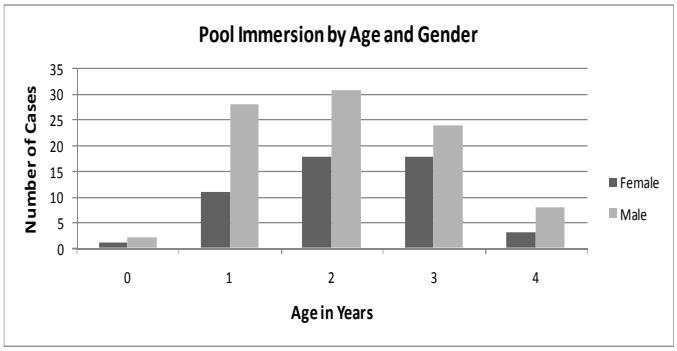
The majority of immersion injuries in children under 5 years occurred between 1200 and 1800 hours (94/144 or 65%). The large variation in the number of immersions by time of day is due to pool immersions with 70% (94/134) of immersions between 1200 and 1800 hours occurring in pools.



Graph 4: Immersion of children under the age of 5 years by time of day and water hazard.

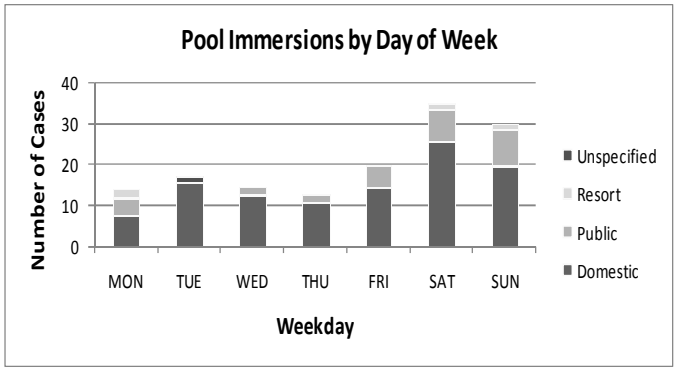
Pool Immersion

The peak age for pool immersion is 2 years, accounting for one third (49/144) of all pool immersion injuries in children under 5 years. Males presented almost twice as frequently as females following pool immersion, with a ratio of 1.8 males to 1 female overall. The gender difference was most marked in the 1 year old age group with a male to female ration of 2.5:1.



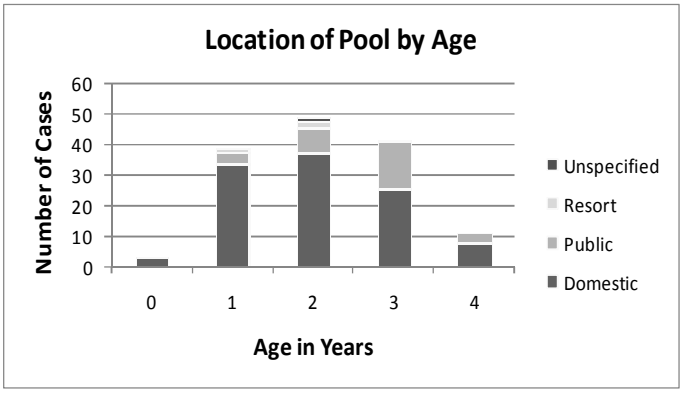
Graph 5: All pool immersions by age and gender: under 5 years

There is variation in the number of pool immersion injuries by day of the week, with 45% (65/144) of all pool immersions occurring on the weekend. The increase in the number of weekend pool immersions is due to both an increase in the number of domestic pool immersions and immersions in public or resort pools. During the week, domestic pool immersions predominate, representing 80% of all weekday pool immersion injuries (63/79).



Graph 6: Number of pool immersion injuries by day of the week.

The peak age for all pool immersion in children under 5 years is 2 years (49/144). This is followed by, children aged 3 years (38/144) and 1 year (34/144).



Graph 7: Number of pool immersion injuries by location of pool and age of child.

Severity

There was no significant variation in severity of injury following pool immersion (as measured by triage category) according to age or gender. Overall, 21% (30/144) required resuscitation, 33% (48/144) required urgent treatment (within 10 minutes) and 42% (61/144) required attention within 30 minutes. Severity did not vary according to pool type (domestic, public, resort). The majority of children required admission following pool immersion (102/144 or 71%), and 4 children died in ED.

Discussion

QISU data is collected from participating hospitals that are concentrated in Brisbane, Mackay area and Mount Isa. The death data represents all fatal drowning in children under 5 years occurring in Queensland between 1983 and 2007. Water hazards vary according to location, with beaches posing a hazard for those residing at or visiting the coast and rivers, dams, irrigation channels and tanks posing a hazard to those in rural areas. Despite the fact that QISU data is not representational for the whole of the state, the proportion of immersion injuries and deaths due to domestic swimming pools is consistent between the two data sets.

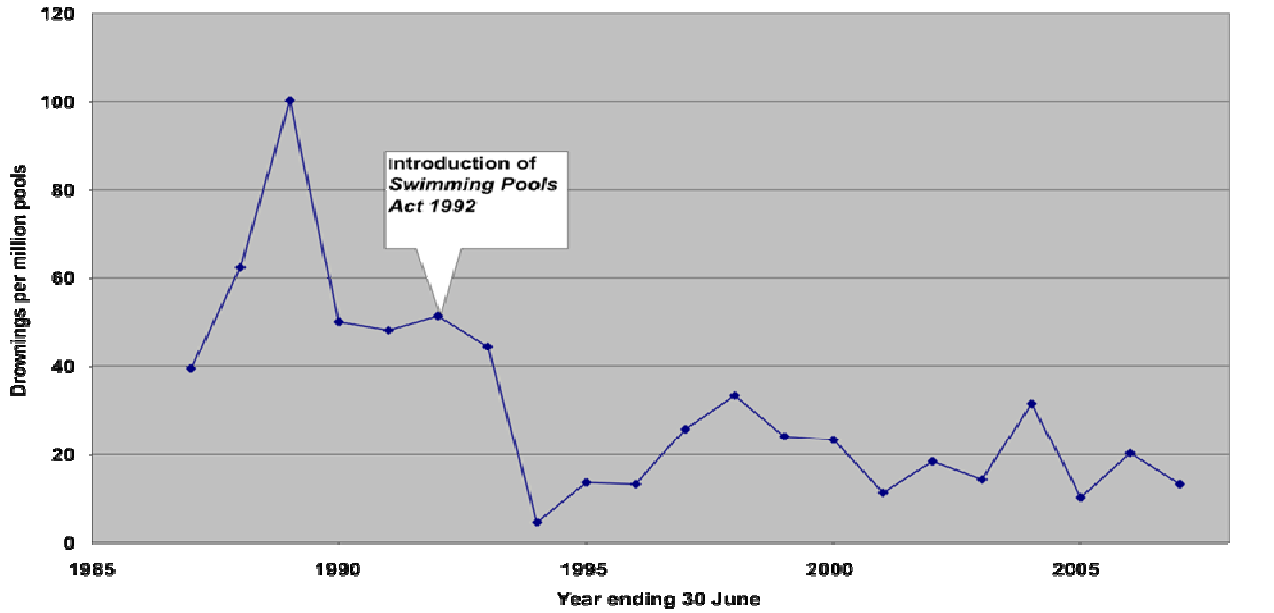
A significant proportion of children in this data set were admitted to hospital (71%) and 4 children died in ED. This is high compared to other injury scenarios discussed in previous bulletins (7,8,9) and reflects both the severity of the initial injury and the need for a period of medical observation following an immersion. Lung damage sustained during a period of lack of oxygen combined with inhalation of water can cause progressive lung damage that manifests in the 24 hours after an immersion event.

In the USA in 1990, GJ Wintemute found that for every immersion death under 5 years, these are 4 presentations to hospital and a further 10 brief immersion events not requiring medical attention. (10)

In a 1991 Brisbane study Pitt found that for every fatal drowning under 5 years in a domestic pool there were nine hospital admissions. (11) In this data series, we estimate that there were 4 to 5 admissions for every fatal drowning.

Pool fencing legislation was first introduced to Queensland in 1991 and has undergone several revisions since then. Under this legislation, a swimming pool is defined as an excavation or structure capable of being filled with water to a depth of 300mm or more and capable of being used for human aquatic activity. This definition includes spa pools (whether portable or not) but excludes portable wading pools. Portable wading pools do not need to be fenced if they hold no more than 2000 litres of water that is less than 450 mm in depth and have no filtration system. (12) Two toddler deaths in the last 3 years (2/21 or 10%) occurred in portable wading pools. Pool details were not recorded in sufficient detail in the QISU injury surveillance database to allow accurate identification of pool type.

The number of domestic pool immersion deaths in Queensland toddlers has fallen dramatically following the introduction of pool fencing legislation. This is in the setting of an increasing Queensland population aged 0-5 years and an annual increase in the number of new pools. It is difficult to accurately estimate the true hazard of toddler exposure to domestic pools in Queensland. In a recent regulatory impact statement (RIS), the NSW Department of Local Government calculated the number of drowning deaths for children 0-5 years in private pools, per million private pools in NSW for the time period 1987 to 2004. (13) This calculation is based on an estimate of the total number of pools in NSW over the time period. It demonstrates that the rate of toddler immersion deaths in private pools has fallen relative to the number of private swimming pools. This is in the setting of a stable 0-5 year old population during the same period.



Graph 8: Drowning of children aged 0-5 years per million swimming pools: Reproduced from the Regulatory Impact Statement of the proposed *Swimming Pools Regulation 2008,* NSW Department of Planning, May 2008.

Prevention

In Queensland, the dramatic drop in the number of toddler domestic pool immersion deaths occurred shortly after the introduction of pool fencing legislation, with the lowest number of toddler domestic pool immersion deaths occurring in 1993. It is likely that this reduction is explained by the physical barrier around the pool in the setting of heightened public awareness that arose from education campaigns and media attention when the legislation was introduced.

An Effective Pool Barrier

In the years following the introduction of the legislation, the emphasis has moved from the need for a pool fence to the need for compliance and ongoing maintenance of the pool fence. Compliance may be defined as follows.

Static compliance refers to the ability of the barrier to meet relevant Australian standards for restricting access to the pool by a toddler after all temporary impediments to compliance are removed. This assesses pool barrier compliance when it is functioning as it was designed to.

Dynamic compliance refers to the ability of the barrier to meet relevant Australian standards for restricting access to the pool by a toddler before any temporary impediments to compliance are removed. This is important where the barrier function has been impaired by a temporary measure (ie. propping open the gate).

QISU data (3) shows that of 50 toddler immersion deaths in domestic pools between 1992 and 2001, 86% occurred in pools where the barrier was non-compliant. In this series, 26% of pools were unfenced, half failed static compliance (gaps in the fence, gates that failed to self-close or self-latch) and a further 10% failed dynamic compliance (the gate/ door had been tied back or propped open at the time of the immersion).

In addition to compliance considerations, the data demonstrated that there was a significant risk of toddler immersion death associated with barriers that allowed direct access from the house to the pool. The current Queensland legislation calls up the previous Australian Standards (14,15), which discourages but still permits a barrier configuration that allows direct access from the house to the pool. The new Australian Standard (16) makes clearer reference to the inherent danger of direct house access. In the QISU series (3), for barriers that failed static compliance, the relative risk of fatal toddler access to the pool via a house door compared to a pool gate was 2.88. Considering compliant and non-compliant barriers together, the relative risk of fatal toddler access to a pool through a house door versus a pool gate was 2.99. This suggests that even when not fully functional, a barrier that separates the house from the pool is more effective at preventing toddler immersion death than a barrier that allows direct toddler ac-

Compliance Enforcement

Western Australia (WA) and the Northern Territory are the only Australian jurisdictions requiring regular council inspections of domestic pool barriers. In WA, inspections occur every 4 years. A parliamentary review in 2002 recommended that the inspection frequency be increased to biannual inspections (17). Although there is provision within the Queensland legislation for an authorised pool fencing inspection process, few councils within Queensland deliver this process.

Action required includes:

* *Development of council databases identifying domestic pools*
* *Systems to identify pools where building inspections are incomplete*
* *Training of pool inspectors*
* *Simpler Interpretation of Standards*
* *Public acceptance of pool inspections*
* *Inspection when reviewing lease or change of home ownership*

In WA, where compliance inspections are conducted by the Royal Life Saving Society, WA, the process involves education and awareness of the need for compliant pool fencing as much as enforcement. The NSW RIS estimated that the cost of pool inspections in NSW was between $50 and $85 per pool inspection. As in Queensland, councils experience difficulty in compelling some pool owners to make the necessary repairs or changes to the pool barrier. This process often takes several inspections. The conclusion in the RIS was that "the analysis does not support substantial resources being allocated to improve inspection and related council activities". (13) Others have argued that the cost of a regular pool inspection should be borne by the pool owner, where that cost is similar to a bucket of pool chlorine.

Revision of the Australian Standard was designed to make the compliance inspection process easier with the development of the "non-climbable zone". (16) Inspectors (and pool owners) can with the aid of a 900mm tape, ensure that there is a non-climbable zone within any barrier adjacent to the pool. This allows less conventional barriers that include new pool fence designs and retaining walls or balconies to be certified as compliant. The NCZ was devised to make interpretation of the regulations simpler and the inspection process easier for all concerned.

Despite the new standard being published, it has still not been adopted by the Australian Building Codes Board.

Several authors have recognised that young families are at greatest risk from toddler immersion in domestic pools within the first 6 months of acquiring or moving into a property containing a pool (11,18). Some jurisdictions have moved to make pool barrier compliance certificates a requirement on sale or rental of a property. At present, this is not required in Queensland.

Whilst a pool is under construction, efforts must be made to prevent toddlers from gaining access to the building site. It is however, unfeasible to have a formal pool barrier installed whilst construction on or around the pool continues. One toddler in Queensland has drowned in the last 15 years, having accessed a neighbouring pool under construction. Barrier tape and temporary covers are insufficient to limit toddler access. Temporary cyclone mesh fencing should be used until a formal pool barrier can be installed. This is not specified under current legislation. Ideally, any building application or contract that includes a domestic pool should have clear provision for both an intermediate and then permanent pool barrier, with a clear timetable for an inspection process during and at the end of construction.

Supervision

The QISU surveillance data does not record the level of supervision at the time of the immersion injury. From the coronial data collated by QISU, for 50 toddler pool immersion deaths reviewed between 1992 and 2001, in 88% of cases (44/50), the toddler gained unintended access to the pool. In the remaining 6 cases, the toddler had been allowed out the back door by a caregiver (direct house access to the pool yard), who presumably was aware that the toddler was in the proximity of the water hazard. However, the majority of drowning occurred when the caregiver was not aware that the child in direct danger.

There are few reports of toddlers who have drowned when directly supervised by adults within a pool enclosure. Non-fatal drowning in this setting is more common, particularly where there are multiple care-givers, multiple children in the pool and distractions.

The Royal Life Saving Society, Australia have developed a Keep Watch @ Public Pools (19) and Keep Watch (20) campaigns where different levels of supervision are specified for different age groups.

These recommendations assume average swimming ability and normal development and health.

* Children aged 0-5 years: be in the water with your child in arms reach
* Children aged 6-10: be within constant eye contact of your child
* Children aged 11-14: physically check up on a regular basis

In situations when multiple adults are likely to be supervising young children in the pool, one adult should be a designated lifeguard (20). This is akin to the Surf Life Saving model, and avoids the situation where one adult incorrectly assumes that another is supervising the children. The designated lifeguard needs to pass the responsibility to the next adult. Ideally, the lifeguard could wear a recognisable hat or similar item, so that other adults are clear as to who is supervising the children.

Summary

The number of toddler domestic pool immersion deaths has fallen significantly in Queensland following the introduction of pool fencing legislation for domestic pools. However, the majority of toddlers who drown do so in domestic pools that do not comply with fencing requirements. More action is required to develop reliable and reproducible systems for routine pool fencing maintenance and inspection. This would be facilitated by adoption of the new Australian Standard by ABCB and referencing of the new standard in state pool fencing legislation.

Recommendations

* The ABCB adopt the new AS1926 standard
* Pool fencing certification be made a condition of sale or rental of property within Queensland
* Councils be assisted to develop data bases of existing pools
* Councils be assisted to develop pool barrier inspection programmes
* Pool barrier inspectors receive appropriate training
* Councils develop community education programmes using a safe communities model
* Local governments be required to inspect pools and pool fences on a cyclical basis

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