

The NSW Study of

# DROWNING AND NEAR DROWNING

in Children (0-16)

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Children's Hospital  
CHILDREN, YOUNG PEOPLE AND FAMILIES

 The Sydney  
children's  
Hospitals Network  
care, advocacy, research, education

 **NSW**  
GOVERNMENT

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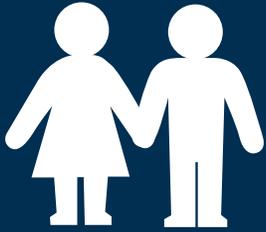
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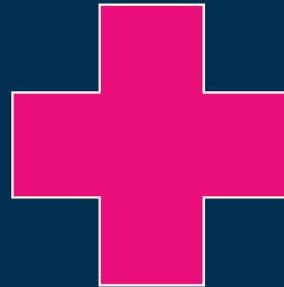
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The views expressed herein do not necessarily reflect the views of the NSW Government.



**78%**

of the 60 children in the study were aged 0-4 years



**90%**

of all children who needed CPR received it



**56%**

of children aged 0-4 years had a near drowning (after a lapse of supervision) while they were in the pool area with their parent/carer



**22%**

of children 0-4 years gained access to the pool because the gate was propped open



**48%**

of all children had a history of swimming lessons

**45%**

of all children had water in the lungs, even those who were under the water for less than one minute



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## Executive summary

Drowning is an important child health issue both nationally and internationally. Children still account for the highest rates of drowning, the most common age group being children aged 0-4 years.

In Australia, drowning with or without morbidity are not included as part of the overall statistical reporting on drowning. There are very few studies in Australia which examine only drowning with or without morbidity and it is unknown whether the circumstances are the same as drowning deaths. As a result, Government policy-makers and the general public are not aware of the complete extent of the drowning burden.

The NSW Study of Drowning and Near Drowning in Children (0-16) involved an in depth analysis of drowning with or without morbidity at the three paediatric hospitals in NSW. The hospitals involved in the data collection included Sydney Children's Hospital (SCH), The Children's Hospital at Westmead (CHW) and John Hunter Children's Hospital (JHCH). A questionnaire was completed with parents and carers of children who had a drowning with or without morbidity either in person at the hospital or retrospectively over the phone. The in depth interviews and questionnaires allowed for additional details which retrospective data collection fails to capture.

The following highlights the significant findings of the first two years of the study from July 2013 to June 2015:

### For children aged 0-16 years

- There were a total of 60 participants who consented to being involved in the study.
- Males and females experienced equal rates at 50%.
- The most common locations included swimming pools (52%), public pools (22%) and baths (17%).
- Cardiopulmonary resuscitation (CPR) was given in 90% of the children who required it immediately following the drowning.
- In 45% of cases, examination of chest radiographs revealed lung changes most likely indicating water inhalation.
- Nearly half (48%) of all the children previously had swimming lessons.

### For children aged 0-4 years

- Over three-quarters (78%) of children were aged 0-4 years.
- The most common locations included swimming pools (58%), baths (21%) and public pools (15%).
- Of the drowning that occurred in swimming pools:
  - 56% of children were let into the pool area by a parent/carer and then experienced a drowning with or without morbidity due to a lapse in supervision.
  - 22% gained access to the swimming pool through a gate that was propped open.
- Almost half (49%) occurred while the children were unsupervised, 28% supervised from a distance and 23% within arm's reach.
- CPR was given to 96% of the children who needed it.
- Where the history of water familiarisation was known, 41% reported attending classes.

The supervision recommendation for children aged 0-4 years is not being adhered to with only 23% of children aged 0-4 years having an adult supervising within arm's reach, regardless of location. Furthermore, children aged 5-10 years (38%) and 11-16 years (40%) also had high rates of being unsupervised. Most of the children in this study were already around water when they drowned, such as in swimming pools and bathtubs; however, this is less common among drowning deaths according to existing research. Detailed information on what appropriate supervision means by age group is essential and how this differs when in high risk locations such as in aquatic environments compared to low risk locations around the home.

In this study, a lack of supervision after the child was already in the pool area with the parent and carer was the sole cause of drowning with or without morbidity in the majority of cases for children aged 0-4 years however this has not been found as a key factor in drowning deaths. Although leaving the gate propped open and faults in the fencing was also of concern in this study, they are reported at much higher levels in drowning death data. This highlights the different circumstances that exist for drowning deaths and drowning with and without morbidity and the need to continue collecting data on both events to ensure the true picture of all drowning is captured.

Although formal CPR training and annual refresher courses were low, most children who needed cardiopulmonary resuscitation (CPR) received it immediately following the drowning. The high rate of CPR may be a contributor to the overall decrease in drowning deaths but the increase in drowning with or without morbidity. Early CPR has been shown to contribute to greater survival following child drowning however greater results could be achieved with an increase in formal CPR training.

The history of swimming lessons for children drowning with or without morbidity has not been reported in previous research. With 41% of children aged 0-4 years having a history of water familiarisation, 63% of children aged 5-10 years and 100% of children aged 11-16 years with a reported history of swimming classes, it is a reminder to parents/carers while water familiarisation and swimming lessons are an important part of drowning prevention, they cannot be relied on to prevent drowning.

The high proportion (45%) of children with evidence of water inhalation is significant, even in the children submerged under the water less than a minute. Water inhalation following a seemingly minor drowning is an important finding to communicate to the community to prevent morbidity and morbidity in children.

This study adds to the evidence base by collecting new information on the level of supervision, respiratory distress and details on the circumstance of drowning with or without morbidity. The results of this study highlight the importance of continued education on what supervision means when in and around the water compared to other locations that are not seen as high risk, appropriate supervision in pools and bathtubs, not propping the pool gate open and ensuring pool fencing compliance, learning CPR and not relying on water familiarisation and swimming lessons to prevent drowning among children of any age.

# 1 Introduction

In this report the terminology drowning death and drowning with or without morbidity will be used for consistency with the 2002 World Congress definition of drowning,<sup>1,2</sup> except when referring to The NSW Study of Drowning and Near Drowning in Children (0-16). The title of the study will remain as it was named upon Ethics approval. The terms drowning and near drowning will be used when providing drowning related injury prevention strategies and health promotion messages to the community. This is to allow for a wide range of health literacy levels and to foster better understanding among members of the public.

In Australia, drowning with or without morbidity is not included as part of the overall statistical reporting on drowning. A comprehensive reporting system from emergency, medical, and healthcare services of any drowning incidence, regardless of outcome, does not currently exist in NSW. As a result, policy-makers, advocacy groups and the general public are not aware of the full drowning burden.

The Kriesfeld and Henley report from the Australian Institute of Health and Welfare (AIHW)<sup>3</sup> is an example of data that has previously been collected for drowning deaths and drowning with and without morbidity in Australia. Data collected on a large scale based on International Statistical Classification of Diseases and Related Health Problems (ICD) coding often lacks detail, particularly on the circumstances that led to the drowning.

Some studies have examined the circumstances of drowning deaths and drowning with and without morbidity in greater detail by retrospectively viewing patient records<sup>4,5</sup> and clinical documents/medical charts<sup>6,7,8</sup> however this is based on the reporting of clinicians and some information has been found to be omitted from the notes.

There are very few studies in Australia which examine only drowning with or without morbidity. A study by Ross et. al.,<sup>9</sup> was one such study which focused on children aged 0-4 years however some of the information collected was unknown due to the retrospective nature of the study.

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<sup>1</sup> Maatschappij tot Redding van Drenkelingen. (2002) *Final Recommendations of the World Congress on Drowning*. Amsterdam. The World Congress on Drowning.

<sup>2</sup> van Beeck, EF, et al. (2005) *A new definition of drowning: towards documentation and prevention of a global public health problem*. Bulletin of the World Health Organisation 83:853-856.

<sup>3</sup> Kreisfeld, R., & Henley, G. (2008). *Deaths and hospitalisations due to drowning, Australia 1999-00 to 2003-04*. Injury Research and Statistics Series Number 39. (Cat. no. INJCAT 109) Adelaide: AIHW.

<sup>4</sup> Stephenson, S., G, H., J, H., & J, L. (2003). *Diagnosis-based Injury Severity Scaling*. Injury Research and Statistics Series Number 20. Adelaide: AIHW (AIHW cat no. INJCAT 59).

<sup>5</sup> Kyriacov, D., Edgardo, A., & Peek, C. a. (1994). Effect of immediate resuscitation on children with submersion injury. *Paediatrics*, 94, 137-142.

<sup>6</sup> Marchant, J., Cheng, N.G., Lam, L.T., Fahy, F.E., Soundappan, S.V., Cass D.T., Browne, G.J. (2008). Bystander basic life support: an important link in the chain of survival for children suffering a drowning or near-drowning episode. *Medical Journal of Australia*, 188 (8), 484-485.

<sup>7</sup> Blum, C. a. (2000). Toddler drowning in domestic pools. *Injury Prevention*, 6(4), 288-90.

<sup>8</sup> Brenner, R., Taneja, G., Haynie, D., Trumber, A., Qian, C., Klinger, R., et al. (2009). Association between swimming lessons and drowning in children: A case-control study. *Archives of Pediatric Adolescent Medicine*, 163(3), 203-210.

<sup>9</sup> Ross, F., Lam, L., & Cass, D. (2003). Children under 5 years presenting to paediatricians with near-drowning. *Journal of Paediatrics and Child Health*, 39(6), 446-450.

## 2 Impact of drowning

In Australia, child drowning deaths have been steadily decreasing since the first research data began to appear in the 1970s.<sup>10</sup> The emphasis on the implementation of strategies based on research findings continues to be instrumental in reducing the child drowning rate in Australia.

It is widely acknowledged that the full impact of drowning is not limited to drowning deaths.<sup>11</sup> Sustaining neurological deficits from drowning could mean a lifetime of potentially immense difficulty for the child and those who care for them. The economic cost of the years of life lost due to death and disability in private swimming pools alone is estimated to be in excess of \$23 million.<sup>12</sup> With four deaths and 35 drowning with or without morbidity in private swimming pools from 2013-14 in children aged 0-4 years, the financial impact of drowning in NSW remains high.

In NSW, in 2012-2013 there were a total of 89 hospital admissions from drowning with or without morbidity among children 0-16 years which increased to 99 in 2013-14 [Table 1].<sup>13</sup>

**Table 1: All hospital admissions for drowning with or without morbidity in NSW (0-16 years), 2012-13 to 2013-14**

	2012-13	2013-14
0-4 Years	60 (67%)	70 (71 %)
5-10 Years	12 (14%)	16 (16%)
11-16 Years	17 (19%)	13 (13%)
<b>TOTAL</b>	<b>89</b>	<b>99</b>

The level of morbidity can vary from no injury to severe neurocognitive deficits. The Department of Local Government (DLG) estimated approximately 10% of morbidity can result in permanent brain damage.<sup>14</sup> This data is consistent with an ongoing long-term study at The Children’s Hospital at

<sup>10</sup> Wigglesworth, E. (2001). Towards an Australian Institute of Trauma Research: learning the lessons of history. *Australian and New Zealand Journal of Surgery* 71(12):765-768.

<sup>11</sup> World Health Organisation. (2014) *Global Report on Drowning: Preventing a Leading Killer*. World Health Organisation. Retrieved from:  
[http://www.who.int/violence\\_injury\\_prevention/publications/drowning\\_global\\_report/Final\\_report\\_full\\_web.pdf?ua=1](http://www.who.int/violence_injury_prevention/publications/drowning_global_report/Final_report_full_web.pdf?ua=1)

<sup>12</sup> The Department of Local Government. (2008) *Review of The Swimming Pools Act 1992*. Office of Local Government. Retrieved from:  
<http://www.dlg.nsw.gov.au/dlg/dlghome/documents/Information/Swimming%20Pools%20Act%201992%20Review%20-%20Report.pdf>.

<sup>13</sup> NSW Ministry of Health. (2015). *Injury Related Hospitalisation (unpublished data)*. Sydney: Centre for Epidemiology and Evidence.

<sup>14</sup> The Department of Local Government. (2008). *Review of The Swimming Pools Act 1992*. Retrieved from:  
<http://www.dlg.nsw.gov.au/dlg/dlghome/documents/Information/Swimming%20Pools%20Act%201992%20Review%20-%20Report.pdf>

Westmead (CHW) by The Centre for Trauma Care, Prevention, Education and Research (CTCPEP).<sup>15</sup> CTCPEP data shows in about 20% of drowning with or without morbidity there is some form of long term behavioural and learning impairment and in 10% of cases there is severe neurological deficit.

Injury Severity Score (ISS) is a predetermined rating used to rank trauma severity [Table 2].

**Table 2: ISS with description**

ISS Scores Used in Drowning
ISS 9 - Near drowning with <b>no</b> neurologic deficit
ISS 16 – Near drowning <b>with</b> neurologic deficit
ISS 25 – Near drowning with cardiac arrest (often leads to death)

Medical professionals use the ISS for drowning, among other traumas. These scores are assigned as a child is admitted and are then used to correlate with morbidity, mortality and length of time in hospital.

In drowning with or without morbidity, when warranted, a chest x-ray will be conducted to verify respiratory impairment. If there is evidence of water in the lungs, this can lead to acute lung injury and serious repercussions. Additional treatment could be required to normalise organ function, eliminate hypoxia and regulate the acid levels in the blood and/or the body's carbon dioxide levels.

Unlike drowning with and without morbidity, drowning deaths are reported on an annual basis in NSW through the NSW Child Death Review Team (CDRT) Annual Reports. The reports provide very detailed information on the circumstances that led to the drowning death which is vital to inform prevention activities. Although this has led to the identification of key contributing factors for drowning deaths, it is unknown if the circumstances are the same for drowning with and without morbidity.<sup>16</sup>

### 3 Prevention of child drowning

There are four evidence based strategies for the prevention of child drowning according to the Australian Water Safety Council; supervision, pool fencing, cardiopulmonary resuscitation (CPR) and water familiarisation.<sup>17</sup> These strategies focus on behaviour as well as the environment in which child drowning occurs. It is vital that work continues with government, industry and the community to promote the educational, environmental and legislative changes required to reduce the drowning rate further.

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<sup>15</sup> Manglick, P. (2015). *Immersion: Long-term Outcomes* (unpublished data). Westmead: The Children's Hospital at Westmead.

<sup>16</sup> NSW Child Death Review Team. (2014). *CDRT Annual Report 2013*. NSW Ombudsman. Retrieved from: [https://www.ombo.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0008/19628/CDRT-Annual-Report-2013.pdf](https://www.ombo.nsw.gov.au/__data/assets/pdf_file/0008/19628/CDRT-Annual-Report-2013.pdf)

<sup>17</sup> Australian Water Safety Council. (2012). *Australian Water Safety Strategy 2012 - 2015*. Retrieved from: [http://www.royallifesaving.com.au/\\_\\_data/assets/pdf\\_file/0011/4016/AWSC\\_Strategy2012\\_Brochure-Lowres.pdf](http://www.royallifesaving.com.au/__data/assets/pdf_file/0011/4016/AWSC_Strategy2012_Brochure-Lowres.pdf)

Studies have shown that parents underestimate the risk of drowning and overestimate the ability of children to protect themselves from this risk.<sup>18,19</sup> The emphasis of adequate adult supervision of children, is especially important because it is the most significant contributor to child drowning deaths.<sup>20 21 22 23</sup> Supervision recommendations have been developed by The Royal Life Saving Society for the Keep Watch @ Public Pools program and range from active supervision within arm's reach for children aged 0-5 years and all non-swimmers, constant active supervision from a distance for children aged 6-10 years and regular checks by physically looking at children for those aged 11 and above.<sup>24</sup> Although supervision within arm's reach is constantly promoted to prevent drowning for children aged 0-4 years when they are in and around the water, there are no clear guidelines on appropriate supervision for children of any age in locations that are not high risk, such as within the home environment.<sup>25</sup>

Drowning in private swimming pools continues to be a significant cause of morbidity and mortality in children, especially those aged 0-4 years. According the Office of the Local Government (OLG) there are over 321,000 private swimming pools on the Swimming Pool Registry of NSW (personal correspondence, July 2015) and does not include portable pools which could inflate this figure.

Current fencing requirements in NSW are set out in *The Swimming Pools Act 1992* (NSW) and its regulations. All new swimming pools require council approval and the installation of four-sided isolation fencing with a self-closing gate.<sup>26</sup> This type of fencing was found by a 2010 Cochrane review to significantly reduce the risk of drowning and is superior to other types of fencing which employ the house or boundary fence as part of the barrier.<sup>27</sup>

A study of drowning with or without morbidity in Australia investigated details surrounding the drowning in children aged 0-4 years in relation to access to private pools, pool fencing, location of drowning and neurological outcomes.<sup>28</sup> Where the information was reported, 39% of children aged 0-4 years were let into the pool area by a parent, 12% gained access via a propped open gate, 31% did not have a fence around the pool and 18% of the children were able to let themselves into the

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<sup>18</sup> Morrongiello, B., Sandomierski, M., Schwebel, D., & Hagel, B. (2013). Are parents just treading water? The impact of participation in swim lessons on parents' judgments of children's drowning risk, swimming ability, and supervision needs. *Accident Analysis & Prevention*, 50: 1169-1175.

<sup>19</sup> Morana K, S. T. (2006 ). Toddler drowning prevention: Teaching parents about water safety in conjunction with their child's in-water lessons. *International Journal of Injury Control and Safety Promotion* 13(4) 254-256.

<sup>20</sup> NSW Child Death Review Team. (2014). *CDRT Annual Report 2013*. NSW Ombudsman. Retrieved from: [https://www.ombo.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0008/19628/CDRT-Annual-Report-2013.pdf](https://www.ombo.nsw.gov.au/__data/assets/pdf_file/0008/19628/CDRT-Annual-Report-2013.pdf)

<sup>21</sup> Marchant, J. (2008). Bystander basic life support: an important link in the chain of survival for children suffering a drowning or near-drowning episode. *Medical Journal of Australia*, 188(8), 484-485.

<sup>22</sup> Asher, L., & al, e. (1995). Water safety training as a potential means of reducing risk of young children's drowning. *Injury Prevention*, 1(4), 228-233.

<sup>23</sup> Williamson, A., Irvine, P., & Sadural, S. (2002). *Analysis of drowning involving children aged five years and under in NSW*. Concord West: NSW Water Safety Taskforce: NSW Injury Risk Management Research Centre.

<sup>24</sup> Royal Life Saving Society Australia. (n.d.). *Keep Watch at Public Pools*. Retrieved from: <http://www.royallifesaving.com.au/families/at-the-local-pool/drowning-prevention/keep-watch-@-public-pools>

<sup>25</sup> Morrongiello, B.A., Schell, S.L. (2009) Child injury: The role of supervision in prevention. *American Journal of Lifestyle Medicine*. 4(1), 65-74

<sup>26</sup> NSW Consolidated Acts. (n.d.). *Swimming Pools Act 1992 - Section 7*. Retrieved from: [http://www.austlii.edu.au/au/legis/nsw/consol\\_act/spa1992192/s7.html](http://www.austlii.edu.au/au/legis/nsw/consol_act/spa1992192/s7.html)

<sup>27</sup> Thompson F, R. T. (2010). *Pool fencing for preventing drowning of children (Review)*. The Cochrane Collaboration.

<sup>28</sup> Ross, F., Lam, L., & Cass, D. (2003). Children under 5 years presenting to paediatricians with near-drowning. *Journal of Paediatrics and Child Health*, 39, 446-450.

pool area. The NSW CDRT 2013 Annual Report stated that in five of the six children who died in private swimming pools, the barrier was deficient and one pool had no fencing.<sup>29</sup>

Research has shown children demonstrate basic movement skills and water confidence at four years of age and the introduction to swimming lessons at younger ages does not have the same outcomes.<sup>30</sup> However, long term safety benefits of early and continuous exposure were not addressed in this study. Two studies have found formal swimming lessons reduce the risk of drowning among children aged 1-4 years by up to 40% and 88%.<sup>31 32</sup> However, both studies estimates were imprecise and included very large ranges for the risk reduction. Despite this, both studies provided evidence that swimming lessons do not increase the drowning risk among this age group, due to increased exposure to water or decreased parental vigilance, as has been raised in previous studies. Of concern is the overly optimistic view from parents of the protective role of swimming lessons and the swimming ability of their child.<sup>33</sup>

The Water Safety Advisory Council recognised Culturally and Linguistically Diverse (CALD) communities as high risk in drowning. These community members have a lower rate of participation in water familiarisation/swimming lessons and lack of language/culturally appropriate drowning prevention and water safety resources and education.<sup>34</sup>

If a drowning occurs, the importance of first aid and CPR training is vital. It is estimated that approximately 30% of paediatric patients, including drowning patients, received CPR.<sup>35</sup> The quicker a child receives CPR the more likely it is that there will be a positive outcome.<sup>36</sup> A child who receives resuscitation efforts is almost five times more likely to have a good health outcome following a drowning.<sup>37</sup> The Australian Resuscitation Council (ARC) recommends CPR refresher classes every 12 months and emphasise that 'any attempt at resuscitation is better than no attempt.'<sup>38</sup> Potential barriers to learning CPR could include the expense of courses, possible language barriers, limited access, and arranging childcare.

There has been no published research of children drowning with or without morbidity in NSW or Australia where the methodology of the study includes in depth interviews with the parents/carers of the child who drowned. This type of data collection allows for more detailed information surrounding the drowning as well as emotional outcomes for the family.

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<sup>29</sup> NSW Child Death Review Team. (2014). *CDRT Annual Report 2013*. NSW Ombudsman. Retrieved from: [https://www.ombo.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0008/19628/CDRT-Annual-Report-2013.pdf](https://www.ombo.nsw.gov.au/__data/assets/pdf_file/0008/19628/CDRT-Annual-Report-2013.pdf)

<sup>30</sup> Parker, H., & Blanksby, B. (1997). Starting age and aquatic skill learning in young children: Mastery of prerequisite water confidence and basic aquatic locomotion skills. *The Australian Journal of Science and Medicine in Sport*, 29(3), 83-87.

<sup>31</sup> Yang, L., et. al. (2007) Risk factors for childhood drowning in rural regions of a developing country: a case-control study. *Injury Prevention*. 2007; 12(3), 178-182.

<sup>32</sup> Brenner, R., Taneja, G., Haynie, D., Trumber, A., Qian, C., Klinger, R., et al. (2009). Association between swimming lessons and drowning in children: A case-control study. *Archives of Pediatrics and Adolescent Medicine*, 163(3), 203-210.

<sup>33</sup> Purnell, M. a. (2008). *Systematic review of drowning interventions and risk factors and an intervention comparison of water safety policies and program*. University of Otago: Injury Prevention Research Unit, Resuscitation Council.

<sup>34</sup> Australian Water Safety Council. (2012). *Australian Water Safety Strategy 2012 - 2015*. Retrieved from: [http://www.royallifesaving.com.au/\\_\\_data/assets/pdf\\_file/0011/4016/AWSC\\_Strategy2012\\_Brochure-Lowres.pdf](http://www.royallifesaving.com.au/__data/assets/pdf_file/0011/4016/AWSC_Strategy2012_Brochure-Lowres.pdf)

<sup>35</sup> Meyer R, T. A. (2006). Childhood drowning. *Pediatric Review*, 27(5), 163-169.

<sup>36</sup> Australian Resuscitation Council. (2011, December). *The ARC Guidelines*. Retrieved from: <http://resus.org.au/guidelines/>

<sup>37</sup> Kyriacov, D; Edgardo, A; Peek, C; Kraus, J. (1994) Effect of Immediate Resuscitation on Children with Submersion Injury. *Paediatrics*, 94, 137-142.

<sup>38</sup> Australian Resuscitation Council. (2011, December). *The ARC Guidelines*. Retrieved from: <http://resus.org.au/guidelines/>

## 4 The NSW Study of Drowning and Near Drowning in Children (0-16)

To address the gaps in knowledge of the circumstances surrounding drowning with or without morbidity, CHW is undertaking a study of child drowning in NSW. The project was designed to enhance the data collection for drowning in all circumstances but particularly for drowning with or without morbidity in private swimming pools.

This report presents the findings of the first two years of the study from July 2013 to June 2015.

### 4.1 Method

This study received ethics approval for a five year period to be conducted across the three paediatric hospitals in NSW; CHW, Sydney Children's Hospital (SCH) and John Hunter Children's Hospital (JHCH). The Research Officer was based only at CHW and members of the other hospitals obtained and forwarded the details of drowning to their hospitals.

Human Research Ethics allowed the Research Officer to gain consent from participants and complete the questionnaire in hospital or retrospectively over the phone after potential participants had been discharged from hospital. For those participants who were not consented in hospital and required phone follow up, it was decided not to contact children with fatal outcomes. This was recognised as an extremely sensitive situation and the need to avoid undue distress for the family.

The Research Officer collected information by completing a questionnaire with the parent or carer of the child involved in the drowning (Appendix A and B). Information obtained from the in depth interview related to demographics, circumstances surrounding the drowning, swimming ability of the child, pool fencing, supervision, and CPR administration. In the case of a drowning in a private swimming pool, the parent or carer was asked if an inspection could be performed of the pool and the fencing. Further data was collected by the Research Officer by examining the medical records for evidence of respiratory distress, ISS, and length of stay in the hospital. If the parent or carer required an interpreter, an appointment was made with an interpreter through the Health Care Interpreter Service.

### 4.2 Results

#### 4.2.1 Results all ages

A total of 84 children aged 0-16 years were reported to the investigator for inclusion in the study between 1 July 2013 and 30 June 2015. The Research Officer obtained consent for 60 (71%) participants. Of the remaining 24, 13 (16%) could not be reached after repeated calls, six (7%) had disconnected phones or wrong numbers listed and five (6%) did not give consent.

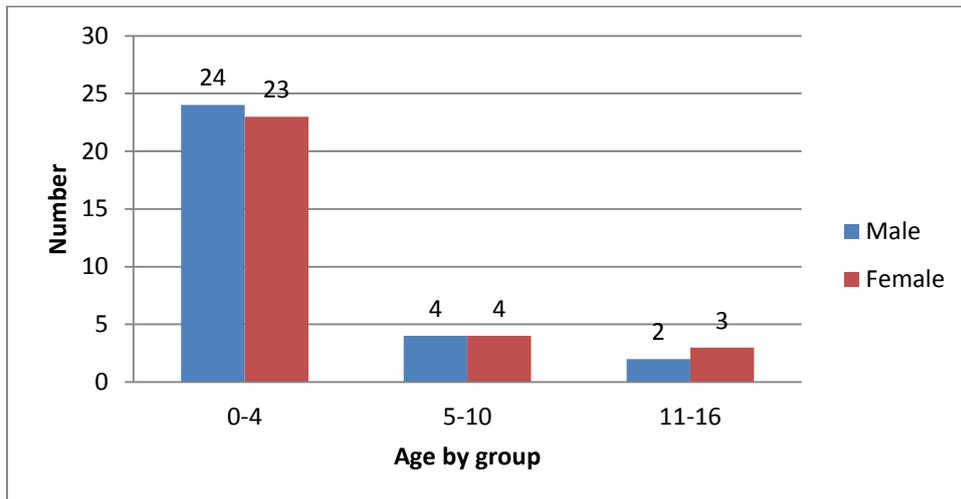
Of the consented participants, 12 (20%) presented to JHCH, 16 (27%) presented to SCH, and 32 (53%) presented to CHW.

English was the predominant language spoken at home (88%) and Australian was the most common nationality (92%). Of the 60 participants, seven (12%) were from a CALD background with the primary languages including Arabic, Burmese, Korean and Mandarin.

The Research Officer obtained consent from 18 (30%) participants in person at the hospital and consent for the remaining 42 (70%) participants was obtained over the phone.

There was an equal proportion of males and females among all age groups and over three-quarters (78%) of all child drowning were aged 0-4 years [Figure 1].

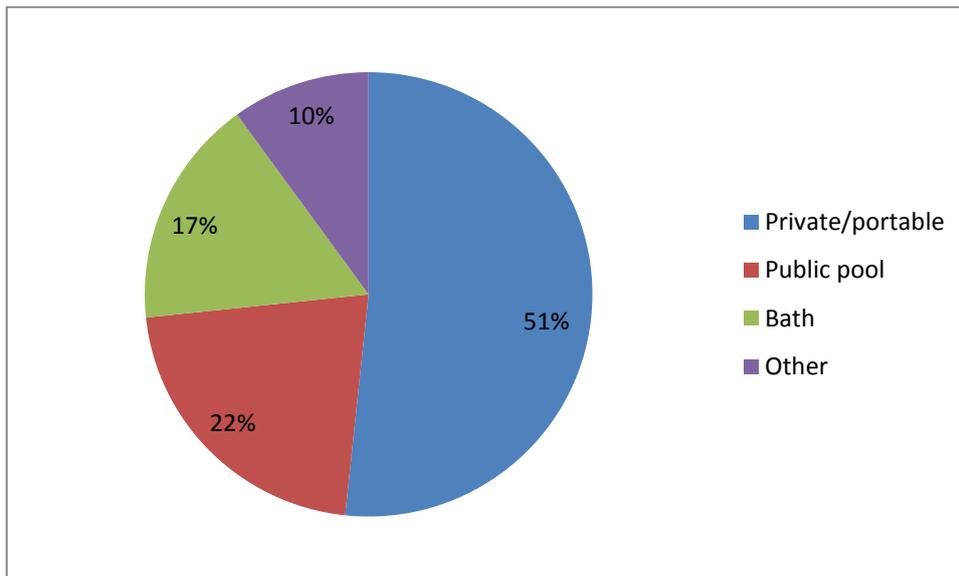
Figure 1: Drowning by age group and gender, 0-16 years



Most of the drowning occurred during summer (60%), followed by spring (20%), autumn (10%) and winter (10%). Saturday was overrepresented with 19 (32%) cases, followed by Sunday with 11 (18%), Tuesday with 10 (17%) and 20 (33%) making up other days of the week.

Most of the drowning occurred in private swimming pools (52%), followed by public pools (22%) and baths (17%) [Figure 2]. Ponds, spas and beaches comprised the other category (9%). All bath drowning occurred among children aged 0-4 years.

Figure 2: Location of all drowning, 0-16 years



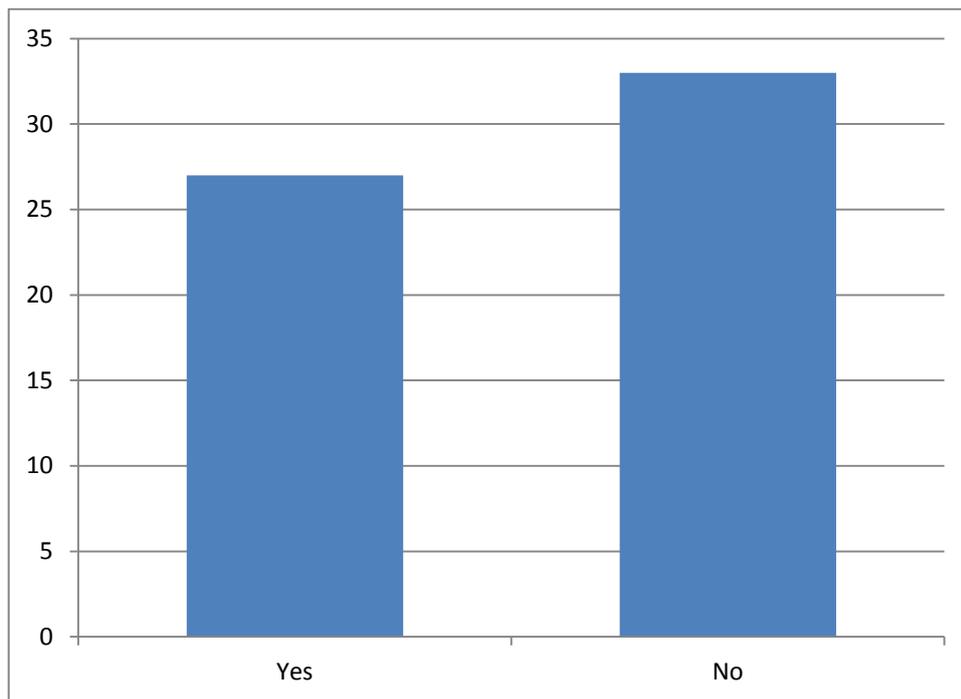
No parents/carers consented to an inspection of the swimming pool where the drowning occurred. In some cases the pool belonged to an extended family member or friend. Other circumstances included no longer living at the site of drowning, the pool was no longer in existence or the participant declined a site visit from the Research Officer.

Of the drowning where the time underwater was known, 34 (68%) were underwater for less than one minute, nine (18%) were underwater for 1-3 minutes and seven (14%) were underwater for three or more minutes. Most children (68%) required CPR after the drowning with or without morbidity. Of the 32% who did not require CPR, children aged 0-4 years had the highest percentage. Of the children requiring CPR, 76% were aged 0-4 years, 16% aged 5-10 years and 8% were aged 11-16 years.

CPR was performed most often by a parent or relative but in some cases by a bystander or lifeguard, depending on the location. In 11% of cases CPR was performed by a lifeguard, all of which were at a public pool. The remaining 89% of CPR was administered by a parent, carer, family member or bystander. Of the parents/carers who performed CPR, 14% undertook a CPR class in the previous 18 months, 14% received training more than 10 years ago, 25% had no CPR training and 36% had CPR training history but no further details were noted. Of the parents/carers who undertook a CPR class in the previous 18 months, 41% required it for work related purposes.

Respiratory distress was experienced in 27 (45%) of all children after drowning with or without morbidity. The presence of respiratory distress was not correlated with the length of time under water; respiratory distress was experienced in children with durations underwater of less than one minute [Figure 3].

Figure 3: Respiratory distress of all drowning, 0-16 years



A total of ten (17%) children were admitted to the Intensive Care Unit and 50 (83%) were not admitted.

The length of stay in hospital varied from a few hours to more than ten days. There were 20 (33%) children who had a hospital stay of less than one day, 27 (45%) who were in hospital for one full day, seven (12%) with stays of two days and six (10%) who were in hospital for more than three days. Most children had an ISS of 9 other than some children with an ISS of 16 or 25 who were in hospital for two days or more than three days.

The majority (92%) of children had an ISS of 9, 5% had an ISS of 16 and 3% had an ISS of 25.

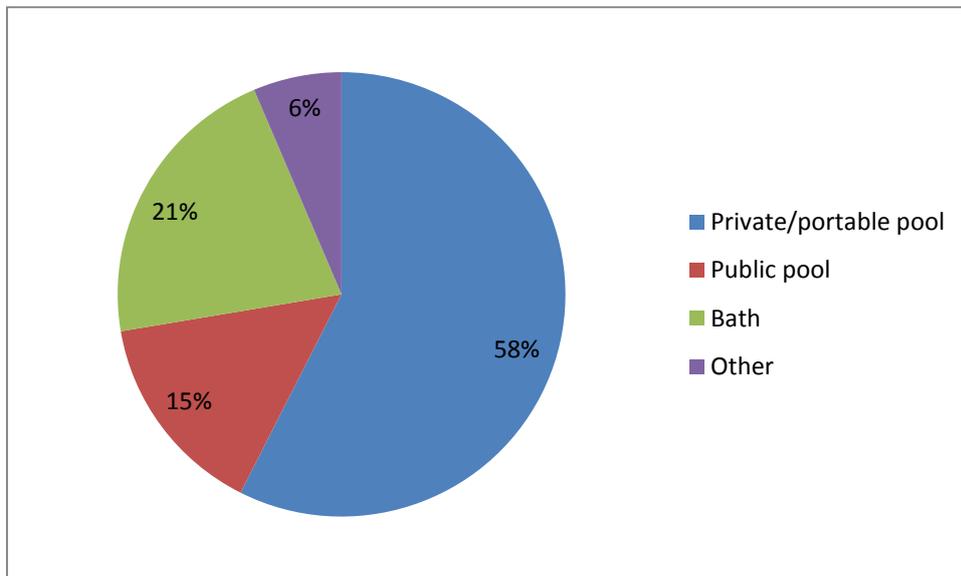
Where water familiarisation and swimming lesson history was known, just under half (48%) of all children reported they had previously taken classes. Where known, children aged 0-4 years experienced rates lower than the other age groups with 41% having water familiarisation classes and 59% not having classes. Children aged 5-10 years and 11-16 years had higher rates of swimming lessons with 62% and 100% respectively.

#### 4.2.2 Results 0-4 years

In total, there were 47 drowning with or without morbidity among children aged 0-4 years, with rates highest among those aged two to three years.

Most of the incidents occurred in private swimming pools, including portable pools (58%), which is higher than the rate for all age groups. Baths and public pools (21% and 15% respectively) are also a concern among this age group [Figure 4].

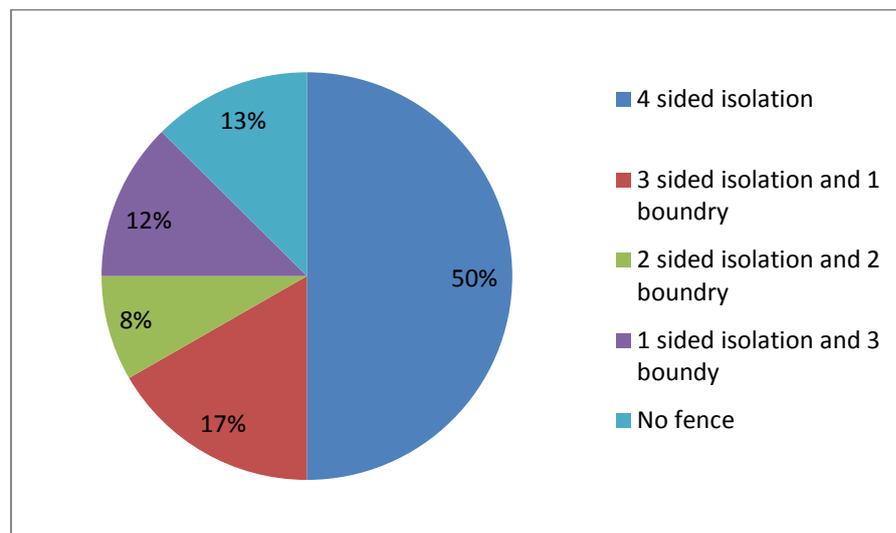
Figure 4: Location of drowning, 0-4 years



Of the 27 children who drowned in a private or portable swimming pools, 11 (41%) drowned in the swimming pool where they were living. Of these, where it was reported, all owned the property. Other locations of private swimming pools where the drowning occurred included at a friend’s home (22%), another family member’s home such as an aunt/uncle or grandparents (33) or in another location (4%).

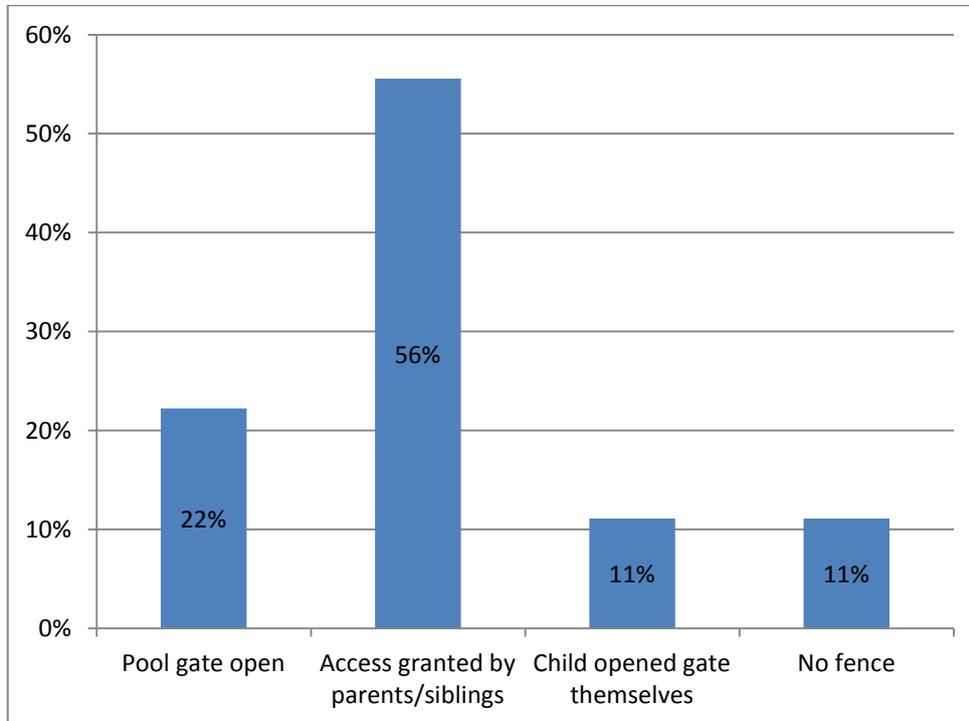
The barriers surrounding the pools for this age group varied. The most popular type of fence reported in the drowning cases, where known, was a four sided isolation fence (50%) or three sided isolation fence with one side a boundary fence (17%). One and two sided isolation fencing with the boundary fence on the other sides and no boundary fence at all reported lower rates [Figure 5]. Of the pools with no fencing, these included portable pools and pools that had been exempted due to the old age of the private pool.

Figure 5: Types of fencing for private pools, 0-4 years



For drowning that occurred in private swimming pools most children gained access into the pool area from their parents or older siblings (56%). In a further six (22%) cases, the child gained access to the swimming pool through a pool gate that had been intentionally propped open [Figure 6].

Figure 6: Means of access to private swimming pools, 0-4 years



Of the children allowed into the pool area by a parent, 47% of the supervising adults were in the pool with the child at the time of the incident, followed by 40% of adults who knew their child was in the water but were not in the water with them and 14% occurring in other situations where the adult didn't know the child entered the water. The level of supervision for these children included 27% supervising within arm's reach, 47% supervising from a distance and 27% of children who were unsupervised.

For the children who gained access to the private pool through a propped opened gate, in every incident the parent/carer did not know their child was in the water and thought their child was elsewhere in the house such as sleeping, riding a push bike or playing with a sibling out of the aquatic environment. In all cases where the child either opened the pool gate themselves or where there was no fence, the parent/carer did not know their child was in the water nor were they supervised.

Of the ten drowning with or without morbidity in baths, all of the children were aged 0-2 years. In 30% of these cases all of the children were unsupervised where the carers left the bathroom for a moment to attend to other tasks. There were 60% of children who were supervised within arm's reach but the drowning with or without morbidity occurred due to a temporary distraction such as addressing the needs of other children in the bath. In 10% of cases there was supervision from a distance, but within the confines of the bathroom where a temporary lapse in supervision occurred.

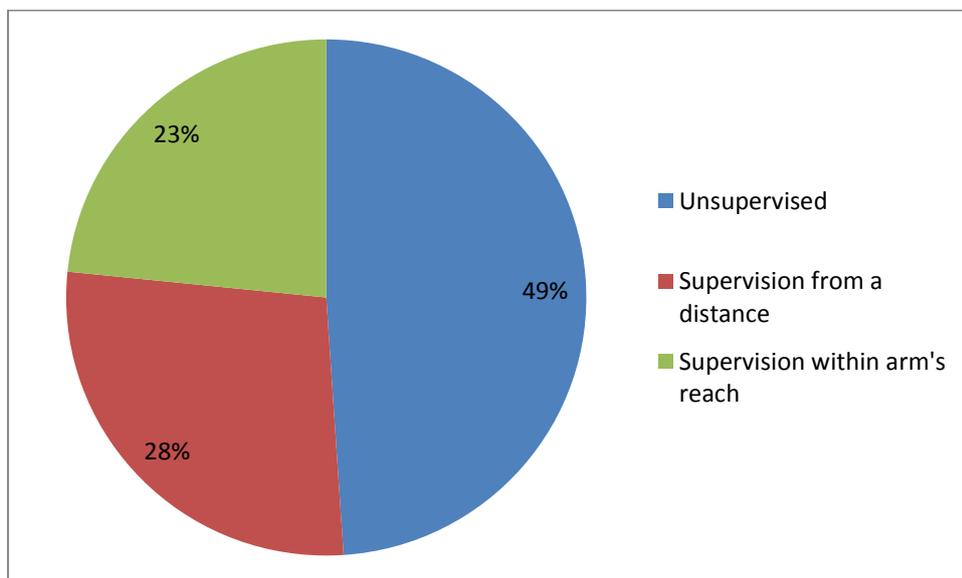
Of the 29 children requiring CPR, 28 (96%) of them received it. CPR was not needed in 18 (38%) cases.

Public pool drowning accounted for 15% of drowning in this age group. For incidents in public pools for children aged 0-4 years, there was no supervision within arm's reach. In each case the parent/carer knew the child to be in the water, yet 47% of the children were unsupervised and 57% were supervised from a distance. In the five children who required CPR, 60% received it from lifeguards and 40% from parent/carer.

Just under half of drowning incidents (49%) for children aged 0-4 years, regardless of location, occurred whilst the children were unsupervised. In 11 (23%) drowning cases for this age group, the supervising parent or carer was within arm's reach of their child [Figure 7].

Based on the data, parents/carers are more likely to supervise within arm's reach in baths. Public pools had highest rates of supervision from a distance.

Figure 7: Degree of supervision, 0-4 years



Length of time underwater ranged from a few seconds to ten minutes. There were 70% of children who were underwater for less than one minute, followed by 18% with duration underwater of 1-3 minutes and 12% were underwater for more than three minutes.

Respiratory distress occurred in 21 (45%) children after the drowning. The level of supervision was unsupervised at 62%, supervision from a distance at 33% and supervision within arm's reach at 5%.

Of the ten children overall who were admitted to the ICU, seven (70%) were aged 0-4 years. The location of the event varied with 43% in private swimming pools, 29% in baths and 29% in public pools or spas. Six out of seven children (86%) were unsupervised which include the parent or carer in a different location from the child when the child was not in water, stepping away from the child to go to the bathroom, or assuming someone else was watching the child at a large gathering. The length of time underwater ranged from one to five minutes.

The children admitted to the ICU also had longer hospital stays. The length of time in hospital was 2-5 days with one child in hospital for more than ten days. The accompanying ISS indicated more severe trauma with three ISS' of 16 and one ISS of 25.

ISS of 16 or 25 indicating some or severe morbidity was observed in 9% of all cases for children aged 0-4 years and each of these children were admitted to the ICU.

Where the history of water familiarisation classes was known, 18 (41%) children reported previously attended classes and the other 26 (59%) had no previous formal water familiarisation courses.

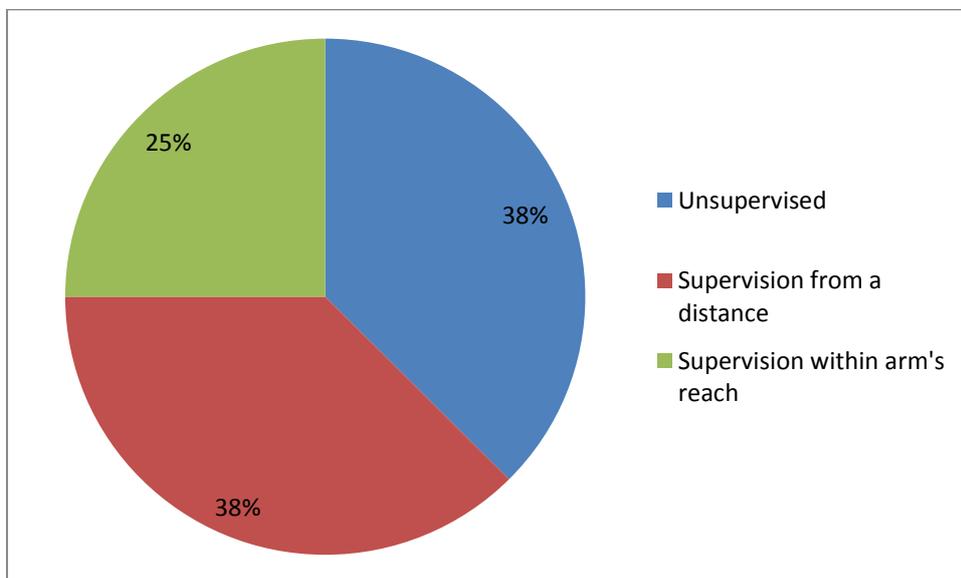
#### 4.2.3 Results 5-10 years

In total, there were eight drowning with and without morbidity among children aged 5-10 years. The locations of the drowning included private swimming pools (50%) and public swimming pools (50%).

All of the children who drowned in private swimming pools were let in by a family member to have a swim together, after which time there was a lapse in supervision such as watching other children in the water, assuming other adults were supervising and the carer assuming a child was more proficient at swimming than was the case.

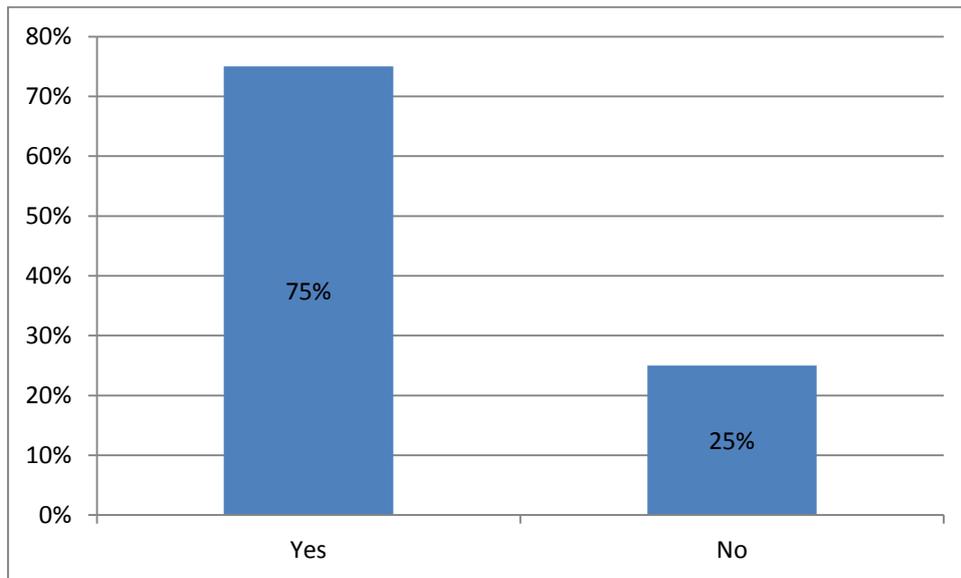
For all locations, supervision was equally distributed between unsupervised (38%) and supervision from a distance (38%) followed by supervision within arm's reach (25%) [Figure 8].

Figure 8: Degree of supervision, 5-10 years



All of the children required CPR, of which 75% received it. CPR was performed by bystander (50%), parents/carers (33%) or a lifeguard (17%). This number is lower compared to the other age groups [Figure 9].

Figure 9: Rate of CPR given, as needed, 5-10 years



Children suffered from respiratory distress 63% of the time after drowning with or without morbidity. This age group had the highest percentage of respiratory distress. The rate of supervision was unsupervised or supervision from a distance (40% each) and supervision within arm's reach (20%). When the length of time underwater was known, it ranged from less than one minute (75%) to five minutes (25%).

Only 13% of the children in this age group were admitted to the ICU following a drowning with or without morbidity, which is the lowest of all age groups.

When the history of swimming lessons was known, almost two-thirds of children (63%) had reported a history of swimming lessons.

#### 4.2.4 Results 11-16 years

There were a total of five drowning with and without morbidity among children aged 11-16 years.

The two locations of drowning with or without morbidity in this age group included public pools (40%) and beaches (60%). All of the incidents reported at the beach were in this age group.

Supervision ranged from unsupervised and supervision from a distance (40% each) and supervision within arm's reach (20%).

Four (80%) children required CPR of which over two-thirds (75%) received it. In each case, CPR was given by a lifeguard at either the beach or public pool.

Children experienced respiratory distress 20% of the time, which is the lowest percentage compared to the other two age groups.

The overall percentage of children being admitted to the ICU was 17%. For children aged 11-16 years, the percentage was higher than the average and the highest of the three age groups at 20%.

Where the history of swimming lessons was reported, 100% of the children had a history of swimming classes which is the highest of all age groups.

#### 4.2.5 Parent/carer feedback

The parents and carers of children involved in drowning with or without morbidity were generally happy to participate in the study and appreciative of the chance to help others. The in depth questionnaire style interview with the parent/carers allowed for qualitative data unique to this study and adds to the existing research on child drowning. The data collected during the interviews are rich in prevention messages.

The psychological impact of witnessing children drown is not often discussed in existing research. Parental and carer feedback in this study shed light onto the mental and emotional effect of such an event. In one case, the child's father had disturbed sleep and flashbacks during the days after the event, the owner of the swimming pool where the drowning occurred was brought to hospital the next day after an episode which was later found to be a panic attack and a bystander who discovered a child under water and performed the initial resuscitation did not come out of his home for a week. This isn't an isolated case, in an additional two cases, the parent/s of the child reported having flashbacks or nightmares about the drowning.

Some parents whose children have been involved in drowning with or without morbidity have used the media to increase awareness of the risk of drowning and to spread drowning prevention messages. Examples of this advocacy work have been previously published online and printed in popular Sydney newspapers.<sup>39,40</sup>

The importance of supervision, pool fencing, CPR and swimming lessons as well as other general water safety messages were common themes when interviewing the parents/carers. Many parent/carers had thoughtful, poignant messages to share with others in the community:

##### **Supervision:**

- "Drowning is a silent event that is what all parents should know. I was a metre away and I did not hear it happen."
- "We as parents need to be more careful and watch every second."
- "Never leave a child unsupervised, but especially around water."
- "No matter how young or old your child, you cannot step away."
- "Just watch them-don't bother otherwise."

##### **Pool fencing:**

- "Mum and Dad should always keep an eye on the fence, [take] CPR classes and have a CPR sign."
- "Pool fencing requirements should be stricter."

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<sup>39</sup> Walker, I. (2014, October 2). Toddler nicknamed 'Lucky Luke' after his mum Iris Li resuscitates him back to life after near drowning at Telopea. *The Daily Telegraph*. Retrieved from: <http://www.dailytelegraph.com.au/news/nsw/toddler-nicknamed-lucky-luke-after-his-mum-iris-li-resuscitates-him-back-to-life-after-near-drowning-at-telopea/story-fni0cx12-1227076638128?nk=ce426bc94d5d6e4e857ae940bf863d09>

<sup>40</sup> Central Coast Advocate Express Gosford. (2015, January 9). Girl, 3, saved by her mother after being pulled unconscious from backyard pool at Kariong. *The Daily Telegraph*. Retrieved from: <http://www.dailytelegraph.com.au/newslocal/central-coast/girl-3-saved-by-her-mother-after-being-pulled-unconscious-from-backyard-pool-at-kariong/story-fngr8h0p-1227179824120>

- “There are problems with fences; you need to be aware of visibility problems. Fences are not 100% safe. Even with swim classes and parents near, drowning can still happen.”

#### **CPR:**

- Parents should be offered free of charge CPR refresher courses each term that their child is enrolled in swimming lessons.”
- “There should be an allocated adult who knows CPR present at children’s pool parties.”
- “CPR should be compulsory and should be offered when we enrol our children into swim class.”
- “We need to help people prepare for when a drowning happens, like CPR.”

#### **Water familiarisation/swimming lessons:**

- “Swimming lessons saved her life.”

#### **General water safety messages:**

- “Never buy a portable pool.”
- “I see the vision of my child from the drowning and I pray in hopes to forget that image.”
- “If in doubt, call for health advice.”

### **4.3 Discussion**

The total number of drowning that presented to the children’s hospitals over a two year period (84) represents nearly half of all drowning with and without morbidity that occurs in NSW among children aged 0-16 years.

This study was unique in its methodology of collecting data via interviews with parents and carers of a child who had a drowning with or without morbidity. The ability to retrospectively call the participants was very important in collecting more comprehensive data if they were not able to be seen when they presented in the hospital. The retrospective calls also allowed more time to be left between when the child presented and when the interview was conducted which seemed to encourage the parent/carer to reveal more detailed information after they had a chance to process the event.

The specific questions of this study have shown that there are many negative impacts on the health and wellbeing of the child involved with drowning with or without morbidity. Costs of drowning have been examined in the past to analyse the cost to the health care system and disability adjusted life year (DALY) calculations. This study has allowed for dialog with the parents and carers regarding drowning with or without morbidity events. This dialog has shown evidence of emotional distress of the person who witnessed the event with some parents reporting flashbacks, nightmares and panic attacks from the drowning.

The overall key findings of this study confirm what is noted in national and international data of children aged 0-4 years being most at risk of drowning and private pools being the most common location.<sup>41,42 43</sup> In this discussion, the focus will be on children aged 0-4 years as the majority (78%)

<sup>41</sup> World Health Organisation. (2014, November). *Global Report on Drowning: Preventing a Leading Killer*. Retrieved from: [http://www.who.int/violence\\_injury\\_prevention/publications/drowning\\_global\\_report/Final\\_report\\_full\\_web.pdf?ua=1](http://www.who.int/violence_injury_prevention/publications/drowning_global_report/Final_report_full_web.pdf?ua=1)

<sup>42</sup> NSW Child Death Review Team. (2014). *CDRT Annual Report 2013*. NSW Ombudsman. Retrieved from: [https://www.ombo.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0008/19628/CDRT-Annual-Report-2013.pdf](https://www.ombo.nsw.gov.au/__data/assets/pdf_file/0008/19628/CDRT-Annual-Report-2013.pdf)

of drowning with or without morbidity in this study fell into this group. Due to the lower sample sizes in children aged 5-10 and 11-16, analysis is difficult.

### 4.3.1 Supervision

Although supervision within arm's reach is consistently promoted in awareness campaigns, further attention needs to be given to this issue in order to help parents and carers understand what appropriate supervision means and how easily a child can drown after a simple distraction. Most of the children in this study were already around water when they drowned, such as in swimming pools and bathtubs; however, this is less common among drowning deaths where children have been found to wander into the aquatic location. Supervision recommendations need to include not only what supervision means in and around the water but also how general supervision around the home differs and the possibility of a child reaching an aquatic environment undetected, such as a bathtub or backyard swimming pool. The supervision recommendation for children aged 0-4 years is not being adhered to with only 23% of children in this age group having an adult supervising within arm's reach, regardless of location. Bathtubs had a higher rate of appropriate supervision within arm's reach (60%) however private pools (19%) and public pools (0%) had much lower rates. Despite the level of supervision, children still had a near drowning highlighting the need for detailed information on what appropriate supervision means.

Children aged 5-10 years (38%) and 11-16 years (40%) also had high rates of children being unsupervised which is not consistent with current guidelines from The Royal Life Saving Society. This data indicates that supervision requirements are lacking in all age groups, putting children at risk. Water safety education campaigns are effective for raising awareness and promoting injury prevention, but more work can be done in order to translate this into changes in behaviour. All major water safety and drowning prevention organisations in NSW and Australia promote supervision as the most important drowning prevention factor; however, only some organisations specify what this actually means.<sup>44</sup> This signifies the need for a standard evidence-based drowning prevention message to be used by various water safety organisations.

### 4.3.2 Pool fencing

In this study, a lack of supervision after the child was already in the pool area with the parent and carer was the sole cause of drowning with or without morbidity in the majority of cases for children aged 0-4 years however this has not been found as a key factor in drowning deaths.<sup>45 46 47</sup> Although leaving the gate open and faults in the fencing was also of concern in this study, they are reported at much higher levels in drowning death data. This highlights the different circumstances that exist for drowning deaths and drowning with and without morbidity and the need to continue collecting data on both events to ensure the true picture of all drowning is captured. In addition, any changes to

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<sup>43</sup> Williamson, A., Irvine, P., & Sadural, S. (2002). *Analysis of drowning involving children aged five years and under in NSW*. Concord West: NSW Water Safety Taskforce: NSW Injury Risk Management Research Centre.

<sup>44</sup> Royal Life Saving Society Australia. (n.d.). *Keep Watch at Public Pools*. Retrieved January 8, 2015, from Royal Life Saving Society: <http://royallifesaving.com.au/familiesat-the-local-pool/drowning-prevention/keep-watch-at-public-pools>

<sup>45</sup> Williamson, A., Irvine, P., & Sadural, S. (2002). *Analysis of drowning involving children aged five years and under in NSW*. Concord West: NSW Water Safety Taskforce: NSW Injury Risk Management Research Centre.

<sup>46</sup> Stephenson, S., G, H., J, H., & J, L. (2003). *Diagnosis-based Injury Severity Scaling*. Injury Research and Statistics Series Number 20. Adelaide: AIHW (AIHW cat no. INJCAT 59).

<sup>47</sup> Blum, C. a. (2000). Toddler drowning in domestic pools. *Injury Prevention*, 6(4), 288-90.

pool fencing legislation will not address the lack of supervision (56%) and behaviour of propping pool gates open (22%) which were significant in this study.

Previous drowning with and without morbidity studies however have reported this trend. In Ross' study, 39% of children were let into the pool area by a parent/family member, 12% of children gained access to the water due to the gate being propped open and 31% had no fence.<sup>48</sup> In the current study, 56% of children were let into the pool area by a parent/family member, 22% of gates were propped open and 11% of pools did not have a fence. The data collected in Ross' study is quite old (1995-2001)<sup>49 50 51</sup> and much has changed regarding pool fencing legislation and awareness campaigns which may be a reason for the differences in the data in this study. Instead, we are now finding much higher rates of drowning with and without morbidity after the child has been let into the pool area by a parent/carer (56%) and higher rates of pools that have fencing compared to the early 1990s after the pool fencing legislation was introduced. Furthermore, although many children drown in a swimming pool at their own home (41%), many children also drown in friends (22%) or families (37%) pools, highlighting the need to not only educate parents of children aged 0-4 years about drowning prevention, but pool owners as well.

Kids Health at CHW has developed a series of pool safety videos and a pool compliance checklist, "Protect Your Pool, Protect Your Kids."<sup>52</sup> This video and checklist were made to help educate pool owners about pool safety legislation, common pool barrier faults and how to fix them. The continued promotion of this program may assist in education of both new and existing pool owners.

#### 4.3.3 CPR

It is encouraging that in this study most children aged 0-16 years who needed CPR received it (90%) immediately following a drowning with or without morbidity. Early CPR has been shown to contribute to increased survival in child drowning incidents.<sup>53 54 55</sup> The high rate of CPR may also be a contributor to the overall decrease in drowning deaths but the increase in drowning with or without morbidity. This suggests that education campaigns promoting the importance of CPR following a drowning may be having the desired impact however; there is still room for improvement. The level of CPR training in those who administered CPR among all ages varied with many not having recent CPR training within the previous 18 months (86%) or relying on lifeguards at public pools (11%). Kids Health at The Children's Hospital at Westmead is currently developing an online CPR Training For Parents E-learning program which will be freely available to address barriers to participation in annual CPR courses such as arranging childcare, cost and time constraints.

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<sup>48</sup> Ross, F., Lam, L., & Cass, D. (2003). Children under 5 years presenting to paediatricians with near-drowning. *Journal of Paediatrics and Child Health*, 39(6); 446-450.

<sup>49</sup> Blum, C. a. (2000). Toddler drowning in domestic pools. *Injury Prevention*, 6(4), 288-90.

<sup>50</sup> Williamson, A., Irvine, P., & Sadural, S. (2002). *Analysis of drowning involving children aged five years and under in NSW*. Concord West: NSW Water Safety Taskforce: NSW Injury Risk Management Research Centre.

<sup>51</sup> Bugeja, L. a. (2013). An analysis of stratagems to reduce drowning deaths of young children in private swimming pools and spas in Victoria, Australia. *International Journal of Injury Control and Safety Promotion*, 20(3), 282-294.

<sup>52</sup> Kids Health. *Protect Your Pool, Protect Your Kids*. Retrieved April 3, 2015, from The Children's Hospital at Westmead: <http://kidshealth.schn.health.nsw.gov.au/projects/drowning-prevention/swimming-pool-fencing>

<sup>53</sup> Marchant, J. e. (2008). Bystander basic life support: an important link in the chain of survival for children suffering a drowning or near-drowning episode. *Medical Journal of Australia*, 188(8), 484-485.

<sup>54</sup> Venema, A., Groothoff, J., & Bierens, J. (2009). The role of bystanders during rescue and resuscitation of drowning victims. *Resuscitation*, 81(4), 434-439.

<sup>55</sup> Kyriacov, D., Edgardo, A., & Peek, C. a. (1994). Effect of immediate resuscitation on children with submersion injury. *Paediatrics*, 94, 137-142.

There is no clear correlation between respiratory distress and time underwater. The level of supervision indicates a correlation to prevalence of water in the lungs. No published research has specifically looked at the level of supervision and respiratory impairment in drowning with or without morbidity. The high proportion of children with evidence of water inhalation is significant as water in the lungs can lead to acute lung injury and its serious sequelae.<sup>56</sup> The fact that water inhalation occurred even after a seemingly minor drowning with or without morbidity is an important finding to raise awareness that even a short drowning duration can result in severe negative health outcomes and strict attention must be given to children in an around water at all times.

#### 4.3.4 Water familiarisation/swimming lessons

The history of swimming lessons for children drowning with or without morbidity has not been reported in previous research. The findings from this study showed a high rate of participation however the detail on the type of lessons and length of time they were undertaken was not collected. While previous studies have indicated that some parents will overestimate the child's swimming ability, descriptive data of that type was not collected in this study.<sup>57,58</sup>

In this study, swimming lessons did not seem to translate to protection. This observation is limited by the small cohort and the fact that the number of swimming lessons varied widely and actual swimming skills of children were not known. However, with 41% of children aged 0-4 years having a history of water familiarisation, 63% of children aged 5-10 years and 100% of children aged 11-16 years with a reported history of swimming classes, it is a reminder to parents/carers while water familiarisation and swimming lessons are important part of drowning prevention, they cannot be relied on to prevent drowning.

#### 4.3.5 Future considerations

The study had no uptake of swimming pool inspections by the Research Officer. This could have been due to the sensitive nature of the injury. Without inspection, details of the pool fence were based on knowledge and recollection by participants. As a result there were limited details of the swimming pool and surrounds.

A near drowning register triggered by Ambulance call outs or presentation to a health care facility could be invaluable in continuing to collect data of drowning with or without morbidity, similar to what is done in QLD. Such a register could mandate inspections of swimming pools, dams and waterways by the local council and lead to a much richer data set. Information of this sort is currently collected for drowning deaths, however with a substantially larger number of drowning with or without morbidity occurring, the potential for robust data collection exists.

Possible gaps in the study include the self-reporting style of questionnaire used which could result in issues of under- or over-estimating the reported proficiency of the child's swimming ability.

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<sup>56</sup> Ibsen, L. a. (2002). Submersion and asphyxia injury. *Critical Care Medicine*, 30(11), S402-S408.

<sup>57</sup> Morrongiello, B., Sandomierski, M., & Spence, J. (2014). Changes over swim lessons in parents' perceptions of children's supervision needs in drowning risk situations: "His swimming has improved so now he can keep himself safe". *Health Psychology*, 33(7), 608-615.

<sup>58</sup> Morrongiello, B., Sandomierski, M., Schwebel, D., & Hagel, B. (2013). Are parents just treading water? The impact of participation in swim lessons on parents' judgments of children's drowning risk, swimming ability, and supervision needs. *Accident Analysis and Prevention*. 50, 1169-1175.

Additionally, important information can be lost through self-reporting in regards to compliance issues with the pool/barrier, level of supervision and the length of time the child was underwater. Either parents and/or carers could intentionally mislead the research officer of compliance status or they could be misinformed of the laws and regulations surrounding pool barriers.

The lack of consent gained to undertake site visits for the private swimming pools further limits the ability to assess the pool fencing and its compliance with the legislation. Of the two portable pool cases in this study, both pools were immediately dismantled and discarded, making it impossible for the Research Officer to view the structure. The questionnaire included a series of questions regarding first aid training and CPR classes such as if the person who administered CPR had formal training, and if so, when they most recently took the course.

#### **4.4 Conclusion**

Drowning deaths and drowning with or without morbidity are an important public health issue where greater information is needed. This study addresses gaps in existing research of children drowning with or without morbidity. The in depth interviews and questionnaires allowed for additional details which retrospective data collection fails to capture. Furthermore, the interviews revealed mental impacts that child drowning has on families and the community. This study was the first of its kind to work collaboratively with the three children's hospitals in NSW. This study adds to the evidence base by collecting new information on the level of supervision, respiratory distress and details on the circumstance of drowning with or without morbidity.

Widespread adoption in Australia of the World Congress on Drowning preferred definition of drowning would be significant in universalising the concept of drowning as an event and death or resulting morbidity as an outcome. The engagement in a common terminology would serve to enhance data collection on the circumstance of the event and the outcome.

Future research could include gaining access for a Research Officer to view the pool/barrier area, detailed intake of swimming lesson history, ranking of swimming proficiency, prompting question on if/how the incident has affected parents/carers mental health, and knowledge and practice of CPR classes.

The results of this study highlight the importance of continued education on what supervision means when in and around the water compared to other locations that are not seen as high risk, appropriate supervision in pools and bathtubs, not propping the gate open and ensuring pool fencing compliance, learning CPR and not relying on water familiarisation and swimming lessons to prevent drowning among children of any age.

#### **4.5 Acknowledgements**

Kids Health and CTCPER at CHW would like to thank the Ministry for Police and Emergency Services for providing funding for the project through the Water Safety Black Spots Fund. The three paediatric hospitals in NSW were invaluable in gathering data and include CHW, SCH and JHCH.

## Appendix A - Interview schedule with parent/carer

Title of study: NSW Study of drowning and near drowning in children (0-16)

### Section 1: Demographic information

1. Name of parent/carer being interviewed: \_\_\_\_\_
2. Full name of child: \_\_\_\_\_
3. Gender: Male / Female
4. Date of Birth: \_\_\_\_\_
5. Age at incident: \_\_\_\_\_
6. Address: \_\_\_\_\_
7. Suburb: \_\_\_\_\_
8. Phone number: \_\_\_\_\_
9. Country of birth: \_\_\_\_\_
10. Language spoken at home: \_\_\_\_\_
11. Aboriginal or Torres Strait Islander:  
 No  Yes, Aboriginal  Yes, Torres Strait Islander  Yes, both Aboriginal and Torres Strait Islander

### Section 2: Incident details

12. Please give a brief description of what happened

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

13. Date of incident: \_\_\_\_\_ 14. Time of incident: \_\_\_\_\_

15. Location of incident (name suburb and name aquatic location e.g. name of beach, river or public pool):

16. Incident site (tick)

- Swimming pool, including inflatable or portable pool (section 3 also needs to be completed)  
 Public pool  Beach  River/lake/creek  
 Bath  Dam  
 Other: \_\_\_\_\_

17. Length of time submerged in the water: \_\_\_\_\_

18. The child was looked after by (if applicable, tick):

- Parent (circle): Mum / Dad  Grandparent  
 Sibling/s (please state age/s): \_\_\_\_\_  Other: \_\_\_\_\_

19. How was the child being supervised?

- Within arm's reach in the water  From a distance while the child was in the water  
 From a distance while the child was not in the water  
 Unsupervised, no one was around the child at the time

20. Where were the adult carers at the time of the incident?

21. Child found by: \_\_\_\_\_ 22. Child resuscitated by: \_\_\_\_\_

23. Swimming lessons (child) (circle): Yes / No

24. Proficiency in swimming (circle): Good / Average / Poor

25. Was an ambulance called (circle): Yes / No

26. Time of ambulance arrival at scene: \_\_\_\_\_

27. Time of ambulance arrival at hospital: \_\_\_\_\_

28. Has the parent / carer had any training in CPR?

- Yes, please name year/s: \_\_\_\_\_  
 No

**Note:** If the incident occurred in a swimming pool, including inflatable/portable pools please complete the next section.

### **Section 3: For swimming pool incidents, including inflatable/portable pools**

29. What type of swimming pool was it?  
 Permanent above-ground pool  Permanent in-ground pool  
 Permanent semi in-ground pool  
 Large inflatable or portable pool (capable of being filled with more than 300mm of water)  
 Small inflatable or portable pool (capable of being filled with less than 300mm of water)
30. How high/deep is the pool (cm/m)? \_\_\_\_\_
31. How much water (cm/m) was in the pool at the time of the incident? \_\_\_\_\_
32. Whose swimming pool was it?  
 The family pool  Friend's pool  Grandparent's pool  
 Neighbour's pool  Other: \_\_\_\_\_
33. In what type of property was the swimming pool located?  
 Department of Housing  Rental property  Owned
34. If the pool was an inflatable or portable pool, how was it purchased?  
 Online  In person from a store  Received as a gift  
 Unsure  Other: \_\_\_\_\_
35. If the pool was an inflatable or portable pool, where was it purchased from?  
 Major department store, e.g. Kmart/ Target/ Big W/ Bunnings etc. (please name): \_\_\_\_\_  
 Other store e.g. one dollar shop (please name): \_\_\_\_\_  
 EBay  
 Other online store (please name): \_\_\_\_\_  
 Unsure  
 Other: \_\_\_\_\_
36. When was the swimming pool installed?  
 Month and Year: \_\_\_\_\_  
 Currently approved or being built  
 Unknown
37. If year is unknown, can an estimate be made as per the categories below?  
 Before August 1990 (exemptions exist on older pools installed <August 1990)  
 August 1990 - 2000  
 2001- June 2010  
 After June 2010 (exemptions removed for waterfront, small and large properties)  
 Installed or set up within the past 6 months  
 I don't know
38. Was the swimming pool already installed/set up prior to moving into the property?  
 Yes (when did the family move in): \_\_\_\_\_  
 No
39. Did the swimming pool have a fence around it?  
 Yes  No  I don't know
40. If yes, what type of fence was it?  
 4 sided isolation fencing  
 Fencing including a boundary fence/s as a side  
 Fencing including the wall/s of the house as a side  
 Other: \_\_\_\_\_
41. If no, did the pool have any exemptions for no fencing?  
 Yes - Built prior to August 1990  
 Yes - Waterfront property (built prior to 1 July 2010)  
 Yes - Small property, less than 230 square metres, (built prior to 1 July 2010)  
 Yes - Large property, 2 hectares or over, (built prior to 1 July 2010)  
 Yes - Other: \_\_\_\_\_  
 No exemptions  
 I don't know
42. If yes to Q39, does the property have child resistant doors and windows?  
Windows - locking device or a security screen present that prevents them from opening more than 10cm  
Doors - self-closing, self-latching, latching device located at least 150cm off the ground, no footholds wider than 1cm on the door or its frame between the floor and 100cm above the floor, no pet doors  
 Yes  No  I don't know
43. Had development approval been obtained from the local council for the pool? Yes / No

44. Has the pool ever been inspected by the local council or a private certifying authority (circle)? Yes / No

45. If yes, when was it inspected?

- |   |   |
|---|---|
| <input type="checkbox"/> When the pool fence was installed  | <input type="checkbox"/> Within the past six months       |
| <input type="checkbox"/> Within the past year               | <input type="checkbox"/> Within the past two years        |
| <input type="checkbox"/> Within the past three years        | <input type="checkbox"/> Within the past four years       |
| <input type="checkbox"/> Five or more years ago             | <input type="checkbox"/> When the house was sold / leased |
| <input type="checkbox"/> Never had the pool fence inspected | <input type="checkbox"/> Unsure                           |

46. Were you aware of any faults with the pool fence at the time of the drowning or near drowning?

- Yes                       No                       No fencing  
 I don't know

47. If yes, please identify below:

- No temporary fencing around new swimming pool as it's being built
- Pool fence height less than 1.2m high
- Objects within the Non Climbable Zone (90cm arc from the top of the fence to the ground)
- Vertical gaps in the pool fence too big (>10cm gap between bars)
- Horizontal gaps in the pool fence too small (Bars <90cm apart from each other)
- Gap at the bottom of the fence too big (>10cm from finished ground level)
- Gate not self-closing (without force, from any open position on the gate)
- Gate not self-latching (without force, from any open position on the gate)
- Pool gate swings inwards, towards the pool area
- Pool gate propped open
- Gate latching device location (if not located at least 150cm above ground level, must be located on the inside of the pool fence, at least 15cm below the top of the gate, with a shield fitted around the latch of at least 45cm radius)
- CPR sign not present, ripped or broken
- No lockable lid or fence around the spa pool
- Windows as part of the barrier not compliant (locking device or a security screen has to be present that prevents them from opening more than 10cm)
- Doors as part of the barrier not compliant: (Please specify below)
- Doesn't self close
- Doesn't self latch
- Latching device isn't located at least 150cm off the ground
- Footholds are present wider than 1cm on the door or its frame between the floor and 100cm above the floor
- Pet door present
- Other: \_\_\_\_\_

48. If yes, is there anything that prevented you from fixing the faults?

- |   |  |
|---|--|
| <input type="checkbox"/> Haven't had time                   | <input type="checkbox"/> Lack of money                   |
| <input type="checkbox"/> Don't know how to fix it           | <input type="checkbox"/> Not urgent                      |
| <input type="checkbox"/> Exemption - not required           | <input type="checkbox"/> Didn't think a fence was needed |
| <input type="checkbox"/> Didn't know about the safety risks |  |
| <input type="checkbox"/> Other: _____                       |  |

49. Would you be happy for me to arrange a time to have a look at the swimming pool where the incident occurred? Yes / No

50. If yes, what days/times would best suit?

- |   |                               |
|---|-------------------------------|
| <input type="checkbox"/> Monday: _____    | Morning / Afternoon / Evening |
| <input type="checkbox"/> Tuesday: _____   | Morning / Afternoon / Evening |
| <input type="checkbox"/> Wednesday: _____ | Morning / Afternoon / Evening |
| <input type="checkbox"/> Thursday: _____  | Morning / Afternoon / Evening |
| <input type="checkbox"/> Friday: _____    | Morning / Afternoon / Evening |
| <input type="checkbox"/> Saturday: _____  | Morning / Afternoon / Evening |
| <input type="checkbox"/> Sunday: _____    | Morning / Afternoon / Evening |

**Note:** Follow up inspection requires completion of pool fencing checklist, photos of the pool, photos of the fence and photos of the faults (if applicable) by the researcher.

## Appendix B - Questionnaire to be completed by researcher (based on patient records)

Title of study: NSW Study of drowning and near drowning in children (0-16)

### Demographic information

1. Full name of child: \_\_\_\_\_
2. MRN: \_\_\_\_\_
3. Country of birth: \_\_\_\_\_
4. Language spoken at home: \_\_\_\_\_
5. Aboriginal or Torres Strait Islander (circle):
  - No
  - Yes, Aboriginal
  - Yes, Torres Strait Islander
  - Yes, both Aboriginal and Torres Strait Islander

### Incident details

6. Please give a brief description of what happened  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. Injury Type:  Immersion  Submersion
8. Mechanism of injury:
  - T68: Hypothermia
  - T75.1 - Drowning and nonfatal submersion
  - W65-W74 Accidental drowning and submersion (please circle below)
    - W65 Drowning and submersion while in bath-tub
    - W66 Drowning and submersion following fall into bath-tub
    - W67 Drowning and submersion while in swimming-pool
    - W68 Drowning and submersion following fall into swimming-pool
    - W69 Drowning and submersion while in natural water, *Incl.*: lake / open sea / river / stream
    - W70 Drowning and submersion following fall into natural water
    - W73 Other specified drowning and submersion
    - W74 Unspecified drowning and submersion
  - X31 Exposure to excessive natural cold
  - X34-X39 Drowning and submersion due to cataclysm
  - X71 Intentional self-harm by drowning and submersion
  - X92 Assault by drowning and submersion
  - V01-V99 Drowning and submersion due to transport accidents
  - Y21 Drowning and submersion, undetermined intent
  - Other: \_\_\_\_\_
  - Unknown
9. How was the patient transported to the hospital?
  - By ambulance from another hospital
  - By ambulance from where the incident occurred
  - Careflight
  - By the family from where the incident occurred
  - Other: \_\_\_\_\_
10. Was Trauma call put out by ED (circle)? Yes / No
11. State of child on arrival: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
12. Was the child intubated (circle)? Yes / No
13. By whom (circle)? Ambulance Officer / At hospital
14. Was the child admitted to ICU (circle)? Yes / No
15. Date of discharge: \_\_\_\_\_
16. Length of stay: \_\_\_\_\_
17. ISS Score: \_\_\_\_\_
18. Outcome:  Died  Near drowning
19. Neurological deficits (circle)? Yes / No / Unknown
20. Any other comments?

# Always remember the **FOUR** drowning prevention strategies for children aged 0-4 years:



**1**

Ensure constant adult **supervision** within arm's reach when children are in and around the water



**2**

Make sure your **pool fencing** is safe and don't prop the gate open



**3**

**Water familiarisation** is important but don't rely on it to save your child from drowning

**4**

Learn **CPR**



Even a small amount of water in the lungs can lead to serious health issues

