

## 25. DROWNING

### 25.1 The nature of the hazard

Unintentional drowning and near drowning are major causes of morbidity and mortality both nationally and globally. Unintentional drowning and near drowning can occur in as little as 5cm of water anywhere from a small pool of water to rivers and oceans. Drowning and near drowning episodes are a sequence of multifaceted, complex events that vary and are widely based on age, gender, geographical region, community, season, race, economic status and location of occurrence.

Unintentional drowning and near drowning occurs within the built environment in a number of structures such as buckets, baths, garden ponds, wading pools, swimming pools, spas and hot tubs. Infants are most likely to drown in the home (usually in a bathtub); toddlers in bodies of water close to the home such as swimming pools or garden ponds; and older children and adults in natural bodies of open water (inland or coastal).

### 25.2 The risks to safety and health

#### Introduction

Drowning is the second leading cause of unintentional injury mortality globally behind road traffic injuries. Globally, it is estimated that 500,000 people drown each year, 1.3 million people are injured as a result of near drowning episode and that many more hundreds of thousands of people are affected through incidents and near misses. Drowning is a significant cause of childhood death in many parts of the globe, and of the 500,000 deaths caused by drowning, 57% of these were among children aged up to 14 years. Children under five years of age have the highest global drowning mortality rates. Twenty six of the world's richest countries report drowning as the second leading cause of mortality in the 0 – 14 age group and in some cases the leading cause of mortality in the 0 – 5 age group.

Annually in the UK, 10,000 people will die from unintentional injuries, of which 5% of fatalities can be attributed to drowning. This represents a fatality rate of 1.0 – 1.5 per 100,000 population. When considering age groups of concern, 9% of accidental injury deaths for ages 0-14 occurred through drowning and 1% of deaths in person's ages 65+. Childhood drownings represent 12% of the UK's annual drowning toll. A recent UK study, repeated at a 10 year interval (1988/9 and 1998/9) reported a significant fall in childhood drowning incidence. The numbers of children drowning fell significantly at all sites apart from significant increases in childhood deaths in garden ponds and in pools abroad (Table 25.1). Three times more male children drowned than females during both time periods reported. Even though childhood drowning is declining, accidental fatality information from the Office of National Statistics (ONS) still shows that the top three causes of death for young people are road traffic accidents, fires and drowning.

An England wide study between 1997 and 2004 found that there were a total of 6464 hospital admissions resulting from a drowning or near drowning episode. The study reported that males have a 2.3 to 3.0 increased risk of hospital admission compared to females and produce a population rate that is three times higher than females. The highest rates of admission were observed in the 0 – 14 age group (3.1 – 4.2 admission per 100,000 population) these rates were all significantly higher than any other age group. The average annual number of admissions for the 0 – 14 age group was 340. In the 0 – 14 age group the population rate was significantly higher in the W66 Drowning and submersion following fall into a bath-tub (2.3 per 100,000 (1.5 – 3.0) and W67 Drowning and submersion following a fall into a swimming pool (2.4 per 100,000 (1.7 – 3.1). However, annual trends indicate that these rates are increasing in the W66 Drowning and submersion following a fall into a bath-tub classification and decreasing in the W67 Drowning and submersion following a fall into a swimming pool classifications.

|  
|Table 25.1 Drownings in children aged 0-14 years in the United Kingdom  
|[pic]  
|Location of drownings |1988-9 |1998-9

	Observed	[pic] Expected	Observed
[pic] Bath	25	23.58	25
Garden pond	11	10.37	21
Domestic pool	18	16.97	4
Private pool	8	7.54	5
River, canal, lake	56	52.81	31
Public pool	2	1.89	2
Sea	20	18.70	10
Other	9	8.41	6
[pic] Total	149	140.51	104
[pic] * P<0.05.			
[pic] 111 boys, 38 girls.			
[pic] 78 boys, 26 girls.			

Drowning is unique in that the case fatality rates are as high as 50% and medical care makes little difference in outcomes for the victims brought to accident and emergency departments without spontaneous respiration. Current data suggests that 25% of victims brought to accident and emergency will die. Near drowning casualties presented to accident and emergency will have a range of possible direct and indirect outcomes from severe brain damage, spinal injuries, hypothermia, pneumonia and other severe infections.

Identifying causal factors are a fundamental part in completing the picture of knowledge of drowning mortality and near drowning morbidity. This is essential for the development of targeted drowning and near drowning prevention and intervention strategies. Current global observations assessing drowning and near drowning causation include; parental supervision, risk awareness and risk taking behaviour; influence of alcohol; underlying medical conditions; swimming ability and participation in water activities.

Parental risk awareness and supervision plays an essential role in children and young people's lifestyle. Research has found that the higher the parental education is, the higher the levels of awareness of the existing environmental risks to their children and consequential levels of supervision. The indication is that risk taking behaviour in both parents and children can be related to levels of education, occupation and income. This can lead two extremes within society. Some parents are highly restrictive about the activities undertaken and levels of supervision of their children and others are unable or choose not to place restrictions or any level of supervision. Lapses and inadequate supervision is one of the most common factors associated with childhood drownings.

Alcohol use has been reported to be in 25 – 50% of adolescent and adult deaths associated with water recreation and drowning. Alcohol use is highest in the 20 – 34 age group and the 35 – 64 age group (33% - 35%) of positive blood alcohol levels. People with blood alcohol levels greater than 100mg/dL (0.10) have a 16-fold increased risk of drowning compared to people with no alcohol in their blood. Alcohol has been found to contribute to drowning episodes by: impairing judgement, resulting in an increased exposure to risky situations (swimming at night); creation of a sense of warmth, resulting in swimmers remaining in cold water longer than they would if they were sober (increasing the risk of water inhalation, cardiovascular collapse or hypothermia); and retardation of the body's normal responses to submersion (laryngospasm and dive response). An associated issue also identified in literature is alcohol consumption of parents and guardians whilst supervising children and toddlers near in or around water. Other contributing factors found were unfamiliar settings and water related activities. These are strong indicators that make the participant more predisposed to near drowning events.

Underlying medical factors have been also been associated with drownings and near drownings. Victims with a history of a prior seizure were present for 10% of all drowning victims in the USA and in 4% to 16% of each age group. In the over 34s age group, 4% had a history of diabetes, 10% heart disease and 22% had a psychiatric condition. In Sweden, drowning was the cause of death in 10% of people with a history of epilepsy independent of location. Children with epilepsy are significantly greater at risk of bath and pool drownings and near drownings.

Few studies have tried to examine the relationship between swim ability and the risk of drowning and near drowning. There is no empirical evidence that suggests that drowning rates are higher in poorer swimmers. It has however been advocated that that at a population level, increased swimming proficiency may lead to an increase in drowning rates through and increased exposure to water. An example of this would be young people and adults, who are competent swimmers, are more likely to participate in more water-related activities and may feel confident enough to swim in higher risk settings, in natural bodies of water with no lifeguard supervision.

### **Bath drownings**

Infants and young toddlers are more predisposed to drowning in baths. Table 25.1, shows that the UK figure has remained constant (n = 25) over the time period observed. From 1989 – 2003 a total of 52, 0 – 2 year olds drowned in baths, of which 6 of the drownings occurred whilst the infant was sat in a bath seat. In the 0 – 1 age group there was no difference in gender, in the 1 – 2 age group 68% were male. Of the infants who drowned in bath seats all were male and 83% were under 1 year. The key associated issue with bath drownings is the developmental stage of the child, and it appears that most of the babies that drown are at the developmental stage where they can sit up unsupported but are unable to right themselves if they fall into water, thus drowning. The young toddler and children who drown in a bath may have either learning difficulties or drown during a fit thus being in the same situation as a baby, unable to right themselves having fallen into water.

Studies of bath drownings indicate that there is usually a history of leaving the infant or toddler unsupervised or in the care of another child. In most of the reports the supervisory adult reported leaving the infant or toddler for a short time. The clear consensus within literature suggests that lack of adult supervision is the key contributing factor to childhood bath drownings. The key preventative measure proposed is uninterrupted adult supervision of children (less than three) whilst in the bath.

Other people more predisposed to drowning in baths are the elderly and adults with underlying medical conditions. Measures reported for adults and the elderly include installation of slip resistance surfaces, grab bars, seats and for people with a history of seizures measures may include showering rather than bathing.

### **Garden ponds**

The number of children drowning in garden ponds in the UK is significantly increasing (Table 25.1). In the UK 111 children under the age of five have drowned during the last decade in garden ponds. This has predominantly occurred in the 0 - 5 age group, who seem to hold a fascination for and a natural

inquisitiveness to water in garden ponds and wander off from parental supervision to investigate. In particular children aged 1 to 2 are particularly at risk, with the risk decreasing as age increases.

Studies have found that there are three possible reasons for this; between the ages of one and two, infant's mobility increases at a terrific, but irregular rate, such that they can escape parents' supervision and get into difficulties unexpectedly quickly; whilst mobility may increase, stability and co-ordination remain poor; and it is not until the ages of four or five that children begin to understand the concept of danger and begin to heed warnings given to them. In frequently adult drownings do occur at garden pond locations predominantly the victim has an underlying medical condition.

The key preventative measures proposed are an increase in adult supervision of children whilst in close proximity to garden ponds. Other measures reported include: complete removal of the hazard (temporarily fill the pond with sand) until the child is older; the creation of a secure cover using a grille or ridged mesh that can support the weight of a child and that remains above the surface of the water; creating a physical barrier such as isolation or perimeter fencing to prevent unsupervised entry.

### **Swimming pools**

Swimming pool drowning deaths represent approximately 4% of all drowning deaths in the UK. Gender and age are common associated factors with the majority of these fatalities involve children and young adults. The number of children drowning in swimming pools in the UK has significantly decreased (Table 25.1), however drowning of children and young adults abroad is increasing annually. In between 1993 to 2003, 137 children aged 15 or under drowned in swimming pools in the UK or whilst holidaying abroad. Of the UK fatalities, 29% occurred in domestic pools, 32 % occurred in private pools, and 37% occurred in public pools. There was a 3:1 male to female ratio, and the average age at drowning of the whole cohort was 6.8 years.

Factors associated with childhood drowning differed with pool type. With regard to domestic swimming pool, 70% of fatalities occurred whilst the child was unsupervised (41% were found floating beneath swimming pool covers). No domestic pools reported any form of physical barriers (isolation fencing or a self locking safety gate) and children who had been left unsupervised were reported to have wandered into a friend or neighbours garden and fallen into the pool, walked on the pool cover and opened doors. 96% of fatalities at private swimming pools occurred during swimming activities (only 22% reported unsupervised) and 100% of fatalities occurred at public swimming in the presence of a lifeguard (only 20% of fatalities reported overcrowding in the swimming pool). Most children admitted to hospital from public swimming pools are effectively resuscitated at the poolside. Adults in particular young adults do frequently drown in all types of swimming pools.

Other near drowning injuries associated with swimming pools are suction / entrapment injuries, brain and head injuries, retinal dislocation, arm, hand, leg, foot and toe injuries. Expert opinion suggests that the latter are common in the UK but generally go unreported. Causation of these injuries include: diving into shallow water; slippery decks; uncovered drains; reckless water entry; running on decks and slipping, tripping and falling; poor maintenance of poolside surfaces; poor supervision of pool users. The majority of these injuries occur in shallow water of four feet or less. Very few injuries are sustained in water depths greater than eight feet.

The key preventative measures proposed in literature include: increased supervision (lifeguard and parental); barriers against unintended access to pools (pool fencing, pool , door alarms and pool alarms; training cardiopulmonary resuscitation (CPR); alcohol related strategies; and discouragement of UK households with children from having private pools.

## **The population at risk**

Drowning rates vary with age, with the highest rates being observed in 0 – 5 age group and the 0 -14 age groups. Drowning and near drowning are a male phenomenon across all age groups in the UK, as is the case for almost all types of unintentional injuries. In fact the male rate of drowning is more than twice that of females and males are more likely to be hospitalised or suffer a near drowning experience.

Drowning and near drowning episodes can occur in seconds within seconds of adverse exposure to water, at any water location or structure, in 5cms of water. Consciousness can be lost within two to three minutes after submersion and irreversible brain damage occurs after 4 to 6 minutes. The majority of children who survive a drowning episode are found within two minutes of submersion and most children who die are found after 10 minutes. 73% of adult drowning victims in the UK are found after 10 minutes and resuscitation has not been attempted.

Causation of drowning and near drowning episodes in the built environment occurs for a number of reasons: parental supervision, risk awareness and risk taking behaviour; influence of alcohol; underlying medical conditions; swimming ability and participation in water activities. The trends identified for the UK by structure (baths, garden ponds and swimming pools) are comparable with other literature reporting findings for other high income countries globally (United States, Australia, Canada, New Zealand).

## **25.3 Preventive measures**

### **Education**

Most people have some knowledge of the risk factors for drowning and near-drowning. Few are aware of the role and importance of adult supervision for children and the recommended age at which to begin children's swimming instruction. As far back as 1981, the Sports and Recreation Committee of the Canadian Paediatric Society indicated that although some emphasis had been placed on teaching younger children to swim, even during the first year of life, infants could not be expected to learn the elements of water safety or to react appropriately in emergencies. The Committee suggested that no young child, particularly one below school age, could ever be considered 'water safe', although parents might develop a false sense of security if they felt their young child could 'swim' a few strokes.

Recent studies have recommended that after the age of 5 years children should be taught to swim. It does seem logical that the better a person is at swimming the less likely they would be to drown or near drown in water. At present there is no concrete evidence that link drowning and near drowning prevention with swimming lessons and swimming ability. Instead it has been advocated that that at an increased swimming proficiency may lead to an increase in drowning rates through and increased exposure to water and also the provision of swimming lessons to all children would result in an increased exposure to water, which inherently increases the risk of drowning and would subsequently increase age and sex specific drowning mortality and near drowning morbidity rates.

Associated with the issue of supervision, parents, guardians, adolescents and homeowners with pools on their property or who are involved with the supervision of children should seek advice on how to and where to obtain training in basic first aid and life support skills. Studies have shown that if response to the victim is rapid, through resuscitation from a bystander, before the arrival of ambulance or first responder personnel, results indicate better health outcomes.

## **Actions to reduce drownings**

A number of prevention and interventions have been identified. With regard to drowning in baths constant supervision of infants and young toddlers is required by adults, for adults with known underlying medical conditions, non slip surface and grab handles may help, however, simple opting to have a shower rather than a bath eliminates the risk of drowning. The fitting of (thermostatically-controlled) showers rather than baths in homes is a simple and potentially very effective measure to reduce the number of bathtub drownings in both children and adults in the home.

At garden pond locations again an increase in adult supervision of children is required. Other options include: complete removal of the hazard (temporally fill the pond with sand) until the child is older; the creation of a secure cover using a grille or ridged mesh that can support the weight of a child and that remains above the surface of the water; creating a physical barrier such as isolation fencing to prevent unsupervised entry.

The key preventative measures proposed for swimming pools include: increased supervision (lifeguard and parental); barriers against unintended access to pools (pool fencing, door alarms, pool covers and pool alarms; training in cardiopulmonary resuscitation (CPR); alcohol related strategies; and discouragement of UK households with children from having domestic and private pools. In the United States, Australia and New Zealand the installation of four-sided isolation fencing or perimeter fencing equipped with self-closing and self-latching gates, has seen a reduction in private and domestic swimming pool drowning and near drowning episodes. It must be acknowledged that there is law, regulation and enforcement governing this intervention in New Zealand and Australia. Evidence suggests that this could prevent 50 to 90% of childhood residential swimming pool drownings and near-drownings. Door alarms, pool alarms and automatic pool covers, when used correctly, can add an extra level of protection.

Soft pool covers, whose purpose is to prevent heat loss and exclude debris, will not offer any protection from drowning and may in fact exacerbate the problem. Someone falling onto a soft pool cover can become entangled in it and struggle to get out, or may slip beneath the cover making it less likely that they will be detected and able to get assistance. It is possible to buy a 'hard' cover for swimming pools, which completely seals off the pool when it is in place and will bear the weight of an adult and prevent immersion. Care must be taken to ensure that rain water either cannot gather on the top of the cover (creating its own pool) or that there is a mechanism in place, like a pump, to ensure that any surface water is cleared from the cover. Caution must be exercised however, because these safety covers can lull parents and supervisors into a false sense of security. The covers are only effective when they are in place, therefore once they are removed and the pool is 'open', supervision of the pool area is absolutely essential

The following proposals have been made to reduce drowning and near drowning episodes (particularly those of children) in the home environment.

- Implementation of an educational campaign to warn parents of the dangers associated with inadequate child surveillance in baths and pools and near other home areas containing water such as drains, garden water butts, trenches and post holes.
- Discouragement of ornamental ponds in gardens; if present, fixed grills should be fitted over them and the water depth should be controlled.
- Extension of the high level of surveillance required for public pools to private and domestic pools.
- Evaluation of fencing and the use of sturdy safety grids near pools; domestic outdoor pools should be fenced and have a self-closing, self-latching gate.
- Installation of isolation or perimeter fences (1.5 m) and self-locking gates around pools and outdoor spas, and keeping of registers of maintenance, if necessary by legislation.
- Review of the design and safety of pool covers so that children cannot crawl underneath and so that a cover can

bear the weight of a child.

- Fitting of fly wire screens or self-closing, self-locking latches to all windows leading onto pools.
- Fitting of a lockable door to all indoor spas.
- Installation of effective drainage so that pooling of water or overspill does not occur.

### Legislation concerning drowning

Building Regulations do not cover the issues related to drowning in the home. It has been recommended that the Building Act 1984 be modified to bring garden pools into Building Regulations, however, this has not occurred. Prevention from drowning may be made more definitive in the revised Fitness Rating system. In view of the nature of this problem, education is probably currently the most important way forward. However, it must be noted that evidence from the southern hemisphere suggests when comparisons were made between communities with and without laws requiring barriers such as pool fencing (1.2 meters high fence with gates that open outwards, closes and latches automatically). Results indicated that pool fencing significantly reduced the risk of drowning in domestic and private swimming pools.

### 25.4 Summary

Unintentional drownings in the built environment are associated with primarily with baths, garden ponds and swimming pools. Drowning is the second commonest cause of accidental death in the home for children aged 0 to 5 years in the UK. This group is at the greatest risk of drowning and near drowning. The elderly and adults with underlying medical conditions are also at risk. The most important prevention strategies to reduce drowning and near drowning episodes are parental supervision of children and the installation of fencing and other barriers around or over areas of water. Discouraging indoor pools, infilling garden ponds and other sources of water and using showers rather than baths in homes may reduce the number of drownings in the home.

Table 25.2 Summary of health and safety risks: drowning

Class of harm	Number of people affected in the UK per year					
	100,000+	10,000+	1000+	100+	10+	1+
Homes						
Class I					***	
Class II						
Class III					***	
Class IV						

Strength of evidence: \*\*\* High, \*\* Medium, \* Low.

For description of Classes I to IV and explanation of shading, see Section 1.3.

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