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Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

Technical Report—Prevention of Drowning

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KEY WORDS
drowning prevention, pools, swimming lessons

ABBREVIATIONS
CPR—cardiopulmonary resuscitation
CPSC—Consumer Product Safety Commission
SVRS—safety vacuum-release system
OR—odds ratio
CI—confidence interval
PFD—personal flotation device

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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abstract

Drowning is a leading cause of injury-related death in children. In 2006, approximately 1100 US children younger than 20 years died from drowning. A number of strategies are available to prevent these tragedies. As educators and advocates, pediatricians can play an important role in the prevention of drowning. *Pediatrics* 2010;126:e253–e262

INTRODUCTION

Background

From 2000 to 2006, drowning was the second leading cause of unintentional injury death among US children between 1 and 19 years of age.[1] In 2006, unintentional drowning claimed the lives of 1077 US children and adolescents, a fatality rate of 1.32 per 100 000 population. Fortunately, drowning deaths of children and adolescents have decreased dramatically since 1985 (2.68 per 100 000) and 1995 (1.96 per 100 000). In 2008, approximately 3800 children younger than 20 years visited a hospital emergency department for a nonfatal drowning event; more than 60% of those children were hospitalized.[1] Most victims of nonfatal drowning do well, but severe long-term neurologic deficits are seen with extended submersion times, prolonged resuscitation efforts, and lack of early bystander-initiated cardiopulmonary resuscitation (CPR).[2–4] Overall, 5% to 10% of drowning incidents result in severe neurologic damage,[2,4–6] but such poor outcomes are even more common when the drowning occurs in open-water settings.[3]

In 2002, the World Congress on Drowning and the World Health Organization revised the definition of drowning to be "the process of experiencing respiratory impairment from submersion/immersion in liquid."[7,8] Drowning outcomes are now to be classified as "death," "no morbidity," or "morbidity" (further categorized as "moderately disabled," "severely disabled," "vegetative state/coma," and "brain death"). The terms "wet," "dry," "active," "passive," "silent," and "secondary drowning," as well as the term "near-drowning," are no longer to be used. The new definition and classifications are more consistent with other medical conditions and injuries and should help both in drowning surveillance and collection of more reliable and comprehensive epidemiologic information.[7,8]

Sociodemographic Factors

Rates of drowning vary with age, gender, and race. The highest rate of drowning is in the 0- to 4-year age group (2.5 per 100 000), and children 12 to 36 months of age are at the highest risk (almost 4 deaths per 100 000). There is a second peak incidence in adolescence, attributable entirely to a high number of male drowning deaths.[1] After 1 year of age,

males are at greater risk of drowning than are females at all ages. Up to 12 years of age, drowning death is roughly twice as common in boys as in girls, but in adolescents, the rate is approximately 10 times higher for boys (see Table 1).[1] The higher drowning rate for males has been explained by greater exposure to aquatic environments, overestimation of swimming ability, higher risk-taking, and greater alcohol use.[9]

In the period from 2000 to 2006, 3 times more white children and adolescents died from drowning than did black children of the same age; however, the drowning-death rate was actually higher in black children than in white children (1.95 vs 1.29 per 100 000, respectively). Drowning-death rates for Native American children (1.79 per 100 000) were almost as high as those for black children, whereas rates for Asian children and adolescents (1.23 per 100 000) were similar to those for white children. Overall, the highest death rates were seen in black boys 15 to 19 years of age (4.46 per 100 000) and white boys 0 to 4 years of age (3.53 per 100 000).[1] An analysis that focused specifically on swimming-pool drowning deaths in the 5- to 24-year age group revealed that black males had higher drowning rates than either white or Hispanic males even when adjustments were made for low income. Although the majority of white children drowned in residential pools, black children were more likely to die in a public pool, often at a motel or hotel.[10] The reasons that black children and teenagers are more likely to drown are not clear, but poor parental swimming skills, lack of early training, poor swimming ability, and lack of lifeguards at motel/hotel pools may be important factors.[10,11]

TABLE 1 Unintentional Drowning Deaths: United States, 2006

Age Group, y	No. of Deaths (Rate per 100 000)		
	Male	Female	Total
<1	27 (1.26)	24 (1.18)	51 (2.64)
1–2	183 (4.36)	127 (3.17)	310 (3.78)
3–4	106 (2.57)	42 (1.07)	148 (1.83)
0–4	316 (3.02)	193 (1.93)	509 (2.49)
5–9	104 (1.03)	38 (0.40)	142 (0.72)
10–14	89 (0.85)	25 (0.25)	114 (0.55)
15–19	282 (2.59)	30 (0.29)	312 (1.47)
0–19	791 (1.89)	286 (0.72)	1077 (1.32)

The role of socioeconomic status and income on drowning rates, independent of race, is not well known. Worldwide, drowning rates are much higher in low-income, underdeveloped countries.[12] In contrast, a study of pool drownings conducted in California revealed that among children younger than 10 years, drowning rates were actually associated with higher family income and parental education. This association was attributed to increased exposure to residential swimming pools in more affluent communities.[13]

Temporal and Geographic Variation

Among all causes of unintentional injury death in the United States, drowning shows the greatest seasonal variation.[14] Among drowning victims younger than 15 years, two-thirds of deaths occur from May through August. Drowning also occurs disproportionately on Saturdays and Sundays. In a 17-year study (1990–2006) from Maricopa County, Arizona, 43% of the 865 life-threatening pool-related incidents among children 0 to 4 years of age occurred on the weekend. The peak time of day was 5:00 to 6:00 PM, and 75% of all incidents occurred between 12:00 and 8:00 PM.[15]

For the period 2000–2006, the 3 states with the highest number of drowning deaths in the 0- to 19-year age group were California (898), Texas (800), and Florida (798). For the same age group, the rates of drowning deaths per 100 000 population were highest in Alaska (3.61), Mississippi (2.77), and Florida (2.69). The lowest drowning-death rates were seen in some of the New England and Mid-Atlantic states.[1]

Location

In a large national study of 1420 drowning deaths in individuals younger than 20 years, 47% occurred in fresh bodies of water (rivers, creeks, lakes, ponds, canals, quarries), 32% occurred in artificial pools, 9% occurred in the home (bathtubs, buckets), and 4% occurred in salt water.[16] Age is an important determinant of drowning location.

Most (78%) of the approximately 60 infant drowning deaths that occur each year are in bathtubs and large buckets.[1,16] Almost all parents, even those who admitted to other risky behaviors, believe that a child should be at least 6 years old before being allowed to bathe alone.[17] Unfortunately, many caregivers confess that they do leave young children unsupervised in the bath for some period of time.[18,19] The association of unsupervised bathtub drowning deaths with the use of bathtub seats and rings was recognized more than a decade ago.[20] Three hazard scenarios have been noted: (1) seat tipping over from suction cup failure; (2) child becoming entrapped in leg openings that are too big; and (3) child climbing out of the seat.[21] In response to reports of at least 27 deaths and 29 nonfatal incidents with bath seats from 2003 to 2005, the Consumer Product Safety Commission (CPSC) has released warnings about these products but has not banned them from the market.[22]

In a national study, more than half (51%) of the drowning deaths of children 0 to 4 years of age occurred in swimming pools, but a sizable proportion (25%) occurred in ponds, rivers, and lakes.[16] Older children in the 5- to 14-year age range are slightly more

apt to drown in a natural body of water than in a swimming pool, but a high proportion (69%) of adolescents 15 to 19 years of age drowned in fresh bodies of water.[16] In a study from Washington state, open-water drowning occurred in 35% of those in the 0- to 4-year age group, 69% of those in the 5- to 14-year age group, and 95% of adolescents.[23] Regarding nonfatal drowning in children and adults, 66% occurred in pools, 22% occurred in natural water, and 12% were unspecified.[24]

Above-Ground Inflatable and Portable Pools

Recently there was an increase in sales of large, inexpensive, inflatable or portable above-ground pools that come in various sizes, shapes, and water depths. The pools are 18 to 48 in deep and can hold less than 200 to more than 5000 gallons of water. Some models even require filtration equipment. Prices range from $50 to $750.[25] From 2004 to 2006, the CPSC reported 47 deaths of children related to inflatable pools.[26] Unfortunately, many parents do not consider fencing for an inflatable or portable pool, and such pools often fall outside of local building codes that require pool barriers. Because they contain such large amounts of water, these pools are often left filled for weeks at a time, which presents a continuous danger. The soft sides of some models allow children to lean over and easily fall into the pool headfirst. In a study of above-ground pools, children between 42 and 54 months of age were shown to be able to climb into a pool with a 48-in wall, even if the ladder was removed.[27] The American Society for Testing and Materials (ASTM) has published a standard (F 2666-07) for above-ground pools for residential use that addresses structural integrity, sanitation, electrical safety, and safety-message labeling.[28]

Drain Entrapment

From 1990 to 2004, 74 cases (13 deaths) of body entrapment in a pool or spa drain were reported to the CPSC.[29] In a separate report, 24 additional cases (2 deaths) were reported in just the 3 years from 2005 to 2007.[30] The situation often involves a child playing with an open drain, inserting a hand or foot into the pipe, and then becoming trapped by increasing suction and resulting tissue swelling. The deaths were from drowning. The majority (77%) of the victims were younger than 15 years. In the same time period (1990–2004), 43 incidents (12 deaths) of hair entanglement were reported.[29] These incidents typically involve females with long hair who are underwater near a suction outlet. The water flow into the drain sweeps the hair into and around the drain cover, where it becomes tangled in the holes and protrusions of the cover. Almost all (92%) of these cases were also in children younger than 15 years. In addition, there have been 2 incidents of evisceration and disembowelment that have occurred when a young child sat on and was sucked into a drain with a missing cover.[29]

Entrapment and entanglement can be prevented by the use of special drain covers, safety vacuum-release systems (SVRSs), filter pumps with multiple drains, and a variety of other pressure-venting filter-construction techniques.[29] Unfortunately, many parents and pool and spa owners are not aware of entrapment/entanglement risk, and only 15% have installed antivortex drain covers, only 14% have multiple drain systems, and only 12% have an SVRS on their pool or spa.[31] In 2007, Congress passed the Virginia Graeme Baker Pool and Spa Safety Act, which requires drain covers, unblockable drains, and SVRSs for all public pools and spas in the United States.[32] Although the sct does not apply to private pools, all pool owners should implement the recommendations reflected in the act.

Lapses in Adult Supervision

Drowning is not generally associated with a complete lack of adult supervision but, rather, with a momentary lapse in supervision. In fact, in a study of 496 drowning deaths in children younger than 14 years that were reviewed by state child-death review teams, only 10% were completely unsupervised at the time of the drowning. Most of the children (68%) were expected to be in or near the water just before the drowning incident.[33] In a questionnaire portion of the same study, parents of children younger than 14 years admitted that they talk to others (38%), read (18%), eat (17%), and talk on the telephone (11%) while supervising their child near water. Attempts to attribute cause to 538 swimming-pool submersion incidents of children younger than 5 years in Maricopa County revealed seasonal differences (warm versus cold months) and differences related to outcome (fatal versus nonfatal). In winter months, both with fatal and nonfatal cases, lack of a barrier and broken fences and gates were responsible for most (76%) cases, and poor supervision was blamed in only 16% of the cases. During warm months, lapses in supervision were responsible for 62% of nonfatal cases; however, lack of a barrier and broken fences and gates were responsible for most (70%) of the deaths.[15] Fencing is clearly important all year round. Overall, nonfunctioning gates were the cause of 17% of all pool drowning incidents in this study.

Alcohol

A recent meta-analysis revealed that 30% to 70% of swimming and boating fatal drowning victims had a measurable blood alcohol concentration (BAC)

and that 10% to 30% of those deaths could be attributed specifically to alcohol use.[34] In boating, there is evidence that the relative risk of drowning death is directly related to BAC, with a 16-fold greater risk when the victim's BAC was more than 0.10 (100 mg/dL).[35] Alcohol intake may increase the risk of drowning not only by impairing judgment and performance but also through physiologic effects (ie, impaired orientation, hypothermia) that affect survival once submersion occurs.[35] Little information is available regarding the association of drug use and drowning. One 10-year retrospective study from Ohio revealed that only 3% of 141 accidental drowning deaths were associated with illicit drugs.[36]

Swimming Ability

Few studies have examined the relationship between swimming ability and the risk of drowning, and there is no clear evidence that drowning rates are higher in poor swimmers. Increased swimming proficiency might lead to an increase in drowning rates through an increased exposure to water and dangerous aquatic situations.[37,38] A CPSC study of 140 swimming-pool child-drowning deaths revealed that better swimming ability, as reported by the parents, was associated with lower drowning risk.[39] An 8- to 12-week training course for preschool-aged (24–42 months) children revealed that the subjects were able to develop the water-safety skills necessary to survive a fall into a home swimming pool.[40] With training, the young children could stand and recover when dropped into 2 ft of water, kick propulsively, and get to the side of the pool after jumping in or being released in the pool by an adult.

Two recent case-control studies revealed that swimming lessons may reduce drowning risk in small children. A study from rural China that examined drowning deaths in children 1 to 4 years of age revealed that drowning "case" children were less likely to have had swimming lessons than were controls (6.8% vs 12%, respectively).[41] Research on 61 drowning deaths in children 1 to 4 years of age (mean age: 2.62 years) from the Eunice Kennedy Shriver National Institute of Child Health and Human Development revealed that the drowning victims were reportedly less likely (3% vs 26%) to have participated in formal swimming lessons (odds ratio [OR]: 0.05 [95% confidence interval (CI): 0.01–0.34]; $P = .002$) and were less likely (5% vs 18%) to be able to float on their back for 10 seconds ($P = .01$). When adjusted for education, race, and risk-taking, formal swimming lessons remained a significant predictor of drowning risk (OR: 0.12 [95% CI: 0.01–0.97]). The authors indicated that "this can be interpreted as an 88% reduction in risk of drowning among those with swimming lessons, with 95% confidence that a protective effect between 3% and 99% includes the true value."[42] The study reports did not describe the details of the swim instruction or water-survival skills training.

Although swimming ability may or may not decrease drowning risk, it does not result in "drown-proofing." A study from the Canadian Red Cross revealed that 16% of those who fatally drowned while swimming had "strong" or "average" swimming skills.[43] In a study of children younger than 5 years from New Zealand, 6 of 36 (17%) of the drowning victims had received swimming instruction.[44]

In recent years, water-survival skills programs designed for infants younger than 12 months have become popular both in the United States and internationally. Many movies of tiny infants who have been taught to swim underwater, float fully clothed on their backs, and even cry out for help have emerged on the Internet. Although there are anecdotal reports of infants who have "saved themselves," no scientific study has clearly demonstrated the safety and efficacy of training programs for such young infants.

Underlying Medical Conditions

Seizure disorder is a known risk factor in drowning. Children with epilepsy are at greater risk of drowning in bathtubs as well as in swimming pools.[45] The relative risk of submersion events and drowning deaths in patients with epilepsy varies greatly from study to study and depends on such factors as age, severity of illness, degree of exposure to water, and level of supervision.[45–47] There is some evidence from studies with small numbers of patients that children with autism spectrum disorders are at higher risk of drowning than those in the general population.[48,49] The risk in children with autism seems to be higher with greater degrees of mental retardation.[48] For children without autism, no study has specifically studied developmental disabilities or attention-deficit/hyperactivity disorder as drowning risk factors. In individuals with long QT syndrome, exertion from swimming may trigger an arrhythmia.[50] Although such cases represent a small percentage of drownings, this syndrome should be considered as a possible cause for unexplained submersion injuries among proficient swimmers in low-risk settings.

Boating

In 2008, the US Coast Guard reported 71 boating deaths of individuals 19 years and younger, with 53 (75%) attributed to drowning. Eighty-five of the 669 injuries in this age group occurred while riding in an open motorboat or personal watercraft. Analysis of all fatal boating incidents has revealed that 79% of the operators had no boating

training, and 22% of the incidents involved alcohol.[51]

The vast majority of boating drowning deaths (90%) occur in individuals not wearing a personal flotation device (PFD).[51] For children younger than 14 years, it is reported that nearly 45% of those who died in a boating-related incident were not wearing a life jacket.[33] Federal law requires life-jacket use for children younger than 13 years on recreational boats in the United States. One observational study revealed that 90% of children younger than 5 years wore life jackets, but only 13% of those 14 years or older used a life jacket.[52]

Reasons commonly cited for not wearing a life jacket include beliefs that there is a low risk of drowning, that life jackets restrict movement, that life jackets are uncomfortable, that life jackets are unattractive, and that wearing a life jacket is a sign of fear.[53] Parents of children who do not always wear life jackets report reasons including (1) the parent is in close proximity to the child, (2) a PFD for the child is on board in case of emergency, and/or (3) the child has good swimming skills.[33]

INTERVENTIONS

In the Haddon matrix of injury prevention, safety interventions are aimed at changing the environment, the individual at risk, or the agent of injury (in this case, water). For drowning prevention, the environment and the individual are the prime targets. Experts generally recommend that multiple "layers of protection" be used to prevent drowning, because no single strategy is likely to prevent all submersion deaths and injuries. Such layers might include environmental changes such as adult supervision, pool fencing, pool covers, water-entry alarms, lifeguards, and CPR training. Additional prevention layers focused on the individual would include strategies such as swimming and survival skills training and use of PFDs.

Studies from the late 1990s revealed that pediatricians report that they were not adequately taught about drowning prevention during their residency training and that few of them counseled parents about this topic.[54,55] There have been no recent publications regarding the current status of drowning-prevention counseling by physicians and no research about whether such an intervention is effective in decreasing drowning rates.

Adult Supervision

Close supervision of young children around any body of water is an essential preventive strategy, but inevitable lapses make supervision alone insufficient.[15,33] Because young children who fall into water often make no noise and are hard to see below the water surface, proper care of a young nonswimmer requires the supervising adult to be within an arm's length and provide "touch supervision." To stress the importance of supervision, some communities have distributed "designated water watcher" badges as part of their drowning-prevention campaigns. While wearing the badge, the adult "water watcher" is responsible for pool safety and is expected not to engage in any distracting activities. The efficacy of such programs still needs evaluation.

Pool Fencing

Pool fencing is an important prevention strategy for decreasing the risk of drowning in swimming pools when children are not supposed to have access to the water. Compared with no fencing, installation of 4-sided fencing that isolates the pool from the house and yard has been shown to decrease the number of pool-immersion injuries among young children by more than 50%.[56–58] One Cochrane collaboration meta-analysis of available studies revealed the OR for drowning in a fenced versus an unfenced pool to be 0.27 (95% CI: 0.16–0.47). In this analysis, pool isolation fencing was revealed to be superior to property-perimeter fencing (OR: 0.17 [95% CI: 0.07–0.44]).[58] A study from Australia revealed that the risk of a child drowning in a pool with perimeter fencing was almost twice that seen in pools with an isolation fence (incidence rate ratio: 1.78 [95% CI: 1.40–1.79]).[59]

Unfortunately, laws and ordinances regarding pool fencing may have dangerous loopholes. Perimeter fencing with self-locking or alarming doors between the house and pool area are often considered acceptable, and in some locales, pool covers can substitute for a fence. Often, the fence law pertains only to new pool construction or to homes in which a young child is actually living at the time of the pool installation. Furthermore, in the United States, pool fences are rarely inspected, and ordinances are often not enforced. A recent study from Australia revealed that government inspections raised the rate of compliance with pool-fencing laws from approximately 50% to 97%.[60]

Children's ability to climb fences varies with the type of fence. In 1 study, chain-link fences were easily scaled by children, whereas ornamental iron-bar fences proved more difficult to climb.[61] Fences should be at least 4 ft high, and no opening under the fence should be more than 4 in (some building codes require a 5-ft fence and a maximum fence-to-ground distance of only 2 in). Vertical members of the fence should be less than 4 in apart to keep a child from squeezing through them, and there should be no footholds or handholds that could help a young child climb the fence. The fence should not prevent a clear view of the pool. Gates should be self-closing and self-

latching, and the latch should be placed at least 54 in above the bottom of the gate. The gate should open away from the pool and should be checked often to ensure that it is in good working order. Pool gate alarms may provide additional protection, but no research exists on their efficacy. Detailed guidelines for safety barriers for home pools are available online from the CPSC,[62] but homeowners must also be aware of local laws and building codes regarding pool-fence construction.

Pool Covers

Retractable pool covers and pool nets capable of holding the weight of a child have been advertised as effective barriers for drowning prevention. Because these covers must be removed and replaced each time the pool is used, they are not likely to be used appropriately and consistently. Because there has been no scientific study regarding the efficacy of pool covers, they cannot be recommended as a substitute for isolation fencing.

Some types of pool covers actually present a hazard for children. In 1980, the CPSC issued a warning about solar pool covers that are designed to keep the water warm and minimize pool chemical and water evaporation. When children try to walk on these thin sheets of plastic, they can fall into the water and drown while entangled in the cover or hidden from view.[63]

Pool Alarms

The CPSC has evaluated the performance of surface, subsurface, and wristband pool alarms.[64] Several of these alarms functioned properly and were thought to provide some protection against drowning; however, the report concluded that alarms "should not be relied on as a substitute for supervision or a barrier completely surrounding the pool." No study results have demonstrated whether pool alarms prevent drowning.

Lifeguards

Although no formal scientific study has quantified the value of lifeguards, anecdotal reports indicate that drowning rates are lower when lifeguards are present.[65] The US Lifesaving Association has reported that only 20 of the 109 beach drowning deaths occurred on guarded beaches in 2007.[66] In addition to rescue efforts, lifeguards serve to make beaches safer by monitoring the aquatic environment, enforcing rules and regulations, and educating beachgoers about safety and injury prevention. Those who choose to swim in natural bodies of water or other sites accessible to the public should swim in designated swim areas with lifeguards present.

CPR Training

Immediate resuscitation at the site of a submersion incident, even before the arrival of emergency medical services personnel, is an important means of secondary prevention and is associated with a significantly better outcome for children with submersion injury.[2,3] For this reason, all parents and caregivers should be trained in infant/child CPR. Initial resuscitative efforts for a drowning victim should include rescue breathing as well as chest compressions when signs of circulation are absent. "Hands-only" CPR is not appropriate for drowning victims. The Heimlich maneuver is not recommended to expel water from the lungs, because positive pressure ventilation by mouth or mask will accomplish adequate oxygenation.[67] Additional CPR information and courses for parents and caregivers is available through the American Heart Association and the American Red Cross. Education for health care professionals on resuscitation of pediatric patients is available through American Academy of Pediatrics programs Pediatric Advanced Life Support (PALS) and Pediatric Education for Prehospital Professionals (PEPP).

Swimming Instruction and Water-Survival Training

All children should eventually learn to swim. In the past, the position of the American Academy of Pediatrics has been that children are not "developmentally ready" for formal swimming lessons until after their fourth birthday.[68] This policy was based on (1) the lack of data needed to determine if infant and toddler aquatic programs increase or decrease the likelihood of drowning, (2) concerns that such programs would cause parents to develop a false sense of security and lead them to provide inadequate supervision around water, and (3) evidence that starting swimming lessons at a very young age does not result in earlier development of proficient swimming skills.[69,70] In addition, there was concern that swimming programs might reduce a child's fear of water and unwittingly encourage him or her to enter the water without supervision.

Concern about parents developing a false sense of security is well founded. Compared with controls, parents of small children who were enrolled in swimming lessons were more likely to endorse the statements "swimming lessons are the best way to prevent drowning," "toddlers can learn to save themselves if they fall into water," and "it is better to develop swimming ability rather than rely on adult supervision."[71] In a follow-up study, when they were given a targeted educational program to reverse misconceptions about toddler water safety, parents of children in a toddler swim program were more likely to agree that their child required more, not less, supervision. These parents were also more likely to disagree that swimming lessons were

the best way to prevent drowning.[72] The authors suggested that "swim schools can provide a valuable opportunity to address parental misconceptions about toddler water safety."

By 4 years of age, most children can learn basic aquatic locomotion, and by 5 or 6 years of age, most of them can master the front crawl.[69,70] The more important question for this report relates to when a child can learn water skills needed to prevent a drowning. Results of research from Asher et al,[40] Yang et al,[41] and Brenner et al[42] have indicated that some drowning-prevention skills can be learned between 1 and 4 years of age. It should be stressed, however, that these were relatively small studies that had outcomes with wide CIs. Although there is anecdotal evidence that even some small infants can successfully learn water-survival skills, there are currently no published scientific studies to indicate that such training results in the "drown-proofing" claimed by some advocates.

The American Red Cross Advisory Council on First Aid, Aquatics, Safety and Preparedness recently published an extensive scientific review regarding minimum age for swimming lessons. They concluded that the "limited empirical research evidence does not support prohibiting early aquatic experiences at any specific age." In their report, the council stated that "children between the ages of 2 and 4 years can optionally start swim lessons for the purpose of building aquatic readiness and water acclimation on an individual basis."[73] Although the council recognized that there may be some drowning-prevention benefit to swim lessons before 4 years of age, they indicated that "there is absolutely no published evidence to support anecdotal claims" that "rolling over and floating are sufficient to prevent drowning."

Although early instruction may be beneficial, there are some concerns about aquatic programs in this young age group. These concerns include the risk of gastrointestinal tract infections, dermatitis, and acute respiratory illness that can result from exposure to infectious agents and pool chemicals. Hyponatremia from drinking pool water and hypothermia have also been reported. Generally, medical problems from swimming are rare, treatable, and preventable events.[74,75] The World Aquatic Infants and Children Network has published guidelines for the operation of aquatic programs for children younger than 3 years. The guidelines address (1) required parental involvement, (2) a fun atmosphere with 1-on-1 teaching, (3) qualified teachers, (4) warm water to prevent hypothermia, (5) maintenance of water purity, and (6) a limited number of submersions to prevent water ingestion and hyponatremia.[76]

Recent articles have been published and suggest a link between infant exposure to chlorination byproducts in swimming pools and damage to respiratory epithelium, resulting in a predisposition to asthma and bronchitis.[77–79] In 1 of these studies, asthma was more likely in infants of atopic mothers.[79] In another study, atopic adolescents exposed to chlorinated pools were more likely to have hay fever, asthma, cough, and shortness of breath than were atopic adolescents who swam in pools disinfected by a copper-silver method.[80]

The AAP continues to support swimming lessons for children 4 years old and older without physical or developmental disabilities. In light of new research that has revealed that swim instruction for children 1 to 4 years of age may decrease drowning,[41,42] it is reasonable for the AAP to relax its policy regarding the age at which children should start learning water-survival skills. The evidence no longer supports an advisory against early aquatic experience and swim lessons for children of any specific age. However, the current evidence is insufficient to support a recommendation that all 1- to 4-year-old children receive swim lessons. Clearly, more research is needed to determine which types of swim instruction and water-survival skills training are most effective in preventing drowning in young children of various ages.

A parent's decision about the age at which to teach water-survival skills or initiate swimming lessons must be individualized on the basis of a variety of factors such as frequency of exposure to water, health concerns, emotional maturity, and physical limitations. Some parents may feel that the benefits of infant or toddler water programs outweigh any possible dangers. Once again, it must be stressed that even advanced swimming skills will not always prevent drowning and that swimming lessons must be considered only within the context of multilayered protection with effective pool barriers and constant, capable supervision.

PFDs

The use of an approved PFD, although not well evaluated, seems likely to decrease drowning morbidity and mortality.[81,82] US Coast Guard boating statistics from 2008 indicate that only 9% of 510 drowning-death victims (all ages) were wearing a PFD.[51] Successful educational and life-jacket–loaner programs designed to increase PFD use have been reported,[83,84] and in the past 10 years, the Coast Guard reported a slight improvement in PFD use in children younger than 18 years from 56% to 65% nationally.[85] It is important to recognize that air-filled swimming aids (such as inflatable arm bands) are toys that can deflate and should not be used in place of PFDs.

Information about infant and child PFDs for a variety of aquatic situations is available online from the US Coast Guard.[86]

Policy Statement

Advice pediatricians may provide to parents and recommendations for advocacy at the community level is specified in the accompanying policy statement.[87]

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