Fencing of swimming pools legislation: Literature review

Report to Water Safety New Zealand

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Preface

This literature review was commissioned by Water Safety New Zealand in July 2005. The aims of the review were to (1) summarise the international literature concerning the implementation and enforcement of swimming pool fencing legislation and (2) to identify experiences that may have enhanced the ability to enforce this legislation. The literature reviewed in this report was published between 1997 and 2005.

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Executive Summary

In 1987, legislation was passed in New Zealand to "promote the safety of young children by requiring the fencing of certain swimming pools" (Fencing of Swimming Pools Act, 1987). The Act requires that private swimming pools (or some or all of the immediate pool area) are fenced to a height of 1.2 metres, with an outward opening door or gate that is self closing and is fitted with a self-latching device. Where any building forms part of a fence and the pool is not contained within that building, any door that gives access to the immediate pool area is required to have a locking device that, when properly operated, prevents the door from being opened by a child under the age of 6 years.

In a survey of local authorities charged with implementing the Fencing of Swimming Pools Act, conducted in 1997, Morrison and colleagues identified the following difficulties:

1) Interpretation:
    a) What constitutes the 'immediate pool area'?
    b) What are the requirements for above ground pools?
    c) Inconsistencies with respect to covers for spa pools and temporary fencing while a pool is being constructed.
    d) Inconsistencies between the Act and the Building Code (1992).
2) Enforcement:
    a) Difficulties in quantifying the number of pools in an area.
    b) No allowance made in the Act for enforcement cost recovery.
    c) Difficulties in achieving and monitoring compliance.
3) Rural pools: increased public resistance to fencing (Morrison, Chalmers et al. 1999).

In a relatively recent development concerning the interpretation of the Act, the Waitakere City Council, supported by the Auckland City Council and Rodney District Council, sought a declaration from the High Court concerning the definition of the 'immediate pool area'. In coming to the ruling that the immediate pool area could contain activities that were, from time to time used in conjunction with the use of the pool, Justice Randerson highlighted the material differences between the Act and the Building Code. He noted that the building code referred to barriers, not fences; that the building code specified only that the barrier height must be 'appropriate'; and that sliding doors were automatically exempt under the building code, whereas all doors are treated alike in the Schedule to the Act. In conclusion, he stated that *"early attention by the legislature to these difficulties is highly desirable"* (Justice Randerson, 2004).

It is with this background that the current literature review was commissioned. The aims of the review were three-fold: (1) to compare the impact of New Zealand legislation and regulations to reduce the likelihood of children drowning with those of other countries; (2) to compare overseas experiences of enforcement and compliance issues with those of New Zealand and consider which experiences may have enhanced the ability to enforce legislation; and (3) to summarise and contribute to the debate on the layers of protection.

Methods

The following data sources were searched for relevant literature to address the above aims: electronic databases (e.g. Medline, SPORT Discus, limited to human studies conducted between 1997 and 2005); reference lists from articles identified in the electronic databases; and the IPRU collection of books, reports, and journal articles. Where practicable, we went beyond peer-reviewed journals to include the 'grey literature' (i.e. commissioned government reports, conference proceedings, internet searches, etc), focusing specifically on those sourced from the United States, France and Australia.

The literature identified in the above search was critically reviewed and ranked according to recognized grades of evidence (adapted from Concato, Shah et al. 2000):

I Evidence obtained from at least one properly randomized, controlled trial.

II-1 Evidence obtained from well-designed controlled trials without randomization.

II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.

II-3 Evidence obtained from multiple time series with or without intervention.

III Opinions of respected authorities, based on clinical or other relevant experience; descriptive studies and case reports; or reports of expert committees.

IV Expert opinion.

In the project brief, Water Safety New Zealand indicated a specific interest in literature from Australia, California, Arizona, Washington, France and Singapore. In the context of legislating for the fencing of private swimming pools, Singapore is substantially less advanced than the other States and Countries of interest. The only published literature to emerge from Singapore focuses on the epidemiology of childhood drowning (Goh and Low 1999; Tan 2004). Although childhood drowning is an area of interest for the Ministry of Health in Singapore, legislation requiring the fencing of private pools is not yet a priority (Lee-Yee Cheong, Personal Communication, November 2005). Accordingly, the literature reviewed was limited to that from Australia, California, Washington, Arizona and France.

Results

A total of 23 papers published in academic journals, 12 papers published in professional journals, and 9 reports were obtained and reviewed. In addition, the authors were able to contact and communicate with seven experts in this area. The publications and reports are graded for level of evidence in the bibliography.

As shown in the bibliography, none of the publications obtained for this review were properly randomized controlled trials (grade I) or well designed controlled trials (grade II-1). One of the publications identified was a case-control study (grade II-2), although this study was from only one research centre and there were a number of limitations to the study. The majority of the references published between 1997 and 2005 were commissioned reports or were published in professional journals. These publications were graded II-3, III or IV.

1. A comparison of the impact of New Zealand legislation and regulations to reduce the likelihood of children drowning with those of other countries.

The aim of this section was to compare the impact of New Zealand legislation and regulations to reduce childhood drowning with those of other countries. Unfortunately, the studies that could be identified for this aspect of the review were not helpful in allowing a comparison of the effectiveness of the legislation. From New Zealand, Hassell reported an interrupted time-series analysis that did not provide further information about the level of conformity with legislation in those pools in which children drowned, and the studies from the United States and Australia were unable to provide evidence of the effectiveness of legislation. Only one of these investigations was a case-control study (Morgenstern, Bingham et al. 2000), the limitations of which prevented any conclusions about the effectiveness of legislation from being drawn. The other investigations were case-series studies, limiting the ability of the investigators to control for other factors that may have impacted on the rate of pre-schoolers drowning. Nevertheless, the Australian studies reviewed show that a high proportion of drowning deaths occurring in non-compliant pools or in situations in which the protective effects of fencing have been over-ridden (e.g. gates propped open).

2. Comparison of overseas experiences of enforcement and compliance issues with those of New Zealand

The three studies identified for this aspect of the review show that the extent of current legislation enforcement is highly variable in the Australian states of Victoria and New South Wales. It is likely that this situation has arisen because of the lack of requirements for local authorities to enforce the relevant Acts. Western Australia and the Northern Territory are the only Australian states that have a legislative requirement for pools to be registered with local councils. The Northern Territory and Western Australia are also the only states to require on-going inspection. A lack of registration and on-going inspection requirements are important limitations in the legislation in the majority of states in Australia. Evidence from Queensland indicates that the majority of toddler drowning occurs in non-compliant pools (Pitt and Balanda 1998). This suggests that in those states where on-going inspection is not required and compliance rates are low, there remains a significant risk for pre-schoolers of drowning in private swimming pools.

The level of enforcement of the Fencing of Swimming Pools Act 1987 in New Zealand is also highly variable. Although there is no requirement under the Fencing of Swimming Pools Act for local authorities to undertake inspection programmes, they are required to *"take all reasonable steps to ensure that this Act is complied with within its district"*. The Building Code requires that building consents be obtained for all new swimming pools, and for any alterations to swimming pools and their fences (Building Code, 2004). In 1997, only 9% of local authorities had procedures for locating and inspecting pools, while 28% had a programme of re-inspection to ensure that pools continued to comply. As a result, there were examples of pools being installed without the authorities being notified (Morrison, Chalmers et al. 1999). Local authorities in New Zealand have called for a national education or publicity campaign to support enforcement activities. It is the view of some New Zealand local authorities that it is the responsibility of pool retailers and/or owners to notify local authorities of all pool purchases (Morrison, Chalmers et al.

1999). Where there is a gap in the lines of responsibility for reporting compliance with legislation, as appears to exist with respect to notification of pool purchasing/installation in New Zealand, there is the possibility for the level of enforcement of legislation to drop, as has been the case in New South Wales and Victoria.

In France, the responsibility for on-going compliance lies firmly with the pool owner – should a child drown in a pool that is found to be non-compliant, the owner could face criminal charges of death by negligence (Larner 2005). As legislation was only recently enacted in France, there are yet to be reported any investigations into how it has been enforced and the level of compliance.

3. The layers of protection debate

The United States Consumer Product Safety Commission was one of the first organisations to endorse the notion of 'Layers of Protection', which they did after a comprehensive investigation of fatal and non-fatal drowning incidents in the mid-1980s. The rationale for this endorsement was that *"many barriers are more effective than just one"* (Marcia Kerr, personal communication, October 2005). The notion of layers of protection is that "the pool, spa or hot tub is equipped with several devices to delay a child's unsupervised access, or warn of a child's presence" (The Association of Pool and Spa Professionals). The so-called layers of protection can include:

- Fencing
- Fence gate closer and latch
- Fence gate alarms
- Automatic power safety covers
- Manual safety covers
- Door exit alarms
- Self closing/self latching devices
- Infrared detectors
- Pool alarms
- Child alarms
- Rope and float lines
- Life rings
- Posted emergency information
- Outside telephones.

The only layer of protection aside from pool fencing to have been evaluated is the pool alarm. Irrespective of the type of barrier installed, there is a degree of intervention required on behalf of the pool owner. For example, isolation fencing requires that the self-closing and self-latching mechanism is well maintained and that climbable objects are kept away from the fence. Pool alarms need to be reactivated and pool covers reinstalled after use of the pool. The difference between these interventions is the amount of attention required on behalf of the pool owner(s) – pool alarms and pool covers require attention every time they are used, whereas gate latches and self closing mechanisms require relatively infrequent maintenance.

The notion of the Layers of Protection has not gained widespread support in Australia or New Zealand. Whether this is primarily because substantial energy has been placed on introducing and implementing legislation for the fencing of swimming pools, because of a smaller market for alternatives to fencing, or because there is not the same weather stimulated need for covers is unclear (Ian Scott, Personal communication, December 2005). What is apparent is that because of this, Australia and New Zealand have not been forced to debate the pros and cons of unproven methods of preventing preschoolers drowning.

Conclusion

The publications reviewed provide little scientifically robust evidence of the effectiveness of legislation in reducing pre-schoolers drowning from private swimming pools. The majority of the investigations reported to date have been case-series studies. No evidence of the effectiveness of swimming pool legislation from well designed analytic studies has been reported. This said, the evidence from Australia and New Zealand suggests that the majority of drowning deaths that have occurred in private swimming pools since the enactment of fencing legislation has occurred in pools with non-compliant fencing or where the protective effects of fencing have been over-ridden (e.g. gates propped open).

The results of this review indicate that where gaps in responsibility, or ambiguities, exist in legislation for the fencing of swimming pools, there is the potential for incomplete enforcement and compliance. As identified by Justice Randerson, ambiguities exist between the Fencing of Swimming Pools Act and the Building Code. Elimination of these ambiguities will strengthen the base from which local authority officers are able to conduct inspections. Strengthening the legislation to require on-going inspection of private swimming pools may achieve higher compliance rates. The evidence reviewed suggests that it would be inappropriate to dilute the current legislation and that, if anything, it could be strengthened by requiring four-sided (isolation) fencing, as the most effective measure to prevent unintended access of pre-school aged children to the swimming pool area.

Background

In a number of industrialised countries with climates favourable for outdoor recreational swimming, the private swimming pool is recognized as a significant drowning hazard (Chalmers, Kotch et al. 2003). Langley, Warner, Smith and Wright, in their description of all cause drowning mortality in New Zealand, reported that the highest drowning mortality rate for New Zealand children aged 0-4 years was for falls and slips into water (2.9 fatalities per 100,000 person years). Of the 114 deaths in this category occurring between 1980 and 1994, 45 (40%) resulted from children falling into pools or spa pools, suggesting a mortality rate of approximately 1.2 fatalities per 100,000 0-4 year olds for drowning in pools (Langley, Warner et al. 2001).

It is apparent from descriptive studies that drowning in private swimming pools is more common in boys, in children aged 1-3 years, during the summer months, in in-ground pools and in the child's household pool (Wintemute 1992; Blum and Shield 2000). In order to prevent drowning in private swimming pools, four principal preventive measures have been identified in the literature (Wintemute 1992; Chalmers, McNoe et al. 2004): (1) barriers against unintended access to pools (i.e. pool fencing), (2) increased supervision, (3) pool alarms and (4) training in cardiopulmonary resuscitation (CPR) (Wintemute 1992). As noted by Morrison, Chalmers, Langley, Alsop and McBean (1999) in their survey of local authorities on compliance with the Fencing of Swimming Pools Act 1987, countermeasures such as pool alarms have limitations that make them less effective than fencing in preventing drowning (such as reliance on someone to activate the alarm when the pool is not in use). Adult supervision is also considered insufficient, as continuous supervision is difficult to achieve and in many cases drowning occurs when supervision has lapsed for only a few minutes (Morrison, Chalmers et al. 1999). Although CPR may prevent a drowning related death, once a submersion incident has occurred, it may not be sufficient to reduce long-term sequelae unless the victim is rapidly rescued and CPR administered (Geddis 1984). A recent systematic review undertaken by the Cochrane Injuries Group presents evidence that pool fencing significantly reduces the risk of drowning, and that isolation fencing is superior to three-sided fencing (Thompson and Rivara 2005). The reviewers reported that the odds ratio (OR) for the risk of drowning or near drowning in a fenced pool compared to an unfenced pool is 0.27 (95% confidence interval 0.16-0.47), and the OR for drowning in a pool with isolation fencing (where only the pool is enclosed) compared to a pool with three-sided fencing (where the house forms one side of the pool enclosure) is 0.17 (95% confidence interval 0.07-0.44) (Thompson and Rivara 2005). The reviewers also cited one study that showed that an 84% reduction in preschool drowning could be attributed to pool fencing. On the basis of their review of much of the evidence cited by the Cochrane Injuries Group, Morrison et al (1999) concluded that *"the inadequacy of other countermeasures leaves pool fencing as the only practical intervention currently available to prevent pre-schoolers from drowning in domestic swimming pools"*.

In 1987, legislation was passed in New Zealand to "promote the safety of young children by requiring the fencing of certain swimming pools" (Fencing of Swimming Pools Act, 1987). The Fencing of Swimming Pools Act 1987 (the Act) was developed after a 1983

Local Bills Committee of Parliament deemed that the fencing of private swimming pools was necessary because:

(a) Private swimming pools present a significant childhood water hazard;
(b) Pool fencing is the most effective means of preventing drownings of pre-school children in private swimming pools;
(c) It is totally impossible for parents to supervise their children every minute of the day;
(d) There are no equal or greater water hazards for children;
(e) Where there is a reasonable and viable means of protecting young children from hazards created in the environment, such as private swimming pools, then those children have the right to that protection;
(f) The value of aesthetically pleasing gardens can not be placed above the value of human lives (Local Bills Committee 1983).

The Act requires that private swimming pools[1] (or some or all of the immediate pool area) are fenced to a height of 1.2 metres, with an outward opening door or gate that is self closing and is fitted with a self-latching device. Where any building forms part of a fence and the pool is not contained within that building, any door that gives access to the immediate pool area is required to have a locking device that, when properly operated, prevents the door from being opened by a child under the age of 6 years (Fencing of Swimming Pools Act, 1987).

The Act has been credited with being a major catalyst in preventing pre-school drowning (Claridge 2005). However, the interpretation, implementation and enforcement of the Act has been a constant source of frustration for those who are charged with its enforcement (i.e. local authorities). From a survey conducted in 1991, the Child Accident Prevention Foundation found that 76% of local authorities had difficulty with some aspect of enforcing the Act (Child Accident Prevention Foundation 1991). In a follow-up study conducted in 1997, Morrison et al identified the following difficulties associated with the Act:

1) Interpretation:
   a) What constitutes the 'immediate pool area'?
   b) What are the requirements for above ground pools?
   c) Inconsistencies with respect to covers for spa pools and temporary fencing while a pool is being constructed.
   d) Inconsistencies between the Act and the Building Code (1992)[2].
2) Enforcement:
   a) Difficulties in quantifying the number of pools in an area.

[1] The following pools were exempt: Above ground pools where the sides are over 1.2 meters high, those that do not contain more than 400ml of water, pools under the administration of a local authority, pools wholly enclosed within a building that is used for purposes not related to the use of the pool, any pool where the access is prevented by locked gates or doors whenever the pool is not intended to be available for use and where persons are employed for supervision whenever the pool is available for use.

[2] The New Zealand Building Code sets out the mandatory standards building work must meet. It is performance based – setting out the level of performance for building work, not how the work should be done. Compliance documents (of which the Appendix to the Fencing of Swimming Pools Act is one) assist people in complying with the building code (Department of Building and Housing, 2005).

b) No allowance made in the Act for enforcement cost recovery.
c) Difficulties in achieving and monitoring compliance.

3) Rural pools: increased public resistance to fencing (Morrison, Chalmers et al. 1999).

In a relatively recent development concerning the interpretation of the Act, the Waitakere City Council, supported by the Auckland City Council and Rodney District Council, sought a declaration from the High Court concerning the definition of the 'immediate pool area'. Until this time, the Waitakere City Council had taken a *"relatively restrictive view"* of 'the immediate pool area', suggesting that it could only include activities carried on exclusively in conjunction with the use of the pool (Justice Randerson, 2004). After considering the background to the Act and the manner in which it was written, Justice Randerson ruled that the immediate pool area could contain areas that were, from time to time, used in conjunction with the use of the pool (e.g. bar-b-que areas), but did not have to be limited to those used exclusively with use of the pool (e.g. changing rooms) (Justice Randerson, 2004). In coming to this ruling, Justice Randerson highlighted the material differences between the Act and the Building Code. He noted that the building code referred to barriers, not fences; that the building code specified only that the barrier height must be 'appropriate'; and that sliding doors were automatically exempt under the building code, whereas all doors are treated alike in the Schedule to the Act. In conclusion, he stated that *"early attention by the legislature to these difficulties is highly desirable"* (Justice Randerson, 2004).

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Methods

The following data sources were searched for relevant literature to address the above aims: electronic databases (e.g. Medline, SPORT Discus, limited to human studies conducted between 1997 and 2005[3]); reference lists from articles identified in the electronic databases; and the IPRU collection of books, reports, and journal articles. Where practicable, we went beyond peer-reviewed journals to include the 'grey literature' (i.e. commissioned government reports, conference proceedings, internet searches, etc), focusing specifically on those sourced from the United States, France and Australia.

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III Opinions of respected authorities, based on clinical or other relevant experience; descriptive studies and case reports; or reports of expert committees.
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[3] A brief review of the literature was conducted by Morrison et al (1997) for a survey of Local Authorities regarding the compliance with and enforcement of the Fencing of Swimming Pools Act 1987. The literature for the current review will draw on reports and studies published since that review.

Results

A total of 23 papers published in academic journals, 12 papers published in professional journals, and 9 reports were obtained and reviewed. In addition, the authors were able to contact and communicate with seven experts in this area. The publications and reports are graded for level of evidence in the bibliography.

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In order to undertake the comparison of enforcement and compliance issues between New Zealand and other countries, it was considered important to describe the development and enactment of legislation in these countries, to provide the reader with an understanding of the relevant legislation from those countries[4].

The development of pool fencing legislation

A comprehensive review of the development of legislation to prevent pre-school drowning in private swimming pools in Australia was reported by Scott in 2003 (Scott, 2003). Scott described the 'natural experiment' which had occurred in Australia over the previous 30 years, during which time all of the states in Australia enacted some form of private swimming pool fencing legislation. Scott's review described how public and commercial resistance slowed the process of enacting legislation, and outlined how this process could be more effectively managed.

Pool fencing legislation in Australia was preceded by the introduction of a Standard specification for pool fences. "Standards are generally voluntary compliance documents and only become mandatory if called up in legislation or in contracts" (Standards New Zealand, 2006). The first Australian Standard for pool fencing was published in 1979 (AS1926-1979 (1979)). This standard required that pool fences be at least 1.2m in height, that the horizontal elements be a minimum of 90cm apart and that the vertical elements be a maximum of 10cm apart. In addition, child resistant guards on gates were recommended. The Standard was reviewed as new evidence emerged about the nature of private swimming pool drowning and, in 1985, a new Standard was published requiring gates that opened outwards and automatically closed and self-latched (AS1926-1985 (1985)). A major flaw in the 1985 Standard, that persists to this day, was that it did not stipulate the required location of the fence (i.e. adjacent to the house (three-sided), or immediately surrounding the pool (four-sided or isolation fencing)) (Scott 2003). In 1993, Standards Australia undertook a revision of the 1985 standard, but due to lobbying

[4] While there is no federal or country-wide legislation in the United States, local ordinances or statewide legislation have been enacted in Arizona, California and Washington. Unfortunately, the authors were not able to locate any literature describing the development of these ordinances or legislation. As a result, this introductory discussion will be limited to comparing New Zealand with the states of Australia and France.

by anti-fencing groups and pool manufacturers, were prevented from progressing further than drafting notes outlining the most effective fencing location and publishing these in the form of an interim standard (AS1926-1993 (1993)). As the interim status of the Standard lapsed in 1994 without any further opposition, it was renewed without modification and the drafted notes were made permanent (AS 1926.2-1995 (1995)). The notes provide suggestions for the most effective fencing locations in order for fences to comply with the Standards (Scott 2003).

In 1991 (at least 18 years after evidence became available on the dangers of private swimming pools in Australia (Scott 2003)), the Uniform Building Code of Australia was adopted in all states (1991). The building code required that private swimming pools deeper than 300mm built on or after the 8th of April 1991 were to have a suitable barrier to restrict access by young children to the immediate pool surrounds. In addition, it was specified that fences and gates were to comply with the relevant Australian Standard. As in New Zealand, the provisions of the Building Code of Australia are performance based and require interpretation (Scott 2003).

Since 1991, all of the states in Australia have responded to the Uniform Building Code by enacting their own legislation for private swimming pools. Because responsibility for building regulatory matters lies with the states and territories, only individual states and territories can give the Building Code the force of law (Australian Building Codes Board 2004).

The variation in fencing requirements between states and the number of iterations that the legislation went through in most states reflects the public response to the legislation initially enacted. For example, the first pool fencing legislation to be enacted in New South Wales required isolation fencing for all (including existing) swimming pools within two years. Public outcry resulted in the act being repealed and replaced by one requiring a minimum of 3-sided fencing for new pools (1992). In Queensland, by comparison, in order to achieve some form of fencing for all pools, the legislature allowed a lesser standard for existing pools. Commentators on the development of pool fencing legislation in Australia argue that the apparent lack of success in enacting the original pool fencing legislation in New South Wales was that it went too far, too fast; whereas the Queensland legislation succeeded because of the level of compromise made to ensure coverage of new and existing pools (Scott 2003; Spinks and Pitt 2004).

Despite there being no local data on pre-school drowning rates, standards or safety regulations for pool fencing, as recently as 1996, France has moved relatively quickly, compared to Australia, to implement legislation, with a law being enacted in 2003. A recommendation from the French Consumer Safety Commission in 1999, concerning the necessity for safety protection for private, uncovered, installed swimming pools (Consumer Safety Committee 1999) received strong support from the then Senator (and soon to be Prime Minister) Jean-Paul Raffarin (Mariana Brussoni, personal communication, Dec 15, 2005), and the so-called 'Raffarin Law' was passed in Senate and Parliament without opposition (Peroueme 2005).

In draft form, the Raffarin Law stipulated that only four-sided fencing provided an acceptable barrier around private swimming pools. In order to obtain the support of swimming pool manufacturers, however, the legislation was diluted to allow pool covers, fences which stand between 1 and 3m from the side of the pool (Larner 2005), enclosed shelters and pool alarms as acceptable alternatives (Securite des piscines et modifiant le code de la construction et de l'habitation, 2003). The outcome of this compromise was that swimming pool manufacturers are now among the leaders in promoting awareness of the legislation. Whereas swimming pool manufacturers originally took the stance that they were not responsible for pre-school drowning as pre-schoolers should be under the supervision of their care-giver at all times (Peroueme 2005), there is now a substantial literature on the internet, aimed at increasing the awareness of the Raffarin Law (i.e. (CVP Piscines 2003; Larner 2005)).

It is evident from this literature that New Zealand was a pioneer in the development of legislation for the fencing of private swimming pools. New Zealand had evidence of a high rate of pre-school drowning to support the necessity for pool fencing legislation from an early stage (e.g. Langley 1983). This allowed the Local Bills Committee to argue the following when recommending the fencing of private swimming pools: *"Private swimming pools present a significant childhood water hazard; Pool fencing is the most effective means of preventing drownings of pre-school children in private swimming pools…."* Other countries, such as France, have not had this evidence-based support. As such, nationwide legislation was introduced in New Zealand well before other countries, reducing the *"number and type of individuals whose co-operation was needed to implement a countermeasure for reducing pre-school drowning rates"* (Langley 1983).

1. A comparison of the impact of New Zealand legislation and regulations to reduce the likelihood of children drowning with those of other countries.

Prior to the enactment of the Fencing of Swimming Pools Act 1987 (1979-1987), the rate of pre-school drowning in New Zealand was 3.5 per 100,000 population (Hassell 2004). Between 1991 and 1993, the rate of pre-school drowning had dropped to 1.1 per 100,000 (Hassell 2004). The proportion of preschool drowning cases occurring in private swimming pools reduced from 43% prior to enactment of the Act to 33% subsequent to the Act. Of those drowning occurring in private swimming pools subsequent to passing the Act, 86% occurred in swimming pools that did not have compliant fencing or were unfenced (Hassell 2004).

The only case-control study to investigate the impact of pool fencing *regulations*[5] on the rate of childhood drowning identified in the literature was conducted by Morgenstern and colleagues in Los Angeles County, California. Since 1967, Los Angeles County has had ordinances (by-laws enacted by local bodies) requiring that properties with private swimming pools have a 1.5m perimeter fence or barrier with self-latching gates. Data were collected for this investigation between 1990 and 1995. Cases were those pools on properties containing single family homes where a drowning had taken place over this

[5] A systematic review of investigations to determine if pool fencing prevents drowning in young children is reported by Thompson and Rivara (2005). The investigations reviewed focus on the effectiveness of the intervention rather than the effectiveness of legislation.

period. Five randomly selected control pools (where no drowning had occurred) were selected for each case. Factors investigated were: the existence of ordinances governing pool fencing (not all cities in the county had enacted their own fencing ordinance for residential swimming pools), the dates swimming pools were built or altered, construction costs, and the type of dwelling on the property (single family home vs other). The authors were not able to obtain information on the presence or type of fencing or the level of ordinance enforcement for the case and control pools, but case and control pools were matched on the area of residence and therefore would be expected to be covered by the same fencing ordinance.

Morgenstern et al found no protective effect of pool fencing ordinances, as 81% of the drownings occurred in pools that were regulated by such ordinances. The researchers concluded that the apparent lack of effectiveness of the ordinances in Los Angeles County was the result of the inability of perimeter fencing without other barriers to limit the access, by toddlers, from the house to the pool (Morgenstern, Bingham et al. 2000).

One of the more significant limitations of the Morgenstern et al investigation was their inability to determine the presence or type of fencing for the pools in the study. An investigation undertaken recently in Western Australia revealed that the risk of drowning in pools that have only three-sided fencing is twice that of drowning in pools with four-sided fencing (Stevenson, Rimajova et al. 2003). Another limitation of the Morgenstern et al study was the inclusion of older children who wouldn't have been protected by barriers at all, as pool fencing regulations are designed to prevent pre-school children from gaining access to a pool (M Kerr, personal communication, October 2005). It is likely that school aged children would be able to gain access through a self-closing self-latching gate.

Morgenstern et al were also unable to obtain information on the level of enforcement of swimming pool ordinances. In the abovementioned study of pre-school drowning in private swimming pools in Western Australia, the researchers found that compliance with swimming pool legislation dramatically increased after inspection by local authority swimming pool inspectors (Stevenson, Rimajova et al. 2003). At first inspection, only 45% of pools in their study were compliant with Western Australian legislation (1960; 1989) for four-sided pool fencing (three-sided required for pools installed prior to enactment of the legislation). Within four weeks of inspection, up to 80% of the inspected pools had become compliant. Stevenson et al found that 48% of private pool drowning occurred in pools that were non-compliant with the legislation at the time of the event. Of those drowning deaths that occurred in pools where the fences were compliant, 43% occurred as a result of the child gaining access to the pool through the house (three-sided fencing) and 43% occurred as a result of the pool gate being propped open. Seven percent of the cases occurred as a result of inadequate supervision. Stevenson et al concluded that "*Almost two thirds of the swimming pools in which children drowned had only 3-sided fencing. With a combination of a change in legislation, enhanced inspection process, and public education, the incidence of drowning in public swimming pools could be reduced in the coming years*" (pg e115).

In Queensland, the number of pre-school children drowning in pools reduced from 12 in 1987 to 5 in 2001 (Cunningham, Hockey et al. 2002). Four-sided fencing has been required in Queensland since 1992, while those pools constructed prior to that time are compliant if three-sided fencing is in place (Standard Building Amendment Regulations 2003). In a case-series study of pre-school drowning in private swimming pools in the 10 years since the legislation was passed, Cunningham et al found that in only 16% (n=8) of cases was the pool involved compliant with the fencing legislation at the time of the event. In four cases the gates were propped open at the time of the incident and in three cases the child had gained access to the pool through the house. In the remaining case, the child was suspected to have scaled the fence.

The aim of this section was to compare the impact of New Zealand legislation and regulations to reduce childhood drowning with those of other countries. Unfortunately, the studies that could be identified for this aspect of the review were not helpful in allowing a comparison of the effectiveness of the legislation. Hassell reported an interrupted time-series analysis that did not provide further information about the level of conformity with legislation in those pools in which children drowned, and the studies from the United States and Australia were unable to provide evidence of the effectiveness of legislation. Only one of these investigations was a case-control study (Morgenstern, Bingham et al. 2000), the limitations of which prevented any conclusions about the effectiveness of legislation from being drawn. The other investigations were case-series studies, limiting the ability of the investigators to control for other factors that may have impacted on the rate of pre-schoolers drowning. There were no well designed analytic studies. Nevertheless, the Australian studies reviewed show that a high proportion of drowning deaths occurring in non-compliant pools or in situations in which the protective effects of fencing have been over-ridden (e.g. gates propped open).

On the basis of the available evidence from analytic studies, it can be argued that, in principal, pool fencing legislation that requires four sided fencing with self-closing and self-latching gates and that is enforced should be effective in reducing pre-school drownings (Thompson and Rivara 2005). The following section will highlight the issues associated with the enforcement of pool fencing legislation.

2. Comparison of overseas experiences of enforcement and compliance issues with those of New Zealand

As highlighted in the introduction, research into the implementation of the Fencing of Swimming Pools Act (1987) in New Zealand has identified some significant barriers to ensuring compliance with this legislation. With the enactment of legislation requiring domestic swimming pool barriers across the states of Australia, several studies have emerged documenting the effectiveness of legislation enforcement in that country. All of these studies are survey based, and none meet the criteria for the first four grades of research evidence (refer page 6).

Paine and Cassell conducted a telephone survey of 35 municipal building surveyors or inspectors with responsibility for enforcing the Victorian private swimming pool

regulations[6]. These researchers used guidelines developed by Queensland Health to assess 'Best Practice' for the enforcement of swimming pool regulations by the local authorities (Box 1). Of those authorities surveyed, 10 (29%) met all four best practice criteria.

Box 1: Queensland Health Best Practice Criteria (2002)

Best Practice Criteria
(1) Having a database of pools detailing their compliance status.
(2) Having a routine (random or systematic) inspection and enforcement process.
(3) Having a written policy or procedure on pool safety enforcement to ensure sustainability.
(4) Regular dissemination of information to pool owners.

Twenty-seven of the 35 respondents (77%) reported that their council recorded the number and location of domestic swimming pools. Of councils involved in the survey, 29% (n=10) conducted routine, on-going inspections. The building surveyors and inspectors estimated that one-third of domestic swimming pools were compliant at the first inspection. Because of the low level of enforcement of the regulations reported in this investigation, the researchers concluded that young children remained vulnerable to drowning in Victoria (Paine and Cassell 2003).

Publications from New South Wales concerning the level of enforcement activities undertaken by local authorities has been described by one commentator as 'muddy thinking and confused research' (Ian Scott, personnel communication, December 2005). This opinion is reinforced by the results of two mail administered surveys, conducted in 1998 (Sayer, Rissel et al. 1998) and 2002 (Mitchell and Haddrill 2004). Sayer, Rissel, Alperstein and Lonie conducted a survey of all 179 local government councils to determine the number, and compliance level, of pools in each council area (Sayer, Rissel et al. 1998). Almost 80% of the councils responded to the survey, and 55% of these were able to provide an estimate of the proportion of pools in their area that complied with the legislative requirements (estimated compliance rates ranged from 1-100%). In 2002, Mitchell and Haddrill also conducted a mail administered survey of all New South Wales local councils. The response rate to the survey was 69%. A total of 84% of the survey respondents were able to estimate the total number of pools in their area, with only 3% reporting that they could identify the exact number. The majority (82%) of the councils that responded to the survey were not able to estimate how many of the swimming pools in their area did not comply with the Swimming Pools Act (1992) (Mitchell and Haddrill 2004), contradicting the results presented by Sayer et al. Although NSW local government councils are not required to enforce the fencing of swimming pools legislation (no agency is specified as being responsible for the enforcement of the

[6] Victorian regulations require 3-sided fencing that incorporates child resistant doors or gates. From December 2001, local authorities have been able to issue fines in the range of $1,000-$5,000 for breaches of the regulations. The legislation does not require on-going inspection of private swimming pools (Paine and Cassell, 2003).

legislation), they are required to promote awareness of the Act to swimming pool owners and ensure that the councils are notified of the existence of all swimming pools in the area.

van Weerdenburg, Mitchell and Warner conducted case studies of three NSW local governments in an effort to compare different approaches to the council management of private swimming pool legislation and the level of compliance of private swimming pools in each local government area (van Weerdenburg, Mitchell et al, 2003). Three levels of management were described:

- Council A had had no inspection and enforcement process for at least three years prior to the investigation (conducted in 2003). There was no specific register or database of pools, and the total number and compliance status of pools was unknown. In an effort to determine the number and proportion of compliant swimming pools in this council, 1003 private swimming pools were randomly sampled by the researchers and inspected by Royal Life Saving Society inspectors. Of the 1003 pools, 48.6% were compliant.
- Council B had a long-term, on-going inspection programme. There were clear lines of responsibility for the management of the inspection process, and a comprehensive pool register was linked to the property management system. A total of 66.2% of the pools in this council area were compliant, with 2.2% non-compliant and 31.6% having inspections pending.
- Although Council C had an electronic register for pools and had conducted inspections in the past, these were conducted irregularly, and the electronic register was not up-to-date. At first inspection 45.7% of pools were compliant.

A mail administered survey was conducted with residents in council A's administrative area. Those who had swimming pools that had been inspected by Royal Life Saving Society inspectors received a questionnaire. The aim of the survey was to determine the level of acceptability of on-going inspections (van Weerdenburg, Mitchell et al. 2003). Slightly over 20% of potential participants responded to the survey and of those, 95.6% reported having a fence around their swimming pool. A total of 95.6% of respondents supported council inspection of swimming pools. The proportion of survey respondents reporting that they had a fence around their pool was substantially higher than the proportion of pools in Council A that were compliant with pool fencing regulations, suggesting that the survey respondents were likely to be those whose pools were fenced. It is possible that some of those respondents whose pools were fenced had non-compliant fences, however the difference in the proportion of those whose pools were fenced in the survey and those who had compliant fences (95.6% vs 48.6%) suggest that the response to the survey there was a biased.

Local government inspectors and managers who contributed information for the case studies reported a number of weaknesses in the enforcement of the NSW Swimming Pools Act, and recommended an immediate review of it. Recommendations from the inspectors and managers that were directly relevant to ensuring compliance with the Act included:

- Efficient enforcement protocols, including the use of fines, fully endorsed by the council.
- Maximum 3-5 year inspection cycle.
- Inspection fee implemented to assist with programme costs.
- Pool owners to be present during inspections.
- Strategies including booked appointments to deal with property access and pool-owner awareness issues.
- Complementary local media campaigns to raise community awareness of domestic swimming pool safety and drowning prevention measures.

The above three studies show that the extent of current legislation enforcement is highly variable in Victoria and New South Wales. It is likely that this situation has arisen because of the lack of requirements for local authorities to enforce the relevant Acts. Western Australia and the Northern Territory are the only states that have a legislative requirement for pools to be registered with local councils. In the remaining states, councils struggle to enforce pool construction completion inspection requirements when they are not notified of the existence of a new pool (Barker 2005). The Northern Territory and Western Australia are also the only states to require on-going inspection. As noted in the previous section, compliance with Western Australian legislation almost doubled with repeated inspections over a four week period (45% to approximately 80%) (Stevenson, Rimajova et al. 2003). A lack of registration and on-going inspection requirements are important limitations in the legislation in the majority of states in Australia. Evidence from Queensland indicates that the majority of toddler drowning occurs in non-compliant pools (Pitt and Balanda 1998). This suggests that in those states where on-going inspection is not required and compliance rates are low, there remains a significant risk for pre-schoolers of drowning in private swimming pools.

The level of enforcement of the Fencing of Swimming Pools Act 1987 in New Zealand is also highly variable. Although there is no requirement under the Fencing of Swimming Pools Act for local authorities to undertake inspection programmes, they are required to *"take all reasonable steps to ensure that this Act is complied with within its district"*. The Building Code requires that building consents be obtained for all new swimming pools, and for any alterations to swimming pools and their fences (Building Act, 2004). In 1997, only 9% of local authorities had procedures for locating and inspecting pools, while 28% had a programme of re-inspection to ensure that pools continued to comply. As a result, there were examples of pools being installed without the authorities being notified (Morrison, Chalmers et al. 1999). Local authorities in New Zealand have called for a national education or publicity campaign to support enforcement activities. It is the view of some New Zealand local authorities that it is the responsibility of pool retailers and/or owners to notify local authorities of all pool purchases (Morrison, Chalmers et al. 1999). Where there is a gap in the lines of responsibility for reporting compliance with legislation, as appears to exist with respect to notification of pool purchasing/installation in New Zealand, there is the possibility for the level of enforcement of legislation to drop, as has been the case in New South Wales and Victoria.

In France, the responsibility for on-going compliance lies firmly with the pool owner – should a child drown in a pool that is found to be non-compliant, the owner could face criminal charges of death by negligence (Larner 2005). As legislation was only recently enacted in France, there are yet to be reported any investigations into how it has been enforced and the level of compliance.

3. The layers of protection debate

The United States Consumer Product Safety Commission was one of the first organisations to endorse the notion of 'Layers of Protection', which they did after a comprehensive investigation of fatal and non-fatal drowning incidents[7] in the mid-1980s. The rationale for this endorsement was that *"many barriers are more effective than just one"* (Marcia Kerr, personal communication, October 2005). The notion of layers of protection is that "the pool, spa or hot tub is equipped with several devices to delay a child's unsupervised access, or warn of a child's presence" (The Association of Pool and Spa Professionals). The so-called layers of protection can include:

- Fencing
- Fence gate closer and latch
- Fence gate alarms
- Automatic power safety covers
- Manual safety covers
- Door exit alarms
- Self closing/self latching devices
- Infrared detectors
- Pool alarms
- Child alarms
- Rope and float lines
- Life rings
- Posted emergency information
- Outside telephones.

The only layer of protection aside from pool fencing to have been evaluated is the pool alarm. Swimming pool alarm systems are designed to sense disturbance or displacement of the pool water (Whitfield 2000). Between 1999 and 2000, staff at the US Consumer Product Safety Commission conducted an evaluation of two surface pool alarms, two subsurface pool alarms and one wrist alarm – an alarm attached to the wrist of a child. The alarm systems were assembled and placed in each of six different test pools according to manufacturers instructions. Each system was then tested to determine whether the sensors would be triggered when a test object was entered into the pool and to determine the susceptibility of the sensors to alarm when water displacement was not created by a test object (e.g. in rain or wind simulated conditions). The test objects were either two or three, one-gallon containers tied together to simulate the weights of a 12-15 month and a 42-54 month old child respectively (Whitfield 2000).

[7] 'Drowning' is usually used to refer to a fatal event. However, a recent international consensus procedure was conducted to provide a definition that allows all relevant cases to be counted, rather than solely fatal events. The newly adopted definition is: *"Drowning is a process of experiencing respiratory impairment from submersion/immersion in liquid"* (van Beek, Branch, et al., 2005).

The results of this evaluation showed that the subsurface alarms were superior to the surface alarms. In the majority of test conditions, both subsurface sensors responded correctly each time the weight was introduced into the pool. In one test condition, one of the subsurface sensors responded only 70% of the time. In this condition, the pool was rectangular in shape and various alcoves were moulded into the shape of the pool. When the sensor was located at the mid-point along the length of the pool, the sensitivity was reduced (Whitfield 2000).

The subsurface alarms had superior sensitivity to surfaces alarms and were less likely to sound a false alarm than the wrist alarm. The problems associated with all of the alarms tested was that they relied on someone remembering to activate them when the pool was not being used, deactivate them when the pool was being used, and that they depended on someone being within hearing range and responding to the alarm (Whitfield 2000). In injury prevention terms they are an active rather than a passive measure (cf. pool fencing), requiring intervention by individuals (i.e. switching them off and on)(Haddon 1974). CVP Piscines (a French pool construction company) describes pool alarms as *"complimentary security systems [in addition to pool fencing and/or reinforced pool covers] as they do not prevent children from falling in the pool"* (CVP Piscines 2003).

Reinforced pool covers have been described by one French swimming pool manufacturer as having *"the advantage of closing the pool off completely, whereas a child could climb over a fence"* (CVP Piscines 2003)[8]. In a review of childhood drowning deaths in Queensland, Pitt and Casey argued that few children will climb a fence and drown as only one such event had occurred between 1992 and 1997 (Pitt and Balanda 1998). Reinforced pool covers are different from solar covers in that they are able to support the weight of an adult or child (CVP Piscines 2003). No independent evaluations of the effectiveness of reinforced pool covers in preventing childhood drowning were identified in the literature search for this review. Despite this lack of evidence, CVP Piscines describes these products as *"totally safe for children, adults and pets"* (CVP Piscines 2003). However, as with pool alarms, they require active intervention to put them in place once the pool is no longer in use.

Irrespective of the type of barrier installed, there is a degree of intervention required on behalf of the pool owner. For example, isolation fencing requires that the self-closing and self-latching mechanism is well maintained and that climbable objects are kept away from the fence. Pool alarms need to be reactivated and pool covers reinstalled after use of the pool. The difference between these interventions is the amount of attention required on behalf of the pool owner(s) – pool alarms and pool covers require attention every time they are used, whereas gate latches and self closing mechanisms require relatively infrequent maintenance.

In contrast with the advocates for the Layers of Protection (see publications from the Association of Pool and Spa Professionals, and Clive Marsh for further endorsement of the Layers of Protection (Association of Pool and Spa Professionals; Marsh 1999)), the

[8] CVP Piscines are distributors and installers for mechanical pool covers.

American Academy of Pediatrics has avoided endorsing this notion in their recommendations to pediatricians. Instead, it has issued a warning that alarms or pool covers are not substitutes for adequate fencing as they are not likely to be used appropriately and consistently (Bull, Agran et al. 2003; Bull, Agran et al. 2003).

The notion of the Layers of Protection has not gained widespread support in Australia or New Zealand. Whether this is primarily because substantial energy has been placed on introducing and implementing legislation for the fencing of swimming pools, because of a smaller market for alternatives to fencing, or because there is not the same weather stimulated need for covers is unclear (Ian Scott, Personal communication, December 2005). What is apparent is that because of this, Australia and New Zealand have not been forced to debate the pros and cons of unproven methods of preventing preschoolers drowning.

Discussion

The publications reviewed provide little scientifically robust evidence from which to compare the experiences of enforcing and implementing swimming pool fencing legislation in New Zealand with those of other countries. The majority of the investigations reported to date have been case-series studies. No evidence of the effectiveness of swimming pool legislation from well designed analytic studies has been reported. This said, the evidence from Australia and New Zealand suggests that the majority of drowning deaths that have occurred in private swimming pools since the enactment of fencing legislation has occurred in pools with non-compliant fencing or where the protective effects of fencing have been over-ridden (e.g. gates propped open).

On the basis of the scientific evidence, as reviewed by Thompson and Rivara (2005), legislation that requires four-sided fencing with self-closing and self-latching gates and that is enforced should, in principle, be effective in reducing pre-school drowning. The reports from Victoria and New South Wales have underlined the importance of legislation requiring the registration of new pools with local councils. Where this legislation does not exist, councils have struggled to enforce pool construction completion inspection requirements. The necessity for on-going inspection to be required by legislation has also been emphasized in the literature from Australia. Where regular follow-up inspections of pools take place, compliance with the relevant legislation is higher.

Although the notion of the 'layers of protection' have gained a foothold in the United States, on the basis that *"many barriers are more effective than just one"* (Marcia Kerr, personal communication, 2005), reports from the United States suggest that there is, at present, no evidence to support the 'layers of protection' argument. Aside from fencing of swimming pools, the remaining layers of protection are active injury prevention measures, requiring activation or installation after pool use. Although it may be useful to advocate for those who own a pool to be familiar with CPR, this should be considered a complementary measure to reduce the risk of death or disability from drowning should submersion occur.

Conclusion

The results of this review indicate that where gaps in responsibility, or ambiguities, exist in legislation for the fencing of swimming pools, there is the potential for incomplete enforcement and compliance. As identified by Justice Randerson, ambiguities exist between the Fencing of Swimming Pools Act and the Building Code. Elimination of these ambiguities will strengthen the base from which local authority officers are able to conduct inspections. Strengthening the legislation to require on-going inspection of private swimming pools may achieve higher compliance rates. The evidence reviewed suggests that it would be inappropriate to dilute the current legislation and that, if anything, it could be strengthened by requiring four-sided (isolation) fencing, as the most effective measure to prevent unintended access of pre-school aged children to the swimming pool area.

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