

Original Article - Water Safety Strategies Worldwide: Lessons from how nations address the drowning risks posed by aquatic environments

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Paulo Franco Rosa  Lúcio Franco Rosa 

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ABSTRACT

It is unfortunate that drowning claims more lives than many diseases, yet it does not receive the same level of attention as many non-accidental illnesses. Hundreds of thousands of deaths occur annually, with most countries failing to address the problem adequately. However, in recent years, a significant concern raised by the World Health Organization (WHO) has prompted a comprehensive investigation into the impact of drowning on national economies. This has raised awareness among governments, leading to the emergence of programs and initiatives developed with the support of the WHO and other organizations that have long addressed the issue, such as the International Life Saving Federation  local fire and lifeguard departments. Some of these initiatives have achieved notable success by focusing on community education, investing in infrastructure in high-risk areas, providing extensive training for rescuers, or managing a mix of all these approaches. Regardless of the format adopted, dozens of projects have proven effective. The goal of this article is to extract the "best of both worlds" from these efforts to present the most comprehensive and practical overview of drowning prevention strategies applicable to the most diverse global contexts. In summary, our objective is to propose

practical strategies for drowning prevention and control based on a narrative review of a wide range of methodologies focused on concrete actions undertaken by governmental and non-governmental organizations worldwide.

INTRODUCTION

Global Scenario

Accidental deaths are difficult to prevent. How can we avoid tragic falls, fatal traffic accidents, or drownings? In most cases, education, awareness, and common sense play crucial roles—especially in the case of drownings, which, as we will see, are the third leading cause of accidental deaths, following traffic accidents and falls. Drowning has caused more deaths than diseases such as malaria, AIDS, and dengue fever, among other illnesses (1). In Brazil, for example—a country frequently cited for its extensive river network (the second largest in the world) and coastline (the nineteenth longest globally)—drowning was the second leading cause of death among children aged one to four until 2020; since then, it has become the leading cause. Besides, more than half of drowning deaths among children aged one to nine years occur in swimming pools (2). Nevertheless Brazil has implemented public policies to address this issue (3), it is concerning that approximately 70% of member countries in the World Health Organization's (WHO) European region lack policies related to drowning prevention (4). Analyzing the rest of the world scenario, the problem is even more severe: the Western Pacific and Southeast Asian regions each account for the largest number of drowning deaths, each representing 28% of the world's drowning deaths (3), while the African region accounts for approximately 22% (5).

Statistics

Statistical figures on drowning deaths vary among different entities, but have consistently remained in the hundreds of thousands for a long time. The UN Global Report in 2024 indicated approximately 300,000 annual deaths (3), slightly fewer than the previous report from 2014, which

recorded 372,000 deaths (6). In parallel, during the World Conference on Drowning Prevention held in 2013 in Germany by the International Life Saving Federation (ILS), a more alarming prediction was made: "500,000 people will drown worldwide" (1). However, the data suggest a decline in annual drowning deaths, possibly due to prevention initiatives implemented during that period. The first significant resolutions and reports addressing this issue were those mentioned above. Notably, in 2023, the WHO, during its 76th World Assembly, adopted its first resolution on drowning prevention (7,8), building on recommendations from a previous assembly (9). This resolution called on member nations to accelerate actions in this direction by 2029, assuming an official global estimate of 235,000 deaths per year (8), excluding drownings related to climate events such as floods and water transport incidents.

What Have Organizations Been Doing?

The primary initiatives to combat drowning have been led by the WHO, as demonstrated through resolutions, periodic reports, and publicly available help guides, such as "Preventing drowning: an implementation guide" (10), a guide that provides practical steps for evidence-based interventions and strategies; and also the "WHO Guideline on the prevention of drowning through provision of daycare, and basic swimming and water safety skills" (11), which is more focused on providing recommendations on daycare services and basic swimming and water safety training, aiming to prevent drowning among children in low- and middle-income countries.

Another prominent organization in the field is the International Life Saving Federation - ILS, which unites more than 140 national federations and attempts to standardize techniques, promote education, and conduct research. Its efforts integrate educational, sporting, scientific, and

political strategies to reduce drowning mortality worldwide. Among its main initiatives are the biennial World Conference on Drowning Prevention (WCDDP), which brings together scholars on the subject to share research on drowning prevention; and its leadership of the World Drowning Prevention Day campaign (July 25). Furthermore, its close relationship with aquatic rescue professionals increases each year through its educational sporting events, such as rescue competitions designed to encourage lifeguards to enhance their rescue skills and physical fitness. Since 1996, the ILS has promoted world aquatic rescue championships, bringing together thousands of athletes from dozens of countries, practitioners of the sport recognized by the International Olympic Committee - IOC (12,13).

Also involved in training professionals is the International Maritime Rescue Federation - IMRF, which conducts lifeboat crew exchanges, workshops, and events to share best practices and improve operational efficiency. The organization defines its mission as follows: "We are the global network of search and rescue organizations, professionals, volunteers, authorities, and industry partners, united by one purpose: to save lives at sea" (14). Since 1924, the IMRF has been working to strengthen rescue services through training, capacity building, and technical support, and currently has 160 members from 50 countries.

Many countries have relied on the efforts of NGOs and various public and private organizations that, even before the frequent warnings from the WHO, have actively engaged in campaigns, guidance, and training to combat drowning, such as the Royal National Lifeboat Institution in England (15), or SOBRASA (Brazilian Aquatic Rescue Society) (16), IDRA (International Drowning Researchers' Alliance) in the USA (17); and even the U.S. Consumer Product Safety Commission with its manual, "Guidelines for

Safety Barriers for Residential Swimming Pools: Preventing Childhood Drowning" (18)

What Countries Have Been Doing

Most often in partnership with official public, private, or non-governmental entities, several nations are leading relevant and exemplary strategies that can help outline practical roadmaps for tackling drowning. European countries address drowning prevention through a combination of public awareness campaigns, coordinated initiatives at national and local levels (often in collaboration with police and child safety associations), and adherence to international guidelines such as the UN World Drowning Prevention Day. Some countries, including the United States, Australia, England, Scotland, and Brazil, among others, have initiatives quite focused on the problem (which we will describe in this article) and have achieved significant results. All the countries mentioned in this article were selected based on carefully evaluated official documents.

The Cost of Drowning

Taking action against drowning is essential for nations, as the cost in terms of lives lost and developmental setbacks is very high. The economic impact calculated by the report "Hidden depths: the global investment case for drowning prevention" (19), published in 2023 by the WHO, is more than US\$ 130 billion annually in countries with a high incidence of the problem, accounting for up to 1% of GDP. In other words, drowning imposes a significant financial burden on modern economies and it is necessary to counterbalance this with the cost of concrete prevention actions. Furthermore, according to the WHO report, effective measures, which we will see in this article (e.g., providing childcare services and teaching basic swimming skills), would cost about 1/3 of what is lost (approximately US\$ 50 billion per year), resulting in substantial savings for these countries, in the range of almost US\$ 100 billion worldwide. In

low- and middle-income countries alone, where 90% of drownings occur, the potential savings would amount to almost half a billion dollars. Thus, the economic benefits of adopting effective drowning prevention strategies are increasingly evident. However, underestimation of the problem continues to impede action and investment. "The main reason is the lack of awareness regarding the seriousness of the problem, such as the number of people who daily expose themselves to the risk of aquatic incidents and the associated human and financial costs of these tragedies, whether fatal or non-fatal (21).

Underestimating the Problem

According to the UN, drownings account for approximately 8% of all accidental deaths worldwide, even when underreporting (22-24): "Underreporting of drowning deaths, misclassification of drownings as other causes, and current methods of categorizing drowning deaths can obscure the true global scale of drowning deaths" (24).

Drowning deaths related to disasters such as shipwrecks and floods are often not recorded as drownings. Additionally, non-accidental drowning deaths, including homicides and suicides, are frequently excluded from statistics. WHO data suggest that this categorization may lead to an underestimation of the total number of drownings by up to 50% (19). The major issue often lies in the lack of knowledge of the universal standard for defining drowning deaths. Consequently, doctors, nurses, first responders, coroners, and others rely on their individual assessments and interpretations of an incident based on their experience and the elements they possess at the time of death (22). It would be beneficial to have a clear, standardized definition proposed by the WHO and, more importantly, to apply it consistently to all cases involving "the process of suffering respiratory impairment due to submersion/immersion in a liquid medium" (25).

METHODOLOGY

Considering that the objective of this article is to suggest practical strategies to combat drowning—particularly for managers of public and private aquatic areas—based on a narrative review of a selected range of publications and reports focused on concrete actions undertaken by governmental and non-governmental bodies at various levels worldwide, we conducted a review of specialized literature, identified key aspects of the problem, and propose a comprehensive framework to systematize drowning prevention. This framework is grounded in an understanding of the various dimensions of knowledge into which the problem can be categorized. Our research emphasized widely disseminated official programs and practical reports of ongoing initiatives in different countries (shown in the Table) rather than academic studies, as our goal was to extract examples rooted in practical experience. Given the exploratory nature and the limited number of strategies selected, this study was designed to gather qualitative insights rather than produce statistically generalizable results. Therefore, the framework proposed here can serve as a foundation for more extensive studies on drowning prevention.

Most Commonly Used Strategies

A comparative analysis of regional, international, and global strategies for drowning prevention or control (see Table) identified three primary dimensions: education, infrastructure, and first aid. These dimensions have guided the implementation of various actions with varying degrees of permeability. Apparently, greater permeability correlates with more effective outcomes. The Table presents the strategies employed by countries that have achieved satisfactory results in drowning prevention. Between 2014 and 2024, countries that invested in this type of preventive action transitioned from being leaders in mortality rates (26) to becoming exemplary models of successful planning,

including Russia, India, Brazil, and several European nations.

In contrast, some developed nations, such as Japan and certain parts of Europe, have experienced increasing drowning rates during the same period. By comparing these countries with those that have obtained better results in combating the problem based on the main strategic approaches examined in this article, it is possible to identify shortcomings in some tactics. These insights will guide the implementation of best practices, which "depend on multidisciplinary, multisectoral action and are more comprehensive than any sector or organization can handle in isolation" (3), after all, the management of the three dimensions of the problem that we suggest here requires this complex conjunctural scope. Thus, Japan, for example, which maintains a high mortality rate, has not invested sufficiently in multidisciplinary movement, its national prevention strategy and its legislation regarding the infrastructure for building swimming pools is flawed or non-existent, in addition, there is a lack of regulations that prevent the consumption and/or sale of alcohol near public bodies of water, and there is a lack of incentive for educating bathers who could avoid accidents caused by the ingestion of alcohol near water. In other words, the failure to manage the permeability of the three dimensions of drowning prevention can lead developed nations to fail in combating the problem. Continuing with this example, while Japan has a rate of almost 6 drownings per 100,000 people, the United States has a rate of just over 1 drowning per 100,000 (in 2021). See Figure 1. Successful prevention requires careful orchestration between educational, infrastructural, and rescue components. Some developed nations act on all three dimensions, but err in managing them as watertight compartments. The permeability of strategies makes all the difference.

Although the methods used by the nations studied have not necessarily undergone academic

validation—with some exceptions—we focused on the practical results obtained and the similarities in the practices adopted. We concluded that all programs and initiatives aimed at combating drowning potentially fit within the developed framework. Therefore, we identified three cardinal areas/dimensions, and their resources:

- 1) Education (physical education and swimming teachers, child caregivers supported by manuals, first aid courses);
- 2) Infrastructure (engineering, safe construction, administrators employing barriers, protective nets/covers, rescue equipment, legislation);
- 3) First Aid (first responders, multidisciplinary team, supported by training, courses, and specialized competitions).

Together, these three intertwined areas or dimensions of knowledge constitute a valuable tool for assisting in planning processes and in understanding the challenges of drowning prevention.

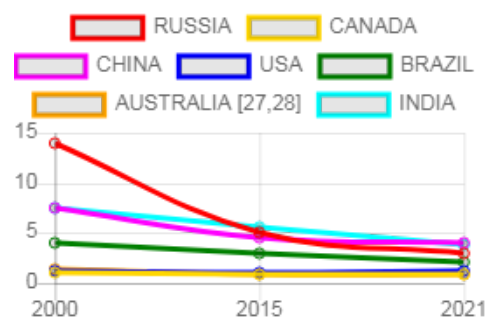


Figure 1. Evolution of the annual drowning mortality rate estimated by the WHO per 100,000 inhabitants in the largest* countries in the world from 2000 to 2021 (6).

*Geographic area.

COUNTRIES / ENTITIES / PRO- GRAMS (A- Z)	Education	Infrastruc- ture	First Aid
AUSTRA- LIA (AUS- TRALIAN WATER SAFETY STRATEGY - 2030)	Opportunity for people of all ages and back-grounds to le-arn to swim and save lives Opportunities for professional development and meaningful engagement of volunteers, tea-chers and lifeguards	Creating safer aquatic environments Partnership with SLS Surf Life Saving	The aquatic safety sector depends on a diverse, skilled, and proactive workforce, including volunteer li-feguards, swimming instructors, and he-althcare professionals
AUSTRA- LIA (Royal Life Saving - Aquatic Health di- rections for people in Australia)	Know your swimming abili-ties. Remember to always stay alert and within arm's reach Alcohol and wa-ter don't mix. Alcohol con-sumption can significantly in-crease the risk of drowning	Beach warning flags Lifeguards on duty Weather fore-cast before and during, as conditions can change rapidly,	Life jackets for each activity and body type Beach or pool with li-feguards on duty

		especially in the water	
BRAZIL (SOBRASA - Representative of Brazil in the International Federation of Water Rescue)	Educational programs: Pool+Safer, Surf-Save and Diving+Safe	Recommendations and complete material available for download on water safety signage	Programs: First Aid, Sports Aquatic Rescue, Rescue School, Junior Lifeguards and Volunteers
SCOTLAND (Water Safety Scotland)	To promote and develop swimming learning, water safety education and initiatives in the early years, primary schools and secondary Ensure that all children have the opportunity to learn to swim Publish research on children's swimming at school age Promote the importance of	Support local authorities in developing a safety policy Water Security Facilitate workshops on policy development Share current water security reports, research, and policies	Partnerships with entities focused on aquatic rescue such as: RoSPA, Scottish Fire and Rescue Service, RNLI Lifeguards Scotland, among others

	school swimming • Encourage opportunities for children to experience water in a safe and controlled environment		
USA (CDC's Model Aquatic Health Code - MAHC)	The functioning of aquatic facilities can be improved through engineering, education, and oversight	Health authorities must play their fundamental role in overseeing the design and construction, advising on operation and maintenance and helping to inform policies and management; working closely Collaboration with those responsible for building codes and strengthening the overall coordination necessary to prioritize health in aquatic facilities	Aquatic facilities should not be opened to users, unless safety equipment is present and in safe and working condition: Emergency communication equipment, first aid equipment, signage and warnings, safety equipment Mandatory equipment in facilities with lifeguards (long immobilization board and its components, immediately available rescue buoy, signaling device such as a whistle or other signaling device, rescue throwing device, reach pole)

USA (U.S. National Water Safety Action Plan)	Programs: Water Safety, Water Competence, and Swimming Lessons (WS WC)	Barriers, Enclosures, and Electrical Safety (BEE) - using pool fences, alarms, and emerging technologies to reduce unintended access Water, and employing measures to reduce entrapment and electrocution	Increase the use of U.S. Coast Guard-approved life jackets by boaters, as well as those engaging in recreational activities in or near the water Rescue and CPR (Res CPR) - promote and enhance rescue and resuscitation of drowning victims by laypersons, lifeguards, and emergency medical professionals Lifeguard and Supervision (LG SUP) - To enhance protection and supervision by parents, group leaders, and lifeguards of those in and near all types of open water, pools, and around the home
NETHERLANDS (Ministry of Health, Welfare and Sport - Teaching children to swim safely	The Swim ABC program is a national teaching program that focuses not only on swimming technique, but on "aquatic safety," teaching children	Advanced engineering for dikes, storm barriers and pumps (modern mills) to prevent flooding and inundation of	Reddingsbrigade Nederland partnership with the INTERNATIONAL WATER RESCUE FEDERATION: volunteer members act as lifeguards during the summer season. Lifeguards have modern equipment at their

with Swim ABC)	how to survive in open water and swim with clothes Public Awareness: Campaigns such as "Getting in and out of the water safely" ("Entering and exiting the water safely") educates about the dangers of currents and temperature changes in open water	inhabited areas	disposal, from inflatable fast rescue boats to radio communication.
EN-GLAND (Greater Manchester Fire and Rescue Service)	Program: Float to Live	The 999 line contacts firefighters or coast guard	Orientation events held in high-risk areas, where safety equipment such as reach poles and tow/throw ropes are installed so that people know how to use them and what measures to take if someone has problems in Water
EN-GLAND (The UK Drowning Prevention Strategy - National Water Safety	All children should have the opportunity to learn to swim and receive water safety education from primary school (Swim Safe Partnership)	Swim Safe Program: Most young people learn to swim in an indoor pool, which is a safe and familiar environment	Children aged 7 to 14 can attend a free 45-minute session that includes beach safety advice provided by RNLI Partnership lifeguards and up to 30 minutes of water lessons with Partnership-accredited

Forum Strategy Working Group (NWSF))			instructors from ASA - Amateur Swimming Association
RUSSIA (EMERCOM (Ministry of Emergency Situations))	Public Education and Awareness: Intensive water safety campaigns and first aid lessons were conducted, including interactive games and training for children (as in Moscow and other regions), focusing on drowning prevention and safe behavior Combating Alcoholism	Ministry of Emergencies: The ministry has increased surveillance, especially in unorganized recreational areas, identifying thousands of high-risk locations and conducting safety inspections on beaches (bottom cleaning, depth monitoring).	Creation of "organized beaches" with the presence of lifeguards and paramedics, in addition to the delimitation of safe areas with buoys, has reduced the number of accidents in unauthorized locations. Training of Rescue Teams: Focus on improving Efficiency of emergency services and training of bystanders in rescue and resuscitation
THAILAND (MERIT MAKER - Thai Stop Drowning)	Implementation of drowning prevention programs in child development centers Training of children aged 6 to 14 in survival swimming	Implementation of safety measures in locations with risk of water contamination Organization of public communication sessions	Training of Community members or children undergoing cardiopulmonary resuscitation (CPR) Appointment of survival swimming instructors

Program: Could
you float for
four hours?
Drowning pre-
vention pro-
gram saves
children

Table. Successful regional, international and global strategies for preventing or combating drowning.

RESULTS

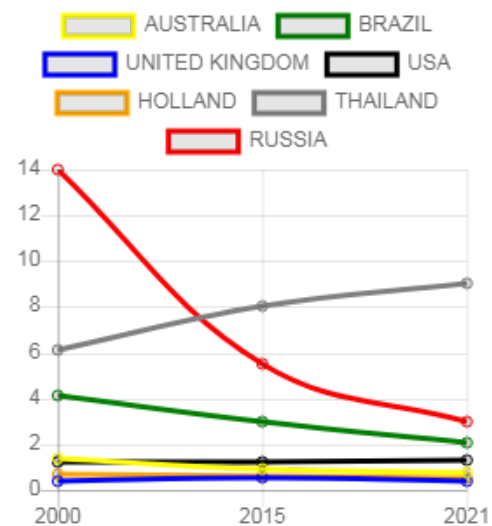


Figure 2. Death rate over time of the nations surveyed (Table) per 100,000 inhabitants (Year/Rate) (A-Z) (3)*.

*Some of the countries in this chart initiated relevant drowning prevention programs after 2021.

Figure 2 presents the results of the actions undertaken by various nations, as detailed in our Table. However, it is important to note that the graph includes only data up to 2021 (sourced from the WHO), and some of the initiatives we analyzed were implemented or had a more significant impact after this date. Thailand, which appears in our Table for its exemplary program focused on children's swimming, unfortunately, stands out from the other countries in Figure 2, as the government program Merit Maker was launched to prevent childhood drowning, yet the total number of drowning deaths remains a serious issue, particularly among the adult population. The mortality rate has increased from 6.1/100,000 to 9/100,000. In any case, the highlights of the Thai program aimed at children include: in the area of education, the implementation of drowning prevention programs in child development centers, with training for children aged 6 to 14 in survival swimming, where the "Could you float for four hours?" challenge campaign stands out; in the area of infrastructure, the implementation of safety measures in locations at risk of water contamination and the organization of public communication sessions are carried out; and finally, in the area of first aid, emphasis is placed on training community members or children in cardiopulmonary resuscitation (CPR) and the appointment of survival swimming instructors.

Featured Countries

Russia

We could not overlook Russia in our analysis, as the country successfully reduced its mortality rate in 20 years, from 14/100,000 to 3/100,000. As a nation with a typically centralized economy,

initiatives to combat drowning are government-led through the Ministry of Emergency Situations (34). Between 2000 and 2021, according to our data, this ministry addressed the three dimensions of drowning prevention with education strategies (intensive water safety campaigns including games for children); infrastructure (increased surveillance in unregulated recreational areas, safety inspections on beaches involving bottom cleaning and depth monitoring); and rescue operations by managing the so-called "organized beaches with the presence of lifeguards and paramedics, in addition to delimiting safe areas with buoys, and training rescue teams.

Brazil

Similar to Russia, Brazil has also achieved a significant reduction in drowning rates (from 4.1/100,000 to 2.1/100,000). The legislative advancements previously discussed have been very helpful, but are mainly focused on public swimming pools regionally, lacking enforcement for private pools. The efforts of SOBRASA, an NGO founded in 1995 with the goal of reducing drowning incidents in Brazil through various initiatives, complement the legislation (infrastructural dimension), with work in the educational field (programs such as "safer pool," "surf-rescue," and "safer diving") and in the area of first aid with programs focused on rescue, aquatic sports rescue, rescue school, and junior lifeguards.

Apart from the nations mentioned earlier, which received atypical attention, we now turn to countries with a tradition in drowning prevention that have maintained average rates of 0.4/100,000 to 1.4/100,000 in recent decades: Australia, the United States, the Netherlands, and the United Kingdom. These countries appear at the bottom of the graph in Figure 2.

Australia

Australia (0.8/100,000) has a significant emphasis on education and public awareness. Royal Life Saving promotes the message: "Drowning prevention starts with you." The country offers comprehensive swimming and rescue training programs for individuals of all ages and backgrounds. In terms of infrastructure, Australia enforces national and local legislation mandating fencing around private and public swimming pools; safety regulations for domestic water passenger transport, compulsory use of life jackets on boats; and restrictions on the consumption and/or sale of alcohol near public bodies of water. Regarding first aid, their beaches and pools are consistently staffed with lifeguards managed by Royal Life Saving. This high density of lifeguards is recognized as a global standard of excellence.

United States

In the U.S., positive outcomes result from a complex array of strategies that, while not necessarily intertwined, complement each other effectively. In the educational sector, three programs are coordinated under the U.S. National Water Safety Action Plan - USNWSAP (29): "Water Safety", "Water Competence" and "Swimming Lessons". USNWSAP was formed in 2014 to promote collaboration among national organizations dedicated to reducing drowning and aims to create a consistent framework for drowning prevention messaging. It comprises a roundtable of national non-profit organizations and government agencies. However, it is in the area of infrastructure where Americans particularly excel, with comprehensive legislation at both the national level (a policy for disaster risk management that specifies drowning and regulations ensuring the safety of waterborne passenger transport within the national territory) and regional level (regulations for fences around private swimming pools, legislation for fences around public swimming pools, laws mandating life jacket use on boats, and restrictions on the consumption and/or sale of alcohol near public

bodies of water). The result is that rescue operations become significantly more efficient when supported by effective infrastructure.

The Netherlands

The three dimensions of drowning prevention are deeply ingrained in Dutch culture, largely due to the country's geographical characteristics. In the educational domain, the "Swim ABC" system is a national teaching program that emphasizes not only swimming techniques but also "water safety," teaching children how to survive in open water and swim with clothes on – about 98% of young Dutch people have one or more swimming diplomas. Furthermore, there is strong social awareness fostered by campaigns such as "Getting in and out of the water safely," which educate the public about the dangers of currents and temperature changes in open water. In the infrastructural area, once again, the cultural aspect contributes to the country's success. Although there is no specific legislation governing the fencing and construction of swimming pools, the Netherlands has an extensive network of dikes, storm barriers, and pumps (modern windmills) to prevent flooding in inhabited areas, thereby reducing the risk of mass drownings—a type of drowning often unrecorded in official statistics and potentially accounting for a significant proportion of unreported fatalities. Finally, in the area of rescue, the country has a partnership with Reddingsbrigade Nederland, an organization that encompasses 180 rescue brigades nationwide and more than 31,000 volunteer members trained to perform aquatic rescues, as well as provide first aid and resuscitation. This training program begins at age five with swimming lessons.

United Kingdom

The countries of the United Kingdom have maintained an average drowning rate of 0.5/100,000 for decades, meaning less than one death per 100,000 inhabitants. A comprehensive strategic plan is coordinated by National Water

Safety, a UK government organization, while other countries have their own initiatives, such as Water Safety Scotland, which has published its own document, Scotland's Drowning Prevention Strategy (33). In the United Kingdom, although there is no legislation mandating the fencing of public or private swimming pools nor legal prohibitions on alcohol consumption near bodies of water, the emphasis on education has been crucial. All children should have the opportunity to learn to swim and receive water safety education from primary school onwards (partnership with "Swim Safe"). In addition, they have implemented the "Float to Live" program (35,36), which focuses on teaching simple flotation techniques, even to those who cannot swim. In the area of infrastructure, the objective is to mobilize resources and investments aimed at drowning prevention, ensuring that all communities with water-related risks conduct water safety risk assessments and develop water safety plans. First aid education begins in childhood, and children can attend beach safety sessions provided by lifeguards through partnerships with rescue organizations, which include in-water lessons taught by instructors accredited by the other partner, the ASA - Amateur Swimming Association.

DISCUSSION

Overview

Examining the three dimensions of drowning prevention (education, infrastructure, and first aid), education has indeed been the main weapon against adversity. All countries that have invested in this area have consistently achieved success. Addressing the educational dimension involves both philosophical and practical considerations, including the implementation of safety policies and programs for learning swimming, rescue techniques, and related activities. The infrastructure dimension depends heavily on investment; therefore, policies must be financially grounded to ensure the safe construction of

facilities and effective management of aquatic environments. Finally, the first aid dimension is multidisciplinary, encompassing local policies, community involvement, and specialized training and expertise.

General Comparison of Methods of Action

Analyzing the most successful ongoing strategies to combat drowning worldwide reveals the necessity of involving individuals, communities, and organizations with the support of governmental entities at all levels. Isolated efforts have a lower chance of success. However, it is also possible for strategies to be managed by different bodies that do not collaborate directly but focus on actions that ultimately contribute, even if each operates within its own sector. For example, the United States has extensive and rigorous legislation regulating the construction of swimming pools (infrastructure dimension), which is politically mandated and independent of the actions of the USNWSAP (U.S. National Water Safety Action Plan) (29), the country's anti-drowning plan, which obviously relies on legislation for the success of its educational recommendations (educational dimension). And finally, they have entities focused on training first responders, such as the American Red Cross or the United States Lifesaving Association (first responder dimension). In other words, the U.S. employs a decentralized and not entirely pervasive strategy, where everyone ends up communicating indirectly enough to ensure a low drowning mortality rate compared to other countries.

However, it is also important to highlight strategies from countries that have focused directly and centrally on the community. For example, while the USNWSAP in the United States makes a general appeal to people across various sectors, agencies in other countries intervene directly within communities by carrying out concrete actions such as rescue and swimming courses, enforcing safety measures in

high-risk locations with community support, and seeking funding in a more unified manner. In these cases, a single entity manages all three dimensions of the problem. A typical example of this approach is Thailand (a country that managed to reduce drowning rates in the mid-2020s), where a single government agency supports an initiative entirely managed by the community itself. This initiative has effectively prevented drowning, especially among children, through actions that involve measures such as skills training for children (education), water risk management with community participation (infrastructure), and the creation of volunteer networks (first aid) (30,31).

Definition of Management Players: 3 Types of Management

In most countries, entities focused on combating drowning fall into two main categories. The first includes official bodies that generally work on injury prevention, such as health centers, fire departments, and government agencies. The second category comprises specialized bodies specifically focused on drowning prevention, such as NGOs, forums, councils, and national or local associations. Entities in the first category typically operate through sector-specific campaigns, whereas those in the second category engage in ongoing, permanent efforts. A third, less common model involves a national official body dedicated exclusively to drowning prevention. Organizations in the second category tend to be more prominent in countries where entities in the first category are well-structured and proactive, as they can leverage existing official systems with guaranteed funding. Associations and NGOs (Non-Governmental Organizations) can and frequently do use structured official bodies (public agencies) to carry out activities that benefit society, often receiving technical, financial, or logistical support. In Brazil, for example, this relationship is regulated by law.

In the first type of management, more generic goals focused on injury prevention stand out, which includes drowning. The main actor in this area is the fire department, which, in some countries, leads exemplary campaigns such as "Float to Live by the Greater Manchester Fire and Rescue Service (England), an educational program that teaches businesses and residents vital water safety tips. Also encompassed within this type of management is the safety legislation of various nations addressing risks in aquatic environments. The United States has a particularly relevant and comprehensive code in this field. The CDC's Model Aquatic Health Code – MAHC (32) is a guide to preventing injuries and illnesses related to aquatic venues—such as swimming pools, hot tubs, and children's water parks—that are open to the public. This guide consolidates the latest scientific information and best practices to help jurisdictions save time and resources when developing and updating pool codes. These are federal regulations that cover topics such as the construction of aquatic facilities, the training and certification of lifeguards, and the monitoring of chlorine levels in water.

The Netherlands exemplifies a model of triple management: a country with a robust governmental structure (the first type of management) through the Ministry of Health, Welfare and Sport, which oversees the educational program "Teaching children to swim safely with Swim ABC with a strong emphasis on drowning prevention (almost a third type of management, given the sector's scope) (33). Additionally, it benefits from the support of non-governmental organizations (the second type of management) through an indirect partnership with the International Lifesaving Federation - ILSF in the area of rescue. The country's geography (11% of the total surface area of the Netherlands is composed of open water and 26% of the country is below sea level) led to this hybrid approach, which stands out globally, with a drowning rate of 0.5 deaths per 100,000 inhabitants. However, there is still no legislation

mandating fences around swimming pools or prohibiting alcohol consumption in these areas.

Administrator Tools: Infrastructure and Legislation

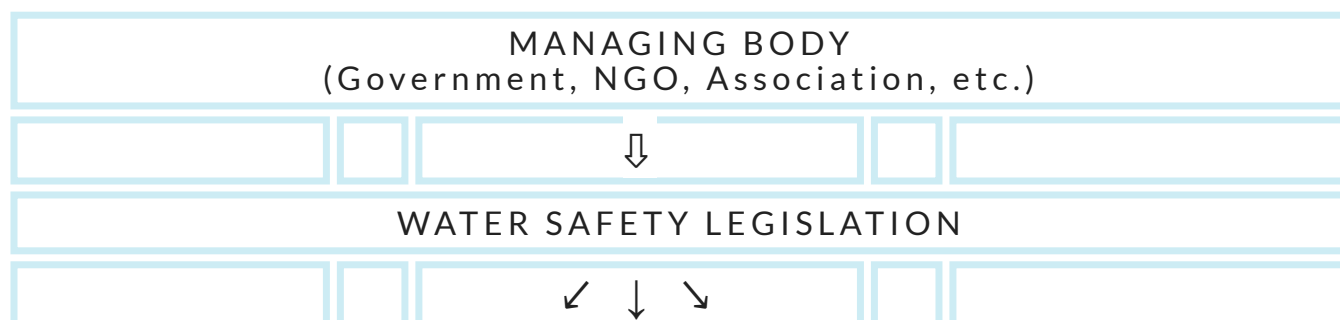
The implementation of prevention strategies depends on adequate infrastructure, and infrastructural solutions rely on laws and enforcement applied to aquatic areas, which remain underdeveloped in most countries. According to the WHO, few countries have invested sufficiently in this sector. "Legislation on pool barriers is worryingly scarce, with only 9% of countries reporting national laws for public pools; 1% reporting national laws for private pools; and 4% reporting national laws for both public and private pools" (3)

Some examples of the application and use of legal tools include the USA, Australia, France, and Brazil. Our table highlights examples from the United States and Australia. The USA, with its specific legislation focused on aquatic areas, employs the CDC's Model Aquatic Health Code (MAHC) to regulate aquatic facilities, which should not be opened to users unless safety equipment is present and in safe and functioning condition: emergency communication devices, first aid supplies, signage and warnings, mandatory safety equipment in facilities with lifeguards (long immobilization board and its components, immediately available rescue buoy, signaling device (e.g., a whistle), a rescue throwing device, reach pole). Australia and France also have strict legislation regarding pool safety, requiring fences and other safety devices according to the type of pool; however, France exemplifies that

legislation and infrastructure alone do not guarantee the elimination of drownings, as the country continues to experience high numbers of fatalities, raising questions about the effectiveness of its strategy. Brazil, which has been active in the areas of education and first aid (mainly through a single entity, SOBRASA - the second type of management), has made significant progress in infrastructure since 2018, when it established important safety standards covering residential and public swimming pools. Federal legislation (related to the first type of management) has been very helpful, particularly the technical standard NBR 10339/2018, which addresses technical details such as filtration, suction, bottom drains, grates, skimmers, return nozzles, suction devices, emergency equipment, electrical systems, physical isolation of access, safety signage, life-saving equipment, ladders, etc.

FINAL CONSIDERATIONS

The data shown in Figure 2 (including Thailand) (37) were achieved based on the operational coordination by drowning prevention organizations (government, NGO, association or other) of an efficient roadmap supported by aquatic safety legislation to deliberate on the strategic areas of education, infrastructure and rescue in a way that permeates these areas, relying on teachers, managers and multidisciplinary personnel to support rescue, who in turn received adequate support regarding training, engineering, documentation, courses and other drowning prevention resources. This framework is clearly illustrated in Figure 3.



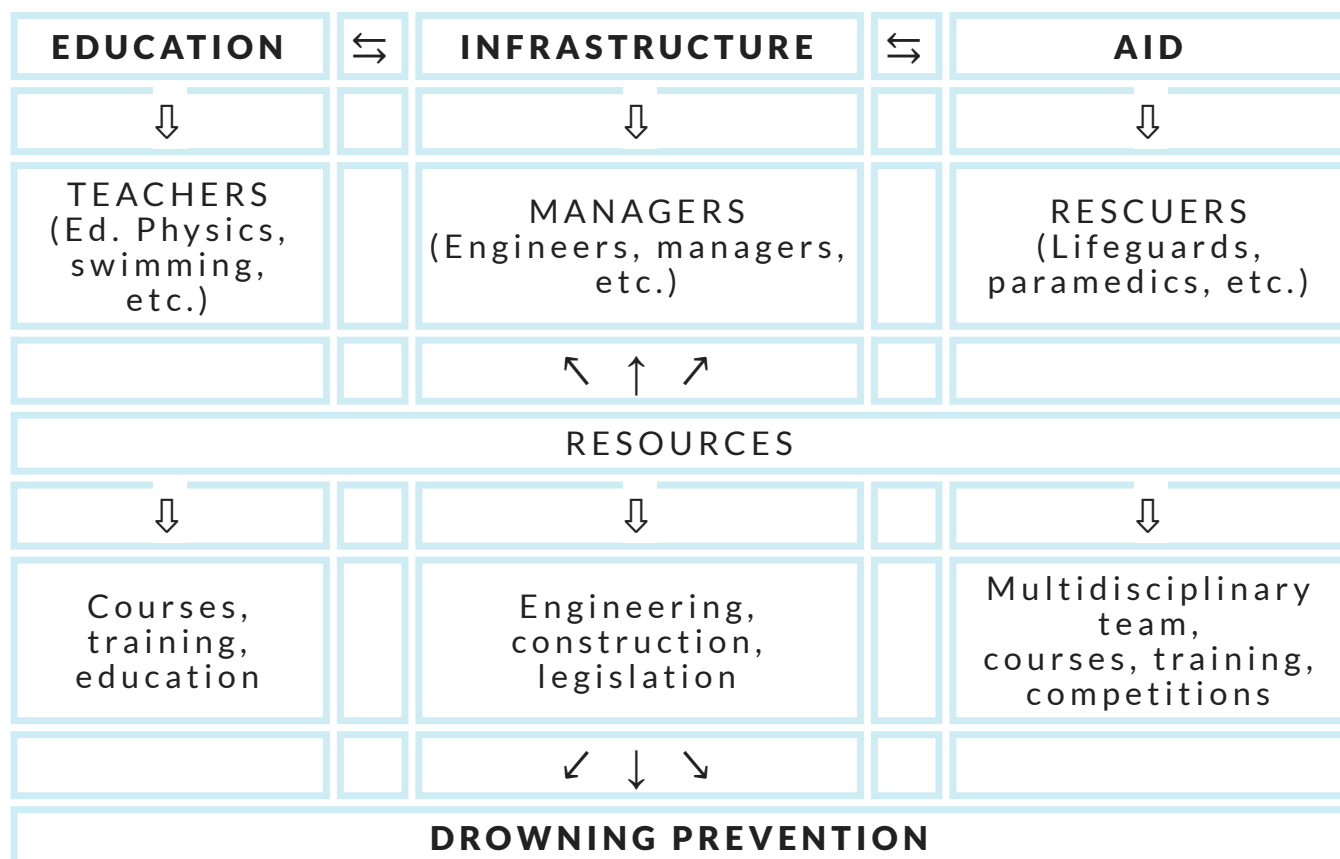


Figure 3. Organizational chart for drowning prevention.

Suggestions

Educational Area

It is essential to provide opportunities for people of all ages and backgrounds to learn to swim and save lives, as well as professional development and meaningful engagement of volunteers, teachers, and lifeguards. Educational programs focusing on swimming, surfing, and diving should include swimming lessons and water safety education from the earliest years in primary and secondary schools, ensuring that all children have the chance to learn to swim. Additionally, research on children's swimming at school age should be widely disseminated. Furthermore, the operation of aquatic facilities can be enhanced through improvements in engineering, education, and oversight, emphasizing the importance of water safety, focusing not only on swimming techniques but also on water safety, teaching

open water survival (swimming with clothes on, for example). Also in the educational area, it is important to create public awareness of the problem through awareness campaigns, such as "alcohol and water don't mix," meaning it is necessary to make people aware that alcohol consumption can significantly increase the risk of drowning.

Infrastructure Area

Public policies aimed at creating safer aquatic environments benefit everyone. In addition to reducing drowning incidents, it is essential to promote the development of water safety skills and encourage healthy physical activity. Local authorities should prioritize the creation of comprehensive water safety policies and collaborate in the supervision of development projects, advising on operation and maintenance and helping to underpin policies and management; working with those responsible for building codes and strengthening the overall coordination necessary to prioritize health and safety in aquatic facilities; it is also important that

every community with water risks undergoes a safety risk assessment. Finally, it is important to increase surveillance, especially in public recreational areas, identifying risk locations and conducting safety inspections in aquatic areas (bottom cleaning, depth monitoring) implementing safety measures in locations with a risk of water contamination, among other hazards.

Lifesaving Area

The aquatic safety sector relies on a diverse, qualified, and proactive workforce, including volunteer lifeguards, swimming instructors, and healthcare professionals. Central to this are opportunities for professional development and meaningful engagement of people. Awareness campaigns should be among the most important activities in lifesaving: for example, "If you are swimming alone, make sure to choose a place with lifeguards on duty." Additionally, teams must be trained through programs in First Aid, Aquatic Rescue, Sports Rescue, and rescue training specifically designed for children. Rescuers, whether volunteers or professionals, must be capable of performing aquatic rescues and trained to provide first aid and resuscitation to victims. Partnerships significantly support rescuers by collaborating with organizations focused on aquatic rescue, such as NGOs and firefighters, among others. An important rule of first aid concerns access—prevention is better than cure. Therefore, aquatic facilities should not be open to users unless safety equipment is present, properly maintained, and in safe and working order. This equipment includes emergency communication devices, first aid supplies, signage and warnings, mandatory safety equipment in facilities with lifeguards (long immobilization board and its components, rescue buoy, signaling device such as whistle or other signaling device, rescue throwing device, reach pole), life jackets, personal flotation devices and others.

In conclusion, our article identifies three key strategies for drowning prevention: education, infrastructure, and first aid. It also presents a work plan that organizations can adopt to prevent and combat drowning in a systematic and structured manner. Based on examples from the countries studied, we suggest that efforts should primarily focus on education and first aid, supported by substantial infrastructural investments underpinned by a legal framework.

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FOOTNOTES

^(a)Alternative access to the Preventing drowning: an

implementation guide: <https://revistanadar.com.br/index.php/Swimming-Magazine/article/view/106>

^(b)The main difference between drowning prevention and response (or rescue) lies in the timing of the intervention:

prevention takes place before the victim is in danger, whereas response occurs during or after the drowning process has begun. According to SOBRASA, prevention is considered the most effective and cost-efficient measure, capable of averting more than 99% of cases. ⁽¹⁶⁾

