

Factors Affecting Lifeguard Recognition of the Submerged Victim. Implications for Lifeguard Training, Lifeguarding Systems and Aquatic Facility Design

Author: Larry Patterson, BSc, Technical Director

Lifesaving Society, 11759 Groat Rd., Edmonton, Alberta, Canada T5M 3K6

Email: larryp@lifesaving.org

Tel. 1-780-415-1755 Fax: 1-780-427-9334

Abstract

In 2003 the Lifesaving Society began a research study to evaluate the ability of lifeguards to see and recognize a submerged victim located on the bottom of a swimming pool. This research was conducted in a variety of different aquatic facilities with different water depths, lighting levels, pool wall/bottom colors, water features and activities. The purpose of the research was to determine the various factors that affected recognition of submerged victims and develop strategies to help lifeguards improve submerged victim recognition. The result of this research is an understanding of the difficulty lifeguards face when scanning the pool bottom and the factors that affect their ability to recognize a submerged victim. Examples of these factors include positioning of lifeguards, fixed vs. patrolling lifeguard positioning, design of the pool, type and location of lighting sources as well as the lifeguards' expectation about what they should be able to see and recognize. The Lifesaving Society has applied this research to improve Society training programs for lifeguards as well as develop criteria for aquatic facility design and operation that can improve the ability of lifeguards to recognize and respond to a submerged victim.

Introduction

For more than 15 years, the Lifesaving Society in Alberta and Northwest Territories, Canada has provided consultation services that assist the owners and lifeguards of public aquatic facilities to develop lifeguarding systems that are optimized to meet the needs of their specific facilities. This service included activities to critically evaluate the facility to identify factors such as blind spots and glare that the lifeguard supervision systems must be able to effectively manage. The process also included using recognizable landmarks on the pool bottom; eg. lane markings, to evaluate the ability of lifeguards to see the pool bottom from various lifeguard positions. The assumption was that if lifeguards could see the lane markings on the pool bottom, they would be able to see and recognize a submerged victim. Beginning in 2003, we introduced using a submerged manikin to evaluate victim recognition. The result was startling. The lifeguards were often unable to see or recognize the submerged manikin. In many situations, if the manikin was placed beside a lane marker, the lifeguards could see the black line of the lane marker, but were not able to see or recognize the submerged manikin. Based on these results, the Society began studying the factors that affected the ability of lifeguards to recognize a submerged victim. The results of this research would be applied to develop strategies to improve lifeguard recognition of submerged victims.

Methods

A submerged manikin simulating a small caucasian boy was used to evaluate the ability of lifeguards to see and recognize a submerged victim at a public swimming pool or waterpark. The facilities used for the testing ranged from simple, rectangular 6 lane by 25 m pools to aquatic leisure centres and waterparks with multiple tanks, waves, spray features, waterslides and other features which added complexity to the lifeguard scanning and recognition tasks. Water depths in the test facilities ranged from less than 30 cm to 5 m. The subjects were experienced staff lifeguards at each of the test facilities. The lifeguards were lead through an exercise to critically analyze the pool space to identify the various factors which affect their ability to supervise

bathers and recognize someone in distress. This analysis included using the submerged manikin to evaluate their ability to see and recognize the manikin under a variety of conditions. These conditions included different distances and elevations between lifeguard and manikin location, lighting levels, different sources of surface turbulence and underwater turbidity, background color of the pool bottom and walls, and different customer activities.

Results

When observing a calm empty swimming pool, lifeguards reported that they could easily see markings on the pool bottom such as the lane lines and T-markers. It was very easy to assume from that experience that a body on the pool bottom could be easily seen and recognized. But the reality was very different. With undisturbed water conditions, the lifeguards often found that they were unable to see the manikin on the bottom when it was only 10 m away from their lifeguard position. In order to find and recognize the manikin, the lifeguards could not stand in a single location and had to move constantly in order to get very close to the manikin's location. As part of the procedure, the lifeguards developed lifeguard patrols that allowed them to effectively see most of the pool bottom by moving through a range of positions. This testing also confirmed that positioning the lifeguard in an elevated lifeguard stand did not improve their ability to see and recognize the manikin. Elevated lifeguard stands from 1.8 to 3.0 m in height were tested. We also found that water depth and the color of the pool walls and bottom affected the visibility of the manikin. Deeper water and darker bottom/wall colors (even light blue) made it more difficult to see and recognize the manikin.

Our research identified a number of factors that further reduced the visibility of the pool bottom and the ability of lifeguards to see and recognize a victim located on the pool bottom. These factors included: glare from lights and windows, reflected images, the number of people in the pool, sightline obstructions such as pillars or play structures, air bubbles suspended in the water and turbulence caused by moving water from spray features, wave generators, water slides or the movement of swimmers.

Discussion

The key result of this research is an understanding of the difficulty lifeguards face when scanning the pool bottom and the strategies they need to use to recognize a submerged victim. A common assumption has been that if the water clarity is very good, the lifeguard should be able to easily recognize a submerged victim and respond quickly to rescue the victim. Another assumption has been that lifeguarding from an elevated lifeguard stand (typically 2-3m elevation above deck) improves this recognition. The Lifesaving Society research confirmed that both of these assumptions are false. The research found that the lifeguard must be very close to the victim – less than 10 m with calm water and as close as 2 m if there is surface turbulence. It also explained why it is common for customers to be the first person to recognize a submerged victim and subsequently notify the lifeguards. By being in the water close to the victim, the customer could more clearly see the victim or may have tripped over the submerged victim.

When examining the expectations of the courts during lawsuits involving pool drownings, it will be necessary to realistically evaluate the Standard of Care for recognizing a submerged victim. Instead of being an easy task, it is very difficult for lifeguards to quickly see and recognize submerged victims. The probability is that if a lifeguard does not see and recognize the surface behaviors leading to the submersion event, there will be a significant delay before a lifeguard will recognize and respond to the submerged victim. If we expect a lifeguard supervised facility to rapidly recognize and respond to submerged victim, it will require more than a lifeguard on the pool deck. Realistically it requires a system to provide clear views of all of the underwater areas. This can be achieved by integrating underwater video surveillance as part of the lifeguard

supervision system. When integrating a video surveillance system, it will be important to ensure that it does not add more complexity to the lifeguard scanning tasks. Our analysis suggests that it requires a separate dedicated monitoring station that is linked with an effective communication system to the on-deck lifeguards.

With the design of modern aquatic facilities, lifeguards often have to manage features that obstruct their view of different parts of the facility. These features include sightline obstructions such as pillars, play structures, curved pool walls or ramps. Glare from lights and windows, reflected images of structures such as a diving board and the number of people in the pool also affects the ability of lifeguard to see below the water surface. The tested lifeguards all agreed that the best solution to managing these obstructions was using a system of walking lifeguard patrols to see around or behind obstructions and to minimize the impact of glare.

Turbulence caused by waves generated by pool equipment or swimmers is a very difficult challenge to manage. In addition to making it difficult to see the pool bottom, wave turbulence also distorts the image making it very difficult to recognize the object on the pool bottom. Often the lifeguards could see a distorted shadow on the bottom that did not look like body or could be mistaken for a towel or t-shirt. In our testing, just the turbulence caused by a single person swimming over or near the manikin's location caused it to disappear from sight until the waves settled or the lifeguard could get closer (eg. within 2-5 m) to the manikin.

This wave turbulence has major implications for lifeguards and pool owners and the strategies they should adopt to improve lifeguard scanning effectiveness. The Lifesaving Society recommends that lifeguards should use these scanning strategies to help them see and recognize a person on the pool bottom:

- Do not lifeguard from a fixed location. In order to see a section of the pool bottom the lifeguard must move and get close to that section.
- Develop and follow walking patrols that optimize the lifeguards' ability to see the pool bottom throughout their lifeguarding zone or area of responsibility.
- Design the patrol paths to keep them short and minimize the time required to travel from the starting point and return to that point. The objective is to minimize the time between repeat observations of the pool bottom throughout the patrol area.
- Always closely inspect any object on the pool bottom and remove items (eg. t-shirts or toys) from the pool bottom. Because of image distortion from wave turbulence, a body may only appear as a shadow or look like a towel or shirt. Lifeguards should not base their victim recognition on the assumption they will see an obviously recognizable body.
- If a customer says there is a body or something on the pool bottom, inspect it immediately. A quick strategy to improve visibility is to put on goggles and put your head under the water to look at the bottom.
- Do not allow the use of sinking toys or other objects that will settle on the pool bottom and are large enough to cause false alarms. Allowing these types of toys will result in lifeguards learning to ignore objects on the bottom and increase the probability of not recognizing a submerged victim.
- Test your pool and analyze your lifeguard supervision system. Use a sinking manikin or other objects to measure how wave turbulence and other factors affect your lifeguards' ability to see an object or person on the pool bottom. Use this information to evaluate the lifeguard supervision system and adjust it for the needs of the specific pool.

The design of aquatic facilities should consider what steps can be taken in the design phase to minimize or eliminate features that negatively impact the recognition of a submerged victim:

- Color of pool walls and bottom should be white. White provides the maximum internally reflected light at the pool bottom to illuminate the victim. Commonly used colors such as light blue reduced the ability of lifeguards to recognize the manikin. The negative effect of the background color is magnified as water depth increases.
- Bubblers that inject air bubbles into the water column should be restricted to very shallow areas where the probability of a submerged victim is very low. This also applies to water spray features such as a water umbrella that create large areas of very turbulent water with lots of entrained air. It is also recommended that these features be operated so that only a small number are operating at the same time to reduce the area that has compromised underwater visibility. Requiring “Within Arms Reach” direct caregiver supervision of small children in these areas is also critical to minimize the risk of drownings in the area of these features.
- Selection, intensity and positioning of lighting sources must be designed to assist lifeguards and minimize or eliminate sources of glare on the water surface. Glare from light fixtures or windows creates a mirror effect on the water surface that prevents the lifeguard from seeing below the surface. The glare results from light reflected off the water from a light source located in front of the lifeguard. Designing the lighting system so that the light source is located behind the lifeguard position(s) can eliminate the glare. Glare can also be reduced by using indirect lighting sources or using light sources that produce a steep (eg. 90°) angle of incidence. Another factor to consider is increasing the intensity of the light source to match water depth. In Canada, building codes do not require increasing lighting levels for deeper water areas of a facility. The Society’s research found that increasing the lighting level for deeper water areas improved recognition of the test manikin.
- Design the layout of the facility to eliminate or minimize structures that create blindspots at or below the water surface for lifeguards. The design process for new facilities or renovations should include a sightline analysis to identify potential blindspots and avoid introducing them where possible. With careful analysis and design adjustments, architects can design aesthetically pleasing and exciting facilities that do not compromise lifeguard scanning effectiveness and public safety.

In Canada, the Lifesaving Society provides design consultation services to assist architects and facility owners to incorporate consideration of lifeguarding requirements as well as other public safety practices into the facility design process.

Conclusions

This Lifesaving Society research has demonstrated that recognizing a submerged victim is a difficult task for lifeguards. Careful consideration of facility design, operating practices, lifeguard training and lifeguard supervision practices can improve the recognition effectiveness of lifeguards. It also identifies the need for further research to improve recognition and evaluate the use of other solutions such as underwater video surveillance systems.

Learning Outcomes

- Understand the range of factors that negatively affect the ability of lifeguards to recognize a submerged victim in a swimming pool.
- Understand training practices that can improve lifeguard recognition skills.
- Understand safety systems such as lifeguard positioning that can affect the recognition of a submerged victim.
- Understand facility design elements that can positively or negatively impact the recognition and rescue of a submerged victim.