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The Lifeguard Rescue Reporting System: Survey Results from a Collaborative Data Collection Method

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Cover Page Footnote

The authors of this manuscript pay special tribute to Roy Fielding, M.A. who passed away before he could see the fruits of his labor on this original project come to fruition in the form of this publication. Roy spent most of his professional career at the University of North Carolina – Charlotte where the aquatic center now proudly bears his name. He was a giant among and champion for the aquatics community.

Abstract

Several water safety organizations have attempted to improve reporting regarding lifeguard actions in order to better understand the characteristics of successful, non-fatal rescues. In 2003, a collective effort initiated the Lifeguard Rescue Reporting System, an online survey distributed to lifeguards and facility managers across the United States and Canada to better understand rescue actions performed in pools/spas, water parks, and open water areas. After seven years of data collection, the online survey accumulated data reflecting 1,676 rescue actions, collecting information including location, victim characteristics and outcome, rescuer characteristics and strategies, and other general circumstances. Descriptive results indicated that at least half of victims were 14 years old or younger across all settings. Depths of 0.9-1.5m (3-5 ft) represented the range at which incidents most frequently occurred in pools and spas and waterparks, whereas the depth of incidents was generally deeper in natural and open waterways. During rescue incidents, water safety personnel generally identified victims either visually (83-92% of the time) and/or audibly (18-29%), although victim "profiling" was also employed 10-14% of the time to identify at-risk swimmers. Notably, across all three water setting types, no medical aid was required in most cases (60-72%), suggesting the efficacy and essentiality of lifeguards as aquatic first responders. Accordingly, as water-based recreation maintains its popularity, systematically collecting and analyzing data specific to everyday, rescue actions are critical to improving lifeguard education and strategic, data-based operating procedures.

Keywords: lifeguards, water safety, drowning, prevention, rescue, aquatics

Introduction

Water-based pursuits are an essential component of human life, and water safety is routinely advocated and monitored due to the serious risks associated with water-based recreational and occupational activities, such as injury and drowning (Morgan et al., 2008; Quan et al., 2012). According to the *Global Report on Drowning*, drowning is one of the top ten leading causes of death worldwide (World Health Organization [WHO], 2016). Concomitantly, attendance at beaches and other aquatic venues is estimated to number in the hundreds of millions of visits per year (United States Lifesaving Association [USLA], 2018). As such, when submersion and drowning-related incidents occur at recreational water sites, the successful rescue of victims is paramount**.**

Given the inextricable relationship between water-based activities and water safety, the provision of trained lifeguards allows for proactive preventative actions and swift responses to rescue swimmers and prevent drowning across water activity settings (Hunsucker & Davison, 2011; Quan et al., 2012). From 2014-2018, between 75,000-95,000 rescues were reported annually by lifeguard and lifesaving

organizations at beach and open-water aquatic venues (USLA, 2018); it is likely many thousands more were conducted at other locations, such as public pools. Beyond active rescues, millions of preventative and enforcement acts by lifeguards are estimated to be employed by lifeguards each year (USLA, 2018). As a result of these preventative and rescue actions, the likelihood of drowning at a beach monitored by lifeguards is estimated to less than 1 in 18 million (Branche & Steward, 2001).

Lifeguards, then, hold crucial roles as aquatic first responders. Due to this role in the prevention of and response to water-based incidents, understanding the greater context and details of lifeguard rescues can provide critical data to inform water safety initiatives. Therefore, the purpose of this study was to identify existing characteristics and patterns regarding real rescues initiated by lifeguards and facility personnel across water settings (pools and spas, waterparks, and natural and open areas). Results from this investigation sought to fill existing gaps in knowledge and better understand the differences between training preparation and actual rescue situations in order to inform lifeguarding training program design and implementation.

In recent years there has been mounting interest in prioritizing the use of data to drive programming, training, and policy decision-making within the lifeguard and water safety community. While federal data sets have provided robust data with respect to accidental drowning victims such as their age, gender, race, and ethnicity (Centers for Disease Control and Prevention, 2020a) and have also reported limited, nationwide details regarding nonfatal drowning/submersion rates (Centers for Disease Control and Prevention, 2020b), understanding the many circumstances surrounding rescue incidents remains an area for further inquiry and exhaustive data collection. This area—rescues reflecting nonfatal outcomes—is particularly important; due to underreporting, the characteristics, behaviors, and circumstances shaping nonfatal incidents are not well understood (Nyitrai, Edwards, & O'Dwyer, 2018). Centralized databases can provide opportunities to gather additional details regarding lifeguard rescue incidents such as their locations, attributes and strategies employed by the rescuers (e.g., location, equipment use), rescue characteristics (e.g., presence of other first responders), as well as the victim's characteristics, activity, and outcome. Through analysis of rescue video and rescuer reports, Avramidis, Butterly, and Llewellyn (2007) categorized four factors contributing to drowning incidences (2007); the 4W Model of Drowning provided a tool for training lifeguards in the dynamic factors that contribute to drowning, including (1) location, (2) causality characteristics (e.g., age, sex, and socioeconomic background of victim), (3) rescuer characteristics, and (4) general circumstances.

The characteristics associated with the swimming location (e.g., type of water body) represent important, contributing factors shaping incident outcomes. In the United States, more than half of drowning deaths are estimated to occur in natural water bodies and approximately one-fifth (17.7%) occur in swimming pools (Lin et al., 2015). Water depth also has played a contributing role. Whereas Venema et al. (2010) found that 95% of drownings occurred in water more than 1m (3.3 feet) deep, their sample of Dutch drowning incidents represented primarily open water drownings at sites such as canals, ditches, and lakes; other evidence indicated that serious injury and drowning frequently occur at shallow depths, particularly among children (Hunsucker &. Davison, 2011; Peden et al., 2018). Additionally, patterns in the characteristics of water incident victims have also been identified by organized, data-driven efforts to better understand lifeguard rescue data (Morgan & Ozanne-Smith, 2013; Moran & Webber, 2014). One study of beach rescues in Australia found that ocean-bathers identifying as male and young adults (under 30 years old) were subjects of lifeguard rescues more frequently than those identifying as female (Morgan & Ozanne-Smith, 2013). Similarly, a study examining lifeguard-beachgoer incidents in New Zealand indicated that most patients were male and younger than 16 years old (Moran & Webber, 2014), a demographic trend further supported by Avramidis, Butterly, and Llewellyn (2009c).

Rescuer characteristics (i.e., training, knowledge, experience, & ability) also represent key factors in determining the outcome of drowning incidents (Avramidis et al., 2007). Surveillance, scanning, and recognition practices represent critical skills for lifeguards who may benefit from additional training and continuing education on rescue techniques (Moran & Webber, 2013; Page & Griffiths, 2014). Hunsucker and Davison (2008) contended that basic scanning skills are essential to identify and recognize drowning victims. The Lanagan-Leitzel and Moore (2010) work provided empirical support to the cruciality of lifeguard training, particularly surveillance methods; they found that during a simulated experiment, experienced lifeguards paid more attention to critical swimming events than two groups of non-lifeguard participants (those briefly trained on identifying drowning behaviors and those without any training). Still, other research studying drowning incidents has indicated that on-duty lifeguards were able to visually recognize a drowning victim in only one-quarter to one-third of documented drowning cases (Avramidis, Butterly, & Llewellyn, 2009a). Evidence also indicated that lifeguard performance can be impacted by fatigue associated with water rescues and CPR, resulting in lower quality chest compressions, which further supports the need for additional lifeguards and trained supervisors to assist in rescues when necessary (Barcala-Furelos et al., 2013). Finally, among general circumstances, such as rescue type and aquatic activity, several factors were associated with rescue incidents (Avramidis et al., 2009d;

Morgan & Ozanne-Smith, 2013). For example, higher beach attendance has been associated with reported rescues (Morgan & Ozanne-Smith, 2013). Additionally, in the Avramidis et al. (2009d) inquiry on circumstantial factors, victims most frequently were engaged in swimming activities prior to drowning in contrast to boating (12.2%), other aquatic activities like diving and snorkeling (4.8%), driving (7.3%), air/space travel (7.3%), or walking on a frozen water surface (4.9%). More specific detail within the swimming category (e.g., swimming, wading, feet-first entry, floating with equipment) represents a gap in current literature.

Little is known regarding other circumstantial details from actual rescues; however, some evidence suggests that the majority of rescue actions are characterized as minor with respect to patient outcomes. In one survey of 8,000 rescue incidents recorded in New Zealand, more than 80% were characterized as minor (e.g., wherein patients remained at the scene in stable condition) which was a particularly noteworthy finding given that these incidents were likely underreported (Moran & Webber, 2014). The lack of data on water depth of reported incidents and types of rescues made (e.g., swimming vs. wading, with or without equipment) represent two additional areas of gaps in the research evidence. Various attempts have been made by organizations to capture information about water-based activity incidents, such as the work of private certification and consulting agencies collecting their own data and the United States Lifesaving Association (USLA) prescribing accredited members to self-report data. These databases differed in the types of information and collection processed; additionally, the specific scope and sustainability of each database limited accessibility for research on a broader scale. For example, in 2006, The National Swimming Pool Foundation (NSPF) established the Worldwide Aquatic News Incident Database to collect information from on-line news sites and provide information related to aquatic drowning incidents in a variety of settings. The data from this database were publicly accessible online; however, while the archive began collecting information in 2006 and served as a valuable tool for those in the aquatic industry, it is no longer available online.

Consequently, when the United States Lifesaving Council initiated and marketed the Lifeguard Rescue Reporting System (LRRS), a collective effort in 2009 to systematically collect data from lifeguards and facility managers across the United States and Canada, the project represented an important opportunity to use real-life scenarios as formative data in the understanding and prevention of water-based incidents. The LRRS data collected over a period of 7 years represent the work presented in this study.

Method

The purpose of the online LRRS survey instrument, which facilitated electronic reporting, was to gather self-reported data from two groups of water safety personnel: (a) lifeguards involved in rescues and (b) management personnel who witnessed the events and had sufficient details of the incident. The project was designed to collect information on a set of variables deemed vital to understanding the nature of rescues at aquatic venues by trained lifeguards, how the lifeguard was made aware of or recognized the victim, and whether other individuals (i.e., either trained responders or bystanders) were involved in the response.

Instrument Development

The initiative was conceived in 2003 during the first meeting of the United States Lifeguard Standards Coalition (USLSC) with a shared, collective interest to begin grounding lifeguard decision-making in disciplined inquiry. Many methods were discussed between organizational representatives from the American Red Cross, The Young Men's Christian Association (YMCA), and the United States Lifesaving Association (USLA). The concept of a survey was expressed as a high priority to better understand contextual factors surrounding incidents in order to improve lifesaving performance. The initial meeting identified main criteria for the survey which included: (a) brevity—the instrument be sufficiently brief to encourage participation, (b) detail—the questions elicit information that captures respondents' involvement in a rescue from start to finish, (c) open-ended—free-response items would be included so that respondents could write in additional comments with details that may not have been foreseen during survey design (and which would guide survey revisions). Additionally, the phone area code of the respondent was included as a demographic component. A final draft survey was reviewed in 2008 by all parties and approved for release with an exception noted by American Red Cross legal counsel that no identifiers were to be used.

Items included on the LRRS were derived from conversations with stakeholder organizations. The survey underwent several rounds of revisions to ensure that the instrument covered the intended scope. Items included a series of fixed-response questions to be completed following a rescue, collecting data regarding location, attributes related to victim recognition, characteristics of rescuer and rescue made, condition and attributes of victim, and final outcomes of the incident. Survey logic was employed to direct respondents to separate portions of the survey based on the answer to the first question, "Site of Incident." This allowed for analysis of venue-specific variables. For example, those choosing "open or natural body of water" as the site of incident would be taken to a different set of questions and characteristics (e.g., bay, lagoon, lake, beach) compared to those who might have initially identified the incident site as a water park (site e.g., current, flume, lazy river, play feature, slide). Original design and approval for the

study were completed through the University of North Carolina – Charlotte (UNCC).

Data Collection

The LRRS was developed and implemented electronically using www.surveyshare.com and distributed via convenience sampling. To reach the target audience of lifeguards and facility managers, recruitment included: (a) word of mouth, (b) email listservs and newsletters with lifeguard training agencies and partners, (c) presentations at national and international conferences such as the World Conference on Drowning Prevention and National Recreation and Park Association, and (d) distribution of 2,000 stickers that promoted the data collection website. As a result, no list of prospective participants was developed by the research team and those who self-reported rescues using the online tool provided no identifiable information, such as their name or their facility's name. This allowed for a reporting system that was fully anonymous.

Data collection began in the United States in June 2009, Canada in April 2010, and the option for multiple incident reporting was added to the survey in 2013 in response to feedback that the single-entry system was laborious and deterred reporting. Several other minor modifications to the original survey were made during its multi-year data collection to address feedback from respondents, aquatic industry professionals, and members of the academic community.

Results

The reported descriptive results represent seven years of data collection; 1,676 independent and documented incidents were submitted through the LRRS between 2009 and 2016. Results have been organized by type of location reported, with most reported incidents occurring in a pool/spa area (n = 1350, 81%) followed by water parks (n = 169, 10%), and open or natural body of water (n = 157, 9%) (Table 1).

Table 1

Victim Location by Facility Type

Pool & Spa	**n = 1350**	**Waterpark**	**n = 169**	**Natural Area**	**n = 157**
Deep water	38%	Slides	24%	Lake area	43%
Shallow water	40%	Wave pools	22%	Ocean/surf beach	33%
Diving area	18%	Lazy river	14%	River area	10%
Play features	5%	Other	30%	Other	14%

Pools/Spas Areas

Pool or spa sites were identified as the most common source of incidents, and victims were identified in a variety of locations including the shallow water (40%), deep water (38%), diving area (18%), or play features (5%) (Table 1). Most rescues

in pool/spa areas were made in water between 0.9m and 1.5m (43%), followed by the 1.5-3m (26%), and 3-5m depths (17%) (Table 2). Upon examination of victim characteristics, the greatest frequency of victims were between the ages of 5 to 14 (69%), followed by toddlers age 1 to 4 comprising 14% of victims.

Victims were often swimming (43%) or wading (20%) in the pool/spa prior to the rescue, with feet first entries representing 18% of reported incidents and head-first or diving 4%. While floating with equipment (9%), running/walking on deck (4%), and other activities (11%) were reported, the victims' activity prior to the rescue was unknown in 14% of the reports. Most frequently (89% of rescues), victims were not using a floatation device at the time of the incident. While pool/spa victim injuries included abrasions (5%) and lacerations (4%), among others (11%), in most cases, no additional aid (71%) or response (69%) was needed, and the majority (81%) of victims reported no injury. After the incident, 53% were released to a parent while some were released to an ambulance (9%) or to another care provider (5%).

Most reporters of incidents occurring in pool/spa settings indicated formal training relevant to aquatic settings. Reported credentials included training in lifeguard/lifesaving (98%), CPR/PR (97%), and AED (93%) training; and several reported having been trained in oxygen administration (46%) and blood borne pathogens (57%; Table 3). Approximately one-third reported engagement in site-specific (32%), weekly in-service (27%), and monthly in-service (37%) training. More rescuers at pool/spa settings were stationed in chairs (59%) rather than walking (16%) or standing (13%) when the victim was spotted; elevated chairs were slightly more common than chairs lower than 5 feet high. Victims were most often recognized visually/by sight (89%); however, audible recognition/sound (26%), victim profiling due to high perceived risk (11%), and information from the victim (10%), a patron (9%), another lifeguard (3%), and other sources (3%) were also noted. Pool and spa rescues were most frequently made by swimming (44%) or wading (11%) with their equipment. Reaching assists were used with (7%) and without (9%) equipment, as well as rescues via wading (10%) and swimming (8%) without equipment. The lifeguards and additional responders generally did not employ advanced first aid (e.g., sustained injury management procedures (4%), CPR (3%), oxygen (3%), or AED (1%)). Only 4% of victims required major first aid in pool/spa spaces; however, 17% were treated with minor first aid.

Table 2

Location and victim characteristics of rescues

	Pools & Spas	Waterparks	Natural & Open Areas
Location			
Water depth where victim located	**n = 1186**	**n = 161**	**n = 153**
On land and less than 0.3 m (1 ft)	5%	5%	4%
0.3 - 0.9 m (1.1-3 ft)	8%	15%	6%
0.9 - 1.5 m (3-5 ft)	43%	66%	18%
1.5 - 3 m (5.1-10 ft)	26%	9%	42%
3 - 5 m (10.1-16.9 ft)	17%	4%	31%
Victim Circumstances			
Approximate age of the victim	**n = 854**	**n = 95**	**n =72**
1 to 4 years old	14%	31%	6%
5 to 14 years old	69%	48%	44%
15 to 24 years old	8%	5%	17%
25 to 44 years old	4%	6%	28%
45 to 64 years old	3%	5%	3%
65 and over	2%	3%	1%
Victim's activity prior to the rescue[1]	**n = 1582**	**n = 187**	**n = 179**
Swimming	43%	22%	44%
Wading	20%	23%	28%
Feet first entry/jumping	18%	15%	8%
Floating with equipment	9%	10%	7%
Head-first entry/diving	4%	1%	2%
Walking/running (not in water)	4%	4%	2%
Other	11%	14%	16%
Unknown	14%	17%	7%
Flotation device used by victim	**n =1281**	**n = 162**	**n =156**
None	89%	86%	77%
Coast guard approved personal floatation device	2%	5%	9%
Inflatable raft	1%	3%	2%
Other (e.g., non-inflatable, pool noodle)	8%	6%	11%
Injuries to victim	**n = 1281**	**n = 163**	**n = 159**
None	81%	87%	73%
Abrasion	5%	4%	8%
Laceration	4%	4%	8%
Other	11%	7%	8%
Victim's outcome[1]	**n = 1228**	**n = 163**	**n=159**
Released	43%	31%	50%
Released to parent	53%	58%	42%
Ambulance	9%	9%	14%
Released to another care provider	5%	4%	8%
Advised to see physician	4%	8%	4%
Other	4%	2%	6%

[1]Summation of column values does not equal 100% where survey permitted multiple selection.

Table 3
Rescuer and rescue characteristics

	Pools & Spas	Waterparks	Natural & Open Areas
Rescuer Characteristics			
Training[1]	**n = 1303**	**n = 166**	**n = 161**
Lifesaving/Lifeguarding	98%	99%	96%
CPR/PR	97%	86%	96%
AED	93%	80%	90%
Oxygen Administration	46%	28%	62%
Blood Borne Pathogens	57%	47%	70%
Emergency Medical	4%	4%	19%
In-service training - Weekly	27%	40%	51%
In-service training - Monthly	37%	44%	34%
Site-specific training	32%	57%	53%
Other	16%	8%	26%
None	0%	3%	3%
Rescuer position at incident time[1]	**n = 1303**	**n = 166**	**n = 161**
Elevated chair - 5 feet or more	40%	28%	36%
Elevated chair - less than 5 feet	19%	15%	11%
Walking	16%	23%	10%
Standing in one place	13%	13%	17%
Already in the water	5%	15%	10%
Watercraft station	1%	0%	11%
Other	1%	7%	15%
Recognition method by lifeguards[1]	**n = 1303**	**n = 166**	**n = 161**
Visual/sights	89%	92%	83%
Audible/sounds	26%	18%	29%
Profiled high risk prior to distress	11%	10%	14%
Informed by victim	10%	6%	7%
Informed by a patron	9%	10%	13%
Informed by another lifeguard	3%	3%	7%
Other	3%	0%	6%
Type of rescue made[1]	**n = 1302**	**n = 166**	**n = 161**
Swimming with equipment	44%	37%	49%
Wading assist with equipment	11%	25%	6%
Wading assist without equipment	10%	17%	6%
Swimming without equipment	8%	5%	11%
Reaching with equipment	9%	4%	12%
Other	14%	8%	31%
Type of aid given[1]	**n = 1303**	**n = 166**	**n = 161**
No additional aid needed	71%	72%	60%
Minor first aid	17%	9%	9%
Major first aid	4%	5%	13%
Sustained Injury Management Procedure	4%	7%	7%
CPR administered	3%	5%	11%
AED used	1%	2%	5%
Oxygen administered	3%	3%	12%
Personal protective barriers used	4%	7%	7%

[1]Summation of column values does not equal 100% where survey permitted multiple selection.

Finally, among general circumstances, most rescues in pool/spa areas occurred during normal attendance periods (64%) with the remaining approximately split between heavy (17%) and light (19%) attendance periods. In cases involving multiple responders, another lifeguard (29%) and/or Emergency Medical Services person (9%) assisted where necessary; in addition, bystanders (6%) or other emergency personnel (4%) were reported to have assisted in some incidents.

Table 4
General circumstances of rescue incident

	Pools & Spas	**Waterparks**	**Natural & Open Areas**
General Circumstances			
Attendance level at the rescue time	**n = 1264**	**n = 164**	**n = 158**
Light	19%	9%	21%
Normal	64%	70%	51%
Heavy	17%	20%	25%
Others responding[1]	**N=1285**	**n=162**	**n=161**
No additional responders	69%	52%	39%
Additional lifeguard	29%	41%	52%
Paramedics/EMS	9%	17%	22%
Police/Fire	4%	3%	19%
Bystanders	6%	6%	9%
Other	4%	4%	20%

[1]Summation of column values does not equal 100% where survey item permitted selecting multiple items.

Waterpark Areas

Based on the waterpark rescue incident reports, rescue incidents occurred in a variety of locations, including the slides (24%), wade pools (22%), lazy river (14%) or other attractions (30%) (Table 1). Most rescues were made in water between 0.9m and 1.5m (66%), followed by the 0.3-0.9m (15%), and 1.5-3m depths (9%) (Table 2). The highest frequency of victims was between the ages of 5-14 years old (48%) followed by ages 1-4 years old which comprised 31% of victims. Victims were often swimming (22%) or wading (23%) prior to the rescue, with feet-first entries representing 15% of reported incidents and head-first entries represented only 1% of total incidents. While floating with equipment (14%) and engagement in other activities (14%) were reported in some cases, the victims' activity prior to the rescue was unknown in 17% of the reports. Few rescues reported abrasions (4%), lacerations (4%), or any other injury (7%). After the incident, 58% were

released to a parent (31% released otherwise) while 9% were released to an ambulance, and 4% were released to other care providers.

Nearly all waterpark rescue reporters indicated training in lifeguarding/lifesaving (99%), CPR/PR (86%), and AED (80%) training; several reported having been trained in oxygen administration (28%) and blood borne pathogens (47%; Table 3). Compared to pool/spa rescue reporters, more lifeguards reported having received via site-specific (57%), weekly in-service (40%), and monthly in-service (44%) training. While more rescuers were in chairs (43%) than walking (23%) or standing (13%) when the victim was spotted, chairs elevated above 5 feet were slightly more frequently reported than lower chairs. Victims were most often recognized by sight (92%), but audible/sound clues (18%), victim profiling based on previously identified risk (10%), and information from other sources such as a patron (10%), the victim (6%) and another lifeguard (3%) were also noted. In waterpark settings, rescues were most frequently made by lifeguards swimming (37%) or wading (25%) with their equipment. While only 4% of rescues were made reaching with equipment, many were made wading (17%) and swimming (5%) without equipment. In most cases, no additional aid (72%) was required; 9% of rescues required minor aid, and fewer required major first aid (5%), sustained injury management procedures (7%), administration of CPR (5%), oxygen administration (3%), or use of an AED (2%).

With respect to other circumstances surrounding the rescue incident, only 20% of waterpark rescues occurred during heavily attended periods, with 70% occurring during normal attendance levels (and 9% light attendance; see Table 4). Additional lifeguards (41%) and Emergency Medical Services (17%) assisted where necessary, in addition to bystanders (6%) or other emergency personnel (3%). However, in most cases, no additional responders (52%) were engaged in rescue efforts.

Open or Natural Body Water Areas

Within open or natural body water areas, victims were identified in a variety of settings, including lake areas (43%), ocean or surf beaches (33%), river areas (10%) or other areas (14%; Table 1). Most rescues were made in water between 1.5 and 3m (42%), followed by the over 3m (31%), and 0.9-1.5m depths (18%; Table 2). The largest portion of open/natural body water victims were between the ages of 5-14 years old (44%), followed by 25 to 44-year-olds (28%) and 15-24-year-olds (17%). Victims were typically swimming (44%) or wading (28%) prior to the rescue, with feet-first entries representing 8% of reports and head-entries representing 2%. The victim's activity was reported as "Other" in 16% of cases, "Unknown" in 7% of cases, and 2% occurred while the victim was running or walking. Victims were reported to have been floating with equipment was reported

23% of the time, and 9% of total victims were reportedly using Coast Guard-approved personal flotation devices at the time of the incident. The majority (73%) of victims were reported to have no injury, although abrasions (8%), lacerations (8%), or other injuries (8%) did occur in some open/natural water cases. After the incident, 42% were released to a parent and 50% released on their own, while 14% were released to an ambulance, 8% to another care provider, and 4% advised to see a physician.

With respect to respondent credentials, the open/natural water area rescue reporters indicated lifeguard/lifesaving (96%), CPR/PR (96%), and AED (90%) training. Many reported training in oxygen administration (62%) and blood borne pathogens (70%). Additionally, approximately one-fifth of open/natural water respondents indicated other emergency medical training (19%; Table 3). Open and natural area rescuers were most frequently in chairs (47%) than walking (10%) or standing (17%) when the victim was spotted, and elevated chairs were slightly more common than chairs less than 5 feet high (Table 3). Other rescue positions included watercraft (11%), in the water (10%) and other positions (15%). Victims were most frequently recognized visually/by sight (83%), but audible/sound recognition (29%), victim profiling (14%), another patron (13%), the victim themselves (7%), another lifeguard (7%), and other sources (6%) were also indicated. Upon recognizing and acting upon the emergency, rescues were made by swimming (49%) or wading (6%) with their equipment. While 12% of rescues were made by reaching with equipment, a small percentage were made wading (6%) and swimming (11%) without equipment. Thirty-one percent of rescues in open and natural water areas were made with other techniques specific to the landscape and area needs. In many cases, no additional aid (60%) or responders (39%) were needed. Minor (9%) and major (13%) first aid were applied in some rescues, in addition to several other types of aid including sustained injury management procedures (7%) and administration of CPR (11%), oxygen (12%), and AED (5%).

Based on the open and natural water reports collected by the LRRS, only 25% of rescues occur during heavily attended periods (Table 4), with 51% occurring during normal attendance levels (21% light attendance). Additional lifeguards (52%) and Emergency Medical Services (22%) assisted where necessary, in addition to bystanders (9%), police and fire (19%) or other sources including the Coast Guard and facility specific resources (20%).

Discussion

As water-based recreation maintains its popularity, it is vital to understand and prioritize drowning prevention and rescue efforts in order to protect participants. In this study, we collected an expanse of original data – reflecting more than 1,600

water rescue incidents reported by lifeguards across multiple water activity sites—with the goal of better predicting and preventing future incidents.

Results shared here illuminate several key elements of lifeguard rescues. Most incidents at pools, spas, and waterparks occurred in 0.9-1.5m (3-5 feet) water depths, suggesting unexpected risk at medium depths, particularly where younger children (and their parents/caregivers) may overestimate the level of safety/security. In natural and open spaces, incidents were more common at deeper depths (1.5-3m, or approximately 5-10 ft); the risk posed by these greater depths in natural waterways—exceeding levels at which victims can stand up—has also been identified by Avramidis, Butterly, and Llewellyn (2009b). These findings are supported by the work of others which have suggested that drownings more frequently occur at shallower depths at waterparks (Hunsucker & Davison, 2011) than in open water environments (Venema et al., 2010). Among individuals rescued, 5–14-year-olds were the most frequent age range which triggered lifeguard action. These results aligned with findings of Morgan and Ozanne-Smith (2013) who found that 45.4% of beach rescues in Victoria, Australia were initiated for individuals between the ages of 6 to 15 years. These were particularly important in context as Moran's (2009) work on parent and caregiver water safety practices indicated that caregivers reduced their supervision of 5-9-year-olds despite their crucial role in the prevention of accidents. Similarly, a study examining lifeguard-beachgoer incidents in New Zealand indicated that most patients were male and younger than 16 years old (Moran & Webber, 2014). In addition to the role of parental efficacy in water safety, previous studies have found that water safety educational programs among school-aged children can reduce drowning incidents (Turgut et al., 2016; Solomon et al., 2013). The role of other victim attributes is less certain; for instance, no flotation device use was reported in 73 to 89% of incidents. Further research may aide in understanding the relationship between swimming skill level, appropriate use of flotation devices, water depth, and positive rescue outcomes.

When considering rescuer characteristics, most lifeguards reported being seated in an elevated chair at the time when the incident occurred. Across all water settings, it was a lifeguard who primarily recognized victims through their own visual and auditory senses, supporting the importance of scanning techniques (Page & Griffiths, 2014). Additionally, lifeguards reported "profiling" high-risk individuals prior to the rescue incident in 10-14% of cases, lending importance to this practice wherein lifeguards pay particular attention to weak or fatigued/slow swimmers, or those grasping flotation devices, lane dividers, or a pool's edge, which may indicate lack of skill (Lanagan-Leitzel & Moore, 2010; Pascual-Gómez, 2011). These data indicated that two-thirds of all lifeguard-related incidents across all water settings resulted in victims being released on-site. Another trained

respondent was reported to be involved in the rescue incident 42% of the time in pools & spas, 61% of the time in waterparks, and 93% of the time in natural body & open water areas. Given that lifeguard performance can be affected by fatigue, such as in the case of performing CPR (Barcala-Furelos et al., 2013), further examination of the role of additional personnel during a rescue is warranted.

Limitations

The LRRS's reliance on voluntary self-reporting represents one important limitation of this study, particularly given that the data reported here may overrepresent the rescues at specific facilities or first responders who were more committed to reporting than others. It is also possible that some reported items represented subjective assessments of lifeguards such as the age of victims and water depth where incidents occurred. Additionally, despite the extent of data reported here, further details reflecting facility attributes, layout, resources, and usage represent unexplored areas that may be crucial in better understanding lifeguard rescue actions. Furthermore, despite the substantial number of responses reflected here (i.e., more than 1,600 reported rescues), the reported cases likely represent a relatively small portion of lifeguard rescue actions occurring on an annual basis. To that end, the LRRS was advertised widely in 2009, but publicity efforts reduced over time, corresponding with fewer reported incidents in later years. Accordingly, efforts to collect even more encompassing and representative data might be augmented by a more persistent and consistent marketing campaign, official participation by more aquatic training agencies, and improved data collection tools, such as a Smartphone app to ease data entry processes.

Conclusions

Despite these limitations, the data reported in this study provide crucial information regarding previously unknown contexts surrounding lifeguard rescues. Perhaps the most important finding was that the large majority of reported rescues indicated no injuries to the victim (i.e., 73-81%, depending on the type of the body of water involved), who was released to themselves or a parent. These results align with those of previous research which also found that approximately 80% of rescue incidents reported from New Zealand beach lifeguard were categorized as "minor" (Moran & Webber, 2014). These results suggest that it is likely that effective lifesaving rescues occur frequently, further supporting the paramount importance of employing well-trained lifeguards and first responders at bodies of water. As such, further investigations into the rapid decision-making processes of lifeguards represents one potential area of future study. Additionally, our data reflecting location, victim, rescuer, and general incident characteristics also provides key information that can be used in lifeguard training (e.g., importance of victim recognition strategies) and parent/caregiver water safety education (e.g., ages of rescue victims, water depth of incidents). In short, despite the outlined limitations

and areas requiring further investigation indicated here, the descriptive results of the LRRS provide crucial data reflecting the context and outcomes of everyday lifeguard rescue actions. Through initiatives like this one to better understand commonplace rescue actions in-depth, further progress can be made to prevent drowning and promote water safety.

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