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Is drowning a mere matter of resuscitation?☆

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ABSTRACT

International data severely underestimates actual drowning numbers. Almost all victims are able to help themselves or are rescued in time. This study aims to report the occurrence of Drowning Chain of Survival actions and resuscitations needed in a fully operational lifeguard service.

Methodology: Data was collected from Dec-2009 to Mar-2015 by lifeguards at a 6km-long beach in Brazil. The Drowning Chain of Survival links were summarized into 3 main action-response sections: Prevention; rescue; and provide care. Rescues were classified by severity.

Results: Lifeguards reported 1,565,699 actions during the study period. Preventative actions comprised 1,563,300(99.8%) and 2044 (0.1%) involved recognizing a person in stress/distress and rescuing them. Of those requiring rescue, 355(0.02%) needed medical assistance due to respiratory symptoms, isolated respiratory arrest, or cardiopulmonary arrest. Those cases were classified by severity as: Grade 1 = 234(65.9%), grade 2 = 78(22%), grade 3 = 22(6.2%), grade 4 = 7(2%), grade 5 = 4(1.1%), and Grade 6 = 10(2.8%). From all 2044 rescues, 14(0.7%) were grade 5 and 6 and needed respiratory or cardiorespiratory resuscitation. An estimative incident rate for each day at a lifeguarded beach revealed: 1 rescue for every 4.227 beach attendances, 1 drowning for every 24,338 beach attendances, and 1 instance of CPR being performed for every 617,142 beach attendances.

The prevalent misconception that majority of drowning require resuscitation is perpetuated by the media and publishers. We are only just seeing the tip of the iceberg and urgently need to look at the problem in its entirety. Considering all the intervention undertaken by lifeguards in a fully operational system, the incidence of resuscitation being performed is only one in every 112,000 lifeguarding actions (0.0009%).

Introduction

According to the World Health Organization, globally drowning claims the life of one person every 1.5 s [1]. International data severely underestimates actual drowning numbers, even in high-income countries [2]. The accepted definition of drowning is “the process of experiencing respiratory impairment from submersion or immersion in liquid”. This definition was established in 2002 and adopted by the International Liaison Committee on Resuscitation in 2003, and the WHO in 2005 [3,4] There are three possible outcomes from a drowning event: death, survival with morbidity, and survival without morbidity.

Almost all drowning victims are able to help themselves or are rescued in time by bystanders or professional rescuers. One study revealed that in areas where lifeguard services operate, less than 6% of all rescued persons need medical attention, 0.5% require cardiopulmonary resuscitation (CPR), and of these more than half (0.34%) died [2]. By contrast, Venema reported almost 30% of persons rescued from drowning by bystanders required CPR [5]. This difference may be explained by the fact lifeguards have be shown to detect persons in distress faster that non-lifeguards and can execute a rescue in less time and much more safer than a bystander [2,6]. Lifeguards also have a duty of care, so are trained and equipped to initiate resuscitation, whereas a member of the public is under no obligation to perform CPR. Prompt initiation of ventilations and CPR on-scene is the most important

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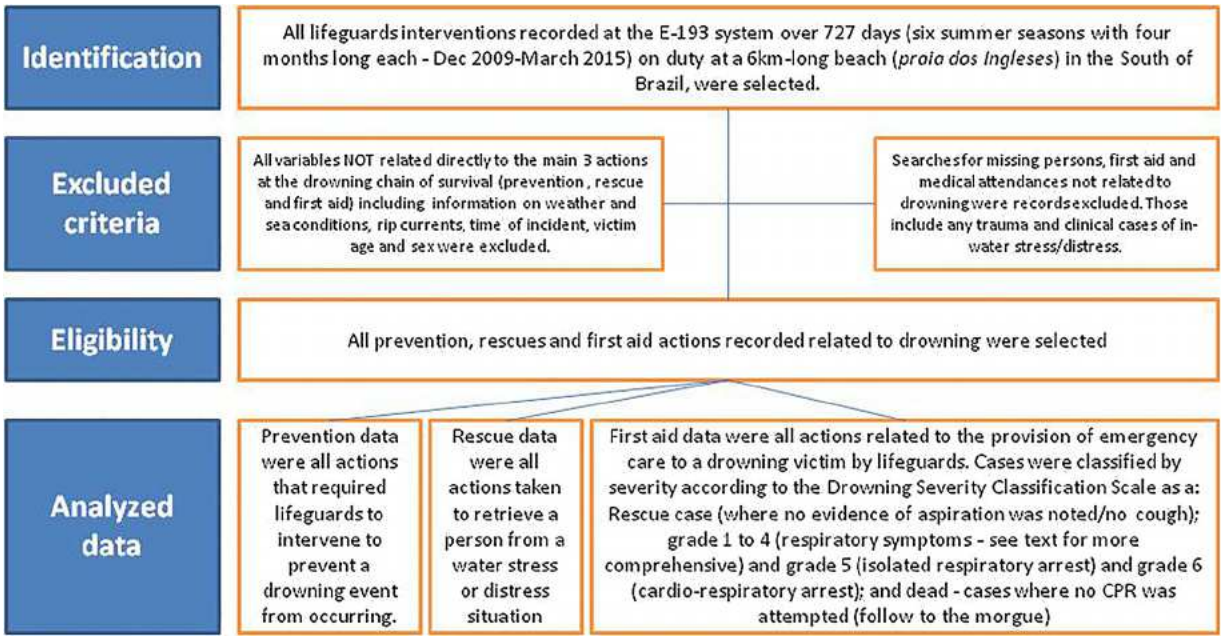

Fig. 1. Identification, excluded criteria, eligibility and analyzed data Prisma.

intervention for any person that is in respiratory or cardiac arrest due to drowning [2]. In addition, epidemiologic data in almost every country lacks reports for more than 94% of drowning incidents because non-fatal drowning is still not recorded in any national or international database unless it results in hospitalization or death. Health professionals may encounter drowning patients in a critical condition in the pre-hospital setting, but also in the hospital emergency department, intensive care unit or ward. There is an urgent need therefore to understand what drowning is (and isn't), in terms of interventions needed to properly care for these patients. In addition, all health professionals have a duty to properly inform and educate patients and families about injury prevention. It is impossible to properly educate patients if the wrong information is communicated.

The 'Drowning Chain of Survival' comprises five life-saving steps for lay and professional rescuers. The steps of the chain are: Prevent drowning, recognise distress and call for help, provide flotation, remove from water and provide [first ad advanced aid] care as needed [7]. Unfortunately, and probably for cultural reasons, most interventions and media campaigns tend to focus on providing rescue and first aid education or care instead of preventing the event from occurring; the so called *preventative actions*.

The aim of this study is to raise public awareness of the fact we are only seeing the "tip of the iceberg" if we measure drowning outcomes by the number of resuscitation attempts, hospitalizations and fatalities. We report on the statistical occurrence of Drowning Chain of Survival actions in a retrospective analysis of a fully operational beach lifeguard service over six summer seasons.

Methodology

Data was collected over six summer seasons (four months long each) from December 2009 to March 2015, a total of 727 days, by lifeguards on duty at a 6km-long beach (*praia dos Ingleses*) in the South of Brazil, State of Santa Catarina. Lifeguards patrol a 4 km stretch of the most hazardous part of this sandy beach. The beach provides recreation for an estimated 40,000 residents, with up to 80,000 visitors on crowded days (120.000 daily). The lifeguard service is provided by military firefighters from Santa Catarina Fire Department (CBMSC) with three fixed towers and 30 lifeguards, who are on-duty from 0800 to 2000 hrs daily. Lifeguards are equipped with 4WD motorcycles, rescue tubes, rescue boards, fins, inflatable rescue boats and supported by a rescue/medical helicopter that can be requested if needed. Lifeguards are re-certified annually after completing their initial training course of 120 h.

Data collection

The Drowning Chain of Survival links were summarized into three main action-response sections: Prevention; rescue; and provide care for drowning. All preventative actions, rescues, and first aids were reported as a digital registers by lifeguards daily by way of completing an electronic form. Data was evaluated retrospectively using an internal reporting system called "E-193″. This system was developed by the Fire Department of Santa Catarina to record beach interventions by lifeguards and has been in use since 2010. The data is collected by lifeguards manually on an incident report form at the beach and then entered into the E-193 system by the beach coordinator. The system allows any variable entered to be retrieved/filtered. The electronic reports also contained information on weather and sea conditions, rip currents, time of incident, victim age and sex. Other incidents such as searches for missing persons, first aid and medical attendances not related to drowning, and other events attended by lifeguards were also recorded. The authors only included data that related to the present study as the number and percentage of lifeguard actions in 3 main topics described in the drowning chain of survival – prevention, rescue, and first aid. When first aid was needed the severity was also tabulated. The terms used to define the interventions recorded in the study were those defined and already in use by lifeguards as part of their ordinary daily reports. Fig. 1 summarized the Identification, excluded criteria, eligibility and analyzed data.

Preventative actions were defined as any intervention triggered by a person or group at risk of drowning that required lifeguards to intervene to prevent a drowning event from occurring [6]. An example of this would include asking swimmers to move from an unsafe location e.g. Adjacent to a rip/hole to a safer location.

Rescue actions were any intervention triggered by a person showing signs of water stress or distress, which was considered the starting point of the drowning process [8]. This sequence included victim recognition and alerting others that a rescue was required, providing flotation to the victim, and finally, removal from water. The response to a potential or actual drowning starts in response to a stressful situation, where a

person feels at risk of drowning. A distress situation was considered the consequence of an inability to cope with the stressful condition. Rescue actions were only considered complete when the victim had been extricated from the water/danger.

First aid actions were any interventions related to the provision of emergency care to a drowning victim by lifeguards that were performed during the post-rescue phase i.e. After removal from the immediate danger and following casualty assessment. These actions were targeted to prevent further injury, improve patient outcomes, and promote recovery. All trauma and clinical cases of in-water stress/distress were excluded from the analysis. Rescues cases were classified by severity according to the Drowning Severity Classification Scale for basic life support as either a: Rescue case (where no evidence of aspiration was noted, and no cough); grade 1 - cough without foam in the mouth or nose; grade 2 - small amount of foam in the mouth or nose; grade 3 - large amount of foam in the mouth and nose (acute pulmonary edema) with palpable radial pulse (i.e. Absence of low blood pressure); grade 4 - large amount of foam in the mouth and nose (acute pulmonary edema) with no palpable radial pulse (i.e. Low blood pressure); grade 5 - isolated respiratory arrest; grade 6 - cardiorespiratory arrest; and dead - cases where no CPR was attempted (submersion over one hour, or obvious physical evidence of death such as rigor mortis, body decomposition, or livor mortis) [2,9].

Results

Lifeguards reported 1,565,699 actions during the study period (727 days). Preventative actions comprised 1,563,300 (99.8%). Only 2044 (0.1%) involved recognizing a person in stress/distress and rescuing them. Of those requiring rescue, 1689 had no evidence of aspiration and no cough, and 355 (0.02%) needed medical assistance due to respiratory symptoms, isolated respiratory arrest, or cardiopulmonary arrest. Cases (n = 355) were classified by severity as: Grade 1 = 234(65.9%), grade 2 = 78(22%), grade 3 = 22(6.2%), grade 4 = 7(2%), grade 5 = 4(1.1%), and Grade 6 = 10(2.8%). From all 2044 rescues, 14(0.7%) were grade 5 and 6 and needed respiratory or cardiorespiratory resuscitation. There were no instances of not attempting CPR amongst the reported cases. Fig. 2 shows the Drowning Chain of Survival with the percentage of actions undertaken in each of the three main action-response sections. Data including residents and visitors in all beach seasons shows an estimative incidence of 1 rescue for each 4227 peoples, 1 drowning for each 24,338 and 1 CPR (ventilation only or full CPR) done to 617,142 for each day at a guarded beach.

Discussion

The prevalent misconception that the majority of drowning incidents results in death and requires resuscitation is perpetuated by the media and publishers, a lack of awareness of accepted drowning terminology in professional and academic circles, and culturally in society through social media, poems, stories, music and art. The word “drowning” has historically been used to describe death in many different forms (e.g: “I´m drowning (dying) in paperwork”) and is strongly attached to this erroneous concept worldwide. As such, the medical profession had to create the term “near-drowning” over 40 years ago to differentiate between patients that did not die from the event., The term “near-drowning” is now redundant and should not be used according to the new and more appropriate drowning definitions published by the WHO in 2005 [4]. Drowning means the injury process from experiencing water stress/distress and can have different outcomes as described above. Especially for English speakers, the new and more appropriate medical concept of the word “drowning” as a process and not an outcome will take time for society to assimilate into everyday language. Aside from the difficulties encountered trying to collect data in low and middle-income countries (LMICs), collectively these are some of the major barriers to accurately counting the true global burden of drowning. From an injury prevention perspective, we are only just seeing the “tip of the iceberg” and urgently need to look at the problem in its entirety. Drowning is not just a matter of mere resuscitation of the apparently dead, but essentially a trauma that if prevented has a high benefit to victims at a relatively low cost of prevention [8]. Hence, drowning is not just death, a person can experience drowning and survive, with or without morbidity, and that is most frequently the outcome.

Several gaps exist in providing accurate numbers of fatal and non-fatal drowning. Some cases of fatal drowning are not classified as such according to the International Classification of Disease (ICD) coding system due to misuse of the term “near-drowning” and other redundant modifiers like secondary, dry or delayed drowning. In many countries numbers do not include drowning that occurs due to floods, tsunamis and boating accidents. It is estimated that 90% of all drowning deaths occur in LMICs with major under-reporting because national data systems do not include these details in their reports, or official/coronial documentation is not required to bury or cremate a deceased person. Limited data are available because many victims are pronounced dead on-scene or never transported to hospital and are not therefore formally recorded in any death or trauma registry [1]. Drowning deaths at the hospital are, in some cases, misdiagnosed, and drowning is not coded as the primary cause, so a significant number of incidents may also be

Fig. 2. Frequency of lifeguard interventions (n = 1,565,358) at “praia dos Ingleses” beach in the South of Brazil, State of Santa Catarina as they relate to the three phases of the Drowning Chain of Survival.
Adapted from Szpilman et al. [5].

missing the ICD code that would allow for a proper analysis of the drowning problem. To date, global estimates of the burden of drowning have primarily used information from resuscitation attempts and hospitalisations [10]. Thus, the majority of drowning incidents, which are non-fatal, are excluded. Drowning datasets worldwide are therefore incomplete, and as a society we are presented with a greatly understated view of this serious public health issue.

In order to provide the best outcomes for victims of drowning it is urgently need to be able to measure it, and this starts with making an informed accurate diagnosis of the outcomes. The first and somewhat aspirational goal is to achieve uniform reporting of data from drowning, which will allow international comparability of research and reports [8]. In addition, improved, standardized, and integrated data collection systems on drowning are still needed. A recent study revealed little consensus among authors around drowning terminology, and the timing or importance of each action on the entire drowning process [8,11]. Only a minority of authors in the published scientific literature attempt to define terms related to drowning before considering their research question, which in turn mostly referred to resuscitation, hospitalisation, and most commonly, death as the only outcomes. Definitions, terminology and data collected by local, national, and international agencies is not uniform, as evidenced by peer-reviewed literature, national drowning reports and media releases [10,11]. Authors still routinely define as preventive activities interventions like first aid courses that do not prevent the drowning process, but instead aim to reduce its negative impact on the victim who has experienced a drowning episode. Additionally, prevention, rescue and life-support services are typically provided and reported by distinct lifesaving and health agencies, using their own data-fields, without follow-up or linkage to downstream care. Underreporting contributes significantly to misunderstanding of the process of drowning and compounds the difficulties of data comparison. Filling these scientific gaps requires building a worldwide consensus on definitions, terminology and clearly defining what data to collect on fatal and non-fatal drowning.

This is the first study to report on the frequency of all key actions in the Drowning Chain of Survival in a fully operational ocean lifeguard service over a number of seasons. For each rescue made there were 765 preventative actions. These actions mostly involved using a whistle to alert an individual or group of bathers in imminent danger or risk and asking them to move to less dangerous part of the beach. For each drowning (person needing medical assistance) there were 6 others rescued that did not require any further medical assistance. From all rescues made, 17% needed medical assistance and just 0.7% needed respiratory or cardiorespiratory resuscitation.

Conclusions

Considering all the intervention undertaken by lifeguards in a fully operational system, the incidence of resuscitation being performed is only one in every 112,000 lifeguarding actions (0.0009%). This does not mean that resuscitation is unnecessary, should have less importance placed on it, or should not be taught to lifeguards. On the contrary, due to the infrequency of having to perform this skill, more training is needed to address some of the technical and process issues that other studies have already identified [12]. This study reinforces the maxim that the prevention of drowning will always be a better cure than resuscitation from it. More attention is needed therefore by educators and researchers to focus on prevention and thereby reduce the social, economic and personal cost to society when engaged water activities, where the risk of drowning is omnipresent.

Limitations

The authors were unable to measure the financial costs of performing the lifeguard interventions reported. For ethical reasons, a comparison of victim outcomes based on whether a lifeguard intervenes or not in any given aquatic incident is not possible. If available, this information would provide irrefutable scientific evidence that all bathing areas should be patrolled by lifeguards. The data was collected and analyzed within a well-organized lifeguard service at a beach attended by a well-educated beachgoing population. Given the site-specific nature of the study, different aquatic environments, beach conditions and levels of public education could produce different results. The authors chose to restrict the use of other variables that were collected by the reporting system that could have allowed a multivariate analysis producing other scientific evidence of interest, however this was considered to be outside the scope and stated objective of the paper.

Conflict of interest

Authors have no conflict of interest.

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