Commentary and concepts

Drowning and aquatic injuries dictionary

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Abstract

Background: Drowning is a significant public health issue with more than 320,000 deaths globally every year. These numbers are greatly underestimated, however, due to factors such as inadequate data collection, inconsistent categorization and failure to report in certain regions and cultures.

The objective of this study was to develop a standardised drowning dictionary using a consensus-based approach. Through creation of this resource, improved clarity amongst stakeholders will be achieved and, as a result, so will our understanding of the drowning issue.

Methodology: A list of terms and their definitions were created and sent to 16 drowning experts with a broad range of backgrounds across four continents and six languages. A review was conducted using a modified Delphi process over five rounds. A sixth round was done by an external panel evaluating the terms' content validity.

Results: The drowning dictionary included more than 350 terms. Of these, less than 10% had been previously published in peer review literature. On average, the external expert validity endorsing the dictionary shows a Scale Content Validity Index (S-CVI/Ave) of 0.91, exceeding the scientific recommended value. Ninety one percent of the items present an I-CVI (Level Content Validity Index) value considered acceptable (>0.78). The endorsement was not a universal agreement (S-CVI/UA: 0.44).

Conclusion: The drowning dictionary provides a common language, and the authors envisage that its use will facilitate collaboration and comparison across prevention sectors, education, research, policy and treatment. The dictionary will be open to readers for discussion and further review at www. idra.world.

Keywords: Drowning, Dictionary, Prevention, Definition, Terminology

"To understand the true burden of drowning we need to be able to use the same terminology and definitions" Szpilman (2017)

Introduction

As one of the most common causes of unintentional injury-related morbidity and mortality worldwide, drowning remains a significant public health issue.[1] The World Health Organization (WHO) estimates that there are approximately 320,000 deaths globally every year due to unintentional drowning.[1] These numbers are likely to be greatly underestimated due to factors such as inadequate data collection, a lack of consistent categorization methods, and failure to report a drowned person in certain regions and cultures, among others.[1] These estimates also do not include the number of people impacted by non-fatal drowning.[2,3]

The true burden of drowning on public health is unknown partly due to a lack of high-quality epidemiological data in the field. Furthermore, lack of uniform and internationally accepted definitions related to drowning have hampered data collection. This pertains to both fatal and non-fatal cases. Individuals and groups still frequently use inconsistent language to describe drowning terms, including water safety and health organisations, experts in the field, publications in the scientific medical literature and lay-persons including both mainstream and social media.[4−6] These inconsistencies result in difficulties comparing data among different collectors, and create many gaps in knowledge that have hindered the improvement of the understanding and mitigation of the drowning problem.[7]

In the past, multiple terms and definitions relating to aspects of drowning have been proposed and used in the literature. Examples where multiplicity exists includes the use of the following terms:

drowning, near-drowning, wet and dry asphyxia, drowning with and without aspiration, immersion, submersion, and submersion injury, among many others.[8]

Efforts in creating a uniform data collection and reporting framework started a few decades ago, when a group of experts in the field began debating the need for standardised terms and definitions. This resulted in a new definition of drowning being agreed upon at the World Conference on Drowning in the Netherlands, in 2002. In 2003, the International Liaison Committee on Resuscitation (ILCOR) released an advisory statement endorsing this definition and a set of guidelines for the uniform reporting of data from drowning.[9] The World Health Organization endorsed this new definition, and it was published in the Bulletin of the WHO in 2005.[8]

The use of out-dated, incorrect and confusing drowning-related terminology is still observed in peer-reviewed literature. A systematic review found that, between 2005 and 2011, 32% of drowning-related articles included non-uniform terminology,[10] including some in high impact factor journals. The US National Library of Medicine database is still using the MeSH term "near-drowning" to index papers regarding non-fatal drowning incidents. It is also possible to find numerous documents online which refer to outdated materials and incorrect information.

The use of obsolete terms circulated on social media and picked up by print and broadcast media also increases confusion and misinformation among the general public regarding drowning.[4] Confusing terminology and inconsistencies in the literature hinder efforts to track and characterise the epidemiological impact of this disease and the efficacy of therapeutic interventions.

Drowning prevention and aquatic safety professionals (lifeguards included), have a responsibility to promote the use of internationally agreed upon terminology to the public, in current practice, in medical reports and through the media.[10−12] A more precise public health

approach[13] will allow the use of data (collected using consistent terminology) to guide interventions that benefit the community more efficiently, especially for prevention.

The objective of this dictionary is to provide standardised terminology and definitions for greater clarity amongst a range of stakeholders across research, practice and policy development with the aim of improving the understanding and communication between these groups. The dictionary will be open to readers for discussion and reviewed continuously at www.idra.world.
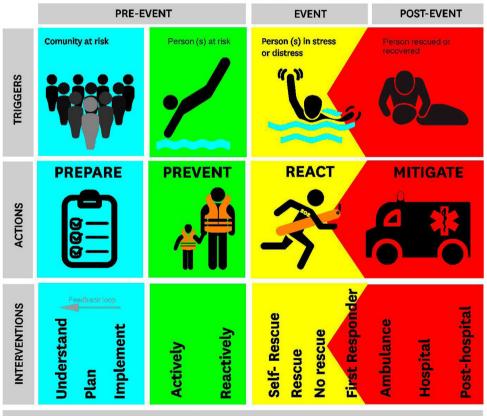
Methodology

Term identification

After establishing the need to create a drowning dictionary, two authors (DS, JPA) met to establish the format of the dictionary, the fundamental concepts, the references to follow, and to list the definitions of terms. Terms were categorized into those which were in agreement in the literature already and those which needed further

clarity. Subsequently, a third author (ACQ) joined the coordinating authors (CA). A first draft of the dictionary, with a list of terms and their definitions, was created. This initial list was based on the drowning timeline phases (Fig. 1).[14]

The CA sent an invitation to participate to 46 international drowning experts via email. Experts contacted were all members of the International Drowning Researchers' Alliance (IDRA). The experts who agreed to participate had to choose one specific field of preference from five different options: preparation (data collection, problem identification, planning, and education), prevention, reaction (rescue), mitigation (basic and advanced life support) or equipment. A total of 16 experts from Australia, Argentina, Canada, Greece, New Zealand, Netherlands, Portugal, Spain, Sweden, and United Kingdom replied (representing 4 continents and 6 distinct languages). Of note, 37% of responders were English native speakers. To confirm that the reviewers had a range of knowledge and skill expertise, a survey prepared by IDRA co-founders was sent to all of its members in order to establish a distinction between "expert" and person with "advanced experience" in a selection of areas. Members were asked to classify themselves based on the following definitions: (a) consider yourself a

Szpilman D, Tipton M, Sempsrott J, Webber J, Bierens J, Dawes P, Seabra R, Barcala-Furelos R, Queiroga AC. Drowning timeline: a new systematic model of the drowning process, Am J Emerg Med. 2016 Nov;34(11):2224-2226. Authors acknowledge SEMES (Sociedad Espanola de Medicina de Urgencias e Emergencias) for the design.

Fig. 1 – The drowning timeline (reproduced with permission from the authors). Triggers, actions and interventions are arranged to reflect the real chronological sequence of the drowning process. The overlap between the reaction and mitigation actions represents the diffuse transition between the two actions. This occurs when the victim is still being rescued, but some of the interventions of the rescuer can already be regarded as mitigating interventions. The original article is mentioned as footnote of the figure and can be consulted for a detailed description of all components of the drowning timeline.

person with "advanced experience" in a topic if you understand a wide range of terms/definitions/actions of that topic but might need to search further before providing an update on its scientific evidence; (b) consider yourself as an "expert" if you would not need to conduct a search on the topic before providing an update on its scientific evidence. Table 1 presents the results from this survey for the members that collaborated in the process of building the dictionary.

The reviewers who agreed to participate were assigned to a smaller panel based on their field of preference: Pre-event — Preparation (3); Pre-event — Prevention (4); Event — Reaction (3); Post-Event — Mitigation (3); and Equipment (3). The CAs created five documents, one per field of preference, and a guide for the review process. Table 1 outlines the instructions provided to each reviewer.

The CA decided to employ a modified Delphi process to reach consensus amongst participants due to its validated, systematic, and interactive forecasting method which relies on a panel of experts.[15] It was decided a priori that the Delphi method would stop after 5 iterations.

Each definition included text, and if applicable, followed by an illustration, picture, or figure and a reference to the scientific literature. An effort was made to apply this format to as many terms as possible. The CA used and cited pertinent terms from the literature if available. The dictionary contained some original illustrations/pictures/figures, while others were modified from the original and appropriately cited.

In the first round, each group separately received a draft with the guide for reviewers (Table 2). The panel was given 15 days to provide their reviews. The CA compiled and examined all edits and comments received from the reviewers. This resulted in a revised and refined version that was sent back to the same five groups of experts (Round 2). After the second iteration, the CA prepared one document, with all the terms included from the five groups combined. This document was again sent individually to all 16 participating experts (Round 3). The complete document underwent commenting and revision two more times until a final document was prepared after the fifth round.

Validation of the content

To evaluate the content validity of each term, Yosoff's content validity index (CVI) was calculated.[16] The CA recruited an external panel of 10 drowning experts (outside authors, but inside IDRA members) and invited them to evaluate the degree of agreement of each item. A four-point Likert scale was used (1 = do not agree; 4 = highly agree). Their responses were coded as '0' if "do not agree" and "somewhat agree" were selected, or as '1' if "quite agree" and "highly agree" agreed. A blank space for their comments was also available.

The CA defined a priori an acceptable Item Level Content Validity Index (I-CVI) value for 10 reviewers as 0.78 or greater. This represents the proportion of content experts who "quite agree" or better with the proposed term and definition.[17] Scale-level content validity index based on the average method (S-CVI/Ave) and Scale-level content validity index based on the universal agreement method (S-CVI/UA) were also calculated.[16]

Definition

Each word, definition, figure, or pictogram previously published in peer-reviewed literature and used in the dictionary was referenced. Those which do not contain references were the result of the iterative review process. The authors decided not to include generic medical terms, or obsolete terms related to drowning.

This project constitutes research not involving human subjects and is therefore exempt from IRB review and ethical approval.

Table 1 – Drowning dictionary reviewers' fields of expertise and research experience.

Expertise fields

Alcohol related issues	Inland waterways drowning	Rescue boat operations
Aquatic disaster	Intentional drowning	Rescue technology
Beach safety	Lifesaving/lifeguarding	Resuscitation
Boating/transport[a]	Low- and middle-income countries drowning	Rip currents
Coastal drowning	Marginalized communities	River drowning
Coastal processes	Marketing	School based education
Cold water immersion	Non-fatal drowning	Scuba injuries[a]
Critical care	Ocean lifeguarding	Special needs group[a]
Elderly drowning	Oceanography	Spinal cord injuries
Emergency medicine	Paediatrics	Submerged vehicle
Epidemiology aquatic injuries	Physiology	Surf lifesaving clubs
Epidemiology drowning	Pool lifeguarding	Swim/water safety instruction
Flood/disaster	Pre-hospital Care	Tourist drowning
Graphic design	Public health/promotion (prevention)	
Hospital care	Public policy	

Research experience

Computer modelling[a]	GIS (geographic information system)[a]	Qualitative methods
Data collection	Grant writing	Research design and methodology
Data visualization	Structured literature review	Risk analysis
English manuscript writing	Peer review	Statistical methods
Epidemiologic methods	Policy analysis	Survey designs
Ethics/institutional research	Program evaluation	

[a] Advanced experience but not expert.

Table 2 – Instructions sent to international drowning experts for the initial round of the drowning dictionary document review.

"Resilience to get something instead of nothing"

Dear [reviewer's name], when reviewing words, definitions and categorization, please consider the following:

- Be simple, short and easily understandable;
- Include language suitable to high, middle and low-income countries;
- Take into account the need to promote data acquisition from a wide range of individuals: layperson, lifesavers, lifeguards, pre-hospital care, ambulance services, doctors, persons filling out hospital and death statistics, etc.;
- Respect and consider language diversity and the need to have terms and concepts translated to other languages in a manner such that readily definable events will have high internal and external validity (e.g., reproducibility, low sensitivity to recall biases, etc.);
- This dictionary should be developed in a manner in agreement with the ICD-10 revision process and capable of integrating it;
- This dictionary needs to be written in a way so that it can easily and widely be communicated and disseminated, including to organizations that will be end-users namely those involved in water safety issues (e.g., health public and epidemiologist, lifeguard organizations, search and rescue teams, swimming instructors, etc.);
- This dictionary should be developed in such a manner that ensures reproducibility and robustness across a wide variety of reporting sites and sources.

What each reviewer needs to do:

- Review all the terms and definitions established by the CA;
- Before suggesting a new term, confirm it was not already listed;
- Identify any missing word that you think would be useful to be included;
- Identify any duplicates/synonyms or words/items that can be aggregated;
- Indicate unnecessary words/items, if you consider them too generic, not relevant for drowning or because there is already a good consensus for their use in literature;
- From the given term, provide your best definition using the fewest words possible;
- Propose a simple categorization to the dictionary's terms, if you feel necessary;
- Suggest obsolete terms to be included in a warning list.

Results

Nineteen experts (3 CA plus 16 invited) in fields related to drowning selected terms, definitions and categorizations included in the dictionary were involved. This process resulted in more than 350 terms, sub-terms and categorizations. Of these, less than 10% of terms, sub-terms and categorizations had been previously published in peer review literature and were referenced in the document.

The drowning dictionary includes a list of acronyms that were used throughout the dictionary that are provided in alphabetical order (Appendix 1 — Acronyms). Both the list of acronyms and the complete list of terms are provided as complementary material (Appendix 2 — Terms, definitions and categorizations).

Using the average method, the scale content validation index (S-CVI/Ave) was 0.91, exceeding the scientific recommended value, and endorsing the drowning dictionary. Ninety one percent of the items received an I-CVI value considered acceptable (>0.78). Nine percent did not reach the *a priori* I-CVI validity cut off, although their values were equal to or greater than 0.50, showing that they were not yet consolidated and will require further revision in the near future before acceptance. The authors (CA) used consensus to amend these words. There was not significant universal agreement among the external panel (S-CVI/UA = 0.44). After content validity evaluation, the CA reviewed the document and identified five words based on the external panel's comments that needed further consideration and were updated. Other reasons cited by the external panel's for terms scoring low on the validity evaluation included: improper English grammar, confusion regarding how to evaluate a term when "see the definition in other item" was listed for related concepts (e.g., aquatic versus water), feeling that the term was out of their field/ knowledge expertise, or that the term was already self-explanatory, among others.

Discussion

Drowning is an extremely complex process and there is no simple or single solution to this public health problem. However, having a standard, consistent and evidence-based communication platform to describe all terms related to drowning can greatly assist the collection of data. This allows for more robust research to be conducted and permits better examination and potentially mitigation of the drowning burden. Until now however, scarce common language was available in the field of drowning.

The benefit of this dictionary includes the involvement of authors with different native languages and incorporation of cultural differences across four continents. The suggested terminology is meant to be useful for a variety of situations, heterogenous contexts environments and research purposes.

In part due to the representation of many cultures and experiences, and inclusion of a high number of terms/definitions, an overall consensus had to be reached rather than universal agreement. However, use of the acceptable validity CVI values to evaluate each term scientifically strengthened the consensus process. Despite the many differences between contributors, the consensus process demonstrated that common ground can be found for the range of drowning-related terms in use and authors envision that future revaluations will increase universal agreement.

The vast number of potential terms and sub-terms that could have been used to describe the whole drowning process was a limitation of this process. A decision had to be made at some point regarding how included sub-terms could be applied and to what level of detail was considered sufficient (e.g., the decision to use both "aquatic" and "water" words as peer reviewed terms in the literature). A further limitation is that the majority of terms and their definitions were a consensus of opinion instead of scientific study confirmation (e.g., authors decided via consensus to avoid referring to the drowning

person as a "victim" in the text, as this implies a random event instead of a preventative one). Although participants were all from the same source organisation (IDRA), there is no membership fee to join and is open access to everyone resulting in the widest representation of the scientific global drowning community. Furthermore, this is a work in process and future reviews by anyone outside the field of research (e.g., service users) will result in improvements.

Like all terminology definitions, this document will only reflect current practice at the time of publication. Future iterations will focus on maintaining an updated compilation as new information and data about the drowning process is obtained.

Conclusions

This drowning dictionary provides a common ground and language, and authors envisage that its use will facilitate discussion across drowning prevention sectors, including education, research and treatment. It is not presented as a final, definitive list of terms and definitions, but provides the foundation for a living document that can be updated in future when a need exists to include, exclude and modify definitions and categorizations. The dictionary will be open to readers for discussion and further review continuously at www.idra.world.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.resplu.2020.100072.

REFERENCES

1. World Health Organization. Global Report on Drowning: Preventing A Leading Killer. Geneva: WHO Press; 2014 ISBN 978 92 4 156478 6. https://www.who.int/violence_injury_prevention/publications/drowning_global_report/Final_report_full_web.pdf.

2. Szpilman D, Barros OR, Mocellin O, Webber J. Is drowning a mere matter of resuscitation? Resuscitation 2018;129:103−6, doi:http://dx.doi.org/10.1016/j.resuscitation.2018.06.018.

3. Peden AE, Mahony AJ, Barnsley PD, Scarr J. Understanding the full burden of drowning: a retrospective, cross-sectional analysis of fatal and non-fatal drowning in Australia. BMJ Open 2018;8:e024868, doi:http://dx.doi.org/10.1136/bmjopen-2018-024868.

4. Szpilman D, Sempsrott J, Webber J, et al. "Dry drowning" and other myths. Cleve Clin J Med 2018;85:529−35, doi:http://dx.doi.org/10.3949/ccjm.85a.17070.

5. Venema AM, Webber J, Schmidt AC, Semsprott J, Szpilman D, Queiroga AC, et al. Reply to letter: neurocognitive and behavioral outcomes in a nearly drowned child with cardiac arrest and hypothermia resuscitated after 43 min of no flow-time: a case study. Resuscitation 2017;122:e7−8, doi:http://dx.doi.org/10.1016/j.resuscitation.2017.07.017.

6. Venema AM, Absalom AR, Idris AH, Bierens JJLM. Review of 14 drowning publications based on the Utstein style for drowning. Scand J Trauma Resusc Emerg Med 2018;26:19, doi:http://dx.doi.org/10.1186/s13049-018-0488-z.

7. Peden AE, Franklin RC, Clemens T. Exploring the burden of fatal drowning and data characteristics in three high income countries: Australia, Canada and New Zealand. BMC Public Health 2019;19:794, doi:http://dx.doi.org/10.1186/s12889-019-7152-z.

8. Van Beeck EF, Branche CM, Szpilman D, Modell JH, Bierens JJLM. A new definition of drowning: towards documentation and prevention of a global public health problem. Bull World Health Organ 2005;83:853−6.

9. Idris AH, Berg RA, Bierens J, et al. Recommended guidelines for uniform reporting of data from drowning: the "Utstein style". Resuscitation 2003;59:45−57, doi:http://dx.doi.org/10.1161/01.CIR.0000099581.70012.68.

10. Sempsrott J, Slattery D, Schmidt A, Penalosa B, Crittle T. Systematic review of non-Utstein style drowning terms. Ann Emerg Med 2011;58:S321, doi:http://dx.doi.org/10.1016/J.ANNEMERGMED.2011.06.456.

11. Sempsrott J, Hawkins S. Position Statement 15-1: Use of the terms near, dry, delayed and secondary drowning. The Starfish Aquatic Institute; 2015. p. 1−3. https://www.stopdrowningnow.org/wp-content/uploads/2018/07/SAI_position_statement_15-1_on_drowning_terms.pdf.

12. Koon W, Schmidt A, Queiroga AC, et al. Need for consistent beach lifeguard data collection: results from an international survey. Inj Prev 2020;0:1−8, doi:http://dx.doi.org/10.1136/injuryprev-2020-043793.

13. Dowell SF, Blazes D, Desmond-Hellmann S. Four steps to precision public health. Nature 2016;540:189−91.

14. Szpilman D, Tipton M, Sempsrott J, et al. Drowning timeline: a new systematic model of the drowning process. Am J Emerg Med 2016;34:2224−6, doi:http://dx.doi.org/10.1016/j.ajem.2016.07.063.

15. Jones J, Hunter D. Consensus methods for medical and health services research. BMJ 1995;311:376−80, doi:http://dx.doi.org/10.1136/bmj.311.7001.376.

16. Yusoff MSB. ABC of content validation and content validity index calculation. Educ Med J 2019;11:49−54, doi:http://dx.doi.org/10.21315/eimj2019.11.2.6.

17. Lynn M. Determination and quantification of Content Validity. Nurs Res 1986;35:382−6.