Future Research Questions

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Christine Branche and Ed van Beeck

23.1 Improved and More Comprehensive Data Collection for Drowning Morbidity and Mortality Remains a High Priority for Fully Understanding the Drowning Problem and for Developing Effective Interventions

The magnitude of drowning is better understood in several regions of the world and improvements in data collection have been observed. However, several barriers in data collection remain. Not all countries use the International Classification of Diseases, 10th Revision (ICD-10) coding for drowning injury, and of those that do, not all report drowning to the 4th digit, thus making for large differences in the level of specification for drowning. Moreover, populations at greatest risk are often omitted from standard data collection methods in many countries. These challenges make it difficult to make international comparisons, which then make it difficult to have a full picture of the drowning burden globally. Lifesaving organizations can play a role here, especially if uniformity in data collection among them can be accomplished. The still new definition of drowning has made it possible to measure the magnitude of the drowning problem globally as never before. Adoption of the definition of drowning has continued at an encouraging pace since 2006. As in 2006, researchers are invited and encouraged strongly to use the new definition and to report the advantages and disadvantages they observe in scientific journal articles and editorials. Furthermore, including the definition of drowning in the ICD coding

C. Branche (✉)
Office of Construction Safety and Health, National Institute for Occupational Safety and Health, Centres for Disease Control and Prevention,
395 E Street SW, Suite 9200, Washington, DC 20201, USA
e-mail: cbranche@cdc.gov

E. van Beeck
Department of Public Health, Erasmus MC, University Medical Centre Rotterdam,
PO Box 2040, 3000 CA Rotterdam, The Netherlands
e-mail: e.vanbeeck@erasmusmc.nl

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would be an ideal way to accomplish consistency in data collection, which should, in turn, affect treatment modalities and prevention strategies for drowning globally. Therefore, exploring the inclusion of our definition in ICD is a key priority.

23.2 Alternative Sources of Data Should Be Used to Improve Worldwide Data on Fatal Drowning

In one study of the global burden of injuries, the availability and quality of cause of death data were evident for only 28 % of the world's population (83 countries). In addition, only 20 countries had national death data registration that was judged to be of high quality. The authors concluded that low- and middle-income countries, which often experience the greatest burden of both fatal and nonfatal injuries, could benefit from an exploration of alternative sources for mortality data. Alternative data sources include mortuaries, national censuses, surveys, demographic surveillance sites, and even databases maintained by lifesaving organizations. In this section, newspapers have been suggested as a potential additional data source to describe the epidemiology of drowning. Drowning research based on these and other alternative sources is encouraged. Where poor quality is evident, it is possible to improve data through, for example, capture-recapture methods, which indirectly estimate the number of cases and have been used previously in injury studies. The application of these methods in drowning studies should be explored further.

23.3 More Studies Are Needed That Collect High-Quality Data on Nonfatal Drowning Worldwide

The current epidemiology of drowning, globally, is based principally on drowning mortality patterns. Recent estimates in Denmark showed the drowning ratio of fatal cases to nonfatal cases with or without morbidity to be 1 (mortality): 0.5 (morbidity): 134 (no morbidity). This is still one of the very few reports available, but it gives a clear demonstration of the value of implementing our definition of drowning. Follow-up studies on the nonfatal consequences of drowning should be pursued rigorously.

23.4 Collecting Data on Nonfatal Drowning Will Assist Also in Calculating Drowning-Related Disability-Adjusted Life Years (DALYs), Which Are Currently Underestimated But for Which Empirical Evidence Is Elusive

A recent study showed that fatal injuries are the source of less than one-third of all injury-related DALYs and that the global burden of drowning is probably three times higher than currently estimated. An international consortium of injury

researchers has confirmed the availability of new methods for assessing nonfatal injury outcomes, and drowning researchers would benefit from applying them. In addition, international guidelines for follow-up studies into injury-related disability should be followed, thus enabling comparisons of the consequences of nonfatal drowning with other injuries and other health outcomes. A pooled analysis of drowning outcomes in injury patients from national cohort studies in the Netherlands, the United Kingdom, New Zealand, and Australia shows promise and could be a first and viable step in this process.

23.5 There Is a Need to Continue the Search for Risk Factors for Drowning

While risk factors have been frequently studied, there remains a critical need for a better understanding of the drowning causal chain and the amount of exposure. It will be important to clarify how age, culture, ethnicity, socio-economic status, and other factors alter the risk of drowning. In addition to epidemiological approaches, for example, by case-control studies, research methods from the social sciences could provide valuable insights given the role of behavioral and cultural factors.

23.6 Include Qualitative Research to Obtain Relevant Information

The application of qualitative methods, such as focus group testing, may be more feasible and may generate additional information on potential behavioral and environmental risk factors. Cross-sectional studies, for example, can be conducted more quickly than, say, longitudinal studies and could lead to novel insights as well as tailored preventive interventions. Conducting studies on drowning using conventional methods is important, but so too will be those that use alternatives. Finding funds for research is always a challenge, and alternative qualitative methodologies often require fewer funds.

23.7 Finally, Enlarging the Body of Evidence on Drowning Prevention Is Urgently Needed

There are still only a very few preventive measures backed by high levels of evidence of their effectiveness, especially for low- and middle-income countries. A stronger emphasis on the role of supervision in drowning prevention, by age and developmental status, is urgently needed. While various frameworks and taxonomies for supervision have been suggested, translation and use of the framework to aid prevention is needed. Since 2006 swimming instruction for children ages four and older is the only new preventive strategy with scientific support on its effectiveness. This has been concluded with consistency in three independent case-control studies. Effectiveness studies using innovative and potentially feasible approaches are needed for drowning

prevention in low- and middle-income countries. These may include play pens, door barriers to prevent exiting the home, and crèches or day nurseries. Because of the financial and ethical constraints of preventive trials, as well as their methodological complexity, the application of novel nonexperimental methods to assess effectiveness of interventions should be explored within drowning research.