African Journal of Emergency Medicine 10 (2020) 219–223

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

Original article

Impact of community-based first responder development for the management of drowning casualties in rural areas of Bangladesh

Mohammad Jahangir Hossain[a,b,*], Md Shafkat Hossain[a,b], Cinderella Akbar Mayaboti[b], AKM Fazlur Rahman[b], Salim Mahmud Chowdhury[b], Saidur Rahman Mashreky[b], Aminur Rahman[a,b]

[a] International Drowning Research Centre, Bangladesh, Mokakhali, Dhaka, Bangladesh
[b] Centre for Injury Prevention and Research, Mohakhali, Dhaka, Bangladesh

ARTICLE INFO

Keywords:
First Aid
CPR
Community volunteers
Drowning

ABSTRACT

Background: Drowning is the leading cause of childhood death in Bangladesh. In order to minimize the number of casualties Centre for Injury Prevention and Research, Bangladesh (CIPRB) incorporated a 'first responder' program which includes Cardio Pulmonary Resuscitation (CPR), in community based drowning prevention program, *SwimSafe*. Along with swimming lessons, swimming instructors provide first responder services in the community. The objective of this study was to describe the results of the volunteer based first responder services for the management of drowned casualties between 2012 and 2015 in the rural communities of Bangladesh.

Methods: Adolescents and youths who volunteered as community swimming instructors were trained as first responders to provide first aid and resuscitation in the community. Trainers from the International Drowning Research Centre Bangladesh (IDRC-B) of CIPRB delivered the training. The first responders were also trained on the documentation of the first responder services they provided in the community. The documented records were collected from the volunteers on a regular basis; when drowning cases were reported CIPRB management followed up with an in depth data collection, using a structured form.

Results: 2,305 community volunteers were trained between 2012 and 2015. Of them 1,461 reported providing first responder services among 6,773 casualties, including 184 drowning casualties. Of the drowning casualties, volunteers treated 31 casualties with Cardiopulmonary Resuscitation (CPR), 51 casualties by putting into the recovery position and 102 casualties were treated for the shock on site. Of those given CPR, 22 (71%) survived and 9 (29%) died. After receiving treatment from the first responder 104 (56.5%) of the drowning casualties were referred to health facilities for further treatment.

Conclusions: The training of community first responders seems to be an effective way of managing and reducing drowning causalities in countries like Bangladesh, where drowning is a significant public health hazard.

African relevance

- Drowning is one of the leading causes of death among children across Asia and Africa.
- Community based first responders can provide first responder services in the areas where there is a lack of emergency health care services.
- By developing community based volunteers it is possible to minimize deaths due to injury.

Introduction

The global burden of drowning is high, claiming 295,000 deaths each year, of which 90% occur in low- and middle-income Countries (LMICs) [1,2]. Drowning is the third leading cause of unintentional injury death, following road traffic accidents and injuries from falls. Globally, it accounts for 7% of all injury-related deaths [3]. In Bangladesh, daily life requires open water bodies for daily household tasks, including: bathing, irrigation and transportation. As a result, both children and adults are widely exposed to open water locations such as ponds, ditches, rives, canals and the ocean. Studies conducted in Bangladesh suggested that drowning is the leading cause of death among

* Corresponding author.
E-mail address: jahangir@ciprb.org (M.J. Hossain).

https://doi.org/10.1016/j.afjem.2020.07.009
Received 19 March 2020; Received in revised form 6 July 2020; Accepted 16 July 2020
Available online 27 August 2020

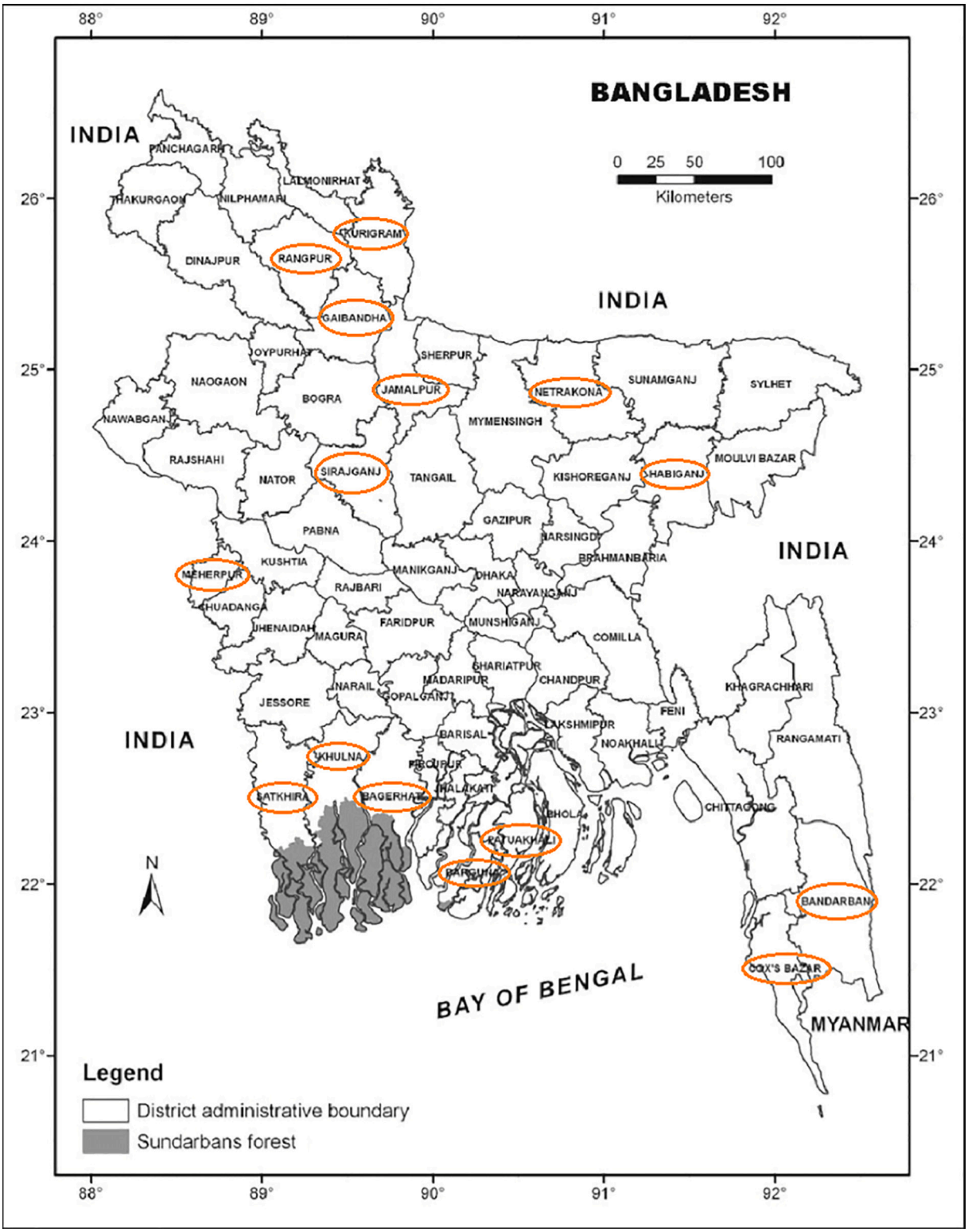

Fig. 1. Location of *SwimSafe* project areas in Bangladesh.

children aged 1–17 years [4–6], accounting for 48 child deaths a day and 18,000 a year. In addition around 68,000 children experiences non-fatal drowning each year [5]. The survey findings also suggest that approximately 8100 adults die from drowning in Bangladesh every year [7].

Emergency medical care is an essential part of medical services for both high and low- income countries and essential for any health related emergencies [8]. In high-income countries, the availability of adequate emergency medical services is considered a basic human right [9–11]. In these countries, citizens are often trained in first response, and they are considered as an important component in the chain of survival [10,12,13]. In LMICs, due to lack of formal emergency services, an estimated 80% of total deaths occur in a pre-hospital settings [14]. Study findings from Bangladesh suggest that 61% of the injured

had no access to medical care before death [15].

The provision of timely rescue and early bystander Cardio Pulmonary Resuscitation (CPR) is considered to be an effective way of increasing the opportunity for survival after drowning [16], however, few studies have examined its effectiveness in low-resource settings where professional pre-hospital care is unavailable. According to WHO, Survival of the drowning casualties depends on how quickly the person is rescued from the water, and how swiftly proper resuscitation is performed [17].

Research findings from rural Bangladesh show that rural community lack knowledge in terms of primary, secondary and tertiary interventions and tend to perform indigenous and harmful practices on non-fatal drowning cases [5,18]. Due to the lack of pre-hospital emergency health services in Bangladesh, drowning casualties are almost never treated by a trained person or trained professional emergency care worker, and are therefore rarely provided with appropriate pre-hospital resuscitation.

In a response to the large number of child deaths from drowning in Bangladesh, in 2005 the Centre for Injury Prevention and Research, Bangladesh (CIPRB) with the support of Royal Life Saving Society Australia (RLSSA), the Alliance for Safe Children (TASC) and the Bangladesh Swimming Federation (BSF) developed a survival swimming training program, called *SwimSafe*. During 2006 and 2015, with the financial support from UNICEF, over 480,000 children aged between 4 and 10 years has completed survival swimming lessons. Ever since, the *SwimSafe* program has been an effective program for the prevention of childhood drowning in Bangladesh [19].

As part of the *SwimSafe* program, adolescents and youths were trained to be survival swimming instructors. Between 2006 and 2011 instructors received training on CPR as a part of the *SwimSafe* instructor training program. In 2012 a two-day formal first aid training program was developed and incorporated in the *SwimSafe* program to provide more thorough training and additional first aid skills among instructors. In addition, swimming instructors were encouraged to act as first responders within the community to provide first aid and CPR apart from the swimming lessons. Between 2012 and 2015 a total of 2305 volunteers were trained under the *SwimSafe* program as first responders across 15 districts of Bangladesh. This paper describes the results of the first responder services provided by the trained adolescents and youths in the management of drowning casualties in rural areas of Bangladesh.

Methods

A cross sectional study was conducted to evaluate the study aim. Data were collected between 2012 and 2015 year.

The *SwimSafe* program was designed to train children from 4 to 10 years of age in survival swimming lessons. As part of this program, adolescents and youths volunteered as community swimming instructors. All volunteers received a five-day basic swimming teacher training and a two-day first responder training prior to giving swimming lessons. The *SwimSafe* program was implemented in 15 districts of Bangladesh gradually between 2012 and 2015. The locations of the district are showed in the map below (Fig. 1).

Two first aid trainers were recruited and trained by the IDRC-B for delivering the program. First aid training manuals were adapted from the IDRC-B, which were designed for using in low-literacy settings. The manual was translated in local Bengali language with sufficient visual aids, for ease of understanding by volunteers with minimal literacy. CPR training mannequins were used during the CPR practical sessions. During the training session volunteers were also trained on filling and keeping the records of the first responder services they provide within the community. The training lasted for two days between 9.00 am to 3.00 pm, pre and post tests were also conducted to assess the skills and knowledge of the trainees. The first response curriculum comprised of treatment for common injuries including cuts, burns, animal bites, electrocution, shock, poisoning and basic life support including CPR for drowning casualties. CPR was taught and assessed following guidelines from the 2010 European Resuscitation Council [20]. All volunteers who passed in both knowledge and skills section separately received a certificate from IDRC-B as a community first responder. A modification to the guideline was made, which recommended that the volunteers should stop CPR after 30 min, if there were no visible signs of life in the casualty. Trainees were also educated when it was necessary to refer casualties to the nearest health care providers.

The training was predominantly hands-on, class sizes was limited to 15 trainees including male and female, led by one male and one female trainer with the support of project supervisors who facilitated training sessions.

Selection of participants

Adolescents and youths who had at least a secondary level of education, aged between 16 and 25 years and good acceptance in the community were selected as volunteers for giving community children swimming lessons. The volunteers were residing in the project areas and to support the different activities of the *SwimSafe* program, supervisors were appointed. The main responsibilities of the supervisors were field level supervision of all activities of the *SwimSafe* program, quality control, coordination and data entry. Each supervisor supervised 25 community swimming instructors.

Data collection

A report form was developed and pre-tested in the project areas, after necessary feedback the form was revised and printed for collecting data. During the training session all participants were trained on completing the reporting form (form 1). This form contained basic information about the date, the name and details of the first aid service provider/recipient, the type of service received and referral. Another structured questionnaire (form 2) was developed for the supervisors to collect detailed additional information on the management of drowned casualties (Form 2).

First response providers recorded information about the first response they provided in the community using the form 1. Every month the area supervisor of the *SwimSafe* program collected the forms from the volunteers. If any volunteers treated a drowning casualty by providing CPR or putting in recovery position, then the supervisor collected additional details to investigate the case further using form 2. All data on CPR and recovery position were re-checked by the Project Coordinators of the *SwimSafe* program. After checking all of the data, the collected forms were sent to CIPRB Dhaka head office for data entry and a sample of the data were re-checked by senior managers to ensure the quality of the submitted data, followed by analysis. Descriptive analysis was conducted using SPSS version 23.

The *SwimSafe* is a regular program of the International Drowning Research Centre, Bangladesh (IDRC-B). Ethical clearance was obtained from the Ethical Review Committee (ERC) of Centre for Injury Prevention and Research, Bangladesh (CIPRB).

Results

Between 2012 and 2015 a total of 2305 community volunteers were trained as first responders across 15 districts of Bangladesh. Of them, 43% (n = 986) of the volunteers were male and 57% (n = 1319) were female. Among these, 63.38% (n = 1461) of the volunteers provided first responder services in the community.

The first responders reported on providing first responder services to 6773 people; of them, 184 (86 males and 98 females) were rescued from the water. After the rescue, the first responders assessed the AB (A-Airway, B-Breathing) and life signs (presence of breathing, state of consciousness, and circulation) of the drowned person. Based on an initial assessment by the first responders, casualties were treated for

Table 1
Information of drowning cases (n = 82).

Age category	Number	Percentage
1-5	36	43.9
6-10	37	45.1
11-17	4	4.9
18+	5	6.1
Activity prior to drowning		
Falling in the water	29	35.4
Bathing in the water	20	24.4
Playing in the water	18	21.9
Swimming	9	11.0
Others	6	7.3
Place of drowning		
Pond	62	75.6
Ditch	4	4.9
River/Canal	13	15.9
Well	1	1.2
Drain	1	1.2
Animal feeding tub	1	1.2
Who first saw the children in the water		
First Responder	24	29.3
Parents	15	18.3
Relatives	12	14.6
Neighbor	16	19.5
Friends	8	9.7
Caregiver	4	4.9
Siblings	3	3.7
Referral		
Health facility (6 deaths)	34	41.5
Registered doctor	5	6.1
Village doctor	21	25.6
Not referred (3 deaths)	22	26.8

visible wounds or shock, by putting the patient in the recovery position or giving CPR. Of all drowning casualties, 82 were treated with CPR and subsequently the recovery position. The rest of the drowning casualties (n = 102) received first responder services for shock. The rescuers included first responders, parents, relatives, neighbors, caregivers and siblings. Among the drowning casualties 89.0% (n = 73; boys-37, girls-36) were children aged up to age 10 years. After providing first responder services 73.2% (n = 60) of drowning victims were referred to the health facilities or health care providers such as village doctors for further treatment (Table 1).

After conducting the rescue, if the drowning casualty was found unconscious and not breathing, then the volunteer provided CPR as per the European Resuscitation Council guidelines for drowning victims. Thirty children received CPR (96.8%) along with one (3.2%) adult. The mean duration of the CPR was 16.23 min (SD ± 10.28), ranging from 2 to 30 min. For six casualties (19.6%) relatives of the victims stopped the First Responder from continuing CPR. Out of the 31 casualties 22 (70.9%) survived and 9 (29.1%) died. Mouth to mouth ventilation was provided to 27 (87%) casualties. After providing CPR, all 23 who survived (74.2%) were referred to local health facilities or health care providers for further treatment.

There were 51 drowning casualties who were treated by being put in the recovery position. Among them, 29 (58%) were unconscious but were still breathing and the rest (42%) remained conscious but were hyperventilating. The mean time for maintaining the casualty in the recovery position was 13.49 (SD ± 4.91) minutes (results of 41 casualties) (Table 2).

After providing first responder services, first responders referred 60 (73.2%) of casualties to the health facilities or health care providers. Thirty-four of them (41.5%) were referred to government and private health facilities such as hospitals located in the district, sub district and union (lowest administrative unit) level. The rest of the drowning casualties were also referred to registered doctors and village doctors (medicine sellers, trained health care providers in rural areas). The drowning cases who received CPR or were kept in the recovery position, 72% (n = 36) of them were referred to the health facility for further treatment.

Table 2
First responder services provided by the volunteers among drowning casualties.

Age category	Types of first responder services provided among the drowned casualty					
	Cardio pulmonary resuscitation (n = 31)				Recovery position (n = 51)	
	Survived		Death			
	Male	Female	Male	Female	Male	Female
1–5	7	5	4	0	10	10
6–10	4	5	2	2	10	14
11–17	1	0	0	0	2	1
18+	0	0	1	0	2	2
Total	12	10	7	2	24	27

Discussion

The overall findings of this study suggest that volunteers, regardless of gender, can provide first responder services to drowning casualties in the community. The volunteers trained as first responder were adolescents and youths aged between 16 and 25 years who had at least secondary level of education. In this study, all community volunteers successfully provided first responder services to the 6773 casualties (including 184 casualties due to drowning). In this study volunteers also successfully managed a significant number of drowning victims by providing advanced level first aid such as CPR and recovery position.

First response volunteers should provide CPR to drowning casualties if they are unconscious or not breathing [21]. A hospital based study, conducted in many other countries suggested that after providing CPR, the survival rate during discharge ranged from 15.5 to 30.5% [22–24], but in this study survival rate was found to be 71% (n = 21). The higher survival rate in this study was perhaps due to the fact that CPR was given immediately after casualties were rescued from the water. The mean duration of CPR in this study was found to be 16.23 (SD ± 10.28) minutes, whereas the mean duration of CPR in emergency department victims with cardiac arrest was 28 (SD ± 17) minutes [25].

Prior to providing CPR to a casualty it is essential that air can reach the lungs [26]. In the rural areas of Bangladesh there are no established emergency healthcare system, so mouth to mouth breathing is the only method for delivering air to the lungs of a casualty who needs CPR. Due to potential cultural limitations mouth to mouth breathing can be an issue in Bangladesh. A study conducted in Bangladesh showed that community people are willing to administer mouth to mouth ventilation among their close relatives rather than to friends of the opposite sex or strangers [27]. In our study community volunteers administered mouth to mouth breathing to 87% (n = 27) casualties; of these casualties 93.5% (n = 30) were children under 10 years of age.

The recovery position is highly recommended for the unconscious drowning casualty who is breathing [28]. In this study, volunteers assessed the consciousness status and breathing of the drowning victims after rescuing. Based on the assessment, volunteers treated 51 drowning victims in the recovery position.

It was also found that, volunteers were hindered to continue CPR among 6 (19.3%) drowning casualties out of these cases 5 (83.3%) died on the site. The reason behind ceasing continuation of CPR may be dute to the inclination of rural citizens to prefer other traditional methods of drowning management. Another reason may be rural citizens often consider drowning as a normal cause of death and do not consider receiving medical care following drowning appropriate; relatives of the drowning victims will initiate the burial process immediately after a fatal drowning occured [7].

Referring the casualty to a proper health care provider in an

emergency is vital to reduce the risk of any life threatening complications. Findings from a community based study conducted in Bangladesh suggested that severely injured individuals, 40% of the moderately injured, and only 12.5% of individuals with minor injuries sought treatment from hospital [15]. In this study the volunteers referred an overall of 73.2% (n = 60) drowning casualties to the hospitals or facilities. 72% (n = 36) of drowning victims, who were given CPR or kept in a recovery position, were referred to health facilities.

In some cases, reports were not collected due to the unavailability of volunteers in the community. All data on CPR and recovery position were re-checked by the Project Coordinators of the *SwimSafe* program, data were rejected if any inconsistency was found during re-check. The first aid training was designed for two days and no refresher training was provided. Further follow up information (such as disability due to neurological damage) was not collected.

Conclusion

Community volunteers can manage drowning causalities by providing first responder services including CPR on site. The training has increased the skills of the bystanders in the rural community, but it is yet to be found if this in turn is managing drowning incidents. By providing immediate first responder services it is possible to save the lives of drowning victims. Bangladesh is a disaster prone area, and so by developing community-based volunteers, a significant number of lives can be saved from drowning. Further in-depth research is required for the scalability and sustainability of this program at the community level. The study findings can contribute to the development of a national health care strategy for Bangladesh.

Dissemination of results

Findings of this study were presented at the World conference on drowning prevention 2017 in Penang, Malaysia. The initial findings were presented at the World conference on drowning prevention 2015 in Potsdam, Germany.

Authors' contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: MJH contributed 50%; MSH and CAM 30%; and FR, SRM, SMC, and AR contributed 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflicts of interest.

Acknowledgements

We acknowledge UNICEF, Bangladesh for providing financial assistance for this program. We also acknowledge the Center for Injury Prevention and Research, Bangladesh, with the support of Ministry of Women and Child Affairs, who implemented the program in the project areas throughout Bangladesh. Special thanks to Shariful, Nahar and Rabbya Ashrafi for their efforts to train the community first responders for the *SwimSafe* program. Anisa Kabir is acknowledged for her English editing for this manuscript. We also acknowledge Laerdal for contributing a large number of mannequins for the *SwimSafe* program.

References

[1] Franklin RC, Peden AE, Hamilton EB, Bisignano C, Castle CD, Dingels ZV, et al. The burden of unintentional drowning: global, regional and national estimates of mortality from the Global Burden of Disease 2017 Study. Inj Prev 2020;2020(0):1–13.
2. Drowning. World Health Organization [Internet]. [cited 2020 Apr 26]. Available from. https://www.who.int/news-room/fact-sheets/detail/drowning.
3. World Health Organization. World Health Organization. Drowning prevention in the South-East Asia region–2014. 2014.
[4] Linnan M. Child mortality and injury in Asia: survey results and evidence. Innocentive Work Pap 2007;3:64–87.
[5] Rahman Aminur, Rahman AKM Fazlur, Sumona Shafinaz ML. Bangladesh health and injury survey. Child report. 2005.
[6] Rahman A, Mashreky SR, Chowdhury SM, Giashuddin MS, Uhaa IJ, Shafinaz S, et al. Analysis of the childhood fatal drowning situation in Bangladesh: exploring prevention measures for low-income countries. Inj Prev 2009;15(2):75–9.
[7] Hossain MJ, Biswas A, Mashreky SR, Rahman F, Rahman A. Epidemiology of adulthood drowning deaths in Bangladesh: findings from a nationwide health and injury survey. F1000Research 2017;6(May):589.
[8] Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, et al. Diseases control priorities in developing countries. Dis control priorities dev ctries. 2nd ed.2006. p. 997–1015.
[9] Razzak J a, Kellermann AL. Emergency medical care in developing countries: is it worthwhile? Bull World Health Organ Jan 2002;80(11):904.
[10] Kyriacou DN, Arcinue EL, Peek C, Kraus JF. Effect of immediate resuscitation on children with submersion injury. Pediatrics 1994;94(2 I):137–42.
[11] Baker R. American independence and the right to emergency care. JAMA Mar 1999;281(9):859–60.
[12] Cummins RO. Emergency medical services and sudden cardiac arrest: the “chain of survival” concept. Annu Rev Public Health 1993;14:313–33.
[13] Kanstad BK, Nilsen SA, Fredriksen K. CPR knowledge and attitude to performing bystander CPR among secondary school students in Norway. Resuscitation Aug 2011;82(8):1053–9.
[14] Mock CN, Jurkovich GJ, nii-Amon-Kotei D, Arreola-Risa C, Maier RV. Trauma mortality patterns in three nations at different economic levels: implications for global trauma system development. J Trauma May 1998;44(5):804.
[15] Rahman F, Andersson R, Svanstrom L. Medical help seeking behaviour of injury patients in a community in Bangladesh. Public Health 1998;112:31–5.
[16] Bierens JJLM, Knape JTA, Gelissen HPMM. Drowning. Curr Opin Crit Care Dec 2002;8(6):578–86.
17. Global report on drowning: preventing a leading killer. World Health Organisation; 2014.
[18] Borse NN, Hyder a a, Streatfield PK, Arifeen SE, Bishai D. Childhood drowning and traditional rescue measures: case study from Matlab, Bangladesh. Arch Dis Child Dec 2011;96(7):675–80.
[19] Rahman F, Bose S, Linnan M, Rahman A, Mashreky S, Haaland B, et al. Cost-effectiveness of an injury and drowning prevention program in Bangladesh. Pediatrics 2012;130(6):e1621–8.
[20] Nolan JP, Soar J, Zideman DA, Biarent D, Bossaert LL, Deakin C, et al. European resuscitation council guidelines for resuscitation 2010. Resuscitation 2010;81(10):1219–76.
21. Middleton R. “Near” drowning. Aust Emerg Nurs J 2007;10:3.
[22] Goldberger ZD, Chan PS, Berg RA, Kronick SL, Cooke CR, Lu M, et al. Duration of resuscitation efforts and survival after in-hospital cardiac arrest: an observational study. Lancet Oct 2012;380(9852):1473–81.
[23] Rasheed AM, Faisal Amera M, Parameaswari P, Sabri Numan O, Elhaj AM, Muteb MA. The initial success rate of cardiopulmonary resuscitation and its associated factors among intensive care unit patients in a tertiary hospital in Saudi Arabia. J Intensive Crit Care 2016;02(03):1–6.
[24] O’Rourke PP. Outcome of children who are apneic and pulseless in the emergency room. Crit Care Med May 1986;14(5):466–8.
[25] Cha WC, Lee EJ, Hwang S. The duration of cardiopulmonary resuscitation in emergency departments after out-of-hospital cardiac arrest is associated with the outcome: a nationwide observational study. Resuscitation Nov 2015;96:323–7.
[26] Perkins GD, Olasveengen TM, Maconochie I, Soar J, Wyllie J, Greif R, et al. 2017 update. 2018;123:43–50.
[27] Mecrow TS, Rahman A, Mashreky SR, Rahman F, Nusrat N, Scarr J, et al. Willingness to administer mouth-to-mouth ventilation in a first response program in rural Bangladesh. 2015;2016:1–5.
[28] Szpilman David, Handley Anthony J. Hand book on drowning: prevention, rescue and treatment. vol. 6. 2005.