Resuscitation 89 (2015) 58–63

Contents lists available at ScienceDirect

Resuscitation

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

Clinical paper

Assessing self-efficacy of frontline providers to perform newborn resuscitation in a low-resource setting

Kristian R. Olson[a,b,c,d,*], Aya Caldwell[e], Melva Sihombing[f], A.J. Guarino[g], Brett D. Nelson[c,d], Rebecca Petersen[g]

[a] Center for Global Health, Massachusetts General Hospital, Boston, MA 02114, United States
[b] Department of Medicine, Clinician Educator Unit, Massachusetts General Hospital, Boston, MA 02114, United States
[c] Division of Global Health, Department of Pediatrics, Massachusetts General Hospital, Boston, MA 02114, United States
[d] Harvard Medical School, Boston, MA 02115, United States
[e] Novartis Foundation for Sustainable Development, Basel CH 4002, Switzerland
[f] Bina Permata Medika School of Health Sciences, Tangerang, Banten, Indonesia
[g] MGH Institute of Health Professionals, Charlestown, MA 02129, United States

ARTICLE INFO

Article history:
Received 10 July 2014
Received in revised form 7 January 2015
Accepted 12 January 2015

Keywords:
Self-efficacy
Newborn resuscitation
Developing country
Newborn health
Neonatal mortality
Birth asphyxia

ABSTRACT

Objectives: Newborn deaths comprise an alarming proportion of under-five mortality globally. In this retrospective cohort study, we investigated the effectiveness of focused newborn resuscitation training and delivery of a positive-pressure device in a rural midwife population in a low-resource setting. The present research attempts to better understand the extent to which knowledge and self-efficacy contribute to resuscitation attempts by birth attendants in practice.
Methods: A one-year retrospective cohort analysis was undertaken in Aceh, Indonesia of two groups of community-based midwives, one having received formal training and a positive-pressure resuscitative device and the other receiving usual educational resources and management. A path analysis was undertaken to evaluate relative determinants of actual resuscitation attempts.
Results: 348 community-based midwives participated in the evaluation and had attended 3116 births during the preceding year. Path analysis indicated that formal training in resuscitation and delivery of a positive-pressure device were significantly related to both increased knowledge ($\beta = 0.55$, $p = 0.001$) and increased self-efficacy ($\beta = 0.52$, $p = 0.001$) in performing neonatal resuscitations with a positive-pressure device. However, training impacted actual resuscitation attempts only indirectly through a relationship with self-efficacy and with knowledge. Combined across groups, self-efficacy was significantly associated with positive pressure ventilation attempts ($\beta = 0.26$, $p < 0.01$) whereas knowledge was not ($\beta = -0.05$, $p = 0.39$).
Conclusion: Although, to date, evaluations of newborn resuscitation programs have primarily focused on training and has reported process indicators, these results indicate that in order to improve intrapartum-related hypoxic events ("birth asphyxia"), increased emphasis should be placed on participant self-efficacy and mastery of newborn resuscitation.

1. Introduction

There has been significant progress in decreasing under-five mortality in accordance with Millennium Development Goal (MDG) 4, heralded by a decrease of 41% since 1990.[1] However, progress towards addressing newborn mortality has been much slower with 2.9 million newborns still dying annually and the contribution of newborn deaths as a proportion of under-five mortality increasing from 37% in 1990 to 44% in 2012 globally and reaching greater than 50% in many regions.[2] 1.2 million of the 2.6 million annual stillbirths also die during labor from largely the same causes.[3] Over 98% of these deaths occur in low- and middle-income countries (LMICs).[4] Without a reduction in these deaths, many countries will not be able to reach MDG 4 even beyond 2015.

Intrapartum-related hypoxic events ("birth asphyxia") comprise nearly one quarter of newborn deaths, and their prevention

Abbreviations: AAP, American Academy of Pediatrics; HBB, Helping Babies Breathe; HIV, human immunodeficiency virus; IRB, Institutional Review Board; LMIC, low- and middle-income countries; MDG, Millennium Development Goals; NRP, newborn resuscitation program; SE, self-efficacy; TM, tube-and-mask positive-pressure device.

* Corresponding author at: Massachusetts General Hospital, 100 Cambridge Street, 15th Floor, Boston, MA 02114, United States.
E-mail address: krolson@partners.org (K.R. Olson).

http://dx.doi.org/10.1016/j.resuscitation.2015.01.008
0300-9572/

requires immediate action within 1 min of birth. Given this and the expansion of community health providers in healthcare systems, there has been a greater emphasis on training these providers in newborn resuscitation with updated and clarified algorithms and materials such as with the Helping Babies Breathe® curriculum (HBB).[5] Introduction of simple devices developed for LMICs and on-site training has been shown to reduce neonatal mortality in the first 24 h by as much as 47%.[6]

Determining whether a simplified neonatal resuscitation program delivered by trained health workers can reduce neonatal death due to intrapartum-related hypoxia was recently deemed the number one research priority of the delivery domain in newborn care globally.[7] However, coverage of neonatal resuscitation has been woefully inadequate. In one evaluation, estimates of the percentage of all babies birthed by staff trained in neonatal resuscitation in six African nations ranged from 2 to 12%.[8]

Our previous research analyzed the effectiveness of a newborn resuscitation training program conducted in Indonesia beginning in 2005.[9] The training program occurred in a disrupted health system after the 2004 Asian tsunami and resolution of the civil conflict in the province of Aceh, Indonesia. The study assessed two groups of midwives. The Intervention Cohort was formally trained in newborn resuscitation as well as with the use and maintenance of a reusable positive-pressure ventilation (PPV) device. Provided in collaboration with the Ministry of Health in Aceh, our training program was a modified version of the American Academy of Pediatrics/American Heart Association's Neonatal Resuscitation Program™ (NRP). The modified training focused on assessment and therapeutic actions and consisted of steps up to and including positive pressure ventilation. Both a bag-valve-mask device and a tube-and-mask device were used in the instruction. Each birthing facility received bag-valve-mask devices and, in addition, each midwife received a tube-and-mask device upon successful completion of the training. This group was compared to a Control Cohort, which was not formally trained and received no device through this program. A similar number of midwives had attended at least one delivery in each cohort (63.6% versus 66.0%, $p = 0.67$) yet those in the Intervention Cohort provided PPV to a higher percentage of total births compared to the control cohort (5.21% versus 2.28% of newborns).[9] The Intervention Cohort rate corresponds to expected values that estimate 3–6% of newborns require basic resuscitation.[10] However, regardless of their cohort, midwives in both groups had similarly high resultant survival rates of newborns provided PPV. Hence, the willingness to perform newborn resuscitation at the time of critical need seems likely to be a key predictor for averting intrapartum-related deaths.

Provider self-efficacy (SE), or a person's *belief* that he or she is competent in a specific ability or behavior, has had limited attention in newborn resuscitation training literature as it pertains to actual practice.[11] A recent educational evaluation of HBB included an assessment of SE after training alone among 133 facilitators and learners.[12] In that study, similar to prior studies, discrepancies were noted between knowledge, skills, performance on manikins, and SE.[12,13] As training programs are scaled globally, specifically in LMICs, implementers will have to understand *how* providers will best learn, retain, and actually *use* this training in real-life situations.

SE is a widely researched concept consistently found to be a significant mediator and predictor of motivation and behavior change in new or challenging tasks.[14,15] Bandura's early research on SE found that a person's willingness to perform tasks was a stronger predictor of efforts to change and of behavioral outcomes than the type of training or learning model employed.[14] The American Psychological Association notes numerous health-related applications (e.g. pain management; exercise; management of high-risk behaviors related to smoking, substance abuse, eating, and human immunodeficiency virus (HIV)).[16] In recent medical research, Turan et al.[17] found a significant relationship between SE and mastering the competencies of a medical education curriculum. SE has also been found to predict clinical performance in nursing students.[18] In the field of midwifery, Jordan and Farley[19] found that SE can be enhanced in recent midwife graduates by appropriate instruction. Nevertheless, because SE is domain-specific, any assessment should focus on the specific task being assessed. We believe that attention to SE has value in training in global health settings, particularly when local birth attendants are asked to learn new techniques and procedures in high-risk situations such as in neonatal resuscitation. Confidence in one's ability to intervene in such settings could significantly impact willingness to initiate resuscitation efforts.

In the current study, we hypothesized that formal training results in greater knowledge of the need for and practice of newborn resuscitation and in greater confidence (i.e., higher SE) in using a PPV device. Furthermore, we hypothesized that, regardless of training, those with greater levels of SE would be more likely to perform resuscitation and that SE would significantly contribute to resuscitation attempts with a positive-pressure device. These hypotheses are represented in the path model in Fig. 1.

2. Methods

As previously described, this study surveyed midwives in three districts in the province of Aceh, Indonesia, an area with a disrupted health system.[9] From October 16, 2008 to January 23, 2009, we conducted an evaluation of retrospective cohorts among community-based birth attendants in the districts of Aceh Barat and Nagan Raya (Intervention Cohort) and in Aceh Selatan (Control Cohort). The survey encompassed the preceding 12-month period from Ramadan to Ramadan in order to aid with recall.

Regions selected were similar in terms of demographics, geography, and impact of both the tsunami and the civil conflict. As above, the Intervention Cohort received training in the use of PPV devices, and each participant received a personal tube-and-mask device for use beginning in September 2005.

2.1. Training intervention

We reported the methods of the three-hour training intervention previously.[9]

The training program was implemented beginning in October 2005.

2.2. Training setting

The modified NRP training occurred on-site at midwives' places of work – often in a secondary clinic within the community.

2.3. Training content

The training curriculum included preparation for delivery, newborn drying, newborn assessment, stimulation and stabilization, and provision of ventilation (instruction was with both tube-and-mask and bag-valve-mask devices). This training was implemented before the release of the HBB curriculum in June 2010.

2.4. Training methods

First, an interactive lecture, predominantly of pictures and graphics, described the context and methods for neonatal resuscitation. After repeated modeling of resuscitation steps by peer-instructors to provide observational learning, hands-on practice with neonatal manikins and PPV was emphasized.

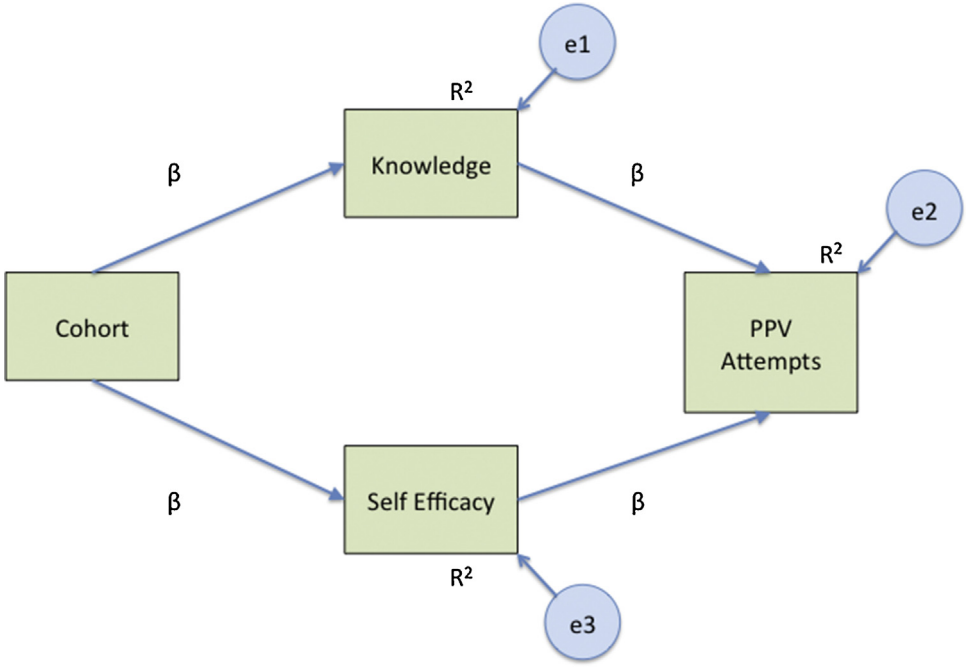

Fig. 1. Hypothesized path analysis model. e: variance not explained by the model; R^2: variance explained; β: path coefficients.

Each midwife repeated hands-on training with the PPV devices on manikins, and a trainer assessed methods and provided corrective feedback with other participants observing. The peer-trainers led each participant through several alternate resuscitation scenarios. Observed Structured Clinical Examinations (OSCE) evaluated performance of the participants. Midwives also practiced administering correct pressure breaths into simple "soda bottle" water-column manometers of 15 cm and 40 cm of water pressure to ensure they could physically sense the pressure required for ventilation. Midwives needed to successfully complete resuscitation steps prior to receiving their own ventilation device. A pre- and post-training knowledge assessment was also performed.

2.5. Outcome measures

During the survey period, both cohorts answered 44 questions from a written and concurrently verbally administered survey form in the Indonesian language (Bahasa Indonesia). Questions addressed information about schooling, past and recent resuscitation training, number and nature of births attended, and use of resuscitation steps over the preceding 12 months from Ramadan 2008 to Ramadan 2009. The midwives were also asked about their resuscitation attempts, knowledge, and self-efficacy (SE), with these three primary outcome variables operationalized as follows:

Resuscitation attempts: Midwives reported the number of newborns in the 12 months for whom they provided at least one PPV.
Resuscitation knowledge: Three multiple-choice questions scored as correct or incorrect and added to reflect percent correct.
Resuscitation self-efficacy (*SE*): Confidence in treating neonatal asphyxia was assessed on a 5-point Likert scale, reverse coded so that 1 = not at all confident to 5 = very confident.

3. Data analysis

Path analysis, an application of multiple regression analysis, was employed in our inquiry to assess how Group (Intervention or Control) and levels of SE and Knowledge impacted Resuscitation attempts. As indicated in Fig. 1, our study hypothesized that Group (Intervention Cohort or Control Cohort) would have a *direct* impact on levels of knowledge and SE, which would then have a *direct* effect on PPV attempts. The effect of Group on PPV attempts would operate *indirectly*, through its impact on knowledge and SE. We were also interested in comparing the relative contributions of knowledge and SE on PPV attempts, regardless of the Group. Prior to analysis, all variables were examined through IBM SPSS (Chicago, IL, USA) to ensure that data met assumptions.

This study was approved by the Institutional Review Board (IRB) of Partners Healthcare, Boston, MA, USA. No IRB existed in the study regions and, therefore, in-country approval for the study was gained through signed letters of permission from each District Health Office. All participants provided written informed consent before participation.

4. Results

A total of 348 midwives participated in the survey and 3116 total births were attended in the preceding 12 months. The majority of these were non-facility deliveries with 84.0% of deliveries occurring within homes. Two hundred and forty-two midwives in Aceh Barat and Nagan Raya comprised the Intervention Cohort; 106 midwives in Aceh Seletan comprised the Control Cohort. There was evidence of training and device use crossover, with 14% of the Control Cohort reporting they had received resuscitation training since 2005 compared to 93% of the Intervention Cohort. Just over 11% of Controls reported owning a resuscitation device compared to 95% in the Intervention Cohort. A comparison between bag-valve-mask and tube-and-mask devices was not performed. The reader is referred to Olson et al.[9] for complete information on these results.

5. Results of path analysis (Fig. 2)

5.1. Impact of training on self-efficacy and knowledge

In the path analysis, the regression of SE and knowledge on Group yielded coefficients of determination of 0.27 and 0.30

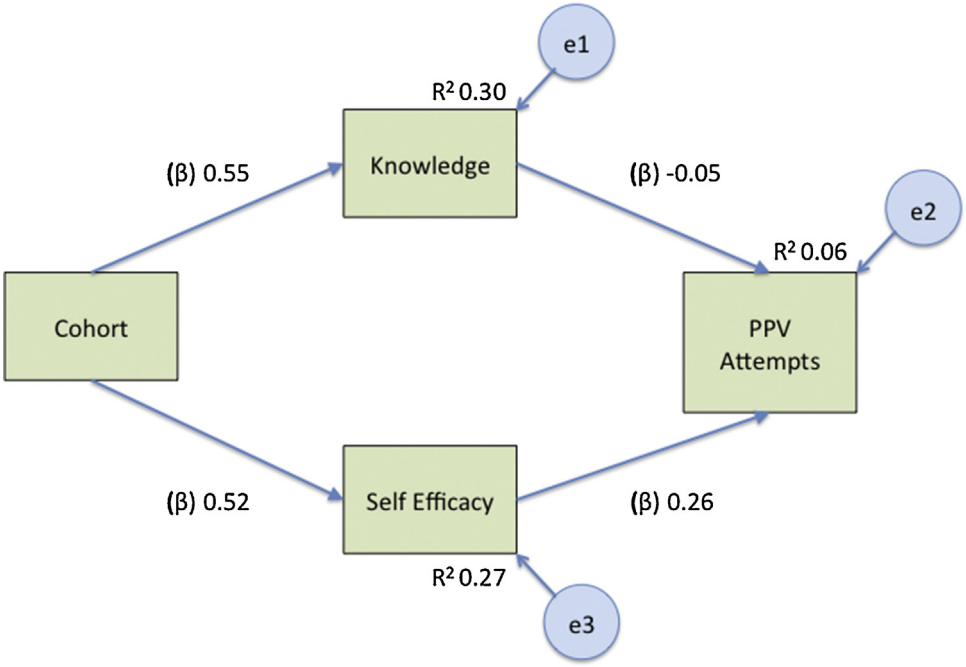

Fig. 2. Observed path analysis results. e: variance not explained by the model; R^2: variance explained; β: path coefficients.

Table 1
Mean self-efficacy and knowledge by Group.

Cohort	*N*	SE rating (rated from 1 to 5)		Knowledge score (% correct)	
		Mean	SD	Mean	SD
Intervention	242	4.15	0.83	87%	0.18
Control	106	2.86	1.25	56%	0.28
Significance level		$p < 0.001$		$p < 0.001$	

respectively, meaning that training accounted for 27% of the variance of SE scores and 30% of the variance in knowledge scores. (Fig. 2) The Intervention Cohort demonstrated significantly greater levels of both SE ($\beta = 0.52$, $p = 0.001$) and knowledge ($\beta = 0.55$, $p = 0.001$). Mean SE and knowledge scores for the two cohorts are listed in Table 1. Compared to the Controls, the Intervention Cohort had significantly higher confidence ratings (SE) in treating neonatal asphyxia (4.15 versus 2.86, $p < 0.001$) and obtained higher knowledge scores (87% versus 56%, $p < 0.001$).

5.2. Impact of self-efficacy and knowledge on resuscitation

For the total sample of midwives, 17.8% provided PPV to newborns during the preceding 12 months ($n = 62$) and 82.2% did not ($n = 286$). A higher percentage of women in the Intervention Cohort gave PPV than women in the Control Cohort (20.2% versus 12.3%, $p = 0.04$). The distribution of midwives in each cohort giving at least one PPV is listed in Table 2. Path analysis (Fig. 2) then examined the relative contributions of SE and knowledge on actual PPV attempts, when looking at all midwives combined between cohorts. Path analysis results for this total sample indicated that SE significantly accounted for 6.76% of the variance in PPV attempts (R^2 of 0.06, $\beta = 0.26$, $p < 0.01$); there was no significant relationship between knowledge and PPV attempts (R^2 of −0.05, $\beta = -0.05$, $p = 0.39$).

6. Discussion

Newborn resuscitation is a life-saving intervention for addressing one of the leading causes of neonatal mortality globally. Improving provider uptake and application of newborn resuscitation skills is a critical priority, but adequate coverage is unfortunately lacking to date.[8] Understanding of how best to enhance program implementation so the greatest number of effective resuscitations are attempted by providers is needed. In this study, we sought to elucidate the relative contributions of SE and knowledge on the delivery of newborn resuscitation attempts in a real practice setting.

Formal resuscitation training impacted PPV attempts indirectly, through its significant impact on both resuscitation knowledge and resuscitation SE. Training accounted for 27% of the variance in SE and 30% of the variance in knowledge. However, only SE

Table 2
Percentage of midwives in each cohort giving and least one PPV and the frequency of attempts by these midwives.

Cohort	% with PPV ≥1	Range of attempts	Number of midwives giving the following number of PPV attempts:								
			1	2	3	4	5	6	7	8	9
Intervention	20.2	0–9	26	10	5	3	2	2	0	0	1
Control	12.3	0–9	5	1	1	0	4	0	1	0	1

demonstrated a significant effect on actual resuscitation attempts with PPV, whereas knowledge did not.

By the time the survey assessed training outcomes, 14% of the Control Cohort had received resuscitation training and 11% owned a device. It is uncertain exactly where these 12 women obtained their devices though the tube and mask device employed in this study was commercially available in Indonesia. That some of these women had obtained training or a device could well indicate that this subset may have been more self-motivated. However, although higher knowledge and SE was associated with the formal training intervention, the impact of levels of knowledge and SE was assessed irrespective of group assignment, therefore, taking into account contamination of the Control Cohort. Our results suggest that regardless of the presence or absence of formal training, midwives' SE or confidence in administering resuscitation breaths is a significant factor in the provision of resuscitation attempts in practice. In this analysis, it was more significant than the level of resuscitation knowledge.

7. Implications and importance of these findings

In Bandura's seminal 1977 article on SE, he found that "expectations of personal effectiveness formed through partial mastery experiences during the course of treatment predicted, at 84% level of accuracy, performance on highly threatening tasks that subjects had never done before".[14] Strategies to enhance SE include mastery with positive feedback, vicarious experience or modeling, verbal persuasion, and increasing physiological and/or emotional arousal states related to the targeted task.[14,15,20] In other domains, participant modeling and repeated observations of successful modeling have been shown to contribute to SE. Our training incorporated all of these elements of SE enhancement.

High-impact interventions to reduce neonatal mortality have already been identified; however, there will be increasing importance placed on how these interventions are delivered to ensure that providers are able to employ the training received.[7,21] Prior studies have shown a discrepancy between self-efficacy and skills with manikin practice.[12,13] However, our study of practice patterns of midwives following training suggests that more systematic emphasis on incorporating techniques to enhance SE among providers is needed. This seems to support a peer-trainer and trainer-of-the trainer delivery model. SE may also be enhanced by frequent re-fresher practice sessions. Making such sessions cost-effective and practical may be an important direction of implementation investigation. These may be able to be performed briefly, frequently, and on-site to overcome logistical and resource constraints regardless of the practitioner's setting of practice. Further investigation is needed to determine the optimal timing, methods, and evaluation measures required for fidelity of skill retention and SE of providers.

8. Limitations

Only 17.8% of midwives performed PPV during the preceding year. This reflects that a large proportion of midwives in the study area attended few or no deliveries. However, this practice pattern does not negate the observed differences in proportions of newborns provided life-saving PPV. The range of PPV attempts made by midwives in both groups was identical. In addition, only five midwives in the Intervention Cohort and six midwives in the Control Cohort provided more than five newborns PPV during the preceding year, suggesting that results were not biased by a few very active midwives. Rather, more midwives were providing at least some PPV attempts in the Intervention Cohorts. Regardless, the benefit of this path analysis is that it investigated the effect of both SE and knowledge for the total population of midwives in both groups. There is a possibility of recall bias among respondents. However, we used the "Ramadan to Ramadan" timeframe to aid with recall through bounding the preceding year's events. Importantly, one might imagine that those who attempted resuscitation gained a perception of SE by doing so, rather than the reverse. This highlights the need for prospective evaluations of self-efficacy in the future. Despite assured confidentiality and anonymity, midwives in both groups may preferentially report successes. In addition, our measures of knowledge included only a few key questions. We believe that enhancing knowledge of resuscitation tasks is indeed essential and a more comprehensive evaluation of knowledge may have revealed that knowledge accounted for a greater degree of the variance in actual resuscitation attempts. Similarly, we utilized a question pertaining to a scale of self-perceived "confidence" as a marker of SE. Context specific, multifactorial SE scales of neonatal resuscitation need to be developed. Further study is required to determine the reproducibility of a SE focus in newborn resuscitation practice in low-resource settings.

9. Conclusion

This study supports the feasibility of an innovative resuscitation training program in increasing both resuscitation knowledge and self-efficacy for using positive-pressure resuscitation devices. Here, path analysis indicated that SE was significantly associated with PPV attempts in practice although knowledge was not.

Greater attention to enhancing SE should be made within training and skill maintenance programs of neonatal resuscitation globally.

Conflict of interest statement

The authors have no conflicts of interest to declare.

Acknowledgements

The authors wish to acknowledge the District Health Offices of Aceh Barat, Nagan Raya, and Aceh Selatan as well as the International Organization for Migration for facilitating these trainings and subsequent evaluation. The Thomas G. Roberts and Susan M. DaSilva Giving Fund provided support to enable this study. None had roles in the study design, collection, analysis, writing, nor decision to submit for publication.

References

1. United Nations. The millennium development goals report 2013; 2013. p. 13–26318.
2. UNICEF, WHO. The World Bank United Nations. Levels and trends in child mortality: report 2013; 2013.
3. Lawn JE, Blencowe H, Pattinson R, et al. Lancet's stillbirths series steering committee. Stillbirths: Where? When? Why? How to make the data count? Lancet 2011;377:1448–63.
4. Oestergaard MZ, Inoue M, Yoshida S, et al. On behalf of the United Nations Interagency Group for Child Mortality Estimation and the Child Health Epidemiology Reference Group. Neonatal mortality levels for 193 countries in 2009 with trends since 1990: a systematic analysis of progress, projections, and priorities. PLoS Med 2011;8:e1001080.
5. American Academy of Pediatrics. Helping Babies Breathe 2014; 2014.
6. Msemo G, Massawe A, Mmbando D, et al. Newborn mortality and fresh stillbirth rates in Tanzania after helping babies breathe training. Pediatrics 2013;131:e353–60.
7. Yoshida S, Rudan I, Lawn JE, et al. Members of the neonatal health research priority setting group. Newborn health research priorities beyond 2015. Lancet 2014;384:e27–9.
8. Wall SN, Lee AC, Niermeyer S, et al. Neonatal resuscitation in low-resource settings: what, who, and how to overcome challenges to scale up? Int J Gynaecol Obstet 2009;107(Suppl. 1). S47, 62, S63-4.

9. Olson KR, Caldwell A, Sihombing M, Guarino AJ, Nelson BD. Community-based newborn resuscitation among frontline providers in a low-resource country. Int J Gynaecol Obstet 2012;119:244–7.
10. Lee AC, Cousens S, Wall SN, et al. Neonatal resuscitation and immediate newborn assessment and stimulation for the prevention of neonatal deaths: a systematic review, meta-analysis and Delphi estimation of mortality effect. BMC Public Health 2011;11(Suppl. 3). S12, 2458-11-S3-S12.
11. Bandura A. Perceived self-efficacy in cognitive development and functioning. Educ Psychol 1993;28, 117, 118–48.
12. Singhal N, Lockyer J, Fidler H, et al. Helping Babies Breathe: global neonatal resuscitation program development and formative educational evaluation. Resuscitation 2012;83:90–6.
13. Carlo WA, Wright LL, Chomba E, et al. Educational impact of the neonatal resuscitation program in low-risk delivery centers in a developing country. J Pediatr 2009;154, 504, 508.e5.
14. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev 1977;84:191–215.
15. Bandura A. Self-efficacy: the exercise of control. Worth Publishers; 1997.
16. Carey MP, Forsyth AD. American Psychological Association teaching tip sheet: self-efficacy 2014; 2014.
17. Turan S, Valcke M, De Maeseneer J, et al. A novel Medical Achievement Self-efficacy Scale (MASS): a valid and reliable tool. Med Teach 2013;35: 575–80.
18. Cheraghi F, Hassani P, Yaghmaei F, Alavi-Majed H. Developing a valid and reliable self-efficacy in clinical performance scale. Int Nurs Rev 2009;56:214–21.
19. Jordan R, Farley CL. The confidence to practice midwifery: preceptor influence on student self-efficacy. J Midwifery Womens Health 2008;53:413–20.
20. Haugland T, Veenstra M, Vatn MH, Wahl AK. Improvement in stress, general self-efficacy, and health related quality of life following patient education for patients with neuroendocrine tumors: a pilot study. Nurs Res Pract 2013; 2013:9.
21. Bhutta ZA, Das JK, Bahl R, et al. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? Lancet 2014;384:347–70.