

Educational Strategies to Improve Outcomes from Neonatal Resuscitation

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Education Gaps

1. Significant attention is paid to the science supporting neonatal resuscitation guidelines, but little attention is paid to the science supporting neonatal resuscitation education.
2. Failure to apply evidence-based educational strategies can have a negative impact on the quality of neonatal resuscitation and decrease survival after neonatal resuscitation.

Abstract

Since 1987, the Neonatal Resuscitation Program (NRP) course has taught the cognitive, technical, and behavioral skills required to effectively resuscitate newborns. To remain relevant and effective, the NRP course needs to continually evolve and embrace evidence-based educational strategies proven to improve outcomes from resuscitation. In this Educational Perspectives article, 6 educational strategies that can be applied to neonatal resuscitation education are reviewed. These educational strategies include *mastery learning and deliberate practice, spaced practice, contextual learning, feedback and debriefing, assessment, and innovative educational strategies*. Then knowledge translation and implementation of these educational strategies through passive and active knowledge translation, change theory, design thinking, performance measurement, deadoptio strategies, continuous quality improvement, incentive and penalties, and psychological marketing are explored. Finally, ways to optimize faculty development of NRP instructors, including both initial instructor training and ongoing instructor development, are examined. The goal of this review is to help NRP program developers and instructors use evidence-based educational strategies to improve neonatal resuscitation outcomes.

AUTHOR DISCLOSURE Dr Sawyer has disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

ABBREVIATIONS

AAP	American Academy of Pediatrics
AHA	American Heart Association
CMAT	Cognitive aids in Medicine Assessment Tool
DVD	digital video disc
NRP	Neonatal Resuscitation Program
PPV	positive pressure ventilation

Objectives After completing this article, readers should be able to:

1. Summarize the history of the Neonatal Resuscitation Program.

2. Describe the formula for survival in resuscitation.
3. Describe educational strategies that can improve outcomes from neonatal resuscitation, if implemented optimally by trained faculty.

INTRODUCTION

Approximately 85% of all newborns start to breathe without assistance within 15 seconds after birth. (1) Around 10% of newborns require stimulation or suction to initiate spontaneous breathing. (2) Between 3% and 5% of newborns need positive pressure ventilation (PPV) or intubation because of a lack of spontaneous breathing after stimulation or suctioning. Less than 0.1% of newborns (1 in 1,000) require cardiopulmonary resuscitation with chest compressions and epinephrine. (3)(4) These statistics stress the importance of having a neonatal resuscitation team prepared to provide lifesaving resuscitation at every delivery. (5) They also highlight the critical importance of delivering effective PPV during newborn resuscitation because the vast majority of newborns who require resuscitation at birth will improve with effective PPV. (6)

Since 1987, the Neonatal Resuscitation Program (NRP) course has taught the cognitive, technical, and behavioral skills required to effectively resuscitate newborns. (7) Today, over 4 million health care professionals have been trained or retrained in NRP, and about 200,000 learners complete the NRP course each year. (8) More than 21,000 active NRP instructors teach these courses. (8) The curriculum of the NRP course has changed over time to keep pace with advances in both medical science and adult learning theory. (9) Since 2010 (6th edition), the NRP course has embraced simulation as a critical educational strategy. (10) The current (7th edition) NRP course format includes standardized testing with an online multiple-choice examination, virtual simulation with NRP eSIM™, and an in-person course that consists of 3 components: performance skills, integrated skills, and simulation and debriefing. (10) To remain relevant and effective, the NRP course needs to continually evolve and embrace evidence-based educational strategies shown to improve outcomes from resuscitation.

In 2018, the American Heart Association (AHA) published a scientific statement titled “Educational Strategies to Improve Outcomes from Cardiac Arrest.” (11) In that statement, a modified formula for survival in resuscitation was introduced. The statement identified 6 educational strategies that could improve outcomes from cardiac arrest if implemented optimally by trained faculty. In this educational

perspective, I will review the AHA’s modified formula for survival and examine how the 6 educational strategies could be applied to neonatal resuscitation education. Then I will explore knowledge translation and implementation of these strategies through the NRP course. Finally, ways to optimize faculty development of NRP instructors will be explored. The goal of this review is to help NRP program developers and instructors to use evidence-based educational strategies to improve neonatal resuscitation outcomes.

THE MODIFIED FORMULA FOR SURVIVAL IN RESUSCITATION

The Figure depicts a modified formula for survival in resuscitation from the AHA’s 2018 scientific statement, “Educational Strategies to Improve Outcomes from Cardiac Arrest.” (11) The creation of the modified formula, and the scientific statement that supports it, followed a multistep process, including steering committee development, defining the scope of the statement, creating working groups, performing a literature review, and performing a consensus-building exercise at an AHA education summit. (11) The new survival formula replaces the original AHA formula for survival that was published in 2013. (12)

The modified formula for survival describes 3 interactive factors that form a chain of survival after cardiac arrest. The first factor is guideline quality, which is based on medical science review by the International Liaison Committee on Resuscitation and the development of consensus treatment recommendations. (13) The second factor is the efficient education of patient caregivers through resuscitation training courses such as the NRP. The third is the local implementation of the resuscitation guidelines and educational activities, which involves health care professionals doing what they learned in an NRP course as part of clinical practice.

EDUCATIONAL STRATEGIES TO IMPROVE SURVIVAL

The modified formula specifies 6 educational strategies (eg, instructional design features) associated with educational efficiency. The 6 educational strategies include *mastery*

learning and deliberate practice, spaced learning, contextual learning, feedback and debriefing, assessment, and innovative educational strategies. Each of these strategies is reviewed in the following subsections, and they are summarized in Table 1. The content covered in this review does not include an in-depth analysis of the evidence supporting the 6 educational strategies. What I provide here is a brief description of each strategy, including essential definitions, followed by an example(s) of implementation of the strategy in an NRP course. Readers interested in a comprehensive summary of the evidence supporting each of the educational strategies and an examination of implementation issues are directed to the original publication. (11)

Mastery Learning and Deliberate Practice

Mastery learning and deliberate practice is an instructional strategy used to ensure that students achieve a level of mastery (eg, 90% on a skills test) during a training event or educational course. As described by McGaghie, mastery learning in health care education involves 7 essential elements. (14) The first 2 elements occur before the training event. The first element is the development of a set of learning objectives for the event or course. The second element is the determination of a minimum passing standard (eg, mastery level) for each learning objective on an assessment tool. (15)(16) During the training event, the instruction starts with a diagnostic test for baseline skills. After baseline skill has been measured, the students engage in deliberate practice focused on reaching the learning objectives and the preset mastery standard. To be *deliberate*, the practice is paired with coaching, which is directed at the diagnosis of errors in performance, informative feedback, and remedial training to correct performance errors. (17) During practice, formative testing is used to ensure that each student's performance has reached the preset minimum passing standard for mastery. Continued deliberate practice is used until each student reaches the mastery standard. Only after the mastery standard has been reached on the first learning objective can the student move to the next learning objective. (14)

An example of the use of mastery learning and deliberate practice in an NRP course is the implementation of a *PPV skills testing station* in which all students are required to demonstrate mastery to pass the NRP course. To implement such a PPV skills testing station, there would need to be a clear set of PPV learning objectives, and an assessment tool would need to be developed to score PPV performance accurately. A minimum passing standard (eg, mastery level) on the checklist would also need to be determined. During the training event, the course would start with a baseline

diagnostic test of PPV skills. After baseline testing, each student would engage in deliberate PPV practice focused on reaching the preset mastery standard. The practice would be paired with instructor coaching and feedback aimed at correcting PPV performance errors. When ready, each student would undergo formative testing to determine if he/she reached the mastery standard. If not, continued deliberate practice would be provided until each student reached the mastery standard. A student who demonstrates mastery on the baseline diagnostic test would not need deliberate practice or formative testing.

Spaced Learning

Massed learning involves the acquisition of new knowledge and skills during a single training event. Spaced learning (also called *spaced practice* or *distributed practice*) involves the acquisition of new knowledge and skills during several discrete sessions that are separated in time. (11) The number of sessions and the intervals between sessions can vary, but the sessions are typically minutes to hours in length and typically separated by days to weeks.

The educational benefits of spaced learning stem from a psychological phenomenon called *the spacing effect*, which is based on cognitive load theory. (18) Cognitive load theory posits that human memory is made up of 2 types: long-term memory and working memory. (19) The capacity of long-term memory is limitless. The capacity of working memory is limited to 7 ± 2 units at a time. Learning new knowledge and skills requires cognitive work (eg, cognitive load) as working memory organizes and stores new information in long-term memory where it can be retrieved later. When the capacity of a learner's working memory to store new information in long-term memory is exceeded, the learner is *overloaded* (eg, cognitive overload) and is unable to process new information effectively. By breaking up learning into small portions over a dispersed period, the cognitive load to the learner is decreased or is less likely to occur. (20)

The differentiation between *initial training* to gain new knowledge and skills and *follow-up training* to retain knowledge and skills that have already been learned is essential. Initial training is aimed at novice learners to achieve a baseline level of competency. Once competency is achieved, follow-up training is needed to retain knowledge and prevent skill decay. Sullivan et al recently described 3 types of follow-up training. (21) In that report, the authors define *maintenance training* as low-dose high-frequency training aimed at preventing skill decay in a competent provider. *Booster training* is provided less frequently but with higher intensity and is intended to overcome some level of skill decay that has occurred. *Refresher training* is aimed at

TABLE 1. Overview of Educational Strategies to Improve Neonatal Resuscitation Outcomes and Examples of Use in an NRP Course

EDUCATIONAL STRATEGIES	DEFINITION	EXAMPLE OF USE IN AN NRP COURSE
Mastery learning and deliberate practice	An instructional strategy that uses repeated practice and coaching to ensure that each student achieves a level of mastery during a training event	Requirement to score $\geq 90\%$ on a PPV skill assessment to pass the NRP course Students continue to practice until they reach the 90% score
Spaced practice	An instructional strategy in which new knowledge and skills are learned over several sessions separated in time, rather than during a single session	Designing an NRP course that uses several spaced practice sessions distributed over days to weeks At each NRP session a new knowledge chunk or skill is introduced
Contextual learning	Providing educational content that applies to the learner's real-world scope of practice and the practice environment	A basic NRP course for low-risk birth attendants with a focus on the basic airway skills of PPV and laryngeal mask placement, and the behavioral skills of knowing the environment, anticipating and planning, and calling for help An advanced NRP course for high-risk birth attendants that includes all the procedural skills needed for a full resuscitation including intubation, chest compressions, and medication administration, and the behavioral skills of team leadership, communication, and delegation of work
Feedback and debriefing	Feedback is the provision of information about the performance compared with a standard Debriefing is a reflective conversation about performance	Feedback: NRP instructor coaching a student on PPV performance during an NRP course, or a student receiving automatically generated feedback from a neonatal simulator that measures the quality of PPV Debriefing: A reflective discussion led by the NRP instructor after a neonatal resuscitation simulation. The discussion should address task work, teamwork, and any performance gaps. The overall focus of the conversation is performance improvement
Assessment	A method of obtaining information from tests and other sources, and using that information to draw inferences about the competency of an NRP course participant's cognitive, technical, and behavioral skills The assessment must involve a method that has evidence of validity to ensure that it accurately measures what it is intended to measure	Assessment of cognitive skill using an online multiple-choice examination that is completed before the classroom portion of the NRP course A technical and behavioral skills assessment during the classroom portion of the NRP course by a well-trained NRP instructor using an instrument with strong evidence of validity
Innovative educational strategies	Innovative educational strategies that can be used to supplement existing resuscitation education and aid in the dissemination of resuscitation-related information Examples include gamified learning, social media, blogs and podcasts, and crowdsourcing	Gamified learning: Using NRP eSim as part of neonatal resuscitation training and/or skill retention Social media, blogs and podcasts: Using Facebook, Twitter, YouTube, blogs, and podcasts to disseminate information about a recently published change to the neonatal resuscitation guideline Crowdsourcing: Using the power of the crowd to determine the format and visual layout of the neonatal resuscitation algorithm

Adapted from Cheng et al. (11) NRP=Neonatal Resuscitation Program; PPV=positive pressure ventilation.

reestablishing skills after competency has been lost. Refresher training is of higher intensity than booster training and is more akin to initial training (eg, retraining). Each of these follow-up training types are distributed in time (eg, spaced), but the learning strategy technically should not be called “spaced learning” because the focus is on knowledge and skill retention, rather than initial acquisition.

An example of the use of spaced training in an NRP course would be to change the format of the course from massed learning sessions (a course completed in 3–4 hours) to several spaced learning sessions distributed over days to weeks. At each NRP session, a new knowledge chunk or skill could be introduced. For example, during session 1, the initial steps of neonatal resuscitation could be reviewed. A few days later, during session 2, PPV could be taught. A few days after that session, the students could learn chest compressions. Thus, the training that was encapsulated in a single 3- to 4-hour session would instead be spaced over several sessions for a total of 3 to 4 hours. Hence, the total dose of education is the same, but the administration of the educational dose differs.

Contextual Learning

Contextual learning is an educational theory that suggests that learning occurs best when information is presented in such a way that students can construct meaning based on their own experiences. Critical factors for contextualization resuscitation training include providing educational content that applies to the learner’s real-world scope of practice and conducting the training in an environment that mimics the learner’s real-world practice environment. (11) Failure to optimize the context of training can negatively affect learning outcomes. (11)

An example of the use of contextual learning in an NRP course is the development of different types of NRP courses for specific learner groups. For each NRP course, the context of the course would be aligned with the student’s real-world scope of practice and the practice environment. For example, one could imagine a basic NRP course that is contextually aligned with the real-world scope of individuals who attend low-risk births and those who have additional help immediately available, such as midwives and labor and delivery nurses in a hospital with a NICU. In such a course, the educational content would only include the procedural skills those individuals are licensed to perform, such as initial steps, PPV, and laryngeal mask placement. Similarly, one could imagine an advanced NRP course that is contextually aligned with the real-world scope of individuals who attend high-risk births, and those who do not have additional help immediately available, such as neonatologists,

neonatal nurse practitioners, and paramedics. In such a course, the educational content would include all the procedural skills needed for a full resuscitation, including intubation, chest compressions, and medication administration. In addition to differences between the basic and advanced courses in procedural skills, behavioral skills would also differ. Behavioral skills learning objectives in the basic NRP course would focus on knowing the environment, anticipating and planning, and calling for help. Behavioral skills learning objectives in the advanced NRP course would focus on team leadership, communication, and delegation of work.

Feedback and Debriefing

Both feedback and debriefing deal with giving information about performance to a student or group of students. Performance information can include both *taskwork* (eg, what was done) and *teamwork* (eg, how team members performed together). (22) Feedback is the provision of information about performance in comparison to a standard. (23) Debriefing is a reflective conversation about performance. (24)(25)(26) During the debriefing conversation, however, some feedback may be provided. Both feedback and debriefing are fundamental elements of resuscitation education. A better understanding of how to structure feedback and debriefing during resuscitation education may enhance the effectiveness of training. (11)

Participants and instructors of NRP courses should be familiar with feedback and debriefing. An example of feedback in an NRP course is coaching provided by an NRP instructor to a student at a PPV performance skills station. (27) Another example would be the automatically generated data from a simulator designed to measure the quality of PPV. Such a simulator could provide students with information on tidal volume delivered, respiratory rate, and mask leak, which they could see in real-time and use to improve performance. An example of debriefing in an NRP course is the reflective discussion that takes place after neonatal resuscitation simulations that take place during the simulation and debriefing portion of the course. As part of that debriefing conversation, the team reviews its performance on both *taskwork* and *teamwork*, and the NRP instructor can provide feedback as needed to correct performance gaps.

Assessment

Assessment is a method of obtaining information from tests and other sources and using that information to draw inferences about the characteristics of people, objects, or programs. (28) In resuscitation education courses, the characteristics being assessed typically include competency

in cognitive, technical, or behavioral skills of the resuscitation. Assessment can have high stakes (eg, a test used to determine passing or failing the course) or low stakes (eg, an assessment made by an instructor to provide specific feedback) Assessment of competence is a critical component of high-quality resuscitation education. Therefore, the assessment strategy should be a key consideration in resuscitation education course design. Students' cognitive, technical, or behavioral skills are complicated, however, and not always directly observable. Therefore, assessment of students' abilities in these areas relies on inferences made from the available assessment evidence. Hence, drawing accurate inferences requires accurate assessment methods.

Validity is the most crucial characteristic of any assessment method. (11) Validity is the extent that an assessment accurately measures what it is intended to measure. (29) Contemporary frameworks of validity present validity as an argument or a testable hypothesis. As such, validity cannot be proven or disproven, but can only be supported or refuted by available evidence. (29) Therefore, an assessment method cannot be described as valid or invalid, but rather, defined according to the level of evidence that supports or refutes the interpretations being made with it. In the past, validity evidence was commonly divided into multiple types. These included content validity, criterion validity, construct validity, and others. Contemporary frameworks of validity consider validity to be a unitary concept, wherein construct validity represents the whole of validity. (30)

Based on this contemporary interpretation, it is crucial to be clear about what characteristic an assessment method is measuring (eg, cognitive, technical, or behavioral skills) when constructing a validity argument. Two threats to the validity of assessment data are construct underrepresentation and construct-irrelevant variance. (31) Construct underrepresentation refers to the inadequate sampling or biased sampling of the characteristic being assessed. Construct-irrelevant variance indicates a systematic error (eg, not random error) in the assessment data by variables unrelated to the characteristic being assessed. Both types of threat decrease the strength of the validity argument by reducing the ability to make reasonable inferences from the assessment data obtained.

The current 7th edition of the NRP course includes 2 formal assessment methods. The first is the multiple-choice examination that is completed online before the classroom-based portion of the course. The multiple-choice examination is intended to assess a student's cognitive skill. All students are required to pass the test before attending the classroom portion of the course. A psychometric analysis of the NRP online examination is performed regularly to

evaluate its level of validity. The questions on the test are amended as needed by the NRP steering committee to ensure a high level of construct validity. The second assessment method is the integrated skills station. This method assesses a student's technical and behavioral skills. This assessment takes place during the classroom portion of the NRP course and is performed by the NRP instructor. All students are required to pass the integrated skills station to receive NRP provider status (eg, an NRP card). The construct validity argument for this assessment is much lower than that of the online examination. Threats to the validity of the performance assessment done during the integrated skills station include both construct underrepresentation and construct-irrelevant variance. (31) Specific threats to include are the availability of too few cases for generalizability, use of an indefensible passing score method, rater bias, and poorly trained rater. The assessment of technical and behavioral skills during the NRP course could be improved by using assessment instruments with documented evidence of validity. (32)(33)(34)(35) Training NRP instructors on how to use assessment instruments is an important consideration and is discussed later in the section on faculty development.

Innovative Educational Strategies

The AHA's scientific statement entitled "Educational Strategies to Improve Outcomes from Cardiac Arrest" identified 4 innovative educational strategies that can be used to supplement existing resuscitation education. The 4 strategies include *gamified learning*, *social media*, *blogs and podcasts*, and *crowdsourcing*. (11) Gamified learning (also known as *gamification* or *serious games*) is an educational strategy designed to increase the enjoyment and engagement of students by using video game design principles and game elements in learning environments. Resuscitation education games are typically computer-based, and a student initiates actions using a mouse or keyboard. Virtual reality games—in which a student's hand movements are tracked—are also possible. These self-directed screen-based games typically focus on cognitive skills and decision-making involved in resuscitation. (11) The benefits of using serious games include the consistent delivery of educational content, the ability to learn without an instructor, flexibility in the timing of content delivery, and lower cost. (36)

Social media is user-generated content that enables dissemination, collaboration, and interaction on various online platforms, such as Facebook, Twitter, and YouTube. (37) When best practices for accuracy and timeliness are followed, social media can increase engagement and support

knowledge exchange within communities of resuscitation providers and instructors. (11)

Blogs are self-published written content, which can include embedded links, graphics, and interactive discussion forums. Podcasts are recorded audio content accessible online or through smartphone applications. Like social media, both blogs and podcasts are powerful tools for information dissemination. Several studies have confirmed the capacity of blogs and podcasts to act as supplementary learning tools to improve the dissemination of research. (11)

Crowdsourcing is using groups of individuals to perform a task that is usually performed by individuals or organizations. (38) Potential applications of crowdsourcing in resuscitation education include using crowdsourcing to develop, vet, and vote on resuscitation educational materials, and using crowdsourcing to evaluate resuscitation performance. However, data on such innovative educational strategies are limited, and issues of quality control and conflicts of interest need to be explored before crowdsourcing is widely used. (11)

An example of gamification in the NRP course is NRP eSim (AHA/American Academy of Pediatrics [AAP]), an online computer-based simulation exercise that allows learners to practice the steps of neonatal resuscitation in a virtual environment. NRP eSim was introduced with the 7th edition of the NRP curriculum and is enjoyed by many NRP students. (10) Research is ongoing to examine the educational benefits of NRP eSim. (39) Multiple other examples of serious neonatal resuscitation games exist, including the Neonatal Resuscitation Game (National Health Service, Education for Scotland, Edinburgh, UK), the Singaporean Neonatal Resuscitation Game (Singapore General Hospital, Singapore), e-Baby (University of São Paulo, São Paulo, Brazil), the Compromised Neonate Program (University of Newcastle, Callaghan, Australia), and Electronic Helping Babies Breathe (University of Washington, Seattle, WA, and Oxford University, Oxford, UK). (36) An example of using social media, blogs, and podcasts to supplement existing resuscitation education is by using these outlets to disseminate findings from newly published AHA focused update on neonatal resuscitation or updates to the AHA neonatal resuscitation guidelines. (40) The NRP maintains a Facebook page that has been used for this purpose. (41) One potential use of crowdsourcing in neonatal resuscitation education is to use the power of the crowd to determine the design properties (eg, format and visual layout) of the neonatal resuscitation algorithm. In such an exercise, the crowd could use the Cognitive aids in Medicine Assessment Tool (CMAT) to score different versions of the algorithm. (42) The CMAT does not evaluate the

appropriateness of the content, but only scores the visual presentation of information, such as clearly linking explanatory notes to the corresponding action item. Such an exercise could be used better to configure the neonatal resuscitation algorithm as a cognitive aid to ensure that the information is accessible in an emergency. (43)

KNOWLEDGE TRANSLATION AND IMPLEMENTATION

The formula for survival depicted in the Figure describes the 3 interactive factors of the resuscitation guidelines: quality (*medical science*), efficient education of health care providers (*education efficiency*), and a functional chain of survival at the local level (*local implementation*). A key to achieving both education efficiency and local implementation is to optimize knowledge translation and implementation of the resuscitation guidelines. Knowledge translation and implementation of guidelines are critical because, without them, even the best, most evidence-based, neonatal resuscitation guidelines will have no clinical impact because no one will know about them and no one will implement them. Therefore, examining ways to optimize knowledge translation and implementation of neonatal resuscitation guidelines is essential.

Current methods for translating knowledge from new resuscitation guidelines and implementing them into clinical care result in significant delays in implementing new science. Prior studies through the Resuscitation Outcomes Consortium showed that the time from publication of the 2005 basic and advanced life support resuscitation guidelines to implementation in emergency medical services agencies ranged from 49 to 750 days. (44) Barriers to implementation of new guidelines included resistance to change, delays in the training material supply chain, financial costs of training, the need to replace outdated technology, regulatory hurdles, and isolation between guideline writers and the providers who were responsible for local implementation. (45) Studies of barriers to the implementation of neonatal resuscitation guidelines have identified disruption of existing workflow, staff attitudes about incorporating additional tasks and responsibilities into their ongoing work, and variation in resources as key thematic barriers. (46)

Finding ways to speed the adoption of new scientific guidelines and overcome barriers to implementation is an active area of investigation. Table 2 provides an overview of the knowledge translation and implementation strategies identified in the AHA's scientific statement on resuscitation education science. (11)(47)(48) In addition to the specific methods and their definition, the table includes some

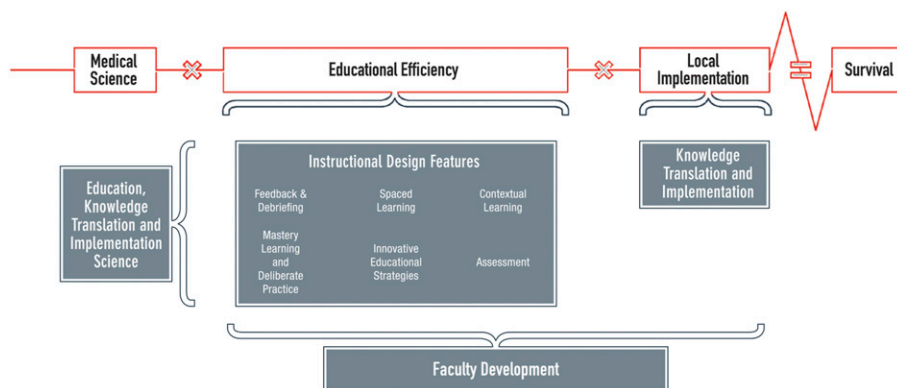


Figure. The modified formula for survival in resuscitation from the American Heart Association’s 2018 scientific statement by Cheng et al. (11) Used with permission.

specific suggestions for how each method could be applied to the NRP.

FACULTY DEVELOPMENT

The AHA’s modified formula for survival highlights the critical importance of faculty development for both educational efficiency and local implementation (Figure).

Faculty development includes a set of strategies to improve the knowledge, skills, and attitudes of resuscitation course instructors so they can initially acquire and then subsequently maintain the skills necessary to teach resuscitation courses effectively. (11) Like the content of the courses they teach, the design of faculty development efforts should be informed by science and rely on evidence-based education strategies. The AHA’s scientific statement on resuscitation education science summarizes the literature on resuscitation course faculty development strategies and provides recommendations for improvements in faculty development based on education science. (11) The statement divides faculty development efforts into 2 phases: initial instructor training and ongoing instructor development. (49)

Initial instructor training is the preparation of an individual(s) to teach a resuscitation course. This preparation is typically accomplished through instructor training programs, workshops, seminars, and the giving and receiving of feedback (eg, coaching). Initial instructor training programs provide instructors with a solid foundation in the scientific evidence behind the resuscitation guidelines taught in the course. They also provide instructors with the skills needed to teach the course effectively. This includes approaches to dealing with common challenges, coaching, the ability to effectively debrief others, contextualizing course content to various audiences, and facilitating the development of teamwork training. (11)

The NRP has used various methods for initial instructor training. With the 6th edition, released in 2011, the NRP changed its education methodology, shifting from the NRP instructor as a “teacher” to a “learning facilitator.” This included a change from a lecture format course design to simulation-based learning design. To help NRP instructors learn these new skills and meet the new requirements, the NRP created and launched the NRP instructor digital video disc (DVD) “An Interactive Tool for Facilitation of Simulation-based Learning.” The interactive DVD familiarized instructors with simulation and guided them on ways to incorporate simulation into NRP courses. With the 7th edition, released in 2016, the NRP retired the instructor DVD and launched an online NRP instructor candidate bundle. The bundle is accessible via the NRP learning management system, and includes 2 parts: part 1—completing the NRP instructor course learning activity, passing the instructor examination, and accessing the NRP eSim cases; and part 2—coteaching 2 instructor-led events under the guidance of an instructor mentor, and completing the “debrief the debriefer” checklist.

Ongoing instructor development is the ongoing improvement of instructors’ skills as they teach a resuscitation course over time. Some strategies for ongoing instructor development include creating systems to support instructors to be self-directed, lifelong learners, with mechanisms that enhance reflective practice and peer coaching. Helping instructors to become change agents, not just teachers, is essential and requires instructors to look beyond the classroom and implement strategies to ensure that students perform optimally in the clinical environment. Developing a community of practice for resuscitation course instructors is also vital. (11)

The NRP has been devoted to ongoing instructor development since the inception of the course. Today, the ongoing development of NRP instructors is accomplished through several methods. The primary method is the online

TABLE 2. **Methods for Knowledge Translation and Implementation of NRP Guidelines**

METHOD	DEFINITION	SUGGESTIONS
Passive and active knowledge translation	<p>Passive knowledge translation means that potential knowledge users must seek out the information themselves. Examples include searching for academic publications and accessing the information contained in an online instructor toolkit</p> <p>Active knowledge translation includes actions that target and push information to potential knowledge users directly without the recipient needing to seek the information. Examples include email blasts and social media strategies</p>	NRP should use both passive and active knowledge translation techniques to improve awareness, adoption, and adherence to NRP guidelines. This includes publishing the guidelines in medical journals and also pushing those publications to health care personnel and NRP instructors to ensure that changes are recognized and implemented
Change theory	Change theory examines how to best communicate and facilitate change in the human context, taking into consideration human biases and behavioral responses to change	NRP should consider change theory to address barriers to change when introducing new scientific guidelines
Design thinking	Design thinking involves the planning of the physical environment and takes into account human factors and ergonomics	NRP should consider the physical space(s) in which neonatal resuscitation occurs and consider human factors and ergonomics into its resuscitation guidelines to support people by making it easy to do the right thing within the neonatal resuscitation environment
Performance measurement	Performance measurement is the collection of data on measurable events such as time to start positive pressure ventilation, use of pulse oximetry, and placement of an advanced airway before the start of chest compressions	NRP should collaborate with performance measurement programs that include benchmarks, feedback, and public reporting on neonatal resuscitation quality metrics such as the AHA Get with The Guidelines®-Resuscitation (GWTG-R) to allow health systems to measure and improve neonatal resuscitation performance (47)
Deadoption strategies	Deadoption, or <i>unlearning</i> , is the systematic deimplementation of an entrenched practice. An example is the discontinuation of suctioning nonvigorous newborns with meconium-stained fluids	NRP should develop strategies to help NRP providers rapidly deadopt practices that are affected by new resuscitation guidelines (48)
Continuous quality improvement	Continuous quality improvement is a structured organizational method to improve the processes of care with a goal to provide improved health care outcomes	NRP should help providers and hospitals adopt formal continuous quality improvement programs for neonatal resuscitation. This effort could include defining and publishing resuscitation quality metrics for the newly born (47)
Incentive and penalties	Performance modification through the use of positive rewards (incentives) or negative consequences (penalties)	NRP should incentivize organizations to achieve high compliance with newly born resuscitation quality metrics by giving NRP resuscitation awards to health systems that achieve high compliance with neonatal resuscitation quality metrics
Psychological marketing	Psychological marketing identifies methods to communicate messages in a way that resonates with the target audience	NRP should use psychological marketing techniques to craft messages and informational campaigns that appeal directly to the beliefs and emotions of health care providers, regulatory agencies, and funders

Adapted from Cheng et al. (11) AHA=American Hospital Association; NRP=Neonatal Resuscitation Program.

NRP instructor toolkit, which is an online repository of NRP instructor resources within the NRP learning management system, including tools, tips, checklists, forms, video clips, blogs, webinars, podcasts, etc. In addition to the toolkit, NRP also publishes a biannual NRP instructor update newsletter. The newsletter is written by members of the NRP steering committee and invited authors. (50) In addition to the instructor toolkit and newsletter, NRP holds many in-person education sessions for instructors. These include the yearly NRP current issues seminar held in conjunction with the AAP national conference and exhibition and series of NRP “road shows” that were held across the United States in 2019 and 2020. With the 8th edition of the NRP course curriculum, to be released in 2021, the methods used for initial instructor training and ongoing instructor development will continue to evolve and improve.

CONCLUSION

In this educational perspectives article, I examined the AHA’s modified formula for survival in resuscitation and reviewed 6 educational strategies to improve survival in neonatal resuscitation, including mastery learning and deliberate practice; spaced practice; contextual learning; feedback and debriefing; assessment; and innovative educational strategies. I then explored knowledge translation and implementation of these strategies through the NRP course. Finally, I reviewed the faculty development requirements for NRP instructors to implement these educational strategies into an NRP course effectively. The goal of this review is to help NRP program developers and NRP instructors effectively use educational strategies to improve neonatal resuscitation outcomes. Application of these evidence-based resuscitation education strategies may increase neonatal resuscitation quality and subsequently improve survival after neonatal resuscitation.

American Board of Pediatrics Neonatal-Perinatal Content Specifications

- Know the proper approach to airway management in the delivery room.
- Know the incidence, causes and pathophysiology, including cellular abnormalities, of acute perinatal asphyxia.
- Know the causes and pathophysiology, including cellular abnormalities, of chronic asphyxia syndromes (eg, chronic fetal hypoxia and placental insufficiency).

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NeoReviews 2020;21:e431

DOI: 10.1542/neo.21-7-e431

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