Resuscitation Quality Improvement®
Annotated Bibliography

Achieving and maintaining proficiency in any skill—such as speaking a foreign language, playing a musical instrument or competing in a favorite sport—requires regular practice and assessment of the skill. The old adage that "practice makes perfect" is no less true in Resuscitation Quality Improvement (RQI®) than in any other human activity. The more often resuscitation knowledge and skills are used and evaluated, the better the performance is, which can lead to better patient outcomes.

The following bibliography provides an overview of the current science on how more frequent training and assessment of resuscitation skills can lead to better performance and, ideally, better patient outcomes. This body of knowledge was used to guide the development of the **American Heart Association (AHA) RQI Program**, a comprehensive system that integrates training and clinical events with debriefing.

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High-quality CPR – Performance Metrics

**Cardiopulmonary Resuscitation Quality: Improving Cardiac Resuscitation Outcomes
Both Inside and Outside the Hospital
A Consensus Statement From the American Heart Association**
Meaney et al. *Circulation*. 2013;128:417-435

> **Conclusion**
> Through better measurement, training and systems-improvement processes of CPR quality,
> we can have a significant impact on survival from cardiac arrest and eliminate the gap between
> current and optimal outcomes.

> **Importance of This Conclusion**
> The **AHA RQI Program** is designed to improve CPR quality throughout the healthcare enterprise
> by providing convenient and regular training and assessment and analytics to help confirm
> competency and identify areas for CPR continuous quality improvement.

Key Points

- Poor-quality CPR should be considered a preventable harm.
- Details of CPR performance metrics are included in the Consensus Statement.
- High-quality CPR is the primary component in influencing survival from cardiac arrest, but there is considerable variation in monitoring, implementation and quality improvement.
- High-quality CPR should be recognized as the foundation on which all other resuscitative efforts are built.
- Every EMS system, hospital and other professional rescuer program should have an ongoing CPR continuous quality improvement program that provides feedback to the director, managers and providers.

Importance of Competency – Feedback Devices

Part 16: Education, Implementation, and Teams
2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care
Bhanji et al. *Circulation*. 2010;122(suppl 3): S920-S933

Conclusion
- Substantial hands-on practice is needed to meet psychomotor skill performance objectives.
- All courses should incorporate adult learning principles and create relevant training scenarios that are applicable to the learners' real-world environments, such as having hospital-based learners practice CPR on a bed instead of on the floor.
- Successful course completion should be based on the learner's competency in the course objectives rather than on the learner's attendance in a course or program for a specific time period.
- Key skills and course content should be repeated with deliberate practice that builds mastery.
- Assessment of learners' competency should promote learning. Learning objectives must be clear and measurable and serve as the basis of evaluation.
- Using a CPR feedback device during training improves learning and retention.

Importance of This Conclusion
The **AHA RQI Program** incorporates evidence-based education, including more frequent assessment and reinforcement of skills by using real-time feedback and subsequent debriefing to help participants maintain competency in CPR.

Key Points

- There is substantial evidence that basic and advanced life support skills decay rapidly after initial training.
- There is a clear need to have more frequent assessment and reinforcement of skills and strong evidence to support the recommendation to use real-time feedback during that training.
- Reflecting the emerging trends of continuous maintenance of competence and continuing professional development in the healthcare professions, there is increasing support for competency-based approach to resuscitation education rather than a time-based certification standard.

Comparison of Two Instructional Modalities for Nursing Student CPR Skill Acquisition
Kardong-Edgren et al. *Resuscitation.* 2010;81:1019-1024

> **Conclusion**
> Students who completed the HeartCode® BLS Course and practiced with voice-assisted manikins (VAM) performed more compressions with adequate depth and ventilations with adequate volume than students who took instructor-led courses.

> **Importance of This Conclusion**
> The **AHA RQI Program** uses automated, self-directed learning tools similar to those used in this study, but with even more advanced feedback and debriefing elements.

Key Points

- Even physicians, nurses and paramedics who had CPR training did not perform CPR at optimal levels.
- Self-directed practice with an automated manikin system that provides continuous verbal feedback and high-quality debriefing (such as the VAMs used in the study) can improve CPR skills.
- Continuous practice with this system in a training program could improve retention of CPR skills.

Improving In-Hospital Cardiac Arrest Process and Outcomes With Performance Debriefing
Edelson et al. *Arch Intern Med*. 2008;168:1063-1069

> **Conclusion**
> The use of real-time feedback with debriefing that incorporates clinical data from an actual resuscitation event is an effective tool to improve measurement of CPR quality and initial patient survival from in-hospital cardiac arrest.

> **Importance of This Conclusion**
> Actual clinical experience combined with performance assessment and debriefing is key to improving skills that can lead to better rates of return of spontaneous circulation. The **AHA RQI Program** allows the inclusion of real and simulated events as "training" events when participants have been appropriately assessed and debriefed.

Key Points

- Equipment to measure and record CPR performance during actual resuscitation events has the potential to change CPR training and improve patient outcomes.
- Combining CPR performance feedback with debriefing was associated with an increased rate of return of spontaneous circulation when compared with the use of performance feedback alone.

Twelve-Month Retention of CPR Skills With Automatic Correcting Verbal Feedback
Wik et al. *Resuscitation*. 2005;66(1):27-30

Conclusion
Subjects who completed CPR training that included receiving automated, auditory immediate feedback for 20 or 50 min performed at the same level when receiving that feedback 12 months later as they did immediately after training.

Importance of This Conclusion
Discussion continues about what can be done to avoid deterioration of CPR skills after completion of CPR training. The present study confirms the potential of using automatic feedback during CPR. The **AHA RQI Program** uses automated, self-directed learning tools with advanced feedback and debriefing elements that could be used to help subjects maintain proficiency.

Key Points

- Previous studies of CPR skills retention have generally showed poor skill acquisition and a rapid decline in skills; these studies did not use an automatic feedback system.
- Authors of this study show in a previous study the advantage of continuous audible feedback in improving skill acquisition; if feedback was added after 6 months, both groups with 20 and 50 min training immediately improved to the skill level they had achieved immediately after the initial course.

Effects of Practice on Competency in Single-Rescuer Cardiopulmonary Resuscitation
Oermann et al. *Medsurg Nurs*. 2014;23(1):22-28

Conclusion
Brief, frequent practice on manikins with automated feedback is an effective strategy for nurses to maintain skills in single-rescuer CPR.

Importance of This Conclusion
Research indicates a need for high-quality CPR, but evidence over the years shows poor retention of CPR skills over time among nurses and other health care professionals. Independent practice on voice-assisted manikins and other types of manikins that guide performance helps nurses and other providers to maintain competence in CPR performance and avoid skill decline. The **AHA RQI Program** offers providers the means to practice and assess CPR psychomotor skills to maintain proficiency.

Key Points

- CPR skills learned during training need to be used or practiced often to maintain competency.
- Practice on voice-assisted manikins and other types of manikins that guide performance helps nurses and other providers to maintain competence in CPR performance and avoid skill decline.
- Students who refreshed their CPR skills with monthly practice also had no loss of ability to ventilate with an adequate volume.

- Nurses who frequently practiced CPR on manikins with automated feedback achieved proficiency quicker than nurses who practiced infrequently.

"Rolling Refreshers": A Novel Approach to Maintain CPR Psychomotor Skill Competence
Niles et al. *Resuscitation*. 2009;80(8):909-912

Conclusion
A novel "Rolling Refresher" bedside CPR skill training approach using 2 specific training programs is effective and well received.

Importance of This Conclusion
"Rolling Refreshers" is a portable manikin/defibrillator system with chest compression sensor providing automated corrective feedback to optimize CPR skills. The **AHA RQI Program** also uses automated, self-directed learning tools and offers real-time feedback and subsequent debriefing; this program could be used to maintain CPR psychomotor skill competence.

Key Points

- No study has demonstrated that didactic instruction regarding CPR theory will improve CPR quality.
- Proficiency performing CPR psychomotor skills is variable after traditional BLS education, but overall poor; retention of those skills is problematic with poor performance 3-6 months posttraining.
- One of two possible targets for improving CPR psychomotor skill delivery mentioned is directive and corrective audiovisual feedback and monitoring of CPR quality during resuscitation attempts.
- Recent modifications of defibrillator technology using a force sensor and accelerometer (Philips MRx/Q-CPR) can provide real•time audiovisual feedback on the rate, depth, and quality of chest compressions during CPR.

Rolling refresher simulation improves performance and retention of pediatric intensive care unit nurse code management
Singleton, MN *et al. BMJ Stel* ; 2017. doi: 10.1136/bmjstel-2017-000243

Conclusion
A "rolling refresher" simulation training program demonstrated significant improvement with low-dose, high frequency skills to manage a pediatric code cart with retention after initial training in PICU nurses.

Importance of This Conclusion
The AHA RQI program allows in-hospital healthcare providers to receive real-time feedback, subsequent debriefing and skill competence in a similar low-dose, high frequency simulation format.

Key Points

- This study evaluated the role of rolling refresher simulation programs on nurse competency and management of code cart in the pediatric critical care setting.
- The study highlights the importance of using optimal training methods for pediatric nursing staff to achieve and maintain skills in emergency situations.

Neonatal Resuscitation Program Rolling Refresher: Maintaining Chest Compression Proficiency through the use of simulation-based education.
Cepeta Brito, JR *et al*. Advances in Neonatal Care. 2017; 17(5): 354 – 361.

> **Conclusion**
> The overall confidence and rate of chest compressions improved in neonatal providers with a rolling refresher simulation program, however, additional studies are needed to determine optimal training frequency and efficiency because the results were not statistically significant.

> **Importance of This Conclusion**
> The **AHA RQI Program** offers the same type of low-dose, high-frequency CPR training as used in this study to improve performance to a level and could be beneficial for neonatal resuscitation program providers.

Key Points

- A simulation based neonatal resuscitation program was developed and executed in a critical care unit to determine if a rolling refresher program would improve provider proficiency and confidence.
- Results indicated that the overall chest compression rate and provider confidence improved, however, there was no statistical significant between the groups.
- Structured training programs have been suggested to improve survival outcomes, however, more research is needed to determine the frequency of training (within 6 months to one year) that will prevent skill decay.

Certified basic life support instructors identify improper cardiopulmonary resuscitation skills poorly: Instructor assessments versus resuscitation manikin data
Hansen C, Bang C, Staerk, M et al. *Simul Healthc*. 2019;14(5):281-286

> **Conclusion**
> Certified BLS instructors observing students performing CPR on manikins poorly judged the adequacy of students' CPR skills. Data captured by the manikins showed that instructors often thought chest compression and rescue breathing done by students was performed correctly when it was improperly done.

> **Importance of This Conclusion**
> Studies have shown that audiovisual feedback can improve CPR quality. The **AHA RQI Program** provides automated, real-time feedback from manikins that helps reinforce correct performance of high-quality CPR skills.

Key Points

- In this study, 89% of CPR students were judged competent by instructors despite performing rescue breaths detected as improper by manikins.
- If instructors fail to identify improper CPR performance, BLS students who are unprepared to deliver successful CPR in real life could become certified in BLS.
- These results support the findings of previous studies showing that instructors and BLS providers are not reliable assessors of CPR quality. Instead of relying on instructor observations to assess learners' skills, manikin data should be included.

Low-Dose, High-Frequency

Low-Dose, High-Frequency CPR Training Improves Skill Retention of In-Hospital Pediatric Providers

Sutton et al. *Pediatrics.* 2011;128:e145-e151

> **Conclusion**
> Low-dose, high-frequency training sessions (or "booster" sessions) more than doubled providers' retention of high-quality CPR skills.

> **Importance of This Conclusion**
> Other studies have demonstrated that the quality of CPR is directly related to survival outcomes. The **AHA RQI Program** offers the same type of low-dose, high-frequency CPR training as used in this study to improve performance to a level that has, separately, been associated with better outcomes during actual resuscitation events.

Key Points

- Not only have varying rates of skill acquisition been documented after traditional AHA training classes, but also universally poor skill performance of providers 3 to 6 months after CPR training has been established.
- The percentage of healthcare providers performing excellent CPR more than doubled (from 26% to 65%) when healthcare providers were retrained 3 times over 6 months by using an automated manikin system with real-time feedback.
- Skills sessions were completed during the participants' normal working hours in patient care areas.

Effects of Monthly Practice on Nursing Students' CPR Psychomotor Skill Performance

Oermann et al. *Resuscitation.* 2011;82:447-453

> **Conclusion**
> Brief, monthly practice sessions helped providers retain CPR psychomotor skills and improved these skills over baseline.

> **Importance of This Conclusion**
> The **AHA RQI Program** provides the means to practice and assess CPR psychomotor skills in short sessions intended to help participants achieve and maintain skills.

Key Points

- Studies have documented that nurses and physicians, even when trained in CPR, often don't perform high-quality CPR.
- Ineffective initial training may cause poor CPR skills performance, but it is more likely the result of providers unable to retain these skills.
- Providers do not retain CPR skills for long without refreshers and practice.
- Practicing for a few minutes a month effectively maintained and improved CPR psychomotor skills.

"Putting It All Together" to Improve Resuscitation Quality
Sutton et al. *Emerg Med Clin North Am*. 2012;30:105-122

Conclusion
Improving training before, monitoring CPR quality during, and debriefing participants after resuscitation events has the potential to improve the quality of care delivered to cardiac arrest victims.

Importance of This Conclusion
The **AHA RQI Program** is designed to help participants achieve *and maintain* competency in resuscitation skills and improve their performance during resuscitation events.

Key Points

- Performance of resuscitation skills during in-hospital, out-of-hospital, and simulated cardiac arrests frequently does not meet established resuscitation guidelines.
- Completion of conventional BLS and ACLS courses does not necessarily translate into adequate performance of these resuscitation skills within a few months after training.
- Participation in programs that improve training quality *and retention* may lead to higher quality CPR performed during actual resuscitation events.

In-hospital Evaluation of Low Dose-High Frequency, Case Based Psychomotor CPR Training Demonstrates High Levels of Program Compliance With Good CPR Quality Metrics
Panchal et al. *Circulation*. 2015;132:A18403

Conclusion
Low dose-high frequency, case based psychomotor training is a feasible method to enhance CPR skill retention in the hospital.

Importance of This Conclusion
The **AHA RQI Program** offers providers the means to practice and assess CPR psychomotor skills in the hospital to maintain proficiency.

Key Points

- High-quality CPR is critical for survival from cardiac arrest, but many providers in hospital settings have infrequent opportunities to perform CPR to maintain proficiency.
- Performance metrics from this study demonstrate high-quality CPR in Q2 and Q3, indicating CPR skill retention. In combined exercises (Q4), compressions are improved while ventilations deteriorate.
- Program compliance was high through four quarters of training.

Low Dose-High Frequency, Case Based Psychomotor CPR Training Improves Compression Fraction For Patients With In-Hospital Cardiac Arrest
Panchal et al. *Circulation*. 2016;134:A17361

> **Conclusion**
> Low dose-high frequency, case based psychomotor CPR training enhanced in-hospital clinical CPR quality.

> **Importance of This Conclusion**
> In this study, using low dose-high frequency, case based psychomotor CPR training improved compression fraction, which was associated with increased compressions/min that were within 2015 AHA Guideline recommendations. Performing compressions at adequate depth and with minimal interruptions—components of high-quality CPR—is a learned skill. The **AHA RQI Program** offers regular skills training and assessment to help providers maintain proficiency when performing CPR and optimal resuscitation performance, including maximal chest compression fraction.

Key Points

- Compression fraction improved pre- to post-RQI.
- Program compliance was high through four quarters of training.
- Improved compression fraction was associated with increased compressions/min.

In-hospital Evaluation of Low-Dose-High Frequency, Case Based Psychomotor Cardiopulmonary Resuscitation Training Demonstrates High Levels of Program Compliance With Good CPR Quality Metrics
Panchal et al. *Circulation*. 2015;132:A18403

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- Program compliance was high through four quarters of training.

Part 14: Education
2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care
Bhanji et al. *Circulation.* 2015;132(suppl 2):S561–S573

> **Conclusion**
> Key recommendations of the 2015 update are outlined. Cost-effectiveness research; higher-quality study outcomes that focus on more that end-of-course performance; and standardization of the use of assessment tools across studies could provide more evidence on which to base AHA education guidelines.

> **Importance of This Conclusion**
> The **AHA RQI Program** uses automated, self-directed learning tools, with advanced feedback and debriefing elements, to help individuals achieve and maintain competency in CPR skills. Research and outcomes from participation in this training program could provide more evidence on which to develop guidelines.

Key Points

- Too much focus of educational research is exclusively on immediate end-of-course performance and may not be representative of participants' performance when they are faced with a resuscitation event months to years later.
- Given potential educational benefits of short, frequent retraining sessions coupled with the potential for cost savings, it is reasonable that individuals who are likely to encounter a cardiac arrest victim perform more frequent manikin-based retraining.
- Recent literature in resuscitation education also demonstrates improved learning from "frequent, low-dose" versus "comprehensive, all-at-once" instruction and a learner preference for this format.
- There is a clear need for cost-effectiveness research because many of the AHA education guidelines are developed in the absence of this information.

The effect of different retraining intervals on the skill performance of cardiopulmonary resuscitation in lay people—a three-armed randomized control study. Hsieh, MJ et al. Resuscitation. 2018, *in press*.

> **Conclusion**
> The conducted study aimed to compare the cardiopulmonary resuscitation performance of lay rescuers/learners with different training intervals. Key conclusion indicated that lay people had the highest retention and/or passing rate for conventional CPR skills at 3-month intervals.

> **Importance of This Conclusion**
> The **AHA RQI Program** offers providers the means to practice and assess CPR psychomotor skills to maintain proficiency with shorter intervals throughout the year, however future AHA RQI programs should incorporate this same "low-dose, high frequency concept" to lay responders/rescuers.

Key Points

- Non-medical university students were divided into three groups after receiving CPR and AED training, 3-month, 6-month and 12-month groups. Each group received the same amount of retraining at these intervals.
- Lay people had the highest passing rate for conventional CPR at 3-month intervals.
- The 3-month interval group had similar performance to the 6-month interval group with chest compression items, however, had overall better performance than the 12-month group.
- All three groups had similar performance with AED training and manipulation.

Low dose- high frequency, case based psychomotor CPR training improves compression fraction for patients with in-hospital cardiac arrest

Panchal AR, Norton G, Gibbons E et al. *Resuscitation.* 2020;146:26-31

Conclusion
Brief, frequent practice on manikins providing automated feedback helped hospital HCPs retain CPR skills and significantly improved the quality of CPR administered to patients. These results support the use of this training method for hospitals in place of standard BLS certification courses.

Importance of This Conclusion
The study showed improvement in simulated and clinical CPR performance as well as excellent program compliance. It builds on previous studies demonstrating the effectiveness of quarterly refreshers in retaining skills quality. The **AHA RQI Program** offers automated skills training and assessment to help participants improve and retain proficiency in CPR skills.

Key Points
- Compression fractions improved from 83% before training on this platform to 93% after.
- Compressions per minute rose from 109 before the training to 120 after.
- Program compliance was high through four quarters of training.
- Training was most effective when compression and ventilation skills were taught separately. When taught together, compressions improved but ventilations decreased.

Implementation of a low-dose, high-frequency cardiac resuscitation quality improvement program in a community hospital
Dudzik LR, Heard DG, Griffin RE et al. *Jt Comm J Qual Saf*. 2019;45(12):789-797

> **Conclusion**
> After a year of frequent, brief CPR training using the RQI program, HCPs in a community hospital improved CPR performance skills and their confidence in using them.

> **Importance of This Conclusion**
> To establish and maintain high-quality CPR performance, the **AHA RQI Program** emphasizes skills mastery through video training, real-time automated feedback from manikins, testing, and frequent refresher training. Sensors in the manikins measure compression and ventilation performance against the most recent AHA standards and provide real-time audiovisual feedback on a laptop screen.

Key Points
- Research has shown that CPR skills learned in traditional, instructor-led Basic Life Support training repeated every 2 years decline within 3 to 12 months after training.
- Total cost of the RQI program per year was 47.4% less than the cost of yearly instructor-led BLS training.
- More research is needed to confirm these findings at other hospitals and determine whether RQI can improve IHCA patient survival.

Team Training

Chest Compression Fraction Determines Survival in Patients With Out-of-Hospital Ventricular Fibrillation
Christenson et al. *Circulation*. 2009;120:1241-1247

Conclusion
Increasing chest compression fraction results in better survival for patients who experience a prehospital cardiac arrest caused by ventricular fibrillation or ventricular tachycardia.

Importance of This Conclusion
Higher chest compression fractions have been shown to contribute to improved patient survival. Performing high-quality CPR with minimal interruptions in compressions (maximizing chest compression fraction) is a learned skill. The **AHA RQI Program** offers regular skills training and assessment to help participants achieve and maintain optimal resuscitation performance, including maximal chest compression fraction.

Key Points

- This study observed that the relationship between chest compression fraction and survival was independent of other known predictors, suggesting that simple changes to resuscitation training and practices are likely to improve survival.
- In clinical practice, chest compression fraction is often low.
- Altering resuscitation training and practices to maximize chest compression fraction will likely result in a sustainable increase in patient survival.

Debriefing

Debriefing Medical Teams: 12 Evidence-Based Best Practices and Tips
Salas et al. *Jt Comm J Qual Patient Saf*. 2008;34:518-527

Conclusion
Debriefings should be used continuously as an instructional tool for medical teams.

Importance of This Conclusion
Debriefing is important as a continuous learning tool. The **AHA RQI Program** offers a debriefing feature that integrates participants' results into employee training records.

Key Points

- Medical teams benefit from recurring debriefs as well as critical-incident debriefs.
- Team members should follow the debriefing guidelines and best practices to identify areas for improvement and create strategies for future events.
- A supportive learning environment is critical to the success of debriefings.

HeartCode® BLS with Voice Assisted Manikin *for* Teaching Nursing Students: Preliminary Results

Oermann et al. *Nurs Educ Perspect*. 2010;31(5):303-308

> **Conclusion**
> Nursing students who completed the HeartCode® BLS program and practiced CPR on a voice assisted manikin were significantly more accurate in their ventilations, compressions, and single-rescuer CPR than students who had the standard instructor-led course.

> **Importance of This Conclusion**
> Debriefing and specific immediate feedback contribute to the effectiveness of practicing CPR on a voice assisted manikin. The **AHA RQI Program** uses automated, self-directed learning tools and offers real-time feedback and subsequent debriefing; these tools could better help nursing students maintain proficiency of CPR skills.

Key Points

- In day-to-day practice settings nurses may use CPR skills infrequently.
- Studies show CPR skill deteriorates more rapidly than does CPR knowledge.
- Instructor-led CPR courses have potential limitations, including preset pace of course and inability to sometimes accurately assess performance or correct errors.

- Few studies include nursing students; however, research with other providers and lay persons suggests that voice-assisted manikins improve CPR skill and retention.
- Findings support the use of the HeartCode® BLS training strategy in nursing programs and potentially other medical and paramedical training.

The Effect of Instructional Method on Cardiopulmonary Resuscitation Skill Performance A Comparison Between Instructor-Led Basic Life Support and Computer-Based Basic Life Support With Voice-Activated Manikin

Wilson-Sands et al. *J Nurses Staff Dev*. 2015;31(5):E1-E7

> **Conclusion**
> Findings suggest a computer-based learning course with voice-activated manikins is a more effective method of training for improved CPR performance than instructor-led courses.

> **Importance of This Conclusion**
> The **AHA RQI Program** uses voice-activated manikins, real-time feedback, and debriefing tools to teach individuals how to perform CPR. Participating in this program could positively affect the number of health care providers who correctly perform high-quality CPR, which has been shown to significantly improve patient outcomes.

Key Points

- BLS instructors who teach in the traditional classroom setting are challenged with reliably validating the psychomotor skills of participants.
- Using feedback devices as an adjunct to CPR skill training can improve immediate skills performance.
- Students who used audiovisual feedback prompts performed with significantly better chest compressions than the instructor-led group both immediately and at 6 weeks after initial instruction.
- Results suggest that the voice-activated manikin may be more effective for correcting skills performance than the feedback provided by instructors during instructor-led BLS courses.

Confidence vs Competence: Basic Life Support Skills of Health Professionals

Castle et al. *Br J Nurs*. 2007;16(11):664-666

> **Conclusion**
> Healthcare assistants and other support staff would benefit from more frequent resuscitation training to develop core BLS skills.

> **Importance of This Conclusion**
> Research shows use of voice-assisted manikins during retraining of CPR skills is feasible and more likely to be effective at helping individuals maintain competency in CPR skills. The **AHA RQI Program** uses automated, self-directed learning tools, with advanced feedback and debriefing elements, to achieve this goal.

Key Points

- The introduction of a structured resuscitation training program resulted in a noticeable improvement in improvement in nurses ability to perform basic life support skills as compared with historical data.
- Healthcare assistants tend to perform CPR skills poorly and are underconfident.
- Research shows an individual's confidence does not always directly reflect competence; training programs should address this mismatch.

Assessing practical skills in cardiopulmonary resuscitation
Discrepancy between standard visual evaluation and a mechanical feedback device

Sánchez González et al. *Medicine (Baltimore).* 2017; 96(13):e6515

> **Conclusion**
> This study shows lack of agreement between human raters and the feedback device in assessing the quality of external chest compressions.

> **Importance of This Conclusion**
> Debriefing and specific immediate feedback contribute to the effectiveness of practicing CPR on a voice-assisted manikin. The **AHA RQI Program** uses automated, self-directed learning tools and offers real-time feedback and subsequent debriefing; these tools could better help students maintain proficiency of CPR skills.

Key Points

- There are differences in accuracy in the evaluation of ECC skills among human raters using classical visual analysis and a mechanical feedback device with dedicated software.
- Mechanical devices such as the manikin used in the study with audiovisual feedback and others ensure accurate feedback about skills, enabling corrections and improvements that help guarantee correct training.
- Devices that provide audiovisual feedback are also useful in human CPR.

Automated Feedback

Automated Testing Combined With Automated Retraining to Improve CPR Skill Level in Emergency Nurses
Mpotos et al. *Nurse Educ Pract*. 2015;15(3):212-217

> **Conclusion**
> Automated testing with feedback effectively detected emergency nurses who needed CPR retraining; this type of training and retesting improved skills to a predefined pass level.

> **Importance of This Conclusion**
> The **AHA RQI Program** uses automated, self-directed learning tools and offers real-time feedback and subsequent debriefing. This program could be used to assess the skill level and competency of nurses and/or be used during initial and refresher CPR training to avoid rapid skill decay.

Key Points

- Nurses have a professional responsibility to remain competent in CPR through regular updates.
- The proportion of nurses achieving a pass level was low enough to confirm rapid skill decay.
- Because not all nurses trained until success, achieving CPR competence remains an important individual and institutional motivational challenge.
- The use of frequent assessments may identify those individuals requiring additional training.
- According to several investigators the most powerful tool for learning improvement consist in delivering individualized feedback and feedforward after a test.

Inability of Trained Nurses to Perform Basic Life Support
Gwynne et al. *Br Med J (Clin Res Ed)*. 1987;294(6581):1198-1199

> **Conclusion**
> Basic life support skills of nurses trained in the United Kingdom are as poor as those reported for nurses in the United States and for preregistration and postregistration doctors. Compulsory retraining programs are therefore necessary.

> **Importance of This Conclusion**
> This study reports that nurses cannot accurately assess their own skills at basic life support. The **AHA RQI Program** provides the means to practice and assess CPR psychomotor skills in short sessions intended to help participants achieve and maintain high-quality CPR skills. In areas of the world where few retraining programs exist, this program could be successfully implemented and ultimately improve patient outcomes.

Key Points

- In hospitals, nurses often have to perform basic life support before the arrival of the crash team in three to five minutes.
- Although it is essential that nurses can perform basic life support competently, there has been no report of the skills in basic life support of trained nurses in the United Kingdom.

- Nurses with poor CPR skills will not necessarily seek further training.
- Nurses with seniority and experience of attending cardiac arrests were confident but no more competent in performance of CPR skills than nurses who lacked confidence.

Self-learning basic life support: A randomised controlled trial on learning conditions

Pedersen TH, Kasper N, Roman H et al. *Resuscitation.* 2018;126:147-153

Conclusion
Three months after training, self-learners using a BLS kit with no facilitator demonstrated better skills retention than students who used the same BLS kit with facilitator-led teaching, performing a higher percentage of correct compressions.

Importance of This Conclusion
This is the first report to show that self-directed instruction with a laptop, an inflatable manikin, and automated, real-time feedback has a greater impact on long-term skills retention than facilitator-led training with the same tools. The **AHA RQI Program** provides automated, self-directed learning tools including debriefing and real-time performance feedback on a manikin.

Key Points
- Although the percentage of correct compressions 3 months after training fell significantly among those who participated in facilitator-led training (48% directly after training vs 28% at follow-up), in self-learners it did not (42% vs 47%).
- After 3 months, self-learners began administering ventilation much earlier in CPR than facilitator-led learners did.
- Advantages of learning without instructors, in addition to better skill retention, include the ability to retrain at the convenience of students whenever needed, and savings on instructor salaries.

Training

Assessment of Long-term Impact of Formal Certified Cardiopulmonary Resuscitation Training Program Among Nurses
Saramma et al. *Indian J Crit Care Med*. 2016;20(4):226–232

> **Conclusion**
> Traditional CPR training programs increase CPR knowledge and skill, but significant long-term effects could not be found. Regular and periodic recertification of CPR skills is needed.

> **Importance of This Conclusion**
> The **AHA RQI Program** uses automated, self-directed learning tools, with advanced feedback and debriefing elements, to help individuals maintain competency in CPR skills. Participating in regular short sessions that allow individuals to practice those skills is one component that makes this training program effective.

Key Points

- Despite widespread training CPR is often poorly performed.
- Pretest knowledge, posttest knowledge, posttest performance, and overall performance were assessed.
- Formal certified BLS and ACLS training courses with the hands•on practice improved rate of immediate survival and survival to hospital discharge rates leading to definitive improvement in the outcome of CPR.
- Certified vs. non-certified nurses were also looked at; there was no significant mean difference in knowledge level, although certified nurses had a higher mean.
- Simulation is an effective teaching strategy to train CPR knowledge and skills.

Retention of knowledge and skills in pediatric basic life support among pediatricians.
Binkhorst, M. *et al.* European J. Pediatrics 2018, *in press*.

Key Points

- Older attending pediatricians with years of experience did not perform as well as their younger colleagues in residency programs.
- Retention of overall pediatric basic life support skills is poor among pediatric healthcare providers and supports the need for necessary training techniques and devices that will boost learner retention and not solely knowledge of related skills.

Neither Basic Life Support nor self-efficacy are predictive of skills among dental students.
Phadraig, MG et al. Eur. J Den Educ. 2017; 21(3): 187 – 192.

Key Points

- This cross-sectional study measured BLS skills and self-efficacy in Dublin undergraduate dental students.
- Although all participants had training within the last 2 years reported that they felt comfortable with BLS skills and training, their actual knowledge of items was incorrect and not consistent with self-efficacy.
- Neither knowledge or self-efficacy was not predictive of BLS skills retention and encourages the need for additional frequent training in shorter intervals.

Compression force—depth relationship during out-of-hospital cardiopulmonary resuscitation
Tomlinson et al. *Resuscitation.* 2007;72(3):364-370

> **Conclusion**
> Average sized and fit rescuers should be capable of performing effective CPR in adult patients because in most out-of-hospital cardiac arrest victims, adequate chest compression depth can be achieved by applying 50 kg force to the sternum.

> **Importance of This Conclusion**
> The **AHA RQI Program** allows individuals to practice and assess their CPR psychomotor skills to achieve and maintain high-quality CPR skills. The Program's use of voice-activated manikins, real-time feedback, and debriefing tools can help individuals achieve adequate chest compression depth.

Key Points

- Limited clinical data on the compression forces needed to achieve adequate compression depth exist.
- For chest compressions to be efficient they must be executed with a force sufficient to produce adequate sternal displacement.
- Do the mechanical characteristics of the adult human chest make it difficult to attain adequate compression depth in certain patients?
- Findings from this study show a strong nonlinear relationship between the force of compression and sternal displacement achieved.
- If it is important that CPR is performed to a certain depth as recommended in the guidelines, trainees should learn to assess the correct depth of compression.

Assessment of BLS skills: Optimizing use of instructor and manikin measures
Lynch et al. *Resuscitation.* 2008;76(2):233-243

> **Conclusion**
> More objective feedback on compression performance during CPR courses is needed; instructor judgment alone is insufficient. Both human examiners and learners would benefit from measurement and feedback on compression performance during CPR courses.

> **Importance of This Conclusion**
> Research shows use of voice-assisted manikins during retraining of CPR skills is feasible and more likely to be effective at helping individuals maintain competency in CPR skills. The **AHA RQI Program** uses automated, self-directed learning tools, with advanced feedback and debriefing elements, to achieve this goal.

Key Points

- Learner competency of CPR skills during layperson CPR training depends entirely on judgments made by an instructor; research suggests these judgments are not precise or accurate.
- Results of this study included *inadequate* compression depth rated as *adequate* 55% of the time, and incorrect hand placement rated adequate 49% of the time.
- Study results show instructors do not always detect poor compression performance; hence some individuals with inadequate skills still receive instructor approval.
- This study cites research that shows a large disparity between manikin and human measures of chest compressions and ventilations.

Importance of High-Quality CPR

The association between AHA CPR quality guideline compliance and clinical outcomes from out-of-hospital cardiac arrest
Cheskes et al. *Circulation.* 2015;132(suppl 2):S561–S573

> **Conclusion**
> Results of this study suggest CPR quality is an important predictor of survival when con-trolling for the timing of ROSC. Strategies to improve overall AHA guideline compliance may have a significant impact on outcomes from out-of-hospital cardiac arrest. More efforts need to be implemented for AHA Guidelines compliance to improve outcomes from OHCA.

> **Importance of This Conclusion**
> The **AHA RQI Program** offers providers the means to practice and assess CPR psychomotor skills, including metrics related to ROSC, in the hospital to maintain proficiency.

Key Points

- CPR quality is a key factor in improving outcomes from out-of-hospital cardiac arrest.
- Little is known about how CPR quality metrics perform in combination or whether they are collectively related to resuscitation outcomes.
- An association between CPR guideline compliance and outcomes was not observed; however, when the cohort was restricted to those with late ROSC, guideline-compliant CPR was associated with improved clinical outcomes.

Cardiopulmonary resuscitation: the science behind the hands

Harris AW, Kudenchuk PJ. *Heart*. 2018;104(13):1056-1061

> **Conclusion**
> CPR works, but better CPR works better. High-quality CPR with effective chest compressions is the foundation of successful resuscitation. CPR that complies with AHA compression and ventilation guidelines can save many lives.

> **Importance of This Conclusion**
> Survival rates after cardiac arrest can improve with when CPR is properly administered. The **AHA RQI Program** offers automated skills training with feedback and assessment to help participants improve and retain proficiency in performing CPR.

Key Points

- Effective chest compressions are the foundation of successful resuscitation outcomes. Resuscitation strategies that promote effective chest compressions can improve outcomes in all patients with cardiac arrest.
- The five key measures of high-quality CPR as defined by the AHA include: chest compression rate (100-120/min), chest compression depth (5-6 cm), chest compression fraction (at least 60% with minimal pauses), full chest recoil (without leaning), and ventilation rate (10 breaths/min, avoiding hyperventilation).
- Compliance with these guidelines can save thousands of lives each year.

Real-Time Feedback by Device

Accuracy of instructor assessment of chest compression quality during simulated resuscitation
Brennan et al. *CJEM.* 2016;18(4):276-282

> **Conclusion**
> The use of objective and technology-based measures of chest compression quality for feedback in simulated resuscitation settings is supported.

> **Importance of This Conclusion**
> Studies have shown that real-time CPR feedback improves performance. The **AHA RQI Program** uses automated, self-directed learning tools, with advanced feedback and debriefing elements. The program includes more frequent assessment and reinforcement of skills by use of real-time feedback and subsequent debriefing to help participants maintain competency in CPR.

Key Points

- Study findings suggest that instructors may not assess chest compression quality accurately during simulated resuscitation training sessions.
- The chest compression parameter with the least accurate assessment was rate; the majority of sessions having rates *within* the guidelines being assessed were inadequate, and the majority of sessions having rates *above* the guideline being assessed were adequate.
- An association between CPR guideline compliance and outcomes was not observed; however, when the cohort was restricted to those with late ROSC, guideline-compliant CPR was associated with improved clinical outcomes.
- The use of objective real-time chest compression quality feedback or post-scenario quantitative debriefing of CPR quality using objective measures may ameliorate this deficiency and concurrently reduce the cognitive load of instructors.

Use of a Real-Time Training Software (Laerdal QCPR®) Compared to Instructor-Based Feedback for High-Quality Chest Compressions Acquisition in Secondary School Students: A Randomized Trial
Cortegiani et al. *PLoS One.* 2017; 12(1): e0169591

> **Conclusion**
> For chest compression technical skill acquistion, in secondary school students, a training for chest compressions based on a real-time feedback software (Laerdal QCPR®) guided by an instructor is superior to instructor-based feedback training.

> **Importance of This Conclusion**
> The **AHA RQI Program** uses a similar automated, self-directed learning tools, with advanced feedback and debriefing elements.

Key Points

- Feedback from the software may improve the acquisition of the ability to perform chest compressions with adequate recoil. Mechanical devices such as the manikin used in the study with audiovisual feedback and others ensure accurate feedback about skills, enabling corrections and improvements that help guarantee correct training.
- Guidelines highlight the option of chest compression only CPR for lay people, since this may increase the willingness to perform CPR by bystanders and early institution of high-quality chest compressions may represent the single intervention with a major role in the overall patient.