

What Evidence Supports State Laws to Enhance Public Access Defibrillation?

A Policy Evidence Assessment Report

Acknowledgments

Disclaimer

The findings and conclusions of this document are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. Furthermore, this document is not intended to promote any particular legislative, regulatory, or other action.

Acknowledgments

This guide was developed by the Division for Heart Disease and Stroke Prevention within the Centers for Disease Control and Prevention (CDC). Contributions to the development and review of this guide were made by Siobhan Gilchrist, JD, MPH and Jennifer VanderVeur, JD (IHRC, Inc.); Nupur Maskara, MPH and Aunima Bhuiya, BSc (Oak Ridge Institute for Science and Education).

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The Big Picture

Cardiac arrest substantially contributes to avoidable death and disability across the United States.^a Although estimates vary by location and study, an estimated 70-90% of people experiencing out-of-hospital cardiac arrest die before reaching the hospital.^{a,b,c} The application of cardiopulmonary resuscitation (CPR) and use of an automated external defibrillator (AED) within minutes of cardiac arrest can dramatically raise survival rates.^a Public Access Defibrillation (PAD) programs and policies work to ensure that AEDs are immediately available for use by lay bystanders when and where they are needed with the intention of increasing survival rates.^d Furthermore, cardiac emergency response planning improves the ability of organizations such as schools to render life-saving care.^e

While all states have enacted some type of law pertaining to PAD, more information is needed to understand which types of PAD interventions could be addressed in an evidence-informed state PAD law. This report assesses best available evidence aligning with state laws that address PAD.

About This Report

This report assesses best available evidence for seven types of PAD interventions addressed in existing state law. These interventions were all

- (a) recommended by experts for PAD programs and/or guidance provided by the American Heart Association^b and the Institutes of Medicine^a and
- (b) authorized by at least one state's law as of December 31, 2016.

These PAD interventions include:

- (1) Targeted AED Site Placement**
- (2) Training Anticipated Responders**
- (3) PAD Coordinated with Emergency Medical Services**
- (4) Emergency Response Plans**
- (5) Routine Maintenance and Testing of AEDs**
- (6) Ongoing PAD Quality Improvement and Quality Assurance Monitoring**
- (7) Limited Liability**

Among states with enacted legislation to support effective PAD programs, the relevant laws often address multiple PAD interventions or program elements. Evidence associated with each type of PAD intervention is assessed here for strength and quality. The evidence search included published journal articles, policy briefs, statements, recommendations, and guidelines available between February 2006 and February 2017. For more on the method used, see the [Appendix](#).

Best available evidence refers to the written evidence base that is available at the current time and relevant to assessing a policy's potential public health impact. It documents empirical and non-empirical analyses of public health policies, programs, and activities. Using data or logic and theory, this evidence directly or indirectly links interventions of interest with actual or expected outcomes.

This evidence can include journal articles, editorials, commentaries, and perspectives; policy briefs, statements, recommendations, and guidelines; evaluation and technical reports; conference papers and presentations; dissertations; and white papers.

- a. Gilchrist, Schieb, Mukhtar, Valderrama, Zhang, Yoon, Schooley. A summary of public access defibrillation laws, United States, 2010. *Prev Chronic Dis.* 2012; 9:E71.
- b. Neumar RW, Eigel B, Callaway CW, Estes NA 3rd, Jollis JG, Kleinman ME, Morrison LJ, Peberdy MA, Rabinstein A, Rea TD, Sendelbach S. American Heart Association Response to the 2015 Institute of Medicine Report on Strategies to Improve Cardiac Arrest Survival. *Circulation.* 2015; 132:1049-1070.
- c. CDC. Cardiac Arrest Registry to Enhance Survival (CARES) National Summary Report. <https://mycares.net/sitepages/uploads/2014/2013CARESNationalSummaryReport.pdf>. Accessed September 22, 2016.
- d. Barbero C, Gilchrist S, Schooley MW, Chiqui JF, Luke DA, Eyer AA. Appraising the evidence for public health policy components using the quality and impact of component evidence assessment. *Glob Heart Mar.* 2015;10(1):3-11.
- e. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse.* 2016; 31(5), 263-270.
- f. The methodology for this QuIC Evidence Assessment is provided in Appendix A.

As of February 28, 2017, there are three PAD policy interventions found to have “best” evidence, and four found to have “promising” evidence (Figure 1). State laws that address the policy interventions with “best” evidence are expected to have the greatest potential for a positive health and associated economic impact. The policy interventions with “best” evidence bases include:

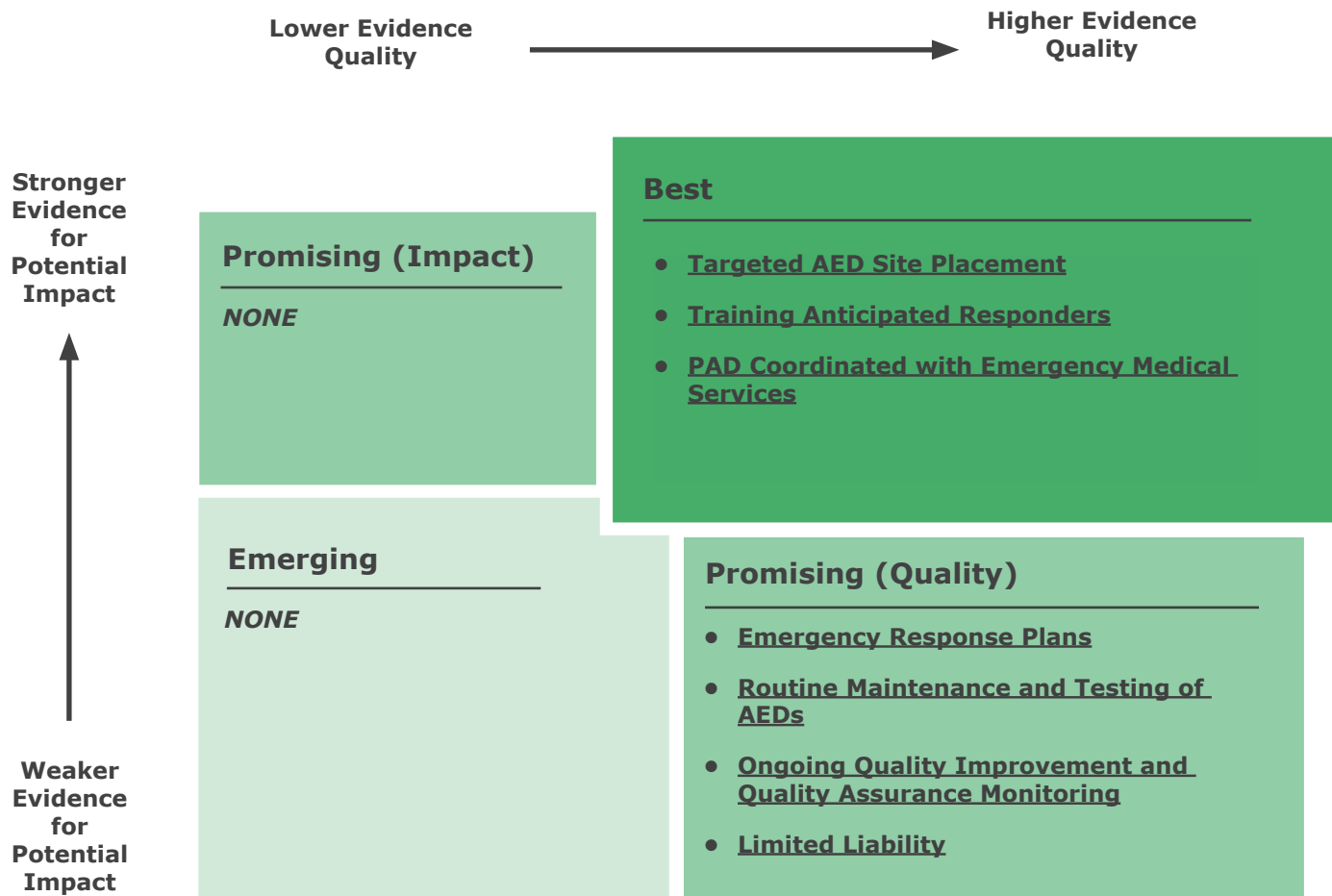
- Targeted AED Site Placement
- Training Anticipated Responders
- PAD Coordinated with Emergency Medical Services

State laws that address the policy interventions with “promising” evidence could also have positive impacts, but the quantity and quality of the evidence for them is limited at this time. These policy interventions include:

- Emergency Response Plans
- Routine Maintenance and Testing of AEDs
- Ongoing PAD Quality Improvement and Quality Assurance Monitoring
- Limited Liability

Researchers and evaluators could help build stronger evidence bases for these “promising” policy interventions. See the [Appendix](#) for how each evidence base could be strengthened.

Figure 1. Seven types of PAD policy interventions that could be scaled up for statewide adoption through state law. Use the links in this figure to navigate to an evidence summary for each type of intervention.



How To Use This Report

State decision makers and public health organizations may consider presenting this report, along with facts about state cardiac arrest rates and existing PAD programs, to the state public health department, Emergency Medical Services Director, health care providers and payers, and others interested in improving health outcomes.

State decision makers and public health organizations may consider planning for a state PAD policy that addresses multiple evidence-based interventions. Many of the interventions presented here are expected to work together to improve cardiac arrest outcomes. State law is a tool that could help initiate policy change, reach whole populations, and increase consistency and coordination across a state. When reviewing or disseminating this report, consider the limitations of the evidence assessment:

- **The evidence about PAD policy was derived largely from non-experimental studies, so causality cannot be inferred.** That is, there were very few studies comparing the effectiveness of PAD policy interventions in jurisdictions with versus without the policies. Additionally, in the few studies that did include control groups, the policy interventions being studied were typically multi-faceted and did not examine the specific effects of a given PAD policy intervention.
- Because PAD policy interventions are often multi-faceted and interconnected, the DHDSP assessment team members worked with subject matter experts and examined existing state laws to define the seven PAD policy interventions included in this assessment. Ratings of the strength and quality of the evidence are directly tied to these seven PAD policy interventions. The evidence examined as part of this assessment varied by jurisdictional level (e.g., state and local) and content of the PAD policy interventions. Therefore, **study findings might not be generalizable** to all states or to other jurisdictions.
- **Non-law approaches** may also be effective at increasing PAD and lay bystander use of AEDs. States may consider other factors, such as the legal, social, political, and fiscal environments, when deciding on a course of action.

Evidence Summaries

The next section provides evidence summaries for all of the PAD policy interventions included in this assessment. The evidence summaries could help state decision makers and public health organizations determine which PAD policy interventions may be useful in their state. The links in the Figure on the previous page can be used to navigate to the evidence summary for each policy intervention.

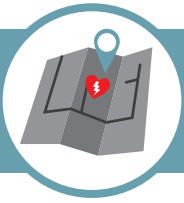
This report summarizes the evidence assessed for each of the seven PAD policy interventions listed above. Each summary provides the overall evidence assessment category, ratings for each of the public health impact and evidence quality criteria, a brief definition, reported public health outcomes, populations shown to benefit, states where the intervention was studied, examples of state laws addressing the policy intervention, and a listing of references included in the assessment.

How to use an evidence summary.

Evidence summaries describe the evidence used to score a policy intervention's evidence base on potential public health impact and quality. Each evidence summary includes a full reference and evidence list and provides the positive outcomes observed in intervention studies, as well the specific states in which these outcomes were found. When there were no intervention studies of a policy intervention, an evidence summary instead includes the rationale for the policy intervention, as described by experts and practitioners. See the [Appendix](#) for more on the method used to develop evidence summaries.

The evidence summaries will help state decision makers and public health organizations to better understand each evidence base as it relates to an individual state. Before reviewing the summaries, it is helpful to have background knowledge about the status of health in the state. State-specific health information can be found on state health department websites. Additionally, CDC provides national, state, and county-level health information on its website.

Evidence Summaries



Targeted AED Site Placement (cont.)

Evidence base

Research-based studies

None as of February 28, 2017

Practice-based reviews

1. Berger S. Cardiopulmonary resuscitation and public access defibrillation in the current era--can we do better yet? *J Am Heart Assoc.* 2014; 3(2).
2. Chan TC, Li H, Lebovic G, Tang SK, Chan JY, Cheng HC, Morrison LJ, Brooks SC. Identifying locations for public access defibrillators using mathematical optimization. *Circulation.* 2013; 127(17), 1801-1809.
3. White MJ, Loccoh EC, Goble MM, Yu S, Duquette D, Davis MM, Odetola FO, Russell MW. Availability of automated external defibrillators in public high schools. *The Journal of pediatrics.* 2016; May 31;172:142-6.
4. Institute of Medicine. *Strategies to improve cardiac arrest survival: A time to act.* Washington, DC: The National Academies Press; 2015.
5. Atkins DL. Realistic expectations for public access defibrillation programs. *Curr Opin Crit Care.* 2010; 16(3), 191-195.
6. Kitamura T, Iwami T, Kawamura T, Nagao K, Tanaka H, Hiraide A. Nationwide public-access defibrillation in Japan. *N Engl J Med.* 2010; 362(11), 994-1004.
7. Moon S, Vadeboncoeur TF, Kortuem W, Kisakye M, Karamooz M, White B, Brazil P, Saite DW, Bobrow BJ. Analysis of out-of-hospital cardiac arrest location and public access defibrillator placement in Metropolitan Phoenix, Arizona. *Resuscitation.* 2015; 89, 43-49.
8. Page RL, Husain S, White LY, Rea TD, Fahrenbruch C, Yin L, Kudenchuk PJ, Cobb LA, Eisenberg MS. Cardiac arrest at exercise facilities: implications for placement of automated external defibrillators. *J Am Coll Cardiol.* 2013; 62(22), 2102-2109.
9. Drezner JA, Courson RW, Roberts WO, Mosesso VN, Jr, Link MS, Maron BJ. Inter Association Task Force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs: a consensus statement. *Prehosp Emerg Care.* 2007; 11(3), 253-271.
10. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse.* 2016; 31(5), 263-270.
11. Drezner JA, Chun JS, Harmon KG, Derminer, L. Survival trends in the United States following exercise-related sudden cardiac arrest in the youth: 2000-2006. *Heart Rhythm.* 2008; 5(6), 794-799.
12. Thomas VC, Shen JJ, Stanley R, Dahlke J, McPartlin S, Row L. Improving Defibrillation Efficiency in Area Schools. *Congenit Heart Dis.* 2016; 11(4), 359-364.
13. Eckstein M. The Los Angeles public access defibrillator (PAD) program: ten years after. *Resuscitation.* 2012; 83(11), 1411-1412.
14. Friedman FD, Dowler K, Link MS. A public access defibrillation programme in non-inpatient hospital areas. *Resuscitation.* 2006; 69(3), 407-411.
15. Drezner JA, Rao AL, Heistand J, Bloomingdale MK, Harmon KG. Effectiveness of emergency response planning for sudden cardiac arrest in United States high schools with automated external defibrillators. *Circulation.* 2009; 120(6), 518-525.
16. Lazar RA. Legislative Strategies for Modernizing U.S. AED Laws. <http://www.sca-aware.org/sites/default/files/u1/docs/Legislative-Strategies-For-Modernizing-US-AED-Laws.pdf>. Accessed June 7, 2016.
17. Stokes NA, Scapigliati A, Trammell AR, Parish DC. The effect of the AED and AED programs on survival of individuals, groups and populations. *Prehosp Disaster Med.* 2012; 27(5), 419-424.
18. Winkle RA. The effectiveness and cost effectiveness of public-access defibrillation. *Clin Cardiol.* 2010; 33(7), 396-399.
19. Griffis HM, Band RA, Ruther M, Harhay M, Asch DA, Hershey JC, Hill S, Nadkarni L, Kilaru A, Branas CC, Shofer F, Nichol G, Becker LB, Merchant, RM. Employment and residential characteristics in relation to automated external defibrillator locations. *Am Heart J.* 2016; 172, 185-191.
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21. Hoyme DB, Atkins DL. Implementing Cardiopulmonary Resuscitation Training Programs in High Schools: Iowa's Experience. *J Pediatr.* 2017; 181, 172-176.e173
22. Chrisinger, B. W., Grossestreuer AV, Laguna MC, Griffis HM, Branas CC, Wiebe DJ, Merchant RM. Characteristics of automated external defibrillator coverage in Philadelphia, PA, based on land use and estimated risk. *Resuscitation.* 2016; 109, 9-15.



Training Anticipated Responders

Evidence Level: **BEST**

Laws to encourage cardiopulmonary resuscitation (CPR) and AED training of anticipated lay responders who are likely to be present during an event; includes laws that encourage training for persons on-site in a specific type of setting (e.g., employees of a health club) or as part of their official duties (e.g., school officials).

Example of state law addressing this type of intervention

Arkansas law requires that expected AED users complete a course every 2 years on CPR and AED use that is based on American Heart Association, American Red Cross, or equivalent course standards.^{(Ark. Code Ann. § 20-13-1304(a)(1))}

Evidence for Potential Public Health Impact:

Effectiveness: ●●●●● Weaker=●●●● ←→ ●●●●●=Stronger
Equity & Reach: ●●●●●
Efficiency: ●●●●●
Transferability: ●●●●●

For more on how evidence for potential impact was assessed, see the [Appendix](#)



SCORE: VERY STRONG

Evidence Quality:

Evidence Type: ●●●●● Lower=●●●● ←→ ●●●●●=Higher
Source: ●●●●●
Evidence from Research: ●●●●●
Evidence from Translation & Practice: ●●●●●

For more on how evidence quality was assessed, see the [Appendix](#)



SCORE: VERY HIGH

Reported health-related outcomes

- Enhanced competency in applying CPR and AED^{1,2,4,5,6,7}
- Improved bystander recognition of cardiac arrest^{2,3,8,9}
- Willingness of bystander to use AED^{3,8}
- Bystander use of AED^{3,8,10,11,12,13}
- Time to first chest compression⁸
- Time to defibrillation prior to EMS arrival^{7,14,15,16}
- Return of spontaneous circulation^{10,17}
- Neurological outcome for patients¹⁰
- Cardiac arrest survival^{2,7,8,9,12,13,14,17,18,19}

Groups studied

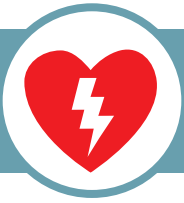
Communities experiencing higher burden of out-of-hospital cardiac arrest including older populations with lower median income as well as African American and Hispanic neighborhoods,^{6,8} and retirement communities.⁸ Schools are uniquely positioned to provide CPR and AED training which could directly benefit athletes,^{14,9} students, staff, and visitors within the school as well as the larger community.^{2,5,8,9,11,16,19,20}

Feasibility and related economic highlights

Community PAD training programs are a cost-effective means for saving lives when compared to other health care-related interventions.¹⁰

States where programs achieved positive health-related outcomes

California,¹⁷ Iowa,⁶ Maryland,¹⁰ Michigan,¹⁶ Minnesota,¹² Nevada,¹⁵ North Carolina²⁰



Training Anticipated Responders (cont.)

Evidence Base

Research-based studies

1. Christenson J, Nafziger S, Compton S, Vijayaraghavan K, Slater B, Ledingham R, Powell J, McBurnie MA. The effect of time on CPR and automated external defibrillator skills in the Public Access Defibrillation Trial. *Resuscitation*. 2007; 74(1), 52-62.
2. Watanabe K, Lopez-Colon D, Shuster JJ, Philip J. Efficacy and retention of Basic Life Support education including Automated External Defibrillator usage during a physical education period. *Preventive Medicine Reports*. 2017;5, 263-267.
3. Hedges JR, Sehra R, Van Zile JW, Anton AR, Bosken LA, O'Connor RE, Moore R, Rowell JL, McBurnie MA. Automated external defibrillator program does not impair cardiopulmonary resuscitation initiation in the public access defibrillation trial. *Acad Emerg Med*. 2006; 13(6), 659-665.

Practice-based studies

4. Garcia EA, Likourezos A, Ramsay C, Hoffman S, Niles C, Pearl-Davis M, Podolsky S, Davidson SJ. Evaluation of emergency medicine community educational program. *West J Emerg Med*. 2010; 11(5), 416-418.1. Institute of Medicine. Strategies to improve cardiac arrest survival: A time to act. Washington, DC: The National Academies Press; 2015.
5. Kelley J, Richman PB, Ewy GA, Clark L, Bulloch B, Bobrow BJ. Eighth grade students become proficient at CPR and use of an AED following a condensed training programme. *Resuscitation*. 2006; 71(2), 229-236.
6. Hoyme DB, Atkins DL. Implementing Cardiopulmonary Resuscitation Training Programs in High Schools: Iowa's Experience. *J Pediatr*. 2017; 181, 172-176.e173
7. Neumar RW, Shuster M, Callaway CW, Gent LM, Atkins DL, Bhanji F, Brooks SC, de Caen AR, Donnino MW, Ferrer JM, Kleinman ME, Kronick SL, Lavonas EJ, Link MS, Mancini ME, Morrison LJ, O'Connor RE, Samson RA, Schexnayder SM, Singletary EM, Sinz EH, Travers AH, Wyckoff MH, Hazinski MF. 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*. 2015; 132(18 Suppl 2), S315-67.
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9. Drezner JA, Rao AL, Heistand J, Bloomingdale MK, Harmon KG. Effectiveness of emergency response planning for sudden cardiac arrest in United States high schools with automated external defibrillators. *Circulation*. 2009; 120(6), 518-525.
10. Bouland AJ, Risko N, Lawner BJ, Seaman KG, Godar CM, Levy MJ. The Price of a Helping Hand: Modeling the Outcomes and Costs of Bystander CPR. *Prehosp Emerg Care*. 2015;19(4), 524-534.
11. Cave DM, Aufderheide TP, Beeson J, Ellison A, Gregory A, Hazinski MF, Hiratzka LF, Lurie KG, Morrison LJ, Mosesso VN, Nadkarni V, Potts J, Samson RA, Sayre MR, Schexnayder SM. Importance and implementation of training in cardiopulmonary resuscitation and automated external defibrillation in schools: a science advisory from the American Heart Association. *Circulation*. 2011;123(6), 691-706.
12. Lick CJ, Aufderheide TP, Niskanen RA, Steinkamp JE, Davis SP, Nygaard SD, Bernenderfer KK, Gonzales L, Kalla JA, Wald SK, Gillquist DL, Sayre MR, Osaki Holm SY, Oakes DA, Provo TA, Racht EM, Olsen JD, Lurie KG. Take Heart America: A comprehensive, community-wide, systems-based approach to the treatment of cardiac arrest. *Crit Care Med*. 2011; 39(1), 26-33.
13. Malta Hansen C, Kragholm K, Pearson DA, Tyson C, Monk L, Myers B, Nelson D, Dupre ME, Fosbol EL, Jollis JG, Strauss B, Anderson ML, McNally B, Granger CB. Association of Bystander and First-Responder Intervention With Survival After Out-of-Hospital Cardiac Arrest in North Carolina, 2010-2013. *JAMA*. 2015; 314(3), 255-264.
14. Drezner JA, Courson RW, Roberts WO, Mosesso VN, Jr., Link MS, Maron BJ. Inter Association Task Force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs: a consensus statement. *Prehosp Emerg Care*. 2007; 11(3), 253-271.
15. Thomas VC, Shen JJ, Stanley R, Dahlke J, McPartlin S, Row L. Improving Defibrillation Efficiency in Area Schools. *Congenit Heart Dis*. 2016; 11(4), 359-364.
16. White MJ, Loccoh EC, Goble MM, Yu S, Duquette D, Davis MM, Odetola FO, Russell MW. Availability of automated external defibrillators in public high schools. *The Journal of Pediatrics*. 2016; May 31;172:142-6.
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18. Kilaru AS, Leffer M, Perkner J, Sawyer KF, Jolley CE, Nadkarni LD, Shofer FS, Merchant RM. Use of automated external defibrillators in US federal buildings: implementation of the Federal Occupational Health public access defibrillation program. *J Occup Environ Med*. 2014; 56(1), 86-91.
19. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse*. 2016; 31(5), 263-270.
20. Drezner JA, Toresdahl BG, Rao AL, Huszti E, Harmon KG. Outcomes from sudden cardiac arrest in US high schools: a 2-year prospective study from the National Registry for AED Use in Sports. *British Journal of Sports Medicine*. 2013; 47(18), 1179-83.



PAD Coordinated with Emergency Medical Services

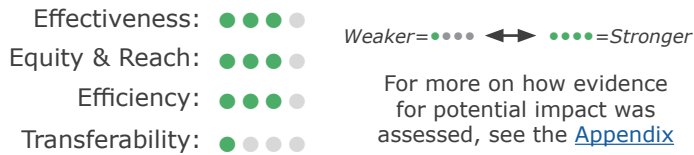
Evidence Level: **BEST**

Includes (1) laws that encourage a state, local or other level PAD registry, or require EMS notification of placement/removal of AED, (2) laws that encourage activation of 911-EMS when an AED is used (excluding testing)

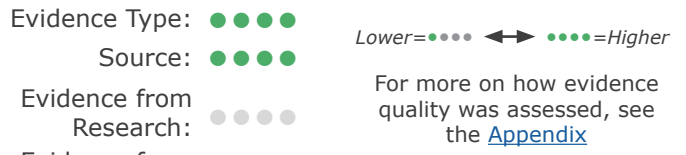
Example of state law addressing this type of intervention

California law requires that (1) anyone who acquires an AED notify EMS of the existence, location, and type of AED acquired, and (2) that any person who renders emergency care or treatment on a person in cardiac arrest by using an AED activates the emergency medical services system as soon as possible, reports any use of the AED to the licensed physician and to the local EMS agency, and reports clinical usage. (Cal. Health & Saf. Code § 1797.196 & Cal. Code Regs, tit. 22, § 100041-100042)

Evidence for Potential Public Health Impact:



Evidence Quality:



Reported health-related outcomes

- Utilization rates for public access AEDs^{1,2,3}
- Bystander use of AED⁴
- Delivery of first shock with an AED^{5,6}
- Time to defibrillation prior to EMS arrival^{7,8,9,10,11}
- Rate of return of spontaneous circulation¹²
- Neurological outcomes for patients⁷
- Cardiac arrest survival,^{1, 2,3,5,7,13,14,15,16,17} survival to hospital discharge,^{5,6,7,13} survival from witnessed ventricular fibrillation sudden cardiac arrest,^{5,8} survival with favorable neurological outcome⁴

Groups studied

Rural communities.^{7,9} Students, student athletes, staff, and visitors within the school setting.^{6,11,14,15,18}

Feasibility and related economic highlights

In sparsely populated rural areas where EMS response includes larger geographic distances, a coordinated system utilizing PAD as part of initial care in a two-tiered system may be more cost-effective while providing a good standard of care.⁹

States where programs achieved positive health-related outcomes

Alabama,¹⁰ Iowa,¹⁰ Maryland,¹² Nevada,¹¹ New Hampshire,⁵ North Carolina,⁴ Oregon,¹⁰ Pennsylvania,¹⁰ Texas,¹⁰ Utah,⁵ Washington,^{2,10} Wisconsin¹⁰



Evidence Base

Research-based studies

None as of February 28, 2017

Practice-based studies

1. Lazar RA. Legislative Strategies for Modernizing U.S. AED Laws. <http://www.sca-aware.org/sites/default/files/u1/docs/Legislative-Strategies-For-Modernizing-US-AED-Laws.pdf>. Accessed June 7, 2016.
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4. Malta Hansen C, Kragholm K, Pearson DA, Tyson C, Monk L, Myers B, Nelson D, Dupre ME, Fosbol EL, Jollis JG, Strauss B, Anderson ML, McNally B, Granger CB. Association of Bystander and First-Responder Intervention With Survival After Out-of-Hospital Cardiac Arrest in North Carolina, 2010-2013. *JAMA*. 2015; 314(3), 255-264.
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13. Atkins, DL. Public access defibrillation: where does it work? *Circulation*. 2009; 120(6), 461-463.
14. Drezner JA, Courson RW, Roberts WO, Mosesso VN, Jr., Link MS, Maron BJ. Inter Association Task Force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs: a consensus statement. *Prehosp Emerg Care*. 2007; 11(3), 253-271.
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16. American College of Emergency Physicians. Public training in cardiopulmonary resuscitation and public access defibrillation. *Ann Emerg Med*. 2006; 47(6), 585.
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18. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse*. 2016; 31(5), 263-270.



Emergency Response Plans

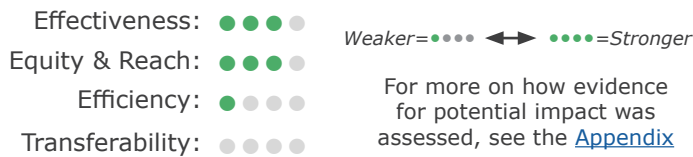
Evidence Level: **PROMISING EVIDENCE QUALITY**

Includes laws that encourage the AED program facilitator (or other) to develop emergency response plans for responding to a suspect cardiac arrest occurrence.

Example of state law addressing this type of intervention

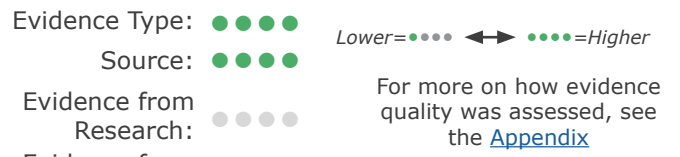
North Carolina law requires the development and practice of emergency response plans for state buildings. (N.C. Gen. Stat. § 143B-370.1)

Evidence for Potential Public Health Impact:



SCORE: MODERATE

Evidence Quality:



SCORE: HIGH

Reported health-related outcomes

- Awareness and access to AED^{1,2,3}
- Utilization of AED by bystanders^{1,2,4}
- Time from collapse to first shock^{5,6}
- Time to defibrillation prior to EMS arrival^{7,8}
- Rate of return of spontaneous circulation⁶
- Cardiac arrest survival,^{1, 2,3,4,5,6,7,9,10,11} cardiac arrest survival to hospital discharge^{1,4,6,9,10}

Groups studied

Students, student athletes, staff, and visitors within the school setting.^{2,3,4,5,7,8,10,11} Employees and customers in airports and casinos,⁵ as well as employees in other types of workplaces.⁶

Feasibility and related economic highlights

Comprehensive emergency planning promotes efficiency.⁵

States where programs achieved positive health-related outcomes

Michigan,⁸ Wisconsin⁵



Emergency Response Plans (cont.)

Evidence Base

Research-based studies

None as of February 28, 2017

Practice-based studies

1. Institute of Medicine. Strategies to improve cardiac arrest survival: A time to act. Washington, DC: The National Academies Press; 2015.
2. Drezner JA, Rao AL, Heistand J, Bloomingdale MK, Harmon KG. Effectiveness of emergency response planning for sudden cardiac arrest in United States high schools with automated external defibrillators. *Circulation*. 2009; 120(6), 518-525.
3. Drezner JA, Toresdahl BG, Rao AL, Huszti E, Harmon KG. Outcomes from sudden cardiac arrest in US high schools: a 2-year prospective study from the National Registry for AED Use in Sports. *British journal of sports medicine*. 2013; 47(18), 1179-83.
4. Atkins DL. Public access defibrillation: where does it work? *Circulation*. 2009; 120(6), 461-463.
5. Drezner JA, Courson RW, Roberts WO, Mosesso VN, Jr., Link MS, Maron BJ. Inter Association Task Force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs: a consensus statement. *Prehosp Emerg Care*. 2007; 11(3), 253-271.
6. Kilaru AS, Leffer M, Perkner J, Sawyer KF, Jolley CE, Nadkarni LD, Shofer FS, Merchant, R. M. Use of automated external defibrillators in US federal buildings: implementation of the Federal Occupational Health public access defibrillation program. *J Occup Environ Med*. 2014; 56(1), 86-91.
7. Drezner JA, Chun JS, Harmon KG, Derminer, L. Survival trends in the United States following exercise-related sudden cardiac arrest in the youth: 2000-2006. *Heart Rhythm*. 2008; 5(6), 794-799.
8. White MJ, Loccoch EC, Goble MM, Yu S, Duquette D, Davis MM, Odetola FO, Russell MW. Availability of automated external defibrillators in public high schools. *The Journal of Pediatrics*. 2016; May 31;172:142-6.
9. Aufderheide T, Hazinski MF, Nichol G, Steffens SS, Buroker A, McCune R, Stapleton E, Nadkarni V, Potts J, Ramirez RR, Eigel B, Epstein A, Sayre M, Halperin H, Cummins RO. Community lay rescuer automated external defibrillation programs: key state legislative components and implementation strategies: a summary of a decade of experience for healthcare providers, policymakers, legislators, employers, and community leaders from the American Heart Association Emergency Cardiovascular Care Committee, Council on Clinical Cardiology, and Office of State Advocacy. *Circulation*. 2006; 113(9), 1260-1270.
10. Swor R, Grace H, McGovern H, Weiner M, Walton E. Cardiac arrests in schools: assessing use of automated external defibrillators (AED) on school campuses. *Resuscitation*. 2013; 84(4), 426-429.
11. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse*. 2016; 31(5), 263-270.



Routine Maintenance and Testing of AEDs

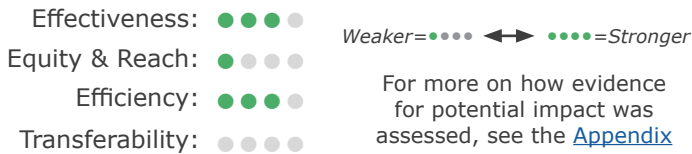
Evidence Level: **PROMISING EVIDENCE QUALITY**

Laws that encourage AED maintenance and testing, includes immunity provisions that only apply if the AED is maintained.

Example of state law addressing this type of intervention

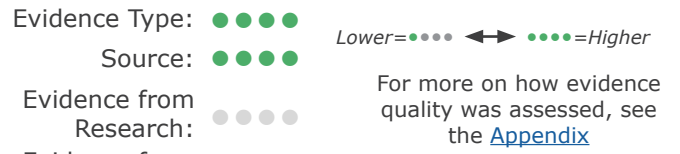
Colorado law requires a person or entity that acquires an AED to regularly maintain and test AED devices according to the manufacturer guidelines. (Col. Rev. Stat. § 13-21-108.1)

Evidence for Potential Public Health Impact:



SCORE: MODERATE

Evidence Quality:



SCORE: HIGH

Reported health-related outcomes

- Utilization of AEDs^{1,2,3}
- Time to defibrillation,^{1,4} arrival of the AED at the victim's side to delivery of the first shock^{5,6}
- Neurological outcomes for patients¹
- Sudden cardiac arrest survival rates,^{2,3,5,7} cardiac arrest survival to hospital discharge⁵

Groups studied

Employees and customers in casinos and airports^{5,8} and in other types of workplaces,² and staff and students in schools.^{4,6}

Feasibility and related economic highlights

No feasibility or economic findings to report as of February 28, 2017

States where programs achieved positive health-related outcomes

California,⁸ Michigan⁴



Routine Maintenance and Testing of AEDs (cont.)

Evidence Base

Research-based studies

None as of February 28, 2017

Practice-based studies

1. Institute of Medicine. Strategies to improve cardiac arrest survival: A time to act. Washington, DC: The National Academies Press; 2015.
2. Kilaru AS, Leffer M, Perkner J, Sawyer KF, Jolley CE, Nadkarni LD, Shofer FS, Merchant, R. M. Use of automated external defibrillators in US federal buildings: implementation of the Federal Occupational Health public access defibrillation program. *J Occup Environ Med.* 2014; 56(1), 86-91.
3. Stokes NA, Scapigliati A, Trammell AR, Parish DC. The effect of the AED and AED programs on survival of individuals, groups and populations. *Pre-hosp Disaster Med.* 2012; 27(5), 419-424.
4. White MJ, Loccoch EC, Goble MM, Yu S, Duquette D, Davis MM, Odetola FO, Russell MW. Availability of automated external defibrillators in public high schools. *The Journal of pediatrics.* 2016; May 31;172:142-6.
5. Aufderheide T, Hazinski MF, Nichol G, Steffens SS, Buroker A, McCune R, Stapleton E, Nadkarni V, Potts J, Ramirez RR, Eigel B, Epstein A, Sayre M, Halperin H, Cummins RO. Community lay rescuer automated external defibrillation programs: key state legislative components and implementation strategies: a summary of a decade of experience for healthcare providers, policymakers, legislators, employers, and community leaders from the American Heart Association Emergency Cardiovascular Care Committee, Council on Clinical Cardiology, and Office of State Advocacy. *Circulation.* 2006; 113(9), 1260-1270.
6. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse.* 2016; 31(5), 263-270.
7. Haskell SE, Post M, Cram P, Atkins DL. Community public access sites: compliance with American Heart Association recommendations. *Resuscitation.* 2009; 80(8), 854-858
8. Eckstein M. The Los Angeles public access defibrillator (PAD) program: ten years after. *Resuscitation.* 2012; 83(11), 1411-1412.



Ongoing Quality Improvement and Quality Assurance Monitoring

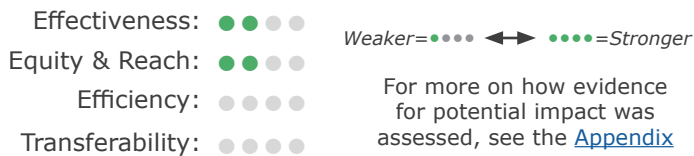
Evidence Level: **PROMISING EVIDENCE QUALITY**

Includes laws that encourage PAD programs to develop and implement quality improvement and quality assurance plans for the purpose of evaluating and monitoring the effectiveness of the PAD program.

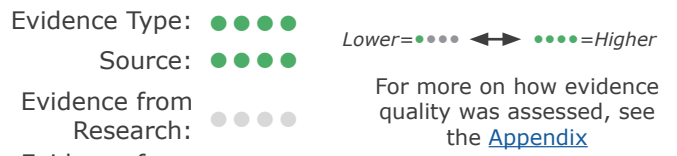
Example of state law addressing this type of intervention

New Mexico law requires AED programs to include quality assurance and review of all cases in which AEDs are utilized. (N.M. Stat. § 24-10C-4 & N.M. Code R. § 7.27.8.9)

Evidence for Potential Public Health Impact:



Evidence Quality:



Reported health-related outcomes

- Time from collapse to first shock^{1,2}
- Rate of return of spontaneous circulation^{3,4}
- Neurological outcomes for patients⁵
- Cardiac arrest survival rates^{1,3,4}

Groups studied

Employees and customers in airports,³ casinos, convention centers, and public sporting venues,^{1,3,4} public businesses and offices,⁵ and schools²

Feasibility and related economic highlights

No feasibility or economic findings to report as of February 28, 2017

States where programs achieved positive health-related outcomes

Arizona,⁵ California³



Ongoing Quality Improvement and Quality Assurance Monitoring (cont.)

Evidence Base

Research-based studies

None as of February 28, 2017

Practice-based studies

1. Aufderheide T, Hazinski MF, Nichol G, Steffens SS, Buroker A, McCune R, Stapleton E, Nadkarni V, Potts J, Ramirez RR, Eigel B, Epstein A, Sayre M, Halperin H, Cummins RO. Community lay rescuer automated external defibrillation programs: key state legislative components and implementation strategies: a summary of a decade of experience for healthcare providers, policymakers, legislators, employers, and community leaders from the American Heart Association Emergency Cardiovascular Care Committee, Council on Clinical Cardiology, and Office of State Advocacy. *Circulation*. 2006; 113(9), 1260-1270.
2. Rose K, Martin Goble M, Berger S, Courson R, Fosse G, Gillary R, Halowich J, Indik JH, Konig M, Lopez-Anderson M, Murphy MK, Newman MM, Ranous J, Sasson C, Tara H, Thompson A. Cardiac Emergency Response Planning for Schools: A Policy Statement. *NASN Sch Nurse*. 2016; 31(5), 263-270.
3. Eckstein M. The Los Angeles public access defibrillator (PAD) program: ten years after. *Resuscitation*. 2012; 83(11), 1411-1412.
4. Stokes NA, Scapigliati A, Trammell AR, Parish DC. The effect of the AED and AED programs on survival of individuals, groups and populations. *Pre-hosp Disaster Med*. 2012; 27(5), 419-424.
5. Moon S, Vadeboncoeur TF, Kortuem W, Kisakye M, Karamooz M, White B, Brazil P, Saite DW, Bobrow BJ. Analysis of out-of-hospital cardiac arrest location and public access defibrillator placement in Metropolitan Phoenix, Arizona. *Resuscitation*. 2015; 89, 43-49.



Limited Liability (cont.)

Evidence Base

Research-based studies

None as of February 28, 2017

Practice-based studies

1. Aufderheide T, Hazinski MF, Nichol G, Steffens SS, Buroker A, McCune R, Stapleton E, Nadkarni V, Potts J, Ramirez RR, Eigel B, Epstein A, Sayre M, Halperin H, Cummins RO. Community lay rescuer automated external defibrillation programs: key state legislative components and implementation strategies: a summary of a decade of experience for healthcare providers, policymakers, legislators, employers, and community leaders from the American Heart Association Emergency Cardiovascular Care Committee, Council on Clinical Cardiology, and Office of State Advocacy. *Circulation*. 2006; 113(9), 1260-1270.
2. England H, Weinberg PS, Estes NA, 3rd. The automated external defibrillator: clinical benefits and legal liability. *JAMA*. 2006; 295(6), 687-690.
3. Lazar RA. Legislative Strategies for Modernizing U.S. AED Laws. <http://www.sca-aware.org/sites/default/files/u1/docs/Legislative-Strategies-For-Modernizing-US-AED-Laws.pdf> . Accessed June 7, 2016.
4. Institute of Medicine. Strategies to improve cardiac arrest survival: A time to act. Washington, DC: The National Academies Press; 2015.

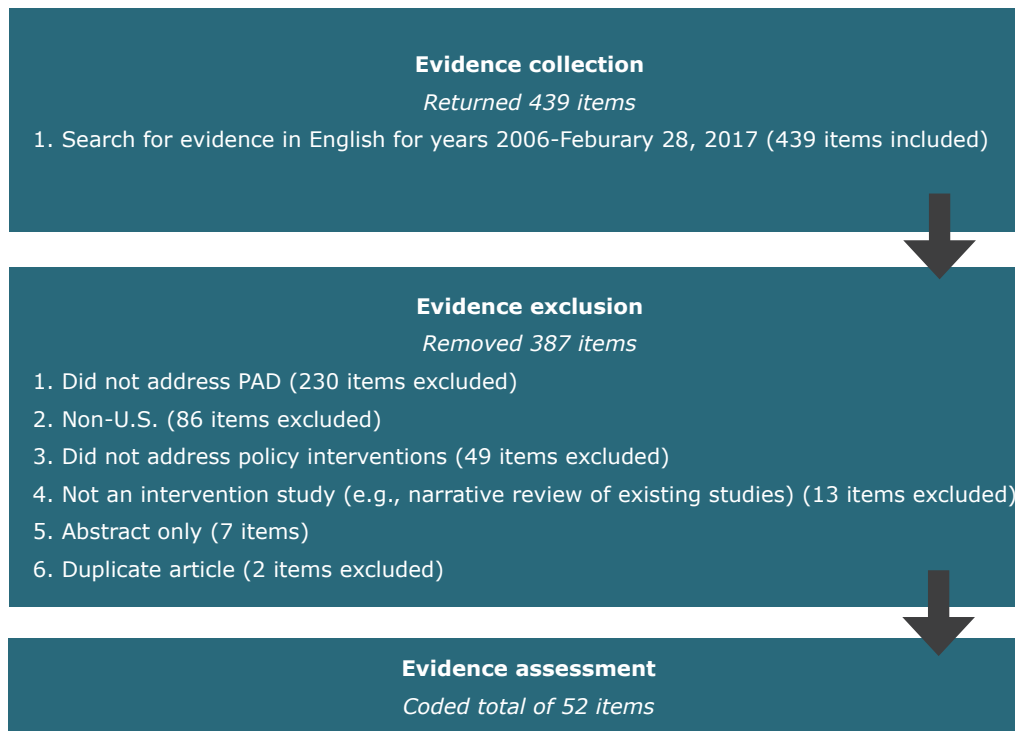
Appendix

Method

Public decision makers need to know which policies are feasible and most likely to achieve the desired effect. Because there are limited studies of the impact of state PAD laws, understanding the potential impact of PAD policy interventions requires assessment of early (best available) evidence. This report uses a novel approach to complete an early evidence assessment called the Quality and Impact of Component Evidence Assessment, or QuIC. For more on the QuIC method, contact CDC DHDSP, email: dhdsprequests@cdc.gov.

The seven PAD policy interventions assessed in this report were identified by determining where the content of existing state laws aligned with guidance provided by the American Heart Association and the Institutes of Medicine. In this assessment, best available evidence included mainly programmatic studies of the types of PAD elements addressed in state law as well as subject matter expert opinion. To collect evidence for the policy interventions, an evidence search was conducted in February of 2017. This assessment included evidence from the previous eleven years. Figure 2 below documents the evidence search.

Figure 2. 2017 State Public Access Defibrillation evidence search



To assess the evidence level for a policy intervention, a QuIC Evidence Assessment appraises (1) evidence for potential public health impact and (2) evidence quality. In this assessment, two trained CDC policy staff independently developed coding rules and coded the evidence bases relevant to each of the seven policy interventions. Initial agreement across the evidence for potential impact codes was 83.3%; across the quality codes, it was 91.0%.

Consensus for each code was reached through discussion and reconciled coding was entered into the QuIC Evidence Assessment Tool (p.22). To calculate the evidence for potential impact level and the evidence quality level, the eight criteria from the QuIC Tool were each assigned a numeric score for the highest level reached (1-4 points). The four criteria scores for evidence for potential impact were summed, as were the four criteria scores for evidence quality.

^bAufderheide T, Hazinski MF, Nichol G, Steffens SS, Buroker A, McCune R, Stapleton E, Nadkarni V, Potts J, Ramirez RR, Eigel B, Epstein A, Sayre M, Halperin H, Cummins RO. Community lay rescuer automated external defibrillation programs: key state legislative components and implementation strategies: a summary of a decade of experience for healthcare providers, policymakers, legislators, employers, and community leaders from the American Heart Association Emergency Cardiovascular Care Committee, Council on Clinical Cardiology, and Office of State Advocacy. *Circulation*. 2006; 113(9), 1260-1270.

^cInstitute of Medicine. *Strategies to improve cardiac arrest survival: A time to act*. Washington, DC: The National Academies Press; 2015.

The numeric scores were converted to ordinal evidence levels using the following approach: 1–4 points= weak evidence; 5–8 points= moderate evidence; 9–12 points = strong evidence; and 13–16 points= very strong evidence. The evidence quality level was determined using the following conversion: 1–4 points= low quality evidence; 5–8 points= moderate quality evidence; 9–12 points = high quality evidence; and 13–16 points= very high quality evidence. For example, if the Effectiveness criterion scored “very strong” and the Equity and Reach criterion scored “very strong” and the Efficiency criterion scored “strong” and the Transferability criterion scored “strong,” then $4+4+1+2=11$ = “strong” evidence for potential impact.

This procedure gave each of the seven PAD policy interventions an evidence for potential impact level and an evidence quality level, which were used to categorize them as “best,” “promising (quality),” “promising (impact),” or “emerging” (Table). Intervention evidence summaries were developed to describe the evidence bases. See page 23 for a description of the evidence summary template.





Table. Method for categorizing overall evidence level using evidence for potential impact and quality levels

Evidence for Potential Public Health Impact Level	Evidence Quality Level	Evidence Level
Strong or Very Strong	High or Very High	Best
Weak or Moderate	High or Very High	Promising Evidence Quality
Strong or Very Strong	Low or Moderate	Promising Evidence for Potential Public Health Impact
Weak or Moderate	Low or Moderate	Emerging

- n. Contact CDC DHDSF for the QuIC Evidence Assessment Handbook.
- o. This method has been shown to achieve Very Good to Excellent inter-rater agreement within 3 previous QuIC assessments: Centers for Disease Control and Prevention. Division for Heart Disease and Stroke Prevention. What Could Be Addressed in an Evidence-Informed State Workplace Health Promotion Law? Atlanta, GA: Centers for Disease Control and Prevention; 2017; Centers for Disease Control and Prevention. Division for Heart Disease and Stroke Prevention. What Evidence Supports State Laws to Establish Community Health Worker Scope of Practice and Certification? Atlanta, GA: Centers for Disease Control and Prevention; 2017; & Centers for Disease Control and Prevention. Division for Heart Disease and Stroke Prevention. What Evidence Supports State Laws to Enhance Public Access Defibrillation? Atlanta, GA: Centers for Disease Control and Prevention; 2017
- p. The evidence for potential impact level was determined using the following conversion: 1-4 points= weak; 5-8 points= moderate; 9-12 points = strong; and 13-16 points= very strong. The evidence quality level was determined using the following conversion: 1-4 points= low; 5-8 points= moderate; 9-12 points = high; and 13-16 points= very high. For example, if the Effectiveness criterion scored “very strong” and the Equity and Reach criterion scored “very strong” and the Efficiency criterion scored “strong” and the Transferability criterion scored “strong,” then $4+4+3+3=14$ =“very strong” evidence for potential impact.





QuIC Evidence Assessment Tool

Section 1. Evidence for Potential Public Health Impact

Criterion and what it measures	Weak Evidence 	Moderate Evidence 	Strong Evidence 	Very Strong Evidence 
Effectiveness <i>Does it work, i.e., improve outcomes relevant to health?</i>	Indirect evidence for a positive expected outcome relevant to health	Direct evidence for a positive expected outcome relevant to health	Indirect evidence of mostly positive actual outcomes relevant to health	Direct evidence of mostly positive actual outcomes relevant to health
Equity and Reach <i>Does it work for target population(s)?</i>	Indirect evidence for a positive expected outcome relevant to equity and reach	Direct evidence for a positive expected outcome relevant to equity and reach	Indirect evidence of mostly positive actual outcomes relevant to equity and reach	Direct evidence of mostly positive actual outcomes relevant to equity and reach
Efficiency <i>Is it a good use of resources?</i>	Indirect evidence for a positive expected outcome relevant to efficiency	Direct evidence for a positive expected outcome relevant to efficiency	Indirect evidence of mostly positive actual outcomes relevant to efficiency	Direct evidence of mostly positive actual outcomes relevant to efficiency
Transferability <i>Does it work across diverse settings?</i>	Indirect evidence for a positive expected outcome relevant to health in two or more regions of the United States	Direct evidence for a positive expected outcome relevant to health in two or more regions of the United States	Indirect evidence of mostly positive actual outcomes relevant to health in two or more regions of the United States	Direct evidence of mostly positive actual outcomes relevant to health in two or more regions of the United States

Note: if none of its requirements are met, a criterion is assigned a score of 0 points, ●●●●

Section 2. Evidence Quality

Criterion and what it measures	Low Quality 	Moderate Quality 	High Quality 	Very High Quality 
Evidence Types <i>What is the most rigorous design?</i>	A narrative review or commentary suggests a positive outcome	A non-experimental study suggests a positive outcome	An experimental or quasi-experiment suggests a positive outcome	A systematic review suggests a positive outcome
Sources <i>What is the most credible source?</i>	A peer-reviewed journal or conference publication without conflict of interest disclosure suggests a positive outcome	A publication by a nonprofit or government organization suggests a positive outcome	A peer-reviewed journal or conference publication with conflict of interest disclosure suggests a positive outcome	A publication by a public health authority suggests a positive outcome
Evidence from Research <i>Relevance to controlled settings?</i>	A small amount of evidence from research suggests positive outcomes	A moderate amount of evidence from research suggests positive outcomes	A large amount of evidence from research suggests positive outcomes	A very large amount of evidence from research suggests positive outcomes
Evidence from Translation and Practice <i>Relevance to real world?</i>	A small amount of evidence from translation and practice suggests positive outcomes	A moderate amount of evidence from translation and practice suggests positive outcomes	A large amount of evidence from translation and practice suggests positive outcomes	A very large amount of evidence from translation and practice suggests positive outcomes

Note: if none of its requirements are met, a criterion is assigned a score of 0 points, ●●●●

Evidence Summary Template

Policy Intervention

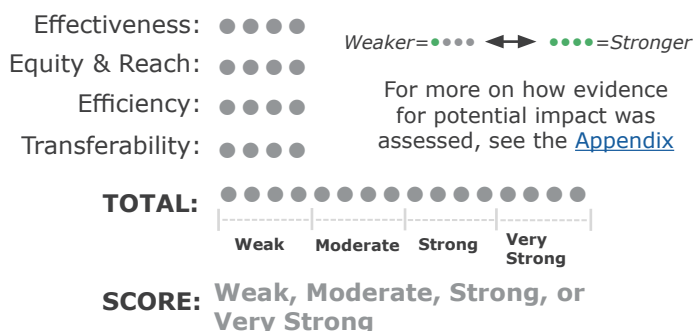
Evidence Level: This field provides this type of intervention’s evidence level which can be used to inform its priority in policymaking. Evidence level can be “best”, “promising (quality)”, “promising (impact)”, or “emerging.”

A brief definition of the PAD intervention including (when applicable) specific elements is included under the type of PAD intervention.

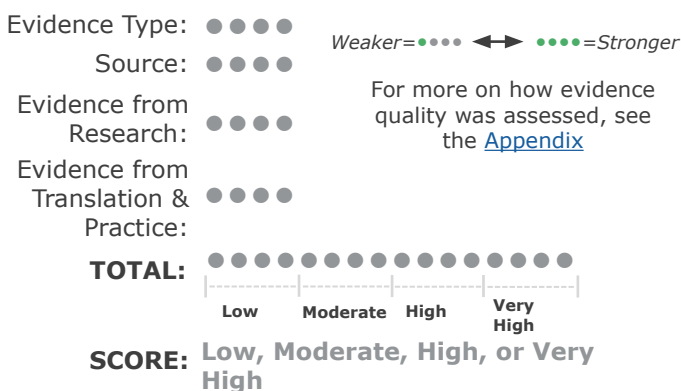
Example of state law addressing this type of intervention

This field provides an example of a state law that typifies this type of PAD intervention. In addition to an abbreviated description of the content of the law, the entry includes a legal citation.

Evidence for Potential Public Health Impact:



Evidence Quality:



Reported health-related outcomes

This field lists positive health-related outcomes associated with PAD interventions from the included studies. Note that in most studies, positive outcomes were not directly linked with specific PAD interventions.

Groups studied

This field reports the groups for which intervention studies found positive health-related outcomes.

Feasibility and related economic highlights

This field reports any positive feasibility findings and related economic outcomes of the interventions studied such as cost-effectiveness, cost savings, and improvement in quality of care.

States where programs achieved positive health-related outcomes

This field provides a list of states in which the studies finding positive health-related outcomes were set, or absence of information on state setting is noted. For example, if a PAD intervention was found to improve health in Seattle, Washington, “Washington” would be listed here.

References

Here you will find the references supporting the description of the policy intervention.

Evidence Base on Potential Public Health Impact

Research-based studies

Here you will find the studies including this policy intervention that took place in a research context, in which researchers were able to allocate subjects into the intervention and the control groups.

Practice-based studies

Here you will find the studies of this policy intervention that took place under real-world circumstances. In these studies, evaluators were not able to allocate subjects into the intervention and the control groups.

Narratives and commentaries

Here you will find the evidence that provides recommendations for this policy intervention from subject matter experts and practitioners.