



# Do-It-Yourself Devices for Training CPR in Laypeople: A Scoping Review

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## ABSTRACT

**Background:** Layperson cardiopulmonary resuscitation (CPR) is an important skill with the potential to save millions of lives. However, CPR courses often require commercial, complicated, and expensive manikins. To increase access to CPR training worldwide at very low costs, Do-It-Yourself (DIY) devices may be a suitable tool for practising compressions.

**Objective:** This scoping review is the first step in scoping and mapping the evidence on the effectiveness of DIY devices for laypersons learning adult CPR, along with defining gaps for future research.

**Method:** This inquiry was structured by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines. A systematic search of 14 academic databases and popular media archives, with additional hand searches, identified academic reports and resources describing DIY

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compression device construction and/or implementation. Research studies were synthesized narratively, and the main characteristics of all resources were presented in a table.

**Results:** Fifteen studies compared learning outcomes of CPR practice either pre-post DIY practice or between DIY and commercial manikins. Studies varied in the intervention (e.g., learning modality, time, manikin) and measurement, which precluded formal meta-analysis. Of the 55 different DIY devices described throughout all resources, 26 (47.3%) used plastic bottles for compression practice. Analysis of the resources revealed gaps in the current evidence base, such as a lack of clear assessment criteria, standardized procedures for comparisons, and sociocultural questions.

**Conclusion:** This scoping review has identified a small number of studies which described different DIY devices for learning basic CPR skills to different extents. While there is a need for a more comprehensive search and full systematic review, the findings serve as a starting point for future investigations and support evidence-based choices regarding DIY manikins for teaching adult CPR.

**Keywords:** Training; Cardiopulmonary Resuscitation; CPR; Manikin; Handmade; Do-it-Yourself; First Aid Education

## ABSTRAITE

**Introduction:** La réanimation cardiopulmonaire (RCP) est une compétence vitale qui peut sauver des vies, mais son apprentissage peut être entravé par le coût et la complexité des équipements commerciaux. Pour rendre la formation de la RCP plus accessible à travers le monde, des appareils fait à main (DIY) pourraient représenter une solution abordable et pratique.

**Objectif:** Cette revue évalue l'efficacité des appareils DIY pour la formation de RCP pour non-spécialistes, et identifie les manques de recherche.

**Méthode:** Nous avons suivi les directives de PRISMA-ScR pour structurer notre recherche. Une analyse approfondie de 14 bases de données académiques et d'archives médiatiques a permis d'identifier des ressources décrivant la construction et l'utilisation d'appareils DIY pour pratiquer la RCP. Les résultats ont été synthétisés de manière narrative et les caractéristiques principales des dispositifs ont été présentées dans un tableau.

**Résultats:** Nous avons identifié 15 études comparant les résultats d'apprentissage de la RCP avant et après l'utilisation de dispositifs DIY, ainsi que par rapport aux mannequins commerciaux. Les appareils DIY variaient largement, par exemple 26 sur 55 utilisaient des bouteilles en plastique pour la pratique des compressions. Notre analyse a révélé des lacunes dans les critères d'évaluation, dans les procédures standardisées, ainsi que des questions socioculturelles non résolues.

**Conclusion:** Malgré le nombre limité d'études disponibles, notre revue souligne le potentiel des dispositifs DIY pour l'apprentissage de la RCP. Des recherches supplémentaires sont nécessaires pour combler les lacunes identifiées, mais ces premières conclusions ouvrent la voie à des choix éclairés dans l'utilisation de mannequins DIY pour enseigner la RCP aux non-spécialistes.

**Mots-clés:** Formation; Education; Réanimation Cardiopulmonaire; RCP; Mannequin; Fait à main; DIY; Bricolage; Formation de Premiers Secours

## ABSTRACT

**الخلفية:** يعد الإنعاش القلبي الرئوي من قبل العامة مهارة مهمة لها القدرة على إنقاذ ملايين الحيوانات. ومع ذلك، فغالبًا ما تتطلب دورات الإنعاش القلبي الرئوي دمي تجارية ومعقدة وباهظة الثمن. ولزيادة الوصول إلى التدريب على الإنعاش القلبي الرئوي في جميع أنحاء العالم بتكاليف منخفضة للغاية، فقد تكون أجهزة "افعلها بنفسك" أداة مناسبة لممارسة الضغوطات.

**الهدف:** يعد هذا المرجع واسع النطاق هو الخطوة الأولى في تحديد ورسم الدليل حول فعالية أجهزة "افعلها بنفسك" للعامة الذين يتعلمون الإنعاش القلبي الرئوي للمصابين البالغين، إلى جانب تحديد الثغرات للبحث المستقبلي.

**الطريقة:** تم تنظيم هذا المرجع بولسطة عناصر ارشادية مفضلة للمراجع المنهجية والتحليلات الوصفية للمراجع النطاقية (PRISMA-ScR). فمن خلال عمل بحث منهجي لعدد 14 قاعدة بيانات أكاديمية وأرشيفات إعلامية عامة، بالإضافة الي البحث اليدوي، فقد تم تحديد التقارير الأكاديمية والمصادر التي تصف إنشاء جهاز ضغط "افعلها بنفسك" و/أو تنفيذه. وتم تجميع الدراسات البحثية بطريقة سردية، وتم عرض الخصائص الرئيسية لجميع الموارد من خلال جدول.

**النتائج:** تمت مقارنة مخرجات التعلم لأداء الإنعاش القلبي الرئوي من خلال خمسة عشرة دراسة إما قبل وبعد الأداء باستخدام جهاز "افعلها بنفسك" أو بين جهاز "افعلها بنفسك" والدمي التجارية. لقد تنوعت الدراسات من حيث التدخل (على سبيل المثال، طريقة التعلم، والوقت، والدمي) والقياس والذي تضمن التحليل الوصفي الرسمي. فمن بين 55 جهازًا مختلفًا تم وصفه في جميع المصادر، تم استخدام 26 (47.3%) زجاجات بلاستيكية لممارسة الضغوطات. وقد كشف تحليل المصادر عن ثغرات في الدليل الحالي مثل عدم وجود معايير تقييم واضحة، وإجراءات موحدة للمقارنات، والتساؤلات الاجتماعية والثقافية.

**الاستنتاج:** هذا المرجع النطاقي حدد عددًا صغيرًا من الدراسات التي وصفت أجهزة "افعلها بنفسك" المختلفة لتعلم مهارات الإنعاش القلبي الرئوي الأساسية بدرجات مختلفة. في حين أن هناك حاجة لإجراء بحث أكثر شمولاً ومراجعة منهجية كاملة، فإن النتائج تكون بمثابة نقطة انطلاق للتحوصات المستقبلية ودعم الخيارات القائمة على الأدلة فيما يتعلق بأشكال الدمى "افعلها بنفسك" لتعليم الإنعاش القلبي الرئوي للبالغين.

**الكلمات المفتاحية:** التدريب، الإنعاش القلبي الرئوي، الدمى، صناعة يدوية، افعلها بنفسك، تعليم الإسعافات الأولية

For people in cardiac arrest, Cardiopulmonary Resuscitation (CPR) is vital for sustaining blood circulation while awaiting advanced care. CPR competencies encompass affective (stress management), cognitive (assessment of hazard and cardiac arrest signs), and psychomotor (chest compressions, rescue breaths) skills (Greif et al., 2020; International Federation of Red Cross Red Crescent Societies, 2020; Olasveengen et al., 2020). Laypersons' CPR training develops and enhances their competencies, confidence, and willingness to act in an emergency. Chest compression-only CPR (i.e., no ventilation) further simplifies training to boost bystander response rates (Bhanji et al., 2015; Schroeder et al., 2023; SOS-KANTO study group, 2007). CPR education usually comes from recognized providers (e.g., Red Cross/Red Crescent, military service, workplace, and schools) and is promoted through a system of policy and requirements for healthcare personnel as well as lay people (i.e., people who are not trained health care workers, Birkun et al., 2021).

Commercial, in-person CPR training is often costly and time-intensive, impacting accessibility (Cariou & Pelaccia, 2017; Iil Dwi Lactona, 2021; Potts & Lynch, 2006). Disparity also exists between high and low-income regions due to resource availability. Statistics suggest that roughly twice as many people in high-income countries receive CPR training compared to low-income countries (Birkun et al., 2021). Additionally, the COVID-19 pandemic highlighted the limitations of in-person training, including access and personal safety. The current system's weaknesses affect the equitable distribution of CPR education (Blewer et al., 2017).

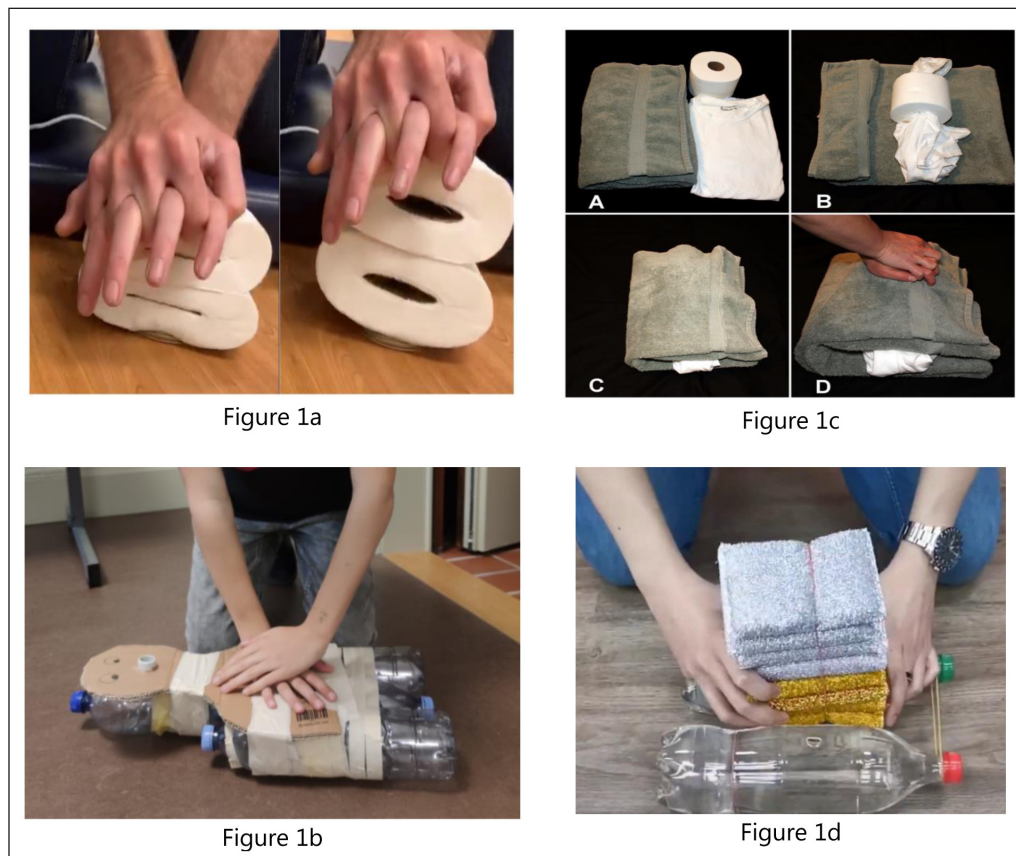
While instructor-led training is recommended, the European Resuscitation Council's guidelines for CPR suggest that self-instruction with hands-on practice is an effective alternative (Bhanji et al., 2015). In recent years, alternative strategies to acquire basic CPR skills have included shortened courses (Beskind et al., 2016; Nas et al., 2020; Ohle, Moskalyk, Boissonneault, Bilgasesm, et al.,

2021), the use of peer educators (Beck et al., 2015; Reder et al., 2006), or remote learning via online instruction, recorded classes, or virtual reality (VR) (Lin et al., 2021; Nas et al., 2020). Extending CPR education outside of required and commercial courses benefits public health by increasing people's awareness, willingness to learn CPR, and CPR competencies. To increase the scope of alternative training methods and to address the issue of commercial manikin availability, low-cost manikins (e.g., inflatable manikins or cardboard kit sets) have been developed and shown to achieve learning and retention of compression motor skills (Jones et al., 2007; Laerdal, n.d.; Roppolo et al., 2007). Grass-roots movements extended this idea and developed a wide variety of Do-It-Yourself (DIY) compression devices, made of inexpensive or reused materials available in the home; the oldest dating back to the early 1960s (Hainfeld, 1966). For examples of DIY compression devices, see [Figure 1](#).

To inform the potential adoption of this idea in practice and to define a trajectory for future research, a clear overview of the current evidence base on DIY compression devices is needed. Therefore, this review aims to describe technical elements that are currently used in DIY devices, narratively present the findings of current research, identify researchable gaps in the evidence base, and provide considerations for future development and implementation. This scoping review is the first step toward describing and building a clearer evidence base for this topic in the future.

## METHOD

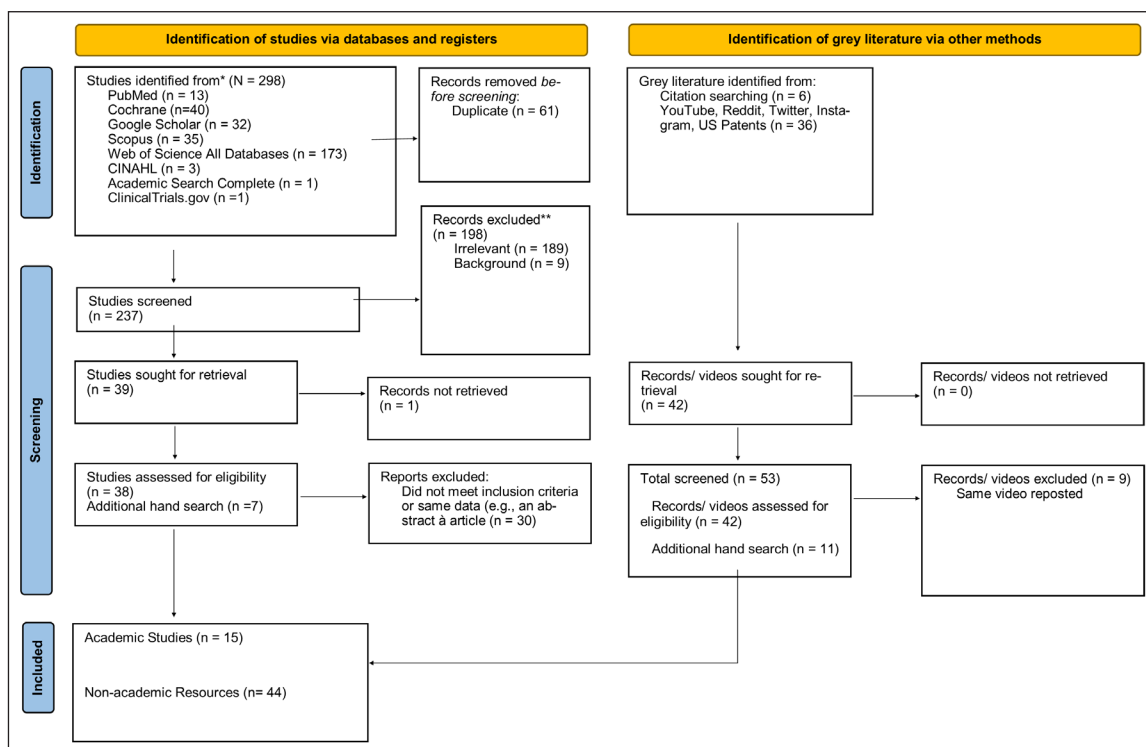
This scoping review followed the recommended Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) framework



**Figure 1:** Examples of DIY devices. From top left: a) Ohle et al. (2021) compression tool; b) Szpilman (2019) manikin construction; c) Wanner et al. (2016) compression tool; d) Singapore Heart Foundation (2020) DIY CPR trainer.

(Tricco et al., 2018). The protocols for the review were not previously published. Eligibility criteria, established through consensus amongst the research team, were laypersons receiving adult CPR training and using DIY compression devices. We included peer-reviewed evidence and additional publicly available resources including abstracts, opinion pieces, and instructional videos to better capture the scope of available information, with no date limit. All databases searched used English terms, see [Supplementary file](#). Scoping reviews, infant/neonatal CPR education, and resources above the lay responder level were excluded from the analysis. Search strings, developed with a reference librarian, were used in PubMed, Web of Science, CINAHL, VIRGO Articles, Academic Search Complete, LILACS, Europe PMC, [ClinicalTrials.gov](#), and Google Scholar to diversify the search (Haddaway et. al., 2015). Grey literature searches covered Google, Google Images, YouTube, Reddit, Twitter, and Instagram. After establishing

selection criteria through an iterative process (i.e., adapting selection criteria and re-running the selection after initial review) academic and grey literature resources were screened using Rayyan (Ouzzani et al., 2016). To increase consistency amongst reviewers and to norm the process, all reviewers screened the first 15 publications and discussed the results. Reviewers subsequently evaluated the titles and abstracts independently, with a minimum of two reviewers per item, and a discussion was conducted in cases of selection disagreement. A total of 298 articles and 42 other resources (i.e., grey literature) were initially identified, with 14 more identified through hand searches. After screening, 17 peer-reviewed studies (two of which were secondary reports of an already-charted study) and 42 other resources met the inclusion criteria (see [Figure 2](#)). Three researchers independently charted the 59 sources based on the media type, peer review status, inquiry type, inclusion of building instructions, and physical components of the DIY device.



**Figure 2:** PRISMA 2020 Flow Diagram for New Systematic Reviews Which Included Searches of Databases, Registers, and Other Sources.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: [10.1136/bmj.n71](https://doi.org/10.1136/bmj.n71). For more information, visit: <http://www.prisma-statement.org/>.

## RESULTS

**Table 1** presents the charted information on the identified resources. We first summarize the scope of current research on the effectiveness of DIY compression devices, before describing the grey literature resources in terms of the physical characteristics of the portrayed DIY devices.

## Summary of Scientific Evidence

Out of the 15 studies, three implemented the use of a humanoid-like compression tool (i.e., with a head and torso), three constructed a torso only, and seven used devices that did not have a clearly defined torso or head as illustrated in **Figure 1**. Two additional studies were

Author/Organization	Country & Resource setting	Media Type	Peer Reviewed	Type of Inquiry	Instruction for Building	Compression Device	Container	Filling
Bonizzio et al. (2019)	Brazil HRS	Academic	P	Observational	Y	PET Bottle	Clothing	Non-fabric
Brush up on EMS (2020)	USA LRS	Video	–	Opinion	Y	Pillow and PET Bottle	Clothing	Fabric
Brush up on EMS (2020)	USA LRS	Video	–	Opinion	Y	Pillow and PET Bottle	Clothing	Fabric
Burckes (1985)	USA LRS	Popular	–	Opinion	Y	Pillow	Clothing	Fabric
Chau et al. (2019)	China LRS	Academic-Augmentation	P	Opinion	Y	–	–	–
Disque foundation (2019)	USA HRS	Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Djadaningrat et al. (2016)	Netherlands HRS	Academic-Augmentation	P	Project description	N	–	–	–
Don't buy it, I can make that (2013)	USA LRS	Popular	–	Opinion	Y	Plunger	–	–
Drajer (2011)	Argentina LRS	Academic	P	Opinion	Y	Spring	Non-clothing	Non-fabric
Eric Paredes Foundation (2023)	USA HRS	Popular	–	Opinion	Y	Toilet Paper Roll	Non-clothing	Fabric
Goldstein et al. (2018)	USA LRS	Academic	P	Experimental	N	Pillow	–	–
Goldstein et al. (2019)	USA LRS	Academic	P	Experimental	N	Pillow	–	–
Gozuen, et. al., (2020)	Brazil LRS	Academic	P	Observational	Y	PET Bottle	Clothing	Non-fabric
Grand Junction Fire Dept (2022)	USA HRS	Video	–	Opinion	Y	PET Bottle	Clothing	Fabric
Grupo Salvando Vidas (2022)	Mexico	Video	–	Opinion	Y	Jerry can	–	–

(Contd.)



Author/Organization	Country & Resource setting	Media Type	Peer Reviewed	Type of Inquiry	Instruction for Building	Compression Device	Container	Filling
Health & Safety Solutions (2020)	United Arab Emirates	Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Ihenz (2022)	Philippines LRS	Video	–	Opinion	Y	Jerry can	Clothing	–
Lambooy & Donohue (2015)	USA LRS	Academic-Augmentation	P	Opinion	N	–	–	–
Lausa (2021)	Philippines LRS	Video	–	Opinion	Y	Pillow	Clothing	Fabric
Lavoie (2021)		Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Life Saving Victoria (n.d.)	Australia HRS	Popular	–	Opinion	Y	PET Bottle	Clothing	Fabric
Marrodán (2022)	Spain HRS	Video	–	Opinion	Y	Jerry can	Clothing	Non-fabric
Masut (2015)	Argentina LRS	Video	–	Opinion	Y	Rolled-up foam mat	–	–
Masut (2013)	Argentina LRS	Video	–	Opinion	Y	Rolled-up foam mat	–	–
McGinnis (2000)	USA HRS	Popular	–	Opinion	Y	PET Bottle	Non-clothing	Non-fabric
Montalban (2021)	Philippines LRS	Video	–	Opinion	Y	Foam	Non-clothing	Fabric
Nakagawa (2021)	Brazil LRS	Academic	P	Experimental	N	PET Bottle	Non-clothing	Non-fabric
Nas et al. (2020)	Netherlands HRS	Academic-Augmentation	P	Experimental	N	Pillow	–	–
Nas et al. (2021)	Netherlands HRS	Academic-Augmentation	P	Experimental	N	Pillow	–	–
Noko O (2021)	USA LRS	Video	–	Opinion	Y	PET Bottle	Clothing	Fabric
Nolan (2020)	USA LRS	Video	–	Opinion	Y	Toilet Paper Roll	Clothing	Fabric
Ohle, Moskalyk, Boissonneault, Simmons, et. al., (2021)	Canada HRS	Academic	–	Opinion	Y	Toilet Paper Roll	–	–
Ohle, Moskalyk, Boissonneault, Bilgasem, et. al., (2021)	Canada LRS	Academic	P	Experimental	Y	Toilet Paper Roll	–	–

(Contd.)

Author/Organization	Country & Resource setting	Media Type	Peer Reviewed	Type of Inquiry	Instruction for Building	Compression Device	Container	Filling
Parent Heart Watch (2023)	USA LRS	Popular	–	Opinion	Y	Toilet Paper Roll	–	–
Pevida (2022)	Philippines LRS	Video	–	Opinion	Y	Foam	Clothing	Fabric
Pillow CPR (n.d.)	USA HRS	Video	–	Opinion	Y	Pillow	–	–
Piscopo, Piscopo, Fonseca, et al. (2018a) [Duplicate report-Piscopo, Piscopo, Avezum, et. all., (2018)]	Brazil LRS	Academic	?	Experimental	N	PET Bottle	Clothing	Non-fabric
Piscopo, Piscopo, Fonseca, et al. (2018b)	Brazil LRS	Academic	?	Experimental	N	PET Bottle	Clothing	Non-fabric
Piscopo, Piscopo, de Oliveira, et al., (2018)	Brazil LRS	Academic	?	Experimental	N	PET Bottle	Clothing	Non-fabric
Rice (1985)	USA HRS	Popular	–	Opinion	Y	Foam and Balloon	Non-clothing	Non-fabric
Russell (2020)	USA HRS	Video	–	Opinion	Y	Blanket in a cardboard box	Clothing	Fabric
Shafiq (2022)	United Kingdom LRS	Academic	P	Opinion	Y	Pillow	Non-clothing	Fabric
Simple Kits (2022)	Philippines LRS	Video	–	Opinion	Y	Jerry can	Clothing	–
Singapore Heart Foundation (2020)	Singapore HRS	Video	–	Opinion	Y	Toilet Paper Roll	Non-clothing	–
Sociedade de Cardiologia do Estado de SP (2015)	Brazil LRS	Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
South Western Ambulance (2020)	United Kingdom HRS	Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Spokane Parks & Recreation (2020)	USA LRS	Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Supa (2021)	Philippines LRS	Video	–	Opinion	Y	Pillow	Clothing	–
Szpilman et al. (2019)	Brazil LRS	Video	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Tanaka et al. (2017)	Singapore LRS	Academic	P	Experimental	N	Foam	–	–

(Contd.)



Author/Organization	Country & Resource setting	Media Type	Peer Reviewed	Type of Inquiry	Instruction for Building	Compression Device	Container	Filling
Unknown (n.d.)	Sweden HRS	Popular	–	Opinion	Y	PET Bottle	Clothing	Fabric
Van Raemdonck et al. (2014) [duplicate report- Van Raemdonck, et al. (2010)]	Belgium LRS	Academic	P	Experimental	N	Foam	–	–
Wanner, Berray, & Osborne. (2016)	USA HRS	Video	–	Opinion	Y	Toilet Paper Roll	Non-clothing	Fabric
Wanner Osborne, & Greene (2016)	USA HRS	Academic	P	Observational	Y	Toilet Paper Roll	Non-clothing	Fabric
Whitehead (2021)	Canada HRS	Video	–	Opinion	Y	PET Bottle	Clothing	Fabric
Wijaya, et. al. (2023)	Indonesia HRS	Academic	P	Experimental	Y	Pillow	–	–
YMCA Aquatics (2023)	USA HRS	Popular-Augmentation	–	Opinion	Y	–	–	–
Youth Heart Watch Philadelphia (2020)	USA LRS	Popular	–	Opinion	Y	PET Bottle	Clothing	Non-fabric
Ypil (2021)	Philippines LRS	Video	–	Opinion	Y	Foam	Clothing	Fabric

**Table 1** Initial Categorization of Sources.

Abbreviations: HRS- High Resource Setting; LRS- Low Resource Setting.

augmentations for existing compression devices. Nakagawa et al. (2021) compared the educational outcomes of CPR training with a commercial manikin (Szpilman et al., 2019) against those of a shortened training course with a DIY manikin within school communities in Brazil ( $n = 1,977$ ). They observed that overall CPR skills were learned to a similar extent in both groups; however, assessing the victim's responsiveness and calling for help were better learned during the extended education course. In a series of conference abstracts and an unpublished manuscript, Piscopo and colleagues described the use of a low-fidelity manikin made by school-age children who stuffed a T-shirt with a PET bottle and filler materials (Piscopo, Piscopo, Avezum, et al., 2018; Piscopo, Piscopo, de Oliveira, et al., 2018; Piscopo, Piscopo, Fonseca, et al., 2018b). In comparison with a commercial manikin, learners performed similarly post-CPR education, except for a

trend towards a higher “variable depth compression” (sic) in the DIY manikin group ( $p = .077$ ) (Piscopo, Piscopo, Avezum, et al., 2018). A larger study did not detect this difference (Piscopo, Piscopo, Fonseca, et al., 2018b). In an unpublished study, Piscopo, Piscopo, de Oliveira et al. (2018) found a DIY-trained group to be non-inferior in all parameters except correct hand placement. Using the same DIY model to train university students, Gozuen et al. (2020) found that CPR knowledge was improved a month post-intervention. Bonizzio et al. (2019) modified the same manikin design by filling PET bottles with 70% water. Participants' knowledge of CPR behaviors and willingness to act significantly improved in that study.

Ohle, Moskalyk, Boissonneault, Simmons, et. al. (2021) designed a CPR compression trainer using two toilet paper rolls that were stacked on top of a mason jar lid to provide feedback (i.e., a clicking sound when correct compression

depth was achieved). This device was compared to a commercial manikin with feedback in a non-inferiority study. The difference in mean overall CPR score was below the non-inferiority margin. Wanner, Osborne, & Greene (2016) used a CPR tool built from a towel wrapped around a toilet paper roll through which a T-shirt is threaded. CPR education with a video and the DIY device led to an increase in compression rate among untrained laypeople. Trained and untrained people claimed a significant increase in comfort when performing chest compressions. The untrained group also significantly increased their willingness to perform chest compressions.

Van Raemdonck, Monsieurs, et al. (2014) described the efficacy of low-cost training strategies using foam dice and plastic bags compared to a commercial manikin, combined with different pedagogies. Six months post-training, no differences between intervention groups in CPR performance were observed. Tanaka et al. (2017) compared untrained laypersons' chest compressions on the Push Heart training model (a heart-shaped foam pad) against the Little Anne manikin. Although fewer participants achieved the recommended depth on the Little Anne, participants preferred it because it was more life-like. Wijaya et al. (2023) found that training on a similar product, a "CPR pillow", improved CPR performance and Goldstein et al. (2019) used a pillowcase printed with chest landmarks for hand position and found that willingness to perform CPR increased significantly, and that compression depth was not negatively affected by replacing a manikin with a pillow (Goldstein et al., 2018). However, Nas et al. (2020) compared a VR educational intervention that included practice on a pillow and a traditional 20-minute instructor-led intervention using a commercial manikin. The VR group was non-inferior in compression rate but inferior in depth. A separate analysis of the same study (Nas et al., 2021) using updated rate and depth showed better compliance with chest compression depth in the VR group. See [Table 2](#) for more details on the scientific studies.

## Methodological limitations of scientific studies

Heterogeneity among the studies limits any strong generalization of the findings, as do several methodological limitations. Many studies assumed that their participants

were starting with equal and low skill levels and did not include any pre-tests (Nakagawa et al., 2021; Ohle, Moskalyk, Boissonneault, Bilgasem, et al., 2021; Piscopo, Piscopo, Avezum, et al., 2018; Piscopo, Piscopo, de Oliveira, et al., 2018; Piscopo, Piscopo, Fonseca, et al., 2018b; Van Raemdonck et al., 2014). The only way to detect a permanent change in skill level is the assessment after a delay – however, only two studies included a delayed retention test for skills or attitude (Gozuen et al., 2020; Van Raemdonck et al., 2014). Some studies relied only on a pre-post comparison without including a control group (Bonizzio et al., 2019; Goldstein et al., 2019; Piscopo, Piscopo, de Oliveira, et al., 2018), increasing the risk of false positives.

Further limitations included the comparison of two intervention groups that were not controlled for demographic variables (e.g., Wanner Osborne, & Greene, 2016) and the use of different intervention protocols between the groups (e.g., Nakagawa, 2021). Non-inferiority studies rely on arbitrary margins, which need to be described clearly in the context of the existing literature (Piscopo, Piscopo, de Oliveira, et al., 2018). Furthermore, many studies assessed skills via outputs from high-fidelity manikin software, for which the underlying calculations are unclear, and which are not validated to our knowledge. In several studies, selection bias was noted concerning participant recruitment, leading to a sample that is not representative of the larger population, see Bonizzio et al. (2019) and Gozuen et al. (2020) as examples. None of the studies assessed rescue breath skills.

## Instruction Tutorials for Building DIY Devices

We categorized 55 DIY compression devices used in 59 academic and grey literature resources based on their construction features (excluding four resources that only presented augmentations, see [Table 1](#)). The compression element of the manikin, which is responsible for the necessary stiffness and recoil was most commonly a PET bottle/jerry can ( $n = 26$ ). These bottles varied in size from fuel containers (20 l) to soda bottles (1–1.5 l) taped together for a compression surface, while keeping their caps on to allow for recoil. Materials could generally be acquired in regular home or school settings.

Author (Year), Funding source (if any)	Design	Participants	Intervention	Main outcome measures	Key Findings
<b>Bonizzio et al.</b> (2019)	Pre-post comparison	Remote Community Total n = 96 <ul style="list-style-type: none"> <li>Lay people n = 69</li> <li>Health professionals n = 17</li> <li>Health students n = 10</li> </ul>	CPR instruction session during three 1.5h periods of the same day, using a DIY manikin (PET bottle inside a T-shirt)  (No control)	Pre- and post-practice CPR-related knowledge  Based on: Quiz with MC and open questions	Improvement in overall knowledge (mean pre: 62.7%, mean post: 75.8%, $p < 0.01$ ). Especially in the concepts related to correct technique.  The concepts of “identifying an emergency” and “role of chest compression” showed no statistically significant difference in learning.  The control group had a significantly higher compression rate, exceeding recommendations. No significant difference between compression depth (both groups below the guidelines) or overall CPR competency.
<b>Goldstein et al.</b> (2018)	Randomized trial	University Students Total n = 242 <ul style="list-style-type: none"> <li>Pillow n = 119</li> <li>Manikin n = 123</li> </ul>	2-min training intervention with video demonstration and practice-while-watching, using a pillow  Control: same video, using a manikin torso.	Post-training performance: Compression rate and depth  Based on: manikin software (Q CPR).	Knowledge of compression depth increased by 47%; knowledge of rate increased by 52%.  Significant improvements in all attitude measures (improvements by 20–45%).
<b>Goldstein et al.</b> (2019)	Pre-post comparison	University Students Total n = 360	Training intervention with demonstration and practice on a pillow  (No control)	Pre- and post-training: CPR knowledge, willingness to perform CPR, confidence in ability, and likelihood to practice in the next year.  Based on: multiple-choice questions, five-point Likert scale questions.	Knowledge of compression depth increased by 47%; knowledge of rate increased by 52%.  Significant improvements in all attitude measures (improvements by 20–45%).
<b>Gozuen et al.</b> (2020)	Pre-post comparison	University Students Total n = 44	CPR instruction session using a DIY manikin (PET bottle inside a T-shirt)  (No control)	Pre- and post-training knowledge of cardiac arrest & CPR  Based on: Questionnaire	Knowledge of cardiac arrest and CPR increased in a 30-day post-intervention survey.  Knowledge of CPR skills was higher, but general knowledge of cardiac arrest did not achieve the same growth.

(Contd.)

Author (Year), Funding source (if any)	Design	Participants	Intervention	Main outcome measures	Key Findings
<b>Nakagawa (2021)</b> <b>Funders:</b> Fundacao de Amparo a Pesquisa do Estado de Sao Paulo, Programa Aprender na Comunidade	Prospective Cohort Study	People in school communities with no prior CPR training. Total n = 1977 • Intervention group n = 1'630, note: age M = 16 y • Control group n = 347, age M = 27 y	Intervention group: 40-minute program using a DIY manikin (Szpilman model). Control group: 120- minute program using Laerdal Little Anne.	Post-training performance: COSB behaviors, compression effectiveness (hand placement, depth, rate, release). Based on: Instructor ratings (Yes or No)	Both programs were effective at improving overall CPR knowledge, skills, and attitudes for ≥89% of school communities. Results were independent of gender, but age played a role in compression depth outcomes (lower depth in young children). The success rate of both programs increased as the age advanced.
<b>Nas, et al. (2020)</b> <b>Funders:</b> Zoll, Samsung, Laerdal Medical, Zeiss	Randomized controlled non-inferiority trial	Adult attendees at a music festival, randomized. Total n = 381 • VR training app group: n = 190 • Control group: n = 191	VR group: 20minute intervention using a Virtual Reality (VR) smartphone app. with practice on a pillow Control group: 20-minute face-to-face training with the instructor, and practice on Laerdal Little Anne	Post-training performance: Rate, depth, and total number of compressions, hand position, hands-off time. Based on: manikin software (Q CPR).	The group that used VR performed worse regarding chest compression depth but was non-inferior in terms of compression rate. Median CPR performance, average chest compression depth within guidelines, and fraction were all significantly higher in the control group.
<b>Nas, et al. (2021)</b> <b>Funders:</b> Zoll, Samsung, Laerdal Medical, Zeiss	Randomized controlled non-inferiority trial- Post Hoc Analysis	Adult attendees at a music festival, randomized. Total n = 381 • VR training app group: n = 190 • Control group: n = 191	VR group: 20minute intervention using a Virtual Reality (VR) smartphone app. with practice on a pillow Control group: 20-minute face-to-face training with the instructor, and practice on Laerdal Little Anne	Post-training performance: Rate, depth, and total number of compressions, hand position, hands-off time. Based on: manikin software (Q CPR).	VR training, although previously found inferior to face-to-face, may lead to CPR compliance with recently proposed quality criteria.

(Contd.)

Author (Year), Funding source (if any)	Design	Participants	Intervention	Main outcome measures	Key Findings
<b>Ohle, Moskalyk, Boissonneault, Bilgasem, et al., (2021)</b> <b>Funder:</b> Northern Ontario Academic Medicine Association	Randomized controlled trial	Visitors to a science center age M = 26.4 y, randomized. Total n = 125 • DIY group n = 64 • Commercial manikin group n = 61	DIY group: 10-minute practice session (including one-on-one demonstration), using a toilet paper trainer with a jar lid. Control group: the same training using a Laerdal Mini Anne trainer.	Post-training overall CPR score, willingness to perform CPR on a stranger and a family member. Based on: manikin software (Q CPR), questionnaire.	Overall CPR scores were 2% lower in the DIY group, which was classed as non-inferior. Similar proportions of participants achieved an adequate compression rate. Adequate depth was reached more often after practice with the DIY tool but alongside lower rates of adequate recoil. Willingness to perform CPR on a stranger was higher in the DIY group, but there was no difference in willingness to perform CPR on a family member.
<b>Piscopo, Piscopo, Fonseca et al. (2018a)</b> <i>[Duplicate report of Piscopo, Avezum, et al. (2018)]</i>	Randomized controlled trial	High School students, age M = 14 y, randomized Total n = 88 • DIY group: n = 48 • Control group: n = 40	DIY group: 60-minute training with instruction, using a plastic bottle manikin. Control group: the same training using a Laerdal Little Anne trainer.	Post-training performance: Rate, depth, and total number of compressions, hand position, hands-off time. Based on: Blinded instructor ratings and manikin software (Q CPR).	The variability in depth of compression was significantly higher in the DIY group, but no significant group effect on compression depth or any other variables.
<b>Piscopo, Piscopo, Fonseca et al. (2018b)</b>	Randomized trial	Students and teachers from invited schools, randomized Total n = 544 No further detail on group allocation	Intervention group: instruction via video and a 20-min mass training intervention, using a DIY manikin (PET bottle in a T-shirt). Control group: the same intervention using a Laerdal Little Anne manikin.	Post-training performance: hand position, rate, depth, number of compressions, and hands-off time Based on unclear, the assumption is Q CPR	No significant differences between the two groups for any variables.

(Contd.)

Author (Year), Funding source (if any)	Design	Participants	Intervention	Main outcome measures	Key Findings
<b>Piscopo, de Oliveira, et al.</b> (2018)	Randomized controlled noninferiority trial	Students at public schools, over 12 years old, randomized Total n = 1324 • DIY group: n = 667 • Control group: n = 666	DIY group: 40-minute training intervention with instructions and using recyclable PET-bottle manikin. Control group: the same training using Laerdal Mini Anne.	Post-practice QPCR scores Based on: manikin software (QPCR).	No significant difference between the two groups after training. Participants showed the same effectiveness in the “step-by-step” and similar quality of chest compressions.
<b>Tanaka et al.</b> (2017)	Prospective crossover study	Laypeople attending a CPR course, randomized Total n = 42 Groups crossed over; thus within-subject comparisons were made.	Intervention group: continuous chest compression practice for 2 minutes using a “Push Heart” (i.e., a foam block) Control group: continuous chest compression practice for 2 minutes using a Laerdal Little Anne manikin.	Within-subject comparisons: Compression depth, rate (using blinded CPR cards). Preference and rating of preparedness (via survey).	The average compression depth and percentage of people who reached adequate depth were significantly higher when performing compressions on the commercial manikin. Participants reported being well-prepared with either model, median score of 8/10 on the commercial manikin compared to 7/10 on the DIY, which was significantly different. The majority of participants, especially the elderly, had difficulty achieving adequate depth.
<b>Van Raemdonck, Monsieure, et al.</b> (2014) <i>[Duplicate report of Van Raemdonck, V, Monsieure, K. G., &amp; De Martelaer, K. (2010)]</i>	Randomized controlled trial	School children (15–16 years), randomized Total n = 593 • CPR manikin + video instruction (n = 146) • Foam dice + teacher instruction (n = 155) • Foam dice + video instruction (n = 149) • Control group: CPR manikin + teacher instruction (n = 143)	50- min learning course standardized in duration, hands-on time (6 min), and pupil-manikin or pupil-dice ratio (4: 1) The course differed between 4 groups in compression tool used (DIY foam dice vs. commercial manikin) and instruction method (video vs. teacher instruction).	Post-practice performance and 6-month retention: compression depth, rate, quartiles of compressions with correct hand position, correct compressions and mean ventilation volume. Based on: manikin software (QPCR).	No significant differences in long-term learning outcomes based on equipment. The use of alternative equipment resulted in small differences in short-term learning outcomes in compression quality, depth, and hand position, but these differences disappeared after 6 months. After 6 months, a quarter of all participants retained the correct compression depth.
<b>Funder:</b> Research Fund of Erasmus University College Brussels					(Contd.)



Author (Year), Funding source (if any)	Design	Participants	Intervention	Main outcome measures	Key Findings
<b>Wanner et al.</b> (2016) <b>Funders:</b> AMA Foundation Seed Grant Research Program, Laerdal Medical	Parallel-design study	Volunteers Total n = 24 • Never-trained n = 12 • Certified n = 12	6-minute training video and practice with DIY tool (T-shirt threaded through a toilet roll, wrapped in a towel). (No control)	Pre-post comparison Compression rate, depth, and recoil Based on: Sensor-equipped CPR manikin (“Skill-reporter”), corroborated by ratings from 2 blinded experts.	Untrained group: Significant improvements in compression rate, hand position, recoil, and hands-off time. Certified group: Adequate compression rates before and after training, significant improvements in the percentage of compressions with the correct release, hands-off time, and time to first compression. Compression depth remained inadequate (<50 mm) in both groups.
<b>Wijaya et al.</b> (2023) <b>Funder:</b> Poltekkes Kemenkes Palembang	Pre-post comparison	BLS trained volunteers Total n = 40	The intervention included practice with a CPR Pillow, but the duration and instructions were unclear. (No control)	Pre-post comparison Performance-based on CPR Operational Procedure checklist. Likert scale-type expert assessment of CPR Pillow: design, thickness, instructions, and whether it enables compressions.	Significant improvement in CPR skills. The expert assessment found the design, thickness, instructions, and promotion of compressions as “good” (i.e., best possible rating)

**Table 2:** Characteristics and Outcomes of Experimental Studies.

Abbreviations: n- Number, CPR-Cardiopulmonary Resuscitation, DIY- Do-It-Yourself, PET- Polyethylene Terephthalate, MC-Multichoice, COSB-Chain of Survival Behaviors, M-Mean, VR-Virtual Reality, QCPR-Quality-CPR (a type of feedback software).

Of the 45 non-academic resources, 60% used clothing as a container for the compression element to represent a human chest. The cavity around the compression device was filled with other clothing, plastic bags, and Styrofoam pieces. Head apparatus options included balloons, cardboard, inflatable balls, and stuffed animals often lodged in the hood of a sweatshirt (or hoodie). The remainder of the compression devices were wrapped in towels, placed in boxes, or were not covered (e.g., pillows or foam blocks).

Nine non-academic DIY models didn't have a human form (i.e., simply the compression device), 15 had just a torso, 18 had a head and torso represented, and three included arms, legs, and head. Outside of compression skill practice, seven contributions addressed the skill of ventilation.

## Quality of the Grey Literature

The academic quality of the grey literature was very low, as the resources came from popular media, often representing opinions without reference to any standard or set of criteria. Several contributions gained face validity by being associated with health organizations by their creators, but only a few appeared to be endorsed by the organization (Disque Foundation, 2019; Eric Paredes Foundation, 2023; Grand Junction Fire Department, 2022; Singapore Heart Foundation, 2020). Most of the identified resources provided information on how to build the manikin but reporting generally lacked information on volume or dimensions. Many of the instructional videos included further explanations of how to practice CPR.

## DISCUSSION

We sought to describe the educational and practical attributes of DIY manikins, from 15 studies of varying quality comparing the outcomes of compressions by learners using DIY devices. These studies were heterogeneous regarding physical design, recording devices, and educational intervention (time, content, etc., see [Table 2](#)). The total 15 studies investigated a range of factors, including skill components such as compression

rate, recoil, compression depth, hand placement and hands-off time, as well as readiness or willingness to act, confidence, knowledge and preferences. The studies investigated different target groups, for example, children in Van Raemdonck De Martelaer, & Aerenhouts' study (2014), adults in Ohle, Moskalyk, Boissonneault, Bilgasem, et al. (2021) and Wanner Osborne, & Greene (2016), and two unmatched groups of different ages in Nakagawa (2021). Aside from comparing skills, other aspects of first aid performance were assessed in some studies, such as hands-off time, calling for help, and assessing the victim's responsiveness (Gozen et al., 2020; Wanner, Osborne, & Greene, 2016). These are likely affected by aspects of educational interventions, and not directly linked to manikin type. A further variable investigated in several studies was the willingness to perform CPR on a stranger or family member. Three controlled intervention studies each reported on outcomes for groups trained with DIY compared to commercial manikins (Ohle, Moskalyk, Boissonneault, Bilgasem, et al., 2021; Tanaka et al., 2017; Wanner, Osborne, & Greene, 2016). Further research is needed before any specific recommendations can be made.

CPR training should address specific socioeconomic, racial, and ethnic populations who have historically exhibited lower rates of layperson CPR (Merchant et al., 2020). Virtual CPR courses without hands-on practice do not adequately promote compression skills (Van Raemdonck et al., 2017). DIY manikins may provide a valuable tool to complement video-based or other virtual instruction by allowing practice (Wanner et al., 2016). The existing studies and grey literature presented in the present review show a concerted effort to address barriers to traditional CPR education. In the future, the quality of such need-inspired interventions may be improved by the availability of online resources and evidence-based guidelines.

## Recommendations for Research

The present review shows clearly that the evidence base for using DIY compression tools is not sufficient to provide any strong conclusions. The following section maps out research priorities that address this current paucity of evidence.

## Research to Establish Benchmarks for DIY Devices

Based on the variety of measurement types, variables, and learning outcomes targeted in the existing studies on DIY devices, we realized that for future research to be consistent, we need to establish a common set of outcomes, outcome measures, and measurement tools. Based on agreed-upon measures, we would anticipate agreement on adequate measurement tools. Extremely precise measurements may not be necessary for studies that focus on other aspects of CPR education, such as readiness to act. All research should be informed by its related field (e.g., public health-survival, medicine-neurological impairment, sociology-motivation to help, education- health awareness).

## Research to Compare Manikins

We advocate for DIY device research to follow a Population, Intervention, Comparison, and Outcome (PICO) approach. Firstly, educational interventions should be clearly described in terms of duration, pedagogical approaches, and which CPR skills or behaviors are targeted. Second, intervention studies need to be rigorous and controlled, include pre-tests and ideally be randomized

(e.g., if the goal of a study is to compare the effect of using DIY and commercial manikins, the didactic approach needs to be identical across intervention groups). Third, we recommend that anterior-posterior diameter, the force needed to compress the manikin by a certain depth, and the durability be reported. For potential comparisons and outcome measures in future studies, see [Table 3](#).

## Research on the Design of Manikins

With no industry standards for the design of CPR manikins, future designs may be based on emerging evidence. Organizations such as the American Red Cross specify required standards in terms of compression depth, lung volume, and feedback (American Red Cross, 2006) but do not specify required resistance or stiffness. Basic research on the attributes of the human body that affect the ideal provision of CPR needs to be conducted and used as a basis for design purposes.

## Research in the Public Health Domain

The more people worldwide who can perform early CPR, the higher the survival rate and neurological outcomes of out-of-hospital-cardiac-arrest victims (Geri et al., 2017).

Study focus	Outcomes Useful for Recommendations
Between various DIY devices <ul style="list-style-type: none"> <li>• DIY compression tool and DIY manikin (anthropomorphized)</li> <li>• DIY device and the augmentation of the device</li> </ul>	<ul style="list-style-type: none"> <li>• Time to construct</li> <li>• Cost to construct</li> <li>• Durability of manikin (personal one-time use, class use, multiple learners)</li> <li>• Overall CPR knowledge (immediate &amp; retention)</li> <li>• Specific skill performance (immediate &amp; retention)</li> <li>• Intention to help in an emergency; Intention to perform CPR (immediate &amp; retention)</li> </ul>
Between or within various populations <ul style="list-style-type: none"> <li>• By age/developmental level</li> <li>• CPR educational level</li> <li>• Various occupations</li> </ul>	
Pedagogical interventions <ul style="list-style-type: none"> <li>• Self-directed (asynchronous/virtual) and facilitated use of a device</li> <li>• Time on skill practice</li> <li>• DIY devices with and without passive or active feedback</li> </ul>	
Implementation of a CPR training program with DIY devices	<ul style="list-style-type: none"> <li>• Financial costs, per learner</li> <li>• Time costs, per learner or organization</li> <li>• Health outcomes</li> <li>• Population acceptance</li> </ul>

**Table 3:** Research Opportunities with DIY Devices for CPR Education.

A DIY device may provide better access to CPR education for people with barriers related to disability, cultural or linguistic factors, geographical location, or economic factors, as well as school-age children. Although various populations used or could use DIY devices, there is no population-based evidence. Qualitative research methods may provide insight into factors that determine expected learning outcomes in a population of interest, and how awareness and empowerment may best be achieved in each community, while quantitative research may describe the effects at the population level. Ethically, it is also important to initiate a discussion on whether the promotion of a DIY device for specific target groups might result in alienation.

### Research in the Field of CPR Practice

Skill acquisition research may focus on aspects of the learning environment that generally help or hinder successful learning and transfer to real-life contexts. Neither DIY nor commercial devices can likely meet all of a learner's needs (Van Raemdonck et al., 2014). We encourage research directed toward a fuller understanding of factors that motivate and facilitate CPR competencies in all laypeople (Pellegrino & Asselin, 2020) with the introduction of DIY devices.

### Research methodology: consideration and reporting of manikin design

This scoping review emphasizes the critical role of DIY manikin design features in understanding study outcomes. To enable appropriate interpretation of the findings and to facilitate informed decision-making by stakeholders, researchers must describe and justify the design of the DIY manikin utilized in their investigations, taking into account the learning objectives and target demographic of the intervention. The following considerations might be a useful tool in this process:

**Physical Characteristics:** If exact compression skills are an intended learning outcome, it is important to practice on a manikin with realistic stiffness and recoil ability for many repetitions. The exact requirements are not known, but Nysaether et al., (2008) reported that 500 N of force

is needed to compress a human chest. Designs that use heavier materials such as plungers, springs, or high-quality foam could be more durable for extended use than lightweight PET bottles or toilet paper rolls (Wanner Osborne, & Greene, 2016). Wanner Osborne, & Greene's (2016) device was modeled on the force needed (35.5 kg) to compress the CPR Anytime kit (AHA, Dallas, TX). This same force compressed their device to 46.6 mm. Mimicking the dampening effect of a human chest may be achieved by placing a pillow under the compression device. These factors are less important when the goal is simply to introduce a learner to the skill – indeed, for children or those with limited body mass, a DIY device that is easily compressed may even increase motivation.

**Shape:** The psychological fidelity of a simulation (i.e., the degree to which a simulation replicates the perceptual-cognitive demands of the real task (Gray, 2019) influences the effectiveness of a learning intervention (Harris et al., 2020). If a DIY compression device presents as non-humanoid (e.g., made from a towel folded into a square), it is much more difficult to link the device to a human chest, as the two do not look alike. Children especially may struggle to make analogical connections between concepts, as they have a lower ability for abstraction (Gentner & Hoyos, 2017). Similarly, the imitation of a human head and neck would also be advised, especially if the intended skills include airway opening and ventilation. Some suggestions found in the grey literature include using clothes pins for pinching the nose (Ypil, 2021) or plastic bags to represent a lung (Grupo Salvando Vidas, 2022; Masut, 2015). Furthermore, the option to modify or individualize a DIY device with gender or cultural characteristics might improve learning and retention (Moghimi et al., 2016).

**Materials:** Environmental sustainability can also be addressed when implementing DIY devices: most of the resources advocate for repurposing previously used materials. A wide range of materials allows flexibility between regions while reducing economic barriers. The most expensive option included a smartphone app which may not be accessible in lower-income communities.

**Building Process:** The time and complexity of constructing a device needs to be appropriate to the learner. Most of the DIY devices required fewer than four

steps to build. To introduce CPR in a large group such as a school, an easy-to-build model may be preferred. The process of building the device may also lead to a better understanding of CPR physiology. For example, Barcala et al. (personal communications, 2023) had children build a device during science class, where they concurrently learned about blood flow and the brain.

**Inclusion of Ventilation:** A clear bias exists in the literature toward compression-only CPR; however, ventilation remains a valuable skill to address in developing a resuscitation system. DIY designs for ventilation practice should allow for ventilation up to 700–1000 ml of air in adult CPR manikins (American Red Cross, 2006) and offer the opportunity to practice manual airway opening maneuvers, see Szpilman (2019), Grupo Salvando Vidas (2022), or Masut (2013, 2015) as examples.

**Provision of Feedback:** The International Liaison Committee on Resuscitation included a weak recommendation for feedback on compression rate, depth, and hand position during CPR training (Greif et al., 2020). DIY design options for feedback include a jar lid that clicks (Ohle, Moskalyk, Boissonneault, Bilgasem, et al., 2021) and a tapping device (Masut, 2015). Augmentations for DIY devices, such as smartphone apps, may provide visual or auditory feedback (Chau et al., 2019; Lamboy & Donohue, 2015).

**Gender Presentation:** Racial, ethnic, and gender-related disparities exist in those who receive layperson CPR (Ok Ahn et al., 2023) and CPR education (Greif et al., 2020). A low-cost hack to simulate female breasts is a bisected foam football that can be placed inside a bra to promote comfort and skill (YMCA Aquatics, 2023). An interactive mat printed with a life-sized female figure may also reduce the stress of demonstrating skills on an actual female (Djajadiningrat et al., 2016). Further research is required to test augmentative tools in combination with DIY devices.

**Augmentations:** Several resources described low-cost augmentations that might further increase the effectiveness of compression devices. Arif et al. (2021) used a mobile app in combination with a pillow to practice compressions. Lamboy and Donohue (2015) showed that practice with a mobile app connected to a manikin provided a fuller

CPR experience than without the app. Chau et al. (2019) reported that a wearable device for the wrist that collects objective feedback on compression depth and rate allows learners to share feedback with a trainer at a distance. Studies in which participants compressed a pillow while following a scenario in VR found that although the compression depth was inferior, the compression rate was non-inferior to that of manikin-trained learners (Nas et al., 2020). Combined with further development on DIY device efficacy, technology could render CPR education more accessible.

## Limitations

Despite a systematic approach through academic and grey literature searches, several resources were identified outside databases, such as non-English resources or conference presentations, so others may still not be identified here. Additionally, we acknowledge that a (subconsciously) ‘Western’ perspective may be pervasive in the statement of the problem, search terms, and writing. The issues linked with access to relevant first-aid skills across different cultures are not well understood and may be better addressed with other solutions. Furthermore, the search strings used could not include all possible terms in all languages that might present a similar idea. To address this, we used MeSH headings in PubMed, but we recognize that there still may have been more possible terms (e.g., adding the terms ‘basic life support’ and ‘training device(s)’ may have yielded more findings). Resources were not excluded based on publication status, as the COVID-19 pandemic caused recent attention to this research topic, leading to many grey literature resources.

## CONCLUSION

This scoping review of the academic and grey literature on DIY compression devices has identified a small number of studies describing different DIY devices for learning basic CPR skills to different extents. There is a need for a more comprehensive search and full systematic review to make statements on their effectiveness. The findings serve as a starting point for future investigations and support



evidence-based choices regarding DIY manikins for teaching adult CPR.

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## COMPETING INTERESTS

JP is an editor for IJFAE and was removed from all editorial discussions relating to the processing of this paper.

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