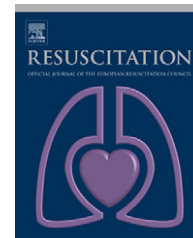




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TRAINING AND EDUCATIONAL PAPER

# Self-training in the use of automated external defibrillators: The same results for less money<sup>☆</sup>

Wiebe de Vries<sup>a,\*</sup>, Mark Schelvis<sup>b</sup>,  
Ingrid Rustemeijer<sup>c</sup>, Joost J.L.M. Bierens<sup>d</sup>

<sup>a</sup> Department of Education and Development, Doczero, Rondweg 29, NL-5406 NK Uden, The Netherlands

<sup>b</sup> Department of Nursing, Kennemer Gasthuis, Haarlem, The Netherlands

<sup>c</sup> Department of Education, Kennemer Gasthuis, Haarlem, The Netherlands

<sup>d</sup> Department of Anaesthesiology, VU University Medical Center, Amsterdam, The Netherlands

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## KEYWORDS

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defibrillator;  
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## Summary

**Purpose:** To compare the educational benefits and cost-effectiveness of initial AED training for nurses, already trained in basic life support, by a 3-h, instructor-based course, with self-training by means of an instructional poster, a resuscitation manikin, and a training AED.

**Methods:** Thirty general ward nurses from a single regional hospital were randomly allocated to one of two groups for training in the use of an AED. Fifteen nurses were trained by a certified instructor and 15 nurses participated in self-training using a poster, manikin, and training AED. Each nurse was assessed on 17 aspects of performance between 13 and 16 days after training.

**Results:** The two groups were comparable for gender, seniority, and experience in resuscitation. No significant differences in performance were found between the groups for 14 of the skills tested. For three skills, there were statistical differences, but these were not considered to be of clinical relevance. If poster self-training were to be used instead of instructor-based courses, it was calculated that there would be a saving in costs of up to €47 for each nurse trained.

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## Introduction

There is growing evidence that the early use of an automated external defibrillator (AED) saves lives following cardiac arrest,<sup>1–5</sup> and an increasing number of first responders and healthcare professionals are being trained in their use.<sup>6–9</sup> AED training courses in Europe last, on average, around 2 h 45 min,<sup>10</sup> mostly with a ratio of 1 instructor to 6 participants.<sup>10–12</sup> With such a potentially large number of people to train, it is important not only to identify the most effective method, but to consider the cost implications.


<sup>☆</sup> A Spanish translated version of the summary of this article appears as Appendix in the final online version at ...


\* Corresponding author at: Warande 69-A, 2404 HS Alphen aan den Rijn, The Netherlands. Tel.: +31 172 495 283; fax: +31 172 479 099.

E-mail addresses: [vriesw@xs4all.nl](mailto:vriesw@xs4all.nl), [vries@doczero.nl](mailto:vries@doczero.nl) (W. de Vries).

# Train jezelf!

## Neem je verantwoordelijkheid: *blijf bekwaam!*






**Aanspreken en voorzichtig schudden**

Reageert? → JA → Ga na of het slachtoffer verder niets mankeert

NEE → Maak de luchtweg vrij



**Controleer of het slachtoffer ademt**


Kijk, voel, luister normale ademhaling? → JA → Indien mogelijk: leg het slachtoffer in de stabiele zijligging. Alarmeren

NEE → Bent u alleen? → JA → Bel 777. Haal de AED. Beadem 2x → NEE → Laat iemand 777 bellen en de AED halen. Laat 2x beademen

**✓Check jezelf**

- ✓ We hebben een werkplek gemaakt.
- ✓ We hebben beoordeeld of het veilig was.
- ✓ Ik heb door praten en schudden "niet bij bewustzijn" vastgesteld.
- ✓ Ik heb de ademhaling gecontroleerd door te kijken, te voelen en te luisteren.
- ✓ Ik heb gestarmd (of laten doen).
- ✓ Ik heb de AED gehaald (of laten doen)
- ✓ Ik heb twee effectieve beademingen gegeven (maximaal 5 pogingen).
- ✓ Ik blies genoeg lucht in (700-1000 ml).

**Druk dan op F3**



**✓Check jezelf**

- ✓ Ik heb door controleren van circulatie gekoken of reanimatie/AED noodzakelijk is.
- ✓ Ik heb de AED aangezet.
- ✓ Ik heb de plakkers op de juiste plaats geplakt.
- ✓ Ik heb geroepen wat opvalt en positie plakker.
- ✓ Ik heb F3 op de afstandsbediening ingedrukt.


**Controleer de halslagader**


Zonder twijfel pulsaties te voelen? → JA → Ga door met beademen. Controleer iedere minuut ademhaling en circulatie

NEE → U bent alleen: Zet AED aan → U bent met iemand die kan reanimeren: Laat reanimatie uitvoeren! Zet AED aan

Volg de aanwijzingen van de AED

Bevestig elektroden





**AED gaat analyseren:** Houd iedereen op afstand!

Shock aanbevolen → Geen shock aanbevolen

Houd iedereen op afstand → Controleer de halslagader. Zonder twijfel pulsaties te voelen? → JA → Controleer ademhaling → U bent alleen: Start reanimatie → U bent met iemand: Laat reanimeren

→ Ga door tot AED zegt te stoppen → Laat doorgaan tot AED zegt te stoppen

**✓Check jezelf**

- ✓ Ik heb op de veiligheid gelet en een duidelijke handbeweging gemaakt.
- ✓ Ik heb – op aanwijzing AED – de halslagader gecontroleerd.
- ✓ We zijn gestart met reanimeren toen er geen pulsaties waren of ik twijfelde.
- ✓ Ik had mijn handen op de juiste plaats.
- ✓ Ik masseerde in de juiste frequentie (toe/minuut).
- ✓ Ik masseerde diep genoeg (4-5 cm).
- ✓ Ik wisselde masseren en beademen juist af (5:5).
- ✓ Ik blies genoeg lucht in (700-1000 ml).
- ✓ Ik heb op de veiligheid gelet en een duidelijke handbeweging gemaakt.
- ✓ Ik heb 'toe' geroepen.
- ✓ Ik heb – op aanwijzing AED – de knop 'shock' gedrukt.

**Doen**

Reanimatie geleidende → Beoordeel slachtoffer en alarmer → Volgens richtlijnen basale reanimatie → Basale reanimatie zolang AED niet aangesloten is → Zet AED aan → Bevestig elektroden → Volg gesproken instructie → Analyseer → Shock → Indien geen pulsaties of twijfel, basale reanimatie gedurende 3 minuten → 1 minuut indien na debrillatie


**Extra uitrusting**

Bij harige borstkas waarop elektroden niet zouden kleven: Plakks weer elektroden komen scheren

Bij natte of bezwete borstkas: Droog de borstkas (bijv. met een washandje of mouw)

Bij gebruik van maskertje: Zorg dat u getraind bent → Zorg dat het maskertje goed afsluit

Bij vastzittende kleding: Kleding loskoppelen



**Storingen**

| Betekent | Doen                                      |
|----------|---|
|          | Accu begint ragen te raken → Vervang accu |
|          | Technisch probleem → Bel leverancier      |

Het apparaat "zegt": "Beweging waargenomen, stop beweging"

Tijdens de analyse fase neemt de AED beweging waar aan het slachtoffer

- of iedereen voldoende afstand heeft
- of het slachtoffer niet tel maal ademt
- of het slachtoffer op een vlakke ondergrond ligt
- Haal de borstak weg.

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Kenemer Gasthuis

Figure 1 The poster used for self training. Train yourself! Take your responsibility: stay competent!

This study set out to compare the educational benefits and cost-effectiveness of initial AED training for nurses, already trained in basic life support, by a 3-h instructor-based course with self-training by means of an instructional poster, a resuscitation manikin, and a training AED.

We hypothesised that there would be no difference in AED skills competence between the instructional groups, in which case the poster-based training would be more cost-effective.

## Materials and methods

The study took place at an 852-bedded regional hospital in the west of The Netherlands employing 743 nurses. Following a decision to provide AEDs in every clinical department, all nurses in the hospital needed to be trained in their use. This training was incorporated into the annual BLS refresher training that is compulsory for all nurses.

Thirty general ward nurses were invited to take part in the study, 3–8 months after their last refresher BLS course and one month before AEDs were available in the hospital. They were randomly allocated to one of the two groups. Fifteen nurses were trained, in a ratio of four to six nurses to one certified instructor, during a 3-h basic AED course that followed the guidelines and organizational standards of the European Resuscitation Council (ERC).<sup>10,13,12</sup> The other group of 15 nurses were invited to take part in individual self-training. For this, three training rooms in the hospital were equipped with an AED training device, a manikin, and a wall poster. This poster was a revised version of that used in previous refresher training studies with police officers (Figure 1).<sup>14</sup>

The training facilities in the three rooms were available 24 h a day for 10 consecutive days, including one weekend. The nurses had to sign in to book times for their training sessions. Subsequent inspection confirmed which nurses had attended training, and for how long.

Assessment was carried out between 13 and 16 days after instructor-based or poster training by two experienced resuscitation officers who did not know the nurses and had not taken part in their training. They were, however, aware of which training method had been used. A score sheet with 17 items on a 7-point VAS scale was used (Table 2).<sup>15,16</sup> The assessors familiarised themselves with the scoring method by prior practice with a specially prepared video of resuscitation scenarios. The nurses' AED skills were tested by means of a simulated, single-shock scenario using an AMBU Man C manikin with the CPR Software Kit 2.3 (AMBU AS,

Ballerup, Denmark) and a Lifepak 500 trainer (Medtronic PhysioControl Corp., Redmond, USA). Each nurse's performance was assessed by both resuscitation officers. If they failed to agree on any point, consensus was reached by discussion.

## Statistics

Differences in the scores were analysed on ordinal level. Afterwards the results were dichotomised to competent or not competent.

For items 1–6, 9 and 10 (Table 2), 1 represents the poorest performance and 7 represents the best. Nurses were considered to be competent in these items when they scored >5.5. For items 7 and 8, 11–17 the best scores were in the middle of the range, and competency was therefore set at 2.5–5.5.

Kruskal Wallice was used to analyse data. All statistics were performed in SPSS® 12.0.1 for Windows (SPSS Inc. Chicago, USA). Time intervals were expressed as medians (range). Significance was accepted when a two-sided *p*-value was <0.05, or when the confidence intervals did not include unity.

To assess the relevance of possible differences, the 95% confidence interval (CI) was calculated. Data within the limits of the 95% CI were considered as non-relevant difference between each group.

Costs were based on actual costs. Prices in Euros were provided by the national distributors of the materials. Costs of the instructors and salaries of the nurses were provided by the hospital administration. All calculations were performed in Microsoft® Office Excel 2003 (Microsoft Corporation, Redmond, USA).

## Results

The two groups were comparable for female:male and nurse:nurse-manager ratios (Table 1). In each group, four nurses had been involved in a resuscitation attempt in the hospital within the previous 4 years; none had been involved in a resuscitation attempt out of hospital. Members of the poster self-training group had, on average, fewer years of working experience (10 years versus 14 years). However, this difference is well within the 95% confidence interval (8.71;16.06), and is probably not relevant.

Table 2 shows the results of the assessments made by the resuscitation officers. For 14 of the 17 items assessed,

Table 1 Composition of the groups

|  | Instructor-based training<br>(Group A, <i>n</i> = 15) | Poster self-training<br>(Group B, <i>n</i> = 15) | 95% CI       |
|--|---|--|--------------|
| Female:Male  | 13:2  | 13:2   |              |
| Nurse:Nurse-manager  | 13:2  | 13:2   |              |
| Age (average)  | 36.1 (min. 16, max. 52)                               | 34.9 (min. 20, max. 53)                          | 31.03; 39.29 |
| Years of experience (average)  | 14.6 (min. 3, max. 34)                                | 10.8 (min. 2, max. 28)                           | 8.71; 16.06  |
| Number of nurses involved in a resuscitation attempt during the last 4 years | 4   | 4  |              |

no significant differences were found in the ordinal scores between the two groups. Statistically significant differences were found in 'creating workspace', 'checking for signs of a circulation', and 'the spatial position of the AED in relation to the victim'.

For 'creating workspace' the instructor-based group scored a mean of 6.73 (6;7) compared with 7.00 (7;7) for the poster self-training group. Both scores were above the minimum for competency and the 95% CI was 6.73;7.00. The differences were, therefore, not considered clinically relevant.

For 'check for signs of a circulation' the instructor-based group scored a mean of 3.87 (1;5) compared with

4.86 (2;6) for the poster self-training group. Both scores were within the range for competency (between 2.5 and 5.5) and 95% CI was 3.83;4.86. Thus, the differences were statistically significant, but not considered clinically relevant.

For 'position of the AED' the instructor-based group scored a mean of 4.53 (2;5) compared with 5.13 (5;7) for the poster self-training group. However, 95% CI was 4.51;5.15. Thus, the differences between the groups were statistically significant but both scores were within the range for competency and therefore the difference was not considered clinically relevant.

**Table 2** Differences in 17 items on ordinal level of AED skills between poster self-training and instructor-based training

|    |                                    | Chi-Square | p           | Percentage of nurses that performed correct after training by an instructor (Mean score) | Percentage of nurses that performed correct after poster self training (Mean score) |
|----|------------------------------------|------------|-------------|--|---|
| 1  | Safety                             | 3.222      | .072        | 100 (6.8)  | 100 (7.0)   |
| 2  | Creating workspace*                | 4.461      | <b>.034</b> | 100 (6.7)  | 100 (7.0)   |
| 3  | Shake and shout                    | .492       | .482        | 100 (6.9)  | 93 (6.3)  |
| 4  | Check breathing                    | .672       | .412        | 73 (5.6)   | 67 (4.4)  |
| 5  | Raising an alarm                   | .673       | .411        | 80 (6.4)   | 87 (6.3)  |
| 6  | Initial rescue breaths             | 1.111      | .291        | 87 (6.7)   | 80 (5.6)  |
| 7  | Check for signs of a circulation** | 4.559      | <b>.032</b> | 80 (3.9)   | 87 (4.9)  |
| 8  | AED-position*                      | 4.003      | <b>.045</b> | 93 (4.5)   | 93 (5.1)  |
| 9  | Electrodes position                | 1.392      | .238        | 87 (6.8)   | 87 (6.6)  |
| 10 | Clear during analyse               | 3.402      | .065        | 100 (6.9)  | 93 (6.6)  |

Table 2 (Continued)

|    |                                   |       |       |              |              |
|----|-----------------------------------|-------|-------|--------------|--------------|
| 11 | Clear during shock                | 1.111 | .291  | 100<br>(5.0) | 100<br>(4.8) |
| 12 | Delivering shock                  | 1.000 | .317  | 100<br>(5.0) | 100<br>(4.9) |
| 13 | Reassess for circulation          | .002  | .960  | 100<br>(4.9) | 100<br>(4.9) |
| 14 | Position hands during compression | .000  | 1.000 | 100<br>(4.9) | 100<br>(4.9) |
| 15 | Compression depth                 | 1.000 | .317  | 100<br>(5.0) | 93<br>(5.0)  |
| 16 | Compression frequency             | 3.214 | .072  | 100<br>(5.0) | 100<br>(5.0) |
| 17 | Ratio compression : ventilation   | .000  | 1.000 | 100<br>(4.0) | 100<br>(4.0) |

\*Significant difference between the mean score of the two groups on this item; however both groups had the same percentage of providers that met the set minimum for competency. \*\*Significant difference between the mean score of the two groups on this item; both groups had a different percentage of providers that met the set minimum for competency.

### Cost-effectiveness

To calculate the cost-effectiveness, it was assumed that manikins and AED training devices could be used for training 500 students, and in this period no additional costs, such as replacement of broken or stolen devices, would be incurred. The AED training devices were calculated to depreciate at a rate of €10 per course, based on a cost of €550 each. Seventy Euro-cents were allowed per student for the replacement of training electrodes. The depreciation of the manikins, replacement of disposable lungs and faces, and the use of disinfectants, were calculated to be €19.20 per training session, based on a ratio of 1 instructor to 6 stu-

dents. Course materials (locally produced manuals) were calculated at €18 per training session. As a single poster was used in the poster self-training room, this was considered to be of negligible cost.

Calculation of the costs of the training methods showed that poster self-training was €8 per nurse cheaper than instructor-based training (Table 3). Extrapolating this to all 743 nurses in the hospital where the study took place, poster self-training would be 5,944 Euro cheaper than traditional instructor-based training. If the nurses undertook self-training in their off-duty time, or without any increase in their paid working hours, there would be a saving of €47 per nurse, giving an overall saving of €34,921.

Table 3 Calculation of costs per nurse

| Issue   | Price (€)      | Frequency of use | Costs per student (€) |          |
|---|----------------|------------------|-----------------------|----------|
|   |                |                  | Method A              | Method B |
| Manikin   | 1350.00        | 500              | 2.70                  | 2.70     |
| Disposables (lungs, airway, etc.)               | 0.50           | 1                | 0.50                  | 0.50     |
| Training devices                                | 550.00         | 500              | 1.10                  | 1.10     |
| Training electrodes                             | 35.00          | 1/48 students    | 0.70                  | 0.70     |
| Manual  | 3.00           | 1/student        | 3.00                  | 3.00     |
| Instructor's fee                                | 16.00          | 3 h/6 students   | 8.00                  |          |
| Assessors' fee                                  | per hour       | 15 min/student   | 4.00                  | 4.00     |
| Total per student                               |                |                  | 20.00                 | 12.00    |
| Nurses salaried working hours spent in training | 13.00 per hour | 3 h/student      | 39,00                 |          |
| Total per student                               |                |                  | 59.00                 | 12.00    |

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## Discussion

This study demonstrates that AED poster self-training for ward nurses is as effective as a course under the supervision of a certified instructor. Fourteen of the 17 items assessed were performed to a similar standard in each training group. For the remaining three items there were statistically significant differences between the training groups, but none of these differences was, however, considered clinically relevant. It should also be noted that two of the items (creating workspace and AED positioning), though part of AED training, are not core elements of the ERC guidelines.<sup>17</sup> The third item (checking for signs of a circulation) is considered an additional skill for experienced healthcare providers.<sup>17</sup>

When comparing the relative merits of the two training methods, another aspect to consider is motivation. With a self-training system, nurses have to decide for themselves when they carry out their training. They have to be convinced of the necessity of mastering BLS and AED skills as a part of their professional competency, and they have to be motivated to make time to attend the training room.

Costs for AED training differ in different countries. The calculations in this paper are based on figures from the Netherlands. The main savings for poster self-training come from not having to pay instructors' fees, and from nurses training themselves in their own (unpaid) time, or when not actively employed on other duties whilst at work. Whether 'free time' could be found for nurses during normal ward working hours is not certain.

## Limitations

Each group was small in number, but the nurses were randomly selected and assigned to one or other of the training groups.

The assessors did not know the nurses they were testing, nor had they been involved in their training. They were, however, aware of the training method used because of the block allocation to a training group. The objective scoring method should have minimised any bias.

Ideally, the assessments should all have taken place the same number of days after training. Due to the nurses' working schedules, however, a range of 13–16 days had to be accepted.

Long-term retention testing was not carried out.

## Conclusions

The objective of this study was to compare poster self-training in the use of an AED with instructor-based training, in terms of efficacy and cost-effectiveness. Assessment of the skills acquired showed little difference between the two training methods. Poster self-training, however, was calculated to be significantly more cost-effective. We suggest that consideration should be given to this method for training nurses, already competent in basic life support, in the use of an AED.

## Conflict of interest

No author has a conflict of interest in regard to the AED devices or manikins mentioned in this manuscript.

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