Public Access Defibrillation: Time to Access the Public

Patrick Schober, MD, PhD, Frederieke B. van Dehn, MD, Joost J. L. M. Bierens, MD, PhD, Stephan A. Loer, MD, PhD, Lothar A. Schwarte, MD, PhD

From the Department of Anesthesiology, VU University Medical Center, Amsterdam, the Netherlands.

Study objective: Public accessible automated external defibrillators (AEDs) are increasingly made available in highly frequented places, allowing coincidental bystanders to defibrillate with minimal delay if necessary. Although the public, as the largest and most readily available group of potential rescuers, is assigned a key role in this concept of "public" access defibrillation, it is unknown whether bystanders are actually sufficiently prepared. We therefore investigate knowledge and attitudes toward AEDs among the public.

Methods: Standardized interviews were conducted at the Central Railway Station of Amsterdam, the Netherlands, a highly frequented and AED-equipped public place with a high number of travelers and visitors from all over the world.

Results: Surveys from 1,018 participants from a total of 38 nations were analyzed, revealing a considerable lack of knowledge among the public. Less than half of participants (47%) would be willing to use an AED, and more than half (53%) were unable to recognize an AED. Overall, only a minority of individuals have sufficient knowledge and would be willing to use an AED. Differences between subgroups were identified, which may aid to tailor public information campaigns to specific target audiences.

Conclusion: Only a minority of individuals demonstrate sufficient knowledge and willingness to operate an AED, suggesting that the public is not yet sufficiently prepared for the role it is destined for. Wide-scale public information campaigns are an important next step to exploit the lifesaving potential of public access defibrillation. [Ann Emerg Med. 2011;58:240-247.]

Please see page 241 for the Editor's Capsule Summary of this article.

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SEE EDITORIAL, P. 248.

INTRODUCTION

Background

Sudden cardiac death is a leading cause of mortality in North America and Europe.[1,2] The initial underlying rhythms are most often ventricular tachyarrhythmias,[3-5] requiring electrical defibrillation to restore coordinated activity of the heart. Even short delays in defibrillation significantly deteriorate outcome because the odds of survival decrease by 7% to 10% per minute.[6-8] To enable early out-of-hospital defibrillation, automated external defibrillators (AEDs) are increasingly made available for public use in highly frequented places.[9] AEDs not only allow undelayed defibrillation but also often provide audible instructions for cardiopulmonary resuscitation by voice prompts and may therefore also provide benefit in patients with a nondefibrillatable heart rhythm.

Importance

Undelayed defibrillation ideally requires coincidental bystanders, ie, the public, to make immediate use of an AED when required without having to await arrival of trained personnel. Although the public is the key player in this concept of "public" access defibrillation, little is known about whether the public is sufficiently prepared to fulfill its role.

Goals of This Investigation

We aimed to investigate knowledge and attitudes toward AEDs among the largest and most readily available group of potential rescuers in public access defibrillation, ie, the public itself.

MATERIALS AND METHODS

Study Design

The study was designed as a cross-sectional survey held at the Central Railway Station of Amsterdam, the Netherlands. Public knowledge about AEDs was addressed multifactorially, including the individual's ability to recognize an AED and his or her awareness of public access defibrillation programs and knowledge about defibrillation in general. Because answering questions about defibrillation could bias subsequent

Editor's Capsule Summary

What is already known on this topic

Automated external defibrillators (AEDs) can save lives and consequently have been placed in many public locations.

What question this study addressed

This survey, which included people from 38 nations, evaluated whether the public knows what AEDs are and would be willing to use them.

What this study adds to our knowledge

Of 1,018 subjects, only 47% recognized an AED and only 47% were willing to use it.

How this might change clinical practice

Extensive public education is needed before AEDs can be expected to maximize their public health influence.

identification of an AED and vice versa, 2 separate questionnaires were drafted with open-answer and categorical questions. Assignment of a participant to one of the 2 questionnaires was not randomized because the purpose of the 2 different questionnaires was to avoid bias, not to perform any comparisons among the questionnaires. The questions were repeatedly tested and readjusted in an internal audit process, as well as with independent noninvestigator physicians and non–medically trained persons. A pilot experiment with 52 questionnaires served as a final evaluation and on-scene training of the interviewers.

Setting

The region of Amsterdam comprises about 1.4 million inhabitants. Approximately 4 million annual foreign tourists and a major portion of inhabitants of migrant origin account for a considerable number of international travelers at the city's Central Station, which handles about 250,000 passengers per day.

Selection of Participants

Amsterdam Central Station is equipped with 8 AEDs throughout the terminal building, of which 5 in glass-faced green containers labeled "AED" are freely accessible to the public. Therefore, all individuals in the terminal building were considered potential rescuers and formed the target population. Because it was not possible to draw a genuine random sample from the large number of individuals present in the terminal building at a given time, ie, assigning equal chances of being selected to each individual, a cluster sampling approach was used. A zone of 3 m around 2 preselected AEDs was defined as the cluster, and individuals entering the zone were invited to participate in such a way that they could not recognize they would be interviewed about medicine, resuscitation, or defibrillation. After the interview was completed or after refusal, the next individual entering the cluster was approached.

Exclusion criteria were refusal to participate, aged younger than 16 years, and language barriers. Permission was granted from the departmental research commission and Dutch Railway Company officials.

Methods of Measurement

Both questionnaires consisted of 3 parts. The first part was unique to each questionnaire, whereas parts 2 and 3 were shared by both questionnaires. In questionnaire A, part 1 consisted of 3 questions, beginning with a general open question about what should be done as quickly as possible if someone has collapsed with a suspected cardiac arrest. Multiple answers to this question were allowed and encouraged; after giving an answer, participants were asked whether they believed that there was something else to be done as quickly as possible. The following 2 questions tested whether the respondent knew what a defibrillator is used for and whether he or she was aware that defibrillators are available for public use. In part 1 of questionnaire B, the interviewer pointed at the AED and asked the respondent to identify the device; subsequently, the participant was asked about the purpose of the device. Part 2 of both questionnaires consisted of 3 items asking about the willingness to use such a device, about who is actually allowed to use it, and about whether people are aware of the importance of early defibrillation. Part 3 consisted of 6 demographic items. Figure 1 summarizes the questionnaire items.

Data Collection and Processing

All interviews were performed by the same 2 interviewers, who were trained by the principal investigators about how to approach individuals and avoid bias, about how interviews are to be conducted, and on how answers are to be documented. Both interviewers are fluent in English, as well as Dutch, and interviews were performed in one of these 2 languages, depending on the background of the participant. Herein, the interviewers individually judged for each participant whether he or she spoke enough English or Dutch to understand the questions and to provide adequate answers. Interviews were held face to face at all daytimes except rush hours in a period of 4 consecutive weeks.

Primary Data Analysis

A sample size of minimally 384 persons per questionnaire was computed to reach a confidence interval (CI) of 5% on a 95% confidence level (Survey System 9.5; Creative Research Systems, Petaluma, CA, USA).

Participants were stratified according to sex, age, region of origin, and previous medical training. Participants were defined as health care professionals if they were professionally

Part 1: Items Unique to Each Questionnaire

Questionnaire A

1. You see that someone is lying on the floor. The person is not breathing and you suspect a heart arrest.
   What do you think should be done as quickly as possible? *(Multiple answers allowed; ask whether there is something else that should be done as quickly as possible after participant gives an answer.)*
2. What is a defibrillator used for?
   (If incorrect or "don't know," explain that a defibrillator is used to apply an electrical shock in case of a cardiac arrest.)
3. Do you know that in many places public accessible defibrillators are available?

Questionnaire B

1. Do you know what this is? *(Interviewer points at AED.)*
2. Why has this device been placed here on the wall?

Part 2: Questions Addressed in Both Questionnaires

1. Who do you think is allowed to use such a public available defibrillator?
2. Would you use such a defibrillator in case of a medical emergency?
   (If "no" or "uncertain," participants were asked to specify the reasons.)
3. Do you agree or disagree with the following statement?
   "If I know that an ambulance will arrive in 5 minutes, then I don't have to use the defibrillator."

Part 3: Demographic Items (Both Questionnaires)

1. Have you been trained in a medical profession (eg, physician, nurse, paramedic)?
   If "yes," participants were asked to specify their profession.
   If "no": Is first aid part of your professional training (eg, fire fighter, police, flight attendant, soldier)?
2. Have you had first aid training within the last 5 years?
   If "yes": Was defibrillation explained during the first aid training?
3. Did you ever have a special AED training?
4. Sex
5. Which country do you live in?
6. How old are you?

Figure 1. Questionnaire items.

trained to treat patients and have a special duty to respond to medical emergencies (eg, physicians, nurses, paramedics). Individuals not meeting these criteria who had received special training because responsibilities in their job or unsalaried functions may require them to respond to medical emergencies were considered first responders (eg, policemen, fire fighters, flight attendants). All others were laypersons. Individuals working at the Central Station including railway company ("Nederlandse Spoorwegen") and subcontractors, were classified as employees, whereas other participants were travelers and visitors.

Results were analyzed with SPSS (version 17.0; SPSS, Inc., Chicago, IL). Continuous data (participant age) are presented as mean (SD). Proportions are reported as percentage (95% CI). CIs of proportions are not reported by SPSS and were separately calculated according to the adjusted Wald method.[10]

RESULTS

Characteristics of Study Subjects

Of 1,019 interviews performed at Amsterdam Central Station, one was excluded because of violation of inclusion criteria, leaving 1,018 interviews eligible for data analysis. Demographic characteristics are summarized in Figure 2. Mean participant age was 40 years (SD 18 years).

Main Results

When asked what should be done as quickly as possible if someone has a suspected cardiac arrest, the most frequently given answer was "call for help" (67%; 95% CI 63% to 71%), followed by "chest compressions" (20%; 95% CI 17% to 24%). Only 6% (95% CI 4% to 8%) of participants spontaneously mentioned defibrillation or AED in any way, indicating that they would bear defibrillation or AED use in mind when confronted with a cardiac arrest. When specifically interrogated,

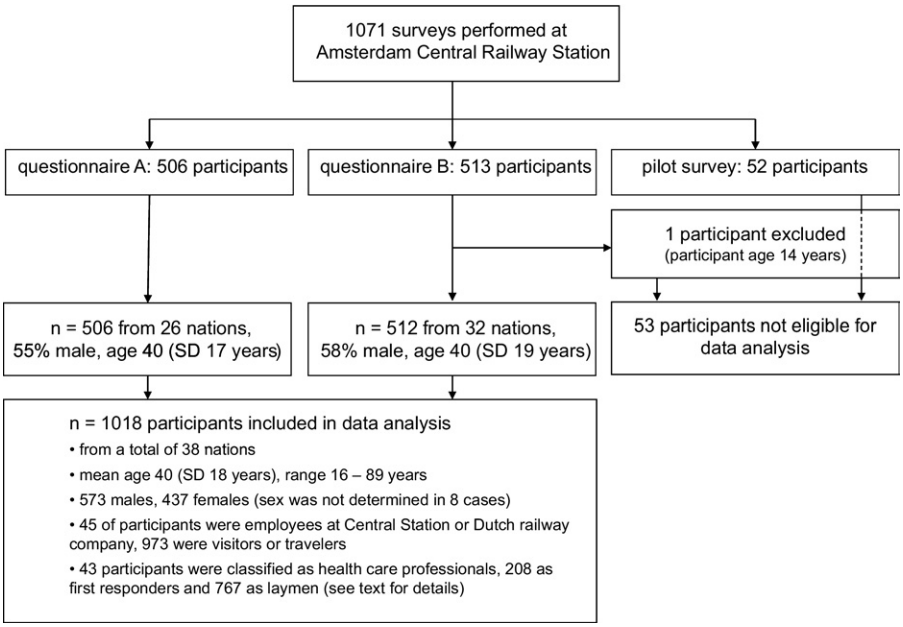

Figure 2. Flowchart showing eligibility for inclusion in data analysis and demographic data of included participants.

Table 1. Questions specific for questionnaire A (n=506).

Participants	Spontaneously Mentioned Defibrillation, % (95% CI)	Knowledge About What a Defibrillator Is Used For, % (95% CI)	Knowledge About the Availability of Public Accessible Defibrillators, % (95% CI)
All participants	6 (4–8)	64 (60–68)	43 (39–47)
Stratified by sex			
Male	8 (5–11)	65 (59–70)	44 (38–50)
Female	4 (2–7)	63 (57–69)	43 (37–50)
Stratified by age group, y			
<25	3 (1–8)	49 (41–57)	39 (31–48)
25–39	8 (4–13)	74 (66–80)	47 (39–55)
40–59	6 (3–12)	70 (60–77)	48 (40–56)
≥60	6 (2–14)	60 (50–70)	34 (25–45)
Stratified by region of origin			
Western Europe and European Union	7 (5–9)	64 (60–69)	48 (44–53)
North America	3 (0–15)	84 (69–93)	18 (9–34)
Other	0 (0–12)	37 (23–54)	6 (1–20)
Stratified by medical background			
Professional	6 (0–31)	75 (50–90)	63 (39–82)
First responder	11 (6–18)	81 (73–87)	62 (53–70)
Layman	4 (2–7)	58 (53–63)	36 (31–41)
Stratified by employment at CS or NS			
Employed at CS or NS	32 (18–51)	79 (60–90)	93 (76–99)
Not employed at CS/NS	4 (3–6)	63 (59–67)	40 (36–45)

CS, Central station; *NS*, Nederlandse Spoorwegen.

64% (95% CI 60% to 68%) knew what a defibrillator is used for; however, only 43% (95% CI 39% to 48%) were aware that defibrillators are often available for public access at heavily frequented places. Data for different subpopulations are summarized in Table 1.

Forty-seven percent (95% CI 42% to 51%) of participants (Table 2 summarizes data of subpopulations) correctly identified the device the investigator was pointing at as a defibrillator or AED, and 53% (95% CI 49% to 58%) knew the purpose of the device.

When asked about who is allowed to use an AED (Table 3), 34% (95% CI 31% to 37%) stated that anyone is allowed to use it, 49% (95% CI 46% to 52%) believe that only trained personnel may use it, and 13% (95% CI 11% to 16%) believe that its use is restricted to health care professionals. When asked about willingness to use an AED, 47% (95% CI 44% to 50%)

Table 2. Questions specific for questionnaire B (n=512).

Participants	Able to Identify AED/Defibrillator, % (95% CI)	Knowledge About the Purpose of AED, % (95% CI)
All participants	47 (42–51)	53 (49–58)
Stratified by sex		
Male	46 (41–52)	54 (48–60)
Female	47 (41–54)	53 (46–59)
Stratified by age group, y		
<25	43 (36–51)	50 (42–58)
25–39	48 (40–57)	58 (50–66)
40–59	56 (47–64)	60 (52–68)
≥60	38 (29–48)	43 (34–53)
Stratified by region of origin		
Western Europe and European Union	45 (41–50)	53 (48–57)
North America	75 (60–86)	75 (60–86)
Other	31 (17–50)	35 (19–54)
Stratified by medical background		
Professional	74 (55–87)	78 (59–90)
First responder	77 (67–84)	81 (72–88)
Layman	38 (34–43)	46 (41–51)
Stratified by employment at CS or NS		
Employed at CS or NS	71 (47–87)	77 (52–91)
Not employed at CS/NS	46 (42–50)	53 (48–57)

stated they would use it, whereas 43% (95% CI 40% to 46%) declared that they would not use it and 10% (95% CI 8% to 12%) were uncertain. The reason most frequently mentioned for not using an AED was not knowing how it works (69%; 95% CI 65% to 73%), followed by concerns about harming the victim (14%; 95% CI 12% to 18%) and legal concerns (5%; 95% CI 4% to 8%).

To be actually able to use an AED, several requirements must be met simultaneously. The potential rescuer not only has to know that defibrillation may be required but also must know that AEDs are available for public use, must be able to identify an AED on site, and must be willing to use it. Merely 18 participants in questionnaire A (4%; 95% CI 2% to 6%) spontaneously mentioned defibrillation, knew what a defibrillator is used for, knew that AEDs are available for public use, and would be willing to use it. In questionnaire B, 144 participants (28%; 95% CI 24% to 32%) correctly identified the AED, knew its purpose, and would be willing to use it.

LIMITATIONS

Because no generally accepted questionnaire was available to test public knowledge and attitudes toward AEDs, the questionnaires were designed from scratch. The questionnaires were repeatedly evaluated for clarity, conciseness, and unambiguousness and were evaluated in pilot interviews; however, they are not a validated study instrument.

In addition, our survey is subject to the inherent limitation that we cannot determine whether subjects' answers actually reflect their personal opinion, and we cannot verify whether AEDs would actually be used by those participants who stated that they would use them and vice versa. Also, we did not count the number of individuals refusing to participate, nor did we collect demographic data from these participants.

Another limitation of the study is that subgroups are not necessarily representative for the entire population they originate from. For example, because of the high costs of transcontinental traveling and the fact that business travelers likely hold higher positions in their respective business, visitors to the Netherlands from other countries may have a financial, educational, and social background that is not comparable to that of the country average. Therefore, observed differences between subgroups should be interpreted with care.

DISCUSSION

We investigated knowledge and attitudes toward AEDs among the public, which forms the largest and most readily available group of potential rescuers in case of a medical emergency in public places.

Early defibrillation is a key link in the chain of survival, and minimizing time-to-shock intervals is a pivotal step to improve probability of survival. In this context, undelayed defibrillation by coincidental bystanders using public accessible defibrillators seems a promising concept. In a landmark study, Caffrey et al[11] described the lifesaving potential of a public access defibrillation program implemented at 3 Chicago airports and showed that bystanders can successfully aid persons with cardiac arrest. However, there is no mention of how many individuals who sustained a cardiac arrest did not receive AED treatment by bystanders; thus, the true effectiveness remains unknown. Moreover, the program was accompanied by regular public announcements on television monitors, distribution of printed information materials, public training sessions, and numerous media reports, and it is unclear whether public access defibrillation programs operating without such massive information campaign could be equally successful. In another seminal article, Valenzuela et al[12] reported promising high survival rates after cardiac arrest in casinos, where patients were defibrillated by AED-equipped security officers. Likewise, in a large multicenter community based trial, Hallstrom et al[13] suggest a doubling in survival after out-of-hospital cardiac arrest in public places with an on-site AED. In these 2 studies, potential AED users had received extensive training and were able to identify and operate the AED when required. In contrast, such trained personnel may not always be readily available outside a study protocol, and even if trained personnel are available, dispatching and awaiting arrival can cost valuable time. Hence, the effectiveness of most "real-life" public access defibrillation programs largely depends on whether coincidental bystanders, ie, the public, will make undelayed use of the AED. We therefore investigated knowledge and attitudes among this largest and most readily available group of potential rescuers.

Our data demonstrate a substantial lack of public knowledge about public access defibrillation. More than half of participants were unable to recognize the AED, almost 60% were unaware that public access defibrillators are available in many places, and

Table 3. Questions asked in both questionnaires (n=1,018).

Participants	Believes That Anyone Is Allowed to Use an AED	Would You Use an AED, % (95% CI)		
		Yes	Uncertain	No
All participants	34 (31–37)	47 (44–50)	10 (8–12)	43 (40–46)
Stratified by sex				
Male	34 (30–38)	53 (49–57)	8 (6–11)	39 (35–43)
Female	34 (29–38)	40 (36–45)	12 (9–16)	48 (43–53)
Stratified by age group, y				
<25	28 (23–34)	38 (32–44)	12 (9–17)	50 (44–56)
25–39	35 (29–40)	51 (45–57)	10 (7–14)	39 (33–44)
40–59	38 (32–44)	56 (50–61)	9 (6–13)	35 (30–41)
≥60	36 (29–43)	44 (37–51)	8 (5–13)	49 (41–56)
Stratified by region of origin				
Western Europe and European Union	35 (31–38)	46 (43–49)	10 (8–12)	44 (41–47)
North America	42 (32–53)	65 (54–75)	10 (5–19)	24 (16–35)
Other	15 (9–26)	42 (31–54)	10 (4–20)	48 (36–61)
Stratified by medical background				
Professional	47 (33–61)	77 (62–87)	9 (3–22)	14 (6–28)
First responder	44 (37–51)	74 (67–79)	7 (4–12)	19 (14–25)
Layman	31 (27–34)	39 (35–42)	11 (9–13)	51 (47–54)
Stratified by employment at CS or NS				
Employed at CS or NS	44 (31–59)	80 (66–89)	4 (1–16)	16 (8–29)
Not employed at CS/NS	33 (31–36)	46 (43–49)	10 (9–12)	44 (41–47)

less than half of participants stated that they would use an AED if required. To actually make use of an AED in an emergency situation requires more than the ability to recognize the AED or awareness that AEDs are available to many public places. Rather, several requirements must be met at the same time, including sufficient knowledge and willingness to operate the AED. The pattern of answer combinations reveals that actually only a minority of individuals have sufficient knowledge and would be willing to use an AED. Only about 6% of participants spontaneously mentioned defibrillation in any form when asked what should be done as quickly as possible in case of a suspected cardiac arrest, but 64% knew what a defibrillator is used for when specifically interrogated. This discrepancy likely suggests that many individuals may have knowledge about what defibrillation is but would not proactively think about using an AED if required. This lack of active awareness of AED programs is likely the bottleneck that might limit AED use in real-life situations because bystanders first of all need to have defibrillation in mind; otherwise, they will not make use of the AED regardless of whether they would be able to identify it or would be willing to use it.

Although the public plays a key role in the concept of public access defibrillation, to our knowledge only 2 studies have previously addressed public knowledge and attitudes. Taniguchi et al[14] examined attitudes toward AED use in Japan. However, the authors selectively interviewed high school students and teachers, emergency medical technicians, nurses, and medical students and therefore did not provide data representative for the public as a whole. The second study, by Lubin et al,[15] is a survey of 359 individuals in a suburban shopping mall in the United States.[15] These authors, however, did not address whether participants would spontaneously have defibrillation in mind when confronted with a suspected cardiac arrest or the participants' ability to identify an AED. Approximately 60% of participants in that study could adequately define "defibrillator," and 71% stated they were willing to use an AED.[15] This latter percentage is substantially higher than what we observed in our overall study population but is in the range of the 95% CI of the North American participants of our survey. In accordance with our own data, Lubin et al[15] concluded that there was a lack of public knowledge and suggested that further public education may be needed.

AED knowledge was limited across sexes, different age groups, and participants from different regions. Because the study was not powered to detect differences between the groups and because the subgroups may not necessarily be representative of the population they originate from (see discussion of limitations above), we did not formally compare subgroups with hypothesis tests. However, the CIs of the data suggest that there may be some differences between subgroups. Among the participants of our survey, women were more often unwilling to use an AED. Participants younger than 25 years and older than 60 years exhibited less knowledge and less willingness to operate an AED than middle-aged participants. North Americans more often correctly identified the AED, knew its purpose, and stated that they would use it. However, North Americans were less aware than Europeans of the existence of public access defibrillation programs. These differences, if confirmed by further studies, can be helpful to better tailor public access defibrillation campaigns to specific target audiences.

Amsterdam Central Station provides AED training for its personnel. The merit is reflected in our study because employees

generally showed better knowledge and higher willingness to use an AED than travelers or visitors. However, only 4.4% of all participants were employees, and a trained employee may therefore not always be readily available but might have to be dispatched first. Thus, when seconds count, the general public remains the largest group of rescuers to provide undelayed defibrillation.

Not surprisingly, health care professionals and first responders demonstrated better knowledge than laypersons. Yet, about 1 of 4 professionals and first responders failed to recognize an AED, and about the same proportion stated they would not use an AED or were unsure whether to use it. This suggests that these subpopulations might also benefit from additional training.

Less than half of all participants would be willing to use an AED. Therefore, it seems important to address the reasons why people are reluctant to use the device. The 2 most common reasons were not knowing how the AED works and concerns about harming the victim. Modern devices offer a figure indicating where to apply the electrode pads, automatically analyze the heart rhythm, and guide the operator by visual and acoustical prompts, allowing efficient and safe use by laypersons.[9,16,17] We are not aware of a single report about inadvertent AED-related injury of any individual. Public information campaigns should emphasize the ease and safety of AED use.

Legal concerns were the third most common reason for not using AEDs. When specifically interrogated about who is actually allowed to use an AED, 2 of 3 participants believed that its use is restricted to specially trained individuals or health care professionals. Legislation varies in different countries; however, in most countries, including the United States and large parts of Europe, laypeople can use AEDs without having to fear legal consequences or liability.[18,19] Only a few countries, including France and South Korea, explicitly prohibit AED use by laypeople.[19,20] To diminish the legal uncertainty that prevails, legislation should be as explicit as possible and information campaigns should address legal aspects.

AEDs are increasingly available all over the world, and as the concept of true "public" access defibrillation is becoming reality, the question arises about whether the public, as a key player in this concept, is prepared for this development. We observed that only a minority of individuals demonstrate sufficient knowledge and willingness to operate an AED, and this may be one likely explanation of why AED application by bystanders seems to save only 1.4 lives per 1 million inhabitants per year in North America.[21] Public access defibrillation programs are expensive, and the question arises about whether marginal improvements in survival justify spending the limited available financial resources for wide-scale deployment of AEDs.[22-24] We do believe that public access defibrillation is a promising approach; however, our study suggests that the public is not yet sufficiently prepared. Wide-scale public information campaigns are an important next step to exploit the lifesaving potential of public access defibrillation.

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Author contributions: LAS proposed the research idea. PS, JJLMB, SAL, and LAS performed the literature search and developed the study protocol. PS, FBD, JJLMB, and LAS drafted and tested the questionnaires and implemented the survey at Amsterdam Central Station. Data collection was performed by FBD and was supervised by JJLMB. Data analysis was conducted by PS and FBD. PS, SAL, and LAS were responsible for data interpretation. PS had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the statistical data analysis. SAL monitored the study progress, provided logistic support, and coordinated work within the study group. PS drafted the first version of the article, and all authors critically revised it for important intellectual content. All authors read and approved the final version. PS takes responsibility for the paper as a whole.

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Address for correspondence: Patrick Schober, MD, PhD, Department of Anesthesiology, VU University Medical Center, De Boelelaan 1117, 1007 MB Amsterdam, the Netherlands; 31-20-4443138, fax 31-20-4444385; E-mail p.schober@vumc.nl.

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