Bystander Defibrillation for Out-of-Hospital Cardiac Arrest in Public vs Residential Locations

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IMPORTANCE Bystander-delivered defibrillation (hereinafter referred to as bystander defibrillation) of patients with out-of-hospital cardiac arrests (OHCAs) remains limited despite the widespread dissemination of automated external defibrillators (AEDs).

OBJECTIVE To examine calendar changes in bystander defibrillation and subsequent survival according to a public or a residential location of the cardiac arrest after nationwide initiatives in Denmark to facilitate bystander-mediated resuscitative efforts, including bystander defibrillation.

DESIGN, SETTING, AND PARTICIPANTS This nationwide study identified 18,688 patients in Denmark with first-time OHCA from June 1, 2001, to December 31, 2012, using the Danish Cardiac Arrest Registry. Patients had a presumed cardiac cause of arrest that was not witnessed by emergency medical services personnel. Data were analyzed from April 1, 2015, to December 10, 2016.

EXPOSURES Nationwide initiatives to facilitate bystander resuscitative efforts, including bystander defibrillation, consisted of resuscitation training of Danish citizens, dissemination of on-site AEDs, foundation of an AED registry linked to emergency medical dispatch centers, and dispatcher-assisted guidance of bystander resuscitation efforts.

MAIN OUTCOMES AND MEASURES The proportion of patients who received bystander defibrillation according to the location of the cardiac arrest and their subsequent 30-day survival.

RESULTS Of the 18,688 patients with OHCAs (67.8% men and 32.2% women; median [interquartile range] age, 72 [62-80] years), 4783 (25.6%) had a cardiac arrest in a public location and 13,905 (74.4%) in a residential location. The number of registered AEDs increased from 141 in 2007 to 7800 in 2012. The distribution of AED location was consistently skewed in favor of public locations. Bystander defibrillation increased in public locations from 3 of 245 (1.2%; 95% CI, 0.4%-3.5%) in 2001 to 78 of 510 (15.3%; 95% CI, 12.4%-18.7%) in 2012 (P < .001) but remained unchanged in residential locations from 7 of 542 (1.3%; 95% CI, 0.6%-2.6%) in 2001 to 21 of 1669 (1.3%; 95% CI, 0.8%-1.9%) in 2012 (P = .17). Thirty-day survival after bystander defibrillation increased in public locations from 8.3% (95% CI, 1.5%-35.4%) in 2001/2002 to 57.5% (95% CI, 48.6%-66.0%) in 2011/2012 (P < .001) in residential locations, from 0.0% (95% CI, 0.0%-19.4%) in 2001/2002 to 25.6% (95% CI, 14.6%-41.1%) in 2011/2012 (P < .001).

CONCLUSIONS AND RELEVANCE Initiatives to facilitate bystander defibrillation were associated with a marked increase in bystander defibrillation in public locations, whereas bystander defibrillation remained limited in residential locations. Concomitantly, survival increased after bystander defibrillation in residential and public locations.
The placement of automated external defibrillators (AEDs) in public places, such as airports, sport facilities, offices, casinos, and aircrafts, is associated with survival rates of out-of-hospital cardiac arrest (OHCA) as high as 74%. Consequently, based on recommendations from the American Heart Association and the European Resuscitation Council, AEDs have been broadly distributed in many countries.

Although cardiopulmonary resuscitation (CPR) performed by bystanders has increased in many countries, defibrillation performed by bystanders (hereinafter referred to as bystander defibrillation) remains limited in broader populations, and strategies for increasing bystander defibrillation are warranted. The limited rates of bystander defibrillation have been associated with logistical barriers to AED use, such as the placement of AEDs in areas with low incidences of cardiac arrests, limited accessibility to AEDs, and difficulties with finding or remembering to use AEDs at the time of the cardiac arrest.

Thus, increasing bystander defibrillation rates depends on improving the strategic placement and accessibility of AEDs and on enhancing the ability of bystanders to locate and use a nearby AED. Furthermore, the location of the cardiac arrest must be considered when designing strategies to promote bystander defibrillation. In general, the conditions for early bystander defibrillation are less favorable in residential than in public locations because factors associated with a nonshockable heart rhythm are more frequent in residential locations, such as a greater number of unattended arrests, less performance of bystander CPR, and older patients with more comorbidities. Consequently, the effect of strategies aimed to improve early defibrillation are likely to differ according to the location of arrest, and different approaches might be needed.

In Denmark, initiatives to facilitate bystander defibrillation have been undertaken, including dissemination of onsite AEDs, registration of the AEDs with location information linked to emergency dispatch centers, dispatcher-assisted guidance to their use, and increased education of the lay public in performing resuscitation. We aimed to examine (1) temporal changes in bystander defibrillation according to the location of cardiac arrest and (2) temporal changes in survival according to bystander defibrillation and location of arrest.

Methods

Setting

This nationwide cohort study included data collected from June 1, 2001, to December 31, 2012, in Denmark. Denmark has approximately 5.6 million inhabitants and covers 42,900 km² (approximately 16,565 square miles). This study was approved by the Danish Data Protection Agency. Ethical approval is not required for retrospective registry-based studies in Denmark (https://www.retsinformation.dk/Forms/R0710.aspx?id=137674).

Initiatives to Increase AED Availability, Awareness, and Use

Several initiatives have been undertaken to strengthen bystander resuscitative efforts and AED use in Denmark. In 2007, the Danish AED Network was established in Copenhagen and became nationwide in 2010. In February of 2010, AED location information was integrated with emergency medical dispatch centers in Copenhagen and instituted nationwide in 2011. In addition, the locations of registered AEDs have been publicly available on the AED Network homepage since 2007 and via a smartphone app since 2012, allowing citizens to locate nearby AEDs. The Danish Health and Medicines Authority issued official recommendations for the dissemination, strategic placement, and accessibility of AEDs in 2011. Efforts were taken to strengthen bystander resuscitation attempts, including mandatory resuscitation training in elementary schools (2005) and when acquiring a driver’s license (2006). The number of annually distributed first aid certificates increased from about 175,000 in 2001 to 2004 to about 300,000 in 2008 to 2011. Since 2011, emergency medical dispatch centers have been staffed nationwide with health care professionals, and dispatchers have followed a standardized nationwide protocol to provide guidance to bystanders to perform CPR and retrieve a nearby registered AED when a cardiac arrest is suspected. The accumulated number of AEDs sold in Denmark was estimated at 30,000 in 2006 and 15,000 in 2011. Finally, public campaigns were launched to increase AED knowledge and awareness. Figure 1 provides an overview of the most important initiatives during the study period.

OHCA, Study Variables, and Study Population

Emergency medical services personnel are activated for all suspected OHCA, and in case of a cardiac arrest, they are subsequently required to complete a short case report for the Danish Cardiac Arrest Registry based on the Utstein template. An OHCA is included in the registry when a clinical condition of cardiac arrest has resulted in resuscitative efforts by emergency medical service personnel or bystanders. This definition excludes cases with obvious late signs of death for which resuscitation is not initiated. The Danish Cardiac Arrest Registry has been described in detail.

In Denmark, each citizen is assigned a unique civil registration number, allowing individual-level linkage of information between nationwide registries. We retrieved the following data from the Danish Cardiac Arrest Registry: the date of...
arrest; whether the arrest was bystander witnessed, nonwitnessed, or witnessed by emergency medical services personnel; public or residential location; whether bystander CPR or bystander defibrillation was performed; the estimated interval from the recognition of the arrest to the first rhythm analysis by the emergency medical service personnel; the first recognized rhythm (shockable or nonshockable); and the patient’s status on hospital arrival. Using the civil registration number of each person in the study population, we obtained data regarding age, sex, and survival status from the Danish National Population Registry. Admission dates, discharge dates, and discharge diagnoses from hospitals were retrieved from the Danish National Patient Registry. We retrieved the causes of death from the Danish Registry of Causes of Death. Discharge diagnoses and causes of death were available according to the World Health Organization International Classification of Diseases and Related Health Problems, Tenth Revision.

Death certificates or discharge diagnosis codes were used to define the presumed cause of cardiac arrest. Death certificates and discharge diagnoses of cardiac disease, unknown disease, or unexpected collapse were defined as presumed cardiac cause of arrest. Death certificates and discharge diagnoses without the above-mentioned diagnoses but showing other medical disorders were defined as noncardiac causes. Trauma, drug overdose, attempted suicide, and violent assault were considered to be noncardiac causes regardless of other diagnoses. For this study, we excluded patients with OHCA and (1) an invalid civil registration number (including foreigners without permanent residence in Denmark), (2) a second or third cardiac arrest, (3) cardiac arrests without registered hospital admission, (4) cardiac arrests that were witnessed by emergency medical services, (5) cardiac arrests with missing information about location and/or bystander defibrillation, and (6) arrests due to a presumed noncardiac cause (Figure 2).

Registered AEDs
To determine the location of each registered AED, we used the geocoded location of the AED according to publicly available municipal land-use plans. A detailed description is available in eMethods in the Supplement. Locations of AEDs were classified into the following 3 groups: (1) residential areas (private homes cover >80% of the parcels), (2) mixed residential and public areas (20%-80% of the parcels consist of private homes mixed with buildings used for business), and (3) public areas (eg, educational buildings, health care institutions, shopping areas, business areas, and recreational areas). In Figure 3, residential areas were defined as residential and mixed residential and public areas.

Study Outcomes
The primary outcome measure was the rate of bystander defibrillation according to the location of the cardiac arrest from 2001 to 2012. This outcome only included patients who had a shock delivered and not those who had AED pads applied but no shock delivered. The secondary outcome measure was 30-day survival according to the location of the arrest and bystander defibrillation status.

Statistical Analysis
Data were analyzed from April 1, 2015, to December 10, 2016. Calendar trends in bystander defibrillation for cardiac arrests in public and residential locations were analyzed separately.
using univariate logistic regression. The calendar changes in 30-day survival, with or without bystander defibrillation for each location, were modeled using logistic regression and restricted cubic splines (with prespecified knots at 2004, 2007, and 2011).

We analyzed whether missing data on bystander defibrillation and/or the location of the arrest (excluded patients) could have introduced bias by comparing the results from complete case analyses with the results based on multiple imputation. Specifically, we imputed 100 data sets using the calendar year and the information in the Table and compared the mean bystander defibrillation probability with the complete case results according to the calendar year and the location of the arrest. Data management and analyses were performed using SAS (version 9.4; SAS Institute Inc) and R software. A 2-sided \( P < .05 \) was considered statistically significant. For trend tests, we used the univariate logistic regression.

Results

A total of 18,688 patients with OHCAs (67.8% men and 32.2% women; median [interquartile range] age, 72 [62-80] years) were included in the study (Figure 2). The patient characteristics according to the location of arrest and bystander defibrillation are shown in the Table. A total of 4783 (25.6%) OHCAs occurred in public locations, and 13,905 (74.4%) occurred in residential locations. The patients who underwent bystander defibrillation in public locations (243 [5.1%]) were younger and more frequently male, had fewer chronic diseases, had more witnessed arrests, and received bystander CPR more often compared with patients undergoing defibrillation in residential locations (117 [0.8%]). For both locations, the patients who underwent defibrillation were younger and more frequently male, had fewer chronic diseases, had more witnessed arrests, and received bystander CPR more often compared with patients who did not undergo defibrillation.

Bystander defibrillation increased markedly in public locations from 3 of 245 (1.2%; 95% CI, 0.4%-3.5%) in 2001 to 78 of 510 (15.3%; 95% CI, 12.4%-18.7%) in 2012 (\( P < .001 \)); in residential locations, bystander defibrillation remained unchanged and limited from 7 of 542 (1.3%; 95% CI, 0.6%-2.6%) in 2001 to 21 of 1,669 (1.3%; 95% CI, 0.8%-1.9%) in 2012 (\( P = .17 \)) (Figure 3). eTable 1 in the Supplement shows the absolute numbers of patients who underwent defibrillation each year according to location. Registered AED units in the Danish AED Net-
work increased from 141 in 2007 to 7800 in 2012. Over time, the distribution of AED location was consistently skewed in favor of public locations. eTable 2 in the Supplement shows the registered AED units and estimated AED units sold.

Thirty-day survival increased among patients undergoing defibrillation in public locations from 8.3% (95% CI, 1.5%-35.4%) in 2001/2002 to 57.5% (95% CI, 48.6%-66.0%) in 2011/2012 (P <.001); for patients undergoing defibrillation in residential locations, 30-day survival increased from 0.0% (95% CI, 0.0%-19.4%) in 2001/2002 to 25.6% (95% CI, 14.6%-41.1%) in 2011/2012 (P <.001). In both locations, survival increased more over time for patients undergoing defibrillation by bystanders than for patients who did not (Figure 4). For patients undergoing defibrillation by bystanders, an increase in bystander CPR was observed over time from 72.6% in 2001 to 92.0% in 2007 and 98.4% in 2012 in public locations and from 58.4% in 2001 to 85.9% in 2007 and 97.1% in 2012 in residential locations (eFigure 1 in the Supplement).

Additional Analyses

When our study population was restricted to patients with a witnessed arrest of presumed cardiac cause and a first shockable rhythm, bystander defibrillation increased in public locations from 1 of 95 (1.1%; 95% CI, 0.2%-5.7%) in 2001 to 66 of 210 (31.4%; 95% CI, 25.5%-38.0%) in 2012 (P < .001) and in residential locations from 2 of 87 (2.3%; 95% CI, 0.6%-8.0%) in 2001 to 18 of 251 (7.2%; 95% CI, 4.6%-11.0%) in 2012 (P = .06) (eFigure 2 in the Supplement). When all OHCA's were considered irrespective of presumed cause, bystander defibrillation increased in public locations from 5 of 350 (1.4%; 95% CI, 0.6%-3.3%) in 2001 to 84 of 707 (11.9%; 95% CI, 9.7%-14.5%) in 2012 (P < .001) and in residential locations from 12 of 770 (1.6%; 95% CI, 0.9%-2.7%) in 2001 to 23 of 2368 (1.0%; 95% CI, 0.6%-1.5%) in 2012 (P = .72) (eFigure 3 in the Supplement). Multiple imputation analysis indicated that the exclusion of the patients with missing data did not affect the observed changes in bystander defibrillation (eFigure 4 in the Supplement). eTable 3 in the Supplement shows the patient characteristics of excluded patients (n = 5424) compared with included patients (n = 18688).

Discussion

This nationwide study showed that national initiatives to facilitate bystander defibrillation using on-site AEDs were associated with an increase in bystander defibrillation of patients with OHCA's from 1.2% in 2001 to 15.3% in 2012 in public locations, whereas bystander defibrillation remained limited in residential locations during the entire study period. In addition, bystander defibrillation was associated with an increase in survival over time for both locations. Furthermore, survival after bystander defibrillation increased over time irrespective of location.

Few studies have assessed the association between bystander defibrillation and publicly available AEDs, likely owing to uncer-

Table. Baseline Characteristics and Survival Among Patients With OHCAs in Denmark According to Location and Whether Bystander Defibrillation Was Performed*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Location of OHCA</th>
<th>Bystander Defibrillation (n = 117)</th>
<th>No Bystander Defibrillation (n = 13 788)</th>
<th>Public Bystander Defibrillation (n = 243)</th>
<th>No Bystander Defibrillation (n = 4 540)</th>
<th>All (n = 18 688)</th>
<th>Missing Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (IQR), y</td>
<td>Residential</td>
<td>68 (58-77)</td>
<td>73 (63-81)</td>
<td>64 (53-73)</td>
<td>68 (58-78)</td>
<td>72 (62-80)</td>
<td>0</td>
</tr>
<tr>
<td>Males</td>
<td>Residential</td>
<td>84 (71.8)</td>
<td>8913 (64.6)</td>
<td>220 (90.5)</td>
<td>3459 (76.2)</td>
<td>12 676 (67.8)</td>
<td>0</td>
</tr>
<tr>
<td>OHCA characteristics</td>
<td>Residential</td>
<td>99 (84.6)</td>
<td>4377 (31.8)</td>
<td>229 (94.2)</td>
<td>2428 (53.6)</td>
<td>7133 (38.2)</td>
<td>47</td>
</tr>
<tr>
<td>Bystander CPR</td>
<td>Residential</td>
<td>82 (70.1)</td>
<td>6475 (47.2)</td>
<td>203 (83.5)</td>
<td>2999 (66.5)</td>
<td>9759 (52.2)</td>
<td>103</td>
</tr>
<tr>
<td>Shockable heart rhythm</td>
<td>Residential</td>
<td>117 (100)</td>
<td>2859 (21.6)</td>
<td>243 (100)</td>
<td>1976 (45.0)</td>
<td>5195 (27.8)</td>
<td>722</td>
</tr>
<tr>
<td>Time interval, median (IQR), min*</td>
<td>Residential</td>
<td>15.0 (10.0-21.0)</td>
<td>12.0 (7.0-20.0)</td>
<td>13.0 (8.0-17.0)</td>
<td>10.0 (6.0-15.0)</td>
<td>11.0 (7.0-19.0)</td>
<td>1771</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>Residential</td>
<td>36 (30.8)</td>
<td>3597 (26.1)</td>
<td>59 (24.3)</td>
<td>1111 (24.5)</td>
<td>4803 (25.7)</td>
<td>0</td>
</tr>
<tr>
<td>Ischemic heart disease (MI not included)</td>
<td>Residential</td>
<td>16 (13.7)</td>
<td>1747 (12.7)</td>
<td>36 (14.8)</td>
<td>531 (11.7)</td>
<td>2330 (12.5)</td>
<td>0</td>
</tr>
<tr>
<td>Previous MI</td>
<td>Residential</td>
<td>29 (24.8)</td>
<td>2987 (21.7)</td>
<td>42 (17.3)</td>
<td>823 (18.1)</td>
<td>3881 (20.8)</td>
<td>0</td>
</tr>
<tr>
<td>Heart failure</td>
<td>Residential</td>
<td>14 (12.0)</td>
<td>2239 (16.2)</td>
<td>6 (2.5)</td>
<td>422 (9.3)</td>
<td>2681 (14.3)</td>
<td>0</td>
</tr>
<tr>
<td>Malignant disease</td>
<td>Residential</td>
<td>13 (11.1)</td>
<td>1698 (12.3)</td>
<td>15 (6.2)</td>
<td>406 (8.9)</td>
<td>2132 (11.4)</td>
<td>0</td>
</tr>
<tr>
<td>Renal disease</td>
<td>Residential</td>
<td>2 (1.7)</td>
<td>715 (5.2)</td>
<td>6 (2.5)</td>
<td>153 (3.4)</td>
<td>876 (4.7)</td>
<td>0</td>
</tr>
<tr>
<td>Survival</td>
<td>Residential</td>
<td>42 (37.2)</td>
<td>1702 (12.6)</td>
<td>133 (56.4)</td>
<td>1121 (25.1)</td>
<td>2998 (16.0)</td>
<td>347</td>
</tr>
<tr>
<td>30-d Survival</td>
<td>Residential</td>
<td>23 (19.7)</td>
<td>660 (4.8)</td>
<td>114 (46.9)</td>
<td>676 (14.9)</td>
<td>1473 (7.9)</td>
<td>0</td>
</tr>
</tbody>
</table>

Abbreviations: COPD, chronic obstructive pulmonary disease; CPR, cardiopulmonary resuscitation; IQR, interquartile range; MI, myocardial infarction; OHCA, out-of-hospital cardiac arrest; ROSC, return of spontaneous circulation.

*Data are presented as number (percentage) of patients unless otherwise indicated. Data were collected from June 1, 2001, to December 31, 2012.

Indicates estimated time from recognition of the arrest to the first rhythm analysis by the emergency medical services personnel.
The 30-day survival among patients with OHCAs in public vs residential locations according to whether the patients underwent defibrillation by bystanders. The results from logistic regression were not adjusted for patient characteristics, and restricted cubic splines were used to model changes in calendar time. Shaded areas indicate 95% CIs.

The present study showed that, although most OHCAs occurred in residential locations (74.4%), no increase in bystander defibrillation occurred in residential areas. One possible explanation is that only 17.4% of the registered AEDs were located in residential areas; furthermore, some AEDs might have been inaccessible to bystanders at a nearby cardiac arrest. In addition, patients with OHCAs in residential locations were older, had more chronic diseases, had fewer bystander-witnessed arrests, and underwent bystander CPR less often than patients with OHCAs in public locations. These factors are thought to reduce the chance of a shockable heart rhythm and therefore limit the potential benefit of early defibrillation in residential areas. A previous study reported that, although 41% of all bystander-applied AEDs were in private locations, only 24% of all delivered shocks occurred in private locations, supporting the notion that a lack of shockable heart rhythm is an important limiting factor. A lack of a shockable rhythm is also likely to have contributed to the low defibrillation rate in nonshockable rhythms in our study, although our study was limited in that it had no data about applied AEDs when no shock was delivered. Our findings support previous observations that the use of on-site AEDs in residential areas seems very limited, even when AED location information is available to emergency medical dispatch centers. To increase bystander defibrillation, recent studies have described strategies in which first responders trained in resuscitation are equipped with AEDs with the chance of providing early defibrillation irrespective of residential or public cardiac arrest location. In addition, training of citizens in performing resuscitation could increase bystander resuscitative efforts further, including those in residential locations. Our study supports the idea that in residential areas, initiatives, such as first-responder programs, should be considered to increase early interventions that allow a shock to be delivered before the heart rhythm degrades to a nonshockable rhythm.

We found that 30-day survival after bystander defibrillation increased in public and residential locations over time, and at the end of our study period, the survival rate in a public, nonselected national environment was as high as that reported in highly selected environments, such as casinos and airports. Survival in both locations increased during the study period. Of note, patient survival without bystander defibrillation also increased during the study period. This indicates that factors other than early defibrillation are important for increasing survival, such as an increase in bystander CPR, which was observed among the patients who underwent bystander defibrillation and improved advanced postresuscitation care. Such improvements have previously been associated with an increase in survival after OHCA in general and in patients undergoing bystander defibrillation in particular. Furthermore, in our study, patients in public and residential locations who underwent bystander defibrillation had additional...
characteristics that favored higher survival rates compared with patients who did not undergo defibrillation.\textsuperscript{15} When we examined the increase in bystander defibrillation and survival after bystander defibrillation, the incidence of OHCA s in Denmark did not change during the study period, reducing the possibility that changes in reporting over time affected our results (eFigure 5 in the Supplement).

Limitations
First, because of its observational design, the study could not interpret the effect of each individual initiative on the increase in bystander defibrillation. In addition, the design precludes assurance that the higher survival rate in patients undergoing bystander defibrillation was due to the increased AED use alone because we cannot exclude the possibility that bystander defibrillation was associated with unmeasured factors that favored high survival, such as higher-quality CPR and more aggressive post–cardiac arrest care. Furthermore, we did not have reliable data on time to bystander defibrillation, which might have decreased during the study period.

Second, only data from registered AEDs in the AED Network were available. As such, the exact number and the actual distribution of all AEDs in public and residential locations are unknown. However, the reported number of registered AEDs can only be an underestimation of the actual number of AEDs in residential locations. Consequently, this limitation does not change our conclusion that, despite several initiatives, including placement of AEDs in residential areas, no increase occurred in bystander defibrillation in residential locations.

Third, data on the exact geographic locations of the cardiac arrests were not available, and we cannot analyze the distance to the nearest registered AED for each cardiac arrest. Fourth, patients with missing data on bystander defibrillation and/or on the location of the arrest were excluded. However, a sensitivity analysis that included these patients did not change our conclusions.

Conclusions
Dissemination and registration of on-site public AEDs with dispatcher-assisted guidance to use them and education of laypersons in performing resuscitation were associated with a marked increase in bystander defibrillation in public locations. However, bystander defibrillation remained limited in residential locations. Concomitantly, survival increased after bystander defibrillation in residential and public locations.
Cardiac Arrest in Any Location
The Need for Fewer Bystanders and More Layperson Rescuers

Clifton W. Callaway, MD, PhD

Location is a critical variable in surviving cardiac arrest because it determines the likelihood of help by trained, willing layperson rescuers. Immediate cardiopulmonary resuscitation (CPR) is essential for preventing organ deterioration while waiting for definitive therapy to reverse the cardiac arrest. Patients who collapse in public places are witnessed by more people, are much more likely to get expeditious CPR, and are more rapidly treated with an automated external defibrillator (AED). An AED can immediately reverse some cardiac arrests caused by tachyarrhythmias. When nobody witnesses a patient collapse or when nobody near the patient is trained and willing to act, CPR or therapy may not begin for many minutes. Consequently, patients who collapse in private residences are disadvantaged and have lower survival compared with patients in public places.

In this issue of JAMA Cardiology, Hansen et al1 describe a steady temporal increase in AED use in public places in Denmark from 2001 through 2012. The authors provide an excellent context for interpreting the steady increase in AED use in this country, clearly describing the various national efforts in education, infrastructure, and implementation. These data illustrate a successful transformation of the public setting into an environment conducive to rapid layperson action, including AED use. However, the data also illustrate how massive efforts have a smaller effect on rescue in private settings.

Many other studies document the effect of layperson rescue in sudden cardiac arrest. Recent studies report that survival rates roughly double when laypersons provide CPR or some intervention before ambulance arrival in Sweden, Japan, Denmark, and the United States. The novel finding in this present study is the magnitude of the incremental survival benefit from layperson use of AED over and above that from the use of CPR, at least in the public setting.

Public health interventions do not have the same effect on survival for patients who collapse in public venues vs patients...