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Community-based AED only resuscitation for Out of Hospital Cardiac Arrest victims

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from

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Key Words: Cardiopulmonary resuscitation, CPR, chest compressions, sudden cardiac arrest, out of hospital cardiac arrest, ventricular fibrillation, defibrillation

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ABSTRACT

Background: Speed is the cornerstone of rescue for out-of-hospital cardiac arrest (OOHCA). As a consequence, community participation programs have been initiated to decrease response times. Even in the very best of these programs, however, short-term survival rates hover around 10% and long-term survival rates are half that. In the majority of locales, survival is far worse. In Piacenza, Italy, responders have been trained for over a decade to use publicly available AEDs and eschew the performance of CPR. It is known locally as “Progetto Vita.”

Methods: From 2001 to 2014, we prospectively collected outcome data on all Progetto Vita treated patients and all 3271 standard Emergency Medical Services (EMS) patients. Progetto Vita rescuers simply accessed a public AED, turned it on, and only followed its instructions. Progetto Vita rescuers did not do CPR of any sort. If EMS arrived prior to initiation or even completion of the Progetto Vita protocol, EMS supplanted Progetto Vita efforts and patients were not included in the Progetto Vita cohort. Follow-up was collected by each responders data files, chart review, and use of the Italian system death index. All cardiac arrest patient death status was validated in 100% of victims through August 1, 2014.

Findings: Survival to hospital discharge occurred in 39 of the 95 patients (41.4%) treated by Progetto Vita and in 193 of the 3271 EMS patients (5.9%). At 13-years follow-up, the Kaplan Meier estimates of survival were 31.8% when AEDs only were used and 2.4% for standard EMS/CPR response. Estimates of survival are significantly better for Progetto Vita AED only therapy when survival was stratified by time to respond, gender, location of cardiac arrest, and shockable rhythm. Relative to the 95 EMS patients with the fastest response times, Progetto Vita intervention was associated with a more than 2-fold increased rate of survival.

Interpretation: This is the first demonstration of excellent long-term survival from out-of-hospital cardiac arrest by promoting speed and ease of lay AED response without CPR.

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INTRODUCTION

Out-of-hospital cardiac arrest (OOHCA) is peerless in its unpredictability, logistical obstacles, and the time-urgency of interventions. Speed is the cornerstone of any rescue strategy for OOHCA. Without speed, the best of therapeutic interventions fails. As a consequence, multiple community participation programs have been initiated to decrease response times. However, even in premier programs, short-term survival rates hover around 10%.\textsuperscript{1,2} In many locales, survival is far worse.\textsuperscript{3,4}

In this study, we broke with tradition and promoted simplicity and speed of AED use over traditional interventional training of the lay populace. We used a unique venue, Piacenza, Italy, where community responders were only trained to use publicly available AEDs and to eschew the performance of CPR. It is known locally as Progetto Vita (Project Life) and was the first early defibrillation effort established in Europe.\textsuperscript{5} Progetto Vita runs in parallel to the city’s Emergency Medical Services (EMS) system with its standardly structured Basic Life Support (BLS) and Advanced Life Support (ALS) vehicle response systems that follow international guidelines for response to OOHCA. Initial short-term survival results from this program were reported in 2002.\textsuperscript{5} In this report, we report long-term survival of this unique approach to OOHCA.

METHODS

Progetto Vita and Standard EMS Response

A novel approach to OOHCA, Progetto Vita, was initiated in 1999 in Piacenza, Italy employing only the use of automated external defibrillators (AEDs) in lay responders. CPR, in any of its variations, was neither taught in training nor conducted during OOHCA. The original structure and organization of Progetto Vita, along with early survival data from the inception through June 2001 have been previously reported, and unlike the current paper, originally included both citizen responders and volunteer BLS ambulance responders (www.progetto-vita.eu).\textsuperscript{5} However, because of a change in Italian law, only citizen responders in Piacenza were allowed to \textit{not} do CPR from June 1, 2001. BLS crews, on the other hand, were re-assigned to EMS and were obliged to be trained in and comply with ILCOR guidelines. The present paper supplements the earlier report but now focuses on survival data from June 1, 2001 through August 1, 2014 using only Progetto Vita \textit{citizen} responders. We describe both the Progetto Vita outcomes as well as contemporaneous survival data from standard EMS care of OOHCA by BLS and ALS systems who responded using methods endorsed by International Guidelines.
Progetto Vita is an independent, donation-supported, citizen volunteer response that supplements standard, government-funded EMS when responding to OOHCA. The Progetto Vita project was initiated June 6, 1999 shortly after AEDs became available in Europe as a low-cost, simplified option for quickly training laypersons without the need of traditional, more expensive and time-consuming BLS AED defibrillation courses. When the small Italian community of Piacenza undertook this project, the EMS system had neither the resources nor the personnel for a broad scale implementation of lay training. Further, the standard EMS system itself was in a rudimentary stage of development in 1999. Nevertheless, over the next 15 years, Progetto Vita grew organically through dedicated effort to recruit over 25,000 citizen volunteers by the end of the reporting period of this study.

The total population served is 288,011 for the city of Piacenza and its suburbs. Thus, over 8% of the population participates in Progetto Vita. Phone calls to EMS (#118, equivalent to #911 in the U.S.) simultaneously activate Progetto Vita and the standard EMS system. Over time, Progetto Vita progressively increased the availability of AEDs in the public places of Piacenza from their initial numbers of 12 in 1999 to 508 by August 1, 2014 (419 in public venues and 89 in police and fire vehicles). AED growth and distribution is shown in Figure 1. AEDs used by Progetto Vita include those manufactured by Laerdal/Philips, PhysioControl and Cardiac Science.

Early in the Progetto Vita implementation (1999-2001), before broad-based public distribution of AEDs in city streets became a reality, volunteer ambulance responders (i.e., BLS) initially served as the cornerstone of the Progetto Vita system and, like all Progetto Vita responders, did not perform CPR. After June 1, 2001, however, Italian national law required that all BLS responders be incorporated under standard EMS control. Accordingly, these BLS responders prior to June 1, 2001 were trained in, and required to perform, CPR using the internationally recommended guidelines at the time. In the present report, however, all patients rescued by those same BLS volunteer ambulances switched to ILCOR guidelines and performed CPR first. Moreover, after June 1, 2001 EMS responders of any type (BLS or ALS) no longer allowed PV responders to complete use of the PV protocol and immediately performed CPR even if the AED use was mid-course. Thus, with these two changes, the Progetto Vita controlled private ambulances (i.e., BLS) decreased to zero, and the overall Progetto Vita treatment protocol fell from 38% of OOHCA to 3%. In turn, the addition of BLS vehicles to the overall EMS response increased the percentage of the EMS response from 62% to 97% in the years after June 1, 2001.

Because two parallel response systems exist in Piacenza and because Progetto Vita was only lay volunteers after June 1, 2001, the survival benefit of Progetto Vita was categorized as such only if they were allowed to follow their protocol. When Progetto Vita volunteers respond first, they quickly deploy the
AED and push the shock button, if instructed to do so by the AED. If no shock is recommended by the AED, volunteers do nothing and wait for EMS. If the standard EMS system arrives prior to Progetto Vita, Progetto Vita volunteers neither act nor interfere. If EMS arrives after Progetto Vita, the Progetto Vita volunteers immediately yield to EMS even if in the midst of awaiting or following AED commands. EMS personnel, either ACLS or BLS, perform standard ILCOR guideline directed resuscitation efforts, including interrupting Progetto Vita AED use to perform CPR.  

**Data collection**

All OOHCA were documented according to standard uniform reporting criteria. Syncope and other forms of transient loss of consciousness were excluded from the analysis. Data regarding OOHCA patient’s gender, age, location of cardiac arrest, and time from call to rescuers’ arrival were tabulated from Progetto Vita and EMS data forms. Up until 2003 for EMS response, data were retrieved from the paper forms that were completed by EMS rescuers responsible for direct, on-site, data retrieval. Time from call to rescuers’ arrival was double-checked comparing the data as registered by the rescuers with the data from the dispatcher who took the phone call. For patients rescued by Progetto Vita, this time was calculated subtracting the time recorded by the AED once it was turned on from the time of the EMS phone call. From 2003 onwards, all data were collected by the EMS dispatcher and stored digitally. ECGs from OOHCA interventions were collected from the data cards housed in all the AEDs. ECGs were classified as asystole, pulseless electrical activity, or shockable rhythm (ventricular tachycardia or ventricular fibrillation). Cardiac arrest patients following administration of cardioactive medications during an acute myocardial infarction were excluded from consideration. All OOHCA were divided into Progetto Vita or standard EMS according to the rescue team in control, as described above. Survival to hospital discharge and long-term survival data were described over this 13-year period for all OOHCA under both Progetto Vita and EMS interventions. Patient vital status up until August 1, 2014 was validated for 100% of OOHCA victims via the Italian national registry of death and review of medical records.

**Statistical analysis**

Distribution of continuous variables were described using mean ± standard deviation. Categorical variables were described using counts and percentages. \( \chi^2 \) test was used to compare dichotomous variables between the two groups. Independent sample t-test was used in order to compare mean age and time from dispatch to arrival on site between Progetto Vita and EMS. Kaplan Meier survival curves were constructed for both Progetto Vita and EMS interventions over the 13
years of follow-up.. However, because we were uncertain of our ability to fully control for the confounding factors that determine which group patients actually end up in, no formal statistical comparison of outcomes were performed. SPSS 13.0 for Windows (SPSS Inc. Chicago, IL, USA) was used for all the statistical analyses.

RESULTS

General characteristics of the population

From June 1, 2001 to August 1, 2014, 3366 OOHCA were recorded in Piacenza. Hospital survival data were available on all 3366 patients. The characteristics of the study population are reported in Table 1. Prevalence of male gender was similar between Progetto Vita and EMS groups, while patients rescued by Progetto Vita were significantly younger (68.9 ± 15.1 vs. 75.2 ± 14.5 years; \( p<0.001 \)). Mean time from dispatch to arrival was 5.3 ± 3.4 minutes for Progetto Vita volunteers and 8.8 ± 5.9 minutes for EMS (\( p<0.001 \)). Shockable rhythms were observed in 68.4% of Progetto Vita patients and 12.1% of EMS patients (\( p<0.001 \)). Progetto Vita intervened on a relatively higher number of OOHCA in public places compared to EMS (29.5% vs 9.0%; \( p<0.001 \)).

Short-term survival for Progetto Vita and for EMS

Survival to hospital admission occurred in 53 of the 95 Progetto Vita patients (55.8%) and in 511 of the 3271 EMS patients (15.6%). Survival to hospital discharge occurred in 39 of the 95 Progetto Vita patients (41.4%) and in 193 of the 3271 EMS patients (5.9%).

Long-term survival for Progetto Vita and for EMS

Survival rates for Progetto Vita and EMS at one-year, five-year and ten-year were 36.5% vs. 4.7%, 34.9% vs. 3.8%, and 31.8% vs. 2.4%, figure 2. Figures 3a and 3b show long-term survival stratified by gender. Figures 4a and 4b show long-term survival according to cardiac arrest location (home vs. public place). Estimates of survival also are significantly better for Progetto Vita AED only therapy when survival was stratified by time to respond, gender, location of cardiac arrest, and shockable rhythm. Presence of a shockable rhythm at rescuers arrival was associated with a 16.8-fold increased chance of survival to discharge. To further assess the effect of arrival time and mode of resuscitation on survival, the 95 OOHCA individuals treated by Progetto Vita were compared to the 95 fastest EMS responses to OOHCA out of the whole 3271. Mean time to arrival for Progetto Vita
was 5.3±3.4 min vs. 1.7±0.6 min for the fastest 95 EMS responses to OOHCA (p<0.001). Yet, as shown in Figure 5, the Progetto Vita model of early intervention yielded a two-fold better outcome.

**DISCUSSION**

This report summarizes a unique 16-year effort to improve resuscitation of out-of-hospital cardiac arrest in a small Italian city by greatly simplifying the bystander resuscitation process and by progressively and relentlessly encouraging and supporting the lay citizenry of Piacenza to embrace the rapid use of AEDs. The long-term survival results of Progetto Vita, 31.8% at 13 years, validate the effort.

The foundational underpinnings of Piacenza’s Progetto Vita is simple, yet iconoclastic. The Progetto Vita approach breaks from tradition in several ways. First, and foremost, Progetto Vita aims to be uncomplicated: Citizens are instructed to access and turn on a nearby AED, apply pads as directed, push a button if commanded, and do nothing else but wait. The AED controls all. Second, AEDs have been progressively added to Piacenza in ever increasing numbers. At every opportunity, more AEDs are bought with donated funds to blanket the city and decrease response times. AEDs are in grocery stores, pizzerias and coffee shops. It is rare not to see one when you walk down a street in Piacenza. Third, an ever larger number of volunteers are brought into the Progetto Vita fold. There are now over 25,000 citizen volunteers who have asked to become part of an alert populace ready to respond whenever they see someone collapse. Fourth, there is a broad based community pride in Progetto Vita. Individuals delight in their community’s success and do-it-yourself attitude. Nowhere is a community more invested in AED use than Piacenza. Citizens of Piacenza donate money; hold car and appliance raffles; and conduct bake sales to buy AEDs. Remembrances in obituaries recommend donations to Progetto Vita in lieu of flowers. A large, boisterous, annual community-wide Progetto Vita fair is held to support the project financially. Fifth, and perhaps most controversial, Progetto Vita eschews CPR. This is for four practical reasons. One, it vastly simplifies the response, focusing on the single item most likely to save a life: shocking ventricular fibrillation. Two, at the time of initiation of the trial, there was trepidation by many lay individuals to perform mouth-to-mouth resuscitation on strangers. Third, CPR, despite promotion to the contrary, is not intuitive, even with chest compression only, frequently changing in its instructions, and requiring significantly more training than using an AED. Fourth, forceful compression of the chest of a stranger, no matter the reason, commands professional discipline such as seen by paramedics which deviates greatly from what lay responders experience when confronted with the disparity between a calmly “treated” ResusciAnne and the chaos and emotional events surrounding the approach to someone who is dying.\(^8,^9\) The historical role of
AEDs and CPR by lay responders is further reviewed in the paragraphs that follow in order to put Progetto Vita into context.

The private or lay use of AEDs certainly is not unique to Piacenza, having been advocated for over 20 years. However, except for niche uses, like airplanes\textsuperscript{10,11} and casinos\textsuperscript{12} and the rare personal home use,\textsuperscript{13,14} the affect in city-wide venues has been underwhelming, even when large resources have been dedicated to the project.\textsuperscript{15} To quote the US National Institutes of Health Public Access Defibrillation (PAD) trial investigators, “To the best of our knowledge, no city has been able to provide defibrillation for the majority of OOH-CA victims within 5 min of the recognition of the event.”\textsuperscript{16} To test whether the public could respond well, the PAD investigators used more than 19,000 volunteer responders from 993 community units in 24 North American metropolitan regions.\textsuperscript{15} Responders to OOHCA were randomly assigned to one of two groups: volunteers performed CPR only until medics arrived or they did CPR and used AEDs. In PAD, the data were selectively analyzed,\textsuperscript{17,18} and showed in a subgroup of those treated that AED use by bystanders increased short-term survival to 23% from 14%, amounting to only 15 more short-term survivors out of many millions in the population over 21 months. This is good, but not as positive as one would have hoped, especially given the enormous resources, time and people committed to the project. Worse yet, the PAD infrastructure and associated lay response either went abandoned or was markedly reduced when the NIH grant monies ended. There was no lasting legacy.

Recent publications further highlight the relatively poor response to OOHCA despite expansive, widespread CPR promotion in the public.\textsuperscript{19,20} In Sweden, the country where CPR is most aggressively promoted in the general population, there is only \textasciitilde 11\% short-term survival at 30 days of follow-up.\textsuperscript{19,20} These 30 day survival numbers, although reported in 2015, really have not changed since the earliest reports of OOHCA lay response in the 1980s.\textsuperscript{21} By many measures, the results are worse than those early reports from the city of Seattle when traffic was less and response times were better.\textsuperscript{22} In fact, a recent study by Abougergi has concluded that co-morbidity, age, and gender adjusted mortality from non-traumatic cause of out of hospital cardiac arrest actually has increased over the past 15 years at an annual economic burden of \textasciitilde $1 Billion in 2010 regardless of the wide-spread teaching of CPR.\textsuperscript{23}

Despite a broad acceptance of CPR in the United States, short-term survival rates remain poor even amongst state-of-the-art EMS resuscitation systems (<10\% from 20,520 sudden cardiac arrests in 10 large EMS systems).\textsuperscript{2,4} Successful resuscitation is dominantly linked to time from collapse to shock delivery in the case of those with shockable rhythms. Each minute passed reduces the chance of survival to hospital discharge by 11\%.\textsuperscript{24} Unlike differences in CPR delivery between professional and lay providers, AED use, be it from trained medical personnel or from laypersons, does not account for any change in outcome.\textsuperscript{1}
These poor, or at best, stagnant outcomes globally, after 50 years of effort, argue for a reassessment of standard operating procedures, especially in light of Progetto Vita’s findings.

The removal of CPR from Piacenza’s lay response, in favor of speed and simplicity, certainly opens up concerns about excluding CPR and the harm that might accrue. In no way does this paper support not doing CPR. Yet, Progetto Vita presents, *prima facie*, survival results that make the counter-argument: no harm, no foul. These findings nevertheless do bring to the surface some interesting questions. Notwithstanding decades of CPR use, outcomes remain less than good. Perhaps the many post-hoc analyses purporting the differential benefit of bystander CPR may merely be the result of a quicker call by a CPR knowledgeable participant, thereby decreasing collapse to call times and indirectly improving survival unrelated to CPR: an association rather than cause and effect. Thus, it behoves us to consider CPR like any other medical therapy, and indeed CPR is a therapy, where unanticipated adverse consequences can occur despite the best of intentions. And by this, we do not merely mean breaking ribs.

Injurious sequelae from CPR are well documented. Coronary arteries can be crushed, esophagi ruptured, and livers lacerated. Krischer, et al, found that in 705 autopsies after CPR, 9.8% had coronary artery air emboli, pericardial bleeding, or lacerations of either the great vessels or the myocardium, another 18.3% manifested hemorrhage in the mediastinum, and 2.7% had abdominal organ or esophageal ruptures. These are not minor complications, any one of which could kill a patient during the resuscitation exercise or shortly thereafter, regardless of the ability to defibrillate or the status of the cardiac rhythm following CPR. In addition, aspiration of gastric content follows mouth-to-mouth ventilation in more than one fourth of patients, which in turn can lead to acute respiratory distress syndrome in hospital, adversely affected in-hospital survival. Further, the alternative of compression-only CPR, has not been shown to provide incremental acute survival benefit compared to using ventilation with compression. Finally, it has been suggested that CPR performed during organized rhythms after a shock, re-induce ventricular fibrillation in 22% of patients with sudden cardiac arrest. Conceivably, CPR during post-shock recovery could harm resuscitation prospects by re-inducing VF at a time when further cardiac hypoxia would harm an already tenuously functioning myocardium and cerebrum. There are parallels in the medical literature that make this scenario more comprehensible. Consider CPR akin to *commotio cordis*, where sternal impact causes death by inducing ventricular fibrillation. It is not unreasonable to consider CPR as comparable to repetitive *commotio cordis*. In fact, a recent case report underlined that magnetic resonance imaging can show CPR-induced cardiac damage, even when echocardiography and angiography fail to show any sign of impairment. Thus, when putting Progetto Vita in perspective, its strengths, and its weaknesses, the Piacenza effort must be assessed in the light of the reality of the
alternatives. The argument that doing nothing (i.e., not doing CPR) is worse or that retrospective evidence supports CPR, is equivalent to what has been proffered in many medical fields where a presumptive benefit from a long-lived, good-intentioned therapy gets grandfathered into practice without being put to the test via state-of-the-art randomized prospective multicenter clinical trials.\textsuperscript{26}

Study Limitations

We must consider at least eight limitations of the present study. First, Progetto Vita is unique and our findings may not be expanded outside of its home. Piacenza is a modest sized city, with a fiercely dedicated, relatively immobile citizenry and leadership. As a consequence, progress made by Progetto Vita is not lost through migration of key individuals. Further, Progetto Vita has no corporate or government control or financing; it is purely citizen run and woven into the identity of Piacenza. Extrapolating Progetto Vita to most American cities, of any size, where the population is more dynamic and less community-minded, may be a futile exercise. Nonetheless, recent work with drone delivery of AEDs may bypass some of these structural limitations and use Progetto Vita as a template, regardless of locale.\textsuperscript{38} Second, the steady increase in lay responders as well as AEDs over the years has not been manifested elsewhere. This requires community “ownership” beyond a mere research project. The dismantling of the responder architecture in the PAD trial is a case in point. Third, although Progetto Vita is prospectively conducted, the non-randomized, observational nature of our study bears the burden and shortcomings of all such observational studies.\textsuperscript{39-41} Fourth, only 3\% of all OOHCA in the city of Piacenza (95 of 3366) was rescued by Progetto Vita volunteers during the last 13 years. Although we believe we have contended with these small numbers fairly and accurately with our statistical analyses, we cannot remove the possibility that the findings would have been different had a moderate number of patients had different outcomes. Further, had the rules of engagement not been changed, Progetto Vita would have treated many more. Fifth, the Progetto Vita bystander rates of intervention may seem relatively small. However, they are indeed similar to the prevalence of OOHCA treated by laypersons using public AEDs in other countries. In a recent paper examining the nationwide dissemination of public access AEDs in Japan, 3.7\% of all cardiac arrests were treated by lay bystanders.\textsuperscript{1} In the Japanese report, survival was significantly less than that observed in our study for reasons that we believe are due to the factors discussed earlier. Sixth, we have no presenting rhythms on a significant number of the patients in our EMS population. We believe, however, that the data in this regard have no reason to be skewed from typical EMS populations. Thus, EMS survival rates, like the percentage treated by lay bystanders in the comments above, are also in line with prior reports.\textsuperscript{1,2}
Seventh, time to arrival for PV was significantly better than EMS. However, as shown in Figure 5, speed can not be used as a ready explanation given the superiority of long-term survival in the 95 Progetto Vita cases when compared to the 95 fastest EMS responses. Eighth, and perhaps most importantly, we have no definitive data to conclude that CPR is harmful, only that very good long-term survival rates can be achieved with the Progetto Vita model that does not use CPR. Any definitive statements about the value of CPR would require a prospective controlled randomized trial.

Conclusions

Progetto Vita provides the first demonstration of excellent survival from out-of-hospital cardiac arrest because of a vastly simplified response protocol coupled to a large and pervasive distribution of AEDs and an entrenched community enthusiasm and awareness. Piacenza’s minimalist approach nevertheless provides a novel model to improve survival in out-of-hospital cardiac arrest. The net gain in time to arrival that PV provides, 3.4 minutes, translates into a 35.5% increase in survival to discharge, consistent with what is already known about the effect of time.24 We believe the findings of this study, at minimum, provide hope for the broadscale dissemination of AEDs entrusted to the public. The fact that survival from OOHCA remains persistently low should encourage alternative approaches as seen in this study. We can not do worse.
TABLES AND FIGURES

Table 1. Patient characteristics.

<table>
<thead>
<tr>
<th></th>
<th>Total population</th>
<th>Progetto Vita</th>
<th>EMS</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>75.1 ± 14.5</td>
<td>68.9 ± 15.1</td>
<td>75.2 ± 14.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male gender</td>
<td>1959 (58.2%)</td>
<td>63 (66.3%)</td>
<td>1896 (58.0%)</td>
<td>0.104</td>
</tr>
<tr>
<td>Mean time to arrival</td>
<td>8.7 ± 5.9</td>
<td>5.3 ± 3.4</td>
<td>8.8 ± 5.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Location of cardiac</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>arrest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>3042 (90.4%)</td>
<td>67 (70.5%)</td>
<td>2975 (91.0%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Public places</td>
<td>324 (9.6%)</td>
<td>28 (29.5%)</td>
<td>296 (9.0%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Initial responder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLS EMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ACLS EMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presenting rhythm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shockable rhythm</td>
<td>461 (13.7%)</td>
<td>65 (68.4%)</td>
<td>396 (12.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unshockable rhythm</td>
<td>2186 (64.92%)</td>
<td>30 (31.6%)</td>
<td>2156 (65.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unknown/not assessed</td>
<td>719 (21.4%)</td>
<td>0 (0%)</td>
<td>719 (22.0%)</td>
<td></td>
</tr>
</tbody>
</table>

BLS = basic life support, vehicle staffed with individuals capable of performing CPR and using AEDs; ACLS = advanced cardiac life support. Note the categories are delineated according to which team arrived first. Or, if two teams arrived simultaneously, the event is ascribed to the senior team (ACLS>BLS>PV).
Figure 1a. Location of all AEDs of Progetto Vita within the city and in the county environ as of study close.
Figure 1b. Location of Progetto Vita’s AED inside the city of Piacenza. In blue, the ones originally present in 2001. Red dots confirm current city locations. See Figure 1a for all city and county locations.

All AED location data inserted using Map data (c) 2015 Google.
Figure 2. Cumulative survival according to intervention group. The values in parentheses are Kaplan–Meier estimates of the cumulative probability of survival at each of the 2-years follow-up step.
Figure 3a. Cumulative survival according to intervention group in female patients. The values in parentheses are Kaplan–Meier estimates of the cumulative probability of survival at each of the 2-years follow-up step.
**Figure 3b.** Cumulative survival according to intervention group in male patients. The values in parentheses are Kaplan–Meier estimates of the cumulative probability of survival at each of the 2-years follow-up step.
**Figure 4a.** Cumulative survival according to intervention group in patients who experienced OOHCA at home. The values in parentheses are Kaplan–Meier estimates of the cumulative probability of survival at each of the 2-years follow-up step.

<table>
<thead>
<tr>
<th>Years</th>
<th>PV</th>
<th>EMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. at risk</td>
<td>Kaplan–Meier estimate</td>
</tr>
<tr>
<td>0</td>
<td>67</td>
<td>2975</td>
</tr>
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<td>2</td>
<td>15 (0.279)</td>
<td>81 (0.030)</td>
</tr>
<tr>
<td>4</td>
<td>11 (0.259)</td>
<td>60 (0.027)</td>
</tr>
<tr>
<td>6</td>
<td>9 (0.259)</td>
<td>40 (0.024)</td>
</tr>
<tr>
<td>8</td>
<td>8 (0.230)</td>
<td>18 (0.019)</td>
</tr>
<tr>
<td>10</td>
<td>5 (0.230)</td>
<td>12 (0.014)</td>
</tr>
<tr>
<td>12</td>
<td>2 (0.230)</td>
<td>3 (0.014)</td>
</tr>
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</table>
Figure 4b. Cumulative survival according to intervention group in patients who experienced OOHCA in a public setting. The values in parentheses are Kaplan–Meier estimates of the cumulative probability of survival at each of the 2-years follow-up step.
Figure 5. Cumulative survival comparing the 95 Progetto Vita OOHCA victims to the fastest 95 EMS responses to OOHCA. The values in parentheses are Kaplan–Meier estimates of the cumulative probability of survival at each of the 2-years follow-up step. Response time for Progetto Vita was 5.3±3.4 minutes vs. 1.7±0.6 minutes for EMS (p<0.001).
REFERENCES


