

# Cardiac Arrest in Medical and Dental Practices

## Implications for Automated External Defibrillators

Linda Becker, MA; Mickey Eisenberg, MD, PhD; Carol Fahrenbruch, MSPH; Leonard Cobb, MD

**Background:** To determine the need for placing automated external defibrillators (AEDs) in medical and dental practices, we identified cardiac arrests at these locations.

**Methods:** Locations of cardiac arrest were abstracted from Emergency Medical Services data from January 1, 1990, through December 31, 1996. We calculated the annual incidence of cardiac arrest per type of practice.

**Results:** There were 142 cardiac arrests in medical or dental practices. Dialysis centers had a relatively high incidence of cardiac arrest ( $\geq 0.746$  per practice annually).

Cardiology, internal and family medicine, and urgent care centers had a medium incidence ( $\geq 0.01$  per practice annually). All other medical and dental practices had a low incidence ( $\leq 0.002$  annually).

**Conclusions:** Placement of 779 AEDs in the high- and medium-incidence practices would have provided treatment for 112 patients with cardiac arrest in 7 years. To provide for the 16 cardiac arrests in low-incidence practices, an additional 1928 AEDs would be required.

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**A** PHYSICIAN'S office, particularly a practice seeing older adults or patients with recognized heart disease, would seem a logical place to locate an automated external defibrillator (AED). An on-site AED would allow immediate defibrillation for patients in whom ventricular fibrillation (VF) develops, thus saving the minutes normally required for emergency medical services (EMS) personnel to arrive. We undertook a study to determine the incidence of cardiac arrest in community medical and dental practices, and to investigate the potential benefit of placing AEDs there.

### RESULTS

A total of 8088 nontraumatic arrests occurred in Seattle and King County during the study period. Of these, 142 (2%) were associated with medical and dental practices. **Table 1** shows the characteristics and outcomes of cardiac arrests compared with those in other public locations and in homes. Overall survival and survival of VF were highest in medical and dental practices. A physician or a nurse ad-

ministered defibrillation to 16 patients. Six (38%) of the 16 had converted from VF to a normal sinus rhythm on arrival of EMS, and 9 (56%) of the 16 survived to hospital discharge. This is comparable to a survival rate of 45% in the 64 patients who were administered defibrillation initially by EMS. We could not obtain survival data for 1 patient.

**Table 2** shows estimates of the incidence per practice and the number of practices in each type to yield 1 cardiac arrest per year. For all types of practices taken together, the annual incidence was 0.008, or 1 cardiac arrest per year for every 133 physicians' and dentists' practices. Dialysis centers had the highest annual incidence, with approximately 1 cardiac arrest per year among the 9 centers collectively. Cardiology practices, urgent care clinics, and family practice and internal medicine practices had a minimum incidence. All other medical and dental practices had a low incidence of cardiac arrest. There were a total of 16 cardiac arrests annually in the combined 779 high- and medium-incidence locations, or 1 cardiac arrest per 48 sites. There were 2.28 cardiac arrests annually

*From the Emergency Medical Services Division, Seattle-King County Department of Public Health (Ms Becker and Dr Eisenberg), and the Department of Medicine, University of Washington (Drs Eisenberg and Cobb and Ms Fahrenbruch), Seattle, Wash.*

## SUBJECTS AND METHODS

The study took place in Seattle and King County, Washington (combined population, 1.5 million in the 1990 census). The first EMS unit arriving for a cardiac arrest is usually a fire department vehicle, staffed by emergency medical technicians trained to use automated or manual defibrillators. Paramedics arrive several minutes later to provide advanced life support.<sup>1,2</sup>

We performed a retrospective record review of EMS run reports from January 1, 1990, through December 31, 1996. A case was defined as a patient having cardiac arrest at a community medical or dental practice and for whom defibrillation or cardiopulmonary resuscitation (CPR) was performed by EMS or professional office personnel. All cases of cardiac arrest with location marked "clinic/doctor's office" were reviewed, as well as those marked "public indoors" or "public outdoors." The address of each was looked up to determine whether it was a medical practice, and if so, what type. The cardiac arrests were due to presumed heart disease or other medical cause. Not included were 11 patients who were revived by a physician's staff using CPR only. Since patient contact was not required and no copies of medical records were needed, permission was not required from the institutional review board.

We recorded type of practice, age, sex, apparent reason for the visit, symptoms before arrest, first identified rhythm after collapse, whether collapse was witnessed by bystanders or EMS personnel, defibrillation before arrival of EMS, cause of the arrest (based on the EMS report, hospital data, and death certificate information), and outcome (death or discharge alive).

We included medical or dental practices outside hospitals. A practice was defined as 1 or more physicians (doctors of medicine or osteopathy) or dentists who used a common waiting area and registration desk. The arrests took place anywhere inside or outside the building. We

included urgent care clinics and dialysis centers, which we identified through telephone book listings and verified by calling. We excluded nursing homes, residential rehabilitation centers, and ambulatory surgery clinics. Also excluded were practices of pediatricians, pathologists, and hospital-based physicians such as emergency physicians and anesthesiologists. Alternative practices (homeopathy, naturopathy, acupuncture, and chiropractic) were not considered, because we identified no cardiac arrests in these settings.

Based on King County Medical Society data from the year 1998, there were 2044 physician members in 1235 practices. The medical society estimates that about one third of physicians in the county are not members. Therefore we adjusted the number of physicians upward by 50%, resulting in an estimated 3066 physicians in 1853 practices. We then adjusted the numbers downward to reflect the 8% fewer physicians in 1995 than in 1998, based on data from the Washington State Department of Licensing, Seattle. We used a list provided by the medical society of physicians sorted by address to count the number of practices. In 1995 there were an estimated 2821 physicians in 1705 practices. The numbers of dentists and dental practices were obtained from 1998 listings of the Washington State Dental Association, Seattle. Using the same methods as with the medical society, we estimated there were 1249 dentists in 976 practices.

We grouped practice types where cardiac arrest occurred into the following 6 categories according to frequency of occurrence: dialysis centers, cardiology practices, urgent care centers, family and internal medicine practices (including general practice and internal medicine specialties other than cardiology), all other medical specialties (dermatology, neurology, obstetrics and gynecology, occupational medicine, ophthalmology, otolaryngology, physical medicine and rehabilitation, radiology, psychiatry, surgery and surgery specialties, and urology), and dental practices. Simple arithmetic was used to calculate an incidence of cardiac arrest for each practice type.

in the 1928 sites with a low incidence, or 1 cardiac arrest per 845 sites.

The reason for the visit could be determined for 117 patients (82%). Renal dialysis was the most frequently cited (47 patients). Thirty-eight patients were described as having cardiac symptoms before the visit. Twenty-six patients were visiting the physician for medical therapy or tests and 6 were visiting a dentist for dental care. Twenty-two patients were visiting for reasons that could not be determined from the report and 3 were employees (a physician, a nurse, and a worker at a loading dock).

### COMMENT

With the exception of the dialysis centers, the incidence of cardiac arrest in medical and dental practices was considerably lower than that in other higher-incidence public locations, which had annual incidences ranging from 0.03 to 7.00.<sup>3</sup> Cardiac arrests in community medical and dental practices and in other public locations have higher

rates of witnessed cardiac arrest and bystander CPR than those occurring at home. As described previously,<sup>4</sup> patients with cardiac arrests in public have higher rates of survival of VF than those with arrests at home. This increased survival is probably the result in part of higher rates of bystander CPR.

We chose to study practices rather than individual physicians and dentists because we assumed that physicians within a practice would share a relatively expensive and infrequently used item such as an AED. Had we used the total number of physicians and dentists practicing as the denominator, the rates of cardiac arrest per physician would be considerably smaller than the rates per practice. For example, there were 55 cardiologists in 35 practices; our calculated rate of 0.06 annually per practice would be 0.03 annually per physician.

Our data support the placement of AEDs in dialysis centers. We presented these data to the local dialysis centers, and all agreed to equip their centers and train their staffs in the use of AEDs. Among the 9 dialysis

**Table 1. Characteristics of Cardiac Arrests in Medical and Dental Practices, Other Public Locations, and at Home\***

	Medical and Dental Practices	Other Public Locations	Home and Other Residences
Total No.	142	1598	6348
Average age, y	66	61	69
No. male	78/142 (55)	1291/1598 (81)	4001/6348 (63)
Witnessed by EMS	9/142 (6)	123/1598 (8)	707/6348 (11)
Witnessed by bystander	118/133 (89)	949/1366 (69)	2568/5566 (46)
Bystander-initiated CPR	121/133 (91)†	873/1498 (58)	2887/5558 (52)
Arrests due to presumed cardiac cause	111/142 (78)	1350/1598 (84)	4683/6348 (74)
Patients with initial rhythm VF	80/142 (56)	1015/1598 (64)	2067/6348 (33)
Survival to discharge	48/141 (34)‡	432/1598 (27)	678/6348 (11)
VF survival to discharge	38/80 (48)§; 29/64 (45)	382/1015 (32)	485/2067 (23)

\*EMS indicates emergency medical services; CPR, cardiopulmonary resuscitation; and VF, ventricular fibrillation. Unless otherwise indicated, data are given as number (percentage) of cardiac arrests.

†Includes CPR by medical staff.

‡One patient had unknown outcome.

§Includes 16 patients who received defibrillation from practice personnel before EMS arrival.

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centers, 20 (43%) of the 47 cardiac arrests took place in the busiest center, but the remainder were evenly distributed among the other centers. The data also support consideration of defibrillator placement in cardiology practices, urgent care centers, and internal medicine and family practice settings. It would appear there are too few cardiac arrests in dental practices and other medical specialties to justify their routine placement at this time.

A potential limitation of the study is the difficulty of determining the exact number of physicians and dentists and practices. Our estimates involve extrapolations based on historical trends and membership percentages in the medical and dental societies. Therefore, the calculated incidences of cardiac arrest in the various practices are only as accurate as the assumptions about the numbers of practices. However, we believe that the relative order of magnitude is accurate.

Failure to identify a cardiac arrest in medical and dental practices could result in underreporting and therefore a lower estimate of the number of AEDs required. The occurrence of this was probably minimal, however, since all cases of cardiac arrest for which EMS is summoned are received and reviewed in our office, and all were evaluated for location of the event.

This is not an intervention study and cannot address whether and to what extent placement of AEDs in physicians' practices will improve survival, but rather a descriptive study attempting to provide information for the rational placement of AEDs based on cardiac arrest data. Although a cost-effectiveness analysis is beyond the scope of this study, we can make some estimates. If we assume an AED costs \$3000 and has a useful life of 10 years, the AED cost is \$300 per year. Placing an AED in the 779 high- and medium-incidence locations in our community would cost \$233 700 annually. We observed 16 cardiac arrests annually in these locations. Using numbers from Table 1, 9 locations (56%) would have VF as the initially monitored rhythm. Using a discharge rate of 56% (the percentage of VF survivors who received defibrillation by medical practice personnel) we would expect 5 discharges

**Table 2. Incidence of Cardiac Arrest by Type of Practice**

Location of Arrest	No. of Practices	Arrests in 7 Years	Annual Incidence of Cardiac Arrest	No. of Practices for 1 Arrest per Year
High-incidence dialysis center	9	47	0.746	1
Medium-incidence				
Cardiology practice	35	11	0.045	22
Urgent care center	17	4	0.034	29
Internal medicine and family medicine practice	718	50	0.011	100
Low-incidence				
All other medical practices	952	10	0.002	667
Dental practice	976	6	0.001	1111
Unknown*	...	14	...	...
<b>Total</b>	<b>2707</b>	<b>142</b>	<b>0.008</b>	<b>1930</b>

\*Ellipses indicate not available.

annually, or \$46 700 per life saved. This estimate does not take into account life expectancy. If the survivors were to live 5 additional years, the cost per year of life would fall to \$9300.

Our analysis does not include an attributable benefit of practice-based AEDs compared with the existing EMS system. Of the many factors that may influence the need for AEDs, our study considers only the location and incidence of cardiac arrest. Other factors to consider are the quality and location of EMS, the response times, and the community survival rate. In many urban communities, the rate of survival of VF is currently less than 5%.<sup>5,6</sup> Clearly, every minute saved from time of collapse to defibrillation will improve survival.

Training and upkeep on hundreds of AEDs are not insignificant. An AED located within a medical practice might be used only once in many years, and yet regular training and maintenance must be performed. It is for

simplifying training and because of infrequent use that our study focuses on AEDs as opposed to traditional defibrillators. The latter are more costly and require rhythm recognition by staff, which includes not only physicians and nurses but also technicians and even parking lot attendants. The AEDs would seem more suitable for this purpose.

Our study demonstrates that medical practices can be divided into locations of high, medium, and low incidence of cardiac arrest. The frequency of cardiac arrest by type of practice in the community should guide the placement of AEDs.

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*Corresponding author and reprints: Linda Becker, MA, Emergency Medical Services Division, 999 Third*

*Ave, Suite 700, Seattle, WA 98104 (e-mail: linda.becker@metrokc.gov).*

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