Emergency CPR Instruction via Telephone

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Abstract: We initiated a program of telephone CPR (cardiopulmonary resuscitation) instruction provided by emergency dispatchers to increase the percentage of bystander-initiated CPR for out-of-hospital cardiac arrest. Cardiac arrests in King County, Washington were studied for 20 months before and after the telephone CPR program began. Bystander-initiated CPR increased from 86 of 191 (45 per cent) cardiac arrests before the program to 143 of 255 (56 per cent) cardiac arrests after the program. During the after period, 58 patients received CPR as a result of telephone instruction, 12 of whom were discharged. We estimate that four lives may have been saved by the program. A review of hospital records revealed no excess morbidity in the group of patients receiving dispatcher-assisted CPR. (*Am J Public Health* 1985; 75:47–50.)

Introduction

Short time intervals from collapse to initiation of cardiopulmonary resuscitation (CPR) and to the delivery of advanced cardiac life support (airway management, drug therapy, and defibrillation) are key factors in survival from out-of-hospital cardiac arrest.[1] In communities with advanced cardiac life support systems, the percentage of patients discharged following cardiac arrest approaches 30 per cent if CPR is initiated within the first four minutes following the arrest.[1]

To increase the chance of rapid CPR initiation, citizen CPR-training programs have been implemented throughout the country. Yet even in communities with large scale training programs, a majority of cardiac arrests do not have CPR initiated by a bystander.[2] The majority of cardiac arrest patients are men over the age of 50,[3] and most cardiac arrests (75 per cent) occur in the home.[4] In contrast, the majority of individuals who voluntarily seek CPR training are quite young (average age 33 in Seattle) and the male/female ratio is roughly equal.[5] Spouses of persons at highest risk are not trained[4] and physicians have not been aggressive in ensuring that family members of their patients obtain training.[6]

One method to increase the percentage of bystander-initiated CPR is for CPR instruction to be provided by emergency dispatchers at the time a cardiac arrest is reported. In an earlier report,[7] we described the initial development and evaluation of a telephone CPR instruction protocol that can be given by emergency dispatchers to untrained bystanders. We found, in simulated cardiac arrest settings, that it was possible to instruct previously untrained community volunteers with a brief telephone message and that the resulting CPR was reasonably effective and comparable in quality to that performed by volunteers who had been formally trained. Based on these findings, we instituted a telephone-CPR program in the emergency communication centers in King County, Washington. To evaluate the program, we addressed four questions: 1) Does a telephone CPR program increase the percentage of cardiac arrest episodes in which bystanders initiate CPR?; 2) Does survival from cardiac arrest increase?; 3) Is such a program safe?; and 4) What is the attitude of callers who receive telephone instructions?

Methods

This study was conducted in suburban King County, Washington, adjacent to Seattle. The 2,000 square mile suburban and semi-rural study area has a population of approximately 700,000. Eight emergency communication centers coordinate a tiered response system for emergency medical services. Primary response to rescue and medical emergencies is provided by fire department emergency medical technician (EMT) personnel with a secondary response provided by paramedic personnel. The average EMT response time is four minutes; the average paramedic response time is 10 minutes.

Study Design

The study was conducted prospectively over a 20-month period from May 6, 1981 to December 31, 1982. Data collection began two months prior to implementation of the telephone CPR program. Implementation of the program among the eight communication centers was staggered with personnel from the first center trained in July 1981 and personnel from the last center in June 1982. Because all dispatchers in any given center could not be trained at the same time, we excluded data obtained during each center's training period, generally four to six weeks for each center. Dispatchers were trained to deliver a formal instruction message designed to assist bystanders in administering CPR. The message consisted of three parts: identification of a cardiac arrest, ventilation instructions, and chest compression instructions. The instructional portion of the message could be delivered in approximately 1.5 minutes.* The training program included practice in delivery of the message and review of actual communication recordings. Before the program, most dispatchers had not had CPR training.

Case Definition

A case was defined as a person with out-of-hospital cardiac arrest due to underlying heart disease, who received cardiopulmonary resuscitation. Etiology was determined from reports of emergency agency runs, autopsy reports, and death certificates. Other causes of cardiac arrest were

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*A copy of the training curriculum and CPR message may be obtained from the authors.

excluded to provide as homogenous a population as possible. Since the focus of the study was to evaluate telephone CPR instruction, only cardiac arrests which occurred before arrival of emergency personnel were included. Cases were grouped into those occurring before the telephone CPR program began at each dispatch center (before period) and those occurring after the program began (after period).

Cases were classified on the basis of whether CPR was initiated by emergency personnel, by bystanders without benefit of telephone CPR instruction, or by bystanders with benefit of dispatcher CPR instruction. A case was considered to be a dispatcher-assisted CPR case: 1) if the dispatcher gave CPR instruction on their own initiative during the before period and by protocol during the after period; and 2) if the caller attempted ventilations and chest compression as a result of the instruction. If only ventilations occurred due to the rapid arrival of EMS personnel, the case was still considered dispatcher-assisted.

Data Collection

Cardiac arrest cases were identified from reports of fire department aid unit runs. These reports, along with reports of paramedic runs and information regarding hospital admission and discharge, are routinely collected by the King County Emergency Services Division as part of an ongoing information system. In addition, communication center tape recordings of cardiac arrest calls were systematically reviewed. Telephone interviews were conducted with the person who reported the cardiac arrest and other bystanders who may have initiated or participated in the administration of CPR. Information collected from interviews included events surrounding the cardiac arrest, characteristics of the bystander, previous CPR training, and impressions of telephone CPR program. Medical records and autopsy records of patients receiving CPR during the period after initiation of the telephone CPR program were reviewed to determine CPR-associated morbidity. It was impossible to obtain communication center tapes or conduct interviews in 35 before and 26 after cases and therefore we could not determine whether instructions had been offered. After deleting these cases, there were 191 cases in the before period and 255 cases during the after period.

Statistical Analysis

Data analysis was based on univariate techniques; differences between the two groups are represented by 95 per cent confidence intervals (CI) about the mean difference. A logistic model that controlled for time and age factors was used to estimate expected survival for cases involving telephone CPR instruction.

Results

• Does a telephone CPR program increase the percentage of cardiac arrest episodes in which bystanders initiate CPR?

The percentage of total bystander-initiated CPR (bystander CPR plus dispatcher-assisted CPR) increased from 45 per cent (86/191) before the program to 56 per cent (143/255) after the program (difference: 11.1 per cent, 95 per cent CI ± 9.3 per cent). Increases occurred at each of the eight dispatch centers. Emergency service factors associated with the incident and demographic characteristics of cases before and after the program are shown in Table 1.

During the after period, telephone instruction was offered by the dispatcher in 98 of 255 cases (38 per cent). Failure to offer CPR instruction resulted from: communication errors in 49 cases (19 per cent), dispatcher errors in 34 cases (13 per cent), and from other or unknown reasons in 74 cases (29 per cent). (Percentages do not add up to 100 owing to rounding.) Communication errors usually involved inability by the caller or dispatcher to differentiate normal breathing from agonal respirations. Dispatcher errors included misinterpretation or misunderstanding of the callers' responses or simply forgetting to follow the message protocol. Other reasons included a variety of situations such as the patient was located too far from the phone or there was a newly hired dispatcher not trained in the program.

Of the 98 callers offered telephone CPR instruction, 58 (59 per cent) accepted the offer. Of the 40 callers who did not accept the offer, 10 (10 per cent) already knew CPR, 22 (22 per cent) refused, five (6 per cent) declined because they heard the fire department units arriving, and for three (3 per cent) the reasons were unknown. Advanced age and poorer health were associated with refusal. The average age of callers accepting the instruction was 51 years (SD 16 years) compared to 57 years (SD 16) among callers refusing. The self-reported health of those accepting the instruction was excellent, 56 per cent; good, 34 per cent; fair, 7 per cent; and poor, 0 per cent. Among those refusing instruction, these percentages were 24 per cent excellent, 47 per cent good, 12 per cent fair, and 18 per cent poor.

The dispatchers gave both ventilation and compression instructions to 41 (71 per cent) of the 58 cases where instructions were accepted. In the remaining 17 cases, only the first part of the message (ventilations) was in progress or completed. Failure to complete the instructions was almost always due to arrival on the scene of emergency personnel. Mean response time for complete instruction cases was 5.1 (SD 2.2) minutes versus 3.7 minutes (SD 1.4) for cases with incomplete instruction.

The mean time to present complete instructions took 2.4 (SD 1.6) minutes and respondents continued to perform CPR for a mean total (during instruction and after instruction) of 4.3 (SD 3.0) minutes.

• Does telephone CPR increase survival from cardiac arrest?

Survival (discharge from hospital) is shown in Figure 1. During the before period dispatchers attempted to improvise

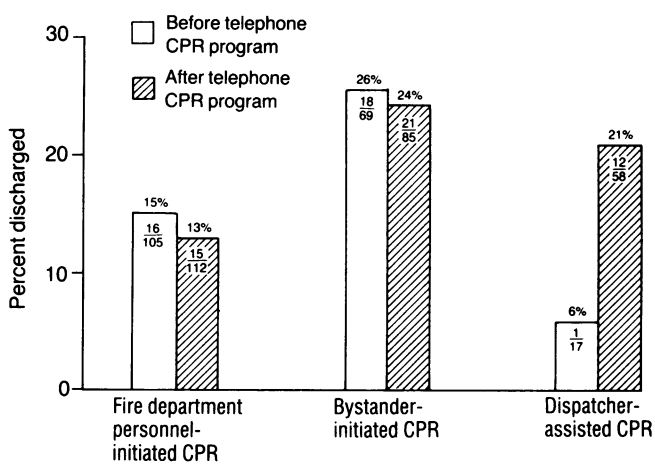

FIGURE 1—Per Cent Discharged following Out-of-hospital Cardiac Arrest before and after Telephone CPR Program

TABLE 1—Emergency Service Factors and Demographic Characteristics of Cases Before and After Telephone CPR Program

	Before Telephone CPR Program	After Telephone CPR Program	Difference (± 95% CI)
No. of cases	191	225	
No. (%) of fire department-initiated CPR	105 (55%)	112 (44%)	
No. (%) of bystander-initiated CPR	86 (45%)	143 (56%)	+11.1% (± 9.3%)
No. (%) of bystander-assisted CPR	69 (36%)	85 (33%)	−2.8% (± 8.9%)
No. (%) of dispatcher-assisted CPR	17 (9%)	58 (23%)	+13.8% (± 6.5%)
Mean age of patient (SD)	65 (± 12)	66 (± 12)	+1.5 (± 2.3)
% male of patients	78	70	−7.3% (± 8.2%)
Mean age of callers (SD)	54 (± 16)	53 (± 17)	−1.1 (± 3.7)
% male of callers	19	30	+10.8% (± 9.6%)
% of cardiac arrest at home	83	85	+1.7% (± 7.4%)
Mean response time of EMT unit, min. (SD)	4.5 (± 2.0)	4.5 (± 2.2)	+0.01 (± 0.50)
Mean response time of paramedic unit, min. (SD)	9.0 (± 4.0)	8.2 (± 3.5)	−0.76 (± 0.91)

CPR instruction, there was one survivor among 17 cases (6 per cent). In the after period when there was a standardized message and training program, there were 12 survivors among 58 cases (21 per cent). Survival was similar in fire department personnel and bystander-initiated CPR cases during the before and after periods.

It is possible to estimate the expected survival rate among the dispatcher-assisted CPR group assuming that dispatcher assisted CPR had no effect, that is, if the fire department EMTs were assumed to be the first persons to begin CPR. This "no effect" estimate of survival was obtained from logistic regression analysis of all telephone CPR cases during the after period. This analysis allows us to control for a number of previously identified factors associated with survival[8] in the following formula:

$$\text{Expected survival rate if dispatcher assisted CPR has no effect.} = \frac{1}{3.27 + 0.17\,(\text{Time from collapse to EMT arrival}) + 0.04\,(\text{Time from collapse to paramedic arrival}) + 0.05\,(\text{age})}$$

Among the 58 cases receiving dispatcher assisted CPR during the after period, there were 31 cases in which collapse was witnessed and times to arrival of EMT and paramedic units could be determined. Of these 31 cases, 10 survived. The expected number of survivors in this group of 31, under the hypothesis that dispatcher-assisted CPR had no effect, was six. The actual number of 10 suggests that four lives in approximately one year may have been saved by the program. The sample size of 31 cases is too small to adequately test the hypothesis (95 per cent confidence: 4 ± 12.1).

In this study, 22 of the 58 people who performed CPR as a result of dispatcher assistance had received prior CPR training. This training, however, does not explain the effectiveness of telephone CPR because survival was actually less

TABLE 2—CPR-associated Morbidity following Out-of-hospital Cardiac Arrest by Who Performed CPR*

	CPR Performed by		
	Fire Department Personnel	Bystander plus Fire Department Personnel	Dispatcher-Assisted CPR + Fire Department Personnel
No. of cases reviewed	46	42	18
No. with broken ribs	4	2	1
No. with flail chest	2	1	1
No. with pneumothorax	0	1	1
No. with gastric distention	1	2	1
No. with stomach/liver laceration	0	1	0

*Only patients receiving CPR after the telephone CPR program was initiated are included.

in the group previously trained (3/22 = 14 per cent), than in the telephone CPR group never trained (9/36 = 25 per cent).

• Is a telephone CPR Program safe?

Hospital records were examined during the after period to determine if patients receiving dispatcher-assisted CPR had increased morbidity compared to patients with bystander-initiated CPR and to patients with fire department initiated CPR. Patients with dispatcher-assisted CPR and bystander CPR received additional CPR by fire department and paramedic personnel. Thus, it is not possible to determine who was responsible for any morbidity that did occur among the dispatcher-assisted CPR and bystander CPR groups. CPR-associated morbidity is shown in Table 2. There was a low proportion of subjects with broken ribs in all three groups. Complications such as flail chest or pneumothorax occurred infrequently. The most serious complications were a stomach and a liver laceration which occurred in a man who received bystander CPR (without dispatcher assistance) from multiple individuals prior to fire department arrival. The overall incidence of complications were similar in all three groups.

• What is the attitude of callers who receive telephone instructions?

Fifty-five of 58 callers during the after period who performed CPR with dispatcher assistance were interviewed. Eighty-four per cent thought the program was an excellent idea and 89 per cent believed the instructions were very understandable. Every person interviewed stated they were glad to have been able to perform CPR.

Discussion

CPR training programs have done much to ensure bystander-initiated CPR. In the Seattle and suburban King County area, over 250,000 people have received CPR training. Despite this large number of trained people, our study observed that a minority of cardiac arrests (45 per cent) received bystander CPR during the before period. The telephone CPR program increased the percentage to 56 per cent. There were numerous cases, however, where poor communications or errors in interpretation prevented the message from being offered. This experience suggests that further training or in-service review could increase the number of cases assisted by dispatchers. It is worthwhile to note that 100 per cent bystander CPR is probably unattainable as there were 22 cases where the caller refused the offer of help. Callers refusing were older and more physically infirm compared to those accepting the offer.

Shortening the time to initiation of CPR increases the likelihood of survival.[9] Even in instances in which there is insufficient time for the full message to be given valuable time is saved.

This study has demonstrated that a program to provide telephone CPR instructions can increase the percentage of bystander-initiated CPR for cardiac arrest. The program appears safe and may have been responsible for saving several lives.

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In the Journal—74 Years Ago

No one need be killed on a grade crossing but that is no reason why grade crossings should be permitted. The future demands not restriction of disease but abolition; not the protection of the individual by individual effort, but the removal of the need for protection by governmental action.

—Hill HW: Public health—past and future. Am J Public Health 1912; 2:871–874.