Interdisciplinary ICU Cardiac Arrest Debriefing Improves Survival Outcomes*

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Objective: In-hospital cardiac arrest is an important public health problem. High-quality resuscitation improves survival but is difficult to achieve. Our objective is to evaluate the effectiveness of a novel, interdisciplinary, postevent quantitative debriefing program to improve survival outcomes after in-hospital pediatric chest compression events.

Design, Setting, and Patients: Single-center prospective interventional study of children who received chest compressions between December 2008 and June 2012 in the ICU.

Interventions: Structured, quantitative, audiovisual, interdisciplinary debriefing of chest compression events with front-line providers.

Measurements and Main Results: Primary outcome was survival to hospital discharge. Secondary outcomes included survival of event (return of spontaneous circulation for ≥ 20 min) and favorable neurologic outcome. Primary resuscitation quality outcome was a composite variable, termed “excellent cardiopulmonary resuscitation,” prospectively defined as a chest compression depth ≥ 38 mm, rate ≥ 100/min, ≤ 10% of chest compressions with leaning, and a chest compression fraction ≥ 90% during a given 30-second epoch. Quantitative data were available only for patients who are 8 years old or older. There were 119 chest compression events (60 control and 59 interventional). The intervention was associated with a trend toward improved survival to hospital discharge on both univariate analysis (52% vs 33%, p = 0.054) and after controlling for confounders (adjusted odds ratio, 2.5; 95% CI, 0.91–6.8; p = 0.075), and it significantly increased survival with favorable neurologic outcome on both univariate (50% vs 29%; p = 0.036) and multivariable analyses (adjusted odds ratio, 2.75; 95% CI, 1.01–7.5; p = 0.047). Cardiopulmonary resuscitation epochs for patients who are 8 years old or older during the debriefing period were 5.6 times more likely to meet targets of excellent cardiopulmonary resuscitation (95% CI, 2.9–10.6; p < 0.01).

Conclusion: Implementation of an interdisciplinary, postevent quantitative debriefing program was significantly associated with improved cardiopulmonary resuscitation quality and survival with favorable neurologic outcome. (Crit Care Med 2014; 42:1688–1695)

Key Words: cardiac arrest; cardiopulmonary resuscitation; chest compression; quality

Cardiac arrest is a major public health problem with 200,000 in-hospital cardiac arrest resuscitations each year in the United States (1, 2). Importantly, quality of cardiopulmonary resuscitation (CPR) performed during resuscitations frequently does not meet recommended guidelines (3–5). In addition, wide variability in duration of resuscitations and survival outcomes further suggest opportunities for improvement (6). Because CPR quality is associated with survival (4, 7–10), interventions to improve quality of CPR are a promising method to improve cardiac arrest outcomes.
Approaches to improve CPR quality include standard resuscitation courses, automated real-time corrective feedback devices, and structured postresuscitation debriefing. Although standard courses are the mainstay of ongoing life support training and maintenance of certification, evidence that courses improve outcomes is modest (11–13). Automated real-time corrective feedback devices incorporated into monitor-defibrillator systems have been moderately effective to improve psychomotor aspects of basic life support (i.e., chest compressions [CCs] and ventilation delivery) (14, 15), yet data demonstrating improved long-term outcomes are limited (16). Structured postresuscitation debriefing is a comprehensive review of resuscitation efforts, including quantitative review of CPR variables. Interestingly, structured postresuscitation debriefing for physicians who were involved in resuscitations has been effective at improving CPR quality and short-term survival; however, its implementation has not been associated with higher rates of survival to hospital discharge or survival with favorable neurologic outcome (17).

To improve resuscitation performance by the entire resuscitation team, we developed a novel interdisciplinary, care-environment–targeted, postevent quantitative cardiac arrest debriefing program (18). Because over 90% of pediatric in-hospital cardiac arrests occur in ICUs (19), we focused our efforts on the interdisciplinary ICU team including physicians, nurses, and respiratory therapists. In a prospective quality improvement intervention, we compared quantitative resuscitation quality and patient outcomes before and after implementation of this novel postarrest quantitative debriefing program. We hypothesized that our intervention, by improving the resuscitative care provided by the entire interdisciplinary team, would improve cardiac arrest survival outcome.

MATERIALS AND METHODS

Design

This is a prospective quality improvement interventional trial using historical controls to evaluate the effect of interdisciplinary, postevent quantitative cardiac arrest debriefing program to improve survival outcomes and CC quality when CPR-recording, feedback-enabled defibrillators are already deployed. Historical controls were resuscitated between December 2008 and June 2010 (18 mo). Events occurring during a 6-month debriefing program run-in period were censored. Resuscitations from December 2010 through June 2012 (18 mo) were considered the intervention group (Fig. 1).

Institutional Review Board at the Children’s Hospital of Philadelphia approved this study protocol, including consent procedures, as well as the prospective in-hospital cardiac arrest database that provided survival outcome data. Data collection procedures were completed in compliance with guidelines of the Health Insurance Portability and Accountability Act.

Study Setting

The study hospital is an academic, tertiary care pediatric facility with 516 inpatient beds. The ICU is a combined medical-surgical unit excluding cardiac surgical patients with 55 beds and ~3,000 admissions per year. The team leader for ICU cardiac arrests is either an ICU fellow trainee or an attending physician, although an attending physician is present for all arrests. In addition to the fellow and attending, ICU response team comprises 3–4 registered nurses, 1–2 respiratory therapists, and 1–2 resident physicians. A critical care attending physician is in hospital 24 hours per day and 7 days per week. All ICU physicians, respiratory therapists, and nurses are pediatric advanced life support and/or advanced cardiovascular life support certified and participate in frequent mock code and rolling refresher CPR training.

Study Population

All consecutive CC events in the ICU during designated study periods were included in the analysis, with 100% data capture and no exclusions. To ensure that CC delivery was indicated in events less than 1 minute in duration, intensive review of the cardiac arrest documentation, monitor output, and interview of bedside providers was completed. Because CPR-recording and feedback-enabled monitor/defibrillators are Food and Drug Administration approved only for use in children 8 years old or older, quantitative CPR quality analysis is limited to this subset of CC events. Of note, all events of this subset were receiving invasive mechanical ventilation and continuous CCs (i.e., not coordinated with ventilations) at time of quantitative CPR quality assessment.

Institutional Resuscitation Care Practices

In both control and intervention groups, Heartstart MRx defibrillator with Q-CPR option (Q: Quality), jointly designed by Philips Health Care (Andover, MA) and Laerdal Medical (Stavanger, Norway), was used to collect quantitative CPR/resuscitation data and provide real-time feedback if CPR was not meeting 2005

Figure 1. Study diagram indicating resuscitation care practices. Censor period was a transition of 6 mo at the initiation of the project to allow for wash in time for providers to attend debriefing sessions. CPR = cardiopulmonary resuscitation.
American Heart Association (AHA) guidelines (5). Additionally, this monitor/defibrillator stores audio recording of the resuscitation to review team dynamics. Resuscitation data were also obtained from central monitoring printouts (e.g., arterial catheters and end-tidal carbon dioxide tracings) and code sheet documentation (18). Resuscitation team composition, in-hospital critical care attending, mock code program, rolling refresher training program, and training targets for CC excellence (CC depth ≥ 50 mm, rate ≥ 100/min, ≤ 10% of CCs with leaning, and a CC fraction more than 90% during a given 30-second epoch) were unchanged during the entire study period. It is important to note that the target for CC depth was increased with release of the 2010 CPR guidelines in October 2010 (2005, ≥ 38 mm; 2010, ≥ 50 mm). However, at our institution, we established that actual CC can be overestimated by as much as 13 mm when CPR-recording defibrillators are used on soft ICU mattresses (20), and we were targeting our training programs to exceed 50 mm well before release of the 2010 guidelines, encompassing all of the control period in this study.

**Intervention**

Comprehensive description of the intervention can be found in our 2012 publication quantitatively evaluating program content (18). Briefly, interdisciplinary team debriefings were conducted within 3 weeks of a CC event. Structured debriefing sessions were led by critical care fellows (C.Z. or H.W.) and supervised by an attending physician with content expertise in resuscitation care (V.M.N., R.A.B., or R.M.S.). Attendees included critical care attending and fellow physicians, resident trainees, advanced practice nurses, registered nurses, respiratory therapists, and consultant services relevant to the discussion presented. There were 25 ± 12 attendees at debriefings. Debriefings were scheduled during usual educational conferences and were advertised to ICU staff via e-mail and flyers. Any ICU provider could attend educational reviews, and attendance was purposefully not limited to providers who participated in the actual resuscitation event. During debriefing sessions, a basic assumption is present that all participants have the best interest of the patient in mind. This emotionally safe learning environment is key to participation and learning.

Using Microsoft PowerPoint (Microsoft, Redmond, WA) for the presentations, the structure of each debriefing was as follows: 1) patient history; 2) pertinent prearrest studies (e.g., radiographs and laboratories); 3) quantitative resuscitation data; and 4) patient outcome and summary. Quantitative resuscitation data could have included any or all of the following: arterial blood pressure and capnography tracings, telemetry and defibrillator printouts, resuscitation records, and defibrillator audio recordings. In the subset of patients who are 8 years old or older, these data were supplemented with quantitative CC rate, depth, fraction, and leaning from the CPR-recording defibrillator. Supporting literature was presented and discussed with particular attention to studies demonstrating improved patient outcomes (18).

**Outcome Variables**

**Survival Outcomes.** Primary outcome was survival to hospital discharge. Prospectively designated secondary outcomes were survival with favorable neurologic outcome and survival of event, defined as return of spontaneous circulation (ROSC) for more than or equal to 20 minutes. Favorable neurologic outcome was defined using previously validated pediatric cerebral performance category score (PCPC) recommended by Utstein guidelines and defined as a score of 1–3 at discharge or no change compared with preadmission baseline PCPC status (21–23). As per the international guidelines (22), ROSC is reported for each CPR event. Survival to discharge and favorable neurologic outcomes among survivors were reported for the index (or first) CPR event for each patient because a patient can only survive to discharge once per hospitalization (22).

**Resuscitation Quality (Subjects 8 Years Old or Older).** Quantitative CPR and electrocardiographic data were downloaded from MRx monitor/defibrillators within 24 hours of each event. CPR quality variables included CC rate (CC/min) and depth (mm), CC fraction (i.e., the percentage of time during a CPR epoch that compressions are provided), and percentage of CC with significant leaning (> 2.5 kg) (24, 25). In accordance with previous publications on CPR quality, an average of each variable was calculated for each 30-second epoch of resuscitation (5). The following a priori thresholds for a given epoch defined high-quality CPR: rate ≥ 100/min, depth ≥ 38 mm, CC fraction > 90%, and ≤ 10% of compressions with leaning (5, 26, 27). Primary resuscitation quality outcome of the study was a composite dichotomous variable of “excellent CPR,” defined as having all four individual variables within target. Even though our training programs were targeting 50 mm before release of the 2010 guidelines, depth threshold for the comparative analysis was more than or equal to 38 mm, as recommended in 2005, to mitigate the potential advantage the interventional period would have had regarding this variable. Particularly, the software of the CPR feedback-enabled defibrillators was not updated to provide audiovisual feedback to 50 mm until January 2012, a year into the interventional period.

**Statistical Analysis**

A Microsoft Windows–based software program, Q-CPR Review (Version 2.1.0.9; Laerdal Medical), was used for initial examination and extraction of quantitative CPR quality data in the subset of children 8 years old or older. Statistical analysis was completed using Stata (Version 12.0; StataCorp, College Station, TX). Assuming a 17% baseline rate of survival to hospital discharge (28), and an absolute improvement in survival to 37% with implementation of debriefing (effect estimate similar to improvements seen in adult short-term survival) (17), pilot data indicated that enrollment to achieve 80% power would be attained within 18 months based on historical cardiac arrest rates at our institution.

Standard descriptive summaries, appropriate for underlying distribution of variables, were calculated. In subsequent regression analyses, the main independent variable was the
study period: control versus intervention. Logistic regression was used to evaluate the effect of the intervention on survival outcomes, adjusting for effects of age (categorical) (29), gender, and first documented rhythm, based on established associations with survival (28–30). Potential confounding variables differing between periods at a significance cutoff of a p value less than 0.10 were also included. In the CPR quality analysis model, to control for within-event correlation of CPR epochs, the effect of the intervention was assessed using generalized estimating equations.

RESULTS
During the study, a total of 120 CC events occurred, 119 with chart review confirmed need for CCs (60 control and 59 interventional). Index events were defined as first arrest for a subject if they had more than one in-hospital arrest in the study period. Of these events, 52 were index events in the control period and 42 in the interventional period. One index event occurred during the censor period and was not included (Fig. 2). Vasoactive infusions at time of index arrest were more common during the control period. Additionally, initial documented rhythm differed significantly between the two periods (Table 1). Measured postresuscitation care variables were not different between the two groups (Table 2).

The intervention was associated with a trend toward improved survival to hospital discharge on both univariate analysis (52% vs 33%, p = 0.054) and after controlling for potential confounders (age, gender, first documented rhythm, and presence of vasoactive infusions at index arrest; adjusted odds ratio [aOR], 2.5; 95% CI, 0.91–6.8; p = 0.075). Notably, the debriefing intervention was associated with improved survival with favorable neurologic outcome on both univariate (50% vs 29%, p = 0.036) and multivariable analyses (aOR, 2.75; 95% CI, 1.01–7.5; p = 0.047). ROSC did not significantly differ between the groups (univariate, 81% vs 72%; p = 0.21; aOR, 1.55; 95% CI, 0.61–3.97; p = 0.36) (Fig. 3).

CC quality was superior during the debriefing intervention period compared with the preintervention control period (Fig. 4). There were 427 epochs collected during the control period and 215 epochs during the interventional period. With implementation of debriefing, the percentage of epochs meeting prospectively designated quality targets improved (mean [SE]) for rate (90 [2] vs 71 [2]), depth (91 [2] vs 81 [2]), CPR fraction (82 [3] vs 64 [2]), and excellent CPR (61 [3] vs 29 [2]) (p < 0.01 for all comparisons). After controlling for within-event correlation and the effect of duration of CPR, CCs during the debriefing period were more likely to meet quality targets for rate (odds ratio [OR], 5.9; 95% CI, 1.4–25.3), CPR fraction (OR, 2.2; 95% CI, 1.4–3.6), and excellent CPR (OR, 5.0; 95% CI, 2.2–11.4) (p < 0.02 for all comparisons).

DISCUSSION
In this prospective quality improvement interventional trial using historical controls, implementation of an interdisciplinary, postevent quantitative cardiac arrest debriefing program was associated with improved CPR quality and substantially higher survival with favorable neurologic outcome after in-hospital CC events, which increased to 50% compared with 29% in the preintervention period. Impressively, this occurred in spite of an initial rhythm profile in the intervention period that would be expected to be associated with worse outcomes (more pulseless electrical activity/asystole and less shockable rhythms) (28, 30).

Previous CPR real-time feedback and resuscitation team debriefing studies in adults showed improvements of CPR elements (CC rate, depth, CC fraction), with modest improvements in short-term survival (14, 15, 17). Our study using a novel, quantitative interdisciplinary debriefing program resulted in improvements of CPR elements to near or above 90% compliance with AHA guidelines (31). The educational program evaluated is novel, debriefing was interdisciplinary, and all ICU providers were invited to participate, rather than only those involved in the event. In contrast, previous investigations focused on debriefing physician trainees/physician code team leaders who were involved in the actual specific resuscitation event that was being reviewed. Although previous approaches were appropriate as a postevent educational experience for

Figure 2. Utstein style diagram. *One patient had index event during censor period and was not included in survival to hospital discharge or favorable neurologic outcome among survivors. CPR = cardiopulmonary resuscitation, CC = chest compression, ROSC = return of spontaneous circulation.
those conveniently available (i.e., individual physician trainees on that rotation), debriefings did not necessarily help other personnel who would be likely to be involved in the next CPR event in that setting, limiting effectiveness of the intervention.

As per our a priori hypothesis, improvements in CC quality associated with the debriefing intervention provide a biologically plausible mechanism for improvements in survival with favorable neurologic outcomes. We believe that nonsignificant improvements in ROSC are also not unexpected, as a portion of those that receive CPR will not have ROSC due to severe nonreversible underlying medical conditions. Additionally, this is also partly explained by a “ceiling” effect given our high starting ROSC rate of 72%. Stated another way, we were simply underpowered for this outcome. If we would have designed the study with ROSC as the primary outcome, assuming a baseline ROSC rate of 72%, we would have had to enroll 85 events in each period for 80% power to detect an increase in ROSC to 90%, a rate that far exceeds any published to date (19, 32).

Mechanistically, an alternate explanation for nonsignificant increases in ROSC is that CC quality is most likely to be associated with systolic blood pressure (33), a driving force of cerebral perfusion pressure, whereas ROSC is primarily determined by diastolic blood pressure, a driving force of myocardial perfusion pressure. Therefore, although speculative, improvements in CPR mechanics may have resulted in superior cardiac output and blood flow to the brain (34, 35), increasing the likelihood

### TABLE 1. Subject and Index Cardiac Arrest Event Data

| Variable                                           | Control       | Intervention  | p  |
|----------------------------------------------------|---------------|--------------|----|
| Age (yr), median (IQR)                             | 2 (0.7, 11)   | 1 (0.5, 8)   | 0.19 |
| Sex: male, n (%)                                   | 27 (52)       | 17 (40)      | 0.30 |
| Age category, n (%)                                | 0.59          |              |    |
| Infant (1 mo to < 1 yr)                            | 17 (33)       | 18 (43)      |    |
| Younger child (1 yr to < 8 yr)                     | 18 (35)       | 13 (31)      |    |
| Older child (8 yr to < 18 yr)                      | 17 (33)       | 11 (26)      |    |
| Interventions at time of index arrest, n (%)       |               |              |    |
| Arterial catheter                                  | 24 (46)       | 17 (40)      | 0.58 |
| Vasoactive infusion                                | 28 (54)       | 12 (29)      | 0.014 |
| Mechanical ventilation                             | 38 (73)       | 30 (71)      | 0.86 |
| Prearrest systolic blood pressure low (mm Hg), mean (sd) | 86 (21)   | 90 (19)      | 0.36 |
| Preexisting conditions, n (%)                      |               |              |    |
| Sepsis                                             | 3 (6)         | 4 (10)       | 0.49 |
| Trauma                                             | 2 (4)         | 1 (2)        | 0.69 |
| Immediate cause of arrest, n (%)^                 |               |              |    |
| Respiratory failure                                | 44 (85)       | 33 (79)      | 0.45 |
| Inadequate airway/obstructed airway                | 8 (15)        | 5 (12)       | 0.77 |
| Hypotension/shock                                  | 26 (50)       | 25 (60)      | 0.36 |
| Electrolyte abnormality                            | 14 (27)       | 12 (29)      | 0.86 |
| Initial rhythm, n (%)                              | 0.026         |              |    |
| Bradycardia                                        | 34 (65)       | 27 (64)      |    |
| Asystole/pulseless electrical activity             | 9 (17)        | 14 (33)      |    |
| Ventricular fibrillation/pulseless ventricular tachycardia | 9 (17)  | 1 (2)        |    |
| Time of arrest, n (%)                              | 0.65          |              |    |
| Night/weekends (11 PM–6:59 AM)^                    | 26 (50)       | 23 (55)      |    |
| Duration of cardiopulmonary resuscitation (min), median (IQR) | 3 (2, 18) | 3.5 (1, 11) | 0.74 |

IQR = interquartile range.

^Immediate cause of arrest included all characteristics present at the time of arrest; therefore, it adds to more than 100%.

Weekend indicates time between Friday 11 PM and Monday 6:59 AM.

Italicized values indicate statistical significance (p < 0.05).
of improved longer term survival and favorable neurologic outcomes without substantial change in ROSC.

These improvements were dependent on having an entire team involved (nurses, respiratory therapists, physicians, and trainees) and changing the culture of the care environment to further encourage the delivery of high-quality CPR. Notably, our intervention to improve CPR outcomes focused on ICU personnel because this relatively limited group of providers is involved in most in-hospital cardiac arrests. In-hospital pediatric ward CPR is becoming increasingly rare (19) and

| Selected Postresuscitation Variables                  | Control | Intervention | p    |
|-------------------------------------------------------|---------|--------------|------|
| Hemodynamic                                           |         |              |      |
| Vasopressor score maximum, median (IQR)a              | 10 (0, 30) | 5 (0, 13) | 0.12 |
| Temperature                                           |         |              |      |
| Maximum, median (IQR)a                               | 37.1 (36.4, 37.6) | 37.2 (37, 37.6) | 0.50 |
| Minimum, median (IQR)a                               | 35.8 (33.8, 36.4) | 36 (34.7, 36.2) | 0.74 |
| ≥ 38.5, n (%)                                        | 4 (12) | 4 (12) | 0.99 |
| Therapeutic hypothermia (32–34°C), n (%)              | 2 (5) | 4 (11) | 0.43 |
| Glucoseb                                              |         |              |      |
| Maximum, median (IQR)                                 | 163 (111, 245) | 145 (106, 219) | 0.80 |
| Minimum, median (IQR)                                 | 107 (73.5, 140) | 101 (79, 143) | 0.88 |
| > 180 mg/dL, n (%)                                    | 11 (39) | 10 (37) | 0.86 |
| < 80 mg/dL, n (%)                                     | 8 (29) | 7 (26) | 0.83 |
| Neuromonitoring                                       |         |              |      |
| CT or MRI during all post return of spontaneous circulation care, n (%) | 17 (46) | 12 (33) | 0.27 |
| Continuous electroencephalogram, n (%)                | 11 (30) | 17 (47) | 0.12 |

IQR = interquartile range.

* = n = 66 (33 control and 33 intervention).

† = n = 56 (28 control and 28 intervention).
Interventions to improve CPR quality through debriefings for ward providers may be less effective.

Postevent debriefing itself is a well-established educational tool. It has been used in military and aviation industries for decades, and more recently, it has demonstrated benefit in medical education (36, 37). Adult learning theory suggests that educational efforts are most effective when the topic is relevant and emotionally motivating (17, 36). CPR events are stressful, somewhat chaotic events that inevitably invoke an emotional response, and that are relevant because they will recur as part of an in-hospital care provider’s career choice. In addition, in-hospital CPR has usually been associated with death. These issues may lead to the optimal environment for postcardiac arrest debriefing to be effective as an educational tool.

The need to improve CPR quality was highlighted in studies that demonstrated CPR quality often does not meet AHA guidelines during resuscitation from cardiac arrest (3–5). More recent observational studies associate high-quality CPR with improved survival outcomes from out-of-hospital resuscitation (8, 9, 38). To that end, two interventional trials using historical controls and a cluster-randomized trial from the Resuscitation Outcomes Consortium evaluated feedback-enabled defibrillators to improve CPR quality. Although all these studies demonstrated improved quality metrics, none of these studies showed a significant improvement in survival (14–16). Why? Resuscitation performance comprises much more than the physical act of providing CPR. There must be coordination between multiple care providers to improve those “orchestrated” tasks of successful resuscitation, such as early recognition (39), prompt defibrillation (40), and timely administration of vasoactive medications (41). The current intervention, using audiovisual resuscitation transcripts as described above, was able to specifically target these tasks previously associated with improved survival. At our institution, provision of high-quality CPR may also be augmented by knowledge that the event will be reviewed and performance recognized and constructive criticism delivered in a nonthreatening manner.

This study has notable limitations. First, time trends on the outcome of interest may not be fully accounted for in studies with historical controls. However, there were no differences in resuscitation team composition or postresuscitation care practices. Furthermore, we measured and controlled for other potential confounders (e.g., vasoactive infusions at time of arrest) that may have been different between periods through linkage with a comprehensive in-hospital cardiac arrest database, highlighting strength of this study. Second, CPR quality metrics were only available in the subpopulation of patients who are 8 years old or older due to Food and Drug Administration limitations of the feedback-enabled monitor/defibrillators (42). Presumably, the concepts of CPR quality were translated to the care of the younger children. However, as we were unable to measure CPR quality in this age group, we were unable to establish that our improved outcomes were directly related to improved CPR quality. Third, the optimal timing of postevent debriefing is not clear, with literature describing both “hot” or immediate debriefings and “cold” or delayed debriefings with success (43). Often people are not in an appropriate mindset immediately after the event to be receptive to learning and reflection. However, it is possible that immediate postevent debriefing alone or in conjunction with our current practice could be beneficial and deserves further study. Fourth, this intervention was implemented in a single-center clinical environment with a culture of CPR research and an infrastructure to evaluate and improve resuscitation care. The intervention was added incrementally to an environment already well trained to use feedback-enabled defibrillators to guide CPR quality, as well as bedside CC refresher training (26, 44, 45) and an active simulated mock code program. Therefore, generalizability to other settings will require further study.

CONCLUSIONS

Implementation of a novel interdisciplinary, postevent quantitative cardiac arrest debriefing program targeted to front-line care providers significantly improved CPR quality. This program was also associated with improved survival with favorable neurologic outcome after index in-hospital cardiac arrest events.

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