

Achieving the 2010 AHA Guideline Metrics is Associated with Improved Survival from Out-of-Hospital Cardiac Arrest



Bentley J. Bobrow^{1,2,3,4}, Daniel W. Spaite³, Uwe Stolz³, Ashish R. Panchal³, Tyler F. Vadeboncoeur⁵, Annemarie Silver⁶, Keith Pyers⁷, Mark Venuti⁸, Gary Smith⁷, Gordon A. Ewy⁴, SHARE Research Group



¹Maricopa Medical Center, Phoenix, Arizona; ²Bureau of EMS & Trauma System, Arizona Department of Health Services, Phoenix, Arizona; ³Arizona Emergency Medicine Research Center, Department of Emergency Medicine, University of Arizona, Tucson, Arizona; ⁴Sarver Heart Center, University of Arizona, Tucson, Arizona; ⁵Mayo Clinic, Jacksonville, Florida; ⁶ZOLL Medical Corporation, Chelmsford, Massachusetts; ⁷Mesa Fire Department, Mesa, Arizona; ⁸Guardian Medical Transport, Flagstaff, Arizona



Objective

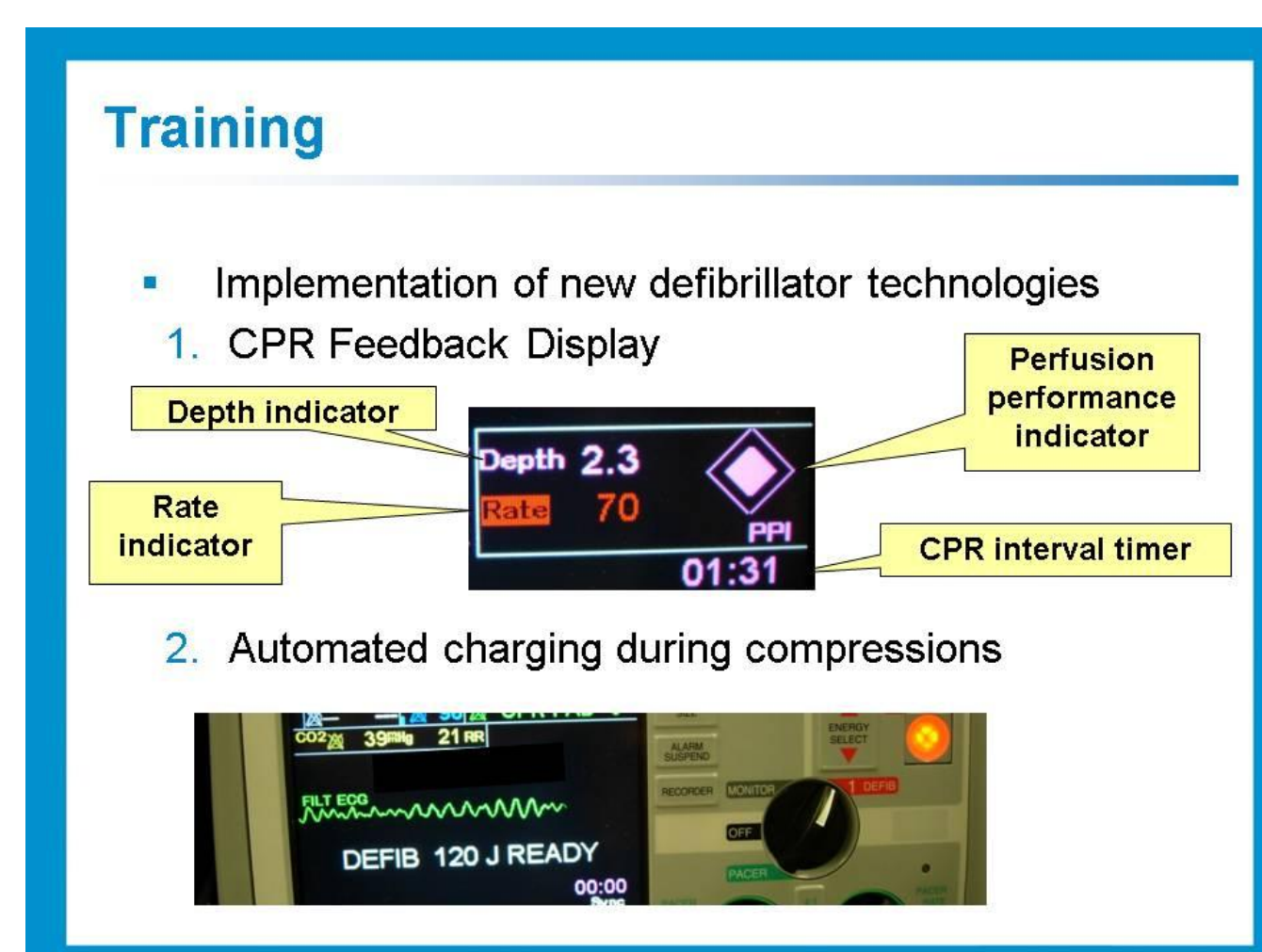
The 2010 AHA Guidelines stress the need for minimally interrupted, high quality CPR. We performed a prospective, before/after trial to determine if real-time audiovisual feedback (RTAVF) along with scenario-based training (SBT) would 1) achieve the 2010 CPR targets and 2) improve survival from OHCA.

Methods

Data were obtained from EMS first care forms and defibrillators (E Series, ZOLL) from 2 EMS agencies (population base-500,000). Phase 1 (P1, before): 18 months of baseline data with the RTAVF mode disabled (9/08-3/10).

Interventions: 1) Guideline-based SBT of ~450 EMTs, 2) RTAVF enabled, 3) EMT post-code debriefings. Phase 2 (P2, after): 8 months following implementation of interventions (5/10-12/10). For univariate analyses we used Fisher's exact test (proportions), t-test (means) or Kruskal-Wallis test (medians). To estimate odds ratios for survival to hospital discharge we used multivariable logistic regression and assessed final model diagnostics, fit, and discrimination.

Novel Monitor/Defibrillator



ZOLL Medical provided both training and data collection support for this CPR quality improvement program.

Training

Two-person "Pit Crew" Formation

Strong emphasis on:

1. Making sure #1 can see the monitor
2. Nothing interrupting CCs
3. #1 focusing on delivery of great CCs

Team leader: Does or directs others to do everything else

Four-person "Pit Crew" Formation

Strong emphasis on:

1. Making sure #1 can see the monitor
2. Nothing interrupting CCs
3. #1 focusing on delivery of great CCs

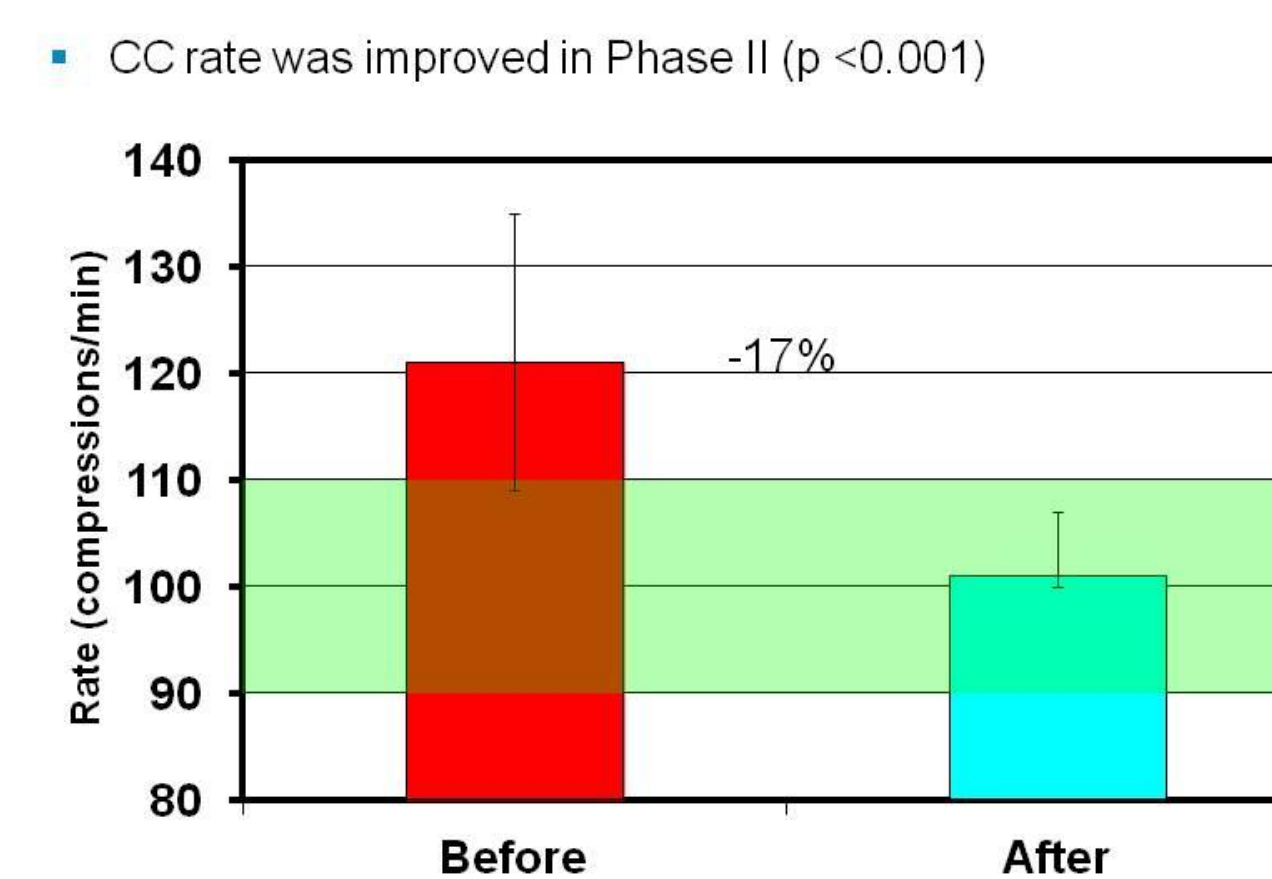
Defib, IV, give meds (#2); Airway, drug prep (#3); Second Compressor, IV Prep and watch monitor (#4)

Results

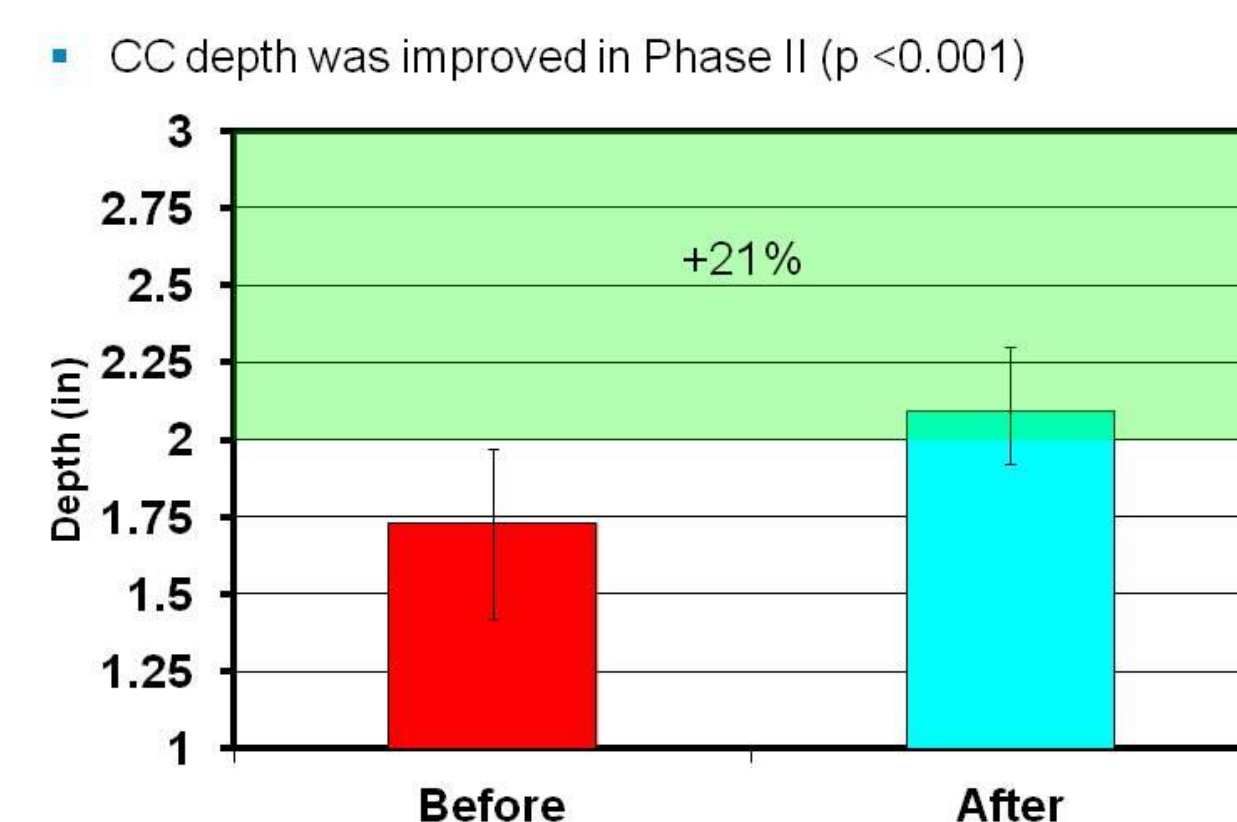
The final analysis included 284 adult OHCA (P1-176, P2-108). Mean age 65.3 years (SD ± 15.3) with 66.6% males. Quality measures improved significantly from P1 to P2: Median (Interquartile range) chest compression (CC) rate-121 CC/min (109-135) to 101 CC/min (100-106), $p < 0.001$; CC depth-1.73 in. (1.42-1.97) to 2.09 in. (1.92-2.3), $p < 0.001$; CC fraction-66.5% (59.3-75.9%) to 84.0% (77.8-88.7%), $p < 0.001$. All-rhythms survival increased significantly ($p=0.034$) from P1 to P2 (18/176, 10.2% vs. 23/108, 19.4%), an absolute survival increase of 9.2% (95% CI: 0.5%-17.9%). Crude odds ratio for survival for P2 vs. P1 was 2.1 (95% CI: 1.1-4.2) and adjusted odds ratio was 5.8 (95% CI: 1.8-18.9), after controlling for confounders including age, sex, location, witnessed arrest, initial rhythm, and therapeutic hypothermia. Survival for arrests with a shockable rhythm was 27.7% (18/65) for P1 and 53.9% (14/26) for P2 ($p=0.028$).

Results

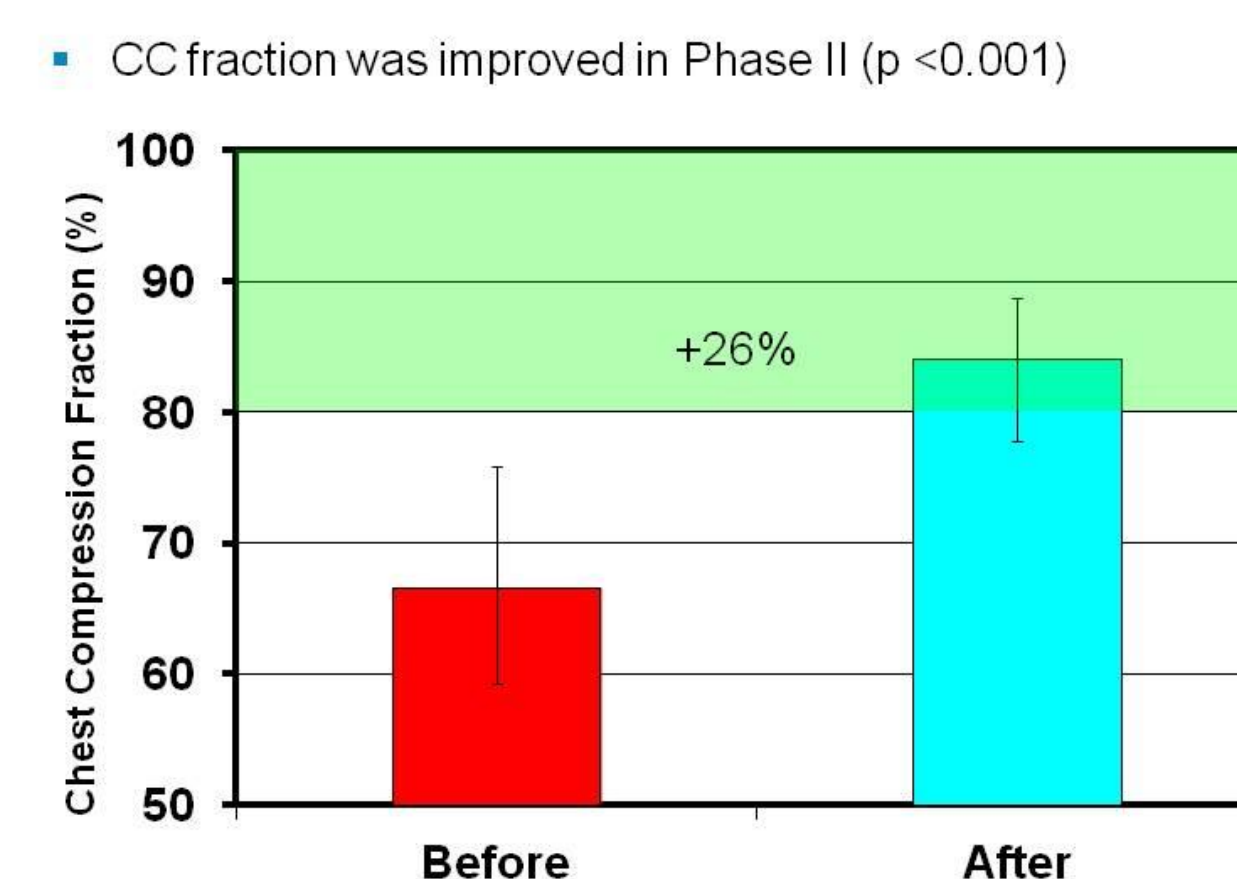
Results: Chest Compression Rate



Results: Chest Compression Depth



Results: Chest Compression Fraction



Population Characteristics:

	Total (N=284)	Pre (N=176)	Post (N=108)	p-value
Age- years (mean ± SD)	65.3 ± 15.3	66.9 ± 14.5	62.9 ± 16.4	0.032
Sex	66.6%	68.8%	63.0%	0.37
Witnessed Arrest	46.1%	44.8%	48.2%	0.62
Shockable Rhythm upon EMS arrival	32.2%	37.1%	24.1%	0.026
Provision of Bystander CPR	44.2%	48.0%	38.0%	0.11
EMS use of CCR	76.8%	65.3%	95.4%	<0.001
Dispatch to EMS Arrival - minutes (median, IQR)	5, 4-7	5, 4-6	5, 4-7	0.11
ROSC	27.1%	24.1%	29.0%	0.41
Provision of Therapeutic Hypothermia (TH)	11.6%	11.9%	11.1%	1.0
Survival to Hospital Discharge				
Overall	13.7%	10.2%	19.4%	0.034
Shockable Rhythm, % (n/N)	35.2% (32/91)	27.7% (18/65)	53.9% (14/26)	0.028
Witnessed & VF, % (n/N)	38.8% (26/67)	31.3% (15/48)	57.9% (11/19)	0.055

Logistic Regression Analysis:

	Odds Ratio for Survival to Hospital Discharge	
	Crude OR (95% CI)	Adjusted OR (95% CI)*
Post vs. Pre-Intervention	2.1 (1.1 – 4.2)	5.8 (1.8 – 18.9)

*Adjusted for Age, Sex, Witnessed Arrest, Initial Rhythm upon EMS arrival, EMS use of Cardiocerebral Resuscitation (CCR), bystander CPR, and provision of TH; Hosmer-Lemeshow GOF, $p=0.634$; area under ROC = 0.941

Conclusions

RTAVF combined with SBT was associated with a significant improvement in the proportion of compressions meeting the 2010 AHA Guidelines. This intervention was associated with a statistically significant 90% relative increase in overall survival. We believe this is the first report to show an improvement in OHCA survival by achieving the 2010 AHA CPR Guidelines.

Acknowledgements

We are sincerely grateful for the dedication and the sacrifices that the Mesa Fire Department and Guardian Medical Transport paramedics make daily in the line of duty.