ResQPOD
Impedance Threshold Device

Clinical Summary

The ResQPOD® is an impedance threshold device (ITD) that enhances circulation during basic or advanced life support CPR by regulating pressures in the chest to improve blood flow to vital organs. The ResQPOD selectively prevents air from entering the lungs during chest wall recoil. This enhances the vacuum needed to pull blood back into the heart. As a result, more blood is circulated to vital organs until the heart can be restarted.

The ResQPOD has been evaluated in more than 50 pre-clinical and clinical studies using both conventional CPR and active compression-decompression CPR (ACD-CPR). Research has shown that use of the ResQPOD **increased survival by 25% or more** over CPR without an ITD.[1] The following is a summary of some of these studies, highlighting improved survival and demonstrated cost effectiveness. Additional studies can be found in our bibliography, available at zoll.com/ResQPODBibliography.

Key Studies

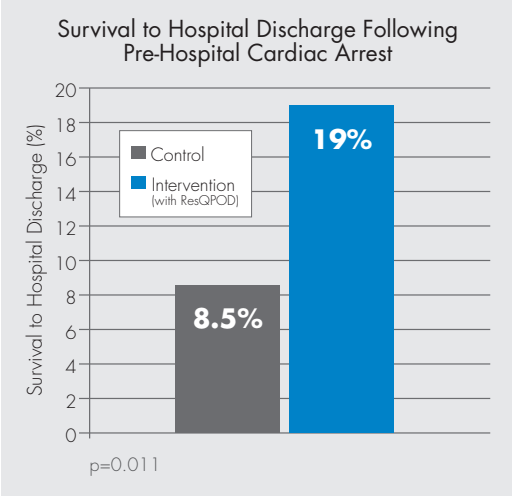
A Systems-Based Approach

Lick CJ, Aufderheide TP, Niskanen RA, et al. Take Heart America: a comprehensive, community-wide, systems-based approach to the treatment of cardiac arrest. *Crit Care Med.* 2011;39(1):26-33.

In this prospective, observational study involving more than 350 pre-hospital cardiac arrest patients, **overall survival to hospital discharge more than doubled following adoption of a systems-based approach** and implementation of the most highly recommended American Heart Association (AHA) CPR Guidelines, which included the use of an ITD.

Despite the costs of implementing a systems-based approach, **the receiving hospital had an average direct margin* of more than $20,000 if the patient survived to hospital discharge,** and more than $3,000 if the patient later died in the hospital.

*Margin after direct costs subtracted



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Key Studies

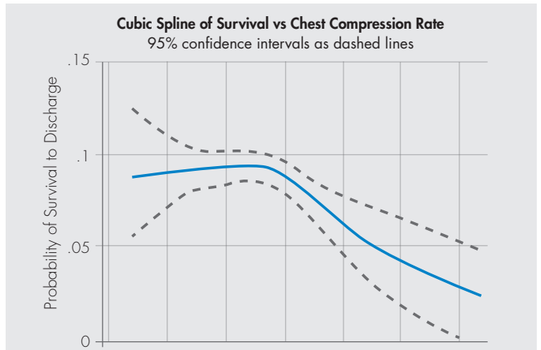
The ROC PRIMED Study

The Resuscitation Outcomes Consortium (ROC) PRIMED study was a large pre-hospital, randomized, placebo-controlled trial that compared a sham impedance threshold device (ITD) to an active ITD. Results published in *The New England Journal of Medicine* in September 2011 and initially concluded that survival in patients who received the active and sham ITD were equivalent.[2] However, subsequent analyses of the ROC data have shown that CPR quality parameters (e.g., compression rate, depth, and fraction) had a significant impact on survival and on the analysis of the ITD's effectiveness.

Dr. Ahamed Idris has published data from the ROC PRIMED study showing that:

- Chest compression rates varied significantly during the trial (50–240/minute) and that compressions were performed at the AHA-recommended rate less than half the time (Figure 1).[3]
- There was a significant interaction between compression rate and functionally favorable survival with the active ITD.[3]
- When compressions were performed at around 100 per minute, survival with favorable neurologic function trended higher when an active ITD was used during CPR compared to a sham ITD.[4]

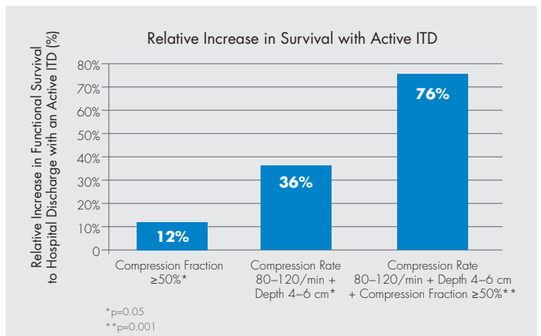
Figure 1



A recent subanalysis of the ROC PRIMED Study was published in Resuscitation by independent investigators[5] showing that:

- Only 1675 patients in the ROC study received high-quality CPR, defined as a compression depth of 4–6 cm (2 inches), a rate of 80–120/min, and a CPR fraction of ≥50%.
- As CPR quality improved, so did survival impact of the ITD. (Figure 2)

Figure 2



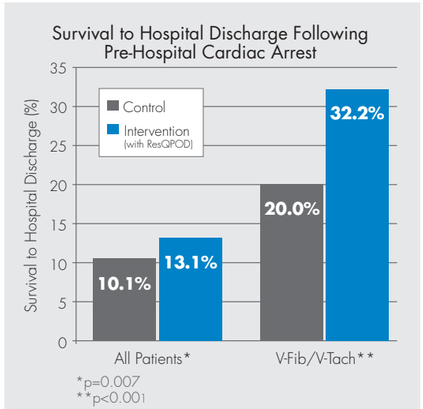
- When acceptable CPR was performed, patients who received the active ITD had a significantly higher chance of survival to hospital discharge with favorable neurological function (7.2%), compared to those who received the sham ITD (4.1%); p<0.001. This represents a relative **76% increase in functional survival** (Figure 2).
- This post hoc analysis demonstrates that CPR quality has a dose-related impact on the ITD's effectiveness. The better the CPR quality, the more impact the ITD has on survival. Therefore, it is important to use the ITD with high-quality CPR. If the ITD is not used with high-quality CPR, it may not deliver it's full therapeutic benefit.

Multisystem Impact

Aufderheide TP, Yannopoulos D, Lick CJ, et al. Implementing the 2005 American Heart Association Guidelines improves outcomes after out-of-hospital cardiac arrest. *Heart Rhythm*. 2010;9(10):1357-1364.

This prospective, observational study of more than 3,000 pre-hospital cardiac arrest patients from five U.S. communities (Minn., Tex., Nebr., Fla., N.C.) found that **survival to hospital discharge improved nearly 30%** following implementation of the AHA CPR guidelines, which included use of an ITD. The effect of the new interventions was most pronounced in patients initially presenting with V-fib or V-tach, with increase in survival to hospital discharge.

Survival to hospital discharge with favorable neurologic function improved more than 75% at three sites that tracked these outcomes (p=0.038).

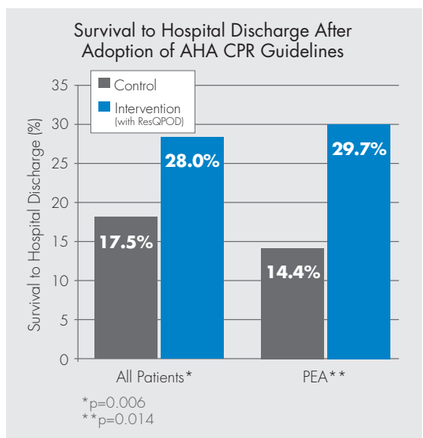


In-Hospital Cardiac Arrest

Thigpen K, Davis SP, Basol R, et al. Implementing the 2005 American Heart Association guidelines, including use of an impedance threshold device, improves hospital discharge rate after in-hospital cardiac arrest. *Respir Care*. 2010;55(8):1014-1019.

In a prospective, observational study involving more than 500 in-hospital cardiac arrest patients, **survival to hospital discharge increased by 60% following adoption of the AHA CPR guidelines, including ResQPOD use.**

The greatest benefit of the intervention was in patients presenting with pulseless electrical activity (PEA), the most common initial arrest rhythm during in-hospital arrests. In these patients, survival improved 106%.



[1] Idris AH, et al. The interaction of chest compression rates with the impedance threshold device and association with survival following out-of-hospital cardiac arrest. *Circulation*. 2012;126:LBBS-22813-AHA.

[2] Aufderheide TP, et al. A trial of an impedance threshold device in out-of-hospital cardiac arrest. *NEJM*. 2011;365:798-806.

[3] Idris AH, et al. The relationship of chest compression rate and survival during out-of-hospital cardiopulmonary resuscitation at Resuscitation Outcomes Consortium (ROC) regional sites. *Circulation*. 2011;124:A289.

[4] Idris AH, et al. Chest compression rates and survival following out-of-hospital cardiac arrest. *Crit Care Med*. 2015;43(4):840-848.

[5] Yannopoulos D, et al. The effect of CPR quality: a potential confounder of CPR clinical trials. *Resuscitation*. 2015;94:106-113.

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