SUMMARY OF SAFETY AND EFFECTIVENESS DATA (SSED)

I. GENERAL INFORMATION

Device Generic Name	Combination compression/decompression manual chest pump with impedance respiratory valve
Device Trade Name	ResQCPR™ System
Device Procode:	**PIZ**
Applicant's Name & Address	Advanced Circulatory Systems, Inc. (ACSI) 1905 County Road C West Roseville, MN 55113
Date of Panel Recommendation	May 6, 2014
Premarket Approval Application (PMA) Number	P110024
Date of FDA Notice of Approval	March 6, 2015
Priority Review	FDA granted priority review status on July 11, 2011 because FDA believed that the ResQCPR System represents a breakthrough technology that may provide clinically meaningful benefit (survival) to patients that suffer non-traumatic out-of-hospital cardiac arrest.

II. INDICATIONS FOR USE

The ResQCPR System is intended for use as a CPR adjunct to improve the likelihood of survival in adult patients with non-traumatic cardiac arrest.

III. CONTRAINDICATIONS

None known.

IV. WARNINGS AND PRECAUTIONS

The warnings and precautions can be found in the ResQCPR System labeling (Instructions for Use).

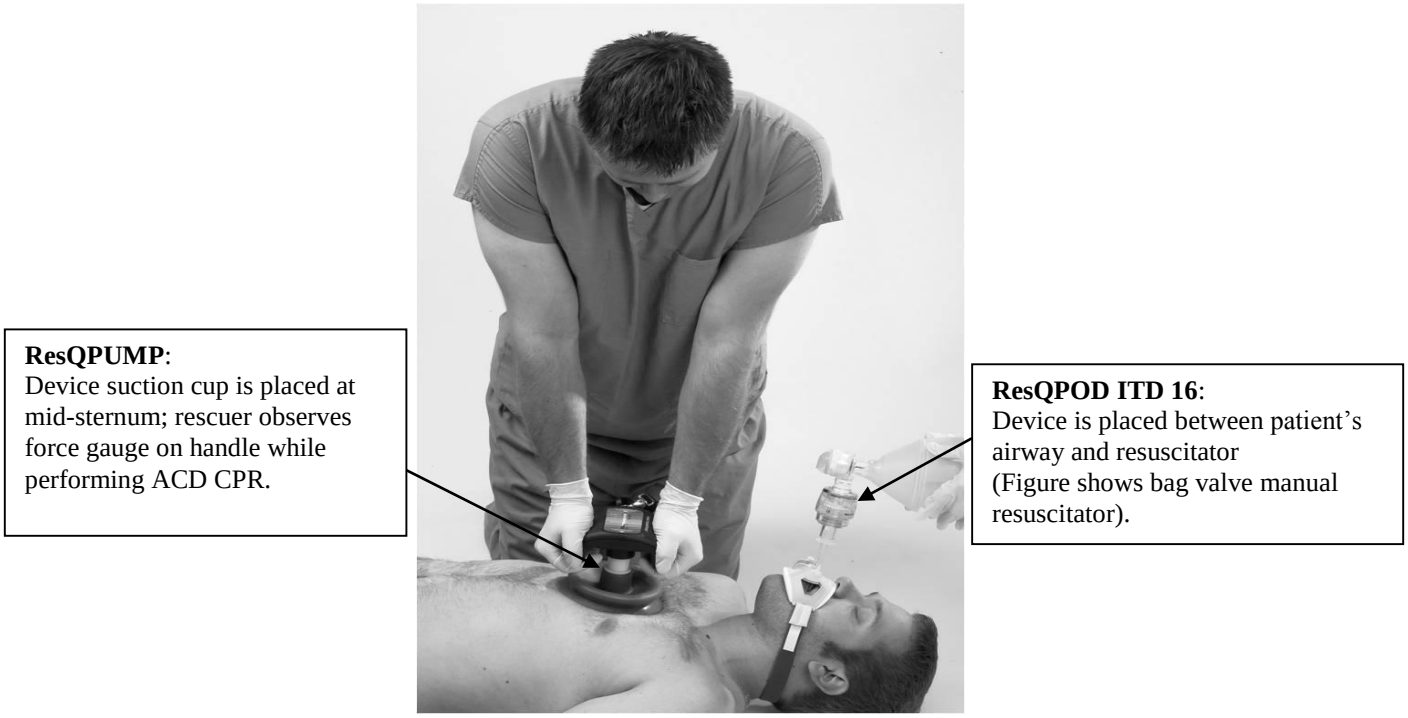
V. DEVICE DESCRIPTION

The ResQCPR System is a manual cardiopulmonary resuscitation (CPR) system that consists of two components: the ResQPUMP ACD-CPR Device ("ResQPUMP") and the ResQPOD ITD 16 (**Figure 1**). Active compression - decompression (ACD) CPR with the ResQPUMP transforms the human chest into an active bellows. The ResQPOD ITD 16 acts to lower airway pressure, thereby reducing intrathoracic pressure by impedance of respiratory gases during the decompression phase of CPR. The ResQCPR System is designed to enhance venous return to the heart, increase cardiac output, and increase blood flow during CPR.

The ResQCPR System also assists rescuers with optimal performance of CPR by use of:

- an audible metronome to guide the chest compression rate (on ResQPUMP)
- a visual display of force applied during compression and decompression (on ResQPUMP)
- timing lights for timing ventilations at a rate of 10 per minute (on ResQPOD ITD 16)

Figure 1: ResQCPR System- ResQPUMP and ResQPOD ITD 16



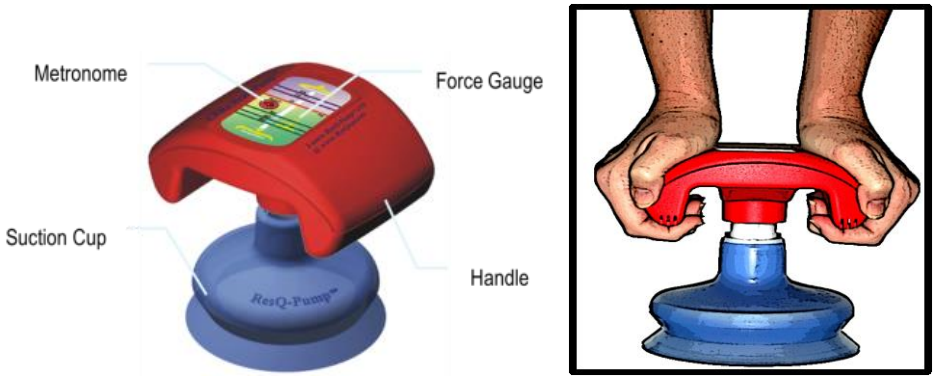
ResQPUMP ACD-CPR Device (ResQPUMP)

The ResQPUMP is a multi-use hand held ACD device that includes a suction cup for attachment to the skin over the mid-sternum, and a handle that the rescuer grasps during the performance of CPR using the ResQCPR System (**Figure 2**). The ResQPUMP assists the rescuer in compressing the chest during CPR and in actively lifting the chest upward during the decompression phase of CPR. The ResQPUMP handle includes a force gauge with a visual display of the forces exerted during chest compression and decompression. The force gauge has visual targets based on chest compliance as follows: 65 lbs of pressure for patients with softer compliance, 65-90 lbs for patients with average compliance, and 110 lbs for patients with stiffer compliance.

Standard CPR should be utilized by rescuers until they are prepared to use the ResQCPR System. When performing CPR with the ResQCPR System, rescuers compress the chest approximately two inches with the ResQPUMP, observe the force depicted on the gauge and use that force as a guideline for continued compressions using the ResQPUMP. Rescuers actively decompress the chest by lifting upwards to a targeted force indicated on the gauge of between -15 and -20 lbs, after each compression. The handle also includes a battery-powered audible metronome to guide timing of chest compressions at a rate of 80 compressions per minute.

NOTE: The CPR compression rate for the ResQPUMP is <u>80</u> compressions per minute, whereas the AHA recommended rate is 100-120 compressions per minute for standard CPR.

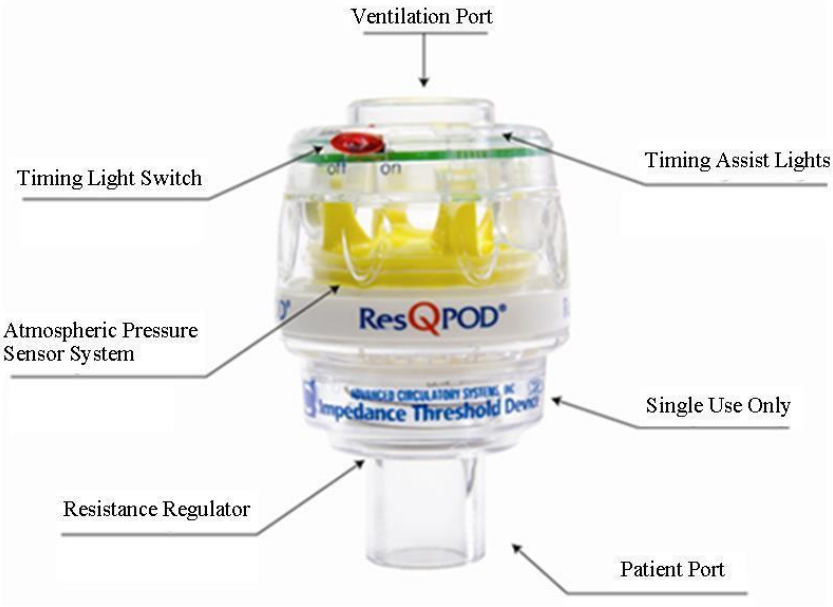
Figure 2: ResQPUMP



<u>ResQPOD ITD 16 Impedance Threshold Device</u>

The ResQPOD ITD 16 is a valve device that impedes air from entering the patient's thorax when pressures within the thorax are <0 atmospheres, and allows for positive pressure ventilation and expiration of respiratory gases with minimal resistance (<5 cm H_2O) (**Figure 3**). The ResQPOD ITD 16 is a fist-sized mechanical valve system that fits between a ventilation source and a facemask or advanced airway device, including an endotracheal tube. When a positive pressure breath is delivered to the patient, respiratory gases pass through the ResQPOD with minimal resistance (<5 cm H_2O). During the decompression phase of CPR, the ResQPOD valves close and impede respiratory gases from entering the patient. This augments the negative intrathoracic pressure and enhances circulation during CPR. The ResQPOD also contains a safety feature that allows the valves to open if the negative pressure within the thorax exceeds -16 cm H_2O. For example, if a patient takes a spontaneous breath during CPR, then the safety check valve will open and allow respiratory gases to flow into the patient's lungs. The ResQPOD may be used with standard ventilation sources (either with or without supplemental oxygen supply), for example a bag-valve or demand-valve resuscitator, a rescuer's mouth, or an automated ventilator. The ResQPOD also has a timing assist light that flashes at a rate of 10 times per minute, thereby providing guidance to the rescuer on the proper ventilation rate during Advanced Life Support CPR using the ResQCPR System with an advanced airway.

Figure 3: ResQPOD ITD 16



VI. ALTERNATIVE PRACTICES AND PROCEDURES

The alternative procedure is standard CPR or CPR performed with the help of a CPR aid.

VII. MARKETING HISTORY

The ResQCPR System has not been previously marketed in the US or any foreign country.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Death remains the most common outcome for patients who experience a cardiac arrest, especially those occurring outside the hospital where time to treatment is critical. The mortality rate for cardiac arrest patients is extraordinarily high. Nationally, survival with favorable neurological function for all patients following out-of-hospital cardiac arrest (OHCA) averages <6%. Potential adverse events that may be associated with use of the ResQCPR System are similar to those associated with standard CPR, including, but not limited to the following:

- Aspiration
- Bleeding, major (requiring intervention)
- Cardiac tamponade
- Cerebrovascular accident/cerebral bleeding
- Death
- Hemothorax
- Internal organ injury
- Pneumothorax
- Pulmonary edema
- Re-arrest
- Rib fracture

- Seizure
- Sternal fracture
- Bruising and soreness of the chest

In the U.S. pivotal clinical trial, there was no difference in the overall major adverse event rates between the study groups. The only difference in adverse events was an increase in the rate of pulmonary edema in patients receiving CPR with the ResQCPR System.

For specific adverse events that occurred in the clinical study please refer to section X below.

IX. SUMMARY OF PRECLINICAL STUDIES

A. Laboratory Studies

Bench studies were performed to assess the relevant structural and functional components of the ResQPUMP and ResQPOD ITD 16 devices and to confirm their compliance with applicable specifications and standards. Critical testing for the ResQPUMP included: force gauge calibration and measurement, metronome verification (tone frequency and sound intensity), software verification, operating and storage temperature extremes, suction cup attachment and release forces, battery service/shelf life, biocompatibility, electromagnetic compatibility, and mechanical shock (drop testing). Critical testing for the ResQPOD ITD 16 included: expiratory and inspiratory airway impedance, air flow/loss, operating and storage temperature extremes, timing assist light functionality, accelerated aging, biocompatibility, electromagnetic compatibility, and mechanical shock (drop testing). Both devices passed all relevant structural and functional bench testing requirements. **Table 1** identifies the relevant bench testing performed on the ResQPump and ResQPOD components:

Table 1: Bench Studies: ResQPump

Test	Purpose	Acceptance Criteria	Results
Force Gauge Measurement and Metronome Verification Test	Verify the device operates within specification	Tested in ambient conditions: Compression: 110 lbs ± 15% Decompression: -30 lbs ± 15% Metronome Rate: 80 tones/minute ± 10%	Acceptable results
Low/High Temperature Operation	Verify the device operates within specification at the labeled low/high temperatures	Tested at temperatures of -18°C and 50°C: Compression: 110 lbs ± 15% Decompression: -30 lbs ± 15% Metronome Rate: 80 tones/minute ± 10%	Acceptable results
Low/High Temperature Storage	Verify the device operates within specification after storage at the labeled low/high temperatures	Tested after storage at temperatures -40°C and 60°C: Compression: 110 lbs ± 15% Decompression: -30 lbs ± 15% Metronome Rate: 80 tones/minute ± 10%	Acceptable results
Cup Release Force	Verify the suction cup allows the device to meet the specified target decompression force	Release at ≥ 10 lbs	Acceptable results

Battery Service	Verify the service life of the device's metronome function	20 hours service life	Acceptable results
Tone Frequency	Verify the tone frequency of the metronome operates within specification	768 Hz ± 5% (low) and 3070 Hz ± 5% (high)	Acceptable results
Electromagnetic Compatibility	Verify the device meets the requirements for electromagnetic compatibility	EN 50081-1: 1992 EN 50082-2: 1995 EN 61000-6-2: 1999 EN 60601-1-2: 1993	Acceptable results
Software Verification	Verify the metronome documentation and software meet established requirements	N/A	Acceptable results
Drop Test	Verify the device operates within specification after being dropped	Tested after physical drop: Compression: 110 lbs ± 15% Decompression: -30 lbs ± 15% Metronome Rate: 80 tones/minute ± 10%	Acceptable results
Biocompatibility	Verify the device is biocompatible	ISO 10993-5, 1999 ISO 10993-10, 2002 OECD 429: 2002 ASTM F2148-06: 2006	Acceptable results
Sound Intensity	Verify the sound level of the device metronome operates within specification	≥ 65 db at distance of 0.5m from sound source	Acceptable results

Table 1 con't: Bench Studies: ResQPOD ITD 16

Test	Purpose	Acceptance Criteria	Results
Electromagnetic Compatibility	Verify the device meets the requirements for electromagnetic compatibility	IEC 60601-1-2: 2004	Acceptable results
Accelerated Aging	Verify the device operates within specification during the specified shelf life	Test after four years of accelerated aging: Timing light flash rate 10±2 flashes/minute; low flow and high flow inspiratory impedance	Acceptable results
Mechanical Shock Drop Test	Verify the device operates within specification after being dropped	Test after physical drop: Timing light flash rate 10±2 flashes/minute; low flow and high flow inspiratory impedance	Acceptable results
Expiratory Airway Impedance	Verify the device operates within its expiratory airway impedance specification	≤5 cmH2O	Acceptable results
Biocompatibility	Verify the device is biocompatible	ISO 10993-5: 1999 ISO 10993-10: 2002	Acceptable results
Air Flow Loss	Verify the device operates within its air flow loss specification	≤2 liters per minute	Acceptable results

Inspiratory Impedance @ -2 lpm	Verify the device operates within its inspiratory impedance specification	Low flow inspiratory impedance specification	Acceptable results
Inspiratory Impedance @ -20 lpm	Verify the device operates within its inspiratory impedance specification	High flow inspiratory impedance specification	Acceptable results
Timing Lights - Low/High Temperature Operation	Verify the device timing lights operate within specification at the labeled low/high temperatures	Tested timing light flash rate at 10±2 flashes/minute at temperatures of -18°C and 50°C	Acceptable results
Timing Lights - Low/High Temperature Storage	Verify the device timing lights operate within specification after storage at the labeled low/high temperatures	Tested timing light flash rate 10±2 flashes/minute after storage at temperatures -40°C and 60°C	Acceptable results
Timing Lights – Environmental Testing	Verify the device timing lights operate within specification after exposure to environmental extremes. Testing was conducted after modifications were made to improve the function of the timing light feature.	Tested timing light functionality after low/high temperature storage and at low/high temperatures per ASTM F920-93 – Clause 8	Acceptable results
Shipping Test	Verify the device timing lights and inspiratory impedance function operate within specification after distribution. Testing was conducted after a change in packaging and after a modification was made to improve the function of the timing light feature.	Tested timing light functionality and inspiratory impedance function after distribution simulation per ASTM D4169-09: 2009 – Distribution Cycle 13	Acceptable results

B. Animal Studies

Multiple studies in porcine models of cardiac arrest have demonstrated that circulation to the heart and brain was consistently higher with ResQCPR System prototypes versus standard CPR (S-CPR). No study showed any harm from the device combination or a worse effect with ResQCPR System prototypes versus controls. In these studies, blood flow to the heart and brain during S-CPR was observed to be approximately 20-30% of normal. By contrast, during CPR performed with ResQCPR System prototypes blood flow to the heart was approximately 70% of normal and blood flow to the brain was restored to normal values.[1-5] These studies demonstrated that the mechanism of action of the ResQCPR System involves harnessing the body's thoracic pump to lower intracranial pressure during the decompression phase of CPR and to circulate

blood to the heart and brain more effectively than S-CPR. This, in turn, resulted in a consistently higher likelihood for successful resuscitation and neurological awakening.

X. SUMMARY OF PRIMARY CLINICAL STUDY

The ResQTrial, the clinical study that formed the basis for the finding that the ResQCPR System is safe and effective for its intended use, was a prospective, multi-center, two-arm, randomized, controlled, partially masked clinical study. The study included a run-in phase and a pivotal phase. Clinical protocol requirements, including patient selection criteria and randomization to study treatment arms, were the same in both phases. The study was conducted under 21 C.F.R. §50.24, *Exemption from Informed Consent under Emergency Circumstances*, and was funded in part by the National Institutes of Health (NIH).

A. Study Design

The ResQTrial was designed to compare standard manual closed-chest CPR (S-CPR) with CPR that used the ResQCPR System, in adult subjects experiencing out-of-hospital non-traumatic cardiac arrest. Subjects were provisionally enrolled using a prospective, computer-generated, block randomization weekly schedule that assigned CPR treatment (S-CPR or CPR using the ResQCPR System) in a 1:1 ratio. Given the emergency nature of the setting for conducting the trial and anticipated poor outcomes in the majority of enrolled subjects, a randomized clinical trial design with pre-defined analysis populations was used in order to collect scientifically sound data while also reducing the potential for bias. Obtaining the subject's consent for continued participation in the study and administering neurological assessments were performed by the study's investigators or research staff.

The primary study objective was to compare S-CPR to CPR utilizing the ResQCPR System. The original study design also included a third group of subjects randomly assigned to S-CPR plus the ResQPOD ITD 16 alone (S-CPR+ITD). The S-CPR+ITD study arm was discontinued in November 2007 because of slower than expected overall enrollment and an intention to focus resources on collection of data in the two primary study groups of interest.

The ResQTrial was conducted at seven study sites in distinct geographic locations in the U.S. These sites included 46 EMS agencies in urban, suburban and rural areas, encompassing a total population of approximately 2.3 million. Approximately 5000 EMS personnel received initial training and routine refresher training on the study CPR procedures throughout the course of the study. A total of 40 hospitals participated in the care of the subjects. Each study site was required to satisfactorily complete a run-in phase prior to beginning enrollment in the pivotal phase. Enrollment in the run-in phase began in October 2005 and ended in April 2009 at the last participating site. Subjects were enrolled in the pivotal phase from March 2006 to July 2009, and one-year follow-up was completed for the final subject in July 2010.

Device Design Changes During the Study

There were several minor design changes made to the ResQPOD ITD 16 to change the recommended rate of ventilation and to improve the accuracy of the respiratory timing lights. These design changes did not affect the primary inspiratory impedance function of the device. The ResQPOD ITD 16 includes timing lights for guidance in providing ventilations at the recommended rate during CPR. The original (version 1) ResQPOD ITD 16 included timing lights that flashed at the rate of 12/minute, in accordance with the American Heart Association

(AHA) CPR guidelines recommendation for ventilation rate at that time. Six months after the start of the study, the CPR guidelines were revised to recommend a slower ventilation rate of 8-10 breaths/minute. Following the revised recommendation, a design change was made to the ResQPOD ITD 16 to reduce the timing light rate to 10 flashes per minute (version 2).

Analysis Populations

Subjects in cardiac arrest represent a heterogeneous population: some individuals are known to respond well to CPR while others respond poorly to CPR with little or no likelihood of survival with any treatment.[6,7] However, when EMS personnel arrive at the scene they cannot discern the underlying cause of the cardiac arrest in many cases.

The Intention-to-Treat (ITT) population was comprised of all subjects randomized to S-CPR or CPR using the ResQCPR System, who were felt by EMS responders to meet the study enrollment criteria, regardless of the cause of the non-traumatic cardiac arrest (see **Table 2** below).

Table 2: ResQTrial Selection Criteria

Inclusion Criteria	Exclusion Criteria
Adult subjects initially presumed or known to be 18 years of age or older	Subjects initially presumed or known to be < 18 years of age
Subjects who present with presumed non-traumatic, out-of-hospital cardiac arrest and who are candidates for resuscitation attempts	Subjects with obvious or likely traumatic injuries causing cardiac arrest
	Subjects with pre-existing do-not-resuscitate (DNR) orders
	Subjects with signs of obvious clinical death or conditions that preclude use of CPR
	Subjects whose family or legal guardians request that the subject not be entered in the study at the time of arrest
	Subjects experiencing in-hospital cardiac arrest Recent sternotomy with wound not appearing completely healed (if unknown) or less than six months (if known

A subset of the ResQTrial ITT population was comprised of patients with cardiac arrest of presumed cardiac etiology who were confirmed by investigators to have met the inclusion and exclusion criteria (see **Table 3** below). This subgroup was defined as the modified intention-to-treat (mITT) primary analysis population. All instances of ITT subjects not being included in the mITT population were adjudicated by the study's independent Clinical Events Committee (CEC).

Table 3: ResQTrial Criteria for mITT population

mITT Inclusion Criteria	mITT Exclusion Criteria
Adult subjects initially presumed or known to be 18 years of age or older	Adult subjects presumed or known to be < 18 years of age
Subjects who present with out-of-hospital cardiac arrest from presumed cardiac etiology or medication/drug overdose and who receive CPR by EMS personnel for at least one minute	Subjects with known or likely traumatic injuries causing cardiac arrest or cardiac arrest of presumed non-cardiac origin (exception: medication/drug overdose)
Subjects whose airways are managed with a cuffed endotracheal tube, Combitube or laryngeal mask airway or facemask	Subjects with pre-existing DNR orders
	Subjects with signs of obvious clinical death or conditions that preclude use of CPR
	Family or legal representative request that the subject not be entered into the study
	Subjects experiencing in-hospital cardiac arrest
	Subjects with a recent sternotomy with wound not appearing

	completely healed (if unknown) or less than six months (if known)
	Subjects who received less than one minute of CPR by EMS personnel
	Subjects with a complete airway obstruction that cannot be cleared or in whom attempts at advanced airway management are unsuccessful
	Subjects intubated with a leaky or uncuffed advanced airway device or presence of stomas, tracheotomies or tracheostomies
	Subjects who re-arrest and are encountered by EMS within 365 days of the index cardiac arrest

Statistical Analysis Plan

The primary study analyses were conducted on the population of subjects randomized to S-CPR or CPR using the ResQCPR System who met the criteria for the mITT population. Comprehensive analyses were also performed with data from the intention-to-treat (ITT) population .The study was designed to test the hypothesis that treatment with the ResQCPR System would result in increased survival to hospital discharge with favorable neurological function, as compared with S-CPR treatment. The primary composite endpoint, survival to hospital discharge with a modified Rankin Score (MRS) ≤ 3, was evaluated using Fisher's Exact Test of the equality of proportions between study arms. The secondary safety endpoint, rate of major adverse events, was evaluated at study completion using an exact, binomial test of the non-inferiority of the rate of major adverse events in the ResQCPR group compared with the S-CPR group, with the non-inferiority margin pre-specified to be 5%. No imputed data were used for analyzing the primary endpoint or the secondary safety endpoint. The secondary effectiveness endpoint was long term neurological function, evaluated in superiority tests of mean Cognitive Abilities Screening Instrument (CASI) scores using a two-group Student's t-test. CASI outcomes were assessed according to a hierarchical closed test procedure (first at 90 days, then repeated at one year). For subjects who survived until discharge, but who died prior to the 90-day or one-year evaluation, a CASI score of zero was assumed.

Sample Size Justification

On the basis expected rates for achieving the primary endpoint(6.0% in the S-CPR group and 10.2% in the ResQCPR group), along with a final significance level of 0.049 and 80% statistical power, a sample size of 700 mITT subjects per group was projected. The 6% rate was based upon the known pre-study survival rates mentioned above, and the hypothesized rate in the ResQCPR group was based upon prior animal and clinical studies.[8-11]

A mid-point interim analysis was initially planned for purposes of potentially stopping the trial for early success, and a sample size re-estimation plan at the interim look was added, in 2007, after enrollment in the pivotal phase had begun. The final significance level requirement of 0.049 reflected an adjustment for this interim analysis based on a Lan-DeMets alpha spending function with O'Brien-Fleming boundaries. Based upon the interim analysis performed in March 2008, a sample size increase to 1348 subjects per arm was recommended by the DSMB to maintain a statistical power of 80%. Two additional study sites were added to increase the enrollment rate. The seventh and last study site began enrollment in the pivotal phase in April 2009.

Early Study Termination

Following the recommendation by the DSMB to increase the sample size, efforts to obtain necessary additional funding to complete the study were not successful. The DSMB accordingly

recommended curtailment of new subject enrollment, and enrollment was terminated in July 2009. Enrolled subjects were followed for up to one year after cardiac arrest according to the study protocol. A total of 2470 subjects in the ITT population and 1655 subjects in the mITT population were enrolled at the time of enrollment discontinuation – approximately 61% of the planned-for enrollment.

External Evaluation Groups

During the course of the study, an independent 3-person CEC met, reviewed all adverse events, and determined, in a blinded manner, whether cases selected for review met criteria for the mITT analysis population. Also during the study, a 7-person independent DSMB reviewed aggregate data to assure the study was performed in the best interests of the public and the subjects and provide recommendations whether or not to continue subject enrollment.

1. Clinical Inclusion and Exclusion Criteria

   Subjects who met the selection criteria listed in **Table 3** were enrolled into the study. All subjects enrolled were included in the ITT study population**.**

2. Treatment and Follow-Up Protocols

   The first basic or advanced life support EMS provider to arrive started chest compressions as soon as possible for patients in both study groups. Standard CPR, defibrillation, and advanced life support treatment were performed in accordance with local and national policies and procedures. The compression to ventilation ratio was 30:2 during basic life support for both CPR techniques. Rescuers provided CPR using the ResQCPR System at 80 compressions per minute using the ResQPUMP force gauge to guide the recommended compression depth and complete chest recoil (control patients receiving S-CPR received compressions at the AHA recommended rate of 100 compressions per minute). Rescuers initially attached the ResQPOD ITD 16 between the ventilation bag and facemask, and subsequently relocated it to the advanced airway. The ResQPOD ITD 16 was removed and CPR using the ResQCPR System was stopped if the subject had ROSC, and initiated again if re-arrest occurred. CPR efforts in both groups were encouraged for at least 30 minutes on scene before the resuscitation attempt was stopped. In-hospital therapeutic hypothermia and coronary revascularization for all applicable subjects were not part of the formal protocol. Survival status and neurological assessments were performed as summarized in **Table 4**.

Table 4: Follow-Up Neurologic Assessment Tools and Schedule

Assessment Tool	**Hospital Discharge** up to 5 days after discharge	**30-day Survival** within 30+/- 5 days	**90-day Survival** within 90 +/- 5 days	**1-year Survival** within 365 +/- 15 days
Modified Rankin Scale (MRS)	X (1° endpoint)			
Cerebral Performance Category (CPC)/ Overall Performance Category (OPC)	X	X	X	X
Health Utilities Index 3 (HUI3)	X	X	X	X
Disability Rating Scale (DRS)		X	X	X
Cognitive Abilities Screening Instrument (CASI)			X	X
Trail-Making Test (TMT)			X	X
Beck Depression Inventory II (BDI-II)			X	X

Mayo-Portland Adaptability Inventory-4 (MPAI-4)			X	
Quality of Life Survey (QOLS)				X

3. Clinical Endpoints

The original primary safety and effectiveness study endpoint defined in the protocol was a composite of survival to hospital discharge with favorable neurological function, defined as a modified Rankin Scale score of ≤ 3. MRS is evaluated on a scale of 0-6, with 0 representing no impairment and 6 representing death. In the ResQTrial, conclusions or inferences regarding survival with good neurological outcome could not be drawn, due to interpretability issues with the neurological data. Therefore, the principal data analysis supporting device approval was a *post hoc* comparative assessment of survival up to one year after cardiac arrest regardless of neurological function.

Patients were followed for one-year after cardiac arrest to assess if CPR using the ResQCPR System improved survival rates after cardiac arrest. Neurological outcomes were assessed at the time of hospital discharge, and then 30, 90 and 365 days after cardiac arrest.

The hypothesis-based secondary safety endpoint was the overall rate of major adverse events through hospital discharge. The hypothesis-based secondary effectiveness endpoint was long term neurological function as assessed by the Cognitive Abilities Screening Instrument (CASI, Version E-1.1). CASI is a validated instrument for screening cognitive impairment. CASI is measured on a scale of 0-100, with higher scores signifying better outcomes. Other pre-specified secondary endpoints included return of spontaneous circulation (ROSC) assessed out-of-hospital and in-hospital and survival to hospital admission, 30 days, 90 days and 1 year after cardiac arrest. MRS, CASI and other secondary endpoints of neurological recovery and psychological status were evaluated as shown in **Table 4.**

B. Accountability of the ResQTrial Subject Cohort

Accountability for all subjects enrolled in the pivotal phase and randomized to treatment with S-CPR or CPR using the ResQCPR System is shown in **Figure 4** and **Table 5** below.

Figure 4: ResQTrial Pivotal Phase- Subject Accountability in S-CPR and ResQCPR Study Groups

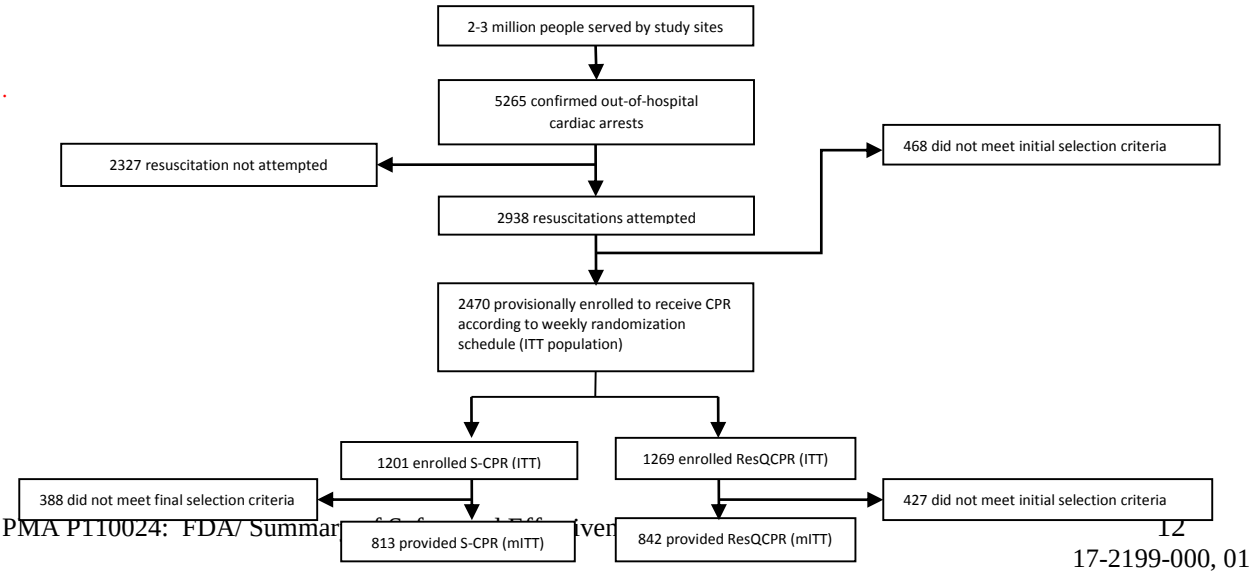


Table 5: Characteristics of the ResQTrial[1]

Study Phase	Design	Purpose	#of Study Sites	Subjects Randomized to S-CPR	Subjects Randomized to ResQCPR
Run-in Phase	Multi-center, prospective, randomized, controlled, partially- masked clinical trial	Confirm that sites were able to successfully execute all aspects of the study protocol prior to beginning enrollment in the pivotal phase	7	134 randomized 90 met mITT criteria: 9 were discharged alive; of these, 0 withdrew or were lost to follow-up by one year; 3 had died.	134 randomized 98 met mITT criteria: 12 were discharged alive; of these, 2 withdrew or were lost to follow-up by one year; 1 had died.
Pivotal Phase	Multi-center, prospective, randomized, controlled, partially-masked clinical trial	Evaluate the safety and effectiveness of CPR using the ResQCPR System on subjects suffering out-of-hospital cardiac arrest	7	1201 randomized (ITT) 813 met mITT criteria: 80 were discharged alive; of these, 13 withdrew or were lost to follow-up by one year; 19 had died.	1269 randomized (ITT) 842 mITT criteria: 105 were discharged alive; of these, 18 withdrew or were lost to follow-up by one year; 13 had died.

[1] Subjects enrolled in the pivotal phase, randomized to S-CPR or CPR using the ResQCPR System, and who met the modified intention to treat (mITT) criteria constituted the primary analysis population per the study protocol. Subjects enrolled in the pivotal phase and randomized to S-CPR or CPR using the ResQCPR System constituted the intention-to-treat (ITT) analysis population.

C. Study Population Demographics and Baseline Parameters

Demographics and baseline characteristics were balanced between the study groups in the ITT population and the mITT subgroup (**Table 6)**.

Table 6: ResQTrial Pivotal Phase- Demographics and Baseline Characteristics[1]

Parameter	S-CPR		ResQCPR	
	ITT (n=1201)	**mITT (n=813)**	**ITT (n=1269)**	**mITT (n=842)**
Age, years (mean ± SD)	64.2 ± 17.2	66.8 ± 14.5	63.3 ± 17.8	67.0 ± 15.2
Male	752 (62.6)	539 (66.3)	803 (63.3)	559 (66.4)
Race:				
White	960 (79.9)	660 (81.2)	1035 (81.6)	715 (84.9)
Asian	39 (3.2)	31 (3.8)	29 (2.3)	19 (2.3)
Native Hawaiian/ Pacific Islander	4 (0.3)	3 (0.4)	1 (0.1)	1 (0.1)
American Indian/Alaska Native	18 (1.5)	9 (1.1)	22 (1.7)	10 (1.2)
Black/African American	152 (12.7)	94 (11.6)	155 (12.2)	88 (10.5)
Unknown	28 (2.3)	16 (2.0)	26 (2.1)	9 (1.1)
Ethnicity:				
Hispanic/Latino	22 (1.8)	15 (1.8)	32 (2.5)	19 (2.3)
Not Hispanic/Latino	1149 (95.7)	782 (96.2)	1207 (95.2)	811 (96.3)
Unknown	30 (2.5)	16 (2.0)	29 (2.3)	12 (1.4)
Bystander witnessed arrest	517 (43.1)	383 (47.1)	546 (43.2)	400 (47.5)
EMS witnessed arrest	146 (12.2)	76 (9.4)	144 (11.4)	80 (9.5)
Unwitnessed arrest	536 (44.7)	353 (43.4)	575 (45.5)	361 (42.9)
Not available	2	1	4	1
Bystander CPR	489 (40.7)	350 (43.1)	532 (42.0)	358 (42.5)
Not available	1	1 (0.1)	2	0 (0.0)
Initial recorded cardiac rhythm:				
Ventricular fibrillation/pulseless ventricular	294 (24.5)	247 (30.4)	335 (26.4)	292 (34.7)
tachycardia	597 (49.7)	379 (46.6)	633 (49.9)	376 (44.7)
Asystole	293 (24.4)	180 (22.1)	284 (22.4)	171 (20.3)
Pulseless electrical activity	17	7 (0.9)	16	3 (0.4)
Not available				
911 call to EMS CPR start, minutes[2](mean ± SD)	6.7 ± 3.5	6.6 ± 3.4	6.7 ± 3.2	6.7 ± 3.2
911-to-first study device placed, minutes (mean ± SD)[2]	-	-	7.1 ± 3.5	7.1 ± 3.5
Duration CPR, minutes (mean ± SD)	25.6 ± 13.0	27.60 ± 12.24	26.3 ± 12.3	28.10 ± 11.45
Pre-hospital ROSC[3]	490 (40.8)	324 (39.9)	524 (41.3)	345 (41.0)

[1]Numbers shown are subjects (%) unless otherwise indicated
[2]Does not include subjects with EMS witnessed arrests
[3] ROSC= Return of spontaneous circulation

D. Safety and Effectiveness Results

1. Survival

Note that the study was not prospectively designed to test a hypothesis based on survival alone.

ITT Population

The likelihood of short and longer-term survival was improved in the arm receiving CPR using the ResQCPR System. The number and percent of subjects that survived to hospital admission, 24 hours, hospital discharge, 90 days, and 1 year after the index cardiac arrest in the ITT population is shown in **Table 7**. At 1 year, there was a 33% increase in the survival rate in subjects in the ITT population receiving CPR with the ResQCPR System compared with S-CPR (adding the run-in patients demonstrated a similar result). This comparison was not prospectively specified or adjusted for multiplicity. As based on secondary neuro assessments (see **Table 10** below) there was no increase in the number of subjects with severe neurological impairment in the group receiving CPR using the ResQCPR System; that is, the neurological outcome in ResQCPR patients appeared to be no worse than the control (S-CPR).

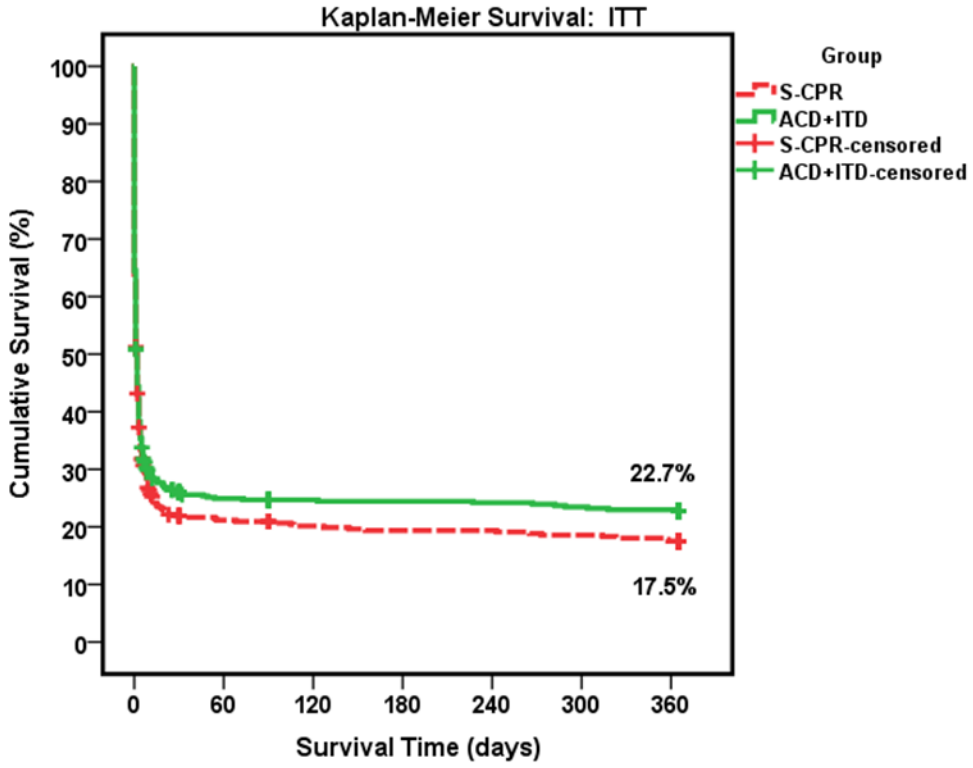
Table 7: Survival of Out-of-Hospital Cardiac Arrest Subjects from ROSC to One Year (ITT)[1]

	S-CPR (n=1201)	**ResQCPR (n=1269)**
ROSC during CPR before hospital admission	490 (40.8)	524 (41.3)
Admitted to hospital	342 (28.5)	381 (30.0)
Survived to 24 hours following arrest	277 (23.1)	310 (24.4)
Not available	12	11
Alive at hospital discharge	123 (10.2)	150 (11.8)
Not alive at hospital discharge	1072	1114
Not available	6	5
Alive at 30 days	98 (8.2)	131 (10.3)
Not alive at 30 days	1086	1123
Not available	17	15
Alive at 90 days	88 (7.3)	116 (9.1)
Not alive at 90 days	1089	1129
Not available	24	24
Alive at 1 year	68 (5.7)	96 (7.6)
Not alive at 1 year	1103	1137
Not available	30	36

[1]Numbers shown are subjects (%) unless otherwise indicated.

A Kaplan Meier analysis was performed in the subgroup of subjects who had a return of spontaneous circulation (ROSC, where the number of subjects with ROSC is shown above in **Table 7**) to determine how many survived for up to one year. Follow up data were available on 94% of all subjects. As shown in **Figure 5**, there was a consistent survival benefit for subjects treated with the ResQCPR system in the ITT population who had a ROSC and survived for one year compared with those treated with S-CPR. The findings in this subgroup are consistent with the overall results of this study population. The Kaplan Meier curve shows that the majority of subjects with ROSC do not survive post-hospitalization after out-of-hospital cardiac arrest. However, the Kaplan Meier estimate of survival to one year was relatively 30% higher in subjects in the ITT population receiving CPR with the ResQCPR System compared with S-CPR (22.7% vs. 17.5%).

Figure 5: Kaplan Meier analysis of subjects with ROSC following out-of-hospital cardiac arrest (ITT)



mITT Population

The survival outcomes for mITT subjects from ROSC to one year later are shown in **Table 8**. Proportional differences between the two treatment groups were observed to become larger over time. Approximately 50% more mITT subjects receiving CPR using the ResQCPR System were alive one year after OHCA compared with those receiving S-CPR. This comparison was not prospectively specified or adjusted for multiplicity.

Table 8: Survival of Out-of-Hospital Cardiac Arrest Subjects from ROSC to One Year (mITT)[1]

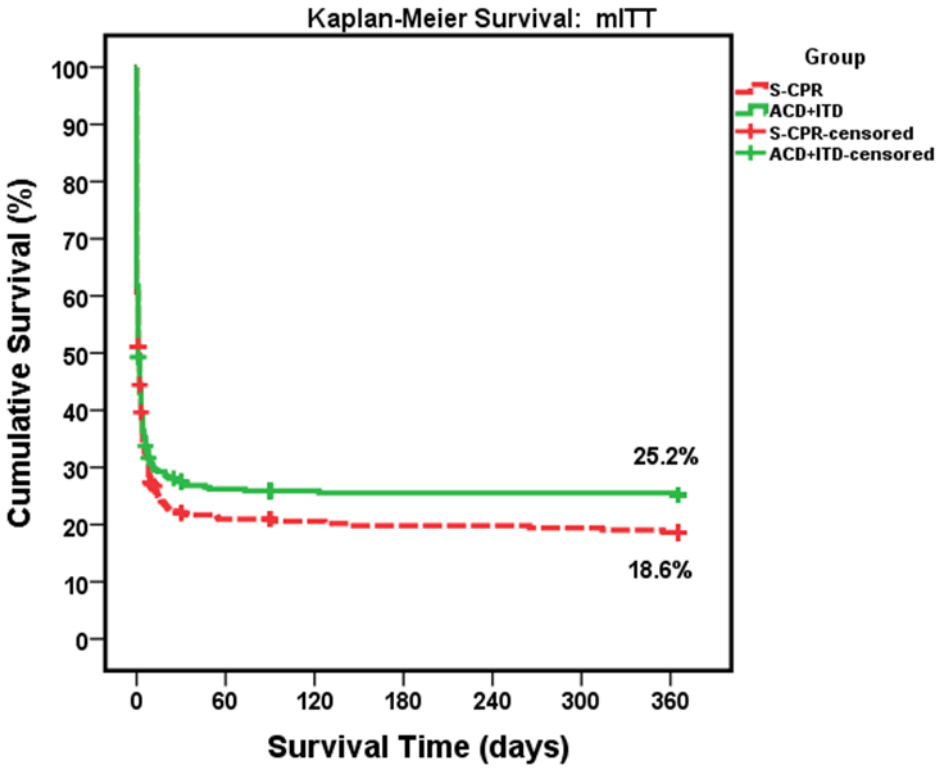
	S-CPR (n=813)	**ResQCPR (n=842)**
ROSC during CPR before hospital admission	324 (39.9)	345 (41.0)
Admitted to hospital	216 (26.6)	239 (28.4)
Survived to 24 hours following arrest Not available	176 (21.6) 9	199 (23.6) 6
Survival to hospital discharge Not alive at hospital discharge Not available	80 (9.9) 727 6	105 (12.5) 735 2
Alive at 30 days Not alive at 30 days Not available	65 (8.1) 738 10	96 (11.5) 741 5
Alive at 90 days Not alive at 90 days Not available	58 (7.3) 740 15	87 (10.4) 746 9

Alive at 1 year	48 (6.0)	74 (9.0)
Not alive at 1 year	746	748
Not available	19	20

[1]Numbers shown are subjects (%) unless otherwise indicated.

A Kaplan Meier analysis was also performed for the mITT population. Follow up data were available on 94% of all subjects. As shown in **Figure 6**, there was a consistent survival benefit for subjects treated with the ResQCPR system who had a ROSC and survived for one year compared with those treated with S-CPR. The findings in this subgroup are also consistent with the overall results of this study population. This Kaplan Meier curve also shows that the majority of subjects with ROSC do not survive post-hospitalization after out-of-hospital cardiac arrest. However, the Kaplan Meier estimate of survival at one year was relatively 35% higher in subjects in the mITT population receiving CPR with the ResQCPR System compared with S-CPR (25.2% vs. 18.6%).

Figure 6: Kaplan Meier analysis of subjects with ROSC following out-of-hospital cardiac arrest (mITT)



2. Secondary Endpoints

Secondary Safety Endpoint

The analysis of safety was based on the randomized cohort of 2470 subjects in the ITT population and 1655 subjects in the mITT population available for the evaluation prior to hospital discharge. The safety analysis included major adverse events that were reported from the time of the pre-hospital resuscitation effort up to the point of hospital discharge, as applicable. There were no differences in overall major adverse event rates between the study groups in the mITT population; thus the secondary safety endpoint was met.

Reported major adverse events by type are shown in **Table 9**. The only difference in adverse events between the two groups was the observation that more patients receiving CPR with the ResQCPR System had pulmonary edema. A *post hoc* analysis appeared to demonstrate that the presence of pulmonary edema did not adversely affect effectiveness as measured by survival.

Table 9: ResQTrial (out-of-hospital cardiac arrest) Subjects with Major Adverse Events through Hospital Discharge[1]

Event	ITT		mITT	
	S-CPR (n= 1201)	**ResQCPR (n= 1269)**	**S-CPR (n=813)**	**ResQCPR (n=842)**
Subjects with ≥1 major adverse event through hospital discharge (secondary safety endpoint[2])	1129 (94.0)	1194 (94.1)	766 (94.2)	789 (93.7)
Death	1074 (89.4)	1115 (87.9)	729 (89.7)	735 (87.3)
Re-arrest	230 (19.2)	260 (20.5)	161 (19.8)	185 (22.0)
Stroke/cerebral bleeding	11 (0.9)	11 (0.9)	3 (0.4)	2 (0.2)
Internal organ injury	2 (0.2)	2 (0.2)	0 (0.0)	1 (0.1)
Hemothorax	3 (0.3)	3 (0.2)	1(0.1)	2 (0.2)
Bleeding requiring intervention	8 (0.7)	17 (1.3)	3 (0.4)	7 (0.8)
Cardiac tamponade	4 (0.3)	5 (0.4)	3 (0.4)	2 (0.2)
Aspiration	20 (1.7)	16 (1.3)	7 (0.9)	8 (1.0)
Pneumothorax	11 (0.9)	13 (1.0)	7 (0.9)	10 (1.2)
Seizure	19 (1.6)	23 (1.8)	13 (1.6)	11 (1.3)
Rib/Sternal fracture	23 (1.9)	18 (1.4)	14 (1.7)	11 (1.3)
Pulmonary edema[3]	96 (8.0)	143 (11.3)	62 (7.6)	94 (11.2)

[1] Numbers shown are subjects with at least one report of the listed adverse event types. If multiple events of same type were reported, the event is only counted once per subject. Reports of deaths, re-arrest, seizure, and pulmonary edema in the field (e.g., pre-hospital) are also shown. All other adverse event types were assessed based on review of medical records for subjects transported to a hospital. There were no Major Adverse Events associated with device malfunctions, defects, or failures.

[2] Secondary safety endpoint: The rate of major adverse events in the ResQCPR group (mITT) was found to be non-inferior to that in S-CPR group ($p < 0.0001$) within a non-inferiority margin of 5%.

[3] Data shown includes combined pre-hospital and in-hospital reports of pulmonary edema. Pulmonary edema was defined as any of the following: *Pre-hospital reports* of advanced airway filled with fluid ≥2 times; blood, mucous, fluid or other secretions in the airway; reports of pulmonary edema or pleural/pulmonary effusion on post-mortem examinations; and, for subjects transported to a hospital, *in-hospital reports* of pulmonary edema or pleural/pulmonary effusion confirmed on x-ray or CT scan. Pre-hospital pulmonary edema was reported in 22 patients (2.7%) in the S-CPR group, and in 30 patients (3.6%) in the ResQCPR group (mITT).

Secondary CASI Effectiveness Endpoint

The pre-specified secondary effectiveness endpoint was an evaluation of long-term neurological function using mean Cognitive Abilities Screening Instrument (CASI) Scores at 90 and 365 days. As shown in **Table 10**, the study was not able to demonstrate an improvement in neurologic function in the ResQCPR arm based on CASI scores (as was hypothesized); however, CASI scores were not significantly different among survivors who were discharged from the hospital. These mean scores included subjects who died after hospital discharge, with a CASI score equal to 0 assigned to those who died. More than 85% of the one year survivors in both study arms completed the one year CASI assessment, and the mean CASI scores for these surviving subjects were 93.7 ± 11.8 (n=30) in the S-CPR arm

and 94.7 ± 4.4 (n=41) in the ResQCPR arm for the mITT population, suggestive of full or nearly full neurological recovery in both groups; ITT scores were 91.9 ± 13.5 (n=43) in the S-CPR arm and 92.3 ± 12.3 (n=49) in the ResQCPR arm. Three patients had CASI scores <70, a score consistent with poor neurological function, in both groups. There is limitation in interpreting the comparison of these CASI results between groups, since the comparison is not based on randomization but rather is conditional on the survival of subjects at 90 days or 1 year.

Other Neurologic Assessments
Pre-planned assessments of additional neurological outcomes were also performed using nonparametric Mann-Whitney U tests. These results are shown in **Table 9**. While there were more survivors in the group receiving CPR with the ResQCPR System, among all survivors there were no differences between the study groups observed in these secondary endpoints.

Table 10: Summary of Secondary Neurologic Assessment Endpoints at 12 months[1] post out-of-hospital cardiac arrest

Neurologic Assessment	ITT		mITT	
	S-CPR	ResQCPR	S-CPR	ResQCPR
Cognitive Abilities Screening Instrument (CASI) (secondary effectiveness endpoint)*	53.42±46.80	62.83±44.52	57.39±47.04	71.89±41.04
Health Utilities Index Mark 3(HUI3)	13.85±7.34	12.45±5.87	12.49±4.45	12.10±6.00
Disability Rating Scale (DRS)	2.46±5.47	2.91±6.09	1.39±3.12	2.19±5.68
Trail Making Test	48.95±41.69	50.96±32.54	49.56±43.37	47.10±27.26
Beck Depression Inventory (BDI)	6.52±7.25	5.87±6.04	5.23±6.29	5.46±5.93
Quality of Life	2.05±0.98	2.20±1.06	2.02±0.90	2.09±0.99

[1]Data shown are mean scores ± standard deviation
*Subjects who survived to hospital discharge but died prior to 90 days or 1 year follow-up had a CASI score of 0 imputed.

3. Device Failures

Device failure rates during the ResQTrial for the ITT and mITT populations are summarized in **Table 11.**

Table 11: ResQTrial Pivotal Phase- ResQPOD ITD 16 and ResQPUMP Device Failures

	ITT (n=1269)	mITT (n=842)
ResQPOD ITD 16 Failure:		
timing lights for ventilation guidance did not work	87	60
male adaptor of bag/valve/mask broke off, lodged within device	1	1
difficult ventilation using device, unspecified	1	1
ResQPOD ITD 16 failure rate, overall	90/1269 (7.1%)	62/842 (7.4%)
ResQPOD ITD 16 failure adversely affecting patient care	0	0/842 (0%)
ResQPUMP Failure:		
force gauge	2	2

metronome suction cup detachment	13 1	9 1
ResQPUMP failure rate, overall ResQPUMP failure adversely affecting patient care	16/1269 (1.3%) 0	12/842 (1.4%) 0/842 (0%)

4. Subjects with a drug/medication overdose

A *post-hoc* analysis of subjects with a presumed medication or drug overdose, as determined by CEC adjudication (CEC), suggested that CPR using the ResQCPR System in this patient population may have resulted in unfavorable clinical results for drug/medication overdose patients as compared to both 1) S-CPR for drug/medication overdose patients, and 2) CPR utilizing the ResQCPR System for non-traumatic arrest patients not having drug/medication overdose as the arrest etiology. Among S-CPR and ResQCPR subjects with drug/medication overdose arrest etiologies 20% of S-CPR (13/65) and 14% of ResQCPR (14/97) subjects survived to hospital discharge.

Overall Conclusions

The results of the pivotal trial demonstrate that CPR using the ResQCPR System increased the likelihood of survival after non-traumatic out-of-hospital cardiac arrest when compared with manual S-CPR, the current standard of care for treatment of out-of-hospital cardiac arrest in the United States today. One year survival rates were relatively 33% higher when CPR was performed with the ResQCPR System compared with S-CPR for all subjects in the ITT population (7.6% vs. 5.7%) and relatively 49% higher for those in the mITT population (9.0% vs. 6.0%). One year after OHCA, more than 95% of surviving subjects in both study groups had excellent neurological function, as determined by cognitive, functional, and quality of life testing. In cardiac arrest of etiology known to be drug/medication overdose, the favorable results with use of the ResQCPR System may not be present.

There were no new safety concerns with the ResQCPR System compared with S-CPR: both treatment groups had similar adverse event rates. The only difference in adverse events was an increase in pulmonary edema in the patients receiving CPR with the ResQCPR System which did not appear to adversely affect effectiveness as measured by survival.

Given the high prevalence and devastating nature of cardiac arrest, lack of alternative effective therapies, and the greater likelihood for survival with the ResQCPR System versus S-CPR, it is concluded that the benefits of performing CPR with the ResQCPR System for the treatment of patients with cardiac arrest outweigh the risks.

E. Financial Disclosure

The Financial Disclosure by Clinical Investigators regulation (21 CFR 54) requires applicants who submit a marketing application to include certain information concerning the compensation to, and financial interests and arrangement of, any clinical investigator conducting clinical studies covered by the regulation. The pivotal clinical study included 7 investigators. None of the clinical investigators had disclosable financial interests/arrangements as defined in sections 54.2(a), (b), (c), and (f). The information provided does not raise any questions about the reliability of the data

XI. SUMMARY OF SUPPLEMENTAL CLINICAL INFORMATION

Four European clinical studies have evaluated the mechanisms of action, hemodynamic effects, safety and clinical effectiveness of the ResQPOD ITD 16 and the ResQPUMP, as summarized in **Table 12**. These clinical studies demonstrated that use of ResQCPR prototypes resulted in improved hemodynamics, lowered intrathoracic pressures during the chest decompression phase, increased circulation as measured by end tidal CO_2, and increased 1- and 24-hour survival rates. The physiologic and clinical outcomes in these studies are consistent with the findings in the pivotal ResQTrial. There were no safety concerns raised by these four clinical studies that included a total of 644 patients. Taken together, these four European studies support a favorable risk/benefit profile when CPR is performed with the ResQCPR System for treatment of patients with cardiac arrest.

Table 12: Published Peer-Reviewed Clinical Studies of ResQPOD ITD 16 and the CardioPump (ResQPUMP)[*]

Journal Citation (reference)	CPR Method	Design	Control Group (n)	Group w/ Active ITD (n)	Endpoints	Results	Odds Ratio (95% CI)[**]
Plaisance et al. *Circulation*, 2000[8]	CardioPump ± ResQPOD ITD 16 (sham vs. active ITD)	Prospective, single center, blinded, randomized; pre-hospital	10	11	systolic arterial pressure (mean peak) diastolic arterial pressure (mean peak)	Sham: 90 ± 6.4 mmHg Active: 108 ± 3.1 mmHg Sham: 36.5 ± 1.5 mmHg Active: 56.4 ± 1.7 mmHg	
Wolcke et al. *Circulation*, 2003[11]	S-CPR vs. ResQCPR	Prospective, single-center randomized; pre-hospital	107	103	1°: Survival to 1 hour after witnessed arrest – all pts 2°: Survival to 1 hour after witnessed arrest – V-fib pts	s-CPR: 32% ACD-ITD: 51% s-CPR (n=38): 27% ACD-ITD (n=46): 68%	2.4 (1.28, 4.62) 5.7 (2.07, 15.9)
Plaisance et al. *Resuscitation*, 2004[9]	CardioPump ± ResQPOD ITD 16 (sham vs. active)	Prospective, multicenter, blinded, randomized; pre-hospital	200	200	Survival to 24 hours – all pts	Sham: 22% Active: 32%	1.67 (1.07, 2.60)
Plaisance et al. *Crit Care Med* 2005[10]	CardioPump ± ResQPOD ITD 16 (sham vs. active)	Prospective, Single-center, blinded, randomized, cross-over; pre-hospital	13	13	1°: Mean peak negative intrathoracic pressure during decompression with facemask 1°: Mean peak negative intrathoracic pressure during decompression with ET tube 2°: Mean peak negative intrathoracic pressure during decompression	Sham: -1.0 ± 0.73 mmHg Active: -4.6 ± 3.7 mmHg Sham: -1.3 ± 1.3 mmHg Active: -7.3 ± 4.5 mmHg Active ITD w/ facemask (n=13): -4.6 ± 3.7 mmHg Active ITD w/ ET (n=13): -7.3 ± 4.5 mmHg	

[*] See reference section for complete references.
[**] Odds ratio (OR) and 95% confidence interval (CI), as applicable

XII. PANEL MEETING RECOMMENDATION AND FDA'S POST-PANEL ACTION

A. Panel Meeting Recommendation

At an advisory meeting held on May 6, 2014, the Circulatory System Devices Panel voted 10(yes)/0(no) that there is reasonable assurance the device is safe, 2(yes)/8(no) that there is reasonable assurance that the device is effective, and 7(yes)/3(no) that the benefits of the device do outweigh the risks in patients who met the criteria specified in the original proposed indication: "The ResQCPR™ System is intended for use in the performance of CPR to improve the likelihood of survival with favorable neurologic function in adult patients with non-traumatic cardiac arrest."

Both FDA and the Panel agreed that the pre-determined effectiveness endpoint (e.g., survival with good neurological outcome) may not have been demonstrated by the available data. However, a post-hoc analysis of survival only, out to 1 year, suggested a trend towards better survival outcomes for patients treated with the ResQCPR System, with these patients appearing to suffer no worse neurological outcome than patients treated with standard CPR. In light of the minimal risk associated with use of the device, this potential survival benefit, supported an approval decision, with revised indications and labeling:

> "*The ResQCPR™ System is intended for use as a CPR adjunct to improve the likelihood of survival in adult patients with non-traumatic cardiac arrest*."

The link to the 24 Hour Panel Summary is below:
http://www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/MedicalDevices/MedicalDevicesAdvisoryCommittee/CirculatorySystemDevicesPanel/UCM397000.pdf

B. FDA's Post-Panel Action

The Sponsor and FDA worked interactively following the panel meeting to determine the appropriate indication for use for this device based on the post-hoc, objective analyses of survival at 1 year.

XIII. CONCLUSIONS DRAWN FROM PRECLINICAL AND CLINICAL STUDIES

A. Effectiveness Conclusions

The results of the pivotal trial demonstrate that CPR performed with the ResQCPR System increases the likelihood of survival in adult patients after non-traumatic out-of-hospital cardiac arrest when compared with manual S-CPR.

B. Safety Conclusions

There are no new safety concerns raised by the use of the ResQCPR System as compared with S-CPR.

C. Benefit-Risk Conclusions

One year survival demonstrated a 33% increase in the survival rate in subjects in the ITT population treated with the treatment device (7.6%) as compared with control (5.7%) and a 49% increase in the survival rate in subjects in the mITT population treated with the treatment device (9.0%) as compared with control (6.0%).

The only apparent difference in adverse events between the treatment device and S-CPR was the observation that more patients receiving CPR with the ResQCPR System had pulmonary edema. However, a post hoc analysis demonstrated that the presence of pulmonary edema did not adversely affect survival.

The aggregate increase in survival rate at 1 year represents an objective benefit that outweighs the potentially harmful risks of pulmonary edema. Although the data do not clearly demonstrate an improvement in neurological function among survivors, there is no indication that survival after use of the device is associated with worse neurological function as compared to survival without use of the device. Thus the device appears to provide a survival benefit without clinically significant unfavorable sequelae. Therefore the probable benefits outweigh the probable risks.

D. Overall Conclusions

The pre-clinical and clinical studies conducted demonstrated that the ResQCPR System provides a reasonable assurance of safety and effectiveness when used to apply cardiopulmonary resuscitation, in accordance with the instructions for use, on subjects suffering out-of-hospital non-traumatic cardiac arrest.

XIV. CDRH DECISION

CDRH issued an approval order on March 6, 2015. The applicant's manufacturing facilities were inspected and found to be in compliance with the Quality System (QS) Regulation (21 CFR 820).

XV. APPROVAL SPECIFICATIONS

Directions for use: See device labeling.

Hazards to Health from Use of the Device: See Indications, Contraindications, Warnings, Precautions, and Adverse Events in the device labeling.

Post-approval Requirements and Restrictions: See approval order.

XVI. REFERENCES

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