New Technologies for Cardiac Arrest

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The Problem

- About 1.5 million people suffer from cardiac arrest and heart attacks each year in the U.S
  - Over 500,000 die
- Many survivors suffer from brain damage within minutes of the attack
- However;
  - CPR along with the use of an AED within the first 3 minutes of attack increases chances of survival by 70% and reduces brain damage
Objective

- Developed three different technologies to help victims of cardiac arrest
  - Increase survival
  - Decrease brain damage
Agenda

- Team Structure
- Team Obstacles
- Shaker
- Cooler
- Patch
- Business Group
- What’s Next
- Conclusion
- Acknowledgments
- Questions
Team Structure

■ Four Sub-Teams

■ Met Once a week as entire group
  – Reported findings, progress, and obstacles from the week

■ Work in Sub-teams remainder of the week
Team Obstacles

- High expectations, not enough time
  - Had to adjust project plan

- New ideas, solutions, and findings
  - Had to adjust project plan and designs accordingly
Shaker Sub-Group
Why Does Shaking Work?

- Whole Body Periodic Acceleration (WBPA) involves oscillating the body along the spinal axis
- Creates better blood flow than traditional CPR (Chest compressions) and reduces brain damage
- Eliminates side effects caused by traditional CPR
- Easier to use with AED
Previous IPROs

Achievements:

- Researched optimal acceleration for oscillation
- Determined optimal wheel and spring size to best achieve optimal acceleration
- Created a prototype
Previous IPROs

Areas for Improvement:

- Surface friction was unpredictable
- Human force provided to move shaker made difficult to insure reaching optimal acceleration
What We Accomplished

- Attached a track system better controlling friction
- Attached a motor
What We Accomplished (Cont.)
Cooler Sub-Group
Why Does Cooling Work?

- Therapeutic hypothermia lowers body temperature to 32-34°C which reduces risk of ischemic injury to tissue
- Ischemic injury occurs when there is a restriction in blood flow to respective tissue
- The faster cooling is applied the lower the risk for brain damage
Previous IPROs

Achievements:
- Determined a solution to be used as a cooling agent, and developed prototype

Issues:
- Design did not allow for quickest cooling
- Designed not easily portable
What We Accomplished

- Determined best materials to use

- Designed vest in a manner that would cover as much surface area as possible and cool body quickly, but not interfere with AED

- Made vest easily portable to continue cooling once victim in transit
What We Accomplished (Cont.)
Patch Sub-Group
The Problem

- Massive brain damage occurs once a victim is resuscitated due to rush of oxygen

- Cooling helps to reduce brain damage, but wanted to explore other solutions that may further decrease brain damage
What We Accomplished

- Found that by inducing a hibernation state and slowly reviving one from such state would slowly re-introduce oxygen to system
- Determined the ideal solution (H$_2$S) to induce hibernation state
- Investigated ways to introduce H$_2$S
  - Trans-dermal Patches
Business Sub-Group
Problem

- In-depth research of underlying technology incomplete and not compile in detail

- Solid and research supported technologies, but what next?
Solution & Findings

- Compiled definitive supporting research for various proposals and deliverables
  - BME Idea & ASME Innovations Showcase

- Investigated testing requirements
  - Animal testing, Clinical human testing, Regulatory pathway: Pre-Market Approval
Solutions & Findings (Cont.)

- Examined existing patents in great detail
  - Current patent for similar technology, expires in 7 years

- Investigated market potential and possible distribution channels
  - Used AED market as model
  - Cardiac Science over 9,800 units sold last year
What Next?

- Fine-tune shaking and cooling technologies
  - Shaking: Improve range of acceleration
  - Cooling: Determine best way to infuse vest with cooling agent

- Testing and government approval for Shaker and Cooler as combined product
What Next? (Cont.)

- Revisit patents, investigate means of mass production, distribution, and marketing of product

- More research needed in the patch area to confirm technology
Conclusion

- Two effective technologies, combined into one life saving product

- Technologies are nearly perfected, and there is a market need for them

- Time to move toward bringing the product to market
Acknowledgments

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Resources

- http://www.heartratemonitors.us/
  - Picture, slide one
- http://www.americanheart.org
- http://www.womensheart.org
Questions?