

CPR Guide Glove

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I. Mission

Our mission is to increase the reliability and effectiveness of cardiopulmonary resuscitation (CPR) as a lifesaving tool.

Vision

Our goal is for CPR Guide Glove to be in the emergency kits of all corporations and large events. This product provides the means for proper CPR techniques to be performed with little to no training.

II. Corporation Structure

Corporate Structure

The CPR Guide Glove company will consist of a Board of Directors and Research and Development team. This team will be staffed by engineers and founding members tasked with overseeing all activities and directly developing the product, researchers who analyze the products other businesses are creating, and a design team who encourage a user-friendly design. In addition, we will have Assembly and Builders positions, consisting of electrical engineers facilitating the final assembly. Once assembly is complete, the Quality Department will inspect each product. Finally, we will have a Marketing Team to sell our product.

Corporate Positions

Name	Role	Responsibilities
Brandon Dai	CEO (Chief Executive Officer)	Manages day to day growth of company
Holly Grezdo	CFO (Chief Financial Officer)	Oversees all financial problems
Chelsea Lang	Director of Research and Development	Oversees quality and development of product
Joey Soliman	COO (Chief Operations Officer)	Responsible for daily operations of company
Ramzi Tweini	CMO (Chief Marketing Director)	Manages marketing of product and company

Table 1. The Corporate Team for CPR Guide Glove

Company Values

By providing an intuitive device with clear instruction, we believe the reluctance to help a victim of cardiac arrest will dissipate. We hope to empower the common bystander to take action in emergency situations without the fear of making a mistake.

Competitive Advantages

This product is set apart from the competitors due to its affordability and intuitive design. CPR assist devices range from \$30 to \$16,000. The products that cost less than \$500 have very basic functions, most of which only convey the compression rate. The Guide Glove will cost \$300 and maintain the high functionality of more expensive products, while also introducing a more convenient operation mechanism. The CPR Guide Glove's mechanism does not require the victim to be repositioned, which reduces the risk of further injury, and does not require any formal training. Along with these benefits, the Guide Glove has size settings. This feature is unique to CPR devices. Guidelines suggest a depth of 2 inches for both children and adults; however, this value would be insufficient for an obese individual. The obese setting takes this into account and increases the minimum required compression depth.

Business Model Canvas

Key Partners	Key Activities	Value Propositions Sleek design Portable design Accurate measurements Helpful CPR guidance	Customer Relations	Customer Segments Worldwide Corporations Large events
Suppliers Distributors Investors	R&D: improve existing product Marketing Key Resources People Product hardware Software		Channels Website Retail stores	
Cost Structure Materials Design cost			Revenue Streams Selling CPR assist devices	
Manufacturing Maintenance and development				

Table 2. A layout of the business model for CPR Guide Glove

III. Problem

Cardiac arrest is among the leading causes of heart-associated deaths with approximately 475,000 deaths in the United States each year. Due to the reluctance for bystanders to respond, many of these victims fail to receive cardiopulmonary resuscitation (CPR) within an adequate time frame. When the brain experiences disrupted blood flow for an extended period of time, the chances of brain damage increases and the chances of survival decreases. The failure of immediate attention is a major contributor to the 90% death rate for out-of-hospital cardiac arrest victims.

Cardiac arrest is when the heart experiences a sudden arrhythmia, or irregular heart beat. The body relies on a constant heart beat because vital organs require constant oxygen delivery via blood flow. When this flow is interrupted, the brain, lungs, and other organs will cease proper function and chances of survival undergo a steep decline. With immediate care, the victim is more likely to recover with minimal injury. CPR is an emergency and lifesaving technique that consists of chest compressions and artificial ventilation. CPR is performed to maintain the blood flow and oxygenation to the brain in the case of a cardiac arrest. Ideally, CPR should be performed within 2 minutes. After 2 minutes, brain damage will likely occur. The more time that passes, the more neurological damage will occur.

When an emergency situation arises, only 30% of people feel confident to take action. Despite the prevalence of CPR training, less than half of out-of-hospital cardiac arrest victims receive CPR from a bystander. According to a study by the American Heart Association, bystanders avoid performing CPR because of worry about causing additional injuries and inadequate skills due to lapse in CPR training, lack of training, and low confidence. In addition to the need of bystanders providing immediate CPR, the quality of CPR also impacts the survival

of patients following cardiac arrest. Three metrics of high-quality CPR include: chest compression rate of 100 to 120 beats per minute, chest compression depth of 2 to 2.4 inches, and hand placement over the sternum.

Without immediate and effective bystander CPR, cardiac arrest survival decreases 7 to 10% for every minute of delay. It is projected that 100,000 to 200,000 lives could be saved each year if immediate CPR is performed, which can double or even triple a cardiac arrest victim's chance of survival. Hundreds of thousands of lives is a huge gain that is relatively feasible with a simple solution: give confidence and the means to help.

IV. Product

The CPR Guide Glove aims to assist rescuers in performing effective CPR on out-of-hospital cardiac arrest patients. The goal of the device is to ultimately train millions of people in CPR, increase user confidence, and improve CPR techniques. This product targets a unique audience with a goal that is new to this market. Rather than aiding trained professionals, the CPR Guide Glove aims to help the common bystander. Although this is not the first CPR device that is intended for untrained individuals, the Guide Glove provides thorough guidance and feedback through audio and visual cues to maximize the technique of the untrained individual, rather than simply telling them to “push,” like other devices on the market. With an easy-to-follow procedure as well as user friendly feedback, correct technique can be achieved by any bystander.

The CPR Guide Glove incorporates features to help optimize technique by providing feedback for the three major components of CPR: compression pace, compression depth, and hand placement. Through a series of signals and feedback mechanisms, the user will have the ability to perform effective CPR with any level of training. The glove consists of an elastic material to fit all sizes. An accelerometer is located on top of the glove to take continuous acceleration measurements, which will be inputted into an Arduino microcontroller and further processed via MATLAB. For compression depth, the product utilizes the acceleration-displacement relationship to provide continuous feedback to the user. LEDs will provide visual feedback to help the user understand if the compression is deep enough. A green light indicates compression within the acceptable range and a red light indicates that adjustment is necessary. The device will provide audio feedback to help the user apply compressions at a consistent pace throughout the entire process. The compression pace will be relayed through a

beeping metronome set at a constant rhythm of 120 beats per minute. A general hand placement guidance system utilizes an extension tool and alignment markers on the glove in order to help ensure the user properly places their hand over the sternum before performing CPR.

To use the Guide Glove, the user will begin by aligning the alignment markers with the centerline of the victim and the nipple line of the victim. If the user is unable to locate the nipple line of the patient, the extendable measuring tape can be used. To use the measuring tape, the user will place the end of the tape on the victim's collar bone and drag down until the tape stops extending. This will leave the user's hand at the appropriate position for compressions. When preparing to begin compressions, the user must position themselves with the gloved hand on top. The switch can be used to turn the device on, as well as to choose a size setting. There will be two size settings to control the range of compression depth. When the beeping begins, the user may then start compressing in time with the beeping signal. The LEDs will provide constant feedback regarding the depth of the compressions.

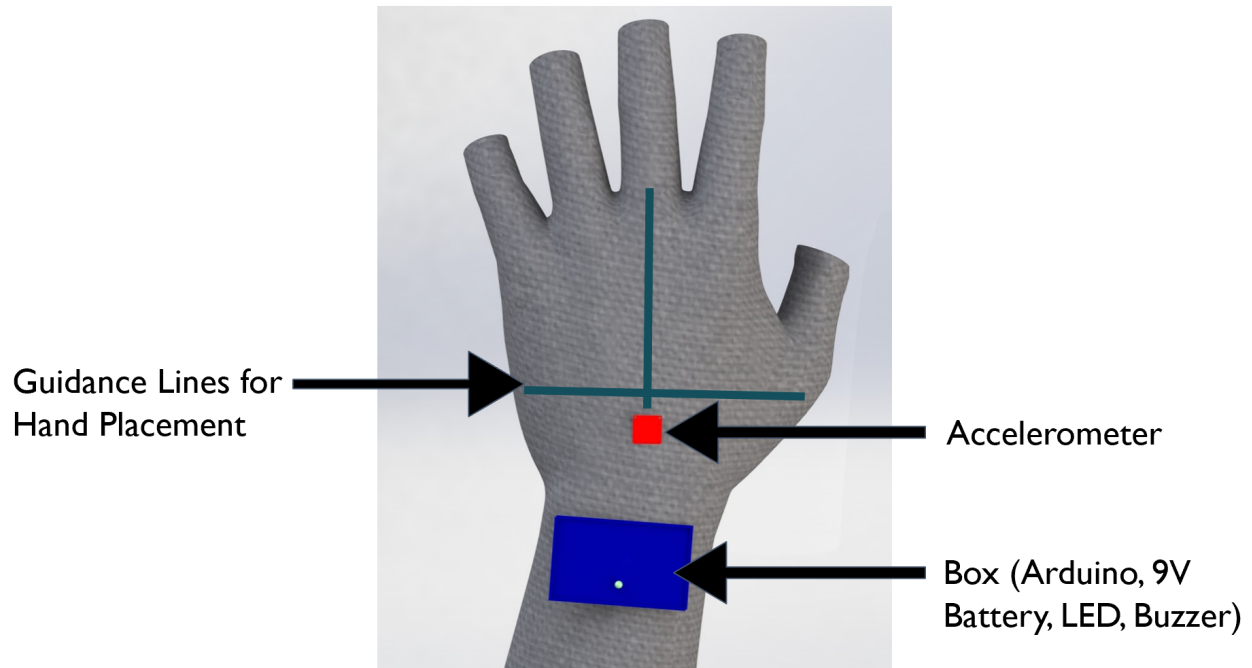


Figure 1. Solidworks Model of CPR Guide Glove Prototype

This device compared to its competitors has some technology that is proprietary to us. This device has the markings on the glove to help with placement to alleviate stress for beginners and bystanders. While there are currently other existing CPR devices that give real-time feedback, they do not satisfy criteria in being ergonomic, cost-effective, portable, and lightweight. The device is wearable which makes it easier to do compressions, rather than trying to focus on a single point like TrueCPR. We also have a unique setting which accommodates people with larger BMIs. The device will change the depth needed in order to do meaningful CPR, allowing this device to be used for multiple weight categories and ages. This device is an improvement on the current products with its depth assistance and hand placement, at a fraction of the price.

V. Market

Target Market

The CPR device market is continuously growing as government initiatives and private companies are encouraging preparedness for cardiac arrest situations. Because heart disease is a leading killer, the urge to be prepared is becoming more prominent. The Guide Glove will target customers by marketing to first-aid kit companies, who sell their first-aid kits to large corporations, businesses, and schools. The end user of our device will ultimately be the person performing CPR, which is done by a bystander or trained medical personnel.

The global CPR devices market was valued at around \$64.99 million in 2017 and is expected to reach around \$124.08 million by 2024. The growth of this market has occurred in the more recent years. With a growth in market, the number of companies selling these devices also experiences a growth. It is estimated that 17 major companies are currently involved in this market. The products that these companies offer range in complexity and price. Listed in Table 1 is a comparison of 3 prominent CPR devices currently on the market and the CPR Guide Glove. CPR RsQ Assist is a very basic model that relays information through audio. It tells the user to call 911 then says “push” to convey the compression pace. It was designed to have an ergonomic shape to reduce the fatigue of the user. It does not provide any feedback and does not provide any guidance for compression depth. TrueCPR has a similar function to the Guide Glove due to the addition of a compression depth feedback feature. The design, however, is not suited for emergency situations. This product requires the user to place one piece underneath the victim, an action that may be difficult for several reasons. Without the part placed appropriately, the depth feature would be rendered useless. Mechanical CPR devices appeal to

a different demographic than the CPR Guide Glove, CPR RsQ Assist, and TrueCPR. It requires no user action and therefore comes at a significantly higher cost.

	CPR Guide Glove	CPR RsQ Assist	TrueCPR	Mechanical CPR Devices
Cost	\$300	\$87.65	\$1990.90	> \$10,000
Customer	Bystander	Bystander	First responders	First responders
Hand Placement	✓	✗	✗	✗
Compression Depth	✓	✗	✓	✓
Compression Rate	✓	✓	✓	✓
Size Adjustment	✓	✗	✗	✓
Requires User Action	✓	✓	✓	✗
Drawbacks	Impacted by user error	Impacted by user error	Expensive, inconvenient design	Expensive

Table 3. Comparison of CPR assist devices on the market

TAM (Total Available Market)

The medical industry as a whole demands tools and products that will improve the well-being of the general population. Products in this industry range in function, from life-saving to minor relief. This includes medical devices that are used in hospitals on a daily basis and emergency first-aid that is performed outside of the hospital setting.

The emergency first response industry, specifically, is the total available market. This is because the product is intended to be used in emergency situations that arise outside of the hospital, or other clinical setting. For example, these include emergency medical technicians (EMTs), emergency medical responders (EMRs), and paramedics. The products used by these individuals range from large, life-saving devices to small simple aids. Some of these items may include stethoscopes, blood pressure cuffs, emergency oxygen system, first aid kits, CPR masks, bandages, gloves, tape, and much more. Because the CPR Guide Glove is intended to be used in a life-saving emergency situation, it appeals to this market.

SAM (Serviceable Available Market)

Within the emergency first response industry, the CPR device market is the serviceable available market. These include mechanical CPR devices and feedback CPR devices. The mechanical devices require no user action. The CPR Guide Glove falls under the category of feedback CPR devices. The glove aids the user in performing CPR by supplying constant feedback regarding compression performance.

SOM (Share of Market)

As a CPR assist device, the CPR Guide Glove is expected to capture a percentage of sales in the CPR devices market. The projected share of market for CPR Guide Glove is 5% of the serviceable available market, or the CPR device market. This projected value takes into consideration the large range of CPR assist devices on the market. The Guide Glove is not competing against the mechanical CPR devices because they appeal to a different consumer base so it will not detract any business from those products. It will, however, detract attention from the very basic devices because of its affordable price.

VI. Finances

The CPR Guide Glove is priced at \$300 for retail stores and online stores. The cost to make a single glove is \$65, which produces a 362% profit. The cost of \$65 encompasses the raw materials to make the product, and does not include labor. Production costs will likely increase as the company expands. When deciding the retail price, we took this into consideration. The cost of \$300 was chosen based on the price of competing devices and production costs. The products that have similar capabilities as the CPR Guide Glove range from \$500 to \$2000. The price of \$300 maintains a competitive edge while providing significant profit that can be reinvested in research and development. We are willing to change the price if the circumstances permit. If we can partner with a private first aid kit company, we are willing to lower the price of each individual glove. With bulk manufacturing, the cost of supplies can be reduced due to bulk purchasing. With a lower production cost, we can offer a low wholesale price.

Item	Cost
Accelerometer	\$32.93
Arduino Nano	\$4.66
Buzzer	\$1.95
Compression Sleeve	\$18.90
Rocker Switch	\$0.95
RGB LED	\$0.50
Retractable Tape Measure	\$4.99
TOTAL	\$64.88

Table 4. The cost breakdown for one CPR Guide Glove

Market Plan

Marketing Channel: Our product will be marketed towards first aid kit companies, specifically those who sell to large corporations, businesses, and schools. We will utilize our immediate connections with universities first, and use them as first supporters towards our target market. When we gather a group of our first clients we will offer them incentives such as offering them a percentage off their next CPR Guide Glove with a referral to a friend in order to gather new potential clients.

Marketing Mix: We plan to sell our product to first-aid kit companies before expanding our product to wholesale retailers and offer bonus referrals as an incentive to other retailers.

Promotional Mix: Social media is the most affordable and accessible form of traffic to create content to inform consumers and potential buyers.

Exit Strategy

Given the application of our product, the first exit strategy approach is to merge our company with a major first aid kit or first response company or sell our company. This option would put us in the best place to maximize the financial return on our company. Merging with a similar company or being acquired by another company is an opportunity for those larger companies to grow and increase revenue. This will allow them to break into a new market, be more competitive, and build a larger customer base. To achieve this exit strategy approach, we will need to build our brand and market ourselves to be attractive to potential companies that want to merge or acquire our company.

In the case that those particular companies are not interested in purchasing our company or merging is not a viable option, the next best option is to liquidate. Liquidation would maximize the profits in a short period of time. Liquidating our assets by selling our land and

equipment will be much faster and easier than finding a seller. However, these physical assets are typically not sold at full value, as they are often discounted in order to sell quickly. Another downside of liquidation is that it destroys any clients, business relationships, and reputation, which play a larger part in the value of the business than the physical assets.

VII. Projected Obstacles

It is vital for CPR assist devices to be user-friendly as the ease of use is a paramount goal. Ease of use is of importance due to the urgent nature of cardiac arrest situations and the necessity to provide life-saving procedures as soon as possible. Our product has faults in this category due to some of the non-intuitive features that it contains. The size setting is one feature that may cause confusion in a high-intensity situation. The user may have trouble deciding if the victim is considered obese or average, slowing down the response time. The feedback is another area of possible confusion. At the current stage of our device, we plan on having easy to follow written instructions to explain how to operate our device. If the user does not read the written instructions, the LED signal will not be clear. We plan to overcome these obstacles in the future by providing the user with clearly defined instructions that will be announced to the CPR operator in real-time to help guide them throughout the entire CPR procedure.

Another obstacle with our CPR Guide Glove is achieving accuracy. Providing accurate readings is important for patient safety while the user is performing CPR. The size and cost of the accelerometer as well as the types of filters applied to the measurements are important considerations for the accuracy of the depth measurement. We plan to overcome this obstacle by performing tests to determine the accuracy of the device. The appropriate LED light must illuminate when the appropriate depth is compressed, as well as when insufficient depth is compressed. We will make the necessary adjustments following the initial tests in order to prevent any false positive or false negatives from occurring. In addition, our hand placement feature may be inaccurate due to the lines serving as a simple approximation of the sternum for the average adult. Because approximation will lead to inconsistencies due to user error, we

want to expand on the hand placement feature in the future to obtain more accurate results, rather than have the user approximate where the sternum is.

Another obstacle is that there are already many options for CPR assist devices currently on the market. It may be difficult to introduce our product to the market since companies will first look towards already established products. We plan to overcome this obstacle by first focusing on first aid kit companies as an easy way to spread awareness for our product. In addition, it may prove to be difficult to market our device to companies who already have these other products. To counteract this problem, we can donate our product to CPR training companies so they can test it and see if they prefer our product over others. We can use these results as leverage when trying to convince companies to purchase our product. We can also use these results to persuade businesses who do not think a CPR assistive device is necessary to have.

VIII. References

- [1] Brouhard, R. (2020, January 26). How Long Does Brain Activity Last After Cardiac Arrest? Retrieved from <https://www.verywellhealth.com/brain-activity-after-cardiac-arrest-1298429>
- [2] CPR Facts and Stats. (n.d.). Retrieved from <https://cpr.heart.org/en/resources/cpr-facts-and-stats>
- [3] CPR & ECC Guidelines. (n.d.). Retrieved from <https://eccguidelines.heart.org/circulation/cpr-ecc-guidelines/>
- [4] AHA Releases 2015 Heart and Stroke Statistics. (2014, December 30). Retrieved from <https://www.sca-aware.org/sca-news/aha-releases-2015-heart-and-stroke-statistics>
- [5] Cardiopulmonary Resuscitation Devices Market 2019 Global Industry Share, Size, Future Demand, Global Research, Top Leading Players, Emerging Trends, Region by Forecast to 2023. (2019, October 4). Retrieved from <https://www.marketwatch.com/press-release/cardiopulmonary-resuscitation-devices-market-2019-global-industry-share-size-future-demand-global-research-top-leading-players-emerging-trends-region-by-forecast-to-2023-2019-10-04>
- [6] Idris, A. H., Guffey, D., Aufderheide, T. P., Brown, S., Morrison, L. J., Nichols, P., ... Nichol, G. (2012). Relationship Between Chest Compression Rates and Outcomes From Cardiac Arrest. *Circulation*, 125(24), 3004–3012. doi: 10.1161/circulationaha.111.059535
- [7] Remino, C., Baronio, M., Pellegrini, N., Aggogeri, F., & Adamini, R. (2018). Automatic and manual devices for cardiopulmonary resuscitation: A review. *Advances in Mechanical Engineering*, 10(1), 168781401774874. doi: 10.1177/1687814017748749