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DESCRIPTION: State the application's broad, long-term objectives and specific aims, making reference to the health relatedness of the project. Describe concisely the research design and methods for achieving these goals. Avoid summaries of past accomplishments and the use of the first person. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from the application. If the application is funded, this description, as is, will become public information. Therefore, do not include proprietary/confidential information. **DO NOT EXCEED THE SPACE PROVIDED.** 

Over 30% of the people between the ages of 35 and 65 years old have been diagnosed with a cardiovascular disease (CVD). These diseases, when left untreated, lead to cardiac events such as heart attack, bypass surgery, angioplasty, and many others. After these events, rehabilitation is paramount. If a patient takes all of his/her prescribed medication and make recommended lifestyle changes they will not only promote regression of their disease, they will decrease their chances dying as a result of future cardiovascular problems by 20-30% according to the <u>ACSM's Guidelines for Exercise Testing and Prescription</u>.

Unfortunately, only 20% the patients who could benefit from cardiovascular rehabilitation participate. A study published in 1996 cited many reasons for this lack of participation. Among the most common reasons for lack of participation among patients were: lack of knowledge, lack of motivation, and lack of access to care. Larger barriers to participation occurred in the medical community; these included: lack of resources and facilities, time and economic constraints, poor communication between specialty and primary care providers, and lack of policies and standards.

The Phase 3 Communicator (P3C) will provide a solution to many of these problems. The P3C is a software application designed to foster communication between cardiac rehabilitation patients and their health care providers, provide a means for health care providers to motivate patients, track specific characteristics of physical fitness in heart patients, and create a community where cardiac rehabilitation patients can communicate and support each other. It has been shown that a simple phone call from a nurse can significantly improve the rate of participation to 85%. Government studies have estimated that participation of as little as 35-40% of potential cardiac rehabilitation patients could result in savings of over \$40 million dollars in direct medical and non-medical costs. By increasing the lines of communication and providing motivation to cardiac rehabilitation patients, the P3C will save the insurance system money by getting cardiac rehabilitation patients to become participants in maintaining their health.

PERFORMANCE SITE(S) (organization, city, state)

Old Dominion University, Norfolk, Virginia

KEY PERSONNEL. See instructions. Use continuation pages as needed to provide the required information in the format shown below. Start with Principal Investigator. List all other key personnel in alphabetical order, last name first.

Name Aaron Auger Kimberly Cook Justin Hollingsworth Jonathan Holloran Masudur Rashid Zachary Young Organization Old Dominion University Role on Project Project Manager Technical Solutions Legal / Resources Medical Issues Webmaster Marketing / Resources

Disclosure Permission Statement. Applicable to SBIR/STTR Only. See instructions. Yes No

The name of the principal investigator/program director must be provided at the top of each printed page and each continuation page.

1.0 Form Pages	1
2.0 Research Plan	6
2.1 Introduction	6
2.1.1 Specific Aims	6
2.1.2 Background and Significance	6
2.2 Proposed Solution	9
2.2.1 Proposed Technical Solution	9
2.2.2 Research Design and Methods	15
2.2.3 Management Plan	16
2.2.4 Evaluation Plan	24
2.3 Conclusion	25
2.3.1 Literature Cited	25
3.0 Appendices	26
3.1 Project Management	26
3.1.1 Gantt Chart	26
3.1.1.1 Phase 0 and Phase I Gantt Charts	26
3.1.1.2 Phase II Gantt Chart	27
3.1.1.3 Phase III Gantt Chart	27
3.1.1.4 Monthly Gantt Charts	28
3.1.2 Product Plan	38
3.2 Resources	43
3.2.1 Phase I Resources	43
3.2.2 Phase II Resources	43
3.2.3 Phase III Resources	43
3.2.4 Resource Overview	44
3.2.5 Personnel Overview	44
3.3 Budget	46
3.2.1 Phase I Budget	46
3.2.2 Phase II Budget	47
3.2.3 Phase III Budget	47
3.2.4 Production Budget Overview	48
3.2.5 Post-Production Out-Years Budget	48
3.4 Marketing Plan	48
3.4.1 Customer	48
3.4.2 Competition Matrix	50
3.5 Testing and Prototyping	51
3.5.1 Test Market	51
3.5.2 Test Plan	51
3.5.3 Prototype Plan	52
3.6 Risk Assessment	52
3.7 Glossary	54

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### 2.0 RESEARCH PLAN

#### **2.1 Introduction**

#### 2.1.1 Specific Aims and Goals

Individuals with cardiovascular diseases that do not continue in a proactive approach to improving their well-being are more susceptible to future cardiovascular problems. Our team plans to solve this problem by providing A software application designed to track specific characteristics of physical fitness in cardiac rehabilitation patients and facilitate continued communication with healthcare providers.

#### 2.1.2 Background and Significance

Currently, coronary atherosclerosis disease (CAD) and cardiovascular disease (CVD) are the leading causes of death in industrialized countries. CAD and CVD are precursors to syndromes such as myocardial infarctions (MI), angina pectoralis, sudden cardiac death syndrome, and heart failure. In America alone, over 60 million people are currently diagnosed with some form of CAD and almost a million died last year as a result of CAD.

The human body is made up of hundreds of miles of blood vessels. These are broken down into two groups, arteries and veins. In general, arteries carry oxygenated blood away from the heart to the rest of the body, and veins carry deoxygenated blood back to the heart and lungs. The whole loop can be visualized as tree. At the trunk of the tree are the largest blood vessels called arteries. As the trunk branches, smaller vessels called arterioles are found. Finally, at the smallest branches, capillaries can be found. Capillaries then rejoin for the bloods return trip to the heart to form venules. These, in turn, join to form veins (Figure 1.)



(Picture Courtesy of: http://users.tpg.com.au/amegann/body/circulatory.html)

Atherosclerosis is the process by which the lining of the arteries hardens. While, this process takes place throughout the human body over the course of a person's lifetime, the hardening of the coronary arteries is by far the most dangerous. During the

process, plaque builds up on the artery walls, constricting the amount of blood flow through these arteries. Since a smaller amount of blood flows through this artery, tissues that are fed by the artery are generally lacking oxygen. This can result in pain localized around the check called angina pectoralis. Once the blockage has occluded a large percentage of the artery, it is possible for artifacts in the person's blood stream, such as other dislodged pieces of plaque or scar tissue, to effectively plug up the rest of the occluded artery. The resulting lack of blood to areas of the heart causes a MI or heart attack. The results of the MI depend largely on what artery was occluded. If the blockage occurs closer to the capillaries, only a small amount of tissue is affected and the MI is generally minor. The closer to the trunk, or main arteries the occlusion is, the more life threatening the resulting MI becomes.

The American Heart Association has identified a number of risk factors for developing CVD. The major factors include: age, family history, smoking, hypertension, hypercholesterolemia, diabetes mellitus, and sedentary lifestyle.

Unfortunately, as a society, we still wait for something bad to happen and then attempt to treat it as opposed to prevent the problem in the first place. After a person has been diagnosed with a CVD, there are a number of ways to treat the disease. Varying success has been had with such methods as: lifestyle changes, cholesterol medication, blood pressure medication, heart rhythm regulating medication, smoking cessation, coronary artery bypass grafts (CABG), and counseling.

Prevention is the best medicine. Whether or not a person has been diagnosed with a CVD or CAD, it is possible to prevent further development of the disease by making lifestyle specific changes. A controlled diet in conjunction with regular exercise can result in regression of the blockage of arteries. Regular exercise is also important for coaxial arterial growth. As a person becomes more physically fit, the amount of oxygen that their muscles demands increase. Eventually, the amount of oxygen that a single artery carries is not enough to supply an entire area. The body will grow additional arteries to compensate for the lack of oxygen. These additional arteries greatly improve a person's chances of survival during a heart attack. While one blood vessel becomes occluded, the other vessels can still feed the oxygen starved area. Interestingly, a similar process occurs in people with a medium to high percentage of occlusion in their arteries. The occlusion reduces the amount of blood flow, signaling the same response where by new arteries are developed.

Once a person has experienced a cardiac event, or been diagnosed with cardiovascular disease, they will often be prescribed to begin cardiac rehabilitation. Cardiac rehabilitation is generally broken down into three phases.

Phase I is an inpatient program. After a person has experienced a cardiac event or undergone surgery, they will generally have a short stay in the hospital. During this stay, hospital staff will assist the patient in getting out of bed and going for short walks to

begin building cardiovascular endurance. These walks get progressively longer until the person is discharged from hospital care.

Once released from the hospital, the patient is usually prescribed phase II rehabilitation. Phase II is generally covered by a patients insurance and lasts about 12 weeks. During phase II, a patient will exercise approximately three times a week, starting at a low intensity and building over the course of their 12 week stay. They will also undergo a small amount of nutritional counseling. At this point, for the safety of the patients, all exercise happen while the person is attached to a 3-lead ECG (encephalocardiogram) that tracks electrical impulses across a person's heart. They also have resting, exercise, and post exercise blood pressures take at every visit. Unfortunately, at the end of 12 weeks, most insurance plans will no longer provide assistance to patients in cardiac rehabilitation. It is at this point that patients graduate to phase III rehabilitation.

Phase III cardiac rehabilitation is perhaps the most important phase. For all intents and purposes, it is maintenance. It is relatively unsupervised exercise where a patient puts into practice what they learned in phase II. In general, people who graduate from phase II rehabilitation are healthier than they were prior to their cardiac event. During phase III it is their responsibility to maintain this healthiness. There are cardiac rehabilitation facilities that provide phase III support, but they often operate as gyms, where memberships require a prescription from a doctor and a large monthly fee. More often though, patients will join local recreation centers or cheaper gyms to gain access to some form of exercise expertise.

It is estimated that between 10-30% of all graduates of phase II rehabilitation start and continue with phase III rehabilitation. There are many barriers to continued participation in phase III rehabilitation, often cited on the patient's side are: lack of motivation to exercise, lack of communication with their physicians, and lack of understanding of the importance of exercise. Healthcare providers are often held responsible for: not stressing the importance of exercise, lack of communication with patients, and lack of communication between primary care physicians and specialists.

The Phase 3 Communicator is expected to mitigate many of the patient's reasons for lack of participation. It will provide communication between a cardiac rehabilitation specialist and the patients. That path of communication is expected to provide motivation. Additional motivation will come from peers that are met on the Phase 3 Communicator's chat rooms that are designed to work as support groups or a place to openly ask questions. The Phase 3 Communicator will provide graphs that show a patient's progress so the patient can give their physician more detailed medical information on what they have accomplished.

### 2.2 Proposed Solution

#### 2.2.1 **Proposed Technical Solution**

Studies have shown that remote supervision along with continued communication with a health care professional helps increase patient participation in Phase III of cardiac rehabilitation, and as a result decrease the incidences of recurrent cardiac complications. Support for a solution of this type was demonstrated in a study conducted at Stanford University, where patients were monitored remotely via telephone contact with a nurse case manager. The study revealed that communication was key in keeping 85% of the patients motivated in maintaining their health, compared to an 80% drop out rate for patients not participating in the program (American Journal of Cardiology.) P3C can facilitate the success of such a program by utilizing technology as a means of communication, tracking and education.

# 2.2.1.1 Characteristics of the Solution

To address the problem of recurrent cardiac incidences due to patients lack of participation in Phase III cardiac rehabilitation, we propose a solution that is designed to track specific characteristics of physical fitness and facilitate continued communication between cardiac patients and health care providers. The characteristics of this solution are as follows:

- Foster communication between health care professionals and Phase III patients
- Provide a forum for patients to communicate and collaborate together
- Incorporate into hospitals for health care professionals' supervision
- Provide an easy to use web-based graphical user interface
- Provide exercise tracking along with certain vital statistics
- Provide a mechanism for monitoring patient health progress
- Supply health care providers with an administration tool designed to help monitor and motivate a large number of patients with minimal staff
- Provide a framework for gathering statistical data related to patient participation in Phase III cardiac rehabilitation
- Reduce financial costs associated with recurrent cardiac incidences

#### 2.2.1.2 Feasibility

Since "nearly one million Americans die of CVDs every year (American Heart Association,)" and "persons with established CHD are five to seven times more likely to experience a heart attack than the general population (Center for Disease Control,)" P3C will be designed to help alleviate the rate of recurrence of cardiac issues by providing a mechanism for health care providers to facilitate and encourage patients to continue participation in Phase III cardiac rehabilitation. The Phase III Communicator (P3C) portal will provide health care professionals and patients with a comprehensive technological solution to directly address the issues associated with Phase III cardiac rehab participation, and indirectly effect the number of occurrences of repeat cardiac complications.

The decision to use a portal as the framework of the solution for this particular societal problem stemmed from the type of characteristics of the solution, that require remote supervision and interaction, along with the fact that portals are inherently suitable for solving problems requiring secure remote access to multiple, closely-related web services. In addition, the fact that "The likelihood of a hospital having a web site grew from roughly six in 10 in 2000 to seven in 10 during 2001 (Hospital Access Management,)" indicates the availability of supporting infrastructure already present in the facilities where the P3C portal will reside. Hospitals currently with the infrastructure in place to support a web-based application will provide a customerbase that has to incur minimal additional expense to implement the P3C solution.

#### 2.2.1.3 Phase II: Functional Prototype and Development

The technical feasibility of the P3C solution will be proven during Phase I of the project, which will include the preliminary development of the software components that make up the P3C solution. The application software and database layout and functionality will be developed during Phase I and used as a baseline to begin fully implementing a functional P3C prototype in Phase II. In Phase II the P3C prototype will consist of two major functional components: an application server and a database server. The major functional component diagram depicted in Figure 2 illustrates the two tier architecture to be utilized by P3C for improved scalability and flexibility. Each server will be an Intel-based multiprocessor platform, with multiple Ethernet network interface cards (NICs), running RedHat's Enterprise Linux AS operating system. The database server will run MySQL as its database software.



Figure 2: Major Functional Component Diagram

The functionality the application server will provide includes:

- Accept new exercise data
- Display patient progress diagrams
- Send automatic email notifications
- Provide messaging service
- Provide Chat service
- Coordinate with the database server for data storage and retrieval
- Process statistics

And the database server will:

- Process requests from P3C application server
- Store patient exercise data
- Store patient communication data
- Store internal messaging data
- Store statistical data

Both servers will be located within the health care provider's facility. The P3C portal will provide secure access for patients and health care providers to do the following:

- Update exercise data and required vital statistics
- View health progress via dynamic graphs extrapolated from collected data
- Send and receive secure internal messages
- Chat with fellow Phase III cardiac patients via an easy to use web-based user interface.

Figure 3 depicts the functional overview of the P3C solution and demonstrates the interaction between external entities, in this case the web browser on the patients home personal computer, and the internal components which represent the application server and the database server located on the health care provider's network.



Figure 3: P3C Functional Overview

The functional overview diagram (Fig 1.1) also illustrates the human requirement necessary for the P3C solution. The nurse located at the health care provider's facility will utilize the P3C application in two major categories: first, to track patients exercise data and health progress, and second to track the communication frequency between patients and their health care provider. When warning thresholds are reached in either category, alerts will be generated so that the nurse can intervene quickly with messages along with external notification emails, or phone calls necessary to keep patients motivated in maintaining their health.

#### 2.2.1.4 The P3C Communication Model

Figure 4 illustrates the communication model that will be implemented by the P3C solution. The communication diagram demonstrates the importance of regular communication between patients who are active members, as well as patients who require extra motivation because of lack of participation. Those patients desiring to collaborate and communicate with each other will be able to do so using the chat service offered by the P3C portal.



Figure 4: P3C Communication Model

### 2.2.1.5 The P3C Application Logical Design

Figure 5 illustrates the overall logical design of the application components required for P3C. The application server will serve the P3C application to users connecting from the Internet. This layer will be implemented using JSP pages and servlets that make up the P3C server application. Also depicted in the diagram are data access objects which represent application software objects that will use JDBC to communicate with the backend database server. Representing the internal messaging service that will be used by patients and health care providers for general communication is the Java mail service shown. When internal mail is received by a patient's account, an automatic, preformatted external email notification will be sent to the patient's external email address. This method of using email notifications instead of direct external emails was chosen to eliminate the need for secure remote email communication between the health care provider and the patient, and ease administration requirements for the mail service.

The application server will also provide a separate application for the chat service Phase III patients will use to communicate and collaborate with each other. To save money and speed to production, a COTS application will be used for this functionality. One application currently being considered is RealChat <sup>(TM),</sup> a javabased chat software application used for server-side chat sessions.



Figure 5: Logical Application Design for the P3C application portal <a href="http://java.sun.com/blueprints/guidelines/designing\_enterprise\_applications/introduction/application\_scenarios/">http://java.sun.com/blueprints/guidelines/designing\_enterprise\_applications/introduction/application\_scenarios/</a>

# 2.2.1.6 The P3C Application Overview

Figure 1.4 depicts the P3C application overview and characterizes examples of the flow of data that will result from use of the P3C application by patients and health care professionals. This diagram demonstrates how use of the portal will provide patients the ability to provide regular updates about their exercise activity, view health progress in graphical format, view messages received from the health care professional, and how the patient will receive external email notifications when either of these attributes changes on his/her account. The nurse or health care professional will be able to view and update the patient's exercise prescription, view patient progress graphs, and keep track of communication frequency via call lists using P3C. In addition, the health care professional will receive alerts via an alert list that will categorize patients based on the alert status they have reached, such as lack of participation, slow health progress, exceeded threshold values, or communication frequency.



### Figure 6: P3C Application Overview

All aspects of the P3C solution work synergistically to provide a comprehensive solution to the problem of non-participation in Phase III cardiac rehabilitation. Since Phase III cardiac rehabilitation is essentially a maintenance phase for continued health, the primary goal of P3C is to provide a mechanism to keep patients motivated and persistent in maintaining their health after having experienced a cardiac condition. Utilizing current technology, P3C aims to keep patients connected to the main force of encouragement capable of ensuring that they are taking the proper steps necessary to stay healthy and live as long as possible. That force of encouragement consists of the health care provider and the invaluable communication they can provide to patients who may be inclined to drop out of the program to their own detriment. P3C facilitates the communication and motivation that has been shown in studies to decrease a patient's chances of experiencing recurrent cardiac complications due to poor health maintenance.

#### 2.2.2 Research Designs and Methods

After a Preliminary Research Phase, Phase Zero, Phase I begins. The beginning of Phase I will be a detailed analysis of the software and components necessary for this product. This will be followed by the creation of a product user's manual.

The second part of Phase I will be dedicated to development of a prototype. This prototype will demonstrate the total feasibility of the product. The prototype will undergo extensive testing and analysis. If no changes are deemed necessary, preparations for final design will begin.

Once the prototype has been approved by the team, advanced testing will occur with the targeted customer base. A test group of potential customers will then use the system and test for any fallibility. After the tests are complete changes will be made, if necessary, to meet the customer's demands.

The conclusion of creating and testing the prototype will start Phase II, the development and preliminary production of the product. First, the product specifications will be reviewed and finalized. A detailed market plan and management plan will be implemented. Then, software development will begin and take approximately one year. Software development includes systems, unit, and integration testing. The end of Phase II will comprise of full systems test in a hospital setting. Upon completion of installation testing the project will shift to the production Phase III.

Phase III will start with putting the product into full production. The marketing plan will continue to be implemented and expanded as customer base grows. Next, an initial indoctrination course will be developed and taught to all customers. All employees will be fully trained on the use of the product. The Phase will end with a shift to out years where technical support and help lines will be implemented and continued production and upgrading.

\*please refer to appendix for a full project plan, yearly Gantt charts and monthly Gantt charts.

#### 2.2.3 Management Plan

Execution of the Project will be performed in accordance with the plans set forth in this SBIR document including the Management Plan (2.2.3), the Evaluation Plan (2.2.4), the Test Plan (3.5.2), the Marketing Plan (3.4), and with regard to our Risk Assessment (3.6). The responsibilities of the Project Team, the capabilities of the system, and the Project deliverables are detailed in this SBIR document.



#### **Project Management Plan**

Figure 7: Management Plan

The Project Management Plan (Figure 7) describes the management philosophy, project organization, schedule, and major milestones that serve as the guide for execution of the Project. The PMP also provides the customer and the quality team with the information they need to monitor and evaluate the progress of the effort. This plan provides the following pertinent information:

#### **Management Approach**

Phase III Communicator's management goal is to work closely with the customer to fully understand the system requirements and field a system that meets those requirements. The management approach to executing contracts at ODU is based on the philosophy that successful projects are delivered by goal-oriented teams. A Project Manager (PM) will lead the Phase III Communicator team. The PM is responsible for all planning, programmatic, technical, and financial aspects of the Project. The PM is the primary Point of Contact (POC) for the customer. The primary duties include supervision of all planning, scheduling, financial and technical activities, and customer liaison. The PM is responsible for all Project-related decisions and commitments with approval, as required, from the Corporate Management Team.

A key element of ODU's Project management approach is customer involvement. ODU encourages the customer to retain an active role in monitoring the progress of all aspects of the Project. The customer is encouraged to discuss technical details directly with members of the Project team, provide planning and schedule recommendations, and assist in resolution of technical and programmatic issues. In order to facilitate customer involvement, Phase III Communicator Project will provide access to project information as it is requested by the customer.

### The Phase III Communicator Team

The Project Team is committed to provide the best value by delivering COTS, open architecture, and low-risk systems at the lowest cost. This commitment is attainable because it is based on the re-use of existing technology that is field-proven. Through strategic teaming and an extensive system selection process, ODU has assembled a cohesive Project Team that is experienced with the implementation of each component that will comprise the Phase III Communicator system.



Figure 8: The P3C Team

Aaron Auger is currently a senior at Old Dominion University College of Sciences, seeking a Bachelors of Science in Computer Science and a Minor in Spanish. Aaron is an officer in the United States Navy. He is currently completing his degree under a scholarship from the U.S. Navy. Aaron serves as the Project Manager on the team.
Kimberly Cook is senior at Old Dominion University and expects to earn a BS in Computer Science in May 2004. Kim has seven years of IT work experience in Systems Administration and Management. After graduation she plans to pursue an MBA. Kimberly's role on the P3C team is the Technical Solution Manager.
Justin Hollingsworth is the Legal and Resources Manager for the Phase III Communicator. Justin is a senior undergraduate student at Old Dominion University working towards a degree in Computer Science with a minor in Business Administration.

Currently, he is employed at Walldingers Inc. working part-time as a Network Administrator, where he hopes to gain the experience necessary to begin a career in I.T. upon graduation.

**Jonathan Holloran** is the Medical Issues Manager for the Phase III Communicator project. He is currently working towards a degree in Computer Science at Old Dominion University. Jonathan works part time for CCG Systems Inc., a fleet management company. He obtained a B.S. in Exercise Science and minor in Chemistry in 2000. During the completion of his first degree, Jonathan interned with Sentara Virginia Beach Cardiac Rehabilitation Center for four months.

**Masudur Rashid**, preferred to be called Jitu for your sake, is diligently working his way toward achieving his BS in Computer Science with a minor in Information Technology. Masudur's favorite field of study is computer graphics and design. His interests, therefore, lend himself to the position of webmaster for P3C. He will graduate in May 2004.

**Zachary Young** is a junior at Old Dominion University pursuing a B.S. in Computer Science and a minor in Philosophy. Graduating in May of 2005, Zachary is currently looking towards job opportunities in Western Europe. Currently, Zachary serves as the Marketing Analyst for the Phase III Communicator team.

The following is an overview of each of the team's positions.

**Project Manager.** Overall management responsibility for Phase III Communicator Project is assigned to a Project Manager who is responsible for planning and coordination of the day-to-day technical, contractual, and financial aspects of the project. He is responsible for the generation and management of all project schedules, for the coordination of project staff assignments, and for coordinating all project activities. His principal assistants are:

**Technical Solutions Manager.** The TD provides overall technical direction for the Project Team. She is the senior software engineer and will directly oversee the development and production of P3C to ensure that the software is being created according to the proposed solution.

**Medical Issues Manager.** The Medical Issues Manager is responsible for providing the team with background and possible feasibility issues that may occur in the medical field. He will also be primary spokesperson of the group behind the Project Manager, as the MIM has a larger background in the topic and is possibly more qualified to answer questions.

Legal / Resource Analyst. The Legal / Resource Analyst is responsible for seeing to it that any necessary waivers or disclaimers are made, and that contractual agreements are fulfilled. He is also responsible for determining the resources needed for the project. Marketing Analyst. The Marketing Analyst provides the team with the resources necessary to successfully sell the product. He is responsible for monitoring competition, monitoring the currently targeted demographic, and the test market and test plan. Webmaster. The webmaster is responsible for maintaining the website, as well as providing the Graphical User Interfaces for prototypes and eventually the final product.

#### **Project Duration**

The Phase III Communicator Project totals four years. The Phase 0 schedule consists of a preliminary design, research, and SBIR funding approval. Phase I will entail creating the prototype development, completing a manual, and applying SBIR Phase II funding approval. Phase II will include the preliminary production and software development. Phase III will involve full-scale production. At this point, the project will switch to out years, where technical support and phone lines are in place.

#### **Work Breakdown Structure**

The project Work Breakdown Structure (WBS) reflects the budgeted cost versus resources required to complete each task. The WBS phase numbers are integrated as part of the master project schedule. Budgets for work planned are entered into ODU's financial tracking system for each WBS element, actual costs and estimates to complete are managed by the Project Manager. The WBS element numbers will be used to track project costs, progress, earned value and progress relative to the master project schedule. The WBS management tools that ODU will use are SmartDraw and Microsoft Project



Figure 9: Work Breakdown Structure

### **Project Planning**

The Phase III Communicator Project team office will maintain the project master schedule. The master schedule contains a line item for each WBS element and will be used to track the progress of each element. All deviations from the master schedule must

be coordinated with the project office. It is the responsibility of each team member to call attention to possible schedule deviations at the earliest opportunity. The project office will coordinate the project schedule with ODU. The project will be developed in phases; within each phase, formal reviews will play an integral part in monitoring project progress. All formal reviews will be announced four weeks in advance of the starting date.

Phase III Communicator Project will take a "top down approach" to the Project Schedule, meaning that we will pace our workload to fit the overall Project requirements. Particular attention will be given to timely milestone completions. It is recognized that the schedule is particularly tight, containing critical project milestones during the first year, and adequate personnel will be available in order to keep the project moving forward.

#### **Progress PERFORMANCE ASSESSMENT**

All Phase III Communicator team members will participate in progress reporting and team management. ODU will track technical and financial progress of the project. Reviews will be held monthly or as mutually agreeable between the Phase III Communicator team and Professor Brunelle.

- Report on progress to date
- Present work to be performed during the next month
- Present status of all deliverables and review planned delivery dates
- Present status of all received GFX/PFX items
- Plan and coordinate activities
- Discuss technical or programmatic issues as necessary.

In preparation for the meetings the Phase III Communicator Project Manager will collect the current status data on relevant on-going activities, progress against schedule and budget, and planned activity for the next reporting period. Quality reviews of all project documentation and procedures will be held periodically. In particular, the quality project will be involved with project deliveries and milestones and will work off of the master project schedule to plan project audits. Technical, financial and quality progress and status reporting will be conducted according to the following general guidelines.

#### **Technical Progress and Reporting**

The schedule for the project is established during the planning phase and monitored throughout the performance period. The schedule contains an entry for each WBS element. The percentage of completion for each WBS element is determined as necessary to manage project progress and is reviewed at least quarterly during Professor Bunelle's review.

#### **Financial Management and Reporting**

The financial profile for the Project is established during the planning phase and monitored throughout the performance period. This profile is generated by assigning accounting phase numbers to every Project activity that has been identified as a scheduled event. A budget representing labor costs, materials purchase, and other expenditures (such as travel expenses) is then prepared for every phase. The schedule and budgets are then integrated to provide a spending profile for the phase. The Project spending profile represents a summary of phase spending profiles.

The PM provides an information package that identifies the phase numbers assigned to each activity, the corresponding budgets and schedules, the overall spending profile for the project, and a synopsis of all major deliverables and milestones specified in the contract. The PM uses this information, combined with an on-line financial summary of the Project to track its financial status on a weekly basis. An updated spending profile is provided automatically by the Contracts Administrator on a monthly basis, or upon request from the PM. The PM uses the financial summary in conjunction with his assessments of technical progress to track the overall status of the efforts.

#### **Earned Value**

Earned Value Ratios will be reported as required. At a minimum, Phase III Communicator Project team will determine earned value quarterly at the overall Project level and will report at the 2<sup>nd</sup> level of WBS indenture in order to provide additional information.

Ratios will be reported in the form of the Schedule Performance Index (SPI) and the Cost Performance Index (CPI). Ratios below 0.90 will be explained in further detail. SPI is to be calculated as follows:

 $SPI = \underline{BCWP}$  (Budgeted Cost of Work Performed)

BCWS (Budgeted Cost of Work Scheduled)

CPI is to be calculated as follows:

CPI = <u>BCWP</u> (Budgeted Cost of Work Performed)

ACWP (Actual Cost of Work Performed)

ODU will use Microsoft Project in order to calculate the ratios. On a monthly basis, actual costs will be downloaded into Project. A baseline of work to be performed will be established in Project and will provide the BCWS. Milestones will be applied against the various WBS elements, and % complete status of the milestones will be updated on a monthly basis. Based upon % complete, Project will calculate BCWP, or earned value, at the individual WBS level and determine the earned value at the overall project level.

#### **Quality Process and Reporting**

Quality management on the project will be a team effort. The Quality System Manager will coordinate conduct, quality reviews, and audits. The PM is ultimately responsible for the development and implementation of the System Quality Project Plan. The SQPP is an umbrella plan which incorporates the quality projects of the project team members. The SQPP describes a team quality concept, including Process Coordination and Quality Evaluators. Team members are responsible for performing the processes required to complete Project tasks. Quality Evaluators are responsible for verifying that the development, production, and handling of all documentation, software, and hardware are performed in accordance with the SQPP and its component processes. The team is also responsible for conducting periodic reviews and evaluations of work-in-process; attending in-house test events, and supporting in-house Project reviews. All planned quality project activities and quality evaluations (internal audits) are submitted to the PM for review.

#### **Monthly Progress Report**

Phase III Communicator Project will submit a monthly progress reports. The report shall cover, at a minimum, the following:

- Progress Summary;
- The Variance Statement;
- Critical Path Analysis;
- Milestone Deliverables, planned actual and forecast;
- Earned Value Schedule and Cost Performance Indices;
- Dependencies: a 'critical items list' of all items, whether or not the Contractor's direct responsibility, which could jeopardize timely completion of the work or any significant parts of the project;
- Risk Status: update of risk register;
- Look Ahead (Future action and Forecast);
- Resource Profile;
- Work Package/Activities planned, actual & forecast status;
- Milestone/Deliverables planned, actual & forecast status;
- Configuration Change Control issues;
- Quality Actions (Reviews, audits);
- One Page Plans and Reports summarising the above for inclusion in the Purchaser's monthly report; and
- Commercial: amendments to Contract status report; No later than meeting + 10 working days.

#### REVIEWS

Reviews will play an integral part in the management and monitoring of all phases of the Phase III Communicator Project. Informal reviews with the Project team members will be held at all levels on a weekly basis to ensure that the project stays on track. Formal technical reviews will be held to ensure that the project is proceeding as planned. The types of reviews, their purpose and presented information are addressed in the following paragraphs.

# **Project Management Reviews**

Project Management Reviews (PMRs) will be conducted with ODU and subcontract representatives. The first PMR will be conducted in July 2004; thereafter PMRs will be conducted approximately every six months (immediately preceding each technical review). The PMRs are scheduled to discuss programmatic issues related to the development and implementation of the Project. The reviews will provide the opportunity to review the progress of the effort; as well as to conduct milestone reviews of deliverables, and identifies and resolves any issues that may arise during the execution of the tasking.

The PM will ensure that all project-related information required to meet the objectives of the review are prepared and delivered not later than two weeks prior to the scheduled review date. The PM will also be responsible for identifying the Phase III Communicator Project team personnel who will attend the review. The PM will attend all Project Management Reviews. The following information will be prepared in support of each PMR. Recorded during the review and delivered before the completion of the review.

### **Technical Reviews**

Formal technical reviews will be conducted on the dates specified in the master schedule. The reviews will be held jointly with ODU, Phase III Communicator Project team members and sub-suppliers as necessary. An agenda and review material will be submitted to ODU two weeks prior to the scheduled meeting. Review meeting minutes will be delivered before the completion of the review. The objectives for each review are outlined below.

Reviews will be held to validate the direction taken for the design, development, and test of the system. The System Requirements Review (SRR), Preliminary Design Review (PDR), and Critical Design Review (CDR) will be formal reviews held at ODU. The Test Readiness Reviews (TRR) will be formal reviews held prior to HAT & SAT.

**System Requirements Review** is conducted to ensure that the Project team fully understands the system performance requirements specified in the System/Segment Specification. A detailed review of requirements for the system and each subsystem will be reviewed. The System/Segment Specification (Technical Specification) will be used in the review.

**System Design Review** is conducted to present and review the system design. System requirement allocation to each system component will be discussed. The general approach to be taken for the integration of each system component will be presented. The documents listed below will be used in the review. This will be an informal review. The data will be included in the PDR.

- System/Segment Design Document
- System Interface Design Document

**Software Requirements Review** is conducted to review the software specification and interface requirement specifications. This review will be conducted as part of the PDR. **Preliminary Design Review** is conducted to present the preliminary design of the Project System. The functional requirements of each subsystem will be discussed in detail. The following documents will be used in the review.

**Critical Design Review** is conducted to review system integration issues. In particular the review will focus on system interfaces in preparation for Subsystem FAT.

**Test Readiness Reviews** are held to determine if the system is ready to proceed to the next level of test. Test configurations and results from the previous test efforts will be presented. The test report from the previous test will be used in the review. The following TRRs will be performed:

- Prior to FAT
- Prior to HAT
- Prior to SAT

# **Quality Reviews**

The PM supported by the quality system manager (QSM) will establish the time and identify attendees for all formal reviews. He will also coordinate with the appropriate managers to conduct quality reviews at key project milestones, and in preparation for formal reviews with the customer. Informal peer review and engineering planning meetings will also be held at the discretion of each subsystem manager to discuss technical issues, conduct internal comment reviews, and provide technical guidance to members of the Project team. As part of the quality activities for the project, the quality team will conduct informal reviews to:

- Evaluate the processes used by the Project team members to perform project tasks;
- Evaluate deliverable products for compliance with contract requirements;
- Evaluate work-in-process during engineering reviews;
- Document results of each evaluation; and
- Recommend corrective and preventive actions if necessary.

# 2.2.4 Evaluation Plan

The product will continually be monitored for progress by the project manager. Phase I will be deemed a success if the prototype is fully functional and passes testing. There must also be a preliminary product manual.

Phase II will be deemed a success when software development is complete and installation testing is complete with no defects.

Phase III will be deemed a success if product reaches full production and a break even number of products are sold.

The evaluation plan is as follows:

- Per Milestones
  - Review progress
  - Review specifications
  - Implement next phase
  - Thorough unit and integration testing

# **2.3** Conclusion

Cardiac rehabilitation is a very important aspect to continued heath in patients who have had a cardiac event. The benefits of exercise can prove the difference in maintaining a long and healthy life. While the first two phases of cardiac rehabilitation are important on getting a person started on the road to healthiness, the third phase lasts the rest of that person's life. The Phase 3 Communicator can assist in the longest part of this journey by providing ways to communicate and motivate patient's to continue being proactive in maintaining their health.

### 2.3.1 Literature Cited

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# 3.0 APPENDICES 3.1 Project Management 3.1.1 Gantt Chart

# 3.1.1.1 Phase 0 and I Gantt Chart

# Project Development Schedule (Milestones) Phase II

2004		Qtr 1			Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Finalize Software Specifications												
Marketing Plan							-					
Final Management Plan								_				
Software Development												
2005	Qtr 1 Jan Feb Mar				Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Software Development												
Client Installation and Testing												
2006		Qtr 1			Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Client Installation and Testing					1							
	-											
Shift to Production Phase	-											
Phase II									-			

# 3.1.1.2 Phase II Gantt Chart Project Development Schedule (Milestones) Phase II

2004	Qtr 1       Jan     Feb     Mar       Jan     Feb     Mar			Qtr 2			Qtr 3			Qtr 4		
Project Steps:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Finalize Software Specifications												
Marketing Plan							-					
Final Management Plan												
Software Development												
2005	Qtr 1 Jan Feb Mar A				Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Software Development												
Client Installation and Testing												
2006		Qtr 1			Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Client Installation and Testing												
	-			-								
Shift to Production Phase	-											
Phase II						<u> </u>						

# 3.1.1.3 Phase III Gantt Chart Project Development Schedule (Milestones) Phase III

2006	Qtr 1       Jan     Feb       Mar       Qtr 1       Jan     Feb				Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production Plan												
Continue Marketing Plan												
2007	Qtr 1 Jan Feb Mar				Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan Feb Mar			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Continue Marketing Plan												
Primary Indoctrination Course												
2008		Qtr 1			Qtr 2			Qtr 3			Qtr 4	
Project Steps:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shift to Out-Years												
Phase III							•		•	·		

# 3.1.1.4 Monthly Gantt Charts

	GANTT CHART WITH PARALLEL WORK																	
	2003				Sep	temb	er						Oc	tobe	r			
ID	Name	Duration	2 5	8 1	1 14	17	20 23	26 29	9 2	5	8	11	14	17	20 2	3	26	29
1	P0 1000 Conduct Preliminary Research		1		1					1	1	1	1			1		
2	1100 Review Internet Sources																	
3	1200 Interview Experts																	
4	1300 Review All Media Resources																	
5	1999 Preliminary Research Complete	•																
6	2000 Develop Plan						I											
7	2100 Select Design Strategy						I											
8	2210 Determine Project Scope						I											
9	2200 Determine Project Problem						I											
10	2300 Determine Available Resources						I											
11	2400 Develop Plan						I											
12	2500 Present Plan						I											
13	2600 Review Plan						I											
14	2700 Revise Plan						I											
15	2999 Plan Approved	•																
16	3000 Deliver Feasibility Presentation														3			
17	3100 Determine Financial Feasibility																	
18	3200 Determine Technical Feasibility																	
19	3300 Determine Societal Feasibility																	
20	3400 Determine Mgmt. Feasibility																	
21	3500 Assemble Presentation																	
22	3600 Practice Presentation																	
23	3700 Revise Presentation																	
24	3999 Deliver Presentation	•																
25	4000 Deliver Milestone Presentation																	_
26	4100 Develop All Future Schedules																	
27	4200 Determine Required Staffing														-			
28	4300 Determine Required Resources																	
29	4400 Develop Project Concept Plan																	
30	4500 Construct Preliminary Budget																	
43	6000 Develop Website																	
44	6100 High Level Design				_	_												
45	6200 ID Critical Information					_												
46	6400 Update Weekly																	
47		W eekly																
49	7100 ID Funding Source																	
50 Br	piect: Phase 0 Milestone	Р	roara															
Co	m. Critical		umma	ary		1												
Da	te: 12/01/2003 Noncritical	M	gmt C	Critica	1 🔜													



# GANTT CHART WITH PARALLEL WORK

	GANTT CHART WITH PARALLEL WORK																	
	2004					Marc	h						Apri					
ID	Name	Duration	2 5	8 11	14	l 17 2	20 23	26 29	2	5	8	11	14	17	20	23	26	29
56	P1 1000 Product User's Manuals							<u> </u>										
57	1100 Gather Data				•													
58	1110 Define Capabilities and Limits								4									
59	1120 Description of Operational Modes								•									
60	1130 Identify Methods of Use								•									
61	1140 Write Operating Instructions								•									
62	1150 ID Required Maintenance						•											
63	1160 Define Safety Issues								•									
64	1170 Parts List and Schematics								•									
65	1180 Write Product Warranty								•									
66	1200 Write Rough Draft																	
67	1300 Edit Rough Draft																	
68	1400 Write Final Draft																	
69	1999 Printed Complete Manual	•																
70	2000 Project WWW Page																	
71	2100 Updated Weekly	Weekly																
73	3000 Product Prototype	ſ																
74	3100 Create Systems Diagram of Prod.																	
75	3200 Create System Diagram Prototype																	
76	3300 Identify Scope of Prototype																	
77	3400 ID Components and Cost																	
78	3500 Acquire Components						•											
79	3600 Create Prototype Prod. Timeline																	
80	3700 Construct Prototype																	
81	3800 Test Prototype																	
82	3900 Correct Problems																	
84	4000 Prod. Development Specifications																	
85	4100 Gather Data																	
86	4200 Problem Definition										I							
87	4300 Project Goals																	
88	4400 Systems Overview																	
89	4500 General Description																	
90	4600 System Operation												I					
91	4700 ID Writes and Responsibility																	
92	4800 Detailed Hardware Specifications																	
Pro	oject: Phase I Milestone 🕈	Р	rogre	ss –														
Co	m. Critical Critical		Summ Iamt	ary <u>–</u> Critical	_													





### 32

Progress

Summary

Mgmt Critical

129 3999 Organization Approval130 4000 Software Development

Project: Phase II Milestone ◆

Date: 12/01/2003 Noncritical

Critical

 131
 4100 Planning

 132
 4200 Requirements

 133
 4210 REQ Inspection

 134
 4300 System Test Plan

Com.







#### GANTT CHART WITH PARALLEL WORK 2005 May June Duration 2 5 8 11 14 17 20 23 26 29 2 5 8 11 14 17 20 23 26 29 2 5 8 11 14 17 20 23 26 29 ID Name 130 4000 Software Development 154 4940 Final Testing Project: Phase II Milestone + Progress Critical Summary C Com. Date: 12/01/2003 Noncritical Mgmt Critical





	GANTT CHART WITH PARALLEL WORK																						
	2005						No	ovei	mbe	er								Dece	mbe	ər			
ID	Nar	ne	Duration	••• <b>2 5 8 11 14 17 20 23 26 29</b>									2	5	8	11	14	17	20	23	26	29	
156	5000 Client Installati	on and Testing											<u> </u>	<u> </u>			<u> </u>	<u> </u>	<u> </u>				
160	60     5400 Identify Defects and Fix																						
161	5500 Change and M	odify																					
Pro	ject: Phase II	ect: Phase II Milestone  Progress																					
Co	Com. Critical Summary																						
Da	te: 12/01/2003	Concritical		Mg	mt (	Crit	tical																







	GANTT CHART WITH PARALLEL WORK																				
	2008					Jan	uary	y							F	ebr	uary				
ID	Name	Duration	2 5	8	11	14	17	20	23	26	29	2	5	8	11	14	17	20	23	26	29
183	4000 Shift to Out-Years		<u> </u>		<u>.</u>		·						1								
184	4100 Project ShutDown ProductionPlar																				
185	4200 Project ShutDown Marketing Plan																				
186	4300 Develop Out-Years Organization																				
187	4400 Technical Support																				
188	4500 On-Site Technical Support																				
189	4999 Shift to Out-Years																				
Pro Co Da	oject: Phase III Milestone m. Critical te: 12/01/2003 Noncritical		Progr Sumr Mgmt	ess nar Cri	y ⊏ itica																

# 3.1.2 Product Plan

		ecessors		Start Date	nish Date
חו	Name	Pred	Resource Names		i
1	P0 1000 Conduct Preliminary Research		Group	09.15.03	09.23.03
2	1100 Review Internet Sources		Group	09.15.03	09.23.03
3	1200 Interview Experts		Group	09.17.03	09.17.03
4	1300 Review All Media Resources		Group	09.15.03	09.23.03
5	1999 M:Preliminary Research Complete		Milestone	09.23.03	09.23.03
	· · ·				
6	P0 2000 Develop Plan		Group	09.24.03	10.01.03
7	2100 Select Design Strategy		Group	09.24.03	09.29.03
8	2200 Determine Project Problem		Group	09.24.03	09.29.03
9	2210 Determine Project Scope	8	Group	09.24.03	09.29.03
10	2300 Determine Available Resources		Group	09.24.03	09.29.03
11	2400 Develop Plan		Group	09.24.03	09.29.03
12	2500 Present Plan		Group	09.24.03	09.29.03
13	2600 Review Plan		Group	09.24.03	09.29.03
14	2700 Revise Plan		Group	09.24.03	09.29.03
15	2999 M: Plan Approved		Milestone	10.01.03	10.01.03
16	P0 3000 Deliver Feasibility Presentation		Group	10.01.03	10.20.03
17	3100 Determine Financial Feasibility		Zach	10.01.03	10.18.03
18	3200 Determine Technical Feasibility		Kim	10.01.03	10.18.03
19	3300 Determine Societal Feasibility		Jonathan	10.01.03	10.18.03
20	3400 Determine Management Feasibility		Aaron	10.01.03	10.18.03
21	3500 Assemble Presentation		Group	10.01.03	10.18.03
22	3600 Practice Presentation		Aaron, Jonathan, Zach	10.01.03	10.18.03
23	3700 Revise Presentation		Group	10.01.03	10.19.03
24	3999 M: Deliver Presentation		Milestone	10.20.03	10.20.03

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25	P0 4000 Deliver Milestone Presentation		Group	10.21.03	11.12.03
26	4100 Develop All Future Schedules		Aaron	10.21.03	10.31.03
27	4200 Determine Required Staffing	26	Justin, Zach	10.22.03	10.31.03
28	4300 Determine Required Resources	26	Justin	10.22.03	10.31.03
29	4400 Develop Project Concept Plan		Group	10.22.03	10.31.03
30	4500 Construct Preliminary Budget		Justin	10.27.03	11.03.03
31	4600 Assemble Presentation		Group	11.08.03	11.09.03
32	4700 Practice Presentation		Group	11.10.03	11.10.03
33	4800 Revise Presentation		Group	11.10.03	11.10.03
34	4999 M: Deliver Presentation		Milestone	11.12.03	11.12.03
35	P0 5000 Deliver Approval Presentation		Group	11.12.03	12.08.03
36	5100 Finalize Deliverable Elements List		Group	11.12.03	11.14.03
37	5200 Complete Deliverable Elements		Group	11.14.03	11.24.03
38	5300 Revise Deliverable Elements		Group	11.24.03	11.28.03
39	5400 Assemble Presentation		Group	11.29.03	11.29.03
40	5500 Practice Presentation		Group	12.01.03	12.07.03
41	5600 Revise Presentation		Group	12.03.03	12.07.03
42	5999 M: Deliver Presentation		Milestone	12.08.03	12.08.03
43	P0 6000 Develop Website		Group	09.15.03	12.08.03
44	6100 High Level Design		Jitu, Zach	09.15.03	09.18.03
45	6200 Write Basic Code	44	Jitu	09.18.03	10.01.03
46	6300 ID Critical Information		Group	10.01.03	12.08.03
47	6400 Update Weekly		Jitu	Weekly	Weekly
48	6999 M:Complete Website		Milestone	12.08.03	12.08.03
49	P0 7000 SBIR \$100 K		Group	10.25.03	12.08.03
50	7100 ID Funding Source		Zach	10.25.03	10.31.03
51	7200 Acquire Appropriate Forms	50	Zach	11.01.03	11.02.03
52	7300 Gather Data		Group	11.02.03	11.15.03
53	7400 Write Rough Draft		Group	11.15.03	11.17.03
54	7500 Write Final Document		Group	11.17.03	12.08.03
55	7999 M: Complete SBIR Document		Milestone	12.08.03	12.08.03
56	P1 1000 Product User's Manuals		Group	03.15.04	04.15.04
57	1100 Gather Data		Group	03.15.04	03.25.04
58	1110 Define Capabilities and Limitations		Group	03.25.04	04.01.04
59	1120 Description of Operational Modes		Group	03.25.04	04.01.04
60	1130 Identify Methods of Use		Group	03.25.04	04.01.04
61	1140 Write Operating Instructions		Group	03.25.04	04.01.04
62	1150 ID Required Maintenance		Group	03.25.04	04.01.04
63	1160 Define Safety Issues		Group	03.25.04	04.01.04
64	1170 Parts List and Schematics		Group	03.25.04	04.01.04
			Onevin	02.05.04	04.04.04

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66	1200 Write Rough Draft	65	Group	04.01.04	04.07.04
67	1300 Edit Rough Draft		Group	04.07.04	04.09.04
68	1400 Write Final Draft		Group	04.09.04	04.15.04
69	1999 M: Printed Complete Manual		Milestone	04.15.04	04.15.04
70	P1 2000 Project WWW Page		Web Manager	01.08.04	05.08.04
71	2100 Updated Weekly		Web Manager	Weekly	Weekly
72	2999 M: Completed Web Page		Milestone	05.08.04	05.08.04
73	P1 3000 Product Prototype		Group	03.01.04	05.08.04
74	3100 Create Systems Diagram of Product		Group	03.01.04	03.07.04
75	3200 Create Systems Diagram of Prototype	74	Group	03.07.04	03.14.04
76	3300 Identify Scope of Prototype		Group	03.14.04	03.16.04
77	3400 ID Components and Cost		Group	03.16.04	03.18.04
78	3500 Acquire Components		Group	03.18.04	03.20.04
79	3600 Create Prototype Production Timeline		Group	03.20.04	03.30.04
80	3700 Construct Prototype		Group	03.30.04	04.15.04
81	3800 Test Prototype		Group	04.15.04	04.19.04
82	3900 Correct Problems		Group	04.19.04	05.08.04
83	3999 M: Complete Prototype		Milestone	05.08.04	05.08.04
	P1 4000 Production Development				
84	Specifications		Group	04.08.04	05.08.04
85	4100 Gather Data		Group	04.08.04	04.10.04
86	4200 Problem Definition		Group	04.10.04	04.11.04
87	4300 Project Goals		Group	04.11.04	04.12.04
88	4400 Systems Overview		Group	04.12.04	04.14.04
89	4500 General Description		Group	04.14.04	04.16.04
90	4600 System Operation		Group	04.16.04	04.20.04
91	4700 ID Writes and Responsibility		Group	04.20.04	04.25.04
92	4800 Detailed Hardware Specifications		Group	04.25.04	04.30.04
93	4900 Detailed Software Specifications		Group	05.01.04	05.08.04
94	4999 M: Complete Product Specifications		Milestone	05.08.04	05.08.04
0.5				00.00.04	00.00.04
95	P1 5000 SBIR \$750 K		Group	03.08.04	06.30.04
96	5100 Funding Source		Budget Manager	03.08.04	03.20.04
97	5200 Acquire Appropriate Forms		Budget Manager	03.20.04	03.24.04
98	5300 Gather Data		Group	03.24.04	04.10.04
99	5400 Write Rough Draft		Group	04.10.04	04.25.04
100	5500 Edit Rough Draft		Group	04.25.04	04.28.04
101	5600 Write Final Document		Group	04.28.04	05.08.04
102	5999 M: Complete SBIR Document		Milestone	06.30.04	06.30.04
400	D4 0000 Destant Archiel		DuductMa	05.00.01	00.00.01
103	P1 6000 Budget Analysis		Budget Manager	05.09.04	06.30.04
104	6100 Technical Resources		l eam	05.09.04	05.24.04
105	6200 Personnel Resources		leam	05.24.04	06.04.04

106	6300 Facilities	Team	06.04.04	06.11.04
107	6400 Detailed Cost Analysis	Team	06.11.04	06.30.04
108	6999 M: Complete Budget Analysis	Team	06.30.04	06.30.04
109	P1 7000 Preliminary Marketing Plan	Marketing Manager	05.09.04	06.30.04
110	7100 Research Potential Customers	Team	05.09.04	05.14.04
111	7200 Research Customer Demographics	Team	05.14.04	05.21.04
112	7300 Contact Customers	Team	05.21.04	06.04.04
113	7400 Construct Detailed Marketing Plan	Team	06.04.04	06.30.04
	7999 M: Complete Preliminary Marketing			
114	Plan	Team	06.30.04	06.30.04
115	P2 1000 Finalize Software Specifications	Project Manager	07.01.04	07.15.04
116	1100 Research	Team	07.01.04	07.10.04
117	1200 Evaluations and Corrections	Team	07.10.04	07.14.04
118	1300 Approval	Team	07.14.04	07.15.04
119	1999 M: Final Specifications	Milestone	07.15.04	07.15.04
120	P2 2000 Marketing Plan	Marketing Manager	07.16.04	08.16.04
121	2100 Detailed Plan	Marketing Manager	07.16.04	07.19.04
122	2200 Contact Potential Customers	Marketing Manager	07.19.04	08.16.04
123	2300 Arrange Demonstrations	Marketing Manager	07.19.04	08.16.04
124	2400 Perform Presentations	Marketing Manager	07.19.04	08.16.04
125	2999 M: Marketing Plan Complete	Milestone	08.16.04	08.16.04
-				
126	P2 3000 Final Management Plan	Project Manager	08.17.04	09.17.04
127	3100 Resources and Hiring Process	Project Manager	08.17.04	09.17.04
128	3200 Program Design Review (PDR)	Project Manager	09.01.04	09.17.04
129	3999 M: Organization Approval	Milestone	09.17.04	09.17.04
130	P2 4000 Software Development	Software Engineers	09.18.04	09.18.05
131	4100 Planning	Project Manager	09.18.04	09.25.04
132	4200 Requirements	Project Manager	09.25.04	10.01.04
133	4210 REQ Inspection	Team	10.02.04	10.14.04
134	4300 System Test Plan	Project Manager	10.15.04	10.30.04
135	4400 High-Level Design	Team	11.01.04	11.14.04
136	4410 HLD Inspection	Team	11.15.04	11.17.04
137	4420 HLD Correction	Team	11.18.04	11.30.04
138	4500 Integration Test Plan	Team	12.01.04	12.15.04
139	4600 Detailed Design	Team	12.16.04	12.22.04
140	4610 DLD Review	Project Manager	12.23.04	12.31.04
141	4620 DLD Inspection	Team	01.01.05	01.07.05
142	4630 DLD Correction	Team	01.08.05	01.15.05
143	4700 Test Development	Team	01.16.05	01.21.05
144	4800 Code	Team	01.22.05	02.16.05
145	4810 Code Review	Project Manager	02.17.05	02.19.05
146	4820 Code Review Correction	Team	02.20.05	02.27.05

147	4830 Compile	Team	02.28.05	02.28.05
148	4840 Code Inspection	Team	03.01.05	03.06.05
149	4850 Code Correction	Team	03.07.05	03.13.05
150	4900 Unit Test	Team	03.14.05	03.15.05
151	4910 Build and Integration Test	Team	03.16.05	03.30.05
152	4920 System Test	Team	03.31.05	03.31.05
153	4930 Correct Defects	Team	04.01.05	04.20.05
154	4940 Final Testing	Team	04.20.05	09.17.05
	4999 M: Completion of Software			
155	Development	Team	09.18.05	09.18.05
-				
156	P2 5000 Client Installation and Testing	Software Engineers	09.19.05	04.20.06
157	5100 Equipment Installation	Technicians	09.19.05	09.30.05
158	5200 Integration Testing	Software Engineers	10.01.05	10.15.05
159	5300 Evaluate Test Results	Software Engineers	10.16.05	10.31.05
160	5400 Identify Defects and Fix	Software Engineers	11.01.05	11.30.05
161	5500 Change and Modify	Software Engineers	12.01.05	12.30.05
162	5600 Factory Acceptance Test (FAT)	Software Engineers	01.01.06	01.31.06
163	5700 Critical Design Review (CDR)	Project Manager	02.01.06	04.19.06
164	5999 M: Completion of Testing	Milestone	04.20.06	04.20.06
165	P2 6000 Shift to Production Phase	Project Manager	04.21.06	07.21.06
166	6100 Project ShutDown Management Plan	Project Manager	05.15.06	07.21.06
167	6200 Develop Production Organization	Production Manager	06.15.06	07.21.06
168	6999 M: Mass Production	Milestone	07.21.06	07.21.06
169	P3 1000 Production Plan	Production Manager	07.22.06	12.22.06
170	1100 First Product Off the Line	Factory	07.22.06	09.01.06
171	1200 Continuation of Production Plan	Production Manager	07.22.06	12.21.06
172	1999 M: Completion of Production Plan	Milestone	12.22.06	12.22.06
173	P3 2000 Continue Marketing Plan	Marketing Manager	12.23.06	07.23.07
174	2100 Implement Detailed Plan	Marketing Manager	12.23.06	07.23.07
175	2200 Expand Potential Customer Base	Marketing Manager	12.23.06	03.30.07
176	2300 Arrange Demonstrations	Marketing Manager	04.01.07	04.30.07
177	2400 Perform Presentations	Budget Manager	05.01.07	07.23.07
178	2999 M: Marketing Plan- Ongoing	Milestone	07.23.07	07.23.07
179	P3 3000 Primary Indoctrination Course	Documentation Dept.	07.24.07	12.24.07
180	3100 Indoctrinate Customers	Documentation Dept.	07.24.07	12.24.07
181	3200 Fully Train all employee's	Documentation Dept.	07.24.07	12.24.07
182	3999 M: Completion Indoctrination Course	Milestone	12.24.07	12.24.07
183	P3 4000 Shift to Out-Years	Production Manager	01.01.08	02.01.08
184	4100 Project Shut Down Production Plan	Production Manager	01.01.08	01.07.08
185	4200 Project Shut Down Marketing Plan	Production Manager	01.08.08	01.15.08
186	4300 Develop Out-Years Organization	Production Manager	01.16.08	01.21.08

187	4400 Technical Support	.	Technician	01.01.08	02.01.08
188	4500 On-Site Technical Support		Technician	01.01.08	02.01.08
189	4999 M: Shift to Out-Years		Milestone	02.01.08	02.01.08

# **3.2 Resources**

# **3.2.1 Phase I Resources**



# 3.2.2 Phase II Resources



# **3.2.3 Phase III Resources**



#### 3.2.4 Resource Overview



#### **3.2.5 Personnel Overview**

#### 3.2.5.1 Project Manager

The project manager will lead all aspects of the project, managing the product development process from concept to commercialization. He will monitor workflow and deadlines, while providing leadership, coaching, and mentoring for the development staff.

#### 3.2.5.2 Software Manager

The software manager will lead the team of software engineers to design and develop the software. He will lead a team consisting of a level 3 software engineer III, 3 level 2 software engineers, a software quality assurance person, and a database architect. Additional responsibilities include writing product requirement documents, and implementing and tracking development timelines.

# 3.2.5.3 Software Engineer III

This software engineer will be the main programmer, working on the most critical parts of the project. He will report to the software manager, while providing assistance to the other software engineers.

#### 3.2.5.4 Software Engineer II

Three level 2 software engineers will be part of the team. These engineers will report to the software manager, working on the less critical aspects of the software.

#### 3.2.5.5 Software Quality Assurance

The function of this position is to ensure the quality of the software. Some of the responsibilities of this position are developing, publishing, and implementing test plans, writing and maintaining test automation, developing quality assurance standards, and defining and tracking quality assurance metrics such as defect densities and open defect counts.

# 3.5.5.6 Data Architect

The Data Architect is responsible for designing and developing the patient database that will be part of the server side software run at the cardiac rehab centers. The Data Architect will report to the software manager.

#### **3.5.5.7 Financial Analyst**

The Financial Analyst is responsible for developing the project's budget, as well as finding sources for funding.

#### 3.5.5.8 Product Marketing Analyst III

The Product Marketing Analyst III will be responsible for developing the marketing plan for our project, overseeing its implementation, determining potential customers for our system, and convincing those potential customers why they should purchase our software.

#### 3.5.5.9 Web Developer

The web developer will be responsible for designing, creating, and maintaining the product's website.

### 3.5.5.10 Sr. Documentation Specialist

The Sr. Documentation Specialist will be responsible for creating precise, and thoroughly detailed user manuals, technical specifications, and other product documents as necessary.

#### 3.5.5.11 Medical Advisor

The medical advisor will assist the software engineers during the design phase to ensure that the software doesn't include any incorrect medical advice or information, that could lead to undesired consequences.

### 3.5.5.12 Legal Advisor

The legal advisor will be responsible for creating unambiguous the disclaimer and terms of use agreement for our product, assuring that our product adheres to HIPAA, and the FDA software policy.

# 3.3 Budget

# 3.3.1 Phase I Budget

	Phase I		
Resources (Personnel)	Yearly Salary	Work Length	Salaries
Project Manager	\$72,764	6 Months	\$36,382.00
Software Engineer II	\$56,997	2 Months	\$9,499.50
Medical Advisor	\$55,940	1 Month	\$4,661.67
Financial Analyst	\$67,732	3 Weeks	\$3,896.91
Product Marketing Analyst III	\$62,772	3 Weeks	\$3,611.54
Documentation Specialist	\$45,933	2 Months	\$7,655.50
Total Personnel Salaries Costs			\$65,707.12
Required Hardware Resources		Costs	
mySQL License			\$449.00
1 Copy of VS .Net Professional			\$1,079.00
Website Hosting (\$100 per month)			\$400.00
4 Copies MS Office 2k3 Professional			\$1,796.00
4 Computers (\$1056 per PC)			\$4,224.00
Total Non-Personnel Costs			\$7,948.00
Phase I Budget Summary		Amoun	t
Total Personnel Costs			\$65,707.12
Total Hard Resources Costs			\$7,948.00
Administrative Costs (40% of Person	nel Costs)		\$26,282.85
Total Phase I Budget:			\$99,937.96

# 3.3.2 Phase II Budget

	Phase II			
Resources (Personnel)	Yearly Salary	Work Length	Salaries	
Project Manager	\$72,764	24 Months	\$145,528.00	
Software Manager	\$75,000	19 Months	\$118,750.00	
Software Engineer III	\$69,596	12 Months	\$69,596.00	
Software Engineer II	\$56,997	6 Months	\$28,498.50	
Software Engineer II	\$56,997	6 Months	\$28,498.50	
Medical Advisor	\$55,940	10 Months	\$46,616.67	
Legal Advisor	\$91,278	3 Months	\$22,819.50	
Product Marketing Analyst III	\$62,772	1 Month	\$5,231.00	
Financial Analyst	\$67,732	1 Month	\$5,644.33	
Web Developer	\$58,092	2 Months	\$9,682.00	
Data Architect	\$76,147	2 Months	\$12,691.17	
Quality Assurance	\$52,398	7 Months	\$30,565.50	
Total Personnel Salaries Cost			\$524,121.17	
Required Hardware Resources		Costs		
2 Copies of VS .Net Professional			\$2,158.00	
6 Copies MS Office 2k3 Professional	l	\$2,694.00		
1 Copy of Dreamweaver MX 2004		\$399.00		
6 Computers (\$1056 per PC)			\$6,336.00	
Webhosting (\$100 per month)			\$2,400.00	
Total Non-Personnel Costs			\$13,987.00	
Phase II Budget Summary		Amo	unt	
Total Personnel Costs	\$524,121.17			
Total Hard Resources Costs		\$13,987.00		
Administrative Costs (40% of Person	nel Costs)		\$209,648.47	
Total Phase II Budget			\$747,756.63	

# 3.3.3 Phase III Budget

Phase III						
Resources (Personnel)	Yearly Salary	Work Length	Salaries			
Project Manager	\$72,764	18 Months	\$109,146.00			
Product Marketing Analyst III	\$62,772	7 Months	\$36,617.00			
Documentation Specialist	\$45,933	5 Months	\$19,138.75			
Web Developer	\$58,092	2 Months	\$9,682.00			
Total Personnel Salaries Cost:			\$174,583.75			
Required Hardware Resources		Costs				
Webhosting (\$100 per month)		\$1,800.00				
Total Non-Personnel Costs:			\$1,800.00			
Phase III Budget Summary		Amo	unt			
Total Personnel Costs		\$174,583.75				
Total Hard Resources Costs	\$1,800.00					
Administrative Costs (40% Personne	\$69,833.50					
Total Phase III Budget			\$246,217.25			

#### **3.3.4 Production Budget Overview**

Costs	Phase I	Phase II	Phase III
Total Personnel Costs	\$65,707.12	\$524,121.17	\$174,583.75
Administrative Costs	\$26,282.85	\$209,648.47	\$69,833.50
Total Hard Resources Costs	\$7,948.00	\$13,987.00	\$1,800.00
Total Phase Budget	\$99,937.96	\$747,756.63	\$246,217.25
	Total Budget:	\$	1,093,911.85

### 3.3.5 Post-Production Out-Years Budget

Production Out-Years							
Resources (Personnel)	Yearly Salary	Work Length	Salaries				
Tech Support	\$50,000	12 Months	\$50,000.00				
Software Engineer II	\$56,997	3 Months	\$14,249.25				
Product Marketing Analyst III	\$62,772	6 Months	\$31,386.00				
Web Developer	\$58,092	3 Months	\$14,523.00				
Total Personnel Salaries Cost:			\$110,158.25				
Required Hardware Resources	Costs						
Webhosting (\$100 per month)		\$1,200.00					
Total Non-Personnel Costs:			\$1,200.00				
Production Out-Years Budget Summ	iary	Amount					
Total Personnel Costs		\$110,158.25					
Total Hard Resources Costs	\$1,200.00						
Administrative Costs (40% Personnel		\$44,063.30					
Total Production Out-Years Budget			\$155,421.55				

#### 3.4 Marketing Plan

# 3.4.1 Customer

The customer base of the Phase III Communicator would have two primary layers. The first and topmost layer would be cardiac rehabilitation facilities. These facilities would provide their patients with the software in order to keep them enrolled in programs at the facility. The second layer of the customer base would be insurance companies. Insurance companies would support P3C by paying the monthly service charges charged by the cardiac care center to the patient. The insurance companies would also cover the licensing charge.

The primary customers of the Phase III Communicator are hospitals and cardiac rehabilitation facilities. There are over 1,500 trauma centers in the United States. Of these, there is at least one level I trauma center in most every large metropolitan area in America. P3C intends to target these institutions. Specifically, P3C will target those facilities with highly competitive cardiac programs wanting an edge in the market. The hospitals expenses in the program would be a server and necessary software, additional personnel needed to run the program, and licenses for the client version (which can be reimbursed by the patient or his or her insurance company.

The secondary customers are insurance companies. To make the program feasible, P3C will need insurance companies to be willing to pay for the software as well as for the hospital's monthly service fee. We plan to market to insurance companies by showing that using our program will decrease the amount of money they spend on cardiac patients. Currently 351.8 billion dollars is spent yearly on cardiovascular diseases (American Heart Association, 2003.) The average cost of a hospital visit for a cardiovascular disease is 7,883 dollars (American Heart Association, 2003.) Those who display a high risk for a cardiovascular disease account for 50 to 70 percent of all cardiovascular diseases patients (Center for Disease Control, 2000.).

The users of the Phase III Communicator would be cardiovascular disease patients. Our main focus is on the patients between the ages of 35 and 60. Over 21 million of these individuals have a cardiovascular disease (Figure 10.) Of those 21 million, an estimated 11 million use the internet (Figure 11.) If one percent of the individuals within the above ranges participate in our program, we could expect to see a user base of approximately 112,660 people.



Prevalence of Cardiovascular Diseases in Americans

Source: NHANES III (1988-94), CDC/NCHS.

20-24 25-34

Figure 10: CVD Percentages by Age

Ages

45-54 55-64 65-74

75 +



Source: NTIA and ESA, U.S. Department of Commerce, using U.S. Census Bureau Current Population Survey Supplements Figure 11: Computer and Internet Usage by Age

#### **3.4.2** Competition Matrix

The competition for the Phase III Communicator (P3C) falls into two categories: software and existing cardiovascular rehabilitation programs. Of the former, the two most potent competitors are Fitlynxx and UltraCoach. The cardiovascular rehabilitation programs surveyed included the California Pacific Medical Center, the Rochester Heart Institute, and the Tidewater Cardiovascular Institute.

Fitlynxx provides support beyond Phase II of rehabilitation and is useable at home via the internet. It does provide contact with a personal trainer who can give feedback and answer the patient's questions. What Fitlynxx does not provide is measurement and tracking of the user's blood pressure and pulse. It also does not provide the user with a phone call from the rehabilitation facility that was shown to increase patient participation in the Stanford Study.

UltraCoach does not specifically target cardiovascular patients, but has been used by cardiovascular patients with some success. It provides exercise feedback based upon historical input. It does not provide any form of communication between a rehabilitation facility and the patient. Both software programs' major feature for cardiovascular patients is their usability at home.

The three cardiovascular rehabilitation facilities provided roughly the same features. They provided support through Phase I, II, and III (with the exception of the Tidewater Cardiovascular Institute.) The key selling point for these programs is their ability to provide professional monitoring and feedback to the patients. The disadvantages are that these programs are not usable at home and are expensive, as the patient must use the existing facilities.

The Phase III Communicator bridges the gap between the two types of programs by providing professional monitoring and feedback at home, while also storing input data from the user and providing the user with an exercise database with equivalencies and other information. P3C will not provide exercise prescription that has not been approved by the medical professional monitoring the patient.

Product	Phase II Support	Support Beyond Phase II	Usable at Home	Nurse/Doctor Prescribed Baseline	Blood Pressure and Pulse Tracking	"Smart" Exercise Prescription	Phone Call from Hospital to Encourage Participation
Fittynxx		Х	Х				
UltraCoach			Х		Х	Х	
California Pacific Medical Center	Х	Х		Х	Х		
Rochester Heart Institute	Х	Х		Х	Х		
Tidewater Cardiovascular Institute	Х			Х	Х		
Hospital with Cardiac 410	Х	Х	Х	Х	Х		Х

Figure 12: Competition Matrix

# **3.5 Testing and Prototyping**

# 3.5.0 Test Market

Our test market will be Sentara Norfolk General Hospital. Their cardiac program is ranked 21<sup>st</sup> in the nation<sup>3</sup>. Recently, Sentara announced plans to open a dedicated heart hospital on the campus of Norfolk General<sup>4</sup>. We will provide a server, the software, and funds for any additional staff that the hospital may require.

### 3.5.1 Test Plan

The test will involve a control group and experimental group of 300 individuals each. The control group will participate in the standard rehabilitation process. The experimental group will be introduced to the software in Phase II of their rehabilitation. We will test to see how many individuals in each group remain in some sort of rehabilitation past Phase II. Provided that the test results prove promising, we will proceed to market the software to other hospitals and cardiovascular rehabilitation centers.

### 3.5.2 Prototype Plan

Phase III Communicator's prototype will involve a small-scale simulation of the actual P3C system. The team will use three personal computers: the first to simulate the patient's computer, the second to simulate the nurse's computer, and the third to simulate the P3C server. A scaled down model of the actual P3C web software will be stored on the server computer. Both the patient and nurse will access their respective portals via the server computer.

The patient side web portal will feature the basic input fields for reporting exercise, as well as display the nurses feedback. The nurse's portal will allow him or her to view patient's records and display a list of patients who need to a motivational phone call.

### 3.6 Risk Assessment

#### **3.6.1 Customer Risks**

# **3.6.1.1 Reluctance to exercise and/or use our software**

<b>Probability:</b>	Moderate
<b>Consequences:</b>	Severe
Solution:	We will emphasize a strong marketing campaign
designed to enlighten cardiac rehab patients about the importance of exercising in order to increase their wel being and to decrease the risk of repeat cardiac issues.	

#### 3.6.1.2 Users incorrectly using our software

<b>Probability:</b>	Moderate
Consequences	s: Moderate
Solution:	Our system will include functionality allowing the
	transmission of measured vital stats from external
	measuring devices connected to the user's computer
	through a USB cable. This will limit the possibility of
	user's incorrectly manually entering in their vital stats.
	Furthermore, we will keep the GUI simple and intuitive to
	use, enabling even those with limited computer knowledge
	to be able to successfully use our system. We will be
	explicit as possible with easy-to-follow on screen exercise
	instructions and directions. We will also be hiring a
	Documentation Specialist to ensure that the user manual
	that we include with our software is thorough and precisely
	detailed.

### 3.6.1.3 Hospitals and Clinics reluctant to use our system

Probability: Moderate

# Consequences: Severe Solution: Through our marketing campaign we will convince hospitals and cardiac rehabilitation centers that our system is an ideal way to distinguish themselves from other cardiac centers and a means to attract new patients to their center thus bringing additional business and revenue.

# 3.6.2 Legal Risks

# 3.6.2.1 Lawsuits resulting from user being injured/dying

<b>Probability:</b>	Moderate
Consequences	s: Severe
Solution:	Clear and unambiguous terms of use agreements
	that the user must read and agree to before installing the
	software. Included in the terms of use will be statements
	absolving C Group from any liability and/or responsibility
	to any possible bodily injury that the user might incur. A
	legal advisor will also be hired in order to handle all the
	cases that might be filed against our company, and to
	ensure that we are adequately protected from lawsuits.
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# 3.6.2.2 Lawsuits resulting from users' health not improving

<b>Probability:</b>	Moderate
<b>Consequences:</b>	Severe
Solution:	Clear and unambiguous disclaimer, that makes it
cl	ear that our company makes no guarantees concerning the
re	sults and outcomes of using our product. Again, our
la	wyer will take care of any lawsuits that might be filed
ag	gainst our company.

# **3.6.2.3** Lawsuits accusing us of violating patient's privacy

<b>Probability:</b>	Moderate
Consequences	: Severe
Solution:	To govern how we collect data from the hospitals
	and clinics running our software, we will closely adhere to
t	the rules set forth by the HIPAA (Health Information
	Portability and Accounting Act of 1996), and its Privacy
	Rule put in effect in April 2003

**3.6.3** Technical Risks

#### 3.6.3.1 Data sent between nurse and patient prone to hackers

Probability:	Moderate
Consequences	s: Severe
Solution:	While the information sent back and forth between
1	the user and the nurse/exercise specialist is not especially
	useful if a third-party gets ahold of it, it does violate
	privacy rules detailed in the HIPAA. Thus, our software
	will use PGP encryption technology to protect the data sent
	and received by our software system.
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# **3.6.3.2** Scope of product considered too limited

<b>Probability:</b>	Moderate
Consequences	: Moderate
Solution:	The scope is intentionally limited in the beginning.
	Once our product starts being used, and we begin to see a
steady revenue flow, we will obviously update our produ	
to add more functionality to it. Not only does this	
	allow our company to roll out a product earlier, albeit a
	somewhat limited scope version, it also allows for new
streams of revenue. Included in future phases of the	
	product will be a heart rate/blood pressure wrist monitor
	that works directly with our software, and nutritional

#### 3.6.3.3 Software bugs causing software to not function as intended

advice and feedback.

Probability:	Low/Moderate
<b>Consequences:</b>	Moderate
Solution:	Design phase to minimize the possibility of design
erro	ors, and a lengthy testing phase to ensure that the critical
and	addressable software bugs are found and fixed.

# 3.7 Glossary

- Aerobic activities Activities of sub-maximal intensity that use large muscle groups with energy supplied aerobically.
- Angina Severe cardiac pain that may radiate to the jaw or arms. Angina is caused by myocardial ischemia, which can be induced by exercise in susceptible individuals.
- Arteriosclerosis An arterial disease characterized by the hardening and the thickening of the vessel walls.

- Atherosclerosis A form of arteriosclerosis in which fatty substances are deposited in the inner walls of the arteries.
- Blood pressure The pressure exerted by the blood on the vessel walls measured in millimeters of mercury by the sphygmomanometer. The systolic pressure is the first sound, followed by the diastolic pressure, which is recorded when there is a change of tone of the sound or disappearance of the sound.
- Blood vessel Any vessel through which blood circulates.
- Cardiac rehabilitation A program designed to help cardiac patients return to normal lives with reduced risk of additional health problems.
- Circulation The continuous movement of blood though the heart, lungs, and tissue via blood vessels.
- Coronary arteries Blood vessels that supply the heart muscle.
- Coronary artery bypass graft (CABG) Surgery to bypass one or more blocked coronary arteries in which a blood vessel is sewn into existing coronary arteries above and below the blockage.
- Electrocardiogram (ECG) The graphical recording of the electrical activity of the heart, obtained with the electrocardiograph.
- Exercise Structured physical activity whose purpose is to improve come component of physical fitness.
- Heart Attack A general term used to describe an acute episode of heart disease; common name for myocardial infarction.
- Heart rate Number of beats of the heart per minute.
- Infarction Death of a section of tissue due to lack of blood flow, as in myocardial infarction.
- Myocardial infarction (MI) Death to a section of heart tissue in which the blood supply has been cut off.
- Myocardial ischemia A lack of oxygen for heart function due to a decrease in blood flow.
- Prescribed exercise A recommendation of type, intensity, frequency, duration, and total work needed to accomplish fitness objectives.
- Risk factor A characteristic, sign, symptom, or test score that is associated with increased

probability of developing a health problem.