Project Deliverable D:

Conceptual Design

GNG 1103 – Engineering Design

Faculty of Engineering – University of Ottawa

Team 2

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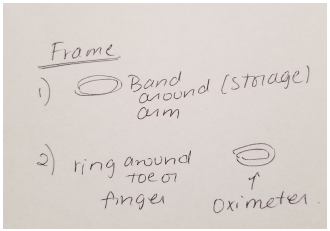
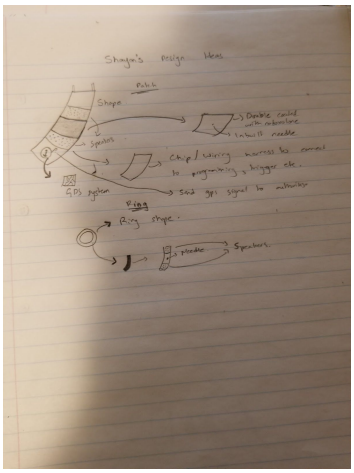
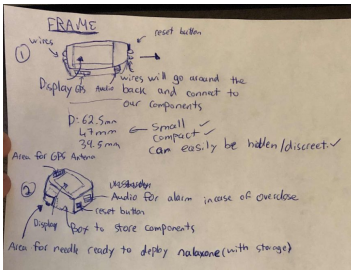
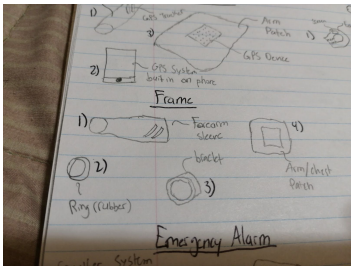
1.1 Introduction

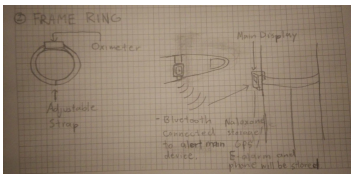
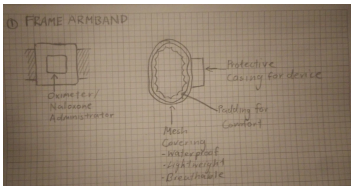
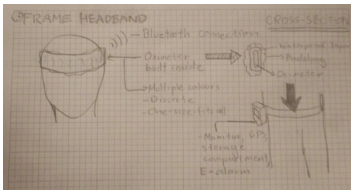
Following the group sessions in design criteria planning and product benchmarking, the main functions and subsystems of the drug overdose detection device have been determined and separated into two main categories. The first category includes functional subsystems. Functional subsystems are devices that actively affect the functionality of the overall system and are essential for the design. From previous planning sessions, our group has decided upon four main functional subsystems, they include a GPS Tracker/Contacter, an Emergency Alarm, a Naloxone Injector/Storage Compartment, and an Oximeter. The second category includes non-functional subsystems. These devices do not affect the overall performance of the

main system but contribute to user satisfaction and comfortability. Our group decided that only one system fit this criterion, which is the Frame or Shell of the overall system. The following is a report in which the ideas towards the design of the aforementioned subsystems are listed and conceptualized.

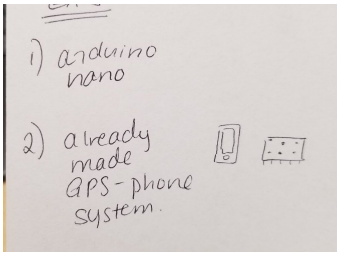
Non-Functional Requirements

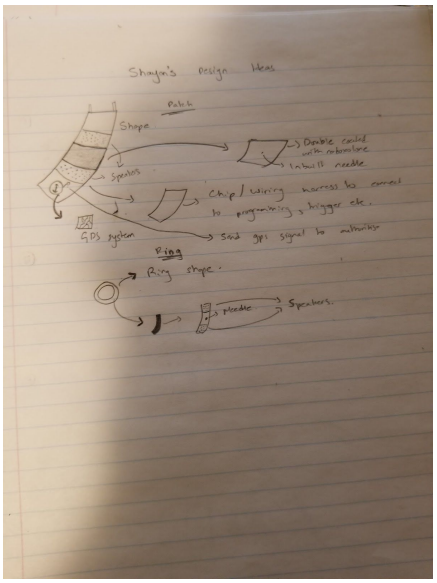
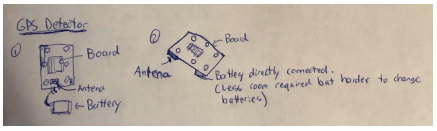
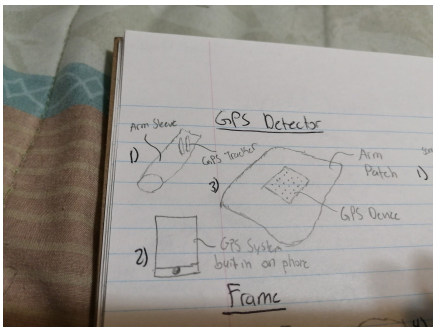
2.1 Frame		
Group Member	**Description**	**Diagrams**
Tharaka	1. The frame consists of a band that will be placed around the arm that will allow for naloxone to be injected. This band will also contain the storage compartment and will consist of a flexible material. 2. The oximeter will be placed around the toe as the other parts of the body will not be discreet enough. 3. Another place the oximeter can be attached to for women can be around the ear as hair can cover the device.	
Shayan	The design will have the naloxone patch in the middle and the speakers beside it. In the middle of the patch, the needle will be situated in direct contact with the naloxone. Beside one of the speakers will be the GPS chip. The patch will wrap around the arm and be adjustable based on the size of the arm either using velcro or a smooth wrap around the buckle. The oximeter will be separated from the patch and will be on the finger, toe or ear.	

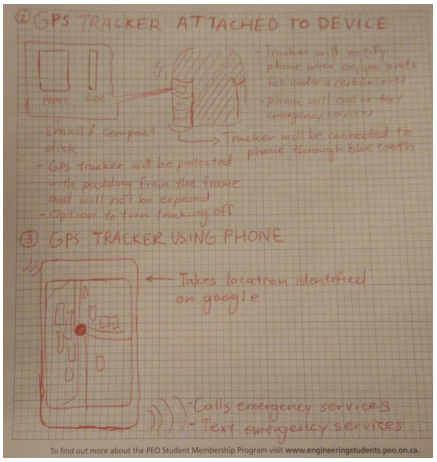
Shady	1. This frame will have all required components such as a GPS, a display, a reset button, and the audio device for the emergency alarm. It is large enough to contain all the components needed, as well as wiring. 2. This frame includes all of the components from the last frame but it also includes a naloxone injector, a smaller display and is thus more compact.	
Sam	1. Forearm sleeve. This design would be made out of a nylon/spandex material and fit comfortably on the person's arm. It would be mostly covered by the sleeve of the person's clothing, making it discrete. 2. Rubber ring. A one size fits all type ring. It would be primarily made out of rubber, allowing it to fit comfortably, and to be flexible and durable. It would contain the oximeter in it to monitor the person's blood oxygen levels. 3. Bracelet. The bracelet design will be made from plastic and rubber. It would be the same style as a watch with belt holes so that the person can adjust it to the right size. It will have the oximeter built into it and it will be able to check the rate of the person's pulse through their wrist. 4. Patch. The person will be able to wear the patch on their bicep or their chest. It will contain the needle to inject the person with naloxone if they are having an overdose.	

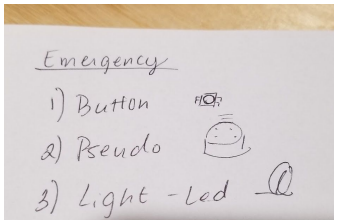
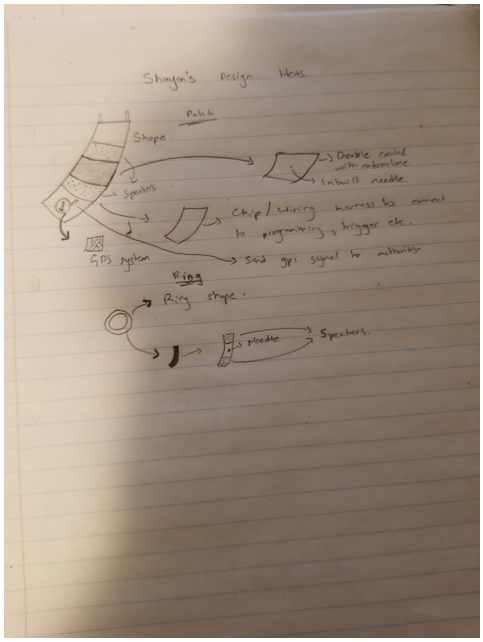
Felix	1. The oximeter will be incorporated into a ring. One benefit of the design is its portability and size. The slim shape and lightweight of the ring can allow the device to be concealed and transported easily. However as the device will be worn on the finger at all times, it will have to be very durable. 2. The oximeter will be incorporated into an armband. The armband will include a case for the oximeter for increased protection of the device. The frame will also allow the device to be easily accessible while being easily concealable. 3. The oximeter will be incorporated into a headband. The design will incorporate a waterproof layer and padding for increased comfort for the wearer and added protection for the oximeter.	1.  2.  3. 

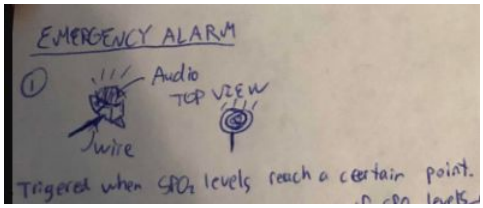
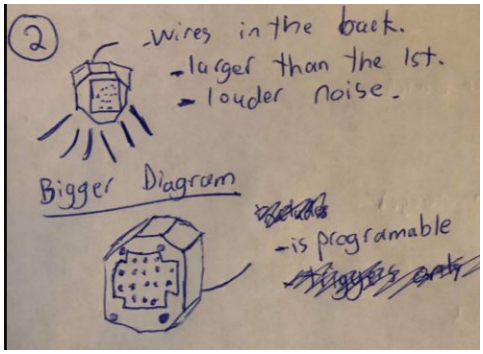
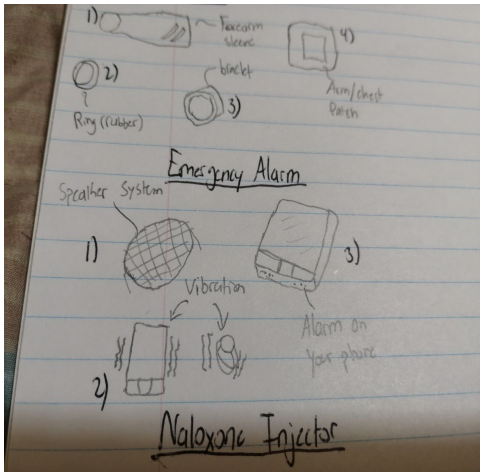
Functional Requirements

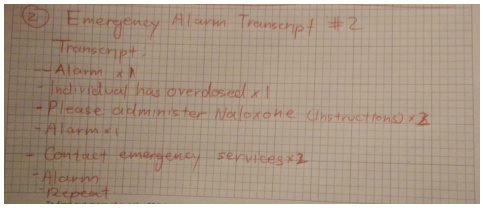
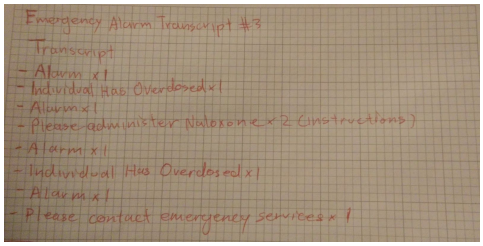
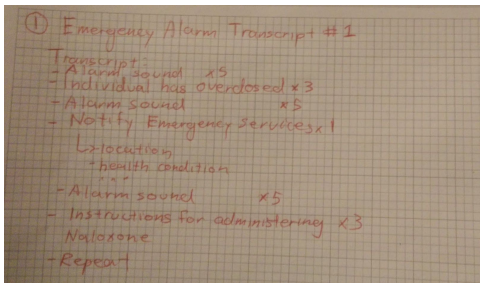
3.1 GPS Detector		
Group Member	**Description**	**Diagrams**
Tharaka	1. The first design is using an Arduino nano. The nano will use a transmitter to tell a phone when the oxygen levels drop to a dangerous amount (less than 90%). The phone will then send an alert to the authorities. 2. This can also be done with a cheaper microprocessor that can already have a built-in GPS system.	

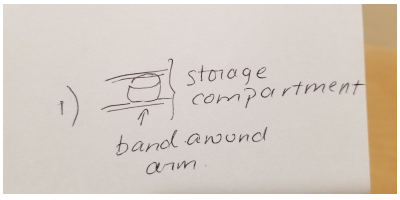
Shayan	1. The Gps system is alerted as soon as the oxygen level goes below normal (<90%) 2. The GPS saves the exact location at the time the overdose is detected. 3. Then sends the signal of the pinpoint location to emergency responders.	
Shady	1. This GPS detector includes a board, an antenna to send the signal, and a battery. 2.This GPS detector includes all components from the first one but is more compact.	
Sam	1.Implanted in the forearm sleeve, so the tracker is constantly with the person. GPS chip would be powered by batteries (probably 3-volt lithium batteries) 2.This second design would use the GPS system already built into the person's phone. It would be connected to the actual opioid device via Bluetooth. 3. This last design would work similar to the first, except the GPS tracking chip would be planted in the arm/chest patch. It would operate using the same kind of batteries.	
Felix	1. & 2. A separate GPS tracker will either be incorporated within the overdose detection device itself or separately in another accessory. Both designs will transmit the location of the individual to the user's	1 & 2 & 3

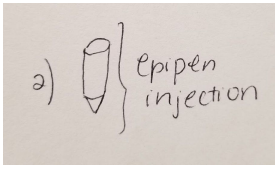
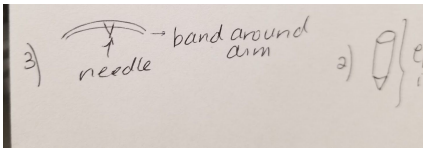
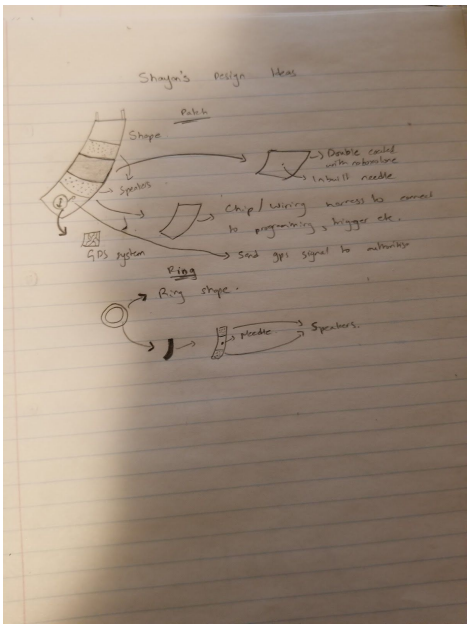
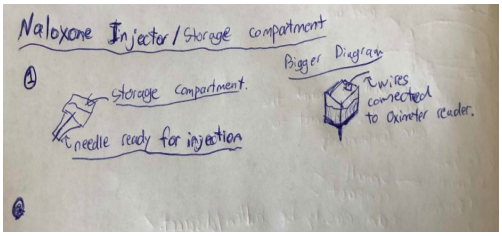
	cellphone when an overdose is detected. The information will then be forwarded to emergency services through text message with an explanation of the emergency situation. The lightweight and high accuracy of GPS trackers allow them to be placed anywhere without detection. However creating a GPS tracker that is small enough to fit within the device will be difficult and even if the GPS tracker does fit, it will consume a large portion of the space needed for the rest of the overdose detection device. 3. The user's phone will be used as the GPS tracker. When the device senses an overdose the location of the user as listed on their phone will be forwarded to emergency services along with a message explaining the emergency situation. One advantage of this process is that a separate GPS tracker will not be required, lowering the cost of the overall device. This method is also more efficient than installing a separate tracker as the phone of the user will already be connected to the overdose detection device through Bluetooth. However, the accuracy of the GPS tracker on one's phone may not be as high as a separate tracker.	

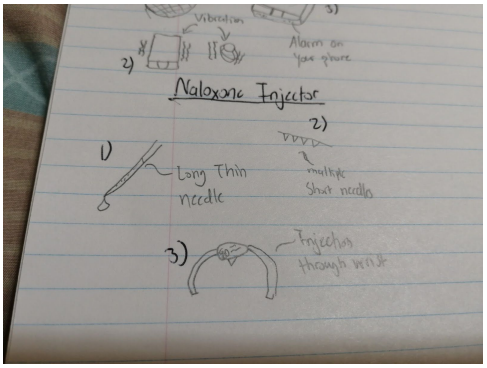
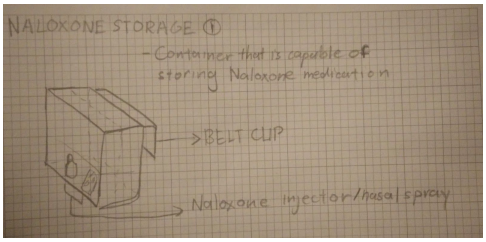
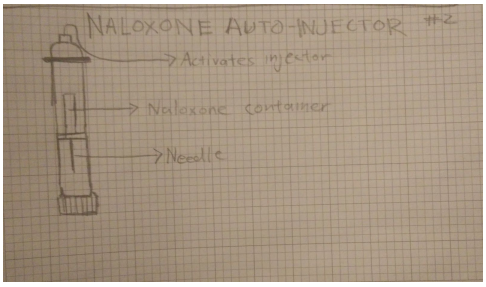
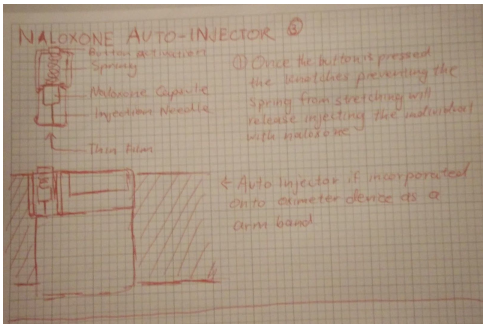
3.2 Emergency Alarm		
Group Member	**Description**	**Diagrams**
Tharaka	1. The emergency alarm goes off once the oxygen levels are detected to be under 90%, this consists of a speaker 2. A very bright LED can be added, however, the light may not be seen by passersby as the device will be hidden under clothes. 3. A button can also be used to alert authorities, but due to the nature of an overdose, the user might not be able to press it in time.	
Shayan	The emergency alarm is installed to alert surrounding personnel of an overdose and also help medics locate a person in a difficult location where the GPS may not be sufficient e.g a construction site. A voice indicating an overdose and instructions for nearby potential help may be added as well.	
Shady	1. This alarm is a cheap component that will be triggered to make a sound once the SPO2 % reaches low levels (<90%). This audio device is cheap, compact, and can easily be connected to other	1.

	components. This can also playback a prerecorded message telling others about the overdose. 2. This emergency alarm is larger and takes more room but is also more powerful. It can alert people in a larger radius than the first design. It has space for wires and can also be programmed to trigger the alarm once SPO2% levels are low.	 2. 
Sam	1. This first design is a mini speaker system that would be connected to the device, and when the person is having an overdose, the speaker will sound an alarm so that the emergency responders or anyone passing by will be able to find the person. 2. For this design, the watch and/or phone of the person would vibrate, as a more discrete alarm system for if the person is already in a quiet environment. It would be connected to the main device with the oximeter via Bluetooth. 3. This last design would be a louder alarm on the person's phone that would go off if the person is having an overdose. Similar to the previous design idea.	

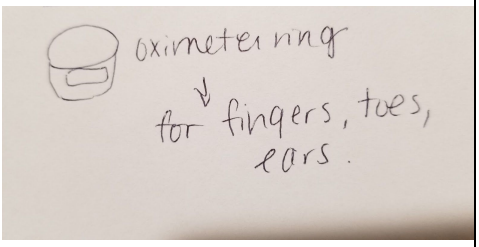
Felix	A speaker will be implemented into the device and a pre-recorded message will play when an overdose is detected. Each of the following is a transcript for the speaker. Each transcript has its own advantages and disadvantages in response times for administering naloxone, contacting emergency services and grabbing the attention of others around the overdosing individual. (situations assume all transcript are first heard from their beginning) 1. Prioritizes informing others surrounding the overdosing individual of their situation and stabilizing the overdosing individual with naloxone. Faster response time for naloxone treatment but slower 2.Prioritizes in getting the attention of others around the overdosing individual. Faster reaction time from 3.Prioritizes in contacting emergency services. This will lead to faster response times from emergency services but a slower response time for naloxone treatment.	1.  2.  3. 

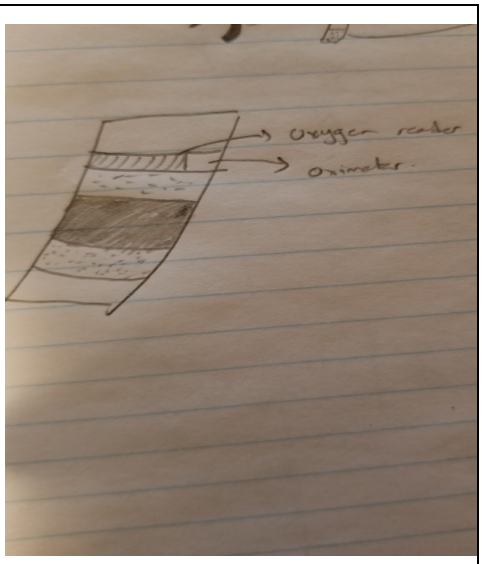
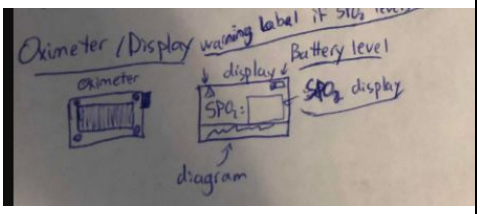
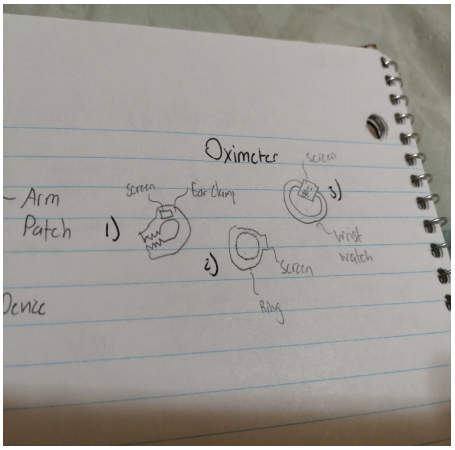
3.3 Naloxone Injector / Storage Compartment		
Group Member	**Description**	**Diagrams**
Tharaka	1. The storage compartment for naloxone can be injected once the oximeter detects overdose. It will be injected through the arm through a very small motor. 2. A needle in an EpiPen format will be used on the thighs at a	**1.**  **2.**

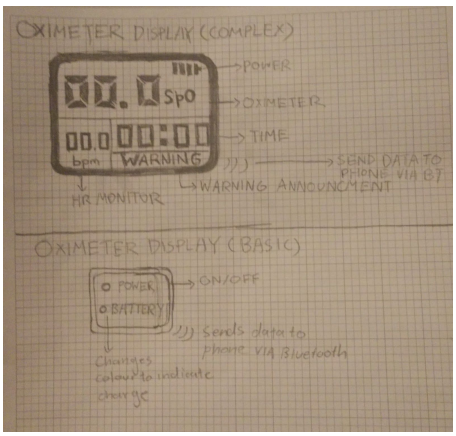
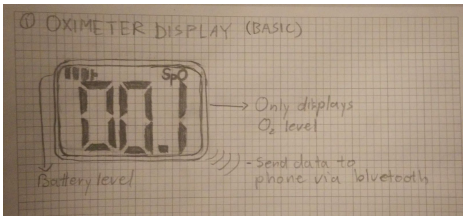
	45-degree angle to deliver naloxone through a small motor that can be concealed and the signal can be sent through Bluetooth. 3. A small needle attached to the compartment around the arm can deliver the naloxone	 3. 
Shayan	The middle of the patch contains the naloxone which also makes that compartment more thick. This allows a needle to be installed in the patch which can easily administer naloxone. The naloxone will enter the arm through the needle as soon as the signal for low oxygen is received.	
Shady	1.This naloxone injector contains a needle and a storage component. The storage component is used to store the naloxone and the needle is for the injection. This is a safe design as the needle has a film below it (Thin film that can only be pierced with pressure directly at one point) to ensure it is safe and will not accidentally inject naloxone. This injector will be triggered when the SPO2 % levels are low (<90%) and will keep injecting a safe	

	amount until the SPO2 % levels are stable once again.	
Sam	1. A long thin needle containing the naloxone would be stored in the armband design, if the person is having an overdose a signal would be sent to the device and the needle would extend out into the person's arm injecting them with naloxone. 2.This design works the same as the previous one, but instead of one long needle it uses multiple tiny ones to inject the naloxone. 3. This last design works through the wrist watch design. There would be a needle stored into the watch which would protrude out into the person's wrist injecting the naloxone.	
Felix	1. Belt storage capsule will be incorporated with the drug overdose detector. The storage capsule will contain a section that stores naloxone injectors and nasal spray which can be easily administered to the overdosing individual. Although this design is the simplest and easiest to use, the overdosing indivudual will most likely be incapacitated and unable to administer the medication themselves, thus they will require another person around them to administer the medication for them. 2. This naloxone injector will resemble the mechanics of a epi-pen in which a needle will inject medication into an overdosing individual when a button is pressed. Although this method of applying naloxone is simple and effective, it will require outside assistance in order to	1.  2.  3. 

	function properly. 3. The final method of administering naloxone to a overdosing individual will be through a auto-injector. The auto-injector will be built into a strap, Although this method is the most effcient and will not require any outside assistance to work; the device remains the most fragile and the chances of an accidental activation are higher than the other two designs,	

3.4 Oximeter		
Group Member	**Description**	**Diagrams**
Tharaka	1. A possible oximeter will be worn as a ring, however this is not discrete or a good price for budgeting 2. Another place for a possible ring that would be more discrete would be the toes 3. If a very small device was created, it could also go onto the ear	 

Shayan	The initial patch is on the upper arm. Unfortunately the oxygen level can not be recorded in that area. Body parts which can give an accurate reading are fingers, toes and ears. In addition to the patch a ring can be placed on the finger or toe. This will send a signal via bluetooth to the alarm and also trigger other components like the GPS and naloxone.	
Shady	1. The oximeter component can be hidden under the display and is very compact. The screen would display the battery level, the SPO2 levels, a diagram of the SPO2% levels, and a warning label. This is to ensure that our device is aesthetically pleasing to our customers and users.	
Sam	1. Ear clamp. Since the skin of the ear is very thin, it is ideal to have an oximeter there to measure the person's blood oxygen level. This design is a bit less discrete, but would be small and light. 2. Ring. This design would use the thin skin of the person's finger to measure the blood oxygen levels. 3. Watch. This design would be around the person's wrist and would be able to monitor the person's heart/breathing rate with their pulse.	

Felix	1.Most complex design, displaying time, heart rate and oxygen levels. Although more complex and expensive, the device is more aesthetically pleasing in comparison to option 2 and allows for better accuracy in breathing rate at any moment. 2.Most basic design only featuring two LEDs to represent the power and battery life of the device. As a result, the device is the easiest to operate and easily concealable in comparison to option 1 and 2. However a lack of a display can lead to uncertainty as the device will only notify the user when an overdose occurs. 3.Device features a basic display screen for the breathing rate of the individual wearing the device. Conveniently allows the user to be notified of their blood oxygen level at any time. Usage of a screen will make the device less durable in comparison to option 2.	1 & 2  3. 

4.1 Conclusion / Group Design Concept

In conclusion, our final prototype will consist of a band that goes on the upper arm. The band will contain the storage for naloxone and an epipen-like device will inject the naloxone. The “epipen” will be triggered through a very small motor after the oximeter relays the overdose signal via bluetooth. It will then inject 4mg of naloxone to the user. The band will have padding in its interior while a waterproof mesh will surround its outer layer, a plastic casing will also be inputted to protect the injection device from impacts. Ultimatley, allowing for maximum user comfortability while having great flexibility and durability.

The oximeter will be placed around the foot for discreteness, and will alert authorities through bluetooth to the person's phone. It will also trigger the naloxone to be administered in the arm. There are very few places in the body where skin is thin enough with less fat to find oxygen levels, which is why we chose the toe for both effectiveness and discreteness.

The overdose will be detected once oxygen levels go below 90%, which will also trigger a speaker on the arm to begin beeping to alert passerbys. This entire process will be completed in under 3 minutes, thus maximizing the chances for survival of the overdosing individual. (Final Design Concept Below)

Final Design Concept