

# Design Criteria

## Introduction:

A successful product that will efficiently meet the basic needs of the client. The client's presentation gave us the means to differentiate between requirements and requests, so we could begin to specify and prioritize the design criteria. Clarifying which needs are the most important can guide us how to focus our efforts during the design process. Functional and nonfunctional requirements are a consideration when determining how the product will reach the customers. Functional requirements are important in ensuring the product works properly and has all the necessary features of an efficient device. Nonfunctional requirements are factors that can help to reach users by making the product desirable in the market. Understanding where constraints should lie is an important factor in product approval and ensuring the product is effective and safe for users.

Not only did the client meeting given us the means to prioritize the important design features, but it also gave us a better understanding of who the product user was. Initially we had thought that the only user was people that had not chosen to use drugs (i.e. those that had been prescribed drugs by a doctor and had wanted to prevent a potential overdose). From the presentation, we learned that we are also creating the product for people who are actively choosing to use drugs even though they know the risk. Understanding that the user may be choosing to use drugs but does not want others to know was important in developing the design criterion that the product be discreet. Some design criteria that was very important to the client was that the device be able to detect an overdose and contact help to get to them in under three minutes. The client also told us that an overdose can occur very slowly or suddenly they can stop breathing. From this need we decided to make a design criterion that may help give extra time to get to the user. If our product measures blood oxygen levels and respiratory rate it will be able to more accurately detect an opioid overdose sooner and allow more time to administer naloxone. The client also informed us that the user will likely not want to wear the product if help is sent and naloxone is administered when they are not overdosing. This prompted us to create two different design criteria to prevent this from happening. First, we plan to have the percent error of blood oxygen levels to be less than or equal to five percent. We also may add an override system that allows the user to override the alert for help if they are not overdosing.

## Benchmarking:

The popular opioid overdose monitors we have considered include the Carnegie Mellon University Hopeband, Smartwatch P68, Biosensors and the Purdue University Armband. Based on our findings, the important features in the design of these benchmarks have been highlighted as seen in table 1. These monitors have all met certain criteria in terms of their size, weight, being discreet, not inhibiting drug use and measuring blood oxygen. Observing from the benchmark designs, it appears that an ideal form of the monitor which have been deployed in the creation of these monitors is in the style of a smartwatch. Also, as important as the cost is in order to ensure accessibility to the public, all our benchmark designs have all stayed below the \$100 mark.

Table 1: Design Features of Benchmarks

	Importance (weight)	Carnegie Mellon University: "HopeBand"	SmartWatch P68	Biosensor	Purdue university
cost	(3)	\$16-\$20 US	33\$	n/a	20\$
weight	(4)		.18lbs	.27lbs	166.65.3mg(device) 11.50.9 drug
battery-life	(4)		5-7 Days	n/a	Portable battery
size	(4)	Wearable Watch-Style	248mm(bracelet length)	Smartwatch size	Wearable Armband 2.88 diameter, 8mm length
customizable	(3)		no	Yes	no
accuracy	(5)	n/a (currently improving prediction accuracy)		86.78%	n/a
intrusive?	(4)	no	no	no	Yes (self administer naloxone)
Inhibit drug use?	(5)	no	no	no	no
Measure respiratory rate and oxygen concentration	(5)	Only detects oxygen concentration with pulse oximetry	yes	yes	yes
Override system	(2)		no	yes	no
Signal for help	(5)		no	NO	no

Give user's location	(5)	Bluetooth connects device to the user's smartphone: sends accurate GPS location to emergency contacts	no	NO	no
Error percentage	(4)			9.04%-13.22%	n/a

There are very few products with similar functions in the market, making the selection of benchmarking limited. Although the limitation it is possible to compare a few products and obtain insight on their specifications. The only accuracy found is from the "Biosensor" which is 86.78%, making its accuracy much lower than the accuracy we are aiming at, 5%. It is worth noting that only the "HopeBand" sends the user's location to emergency contacts. Although this feature being very useful it is impractical since it requires a personal-Bluetooth-connected smartphone. In addition, only the Biosensor its customizable and pursue an override system, establishing a more personal connection with the user by adjusting the product to their body and overriding the system in case of a mistake, avoiding unnecessary problems. All the products are very light, the heaviest reaches the weight of only 0.27lbs. Due to the lack of information on the products, it is not possible to determine which one is the best but they are good examples to compare our product to.

## Design Specification:

From our developed design criteria and based on benchmarking, we have defined our target design specifications using both ideal and acceptable values. These specifications have been presented in table 2. Also, classifications were carried to state where each criteria and specifications would be grouped. That is, either as a functional requirement, as a non-functional requirement or as a Constraint.

*Table 2: Design Specifications*

	Design Specification	Relation	Value	Units	Verification Method
	<b>Functional requirements</b>				
1	Percentage error	<=	5	Percent	Test
2	Monitoring Time	=	10	second	Test
3	Battery Life	>=	1	day	Test
4	GPS tracking accuracy	<=	10	meter	Test

5	Customizable	=	yes	n/a	Test
6	Override System	=	yes	n/a	Test
7	Detects overdose	=	yes	n/a	Test
8	Non-invasive	=	yes	n/a	n/a
<b>Constraints</b>					
1	Size	<	6.5	inches	Measure size
2	Weight	<	1	lb	Weight device
3	cost	<	100	\$\$\$	Calculate price
<b>Non-Functional Requirements</b>					
1	Discreet	=	Yes	n/a	Survey
2	Location of application	n/a	n/a	n/a	n/a

## Improvements:

Observing from the benchmarked designs, there has been specific criteria that has not been met. One of these includes the overdose monitor's ability to signal for help. During an overdose event it is known that the patient can't call for help, so it is a very important criterion. Also, having a highly accurate gps location when finding the user is considered beneficial given the short time span to save a life. Reducing the perimeter of search for the patient would enable quicker assistance. Accuracy in measurements and a reduced error percentage is another specification that would improve in the development of better overdose monitors. Additionally, to accommodate certain health issues the device should be able to be customized based on the user's health history.

## Conclusion

In conclusion, understanding the problem through the client perspective as well as understanding how our constraints and variables affect the end product is crucial in building an efficient device. During the client's presentation, not only did it give us a better understanding of who our target clientele was but also what is to be prioritized when designing this product. Through the meeting, we were able to clarify our functional and non-functional requirements, different constraints as well as metric to correctly measure our criteria. We researched different devices that might fit some/all our client needs. Many of these devices were still in their prototype, but they were still able to give us a good insight of what we can ideate from and how we can improve on these designs. One essential criteria that we will make sure to include is a monitoring system that is able to contact for assistance. Our end goal is to ensure that we have

a safe, effective product but also one that they will use and enjoy using. In the words of Francis Brown, Product Development Manager at Alaska Airlines, "At the heart of every product person, there's a desire to make someone's life easier or simpler. If we listen to the customer and give them what they need, they'll reciprocate ..."

## References

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