Dane Hart

OSSO Wearable Vital Sign Monitor

“Hospitals are horrible places to get better”

- Joe Schlesinger, musician and anesthesiologist at Vanderbilt Medical Center

Several alarms attempt to alert clinicians all at once

Alarms quickly lose meaning

Clinician experiences alarm fatigue and saturation

Patient outcomes worsen as a result

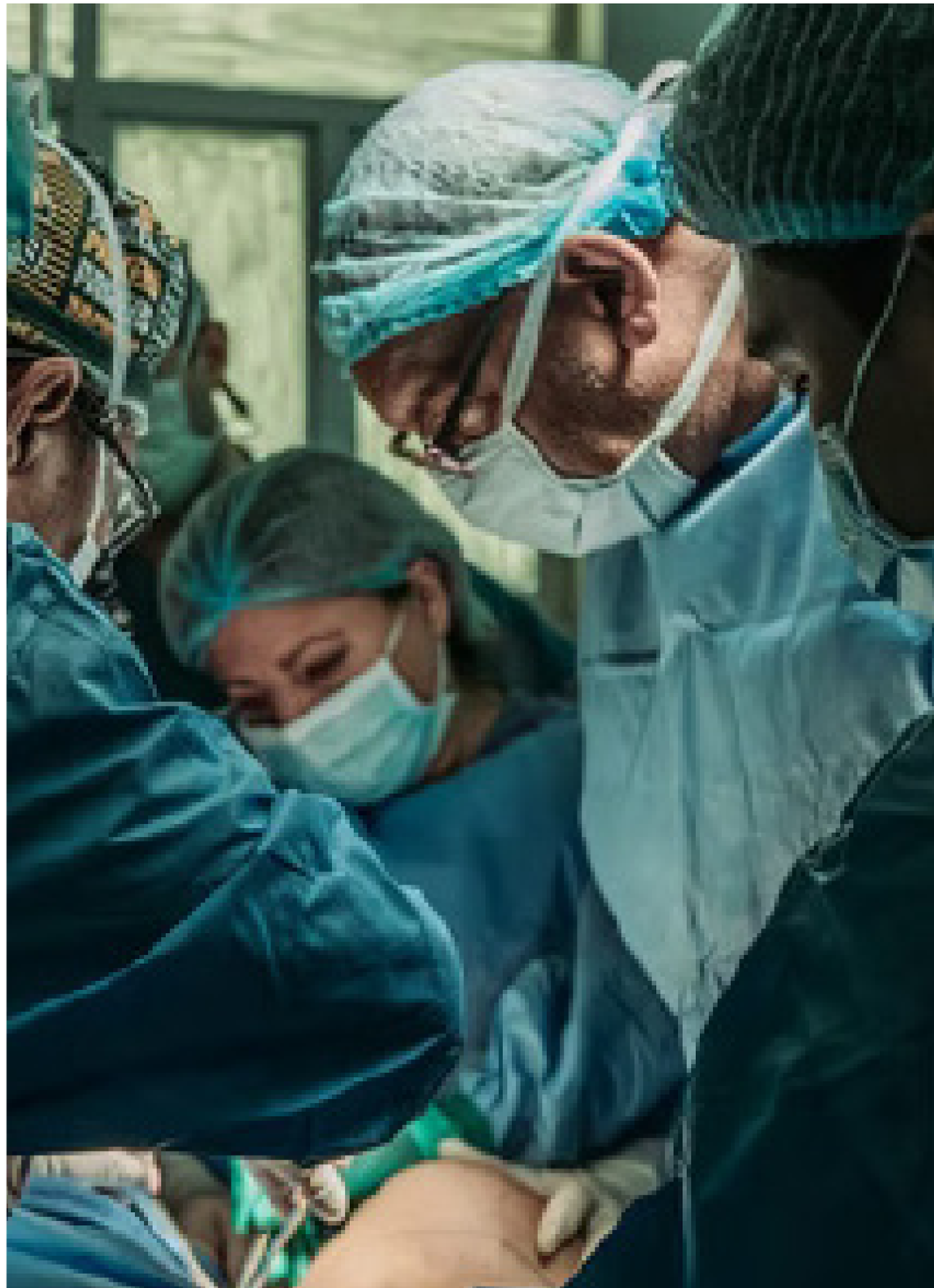
Discover

Stakeholders Interviewed

7 clinicians interviewed in person

60+ minutes per conversation

20+ clinicians survey



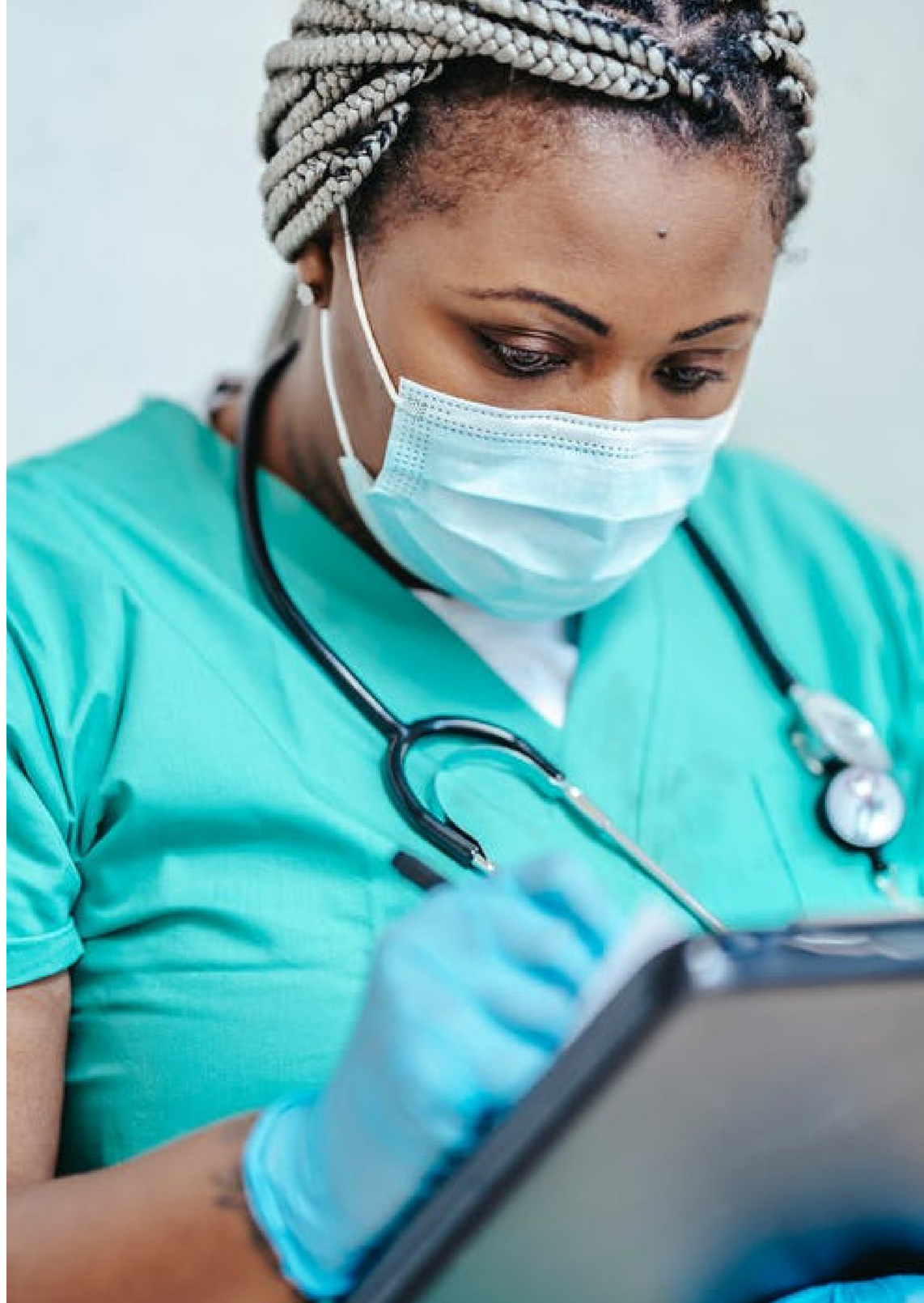
Key Stakeholder

The Floor Nurse

Operates as a floor nurse at their hospital

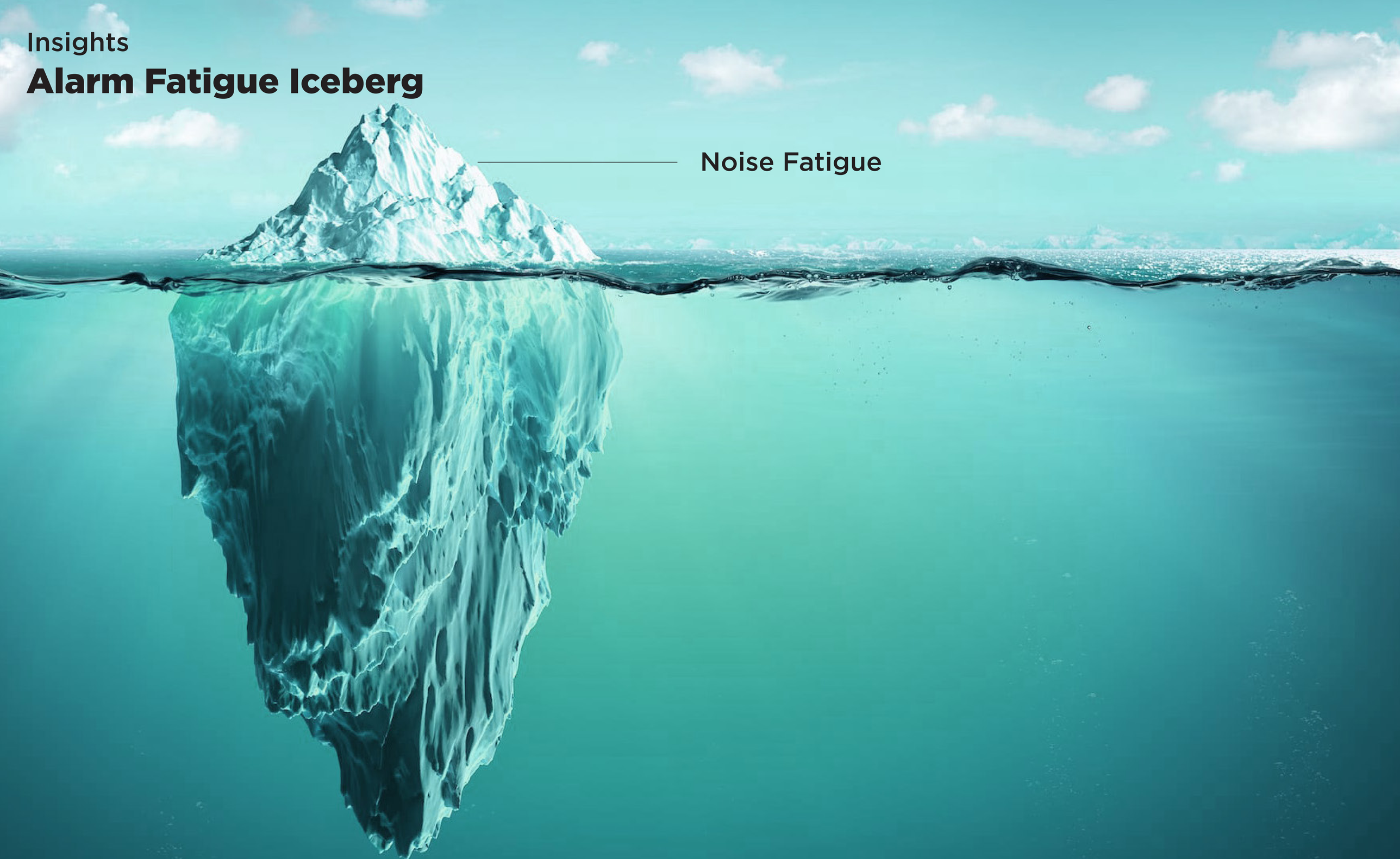
They are exposed to a considerable amount of meaningless alarms

Wants to reduce time and ease operating activities



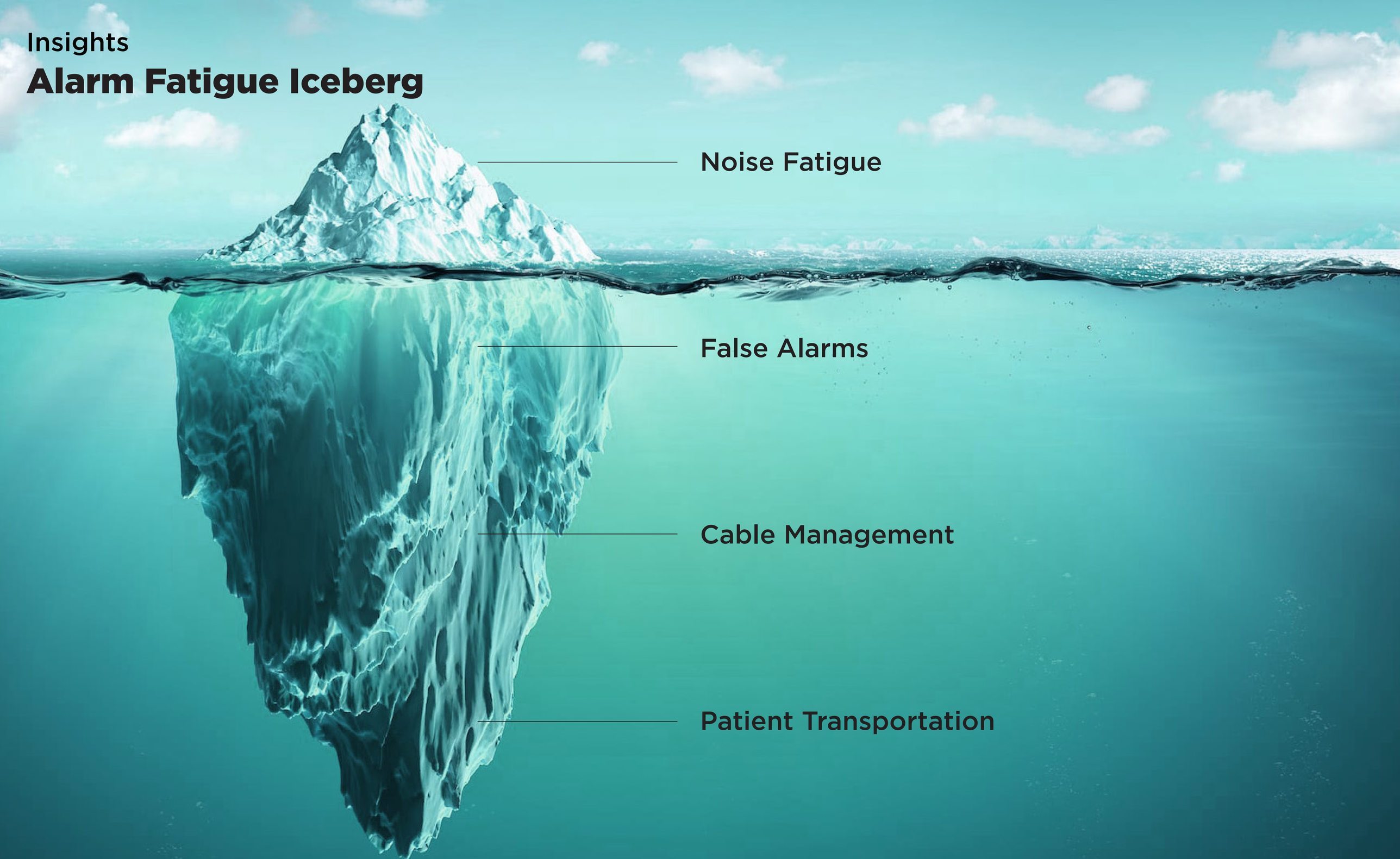
Insights

Alarm Fatigue Iceberg



Insights

Alarm Fatigue Iceberg



Market Research

Current Solutions

GE CARESCAPE V100

Masimo Rad-67

Apple Watch

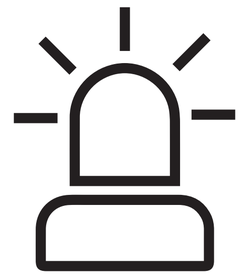
Stationary

Opportunity

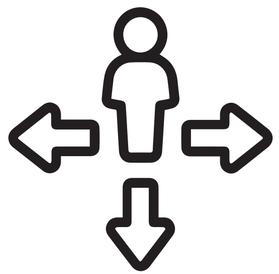
Wearable

Insights

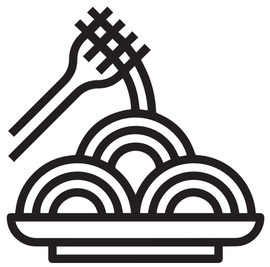
Wearable Advantages



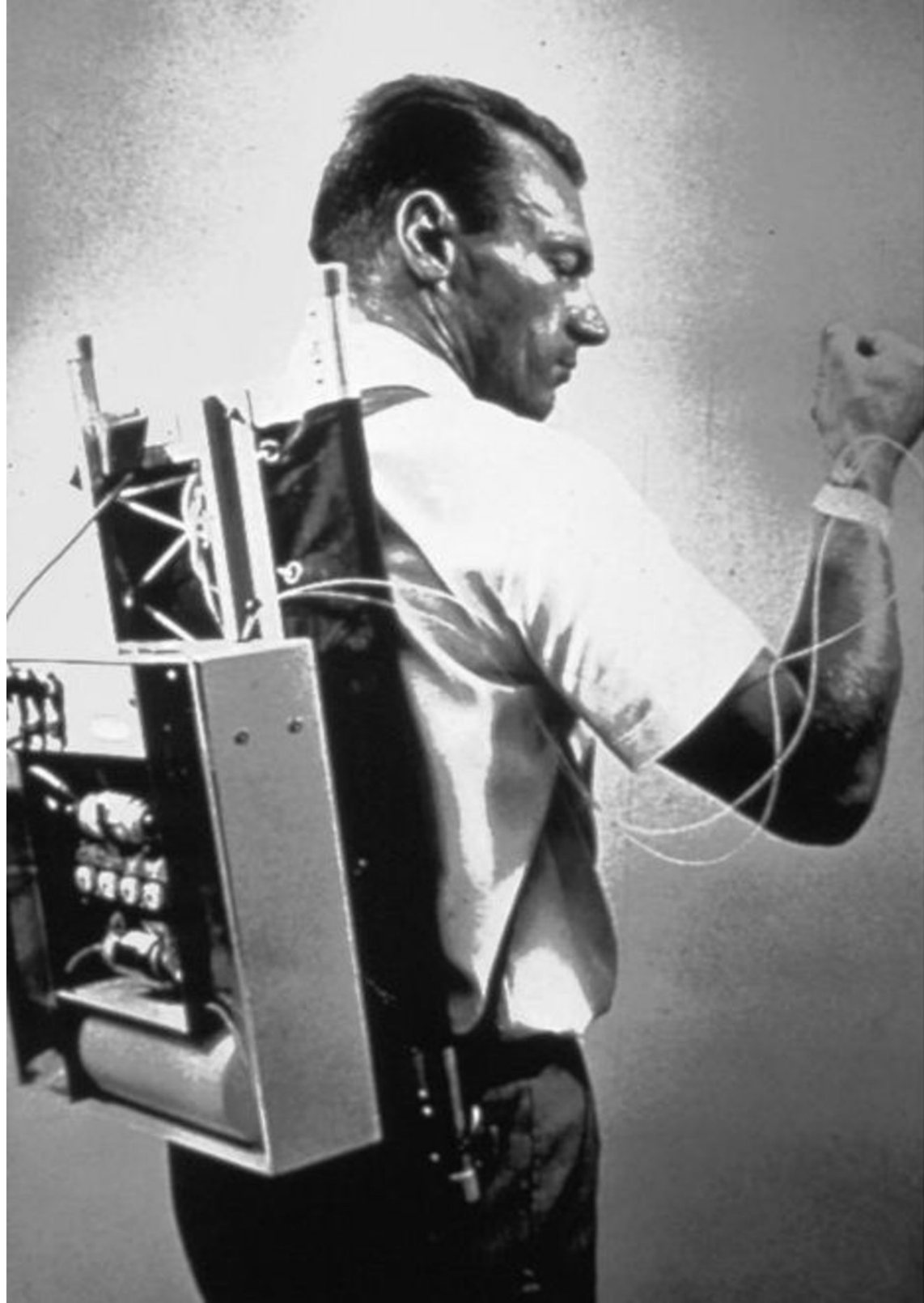
Mitigates misplaced sensors



Increases patient mobility



Reduces cables



How might we
create a wearable patient vital sign monitor to mitigate alarm fatigue?

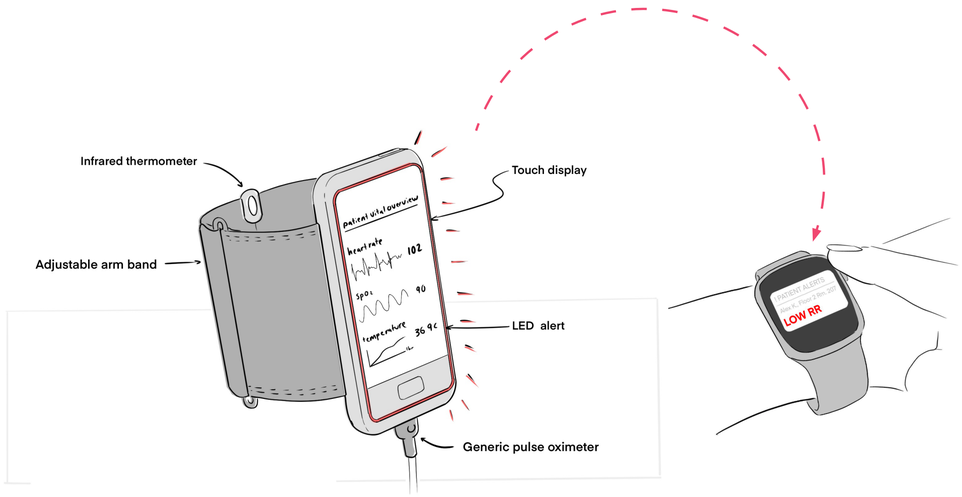
Heart Rate | Blood Pressure | Resp. Rate | SPO2

Develop

Concept Feedback & Refinement

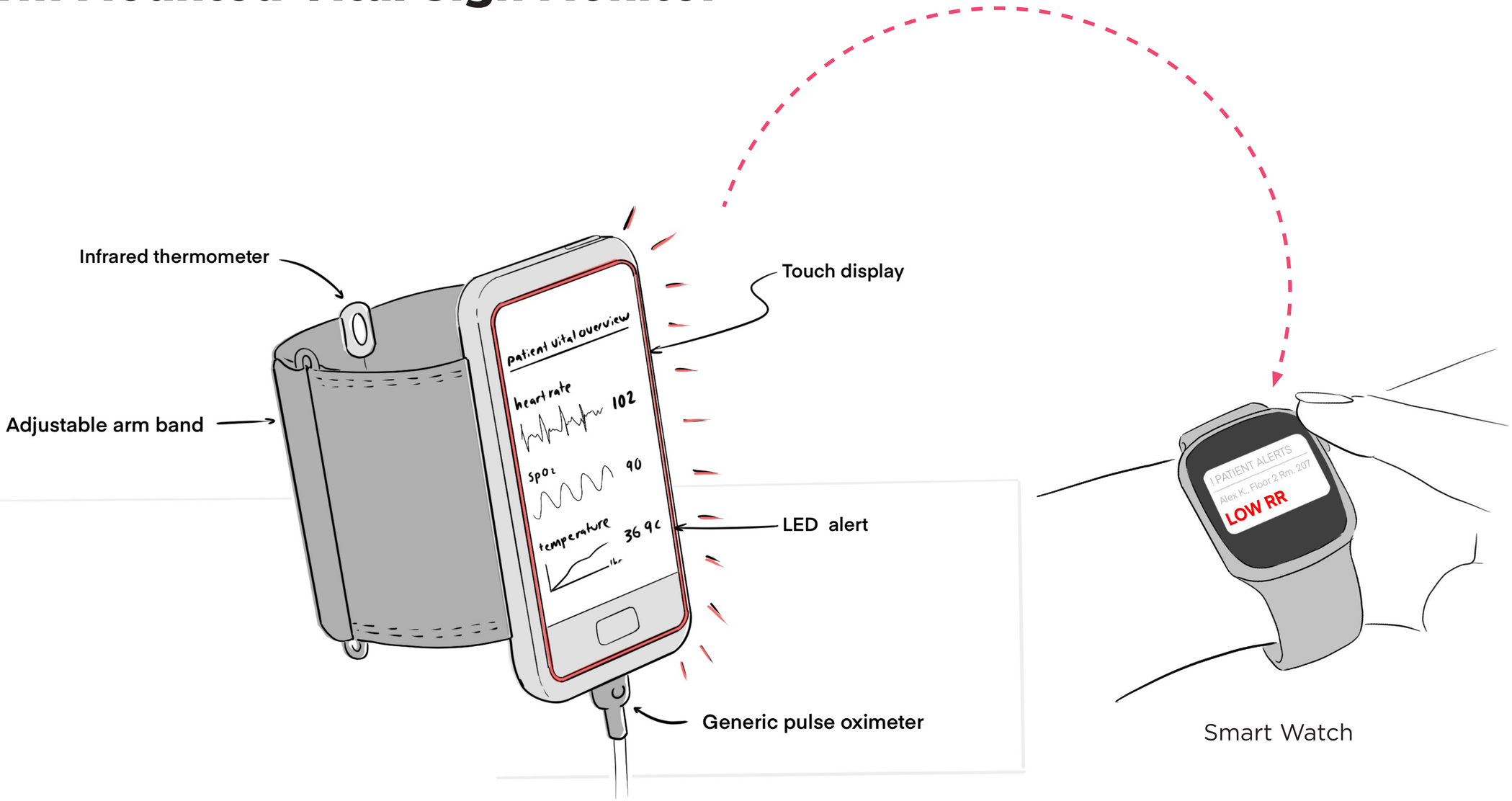
Initial Ideation

Refinement



Develop

Arm Mounted Vital Sign Monitor



Smart Watch

Develop

Technology

ECG Cables

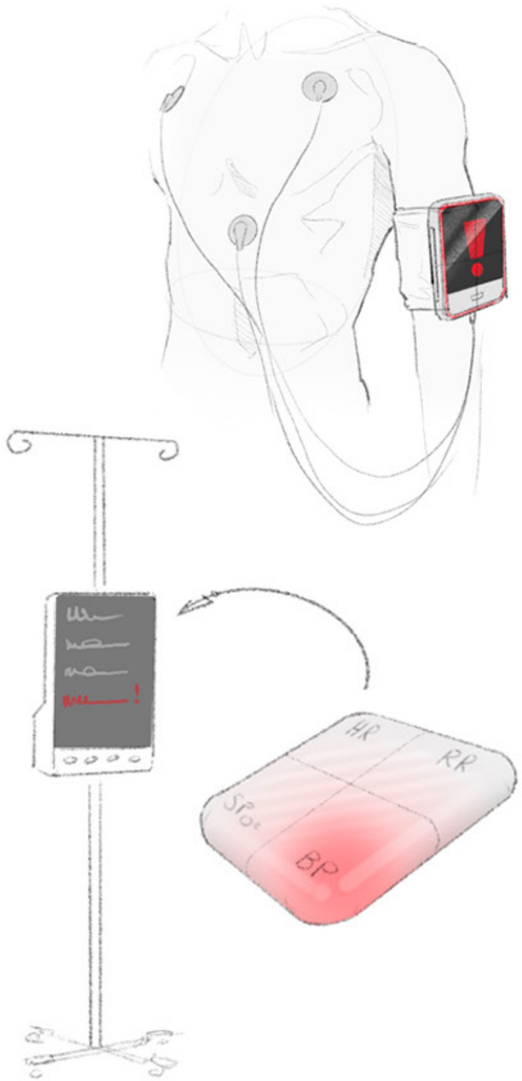
Heart Rate
SPO2
Respiratory Rate

Blood Pressure Cuff

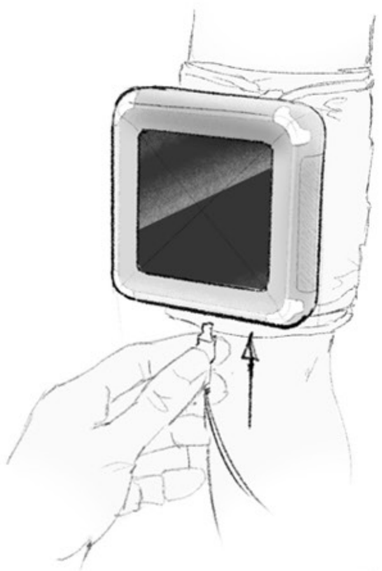
You'll never guess,
blood pressure

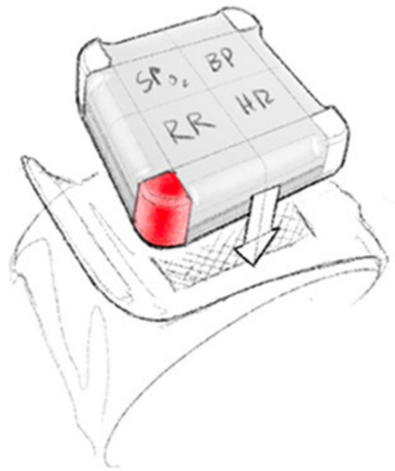
Develop

Sketching



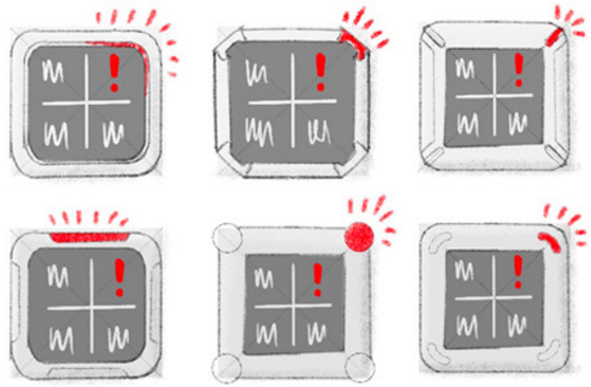
ECG connection





Velcro BP cuff connection

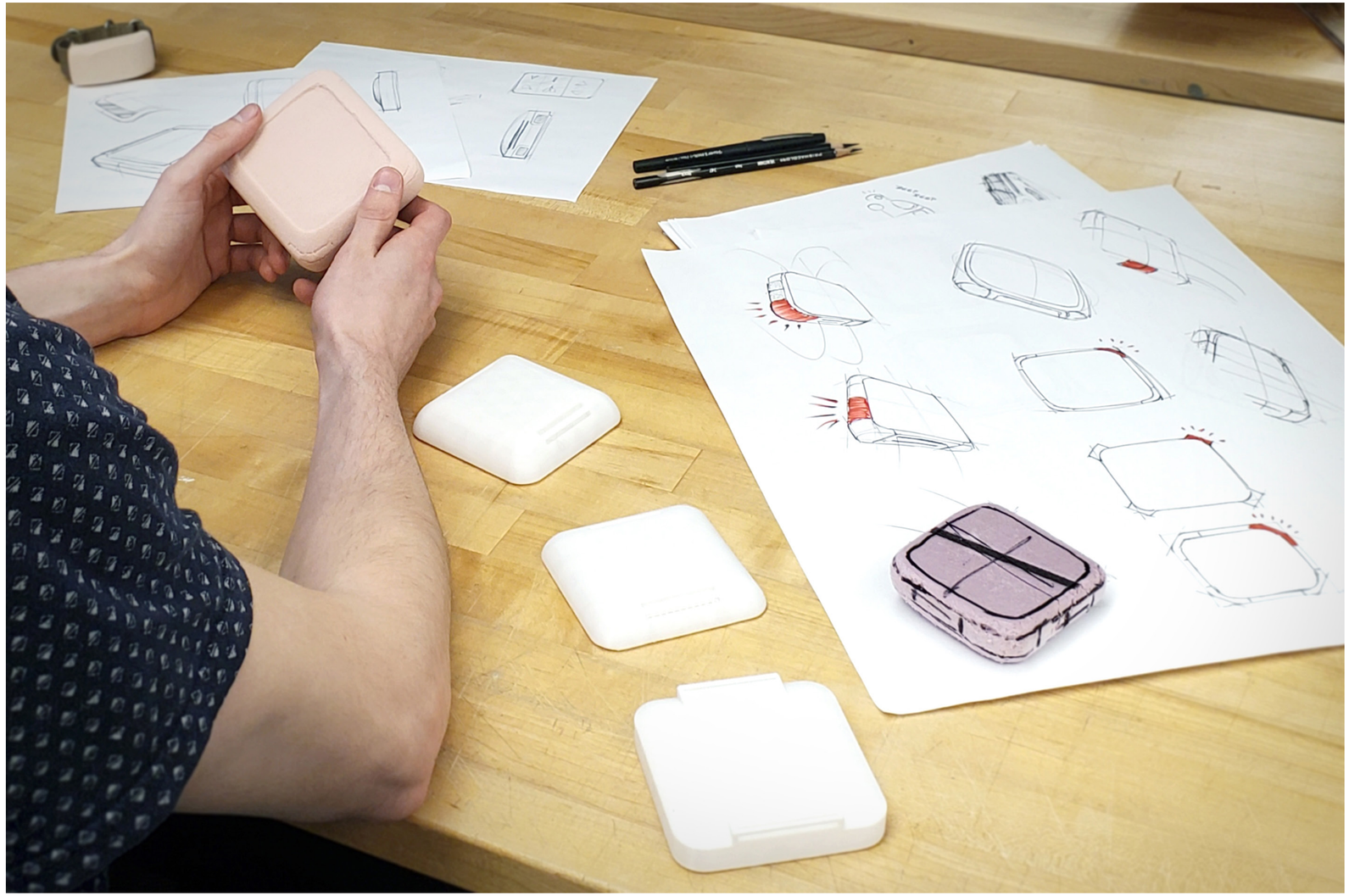
Easy patient transport



Four quadrant vital sign layout

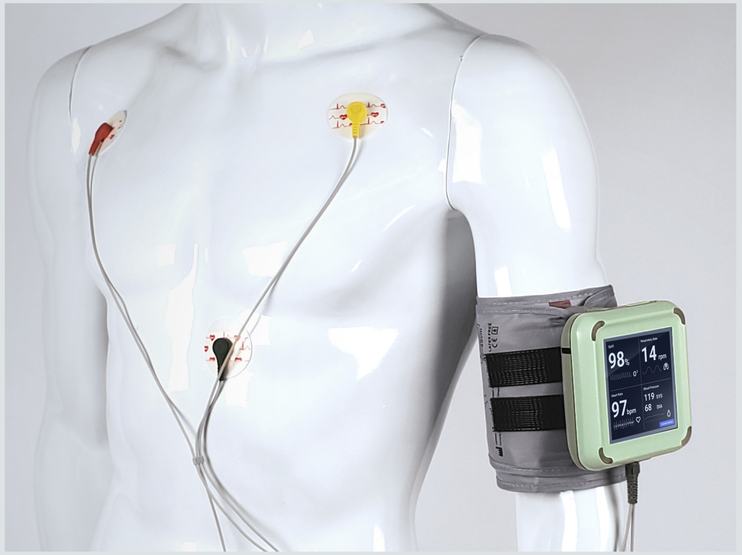
Develop

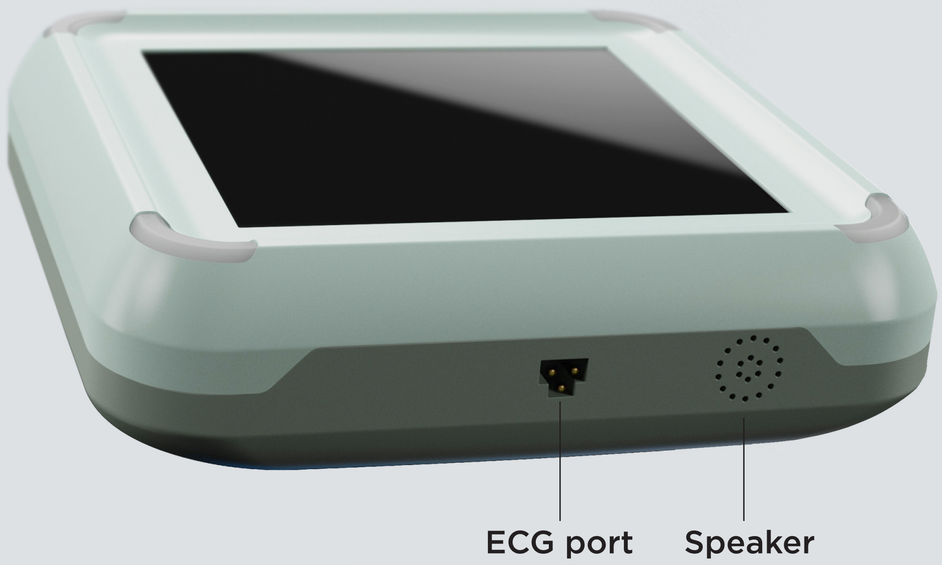
Prototyping



OSSO

Final Product

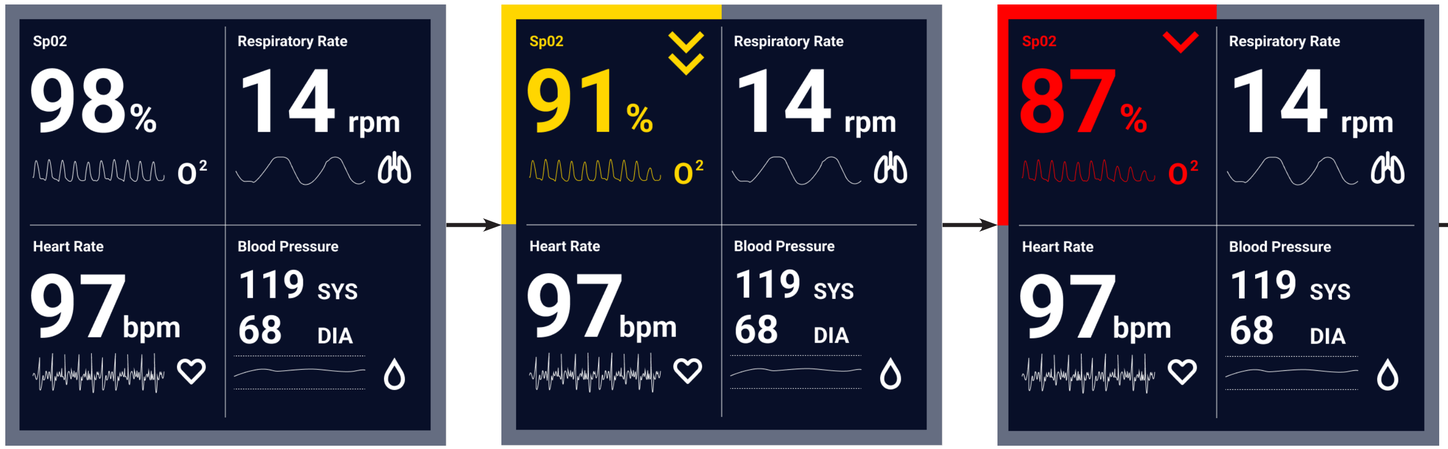




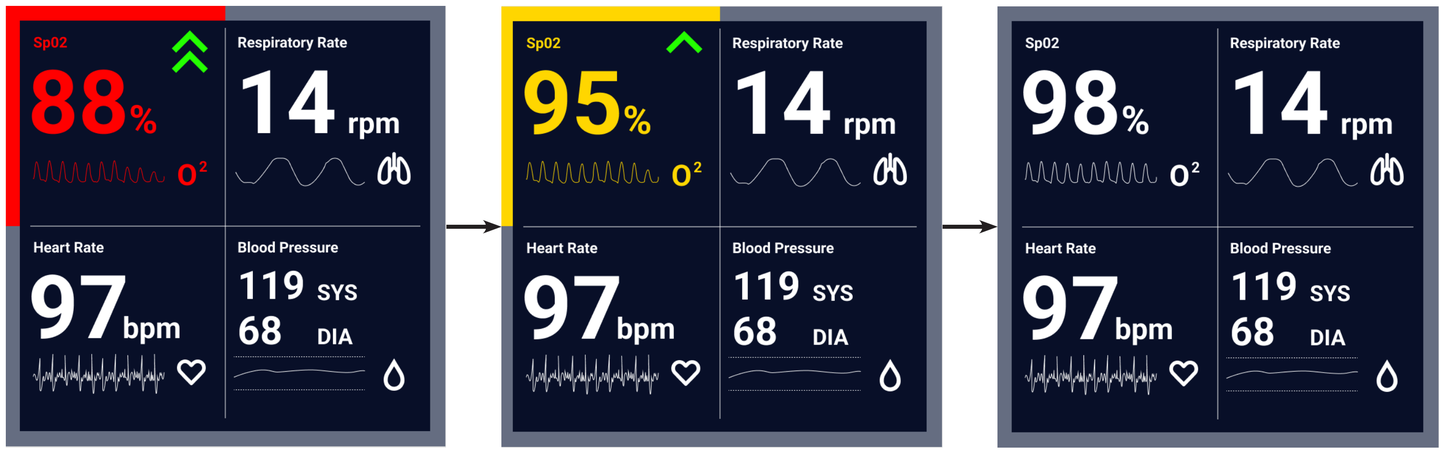
Product Innovation

Four Quadrant Mapping

Patient trending negatively



Patient recovering



LED indicator lights up

User Journey

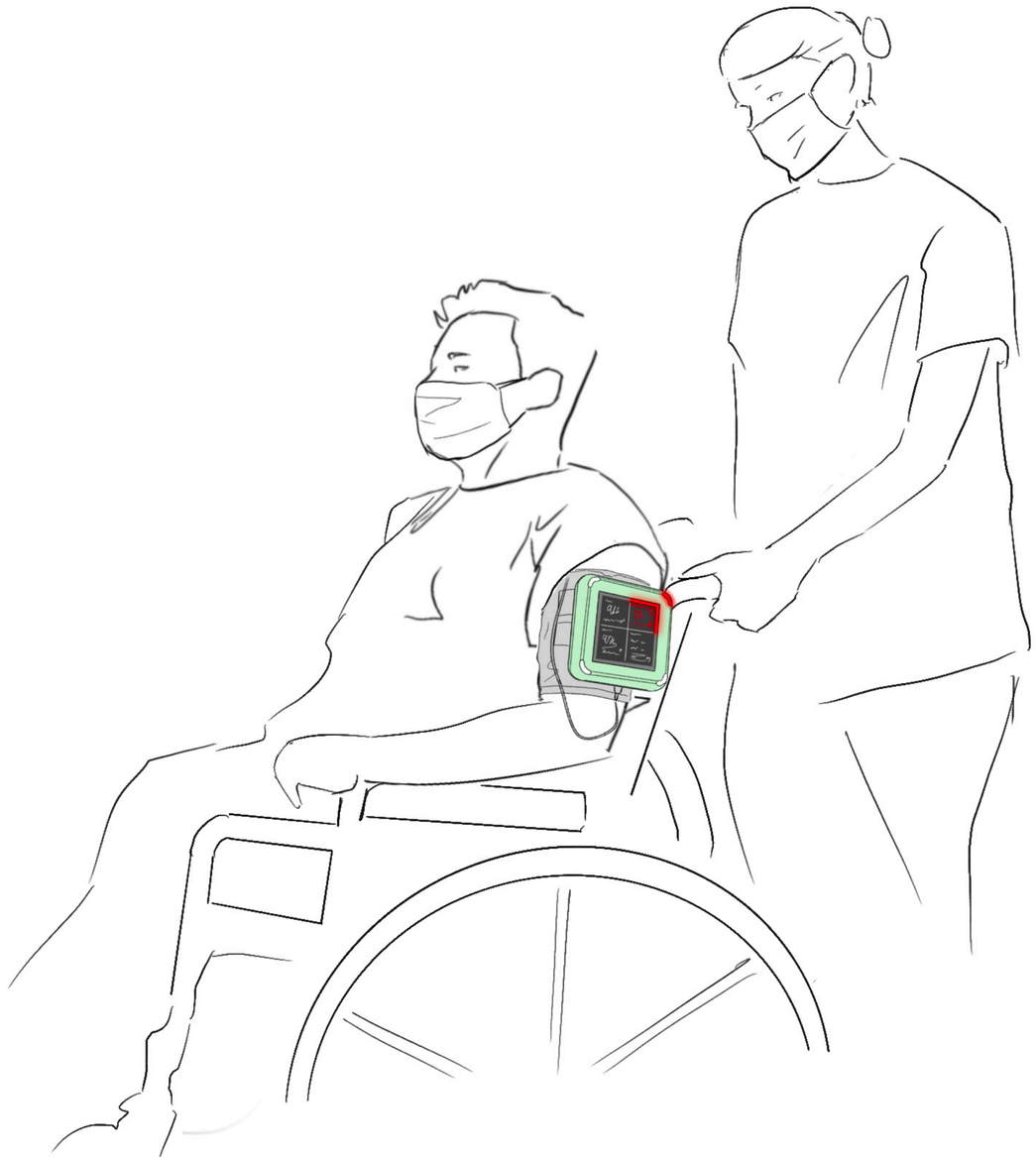
Alert is Received

User Journey

Patient Assessment

User Journey

Patient Transport



User Journey

Nurse Treats Patient

OSSO Wearable Vital Sign Monitor

How does OSSO mitigate alarm fatigue?

Mitigates **noise fatigue** by leveraging secondary monitors (smartphones/watches)

Reduced **false alarms** and alleviates **cable management** through wearable architecture

Improves **patient transportation** through integrated display

Improves **visual communication** through four quadrant display

User Testing

Concept Feedback

If it were up to you, would you be interested in integrating a product like this into your workflow over traditional vital sign monitors?

“Yes! Sounds like a convenient piece of equipment as long as it would interface to a monitor of some type.”

User Testing

Concept Feedback

If it were up to you, would you be interested in integrating a product like this into your workflow over traditional vital sign monitors?

“Yes! Sounds like a convenient piece of equipment as long as it would interface to a monitor of some type.”

“Absolutely.
Especially for transport to/from imagining with trauma/stroke patients.”

User Testing

Concept Feedback

If it were up to you, would you be interested in integrating a product like this into your workflow over traditional vital sign monitors?

“Yes! Sounds like a convenient piece of equipment as long as it would interface to a monitor of some type.”

“Absolutely.
Especially for transport to/from imagining with trauma/stroke patients.”

“Yes!”

User Testing

Concept Feedback

If it were up to you, would you be interested in integrating a product like this into your workflow over traditional vital sign monitors?

“Yes! Sounds like a convenient piece of equipment as long as it would interface to a monitor of some type.”

“Absolutely.
Especially for transport to/from imagining with trauma/stroke patients.”

“Yes!” (x10)

Founder's Day

CARLSON
SCHOOL OF MANAGEMENT
UNIVERSITY OF MINNESOTA

MVP Founder's Day May 10th

Dane Hart

OSSO Wearable Vital Sign Monitor

Thank You!

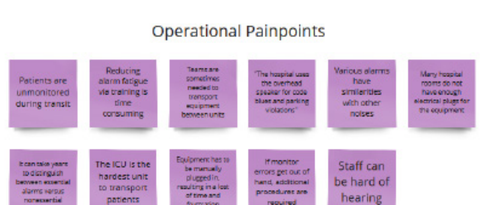
Dane Hart

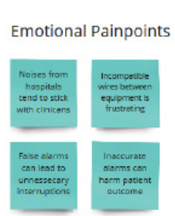
OSSO Wearable Vital Sign Monitor

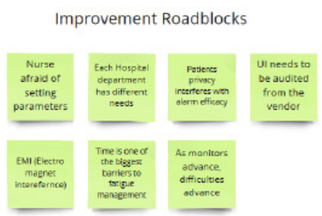
Appendix

Discover

Affinity Mapping





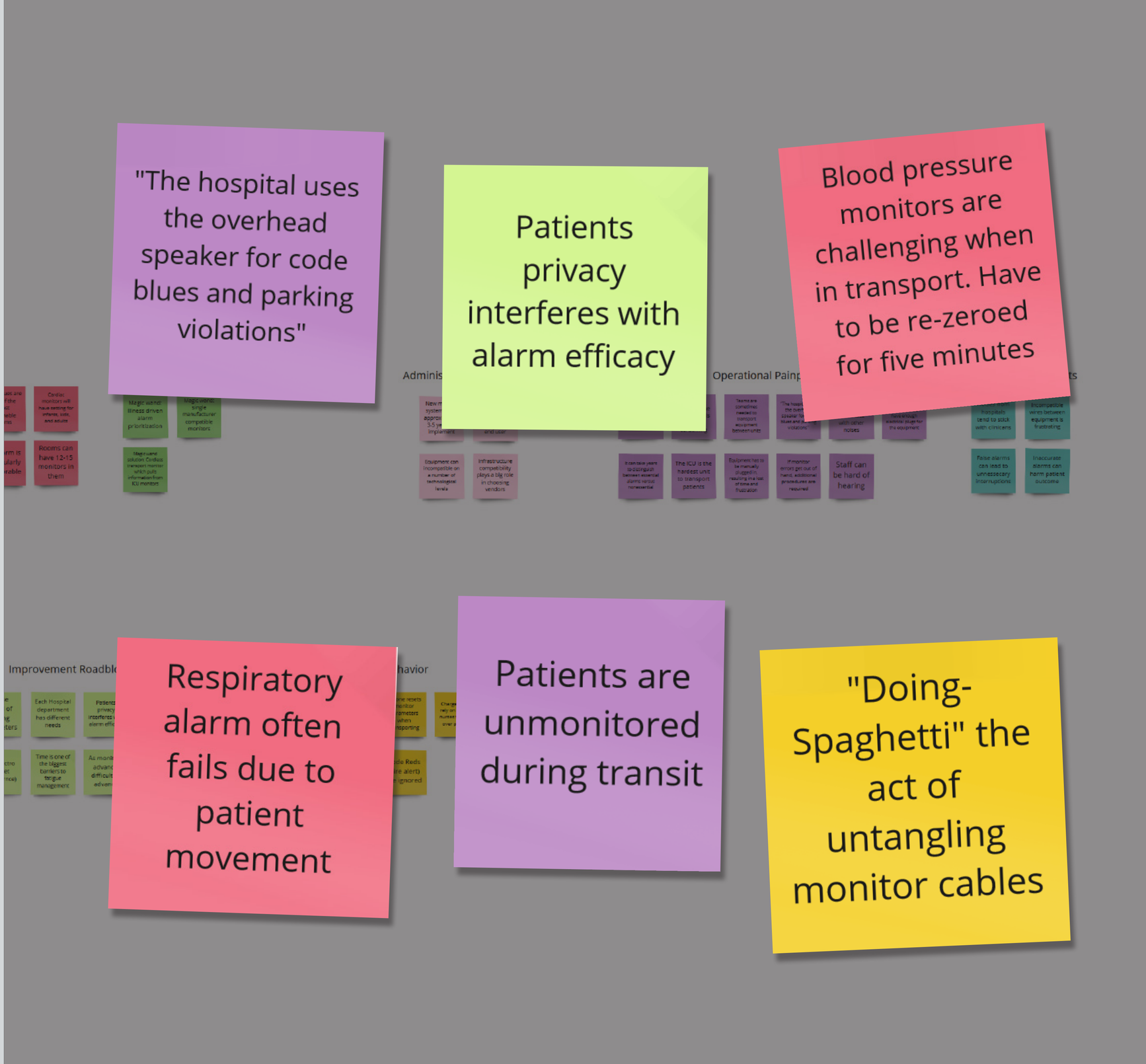


Insights

Affinity Mapping

Clinicians reported that current patient monitoring systems cause all sorts of added stress.

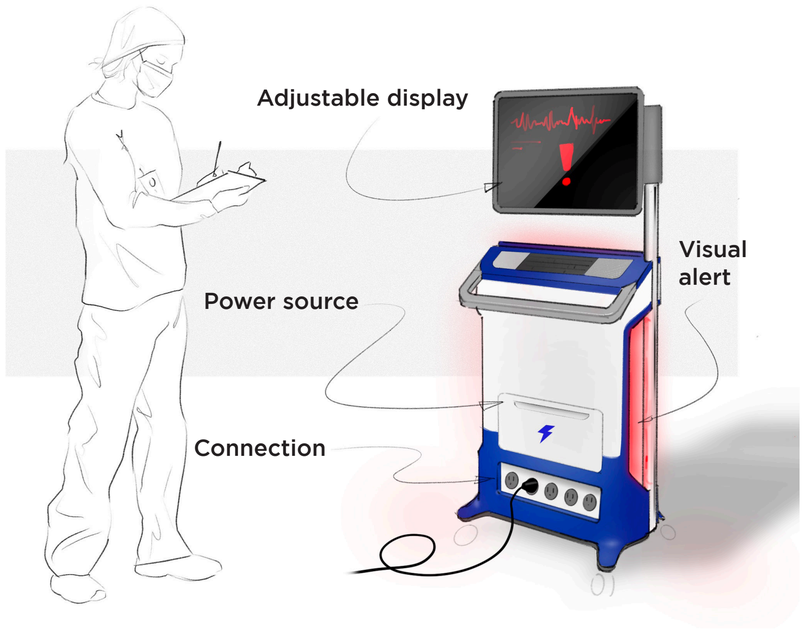
Not only do patient monitors create unneeded **noise**, but they also create patient **transporting**, **privacy**, and **device management** challenges.



Define

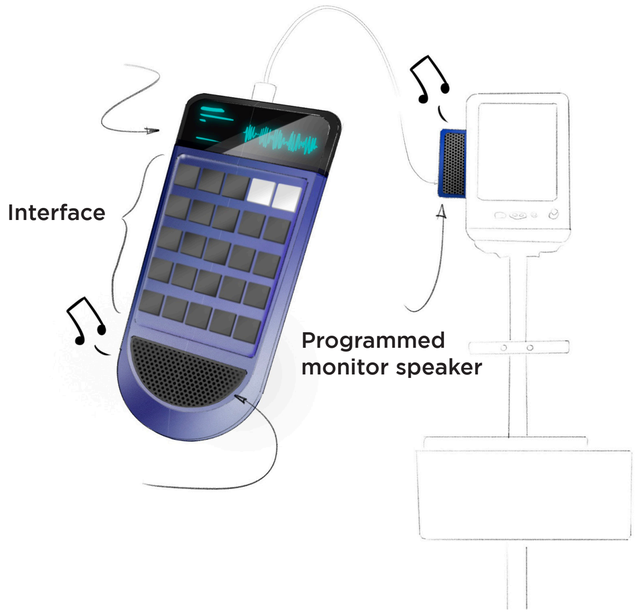
Preliminary Concepts

The Monitor's Monitor



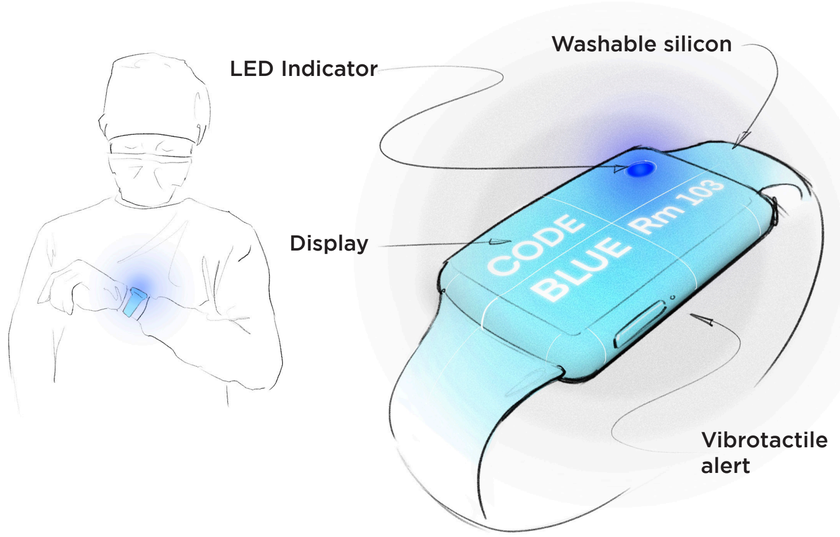
"Adjusting patient baseline's would be essential to making monitors more meaningful"

Beat's by Doc



"Doctors are like artists, they don't like standardization"

Clinician Wearable



"When patients want privacy, it can be difficult to monitor their condition"

Nurse-Facing Wearable

Backlit interactive
E-Ink Display

Notetaking stylus

Vibrotactile alert

LED visual alert

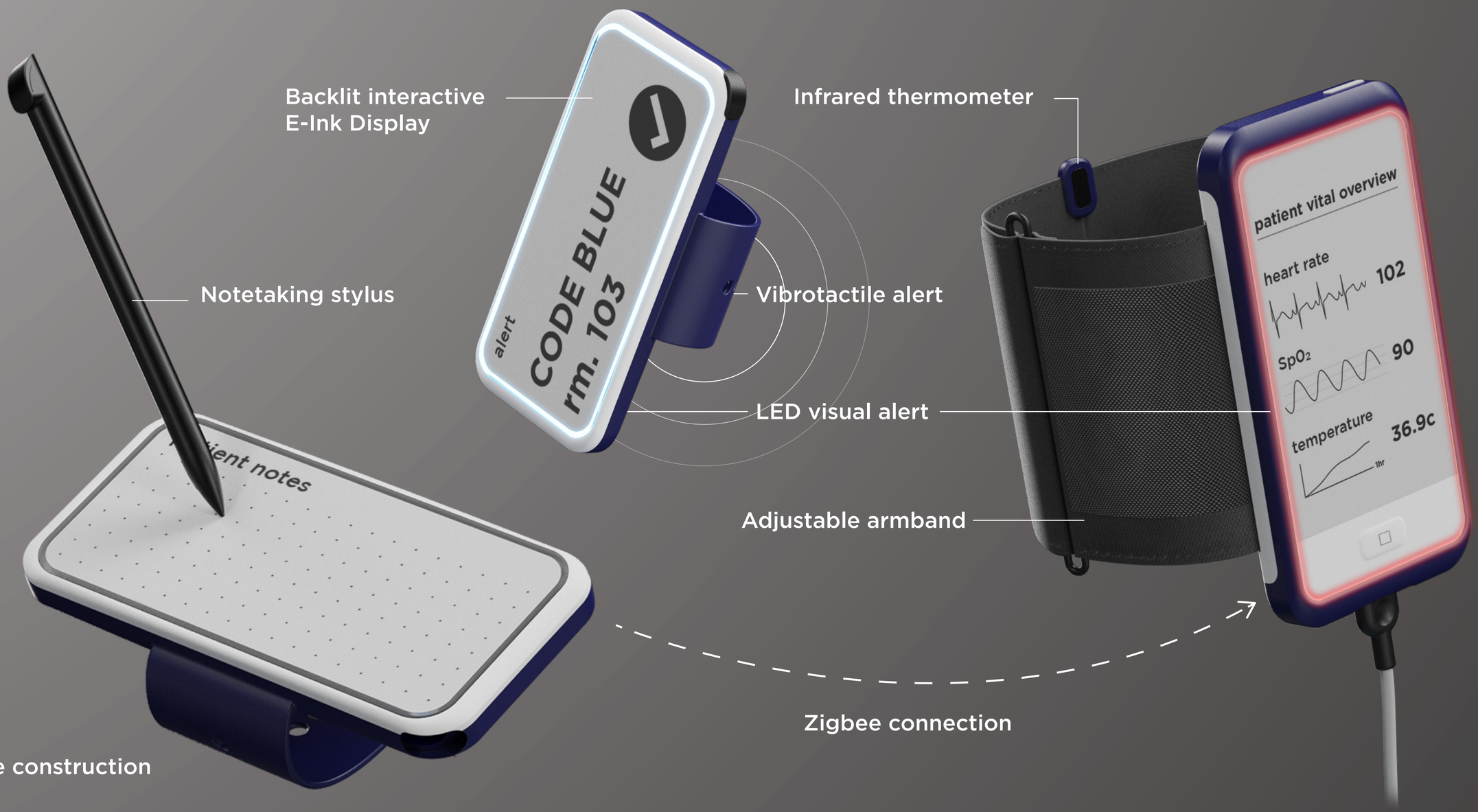
Silicone construction

Patient Facing Wearable Vital Monitor

Infrared thermometer

Adjustable armband

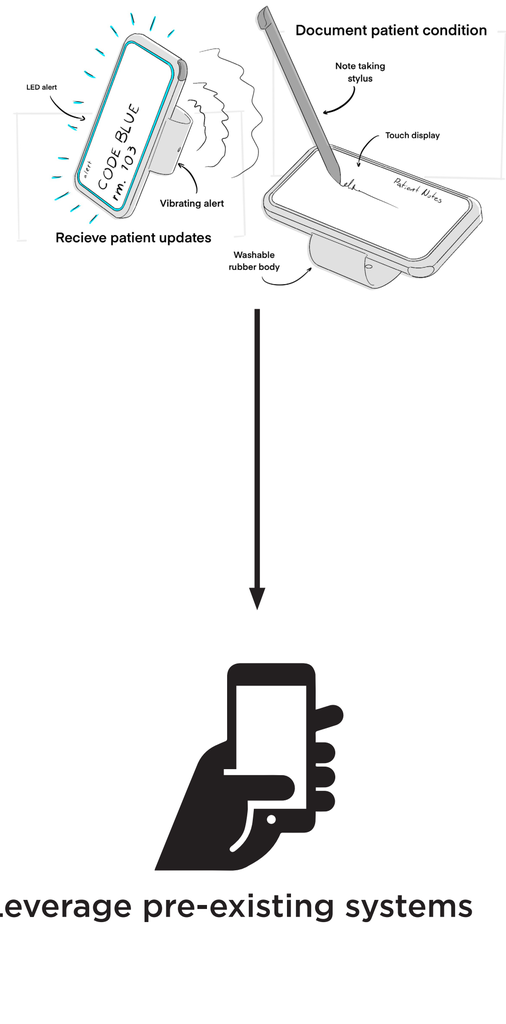
Zigbee connection

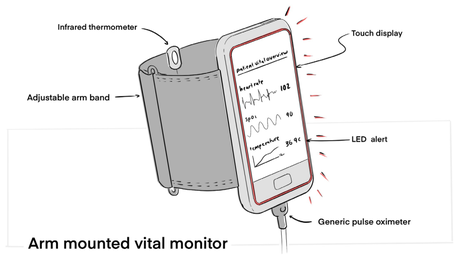


Define

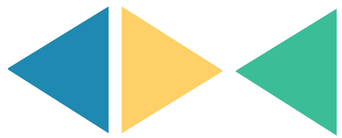
UMN Product Design Showcase

Feedback from Nurses and Industry





Leverage pre-existing systems



Continue exploration

Develop

Requirements and Heuristics

Product requirements, heuristics, and additional human factor considerations were leverage to better develop the product's design.

No.	Metric	Imp.	Unit	Marginal Value	Ideal Value
1	Adjustable armband	5	In		Subj.
2	Lightweight	3	g	<60g	>30g
3	Durable material	3	ksi	>0.348	<0.797708
4	Sized appropriately for bicep	3	Subj.	>3	>5
5	Non-porous material	5	nm	<2	<2
6	Water resistant	3	Bar	>.5	>1
7	Interactive display	5	Binary	Pass	Pass
8	High resolution display	3	Pixel	<720	<1080
9	Color blind friendly	2	Binary	Pass	Pass
10	Accessible interface	3	Subj.	>3	>5
11	Bright LED notification	5	Lumens	>70	<100
12	Communicate with other devices such as the clinician-facing wearable	5	Binary	Pass	Pass
13	Rechargeable battery	5	Binary	Pass	Pass
14	Long battery life	3	Hours	>8	>12
15	Easy to Clean	5	Subj.	>3	>5
16	Compatible with off-the-shelf pulse oximeter	5	Binary	Pass	Pass
17	Accurately measures patient's axillary temperature	5	Binary	Pass	Pass
18	Accurately measures patient's blood oxygen	5	Binary	Pass	Pass
19	Accurately measures patient's heart rate	5	Binary	Pass	Pass

Hick's Law	This concept will reduce the amount of time needed for the user to take action by better reflecting the patient's condition and therefore allowing the clinician to react more quickly.
Miller's Law	This concept will consider less than seven pieces of information by only exposing the user to the patient's four primary vital signs and their condition in relation to the patient's set parameters.
Fitts' Law	The touch targets of my concept will be large enough to be selected.
Interface Effects	Because perception differs from representation, I will have to conduct usability tests to better understand how the information on the screen is perceived.

Match	The patient monitor leverages a digital touch screen in a way similar to that of a common tablet/electronic. The monitor can be interfaced with pre-existing secondary monitor interfaces such as smart watches and phones. The experience of the common consumer of electronics will have to be understood in all details, such as charging.
Anticipate	The concept would provide real time and historical information of the patient's condition.
Complexity	The physical architecture of the patient monitor concept leverages a user experience similar to an armband blood pressure monitor.
Consistency	The interface of the patient monitor will be consistent with the interface of the clinician facing app.
Place	The user experience of this product concept is all about place. The concept provides a sense of place by allowing clinicians to readily identify patient condition through the device's interface and their secondary monitor anywhere in the hospital.
Constraints	This concept prevents misuse through visual product semantics which psychologically imply how the product is used.
Aesthetics	The concept leverages aesthetics which are appropriate for a medical environment. The form and CMF of the product will reflect the hygienic aesthetic of a medical product and allow for easy sanitation.
Language	The language implemented into this concept will reflect the most essential information necessary to convey in the user's experience of the product. This information includes descriptions of patient condition, and vital parameters.
Feedback	As a monitor, the concept will provide feedback to the users regarding the patient's condition. The feedback will be translated through LED lights and primary and secondary monitor displays.
Errors	The device will work towards preventing errors through non-permanent user interfaces. Patient parameters can be edited by the clinician and app screens can be navigated in a way which allows the user to access all pertinent information.

Develop

Feasibility

Feasibility has been assured through market research as well as through the development of a detailed bill of materials.

Number	Qt.	Cost per Unit	Part	Part Description	Material
1	1	$8,644.00	*Tooling for Enclosure	Injection mold tooling required to manufacture the main housing of the device	Steel
2	1	$10.00	Plastic Enclosure	The plastic housing which contains the devices electronics	ABS
3	1	$25.00	Blood Pressure Cuff	Cuff that measures blood pressure, also secures the device to the patient	Purchased
4	1	$0.25	Rectangular Buckle Ring	A buckle which when built into the armband, allows users to adjust the device's tightness	ABS
5	1	$2.00	Velcro	Velcro which when built into the armband, allows users to adjust the device's tightness	Velcro
6	1	$20.00	Lithium Ion Battery	A rechargable battery that powers the device	Electronic
7	2	$1.25	ECG Electrode Foam Pad	The foam pads which holds the ECG leads to the patient	Electronic
8	1	$50.00	ECG Lead Cable	ECG allows for the monitoring of all nessecary vital signs	Electronic
9	1	$50.00	4" Capacitive Touch AOMLED Display	A screen which allows users to digitally interact with the device	Electronic
10	1	$10.00	Air Pump	Used to inflate blood pressure cuff	Electronic
11	1	$25.00	ECG Connection	Recieves ECG leads to the PCB board	Electronic
12	1	$35.00	Custom PCB board	The custom circuit board which acts as the device's computer	Electronic
13	2	$0.25	Push Button	Allows users to interface with the device	Purchased
14	4	$0.10	Fasteners	Connects the PCB board to the housing	Purchased
15	1	$0.10	2" rubber tubing	Connects the air pump to the blood pressure cuff	Purchased
	Total Price	**$228.85**		***Tooling is not included in total cost of parts in device**	

User Journey

Storyboard

Alert is received across the hospital

Nurse arrives to patient, quickly assessing condition

Nurse is able to treat patient