A NEW CONCEPT FOR HEALIUM:

Physician-Centered Design

Capstone Winter 2015 Final Report

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healium
EMR from your POV

HCDE Human Centered Design & Engineering

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Meet the Team

Tony Corneto

Tony is a user experience designer and researcher with focus on the following areas: information architecture, interaction design, user research, usability, rapid prototyping, visual, motion design, brand integration, and content creation. He's urrently Director of User Experience at Virtuoso.

Lisa Lowery

Lisa is a user researcher with experience conducting research using a variety of quantitative and qualitative methods. Prior experience includes working in an academic research lab that focuses on documenting the link between inequalities in communication and health disparities. Research interests include understanding the impact of Information and Communication Technologies (ICTs) on health disparities.

Bipin Mathew

Bipin is an experienced software developer who has worked in several industries - National Instruments, Motorola, Ubermind and is currently working as a software architect in Deloitte Digital. As part of his job there, he's worked on applications in the retail, airline and transportation space. He's also a technology volunteer with the Washington Trails Association - he helped design and write their current iOS and Android mobile applications.

Gabrielle Mehlman

Gabrielle (Gabby) is a UX designer/researcher, and former Mechanical Engineer. Her prior internships include Amazon and Physio-Control, a medical device company. She is passionate about working on projects that have a positive impact on society, and is particularly interested in the healthcare space.

Ian Wyosnick

Ian comes from a background of mechanical engineering, forensic structural engineering and architecture, and now devotes his time as a User Researcher with a special interest in Service Design and physical environments. He focuses on incorporating social benefit, working with organizations in government and the public sector or low-resource communities and developing countries. He currently works for the user-centered design consulting firm Anthro-Tech as a User Researcher and Service Designer.

Executive Summary

Physicians are currently estimated to click 4000 times on a computer in a given 10 hour shift. It is estimated that physicians spend nearly twice as much time at their computers than with patients.[1] Healium is working to fix this, and we wanted to help. Our goal was to design a system that would improve patient care in the emergency department (ED) while reducing the amount of time that physicians spend finding and using current electronic medical record (EMR) systems.

By utilizing the user-centered design (UCD) approach, we used end-user input to map a physician's current experience when working with EMR and visiting patients, identified their pain points, and explored opportunities to improve their processes. Our research methods included a literature review about EMRs and usability, interviews of seven ED experts, a particpatory design session and the creation of an ED doctor experieance map. Through ideation, iteration, and testing, we refined our ideas and prototypes into a final User Experience (UX) concept that illustrates a new vision for the integration of Healium in the emergency department.

This UX concept incorporates three devices - Glass, Watch, and Tablet - to push information to doctors when and where they need it rather than having them seek it. It alerts them when critical results need their attention, allows them to send orders and dictate notes whenever it is convenient, and even provides the patient with insight into how their emergency department experience is unfolding around them. In total, our concept for Healium provides a seamless emergency department workflow that allows physicians to improve the care they provide while contributing to a better experience for patients.

Overall this has been an amazing project to be a part of, and we thank Healium and the University of Washington HCDE department for providing us with the opportunity. It was a capstone project that was not only intellectually challenging, but also an honor to design something that will have such a positive benefit for patients and doctors alike.

1 Hill, R. G., Sears, L. M., & Melanson, S. W. (2013). 4000 clicks: a productivity analysis of electronic medical records in a community hospital ED. The American journal of emergency medicine, 31(11), 1591-1594.

Motivation

Emergency department physicians, who have an underlying goal to deliver timely and quality patient care, are faced with many difficult situations throughout their day and need to make crucial medical decisions. Emergency medical records were created in order to facilitate these goals, but is currently one of the major barriers to deliver quality care. It is estimated that a physician's typical ten hour shift is spent:

44% in data entry
12% reviewing test results and records
[& only]
28% in direct patient care[1]

To overcome the current limitations of EMRs, Healium leverages wearable and portable technologies to interface with existing EMR systems to improve patient care and physician satisfaction. Healium creates an ecosystem of technology that fits seamlessly into the physician's workflow and is available whenever they need it, instead of forcing them to change their workflow to interact with existing EMR systems.

1. Hill, R. G., Sears, L. M., & Melanson, S. W. (2013). 4000 clicks: a productivity analysis of electronic medical records in a community hospital ED. The American journal of emergency medicine, 31(11), 1591-1594.

Design Question

How can we decrease the amount of time a doctor in the emergency department spends using electronic medical records and improve patient care?

Design Process

We followed the principles of the user-centered design process, relying on research and findings about the user to guide design decisions and iterate before arriving at a final concept.

1. Discovery & research

- Literature review of over 25 articles
- Interviews with ED experts, in person and phone (7 total)
- Participatory design with ED expert
- ED Doctor Experience map

2. Ideation & 1st designs

- Affinity diagram to determine & prioritize feature set
- Storyboarding - basis for usability study & concept video
- 1st design/wireframe iteration

3. Testing & final design

- Usability test with 1 ED physician, utilizing a paper prototype
- Final design iteration
- Concept video to show design in context

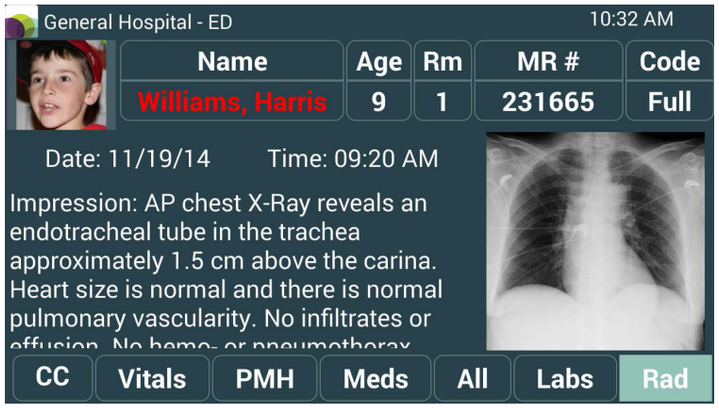
PHASE 1: DISCOVERY & RESEARCH

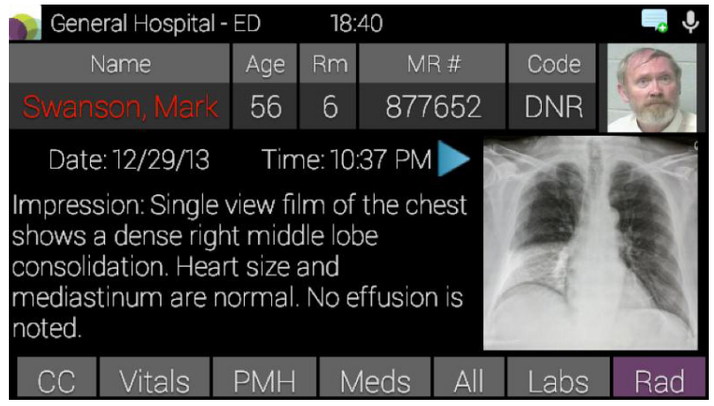
Prior Work

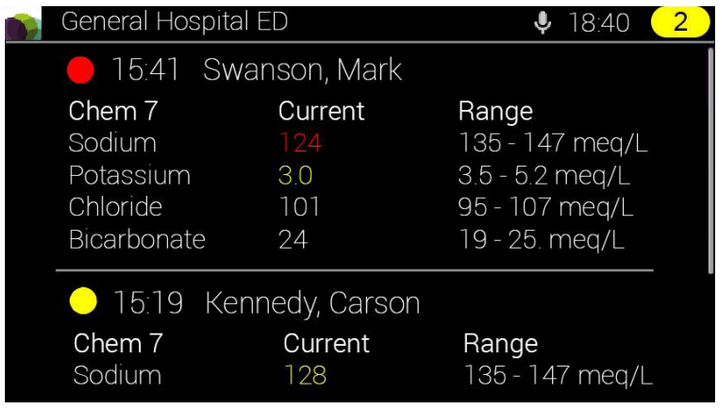
Healium supplied a working prototype on Google Glass at the beginning of the project. The tabular design supported a great depth of functionality, but was informed by limited user research. Their stated deliverables were:

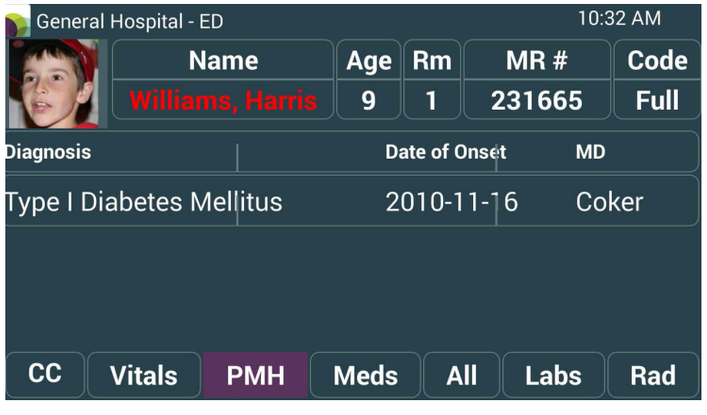
- Perform research on using wearable technology showing EMR information in an emergency department
- Create new user interfaces for the Healium system

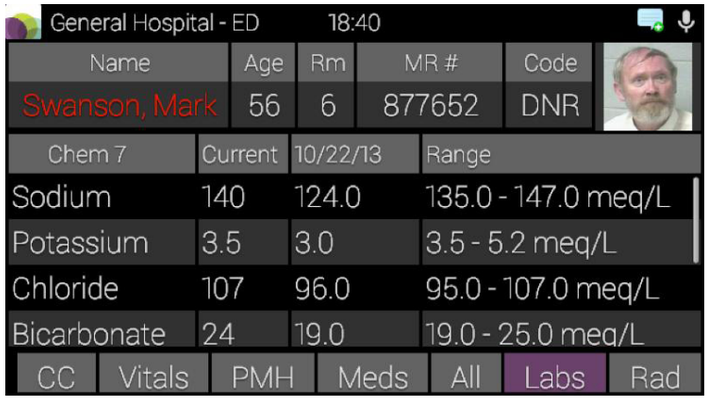
Healium also provided documentation of prior research conducted by the firm BSSP. The report's comprehensive competitive analysis helped our team better understand the wearable medical software space and how Healium might position themselves in this growing market.











Screenshots of the existing interface when we first met with Healium

Research Methods

The use of triangulation, or a combination of research methodologies, provided an enriched explanation of the research problem, painting a more complete picture of the user and their environment. We performed a literature review, in-person and phone interviews, held a participatory design session and created an experience map.

We also created a detailed research report which was delivered to our stakeholders.

Literature Review

The literature review was conducted with the intention of familiarizing our team with the problem space of EMRs in the ED and gaining a baseline understanding for the direction of our further research. Over 25 articles were reviewed, and our high-level findings by topic include:

1. EMRs: Their history and their implementation in hospital environments
    - The implementation of EMR systems has reduced paperwork and physician errors in the workplace.
    - However, the cumbersome design of EMRs causes physicians to spend more time in front of a reducing face-time with patients.

2. The design and usability of EMR systems
    - Organizations like the AMA have released guidelines detailing how to build usable EMR systems in an effort to increase physician satisfaction and patient safety.

3. Wearable technology: The design of applications for them and any current uses with EMR systems
    - Studies show that physician access to handheld technology provides easy and timely access to information and increases efficiency at work.
    - Hospitals are piloting programs testing the feasibility of incorporating wearable and handheld technologies into physician workflow.

Interviews

In-person and phone interviews were conducted with seven emergency department experts.

Questions asked covered the following topics:

- What are the critical tasks that doctors need to do or what information do they need during their daily process?
- How does emergency department staff currently use EMR software?
- What are their primary tasks?
- Where are the pain-points in their process?
- What barriers exist for information gathering for staff in an emergency department?

Our high-level findings included:

Poor user friendliness: Cumbersome information architecture (IA) and interface design (IxD) contribute to physician frustration.

Poor user interface design: IA and IxD (system navigation) contribute to cognitive overload

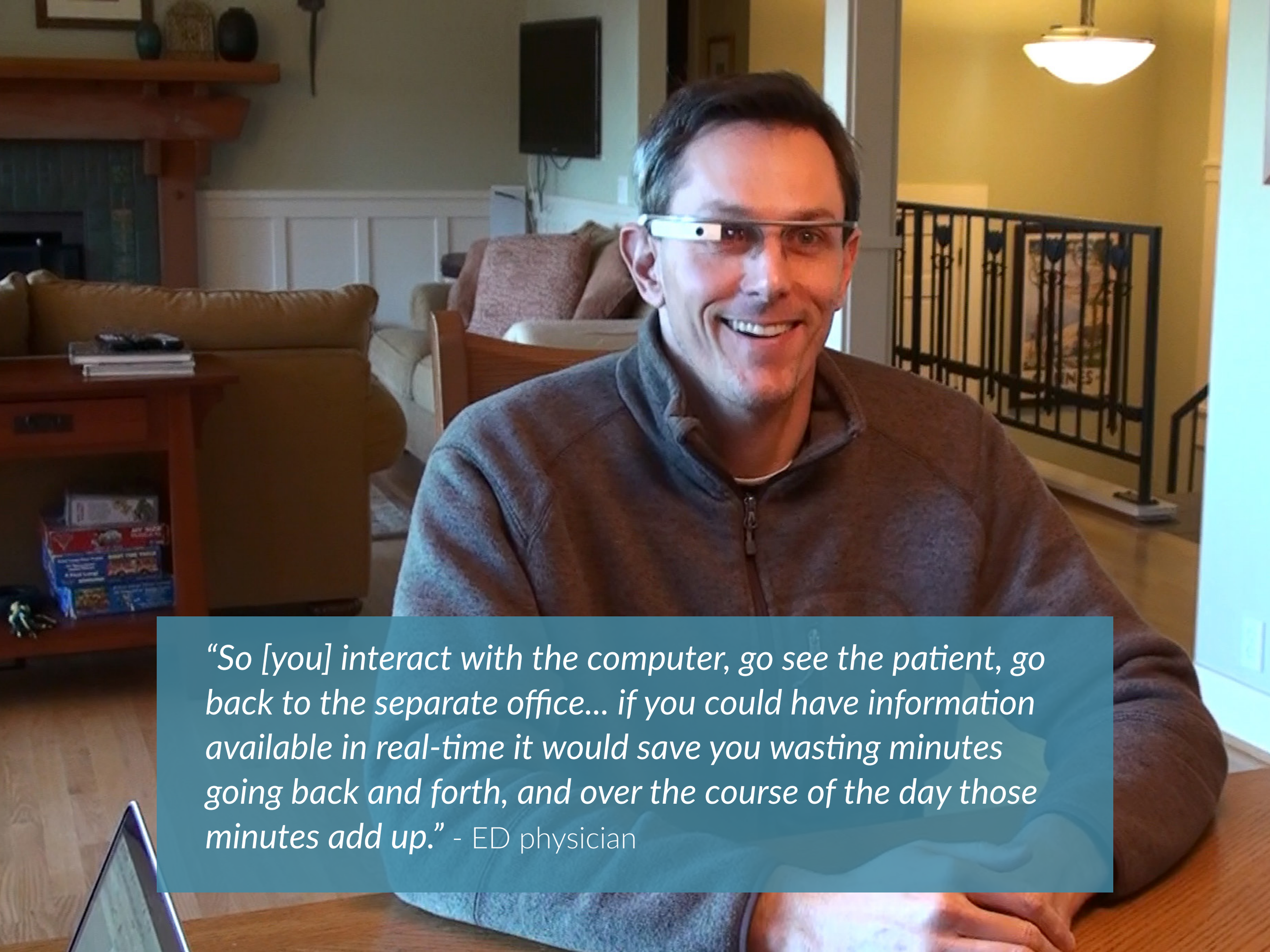
Lack of mobility: Lack of customized and reliable mobile technology to support the ED workflow

Patient facetime: Decreased engagement between patients and physicians because they spend more time in front of a computer screen.

Inefficient workflow: Time-consuming data entry

Lack of notifications: Lack of appropriate visual feedback/cues to signal that actions have been completed

Alarm fatigue: Physicians are inundated with annoying noise and pop ups that can cause them to inappropriately mute sounds and ignore warnings that may lead to unintentional harm.



“So [you] interact with the computer, go see the patient, go back to the separate office… if you could have information available in real-time it would save you wasting minutes going back and forth, and over the course of the day those minutes add up.” - ED physician

Participatory Design

The final piece of the user research was a participatory design session with a physician from UW Medical Center. Participatory design involves the input of an eventual user in the research and design process to help ensure accuracy defining the problem space and associated processes, along with improving design assumptions, decisions, and requirements. Her input on how she would imagine the experience to look like was invaluable.

Experience Mapping

We gathered to synthesize all of our research findings into an experience map of a doctor's workflow with a stable patient from start to finish. It allowed our team to clearly understand and empathize with how a doctor provides care to patients and the influence of electronic medical records on their processes.

This experience map is illustrated on the following page. The workflow of the emergency room physician is categorized into four phases; Discover, Interact, Orders, and Discharge. In each phase, the smaller steps of the doctor's flow are shown, along with their interactions with the EMR system. The top pain-points and highlights we observed in our research, along with the needs of the doctor during each phase are listed at the bottom.

Emergency Doctor Experience Map

What opportunities currently exist to improve the over-all experience?

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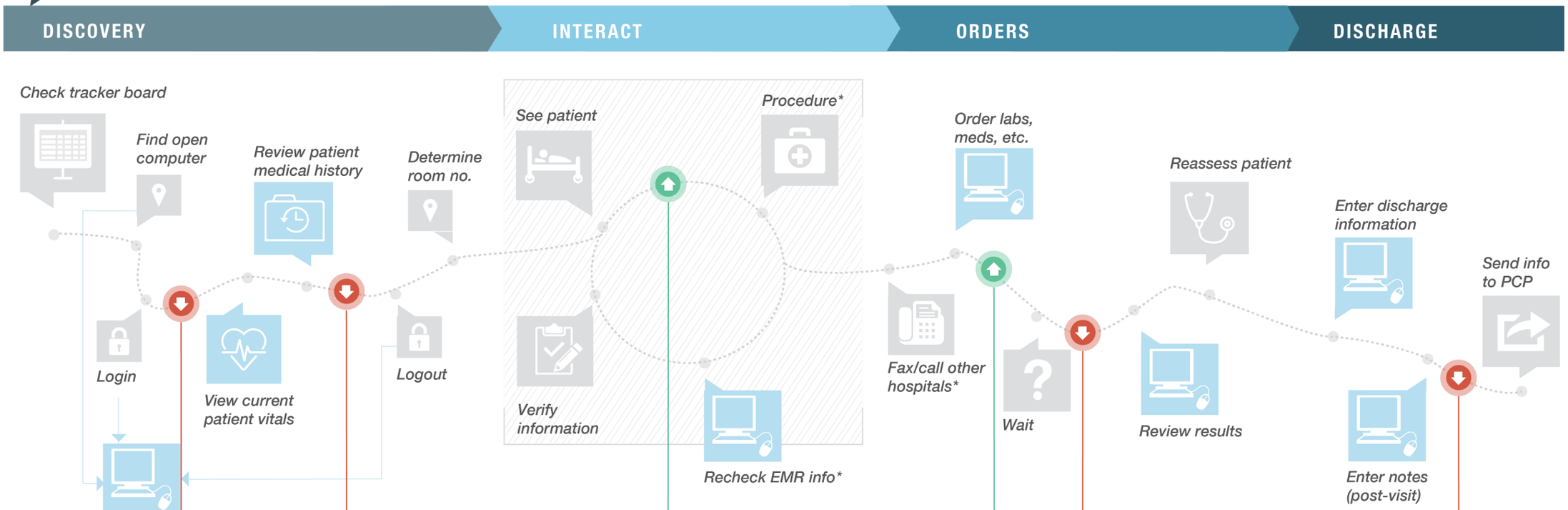


INSIGHTS

PAINPOINT
Time consuming to find and log into a computer each time information is needed

PAINPOINT
EMR does not fit doctor's mental model, and finding information is very difficult

HIGHLIGHT
EMR enables access to prior medical history, which improves patient care

HIGHLIGHT
Ordering labs/imaging and contacting specialists is made easier by EMR

PAINPOINT
Doctors are not notified when orders are complete and must continuously check

PAINPOINT
Doctors must find time to enter notes through-out the day, leading to possibly errors

NEEDS

DISCOVERY

- Patient name, location and chief complaint
- Ability to signup for patient and gain feedback that selection has been made
- Access to EMR for current vital information and past medical history - What the doctor needs to know about past medical history is different depending on the patient's chief complaint
- Maintain privacy, security and tracking

INTERACT

- Find patient location
- Knowledge that patient is able to be seen
- Medical history available at patient bedside
- Ability to take notes while interacting with patient
- May require more in-depth knowledge of past medical visits from outside hospitals

ORDERS

- Reference information
- If specialist is required, knowledge of their availability and ability to communicate
- Patient insurance coverage of orders
- Status of orders when not at a computer
- Push orders out to labs or specialists from EMR
- Real-time vitals of patient
- Orders results (labs, radiology, etc)

DISCHARGE

- Contextual discharge instructions
- Forward information to patient's Primary Care Provider
- Patient's insurance coverage of varying prescriptions

Final digital version of the Emergency Dr. Experience Map, assuming a stable patient

Painpoints

Our research concluded the top four pain points for doctors while using electronic medical records are the following:

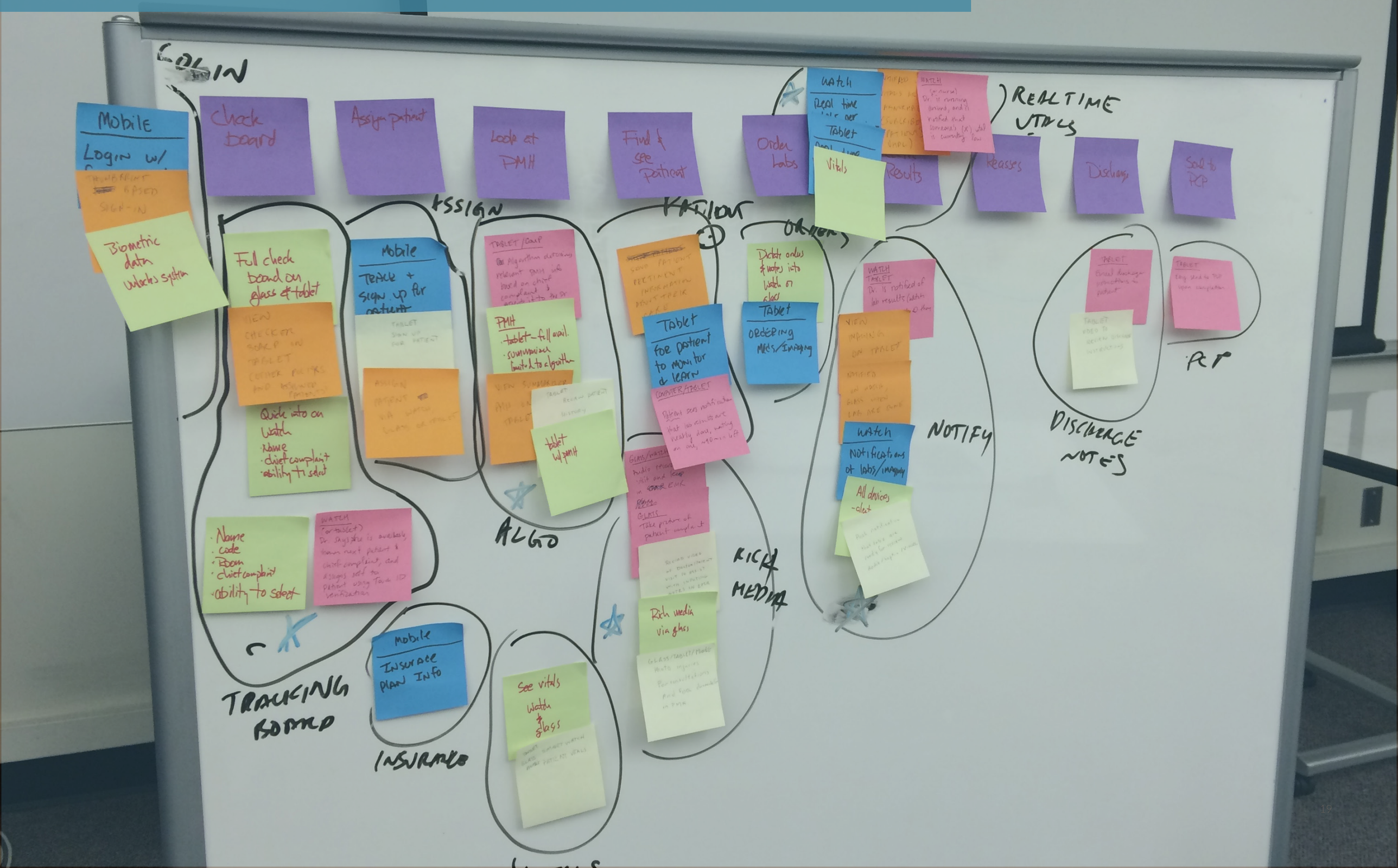
1. Time consuming to find a computer and log in
2. EMR does not fit doctor’s mental model
3. Doctors must continuously check to see if orders are complete
4. Doctors must find time to enter notes throughout the day

Opportunities

Our research identified five areas of opportunity where Healium could make a significant positive impact on improving patient care, and also provide a unique experience.

- Integrate real-time data
- Reduce barriers to accessing information
- Integrate rich media documentation
- Keep the patient informed
- Expand integration with other auxiliary technology tools

PHASE 2: IDEATION & 1ST DESIGNS



Affinity Diagram

The beginning of our ideation for a user experience (UX) concept was an affinity mapping session where the team was encouraged to brainstorm and think of innovations for Healium. Using post-it notes and sharpies, these ideas were posted on a whiteboard, grouped for similarity, and refined into five distinct opportunities:

- Integrate real-time data
- Reduce barriers to accessing information
- Integrate rich media documentation
- Keep the patient informed
- Expand integration with other auxiliary technology tools

The previous page featured the final version of our sorted affinity diagram.

These opportunities were further refined into design choices that would to drive our initial concept development and wireframing.

Opportunities

Integrate real-time data

Reduce barriers to accessing information

Integrate rich media documentation

Keep the patient informed

Expand integration with other auxiliary technology tools

Design Choices

Notifications of important results

Surface relevant past medical history

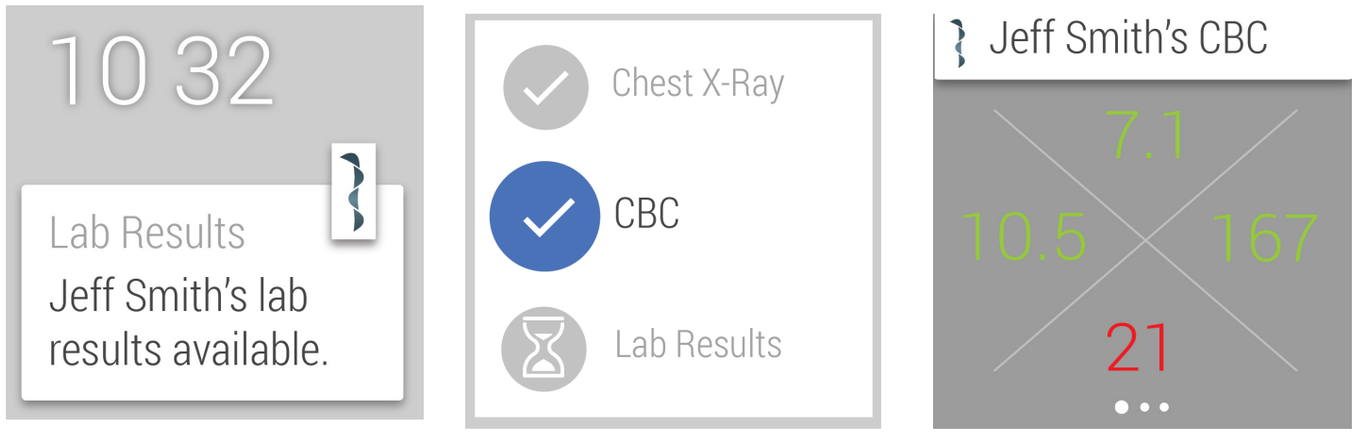
Take pictures, audio, or video recordings

Patient dashboard with status

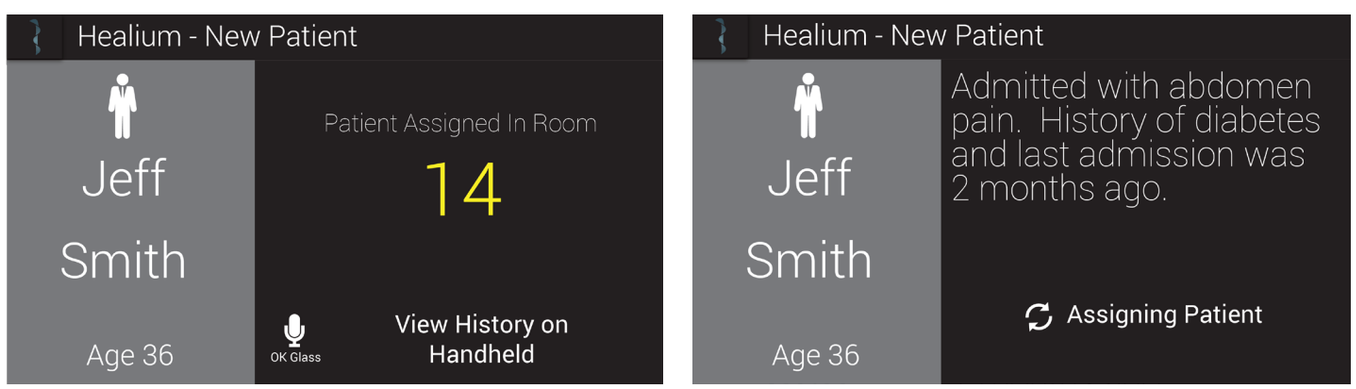
Real-time vitals possible by integrating with 3rd party software

Preliminary Wireframes

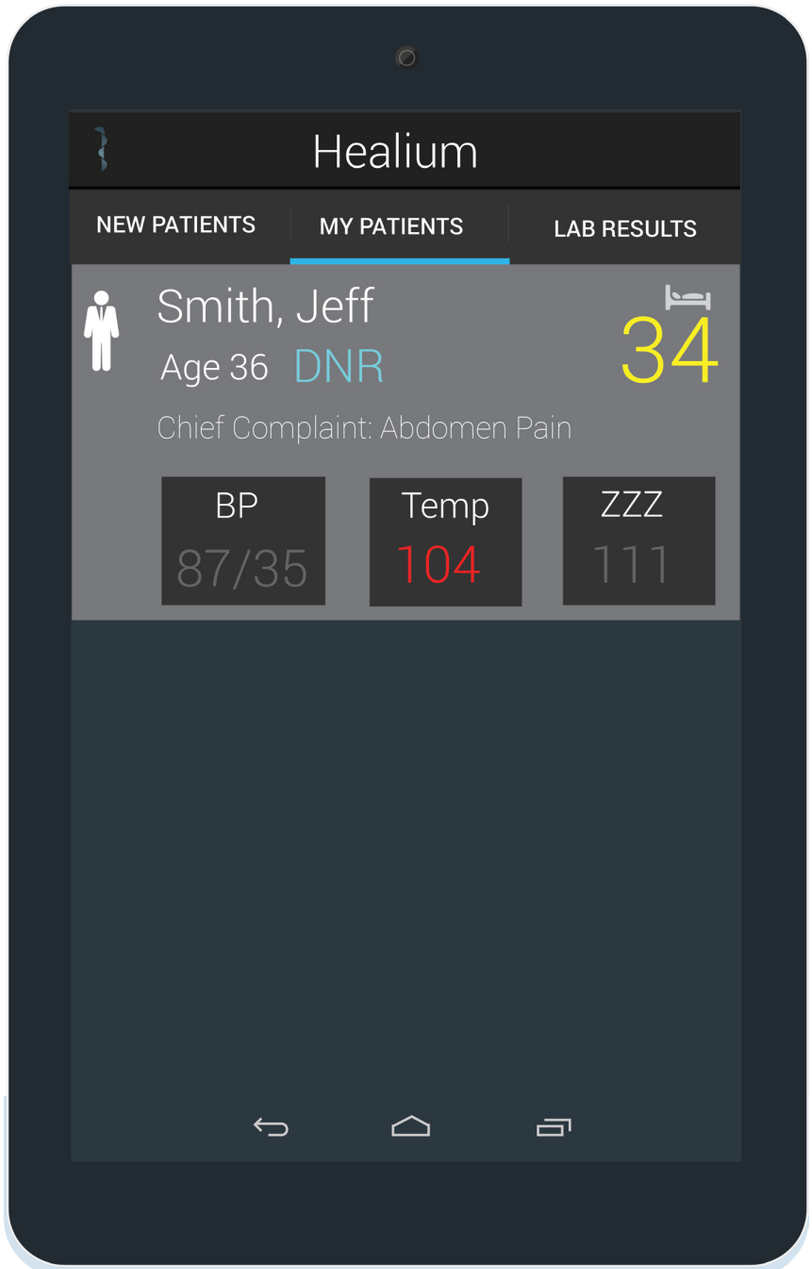
Once we selected our design choices, we began creating preliminary wireframes to use for our usability testing. Below are a sample of these wireframes.



First iteration of assigning a patient on the watch



First iteration of assigning a patient on Google glass

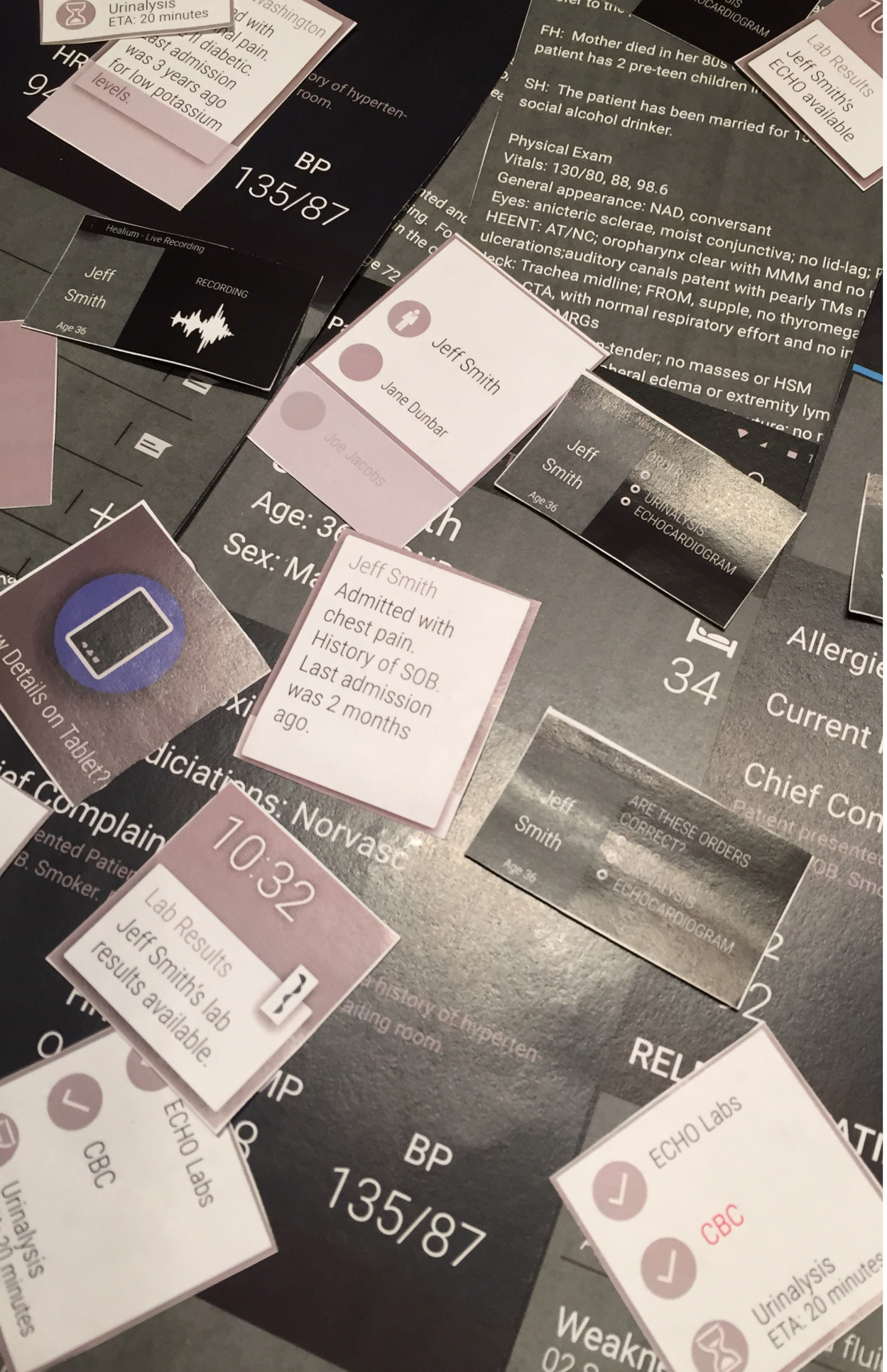


First iteration of finding a patient on the tablet

Storyboarding

The final step in our ideation phase was to create a storyboard to visualize our team's concept of Healium. Using our previous experience map, we stepped through the workflow of an emergency department physician, and theorized the steps where Healium would fit, what functionality it would provide, and what devices it would be used on. This exercise solidified our ideas into more refined wireframes and allowed us to dive deeper into what the new experience of an emergency department physician would look like using Healium.

PHASE 3: TESTING & FINAL DESIGN



Usability Testing

We performed one usability study with a practicing emergency department physician. A paper prototype (pictured on the left) was used to facilitate the study, and we ran through six scenarios:

1. Assign a new patient
2. Interact with patient
3. Order labs and radiology
4. Notification of complete results
5. View other results & review past medical history
6. Order prescriptions to prepare discharge of patient

The scenarios strategically transitioned the user from one device to another while completing tasks. Our intention was to test the ecosystem, and how natural this felt to a physician, and whether or not the device chosen made the most sense.

“Keeping the patients’ informed would increase patient satisfaction scores, and also save me time.”

- ED physician

Usability Test High-level Findings

The high-level findings from the usability testing fell into three categories describing aspects of the design: user interactions, presentation of information and results, and general or "other." While these findings were useful in guiding decisions for a final UX concept, more usability study work with emergency department physicians is necessary to refine the concept further, especially as the design moves closer to a high-fidelity prototype.

Interaction

Interaction with device depends on factors such as physicians preference or comfort level, working conditions, and task at hand

Interaction with device must not interrupt communication with patient, i.e. felt performing voice commands while in front of the patient would be "weird"

Results

The imaging technician report may be more important than images in some cases

Expects to view normal range and prior results for labs

Lab comparison is an important functionality provided by the EMR

Expects a notification when there is a critical lab result

Shorthand lab result diagrams may not be recognized/used by physicians post-residency, and thus need to be defined if used.

Other

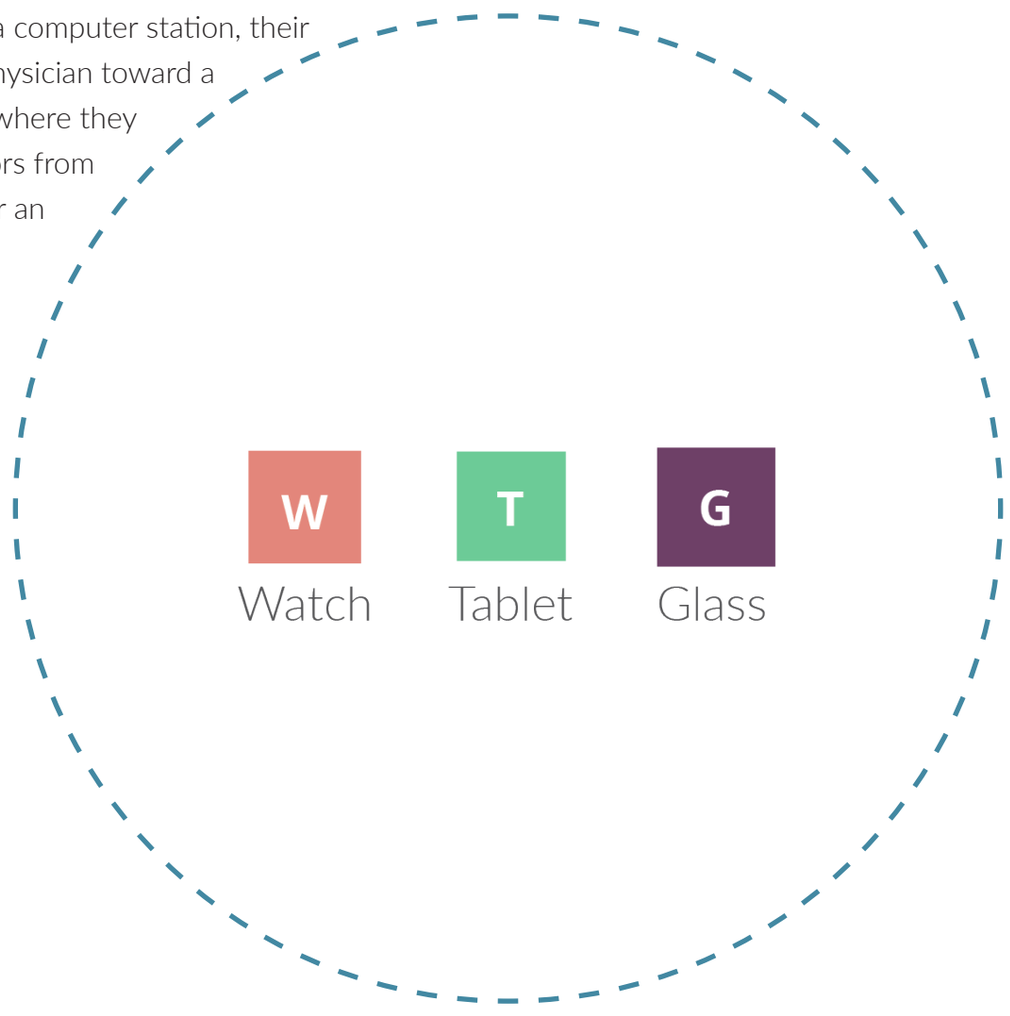
Patient centered: Presenting patients with lab status, consent forms, and videos explaining procedures would be helpful

Contacts: Would like a way to view physician specialist on duty and contact information

A New Concept for Healium

Our research and design solutions support a new approach to shaping the physician's workflow experience in the emergency department. We shift away from the traditional linear experience where the physician is bound to a computer station, their main source for information. Healium moves the physician toward a more circular and integrated workflow experience where they are supported by wearable and portable form factors from anywhere at anytime. The new experience map for an ED physician using Healium can be found on the next page.

On the pages thereafter, we will provide a detailed description of each step in our process along with an example of the flow to perform each step using the different devices.



Follow the ER doctor through their Healium experience

Streamline patient discharge

Enhance the patient experience by reviewing easy to read notes with your patient. Healium also quickly and conveniently collects and sends discharge instructions to care providers on duty.

Assign a patient from anywhere

Manage your patient assignments without visiting a checkerboard. Healium uses push technology to provide new patient information to your wearable or handheld device.

Order medications quickly

Simple voice commands allow physicians to order medications from their wearable device. Healium leverages advanced prescription technology to automatically check for drug interactions to ensure the right decision is made for every patient.

Securely log in and out

Healium uses biometric data such as heartbeat and fingerprint ID to instantly and securely log you in and out. Once logged in, data is synced seamlessly between devices.

Relevant problem list

Healium summarizes a patient's past medical history and creates a relevant problem list based on the chief complaint so that you aren't spending time searching for information.

Easily review past medical history

Access a patient's full past medical history through the tablet via the 'Charts' tab. Access to all of the notes and diagnostics from that visit are also already populated and ready for review.

G Glass W Watch T Tablet

Document with rich detail

Physican's can dictate notes throughout their day, wherever and whenever they want. Healium technology also records video, audio, and photographs to add richer context to physician notes.

Receive timely push notifications

Push notifications improve efficiency by alerting the physican when labs and imaging are complete, reducing the number of visits to a desktop computer. Unique alerts sound to notify the physical of an abnormal lab result.

Patient dashboard

Healium also directly improves patient care by informing them of their lab status and by conveniently emailing discharge instructions after their visit.

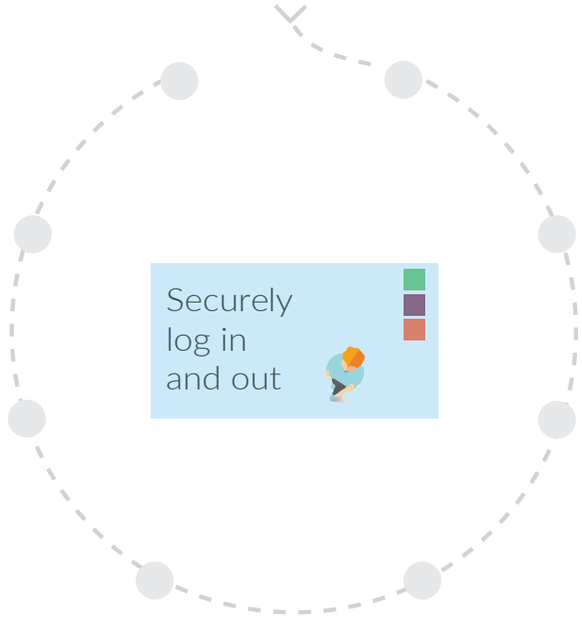
Send orders on the go

Healium facilitates lab and imaging orders without the restriction of being tied to a desktop computer. Physicians can easily dictate orders into wearable devices or input them into their tablet.

Experience Map for an ER doctor using Healium

Secure login using biometric data

Healium uses biometric data such as heartbeat and fingerprint ID to instantly and securely log you in and out. Once logged in, data is synced seamlessly between devices.

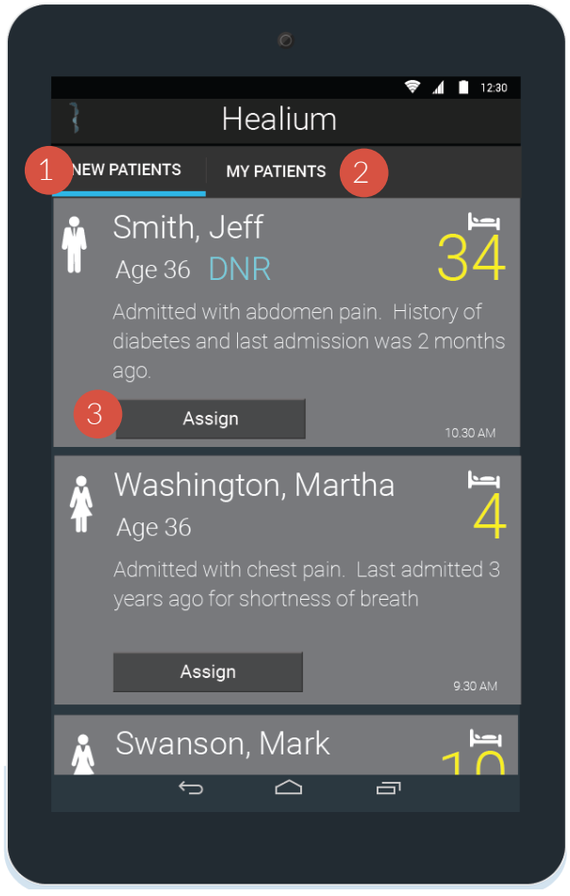


Users can securely login using biometric data such as:

1. Fingerprint
2. Heartbeat
3. Voice recognition

Assigning a patient

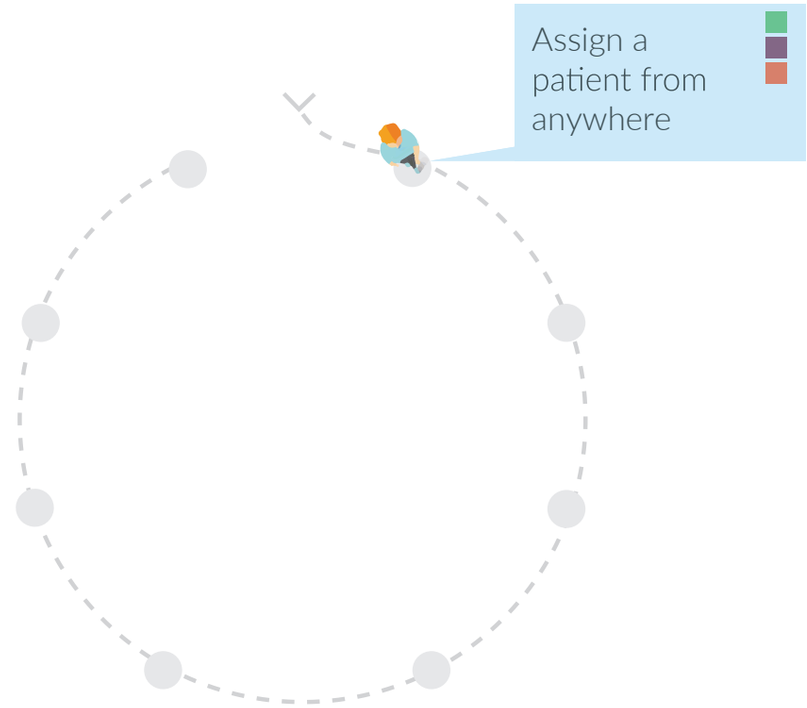
A doctor can assign themselves a new patient without ever having to go to a checkboard. Healium pushes information on new patients to them on their wearable or handheld device when they are ready.



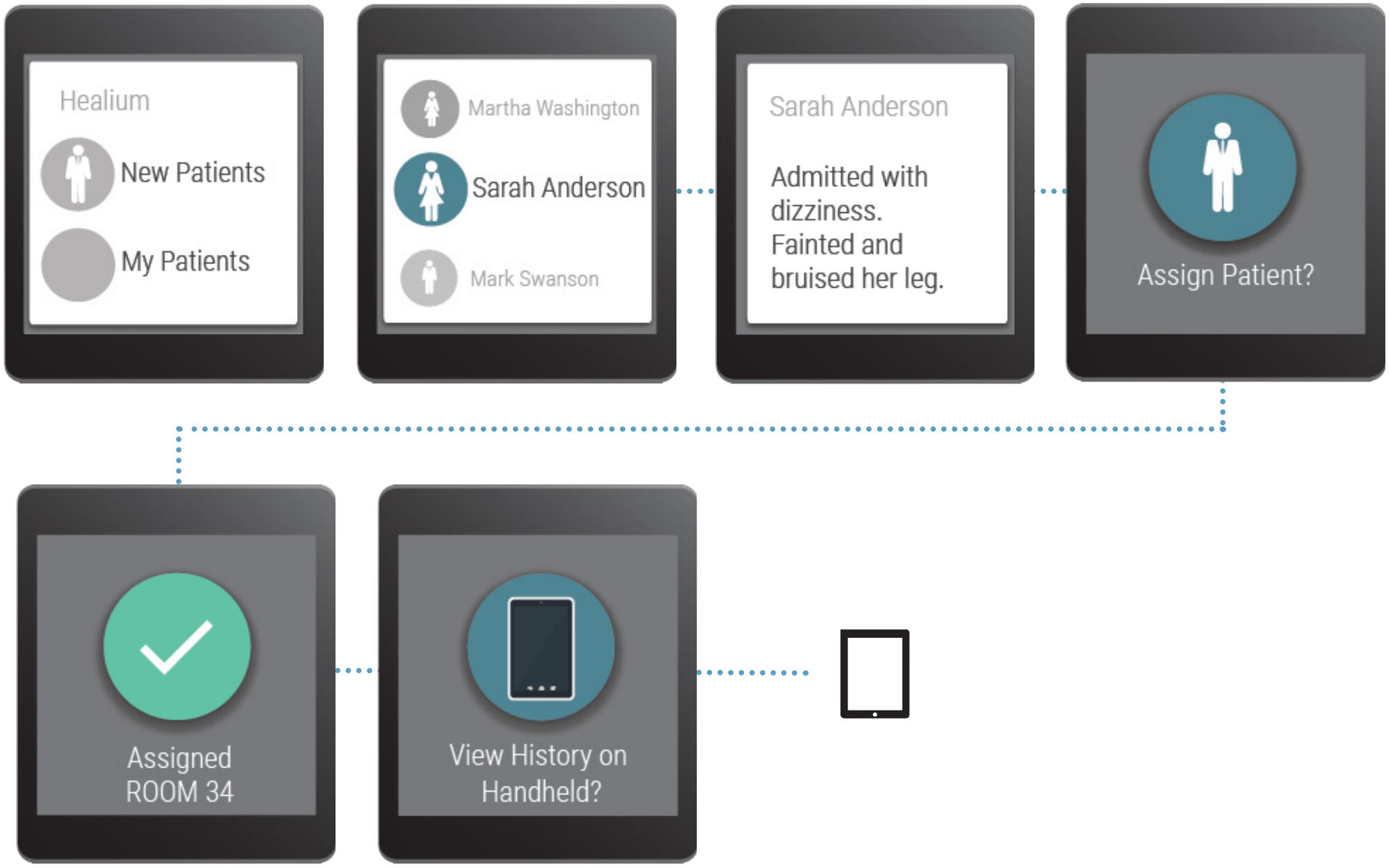
1. View all new patients on the emergency department checkerboard

2. User can view all patients that have been assigned to them and are receiving treatment.

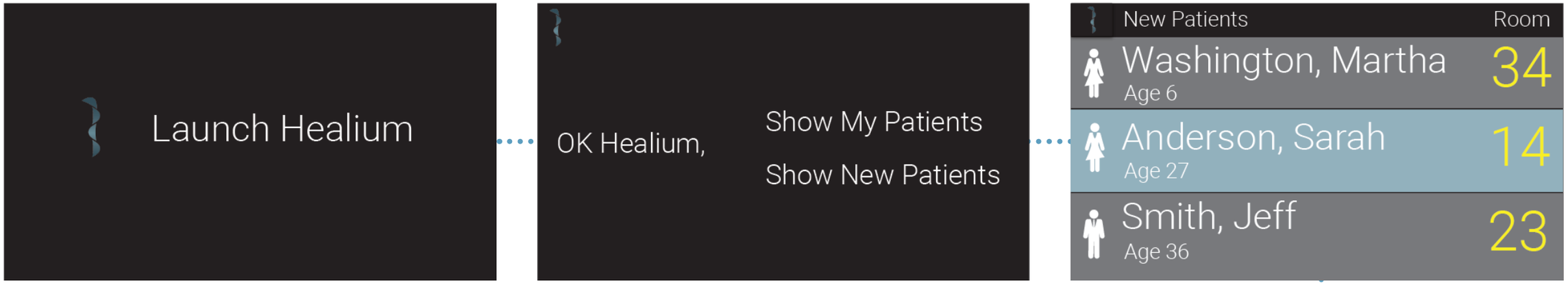
3. If a user is ready to accept a new patient, they can select assign.



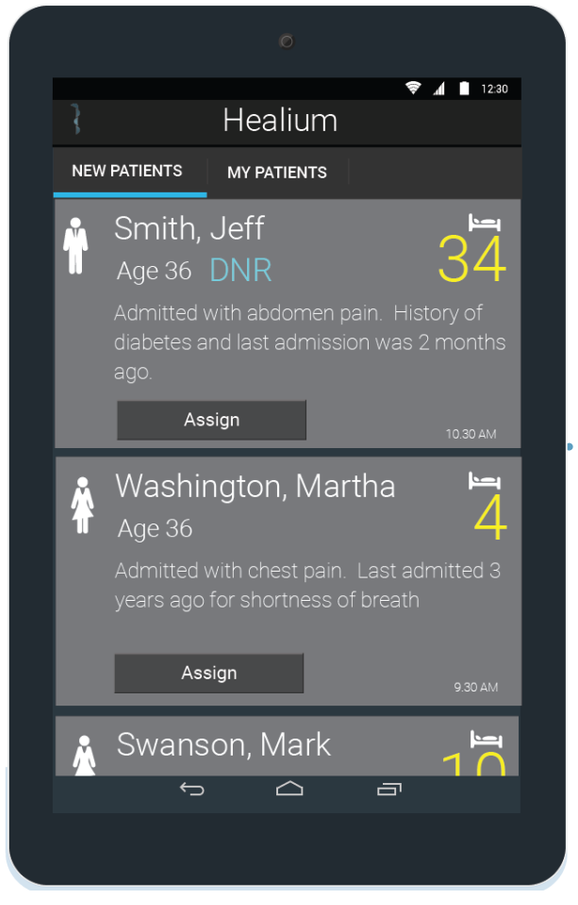
Assigning a patient

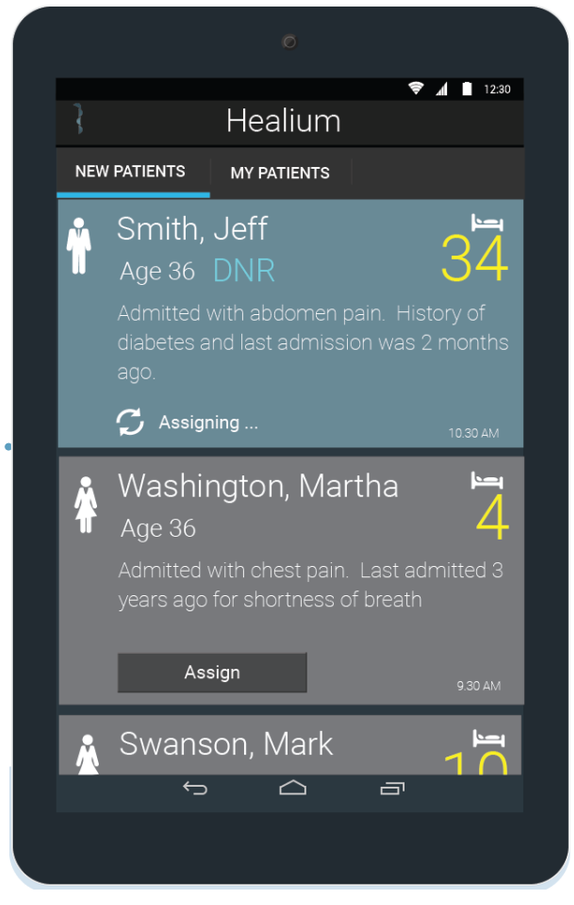


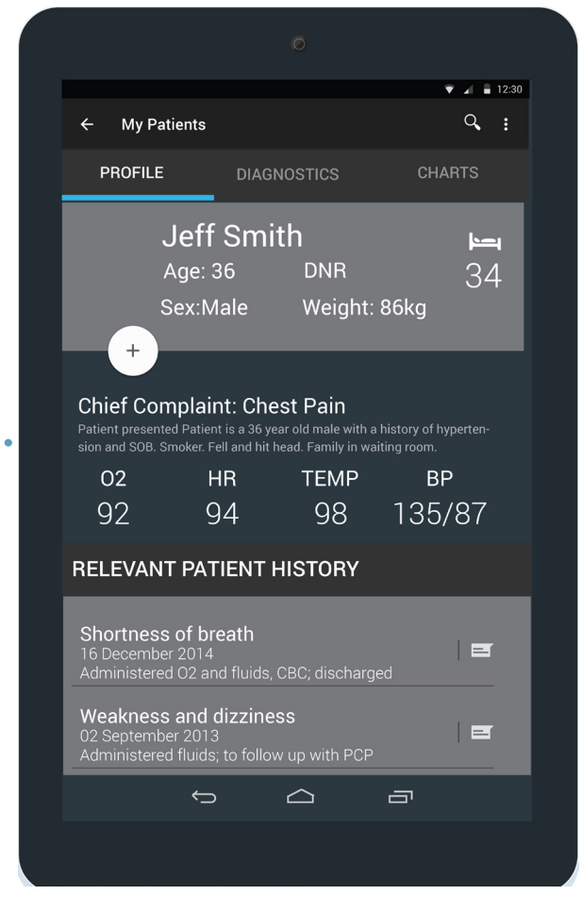
Assigning a patient



Assigning a patient

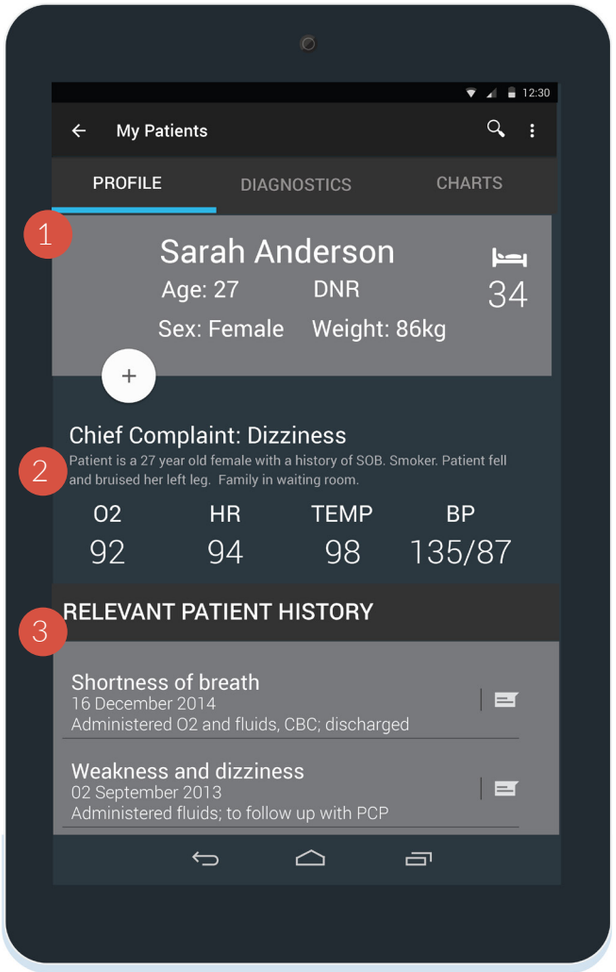






Relevant problem list

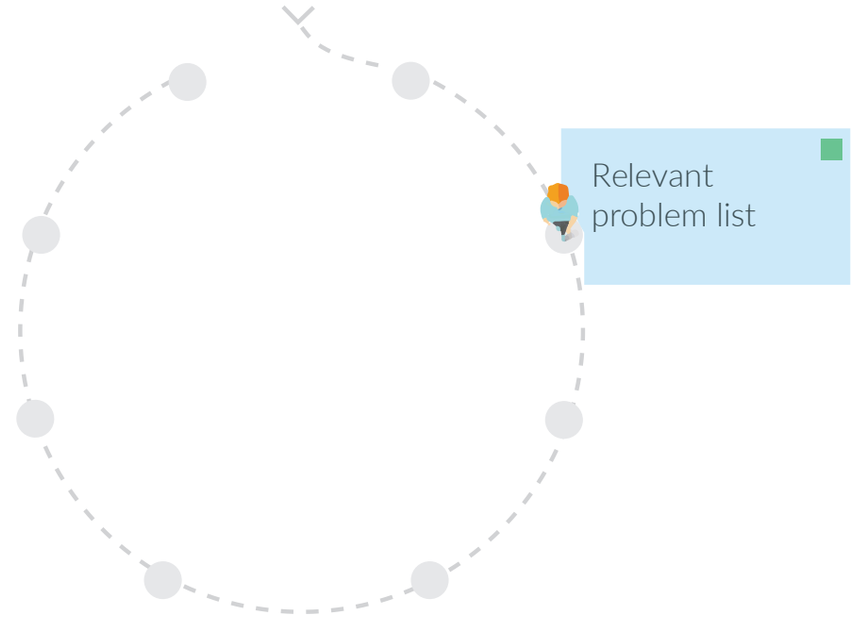
When the doctor is ready to see a new patient, Healium summarizes a patient's past medical history and creates a relevant problem list based on the chief complaint so that you aren't spending time searching for information.



1 Patient's identifying information remains persistently at the top of the screen.

2 User can quickly view the patient's chief complaint and real time vital data.

3 Relevant patient history is populated based on the chief complaint.



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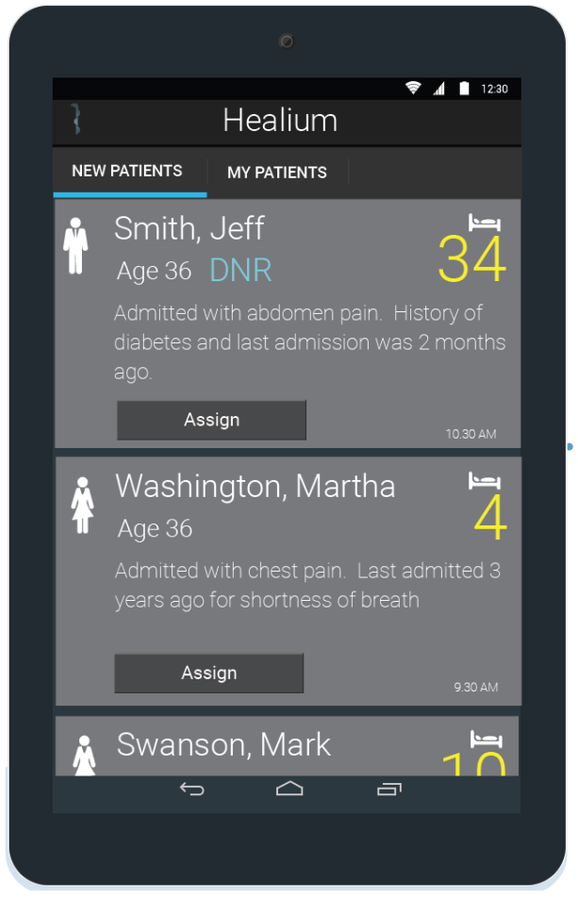
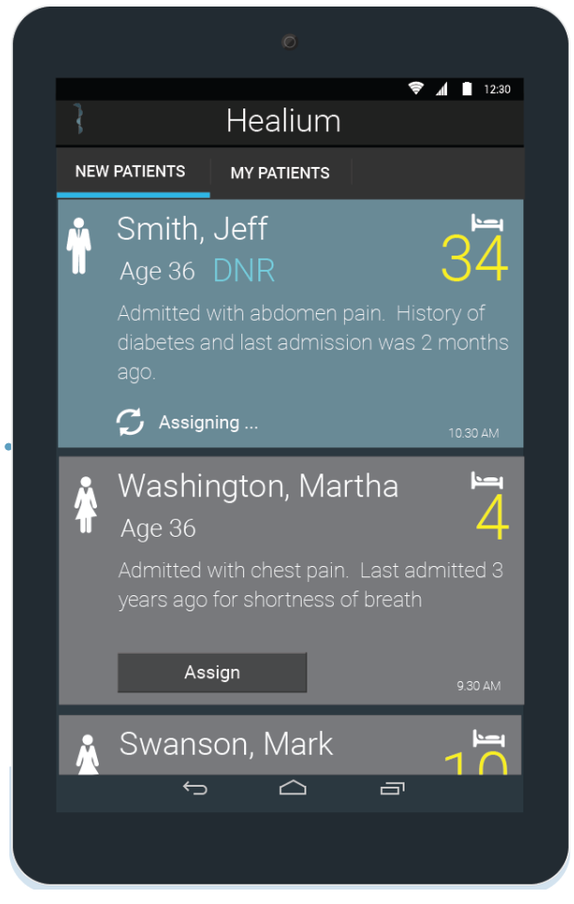
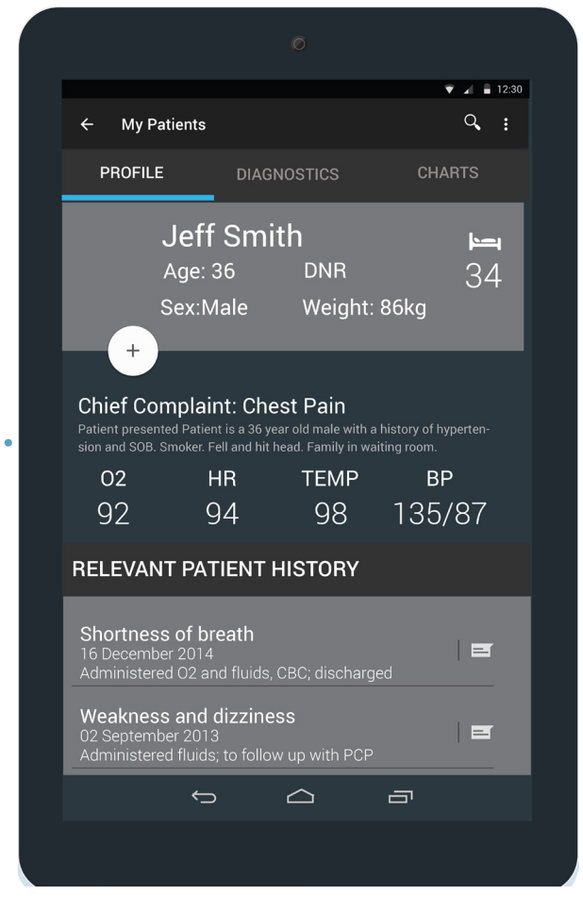
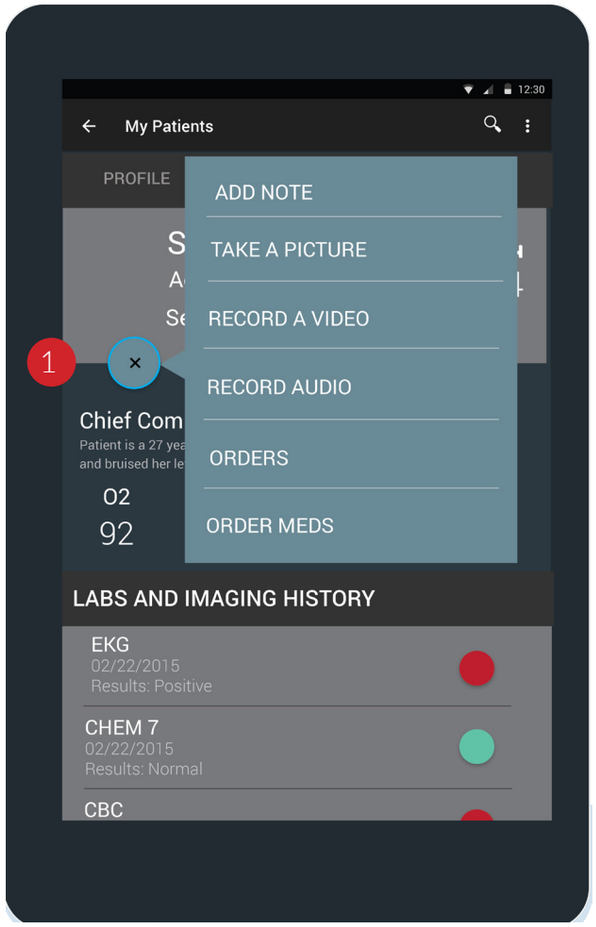




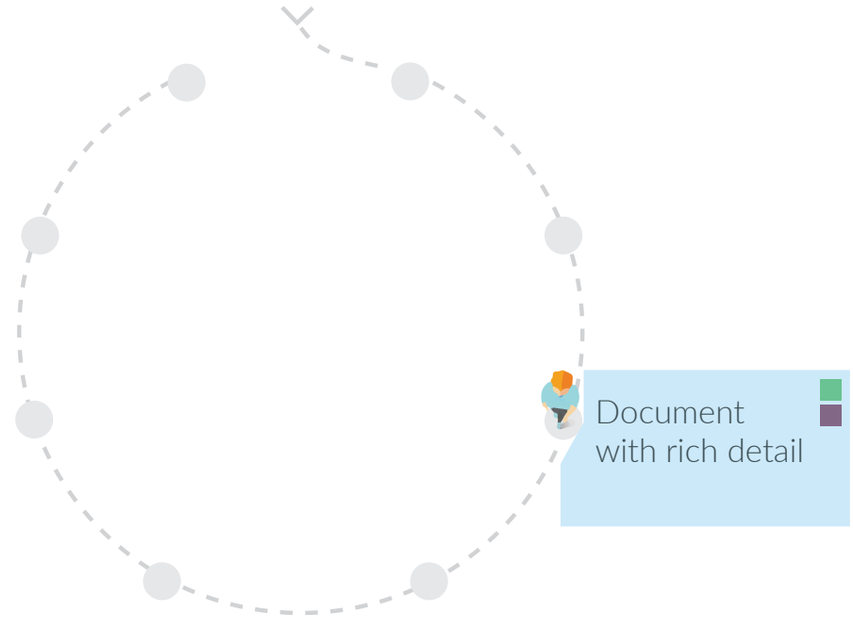


Document with rich detail

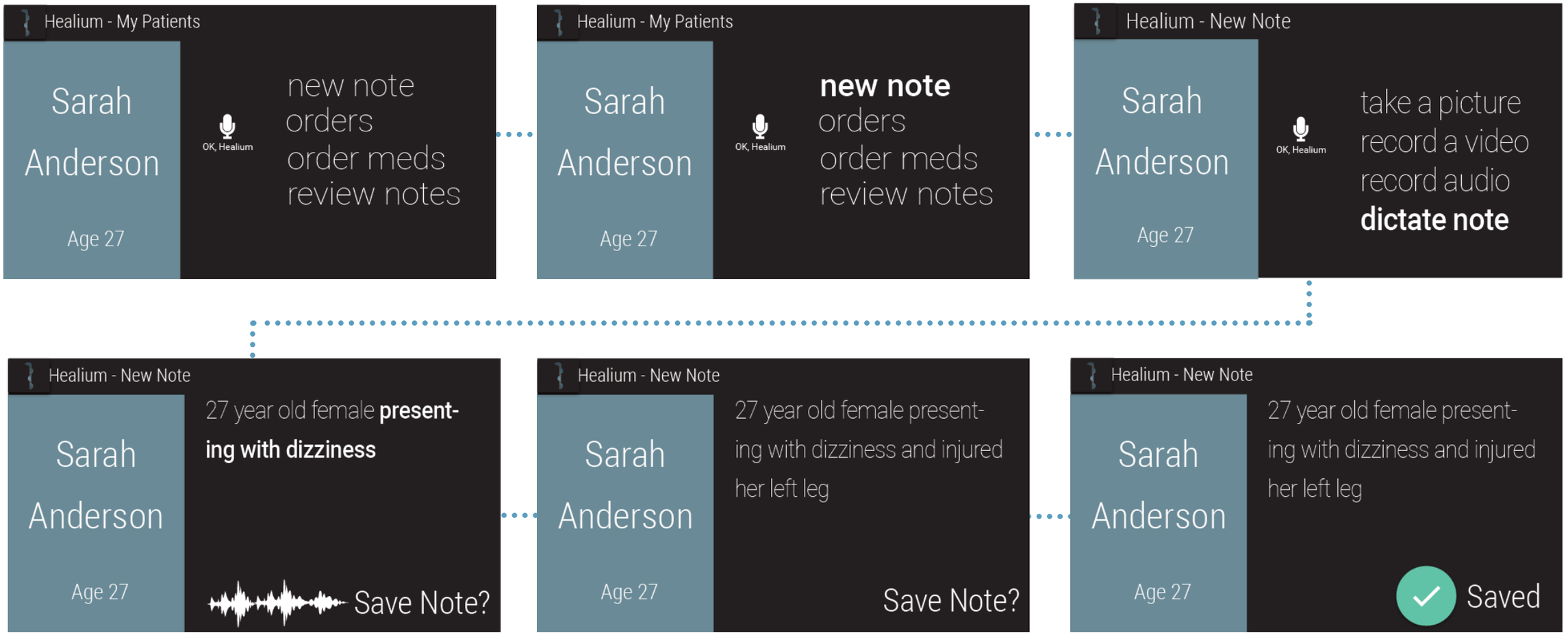
Physicians can dictate notes throughout their day, wherever and whenever they want. All devices are voice activated, so a doctor can dictate directly into the system, or even record the entire patient interaction. Healium allows doctors to document with video and photo to add richer context to their notes.



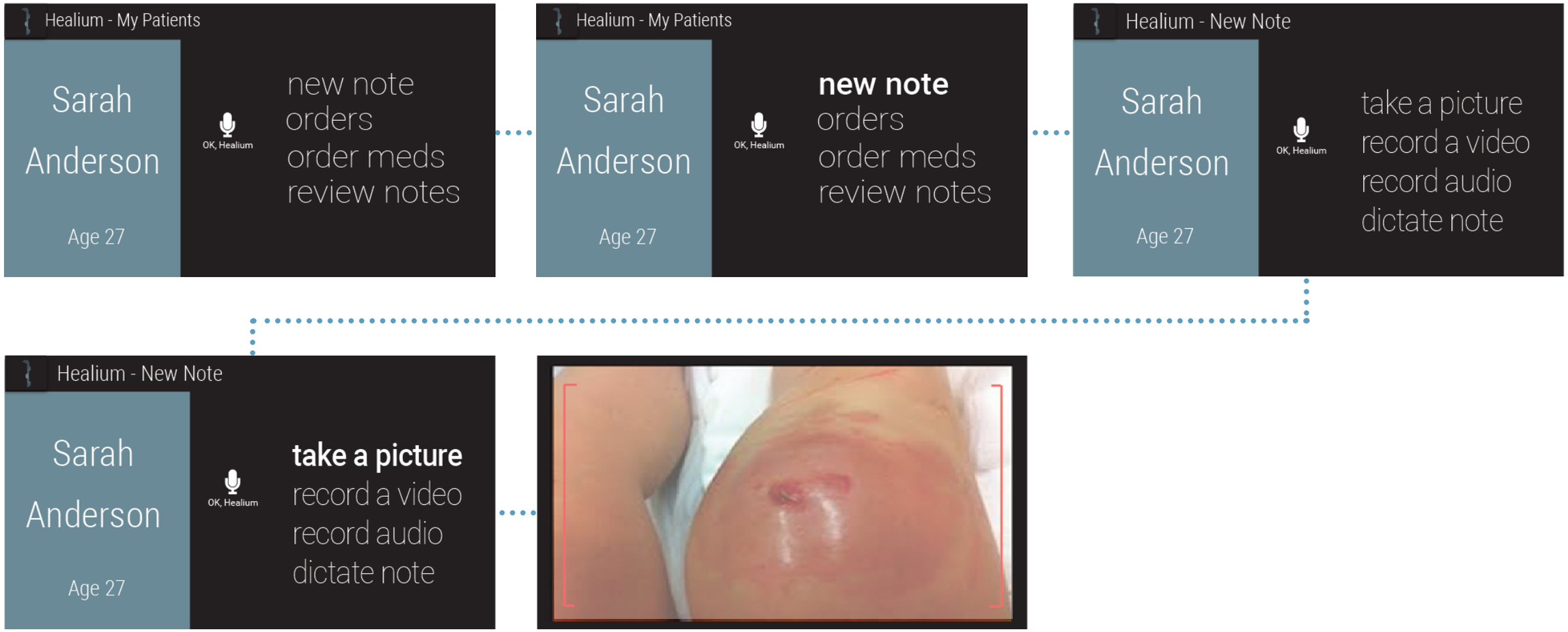
1. Users can quickly add rich media files to the patient's medical record by tapping the (+) button.



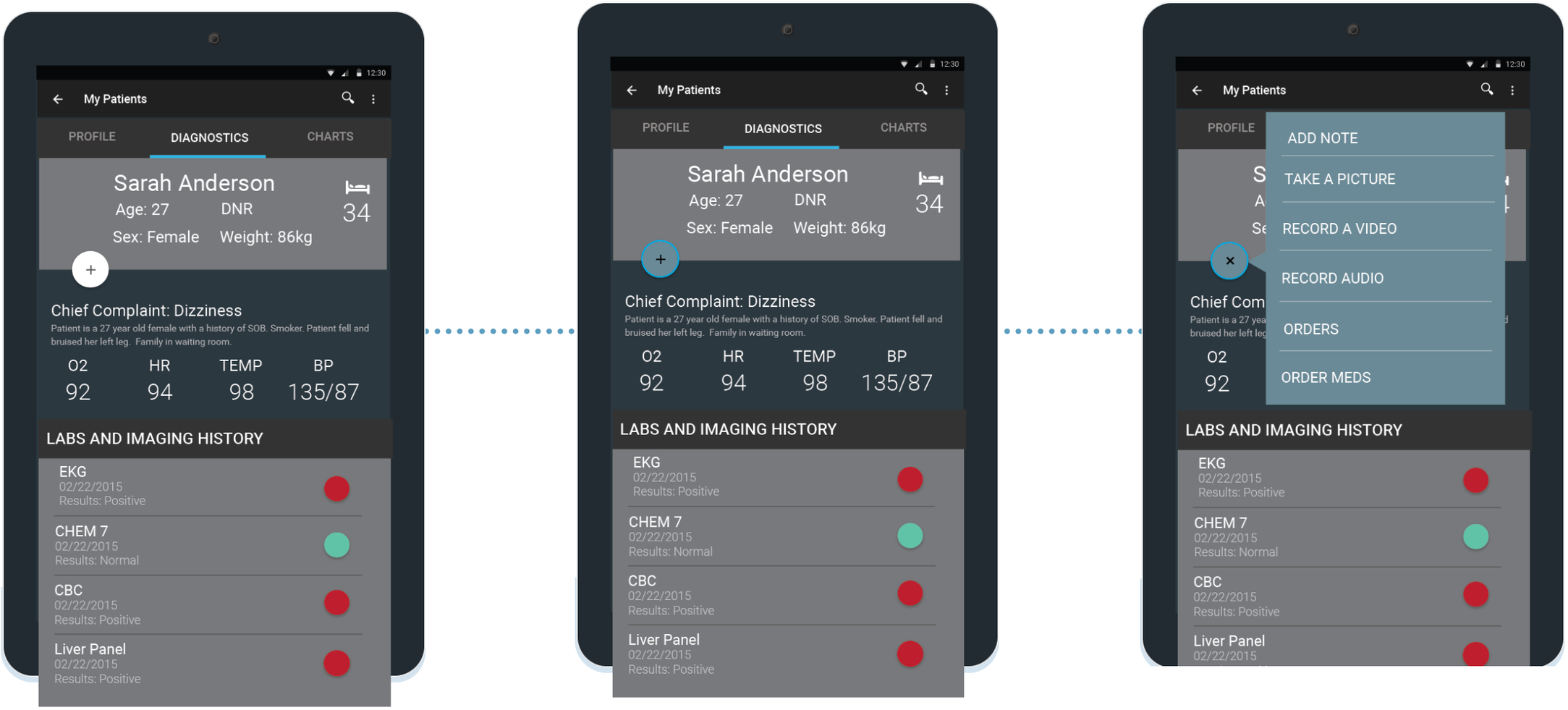
Dictate notes



Rich media notes

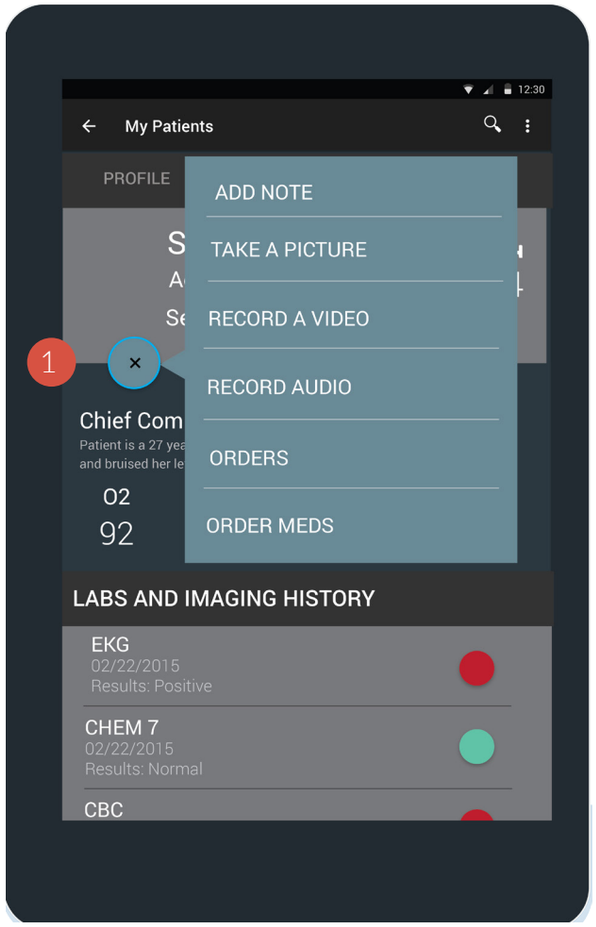


Rich media notes

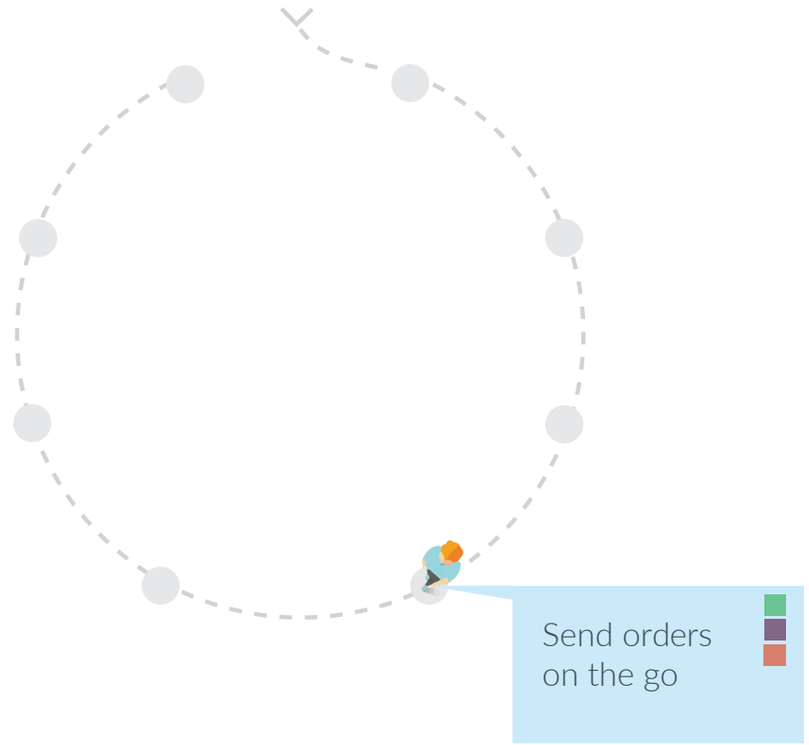


Send orders on the go

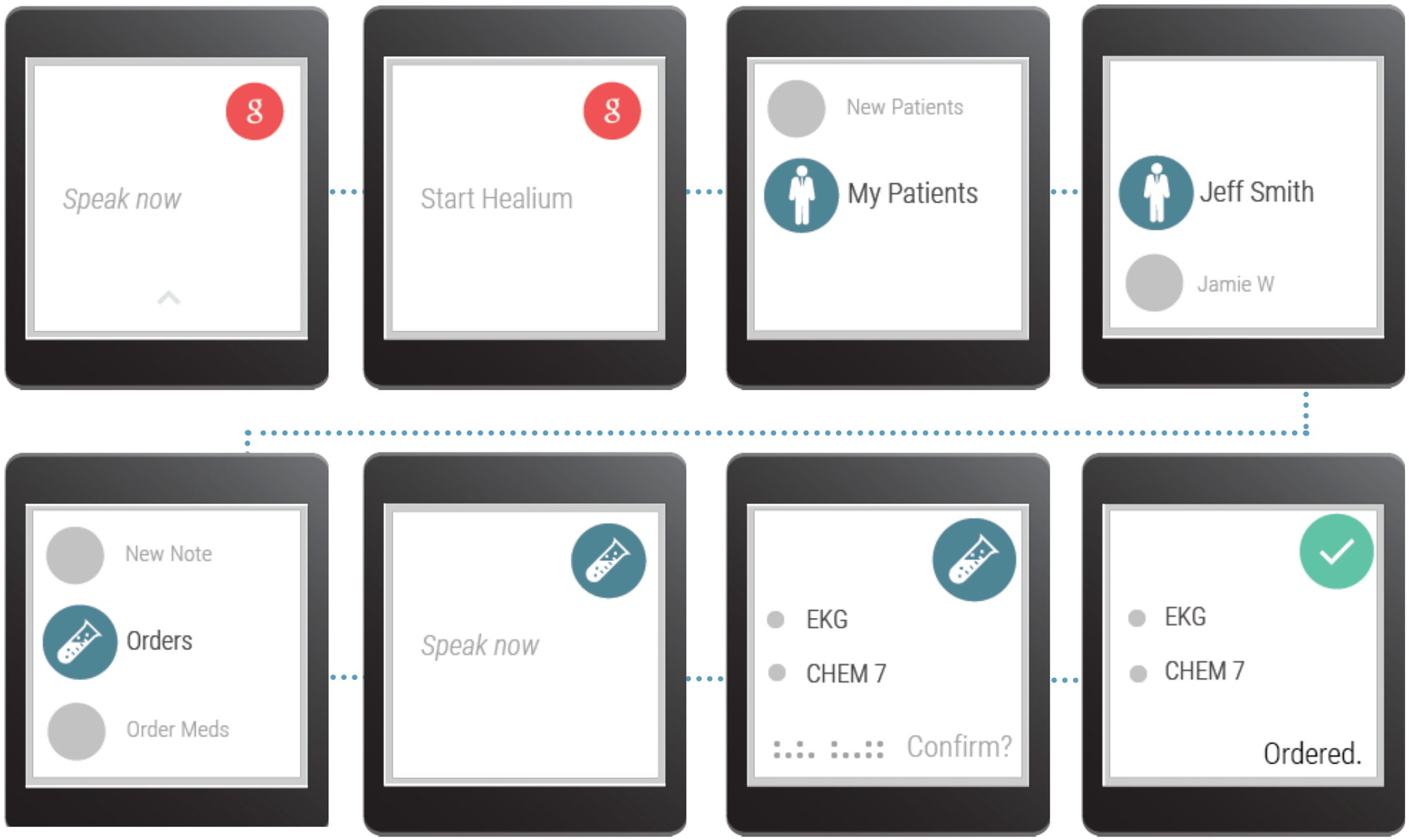
Healium facilitates lab and imaging orders without the restriction of being tied to a desktop computer. Physicians can either type in their orders on tablet or dictate them to wearable technology while seeing them displayed for their review and confirmation. Healium will also alert users if additional steps or verification is needed.



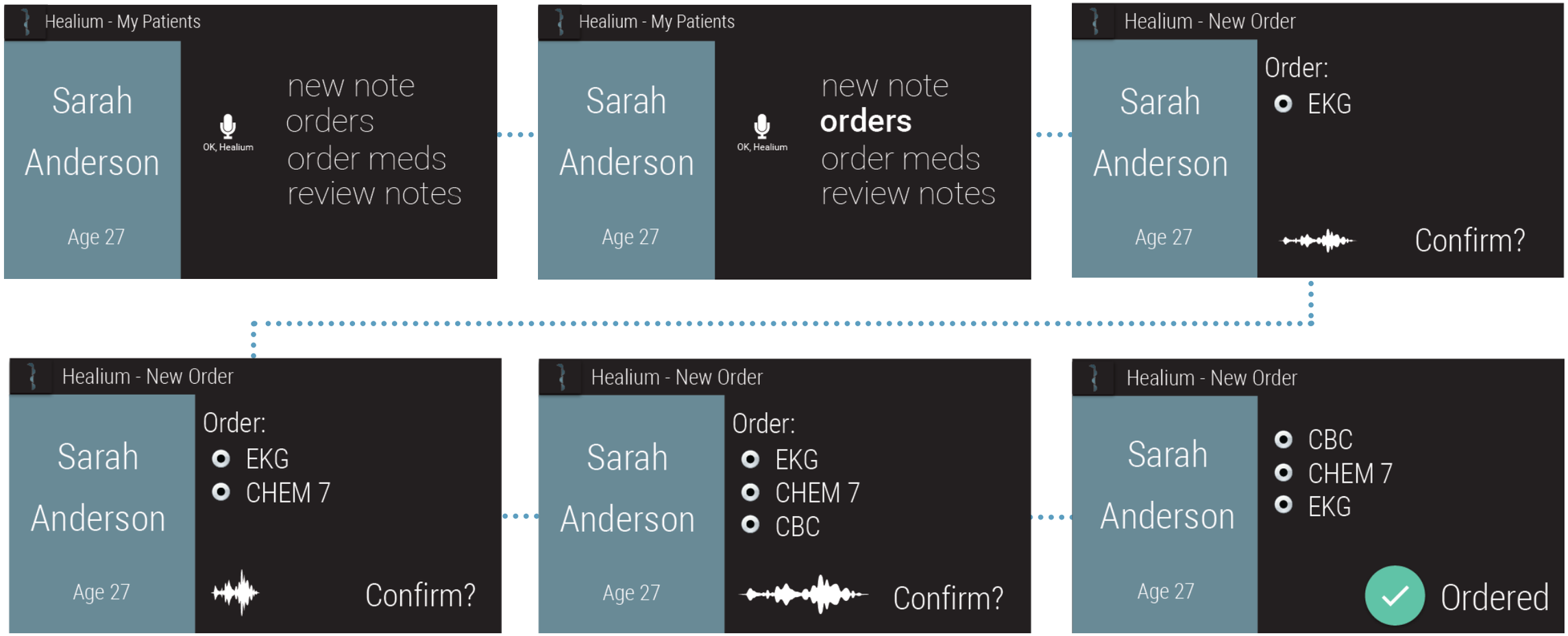
1 Users can order labs and imaging for the patient by tapping the (+) button.



Send orders on the go

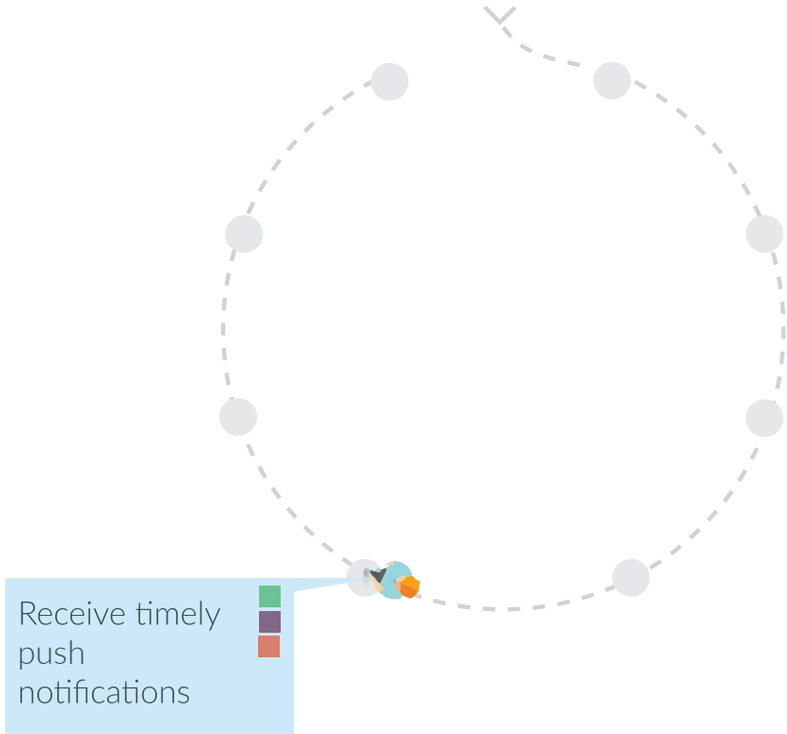


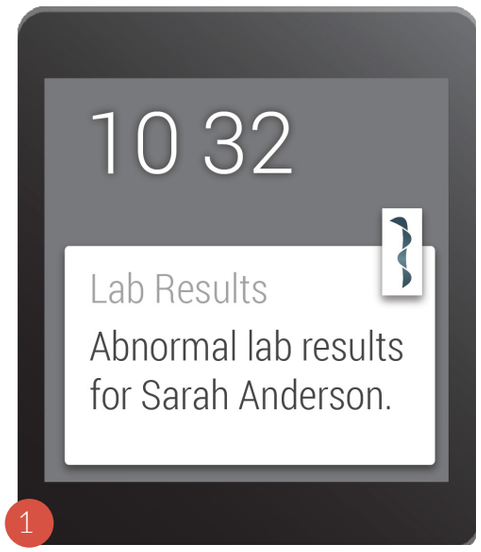
Send orders on the go

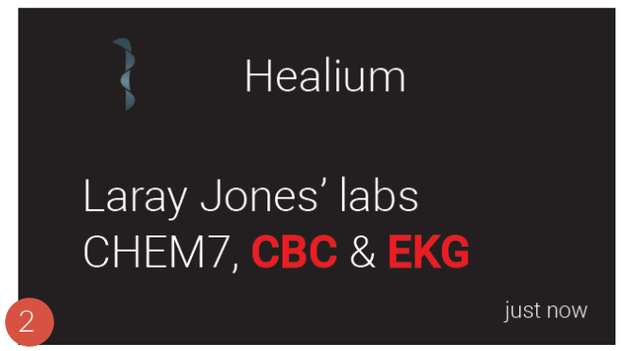


Receive timely notifications

Healium's push notifications improve efficiency by alerting the physician when labs and imaging are complete, reducing the number of visits to a desktop computer. Unique haptic and visual alerts notify a physician of an abnormal lab result and visual treatments such as red callouts and highlights help the physician quickly notice and ascertain the impact the problem. If need be, the tablet offers a deeper dive into the diagnostic results, along with providing notes from technicians.



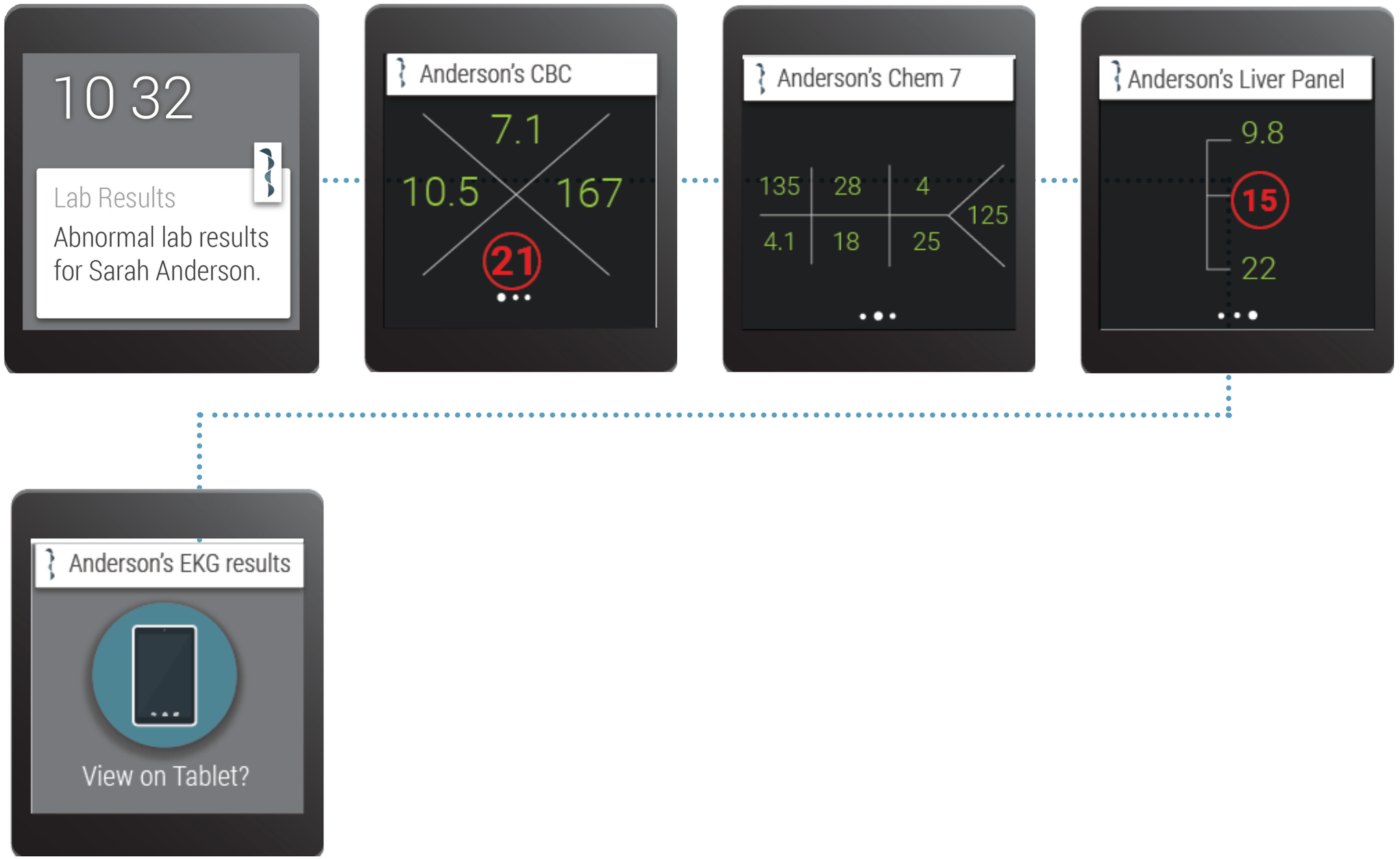




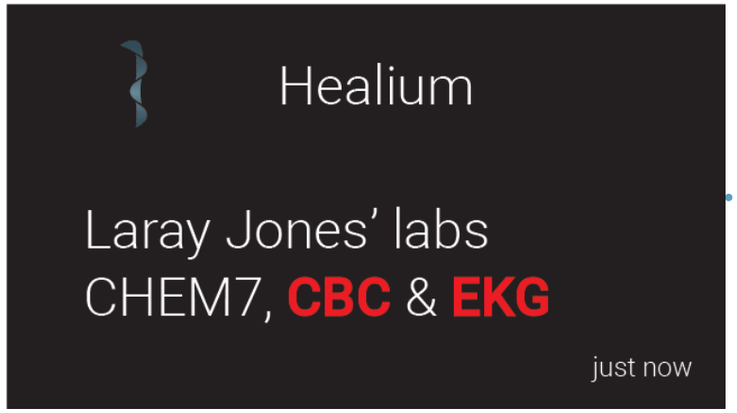
Users are notified of critical lab results on-the-go on wearable technology, on either:

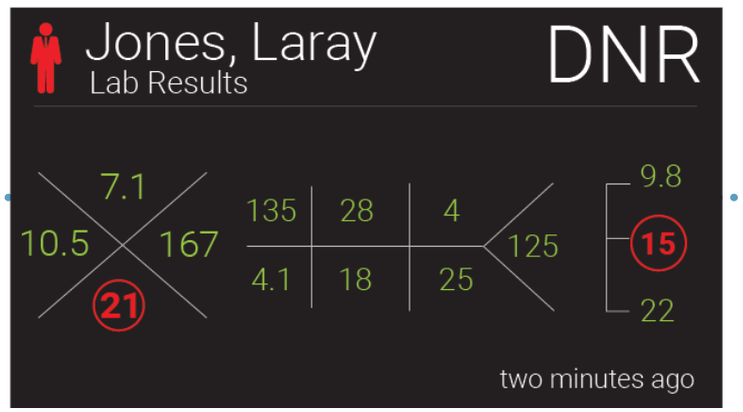
1. Watch screen
2. Google glass screen

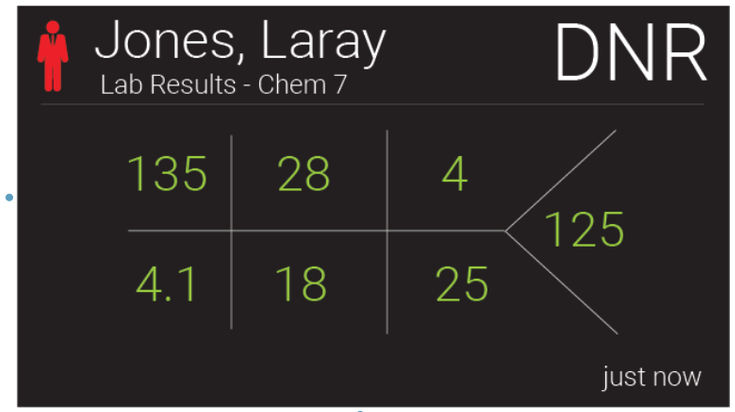
Receive timely notifications: labs and imaging

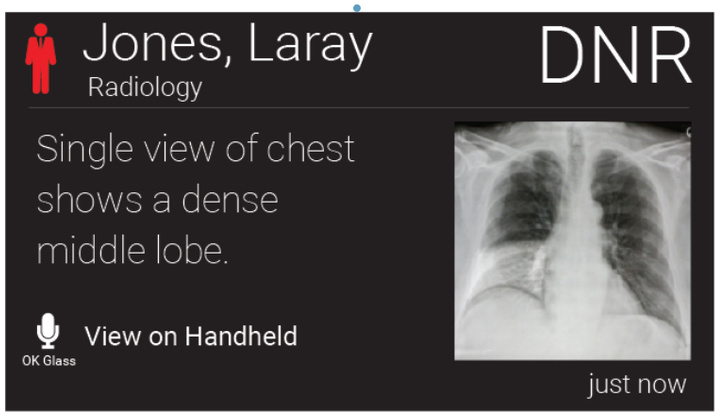


Receive timely notifications: labs and imaging

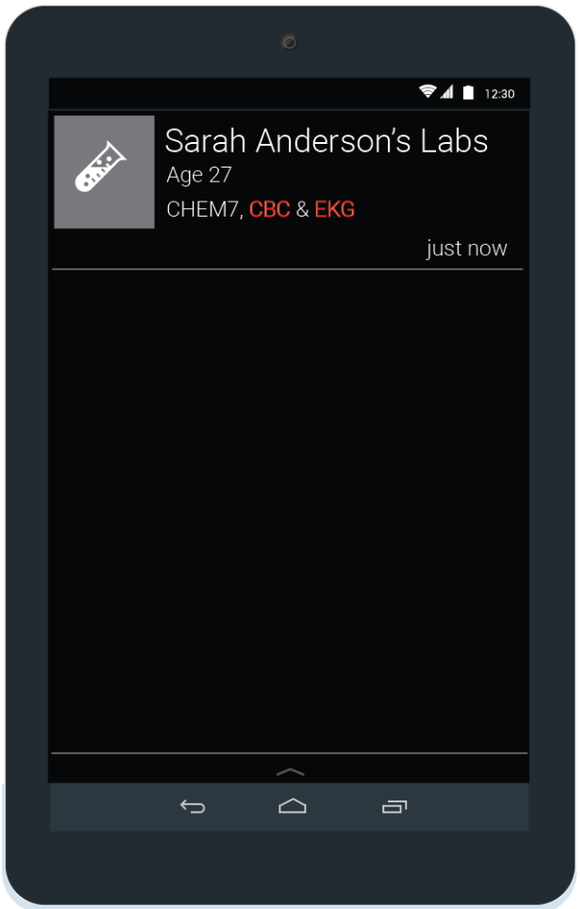


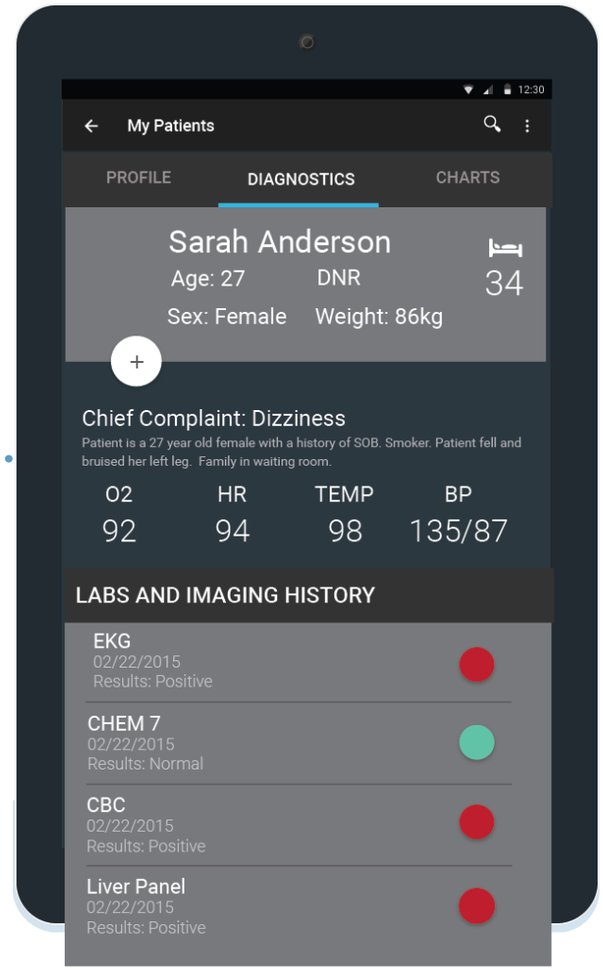


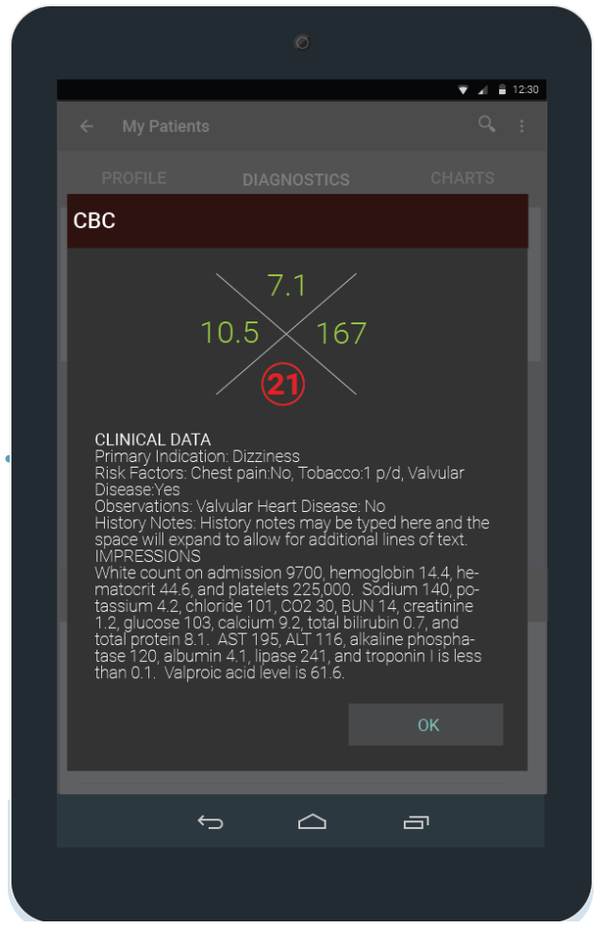




Receive timely notifications: labs and imaging

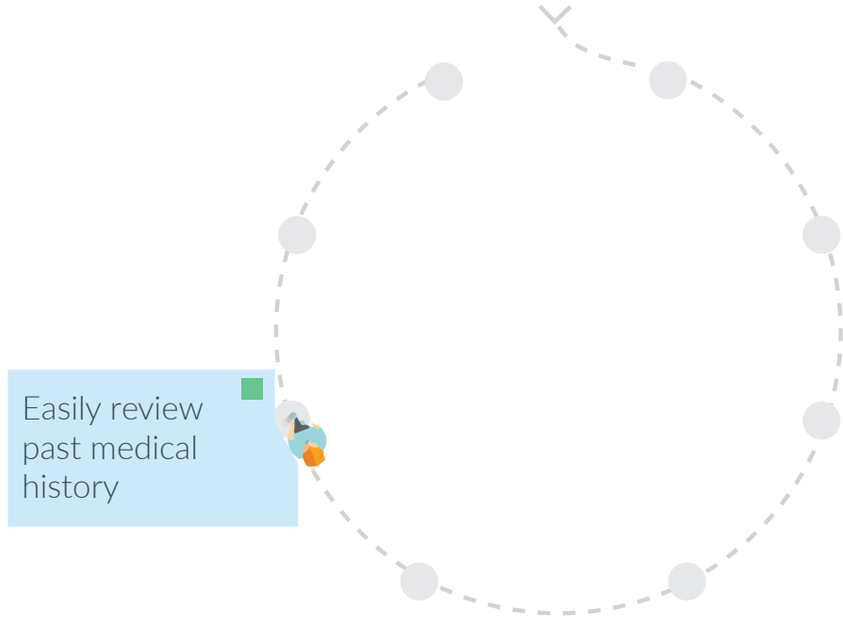


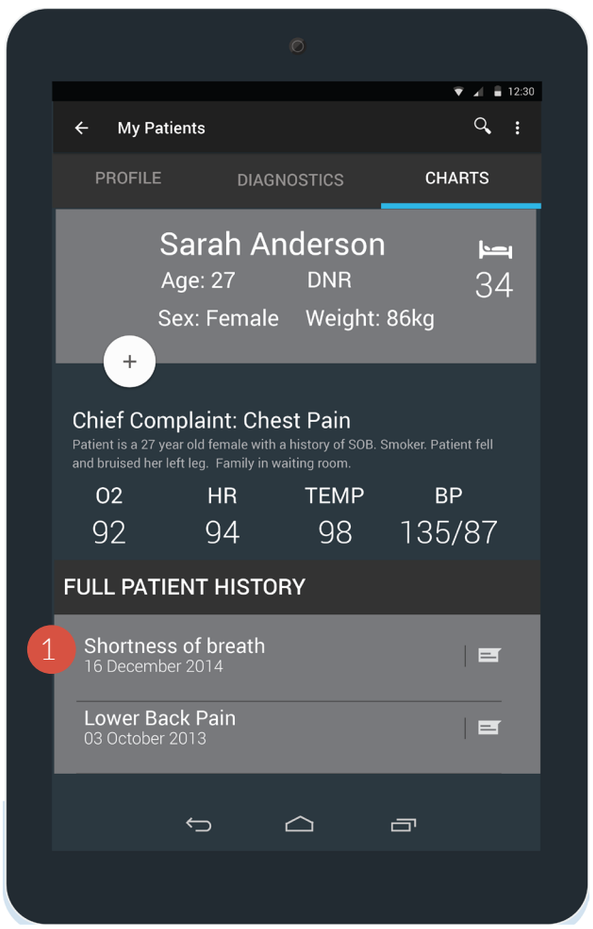




Review past medical history

The tablet provides the ability for the physician to dive deeper into a patient's past medical history (PMH), much like they would with a desktop EMR system. They are able to review past visits, notes, medications, diagnostics and any other pertinent data. Through the use of collapsible information bars the doctor can easily skim the PMH, or they may choose to enter their query into the search function to get more specific results. All the while, they have the ability to easily add their own notes with the (+) button.



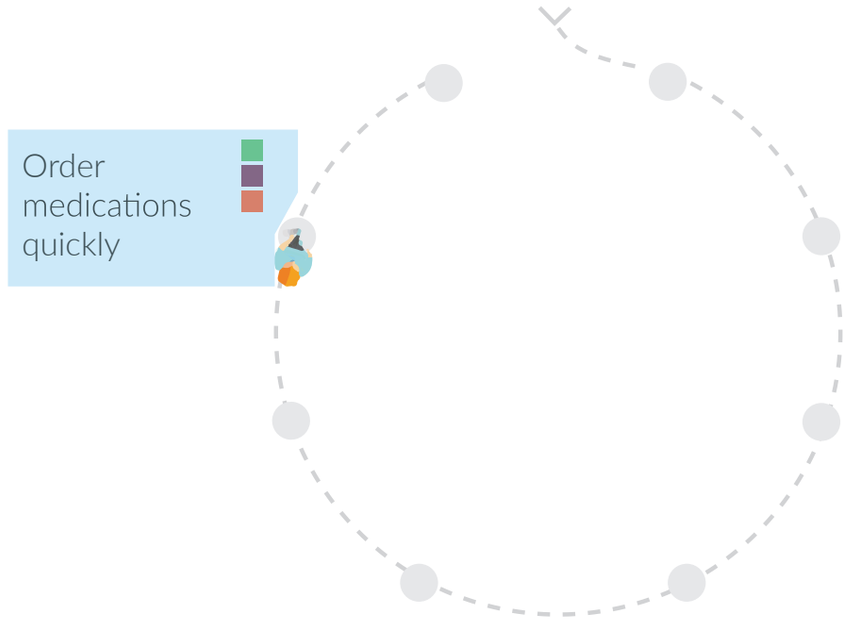


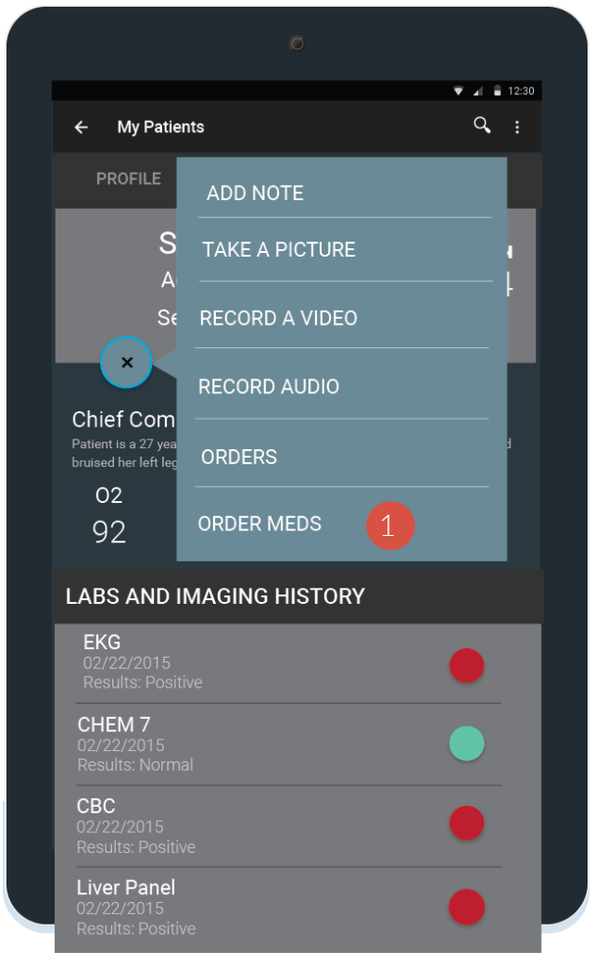
1 Users can tap on a previous case to read a detailed report including lab results and previous physician's notes.

Review past medical history

Order medication quickly

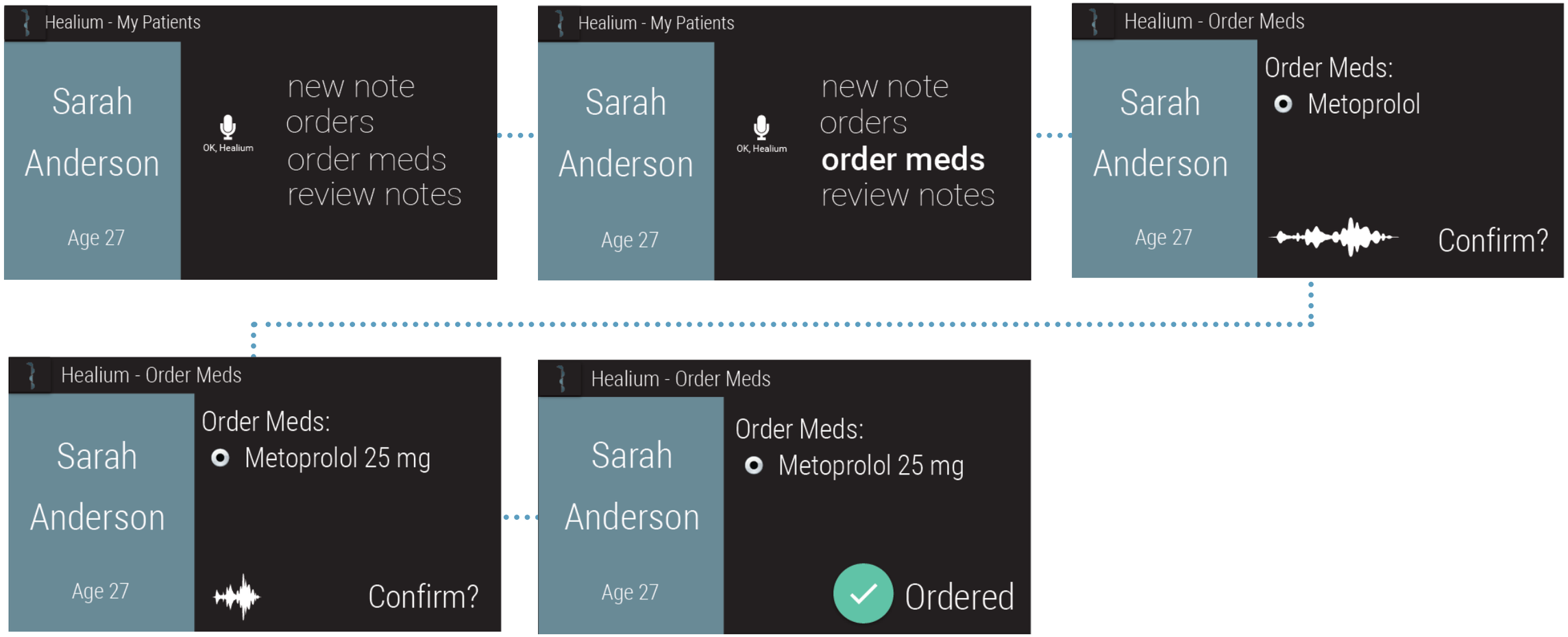
Physicians can order medications from any device anywhere. Healium automatically checks for harmful drug interactions or mis-diagnosis to ensure the right decisions are made for every patient. Much like the ability to send lab or imaging orders on the go, Healium allows the doctor to use voice commands to order medications from the Watch or Glass, or easily place orders from the Tablet interface with voice or touch.





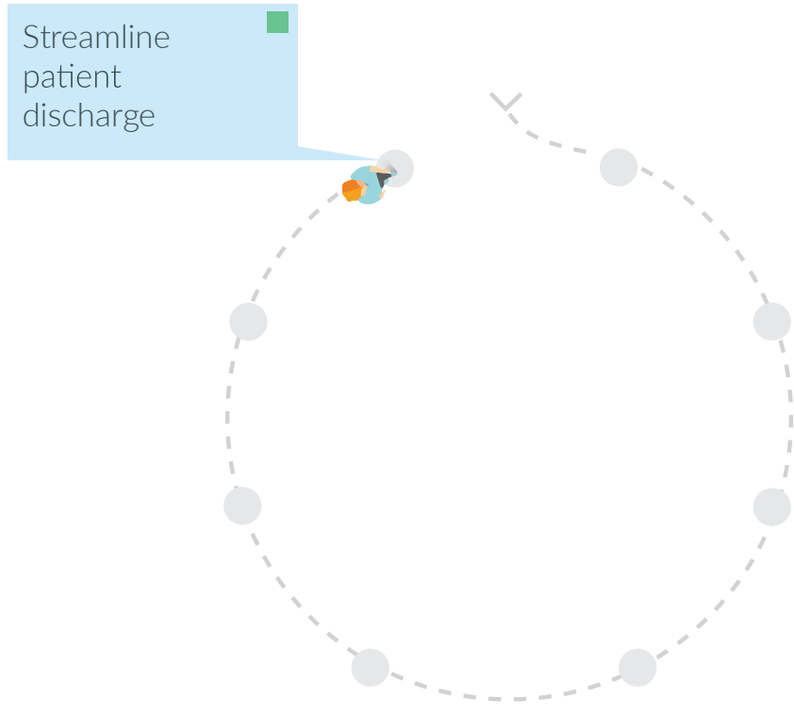
1 Users can order medication for the patient by tapping the (+) button.

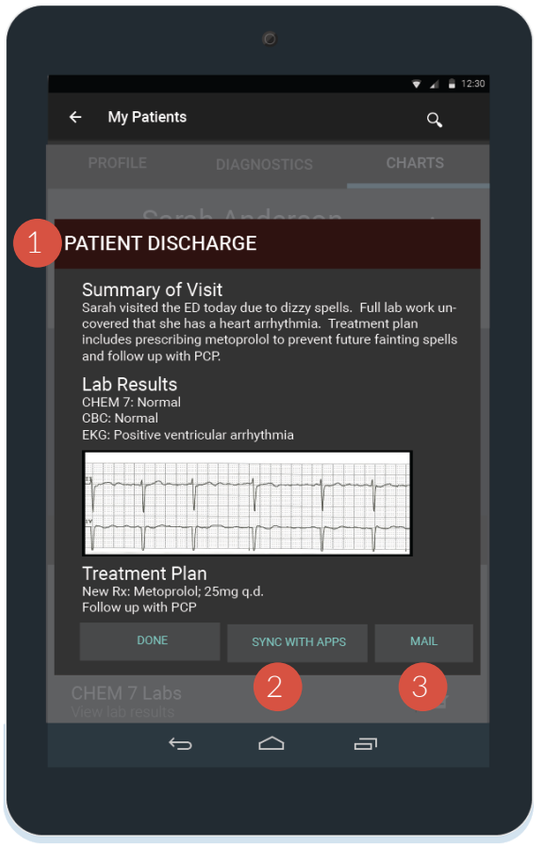
Order medication quickly



Streamline patient discharge

Review all notes from a patient's visit and have the capability to quickly summarize and read the pertinent info for consultation before their release. Healium also quickly and conveniently collects and sends discharge instructions to care providers on duty, along with providing patients the ability to email discharge instructions to themselves.



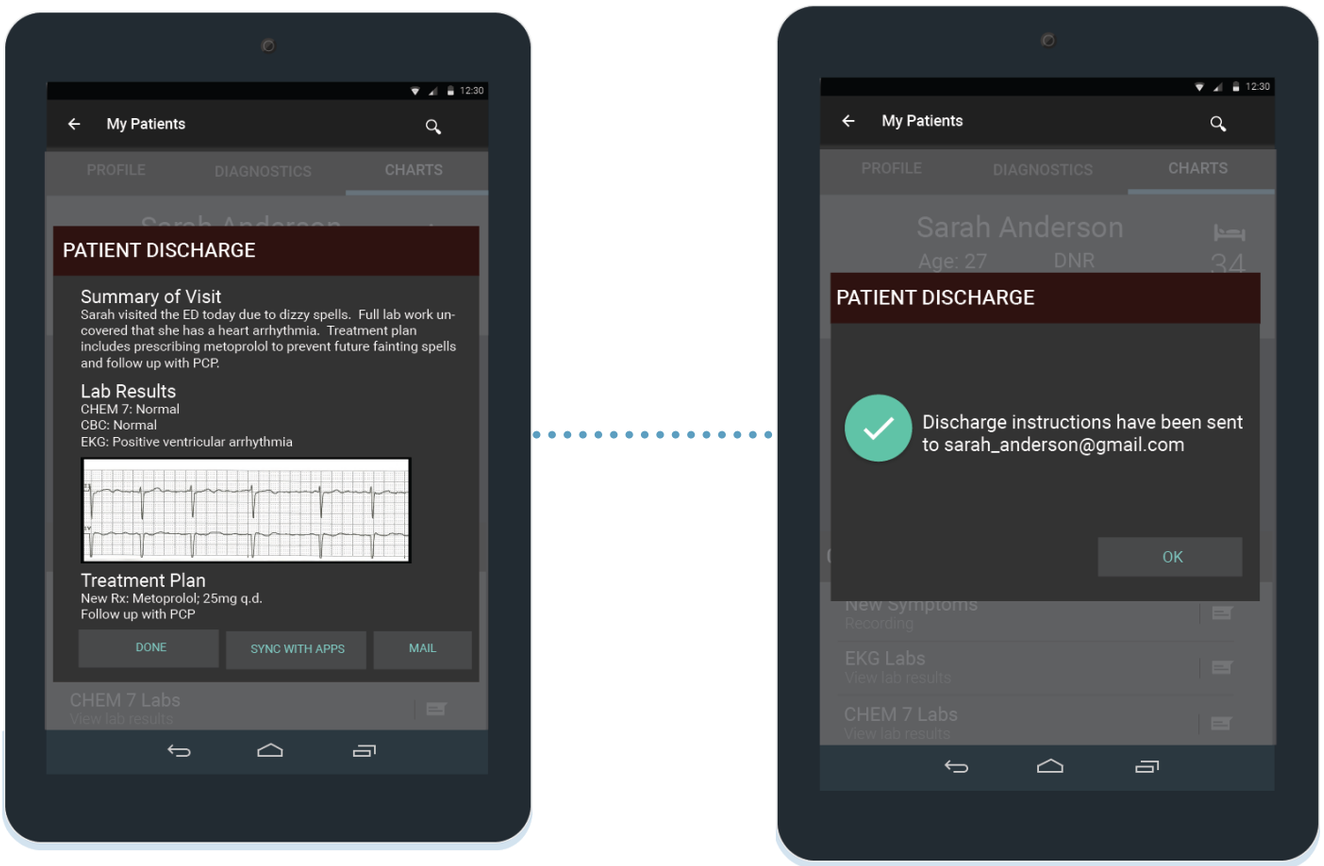


1. Review patient discharge instructions in an easy to read format

2. Extend EMR data collection capability beyond the care facility by syncing patient profiles with their favorite health applications.

3. Email discharge instructions to patients.

Streamline patient discharge

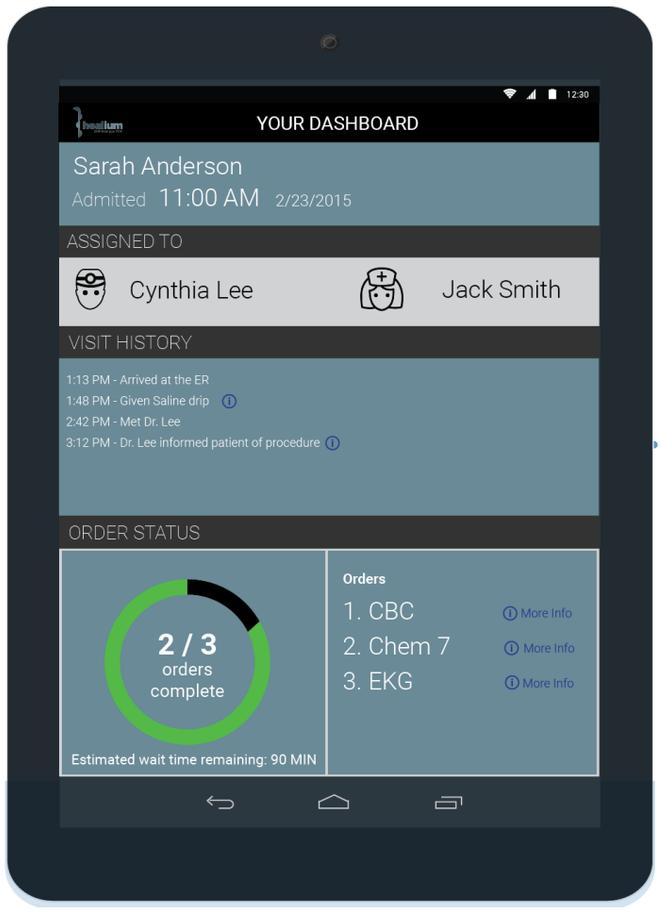


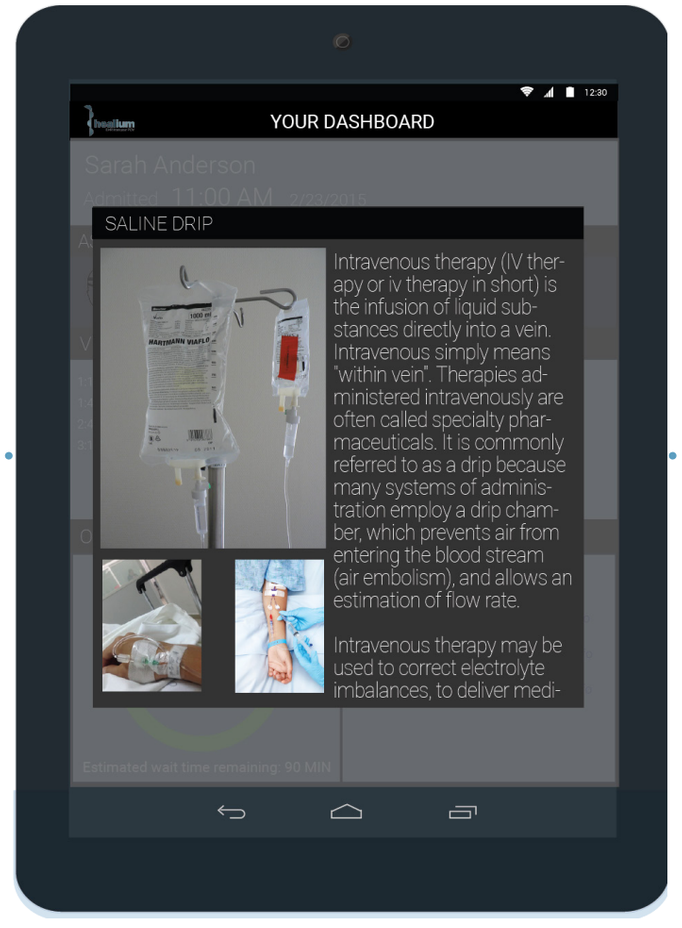
Patient dashboard

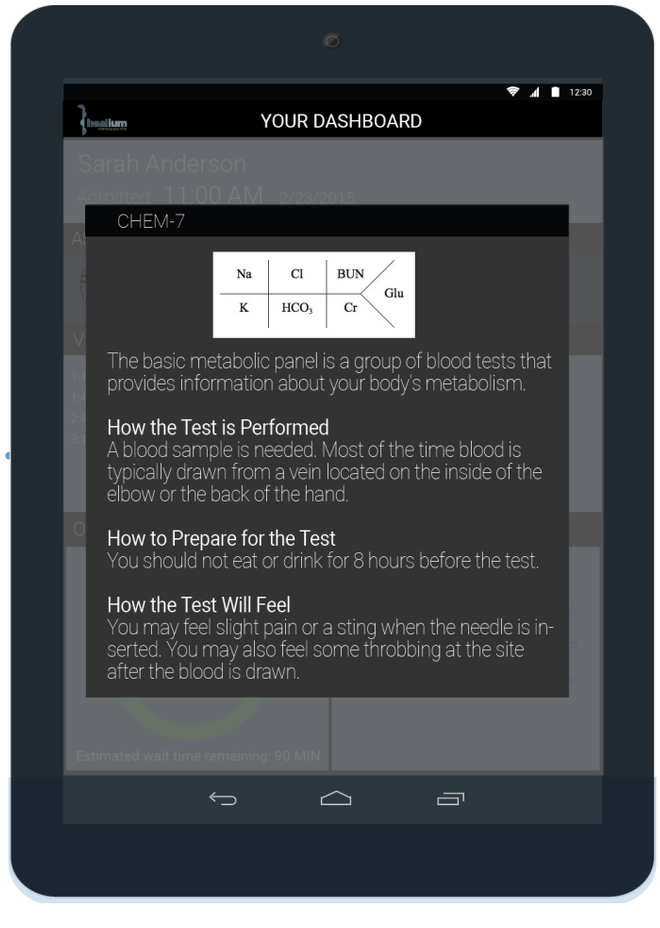
Healium also directly improves patient care by giving patients' insight into how their emergency department experience is unfolding around them. They can find information on the status of their lab results, wait times and length of stay, and the history of their current visit. It also provides detailed information on procedures or medication so the patient can learn more about his or her treatment, and feel informed. They are also given the opportunity to email discharge instructions to themselves.

1. Users can view the care team assigned to manage their case.
2. Users can review their visit history.
3. Users can stay informed regarding the status of their orders.

Patient dashboard







Conclusion & Future Work

We entered this project with the intention of creating some screens for Google glass, and completed it with a device agnostic ecosystem that better fits the current ED physician's process. From our research, we modified our original plans and thought more about the high-level experience. It was a highly rewarding and engaging experience. To better show what our vision is, we created a product demo concept video, which can be found at bit.do/healium.

The next step would be to perform more usability studies, first still on paper and then, after iterating further, on high-fidelity interactive prototypes. Since we discovered that each ED physician does his or her job differently in a slightly different environment, this would be highly important to the development of the product. Furthermore, we'd want to do usability studies in the context of the emergency department. Other possible future work would include exploring how integration with the Apple Watch and iPad would work, and also exploring how this could be used in departments outside the ED. We are excited to see where Healium goes!

Thank you!

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