

Art 484 Interaction Design
Projects in Health and Wellness

University of Washington
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Medical Records Visualization Tool
Documentation

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Table of Contents

- 01** Problem Definition / The State of Your Medical Records
- 02** Goals / Solution
- 03** Early Concepts and Other Ideas
- 04** User Research
- 05** Product Evolution
- 06** Final Implementation / Interface Introduction
- 07** Scenario and Interface Walkthrough
- 08** Conclusion

Introduction

A Long Term View of Health

How can you determine if someone is truly healthy? When people are asked about their health, their responses most likely will reflect how they are feeling presently. Now if the same people are being asked about if their health is declining or improving, it is unlikely that they will remember how healthy they are a year ago, let alone five years ago. In other words, what if you had a window to view 'inside' your body over time?

As an example, Chronic Kidney Disease is a problem that afflicts 20 million people a year in the United States. It is a silent condition that in its early stages won't show any symptoms. The disease develops so slowly that the afflicted don't realize they are sick until the disease advances to a point where it is life threatening. Yet, if people are made aware of the trends in their medical history, the disease can be easily treatable before it worsens.

Access to Your Own Medical Data

Since people, patients have medical data distributed amongst different doctors, specialists, cities, states, there is a large need for collecting that data.

Aggregating the data in some form or another will allow patients to take a more active role in their own healthcare and that of their loved ones. Patients might be better able to get a second opinion; they might be able to better fulfill a need to do their own health research, they may take more responsibility for their own healthcare and they may even fulfill a deep need to conquer their fears of illness with more data, their own data, at their disposal.

The Portable Medical History project serves as a platform on which your entire medical history can be stored and displayed. Patients exercise ownership of their medical history. Such ownership works in several directions: patient ownership of the medical information allows the patient to view and for the first time keep a professional opinion of their health on hand. The patient lends ownership of that data to doctors, and can permit or deny access of that information to relatives, friends, insurance companies, or researchers.

01

Problem Definition / The State of Your Medical Records

01 Soon most medical records will be available in digital form

Companies like Azyxxi and Dossia are providing the infrastructure to coordinate and 'make fluid' these medical records, but so far their solutions are squarely aimed at hospitals, doctors and other professionals.

02 Patients want access to their own medical data!

The Manila Folder. People don't currently have access to their manila folder. From what we've seen, people are able to get medical records in digital form, but they often come in the form of a 1000 page unsorted PDF file.

03 Raw medical records can easily cause data overload

The consolidation with the graphs is an example of the Big Picture to the user, because users will not be able to dig through 50 pages of PDF files to compile a coherent picture of what is happening to their blood pressure.

04 More accessible data, 'always at your fingertips'

Their doctor would be able to tell them, but only in vague terms once every few months when the patient actually visits the doctor.

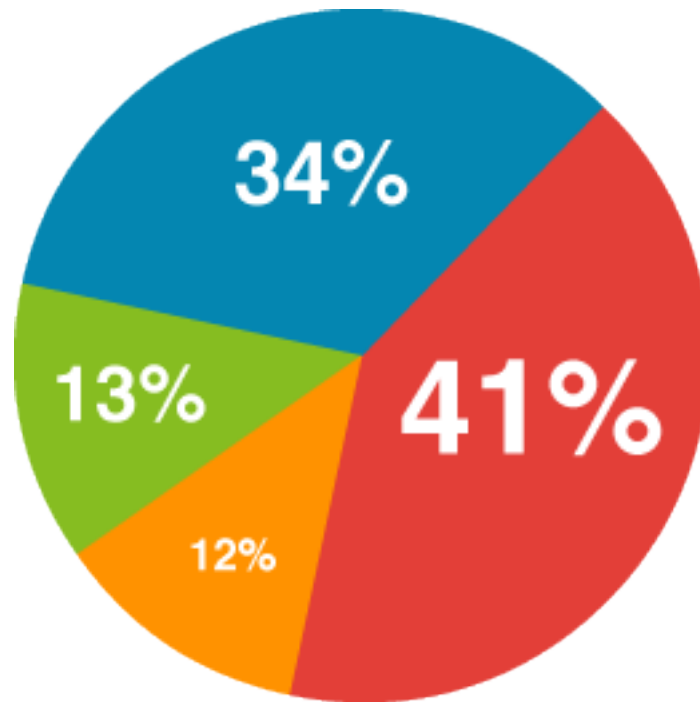
This allows them to look at the complete patterns (not this vague "you're getting better in the Blood Pressure area" statement)

05 What is currently happening in this area? Aren't other companies already doing this?

There are a ton of companies out there working on the back-end infrastructure, but very few really putting resources into the consumer end. Others companies have basic solutions, (group health, blue shield, etc) but they are tacked-on additions; afterthoughts. Revolution health is the one promising one.

We are the ones providing the consumers with their own medical data. This concept acts as a front-end that enables the patient to access the details of their own medical record, and to make sense of it, not to just get slammed by a 1000 page PDF file.

Adoption of Electronic Medical Records in the United States



- EHR in use
- EHR adoption in progress
- Planned within two years
- No plans

02

Goals / Solution

Our big goal in terms of a consumers medical records was to get the 'Manila Folder' out of the doctors office and into your home. We've created a platform for collecting, storing and displaying a person's medical records.

01 Medical Records from Hospitals and other clinics

Takes the 50-or-so pages that all relate to one subject (e.g. Blood Pressure) and consolidates it down to one or two overall pages. Makes the information "glance-able"

02 Day to Day Data

Tracks their data from exercise devices such as Apple + Nike iPod exercise sensors, Suunto Training sensors, all sorts of exercise data. Our platform also serves as a storage and display point for diet information that dieters often keep track of.

03 Overall

By having each category and section (e.g. Medical Stats, Medications, etc) summarized, consumers are able to see a 'visual map of your health' that helps them see the big picture. For all people, it's a way to see the trajectory of their health. A way to make sense of their medical data over time.

In addition to displaying health information, the software can share this health information with doctors, hospitals, as well as friends and family of the user's choice. The user may also look at other the data that other people have shared, such as a biking group's overall statistics.

For healthy people, it is a warning system as well as a way to see if they are indeed on the right track.

For the sick, it is supplement to their doctor, a way to find the cause-and-effect amongst their different medical stats and other data.

Who are we designing this for? Our target audience is anybody from Gen X to Baby Boomers. These are regular people (not aimed at doctors) who want to be aware of where their health is at, where it has been, and where it is going.

9

03

Early Concepts and Other Ideas

01 Network for Sharing Health Information

Who to share with:

Sharing with entities that are not peers

- Doctors
- Insurance companies
- Researchers

Sharing with Family

- Friends
- Relatives

Sharing for General Wellness

- Exercise groups
- Diet and Nutrition groups

Information to be Shared:

Individual Exercise Events

- Type of exercise or sport
- Exertion
- Top heart rate
- Other people that participated alongside of you

Health Events

- Doctor and Hospital Visits
- Surgeries
- Medications

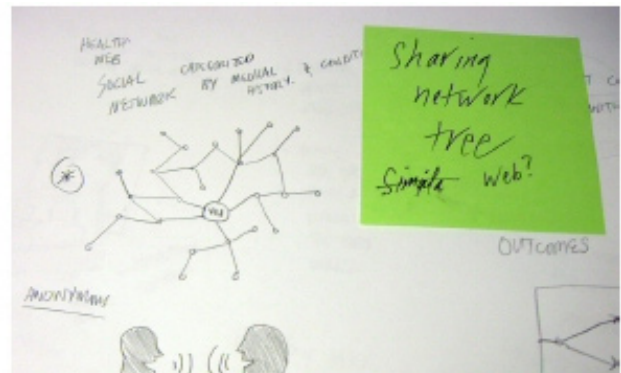
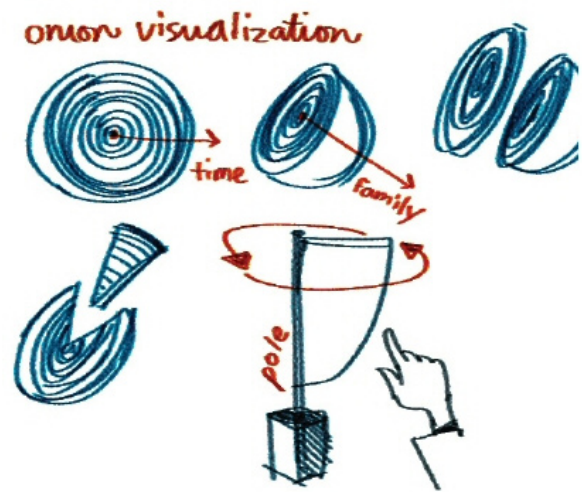
Medical Statistics

- Blood Pressure
- Cholesterol
- Heart Rate

Sharing to Find a Solution:

- People that share a common condition
- Doctors that can provide an alternative treatment option
- People that take the same medications as you do

There would be a “health match-making” message board. There are health questions that have been asked before (such as a misaligned collarbone scenario) and answered (Visit Expert-Exchange for an example of how such an exchange would work). The system will then match your health question to an existing answer based upon your medical stats are similar to the original person asking the question.



02 Health wallet card credit card

Our team proposed a credit card sized flash drive similar to the one we give our service providers when they ask for our insurance information. With a single point of data residing in the end-user's hands we intend to show that the user is the ultimate decision-maker, and can be the custodians of their own health and well-being.

Some features that the device may have:

- Bio sensor thumb
- Magnetic stripe
- RFID

It would allow the user to:

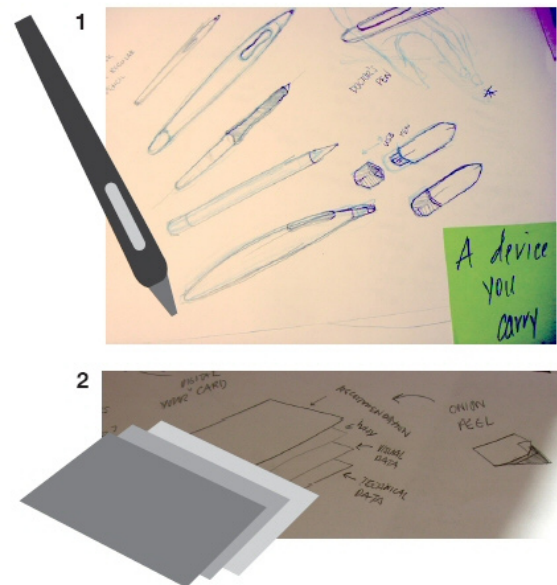
- Bring it with them when they do any health related thing
- Be able to access it at hospitals and other healthcare places
- Take ownership of their data. It is not under hospital's lock-and-key, nor the doctors or the insurance company's.
- Compare their health data with other people who share similar medical conditions. (Identifying information would be stripped before being sent out onto the internet).
- Serve as a storage area for x-rays, lab test results, exercise information, and other medical research info.
- Run it against a profile of illnesses or health desires like a portfolio for investments.
- Can combine this with their siblings' information and get a genetic profile. They could investigate the genetic conditions that may be affecting themselves.



12

03 Pen Device idea

Whatever you wrote will be uploaded instantly onto your computer / secure web account via WiFi. You can use the pen with or without ink and on any surface you want. So whatever the doctor writes on his clipboard, the information will be uploaded. You also have a special group of commands that allows you to code and help differentiate specific commands from information. Say you want to save something, you circle the information you want to save, draw a separate box with the word 'save'.



04

User Research

Questions for Patients

- How often do you see your doctor?
If you were in consistent contact with your doctor, how will that impact your health?
- What did you like or dislike about your most recent doctor visit?
- How well did you remember the doctors instructions after the visit?
- Did the doctor give you any customized information, such as a “report card” printout?
- Have you switch doctors / health care providers?
What were the problems in switching that you encountered, if any?

- Where do you go for your medical history?
How easy / difficult is it for you to access your medical history?
If it is difficult, what suggestions do you have to change this?
- Do you have any medical history records at home, such as the “manila folder” from the doctors office?
- Do you log or journal any information about your health, such as your diet?
Was it manual or automatic logging of information?

- Would seeing your past 20 years of medical history (such as blood pressure levels) at a glance be useful or not useful?
- If you could look inside of your medical records easily, what would the most valuable thing about it be?
- How healthy are you at the moment?
How healthy were you 5 years ago? 10 years ago?
Is your health generally getting better or worse?

14

Questions for Doctors

- How many patients do you see everyday?
- How many patients do you know whose health you know offhand?
- Compare the relationship you had with patients 10 years ago to now. What are the differences?
- How are patient medical records stored here?
- Whose records are stored at this hospital? Only current patients? Or former patients as well?
(If former patients, for how long?)
- Is this [medical history] information shared? How? With whom?
- What information or summaries do you hand out to patients, if any?
- Assuming you had documents digitized, would you feel comfortable giving out medical histories to each patient? Why or why not?
- Is there a risk of the patient becoming hypochondriac? What can be done to guard against that?
- What do you think of the Portable Medical History concept?
- Who else would you recommend that I talk to?

UI Usability Study

Usefulness

- Is this what I want to do?

Usability

- Can I do what I'm trying to do?

Understandable

- Do I know how to do what I'm trying to do?

Interviews

Male, Age 36, Marketing Manager

He has had his collarbone had fused improperly. The surgeon said that it is uncorrectable since no surgeons operate around the nerves and the artery on right side; the patient would need to just live with it. The most the local surgeon was able to do was to shave the collarbone down down so it was not so uncomfortable. The patient lived with it for two years, but eventually he was experiencing pain and discomfort both mental and physical, as well as interference during sleep and exercise. The patient looked on the Internet for what other people in his situation have done, and found a collarbone reconstruction surgeon developing a new technique at Duke Medical. He visited the surgeon, who successfully performed the new operation. The patient now has his collarbone fused properly.

Male, Age 30, Personal Medical Consultant

He does medical care for a heart bypass patient, age 72. He has at least 15 service providers, two general doctors, a Geriatrician and five of his specialists including x-ray tech, mental health tech, ultrasound techs, a cardiologist, a surgeon, an optometrist, an ophthalmologist, a nurse at the home, exercise coach, nutritionist, and social coordinator. His data is distributed among five clinics, and three hospitals. He manages his healthcare, sets appointments, follows up with doctors, provides rides, and plans for the next phase. He has researched medical procedures online. He wishes that he had more meaningful data. Additionally, he wishes that he had some central source of medical care to analyze all of the existing data.

Impromptu Interviews

01 Male, Age 55, Pharmacist

Works at the hospital, so he can and does review his own medical records whenever he wants to. He believes that everyone should have their own record available.

02 Attorney

Has participated in cases of litigation about doctors with handheld devices.

03 Microbiologist

Uses the services of 'Rules-Based Medicine', a company that provides 300+ blood tests bi-annually for a large subscription fee.

04 Herbalist, Supplement expert

Believes our concept could be an interesting application for people to compare traditional medical treatments with their nutritional needs

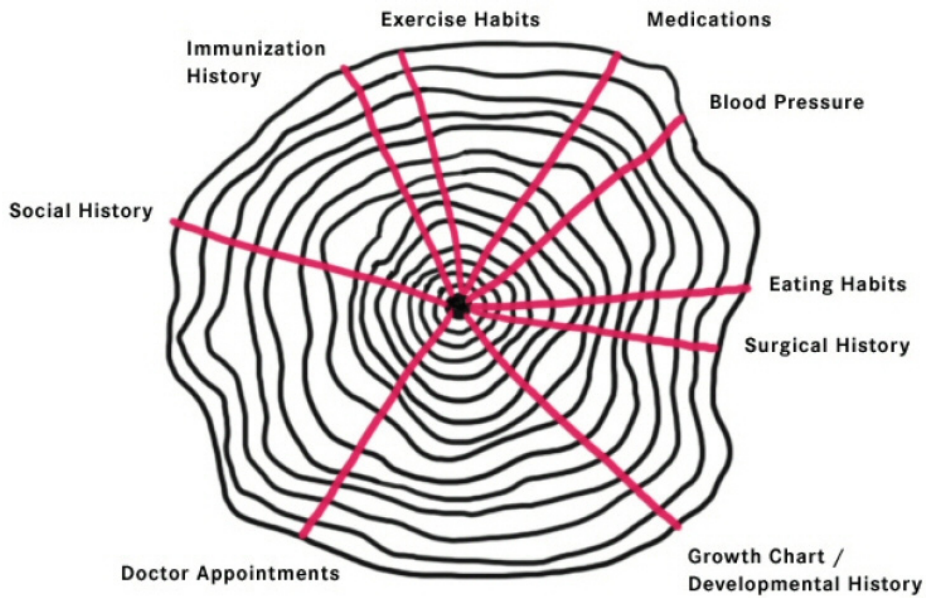
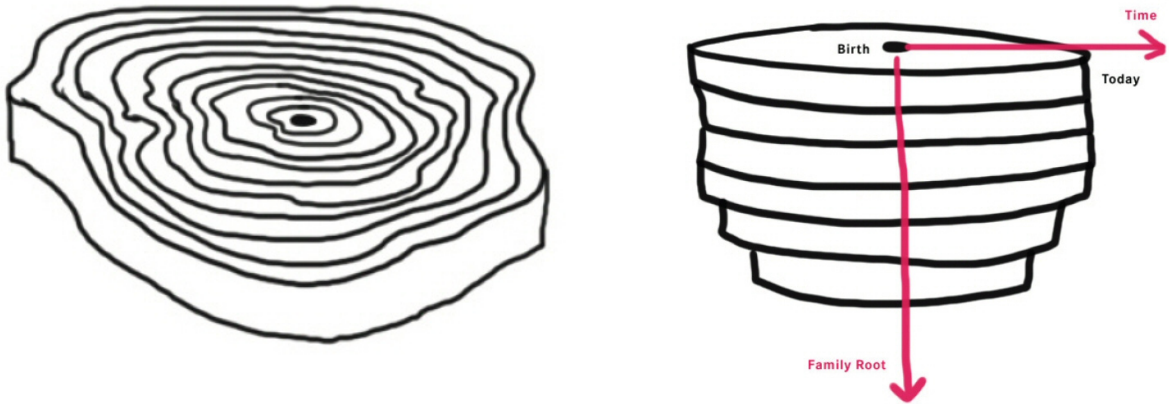
Other Sources of Information

- Personal Experiences
 - Births
 - Surgeries
 - Doctor visits
 - Emergency room visits
- News Articles and Web Links
 - General Medical Records
 - Wearable Health Reports
 - Wikipedia: Electronic Medical Record
 - Wikipedia: Electronic Health Record
 - Wikipedia: Health Informatics
 - For Doctor and Hospital Use
 - Wired.com: Docs for Docs
 - Azyxxi Demonstration
 - Wikipedia: Azyxxi
 - For Consumer Use
 - Revolution Health
 - About the iHealthRecord
 - Cnet Video: Gordon Bell: Storing your life on one terabyte
 - Wired.com: Grow Your Own Digital Med Records
- Television Shows and Channels
 - PBS
 - The Boomer Century
 - UW Medical Channel
 - Stanford Symposium on Remote Operations using DaVinci
- Class discussions
- Internet

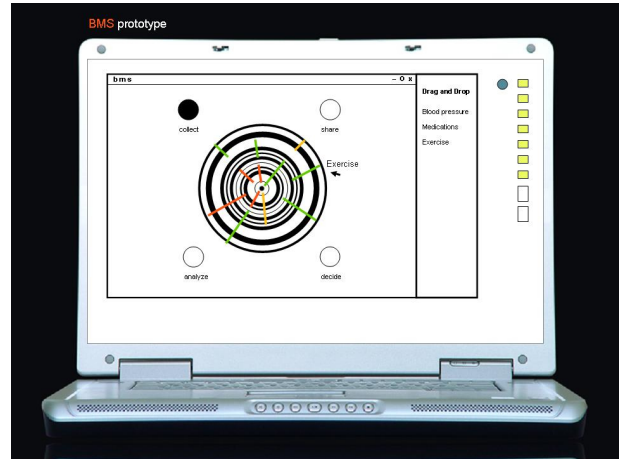
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Product Evolution

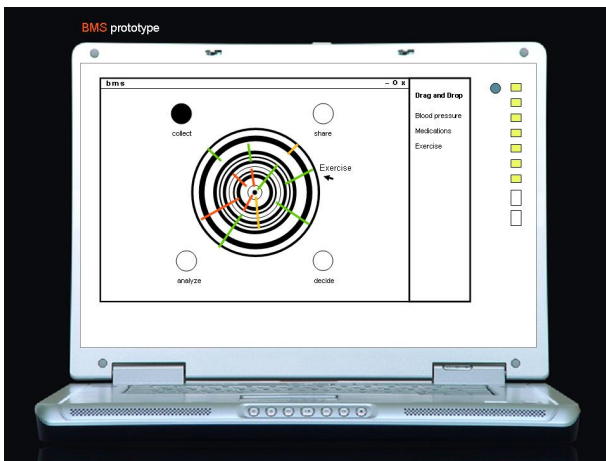
Product Iteration One



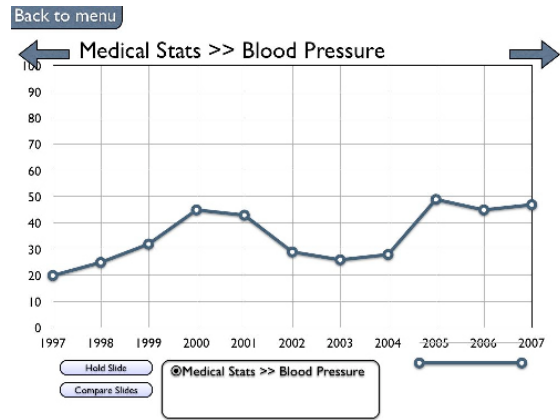
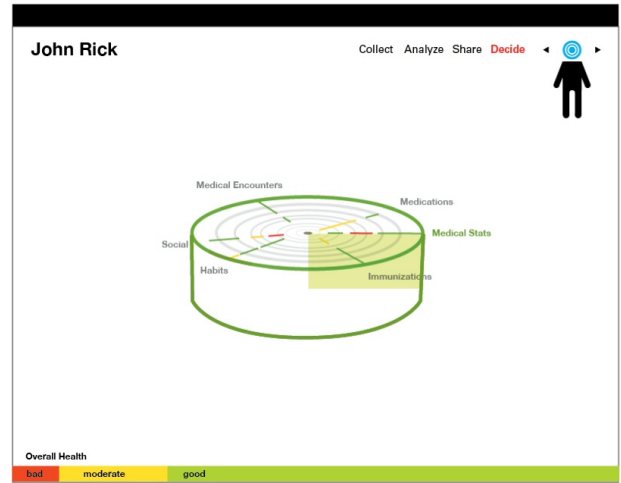
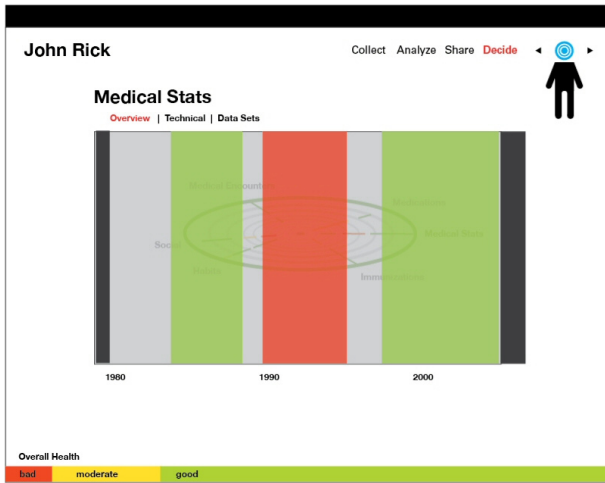
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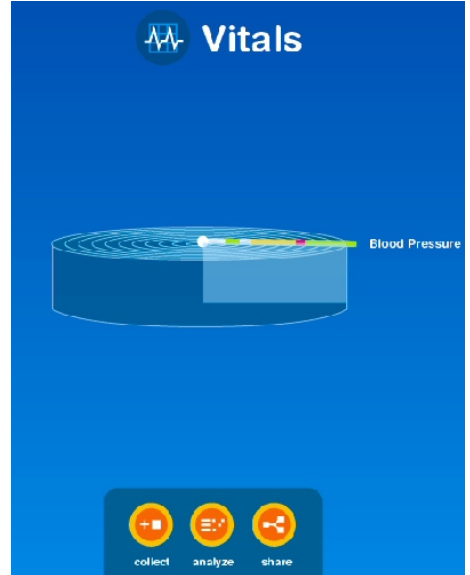


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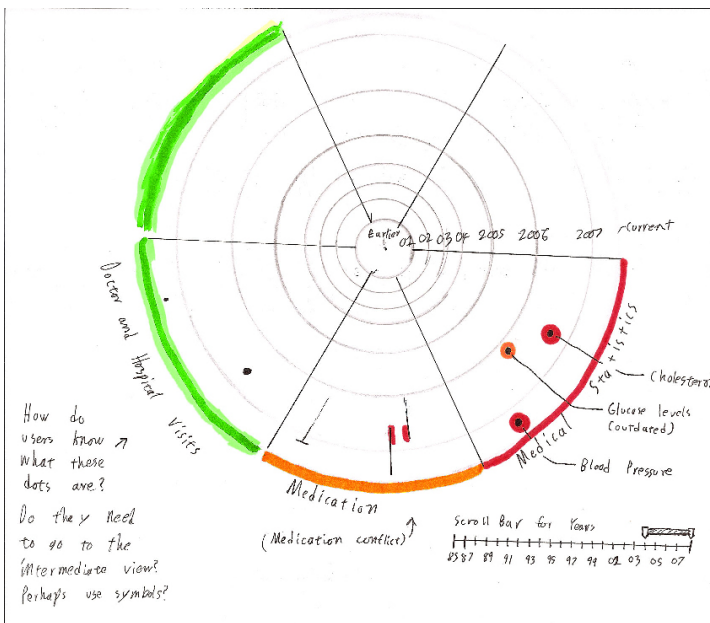


Product Iteration Three





21



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**Final Implementation /
Interface Introduction**

The goal that we aimed to accomplish is to display consumer's medical records in an immediately understandable format.

What type of information is in a medical record that we need to display?

The majority of the information contained within a medical record is raw numbers, such as systolic and diastolic blood pressure. Because of this, we focused on finding a way to organize the numbers into useful displays. Additionally, the raw numbers were usually found within data from a doctor visit as well as lab test results, and many times there were many pages that all related to one specific area (such as Blood Pressure data spread out across 40 different pages).

23

So we have all of these different 'data sets' (e.g. Blood Pressure), and we need a way to sort all of these charts into a central area that is still easily navigable.

Enter, the Tree-Ring view!

How the Tree-Ring View Works

01 The ‘Physics’ of the Tree-Ring

The tree-ring is composed of graphs all rotated around the center axis. Each graph has the left side attached to the center of the tree-ring, where the oldest data is located, and the right side of the graph is attached to the outer edge of the tree-ring, where the newest info is.

The tree-ring itself is divided up into a few general categories, and all of the graphs, (we call them ‘slices’) are contained within those few categories.

02 Status Lights

Status Lights are a way of quickly conveying to the user the general condition of each health section. We decided to use a traffic light analogy, with green, yellow, and red to signify areas of the user’s health that are fine, need attention, or are potentially dangerous. These determinations are based off of the National Institute of Health’s recommended values for different vital areas (e.g. recommended Blood Pressure, recommended Cholesterol levels, etc).

03 Last Updated

Users are able to glance at the sections within the tree-ring and see which sections have been updated recently. The user does not have to hunt and peck for the pertinent areas, as the tree-ring view will show them when each section has been last updated.

Intermediate View

For each section of the Tree-Ring, there is a corresponding Intermediate View. Within this view, users are able to choose from a list each graph that they wish to investigate further. Additionally, the user may select multiple graphs to overlay, in order to get a perspective of how various areas of ones health is affecting other areas.

01 Presets

Choosing which graphs to investigate and then comparing them is decidedly a power-user activity, but we wanted to bring that ability to more casual users of the software. We introduced Presets as a way to show the user graphs that closely relate to each other. Presets are simply groupings of graphs that closely relate; clusters of data sets that all focus around one theme. Some example presets could be “Vitals” as well as “Exercise data”, the latter of which might entail ‘Weight’, ‘Exercise Duration’, ‘Heart Rate’, and ‘Calories’ graphs.

24

Graph View

The Graph View presents a detailed view for users that want to investigate their data further. Within this view, users can see the data from their medical records charted out over several years, not unlike a stock chart. Events such as doctor visits, surgeries, and medications, are also available within this view.

Conclusion

The Tree-Ring, being the initial view the user is presented with, is an “overhead view” in both a figurative and literal sense. The users can see where the problem areas are very quickly, they can see where the most active areas are, and they can see useful combinations of data with little effort.

25

07

Scenario and Interface Walkthrough



SIX KILLERS: Heart Diseases, Lessons of Heart Disease, Learned and Ignored
By Gina Kolata

27

Before Personal Medical Records

Our scenario centers around Keith, a man who had a heart attack at 35 and has a second heart attack at 45, even though he thought he was being a good custodian of his health. While he was losing weight through exercise, he was unknowingly at great risk of a second heart attack because he had stopped taking his medication.

We feel that if he had a medical record visualization tool he could have prevented his second heart attack because he would have been better informed.

After Personal Medical Records

Imagine that before his second heart attack at 45 his doctor provided him with the Personal Medical Records software. His doctor would assign specific 'healthy and unhealthy' ranges for his heart risk areas such as blood pressure, weight, and cholesterol.

Keith logs into his new device and imports his data from his doctors office. This data is all of his medical record that his doctor has access to. His doctors office recently digitized all of their records and from now on are entering record in a purely digital format.

Keith is primarily concerned about all records and data that relate to his cardiac system.

01 Keith's current profile:

Since Keith is closely concerned about his cardiac system, he decided to obtain a digital blood pressure cuff, digital weight scale, electronic cholesterol testing tool, all of which can export data into a format readable by the Personal Medical Records software.

He takes three medications: aspirin, a beta blocker, and an ace inhibitor for his high blood pressure.

He tracks his exercise data by monitoring his target heart rate and the duration of his exercise.

28

02 Tree ring visualization tool in action:

Three status lights on the tree-ring view are glowing red. These sections, vitals, medications, and exercise, are glowing red based upon the 'healthy and unhealthy' ranges that his doctor assigned to his medical profile. The data within these sections are either higher than lower than what is normally healthy, so the status lights serve as a warning for Keith to be aware of what health areas need attention.

03 Tracking Progress:

Keith has been exercising over the last 3 months to lose weight and he wants to see how he's doing.

He first clicks on the Vitals section of the tree ring. Within this section, he wants to compare his statistics, so he puts a check mark after weight, blood pressure, and cholesterol. He then switches from the Vitals section over to the Exercise section, in order to compare his Vitals graphs with some graphs in the Exercise section.

He selects the "Jogging" slice, clicks the "Compare these Graphs" button, then the graphs are displayed on top of each other.

Keith is now able to see how his Jogging has affected his overall health, as well as which areas still need work.

Results over 3 months:

His weight is down, but both his blood pressure and cholesterol are up.

04 Finding Answers:

He is confused by this data, he wants to know why some areas still seem to be unaffected by his exercise.

He clicks a preset group of graphs related to his medications.

The preset graphs Vitals and Medication over a three month time period.

The medication graph has downloaded his prescription information from the pharmacist. This information doesn't include the how long he has actually been taking the medications, so for each medication he assigns the length of time he has actually been taking each medication.

A calendar pops up for each medication and he assigns a three month duration for each medication, beginning when he first bought the medication.

He stopped taking his medication after the third month because he thought he was on his way to a new healthy lifestyle through exercise and that the medication wouldn't be necessary.

05 Saving a life:

Keith sees an immediate correlation between the lack of medications and his blood pressure and cholesterol. When overlaid with the weight and exercise he can see that taking his medications has a greater impact on his blood pressure than exercise had alone.

Keith starts to take his medications again, and after a month he revisits the software to see that the medication and exercise has been working well together to bring his cholesterol and blood pressure down.

06 Communicating with Physician:

Keith goes back to his doctor and talks about developing a more comprehensive plan to treat his medical conditions. He wants to know if his diabetes can be controlled with diet to reduce his blood pressure.

He wants to know if he can replace some of his medication with new ones that make him feel less nauseated.

He wants to be sure that since his blood pressure is still in the yellow range -- the unhealthy range-- that his exercise regiment is not overdoing it.

Overall, he is very excited to use his new tool, since he is confident that he knows where his health is going, and knows that his actions do make a difference in moving closer to a healthy lifestyle.

His doctor believes that he is finally getting through to Keith and that he can now more easily improve Keith's quality of life.

07 Happy Ending:

Keith is able to prevent a second heart attack.

He can use his software to send more frequent reports to his doctor, resulting in improved communication.

He has even found a user group using this software to track similar conditions.

He has generally been empowered to make changes in his health and encouraged to get involved.

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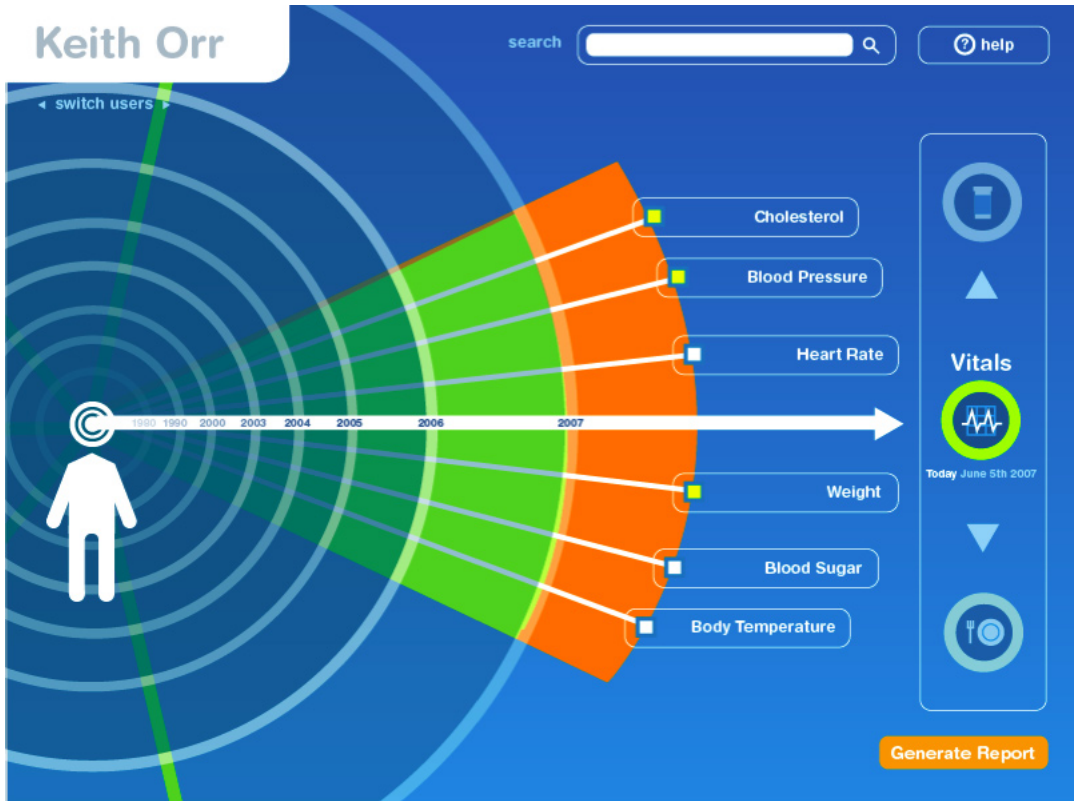


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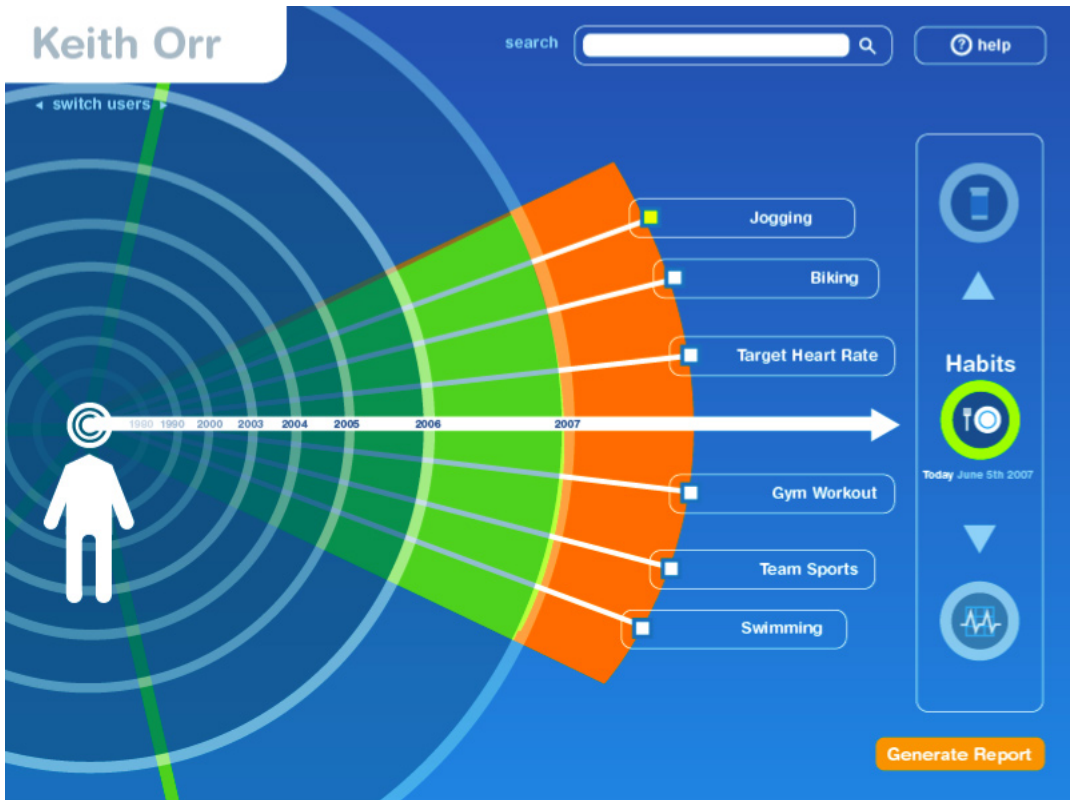


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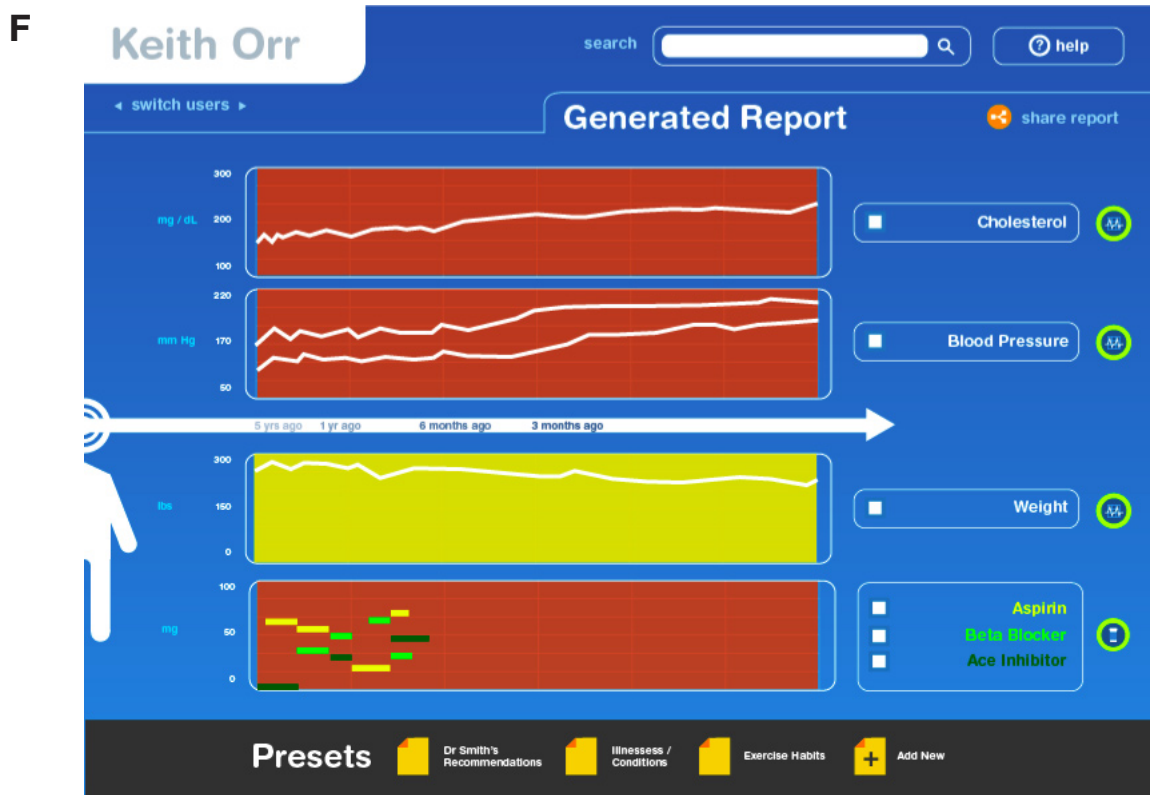
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Conclusion

The Problem

Most consumers don't currently have access to their own medical records, although this information is very pertinent to their everyday health. Hospitals are digitizing their systems, though these systems are meant for use by doctors, hospitals, and insurance companies. When consumers do get a copy of their digital medical record, it often will be a PDF file with more pages than the user could ever manage to sort through.

Our Solution

Our primary goal is to collect, store, and display the user's medical records and other health data in one central, easily accessible piece of software.

Through these functions we aim to provide the user with a map of the users health that helps them see "The Big Picture".

The user will not have to navigate through individual medical report pages or multiple pages of lab results; the information will be consolidated by category.

We are providing an access point for the consumers to view their own health information.

Our Product

This product provides a visual map of your health history that helps you see your health over time. You can use this product to spot trends in your health changes, to share data with doctors, and to learn how areas of your health have affected other areas of your health.

With several views available to the user, the Personal Medical Records software provides various levels of detail. The users can see where the problem areas are very quickly, they can see where the most active areas are, and they can see useful combinations of data with little effort. If they wish to investigate further, they can access a more detailed view that shows the trends in their health statistics. Even then, the software makes it makes it easy to view their health history.