

hGraph: An Open System for Visualizing Personal Health Metrics

Jonathan Follett
Juhan Sonin

Introduction:
The Coming
Sea Change
in the
Experience of
Healthcare

There's no question that, in the United States, the inefficient delivery of healthcare rates chief among our societal problems of this young century. In particular, the design of healthcare experience is ripe for improvement. At the moment, our healthcare system is dominated by an almost entirely reactive model, aimed at care of the sick, not a preventative, proactive one built around improving the wellness of the individual. While this reactive approach to healthcare is changing, a great opportunity exists to enable healthcare professionals to better access and analyze patients' records and similarly to allow people to own and interact with their healthcare data.

To further understand this multi-faceted problem, as well as the coming sea change in the way we experience healthcare, it's worth examining four converging trends: the quantified self, a boom in software for mobile devices, a universal push for measurement and data analytics, and a dramatic increase in public funding for health care information technology.

The Quantified Self

The quantified self movement, in which adherents measure and record personal health data for self-tracking, aptly demonstrates the application of readily available monitoring technology to day-to-day living and health related activities.

As the costs of sensors and measurement technology drops to almost zero, regular and accurate readings of key health metrics becomes not only possible, but affordable as well. And while the quantified self movement does not purport to be solely focused on healthcare, it clearly shows the

evolution of self-monitoring and the potential for acquiring personal health data in a proactive way.

Explosive Growth of Mobile Devices

Similarly, the explosion of the mobile device market over the past three years has greatly increased the consumer understanding of, comfortability with, and demand for software. Software is no longer confined to our desktops at home or at work; It is with us every moment of the day.

The Rise of Analytics

In parallel to this mobile software boom is a subsequent increase in the amount of personal data being collected, which drives a burgeoning need for information visualization and analytics as well as an increase in total understanding of visual depictions of data.

On the consumer side of the equation, health monitoring products like the Jawbone UP and Fitbit, capable of tracking physical activity, sleep cycles, food consumption and the like, illustrate the growing demand for measurement tools and analytics software.

Public Funding for Healthcare Technology

Lastly, and perhaps most importantly, in 2009, the US government, through the Health Information Technology for Economic and Clinical Health Act (HITECH), a section of the American Recovery and Reinvestment Act (ARRA), designated \$20 billion in incentives through Medicare and Medicaid to assist organizations in the adoption of Electronic Health Records (EHR). Electronic Health Records enable doctors and nurses access to more information about a patient, and more quickly and efficiently understand their total health picture. Additionally, the records enable patients to easily share their data with other health care providers and their families.

Information
Visualization
for the
Healthcare Field

As we slowly pivot toward a proactive perspective on healthcare, there's a growing need for individual measurement and understanding of health related metrics, as well as standard, easily comprehensible graphical depictions of data for health care practitioners and patients alike.

People need to be able to actively use and benefit from the healthcare data collected about them, while avoiding information overload. Here, the healthcare experience is ripe for improvement. Like most information heavy fields, it is fraught with the problems caused by too much data with no easy way to sort it all.

Additionally, as the transformation from paper to electronic records takes place, we must provide software tools to health care providers that enable the decision grade analysis.

In order to gain insight into the complex, multi-dimensional data sets that represent health metrics healthcare data requires visual representations that are engaging, optimized for use by both the health care provider and the patient, and support high level pattern recognition and analysis as well as the ability to see deeper details.

The hGraph Information Visualization

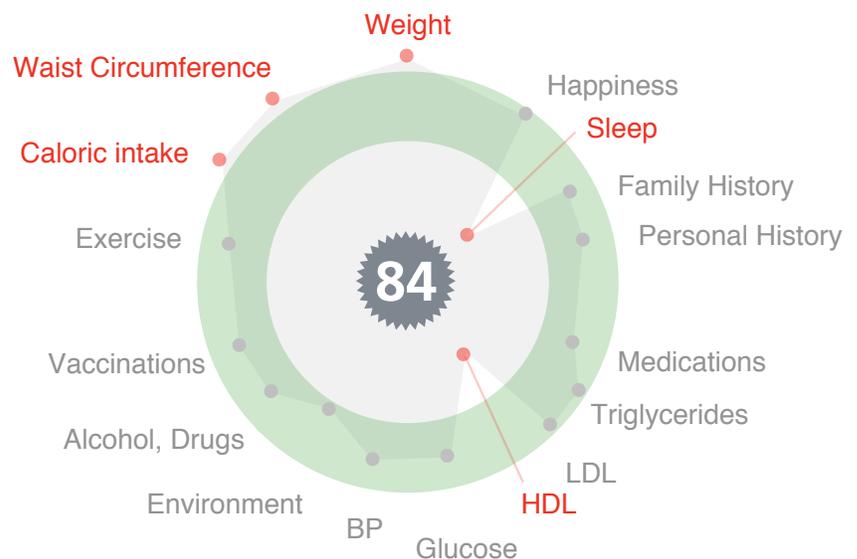
The History of hGraph

In August, 2010, the MITRE Corporation publicly released a paper on the open source hGraph project, entitled “hGraph: Your Health in One Picture”, which described the use of a single information visualization to depict a person’s health. The authors of this paper were Sam Birch, Snyukta Inamdar, Harry Sleeper, and Juhan Sonin.

One of the insights that these original designers brought to this visualization technique was normalizing the scales used for depicting the various health care metrics in hGraph. The green circle in the graph represents the good area for a particular metric, while the area either inside or outside the circle represents the bad, either too high or too low. In this deceptively simple fashion then, the design of hGraph enables the compilation and display of much information within a relatively limited space.

Mobile Application and Health Ecosystem

The initial paper outlined a mobile application for hGraph, which would enable people to create their personal visualization based on certain health metrics — including weight, caloric intake, exercise, sleep, and alcohol consumption, among others — and update those metrics as they changed over time. The hGraph mobile application was imagined as part of a larger



ecosystem in which patients would be able to interact with a network of clinics and doctors that would support a preventative health care model.

Ongoing Development

Since 2010, the hGraph concept has been further developed by private companies including Involution Studios in Arlington, Massachusetts and CrossOver Health, in Aliso Viejo, California, in line with its original purpose — to provide a single source representation of a person’s overall health state — given the great need for standardization of health information visualizations.

The Benefits of hGraph



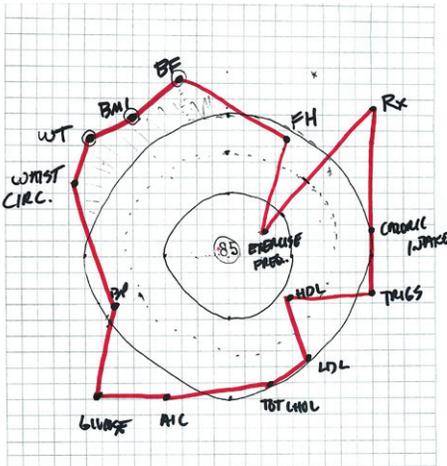
This mini visualization of hGraph conveys valuable data, as does its much larger counterpart below.

hGraph is particularly well-suited for viewing complex healthcare data.

One Graph for All Metrics

hGraph provides a complete overview of an individual’s health. This single picture method can have a profound effect on a person’s understanding of their total well being, because it compiles multiple metrics into a unified graph that can be viewed at a glance.





An hGraph sketch depicting a 56 year old male with diabetes

A Visualization System for Many Scenarios

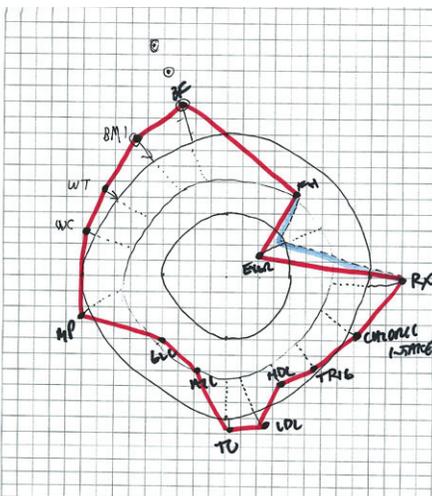
hGraph can be used in a variety of scenarios, wherever a quick visualization would be valuable, because it effectively conveys important data at sizes both large and small.

Data Input Flexibility

Similarly, hGraph can accommodate both small and large amounts of data. The visualization scales easily as more metrics are added.

Highlighting of Abnormal Metrics

It's easy for the hGraph user to identify metrics that exist in a normal range, versus those that may be too high or low. The normal range for a particular metric is shown the green zone on the chart, while metrics outside normal range are highlighted only if they are currently problematic



An hGraph sketch depicting a 46 year old female with hypertension

Identifying Condition Patterns

Healthcare information visualizations should enable pattern recognition. With hGraph, healthcare providers and patients can learn to recognize representative visualizations for common disease states.

Health Score

The hGraph health score, the algorithm for which is described in detail in "hGraph: Your Health in One Picture", is based on a formula that weighs metrics differently based on their contribution to overall health. It provides an easily understood numerical confirmation of the total data picture presented in the graph.

Opportunities for Implementing hGraph

At the moment, healthcare data visualization for patients are few and far between and those for providers are not well understood or widely distributed. General visualization solutions, while powerful, are inaccessible to those who lack the ability to customize to their particular healthcare data set. Proprietary software solutions are unlikely to take hold in great enough numbers that they can provide universal access and a standard. And consumer software / hardware products like the Jawbone UP limit the total universe of health data to what the device can measure itself.

If electronic health records are to be successfully implemented over the coming five years, we will need methods of viewing the data in aggregate. hGraph fills a desperate need for a standards in information visualization for EHR.

Given the trends towards preventative health care, responsibility for your own wellness, combined with a willingness to measure data, learn, and take steps to improve your lifestyle will become the tenets of the new paradigm. While patients have the legal right to request their medical records, at least in the U.S., this data remains the property of the healthcare provider, which means that a simple but comprehensive visualization of health state is an imperative from public health standpoint.

The open source nature of the hGraph visualization specification — which is distributed under the Apache license — means that it can be modified, improved, and incorporated into software systems with minimal overhead.

hGraph Design Consulting

For further information on hGraph or information visualization for healthcare software user experience, please contact Involution Studios at info@goinvo.com or call (617) 803-7043.

INVOLUTION BACKGROUND

Involution Studios was incorporated in 2004 in Palo Alto, California, with a second office in Arlington, Massachusetts. Over the last seven years we have worked with over 150 different companies providing application design for web, desktop, and a variety of mobile and alternate platforms. Today we are headquartered in Arlington, Massachusetts and service customers across the United States. The biggest and best technology companies in the world trust us as their software design partner, along with notable non-technology companies.

OUR CLIENTS



OUR SERVICES

We offer the entire gamut of services related to the design and development of software, including:

- ✦ Management consulting
- ✦ User research
- ✦ Business / technical / user requirements
- ✦ Product strategy
- ✦ Use case exploration, validation and writing
- ✦ Product planning and architecture
- ✦ Technical planning and architecture
- ✦ Product design and development
- ✦ User testing and quality assurance
- ✦ Technical writing
- ✦ Integration and deployment
- ✦ Field training
- ✦ Product testing and documentation
- ✦ Product re-orientation for next release candidate

While the majority of our engagements fall within the areas of product architecture, design, and front-end development; we have also led McAfee and Oracle to build from scratch new user experience teams, completely overhaul their engineering organizations and—in Oracle's case—implement an agile development process to replace that team's traditional waterfall approach.