



# Data Empowering Patients

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# The Internet of Me: Data Empowering Patients

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I could not figure out  
how to **take my pulse.**

**Exercise** >>>

**1 sec**





A photograph of a hospital room, including a gurney, medical equipment, and a window, overlaid with a semi-transparent red filter. Large white text is centered over the image.

270

*beats per minute*

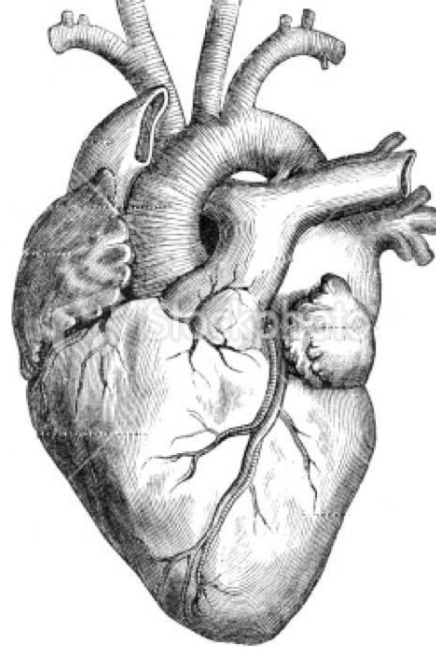




# *Maui, Hawaii*



atrioventricular node ablation  
*(electrocutation)*





# 100%

*battery dependent*



*How would I feel?*

*What would a pacemaker look like in my chest?*

*Would I ever wear a swimsuit again?*





**6 pacemakers**

*Am I really a **heart patient**?*

*How do I prepare for **open heart surgery**?*

*I need a goal: **LOTOJA Classic bike race**!*







*Everything was going so well...*







## *post-surgery training plan*



a production of

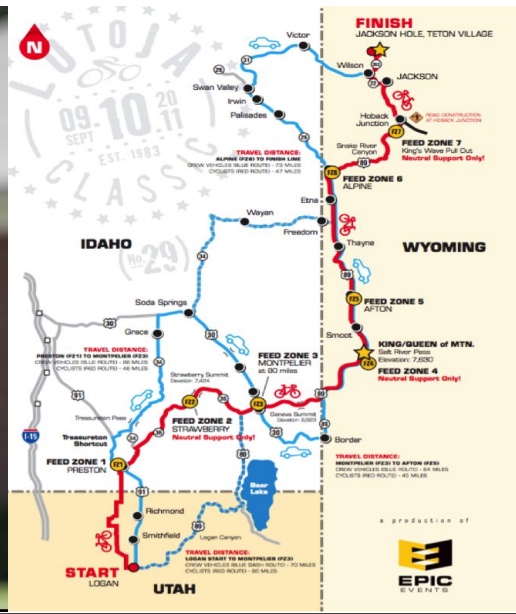


LOTTOJA  
1 DAY / 2 STATES / 206 MILES

1:51:41







## Field testing:

I refuse to sit still. Since having open heart and lung surgery in 2010, I've competed in multiple 200-mile, single-day road and gravel bike races around the world.

This has given me a unique experience as to how data collection, analysis and management can prove beneficial to personal health.



145677825 678 47880 15007 78155 33344 8078966811316  
8124533 81234 78288 9670861 416 16128 8678 13888133845  
3456 456 878 14567 13456 78910 11234  
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2345678910 578  
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# Healthcare: A Patient's Perspective

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9123 456 889 32345 25678 92345 80678  
O<sup>-</sup>  
O=P-O<sup>-</sup>



# Data to live my life... and keep my Doctors in the Loop

I have relied on machines for 30 years.

100% dependent on a pacemaker (on my seventh one).

Current Boston Scientific device collects data on every heartbeat, checks for abnormal rhythms, and monitors voltage settings and battery life. The information is transferred via a wifi-enabled communicator and made available to doctor for analysis.





# Data from my Pacemaker:

LATITUDE® Patient Management - Combined Follow-up Report

Report Created: Jun 22, 2016



Dohse, Heidi (01126890)

Date of Birth: Jan 23, 1964  
 Device: ADVANTIO K063/121439  
 Clinic: UCSF EP & Device Clinic  
 Search Tags: PACER

Latest Device Transmission: Apr 11, 2016 13:38 EDT  
 Last Office Interrogation: Apr 06, 2016  
 Implant Date: Jan 31, 2013  
 Patient Group: All patients (Primary)

## My Alerts

There are no alerts to display.

## Events Since Last Reset (Apr 06, 2016)

Apr 10, 2016 23:48 RV Auto

## Battery OK

Approximate time to explant: 6 years from Apr 11, 2016

Magnet Rate 100 ppm

One Year Remaining



Explant

See last page for additional battery information.

Leads	Implant (Jan 31, 2013)	Most Recent In-Office Measurement (Apr 06, 2016)	Most Recent Daily Measurement (Apr 10, 2016)
<b>Atrial</b>			
Intrinsic Amplitude	2.0 mV	1.8 mV	1.7 mV
Pace Impedance	650 Ω	832 Ω	794 Ω
Pace Threshold	0.6 V @ 0.4 ms	0.7 V @ 0.4 ms	
<b>Ventricular</b>			
Intrinsic Amplitude	N/R	N/R	N/R
Pace Impedance	500 Ω	534 Ω	508 Ω
Pace Threshold	0.7 V @ 0.4 ms	Auto 0.8 V @ 0.4 ms	0.8 V @ 0.4 ms

## Settings

### Ventricular Tachy

Ventricular Tachy EGM Storage On  
 Detection Rate 190 bpm (316 ms)

### Atrial Tachy

ATR Mode Switch 190 bpm DDIR  
 Pacing Output  
 Atrial 2.5 V @ 0.4 ms  
 Ventricular Auto 1.3 V @ 0.4 ms

### Brady

Mode DDD  
 Sensitivity  
 Atrial Fixed 0.5 mV  
 Ventricular Fixed 2.5 mV

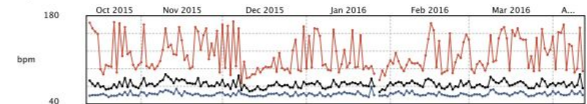
Leads Configuration (Pace/Sense)  
 Atrial Bipolar  
 Ventricular Bipolar

Rate Adaptive Pacing  
 Minute Ventilation ATR Only  
 Accelerometer ATR Only

## Trend Graphs

Most Recent Measurement: Apr 11, 2016

### Heart Rate



### AT/AF Burden



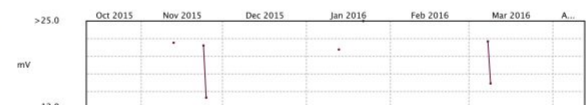
### Atrial Intrinsic Amplitude



### Atrial Pace Impedance



### Ventricular Intrinsic Amplitude



### Ventricular Pace Impedance



### Ventricular Auto Pace Threshold



VARIANTS

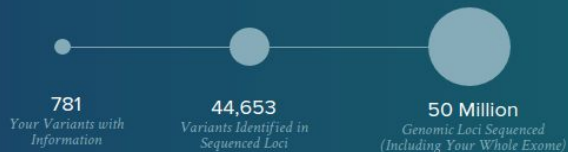
781

[View variants](#)

Your Variants with Information

This tool enables you to learn more about genomics by exploring your variants that have information.

[Genetics 101 >](#)



CONDITIONS



View conditions associated with your variants with information

TRAITS



Learn how the variants found in your genome influence your traits.

VARIANTS



Explore the list of your variants that have information.

MAP OF CHROMOSOMES You have 781 variants with information in your genome. Choose a chromosome to zoom in.



Disclaimer: This tool enables users to explore their genomic variants identified by comparing their DNA sequence to a standard reference genome maintained by the Genome Reference Consortium (GRC). The information that can be accessed through this tool does not provide a diagnosis, prediction, prognosis or other medical advice of any kind.

[View Variants Report](#)

# Genomic Data:

- Link to heart issues?
- Donate to research

# Genome Variant Details:

There are 536 conditions in [NHGRI CGD](#) associated with genes where you have variants with information.



## CARDIOVASCULAR

You have 176 conditions with findings in this category.



Remember, you may see variants that have been associated with medical conditions in the scientific literature. That doesn't mean you have those conditions. Genos is not intended for diagnostic or prognostic use. If you have any health-related questions about your DNA sequence information, contact your doctor.

Condition Name ▾

Search  X

Condition	Variants	Assessments
<b>Acrodysostosis 1, with or without hormone resistance</b> <i>Cardiovascular, Dermatologic, Endocrine, Musculoskeletal, Neurologic, Oncologic</i>	1	1
<b>Acute myeloid leukemia, familial</b> <i>Oncologic, Allergy/Immunology/Infectious, Cardiovascular, Audiologic/Otolaryngologic, Dermatologic, Hematologic, Pulmonary</i>	1	1
<b>Acyl-CoA dehydrogenase, very long chain, deficiency of</b>	1	1



# The impact technology, devices and data have had:

Devices offer a **“window”**  
into my body

## Better discussions with my care team

It is not just about how “I feel”  
but having actual data points to  
support what is or is not going  
on!

## Not all successful “healthcare” comes from the clinic:

Peer-to-peer support and  
sharing of information.

No one understands like  
someone that has been there.

Online support communities

## Overcoming the fear:



## HIPAA AUTHORIZATION FORM B

(This brings in your medical records from other doctors, therapists, hospitals, etc.)

Printed Name:

I, hereby authorize (insert name of practice / person)

Phone#  Fax#

to release the following information: (Please be specific and check those that apply)

<input type="checkbox"/>	History & Physical	<input type="checkbox"/>	Activity / Occupational Assessment
<input type="checkbox"/>	Psychiatric Assessment	<input type="checkbox"/>	Clinical & Laboratory Results
<input type="checkbox"/>	Psychological Evaluation	<input type="checkbox"/>	Pregnancy Status
<input type="checkbox"/>	Treatment Plan / Report	<input type="checkbox"/>	Discharge summary from @ facility/practice
<input type="checkbox"/>	Vocational Assessment	<input type="checkbox"/>	Transfer Forms
<input type="checkbox"/>	Physician Progress Notes	<input type="checkbox"/>	Radiology Films or Disk and Reports

To: Jonathan Woodcock, MD, Neurological Rehabilitation Resources, PC  
C/O: Sara Burns, 8515 Pearl Street, #203, Thornton, CO 8022, Fax: 303-288-7874 / Email: [info@nrmd.com](mailto:info@nrmd.com)

Neurological Rehabilitation Resources does not pay for copying or mailing fees. These fees are the responsibility of the patient or the authorized personal representative. **(Please do not fax over 25 pages)**

**This Private Health Information (PHI) is being used or disclosed for carrying out treatment, evaluation, disability evaluation, payment and/or:** \_\_\_\_\_

*(HIPAA requires you to provide a specific reason(s))*

This authorization shall be in force and effect until (specify date) \_\_\_\_\_ or (specify an event that relates to the patient or the purpose of the use or disclosure) \_\_\_\_\_ at which time this authorization is to be used and the disclosures expiration. I understand that I have the right to revoke this authorization, in writing, at any time by sending a revocation.

I understand that the information used or disclosed pursuant to this authorization may be subject to re-disclosure by the recipient and may no longer be protected by federal or state law. I understand that I have the right to inspect or copy the PHI to be used or disclosed as permitted under federal or state law. I understand that I have the right to refuse to sign this authorization.

Patient's Social Security #  Patient's Date of Birth

Signature of Patient or Personal Representative: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Patient or Personal Representative: \_\_\_\_\_

Description of Personal Representatives Authority: \_\_\_\_\_

**This form may be photocopied.  
Each entity/person releasing your medical records needs a separate form.**



Everytime we go to the doctor in the United States we are handed the HIPAA consent form. We are conditioned to think that horrible things will happen should anyone even glance at our medical data.



When your quality of and length of life is dependant on the medical world making advances, you don't mind sharing your data.

Personally, I just want to control who is using it and for what. I want to give the consent and be valued for my contribution.







# Current State of Healthcare Technology

145677825-678 47880 15007 78152 33344 8578995811316  
8124533 81234 78288 9670864 416 14738 9876 1398911324567  
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145677825-678 47880 15007 78152 33344 8578995811316  
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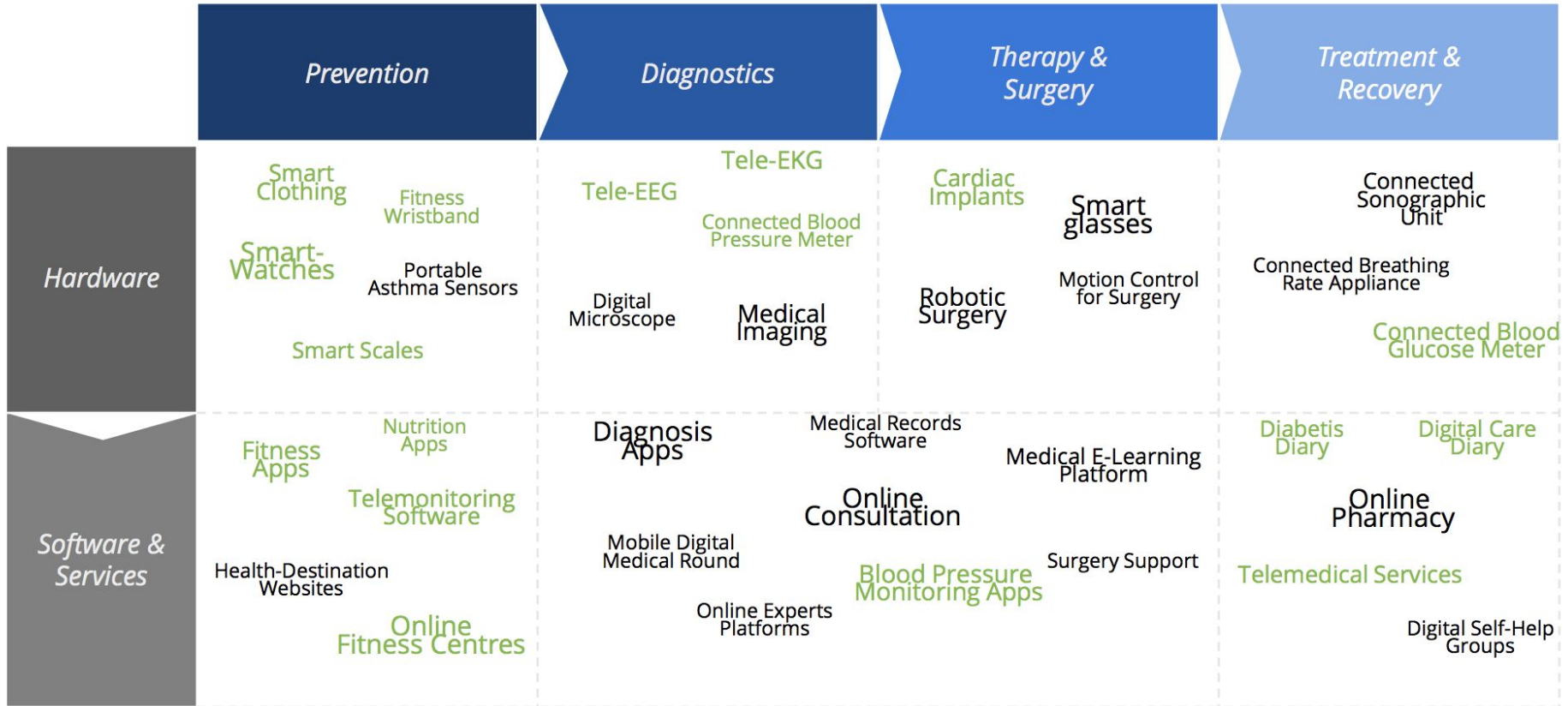
Chemical structures and network diagram illustrating molecular interactions and connectivity.

# Healthcare Market Segments:

"Legacy" Healthcare Systems	Future of healthcare: "Disruptors"	Research
<b>Payers and Providers</b> <ul style="list-style-type: none"><li>• Hospitals / Clinics</li><li>• Insurance companies</li></ul>	<b>Patient Centered Care</b> <ul style="list-style-type: none"><li>• Telemedicine</li><li>• Customized care</li></ul>	<b>Pharma / Medical</b> <ul style="list-style-type: none"><li>• Population Health</li><li>• Big Data / Genomics</li></ul>
<b>Opportunities:</b> <ul style="list-style-type: none"><li>• Data interoperability between EHR systems and patient portals</li><li>• Image archiving / data storage</li></ul>	<b>Opportunities:</b> <ul style="list-style-type: none"><li>• Patient generated data</li><li>• IoMT / Sensors / Wearables</li><li>• Smart Home</li><li>• Doctor on your mobile device</li></ul>	<b>Opportunities:</b> <ul style="list-style-type: none"><li>• Find the "needle in a haystack" for diagnosis and treatment of disease</li><li>• Machine Learning</li></ul>
<b>Key to success: Data must be interoperable and flow across segments</b>		



# Healthcare IT Scenarios:



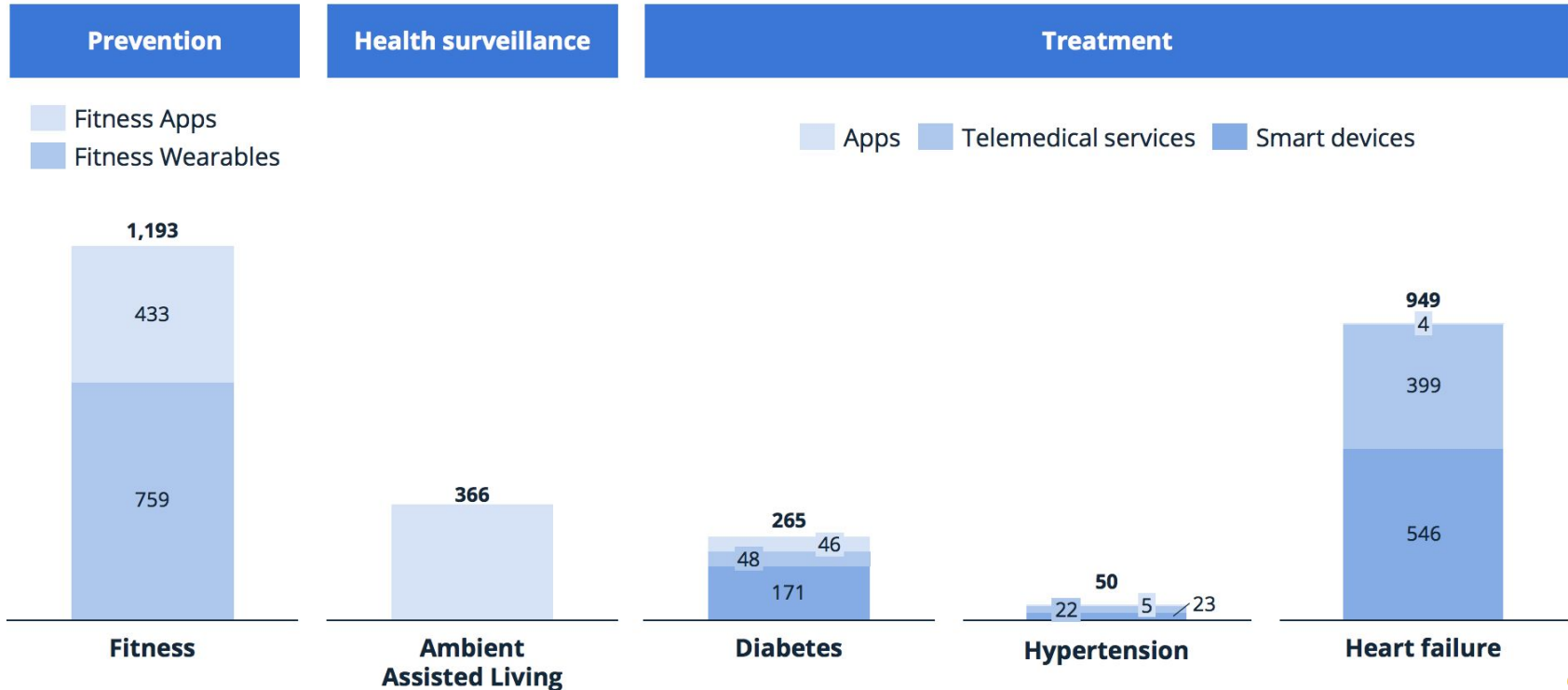




# IoT & App eHealth Opportunities

# eHealth Trends: Fitness and Heart Failure Solutions

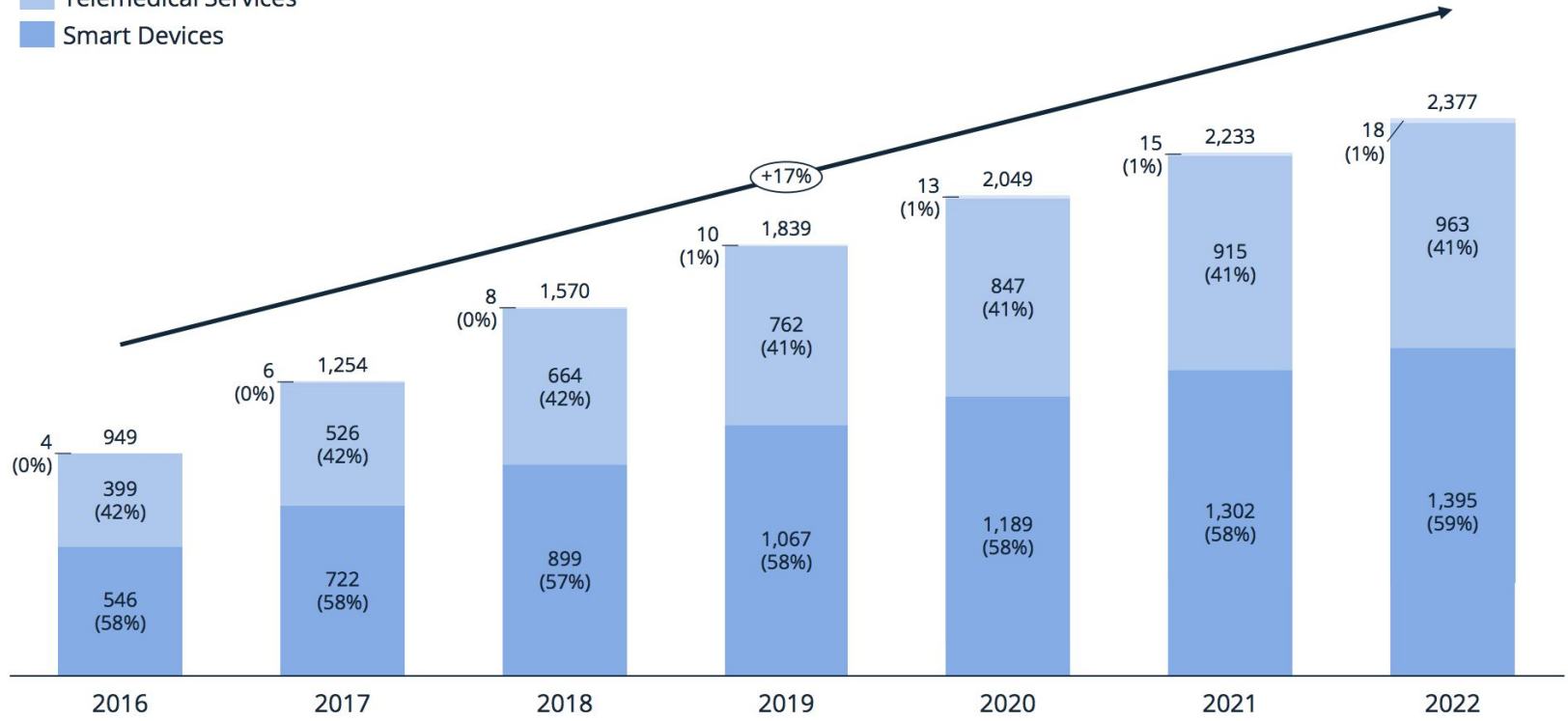
Revenue eHealth products in the U.S. in million US\$ in 2016



# Revenue Growth of Heart Failure eHealth solutions from 2017 to 2022:

Revenue forecast for 'eHealth solutions for Heart Failure' in the U.S. in million US\$

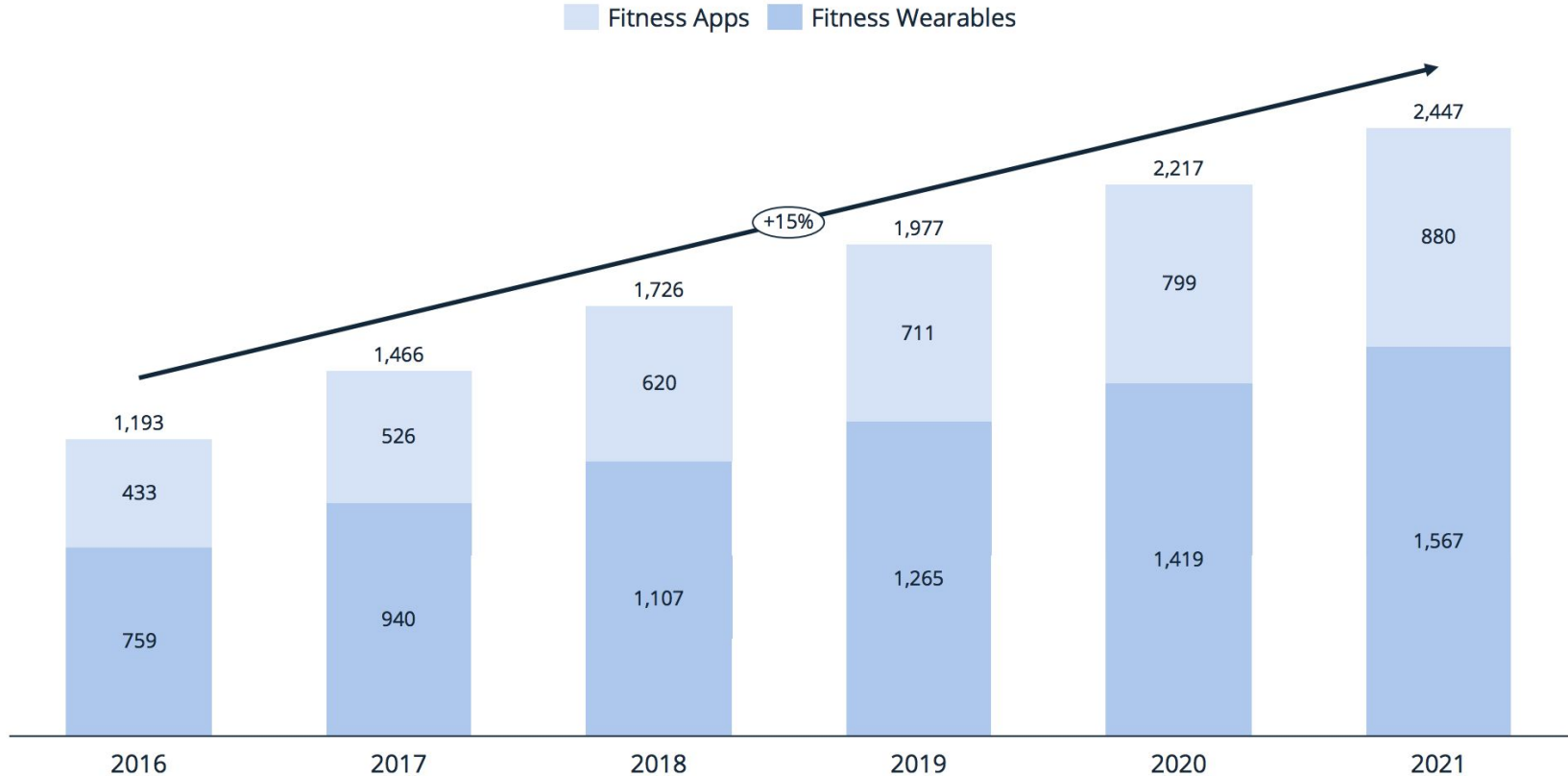
- Apps
- Telemedical Services
- Smart Devices





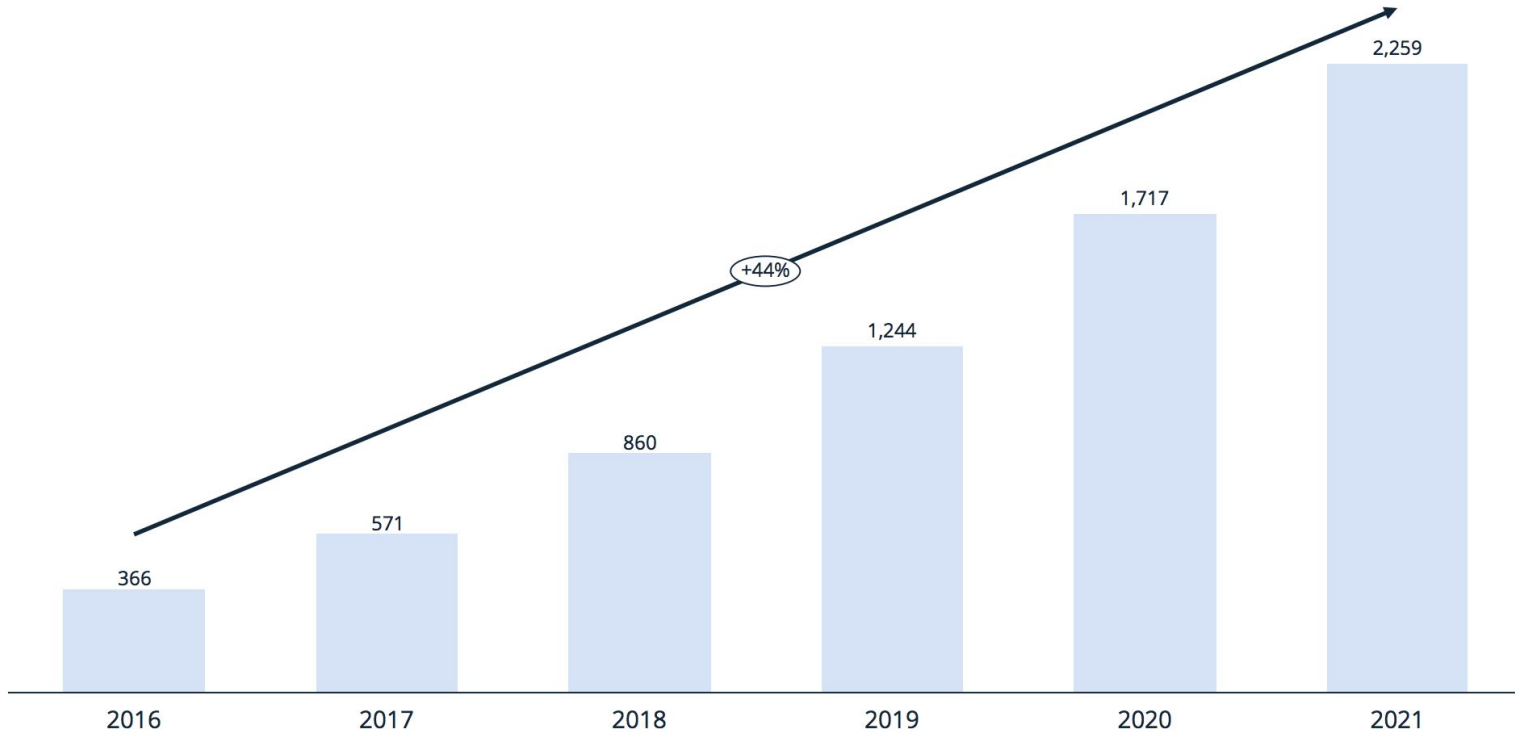
# Fitness Products will continue to grow:

Revenue forecast for fitness products in the U.S. in million US\$

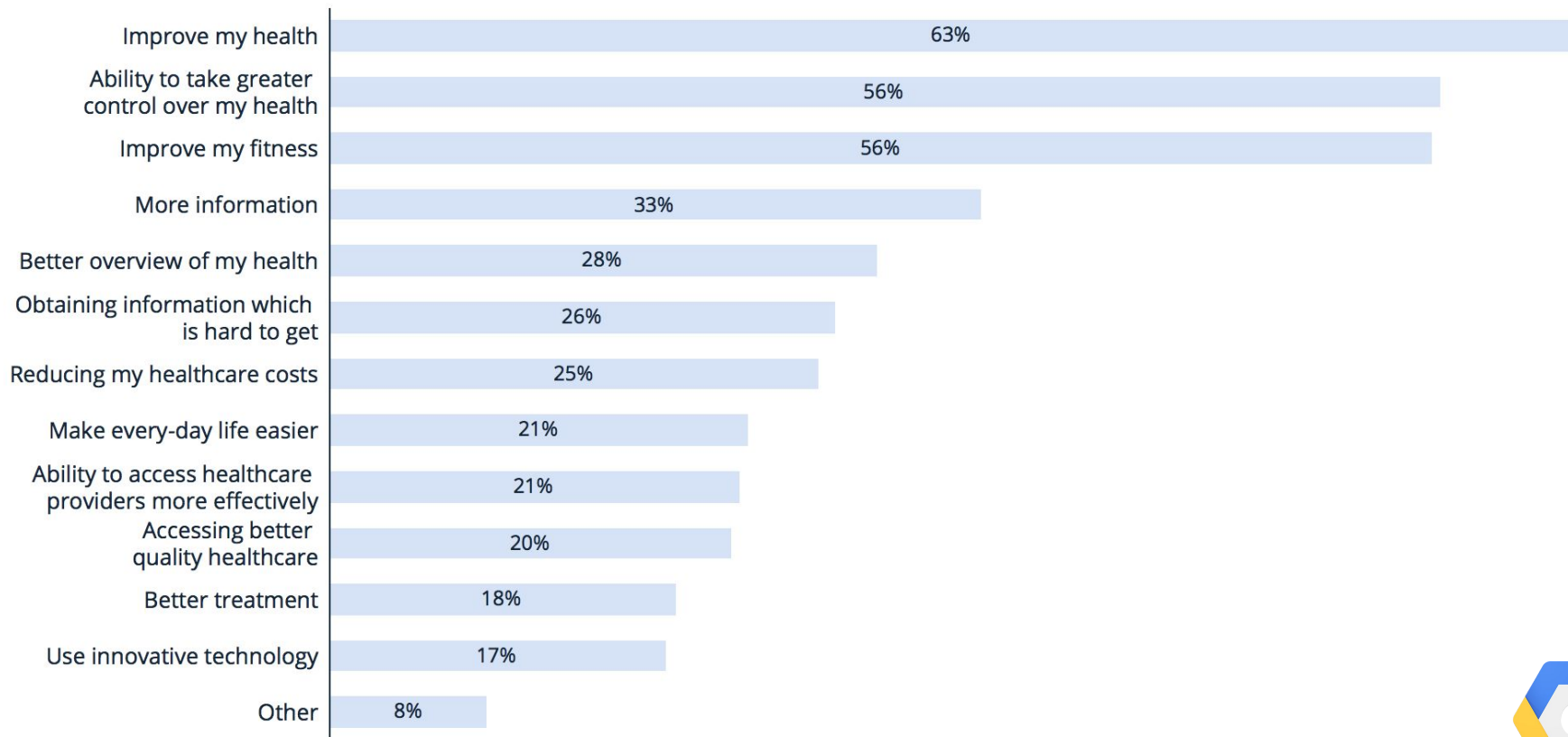


# Ambient Assisted Living Products are Growing Fast:

Revenue forecast for AAL products in the U.S. in million US\$



# eHealth User Adoption Potential:



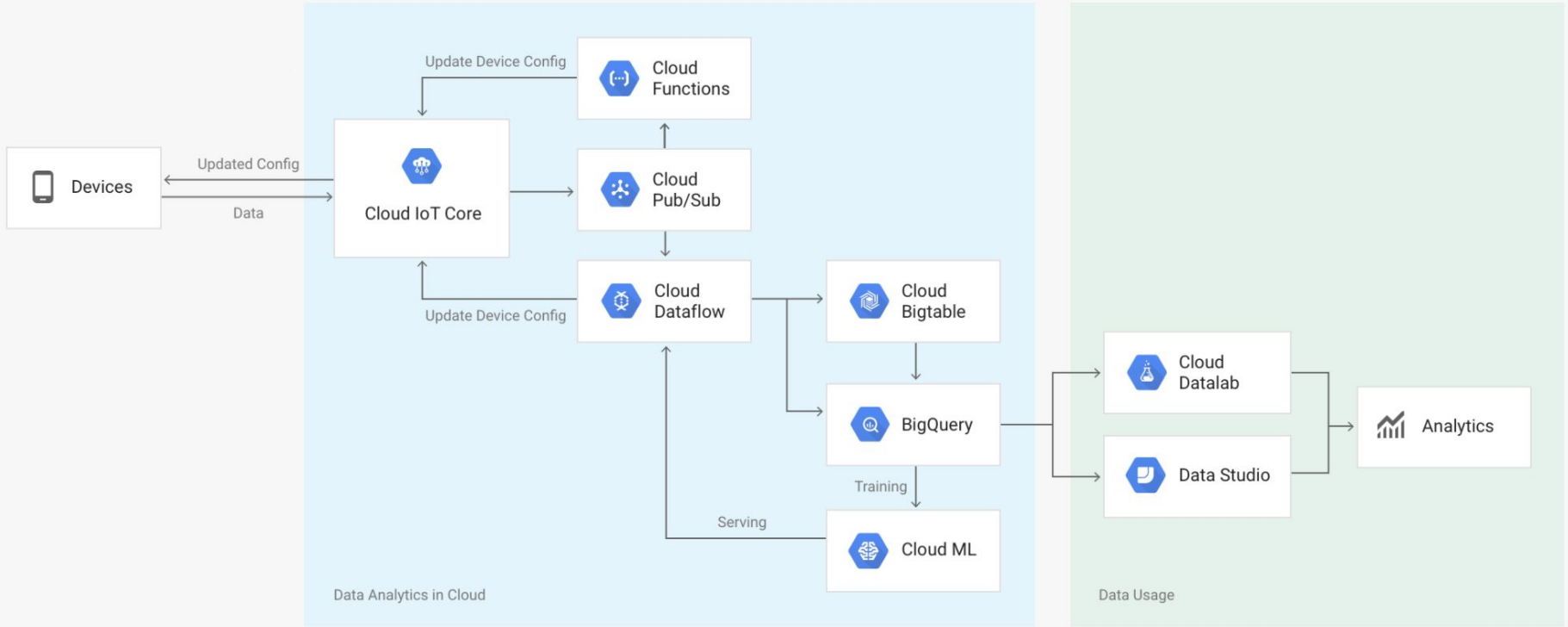


# Cloud Solutions to Support eHealth



Google Cloud Platform

# Cloud IoT Core: Real Time Stream Processing - eHealth IoT



# Cloud IoT Core: Secure device connection and management

## End-to-end security

Enable end-to-end security using asymmetric key authentication over TLS 1.2; CA signed certificates can be used to verify device ownership. Devices running Android Things or supporting the Cloud IoT Core security requirements can deliver full-stack security.

## Single global system

Connect all devices and gateways to Google Cloud over standard protocols, such as MQTT and HTTP, through the protocol endpoints and manage all your devices as a single global system. The service uses Cloud Pub/Sub underneath, which retains data for 7 days.

## Out-of-box data insights

Use downstream analytic systems by integrating with Google Big Data Analytics and ML services such as Dataflow, BigQuery, Bigtable, ML, Data Studio, or partner BI tools.

## Fully managed and scalable

The service is serverless and doesn't require any upfront software installation. It scales instantly without limits using horizontal scaling of Google Cloud Platform.

## Role-level access control

Apply IAM roles to device registries to control user access to devices and data

## Device deployment at scale

Use REST APIs to automatically manage the registration, deployment, and operation of devices at scale. Also, use the APIs to retrieve and update device properties and state even when the devices are not connected.





Researchers



Health Providers / Payers



Patients

## Analysis Engine



Medical Records



Genomics



Devices



Imaging



Patient Reports



Public Data



Controlled Access Data

# Digital Healthcare is changing how individuals manage and allocate their data:



Health eHeart™

Study

[www.health-eheartstudy.org](http://www.health-eheartstudy.org)



Using patient-generated data to change how heart disease is diagnosed and treated.



Patients are considered peers with researchers and doctors and have a voice.



Big Data buckets that can be shared, **with patient consent**, with other researchers.



14982 3274 12447 26434  
8124533 81234 78288 9670864 416 16728 16278 130001302645  
**4567**  
2345353247 576  
6789 7891 912 300019800

# Conclusions

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9123 456 809 32345 32578 52345 20678  
O=P(=O)(O)O



# Final Thoughts...

As a lifelong heart patient, I have waited a long time for all the pieces to come together and we are finally here!

Today, we have the data-collection devices and the infrastructure to successfully empower patients and enhance research opportunities.

We can see the potential to monitor health in new ways with wearable devices and apps on mobile.

In the near future we will be able to completely customize healthcare with the use of genomics data and proactively diagnose health issues before they become expensive to treat.





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# Thank you!

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Google Cloud Platform