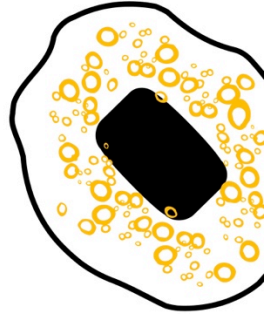


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# BIG DATA & BIG HEALTH

## PERSONALIZED MEDICINE AS A PARADIGM SHIFT

Lisette van Gemert-Pijnen

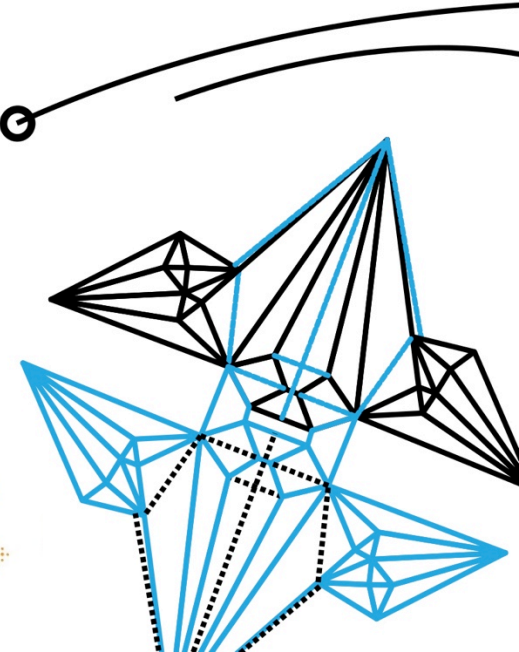
University of Twente, Enschede

University Medical Center  
Groningen

The Netherlands



FEAM Bern  
May 20<sup>th</sup> 2016



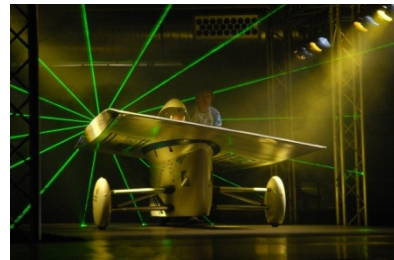
# OUR PROFILE: HIGH TECH HUMAN TOUCH

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The University of Twente is noted for:

- Excellent education & research
- New technology as a catalyst for change, innovation and progress
- *Combination of technology & social sciences*
- Entrepreneurial attitude

Themes: ICT, Nano-, Bio-, Geo-Engineering, Management, Behavioral Science





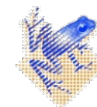
3TU.Federatie



Faculty of Geo-Information Science and Earth Observation



minddistrict



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# THIS TALK

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- What are the paradigm shifts in Healthcare?
- What are the challenges? Value creation of Big Data
- What are we doing? Our *new* research projects

[www.cewr.nl](http://www.cewr.nl) (persuasive technology lab)

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The screenshot shows a video player interface. At the top, there is a navigation bar with a search icon and the text "CONTACT". Below this is the header "Centre for eHealth & Wellbeing Research". The main content area displays a slide with the text "IGS > Home > Research > Persuasive Health Technology". The slide features a large graphic of a network of interconnected nodes and lines, with a central cluster of nodes highlighted in pink. To the right of the slide are three social media icons: a heart, a clock, and a share icon. Below the slide is a video player control bar with a play button, a progress bar showing "00:01", and a "vimeo" logo. Below the video player, the text reads "Welcome to the Persuasive Health Technology Lab!" followed by a paragraph: "The Persuasive Health Technology lab enables personalized healthcare via empathic, user-adaptive technologies that are implementable in practice. We see technology as a human character: it can engage and create deep affective relationships, thereby improving adherence. We study how persuasive designs and real time evaluations can improve personalized healthcare."



# PERSONALIZED MEDICINE / PERSONALIZED HEALTHCARE

## PARADIGM SHIFTS

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1. People-centered versus disease-centered
  - *Health as the ability to adapt and to self-manage, (Huber, 2011)*
  - *Function oriented; self-management; resilience*
  - *No one size fits all*
2. Medicine digitized, unplugged, democratized
  - *Healthcare technologies*

# BOTTOM UP MEDICINE

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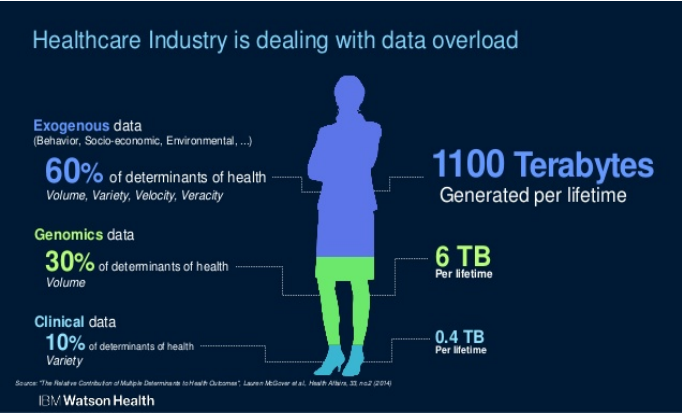
Old Medicine	New Medicine
Population-Based	Individualized
One-Off, Doctor's Office	Real-Time Streaming, Real World
Doctor Ordered Data	Patient Generated Data
Doctor's Notes, Unshared	Our Notes, Patient Edited
Information Owned by Doctors and Hospitals	Information Owned by Rightful Owner
Expensive, Big-Ticket Tech	Cheap Chips, Moore's Law
Data Limited	Panoromic

Eric Topol, 2015

# DATA DRIVEN SOCIETY

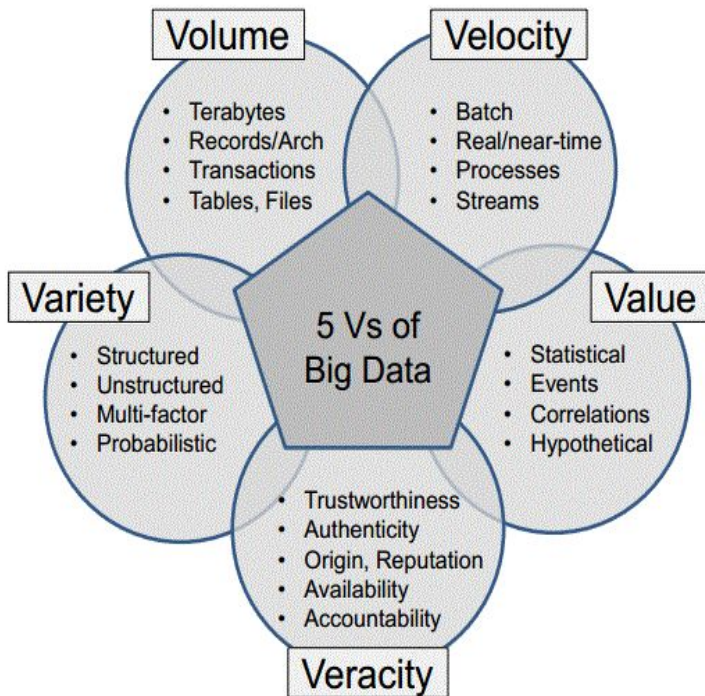
## PARADIGM SHIFTS

- Amount of data is growing explosively
- 3. Breaking the wall of knowledge
- 4. Health Industry blurs medicine



# CHALLENGE: BIG DATA; NOT ALL DATA IS BIG

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The datification of our world gives us boundless data in terms of *Volume*, *Velocity*, *Variety* and *Veracity*

Advanced analytics allows us to leverage all types of data to gain insights and add *Value*

# WHAT ARE THE CHALLENGES? SOME EXAMPLES

## VALUE OF BIG DATA

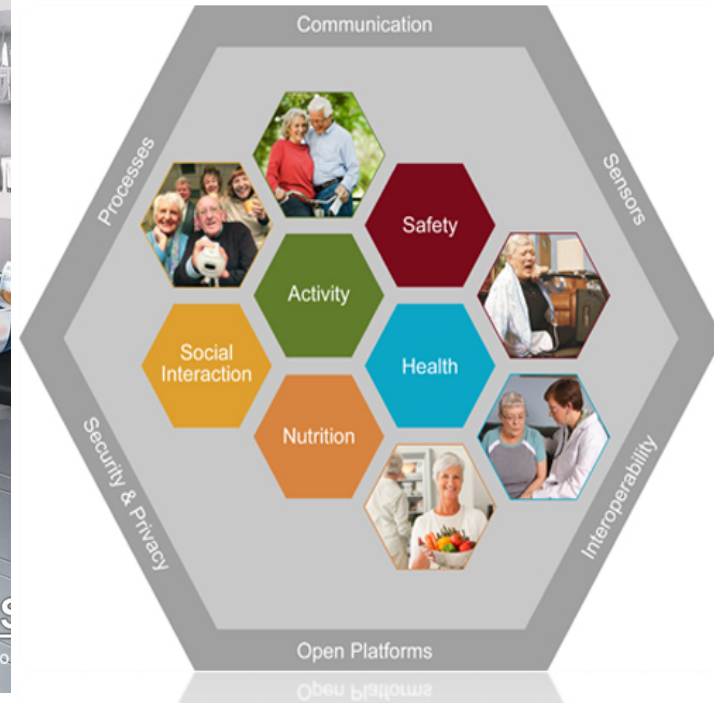
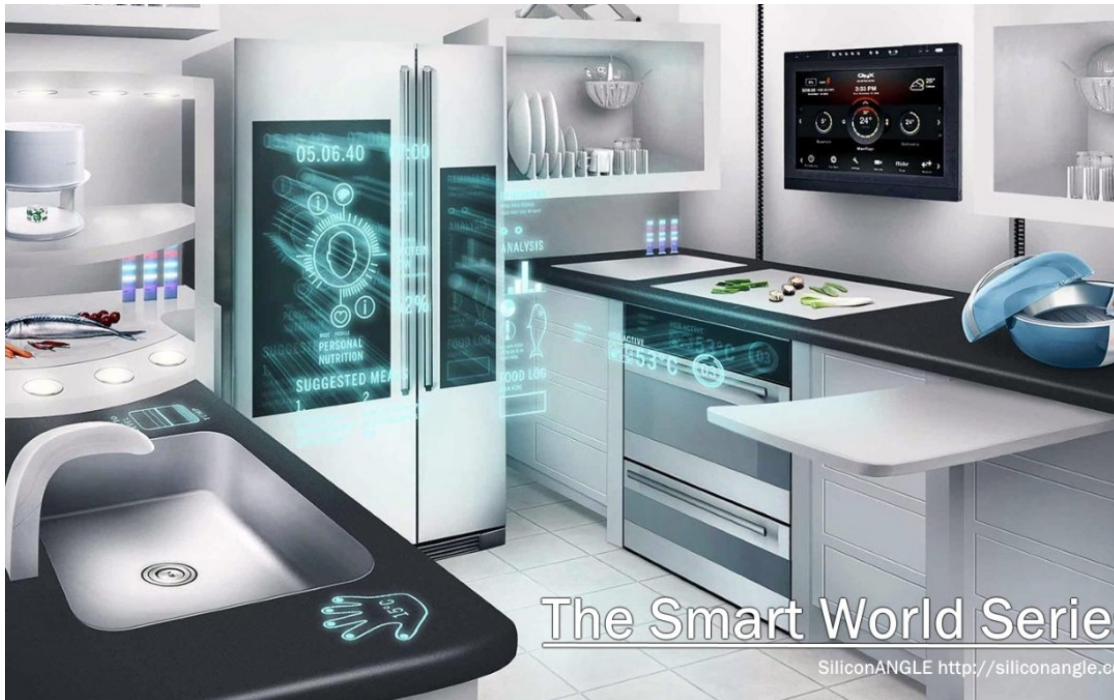
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# SMART HOMES, SMART COMMUNITIES

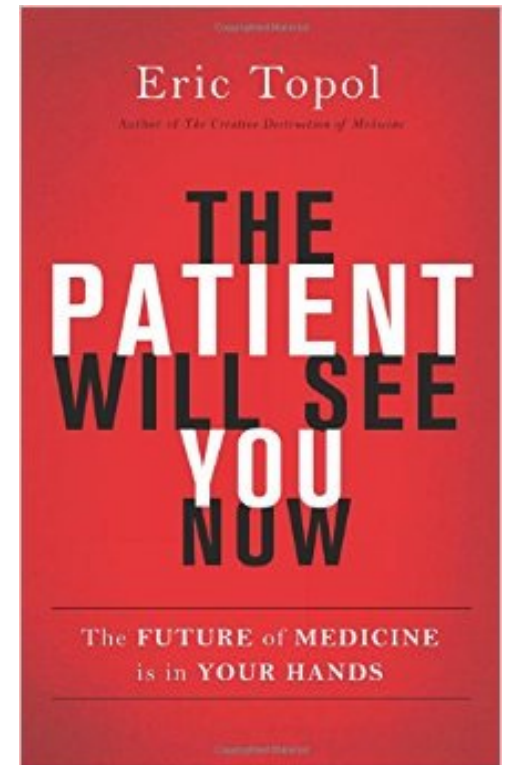
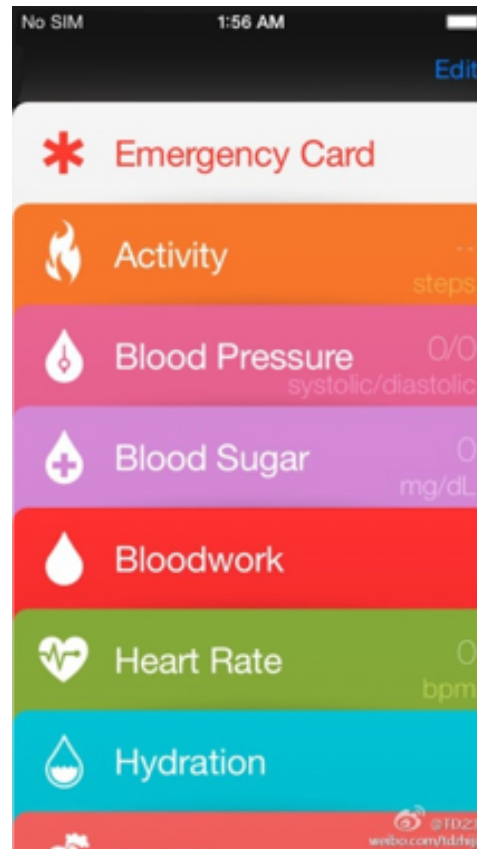
VALUE: DIGITAL EMPOWERED CITIZENS



# BOTTOM-UP MEDICINE

DATA GENERATED BY PATIENTS; 24 H MONITORING

VALUE: MEANINGFUL Real-Time FEEDBACK



**Super surveillance...Smart Blood to track 24h, everywhere**





# VALUE: Need for Prediction models

## The Next Chapter for Flu Trends

Thursday, August 20, 2015

Posted by The Flu Trends Team

When a small team of software engineers first started working on Flu Trends in 2008, we wanted to explore how real-world phenomena could be modeled using patterns in search queries. Since its [launch](#), Google Flu Trends has provided [useful insights](#) and served as one of the early examples for "nowcasting" based on [search trends](#), which is increasingly used in health, [economics](#), and [other fields](#). Over time, we've used search signals to create prediction models, [updating](#) and improving those models over time as we compared our prediction to real-world cases of flu.

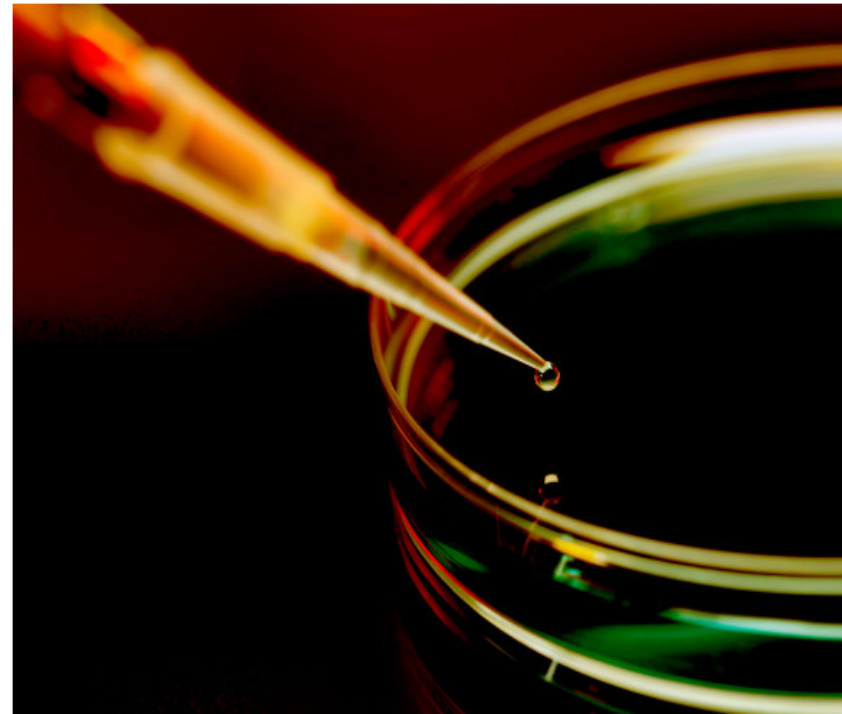
Instead of maintaining our own website going forward, we're now going to empower institutions who specialize in infectious disease research to use the data to build their own models. Starting this season, we'll provide Flu and Dengue signal data directly to partners including [Columbia University's Mailman School of Public Health](#) (to update their [dashboard](#)), [Boston Children's Hospital/Harvard](#), and [Centers for Disease Control and Prevention \(CDC\) Influenza Division](#). We will also continue to make historical Flu and Dengue estimate data available for anyone to see and analyze.

Flu continues to [affect millions of people every year](#), and while it's still early days for nowcasting and similar tools for understanding the spread of diseases like flu and dengue fever—we're excited to see what comes next. To download the historical data or learn more about becoming a research partner, please visit the [Flu Trends web page](#).

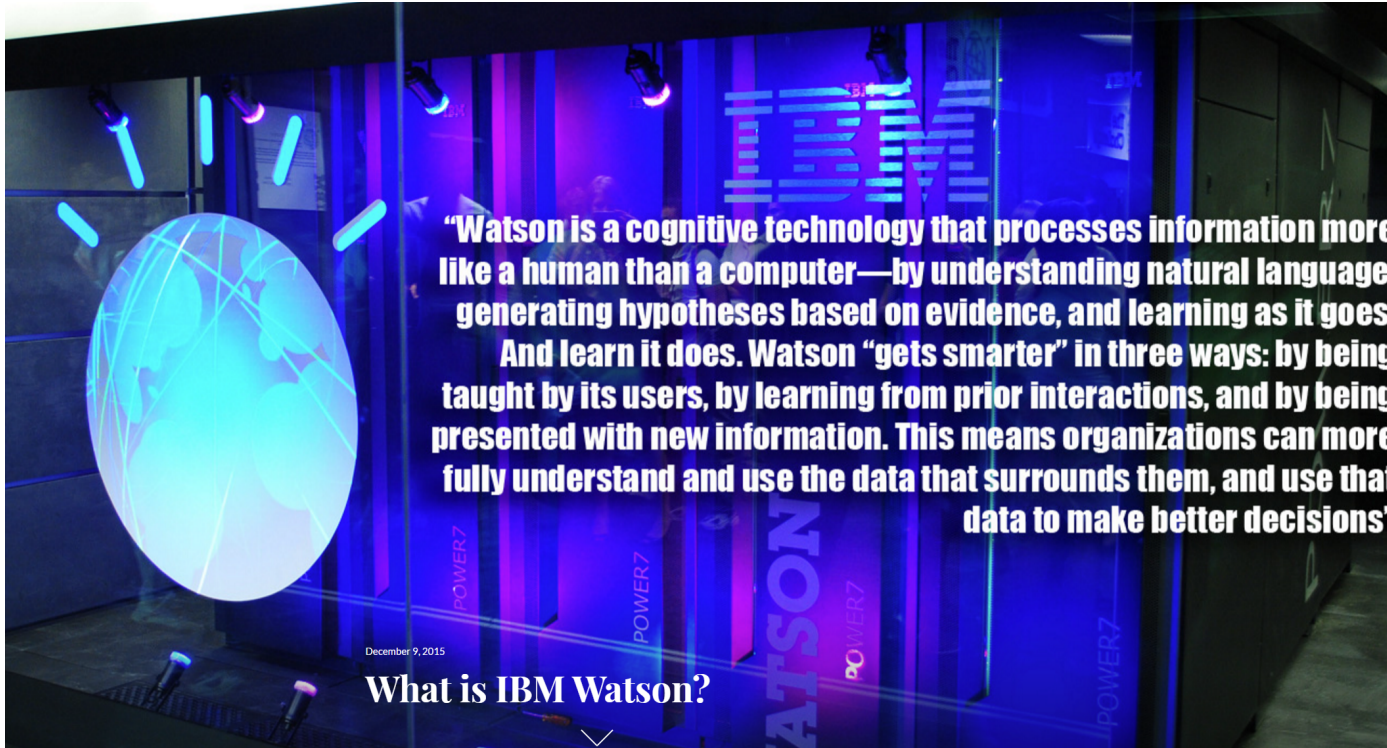
**Big data hubris  
missing swine flu (2009),  
the peak of flu season (2013)**

DAVID LAZER AND RYAN KENNEDY SCIENCE 10.01.15 7:00 AM

## WHAT WE CAN LEARN FROM THE EPIC FAILURE OF GOOGLE FLU TRENDS



# COMPUTERS WITH ATTITUDE NOT ON THE HORIZON



It Was A Bad Idea For Watson The Supercomputer To Learn The Urban Dictionary...

**Value: Sense making Communication (NLP, contextualized)**



# WHAT ARE WE DOING? SOME EXAMPLES

## DIGGING INTO *THE VALUE* OF DATA

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- Big Data experts 'views (examples Big data, what if-scenarios)
  - Psychology
  - Philosophy
  - Computer Science
  - Business Administration
  - Law
  - Data Science
- HCWs' experiences
  - Cardiology
  - Microbiology



# EMPOWERMENT

## CRITICAL THOUGHTS

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### Profiling

- Affinity groups, filter bubble
- Personalizing without knowing persons

### Autonomy

- Data sharing > data ownership
- Data arrogance, accountability
- Algorithms rule; are we still in control?

# TRUST

## CRITICAL THOUGHTS

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- Disruptive business models; who benefits?
- Liability; Who is liable when things go wrong?
- Accountability; Who has to prove what and how it is regulated?
- Interpretation; Data versus a Clinical eye

# DATA WISDOM

## BIG DATA BIG INSIGHTS?



- Knowing *what* vs. knowing *why*
  - Relationships are correlational, not causal
  - Quantity above quality
- Those who generate data, do not have the knowledge to analyse. Those who analyse lack domain insights
  - Data education to support critical and creative thinking
  - Multidisciplinary Data-skills

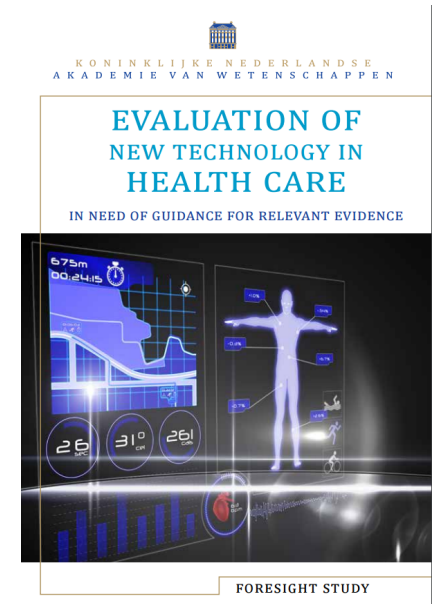


# EVIDENCE

## CRITICAL THOUGHTS

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- Search for patterns rather than testing hypotheses
- Critical volume, variety, veracity of data
- Beyond RCTs; Life Logging
- Power of Analytics (Machine learning)
- Bottom up evidence (reverse epidemiology)





# **BIG DATA**

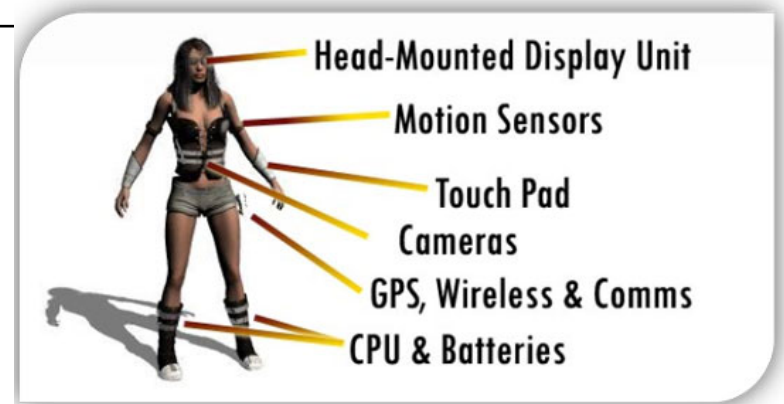
## OUR RESEARCH

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- Real time monitoring (Lifeloggging, use of tech to support health & wellbeing)
- Persuasive coaching (tailored, contextualized) based on real time analysis (qual & quan)
- Value of data (empowerment, trust, wisdom, evidence )

# BIG DATA WEARABLES @WORK; @ HOME

- Unobtrusive *life-tracking* 24h
- Just in time coaching
- Prevention of complications
- Empowerment, Trust, Wisdom
- Evidence: real time analysis

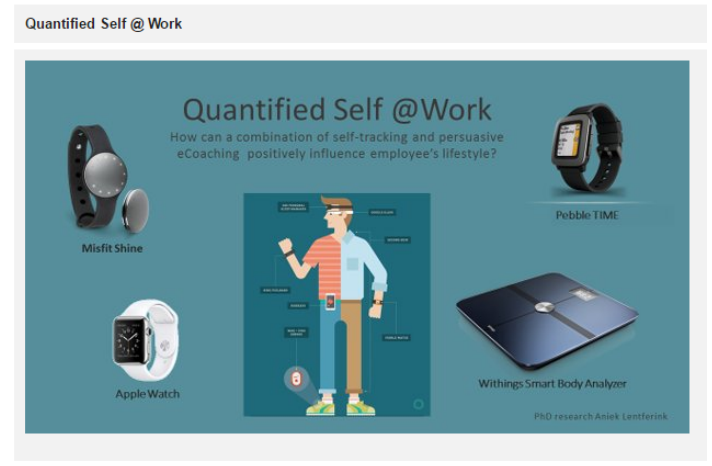


Twente-**T**hales Im**E**disense Telemonitoring  
in **s**tAble **C**hronic **H**eart Failure (Twente  
**TEACH**)

THALES



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# BIG DATA IN PSYCHIATRY

## JUST IN TIME COACHING

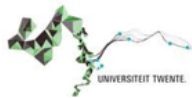


MENTAL HEALTH

## Can Big Data Help Psychiatry Unravel the Complexity of Mental Illness?

Pervasive Technology to better measure, aggregate and make sense of **behavioral, psychosocial, biometric and geodata** to develop personalized coaching programs,

to make predictions about how a given individual will proceed



# BIG DATA IN INFECTION PREVENTION

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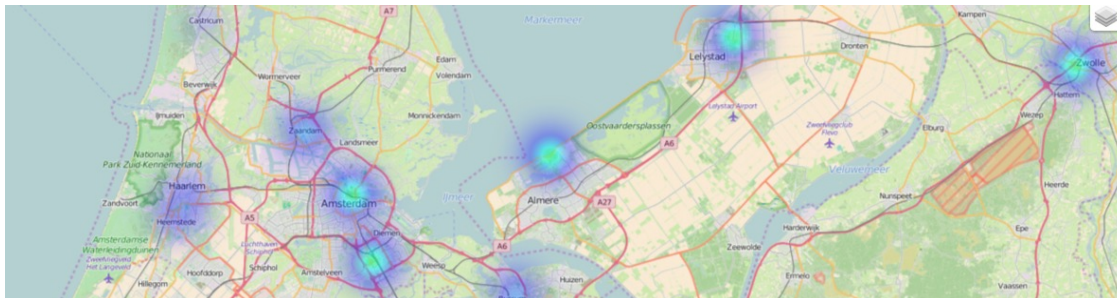
- Highly Resistant Micro Organism, e.g. MRSA; Zoonotics (Animal>humans)
- **Digital surveillance** to track, trace infections and to develop a **predictive model to prevent outbreaks**



# PREDICTIVE MODELING

## COOPERATION HEALTH-BUSINESS-SCIENCE

- Integrating **geospatial data** with **epidemiological** and **clinical** data
- to develop a **smart surveillance system (EWS)**
  - Path of movements (HCWs inside/outside hospital)
  - Pathogens and HRMO are monitored real-time (over 5 years)
  - **New computational methods** for analysing *geospatial* and *laboratory data*
  - **User centred methods** for presenting (*visualization* of) data



HEALTH *i* CARE

INTERREG  
Deutschland  
Nederland



[www.deutschland-nederland.eu](http://www.deutschland-nederland.eu)



# WRAP UP

## BIG DATA & BIG HEALTH & BIG VALUE

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- Bottom up Medicine
- Management of security/privacy, regulations
- Data Wisdom to make sense of Big Data
- Boundless potentials (health, business, science)
- Evidence via real time observations
  - knowing what & knowing why
  - individuals vs populations

# eHealth: Combining Psychology, Technology and Health

How can technology make you healthy? Learn about the design, application, implementation and evaluation of eHealth.

Go to course – starts 23 May

## MOOC eHealth

<https://www.futurelearn.com/courses/ehealth>

[j.vangemert-pijnen@utwente.nl](mailto:j.vangemert-pijnen@utwente.nl)

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[View transcript](#)

[Download video: standard or HD](#)

UNIVERSITY OF TWENTE.

FREE online course

Duration: 6 weeks

3 hours pw

Certificates available

SHARE



EDUCATORS

Saskia Kelders

Floor Sieverink

Hanneke Kip

Lisette van Gemert-Pijnen

### ABOUT THE COURSE

eHealth refers to the use of technologies to improve well-being, health, and healthcare. It is an umbrella term that captures concepts about the health context, technology, and people.

In this free online course, we will provide you with insight into the domain of eHealth, describe methods to develop eHealth, and explain theories that enable behaviour change and facilitate implementation. You will also understand how eHealth technologies are developed and used in practice, by means of a variety of case studies, assignments and examples.

This course pays attention to the perspectives of the eHealth developers, patients, healthcare professionals and healthy people who want to improve or maintain their health and wellbeing. These perspectives are applied to the three main topics of this course:

- During Weeks 1 and 2, we will introduce eHealth and show you how eHealth technologies are used to enable or improve self-care and prevention, supportive care, and societal health.
- Weeks 3 and 4 will focus on design. You will learn how to design eHealth that fits the user and the context, and is able to seduce or support people into changing their behaviour.





## SUPPORTING HEALTH BY TECHNOLOGY VII

The conference on supporting health by tech

In collaboration with the University Medical Center Groningen and the Center for eHealth & Wellbeing Research, the Institute for Innovation and Governance studies of the University of Twente presents a new edition in the successful 'Supporting Health by Technology' series.

This year's theme is: **Personalized Healthcare, Persuasive Coaching using Technology**

## The healthcare sector is best placed to benefit from the merging of physical, digital and biological systems, but it is among the least well prepared

The healthcare sector is the most likely to benefit from what the World Economic Forum calls the “Fourth Industrial Revolution”, according to executives polled by The Economist Intelligence Unit this week.

Described as an emerging industrial revolution triggered by “a fusion of technologies that is blurring the lines between the physical, digital and biological spheres”, the Fourth Industrial Revolution is the main focus of debate at this week’s WEF Annual Meeting in Davos, Switzerland.


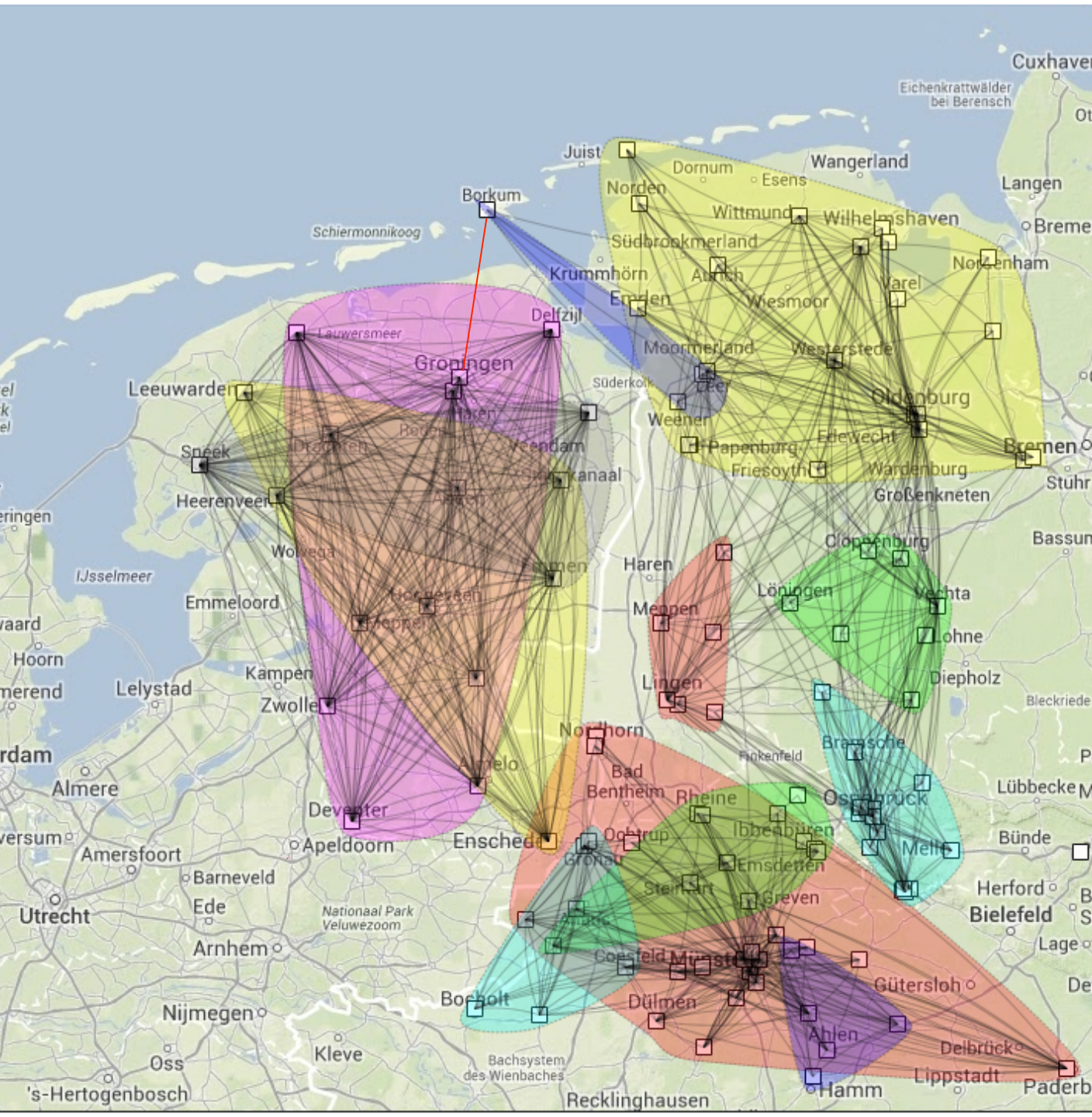
To gauge executive opinion on this anticipated megatrend, The Economist Intelligence Unit this week polled 622 business leaders, from around the world and a range of industries. The poll revealed that a significant majority of executives believe that healthcare is the sector that will benefit most from its impact (see chart).





# Patient Mobility & Infections


## eSurveillance for just in time Interventions



**RAPID RISK ASSESSMENT**

Risk of importation and spread  
of malaria and other vector-borne diseases  
associated with the arrival of migrants to the EU

21 October 2015

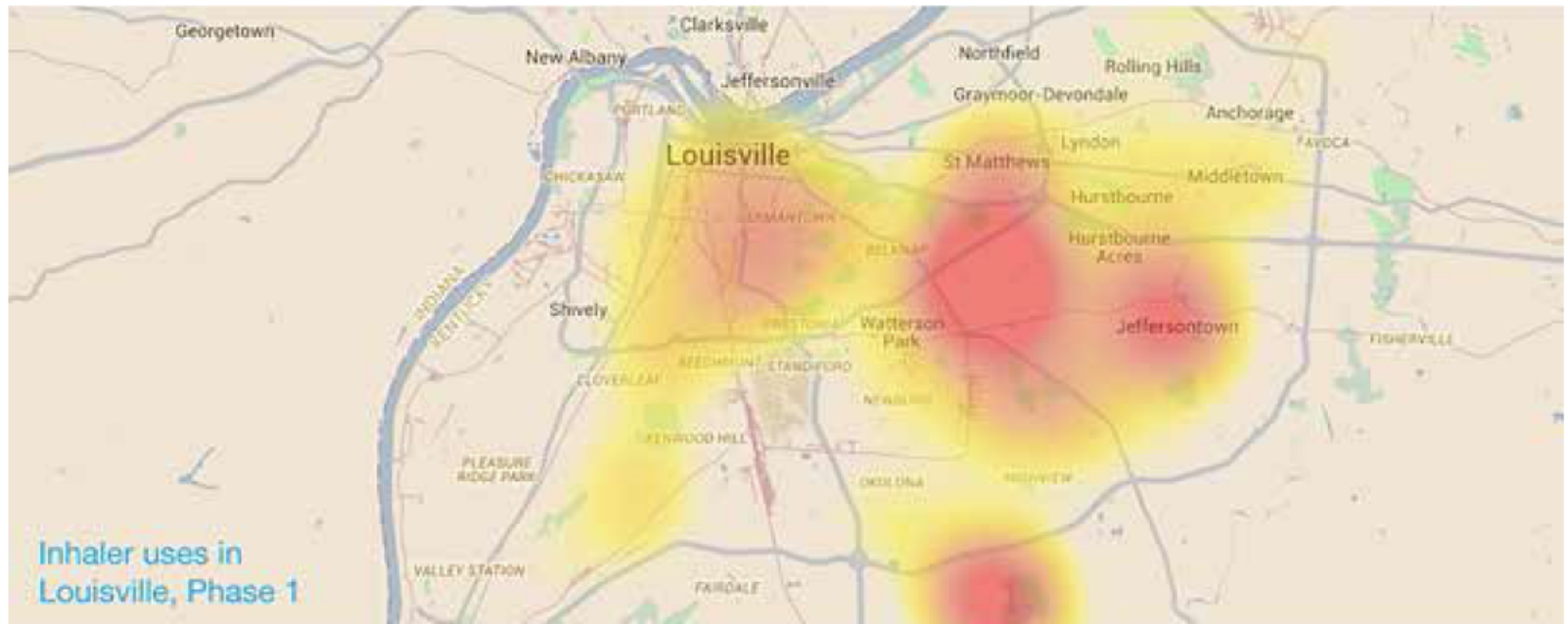




# PREDICTIVE MODELING

RISK FACTORS USING DATA FROM SMART-COPD INHALERS

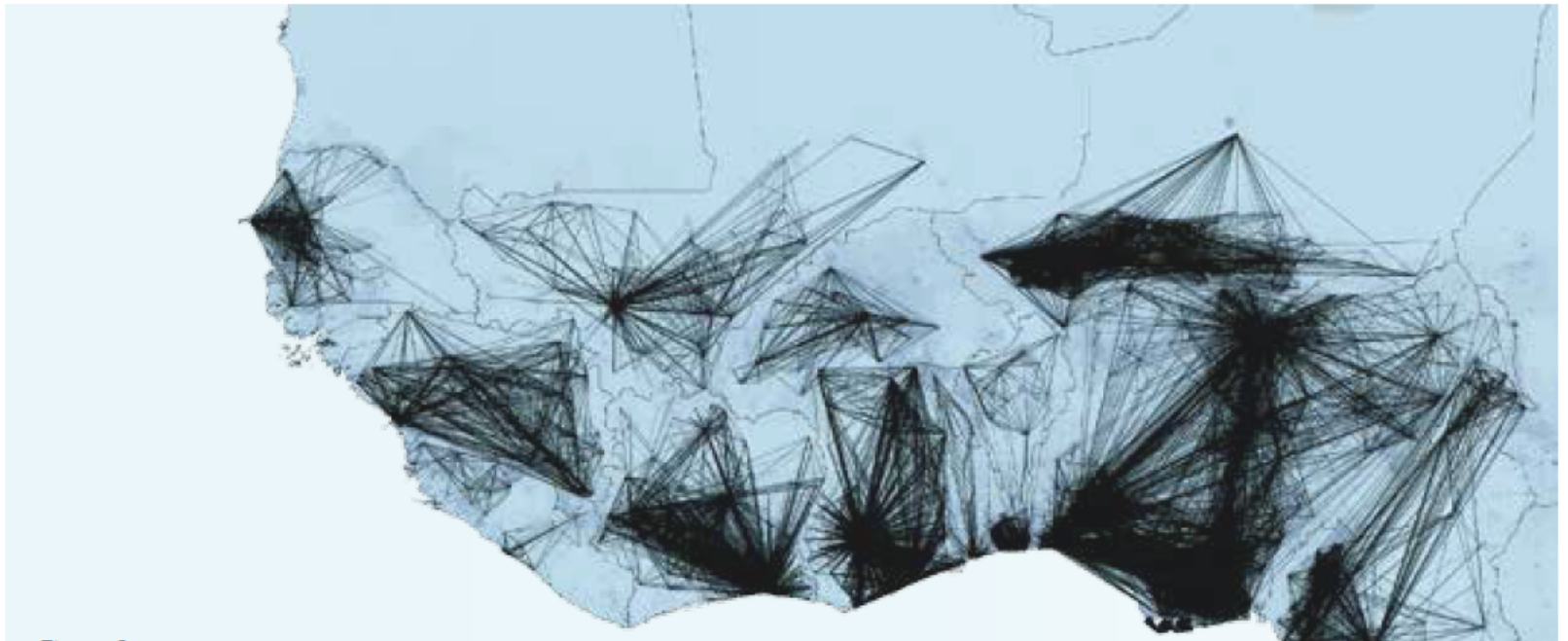
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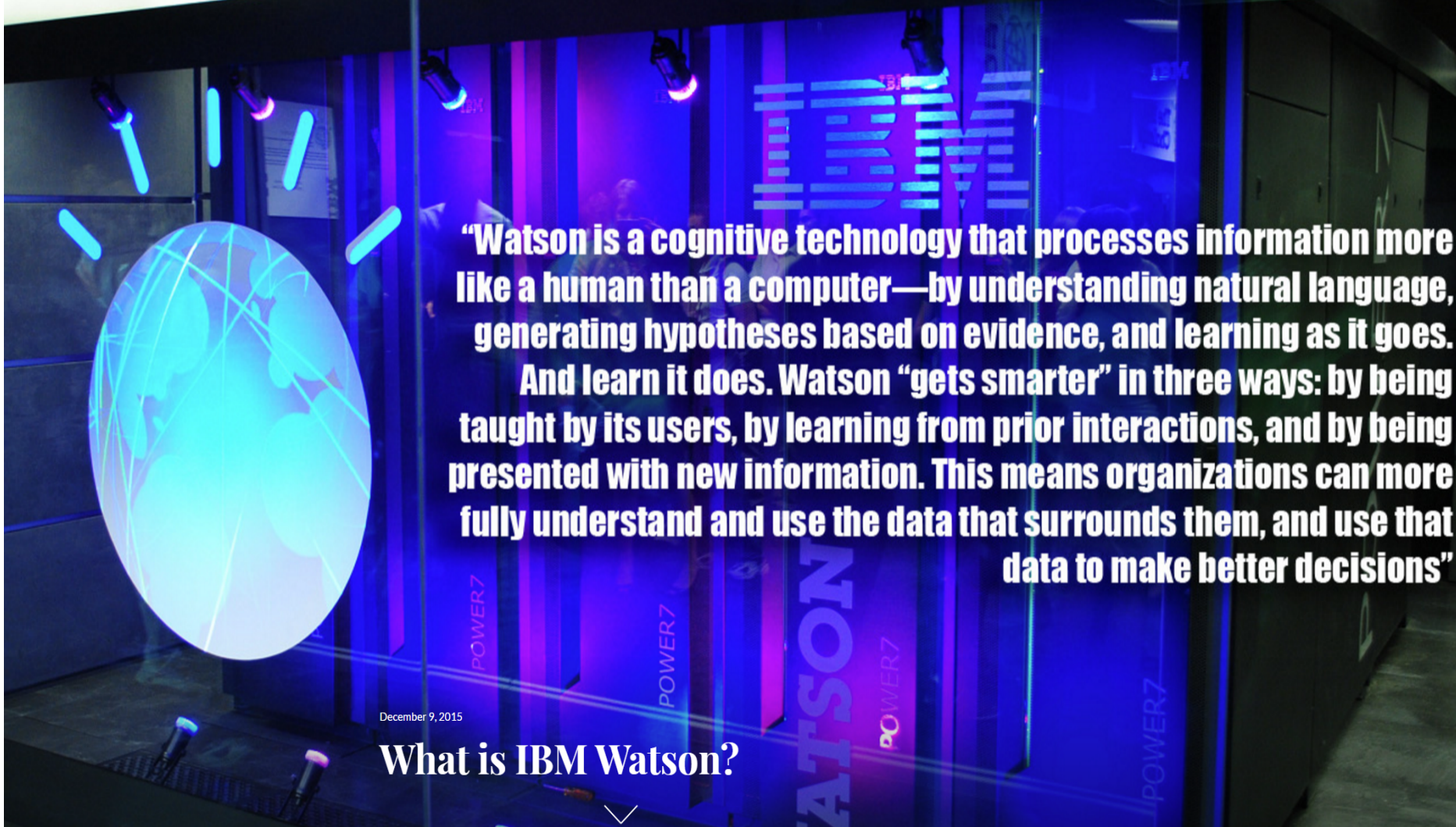




# EBOLA SPREAD eSURVEILLANCE SYSTEMS

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**“Watson is a cognitive technology that processes information more like a human than a computer—by understanding natural language, generating hypotheses based on evidence, and learning as it goes. And learn it does. Watson “gets smarter” in three ways: by being taught by its users, by learning from prior interactions, and by being presented with new information. This means organizations can more fully understand and use the data that surrounds them, and use that data to make better decisions”**

December 9, 2015

## What is IBM Watson?

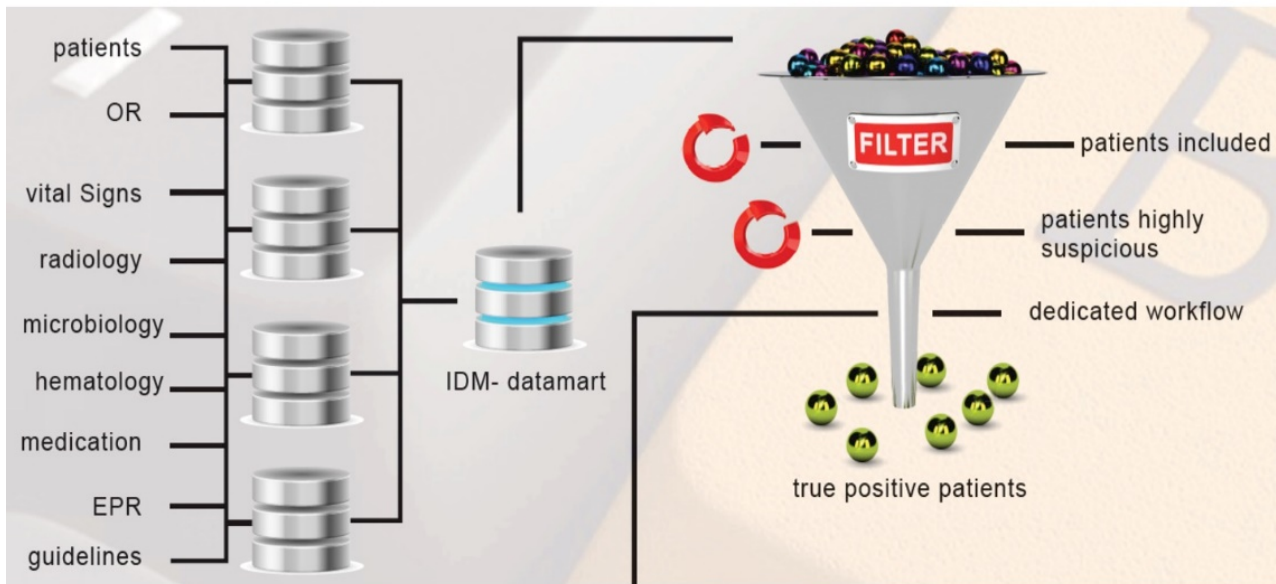


It Was A Bad Idea For Watson The Supercomputer To Learn The Urban Dictionary...

**Understanding Natural Language, BIG Challenge**

# Update with Geospatial data & behavioral data

## IDM-Alert<sup>®</sup> algorithm workflow



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