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eHealth Research Institute Director
School of Management
Harbin Institute of Technology (哈尔滨工业大学)

Healthcare Knowledge Management and E-Learning

My Professional Background

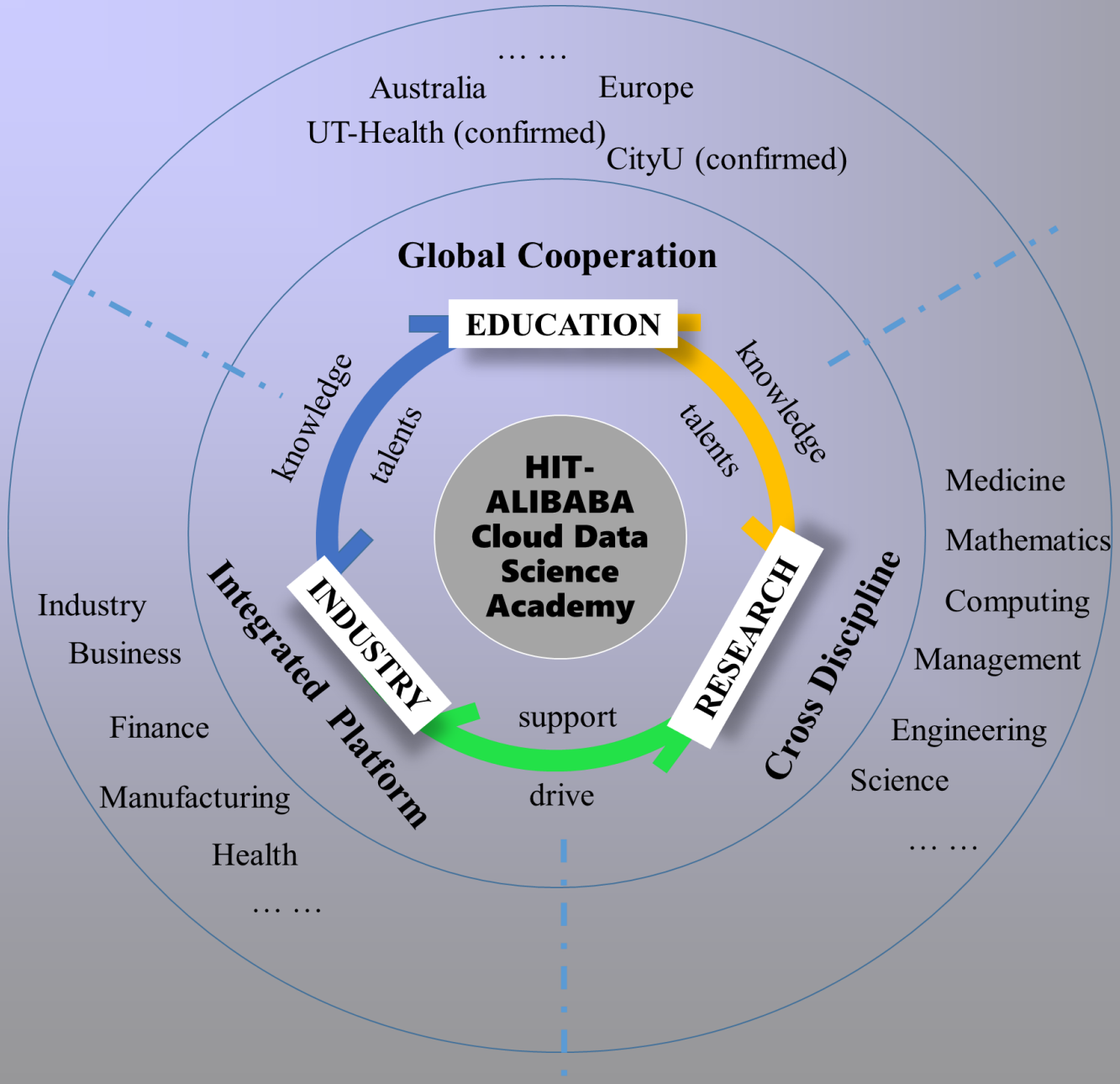
- Started in engineering/computer science
- Built up my own company before PhD
- First academic experiences were USA
- Moved to Hong Kong in January, 1998
- Assoc. for Information Systems President
- Presence in over 100 countries
- China “Thousand Talents” appointment
- HIT eHealth Research Institute Director
- HIT Alibaba Cloud Data Science Academy Honorary Dean

电子健康研究所
eHealth Research Institute
(http://ehealth.hit.edu.cn/eHealth/Home_En)

- (**Research Direction 1**) Modeling and Analytic Research
- (**Research Direction 2**) Behavioral Research
- (**Research Direction 3**) Design Science Research
- **(Research Direction 4)** Empirical Research
- **(Research Direction 5)** Integrated Research

More Normal Appearance

Alibaba Collaboration Signing



HIT Alibaba Cloud Data Science Academy

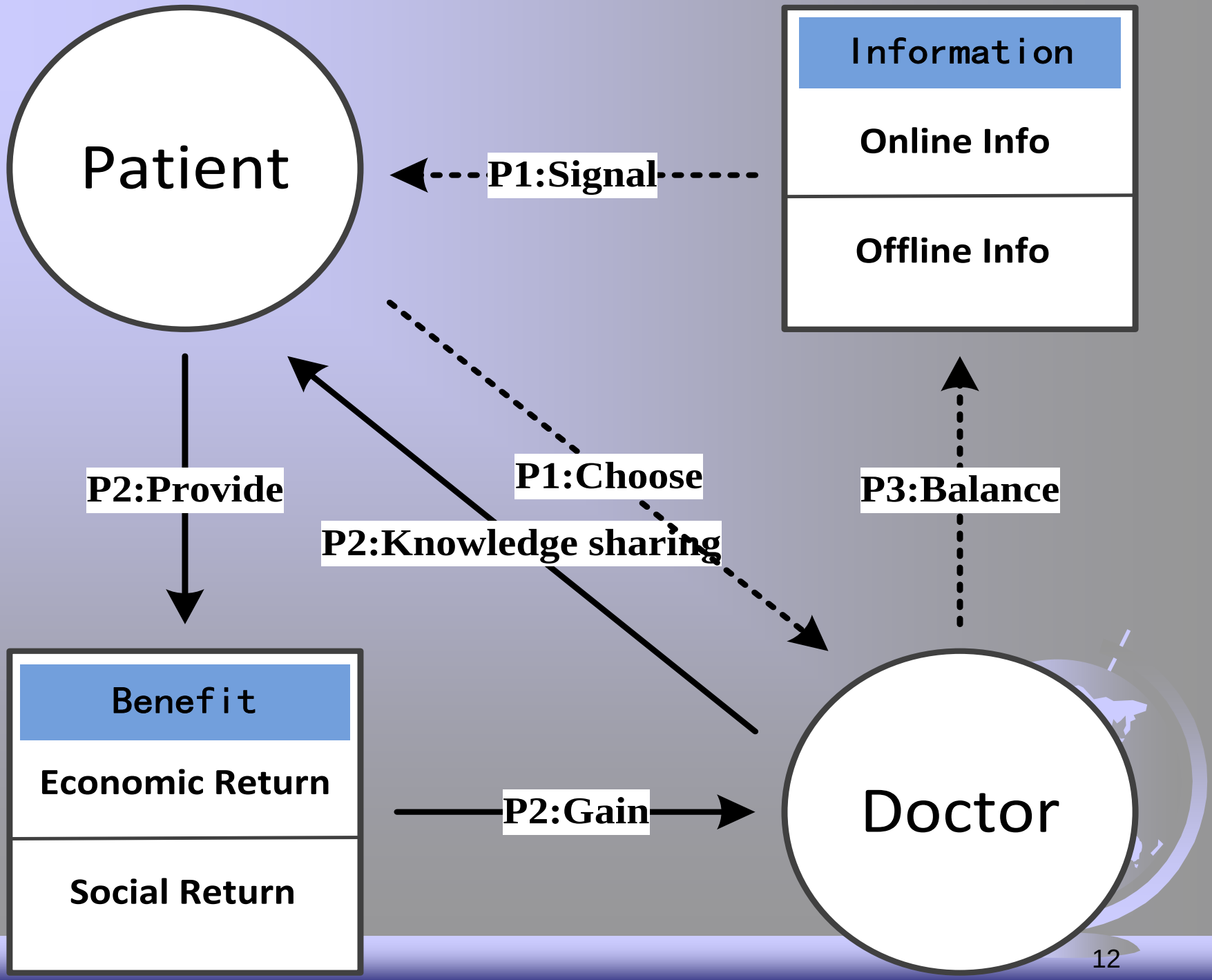
Healthcare

- Healthcare as we know it is increasingly unaffordable and incapable of dealing with emerging population dynamics
  - Life expectancy has increased over 25 years in less than a century
  - Birthrate is significantly lower
  - High incidence of chronic diseases
- Informatics plays an important role in the future of healthcare
- Great need for creative thinking, knowledge management and e-learning

Online Healthcare Communities

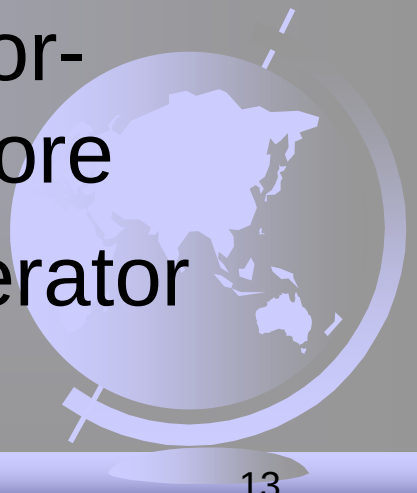
- Interaction between doctors and patients
  - patients search and select doctors
  - doctors share knowledge with patients
  - patients respond to doctors through online comments, thanks letters, etc.
- Examples in China
  - http://www.haodf.com/
  - http://www.xywy.com/
  - http://www.120ask.com/
  - http://www.91.cn/

www.haodf.com


Patient
Information
Online Info
Offline Info
P1:Signal
P2:Provide
P1:Choose
P2:Knowledge sharing
P3:Balance
Benefit
Economic Return
Social Return
P2:Gain
Doctor

Patient Perspective

- Appreciate the opportunity to have more information at their disposal and engage in exchanges with doctors
- Previous Internet experience seems not that influential
- Issues such as information privacy and considerations of traditional doctor-patient interactions come to the fore
- Disease severity is a likely moderator and especially influential



Doctor Perspective

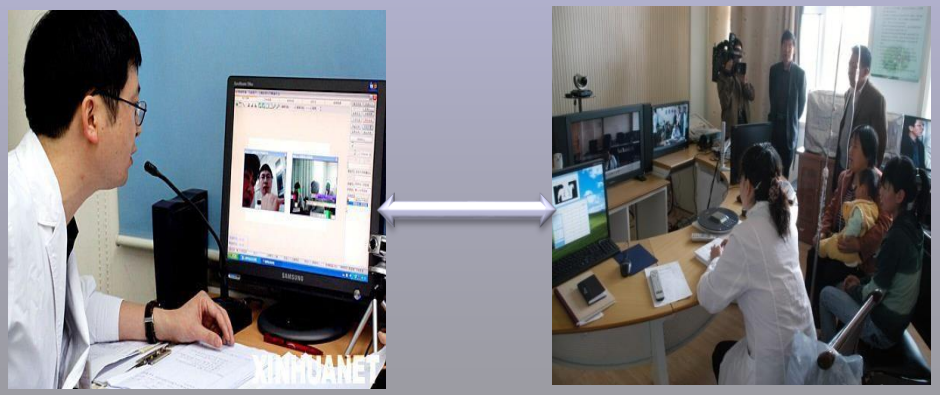
- Doctors seeking more recognition tend to use a broader range of functions and more actively engage
- Better established doctors tend to stay more in-depth in particular functions
- Doctors recognize the importance of establishing long-term relationships
- Doctors are not nearly as enthusiastic as patients in engaging and sharing and are wary of patient supplied information

The Future for OHCs

- Online healthcare communities open new avenues for interaction
  - Help ease patient uncertainty and frustrations with traditional medical systems
  - Give doctors an additional venue and avenue for career development and recognition
- Reasonable to expect that these communities will continue to evolve to meet ever expanding interests of both doctors and patients (at least in China)

Teleconsultation Example

- Distributed expertise
- Big hospitals and rural hospitals / clinics
- Synchronous and asynchronous options
- Large-scale systems and service issues



Real time video conference

Store and foreword web-based service


哈医大 附属第二医院
教学会诊中心

Myriad of Issues

- Technology unreliability
- Insufficient support / technostress
- Process vagueness
- Alternatives e.g., train to hospital
- Lack of time and motivation
- Local unwillingness to share information
- Lack of trust
- Reward system
- Legal concerns
- Business model

Using Analytics to Drive Healthcare

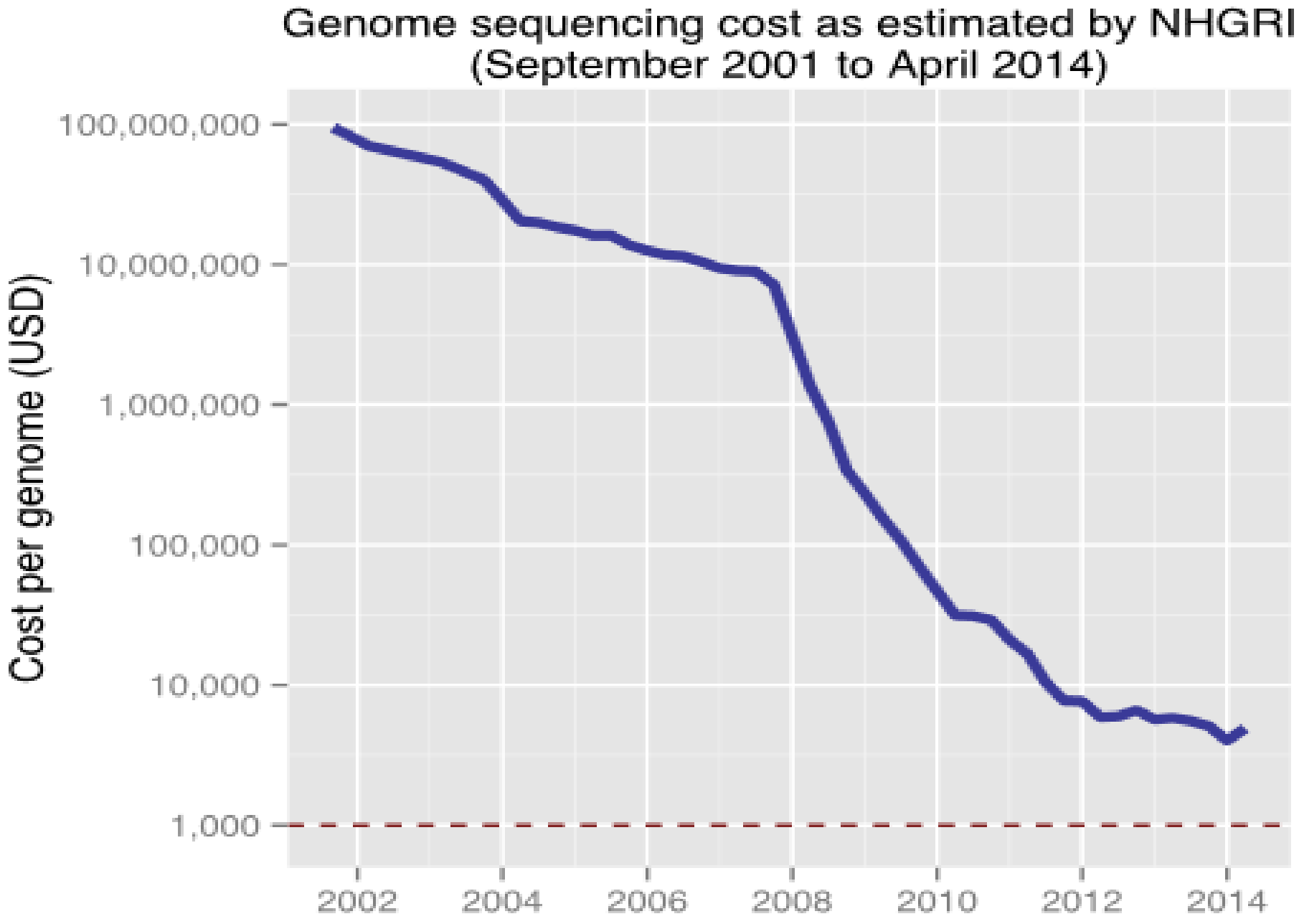
- Data collected in patients' homes is very unique and extremely credible
- Rich asset they hasn’t been leveraged
- Applying analytics to help improve patient outcomes based on the combinations of medications they take
- Optimizing patient enrollment processes, using predictive analytics to identify patients who are more likely to enroll and maintain their medication regimens

Mature Teleconsultation

- Routine medical tests done in rural homes
- Portable all-in-one diagnostic devices
  - Heart monitoring
  - Blood pressure
  - Urine and blood analysis
- Results transmitted electronically and stored
- Central analysis and visualization
- Doctor remote consultation if appropriate
- Expedited access to hospital if necessary
- Cost effective service & happy stakeholders

Extended Opportunities

- Using analytics to identify new business lines and other revenue opportunities
- Finding new insights about how certain types of patients have likelihoods of significant barriers in the way they manage their health
- Insights become sellable assets, which can lead to more service lines
- Personalized medicine on the horizon based on individual DNA


Genome sequencing cost as estimated by NHGRI
(September 2001 to April 2014)
Cost per genome (USD)
100,000,000
10,000,000
1,000,000
100,000
10,000
1,000
2002
2004
2006
2008
2010
2012
2014

Outline of the National Health Genomics Policy Framework (consultation draft)

Health System Policy Intent

An integrated Australian health system that effectively informs health care for individuals and populations

Genomic Policy Intent/Mission

To harness the health benefits of genomic knowledge* into the Australian health system in an efficient, effective and equitable way to improve individual and population health

Scope of the Framework

Genomic knowledge, not limited to the human genome, used to inform and transform testing, treatment and prevention of disease to improve human health

CROSS-CUTTING ISSUES

- Ethical, legal and social issues (ELSI)
- Regulatory issues
- Collaboration and partnership

PRIORITY AREAS	Strong leadership and governance	A skilled and literate genomics workforce	Application of genomic knowledge is evidence based, high quality and safe	Integration of genomic knowledge into person-centred health care, supported by equity of access to services	Sustainable investment in health genomics	Effective and appropriate collection, management and utilisation of genomic data**
OPPORTUNITIES FOR IMPROVEMENT	Clear understanding and shared commitment to integrate genomics into the health system	Appropriate and ongoing genomic workforce education and training	Development of genomic guidelines and standards for ethical, clinical and regulatory purposes	Genomics integrated into the patient care	Cost effective and efficient genomic financing and funding arrangements	Establish a national data governance framework that aligns with international frameworks
	Define roles and responsibilities of Governments and other key bodies	Targeted genomics literacy education embedded in undergraduate and postgraduate health professional programs	Monitor, identify and report best practice	Patients and their families are empowered to make informed health care decisions	Understanding the role of industry to support the development and application of genomics	Agreed consent, data sharing, custodianship and privacy requirements
	Effective strategic advice to Governments and other stakeholders on emerging issues	Partnerships and networks to promote and support sharing knowledge	Nationally agreed process to evaluate, collect and share clinical validity and utility	Community engagement in legal, ethical and social issues	Investment in genomics is strategic to achieve shared goals and maximise benefit	Nationally agreed standards for data collection, safe storage, analysis and reporting
	Reporting mechanisms promote transparency and accountability	Workforce strategies/planning to support capacity and access	Appropriate use of research to resolve uncertainty in genomics	Equity of access and choice for genomic services which are culturally appropriate and consistent across Australia	Research translation in clinical practice is timely and cost effective	Contribute to international genomic data sharing where appropriate
	Effective and coordinated international engagement	The health workforce understands the impact of genomic knowledge on their practice and effectively communicates this to patients and their families		Genomics data integrated with electronic health records to improve coordination of care		Data collection and sharing is reflective of the ethnic diversity within the Australian population
				Public awareness and understanding of genomics, through availability of linguistically and culturally appropriate information resources		

* **Genomic knowledge** includes information about the interpretation of genomic data and the implication of these findings, as well as relevant non-genomic clinical information.

** **Genomic data** refers to the data produced from the sequenced genome and variant calling or filtering (comparison with reference genome).

Wellness

- Staying healthy is an increasingly important element of healthcare
- By not requiring as much focused treatment (e.g., for chronic conditions), resources can be better allocated
- Quality of life involves staying healthy through being physically and mentally fit
- Wellness includes attention to diet and food quality as well as exercise plus a lot more e.g., social, psychological, emotional

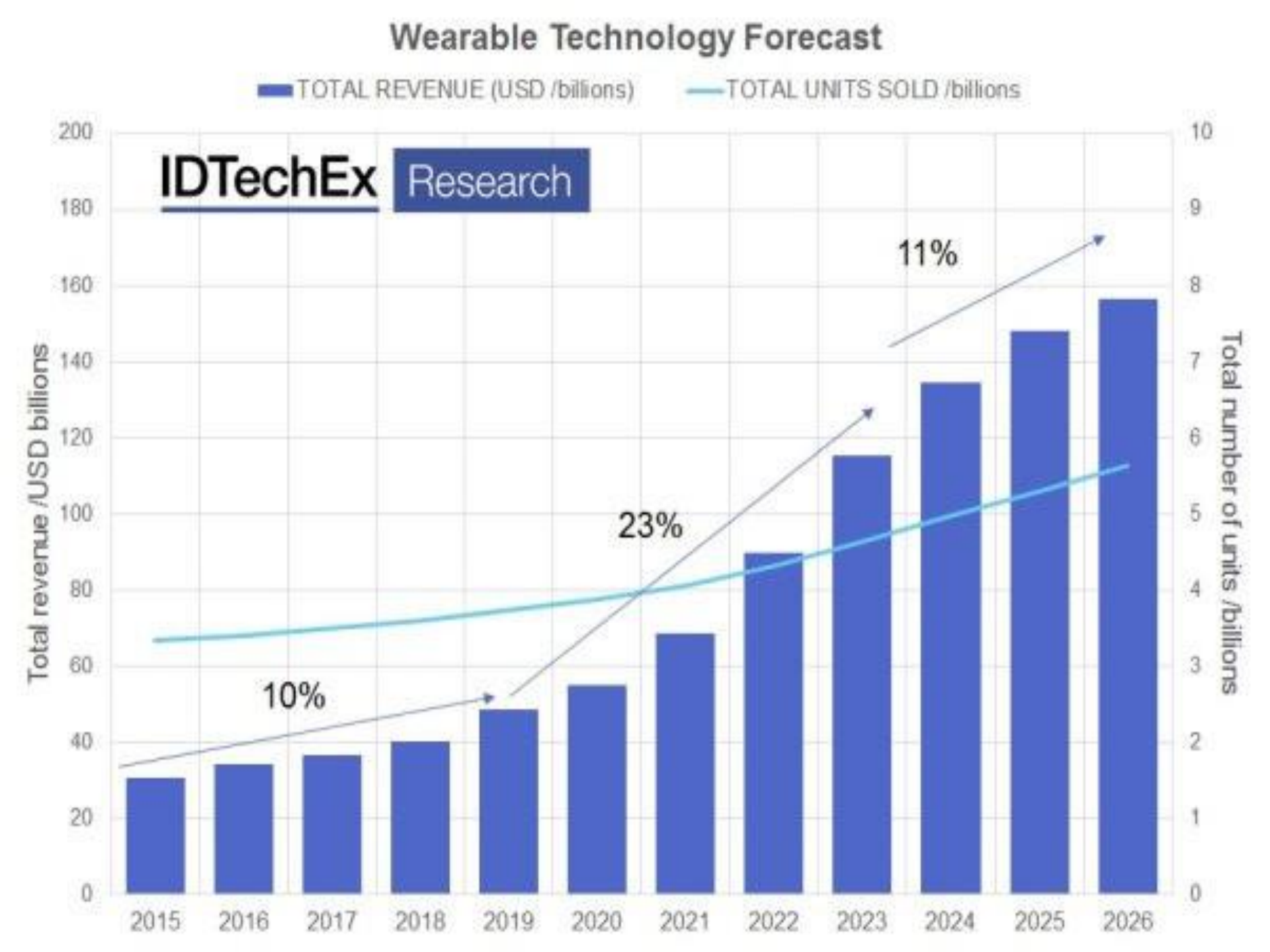
"Quantified Self"

- Every individual can benefit from better access to information about their bodies
- Greater awareness leads to better understanding of the consequences
- Little by little this starts to change behaviors
- Understand your health immediately based on the data your body has provided
- Wide range of technology assists

Quantified Self Technology

- Data acquisition on aspects of a person's daily life in terms of inputs (e.g. food consumed, quality of surrounding air), states (e.g. mood, arousal, blood oxygen levels), and performance (mental and physical) e.g.,
  - Physiological testing
  - Activity monitors
  - Sleep monitors
  - Biometric measurement
  - Blood Glucose monitors
  - Food intake monitors

Wearable Device Engagement


Wearable Technology Forecast
TOTAL REVENUE (USD /billions)
TOTAL UNITS SOLD /billions
IDTechEx Research
Total revenue /USD billions
Total number of units /billions
200
180
160
140
120
100
80
60
40
20
0
10
9
8
7
6
5
4
3
2
1
0
10%
23%
11%
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026

Big Data to Huge Data

- Voluminous streaming data from sensors
- Unobtrusive and non-invasive
- Accurate relative to patient-recorded data
- Needs to be transmitted
- Needs to be accumulated and reduced
- Needs to be analyzed
- Needs to be calibrated to human values
- Needs to be integrated and visualized
- Needs to be converted to knowledge

Knowledge Management

- Data everywhere but where's the knowledge management?
- Healthcare seriously lagging in knowledge management application
- Some traditional approaches apply and some don't
- Useful to go deeper into reasons
- Multi-dimensional problem and issues
- E-Learning plays an important role

Knowledge Management

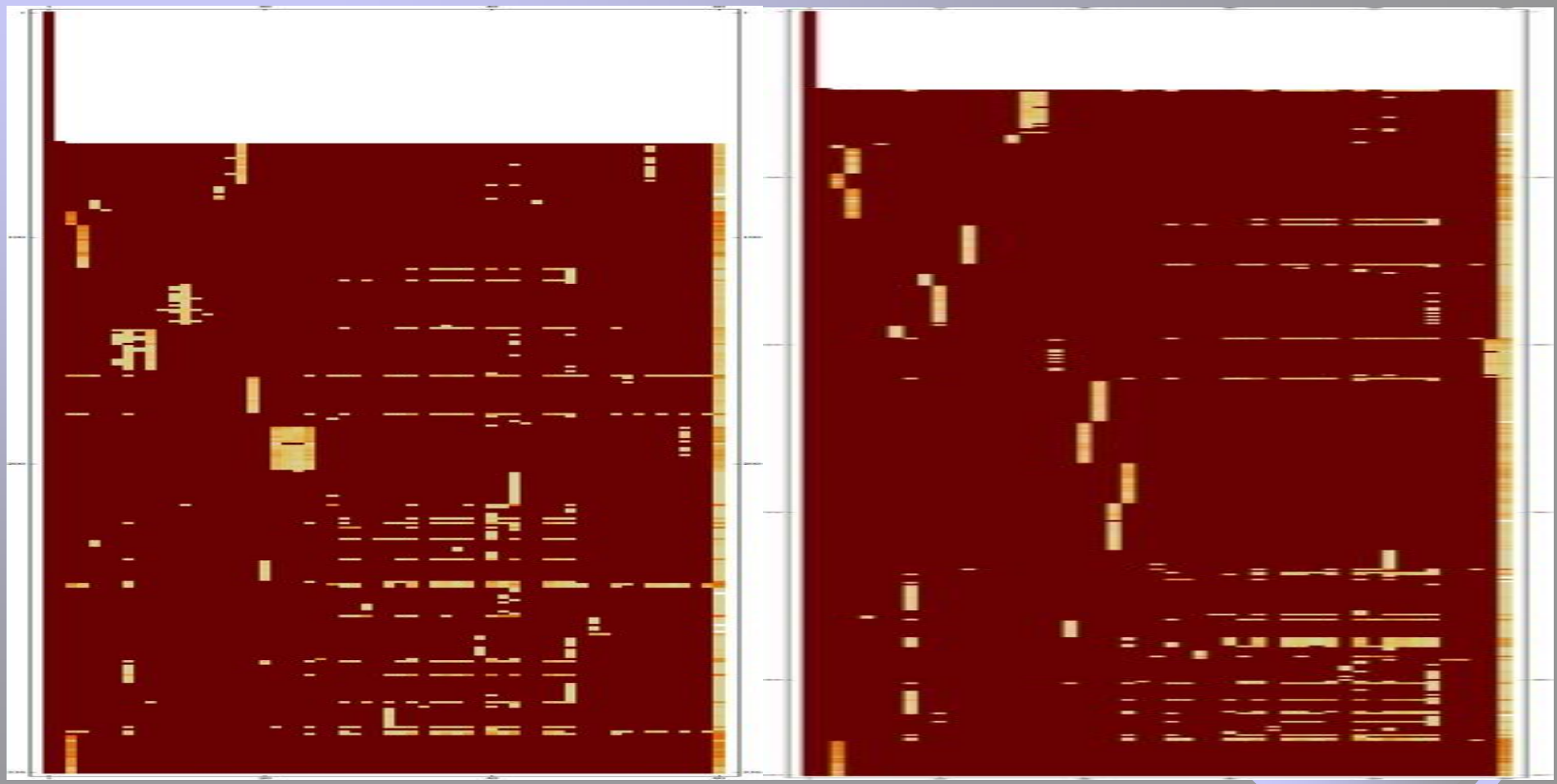
- Multiple incompatible systems
- Hesitancy/disagreement on what to include
- Fragmented data
- Serious privacy and security concerns
- Lack of visualization support
- Some commercial attention
  - SAP / Oracle
  - VitalHealth / Epic Healthcare
- Mixed acceptance success

Hospitals

- Natural source of data
- Highly trained professionals
- Wide range of technologies generating data for potential knowledge management
- Definitely an appreciation for application
- Unfortunately, some hospitals don’t have any systems to collect data
- Hospitals with systems to collect data generally not making good use of analytics or knowledge management

Hospitals Can Make Better Use of Knowledge Management

Snapshots of Hospital DataBase Tables



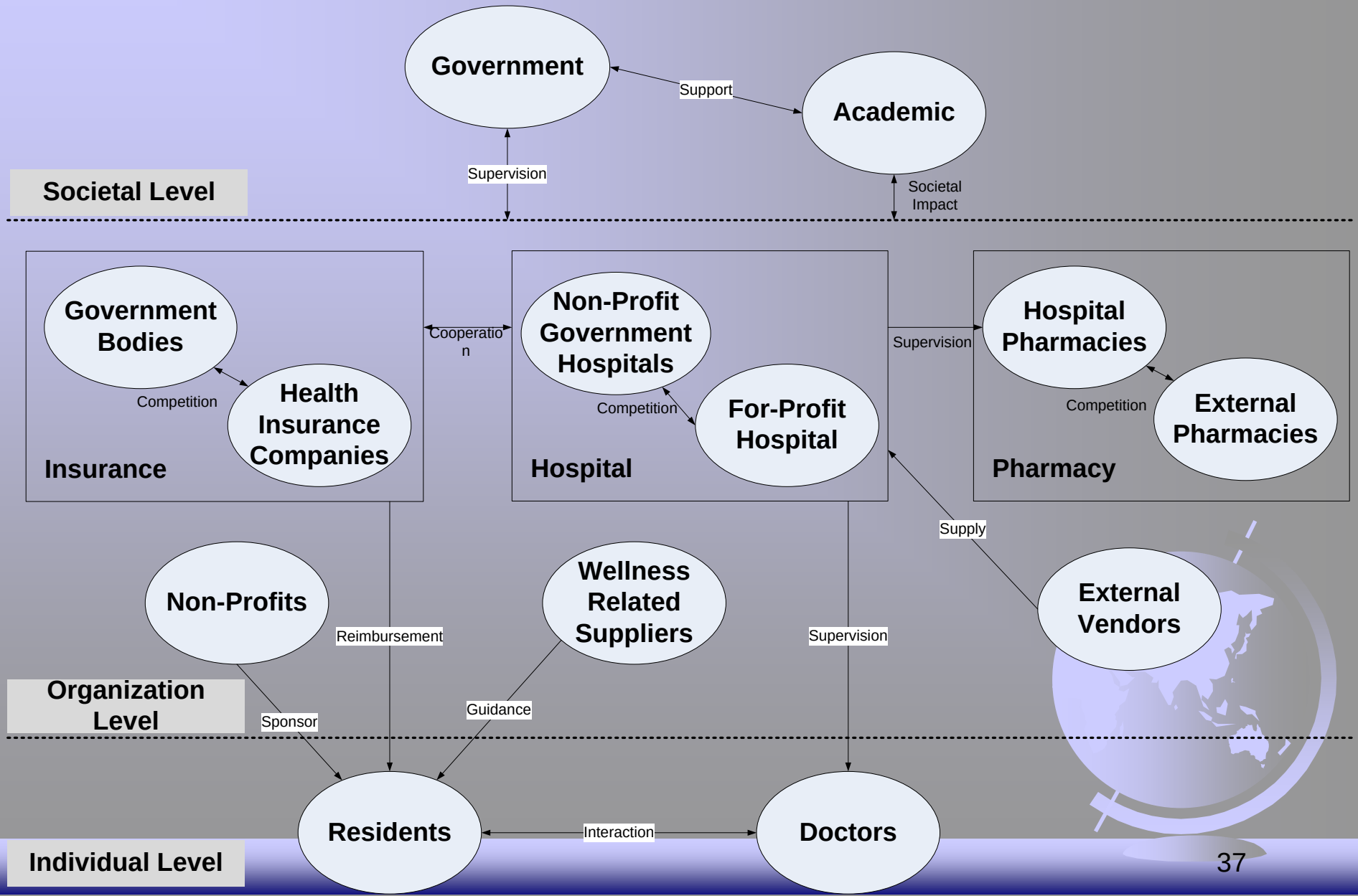
Problems

- Lack of comprehensive / visualized data
- Doctors and nurses not knowledge management educated or oriented
- Doctors may be especially reluctant to use data collected by other organizations
- Some doctors are more comfortable with the liability in a system that does not have rich data than in a system that does
- Electronic health records are not designed to allow for the easy inclusion of externally-generated data

More Problems

- Citizens lacking healthcare literacy
- Huge privacy and security issues
- Stakeholder tensions and disagreements
- Healthcare has emotional baggage
- Stakeholder buy-in is crucial
- Stakeholder involvement is critical
- Adaptation to change is necessary
- Need for creative knowledge management
- Complex multi-level ecosystem

Healthcare Ecosystem Stakeholders



Sustaining Behavioral Change

- When it's possible to mandate compliance – relatively straight forward
  - Do what I say!
  - Direct link between rewards and compliance
- When it's NOT possible to mandate compliance – can become very difficult
  - You can't make me do it!
  - Coercion is often not straight forward
  - Depends on perceived value and more
  - Can require a lot of convincing

Think Services

- Services by nature are something that we choose – usually not mandated
- Difficult to sustain interest, engagement and compliance
- Lots of opportunities for creative services
  - Technological advances
  - Big data analytics
  - Knowledge management
- Success through high levels of personalization

Wellness Services

- Assisting citizens in achieving a desired state of health
- Combination of data, processes and technology to generate usable knowledge
- Support for multiple stakeholder interaction
- Sustained behavioral change objective
- Need for effectiveness, efficiency, feasibility and desirability
- Services are only effective if used
- Wellness particularly cannot be mandated!!

Services are not just Systems

- Systems are more easily defined
- Services are people centric
- People are unpredictable
- Contextually-dependent processes
- Unforeseen consequences
- Unintended behaviors
- Lots of unknown unknowns
- Chaotic dynamics

Critical Success Factors for Sustainable Wellness Services

- Raise our collective level of thinking
- Shift from disease intervention to heath promotion and disease prevention
- Practice knowledge management
- Create robust services, not just systems
- Incorporate monitoring devices
- Personalized coaching
- Appreciate sustainability criteria

Sustainability Criteria

- Used and useful for those intended
  - Individual customization
  - Everyday usage
- Economically viable
- Robust in terms of stakeholder reward
- Able to evolve to meet changing needs
- Scalable within defined contexts
- Consideration of ability (or lack thereof) to mandate compliance
- Portfolio of value propositions

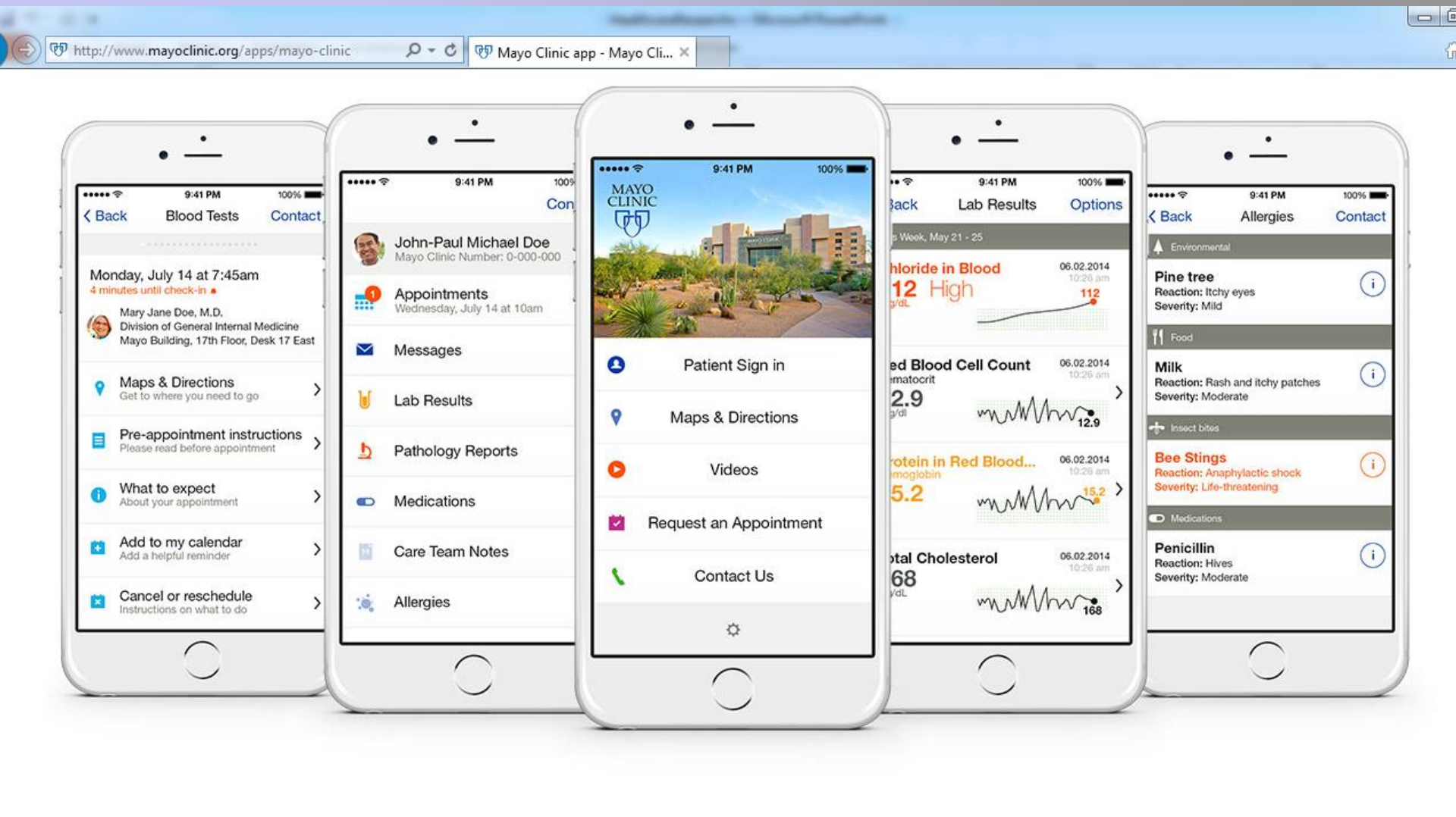
Service Examples

- Retrofit (Chicago, Illinois)
  - Focus on weight loss
  - Intervention team plus Fitbit
  - Missing broader prevention opportunities
  - Quite pricy
- Canyon Ranch (Tucson, Arizona)
  - Focus on wellness / lifestyle
  - Intervention team but no advance data
  - Minimal formal follow-up after stay
  - Very pricy

Mayo Clinic Service

- Closed system – need to be a Mayo patient
- Hospital after-care focused
- Lots of attention to information dissemination
- Missing elements of prevention & wellness
- More reactive than proactive
- Not especially sustainable in terms of lifestyle change and high personal cost
- Knowledge management oriented

Mayo Clinic System App



Collaboration with Apple

Online Healthcare Communities

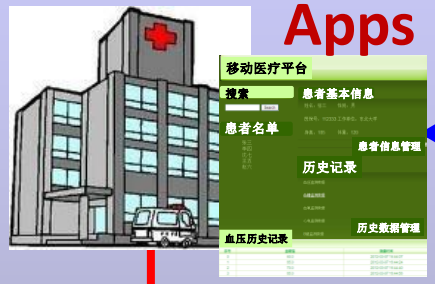
- Interaction between doctors and patients
  - patients search and select doctors
  - doctors share knowledge with patients
  - patients respond to doctors through online comments, thanks letters, etc.
- Examples in China
  - http://www.haodf.com/
  - http://www.xywy.com/
  - http://www.120ask.com/
  - http://www.91.cn/

21st Century Healthcare Transformation

- Historically, face-to-face doctor-patient visits in hospital systems with limited facilities
- Moving towards more patient centricity with broadened objectives including wellness
- Rapid Internet and mobile device infusion
- Emergent technologies for broadened use
- Internet of Things with wide range of sensors
- Heavy investment in healthcare services
- Serious attention to knowledge management

mHealth ecosystem to improve chronic disease management

III. Providers



Apps

Alert

3

Log in

II. Healthcare Cloud

Information Visualization Platform

Clin. Decision

- Risk Model
- ANN data mining
- Reference

PHR

4

Telemedicine

I. Mobile Devices

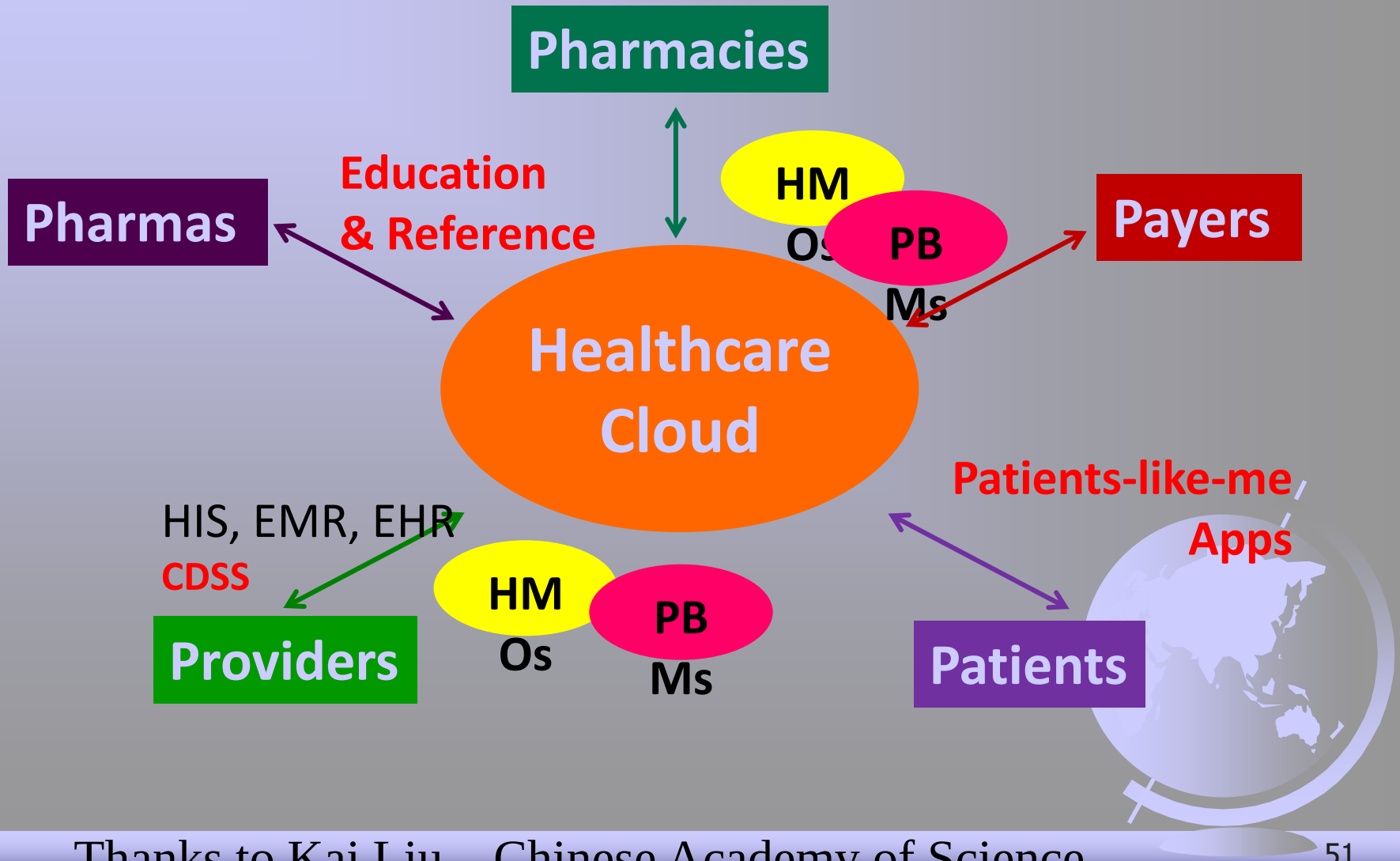
1

Bluetooth

GPRS

2

Healthcare cloud connects all stakeholders



Shanghai Lujiazui Smart Community Information Center

- Not-for-profit non-governmental organization
- Initiated with government support
- Smart-card oriented
- 0 - 10,000 clients in 1 less than year
- Key feature of business model is 365 young elderly volunteers
- Rewards include points for use for discounts from local merchants

KnowBody.com.cn

Portable Devices 部分健康服务设备

心电一体机
Electrocardiograph (ECG Exam)

移动远程血压计
Portable BPG (Blood Pressure Gauge)

光通量智能毯
Smart Carpet (Flux Sensors)

前台功能：

测试内容包括：血压、血糖、血氧饱和度、心电、体温、睡眠监控、人体成份分析等生理参数；

连接其他测试设备：电子血压计、心电一体机、光通量智能毯、压力感应毯、数字听诊器，呼吸监测仪；

实现在线高清视频问诊，信息查询。

在线咨询

后台功能：

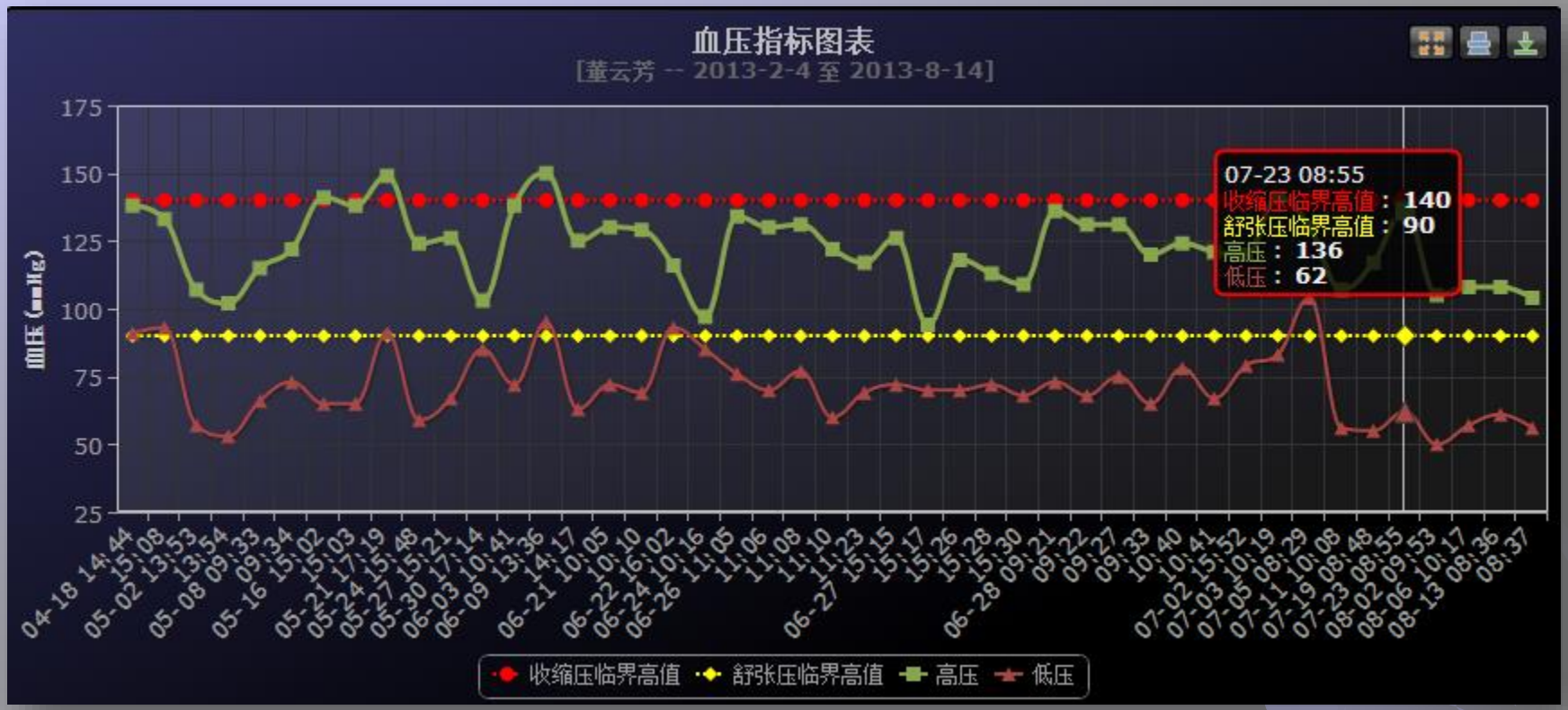
通过In
收服务器
户提供更
动及膳食，并能在线与专家咨询和交流，从而更好地提高生活品质。

More wearable devices will be introduced

Thanks to Dr. Stella Tian - Shanghai Lujiazui Smart Community Information Development Center

Individual Health Data Monitor 个人健康指标监控

注册用户可以通过设备进行健康检测，所有的检测数据都会上传到健康服务器；用户可以查看各类健康指标的趋势图；

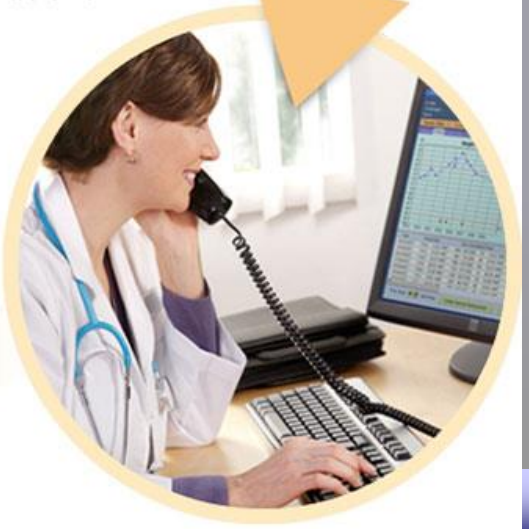


“Red-line” medical staff alert

Thanks to Dr. Stella Tian - Shanghai Lujiazui Smart Community Information Development Center

Philips

- Improved clinical outcomes
- Reduced acute care hosptalizations



Technology Paradigm Shift

Personal devices
Ubiquitous access
Self-directed use

Medical devices
Specialist access
Directed use

Healthcare Paradigm Shift?

Network oriented
Patient centric
Disease prevention

Hospital oriented
Doctor centric
Disease treatment

Need Big Data Paradigm Shift

Application impact
(Near) Real-time
Knowledge Mgmt.
Education

Understanding
Archival analysis
Reported statistics
Delayed application

E-Learning

- Broad-based stakeholder education is key to success
- E-learning is a powerful mechanism
  - Multiple ways of engagement and delivery
  - Blends well with traditional education
  - Flexible to meet changing needs
- Your time, your pace, your place education and learning
- Needs to be pedagogically-based with a portfolio of activities and options


Edit View World Help
OPS Careers 117, 115, 27 (Mature) - Ontario Public Service Careers
2:28 AM PDT
L$18
Search
RESET
MASTER
Human Resources
Ressources humaines
OHKnet-11
isdoug Heron
Health Center – Ontario Public Service
Local Chat
Say
Gestures
Talk
Communicate
Fly
Snapshot
Search
Build
Map
Mini-Map
Inventory


Edit
View
World
Help
English Orchid 21, 32, 35 (Mature) - Orchid General Hospital
2:22 AM PDT
L$18
Search
rchid
General
Take the first step.
OHKnet-11
isdoug Heron
RESET
MASTER
Sexy Mamas
BUY AS A GIFT
ocal Chat
Say
Gestures
Talk
Communicate
Fly
Snapshot
Search
Build
Map
Mini-Map
Inventory


Jessica: note the evidence of significant arterial scarring
Basil: unfortunately, the location is not conducive to angioplasty
Basil: but we can use a robot-assisted minimally invasive procedure

Google Glass in the Hospital

Social Media

- Knowledge sharing in action
  - Within the medical community
  - Between the medical community and patients
  - Between engaged citizens
  - Support groups
  - Interaction with government agencies
- Mechanism to promote health practice
- Foundation for increased intelligence
- Specialized support e.g., patients like us

Change Will Happen

- Tomorrow's world will be different
- Likely evolution, not revolution
- Government policy will assure stability
- Big data and analytics in business is becoming increasingly commonplace
- Advances in machine learning, artificial intelligence and robotics will occur
- Life-long e-learning is paramount
- Key to success is knowledge management

The future is challenging, but bright!!