The Healthcare Pivot: Technology and the Transformation of Healthcare

January 19, 2018

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Gregory Mario and Jeremy Mario Professor of Business Administration (2010-2016)

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Faculty Associate Director

Duke Clinical Research Institute

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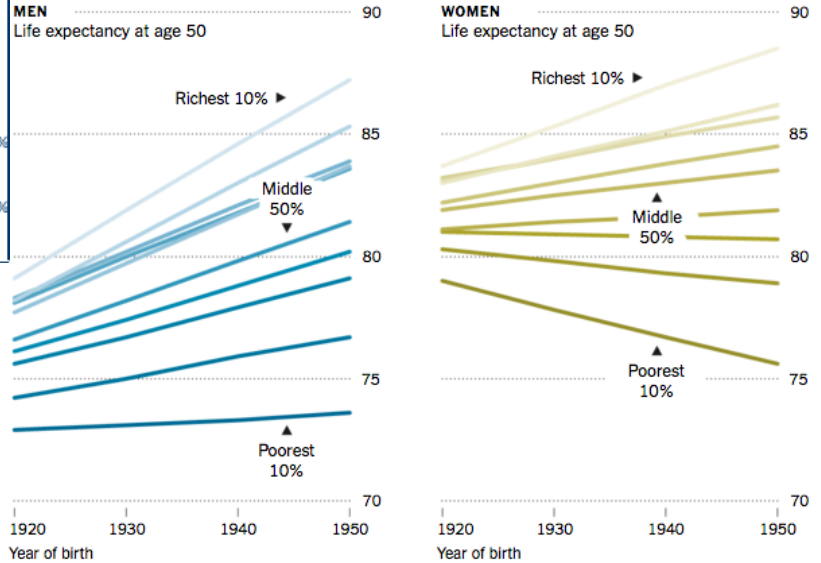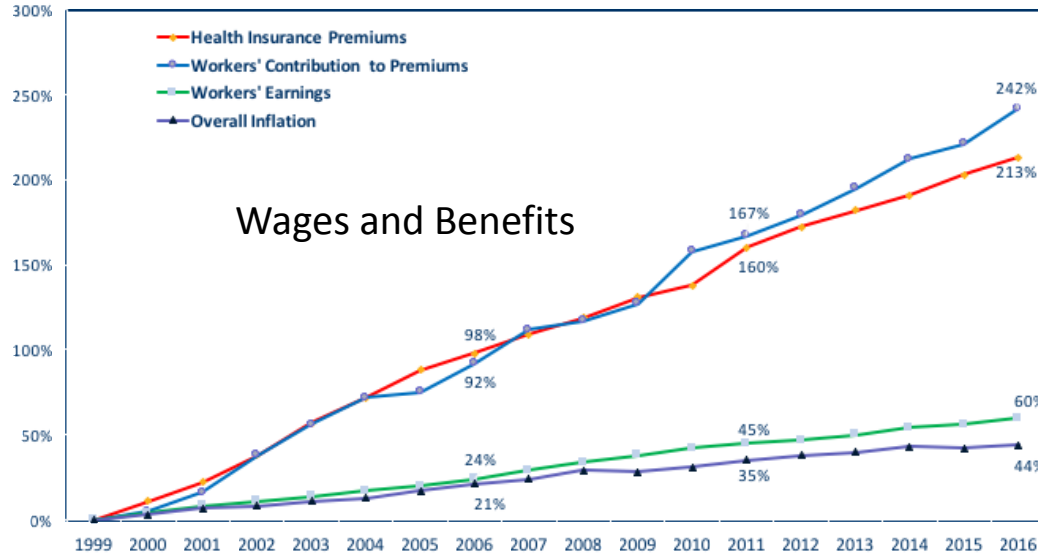
From Thought Leadership to Clinical Practice

$75,062

https://www.census.gov/newsroom/press-releases/2017/income-povery.html

$18,764

http://www.kff.org/report-section/ehbs-2017-section-1-cost-of-health-insurance/#figure11

Cost, Quality, Access


Wages and Benefits

Access

An Expanding Longevity Gap

SOURCE: Kaiser/HRET Survey of Employer-Sponsored Health Benefits, 1999-2016. Bureau of Labor Statistics, Consumer Price Index, U.S. City Average of Annual Inflation (April to April), 1999-2016; Bureau of Labor Statistics, Seasonally Adjusted Data from the Current Employment Statistics Survey, 1999-2016 (April to April).
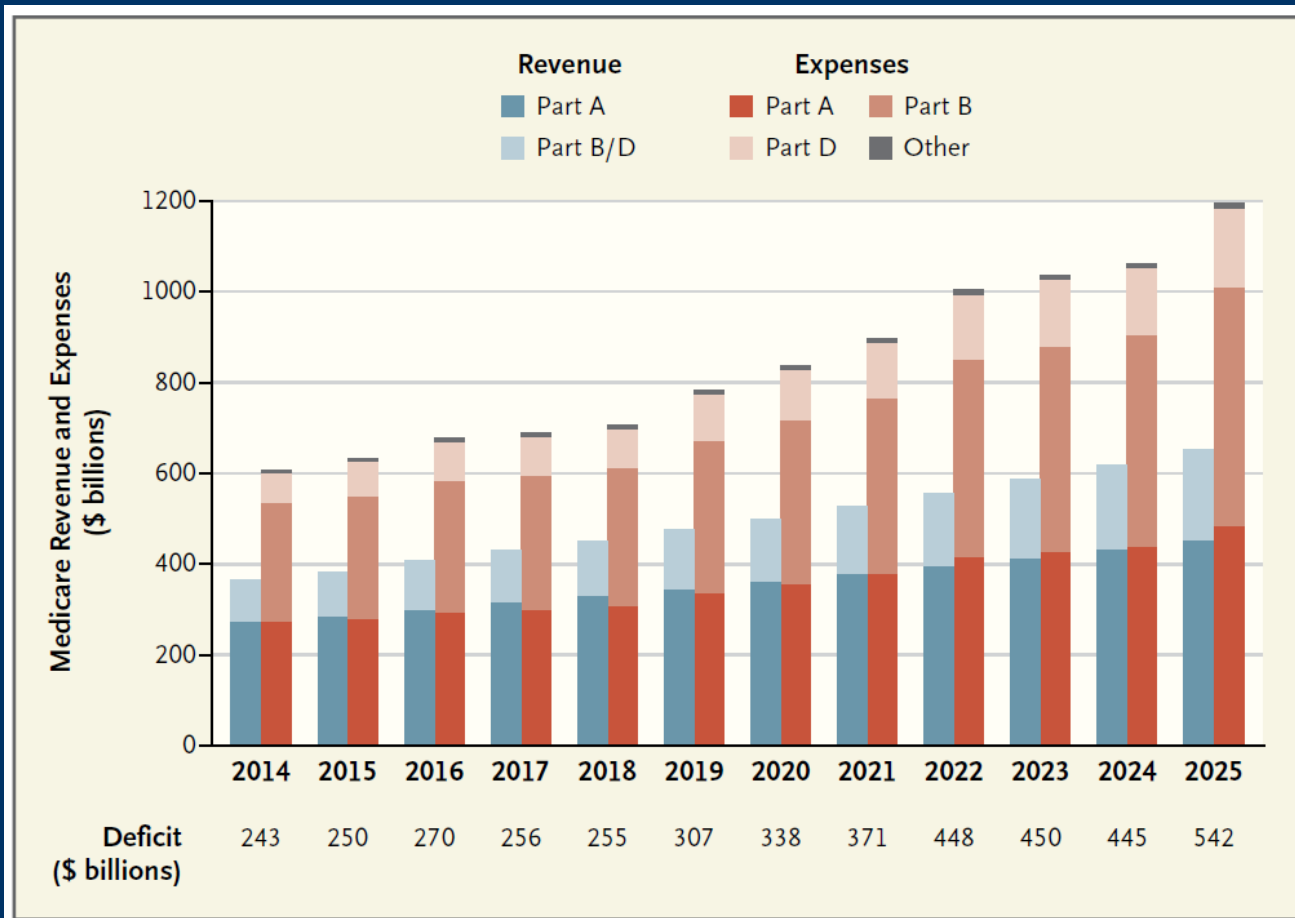http://www.nytimes.com/2016/02/13/health/disparity-in-life-spans-of-the-rich-and-the-poor-is-growing.html

Sustainability

Number of people age 65 and over, by age group, selected years 1900-2010 and projected 2020-2050

http://www.aoa.acl.gov/Aging_Statistics/future_growth/future_growth.aspx
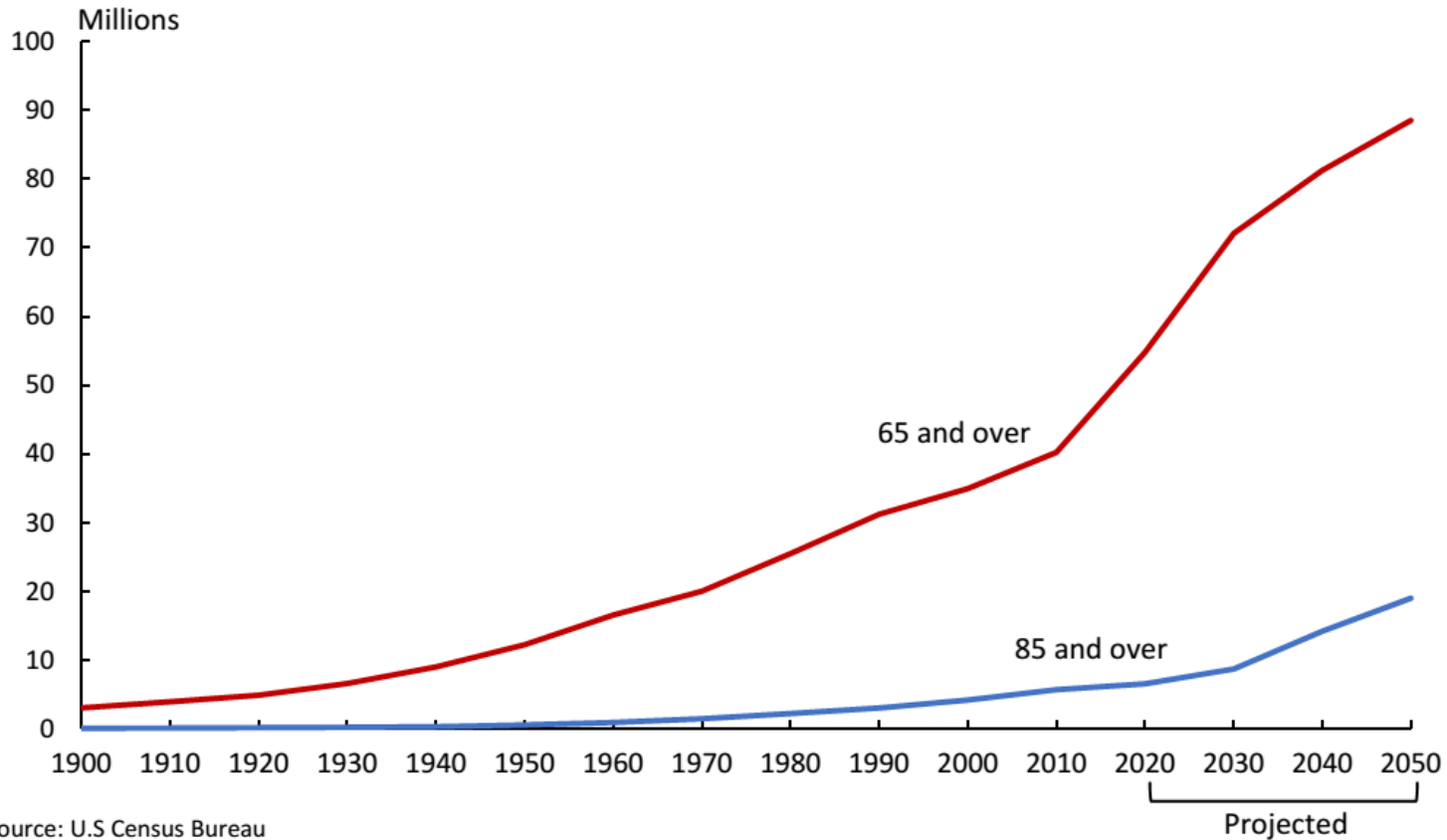
Medicare Spending

Trends in Medicare Revenues and Expenses

Data from the Congressional Budget Office reveal rising Medicare expenses without a matching increase in offsetting receipts. This deficit is funded by general tax revenues. Medicare Parts B and D accounted for 55% of Medicare expenditures in 2015 and are projected to account for 59% in 2025.[2]

Specialty Pharmaceuticals
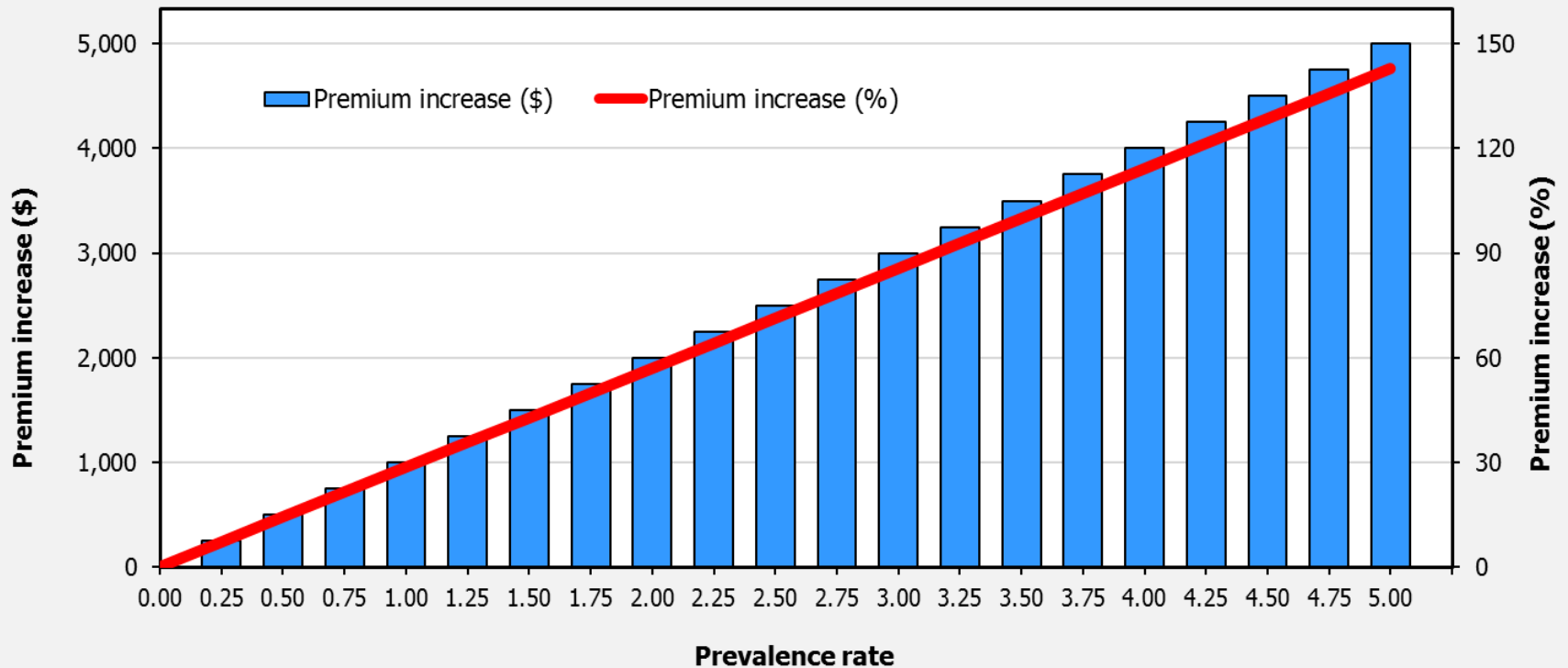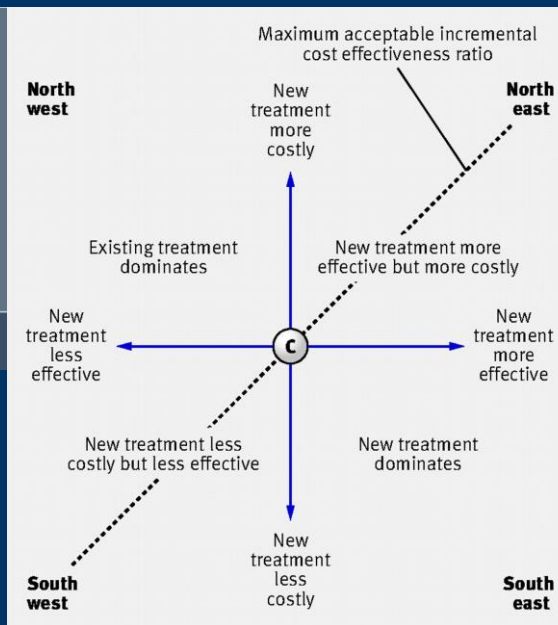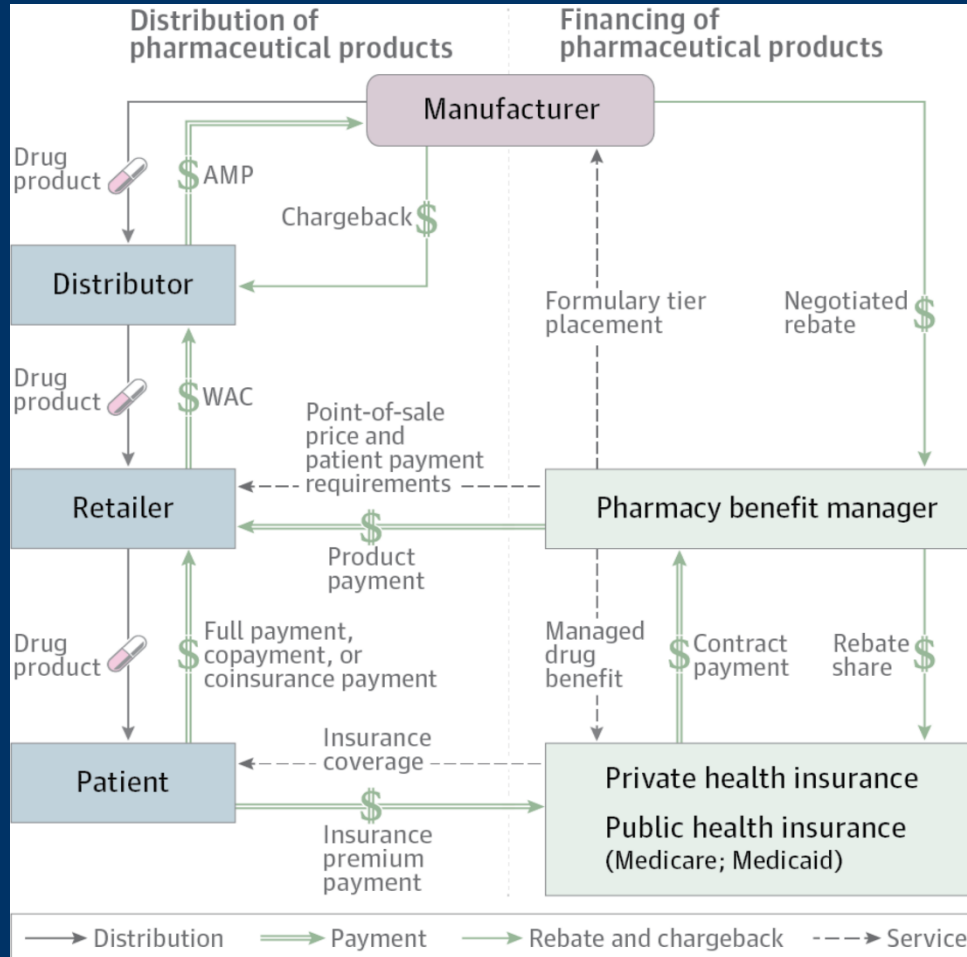
PCSK-9 Inhibitors

PCSK9 Inhibitors and the Choice Between Innovation, Efficiency, and Affordability

Daniel B. Mark, MD, MPH; Kevin A. Schulman, MD, MBA.

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Financing and Distribution of Pharmaceuticals

Flow of Pharmaceutical Funds, Products, and Services Adapted from a figure by the Congressional Budget Office. Services represent contractual relationships between entities. Rebates are payments from manufacturers to pharmaceutical benefit managers. Chargebacks are payments from manufacturers to distributors. Retailers include pharmacies, hospitals, group purchasing organizations, and mail-order programs. AMP indicates average manufacturer price; WAC, wholesale acquisition cost.

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How Do We Transform the Health Care System?

https://jmichaelrios.wordpress.com/2014/04/17/resurrection-butterflies/

Health Informatics

http://static1.squarespace.com/static/5330c47be4b03ea35b2645a8/t/536 19b00e4b08cab3cb7ddee/1398905604179/dreamstime_m_29502544.jpg? format=1500w

The Economics of Health IT

- Scale
- Network Economics
- Disruptive Innovation
- Organizational Innovation
- Business Process Improvement

- Analytics
- Workflow
- Connectivity and Services
- Patient Engagement
- Substitution

Scale

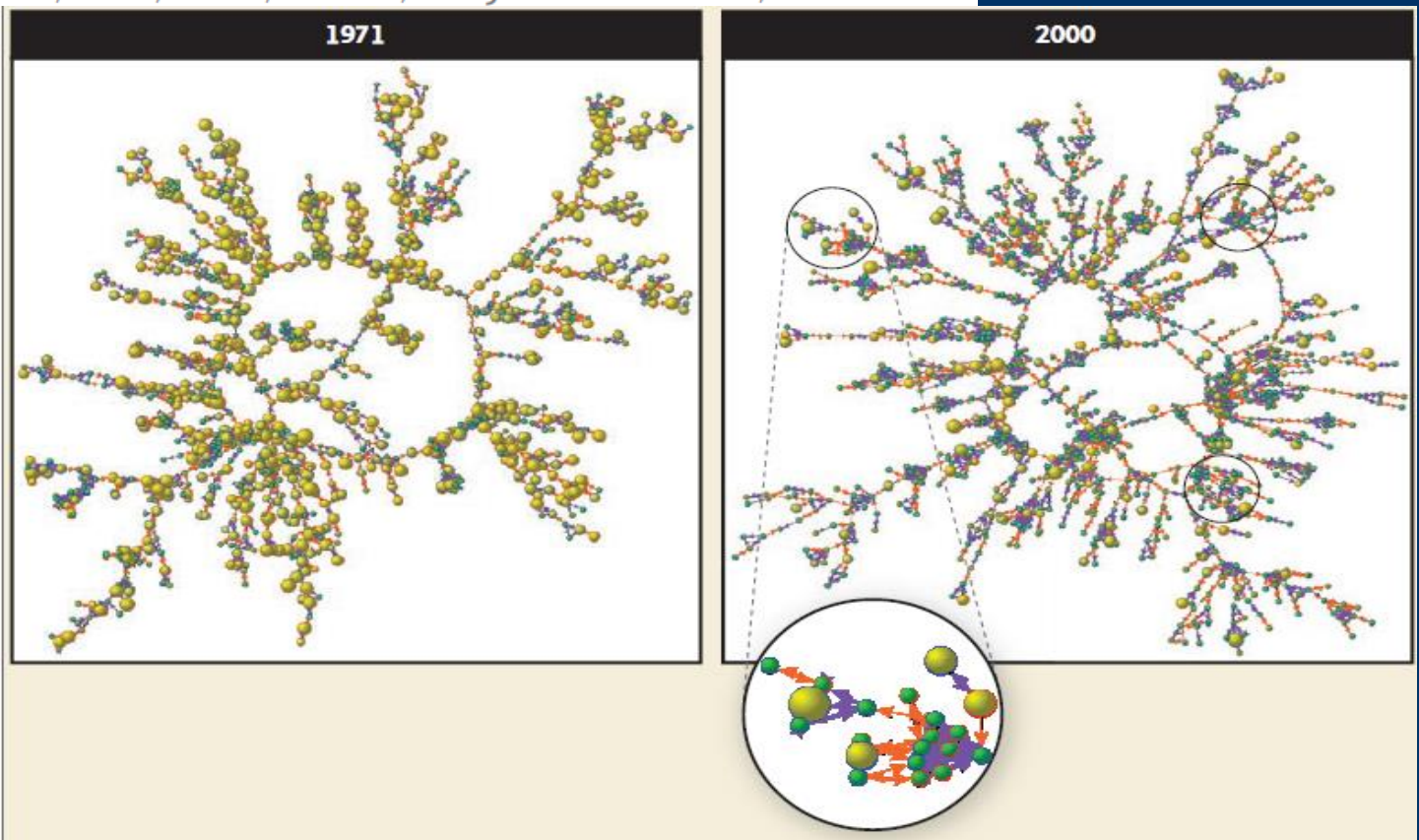https://www.roboticsbusinessreview.com/wp-content/uploads/2015/10/kiva.jpg

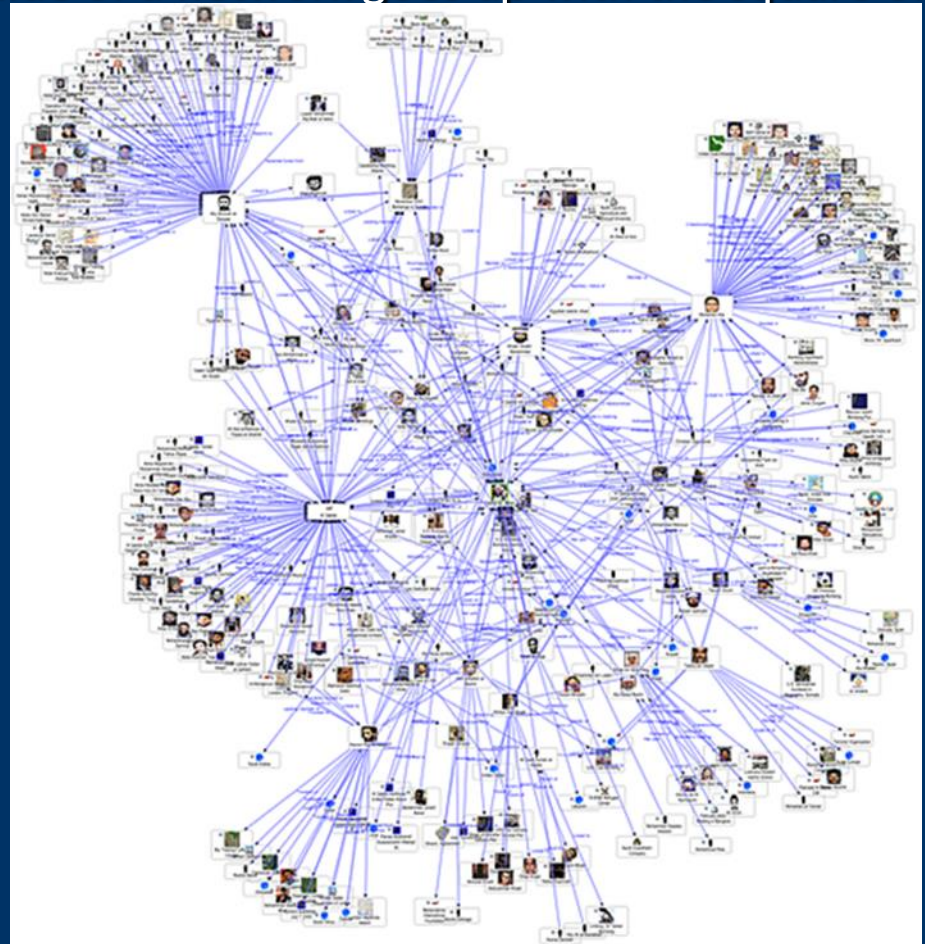# Network Economics

The NEW ENGLAND JOURNAL of MEDICINE

The Collective Dynamics of Smoking in a Large Social Network

Nicholas A. Christakis, M.D., Ph.D., M.P.H., and James H. Fowler, Ph.D.

Network Economics

- Metcalfe's Law: The value of a network goes up with the square of the number of users

- **Value = n^2**

- 1 = 1

- 10 = 100

- 100 = 10000

- 1000 = 1000000

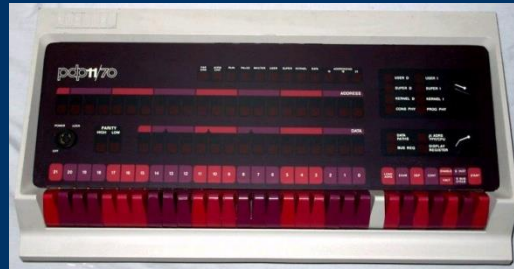**Duke** Clinical Research Institute

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Google Images

Disruptive Innovation

AMDAHL

DEC

COMPAQ
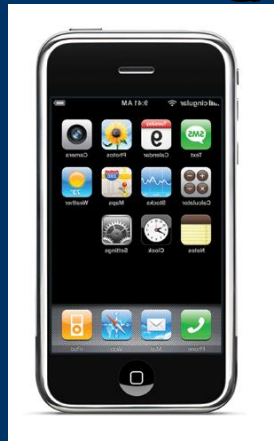
Clay Christensen

iPhone

BlackBerry™

IBM

Organizational Innovation Vs. Disruptive Innovation Slide

http://continuumgames.com/shop/rock-em-sock-em-robots/

Organizational Innovation

Harvard Business Review

CHANGE MANAGEMENT

We Interviewed Health Care Leaders About Their Industry, and They're Worried
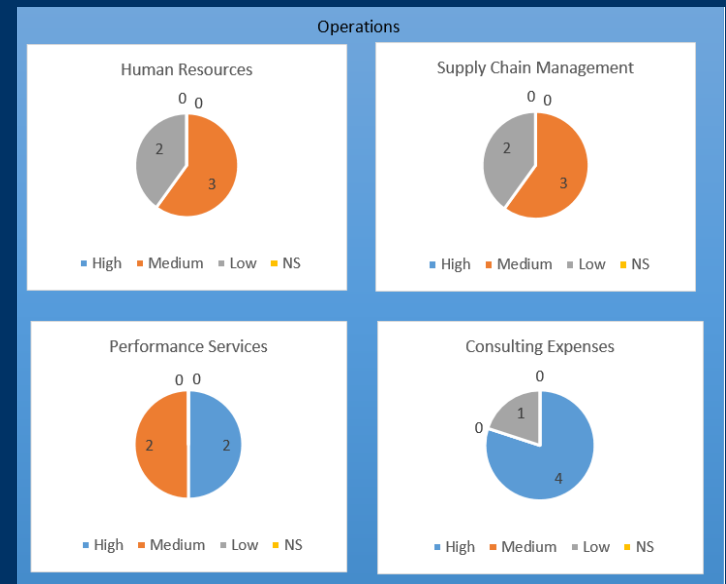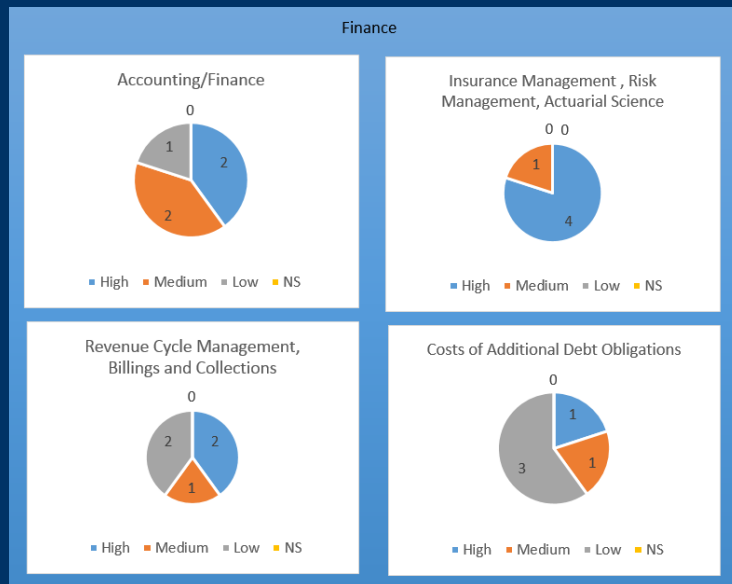
by Michael Poku and Kevin A. Schulman

DECEMBER 14, 2016

Finance

Operations

Organizational Innovation

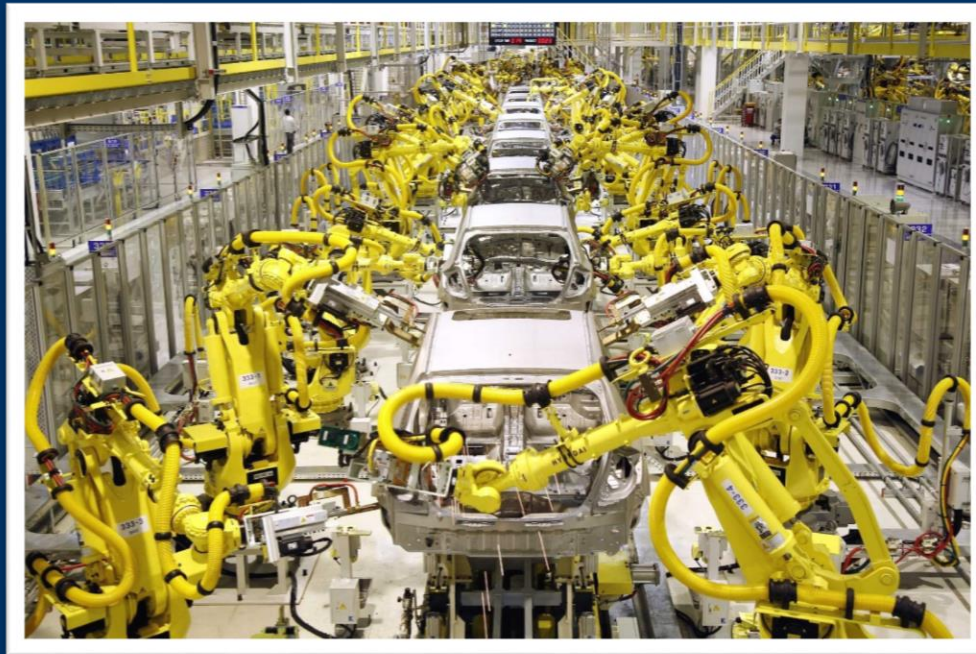**Table 1**. Characteristics of Chief Innovation Officers by Primary Function

Characteristic	Strategic (n = 13)	Operational (n = 6)	Financial (n = 6)	Total (N =25)
Reporting directly to chief executive officer, %	54	0	33	36
Business unit outside existing structures, %	8	0	67	20
Budget (in millions), median, $[a]	3.0	2.0	35.0	3.5
Headcount, median, No.[b]	17.0	6.5	30.0	9.5

[a] Budget data were provided by 9 of 13 chief innovations officers in the strategic function, 5 of 6 in the operational function, and 6 of 6 in the financial function.

[b] Headcount data were provided by 13 of 13 chief innovation officers in the strategic function, 6 of 6 in the operational function, and 5 of 6 in the financial function.

Business Architecture

A business model/business architecture is a fixed characteristic of an organization that is resilient and resistant to incremental change

Richman, Barak D., Mitchell, Will and Schulman, Kevin A.,2013
"Organizational Innovation in Health Care. HMPI, 1(3): 36-44

Organizational Structure

Source: Dossary, K

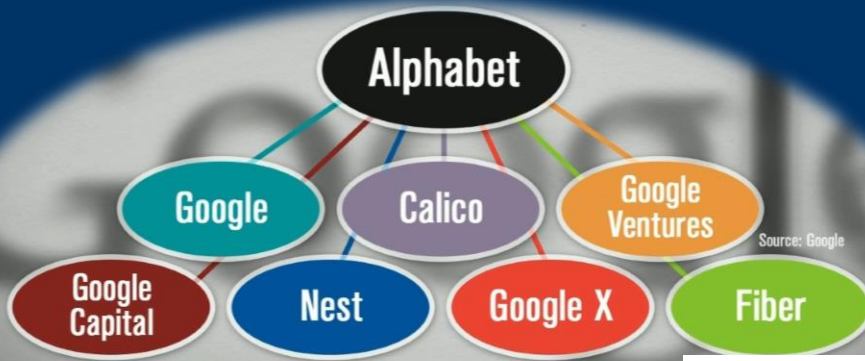# Organizational Innovation

Production Engine

Innovation Agenda
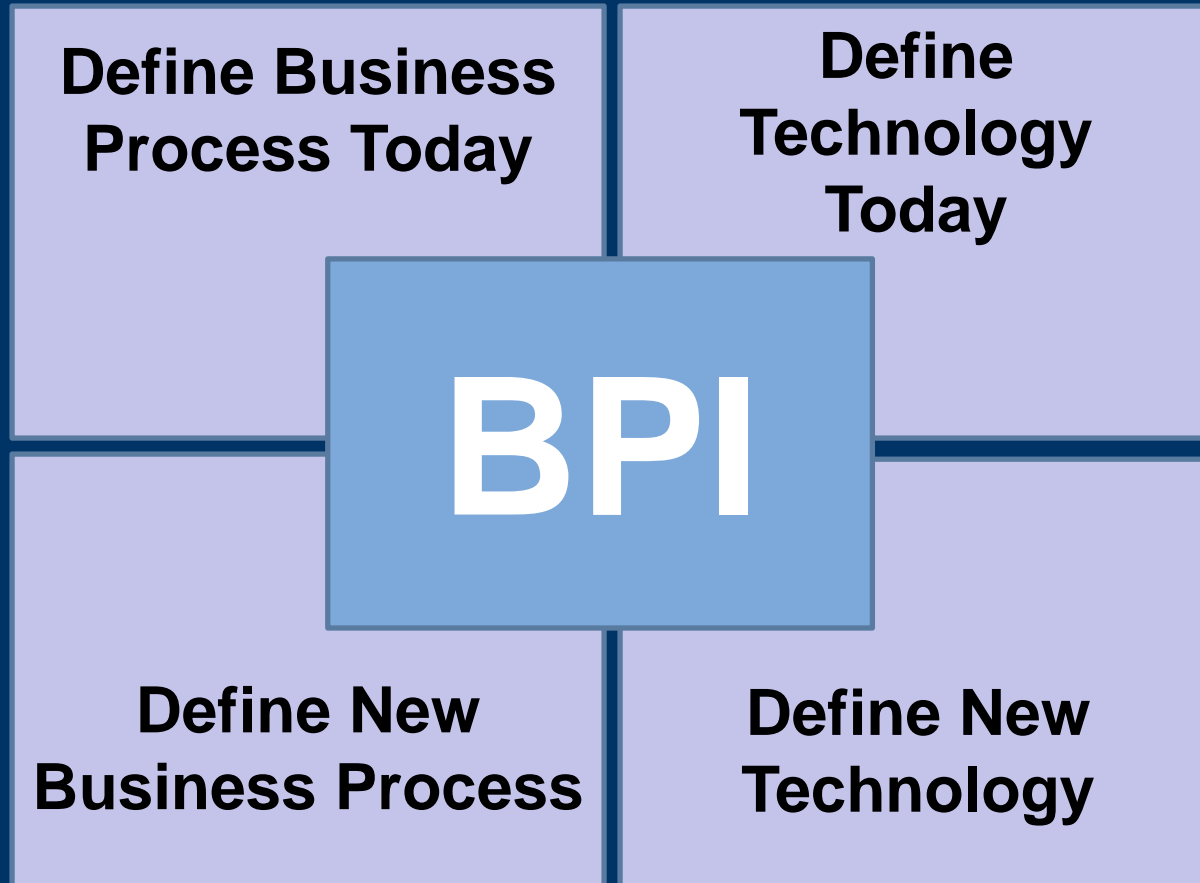
Google Alphabet: Structure

We are excited about...

- Getting more ambitious things done.
- Taking the long-term view.
- Empowering great entrepreneurs and companies to flourish.
- Investing at the scale of the opportunities and resources we see.
- Improving the transparency and oversight of what we're doing.
- Making Google even better through greater focus.
- And hopefully... as a result of all this, improving the lives of as many people as we can.

What could be better? No wonder we are excited to get to work with everyone in the Alphabet family. Don't worry, we're still getting used to the name too!
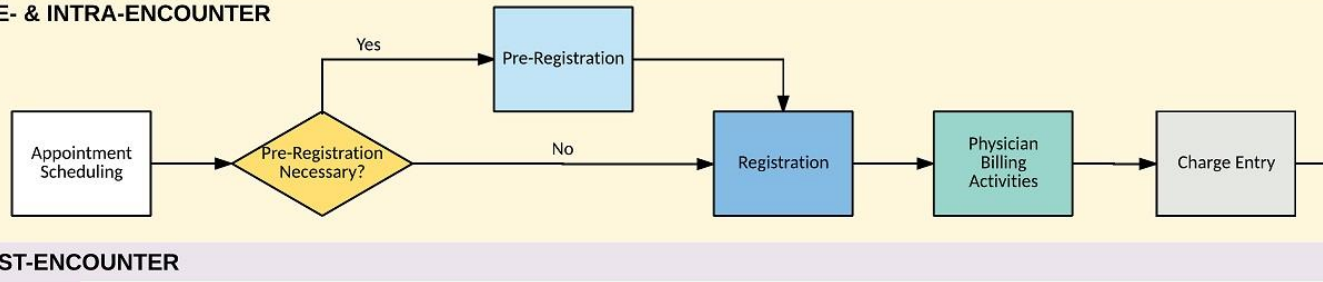
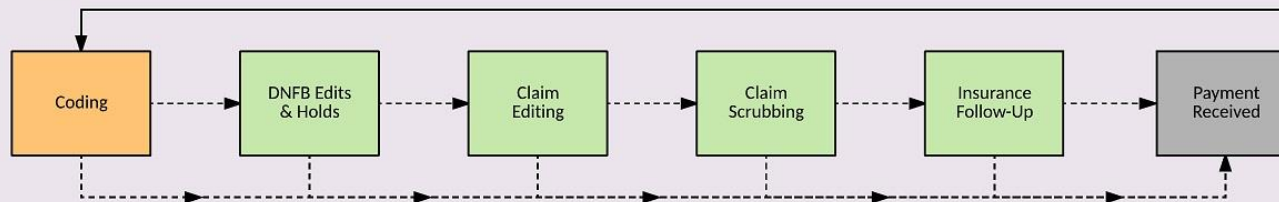Larry Page
CEO, Alphabet

Business Process Improvement

Define Business Process Today

Define Technology Today

BPI

Define New Business Process

Define New Technology

BPI: US Billing Process

PRE- & INTRA-ENCOUNTER

Appointment Scheduling → Pre-Registration Necessary? — Yes → Pre-Registration → Registration → Physician Billing Activities → Charge Entry

Pre-Registration Necessary? — No → Registration

POST-ENCOUNTER

Coding → DNFB Edits & Holds → Claim Editing → Claim Scrubbing → Insurance Follow-Up → Payment Received

TEAMS INVOLVED
- Excluded From Study
- Automated
- Pre-Registration
- Registration
- Physician
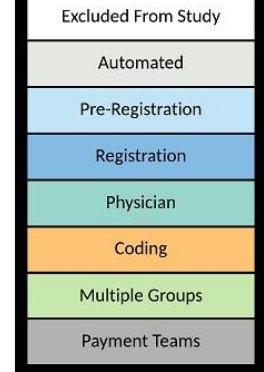- Coding
- Multiple Groups
- Payment Teams

Table 1. Estimated Billing and Insurance-Related Administrative Costs by Activity [a]

Costs and Processing Time	Primary Care Visit		Emergency Department Visit [b]		General Inpatient Stay		Ambulatory Surgery		Inpatient Surgery	
Total processing time, min	13		32		73		75		100	
Total cost	$20.49	100%	$61.54	100%	$124.26	100%	$170.40	100%	$215.10	100%
Cost breakdown by activity										
Pre- and intra-encounter costs										
Registration and preregistration	$3.82	19%	$5.58	9%	$16.48	13%	$16.48	10%	$16.48	8%
Physician time	$6.36	31%	$10.97	18%	$13.29[c]	11%	$51.20	30%	$51.20	24%
Post-encounter costs										
Professional billing	$4.22	21%	$11.72	19%	$4.22[c]	3%	$45.55	27%	$45.55	21%
Hospital billing	—	—	$13.70	22%	$44.43	36%	$17.44	10%	$44.43	21%
Overhead	$6.10	30%	$19.57	32%	$45.84	37%	$39.72	23%	$57.43	27%

[a] Percentages may not sum to 100 because of rounding.

[b] Emergency department visit without hospital admission.

[c] For a general medicine inpatient stay, the billing and insurance-related cost of physician time assumes that auto-population of the EHR after the first inpatient day occurs correctly without subsequent need for physician time or alterations. The cost of professional billing assumes that the incremental cost of additional inpatient days is minimal with respect to the first inpatient day and that physicians are timely with their billing responsibilities, such that all inpatient professional rounding charges are processed and submitted to payers concurrently.

Analytics: Business Challenges to Solve

Business Process Intelligence
- Clinical use cases
- Data collection (structure)
- Clinical Performance

Population Health
- Clinical risk prediction
- Cost/utilization prediction

Patient Experience and Behavior
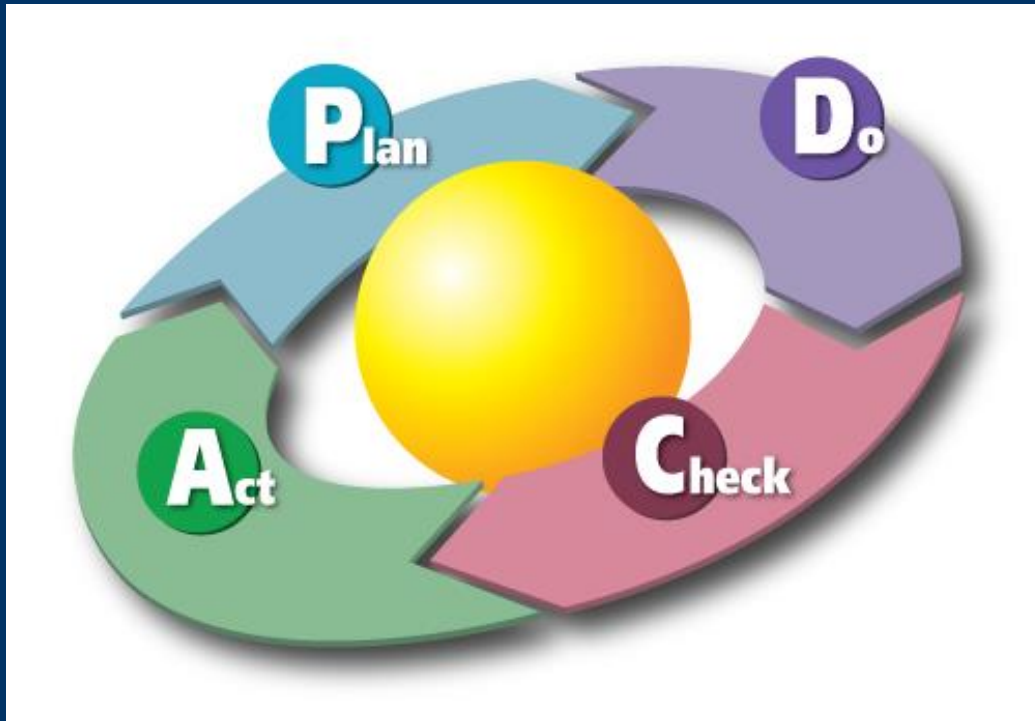- Engagement
- Access
- Portal Services

Research & Innovation
- Novel Insights
- Technology Assessment

Financial Optimization
- Plan negotiations
- Cost allocation

Data Culture

- Lean
- Six-Sigma
- Toyota Production System (TPS)

Risk Stratification

| Population Size | 100,000 |
| Revenue Per Member Per Year | $2,965 |

Case Volume

Patient Type		I Highest Users	II Next Percentile	III Next Percentile	IV Prevention
	Sum				
Population Distribution	100%	1%	4%	10%	85%
Count	100,000	1,000	4,000	10,000	85,000

Cost of Care	**Average**				
Expected Per Person Cost of Care	$2,965	$65,000	$20,000	$7,500	$900
Disease Management Costs	**Percentage**				
	5%	$3,250	$1,000	$375	$45
Disease Management Cost Reduction					
Actual Care Costs	5%	$61,750	$19,000	$7,125	$855

Delivering Actionable Data to Clinicians

Mentors

Category ⇕	Mentor ⇕	Top-Box ⇕	Score ⇕	Response Count ⇕
Communication	Provider 2331	73.1	4.39	140
Patient Centered Care	Provider 2011	65.4	4.44	405
Provider Expertise and Interpersonal Skills	Provider 2011	85.6	4.69	405

Providers

Name ⇕	Top-Box ⇕	Score ⇕	Communication ⇕	Patient Centered Care ⇕	Provider Expertise and Interpersonal Skills ⇕	# of Responses ⇕	Download Report ⇕
Peer Group Average	66.17	4.04	3.85	4.14	3.87	167.47	
Provider 1992	66.0	3.98	3.98	4.16	3.80	235	🗎
Provider 1998	51.0	4.05	3.91	3.81	4.42	320	🗎
Provider 2011	64.9	4.41	4.10	4.44	4.69	405	🗎
Provider 2034	58.9	4.32	4.22	4.27	4.46	142	🗎
Provider 2043	72.6	4.22	4.03	4.27	4.37	103	🗎

- Detailed physician & nurse-specific reporting
- Peer Comparisons and mentorship for actionable improvement
- Downloadable reports
- mobile provider report card
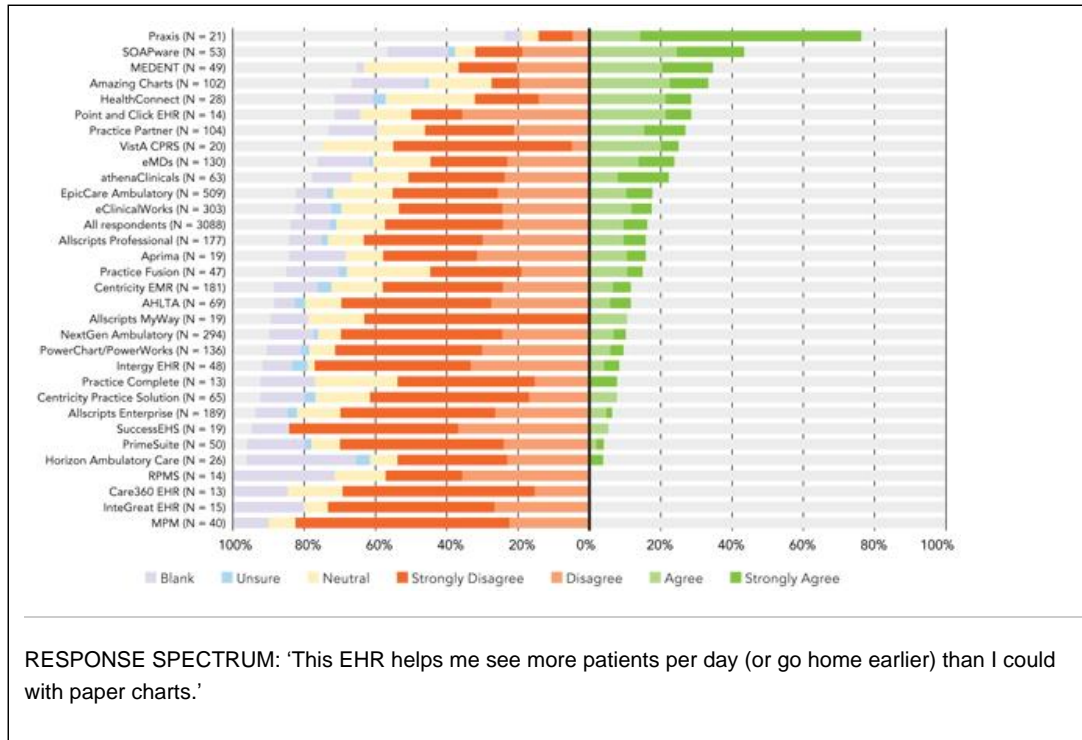
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www.Bivarus.com

Workflow

RESPONSE SPECTRUM: 'This EHR helps me see more patients per day (or go home earlier) than I could with paper charts.'

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http://www.aafp.org/fpm/2012/1100/p23.html

Connectivity

Hospital Health Record

Personal Health Record

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Singapore PHR

Brochure content (NEHR — National Electronic Health Record, Singapore):

Wouldn't it be helpful and assuring if, each time you see your doctor, he has your past medical record? You wouldn't have to try to remember past episodes of illnesses or test results. Your doctor would see your record even if you had visited different public hospitals or clinics using the National Electronic Health Record (NEHR) system.

The NEHR is a data exchange system that stores the medical record of every person in Singapore who has seen a doctor in the public healthcare system since February 2011.

Through the NEHR, doctors have access to the medical history of patients to support them in decision-making. The goal of the NEHR is to ensure a seamless healthcare experience for each patient.

Your doctor can access your medical history

Your doctor can make more informed patient care decisions

Why NEHR?
The NEHR is a key enabler of Singapore's strategic vision, "One Patient, One Health Record", a vision that focuses on providing customised and convenient care to patients. By providing a consolidated view of a patient's medical history, the NEHR ensures that healthcare professionals have the necessary information to help them make the best care decisions for the patient.

What medical information is in the NEHR?
Information in the NEHR includes:
1. Admission and visit history
2. Hospital inpatient discharge summaries
3. Laboratory results
4. Radiology results
5. Medication history
6. History of past operations
7. Allergies and adverse drug reactions
8. Immunisations

Is your medical record safe?
Your medical record is safe. The confidentiality of your medical record, whether manual or online, is governed by law and only authorised users of the NEHR can access it. Neither can the information be forwarded to a third party. All access to the records are logged and reviewed periodically.

You may avoid duplicate tests or referrals

Patients are automatically included in the NEHR to enjoy the benefits that it brings. For more information, including your opt-out option, please speak to the staff at your healthcare institution. You can also contact the MOH Quality Service hotline at 1800 225 4122.

MINISTRY OF HEALTH SINGAPORE

One Patient, One Health Record

https://www.moh.gov.sg/content/dam/moh_web/Publications/Information%20Papers/2014/NEHR/English%20Brochure%20(Final).jpg

Patient Portal

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mHealth: Data and Services

mPower
Placing patients at the center of their healthcare experience

DUKE GLOBAL HEALTH INSTITUTE

Patel, Rajan | Nguyen, Thao | Popli, Karishma | Iwelumo, Chioma | Hwang, Laurie

Patient Centered Care

Objectives:
- Empower patients to easily store, access, understand and utilize their health records from their mobile phone.
- Provide interactive and customized health information and education to patients, enabling them to take ownership of their healthcare.

Background
- Patient-centered care is gaining prevalence in hospital systems worldwide
- Electronic health records can play a key role in patient-centered care, but they currently fail to do so
- Patients have very limited access to their records and information is difficult to comprehend
- Current EHRs are created for and owned by provider systems, and information sharing across provider systems is a challenge
- EHR vendors prioritize maximizing provider profits over improvements in the storage and transfer of patient health information
- Implementing provider-centric EHR systems is expensive and many countries have yet to adopt them at scale

Product development

Our Design Process — Physicians in Nigeria, Duke Physicians, Global Health Faculty, User Story Development, Design Thinking, Iterative Development, Stakeholder Deliberation, Patient Focus groups

Key system features
- **Mobile and cloud-based:** Patients can have access to their records whenever, wherever
- **Tiered access:** patients control who can see their record, and how much information they will see.
- **Modular approach:** A patient's EHR starts small, and grows to meet their needs, through the addition of health and service modules
- **Education modules:** Patients can easily become informed about their diseases and treatment
- **Personal health plan:** Based on their records, patients can set short- and long-term goals with their provider, to improve their health
- **Patient-provider interaction:** Patients can easily communicate and collaborate with their care team directly from the application

Future directions
- Develop mobile application prototype
- Leveraging our Nigerian advisors, conduct a pilot test in Abuja, Nigeria to evaluate and increase the usability of product for our initial target market.
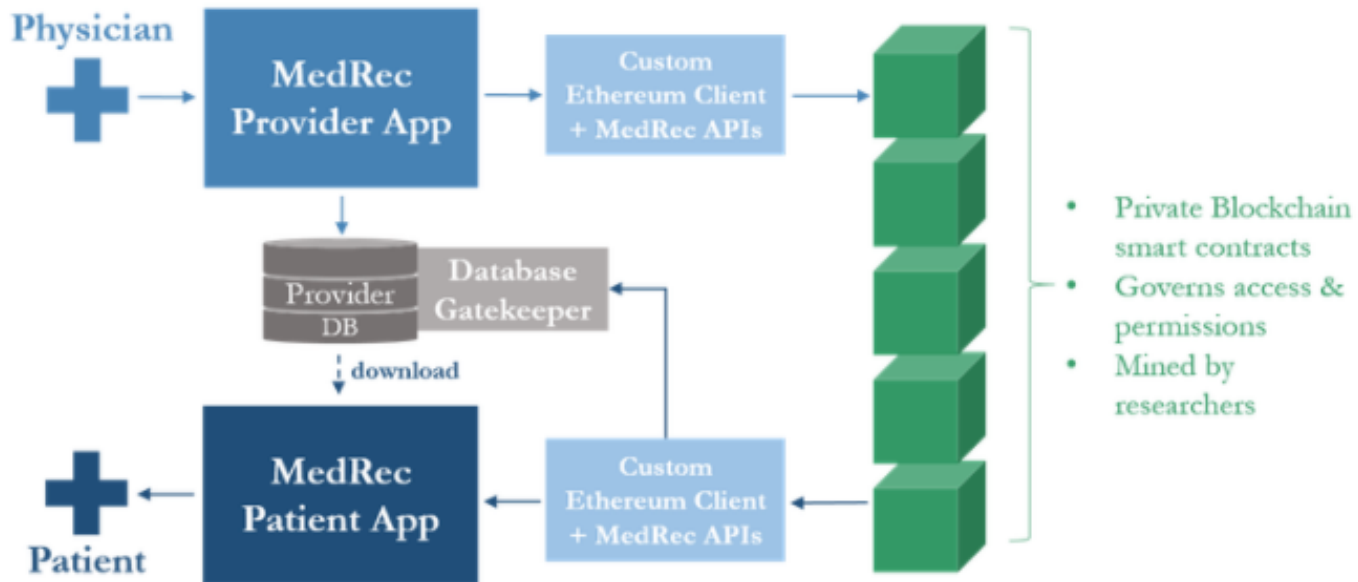
Acknowledgements
- Dr. Kevin Schulman, Dr. Eric Green, Dr. Mohammad Pate, DIHI, Dr. Okoronkwo Ogan

Blockchain PHR

MedRec: Medical Data Management on the
Blockchain

Patient Engagement

Table 2 Engagement Methods for Health Factors

| Health Factor	Engagement Method				
	Facilitating Social Support	Goal Setting	Reinforcement Tracking	Self-monitoring	Other
Diet/Caloric Intake	5	9	8	46	0
Fitness/Training	4	8	7	35	0
Health Education	0	0	0	0	16
Health Resource	4	0	1	20	38

Source: Casewriters.

Note: The number of apps for each health factor or engagement method may represent overlapping categories.

Use Cases:
- Prevention
- Compliance
- Population Health

Approaches:
- Market Segmentation
- Behavioral Economics

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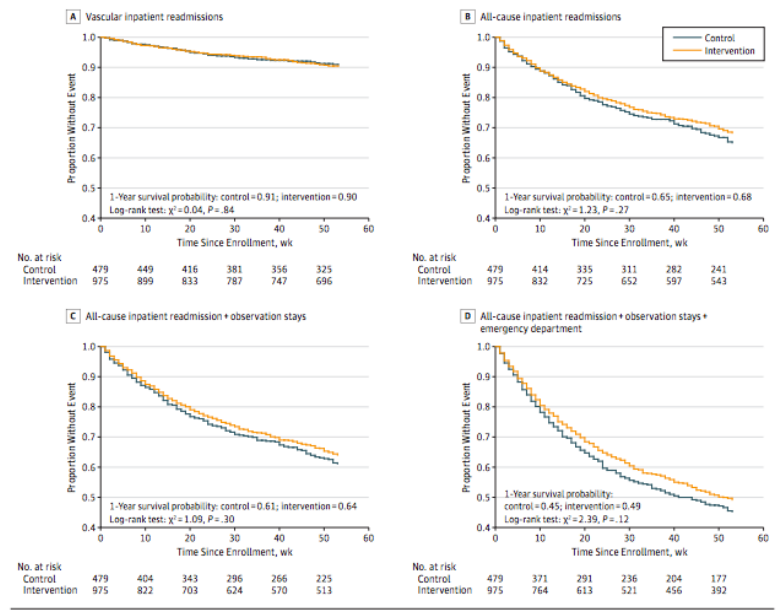From Thought Leadership to Clinical Practice
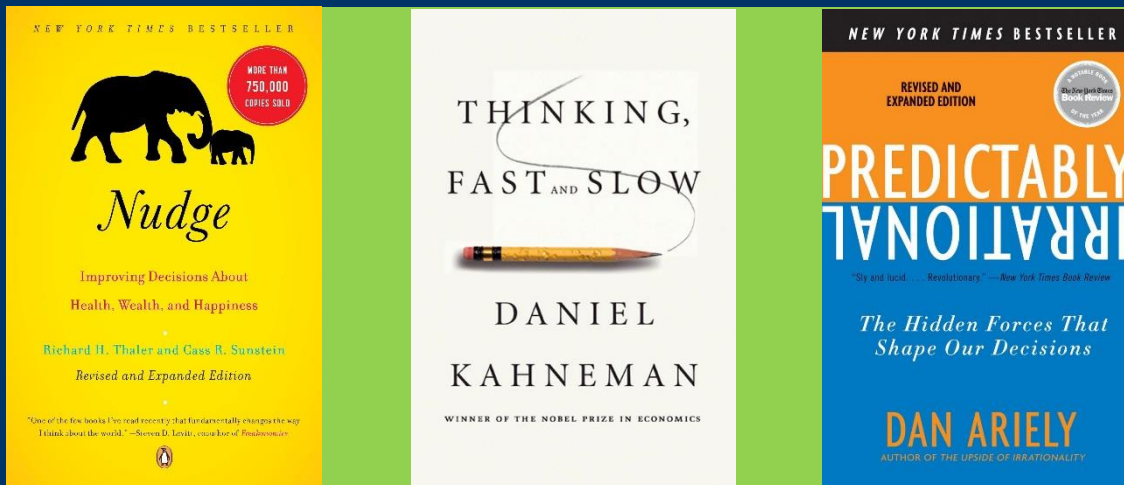
Patient Engagement

JAMA Internal Medicine | Original Investigation

Effect of Electronic Reminders, Financial Incentives, and Social Support on Outcomes After Myocardial Infarction
The HeartStrong Randomized Clinical Trial

Figure 2. Kaplan-Meier Curves for Hospitalization

Population Health

Scale	Commitment Ladder	Qualifiers
1	Staunch	Takes medication every day as prescribed
2	Loyal	Takes medication on correct day
3	Regular	Takes most medication as prescribed
4	Confused	Wants to take medication – multiple instructions and medications
5	Cost Conscious	Wants to take meds – worried about expense
6	Splitters	Takes some medication as prescribed
7	Lapse – a – daisical	Know they have medication but does not pay attention to refills
8	Unaware	Does not know they have a medication
9	Reject Doctor	Does not like their doctor, won't follow doctor's instruction
10	Reject Medication	Does not believe in medication

Substitution (Capital for Labor)

Google Images

Machine Learning: Curated Data Sets

Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs
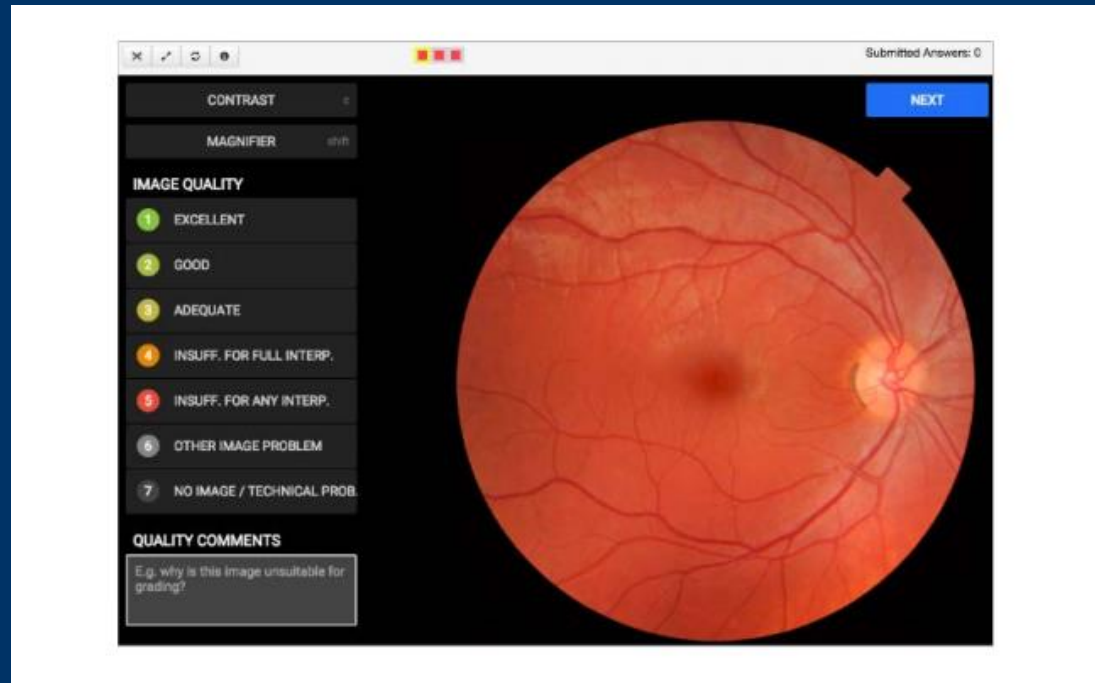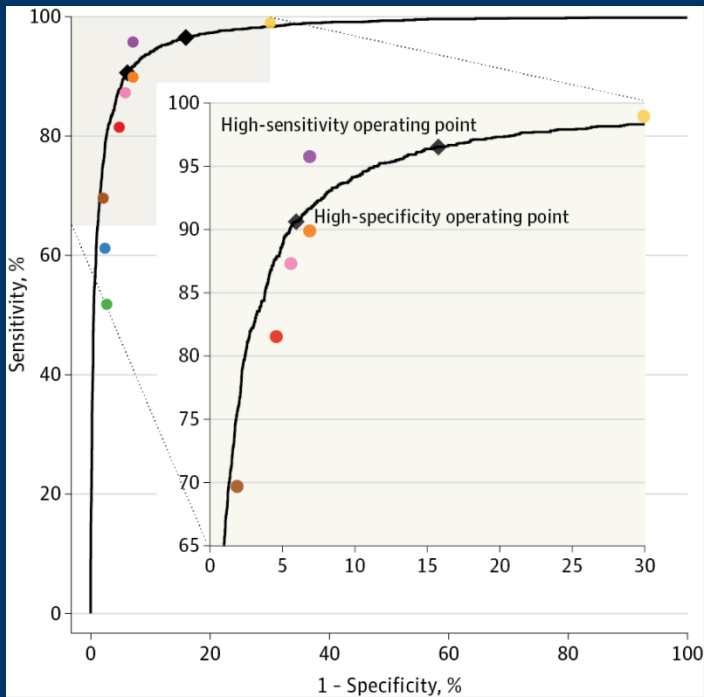
Validation Set Performance for All-Cause Referable Diabetic Retinopathy in the EyePACS-1 Data Set (9946 Images)Performance of the algorithm (black curve) and ophthalmologists (colored circles) for all-cause referable diabetic retinopathy, defined as moderate or worse diabetic retinopathy, diabetic macular edema, or ungradable image. The black diamonds highlight the performance of the algorithm at the high-sensitivity and high-specificity operating points. For the high-sensitivity operating point, specificity was 84.0% (95% CI, 83.1%-85.0%) and sensitivity was 96.7% (95% CI, 95.7%-97.5%). For the high-specificity operating point, specificity was 93.8% (95% CI, 93.2%-94.4%) and sensitivity was 90.7% (95% CI, 89.2%-92.1%). There were 8 ophthalmologists who graded EyePACS-1. The area under the receiver operating characteristic curve was 97.4% (95% CI, 97.1%-97.8%).

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Business Model Innovation
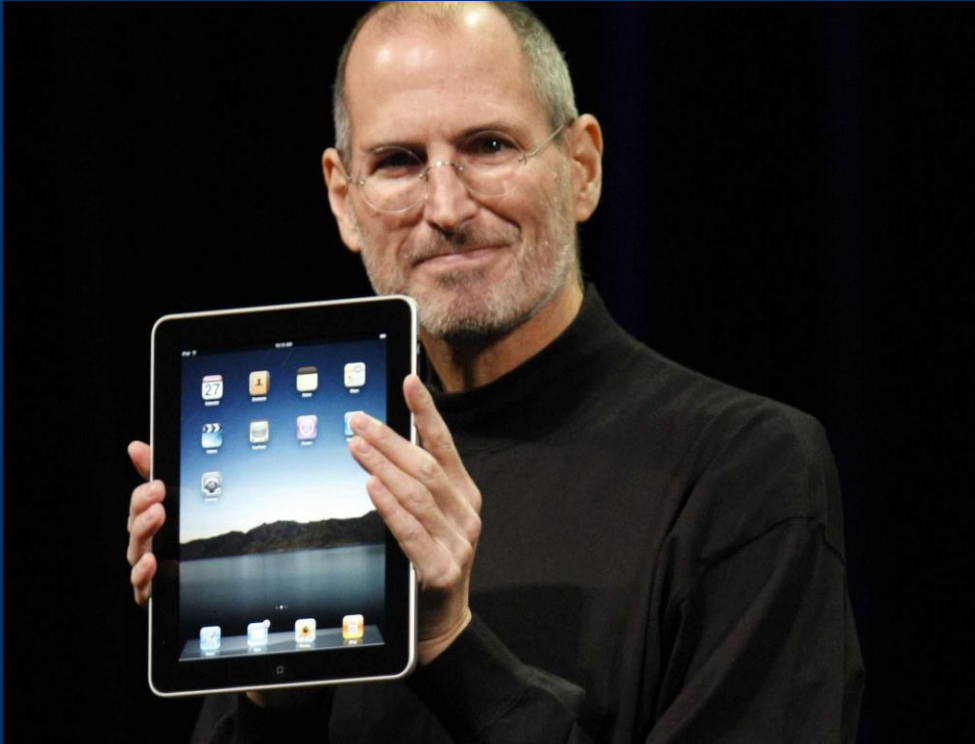
What if 50% of health care was delivered via mHealth technology by 2025?

Business Model Innovation

Robert M. Pearl, MD
The Permanente Medical Group

"We predict that by 2018, our virtual visits will outnumber the in-person ones."

http://catalyst.nejm.org/engaging-physicians-in-telehealth/

Discussion