PARTNERS HEALTHCARE

FOUNDED BY BRIGHAM AND WOMEN'S HOSPITAL
AND MASSACHUSETTS GENERAL HOSPITAL

MGH 1811

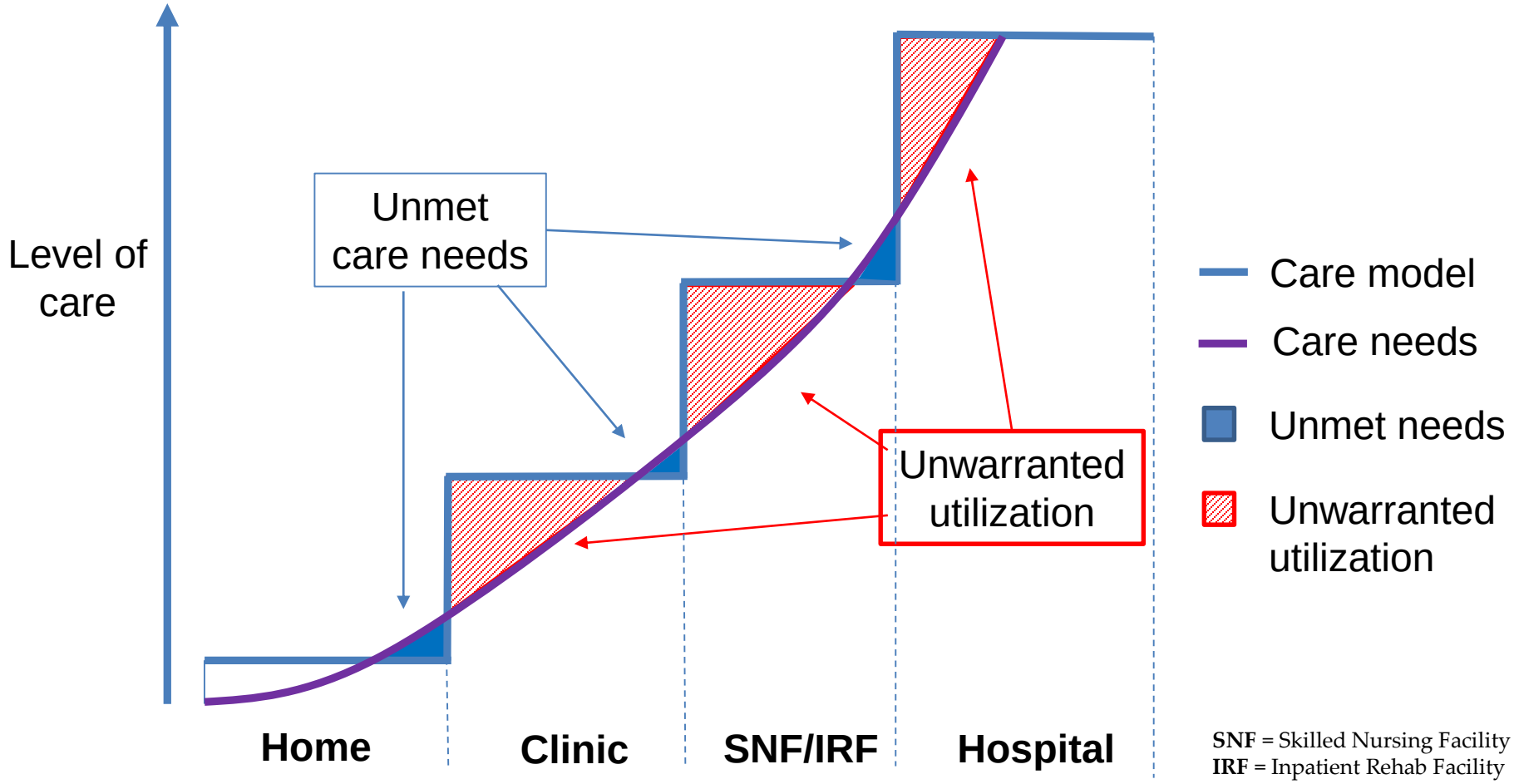
HARVARD MEDICAL SCHOOL

BWH

Digital Health and the Transformation of Care Delivery

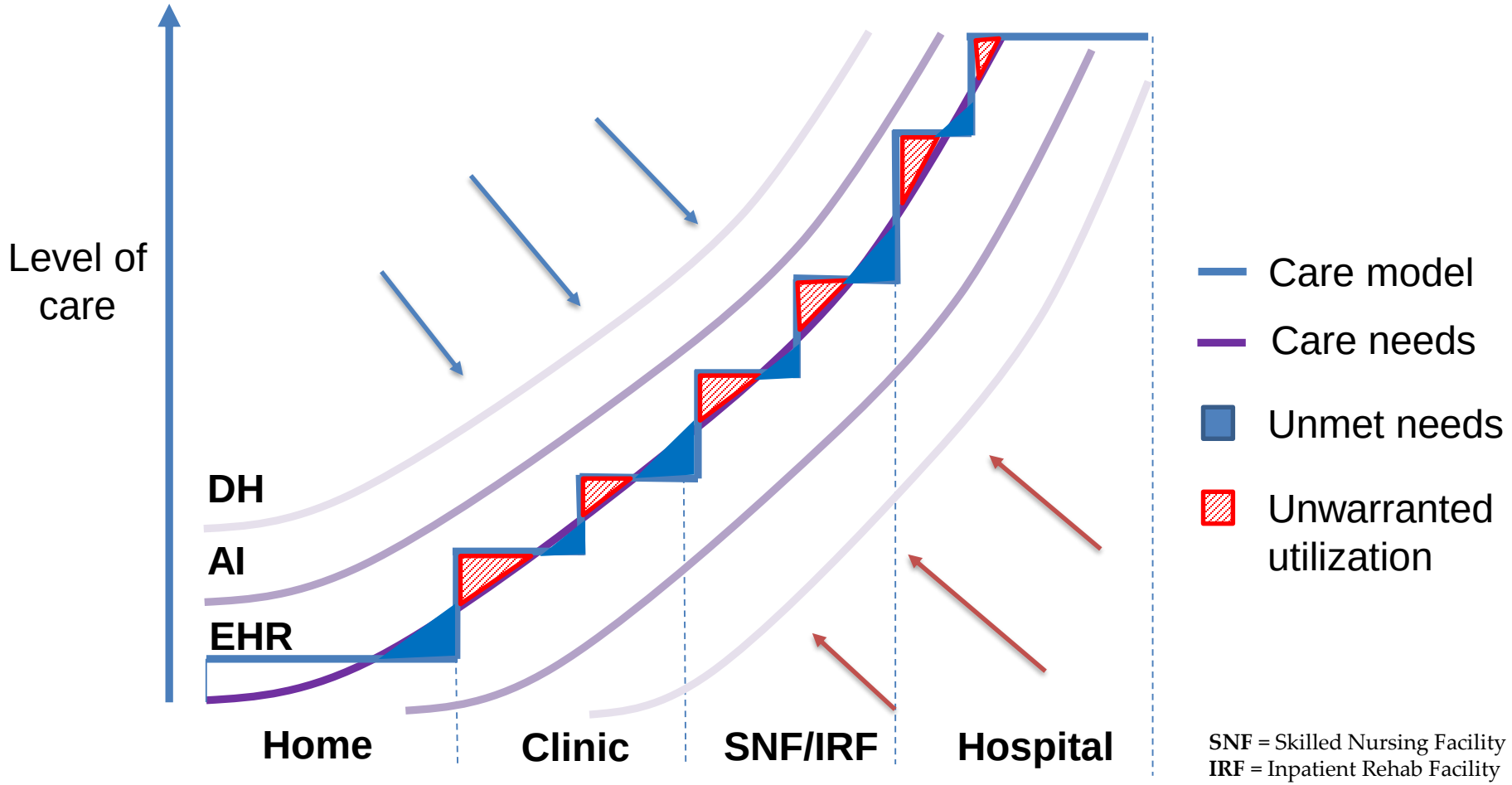
Alistair Erskine MD MBA
June 13th, 2019
@transformatics

Today: Existing brick & mortar based care models do not match patient care needs



SNF = Skilled Nursing Facility
IRF = Inpatient Rehab Facility

Future: appropriate use of EHR, data, analytics and AI could help mitigate the patient care need mismatch



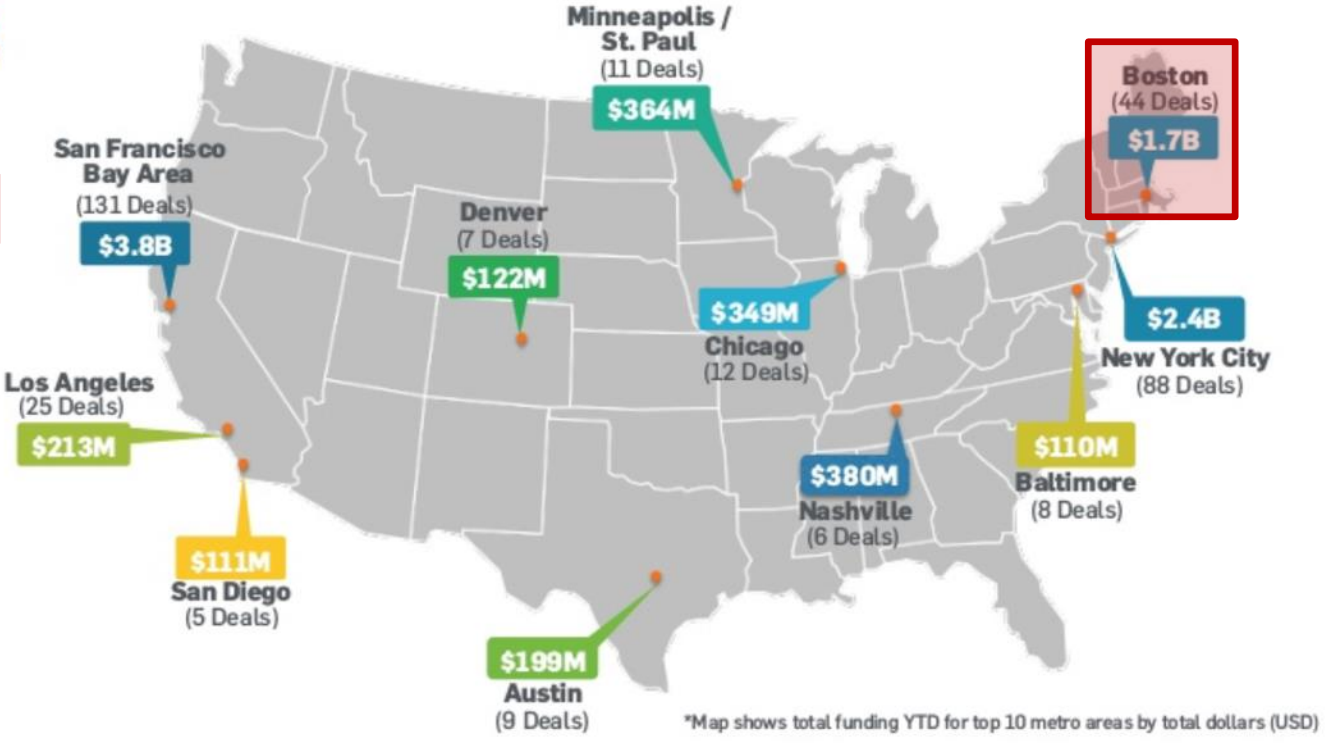
SNF = Skilled Nursing Facility
IRF = Inpatient Rehab Facility

The impact of technology on digital health has been significant over the past few decades

TDS 8000 system circa 1980s

44 deals ($1.7B) closed in 2018 alone from Boston's life sciences innovation hubs – an 152% increase from 2017

	Region	Total 2018 Deal Count	Total 2017 Deal Count
1	SF Bay Area	131	126
2	New York City	88	63
3	Boston	44	29
4	Los Angeles	25	21
5	Chicago	12	20
6	Minneapolis	11	11
6	Seattle	11	14
7	Austin	9	11
8	Baltimore	8	10
8	Miami	8	6
9	Denver	7	11
9	Philadelphia	7	12



5	23andMe	$300M	Personalized Health
6	DevotedHealth	$300M	Patient Empowerment
7	American Well	$291M	Patient Empowerment
8	Butterfly Network, Inc.	$250M	Biometric Data Acquisition
9	HeartFlow	$240M	Clinical Workflow
10	AURIS	$220M	Biometric Data Acquisition

Source: StartUp Health Insights Global Digital Health Funding Report: 2018 Year End Review

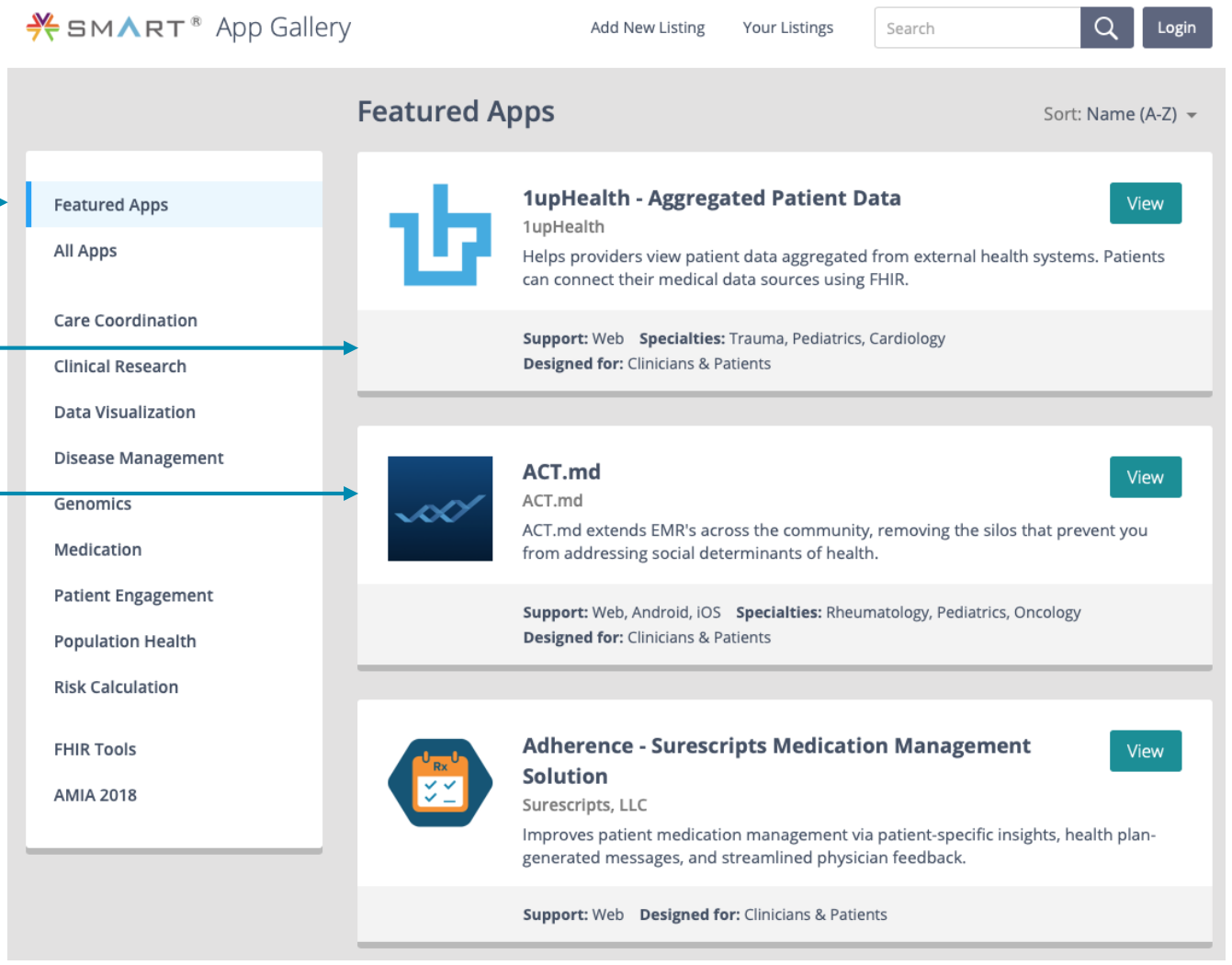
SMART Apps: Collection of FHIR compatible Apps that visualize clinical data or introduce new workflows

App List

Compatibility

Contact info

No business model



Clicks: despite $36B government investment in EHRs, considerable room for improvement exists

- **Patient harm** (glitches)
- **Signs of fraud** (upcoding, MU)
- **Gaps in interoperability**
- **Clinician burnout**
- **Web of secrets** (gag clauses)

Source: Kaiser Health News

Burnout: EHRs are the tip of the spear to a healthcare delivery process laden with administrative burden

THE NEW YORKER

ANNALS OF MEDICINE NOVEMBER 12, 2018 ISSUE

WHY DOCTORS HATE THEIR COMPUTERS

Digitization promises to make medical care easier and more efficient. But are screens coming between doctors and patients?

By Atul Gawande

EHR adoption: Plagued by numerous barriers to usability and generators of clicks

Interoperability (Privacy/funding)

Data hungry (Research/AI)

Burnout

Unintended Consequences (shift roles)

Administrative Burden (MU/Coding)

Cybersecurity

Incumbents: vexing inability to upgrade/replace legacy technologies despite readily available alternatives

Fax machine
(interoperability)

Phone
(Online)

Pager
(Smartphone)

CD-ROM
(Cloud)

New entrants: vertical integration of healthcare value chain is opening new 'front doors' to patients

Humana in talks to acquire Kindred Healthcare (largest home health care provider and hospice operator)

Amazon, Berkshire Hathaway and JPMorgan announce partnership to launch company to address "The ballooning costs of healthcare act[ing] as a hungry tapeworm on the American economy."

CVS Health purchased Aetna for $69 billion "…to position the combined company as America's front door to quality health care…"

UnitedHealth's Optum unit acquires DaVita Medical Group for $4.9 billion

Cigna agrees to purchase pharmacy benefits manager Express Scripts for $67B in cash and stocks

Walmart engaging in preliminary talks to acquire insurer Humana, adding an incremental $37B of market value to Walmart

Partners Data and Digital Health

Why digital Health - less about '**d**igital' and more about modern '**H**ealth' approaches

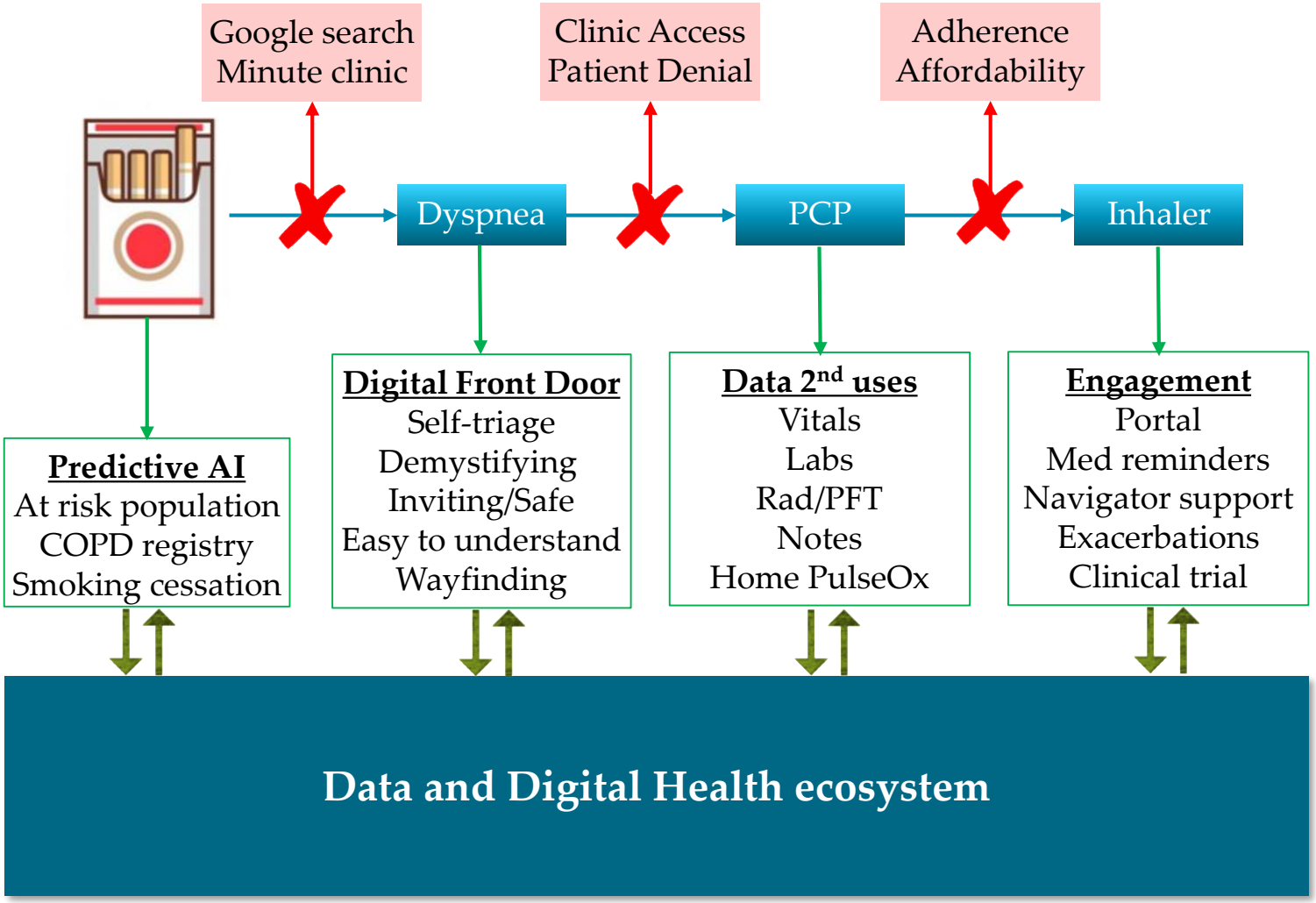
- **Improve access**: online scheduling, symptoms checkers, triage functions, virtual care options, patient portals
- **Participatory**: patient can better engaged in shared decision making, connect to the entire care team in-between visits
- **Home options**: moving care outside of hospital/clinic, remote monitoring for chronic illness, access patient-generated data
- **Better decisions**: tailored treatments, adherence to guidelines, elimination of unwarranted variation, up to date evidence-based medicine
- **Anticipatory**: consume and model healthcare and non-healthcare data (e.g. credit scores) towards prescriptive intelligence.
- **Imaging**: dashboard view of available modalities, remote interpretation of diagnostic imaging and pathology, sharing studies with patients
- **Digitalization**: generating 'big-data' ready analysis, converting tribal knowledge into business process automation
- **Pop Health**: care gaps closure by cohorts of patients, by providers, by illnesses
- **Life-sciences**: aggregation of biotech and pharma ultramodern advances in treatment options

Investment: Upgraded facilities function synergistically with digital technologies

Future Towers >>> Diversify investment >>> **Digital bricks**

Patient experience
Improved operations
Care transformation
Digital innovation
Artificial Intelligence

Digital Health can help identify cohorts of patients, enroll them into care process and make better use of their data



Experience (Patient, Proxy/Families, Clinicians)

FY 20

Problem: Lack a patient-centric care journey tailored to individual needs and preferences

Pillar Aim: Create vision for the patient experience centered on **proactively engaging patients and consumers** wherever they are in their care journey. Providing patients with the resources, services, and solutions that help **improve their health and quality of life**

Relaunch the Partners Patient Gateway	*Ability to provide patient with seamless navigation across clinical touch-points*
Virtual Care Services	*Offer asynchronous (text, messaging) & synchronous (video, chat, voice) interaction*
Enabling Provider Index	*Online open scheduling; patient relationship management strategy, tools and data*
CRM/PRM	*Improve patient engagement through a unified, patient centric approach*

System Value

Maximize Historical Investments
Epic optimization, CRM consolidation

Feeds Into Strategy
Commercial growth strategy, patient engagement

Catching Up in Digital
To meet consumer expectations

Operations (Clinical, Quality/Safety, Admin)

FY 20

Problem: data systems lack operational support, raw data availability, inadequate analytic toolsets

Pillar Aim: Enable system-wide operations through foundational and advanced **data & analytic capabilities** to improve enterprise and local teams' ability to deliver insights. The suite of system-wide tools includes developing highly usable data infrastructure, dynamic dashboards / reports and analytic solutions to answer clinical and business questions

Clinical Operations

Curated data platform for dynamic dashboards / reports / analytics solutions
- *Increase capacity / patient flow (Periop, ED and Inpatient)*
- *Enterprise Medical Imaging*

Quality & Safety

Curated data platform for dynamic dashboards / reports / analytics solutions
- *Expand Physician Variation tools*
- *FY19 World Café Event and execute plan in FY20*

Financial & Admin

Curated data platform for dynamic dashboards / reports / analytics solutions
- *RCO POS collections*
- *Enterprise Performance Management*
- *HR Overtime and Turnover*

TBD

This space is not exhaustive and we will be expanding over time, e.g. GME, other

System Value

Increase capacity and patient flow

Resource efficiency with standardized metrics

Improve Point of Service (POS) Collections

Decrease Physician Variation

Actionable dashboards and reports

R&D: Digital Health Innovation

FY 20

Problem: Slow to scale pilots/prototypes and difficulty supporting digital capabilities across organization

Pillar Aim: To supplement and sustain efforts in coordinating, supporting, and providing infrastructure for digital health initiatives at Partners. The program will utilize the power and strength of the entire integrated health system to accelerate high impact, strategic early stage innovation and spread success across and outside the system.

Establish Innovation Pathway	*Identify program/process to support end-to-end innovation piloting solutions in clinical environment*
Scale Electronic Safety Net (ESN) & Medumo	*Complete sepsis and colonoscopy pilots; make decision on scale across enterprise*
Identify Next Set of Innovation Projects	*Use new DHI process and governance to select at least 5 new pilot digital innovation projects*

System Value

Scalable digital capabilities

Innovative workflow redesign with broad clinical application

Better patient engagement

R&D: Digital Care Transformation

FY 20

Problem: High-cost, physician-centric, variable care not optimized around patient; protracted innovation cycle

Pillar Aim: Involves expert-developed algorithms, personalized patient profiles, and fundamental workflow redesign as part of a care plan that is executed through lower-cost, non-licensed care navigators

Establish DCT ecosystem — *Improve care and reduce costs through adoption of digital technologies and novel workflows focused on patient journey*

HTN / Lipids — *Scale to achieve demonstrable value: TME reduction, and improved quality metrics and primary care capacity*

New Clinical Use Case — *Develop transformative new clinical workflow that demonstrates high value for patients and providers*

System Value

External Funding

Operational Efficiency

Quality of Care: Increased Standardization & Quantification

TME Reduction

Digital Care Transformation (DCT): Digital tools, high-touch model w/new clinical workforce

High quality care and high value patient experience executed through **Health Navigator** workforce

Health Navigators

- Patient Identification
- Program Selection

- Outreach and Enrollment
- Data Augmentation

- Communication w/ care team (PharmD, NP, MD)

- Ongoing relationship management Follow-up engagement and patient monitoring

- Additional Program Recruiting

DCT Program Components

- **Protocol Based Patient Care Management**
  - Drug Selection, Titration
  - Biological and Transactional Data Capture
  - Lab Ordering
  - Follow-up Tasks and Relationship Engagement

- **Clinical oversight** through licensed prescriber (PharmD, NP, MD)
  - Exception Care Guidance
  - Prescribing, Urgent Help
- **Program Management** through Protocol Owner, Department Lead
  - Ongoing Program Improvement
  - Process Feedback
  - Task Configuration

Tools and systems

- Navigator software
- EHR Integrations
- Analytic and Data Tools (EDW, Business Intelligence software)
- Remote patient monitoring tools (e.g. blood pressure cuffs)
- Patient Reported Outcomes

Value Realized: Application of DCT improves care of patients with hypertension, hyperlipidemia and heart failure

BWH Cardiovascular Innovation and the Partners HIP team have jointly developed a series of remote, risk/disease management programs fully implemented using non-licensed navigators; building upon the success of multiple pilots.

- In collaboration with BCBSMA, scaled Lipid Optimization remote management program to 1012 BWH patients with high ASCVD and **obtained 40% LDL reduction in 12-16 weeks**; better than standard therapeutic trial.
- Through an internally funded pilot, scaled Hypertension Management Program to 250 BWH patients with **blood pressure in patients reaching control in approximately 7 weeks**.
- As part of a Novartis funded pilot, developed and actively scaling remote Heart Failure management program (w/ reduced EF) to nearly 1000 BWH patients to- date; **early results indicate the treatment algorithm is able to increase both the overall utilization of guideline-directed medications and the proportion of patient who achieved target doses**.
- In collaboration with Allways Health Plan and PHM, actively scaling Lipid/ HTN remote management program to **Allways members at the BWH and NSMC, with over 200 enrolled to-date**.

AI Engine: Center for Clinical Data Science

FY 20

Problem: Inability to utilize data to deliver automatic, precise execution of complex cognitive processes and provide actionable insights

Pillar Aim: Create machine learning capabilities and assets, including an AI model development-at-scale cluster, to support care delivery across the enterprise and to bring leading edge solutions to market

AI Training Environment — *Develop tools for cohort development, annotation, and Data Analysis & Transformation. Enable efficient model training across multiple data types*

AI Validation & Inference System — *Facilitate deployment of AI models across imaging, wave form, and clinical data types for internal and external collaborators*

https://www.ccds.io

System Value

External Partnerships

Partners eCare

Reduction in Model Development Cost [1]

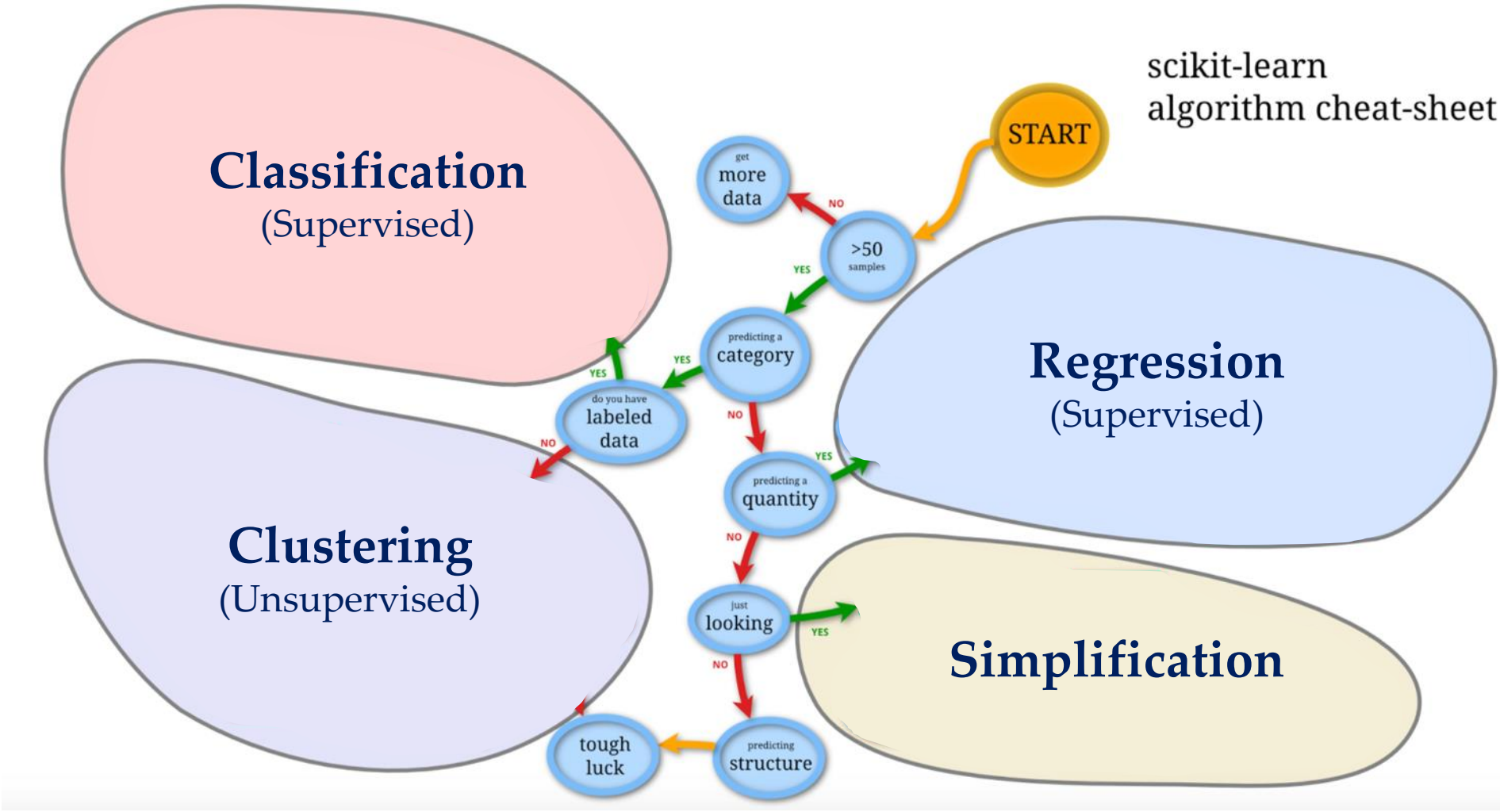
Rapid Expansion of Machine Learning Capabilities

Royalty Generation

Today: Common and practical applications of AI with software that helps automation care processes

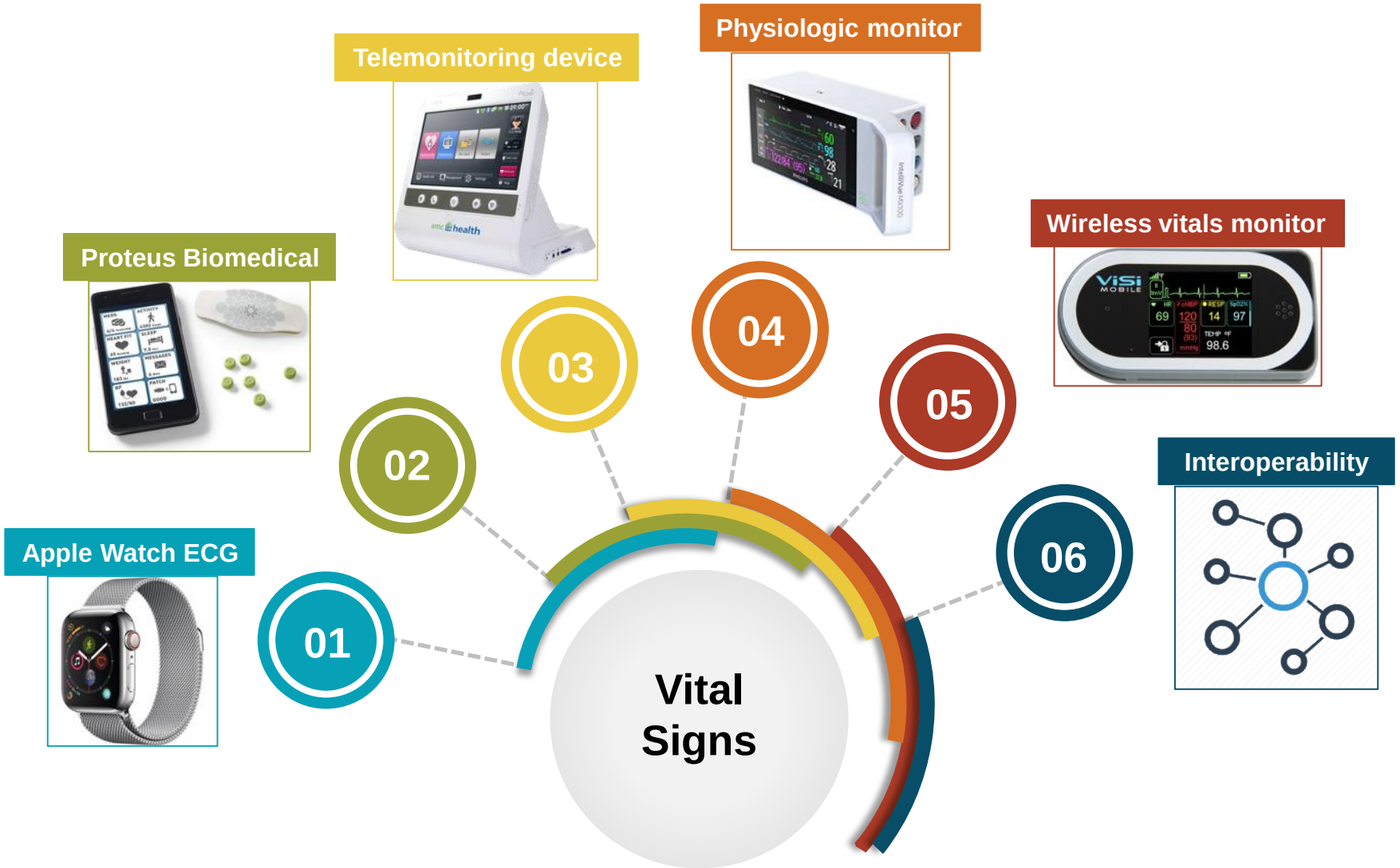
- **Robotic Process Automation (RPA)** helps remove remedial work and redirect the healthcare workforce towards more value-added work
- **Centralized monitoring**: remote monitoring of 300+ patient specific inpatient data elements on a minute-to-minute basis helps identify and escalate care at scale (e.g. Sepsis, Rapid Response Teams)
- **Chatbots**: Patients begin care interaction with chatbots, help address their questions especially during off hours and tease out answers to topics that might be uncomfortable during face-to-face encounters and reduce dependency on call centers
- **Algorithms**: Models derived from clinical data sources now exist that can reduce non-ICU codes by 44%
- **Decision Support**: Appropriate selection of chemotherapy agents has been augmented by AI
- **Throughput**: AI helps hospital capacity and throughput by identifying when patients with flu-like symptoms have not been tested and notifying providers with the results
- **Prioritization**: alternative to default 'first in, first out' order of care delivery by identifying and resorting the order of priority care needs

Interpretive vs Black-box: Not all Artificial Intelligence is created equal

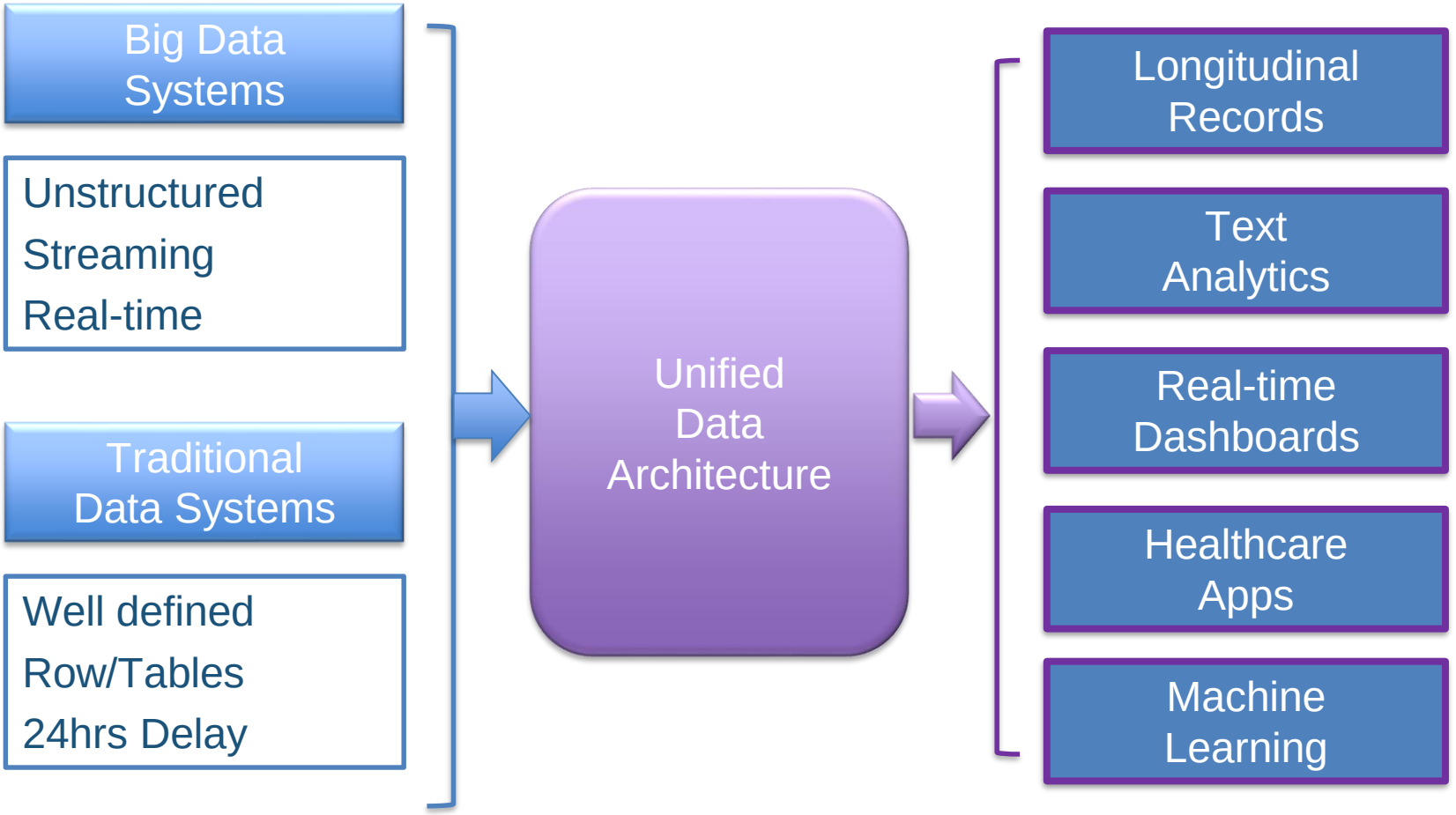


Courtesy Andy Mueller located here

Data Types: Vitals signs enter the data systems in different formats with different timings and significance



New Data Architecture: hedged environment that addresses novel data types alongside relational data

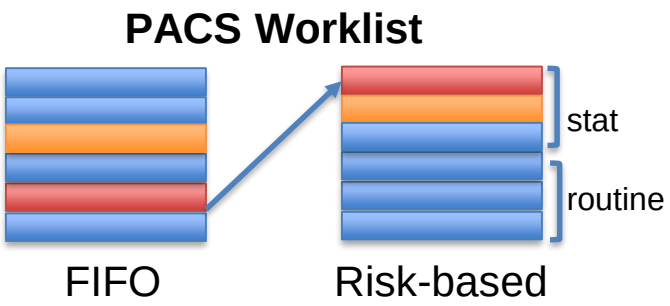


Erskine A et al, *How Geisinger Health System Uses Big Data to Save Lives*, Harvard Business Review, Dec 2016

Real use-case: saved 27 patients lives by identifying patients with unrepaired Abdominal Aortic Aneurysms

https://www.hcinnovationgroup.com/clinical-it/article/13026365/how-unleashing-trapped-clinical-data-has-saved-lives-at-geisinger-health-system

Real use-case: Image classification saves lives of patients with stroke



Problem: Needed to improve the timeliness ICH assessment for clinic patients without solely relying on the ordering physician priority designation.

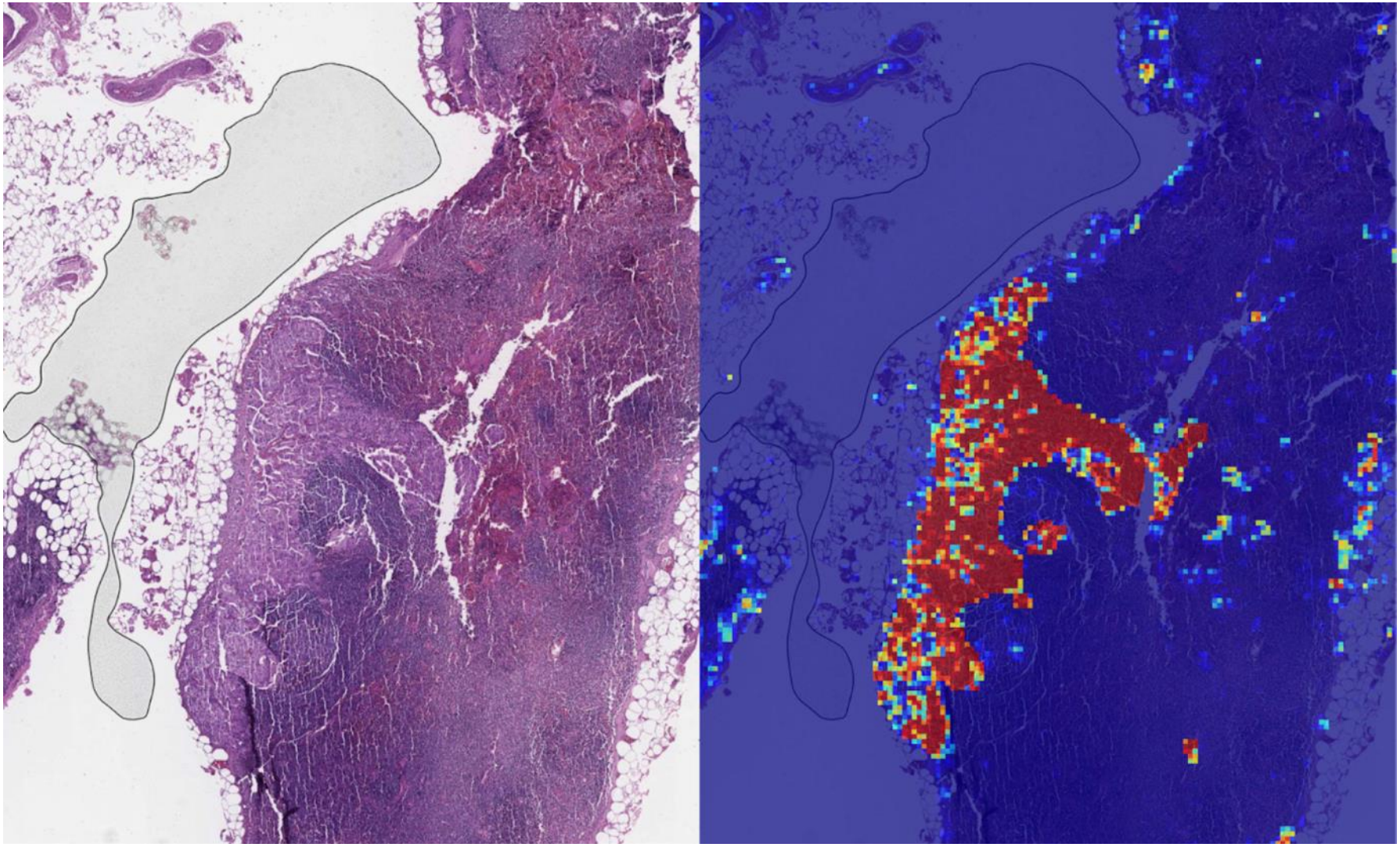
Approach: 46,583 head CTs (~2 million images) acquired from 2007–2017 were collected from several facilities across Geisinger. A deep convolutional neural network was trained on 37,074 studies [training set] and subsequently evaluated on 9499 unseen studies [testing set]. The predictive model was implemented prospectively for 3 months to re-prioritize head CTs at high risk of ICH.

Results: The model achieved an area under the ROC curve of 0.85.

- 94 of 347 (27%) "routine" studies were re-prioritized to "stat"
- 60 of 94 (63%) had ICH identified by the radiologist
- 5 new cases of ICH were identified
- Median time to diagnosis was reduced ($p < 0.0001$) from 512 to 19 min.

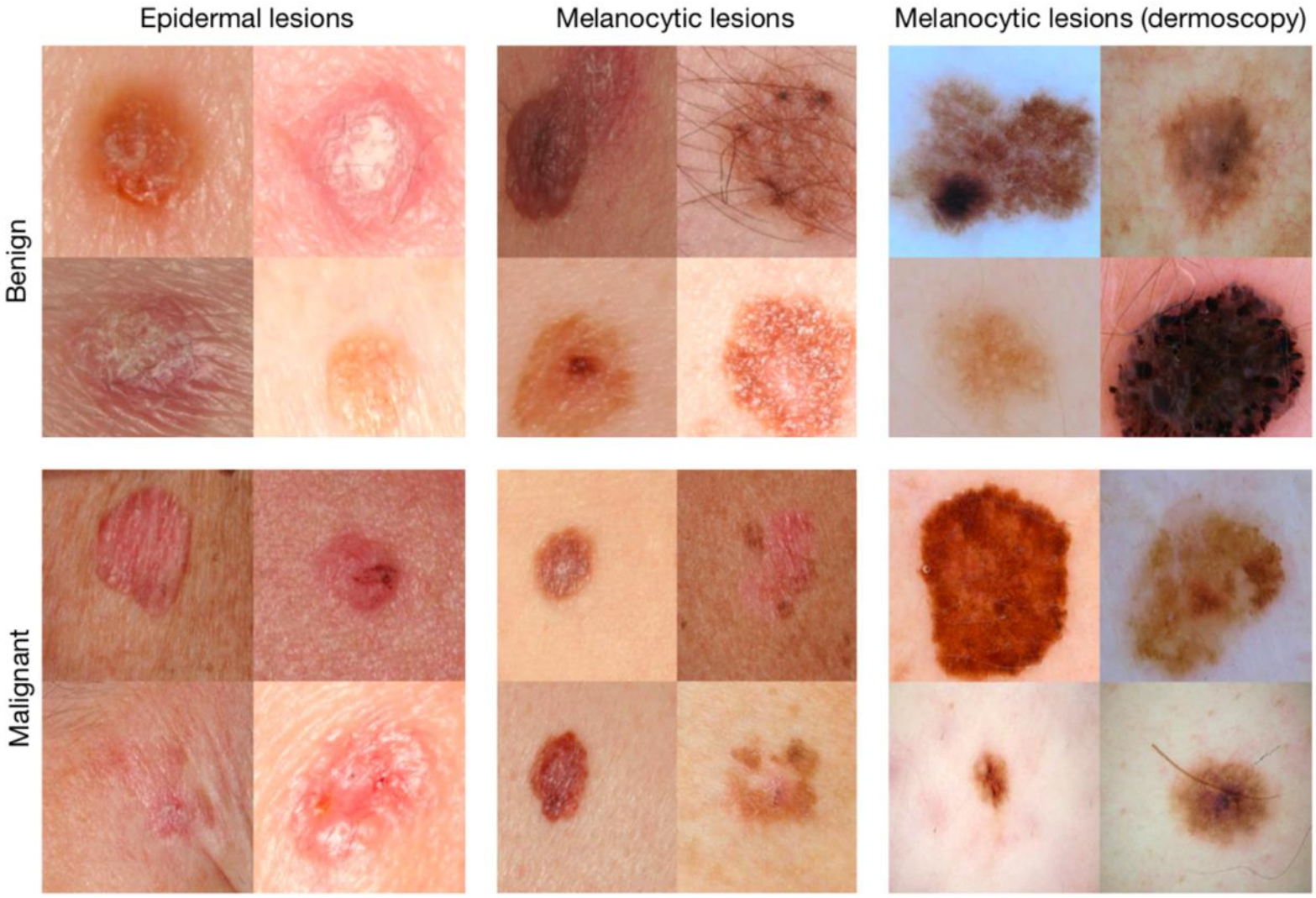
Arbabshirani et al, *npj Digital Medicine* **volume 1**, Article number: 9 (2018)

Oncology: LYNA Algorithm performs *better* than pathologist at detecting breast cancer cells



Liu et al (2018) *Artificial Intelligence–Based Breast Cancer Nodal Metastasis Detection*. Archives of Pathology & Laboratory Medicine In-Press

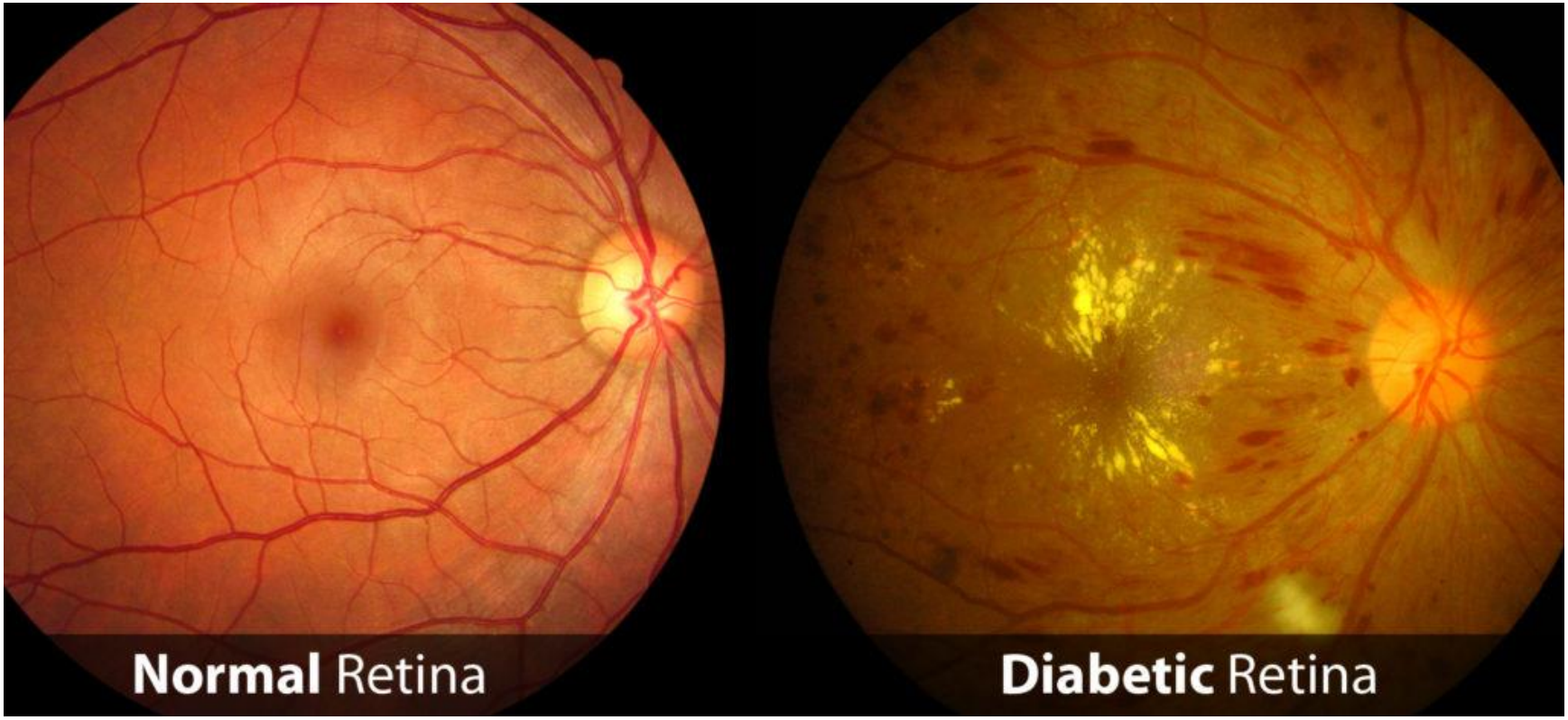
Dermatology: Deep neural network classifies skin conditions ***as well as*** dermatologist



Esteva et al, *Dermatologist-level classification of skin cancer with deep neural networks*, Nature, VOL 542, 2 February 2017

Ophthalmology: Deep learning system detects diabetic retinopathy across multiethnic population

The Deep Learning System had high sensitivity and specificity for identifying diabetic retinopathy and related eye diseases using retinal images from multiethnic populations with diabetes.



Ting et al, *Development and Validation of a Deep Learning System for Diabetic Retinopathy*, JAMA. 2017;318(22):2211-2223.

Headwinds: As with any new technology adoption, AI comes with its own set of barriers to adoption

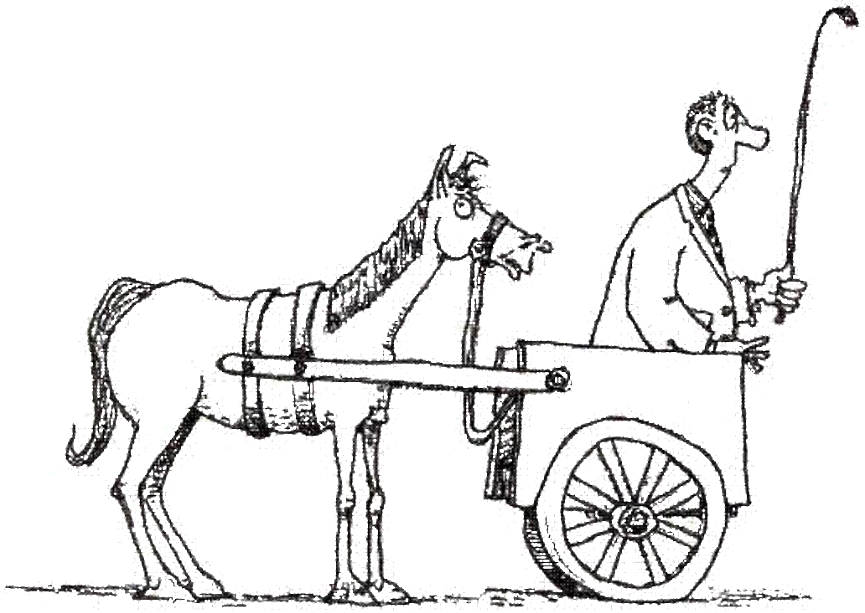
- **Hype**: The marketing of AI tends to get ahead of the real-world application of useful AI models
- **Validation**: AI models are highly dependent on the data that feeds them, and might need to be re-tested in different care settings/locations to avoid bias
- **Education**: How and when should AI be applied? When is one algorithm more appropriate than another?
- **Adoption**: Intent needs to be to make clinician lives easier, provide a less expensive solution, generate fewer clicks, craft the path of least resistance for the desired outcome and make sure that AI tools are bulletproof
- **Leadership**: key as with any change management and care transformation requiring buy-in at all levels and answering the "how is this affecting me" questions.
- **Incentives**: Compensation structure might not support what AI offers and it is worth taking the time to align incentives
- **Consent**: consent to treat might be different than consent to make secondary use of data from AI models
- **Privacy**: sophisticated machine algorithms have been used to re-identify previously anonymize patients

Data currency: market for clinical data on the dark web and at your local coffee shop

At Shiru Cafe in Providence, R.I., students "pay" for coffee, but not with money

But first… the Basics

Avoid placing the cart before the horse



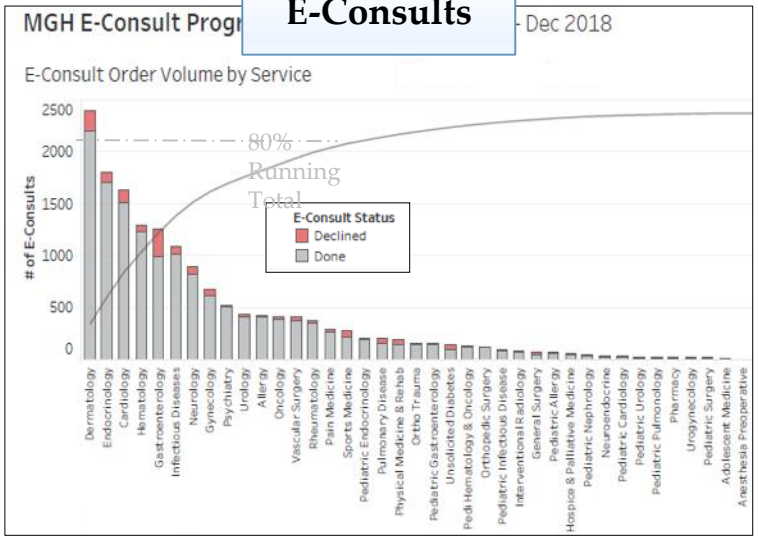
Basics – Scale horizontally across Partners

Take example of best practice/implementation and scale elsewhere

Teleneurology

Wayfinding

E-Consults



Call Centers

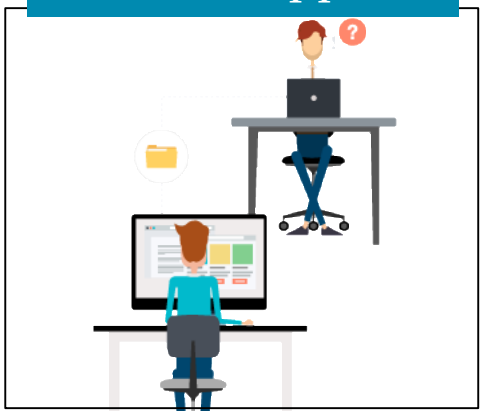
Basics - be mindful of the user ecosystem

Login, virtual scribes, at-the-elbow support and secured texting

Simplified login

Virtual Scribes

Virtual support



Secured Texting

Basics – EHR optimization and training/support

Enterprise configuration need local fit testing

The NEW ENGLAND JOURNAL of MEDICINE

Perspective

NOVEMBER 8, 2018

Getting Rid of Stupid Stuff

Melinda Ashton, M.D.

Many health care organizations are searching for ways to engage employees and protect against burnout, and involvement in meaningful work has been reported to serve both functions. According to Bailey and Madden, it is easy to damage employees' sense of meaningfulness by presenting them with pointless tasks that lead them to wonder, "Why am I bothering to do this?"[1] my colleagues and I had reason to believe that there might be some documentation tasks that could be eliminated. Our EHR was adopted more than 10 years ago, and since then we have made

of the beholder. Everything that we might now call stupid was thought to be a good idea at some point."

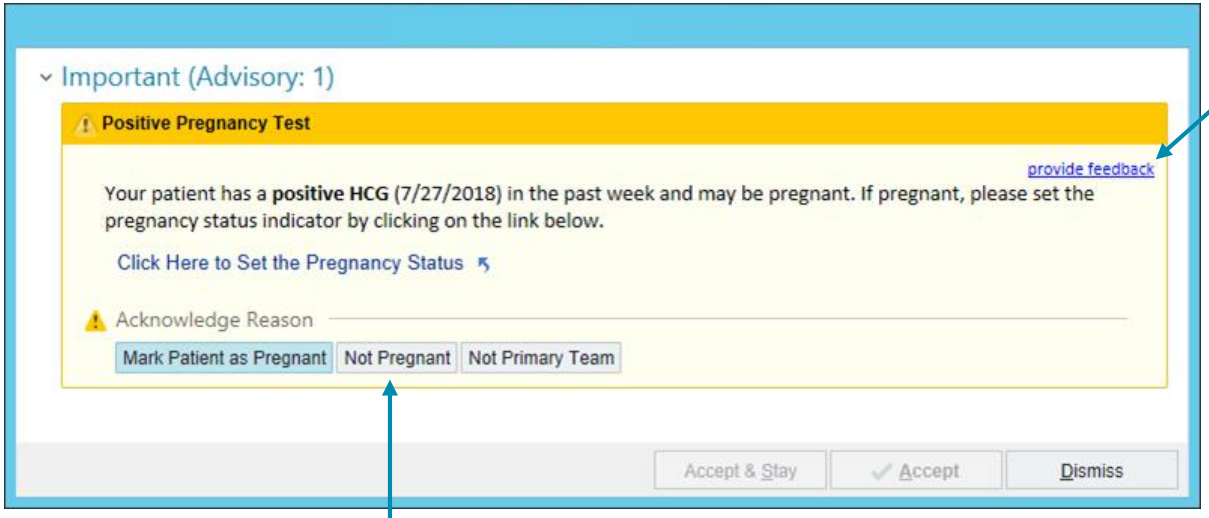
We thought we would probably receive nominations in three categories: documentation that was never meant to occur and would require little consideration to eliminate or fix; documentation that was needed but could be completed in a more efficient or effec-

***Ashton M**, Getting Rid of Stupid Stuff,* n engl j med 379;19 nejm.org November 8, 2018

User Experience

Users - Making Alert actionable
-- Improving Documentation of Pregnancy Status

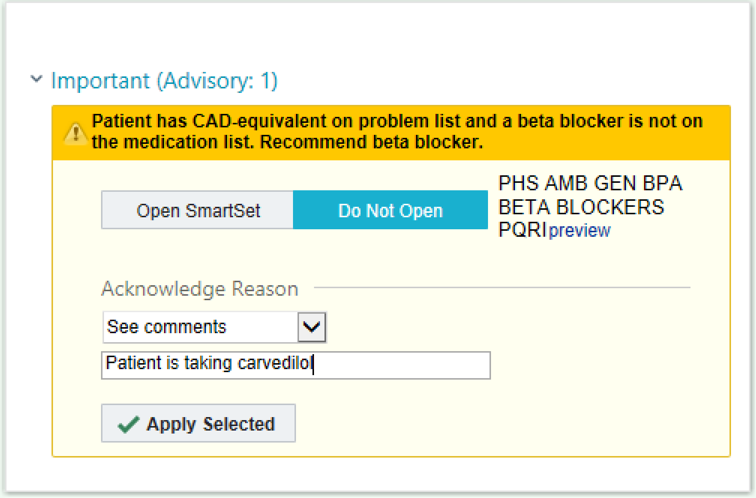
- Updating "Patient may be pregnant" alert to allow clinician to mark the patient as pregnant directly from alert.
- The scope of the previous alert was narrowed to focus on marking patients as pregnant



Feedback

Option in Alert

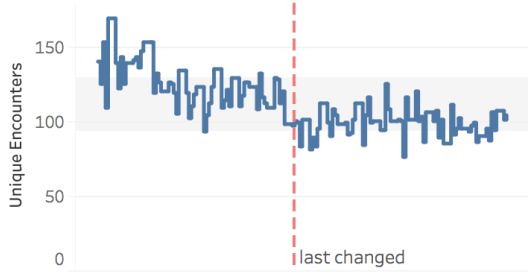
Evaluation and Monitoring– Sentiment Analysis
Sample Comments



- "patient on xarelto. I just spent 10 second of my time filling out this box. Enough!"
- "she was given insulin already!!"
- "NOT ON CYCLOSPORINE!!!!!!!!!!!!!!!!!!!!!!!!!!"
- "Longstanding inaccuracy with Epic!"
- "stupid EPIC reminder-N/A for ophthalmic CyA"
- "you are stupid"
- "he is in DKA you stupid alert"
- "he hed it already - so why do you bother me with this advisory you idiots"
- "wrong!!!! She gets them per GI!! Stop these stupid warnings that are inaccurate"

Evaluation and Monitoring– CDS Dashboard

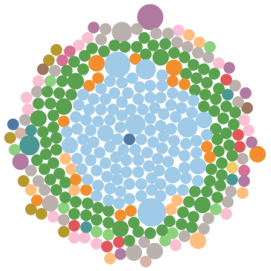
BASE PHS ED/IP DISEASE PROVIDER MANAGEMENT (SEPSIS)



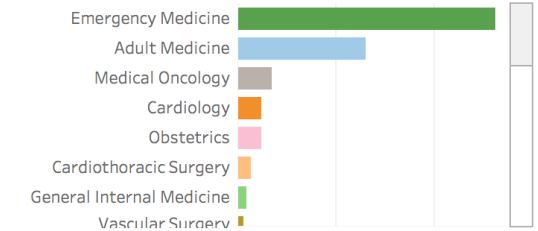
3/3/2018 12:00:00 AM to 8/29/2018 11:59:59 PM

metrics	
Total Alerts	64,324
Avg. Alerts per Day	355
Unique Encounters	14,427
Avg. Unique Enc per Day	80
Unique Patients	12,028
Unique Users	4,478

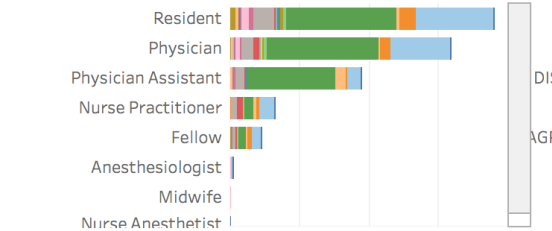
Override Comment



Department Specialty



User Type



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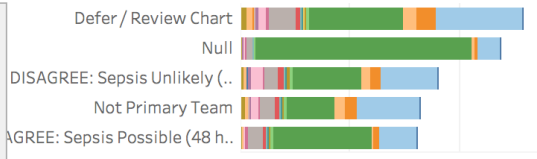
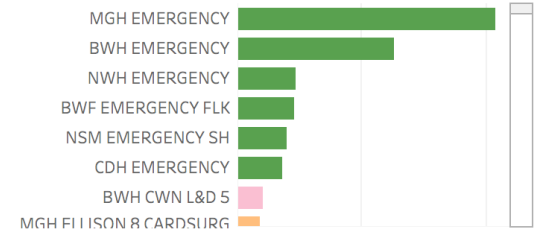
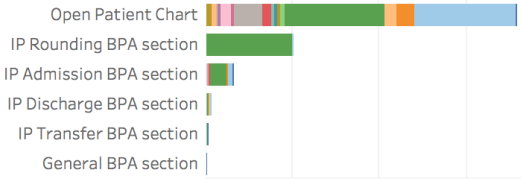


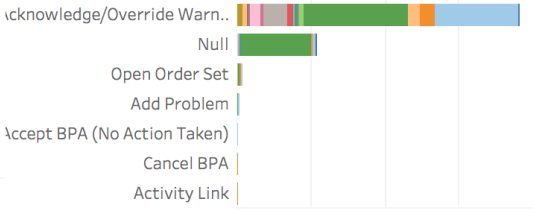
Department



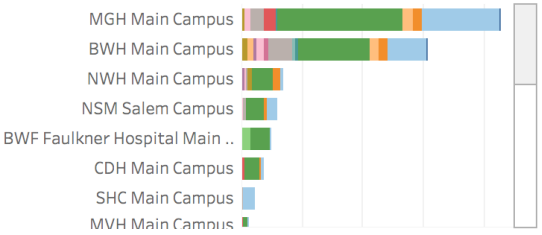
Trigger



Followup Action

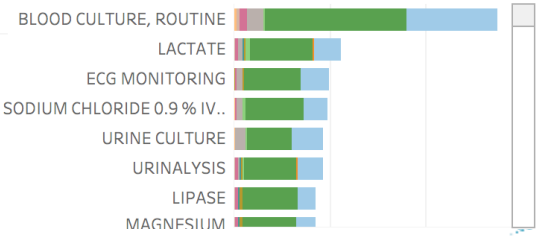


Facility



Encounter Type

Signed Orders



Patient Experience

Patient Experience will become the new differentiator to those less bound by loyalty and more tuned to relevance

$$\text{Value} = \text{Digital Innovation} \left(\frac{\text{Quality} + \text{Experience}}{\text{Cost}} \right)$$

Access

Online

Cost

Personalize

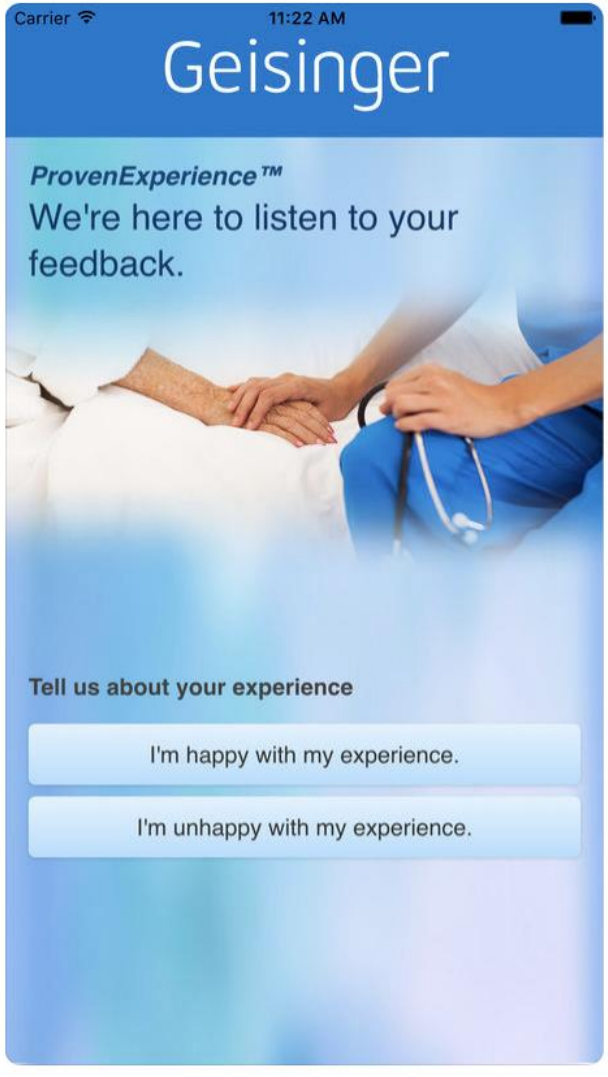
Caring

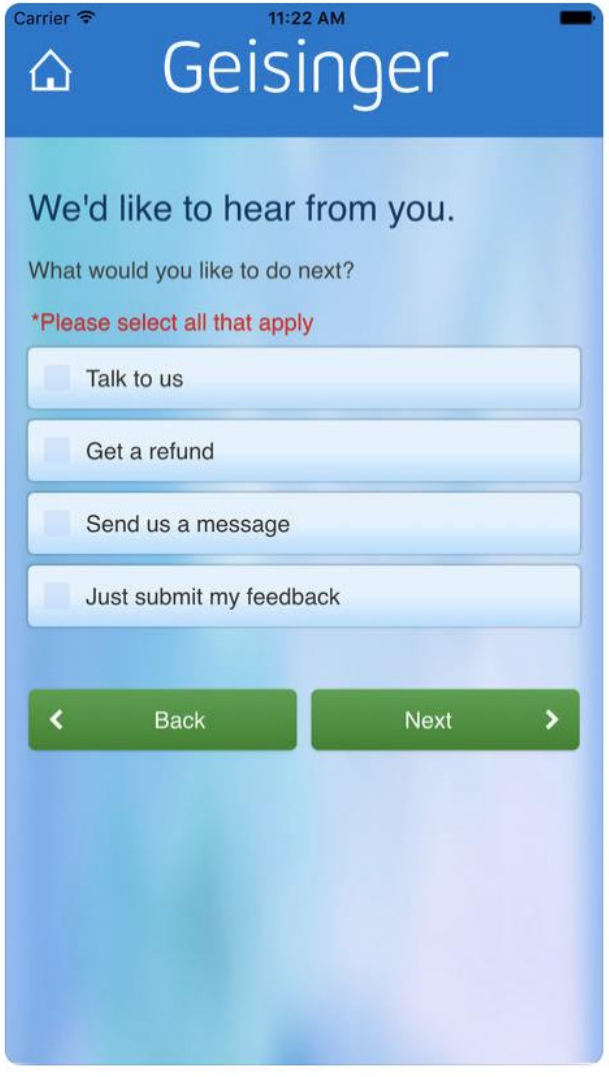
Tech

Share

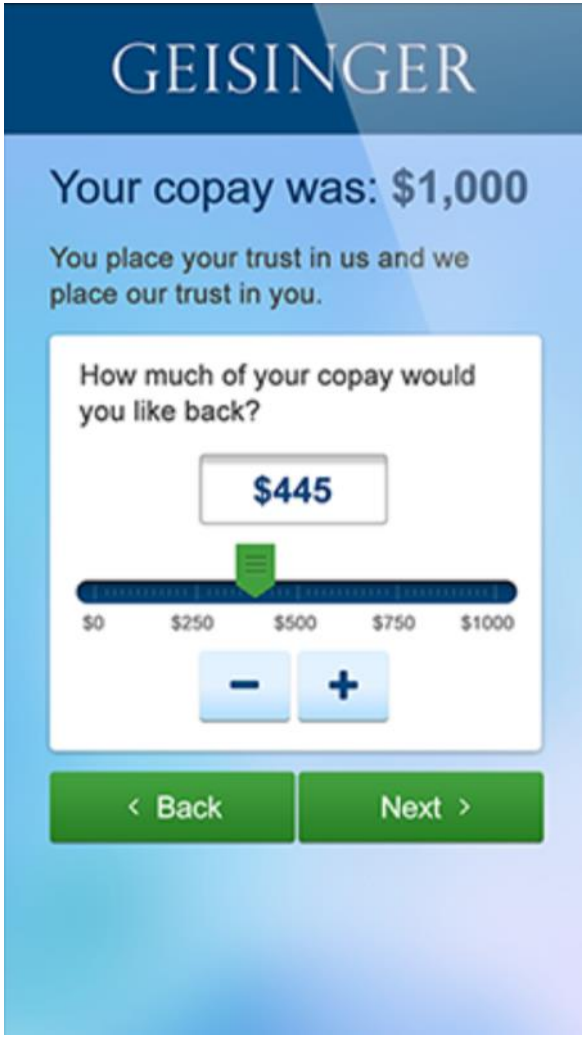
Guide

ProvenExperience App let patient provide feedback and request refund based *their* perception of care





Geisinger's App was part of a comprehensive Proven Experience program



~$235 per refund and 108 patients per month
Handled as *adjustments* prior to billing 79% of time
23% increase in feedback to patient advocates
Vast majority of patient request *partial* refund
Total refunds made ~$300-$400k per year
Similar to complaint-based payout
Increase Patient Experience team by 3.5FTE (15FTE)
Increase in Patient Satisfaction score post program

Key feedback:

- Access to clinic was the priority issue
  - Offer same-day appointments
  - Offer extended hours
- Changed construction schedule for quieter wards
- Used Talent+ to recruit service-minded staff
- Train employee with better bedside manner
- Categorized feedback to drive system goals

New directions

New Models: virtual care has the potential improving access and offering more convenient options for patients

Cleveland Clinic

"Access Anytime Anywhere"

Click in.

Patients can receive virtual care, view medical information, manage appointments, and renew prescriptions through various digital assets

Walk in.

Cleveland Clinic leverages a network of express care clinics, urgent care, and 24/7 EDs to expand patient access. Patients use website to find "walk in" treatment locations

Call in.

Patients can schedule appointments via phone across 150 area locations

Sources: Sg2 2017, clevelandclinic.org

NewYork-Presbyterian

The University Hospital of Columbia and Cornell

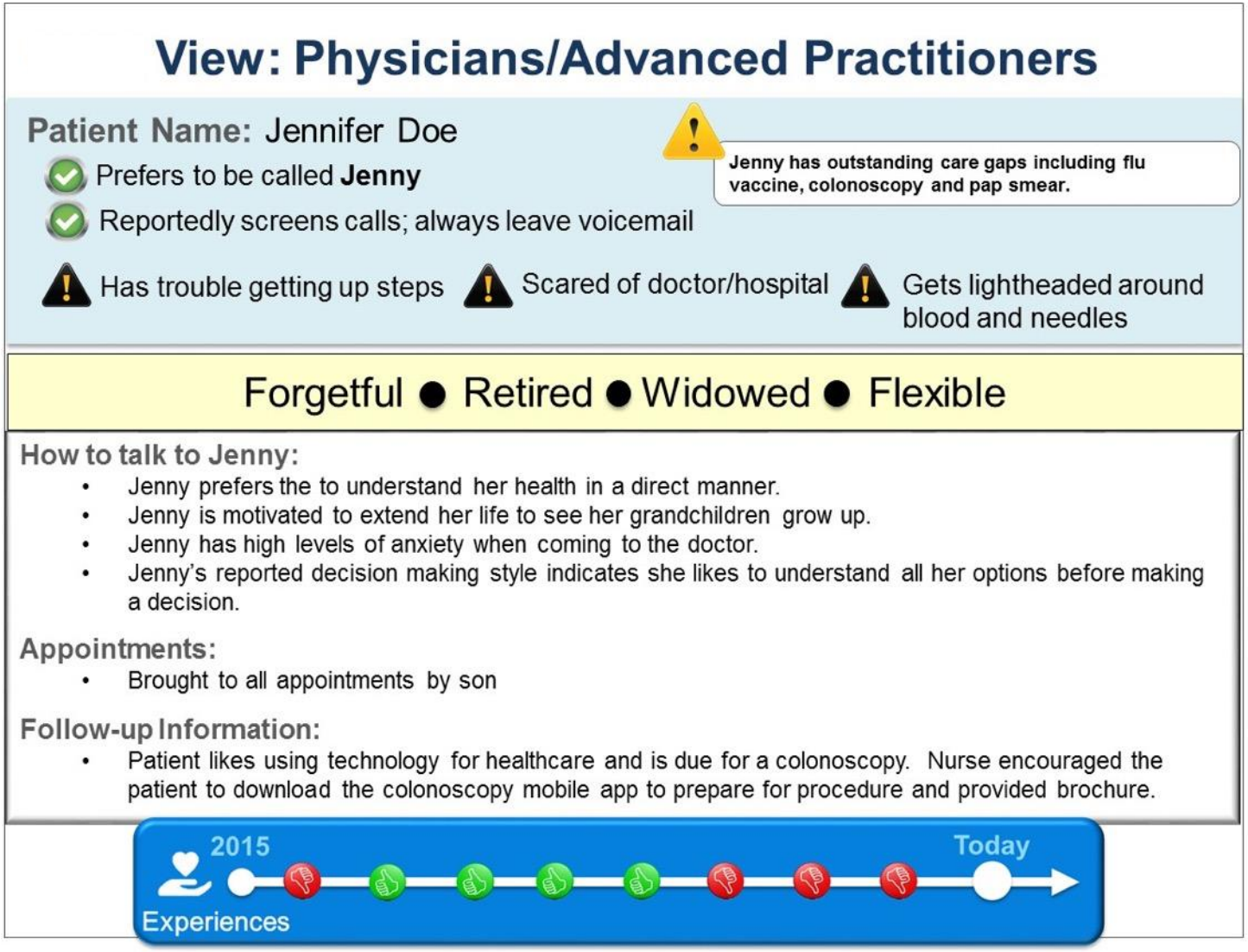
For patients who require urgent care treatment but are unable or don't want to travel, app provides virtual examination, diagnosis, and treatment

Feature provides patients within NYP Regional Network Hospitals access to NYP Hospital specialists and increases communication between providers

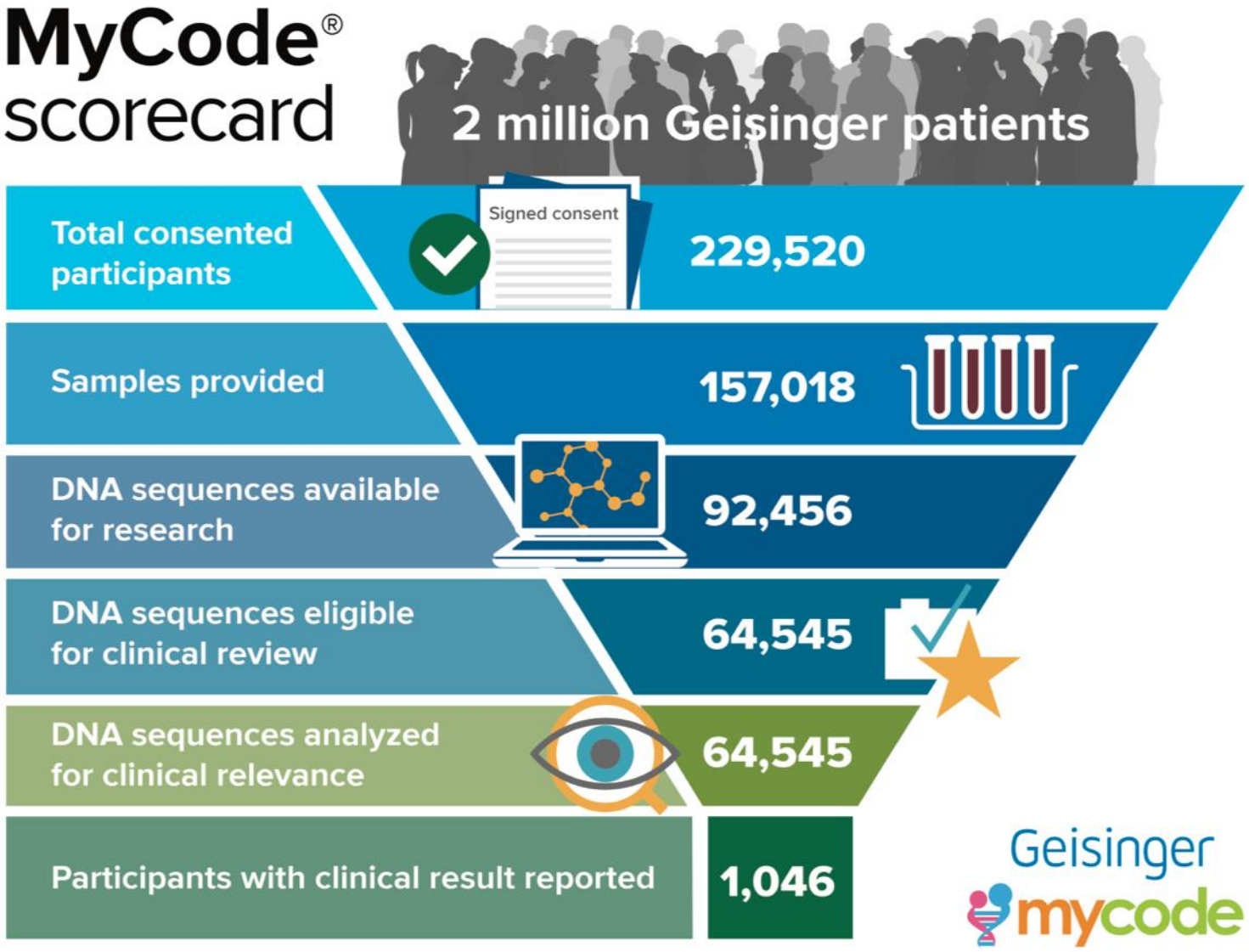
Online portal allows patients to access second opinions from NYP specialists within the ColumbiaDoctors and Weill Cornell Medicine network

Source: nyp.org/ondemand

New Tech: Patient Relationship Management is new to the digital health lists of transactional systems (beyond EHR)

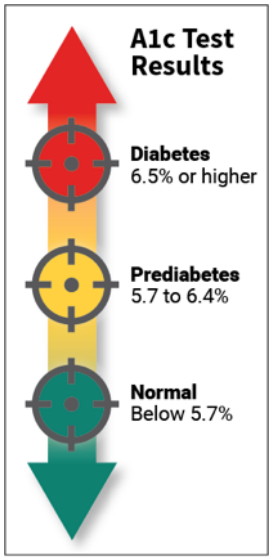


New Data: Geisinger's Health Plan has begun covering the cost of whole exome genetic testing for its members



New partners: Geisinger adds a grocery store to its diabetic clinics through its Fresh Food Farmacy program

Clinical impact



Financial impact

Hospital

Health Plan

Patient

Social impact

Apple Video - https://apple.co/2B5e19A

Feinberg A et al, *How Geisinger Treats Diabetes by Giving Away Free, Healthy Food*, HBR October 2017

Feinberg A et al, *Prescribing Food as a Specialty Drug*, NEJM Catalyst, April 10 2018