Digital Health and the Transformation of Care Delivery

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

Unmet care needs

Unwarranted utilization

Level of care

Home  Clinic  SNF/IRF  Hospital

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.
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

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

Featured Apps

1upHealth - Aggregated Patient Data
1upHealth
Helps providers view patient data aggregated from external health systems. Patients can connect their medical data sources using FHIR.

Support: Web
Specialties: Trauma, Pediatrics, Cardiology
Designed for: Clinicians & Patients

ACT.md
ACT.md
ACT.md extends EMR’s across the community, removing the silos that prevent you from addressing social determinants of health.

Support: Web, Android, iOS
Specialties: Rheumatology, Pediatrics, Oncology
Designed for: Clinicians & Patients

Adherence - Surescripts Medication Management Solution
Surescripts, LLC
Improves patient medication management via patient-specific insights, health plan-generated messages, and streamlined physician feedback.

Support: Web
Designed for: Clinicians & Patients
Death By 1,000 Clicks: Where Electronic Health Records Went Wrong

The U.S. government claimed that turning American medical charts into electronic records would make health care better, safer, and cheaper. Ten years and $36 billion later, the system is an unholy mess. Inside a digital revolution that took a bad turn.

By Fred Schulte and Erika Fry, Fortune • MARCH 18, 2019
(The Voorhes for Fortune)

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

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)
- Unintended Consequences (shift roles)
- Administrative Burden (MU/Coding)
- Cybersecurity
**Incumbents:** vexing inability to upgrade/replace legacy technologies despite readily available alternatives

- Fax machine (interoperability)
- Pager (Smartphone)
- Phone (Online)
- 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 ‘digital’ and more about modern ‘Health’ 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.

- **Predictive AI**
  - At risk population
  - COPD registry
  - Smoking cessation

- **Digital Front Door**
  - Self- triage
  - Demystifying
  - Inviting/Safe
  - Easy to understand
  - Wayfinding

- **Data 2nd uses**
  - Vitals
  - Labs
  - Rad/PFT
  - Notes
  - Home PulseOx

- **Engagement**
  - Portal
  - Med reminders
  - Navigator support
  - Exacerbations
  - Clinical trial

- **Data and Digital Health ecosystem**

- **Google search**
  - Minute clinic

- **Clinic Access**
  - Patient Denial

- **Adherence**
  - Affordability
**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

- **Enabling Provider Index**
  - Online open scheduling; patient relationship management strategy, tools and data

- **Virtual Care Services**
  - Offer asynchronous (text, messaging) & synchronous (video, chat, voice) interaction

- **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
**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

**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**

**System Value**

**Innovative workflow redesign with broad clinical application**

**Better patient engagement**
**R&D: Digital Care Transformation**

**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**

**Partners eCare**
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)
- Additional Program Recruiting
- Ongoing relationship management
  - Follow-up engagement and patient monitoring

**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.
**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, waveform, and clinical data types for internal and external collaborators.

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**System Value**

- **External Partnerships**
- **Reduction in Model Development Cost**
- **Rapid Expansion of Machine Learning Capabilities**
- **Royalty Generation**

[https://www.ccds.io](https://www.ccds.io)
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 resoring the order of priority care needs
Interpretive vs Black-box: Not all Artificial Intelligence is created equal

Classification (Supervised)

Regression (Supervised)

Clustering (Unsupervised)

Simplification

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

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

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

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.

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
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
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?”

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 significant improvements to our organization. We felt that our documentation was no longer the best way to manage patient care and that we might be able to simplify it further. However, we also knew that any changes we made would have to be carefully planned and executed to avoid disrupting the workflow 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 effective way; and documentation that was never intended to be used in the way it was.”
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.
• “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

#### 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

#### Department Specialty
- Emergency Medicine
- Adult Medicine
- Medical Oncology
- Cardiology
- Obstetrics
- Cardiothoracic Surgery
- General Internal Medicine
- Vascular Surgery

#### User Type
- Resident
- Physician
- Physician Assistant
- Nurse Practitioner
- Fellow
- Anesthesiologist
- Midwife
- Nurse Anesthetist

#### Department
- MGH EMERGENCY
- BWH EMERGENCY
- NWH EMERGENCY
- BWF EMERGENCY FLK
- NSM EMERGENCY SH
- CDH EMERGENCY
- BWH OWN L&D 5
- MGH FLYNN R CARSBURG

#### Facility
- MGH Main Campus
- BWH Main Campus
- NWH Main Campus
- NSM Salem Campus
- BWF Faulkner Hospital Main
- CDH Main Campus
- SHC Main Campus
- MWH Main Campus

#### Acknowledgment Caption
- Defer / Review Chart
- Null
- DISAGREE: Sepsis Unlikely (not primary team)
- Not Primary Team
- AGREE: Sepsis Possible (48h...)

#### Trigger
- Open Patient Chart
- IP Rounding BPA section
- IP Admission BPA section
- IP Discharge BPA section
- IP Transfer BPA section
- General BPA section

#### Followup Action
- <knowledge/Override Warning>
- Null
- Open Order Set
- Add Problem
- Accept BPA (No Action Taken)
- Cancel BPA
- Activity Link

#### Encounter Type
- Hospital Encounter

#### Signed Orders
- BLOOD CULTURE, ROUTINE
- LACTATE
- ECG MONITORING
- SODIUM CHLORIDE 0.9 % IV...
- URINE CULTURE
- URINALYSIS
- LIPASE
- MAGNESIUM
Patient Experience
Patient Experience will become the new differentiator to those less bound by loyalty and more tuned to relevance.

Value = Digital Innovation

\[
\text{Quality} + \text{Experience} \over \text{Cost}
\]

- Access
- Online
- Cost
- Personalize
- Caring
- Tech
- Share
- Guide

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

**Tell us about your experience**

- I'm happy with my experience.
- I'm unhappy with my experience.

**Where did your experience go wrong?**

You put your trust in us, and we didn't meet your expectations. Let us know what happened so we can make it right.

*Please select all that apply*

- Working with office or support staff
- Working with nurses
- Working with my doctor or physician assistant
- Learning what to expect about my care
- Billing
- I felt like the team did not adequately address my pain, if I had any
- Other

**We'd like to hear from you.**

What would you like to do next?

*Please select all that apply*

- Talk to us
- Get a refund
- Send us a message
- Just submit my feedback

BackNext
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”

- Patients can receive virtual care, view medical information, manage appointments, and renew prescriptions through various digital assets
- 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
- Patients can schedule appointments via phone across 150 area locations

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

Sources: Sg2 2017, clevelandclinic.org

Source: nyp.org/ondemand
New Tech: Patient Relationship Management is new to the digital health lists of transactional systems (beyond EHR)

**View: Physicians/Advanced Practitioners**

<table>
<thead>
<tr>
<th>Patient Name: Jennifer Doe</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ Prefers to be called Jenny</td>
</tr>
<tr>
<td>☑ Reportedly screens calls; always leave voicemail</td>
</tr>
<tr>
<td>! Has trouble getting up steps</td>
</tr>
<tr>
<td>! Scared of doctor/hospital</td>
</tr>
<tr>
<td>! Gets lightheaded around blood and needles</td>
</tr>
</tbody>
</table>

**Forgetful • Retired • Widowed • Flexible**

**How to talk to Jenny:**
- Jenny prefers the to understand her health in a direct manner.
- Jenny is motivated to extend her life to see her grandchildren grow up.
- Jenny has high levels of anxiety when coming to the doctor.
- Jenny's reported decision making style indicates she likes to understand all her options before making a decision.

**Appointments:**
- Brought to all appointments by son

**Follow-up Information:**
- Patient likes using technology for healthcare and is due for a colonoscopy. Nurse encouraged the patient to download the colonoscopy mobile app to prepare for procedure and provided brochure.
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

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