

DIGITAL THERAPEUTICS:

THE CASE FOR VALUE-BASED TECHNOLOGIES IN HEALTHCARE

DHIMSS 2019 Spring Symposium

Bimal Desai, MD, MBI





*“Chant no more your old rhymes
about bold Robin Hood,
His feats I but little admire,
I will sing the Achievements of
General Ludd
Now the Hero of Nottinghamshire”*

**Can (should?) healthcare be
more like Silicon Valley?**

MAJOR CHANGES AHEAD



Apple

- Ricky Bloomfield & Steven Gipstein

Google

- Toby Cosgrove & David Feinberg

Verily

- Vivian Lee & Jessica Mega

Haven

- Atul Gawande

Microsoft

- Jim Weinstein & Josh Mandel

BIG TECH IN HEALTHCARE

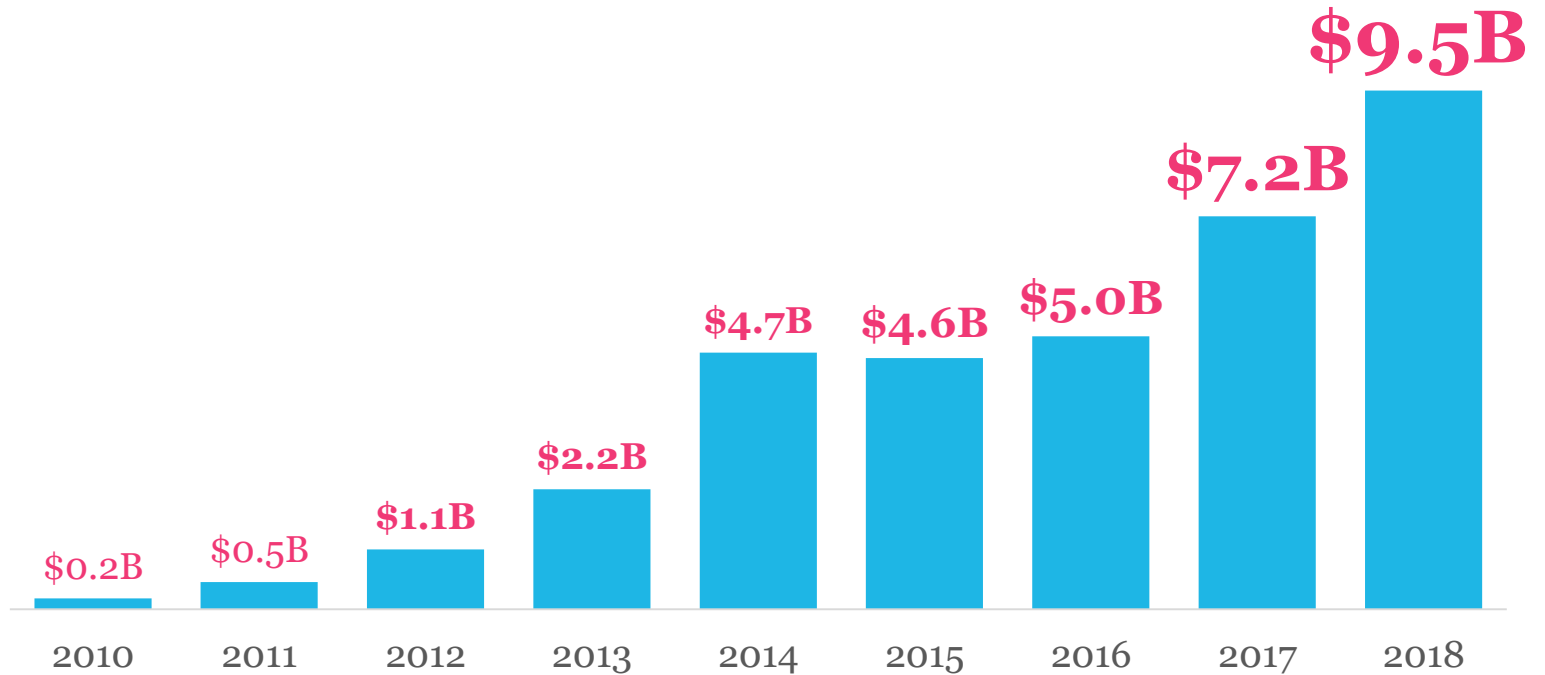
How the Big Four tech companies are transforming healthcare in the US

	Alphabet	amazon	Apple	Microsoft
Strengths	<ul style="list-style-type: none"> • Google Cloud Platform • AI • Cloud infrastructure • Verily Life Sciences 	<ul style="list-style-type: none"> • AWS • Alexa • Supply delivery 	<ul style="list-style-type: none"> • iPhone consumer base • Apple Watch • App Store frameworks 	<ul style="list-style-type: none"> • Azure • Healthcare NEXt • Microsoft Genomics
Weaknesses	<ul style="list-style-type: none"> • Fragmentation • Limited clinical evidence of platform effectiveness 	<ul style="list-style-type: none"> • Limited clinical evidence of platform effectiveness • Health system relationships 	<ul style="list-style-type: none"> • Audience limited to iOS • Limited clinical evidence of device effectiveness 	<ul style="list-style-type: none"> • Muted customer awareness • Small developer community
Opportunities	<ul style="list-style-type: none"> • Population health • Precision medicine • Clinical decision support 	<ul style="list-style-type: none"> • Medical supply services • Personalized health benefits 	<ul style="list-style-type: none"> • Personalized health insurance • Remote patient monitoring • mHealth 	<ul style="list-style-type: none"> • Population health • Precision medicine • Clinical decision support
Threats	<ul style="list-style-type: none"> • AWS' and Microsoft's IaaS • Data security • Consumer trust 	<ul style="list-style-type: none"> • Google's and Microsoft's IaaS • Incumbent M&A activity • Consumer trust 	<ul style="list-style-type: none"> • Competing device manufacturers • Non-iOS ecosystem growth • Consumer trust 	<ul style="list-style-type: none"> • AWS' and Google's IaaS • Data security • Consumer trust

HEALTHCARE MARKET OPPORTUNITY

- Healthcare represents nearly **1 in every 5 dollars** of goods produced in the U.S. (18% of GDP)
- That's **~\$11,000** for every person in the US!
- In 2018, **60% of new IPOs** were in healthcare and technology stocks

DIGITAL HEALTH V.C. FUNDING

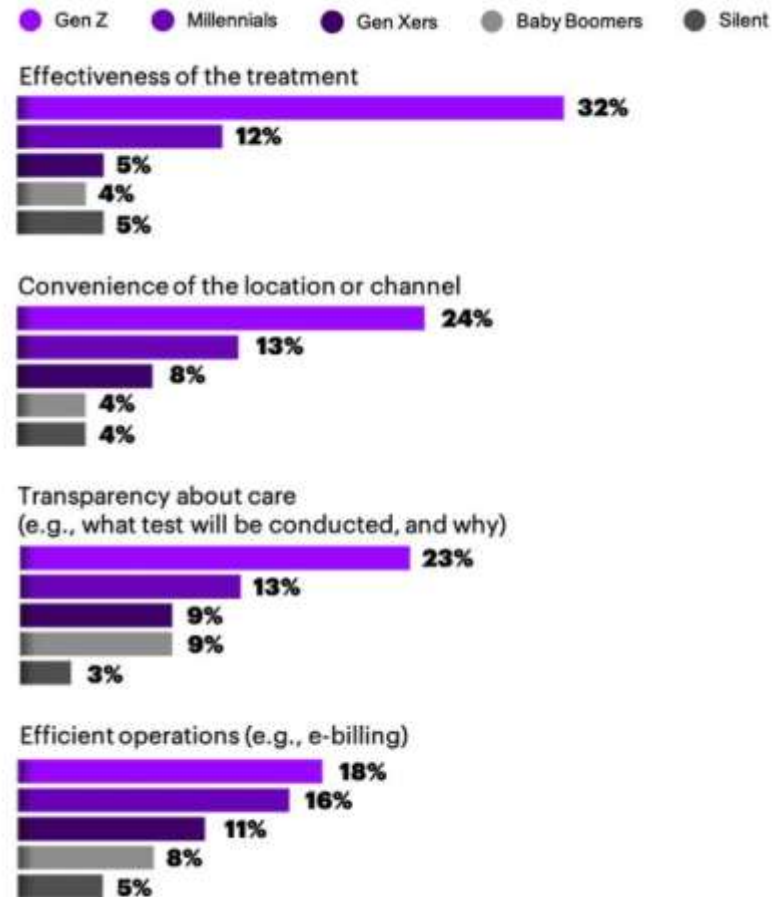


Source: BusinessWire.com

PATIENT EXPECTATIONS ARE CHANGING

GenX and **Millennials** are more likely to be “Very Dissatisfied” or “Dissatisfied” with traditional care delivery, as measured in domains of effectiveness, convenience, transparency, and efficiency.

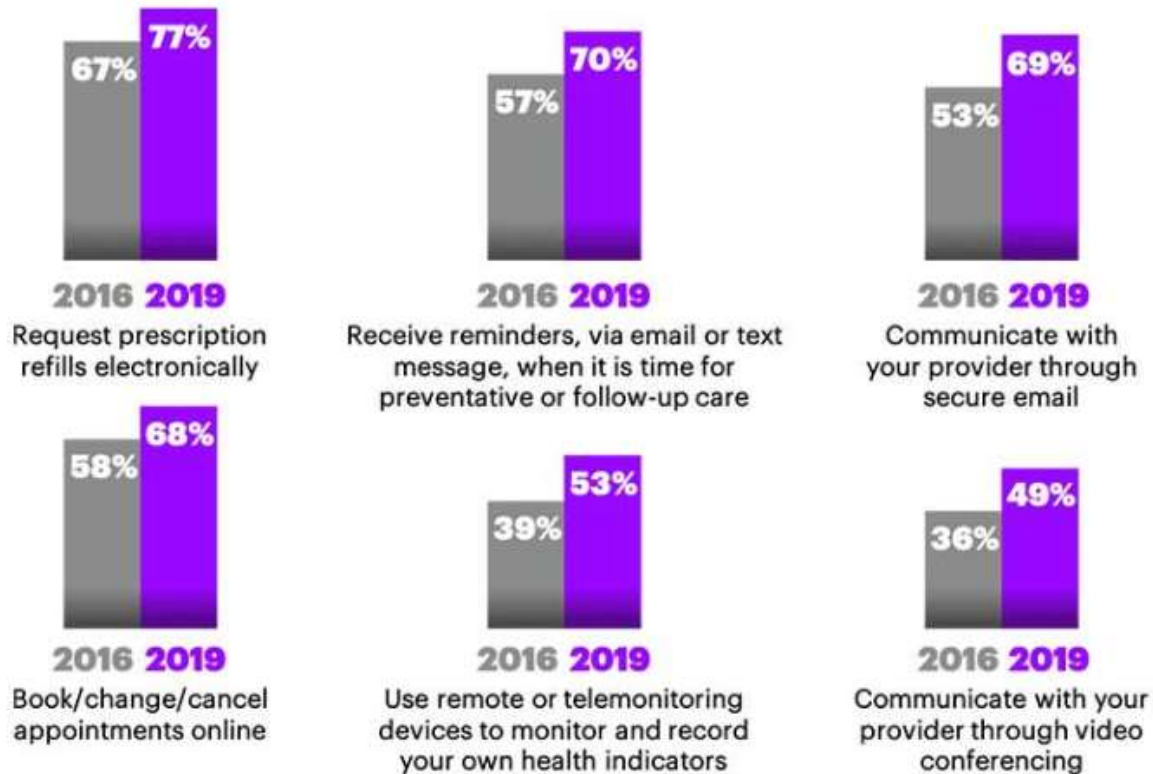
It is imperative we adjust and align our service delivery to meet those expectations.



Source: Accenture 2019 Digital Health Consumer Survey

PATIENTS PREFER DIGITAL

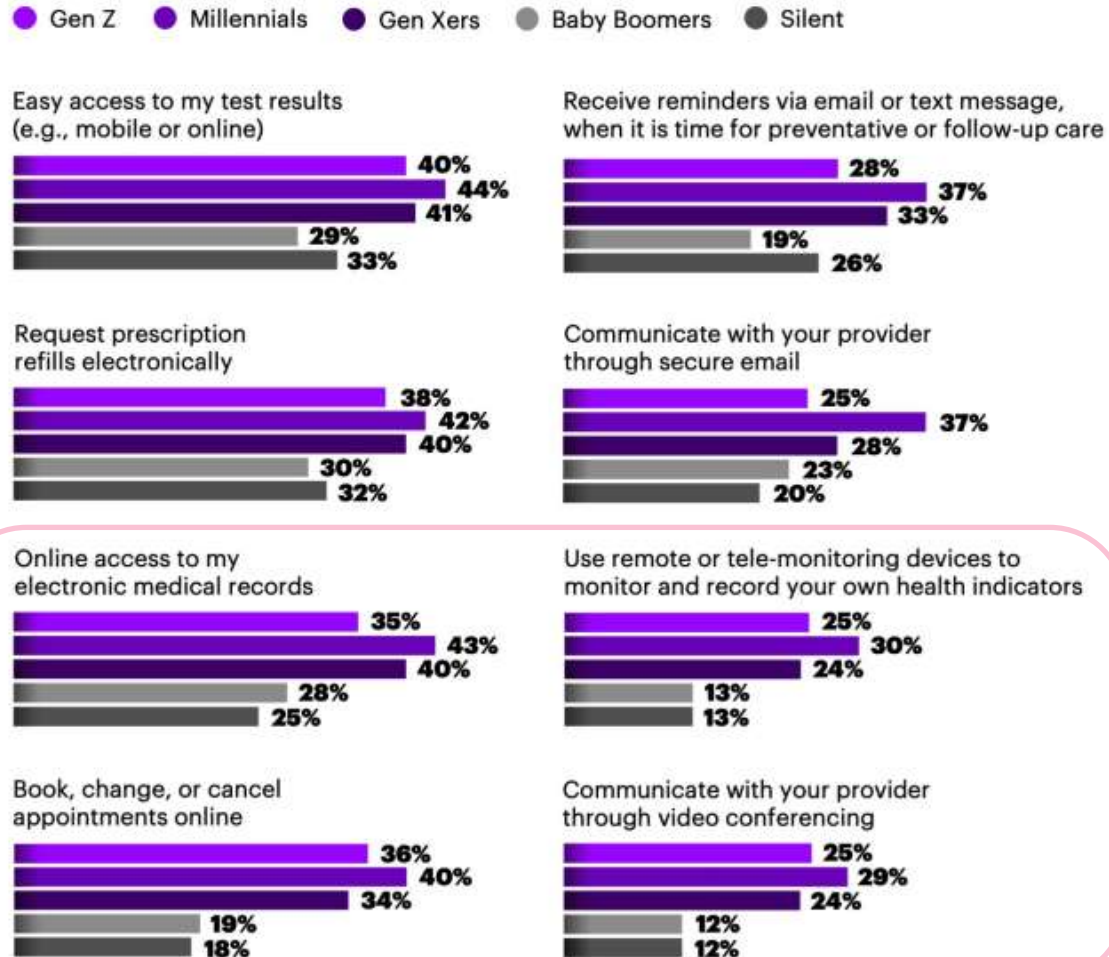
Proportion of patients who are “More Likely” to choose providers who offer...



Source: Accenture 2019 Digital Health Consumer Survey

ESPECIALLY GEN-X, MILLENNIALS

Proportion of patients who are “Much More Likely” to choose providers who offer...



HYPE + DEMAND + MONEY + OPPORTUNITY



So. Many. Buzzwords.

“MOVE FAST, BREAK THINGS”

“Many digital health companies fall short because they apply a strategy to healthcare that was developed and refined in the tech sector, an entirely different industry with its **own set of rules.**”

-Paul Yock, Fast Company

Source: <https://www.fastcompany.com/90251795/why-do-digital-health-startups-keep-failing>

Hi, I'm your doctor!
Let's move fast and break things!



MY MOTTO IS
"MOVE FAST AND
BREAK THINGS."



JOBS I'VE BEEN FIRED FROM

FEDEX DRIVER
CRANE OPERATOR
SURGEON
AIR TRAFFIC CONTROLLER
PHARMACIST
MUSEUM CURATOR
WAITER
DOG WALKER
OIL TANKER CAPTAIN
VIOLINIST
MARS ROVER DRIVER
MASSAGE THERAPIST

By Kyan Safavi, Simon C. Mathews, David W. Bates, E. Ray Dorsey, and Adam B. Cohen

Top-Funded Digital Health Companies And Their Impact On High-Burden, High-Cost Conditions

DOI: 10.1377/hlthaff.2018.05081
HEALTH AFFAIRS 38,
NO. 1 (2019): 115–123
©2019 Project HOPE—
The People-to-People Health
Foundation, Inc.

“We found that few companies studied their products and services in high-cost, high-burden populations or measured their impact in terms of key health metrics such as outcomes, costs, or access.”

GOOGLE'S PILLARS OF INNOVATION



1. Have a mission that matters
2. Think big but start small
3. Strive for continual innovation, not instant perfection
4. Look for ideas everywhere
5. Share everything
6. Spark with imagination, fuel with data
7. Be a platform
8. Never fail to fail

Source: <https://www.thinkwithgoogle.com/marketing-resources/8-pillars-of-innovation/>

HEALTHCARE PILLARS OF INNOVATION?

1. Have a mission that matters → Hey! We have one of those!
2. Think big but start small → Hard to pilot in busy clinical settings
3. Strive for continual innovation, not instant perfection → Isn't this QI?
4. Look for ideas everywhere → We should do this, but be thoughtful
5. Share everything → This is encouraged (academic, research, QI).
6. Spark with imagination, fuel with data → We need more “what if” / free time.
7. Be a platform → Let's talk about FHIR, Webservices, Device integration!
8. Never fail to fail → Tough to do without perturbing the system.

Source: <https://www.thinkwithgoogle.com/marketing-resources/8-pillars-of-innovation/>

derisk

verb [I or T] (ALSO **de-risk**) / ,di:'rɪsk/

to make something safer by reducing the possibility that something bad will happen and that money will be lost.

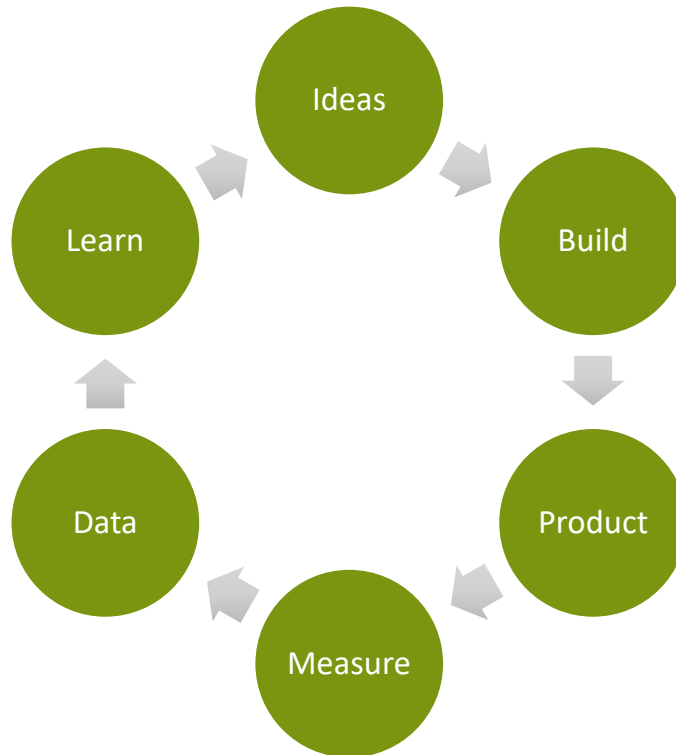
GOALS OF DERISKING

- Convert assumptions into knowledge
 - At low cost
 - As quickly as possible
- Decrease assumptions to increase value
- Consume intellectual capital before outside capital
- Know when to proceed and when to pivot



Credit: Steve Barsh, DreamIt Ventures

VALIDATE, ITERATE



Credit: The Lean Startup Book by Eric Ries

- **Customers**

- Who are they?
- What do they think?
- What do they like/dislike?

- **Investors**

- Who will fund this and why?

- **Talent**

- Who do you need to bring this to market?

- **Time**

- How can we shorten the time to market and how do we get there?

CAN WE ADAPT THESE TO DIGITAL HEALTH?

- How can healthcare be more **nimble, innovative**?
- Can we rapidly **assess and adopt** new technologies?
- How do we use tech to address gaps in **quality**?
- How do we improve healthcare **operations**?
- Can we do it in a **cost-conscious** way?
- Can we do it **safely**?
- What does **disruption** mean in healthcare?

INNOVATION IN HEALTHCARE

RESEARCH

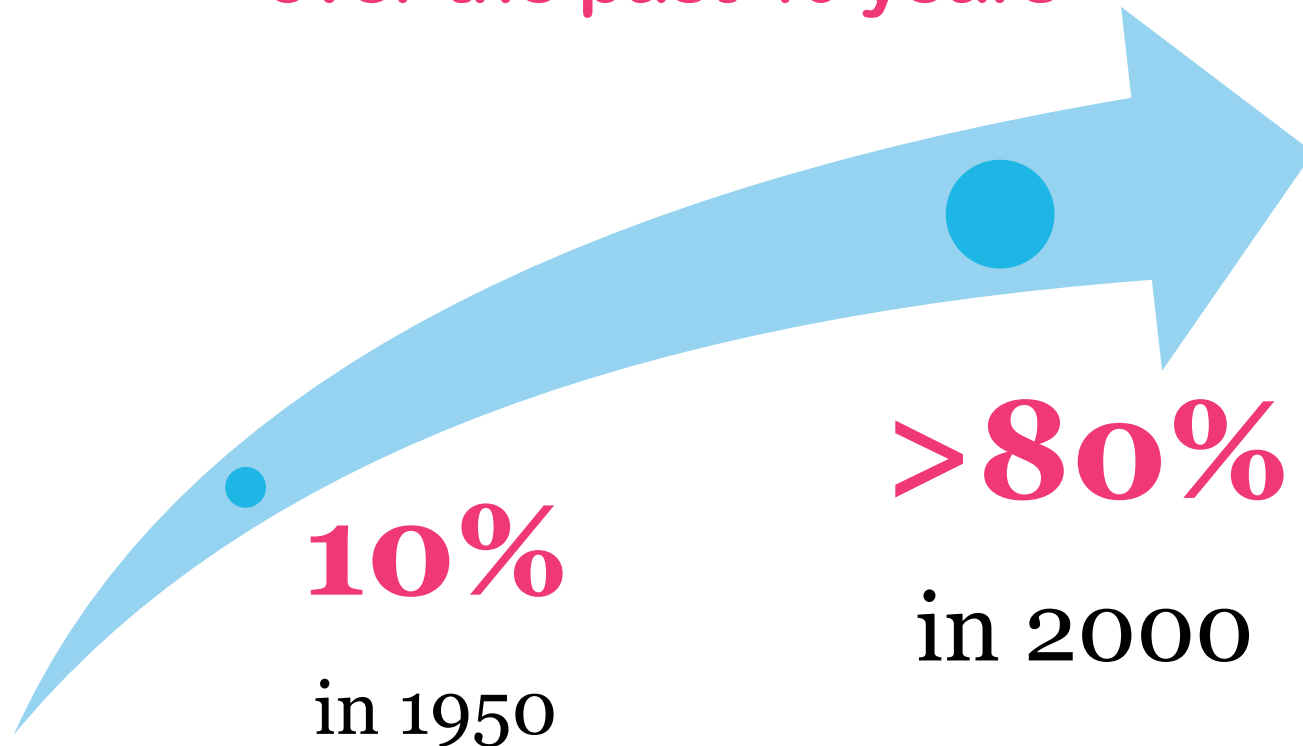
- Systematic testing of a hypothesis
- Need IRB / Human Subjects
- Goal is discovery (but may result in IP)
- External funding source with no fiduciary expectation

QUALITY IMPROVEMENT

- Serial testing of changes to a system to gauge impact on process
- Follows a standard methodology like PDCA
- Goal to improve quality of a structure/process/outcome
- Typically internally funded

RESEARCH WORKS

5-Year pediatric cancer survival
over the past 40 years

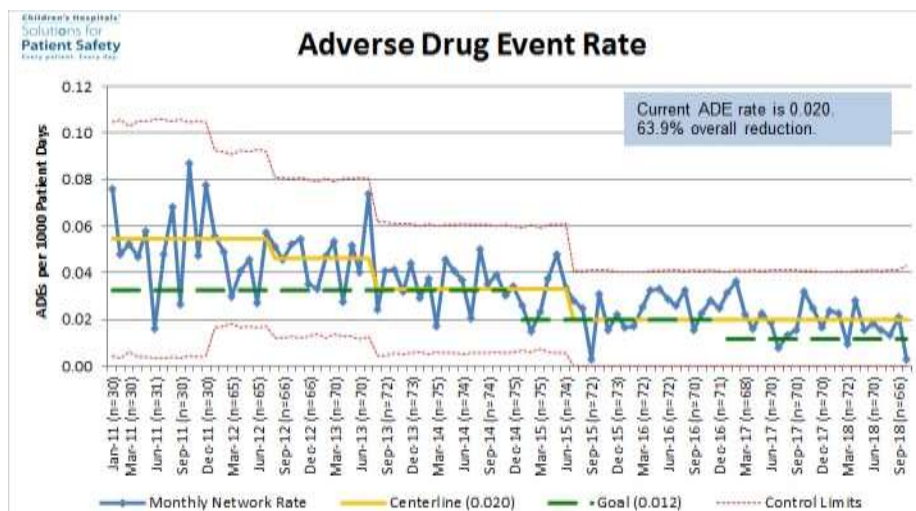


QUALITY IMPROVEMENT WORKS

Children's Hospitals'
Solutions for
Patient Safety
Every patient. Every day.

In 2018:

- 11,108 children saved from serious harm
- \$182,604,000 saved



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Source: <https://www.solutionsforpatientsafety.org/>

Value = Quality / Cost

Quality

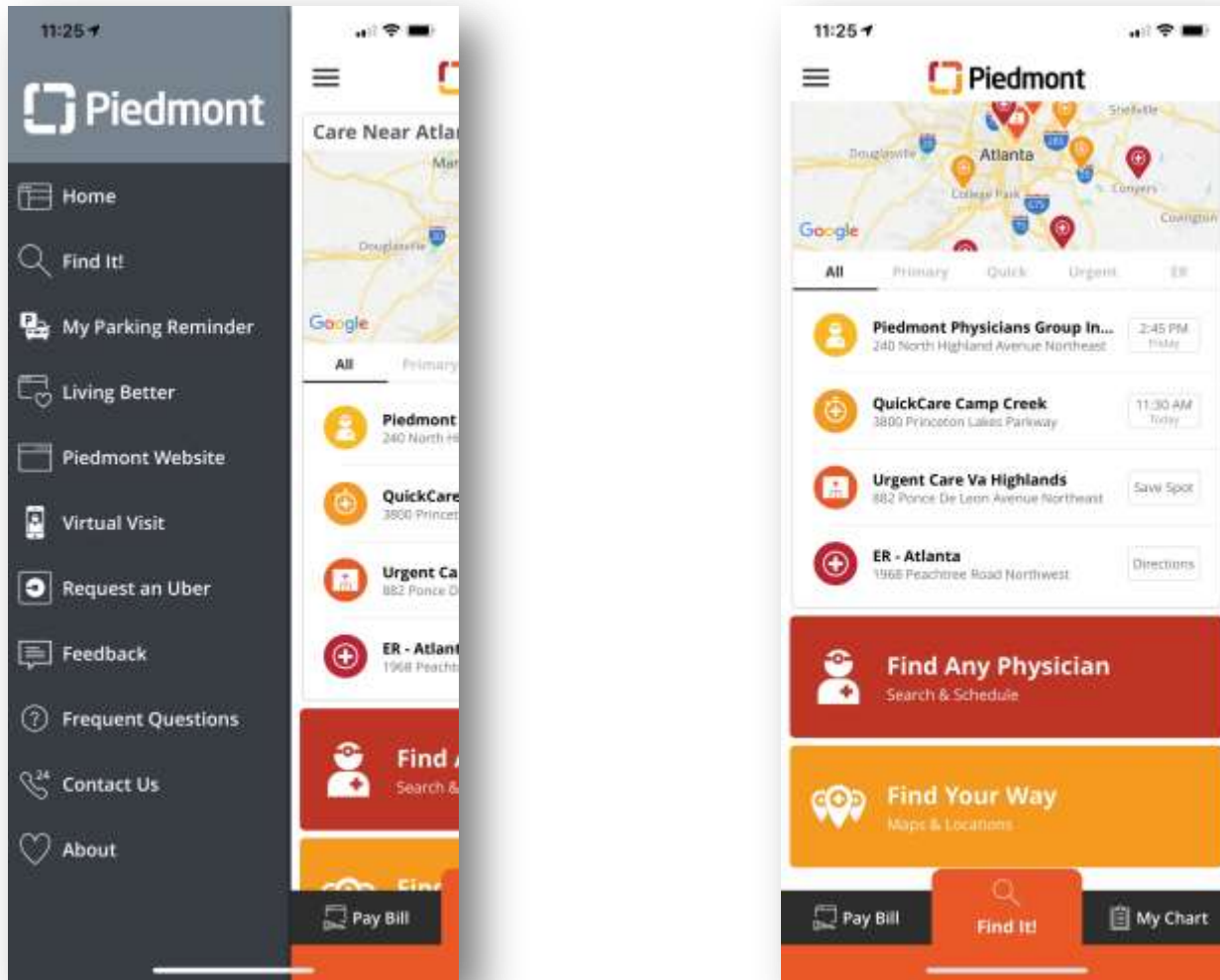
- **Safe** → does not cause harm
- **Effective** → evidence-based
- **Efficient** → not wasteful
- **Timely** → avoids delays
- **Patient-Centered** → “consumerism”
- **Equitable** → addresses disparities

QI OPPORTUNITIES

- **Value-based care**
- **Process innovation**
- **Consumerism**
- **Decentralized healthcare (e.g. home care, remote monitoring)**
- **Innovative disease management**
- **Administrative / operational efficiency (30% of cost!)**
 - \$68K per physician per year spent on billing
 - 0.67 non-clinical FTE for each physician, just for billing/insurance

Sources: <https://www.advisory.com/daily-briefing/2018/07/23/administrative-costs>
<https://www.forbes.com/sites/hbsworkingknowledge/2013/07/15/5-imperatives-for-improving-health-care/#7d3b178ec91c>

FIX THE CONSUMER EXPERIENCE



Source: MyPiedmont app, available on the Apple AppStore

LOOK FOR CROSSOVER PRODUCTS



NI/ICU Cameras

- **100 cameras** installed
- **>70K** visits to Angel Eye mobile / web application since November 2017
- **43 states** and **33 countries**
- **>2x reduction in parental stress/anxiety**

(33% vs. 72%; $p < 0.05$)

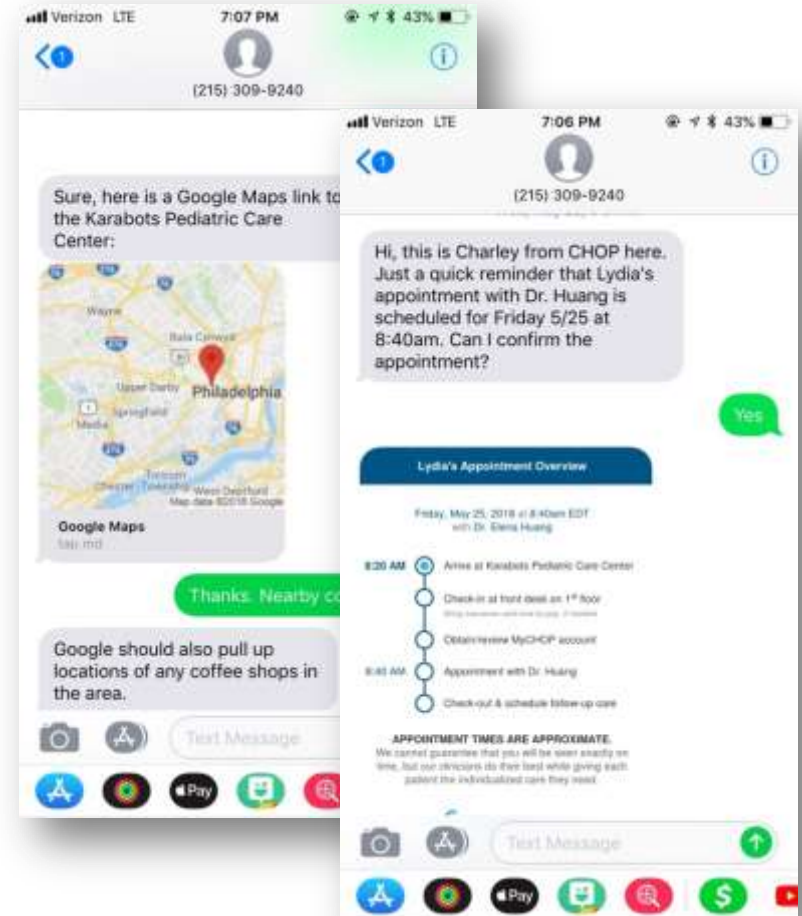


LOOK FOR CROSSOVER PRODUCTS

AI Chatbot sent **415K** **appointment reminders** and interacted with parents 140K times, for a total of **1.2M** **messages**

Value to Families: just-in-time information using SMS, live chat

Value to CHOP: additional 24h of advance notice about intent to cancel



Digital Therapeutics:

**Technologies “prescribed” to a patient
with the goal of improving health**

**For Digital Therapies to be successful,
they must create value in healthcare
or else risk making the problem worse.**

HOW TO INNOVATE WITH VALUE?

- Be clear on the problem, how it's measured, the magnitude, and the target.
- Be clear on the cause/effect between your digital intervention and the improvement you seek.
- Be clear on the value proposition and alignment?
- What is the efferent arm of the clinical process?
- Insist on evidence → treat Digital Therapies like medications
- Insist on enterprise scalability.

Should your cardiologist “prescribe” this device as a digital therapy for atrial fibrillation?

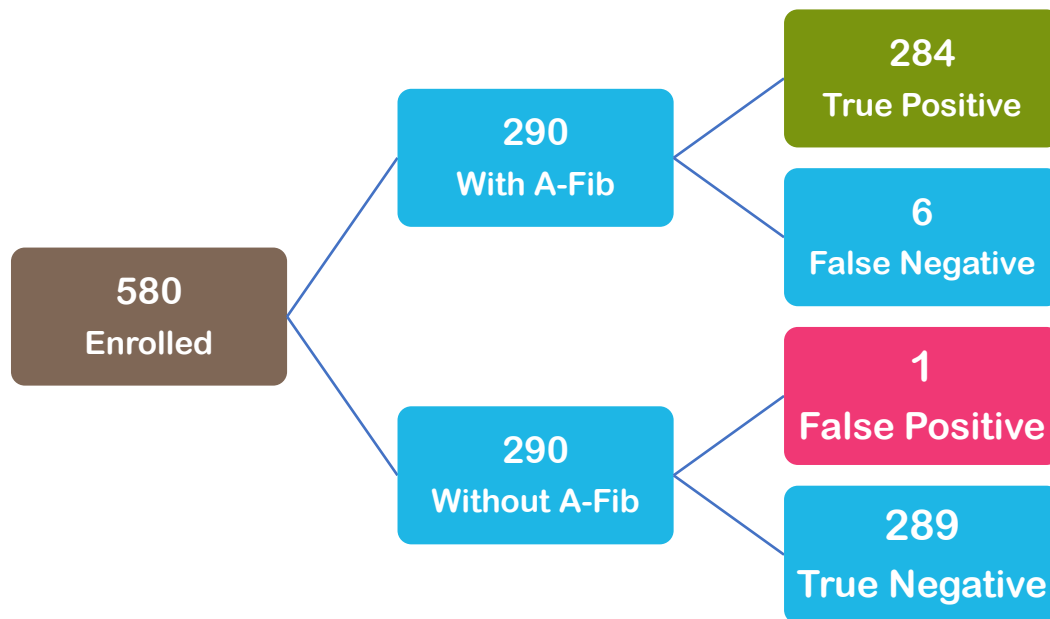


THE DATA

- Atrial fibrillation is the most common arrhythmia
- Higher risk of heart failure and stroke
- Apple submitted study data to FDA, which reveals:
 - 580 people in the study, half were known to have A-fib
 - Correctly **detected** atrial fibrillation **98%** of the time
 - Correctly **ruled out** atrial fibrillation **99.6%** of the time

Source: <https://www.statnews.com/2018/09/13/heres-the-data-behind-the-new-apple-watch-ekg-app/>

IF YOU WERE IN THE STUDY



If the watch says you have A-Fib,
the watch is **99.6% likely** to be correct (284 out of 285)

HOW COMMON IS THIS DISEASE?

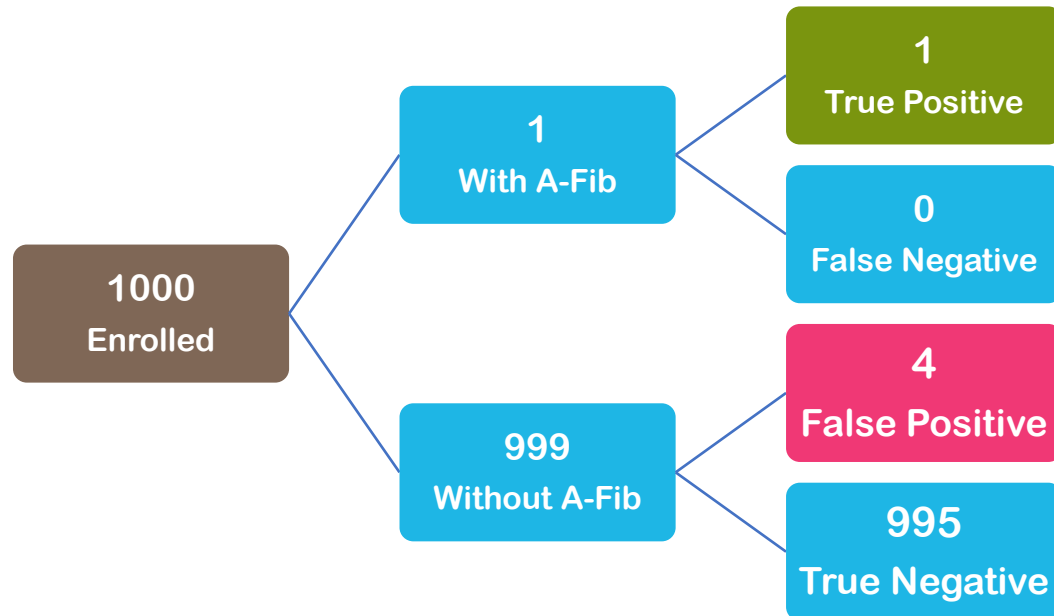
Risk of atrial fibrillation **increases with age**:

- **0.1%** in adults younger than 50
- **4%** in those between 60-70 years
- **10-17%** in those over 80

Stanford Heart Study identified **prevalence of 0.5%** (2K out of 400K participants)

The only population that has a 50% prevalence is one that has been medically-selected.

IF YOU ARE MY AGE (0.1% RISK)



If the watch says you have A-Fib,
the watch is **20% likely** to be correct (1 out of 5)



If you are at high risk for A-fib, most people in this room,
Apple Watch is a low-cost, Apple Watch would be
accurate monitoring tool long 4 times out of 5.

INFANT PULSE OXIMETRY

- Many use cases (congenital heart disease)
- Many emerging products, often B2C



Society for Technology in Anesthesia

Section Editor: Maxime Cannesson

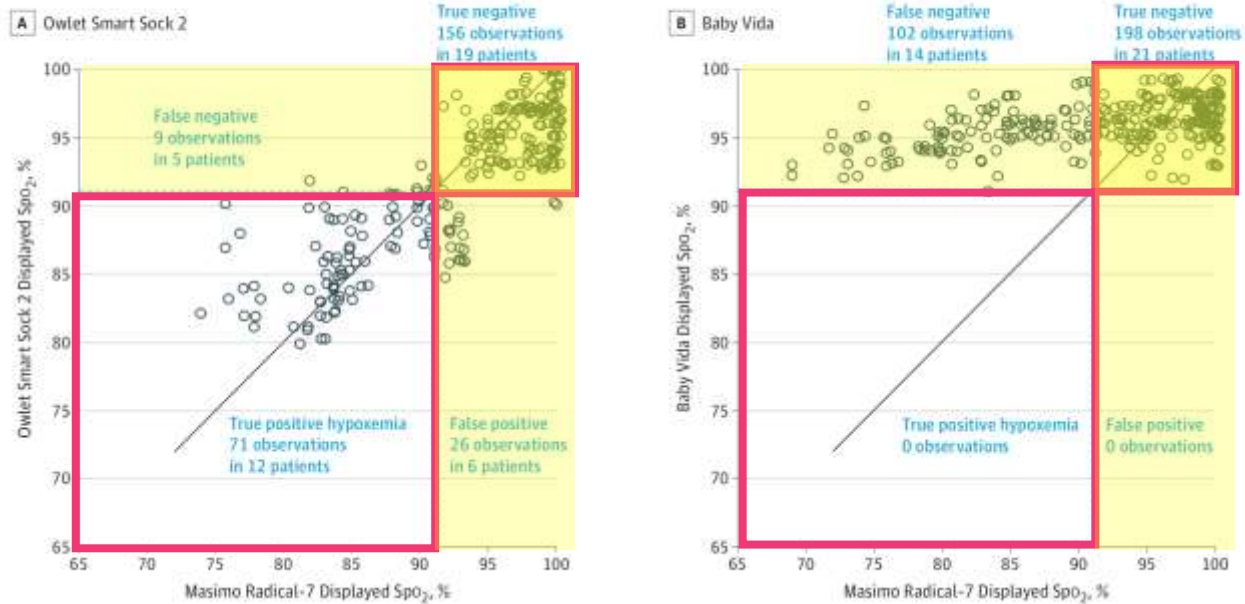
The Accuracy of 6 Inexpensive Pulse Oximeters Not Cleared by the Food and Drug Administration: The Possible Global Public Health Implications

Michael S. Lipnick, MD,* John R. Feiner, MD,* Paul Au, BS,* Michael Bernstein, BS,† and Philip E. Bickler, MD, PhD*

CONCLUSIONS: Many low-cost pulse oximeters sold to consumers demonstrate highly inaccurate readings. Unexpectedly, the accuracy of some low-cost pulse oximeters tested here performed similarly to more expensive, ISO-cleared units when measuring hypoxia in healthy subjects. None of those tested here met World Federation of Societies of Anaesthesiologists standards, and the ideal testing conditions do not necessarily translate these findings to the clinical setting. Nonetheless, further development of accurate, low-cost oximeters for use in clinical practice is feasible and, if pursued, could improve access to safe care, especially in low-income countries. (Anesth Analg 2016;123:338–45)

HOME BABY MONITORS

Figure 1. Oxygen Saturation (SpO₂) for Oxygen Baby Monitors Owlet Smart Sock 2 and Baby Vida (Consumer Monitors) vs US Food and Drug Administration-Cleared Masimo Radical-7 (Reference Monitor)



These are true positives (abnormal pulse ox readings)

Source: Bonafide et al. JAMA 2018. <https://jamanetwork.com/journals/jama/fullarticle/2697685>

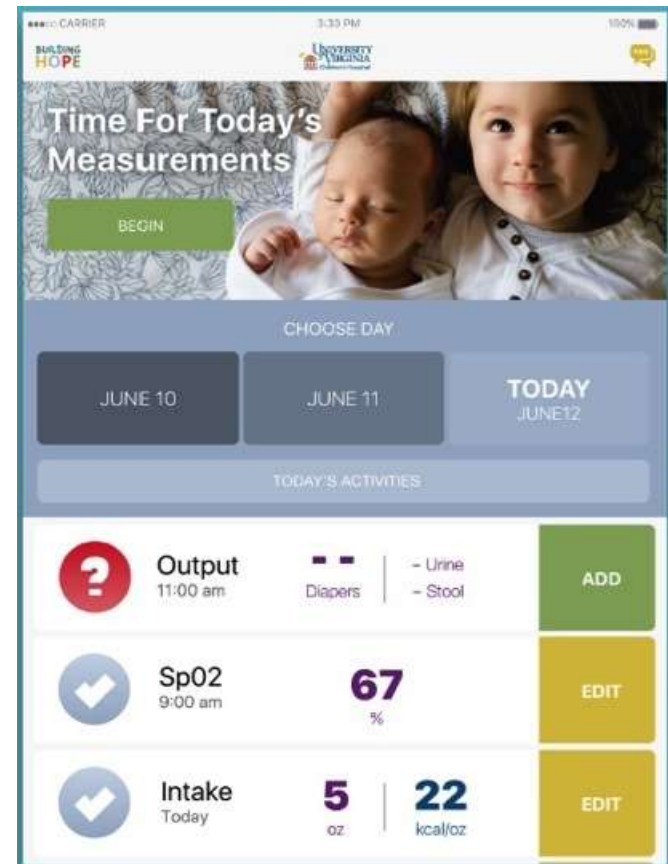
CURRENT STATE OF THE ART

- Routine home-monitoring for infant apnea is not recommended
- For select populations (SIDS, congenital heart disease, chronic lung disease), may be warranted
- Must be an FDA-approved, medical-grade infant monitor
- Today, none can easily be interfaced to EHR



UVA CONGENITAL HEART DISEASE APP

- **Clear value:** for a specific category of infants with congenital heart disease, mortality approaches double-digits.
- **Clear intervention:** aggressive home monitoring with medical Pulse Oximetry and home journal works, but is cumbersome.
- **Clear platform opportunity:** an iPad App functions as the journal, can be platform for education, video consults, and more over time. Could be used for other diseases.



Source: Vergales et al. <https://www.uvaphysicianresource.com/new-app-platform-aims-to-improve-in-home-monitoring-of-congenital-heart-patients/>

DIGITAL HEALTH FOR CHRONIC ILLNESS

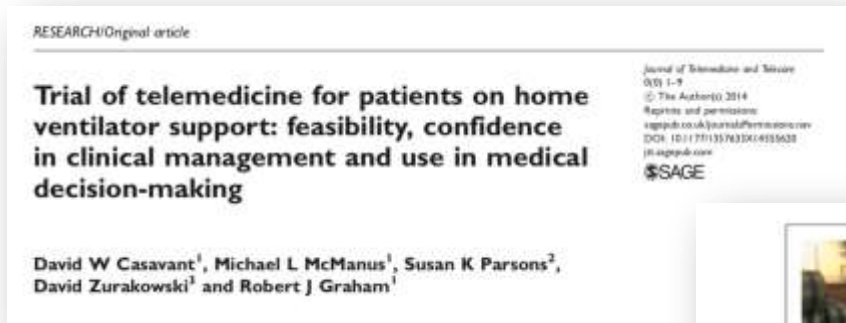


Figure 1. Telemedicine with patient with SMA type 1.

9 month study of 14 patients on BiPAP / Vent at **Boston Children's Hospital**

27 visits provided by telemedicine

Avoided Visits: 23 specialty care, **3** ED visits, **1** IP admission

DIGITAL EXTENDS OUR REACH

- High utilizer populations have more to gain from these technologies
 - Chronic care management
 - “Digital Hovering”
- “[many specialty referrals] — upward of 40 percent in some cases — are not needed.” - NYT, March 18th
 - Our patients avoid 50 miles of driving each way for post-op teledemed
 - Our Palliative Care team physically can’t drive to homes of patients in the Poconos
 - Our medically-fragile patients require expensive medical transport
 - Our Home Care respiratory therapists can often troubleshoot by video

DIGITAL INNOVATION + QI

Digital Therapeutics Portfolio

- Finding clinical value requires a **QI and evaluation mindset**
- Identify the subset of patients who would benefit
- Identify true waste, gaps, variation in clinical practice
- Identify consumer tech or medical devices that can address that gap
- Focus on successful, enterprise-safe intervention
- Consider if the solution works in other domains?
- Mandatory: build evaluation into the project

PRAGMATIC INNOVATION

- First, identify problems, not solutions
- Your problem is **not new**: look to other industries
 - Eg: What do FitBit and Apple Watch tell us about consumer engagement?
- Like Google says, build platforms, not point-solutions
- De-implementing is the new “fail fast”
- Create value for your patients AND for the health system
- Who pays and why?

LOOKING TO A DIGITAL FUTURE



Pre-Visit

- Digital Concierge → AI Chatbot, symptom checkers, triage functions
- Self-service functions → scheduling, bill-pay, wait-times, “Fast Pass”
- Reminders, questionnaires, visit-prep, cost estimators

During Visit

- On-campus wayfinding, check-in, MyCHOP Bedside
- Interactive Patient Experience → media, education, digital therapies
- Environment of Care → climate, lighting, concierge services

Post-Visit

- Digital Treatment Plan → questionnaires, adherence reminders
- Continuity of care → telemedicine/consultation, care coordination
- Remote monitoring → wearables, connected devices



THANK YOU!



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