



DIGITAL HEALTH IS MOVING MAINSTREAM: How Can We Harness the Opportunity?

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THE DIGITAL HEALTH VISION

Care delivered outside of a traditional setting that is not dependent on specific time and place restrictions. It integrates technology, often includes Patient Generated Health Data and seeks to include the patient in the process and help them become more engaged.



DIGITAL HEALTH BY THE NUMBERS

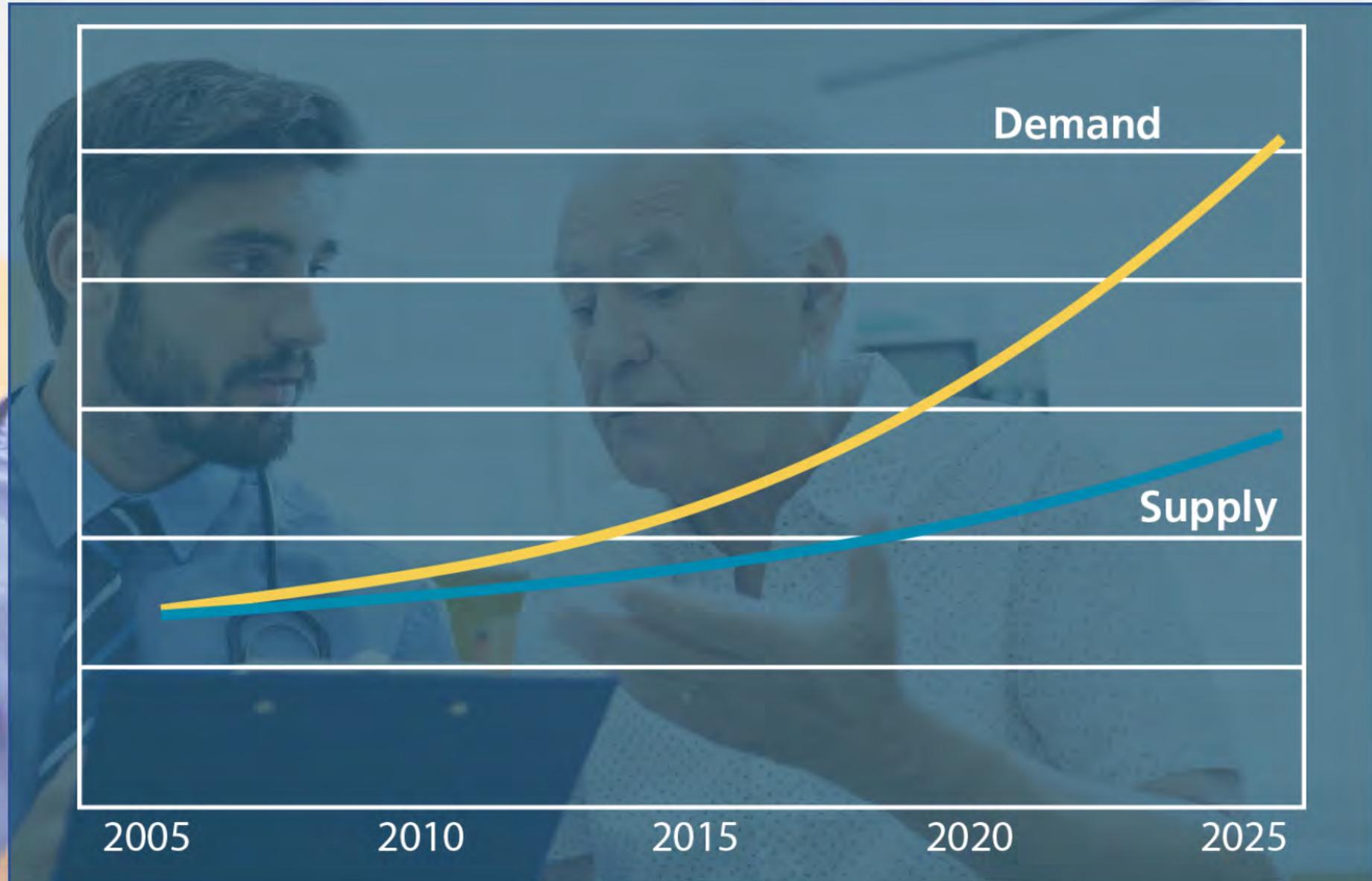
Worldwide mHealth market to reach
\$59 Billion
by 2020

More than
6.1 Billion
people will have smartphones or tablets with access to mobile health apps by 2020.

There will be
300 Million
pieces of clothing & accessories with embedded health monitoring devices by 2020

The **top 3** therapy fields for connected health solutions are **diabetes**, **obesity** and **hypertension**.

We Must Get it Right!



THE DIGITAL HEALTH LANDSCAPE

Telehealth

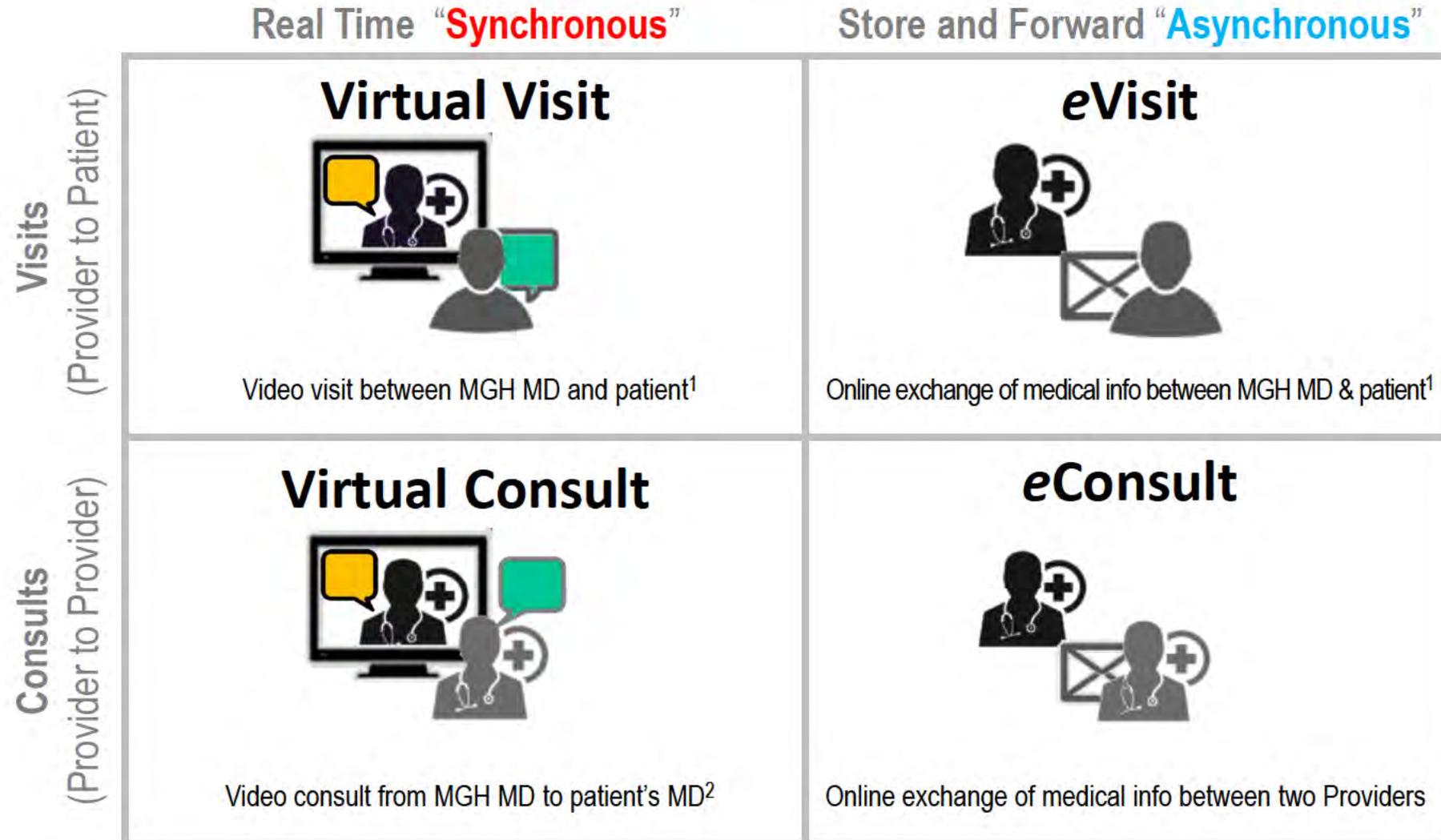
Remote Monitoring

Digital Therapeutics

Artificial Intelligence



TELEHEALTH TAXONOMY



¹ Exchange where the provider gives the patient medical advice, or determines if travel to MGH for in-person encounter is advisable

² Exchange where the MGH consultant “Expert” gives referring provider medical advice

TELEMEDICINE ADOPTION TRENDS

TELEMEDICINE ADOPTION BY CHANNEL
2015-2018

ROCK
HEAL+H



*Missing data point means the question was not asked in 2015.
Source: Rock Health Digital Health Consumer Adoption Survey (n₂₀₁₈ = 4,000; n₂₀₁₇ = 3,997; n₂₀₁₆ = 4,015; n₂₀₁₅ = 4,017)

- Wearable use shifting from fitness to managing health
- Urban patients twice as likely to use video telemedicine than rural
- Currently only capturing 0.5% of a 400+ million patient addressable market

Data from 2018 Rock Health
Digital Health Consumer
Adoption Report

MGH VIRTUAL VISITS STUDY RESULTS

79% of patients found it more convenient to find a time for a follow-up virtual visit vs. an in person one

68% of patients rated virtual video visits at 9 or 10 on a 10 point scale

Clinicians reported that virtual video visits are superior to office visits for timely scheduling of appointments (**70.5%**) and for visit efficiency (**52.5%**)

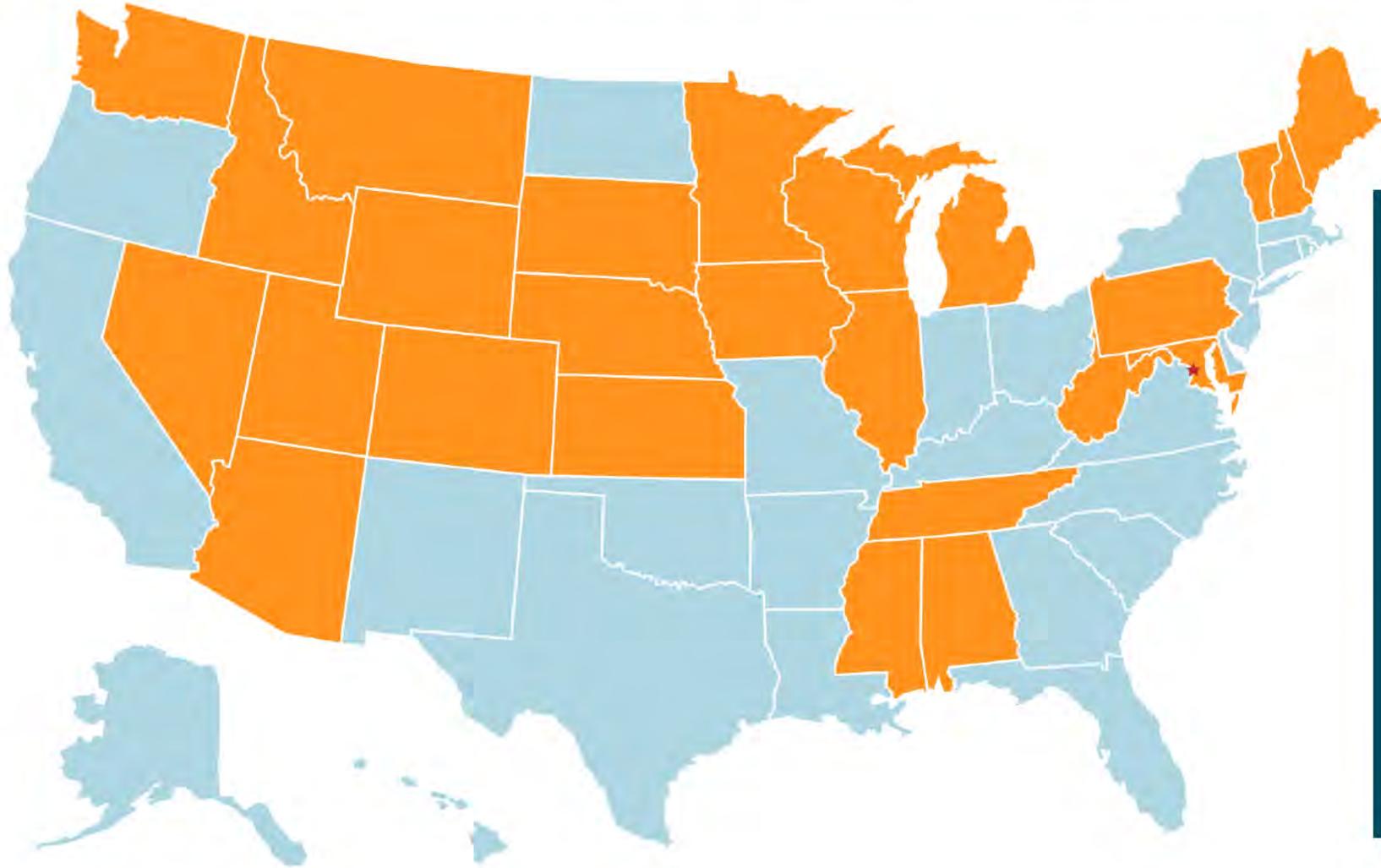


A photograph of an elderly Black man with a grey beard and mustache, wearing a light purple button-down shirt, looking confused and frustrated while holding a smartphone. A woman in a white lab coat is standing next to him, pointing at the phone's screen. The background is a bright, out-of-focus indoor setting.

ISSUES WITH FRAGMENTED APPROACH

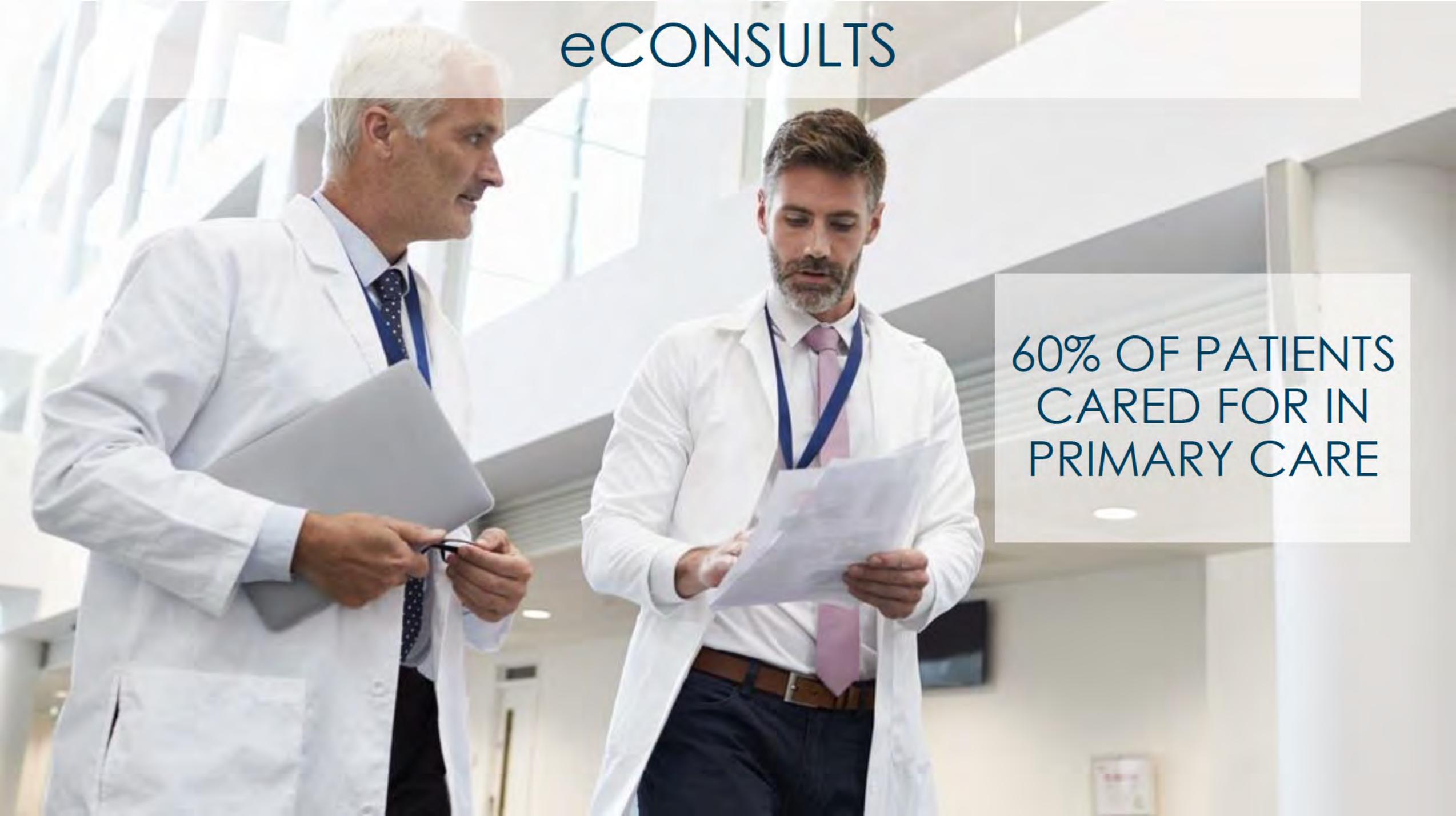
- Patient Confusion & Dissatisfaction
- Reimbursement & Revenue Differences
- Increased Legal Exposure
- Inefficient Use Of System Resources

INTERSTATE MEDICAL LICENSURE COMPACT



- Launched in 2014 by the FSMB
- 25 States are current members (District of Columbia & Guam as well)
- As of December 31, 2018, 4,511 medical licenses have been issued to providers to practice telehealth in multiple states

eCONSULTS

A photograph of two male doctors in white lab coats walking through a modern hospital hallway. The doctor on the left is older with white hair, wearing a blue tie and holding a folder and glasses. The doctor on the right is younger with a beard, wearing a pink tie and holding several sheets of paper. They appear to be in a professional discussion. The background shows a bright, clean hospital environment with large windows and architectural details.

60% OF PATIENTS
CARED FOR IN
PRIMARY CARE

ONLINE SECOND OPINIONS



ONLINE SECOND OPINIONS

THE ADDRESSABLE
MARKET FOR ONLINE
SECOND OPINIONS IS
ESTIMATED TO REACH
\$3.4 BILLION BY 2020



PARTNERS ONLINE SECOND OPINIONS

A 2003 study in the British Journal of Medicine documented the significant impact online second opinions have had on improving patient outcomes

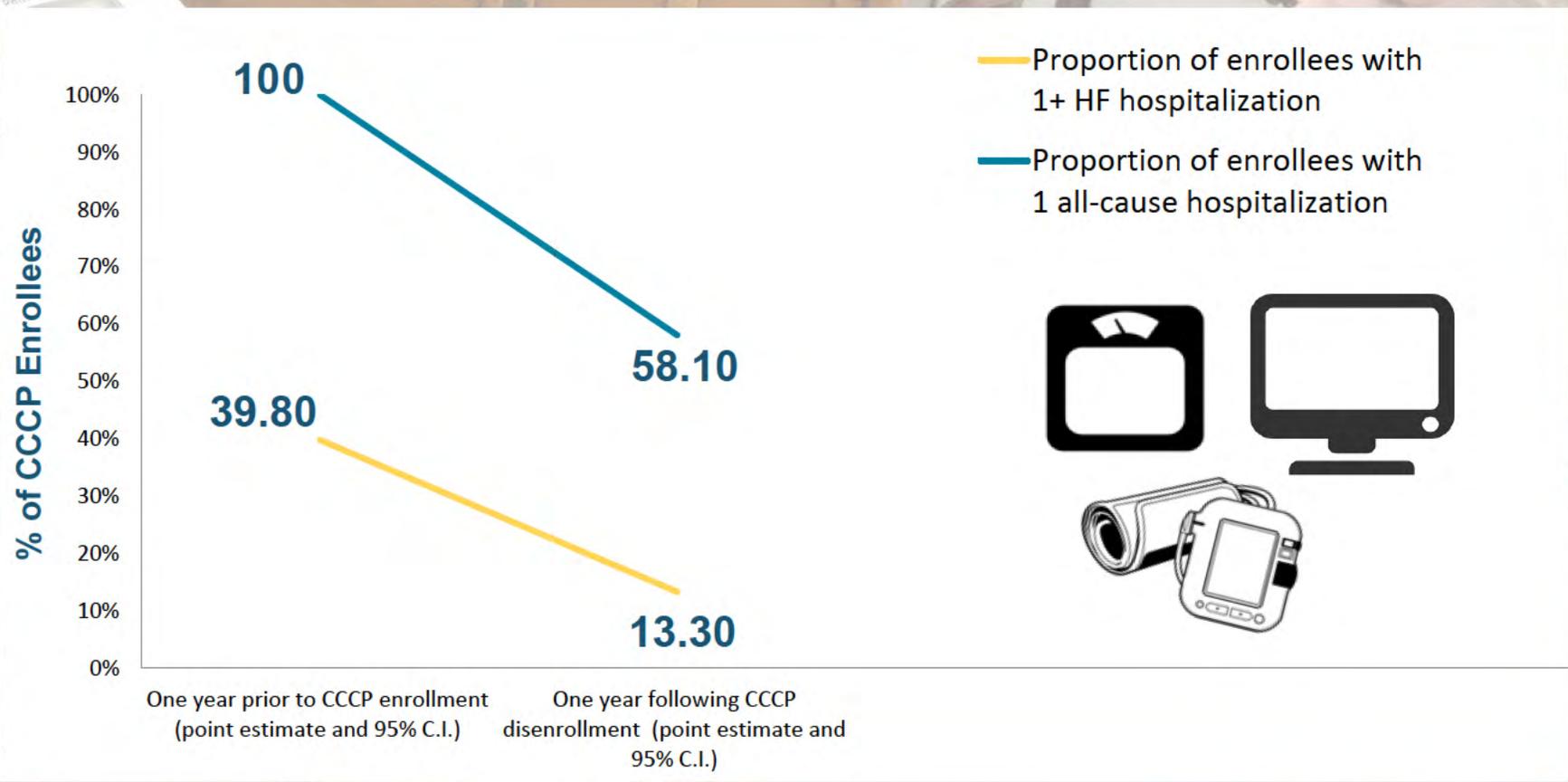
- **90%** of patients over the year studied received a new recommended treatment plan
- **5%** of patients had a change in diagnosis



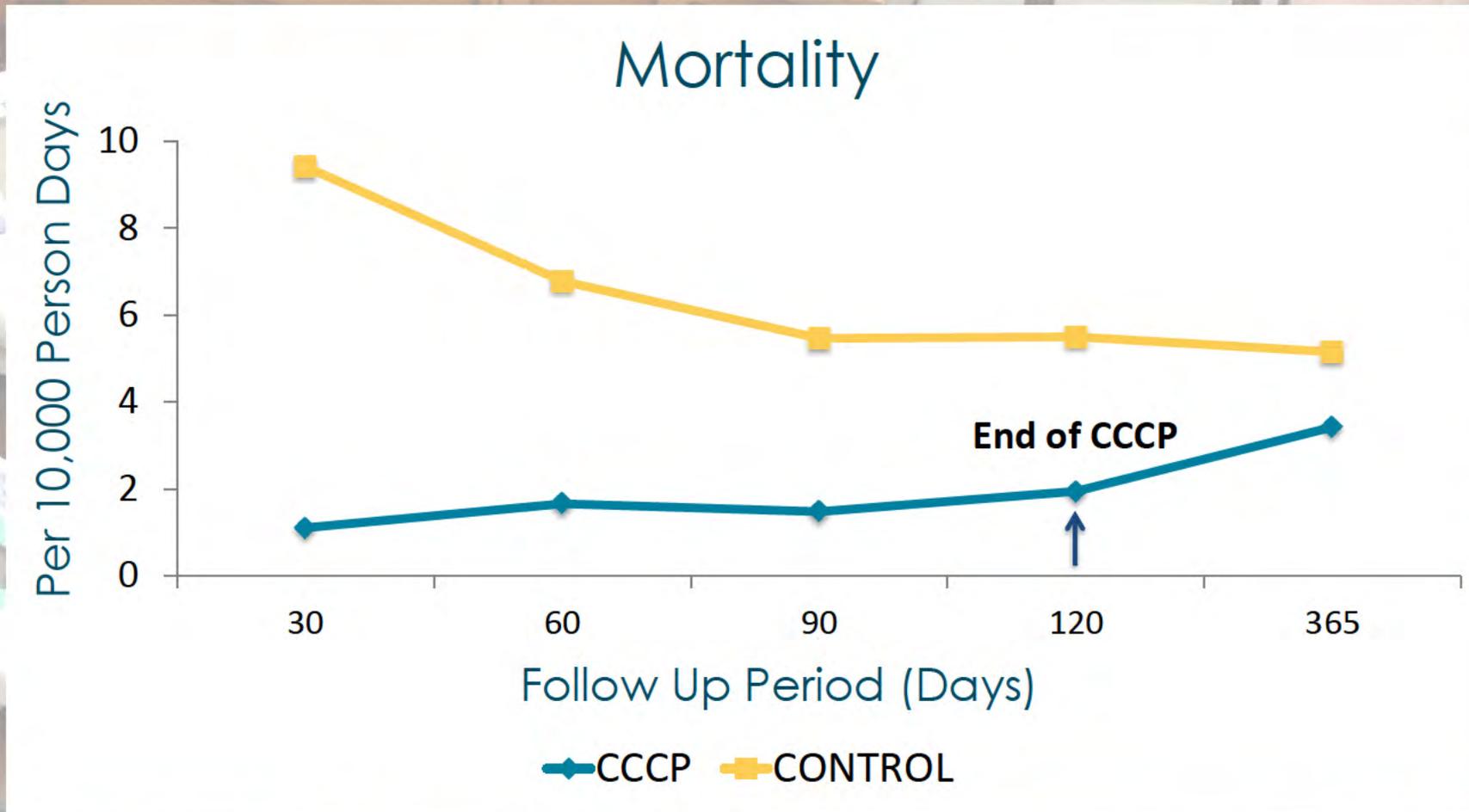
REMOTE MONITORING



CONNECTED CARDIAC CARE



ONE YEAR MORTALITY IN CCCP



Data Includes 303 CCCP patients and 252 controls seen at Partners Healthcare in 2012.

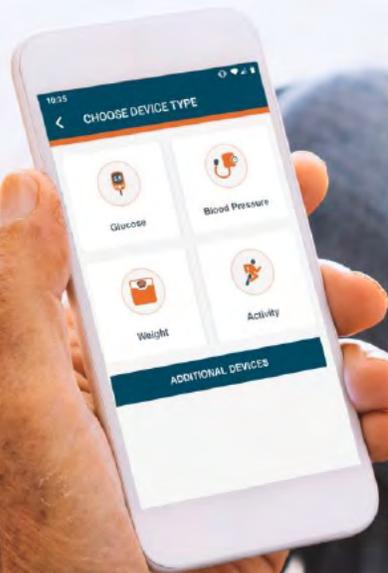
Ref: J Med Internet Res. 2015 Apr 22;17(4):e101. doi: 10.2196/jmir.4417.

PGHD*Connect* is a cloud-based digital health platform that provides a link to securely share patient generated health data between patients and providers.

Members of the patient's care team can view the data via *MyChart* and *Epic*.



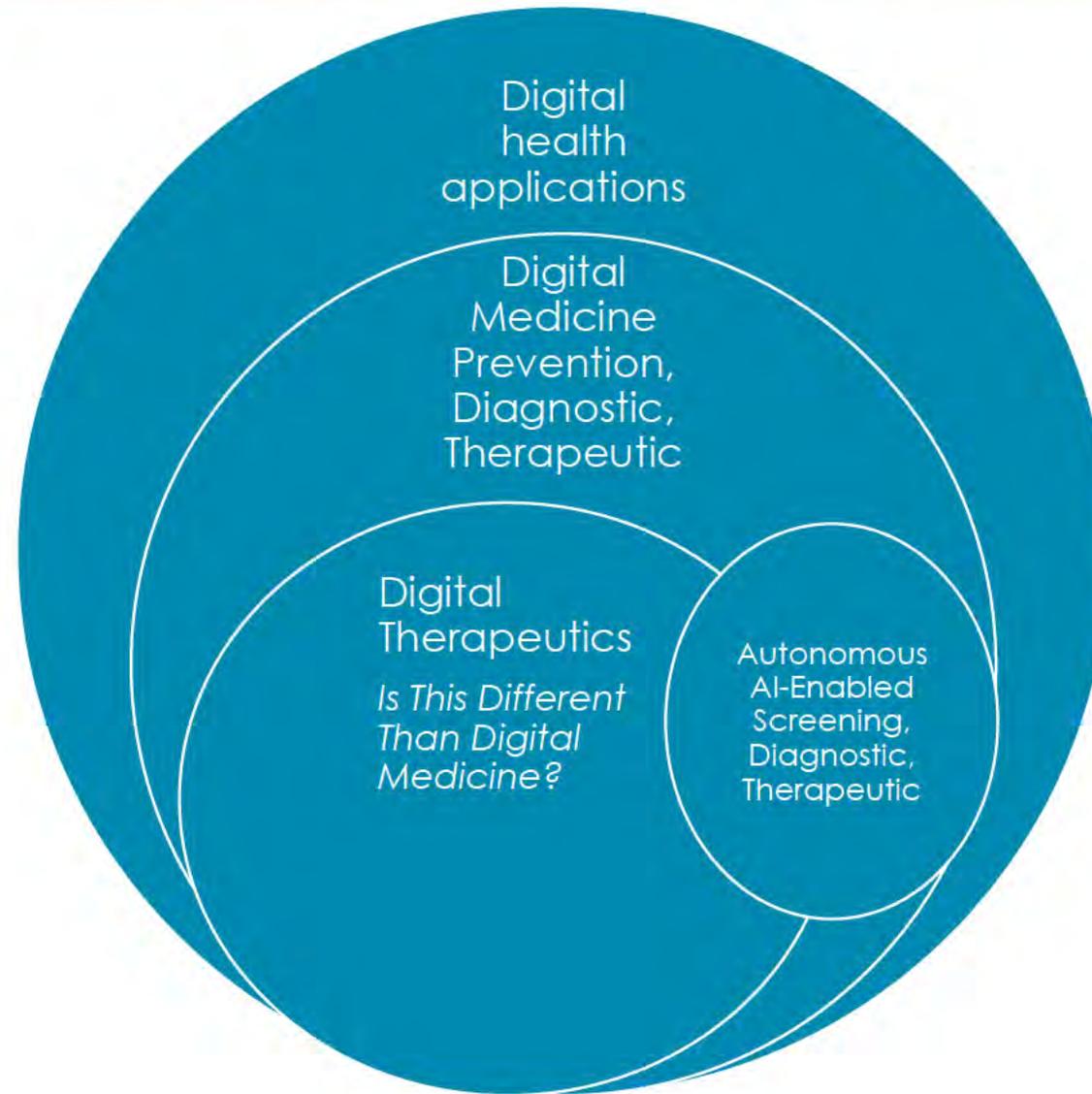
THE NEW PGHDCConnect MOBILE APP



DIGITAL THERAPEUTICS

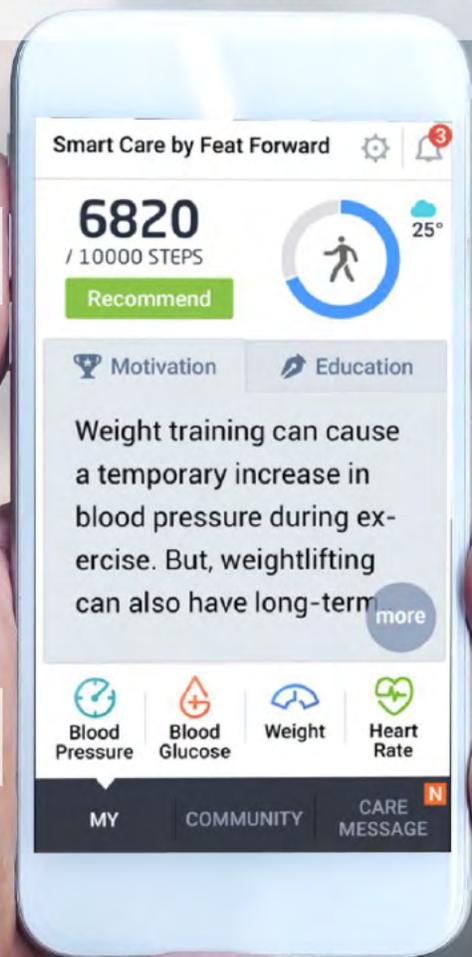


CONTEXTUAL PERSPECTIVE



FEATFORWARD

Activity Goals



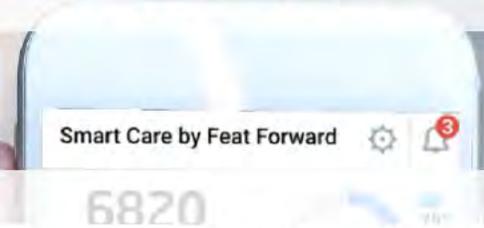
Alerts

Weather

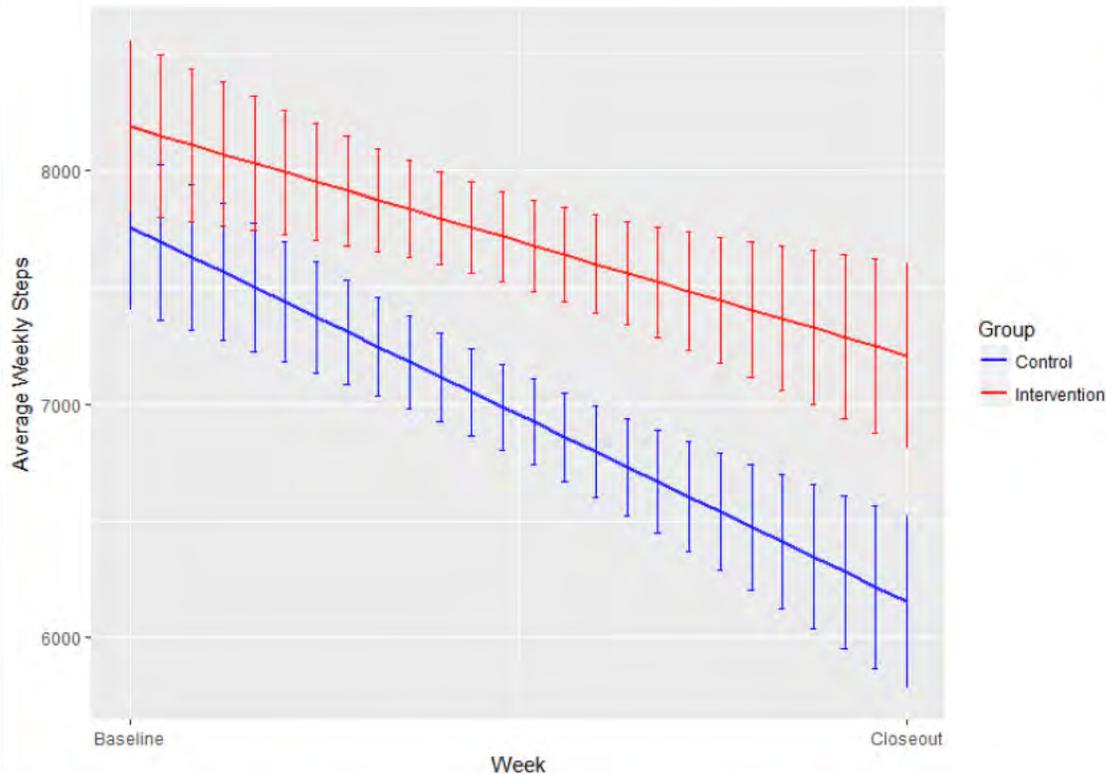
Messaging

Biometric Tracking

WEEKLY AVG DAILY STEPS (WDS)



Change in WDS by group over time (*unadjusted*)



Baseline-adjusted slopes for WDS by cohort

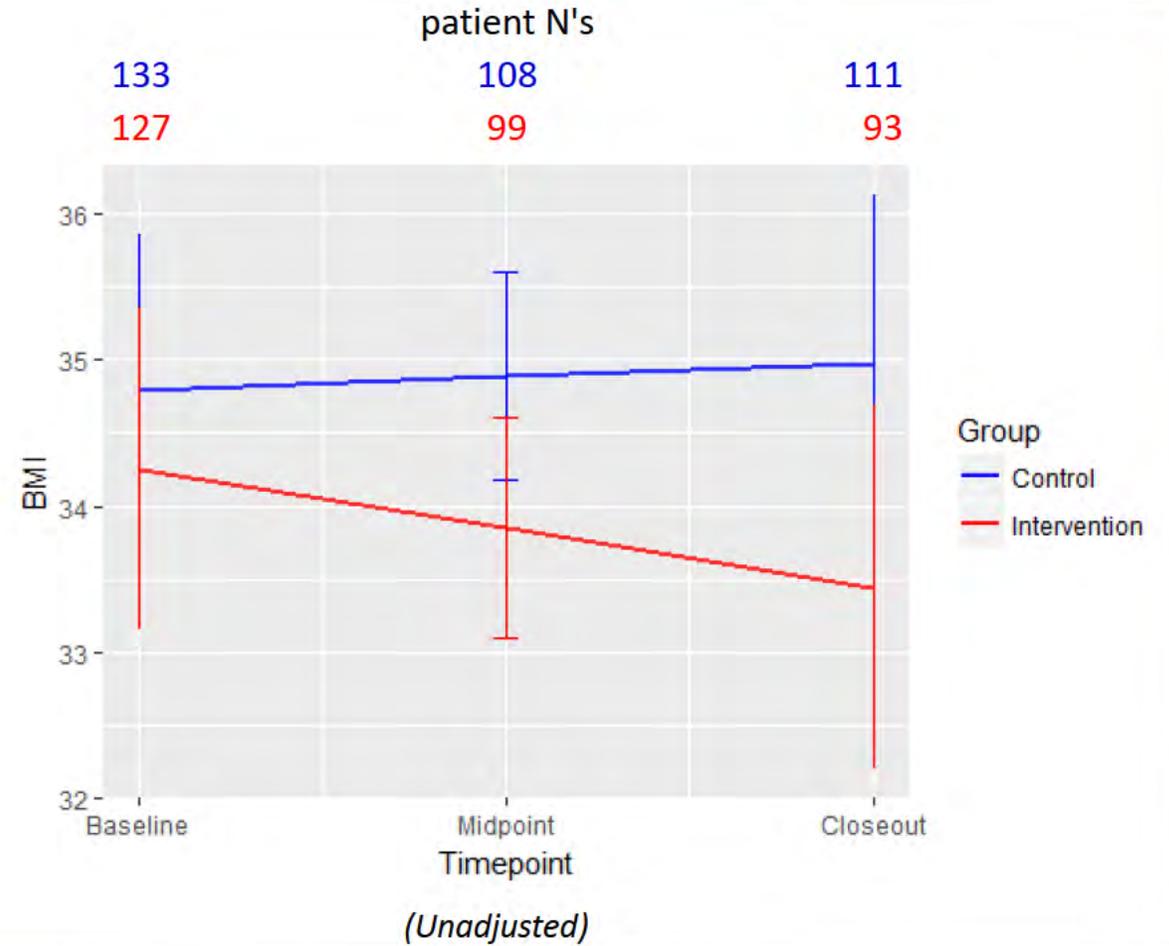
	Control [n]	Intervention [n]	p-value
Overall	-57.94 [110]	-29.29 [100]	0.015*
Obesity	-90.23 [59]	0.95 [52]	<0.001***

BMI

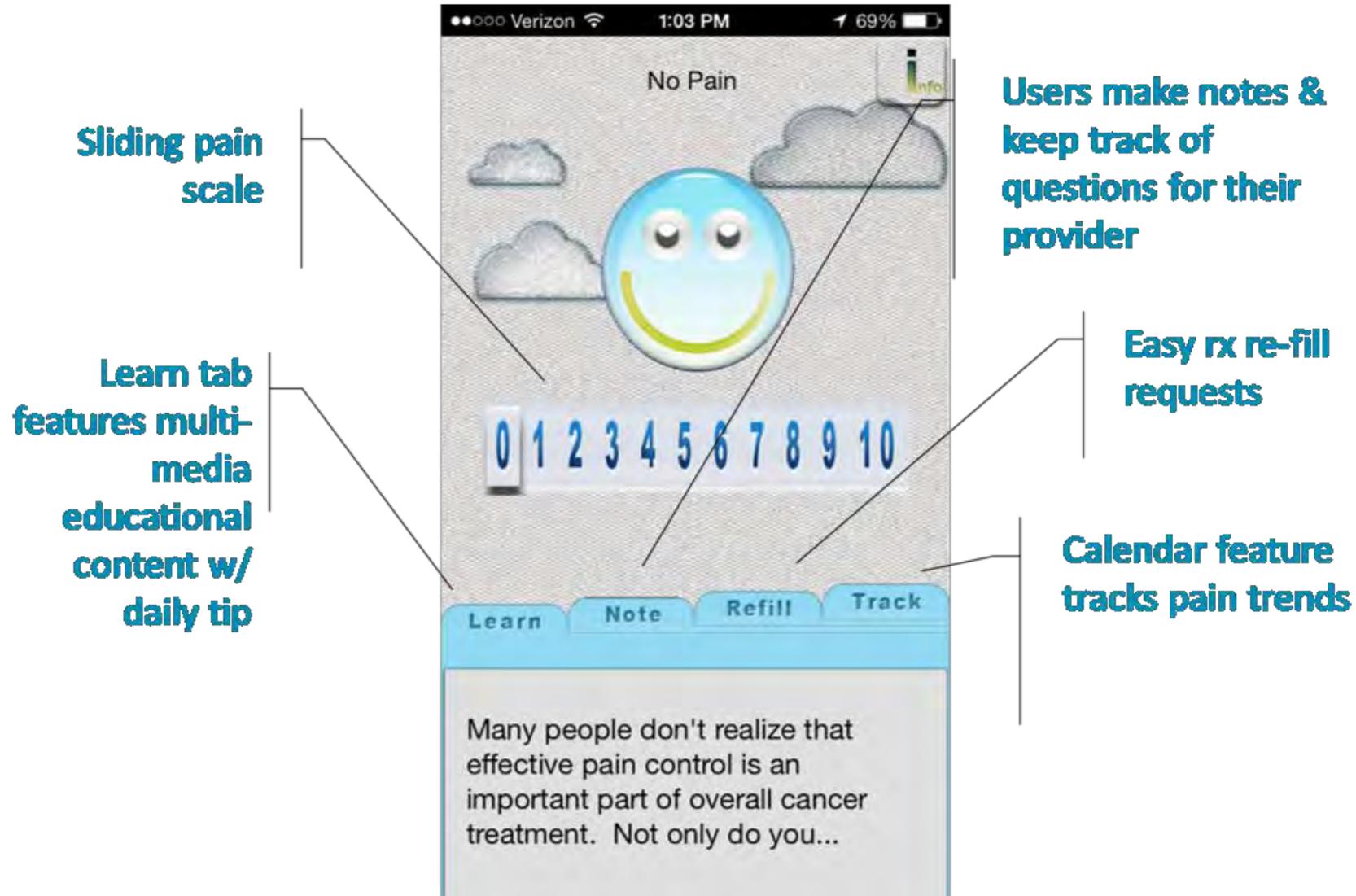
Smart Care by Feat Forward

Baseline-adjusted slopes for BMI by cohort

	Control [n]	Intervention [n]	p-value
<i>Overall</i>	-0.025 [133]	-0.232 [128]	0.041*
<i>Obesity</i>	-0.086 [68]	-0.236 [67]	0.362
<i>Hypertension</i>	0.056 [74]	-0.253 [75]	0.002**



ePAL

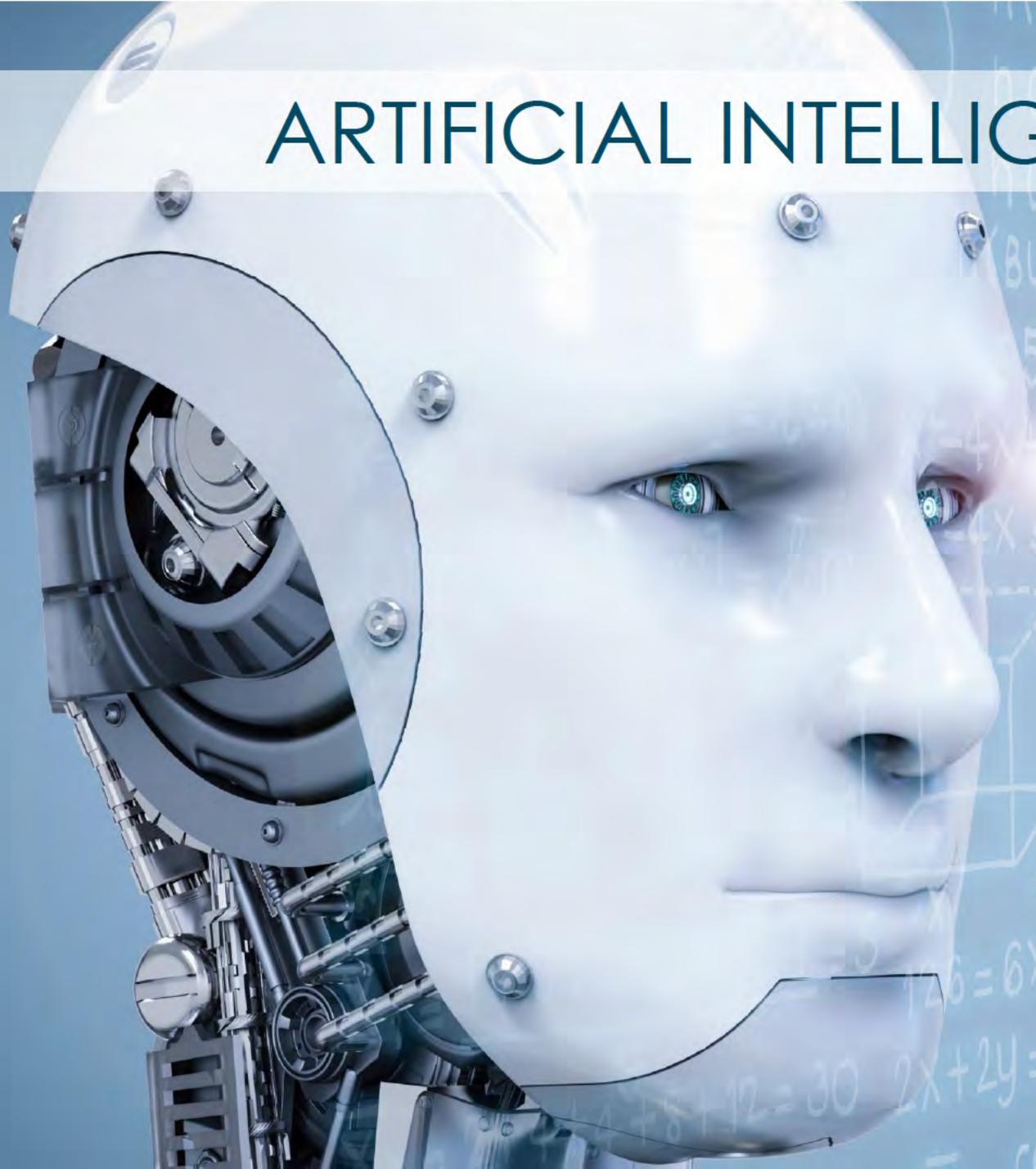


ePAL CLINICAL RESULTS

Median Pain Severity levels (BPI Severity): Control vs. Intervention



ARTIFICIAL INTELLIGENCE



Background mathematical and scientific formulas:

- $f = \{(x, y) \in \mathbb{R}^2 \mid x = a^y, a > 0, a \neq 1\}$
- $n = 360^\circ / \theta - 1$
- $z_1 = a \frac{|D_1 B_1| - b |D_1 A_1|}{|D_2 B_2| - b |D_2 A_2|}$
- $4 \frac{10}{15} - 4 \frac{2}{5} + 5 \frac{1}{3} = \frac{(15 \times 4) + 10}{15}$
- $\sqrt{a^3} \sqrt{a} = \sqrt{a \cdot a^3}$
- $= \sqrt{a^3 \cdot a^1}$
- $\sqrt{5 + \sqrt{24}} = \sqrt{5 + \sqrt{4 \cdot 6}}$
- $a_n = \frac{1}{2^{n-1}} = \frac{1}{2^{10-1}}$
- $v = \frac{1}{3} \pi r^2 h$
- $A = \pi r^2 h$
- $\lambda = \frac{2l}{n} \quad v = \frac{T}{\sqrt{\mu}}$
- $2Cr(OH)_4 + 20H^+ + 3H_2O_2 \rightarrow 2CrO_4^{2-} + 8H_2O$
- $SO_4^{2-} + Cr_2O_7^{2-} + H_2O$
- $2CrSCN^{2+} + Cl_2 + H_3O^+ \rightarrow 2Cl^- + NO_3^- + CO_2 \uparrow$
- $MO_3S_7 + 8NO_3^- \rightarrow MO_3 + 7O$
- $E = mc^2 \quad g = 6m_e$
- $O: 3y = 16 + y + \frac{x}{2}$
- $MO_3S_7 + 8NO_3^- \rightarrow MO_3 + 7O$
- $2CrSCN^{2+} + Cl_2 + H_3O^+ \rightarrow 2Cl^- + NO_3^- + CO_2 \uparrow$
- $SO_4^{2-} + Cr_2O_7^{2-} + H_2O$
- \vec{v}_1
- n_1
- \vec{v}_2

BIGGER THAN WHAT HUMANS OR
TECHNOLOGY CAN ACHIEVE ALONE



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AI ALONE: 92%



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AI ALONE: 92%

HUMANS ALONE: 96%



BIGGER THAN WHAT HUMANS OR TECHNOLOGY CAN ACHIEVE ALONE

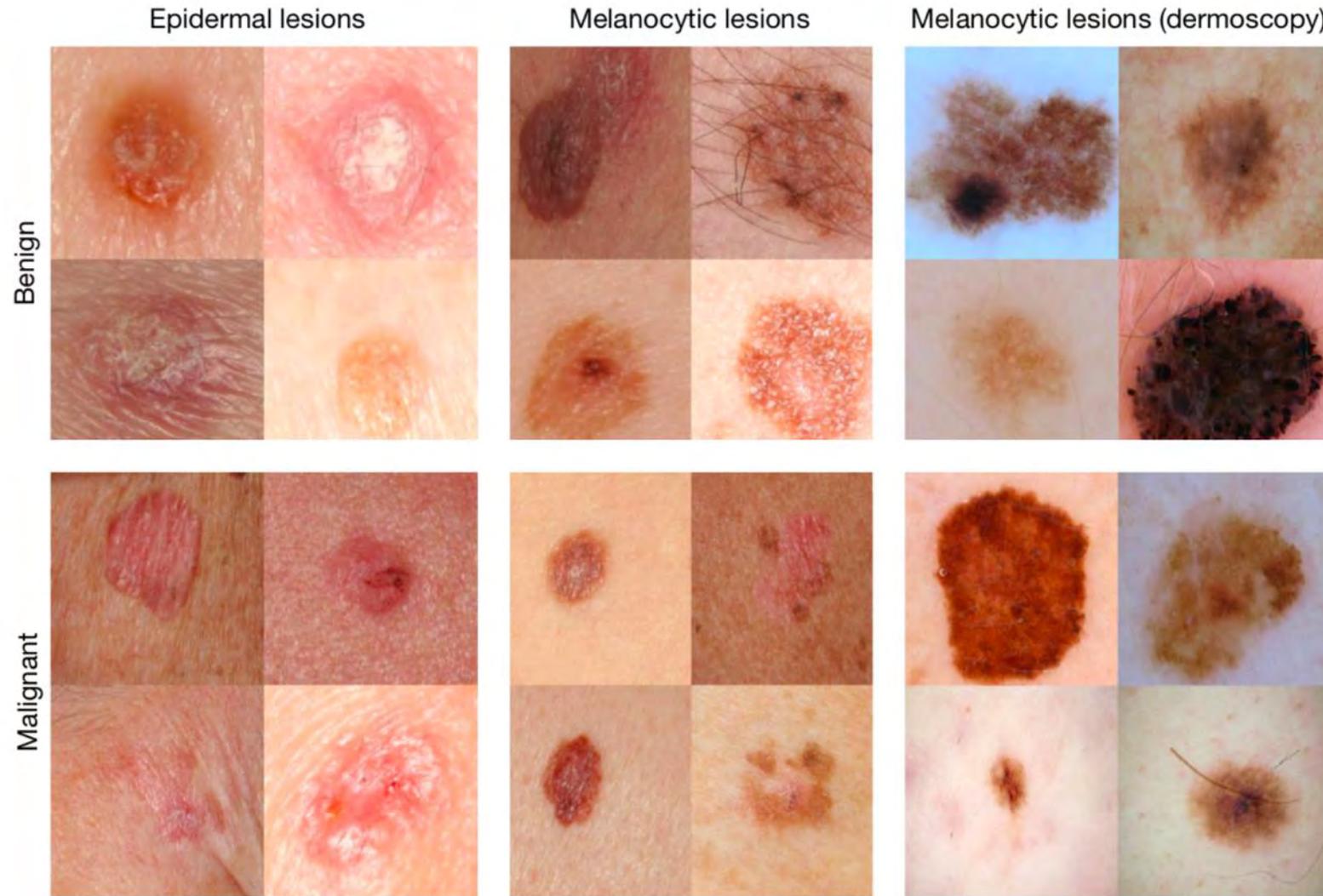
AI ALONE: 92%

HUMANS ALONE: 96%

AI + HUMANS: 99.5%

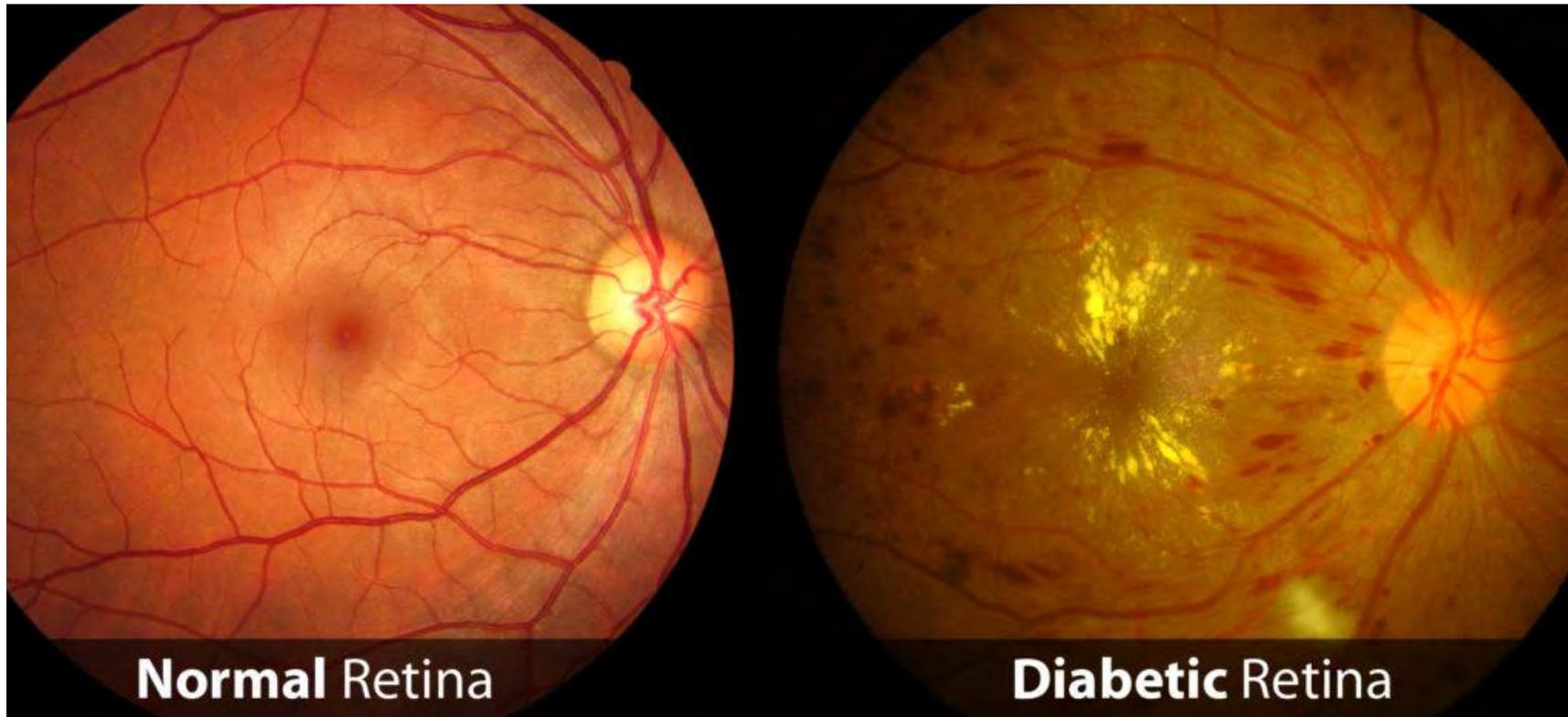


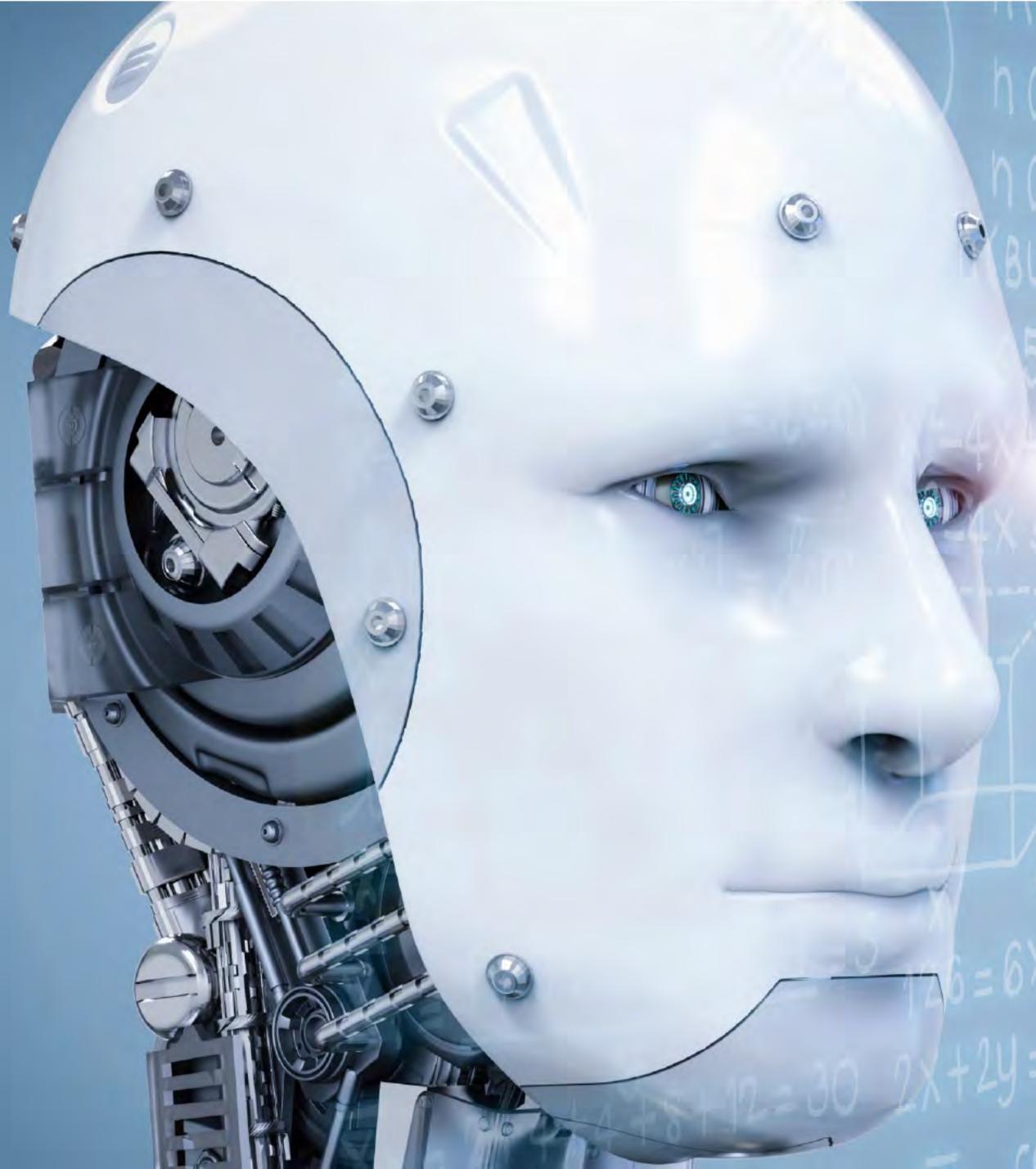
Dermatology: Deep neural network classifies skin conditions *as well as* a dermatologist



Ophthalmology: Deep learning system detects diabetic retinopathy across multiethnic population

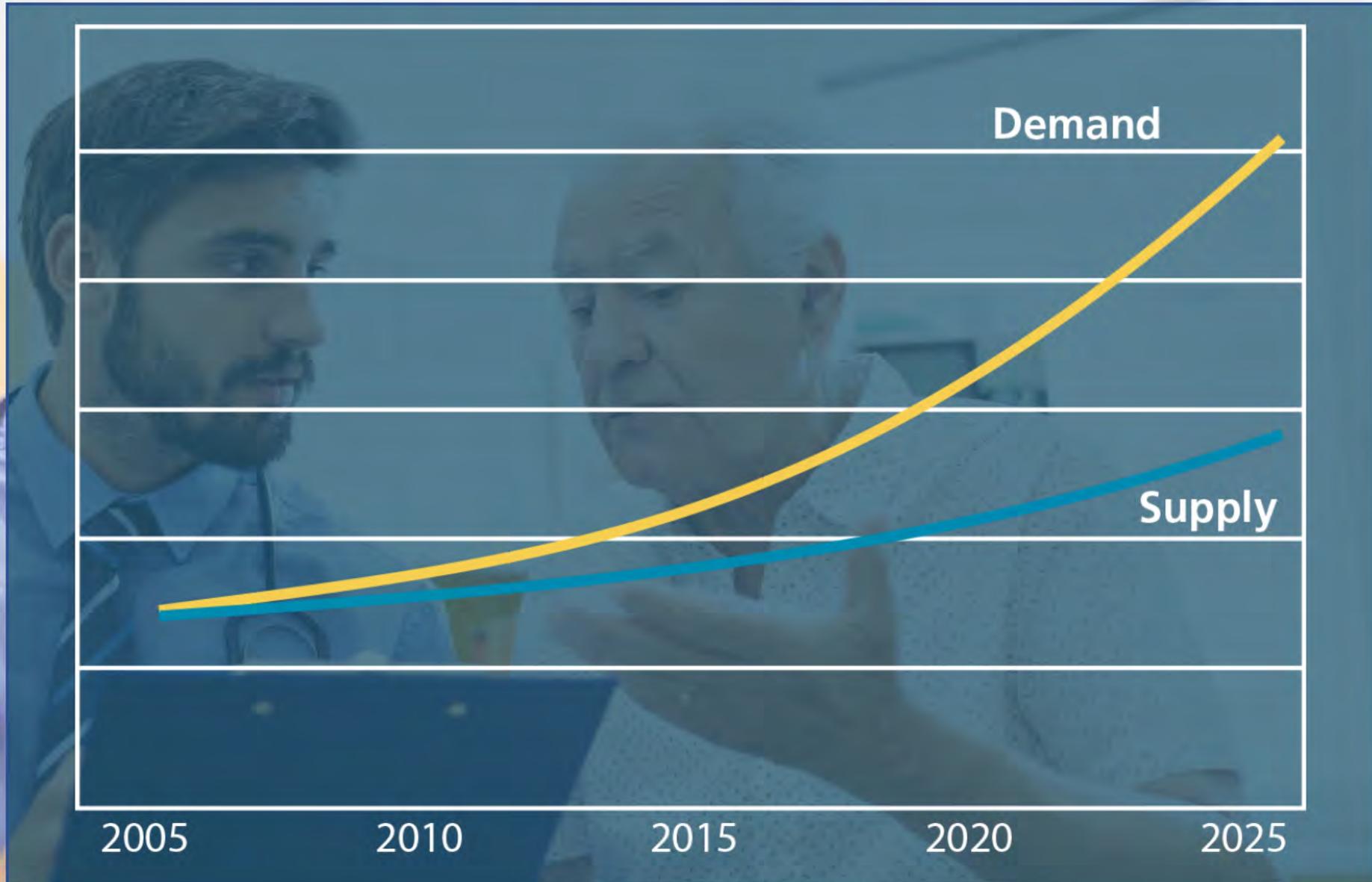
The Deep Learning System had high sensitivity and specificity for identifying diabetic retinopathy and related eye diseases using retinal images from multiethnic populations with diabetes.





HOW WILL WE REGULATE AI?

RATIO OF PROVIDERS TO PATIENTS



A photograph of two men in an office setting. On the left, an older man with grey hair, wearing a white lab coat over a light blue shirt and a dark patterned tie, is seated and gesturing with his hands while speaking. On the right, a younger man with reddish-brown hair, wearing a red and blue plaid shirt, is seated at a desk, looking towards the older man. The desk has a computer monitor, a keyboard, and a mouse. The background shows a window with blinds and a door. A semi-transparent white banner with blue text is overlaid across the middle of the image.

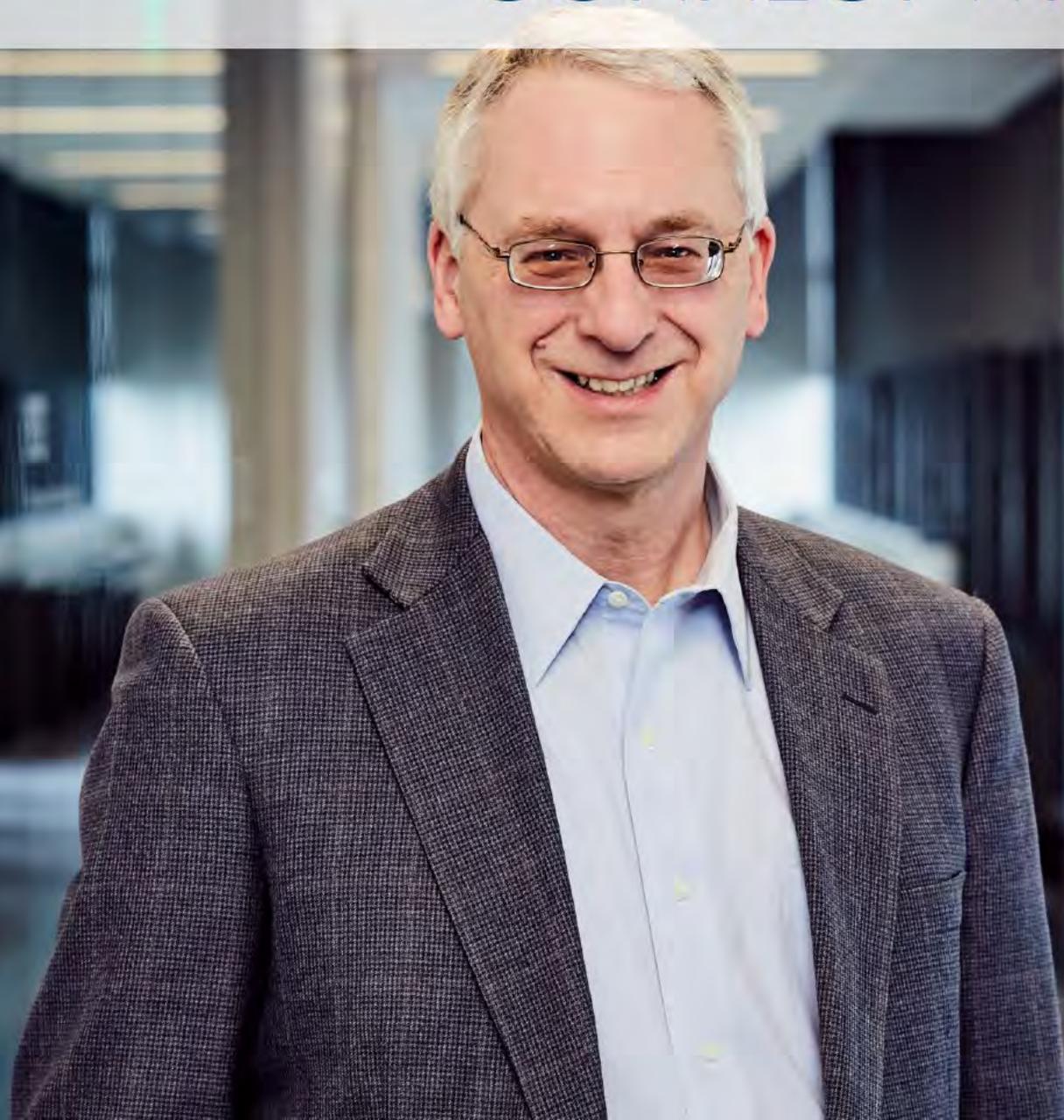
THE TECHNOLOGY GENIE IS OUT OF THE BOTTLE

A photograph of a doctor in a white lab coat and tie sitting at a desk, gesturing with his hands while talking to a younger man in a red and blue plaid shirt. The doctor is on the left, and the patient is on the right. The background shows a computer monitor and a window. A semi-transparent white box is overlaid on the image, containing text.

THE TECHNOLOGY GENIE IS OUT OF THE BOTTLE

A new regulatory framework that accepts time and place independent care delivery, but maximizes patient safety is required

CONNECT WITH ME



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