Jonathon D. Truwit, MD, is Enterprise Chief Medical Officer (CMO) for Froedtert Health and Senior Administrative Dean for the Medical College of Wisconsin. He is a Professor in Pulmonary and Critical Care Medicine. His research interests are NIH supported and focused in ARDS and weaning from mechanical ventilation. Prior to these positions he was CMO and Senior Associate Dean for Clinical Affairs at the University of Virginia. His education includes a Bachelor's degree in Biomedical Engineering at Duke University, Doctoral degree from Georgetown University in Medicine and a Master’s degree at University of Virginia in Business and Administration. His internship in Medicine and pulmonary fellowship were at Vanderbilt University.

OBJECTIVES:
Participants should be better able to:

1. The participant will gain an understanding of digital revolution in healthcare - Why, How and What

2. The participant will gain an understanding of how this impacts
The Digital Revolution is Upon Us

Jonathon Truwit, MD, MBA
Professor of Medicine
Pulmonary and Critical Care Medicine
Froedtert Health & Medical College of Wisconsin

Objectives

• The participant will gain an understanding of digital revolution in healthcare
  • Why, How and What
• The participant will gain an understanding of how this impacts PCCM
No Disclosures but Yes Disclaimers

• I did not include sleep or insomnia
  • Hey I am ICU guy – we don’t sleep
• I am not a techie and I did not sleep at a Holiday Inn Express last night
• When it comes to consumerism consumers and businesses do not wait on p values. So are providers with transition from volume to value.
  • Open for effectiveness research

Drop your hand at your first NO answer

• Have you used and ATM?
• Have you used a smart phone as a camera?
• Have you ordered from Amazon?
• Have you or a family member used MyChart or equivalent?
• Have you been on either end of a virtual video visit?
Digital Pace of Change

- Health Care is crossing over to **digital**
  - Records, testing, delivery of care, treatments, research, experience
- Venture Capital inflows (Google, Apple, Amazon, etc)
  - $10 Billion in investment in first half of 2017
- AI changing what is possible exponentially

“When I tried to renew my healthcare plan, it was so expensive I had to get rid of two kids.”
1958

22.7 Days

Cost = days of median wages

2012

3.9 Days

8.5 Days

Cost = days of median wages
2012

63.7 Days

Cost = days of median wages
Baby boomers: the gray wave

- By 2030, boomer generation to account for 21% of U.S. population
- 60% growth in Medicare population varies by state, ranging from 33% to 85%
- 25 states projected to increase by >50%
- Over 4.6 workers per Medicare beneficiary in 1965 drops to 2.4 in 2030
- Funding will require incremental payroll taxes on increasingly leveraged workforce
The Experience Economy

- People hire products and services to solve their problems
- Expectations rise with experience they gain in other industries
- Transition to individual consumers/patients at the center vs. clinicians
Which would convince patients most to use health apps?  - Choose two

A. Be free of charge
B. Provide trustworthy data
C. Provide guarantees that my personal data is secure
D. Easy to use, simple, well designed
E. Contain no advertisements
What would patients rate as the most important service health apps should provide? **Choose One**

A. Help me track my medical symptoms
B. Allow me to examine my health records/medical tests online
C. Help me communicate with my doctor/nurse
D. Give me understandable info on symptoms/medical conditions
E. Allow me to comment about or rate local healthcare services
**Question 2 (Truwt) - What would patients rate as the most important service health apps should provide? (Choose ONE)**

- A. Help me track my medical symptoms
- B. Allow me to examine my health records/medical tests online
- C. Help me communicate with my doctor/nurse
- D. Give me understandable info on symptoms/medical conditions
- E. Allow me to comment about or rate local healthcare services

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**Figure 7. What do patients and carers want from health apps?**

<table>
<thead>
<tr>
<th>Feature of Health Apps</th>
<th>Want to Use Regularly (%)</th>
<th>Most Important Service (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide2 EasytoComprehensible Information</td>
<td>69</td>
<td>23</td>
</tr>
<tr>
<td>Be easy to use</td>
<td>66</td>
<td>17</td>
</tr>
<tr>
<td>Be free of charge</td>
<td>62</td>
<td>16</td>
</tr>
<tr>
<td>Provide guarantees that my personal data is secure</td>
<td>56</td>
<td>14</td>
</tr>
<tr>
<td>Contain no advertisements</td>
<td>51</td>
<td>13</td>
</tr>
<tr>
<td>Work effectively and consistently over time</td>
<td>44</td>
<td>7</td>
</tr>
<tr>
<td>Not expensive to buy, and provide value for money</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td>Allow me to network with other people important to me</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>Be packed with detail (I don’t mind complex apps)</td>
<td>23</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: PatientView survey of 1,110 people with a long term condition, 2016
Health provider view

Benefits of digital health for providers

- Minimizes paperwork
- Improves outcomes
- Promotes patient independence
- Focuses on prevention

Patient view

Patients single most important use of health apps

- 2nd: 17%
- 1st: 23%
- 3rd: 16%

Factors that increase the use of health apps:
- Trustworthy, accurate data: 63%
- Ease of use, simplicity and design: 66%
- Guarantees of data security: 62%

Evidence of health technology benefit for providers

- Mobile working solution for community nurses: -60%
- Patient face time: +29%
- 2 extra patients seen daily

Evidence of health technology benefit for patients

- 75% of the UK population goes online for health information

Patients using technology to manage their COPD:

- 97% high satisfaction
- 62% increased confidence
- 94% better treatment compliance

Deloitte
PatientWisdom: Moving forward. Together.

PatientWisdom is an online platform that improves the experience and delivery of care by collecting, analyzing, and sharing information about what matters to patients.

↑ communication
↑ patient experience
↑ provider engagement
↑ reimbursement / outcomes
Physician and care teams need a quick reliable way to learn about patients as people.

Physicians and care teams are busier than ever, making it hard to connect with patients.

- 15 Minutes per patient\(^1\)
- \(\frac{2}{3}\) Of time is spent on paperwork\(^2\)
- 54% Experience at least one symptom of burnout\(^3\)

PatientWisdom: Moving forward. Together.

How It Works

- Patients, families, and caregivers use PatientWisdom to share stories and brief videos about themselves, their health, and their care.
- **For Providers:** PatientWisdom runs analytics on the data collected, and packages it into actionable, intuitive, visualizations with access to patient-level detail.
- **For Patients:** PatientWisdom makes it easy to search, filter, and view highly indexed content, and to connect with others facing similar challenges.
Early results: Doing better without taking longer

90% of patients say PatientWisdom improves communication with doctors who use it

< 20 seconds time it takes for busy providers to read the inSIGHT summary before seeing a patient

95% of visits using the inSIGHT summary were rated as going 'extremely well', a significant improvement

82% of providers confirm that PatientWisdom helps them know what’s important to their patients

"By using PatientWisdom, I’m giving a gift to my doctor. And to myself. My doctor has an easy way to learn what’s important to me, so I get better care."
- Patient, February 2017

"It would take me 45 minutes to get all of this information."
- Physician, July 2017

Image of Jackie Sample: 10/18/2018

Patient Wisdom

PROPRIETARY AND CONFIDENTIAL – NOT FOR DISTRIBUTION

patientwisdom.com
From: Effect of Reminder Devices on Medication Adherence: The REMIND Randomized Clinical Trial

JAMA Intern Med. 2017;177(5):624-631
Different approaches to reminders + adherence

Companies are taking different approaches to adherence, from smart pillboxes and bottles, to leveraging the smartphone and machine vision, to creating ingestible sensors that monitor pills.
THE FIRST COMPUTER POWERED BY YOU

Cleared by U.S. FDA, CE Marked in Europe
Designed to be combined with drugs
Supported by technology and data platform

1. Clinic/Prescriber
- Writes/orders, submits prescription

2. Compounding Pharmacy
- Receives, bills, compounds, delivers prescription

3. Patient or Clinic
- Receives Prescription

Proteus Ingestible Sensor + Medication → Co-encapsulation

COMPUTER INGREDIENTS
Silicon: 0.9mg - Bananas have 5mg per 100 grams
Copper: 0.02mg - Cashews have 2.3mg per 100 grams
Magnesium: 0.5mg - Haddock has 10mg per 100 grams
**Interim analysis Jan 5 2016**

**Study Population (n=99)**
- Failed multiple medications
- Elevated lipids
- Diabetes duration = 10 years
- Mean age = 58, 31% 65+
- 56% earn <$20k/year
- 29% <high school
- 43% Hispanic
- 15% African American
- 22% psychiatric comorbidities

- 85% patch adherence
- 83% Rx adherence
- Physician interventions (counseling, med changes, etc.): 95.8% Proteus; 37.5% UC
- Net promoter score = 62%

<table>
<thead>
<tr>
<th>Effect: Week 4 after 4 weeks</th>
<th>Discover</th>
<th>Change in SBP(^1) (mm Hg)</th>
<th>Change in LDL(^2) (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-22.1</td>
<td>-3.0</td>
</tr>
<tr>
<td>Durability: Week 12 after 4 weeks Discover</td>
<td>69% at BP Goal</td>
<td>-12.9</td>
<td>-1.1</td>
</tr>
</tbody>
</table>

More Effect: Week 12 after 12 weeks Discover: 97% at BP Goal

-24.6  -4.5  -0.3

-25.2  -4.5  -0.3

-20.1  -2.9  -0.2

Interim results; final results may change

*For patients with elevated lipids on a statin*

N=33 for both A1c analyses

N=96, N=41, N=54 for BP analyses (from top to bottom)

1N=41, N=54 for BP analyses (from top to bottom)

2For patients with elevated lipids on a statin

3N=33 for both A1c analyses
60% improvement seen in 495 patient randomized controlled clinical study.

Severe asthma population (adult asthma)
Rescue inhaler user per day
**Difference in direct asthma costs per year**

($ studies, n=152, 432$)

<table>
<thead>
<tr>
<th>Study</th>
<th>Cost ($/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zeiger et al., 2006</td>
<td>855</td>
</tr>
<tr>
<td>Silver et al., 2010</td>
<td>739</td>
</tr>
<tr>
<td>Ibrahim et al., 2010</td>
<td>893</td>
</tr>
<tr>
<td>Sullivan et al., 2007</td>
<td>1,481</td>
</tr>
<tr>
<td>Geelhoed et al., 2019</td>
<td>1,359</td>
</tr>
</tbody>
</table>

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**Education of Patients**

**Proper use of inhaler**

**Air Quality Assessment**

**Online Patient Forums**

**Support Medical Providers**

**Efficient Communication**

**Disease and Treatment**

**Physiology**

**Lifestyle**

**Environment Air Quality**

**Holistic Personalized Models of Respiratory Health**

---

Dr. Votis Konstantinos¹, Dimitrios Kikidis¹, Dr. Dimitrios Tzovaras¹, Dr. Omar S. Usmani²
Propeller for COPD

- 198 patients
- 78% were 60 or older and
- 66% were female.
- 53% White, 44% Black, and 3% other.
- 97% transmitted data via wireless hub.
- After 6 months, SABA use decreased from 1.53 (first week) to 0.74 uses/person/day (last week), a significant reduction of 51.7% (p<0.01).

Chen et al. Am J Respir Crit Care Med 2017;195:A1722
<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Value</th>
</tr>
</thead>
</table>
| **Patients**        | • Provides clinically-validated CBT with actionable learning modules  
                      • Facilitates asynchronous support through self-care process (with the ability for synchronous access)  
                      • Facilitates movement to different care modules based on system’s monitoring and tracking of self-care progress |
| **Providers**       | • Increases opportunity to manage mild mental health diagnoses without referring to 1:1 specially visits, often delaying treatment |
| **Mental Health Providers (MHPs)** | • Builds capacity for MHPs to see high acuity patients  
                      • Creates care plans that often require fewer 1:1 patient visits than traditional clinical processes  
                      • Allows for insight into patient mental health journey through progress reports |
| **Health Systems**  | • Screens and triages patients in need of mental health resources  
                      • Prevents future ED visits, acute admissions or acute readmissions for at-risk populations  
                      • Builds capacity for providers to dedicate more time for high acuity patients |
Access

- 10-fold reduction in waiting time for access to mental health treatment\(^1\)
- Average waiting time for mental health treatment down from 90+ days to 8.8 days
- On track to deliver over 400,000 online-supported sessions in 2016

Engagement

- 3x the average engagement when compared with other digital solutions\(^2\)
- Program drop-out rate of 36% (status quo: ~80%)\(^2\)
- Clinical studies show that average patient completes 14.7 CBT sessions\(^4\)

Outcomes

- Recovery rates between 57-62% (status quo: 45%)\(^2\)
- Severe BDI (Beck Depression Index) score drops from 50% pre-intervention to 11% post-intervention\(^3\)
- 50% patients enter total remission stage

Number of Clients: 273

Details of Users' Sessions

- Average number of sessions per user: 5.5
- Average total time: 1:31.8
- Average time of session: 0:16.43
- Average reviews per user: 4.0
- % of clients caseness: 36.99%
- % of them recovered: 47.10%
- % of them showing reliable change: 54.9%
- % of them reliably recovered: 34.31%

Progress Points Summary

- S Agree
- Agree
- Disagree
- S Disagree

\(^1\) 7/10/17-2/28/18
\(^2\) FMCW pilot
\(^3\) 7/10/17-2/28/18
Disrupting brick and mortar primary care

Primary care has clear benefits
A meta-analysis of 30 studies on primary care found

1. Reduced utilization of healthcare services
2. Overall cost decrease
3. Better long-term health and/or feelings of wellness

Retail Clinics
Urgent Care
Direct Primary Care/Concierge
Home Diagnostics/Monitoring
Telemedicine
Medication Management
Retail Healthcare Clinics

• CVS Health’s Minute Clinics
• Walgreens
• The Little Clinic (Kroger)
• Meijers
• Amazon
• Apple

Targeting millennials - disposable cash for convenience
How One Medical works

**Membership and insurance**
We accept most insurance plans and bill your carrier directly for office visits and other in-office services. Your membership fee enables us to provide additional services, including our app.

**Our members enjoy:**
- Warm, inviting offices to make you feel comfortable
- Unlimited contact with providers using secure messaging
- Mobile app for prescription renewals, appointment scheduling, on-demand video visits, and vaccine and medication history
- Select lifestyle and wellness programs
- Help with insurance billing, specialists' referrals, and hospital admissions as needed to better health over time.

Just ask the hundreds of thousands of One Medical members who experience these benefits every day.

---

Top performance in quality and downstream cost reduction

- **90th percentile** HEDIS scores
- **100%** NCQA-informed access to care scores

<table>
<thead>
<tr>
<th>Metric</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>39% fewer ER visits</td>
<td>39% fewer ER visits</td>
</tr>
<tr>
<td>32% fewer inpatient days</td>
<td>32% fewer hospital admissions</td>
</tr>
</tbody>
</table>

**Top three reasons people recommend One Medical**

1. Provider quality
2. Patient experience
3. Service & support
Retail Clinics
Urgent Care
Direct Primary Care/Concierge
Home Diagnostics/Monitoring
Telemedicine
Medication Management

MedNow
Primary Care
- Virtual
- eVisits

Spectrum Health

<table>
<thead>
<tr>
<th>What We Treat</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acne</td>
<td>Heartburn</td>
</tr>
<tr>
<td>Allergies (Seasonal)</td>
<td>Nausea/Vomiting</td>
</tr>
<tr>
<td>Back Pain (New Onset)</td>
<td>Pink Eye</td>
</tr>
<tr>
<td>Birth Control</td>
<td>Rash/Hives</td>
</tr>
<tr>
<td>Bites &amp; stings</td>
<td>Sinus problems</td>
</tr>
<tr>
<td>Constipation</td>
<td>Sleep Concerns/Insomnia</td>
</tr>
<tr>
<td>Cough, Cold &amp; Flu</td>
<td>Sore throat</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Sprains &amp; Strains</td>
</tr>
<tr>
<td>Ear ache/pain</td>
<td>Tooth pain</td>
</tr>
<tr>
<td>Eye irritation</td>
<td>Urinary problems</td>
</tr>
<tr>
<td>Fever</td>
<td>Women’s health issues</td>
</tr>
<tr>
<td>Headache</td>
<td></td>
</tr>
</tbody>
</table>
### Spectrum Health

<table>
<thead>
<tr>
<th>Specialty MedNow</th>
<th>Breastfeeding MedNow Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn how we partner with specialties throughout Spectrum Health to bring care closer to home.</td>
<td>Using a webcam from the comfort of your own home, you can talk to a lactation peer counselor.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MedNow at Work</th>
<th>MedNow Travel Consultations</th>
</tr>
</thead>
</table>

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**MedNow is currently working with:**

<table>
<thead>
<tr>
<th>Bariatrics</th>
<th>Orthopedics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioral Health</td>
<td>Pediatrics</td>
</tr>
<tr>
<td>Bone Marrow Transplant</td>
<td>Post-Acute</td>
</tr>
<tr>
<td>Cardiology</td>
<td>Pulmonary</td>
</tr>
<tr>
<td>Care Management</td>
<td>Sleep</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Surgical Services</td>
</tr>
<tr>
<td>Infectious Disease</td>
<td>Vascular</td>
</tr>
<tr>
<td>Hospitalists</td>
<td>Women's Health</td>
</tr>
<tr>
<td>Oncology</td>
<td>Wound</td>
</tr>
</tbody>
</table>
Telemedicine helps hospitals...

...EXTEND PHYSICIANS

**Bright.md**

*Increase Capacity*
- Increase provider panel size by 30% — with no additional staff or facilities
- Care for more patients by helping your providers work smarter, not harder
- Creative care day openings for complex and high needs patients
- Emergency and convenience appointments provided and covered

...ACCESS SPECIALISTS

**Avizia**

*Patient Care at Risk Due to Limited Access to Specialists*
- Patient data
  - 24 hours a day
- CMS utilization
  - 70% reduced
- US healthcare
  - $1,233 per month

...MANAGE CHRONIC DISEASE

**CHIRON HEALTH**

*Medicare CCM Program*
- The new Chronic Care Management Program reimburses providers $42.30 per month for 20 minutes of clinical staff time spend on patients with two or more chronic conditions. In a year, practitioners can earn upwards of $200,000 in additional revenue.
- Telemedicine is ideal for taking advantage of the CCM program.

Genomics is blurring the line of diagnostics and prediction

23andMe forced the FDA to create a classification for predictive diagnostics. This allows people know their risks in advance and allows companies establish direct relationships with these patients.
IMPRECISION MEDICINE

For every person they do help (blue), the ten highest selling drugs in the United States fail to improve the conditions of between 3 and 26 people (red).

1. ABRILIT (aripiprazole) Schizophrenia
2. NEURON (neurontin) Neuropathy
3. HUMIRA (adalimumab) Arthritis
4. CREOSTRA (creon) High cholesterol
5. CYMBALTA (duloxetine) Depression
6. ADDERALL DISK (methylphenidate) ADHD
7. ENHREL (etanercept) Arthritis
8. REMICADE (adalimumab) Crohn’s disease
9. COPAXONE (glatiramer acetate) Multiple sclerosis
10. NEULASTA (pegfilgrastim) Neutropenia

Based on published data needed to treat (IMT) target. For a full list of references, see supplementary information at go.washington.edu/IMT.
Interstitial Lung Disease that is UIP
Genomic Classifier of Surgical Lung Biopsy

- UIP from non-UIP
- Pathologic diagnoses by SLB – 125 cases
- RNA sequence data from SLB samples
- Genomic classifier trained on 77 samples
- Genomic classifier validated on 48 samples

Genomic Classifier of TBBx

- UIP from non-UIP
- Pathologic diagnoses by 3 pathologists from SLB, TBBx or cryobiopsy
- RNA sequence data from TBBx
- Genomic classifier trained and validated against pathologic biopsy

Training set (53 pts, 170 TBBx)
Validation set (31 patients, 113 TBBx)


Google’s algorithms are matching doctors

“\textit{The results show that our algorithm’s performance is on-par with that of ophthalmologists.}”

Performance of the algorithm (black curve) and eight ophthalmologists (colored dots) for the presence of referable diabetic retinopathy based on 9,000+ images.
Enlitic applies the state of the art in deep learning technology to medicine.
The performance of the leading submission by a team from Harvard/MIT is significantly better (AUC of 0.99) than the human benchmark (AUC of 0.96).

Detection of Breast Cancer Metastases

COPD and Pulmonary Rehab

• Single Most important intervention that improve quality of life and reduce cost associated with COPD.
  • Improves patients quality of life & reduce symptoms of Breathlessness.
  • Reduces hospital admission by up to 30%.
  • Reduces Length of Stay during hospital admission by up to 50%.
  • Reduces hospital re-admission rates by up to 30%.

• Only 10 – 15% patients Receive PR due to Costs and shortage of Healthcare professionals.
PRinVR: Pulmonary Rehab in Virtual Reality

Virtual Reality Delivered, Artificial Intelligence Powered Therapy. We call the concept The 5th Therapist!

Premises based – Supervised PR

• Key Benefits
  • Supervised – led by Physiotherapist.
  • Patient exercise performance is measurable.
  • Social benefits to patients – peer support.

• Key Disadvantages.
  • Premises based – Patients have to travel (Date & Time specific.)
  • Most expensive for both patients and healthcare providers.
  • Limited availability due to shortage of Healthcare professionals.
  • Up to 50% drop-out. (Time & day specific.)
  • Difficult for patients with Mental health conditions such as anxiety.

Cost

£ £ £
Home based – Non-Supervised

• Key Benefit.
  • Patient can participate in PR Program.
  • Delivered via, DVD or Laptop / Mobile app.
  • Cost effective to deliver.

• Key Disadvantages.
  • Not-supervised.
  • No way to measure compliance
  • No ability to measure exercise performance.

Cost

Patients Perspective & Skills Needed
We provide products and services that allow you to age gracefully at home.

Services can include:
- Robotics,
- Health monitoring,
- ADL support,
- Home modification,
- Memory Support.
Filling the health services void with robots

Home robots can help assist elderly patients with managing dementia, medications, and even provide companionship.

intuition robotics

"You can't list your iPhone as your primary-care physician."