Digital Medicine R&D in Low-Resource Settings

Wednesday, December 8 at 11am-12pm ET
Housekeeping

• **This session will be recorded**
  • Slides and recording will be available on DiMe’s webinar page after the session

• **Ask questions!**
  • ‘**Raise your hand**’ in the Reactions and the moderator will unmute you, or
  • **Type your question** in the chat box
Digital Medicine R&D in Low-Resource Settings

Wednesday, December 8 at 11am-12pm ET

Santosh Shevade
Healthcare Consultant

Brinnae Bent, PhD
Digital Health Data Scientist
Edge Analytics

Amy Sheon, PhD, MPH
Digital Health Equity Consultant
Public Health Innovators, LLC

Prof Christopher James
Dir. Biomedical Engineering Institute
University of Warwick

Isaac Rodriguez-Chavez, PhD, MHS, MS
SVP, Scientific & Clinical Affairs
ICON
Moderator
DiMe Research Committee

DiMe Research Committee Members

- Isaac Rodríguez-Chavez, PhD, ME.Sc, MD, CCM; Indie Research Scholar
- Benjamin Vandendriessche, PhD; Senior Scholar
- Brinnae Benti, PhD; Senior Scholar
- Charmaine Demosthenes, PhD; Senior Scholar
- Céline Vetter, PhD; Senior Scholar
- Christopher James, PhD; Senior Scholar
- Cindy Groggeman; Senior Scholar
- Elizabeth (Beth) Kunkowski; Senior Scholar
- Amy R. Sheon, PhD, MPH; Public Health Innovators, LLC
- Yassaman Demosthenes, PhD; Vadic Innovators
- Jordan Silverman, MD, PhD; M.I. P.I.

Source: https://www.dimesociety.org/research/dime-research-committee/
Santosh
Why are we talking about Digital Medicine in Low-Resource Settings?
Most impact areas of digital medicine match the needs in low-resource settings

- Efficient resource utilization
  - Financial
  - Human Resources
  - Infrastructure
- Optimal care delivery
- Affordability
- Learning Systems and Knowledge Management

...and more
Through our research group’s initial work, we see a different picture so far
Paucity of systematic strategy design implementation for many digital medicine innovations

DiMe’s own work shows that research related to digital clinical measures not keeping pace with the rapid expansion & adoption of digital sensing products.

This lack of evidence gathering in ‘normal’ settings continues to have domino impact on low-resource settings.
Qualitative feedback received from the field suggest a worrying picture

- **Entrepreneurs** interested in designing/piloting/implementing digital medicine in low-resource settings face further fragmented picture of funding, regulations, and commercialization challenges.

- **Clinicians** in low-resource settings have clear ideas of what could be needed in field but are often not approached at all/only approached at later stages

- **User/patient** involvement has been nil/quite minimal and only empirical feedback is being collected.
Not all is lost!

- **Health** authorities and governments are taking more active role
- **WHO** recently released a compendium innovative health technologies for low-resource settings 2021, which include interesting examples of digital medicine intervention products
- **DiMe** has been working actively in this field including it’s work on Health Equity and Access Leadership (HEAL) Coalition.
We will continue to review this field, and push for more action!

- Our research group will continue to study the field, bring further insights from the field and ultimately aiming to provide practical tools for design, strategy and implementation of digital medicine in low-resource settings
Comprehensive foundational evaluation framework for BioMeTs (Biometric Monitoring Technologies) incorporating V3 (Goldsack, et.al. 2020) and U3 (utility, usability, user experience).

A primary focus for the group has been on incorporating EDI (equity, diversity, and inclusion) into the U3 framework.

Team Members: Smit Patel, Sarah Valentine, Sunil Soni, Ninad Gujar, Ryan Bolick, Emre Sezgin, Elena Izmailova, Julien Dumail, Ben Vandendriessche, and Isaac Rodriguez-Chavez
What is usability?

Usability is concerned with the “effectiveness, efficiency and satisfaction with which specified end users achieve specified goals in particular environments” (ISO 9241-11)

- Is the digital medicine product safe to use?
- Is the digital medicine product easy and intuitive to use?
- Do the end user(s) like the way the product is designed, looks, and feels?
- Does the digital medicine product impede in any way daily living?
What is utility?

Utility refers to whether a digital medicine product has appropriate features to meet the needs of end users.

Is the digital medicine product useful to the end user(s)?

Does the BioMeT meet the needs of the end user(s)?
What is user experience (UX)?

User experience (UX) is concerned with all aspects of the end user’s level of satisfaction when interacting with the product.

Is the BioMeT desirable - do end user(s) want to use it?

Does the end user(s) feel good about the BioMeT and the company/brand that makes it?
U3 considerations in low-resource settings

- Dependence on smartphones (BLE)
- Access to broadband internet
- Digital literacy
- Language barriers
- Lack of trust in technology
- Vulnerable populations (people with disabilities, older adults, children)
- Abandonment of wearables is 30% in the first 6 months
What can the digital medicine community do to make U3 R&D more inclusive and accessible in low resource settings?

- **Intentional workflows and training programs**
- **Design linguistically and culturally tailored products**
- **Leverage more diverse user personas during R&D + usability testing**
- **Promote evaluation of technologies with a focus on equity as a value measure to drive investment decision-making**
- **Engage with users as early as possible in the design process**
- **Rigorous standardization of evaluation (V3 + U3)**

*Promote evaluation of technologies with a focus on equity as a value measure to drive investment decision-making.*
Effect of Race & Income on Health

https://healthinequality.org/

https://www.jsi.com/racial-disparities-in-aging/
## Digital Inclusion as a **SUPER SDOH**

<table>
<thead>
<tr>
<th>Economic Stability</th>
<th>Neighborhood and Physical Environment</th>
<th>Education</th>
<th>Food</th>
<th>Community and Social Context</th>
<th>Health Care System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Income</td>
<td>Housing, Transportation</td>
<td>Literacy</td>
<td>Hunger</td>
<td>Social integration</td>
<td>Health coverage</td>
</tr>
<tr>
<td>Expenses Debt</td>
<td>Safety, Parks</td>
<td>Language</td>
<td>Access to healthy options</td>
<td>Support systems</td>
<td>Provider availability</td>
</tr>
<tr>
<td>Medical bills Support</td>
<td>Playgrounds, Walkability</td>
<td>Early childhood education</td>
<td>Vocational training</td>
<td>Community engagement</td>
<td>Provider linguistic and cultural competency</td>
</tr>
<tr>
<td></td>
<td>Zip code / geography</td>
<td>Higher education</td>
<td>Healthy options</td>
<td>Discrimination</td>
<td>Quality of care</td>
</tr>
</tbody>
</table>

### Social/Economic
- Employment Income
- Expenses Debt
- Medical Bills Support

### Behavior
- Housing, Transportation
- Safety, Parks
- Playgrounds, Walkability
- Zip code / geography

### Physical environment
- Literacy
- Language
- Early childhood education
- Vocational training
- Higher education

### Health care
- Hunger
- Access to healthy options
- Social integration
- Support systems
- Community engagement
- Discrimination
- Stress
- Quality of care
Device Ownership Disparities

Pew Research Center

Digital Access Disparities Reflect and Compound Impact of SDOH Disparities on Health Disparities
Digital Inclusion

Ensuring that all individuals and communities have access to digital tools and technology, and the skills to use them effectively.
Digital Equity for Digital Medicine

- Affordable Broadband Advocacy
- Monitor Use Equity
- Adopt User-Friendly Technology

- Community Partnerships
- Provider Encouragement

- Screen for Digital Readiness

- Connectivity
- Device
- Digital Skills

- Digital Navigator
  - Fill gaps or engage caregiver

- Needs Any
- Has All

Digital Medicine Unready

Digital Medicine Ready

- Provide design input
- Digital Health Coach
- Dig Med Skills
- Digital Medicine Use
- Tech Support
Learn More

Digital inclusion as a social determinant of health
Cynthia J. Sieck, Amy Sheon, Jessica S. Ancker, Jill Castek, Bill Callahan and Angela Siefer
npj Digital Medicine (2021) 4:52; https://doi.org/10.1038/s41746-021-00413-8

An Algorithm for Digital Medicine Testing: A NODE.Health Perspective Intended to Help Emerging Technology Companies and Healthcare Systems Navigate the Trial and Testing Period prior to Full-Scale Adoption
Amy R. Sheon, Brian Van Winkle, Yauheni Solad and Ashish Atreja

Improving Digital Literacy to Improve Telehealth Equity

Solutions for Connectivity and Hardware Barriers to Telehealth Equity from TEC Members

https://www.nature.com/articles/s41746-021-00413-8.pdf

https://www.karger.com/Article/FullText/494365

https://www.telehealthequitycoalition.org
Christopher to add slides here
Emerging model of healthcare creates a challenging framework

Old model of care:
- Focus on acute conditions, reactive management
- Hospital centred, disjointed episodes
- Doctor dependent
- Patient as passive recipient; self care infrequent
- Use of ICT rare

New model:
- Focus on long term conditions, prevention & continuing care
- Integrated with people’s lives in homes & communities
- Team based, shared record
- Patient as partner; self care encouraged & supported
- Dependent on ICT & devices
1.2 Million wheelchair users in England
1.2 Million wheelchair users in England

more than half will abandon the product / service
Observations

“We have no idea what the patient does outside the clinic; how the patient interacts with their tech on a daily basis.

Further, We do not truly understand the compliance with, and efficacy of, individually prescribed healthcare tech.”

AT and RT clinician interviews, UoW, 2016
wearable

consumer devices

Smart watch

smartphone

clothes

connected devices

fixed sensors

small

large

PORTABILITY

SIZE

tablet

laptop

computer
Hi, Mom and Dad! I'm e-mailing you a 3-D image of the baby I just took with the sonogram function.

These iPhones are amazing...
BIG DATA
IN A SINGLE DAY ONLINE

ENOUGH INFORMATION IS CONSUMED TO FILL
168 MILLION DVDS
294bn E-MAILS ARE SENT
MINUTES SPENT ON FACEBOOK 4.7M
2 MILLION BLOG POSTS ARE WRITTEN
VIDEO UPLOADED TO YOUTUBE 864,000 HRS
MORE IPHONES ARE SOLD THAN BABIES BORN
Where I've used electricity in the last 30 days

- Refrigerator: 6.2%
- Kitchen Counter: 1%
- Clothes Dryer: 9.5%
- Cooking Range: 6%
- Well Pump: 2.4%
- Bathrm + Mudrm: 1.1%
- Sewer Pump: 0.2%
- Home Office: 28%
- Kids BR + Basemt: 19.5%
- Bathrm Htr + Light: 0.5%
- Clothes Washer: 3.9%
- Mudrm + Sink Lt: 13.3%
- Livingroom: 2.6%
- Oil Boiler: 3.5%
- Dishwasher: 2.5%

Home Electricity Use

dryer
fridge
web server
outdoor lights
heater

energy now: £2.35 per hour
daily average: 8.02 kWh
Individualized condition signature

‘Tattoo’ Sensors
Measure: Motor, activity, cognitive, physiological

Wheelchair users
Older people
Prosthesis

Environment

Sensing & Data Acquisition Platform

Secure Transmission

Data Processing

Individualized Condition Signature

User

Clinician/Carer

Research Stakeholder

Adaptive Assistive Rehabilitative Technology - Beyond the Clinic
Conclusions: what is needed?
transforming healthcare of the future

- Changed mindset of end-users: patients & carers (policy makers)
- Not “patients” but end-users
- Pre-emptive efforts rewarded
- More integration with everyday technology (common language, standards)
- Agreed monitoring parameters (condition signatures)
Digital Medicine R&D in Low-Resource Settings

Wednesday, December 8 at 11am-12pm ET
Digital medicine and the curse of dimensionality

December 14th, 2021
11a ET
THANK YOU!

Want to present at a future DiMe webinar? Reach out to us!

Michelle@dimesociety.org

@_DiMeSociety

linkedin.com/company/dime-society