What is ACCORDS?

Adult and Child Center for Outcomes Research and Delivery Science

ACCORDS is a ‘one-stop shop’ for pragmatic research:

- A multi-disciplinary, collaborative research environment to catalyze innovative and impactful research
- Strong methodological cores and programs, led by national experts
- Consultations & team-building for grant proposals
- Mentorship, training & support for junior faculty
- Extensive educational offerings, both locally and nationally

ACCORDS Upcoming Events – mark your calendars!

Fall – Spring series	**Emerging Topics in Digital Health & Clinical Informatics**
Spring – Summer series	**Transforming and Advancing a Learning Health System: Multiple Perspectives for Mutual Gain**
Annual Workshop October 21 & 25	**Introduction to Qualitative Research Workshop** Registration open at https://medschool.cuanschutz.edu/accords Space still available for morning didactic sessions
Spring Workshop Dates TBD	**D&I Science for Researchers Workshop**
Spring Workshop Dates TBD	***New* Pragmatic Research Planning Workshop**
Annual Conference June 4-6, 2025	**Colorado Pragmatic Research in Health Conference** Future of Pragmatic Research: Building Multidisciplinary Teams for Innovation and Impact
→ Plus more!	

Emerging Topics in Digital Health & Clinical Informatics

2024-2025 Seminar Series

Presented by:
Susan L. Moore, PhD, MSPH

Topics and Trends in Digital Health

Topics and Trends in Digital Health

Susan L. Moore, PhD, MSPH

ACCORDS Mobile Health & Informatics Core Director

Department of Community & Behavioral Health,
Colorado School of Public Health

University of Colorado Anschutz Medical Campus

Session Summary & Objectives

- Introduction to core concepts and terms in digital health
- Overview of current and emerging digital health technologies (DHTs)
- Benefits and challenges of DHTs in health care and public health
- Considerations for using DHTs in research
- ACCORDS Mobile Health & Informatics Core

What is Digital Health?

- Digital health "includes categories such as mobile health (mHealth), health information technology (IT), wearable devices, telehealth and telemedicine, and personalized medicine."
- -- FDA definition

* U.S. Food and Drug Administration: https://www.fda.gov/medical-devices/digital-health-center-excellence/what-digital-health

What is Digital Health?

- "Digital health and care refers to tools and services that use information and communication technologies (ICTs) to improve prevention, diagnosis, treatment, monitoring and management of health-related issues and to monitor and manage lifestyle-habits that impact health."
- -- European Commission definition

* EC: https://ec.europa.eu/health/ehealth-digital-health-and-care/overview_en

What is Informatics?

- From AMIA: "Informatics is the science of how to use data, information and knowledge to improve human health and the delivery of health care services.
- Biomedical and health informatics applies principles of computer and information science to the advancement of life sciences research, health professions education, public health, and patient care."

* AMIA: https://amia.org/about-amia/why-informatics/informatics-research-and-practice

What is Informatics?

Areas of Focus	Brief Description
(Applied) Clinical Informatics	Use of of informatics, digital health and health IT to provide health care; operational, applied
Clinical Research Informatics	Discovery and management of new knowledge relating to health and disease. Includes clinical trials information management and secondary research uses of clinical data
Consumer Health Informatics	Patient (primarily) as consumer; related to consumer information needs, health literacy, patient-provider communication, patient education, data exchange
Public Health Informatics	Population focus; surveillance, prevention, preparedness, and health promotion
Translational Bioinformatics	Methods and practice for manipulating/using/transforming large biomedical and genomic data into health insights

* AMIA: https://amia.org/about-amia/why-informatics/informatics-research-and-practice

A Few Important Milestones

1st telemedicine video consult (Univ. Nebraska, 1959)

Early EMR testing (1965)

NASA + IHS = STARPAHC rural telehealth (1970s)

Epic & Cerner founded (1979)

The Internet (1983)

Epic Care launched (1992)

First patient portals; Epic, KP, Beth Israel Deaconess (1999-2000)

ARRA/ HITECH Act passed (2009)

Pandemic telehealth (2020--)

EHR adoption increases from 20% to 88% (2004 – 2021)

1960s 1970s 1980s 1990s 2000s 2010s 2020s

First mobile phone (1973)

First calculator watch (1979)

PDAs: Blackberry, Palm Pilot, etc. (1996-1999)

1st gen CGM (DexCom, 2006)

1st gen iPhone (2007)

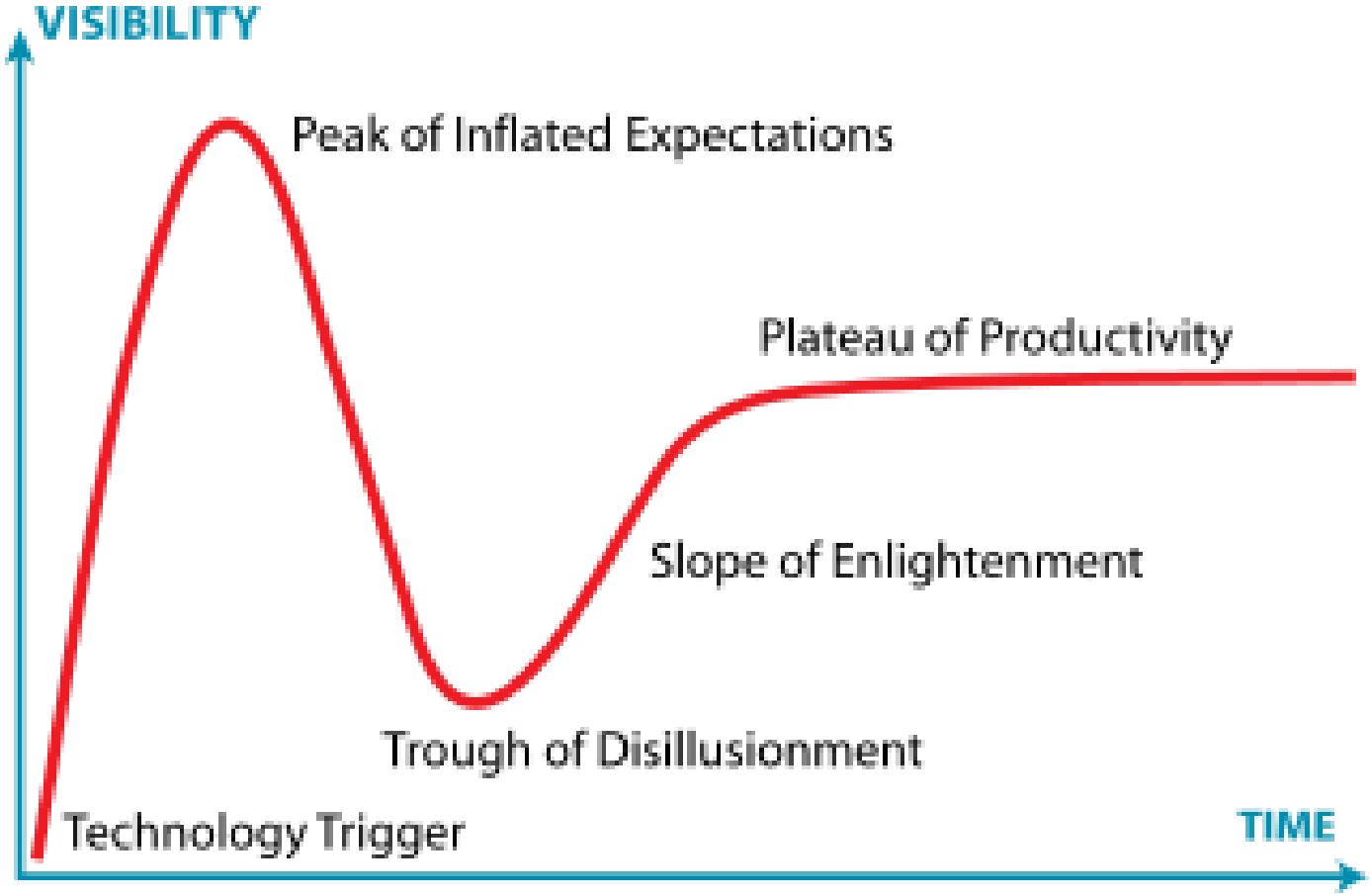
1st Fitbit tracker (2010)

Smartwatches: Galaxy Gear, Apple Watch (2013-2015)

Mobile health apps >250,000

ChatGPT launched (2022)

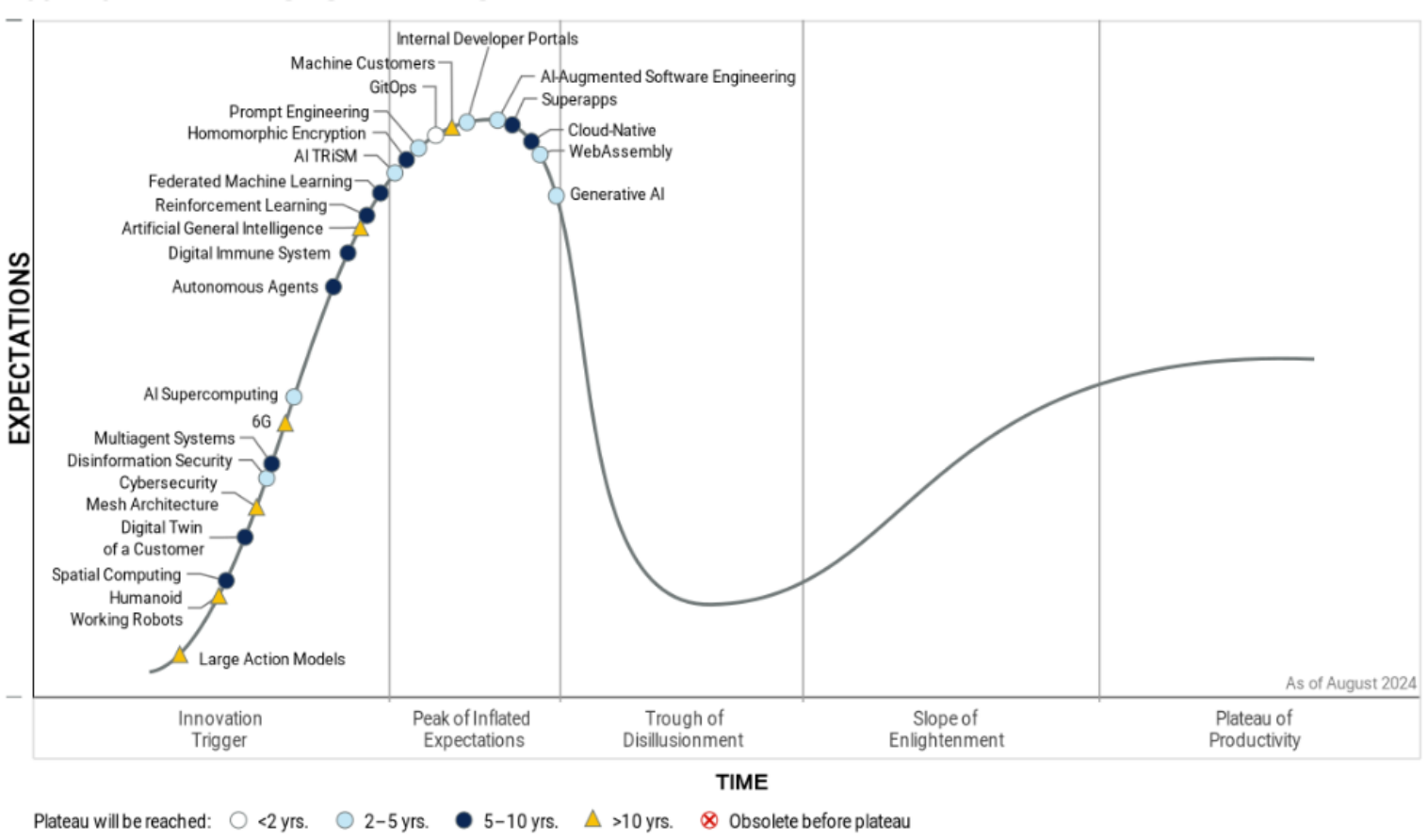
The Technology Hype Cycle



Gartner Hype Cycle Methodology: https://www.gartner.com/en/research/methodologies/gartner-hype-cycle

Emerging Technologies, **2015** vs 2024

Emerging Technologies, 2015 vs **2024**



Gartner

Current Common DHTs

- Clinical Information Systems/EHRs
- Mobile applications
- Wearable devices
- Environmental sensors
- Social media

Epic

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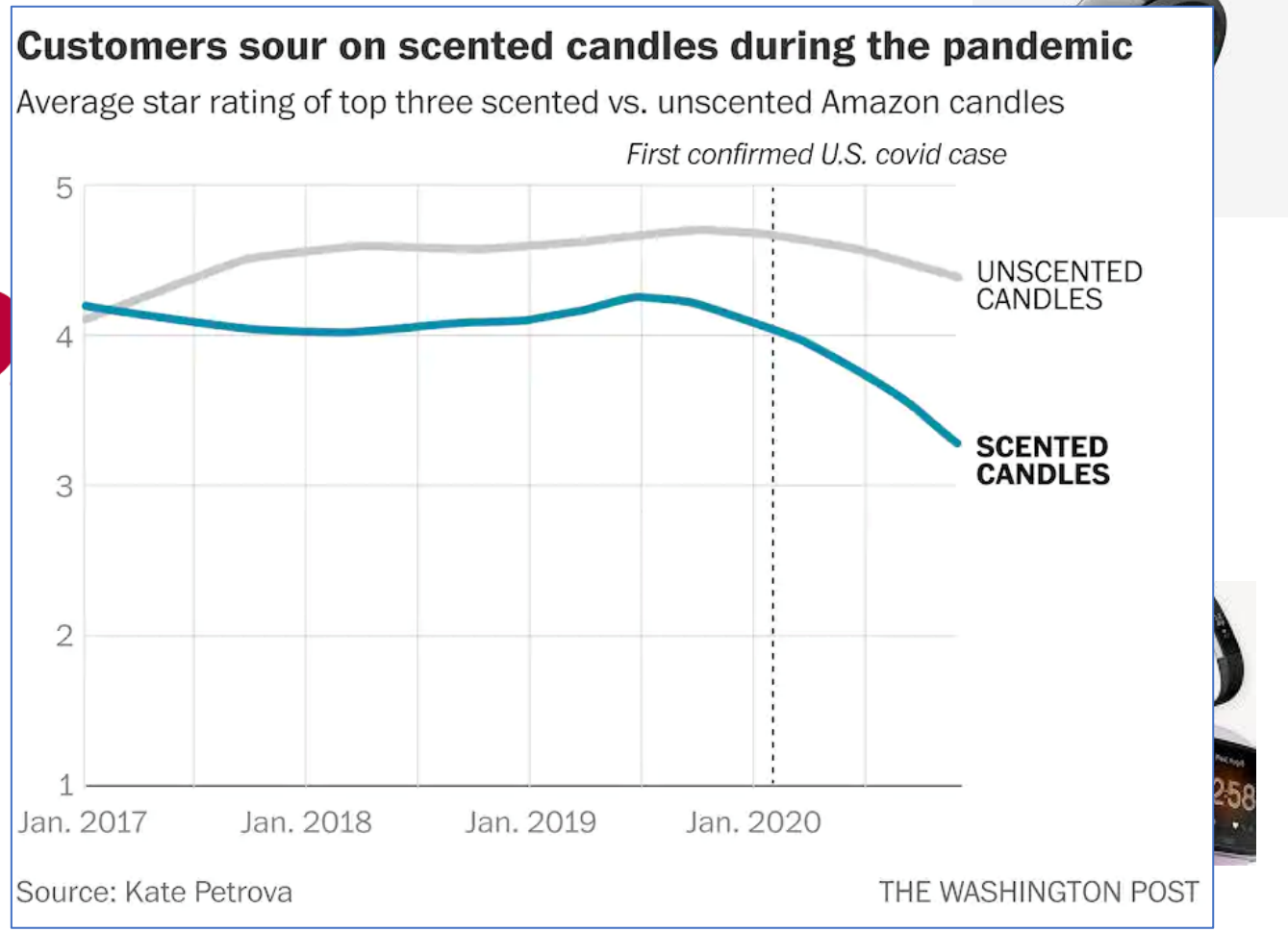

Examples of Areas Where DHTs Can Help

- Addressing administrative burden
- Connecting communities to providers (e.g., specialists)
- Clinical decision support
- Predictive analytics and personalized medicine
- Chronic condition management
- Remote patient monitoring
- Patient-provider communication
- Patient education and support

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NEJM Catalyst | Innovations in Care Delivery

COMMENTARY

Ambient Artificial Intelligence Scribes to Alleviate the Burden of Clinical Documentation

Aaron A. Tierney, PhD, Gregg Gayre, MD, Brian Hoberman, MD, MBA, Britt Mattern, MBA, Manuel Ballesca, MD, Patricia Kipnis, PhD, Vincent Liu, MD, MS, Kristine Lee, MD

Vol. 5 No. 3 | March 2024
DOI: 10.1056/CAT.23.0404

Clinical documentation in the electronic health record (EHR) has become increasingly burdensome for physicians and is a major driver of clinician burnout and dissatisfaction. Time dedicated to clerical activities and data entry during patient encounters also negatively affects the patient–physician relationship by hampering effective and empathetic communication and care. Ambient artificial intelligence (AI) scribes, which use machine learning applied to conversations to facilitate scribe-like capabilities in real time, has great potential to reduce documentation burden, enhance physician–patient encounters, and augment clinicians' capabilities. The technology leverages a smartphone microphone to transcribe encounters as they occur but does not retain audio recordings. To address the urgent and growing burden of data entry, in October 2023, The Permanente Medical Group (TPMG) enabled ambient AI technology for 10,000 physicians and staff to augment their clinical capabilities across diverse settings and specialties. The implementation process leveraged TPMG's extensive experience in large-scale technology instantiation and integration incorporating multiple training formats, *at-the-elbow* peer support, patient-facing materials, rapid-cycle upgrades with the

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NEJM Catalyst | Innovations in Care Delivery

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physicians and staff to augment their clinical capabilities across diverse settings and specialties. The implementation process leveraged TPMG's extensive experience in large-scale technology instantiation and integration incorporating multiple training formats, *at-the-elbow* peer support, patient-facing materials, rapid-cycle upgrades with the technology vendor, and ongoing monitoring. In 10 weeks since implementation, the ambient AI tool has been used by 3,442 TPMG physicians to assist in as many as 303,266 patient encounters across a wide array of medical specialties and locations. In total, 968 physicians have enabled ambient AI scribes in ≥100 patient encounters, with one physician having enabled it to assist in 1,210 encounters. The response from physicians who have used the ambient AI scribe service has been favorable; they cite the

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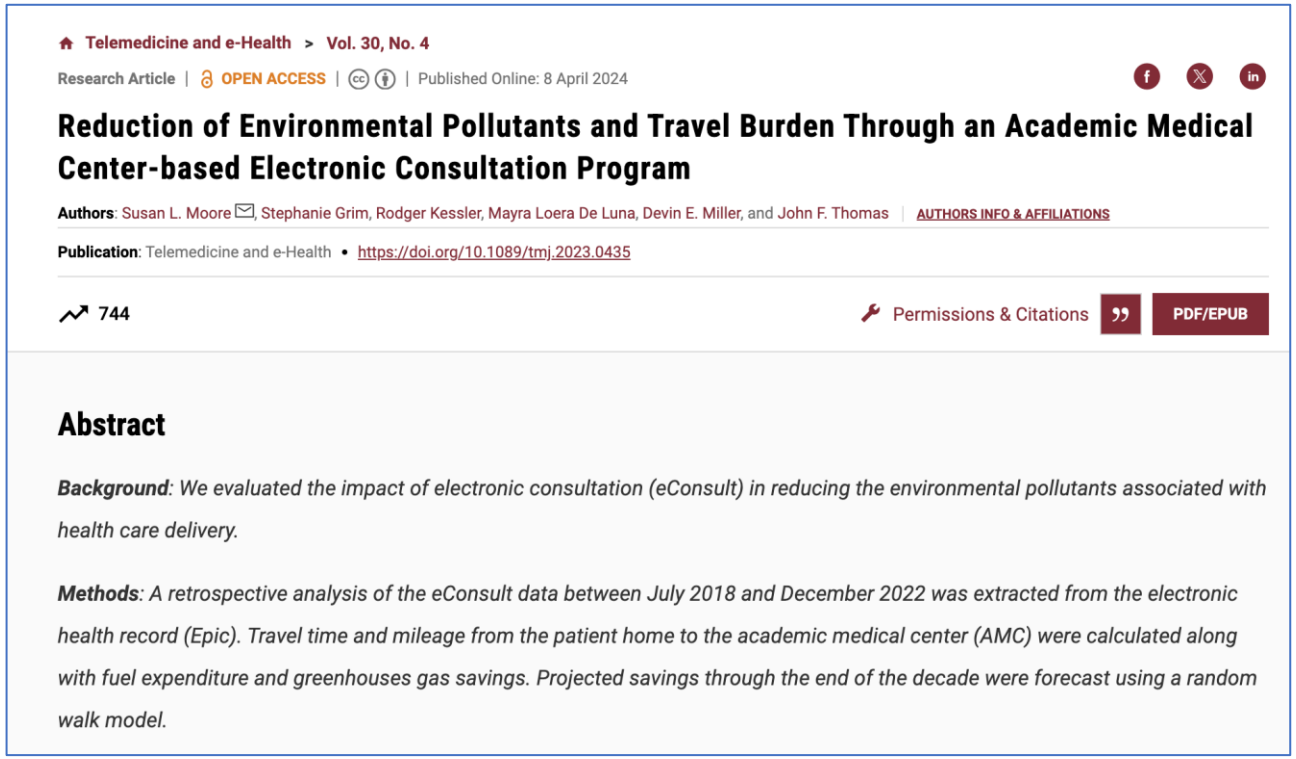

Telemedicine and e-Health > Vol. 30, No. 4

Research Article | OPEN ACCESS | Published Online: 8 April 2024

Reduction of Environmental Pollutants and Travel Burden Through an Academic Medical Center-based Electronic Consultation Program

Authors: Susan L. Moore, Stephanie Grim, Rodger Kessler, Mayra Loera De Luna, Devin E. Miller, and John F. Thomas | AUTHORS INFO & AFFILIATIONS

Publication: Telemedicine and e-Health • https://doi.org/10.1089/tmj.2023.0435

744 Permissions & Citations PDF/EPUB

Abstract

Background: *We evaluated the impact of electronic consultation (eConsult) in reducing the environmental pollutants associated with health care delivery.*

Methods: *A retrospective analysis of the eConsult data between July 2018 and December 2022 was extracted from the electronic health record (Epic). Travel time and mileage from the patient home to the academic medical center (AMC) were calculated along with fuel expenditure and greenhouses gas savings. Projected savings through the end of the decade were forecast using a random walk model.*

Examples of Areas Where DHTs Can Help

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***Results**: A total of 15,499 eConsults were submitted to AMC specialist providers from community primary care providers. Completed eConsults (n = 11,590) eliminated the need for a face-to-face visit with a specialist provider, eliminating mileage, fuel, time, and pollutants associated with face to face visits. In-state travel distance saved was 310,858 miles, travel time saved was 5,491 h, with an associated fuel reduction of 13,575 gallons and $56,893 savings. This reduced greenhouse gas emissions by 128 metric tons of carbon dioxide, 0.022 tons of nitrogen oxide, 0.005 tons of methane, and 0.001 tons of nitrous oxide. Out of state travel distance saved was 188,346 miles with 2,842 h reduced travel time, and associated fuel reduction of 8,225 gallons and of $34,118. Reduced greenhouse gas emissions were equivalent to 77 metric tons of carbon dioxide, 0.0132 tons of nitrogen oxide, 0.0033 tons of methane, and 0.0007 tons of nitrous oxide.*

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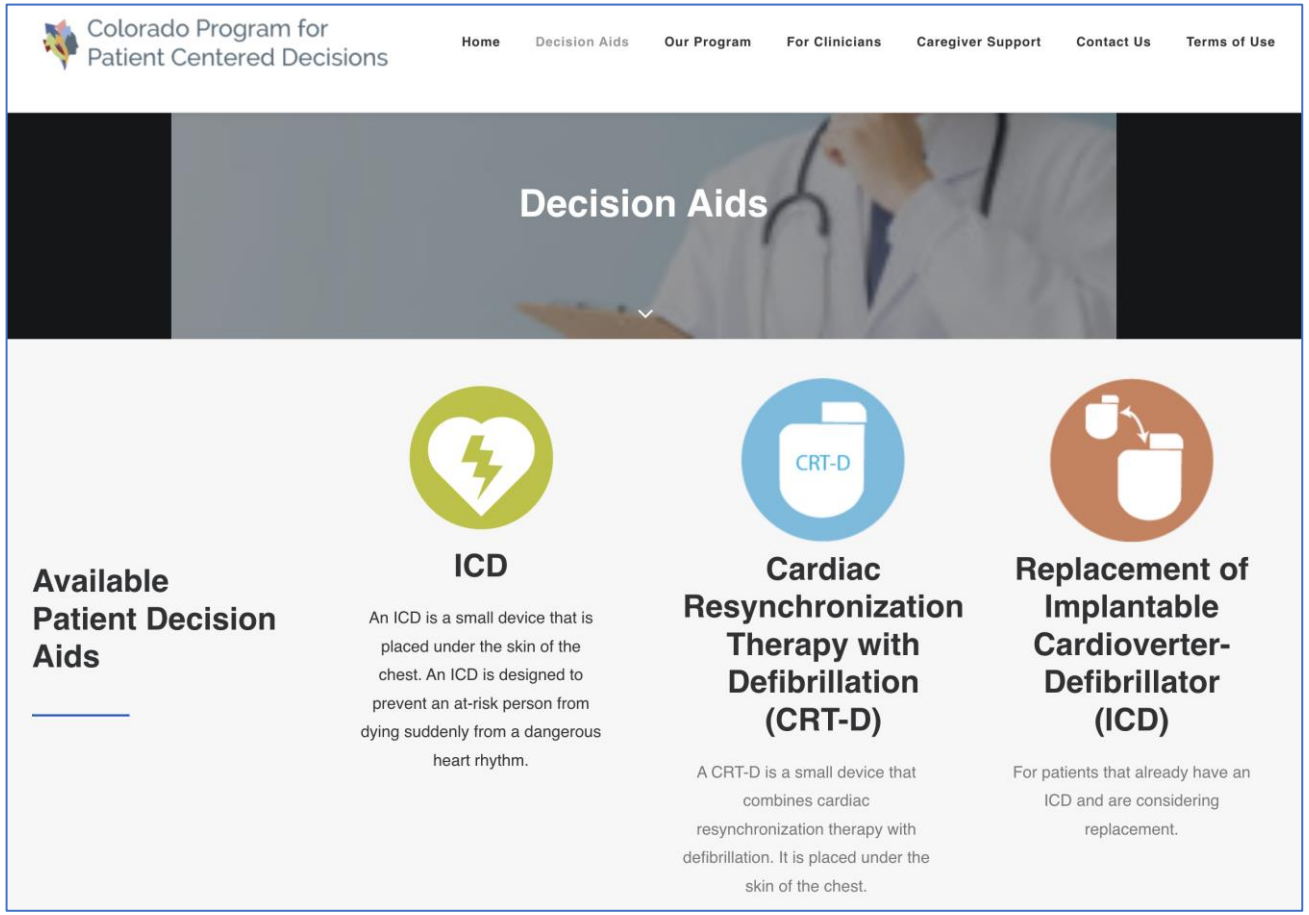

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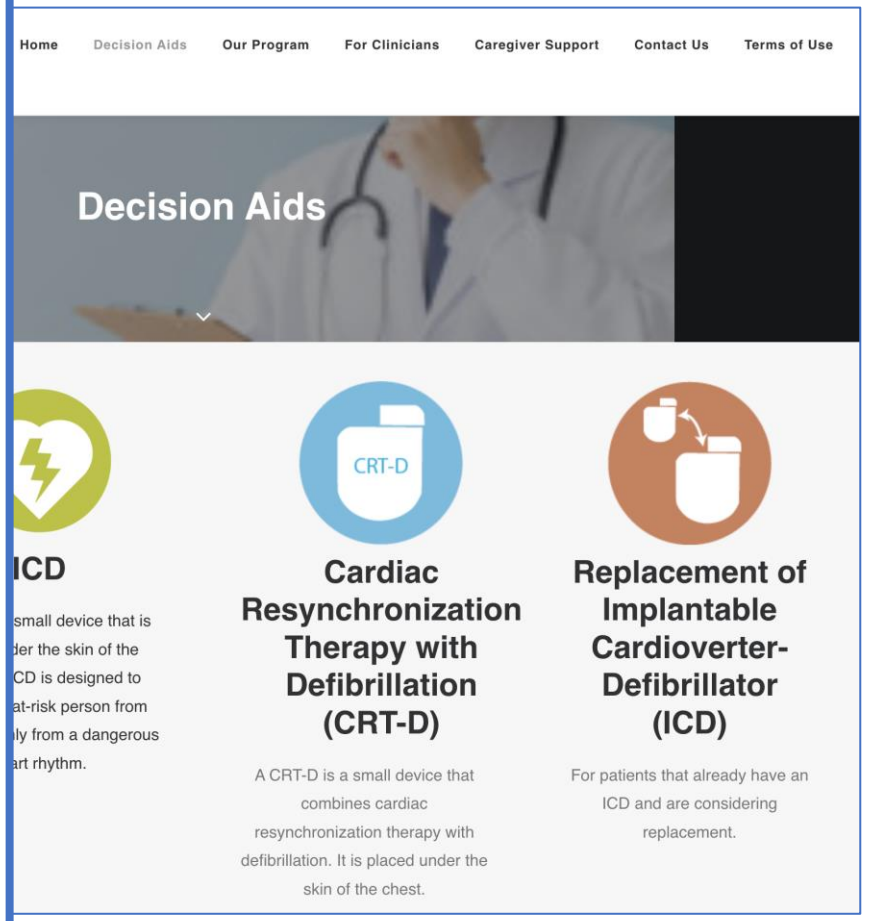

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npj | Digital Medicine
www.nature.com/npjdigitalmed

PERSPECTIVE OPEN

Best practices for analyzing large-scale health data from wearables and smartphone apps

Jennifer L. Hicks[1], Tim Althoff[2], Rok Sosic[3], Peter Kuhar[4], Bojan Bostjancic[4], Abby C. King[5,6], Jure Leskovec[3,7] and Scott L. Delp[1,8]

Smartphone apps and wearable devices for tracking physical activity and other health behaviors have become popular in recent years and provide a largely untapped source of data about health behaviors in the free-living environment. The data are large in scale, collected at low cost in the "wild", and often recorded in an automatic fashion, providing a powerful complement to traditional surveillance studies and controlled trials. These data are helping to reveal, for example, new insights about environmental and social influences on physical activity. The observational nature of the datasets and collection via commercial devices and apps pose challenges, however, including the potential for measurement, population, and/or selection bias, as well as missing data. In this article, we review insights gleaned from these datasets and propose best practices for addressing the limitations of large-scale data from apps and wearables. Our goal is to enable researchers to effectively harness the data from smartphone apps and wearable devices to better understand what drives physical activity and other health behaviors.

npj Digital Medicine (2019)2:45 ; https://doi.org/10.1038/s41746-019-0121-1

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ONCOLOGY CARE AT HOME: A PATIENT-CENTERED APPROACH TO MANAGING CARE FOR
BONE MARROW TRANSPLANT AND CAR T-CELL THERAPY PATIENTS

, MD[4]

z Research Administration, Aurora, CO; 4. CU

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NEJM Catalyst

JOURNAL EVENTS INSIGHTS C

CASE STUDY

Remote Patien
Management o
Patients

Authors: Joshua C. Pritchett, MD, Jon
MD Author Info & Affiliations

Published March 20, 2024 | NEJM Catal Innov Care Deliv 2024;5(4) | DOI: 10.1056/CAT.23.0365 | VOL. 5 NO. 4

J Med Internet Res. 2023; 25: e42335.
Published online 2023 Mar 16. doi: 10.2196/42335

The Next Frontier of Remote Patient Monitoring: Hospital at Home

Monitoring Editor: Tiffany Leung

Reviewed by Katharine Lawrence, Emre Sezgin, and Nasrin Aldawoodi

David Whitehead, MD, MBA[#1,2] and Jared Conley, MD, MPH, PhD[#1,2,3]

[1] Department of Emergency Medicine, Massachusetts General Hospital, Boston, MA, United States
[2] Harvard Medical School, Boston, MA, United States
[3] Healthcare Transformation Lab, Massachusetts General Hospital, Boston, MA, United States

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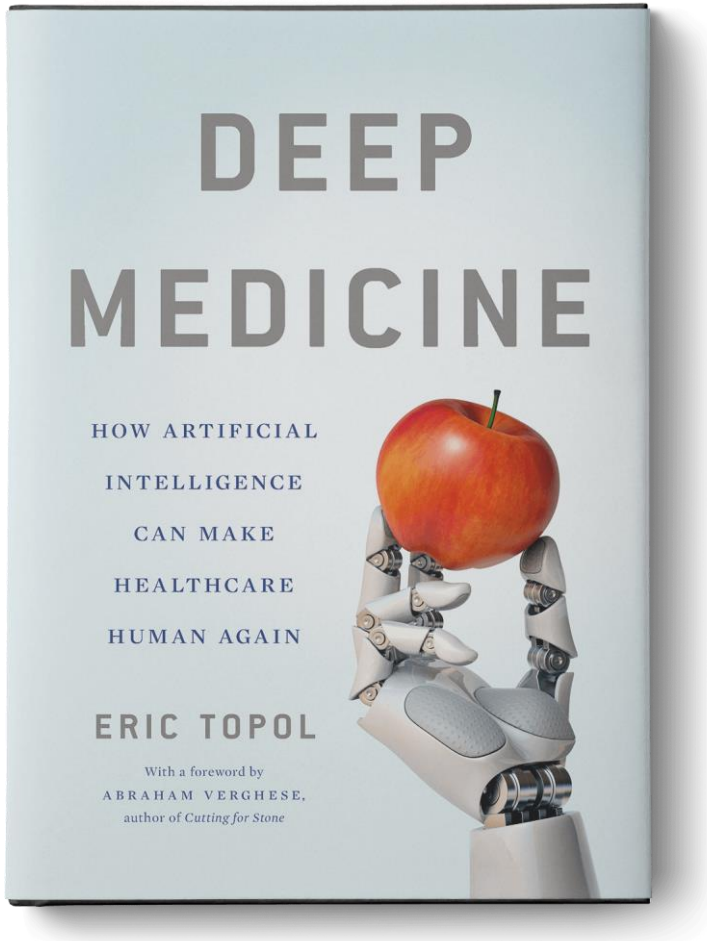

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JAMA Network | Open

Original Investigation | Health Informatics

Large Language Model–Based Responses to Patients' In-Basket Messages

William R. Small, MD, MBA; Batia Wiesenfeld, PhD; Beatrix Brandfield-Harvey, BS; Zoe Jonassen, PhD; Soumik Mandal, PhD; Elizabeth R. Stevens, PhD; Vincent J. Major, PhD; Erin Lostraglio, BA; Adam Szerencsy, DO; Simon Jones, PhD; Yindalon Aphinyanaphongs, MD, PhD; Stephen B. Johnson, PhD; Oded Nov, PhD; Devin Mann, MD

Abstract

IMPORTANCE Virtual patient-physician communications have increased since 2020 and negatively impacted primary care physician (PCP) well-being. Generative artificial intelligence (GenAI) drafts of patient messages could potentially reduce health care professional (HCP) workload and improve communication quality, but only if the drafts are considered useful.

OBJECTIVES To assess PCPs' perceptions of GenAI drafts and to examine linguistic characteristics associated with equity and perceived empathy.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional quality improvement study tested the hypothesis that PCPs' ratings of GenAI drafts (created using the electronic health record [EHR] standard prompts) would be equivalent to HCP-generated responses on 3 dimensions. The study was conducted at NYU Langone Health using private patient-HCP communications at 3 internal medicine practices piloting GenAI.

EXPOSURES Randomly assigned patient messages coupled with either an HCP message or the draft GenAI response.

Key Points

Question Can generative artificial intelligence (GenAI) chatbots aid patient-health care professional (HCP) communication by creating high-quality draft responses to patient requests?

Findings In this cross-sectional study of 16 primary care physicians' opinions on the quality of GenAI- and HCP-drafted responses to patient messages, GenAI responses were rated higher than HCPs' for communication style and empathy. GenAI responses were longer, more linguistically complex, and less readable than HCP responses; they were also rated as more empathetic and contained more subjective and positive language.

Challenges and Considerations

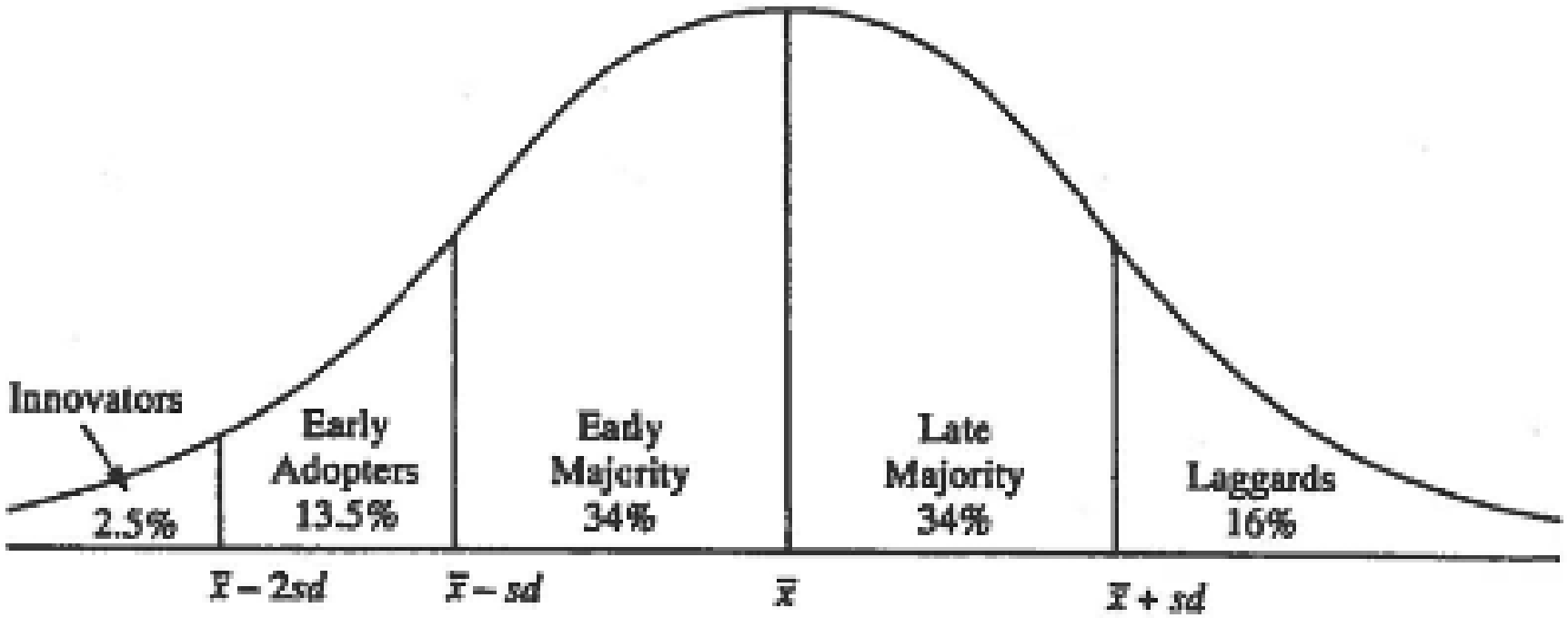
- The Digital Divide
- Adoption & engagement
- Data quality, security, & ownership
- Policy & regulatory
- Ethics & equity
- Misinformation Disinformation
- Integration and sustainability

The Digital Divide

- Differential access to broadband internet
  - *And* everything technological that requires broadband services – eg telehealth
  - New social determinant of health; even a "super-determinant"
- Co-occurring with other population characteristics representative of those who experience higher burdens of health disparities
  - Age
  - Geographic location (rural vs. urban)
  - Socioeconomic status

DHT Adoption & Engagement

- *A technology solution is not useful if no one uses it.*



Diffusion of Innovations Distribution Curve (Rogers 2003)

Challenges and Considerations

- The Digital Divide
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- **Policy and regulatory issues**
- Ethics and equity
- Misinformation & disinformation
- Sustainability

- Health Information Portability & Accountability Act (HIPAA) & General Data Protection Regulation (GDPR)
- Data storage and health data exchange (including the European Health Data Space)
- FDA, EMA, and other regulatory agencies
- CAN-SPAM, FD&C Act, FTC Act
- Conflicts of interest with tech makers

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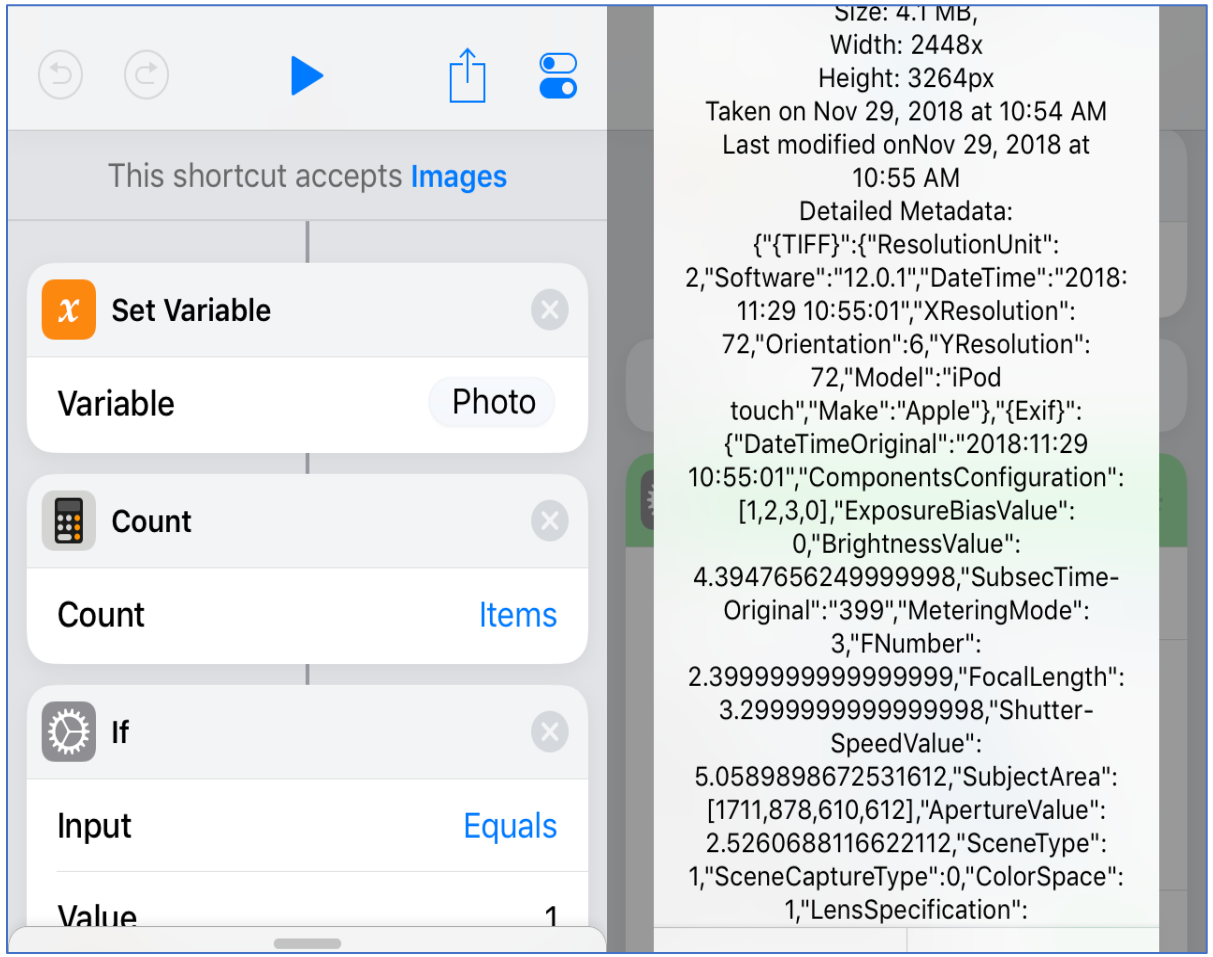

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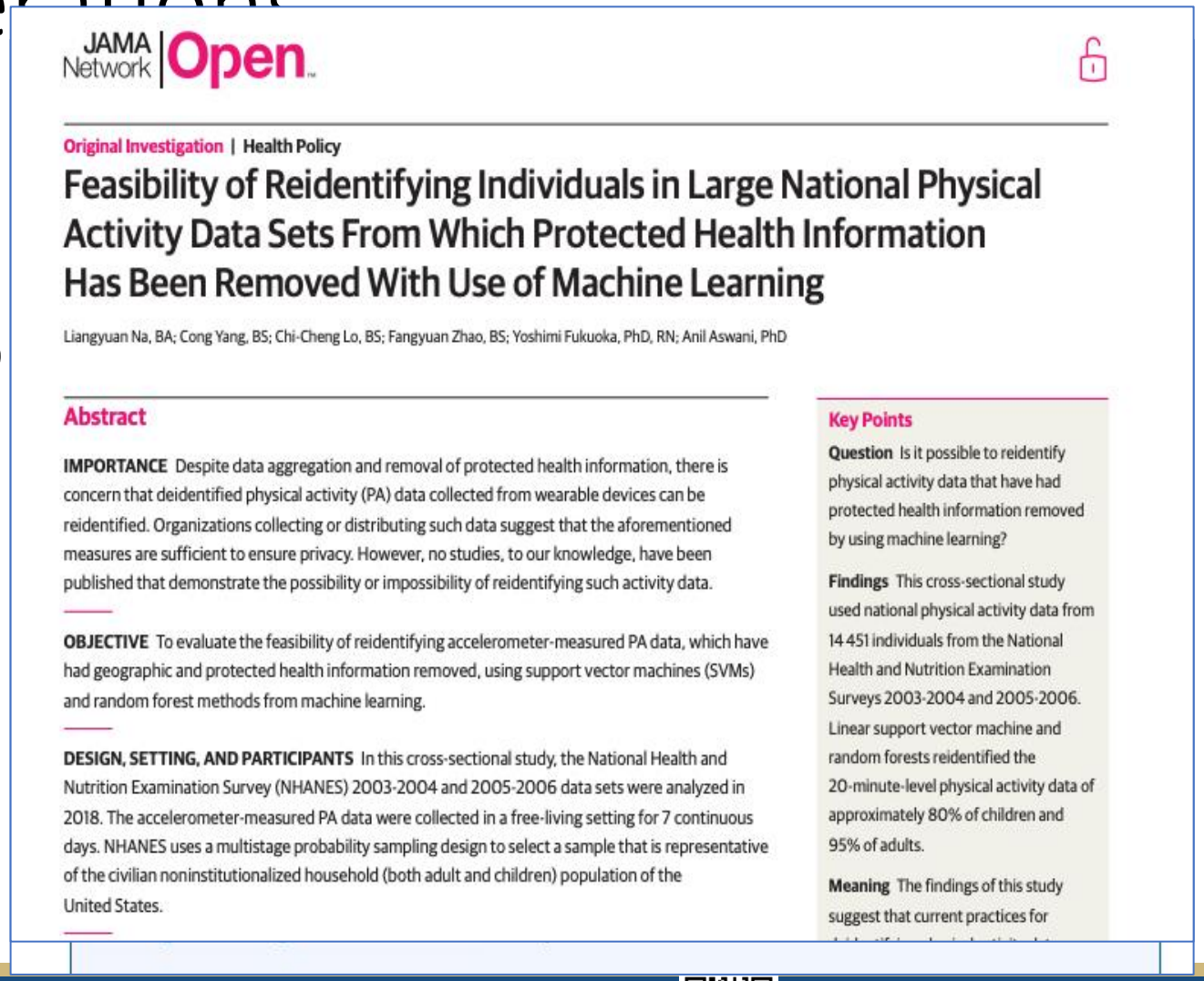

JAMA Network Open

Original Investigation | Health Policy

Feasibility of Reidentifying Individuals in Large National Physical Activity Data Sets From Which Protected Health Information Has Been Removed With Use of Machine Learning

Liangyuan Na, BA; Cong Yang, BS; Chi-Cheng Lo, BS; Fangyuan Zhao, BS; Yoshimi Fukuoka, PhD, RN; Anil Aswani, PhD

Abstract

IMPORTANCE Despite data aggregation and removal of protected health information, there is concern that deidentified physical activity (PA) data collected from wearable devices can be reidentified. Organizations collecting or distributing such data suggest that the aforementioned measures are sufficient to ensure privacy. However, no studies, to our knowledge, have been published that demonstrate the possibility or impossibility of reidentifying such activity data.

OBJECTIVE To evaluate the feasibility of reidentifying accelerometer-measured PA data, which have had geographic and protected health information removed, using support vector machines (SVMs) and random forest methods from machine learning.

DESIGN, SETTING, AND PARTICIPANTS In this cross-sectional study, the National Health and Nutrition Examination Survey (NHANES) 2003-2004 and 2005-2006 data sets were analyzed in 2018. The accelerometer-measured PA data were collected in a free-living setting for 7 continuous days. NHANES uses a multistage probability sampling design to select a sample that is representative of the civilian noninstitutionalized household (both adult and children) population of the United States.

Key Points

Question Is it possible to reidentify physical activity data that have had protected health information removed by using machine learning?

Findings This cross-sectional study used national physical activity data from 14 451 individuals from the National Health and Nutrition Examination Surveys 2003-2004 and 2005-2006. Linear support vector machine and random forests reidentified the 20-minute-level physical activity data of approximately 80% of children and 95% of adults.

Meaning The findings of this study suggest that current practices for

Challenges and Considerations

- The Digital Divide
- Adoption and engagement
- Data quality, security & ownership
- Policy and regulatory issues
- **Ethics and equity**
- Misinformation & disinformation
- Sustainability

Human stereotypes are evident in multimodal/visual generative AI models, for example:
• "Medical doctor" → white men wearing white coats and stethoscopes
• "Flight attendant" → showed only women
• "Person with autism" → young, thin, dark-haired white men

Challenges and Concerns

- The Digital Divide
-
-
-
-
-
- Sustainability

> Despite their ubiquity, medical algorithms' fatal flaw is that they are often built on biased rules and homogenous data sets that do not reflect the patient population at large. Patients should never have to worry that an algorithm could prevent them from receiving an organ transplant, yet this is the reality for many Black patients on transplant lists. Even though Black Americans are four times more likely to have kidney failure, an algorithm to determine transplant list placement puts Black patients lower on the list than White patients, even when all other factors remain identical.

SEPTEMBER 9, 2021 10.1377/forefront.20210903.976632

Challenges and Considerations

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SCIENCE · 25 O

Racial bias in health algorithms

The U.S. health care system uses commercial algorithms to guide health decisions. Obermeyer *et al.* find evidence of racial bias in one widely used algorithm, such that Black patients assigned the same level of risk by the algorithm are sicker than White patients (see the Perspective by Benjamin). The authors estimated that this racial bias reduces the number of Black patients identified for extra care by more than half. Bias occurs because the algorithm uses health costs as a proxy for health needs. Less money is spent on Black patients who have the same level of need, and the algorithm thus falsely concludes that Black patients are healthier than equally sick White patients. Reformulating the algorithm so that it no longer uses costs as a proxy for needs eliminates the racial bias in predicting who needs extra care.

Science, this issue p. 447; see also p. 421

Challenges and Considerations

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- Policy and regulatory issues
- Ethics and equity
- **Misinformation & disinformation**
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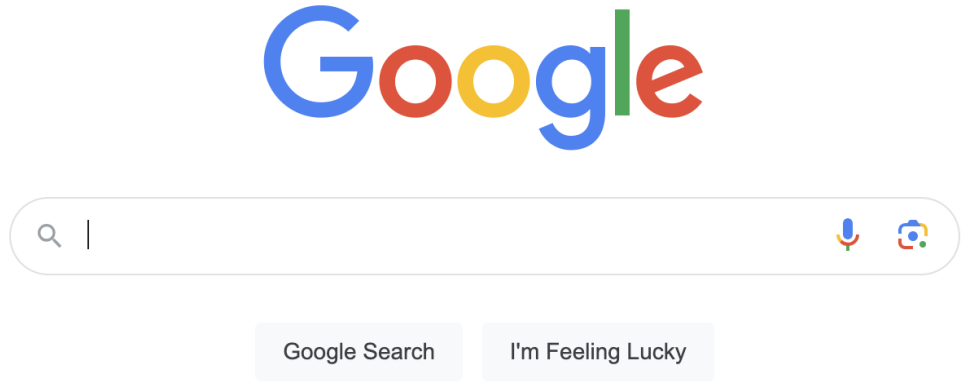

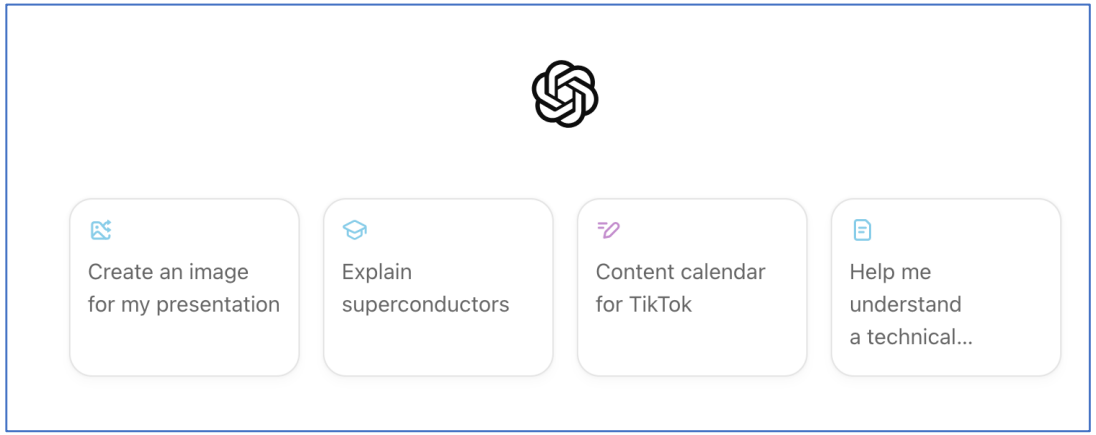

Challenges and Considerations

- The Digital Divide
- Adopt
- Data q
- Policy
- Ethics
- **Misinf**
- Sustainability

Results:

ChatGPT achieved an overall accuracy of 71.7% (95% CI 69.3%-74.1%) across all 36 clinical vignettes. The LLM demonstrated the highest performance in making a final diagnosis with an accuracy of 76.9% (95% CI 67.8%-86.1%) and the lowest performance in generating an initial differential diagnosis with an accuracy of 60.3% (95% CI 54.2%-66.6%). Compared to answering questions about general medical knowledge, ChatGPT demonstrated inferior performance on differential diagnosis (β=−15.8%; *P*<.001) and clinical management (β=−7.4%; *P*=.02) question types.

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) of this paper are available at https://preprints.jmir.org/preprint/48659, first published May 02, 2023.

Assessing the Utility of ChatGPT Throughout the ... l Usability

eni [1, 2, 3]; Dreyer [1, 5];

Metrics

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physicians, has not yet been evaluated.

Objective:

This study aimed to evaluate ChatGPT's capacity for ongoing clinical decision support via its performance on standardized clinical vignettes.

Methods:

We inputted all 36 published clinical vignettes from the *Merck Sharpe & Dohme (MSD) Clinical Manual* into ChatGPT and compared its accuracy on differential diagnoses, diagnostic testing, final

Challenge

- The Digital
- Adoption a
- Data quality
- Policy and r
- Ethics and e
- **Misinforma**
- Sustainabili

This post, identified by Reuters, matched the messaging, timeframe and design of the U.S. military's anti-vax propaganda campaign in the Philippines, former and current military officials say. Social media platform X also identified the account as fake and removed it.

TRANSLATION FROM TAGALOG

#ChinaIsTheVirus

Do you want that? COVID came from China and vaccines came from China

(Beneath the message is a picture of then-Philippines President Rodrigo Duterte saying: "China! Prioritize us first please. I'll give you more islands, POGO and black sand." POGO refers to Philippine Offshore Gaming Operators, online gambling companies that boomed during Duterte's administration. Black sand refers to a type of mining.)

REUTERS/Peter Blaza. Illustration: Jo

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Challenges and Considerations

- The Digital Divide
- Adoption and engagement
- Data quality, security & ownership
- Policy and regulatory issues
- Ethics and equity
- Misinformation & disinformation
- **Sustainability**

Cramming more components onto integrated circuits

With unit cost falling as the number of components per circuit rises, by 1975 economics may dictate squeezing as many as 65,000 components on a single silicon chip

By Gordon E. Moore

Director, Research and Development Laboratories, Fairchild Semiconductor division of Fairchild Camera and Instrument Corp.

Electronics, Volume 38, Number 8, April 19, 1965

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