Virtual journal club

Wearable Digital Health Technology

DIGITAL MEDICINE SOCIETY

Thursday, October 3, 2024

11:00am ET

Geoffrey S. Ginsburg, MD, PhD
Chief Medical and Scientific Officer
All of Us Research Program, National Institutes of Health

Rosalind Picard, Sc.D.
Grover M. Hermann Prof. in Health Sciences and Technology and Chief Scientist
MIT Media Lab, Empatica

Stephen H. Friend, MD, PhD
Visiting Prof. of Connected Medicine and Department of Psychiatry
Oxford University, Warneford Hospital

Bert Hartog, MSc, PhD
Chief Impact & Innovation Officer
Digital Medicine Society (DiMe)
(Moderator)

But first, housekeeping

- Please note today's session is being recorded
- To ask a question for discussion during Q&A, please:
  - Either 'raise your hand' in the participant window and moderator will unmute you to ask your question live, or
  - Type your question into the chat box
- Slides and recording will be available after today's session

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The NEW ENGLAND JOURNAL of MEDICINE

Wearable Digital Health Technology

Stephen H. Friend, M.D., Ph.D., Geoffrey S. Ginsburg, M.D., Ph.D.,
and Rosalind W. Picard, Sc.D.

"Wearables" is a term used for forms of technology that are worn on the body, such as smartwatches or adhesive patches containing sensors, and that perform a useful function for the wearer or a caregiver. Common examples include devices that track physical activity and sleep or provide physiological data about the wearer, such as heart rate and rhythm or blood glucose levels. Increasingly, wearables are being used by medical professionals to provide clinical data on their patients and for their patients. This digital health technology (DHT) that is worn by patients and connected through mobile apps or personal digital assistants can be used for disease monitoring, diagnostics, alerts, or other clinical care services. In this series, we refer to this specific class of technology as "wearable DHT."

Is wearable DHT going to improve patient

reported that they used the devices to maintain their health and manage it. As for other wearables, more than a million smart rings had been sold by 2022, and more than 7 million continuous glucose sensors will be sold this year. As for the market for wearable medical devices, Bloomberg estimates that it will grow to $76 billion by 2028.[4] At the same time, these devices are collecting increasingly reliable data, and programmers are developing ever more powerful algorithms to process them. The goal of this series in the *Journal* is to bring awareness to emerging forms of wearable DHT that are affecting medical research and clinical care in ways worth framing for clinicians and medical researchers ahead of general awareness or consensus on their benefits and risks.

Wearable DHT as well as artificial intelligence and machine learning (AI–ML) are closely

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Wearable Technology in Clinical Practice for Depressive Disorder

Szymon Fedor, Ph.D., Robert Lewis, M.Sc., Paola Pedrelli, Ph.D., David Mischoulon, M.D., Ph.D., Joshua Curtiss, Ph.D., and Rosalind W. Picard, Sc.D.

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Key Issues as Wearable Digital Health Technologies Enter Clinical Care

Geoffrey S. Ginsburg, M.D., Ph.D., Rosalind W. Picard, Sc.D., and Stephen H. Friend, M.D., Ph.D.

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Wearable Digital Health Technology for Epilepsy

Elizabeth Donner, M.D., Orrin Devinsky, M.D., and Daniel Friedman, M.D.

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Digital Technology for Diabetes

Michael S. Hughes, M.D., Ananta Addala, D.O., M.P.H., and Bruce Buckingham, M.D.

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Wearable Digital Health Technologies for Monitoring in Cardiovascular Medicine

Erica S. Spatz, M.D., M.H.S., Geoffrey S. Ginsburg, M.D., Ph.D., John S. Rumsfeld, M.D., Ph.D., and Mintu P. Turakhia, M.D., M.A.S.

Diabetes:
Maintaining Glycemic Targets Using Sensors and AID

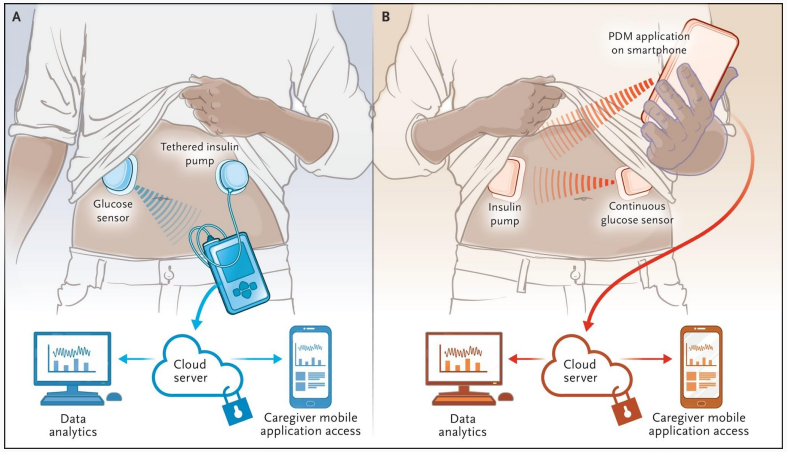


Table 1. Effects of Technology on Reaching Glycemic Targets.*

Target and Diabetes Technology	Glycated Hemoglobin Level	Glucose Sensor Metrics		
		Glucose Level, 70–180 mg/dl	Mean Glucose Level	Glucose Level <70 mg/dl
	%	% of time	mg/dl	% of time
Target[6]	<7	>70	154	<4
MDI insulin therapy and blood-glucose meters[7]	8.2	45	189	5.5
MDI insulin therapy and glucose sensors[7]	7.6	51	180	4.8
Pump and glucose sensors[8]	7.4	59	170	2.2
AID[8-10]	6.8–7.1	71–75	148–156	1.3–2.3

* To convert the values for glucose to millimoles per liter, multiply by 0.05551. AID denotes automated insulin delivery, and MDI multiple daily injection.

<u>Summary:</u>

- Glucose sensors improve glycemic control in diabetes management
- Automated insulin delivery (AID) enhances patient outcomes and safety
- Technology reduces diabetes complications and improves patient quality of life
- Barriers include equitable access, insurance coverage, and provider bias
- Remote monitoring allows for timely adjustments and better outcomes

Hughes MS et al., *N Engl J Med*, 2023

Epilepsy:
Physiological and Physical Alerts

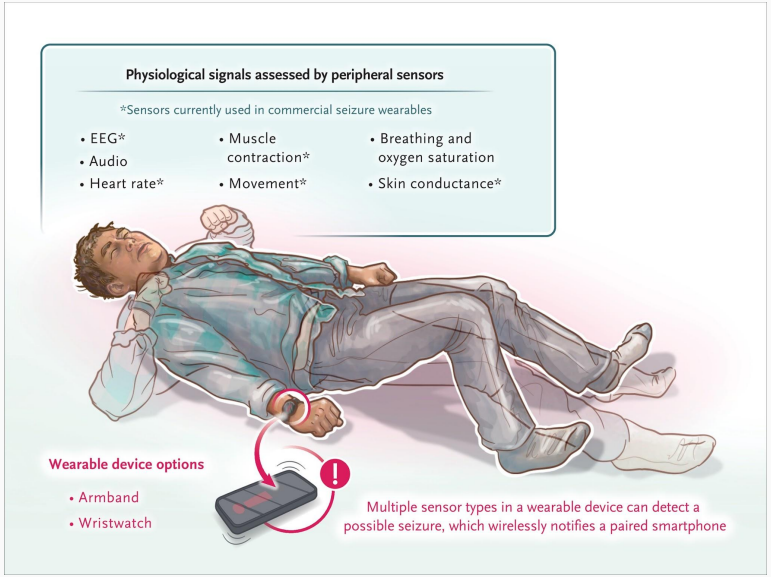


Table 1. Risk of Sudden Unexpected Death in Epilepsy According to the Frequency of Generalized Tonic–Clonic Seizures and Living Situation.*

Living Situation	No. of Seizures in Preceding Year					
	No Seizures		1–3 Seizures		≥4 Seizures	
	no. of cases/no. of controls	*odds ratio (95% CI)*	*no. of cases/no. of controls*	*odds ratio (95% CI)*	*no. of cases/no. of controls*	*odds ratio (95% CI)*
Shared household and bedroom	8/138	1.00 (reference)	16/50	15.89 (6.05–41.78)	8/21	19.85 (6.37–61.84)
Shared household but not bedroom	4/287	1.10 (0.30–4.02)	18/50	31.34 (11.22–87.53)	27/61	33.55 (12.21–92.18)
Living alone	26/260	3.92 (1.69–9.13)	72/50	65.90 (27.72–156.65)	76/48	81.81 (33.60–199.15)

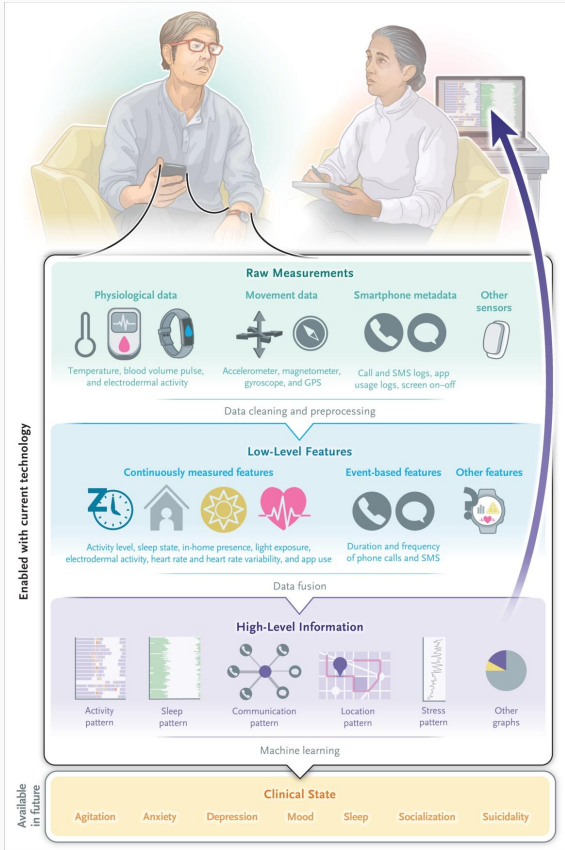
* Data are from Sveinsson et al.[7] Odds ratios have been adjusted for age and sex (matching variable). CI denotes confidence interval.

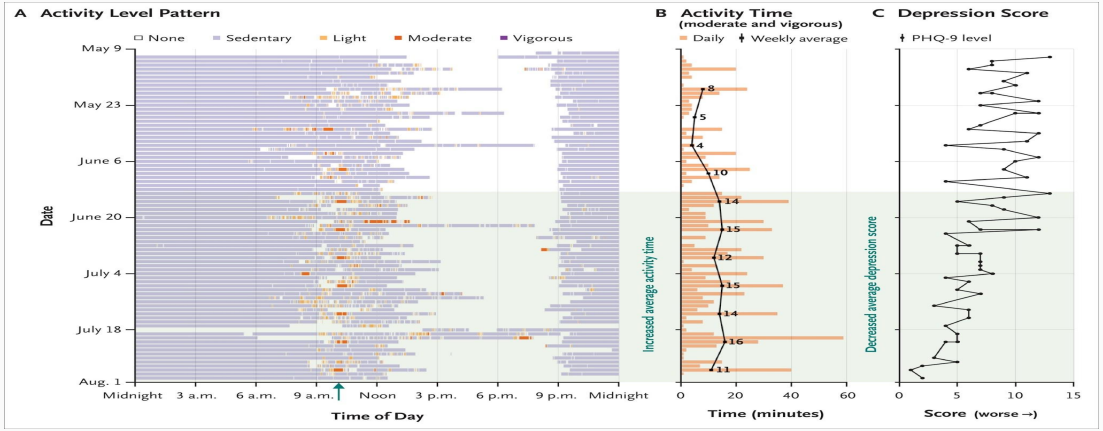
Summary:

- Wearables improve seizure detection and patient safety
- Seizure alarms aid timely interventions during epileptic episodes
- Accuracy of reporting seizures enhances treatment assessment and management
- Wearables face challenges in detecting nonconvulsive seizures.
- False alarms and usability concerns impact device adoption and effectiveness

Donner E et al., *N Engl J Med*, 2024

Depression:
Insights Provided by Layered Data



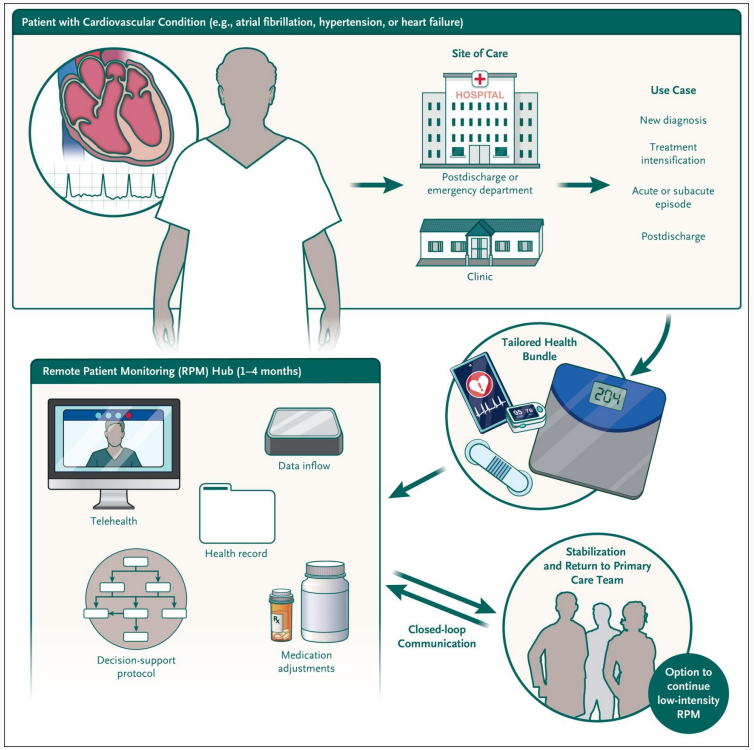


Summary:

- Objective data enhances clinical decisions in depression treatment
- Supports research on depression subtypes and treatment outcomes
- Improves patient engagement and treatment adherence
- Challenges include data interpretation, patient compliance, and privacy concerns.

Fedor et al., *N Engl J Med*, 2023

Cardiovascular Disease: Multimodal Monitoring



Summary:

- Remote monitoring improves cardiovascular disease management and outcomes
- Wearable devices detect arrhythmias and guide treatment adjustments
- Continuous monitoring helps prevent heart failure exacerbations and hospitalization
- Barriers include reimbursement, adoption, and integrating data into clinical workflows
- Patient adherence and device accuracy affect clinical effectiveness and utility

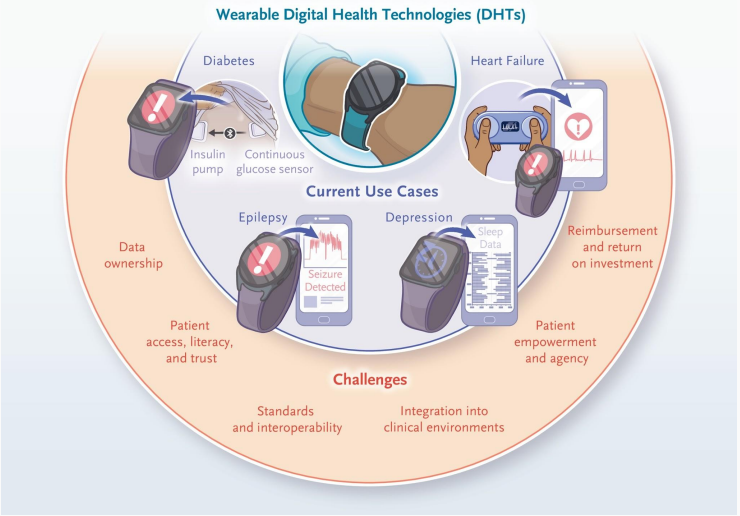
Spatz ES et al., *N Engl J Med*, 2024

Important Considerations:
Integrating DHTs into Clinical Care and Research

1.Data Ownership
- Ownership is unclear, involving multiple stakeholders.
- Patients should understand data use and privacy policies
- Aggregating data for research raises privacy concerns

2. Patient Trust, Literacy, and Access
- Trust requires transparency and secure data handling
- Low digital literacy can hinder adoption of wearables
- Access and support can reduce digital health disparities

3. Standards and Interoperability
- Lack of widely adopted standards hampers data integration
- FDA guidelines regulate some wearable medical devices
- Consistent interoperability standards are needed for efficiency



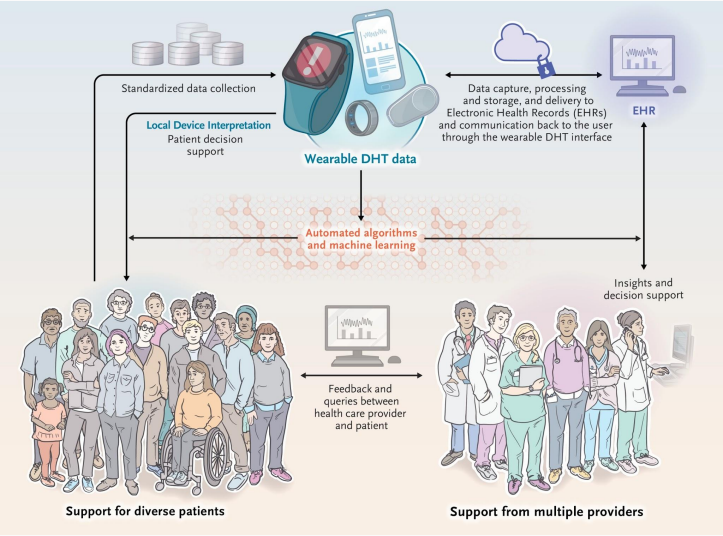
Ginsburg GS et al., *N Engl J Med*, 2024

Important Considerations: Integrating DHTs into Clinical Care and Research

4. Integration into Clinical Care
   - Massive data volume poses workflow challenges
   - Effective data incorporation into EHRs is essential
   - AI and summary data can improve clinical decision-making

5. Patient Empowerment and Agency
   - Patients gain control and real-time insights into their health
   - Enables proactive health management and self-monitoring
   - Patients need to understand limitations and avoid overreliance

6. Reimbursement and ROI for Healthcare Systems
   - Wearables need cost-saving evidence for reimbursement.
   - Investments in infrastructure and education are required.
   - Equity in wearable access will drive improved health outcomes.



Ginsburg GS et al., *N Engl J Med*, 2024

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Wednesday, October 16

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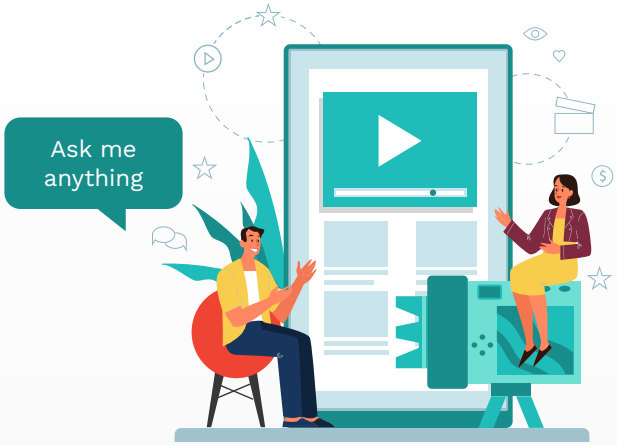

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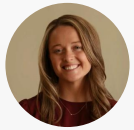

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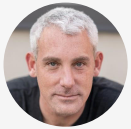

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Thank you.

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