Digital Diagnostics

ICS 491

Upcoming guest lectures

- November 14: Aekta Shah (Ex-Google) - Data Ethics

We may need to move around some discussion question presentations.

Digital Diagnostics

AI

Modalities for Digital Diagnostics

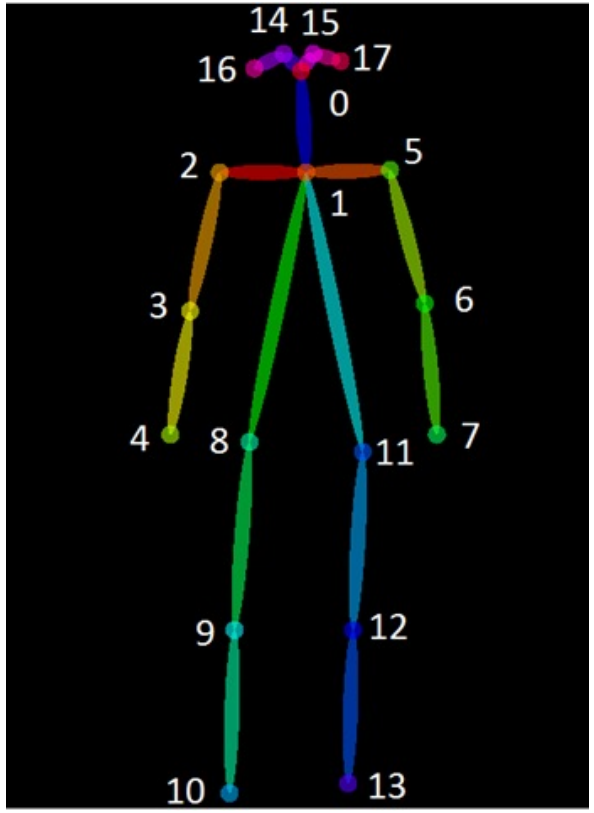
Modalities for Digital Diagnostics

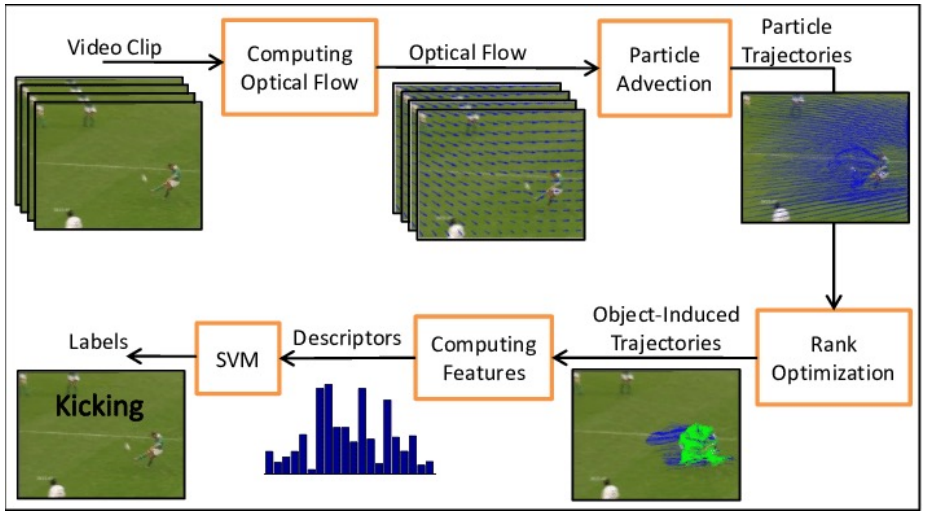
For each of these, think about what kinds of diseases or conditions could be diagnosed using these types of data

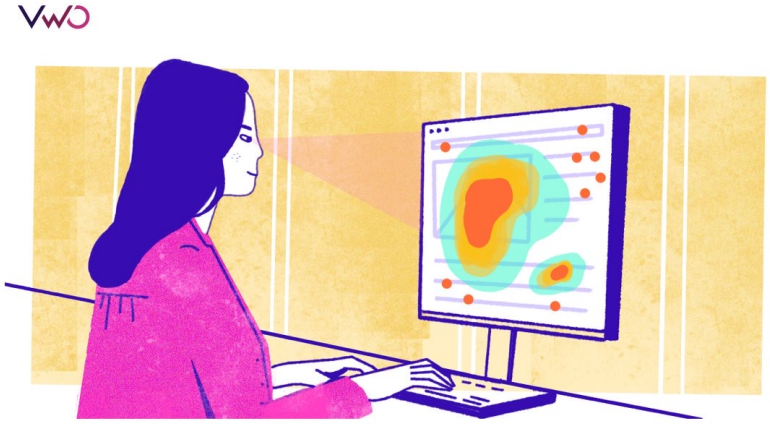
Sensor Analysis

Text Analysis

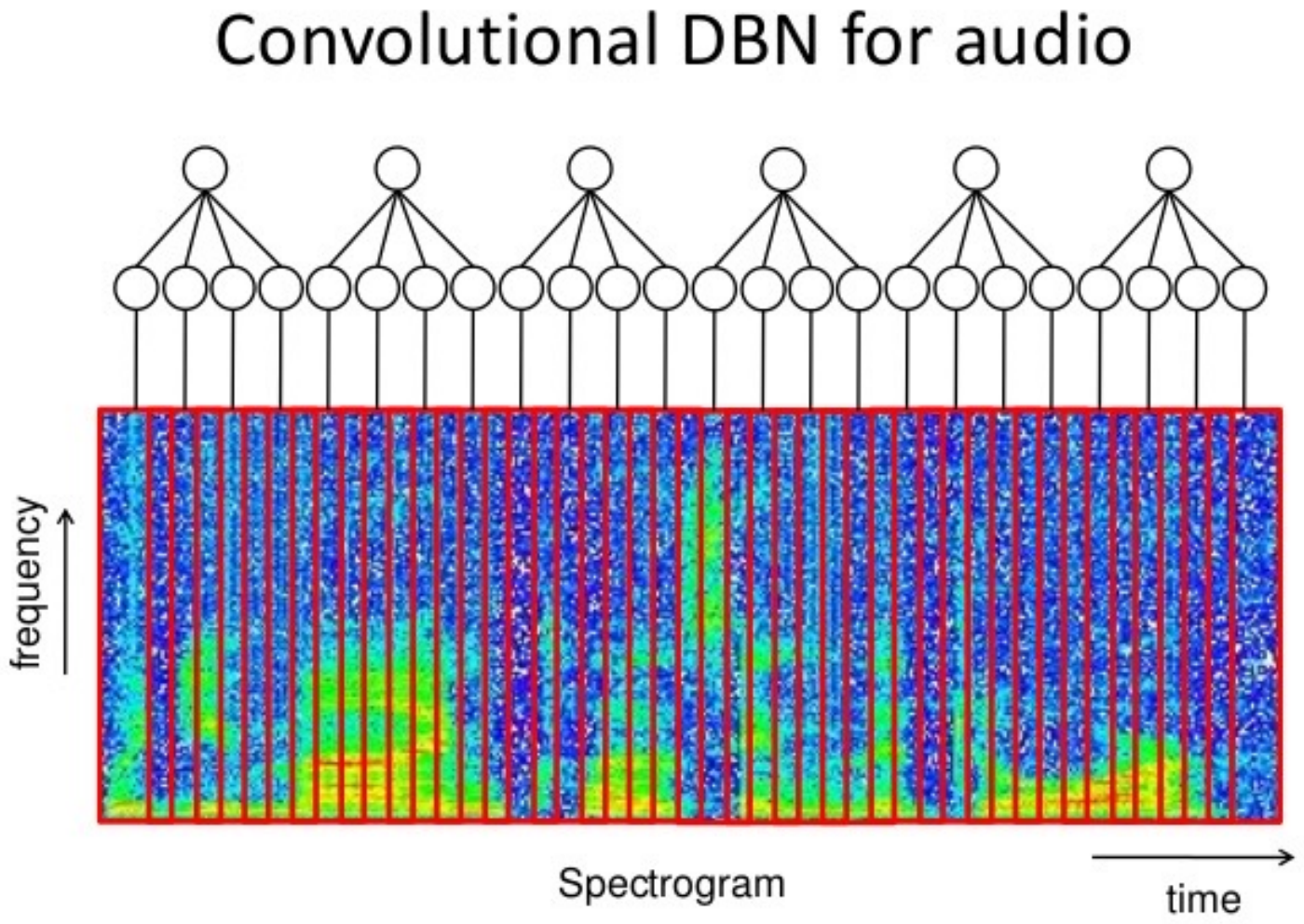
Vision Analysis







Audio Analysis



Exciting Research

npj | digital medicine

www.nature.com/npjdigitalmed

ARTICLE OPEN

Check for updates

An artificial intelligence based app for skin cancer detection evaluated in a population based setting

Anna M. Smak Gregoor[1], Tobias E. Sangers[1], Lytske J. Bakker[2], Loes Hollestein[1], Carin A. Uyl – de Groot[2], Tamar Nijsten[1] and Marlies Wakkee[1] ✉

Artificial intelligence (AI) based algorithms for classification of suspicious skin lesions have been implemented in mobile phone apps (mHealth), but their effect on healthcare systems is undocumented. In 2019, a large Dutch health insurance company offered 2.2 million adults free access to an mHealth app for skin cancer detection. To study the impact on dermatological healthcare consumption, we conducted a retrospective population-based pragmatic study. We matched 18,960 mHealth-users who completed at least one successful assessment with the app to 56,880 controls who did not use the app and calculated odds ratios (OR) to compare dermatological claims between both groups in the first year after granting free access. A short-term cost-effectiveness analysis was performed to determine the cost per additional detected (pre)malignancy. Here we report that mHealth-users had more claims for (pre)malignant skin lesions than controls (6.0% vs 4.6%, OR 1.3 (95% CI 1.2–1.4)) and also a more than threefold higher risk of claims for benign skin tumors and nevi (5.9% vs 1.7%, OR 3.7 (95% CI 3.4–4.1)). The costs of detecting one additional (pre)malignant skin lesion with the app compared to the current standard of care were €2567. Based on these results, AI in mHealth appears to have a positive impact on detecting more cutaneous (pre)malignancies, but this should be balanced against the for now stronger increase in care consumption for benign skin tumors and nevi.

npj Digital Medicine (2023)6:90 ; https://doi.org/10.1038/s41746-023-00831-w


15:50
Search
Close
skin spot not clearly visible

scientific reports

OPEN

Screening COVID-19 by Swaasa AI platform using cough sounds: a cross-sectional study

Padmalatha Pentakota[1], Gowrisree Rudraraju[2]✉, Narayana Rao Sripada[2], Baswaraj Mamidgi[2], Charishma Gottipulla[2], Charan Jalukuru[2], Shubha Deepti Palreddy[2], Nikhil Kumar Reddy Bhoge[2], Priyanka Firmal[2], Venkat Yechuri[2], Manmohan Jain[2], Venkata Sudhakar Peddireddi[1], Devi Madhavi Bhimarasetty[1], S. Sreenivas[1], Kesava Lakshmi Prasad K[1], Niranjan Joshi[3], Shibu Vijayan[4], Sanchit Turaga[5] & Vardhan Avasarala[6]

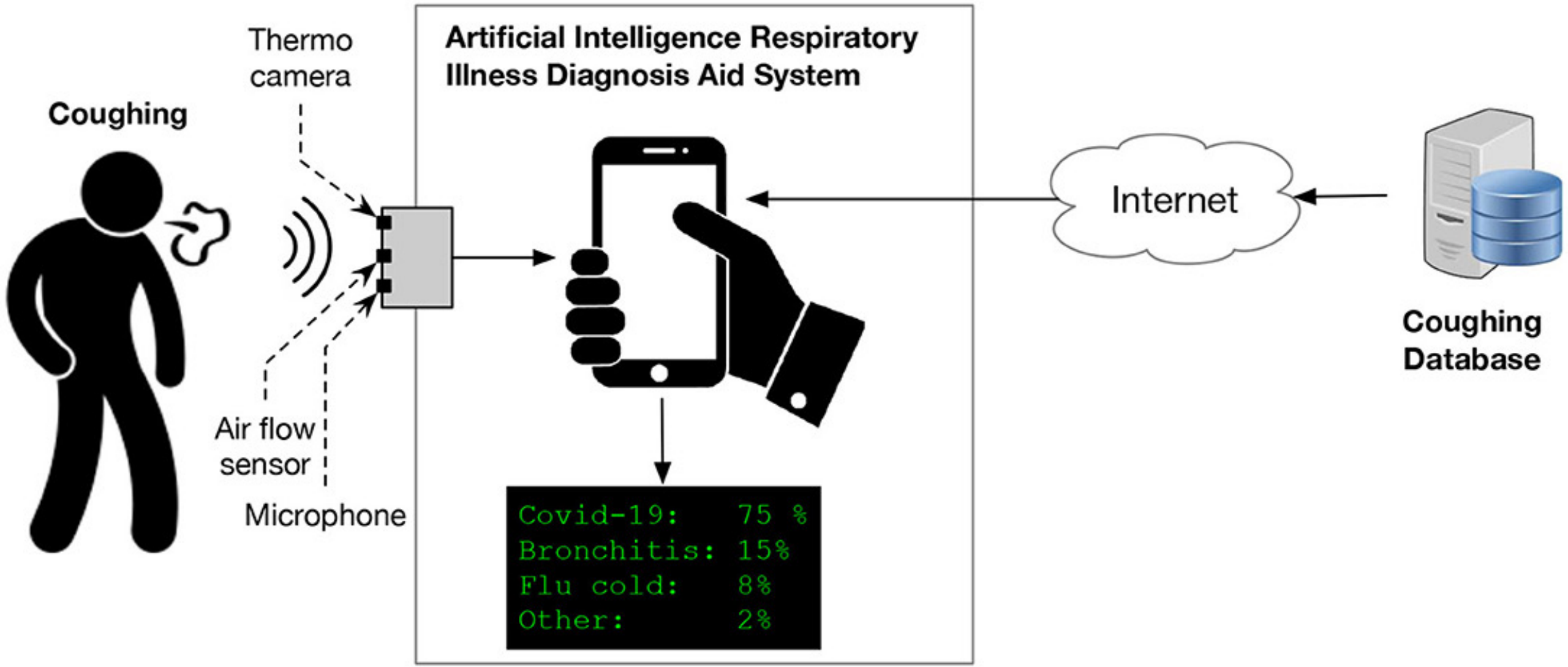
The Advent of Artificial Intelligence (AI) has led to the use of auditory data for detecting various diseases, including COVID-19. SARS-CoV-2 infection has claimed more than six million lives to date and therefore, needs a robust screening technique to control the disease spread. In the present study we created and validated the Swaasa AI platform, which uses the signature cough sound and symptoms presented by patients to screen and prioritize COVID-19 patients. We collected cough data from 234 COVID-19 suspects to validate our Convolutional Neural Network (CNN) architecture and Feedforward Artificial Neural Network (FFANN) (tabular features) based algorithm. The final output from both models was combined to predict the likelihood of having the disease. During the clinical validation phase, our model showed a 75.54% accuracy rate in detecting the likely presence of COVID-19, with 95.45% sensitivity and 73.46% specificity. We conducted pilot testing on 183 presumptive COVID subjects, of which 58 were truly COVID-19 positive, resulting in a Positive Predictive Value of 70.73%. Due to the high cost and technical expertise required for currently available rapid screening methods, there is a need for a cost-effective and remote monitoring tool that can serve as a preliminary screening method for potential COVID-19 subjects. Therefore, Swaasa would be highly beneficial in detecting the disease and could have a significant impact in reducing its spread.

UNIVERSITY OF CAMBRIDGE

COVID-19 Sounds App

Upload short recordings of cough and breathing and report symptoms to help researchers from the University of Cambridge detect if a person is suffering from COVID-19.

GET IT ON Google Play


Artificial Intelligence Respiratory
Illness Diagnosis Aid System
Thermo
camera
Coughing
Air flow
sensor
Microphone
Covid-19: 75 %
Bronchitis: 15%
Flu cold: 8%
Other: 2%
Internet
Coughing
Database

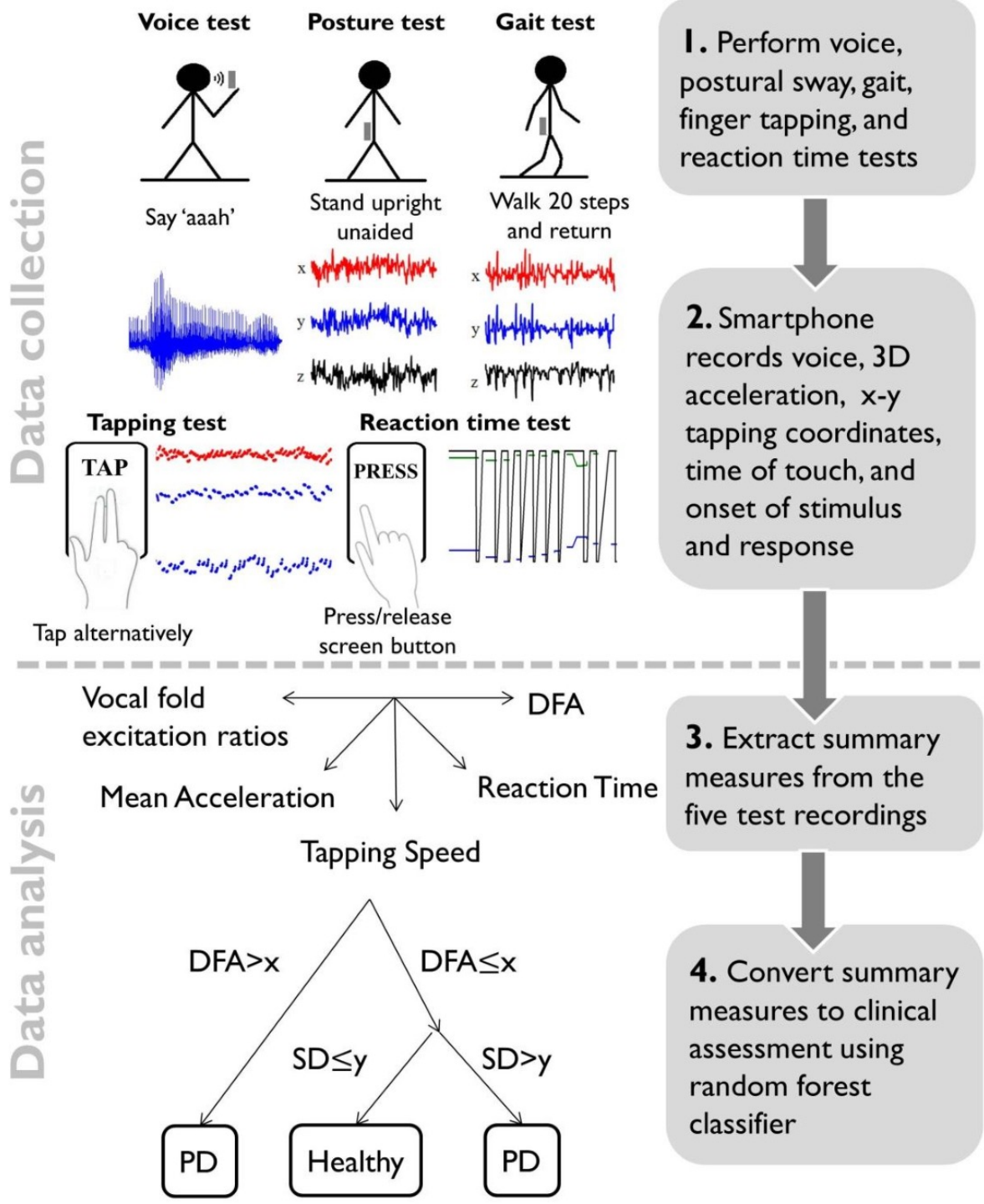
ARTICLES
https://doi.org/10.1038/s41587-021-00974-9
nature biotechnology

Check for updates

Remote smartphone monitoring of Parkinson's disease and individual response to therapy

Larsson Omberg[1,10] ✉, Elias Chaibub Neto[1,10] ✉, Thanneer M. Perumal[1], Abhishek Pratap[1,2], Aryton Tediarjo[1], Jamie Adams[3,4], Bastiaan R. Bloem[5], Brian M. Bot[1], Molly Elson[3], Samuel M. Goldman[6], Michael R. Kellen[1], Karl Kieburtz[3,4], Arno Klein[1], Max A. Little[7,8], Ruth Schneider[3,4], Christine Suver[1], Christopher Tarolli[3,4], Caroline M. Tanner[6], Andrew D. Trister[9], John Wilbanks[1], E. Ray Dorsey[3,4] and Lara M. Mangravite[1] ✉

Remote health assessments that gather real-world data (RWD) outside clinic settings require a clear understanding of appropriate methods for data collection, quality assessment, analysis and interpretation. Here we examine the performance and limitations of smartphones in collecting RWD in the remote mPower observational study of Parkinson's disease (PD). Within the first 6 months of study commencement, 960 participants had enrolled and performed at least five self-administered active PD symptom assessments (speeded tapping, gait/balance, phonation or memory). Task performance, especially speeded tapping, was predictive of self-reported PD status (area under the receiver operating characteristic curve (AUC) = 0.8) and correlated with in-clinic evaluation of disease severity ($r = 0.71$; $P < 1.8 \times 10^{-6}$) when compared with motor Movement Disorder Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS). Although remote assessment requires careful consideration for accurate interpretation of RWD, our results support the use of smartphones and wearables in objective and personalized disease assessments.



1. Perform voice, postural sway, gait, finger tapping, and reaction time tests

2. Smartphone records voice, 3D acceleration, x-y tapping coordinates, time of touch, and onset of stimulus and response

3. Extract summary measures from the five test recordings

4. Convert summary measures to clinical assessment using random forest classifier

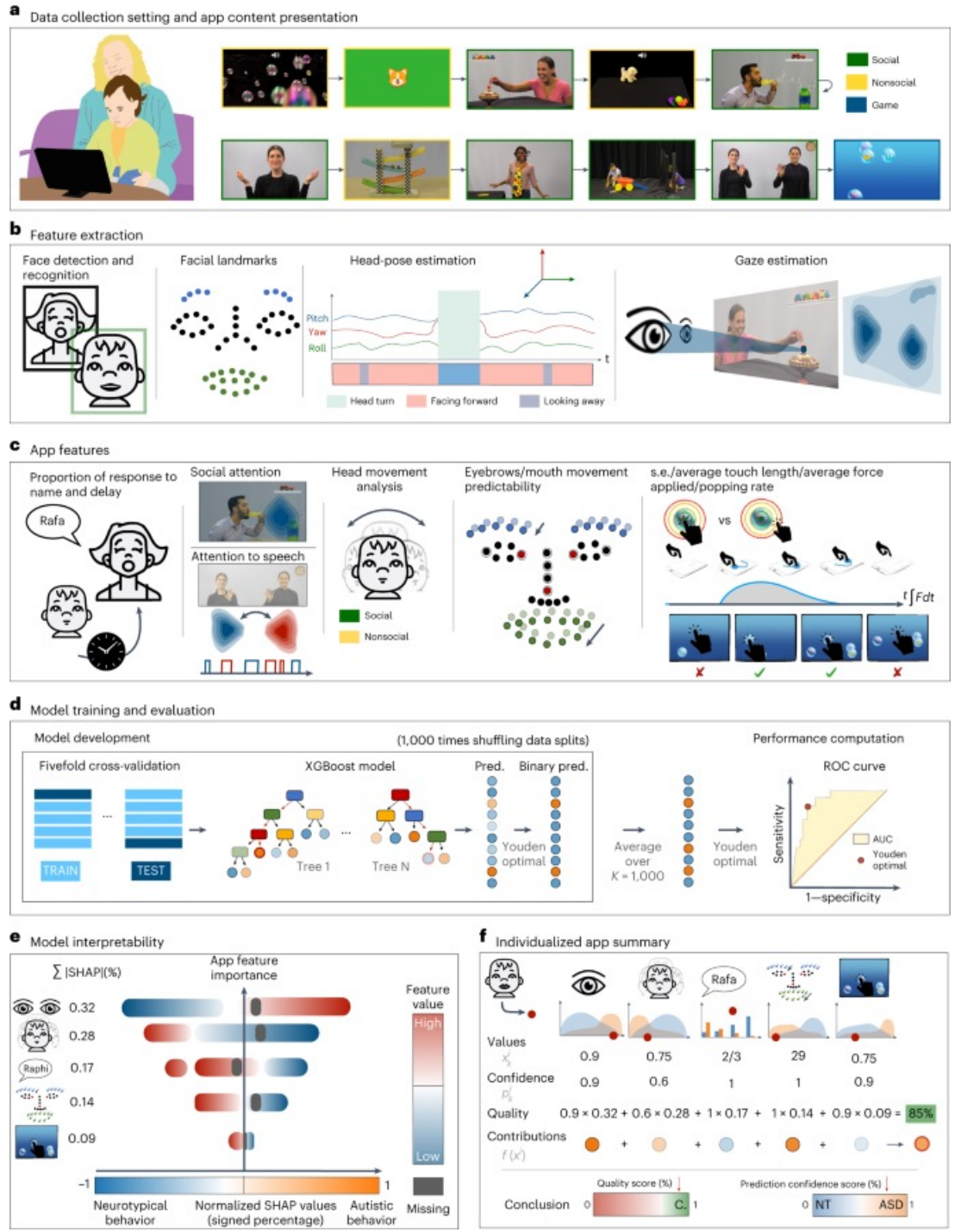
nature medicine

Article | Open access | Published: 02 October 2023

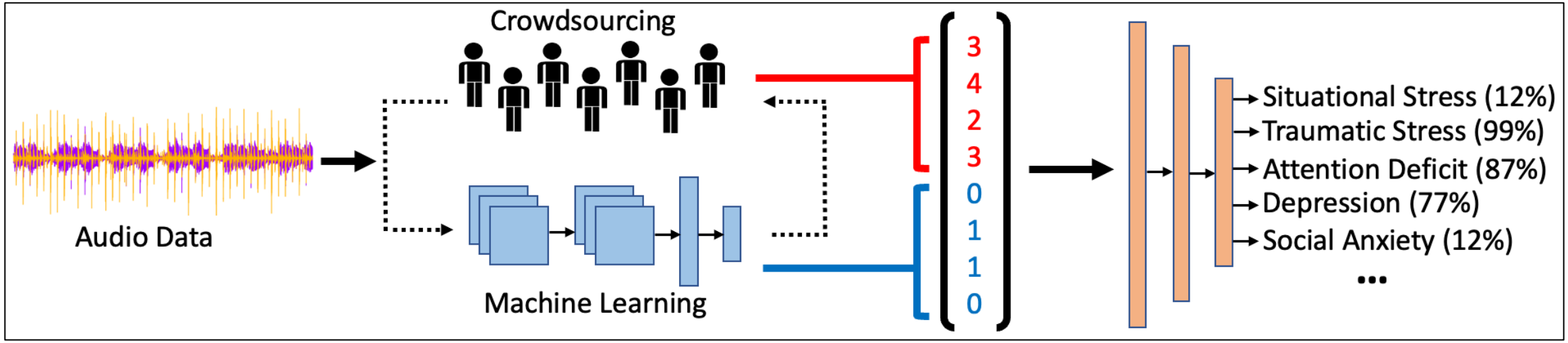
Early detection of autism using digital behavioral phenotyping

Sam Perochon, J. Matias Di Martino, Kimberly L. H. Carpenter, Scott Compton, Naomi Davis, Brian Eichner, Steven Espinosa, Lauren Franz, Pradeep Raj Krishnappa Babu, Guillermo Sapiro & Geraldine Dawson

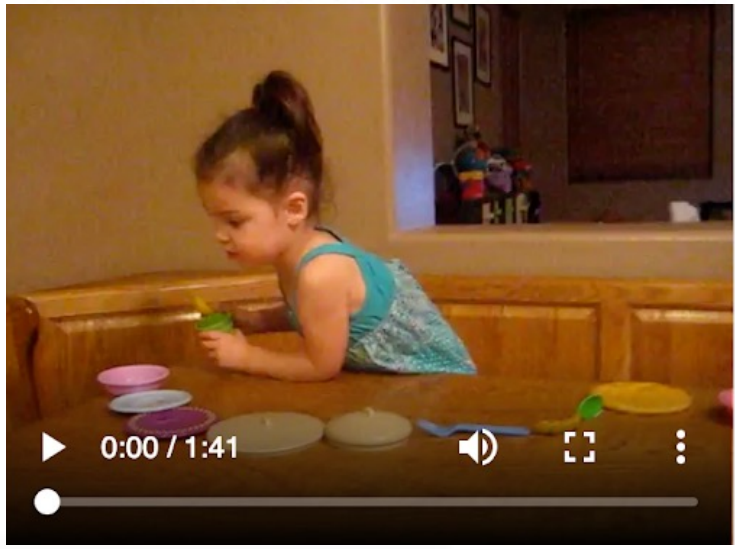
Nature Medicine **29**, 2489–2497 (2023) | Cite this article


a
Data collection setting and app content presentation
Social
Nonsocial
Game
b
Feature extraction
Face detection and recognition
Facial landmarks
Head-pose estimation
Pitch
Yaw
Roll
t
Head turn
Facing forward
Looking away
Gaze estimation
c
App features
Proportion of response to name and delay
Rafa
Social attention
Attention to speech
Head movement analysis
Social
Nonsocial
Eyebrows/mouth movement predictability
s.e./average touch length/average force applied/popping rate
vs
t ∫Fdt
d
Model training and evaluation
Model development
(1,000 times shuffling data splits)
Performance computation
Fivefold cross-validation
XGBoost model
Pred.
Binary pred.
TRAIN
TEST
Tree 1
Tree N
Youden optimal
Average over K = 1,000
Youden optimal
ROC curve
Sensitivity
AUC
Youden optimal
1—specificity
e
Model interpretability
∑ |SHAP|(%)
App feature importance
Feature value
High
Low
0.32
0.28
Raphi
0.17
0.14
0.09
−1
1
Neurotypical behavior
Normalized SHAP values (signed percentage)
Autistic behavior
Missing
f
Individualized app summary
Rafa
Values
0.9
0.75
2/3
29
0.75
Confidence
0.9
0.6
1
1
0.9
Quality
0.9 × 0.32 + 0.6 × 0.28 + 1 × 0.17 + 1 × 0.14 + 0.9 × 0.09 = 85%
Contributions
Quality score (%)
Prediction confidence score (%)
Conclusion
0
1
NT
ASD

Some of the research from my lab



Crowdsourcing experiment interface

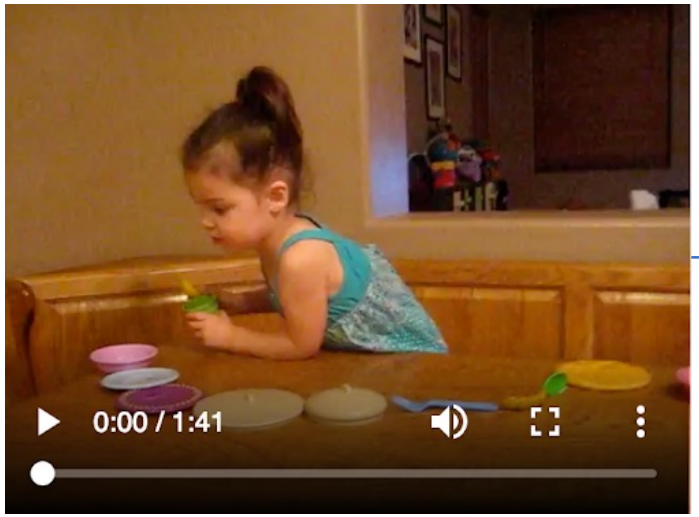


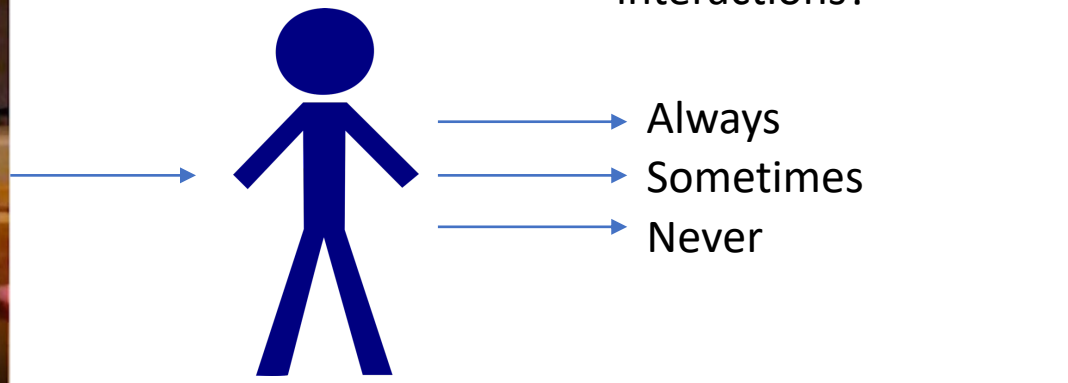
Rate this child's display of echolalia (does the child immediately repeat the last statement made by the parent/caregiver, for example, repeating the parent's question? Do not include repetition that is appropriate to use in conversation or that is requested by the parent, i.e. "Say, 'dog.'").

- ○ No demonstration of echolalia. Does not repeat others' speech.
- ○ Occasionally or rarely echoes others.
- ○ Mixed: some regular echoing of words and phrases, but also some language.
- ○ Mostly echoed speech.
- ○ N/A: no speech was displayed.

Washington et al. *Scientific Reports*. 2021.

Evaluating workers

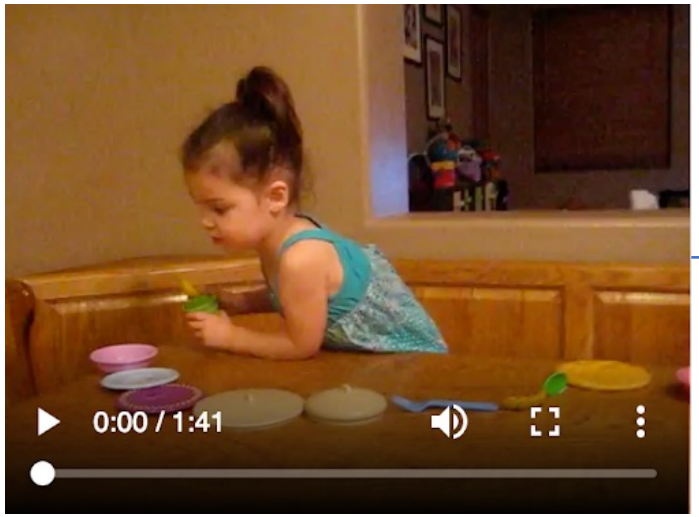




Does the child enjoy participating in social games and interactions?

- Always
- Sometimes
- Never

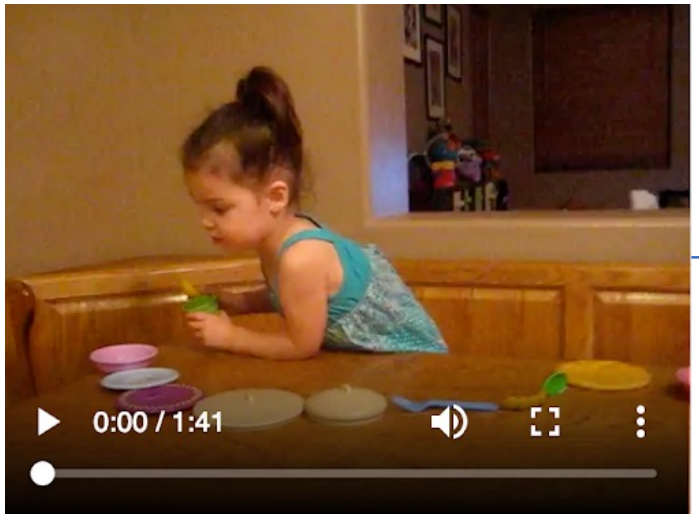
Evaluating workers



Does the child enjoy participating in social games and interactions?

- Always
- **Sometimes**
- Never

Evaluating workers



Does the child enjoy participating in social games and interactions?

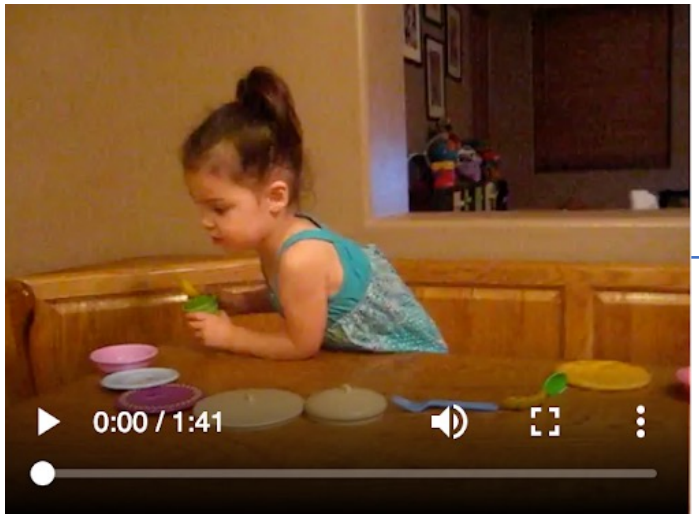
Always

Sometimes

Never

1

Evaluating workers



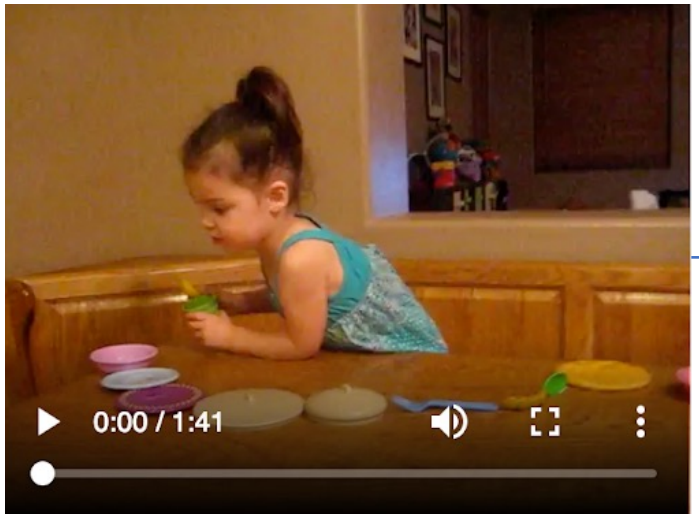
Does the child entertain herself/himself/themself without help from others?

Always 2

Sometimes 1

Never

Evaluating workers



Rate the child's expressive language and conversation ability.

Excellent

Satisfactory

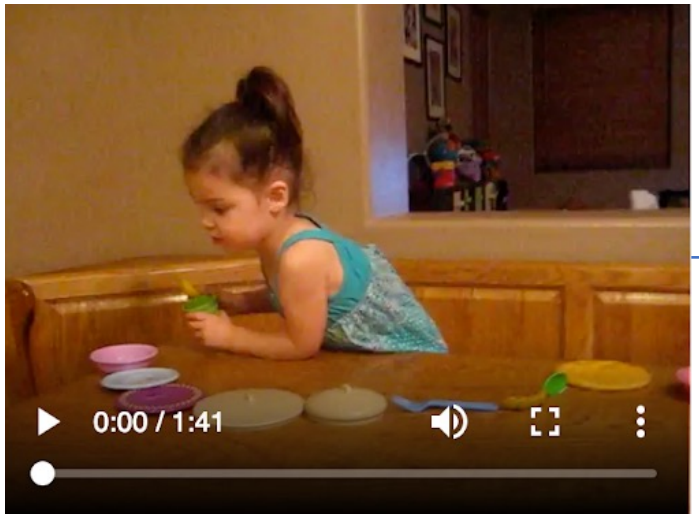
Poor

2

1

0

Evaluating workers

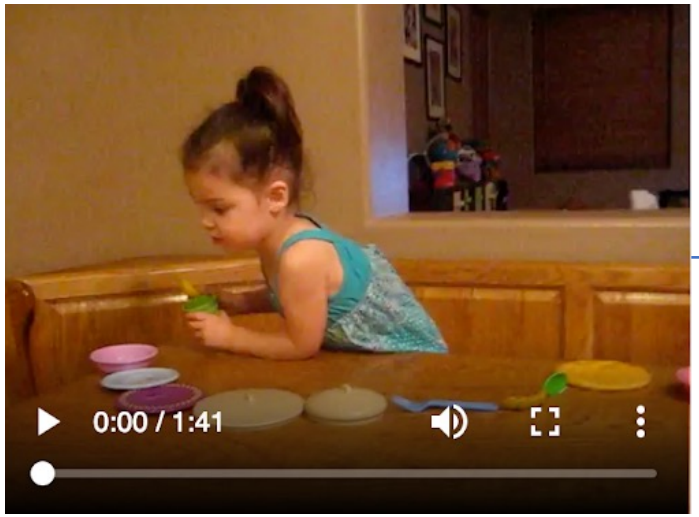


Does the child understand and respond to spoken language?

Always
Sometimes
Never

1
2
1
0

Evaluating workers

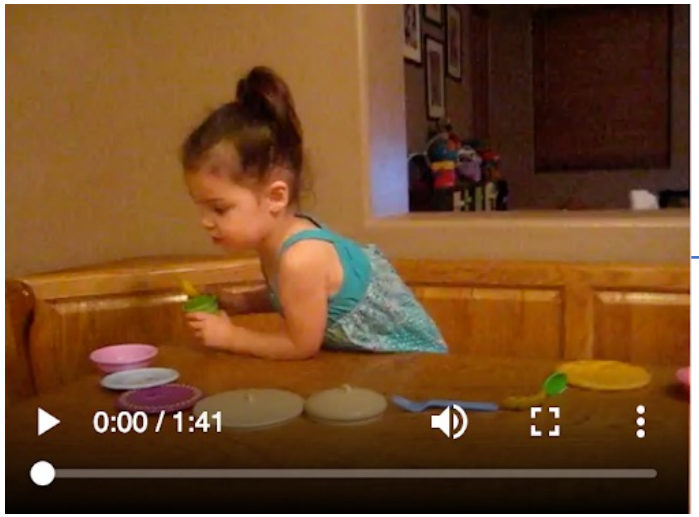


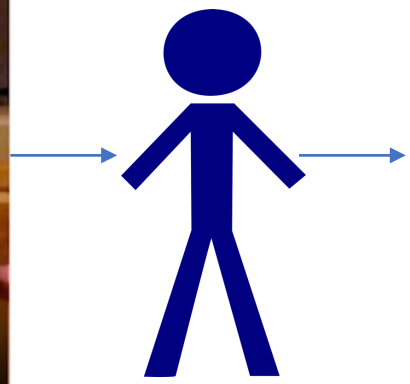
Would the child comfort someone if they were feeling upset, hurt, or sad?

Yes
Probably
Unlikely

1
2
1
0
0

Evaluating workers





1

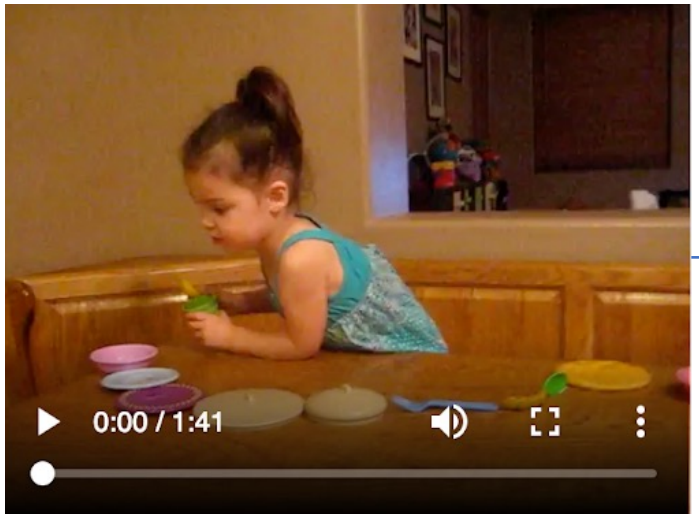
2

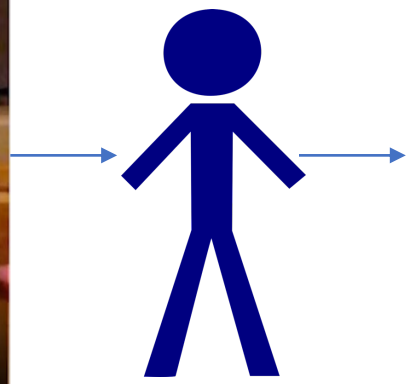
1

0

0

Evaluating workers





1

2

1

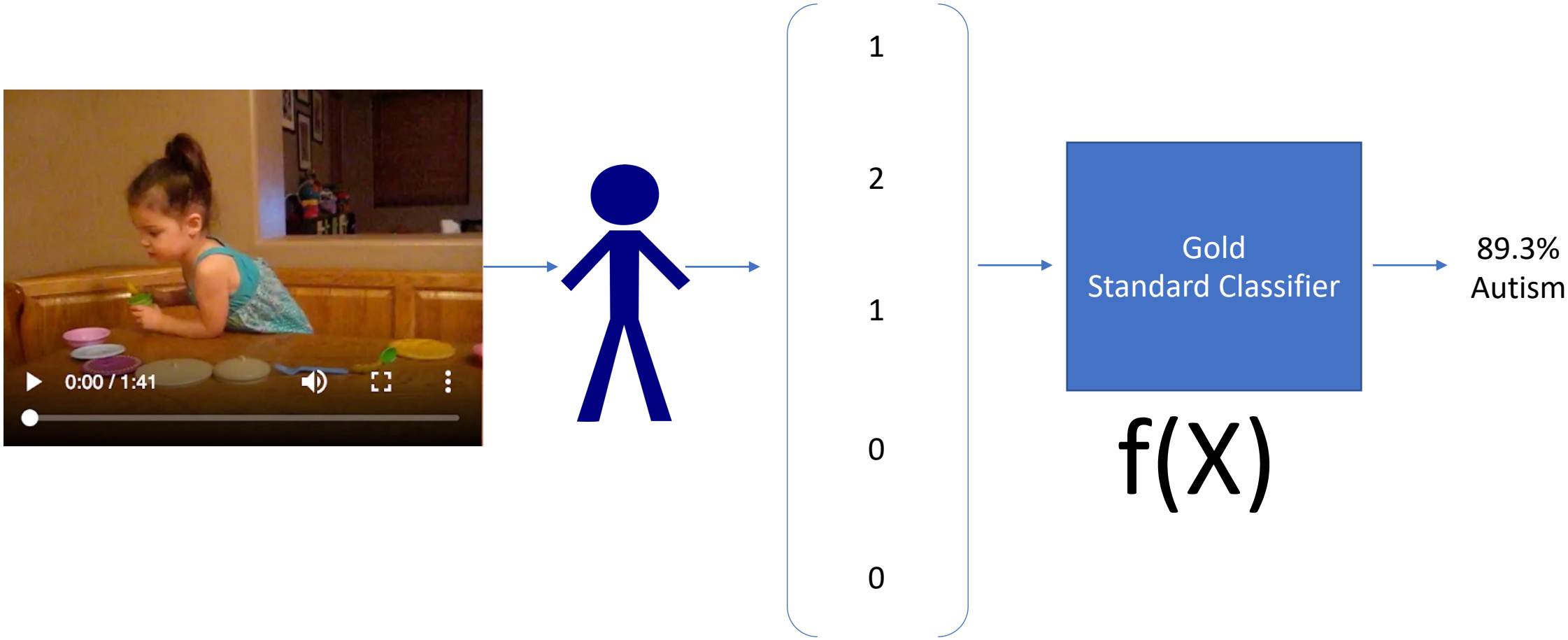
0

0

Gold
Standard Classifier

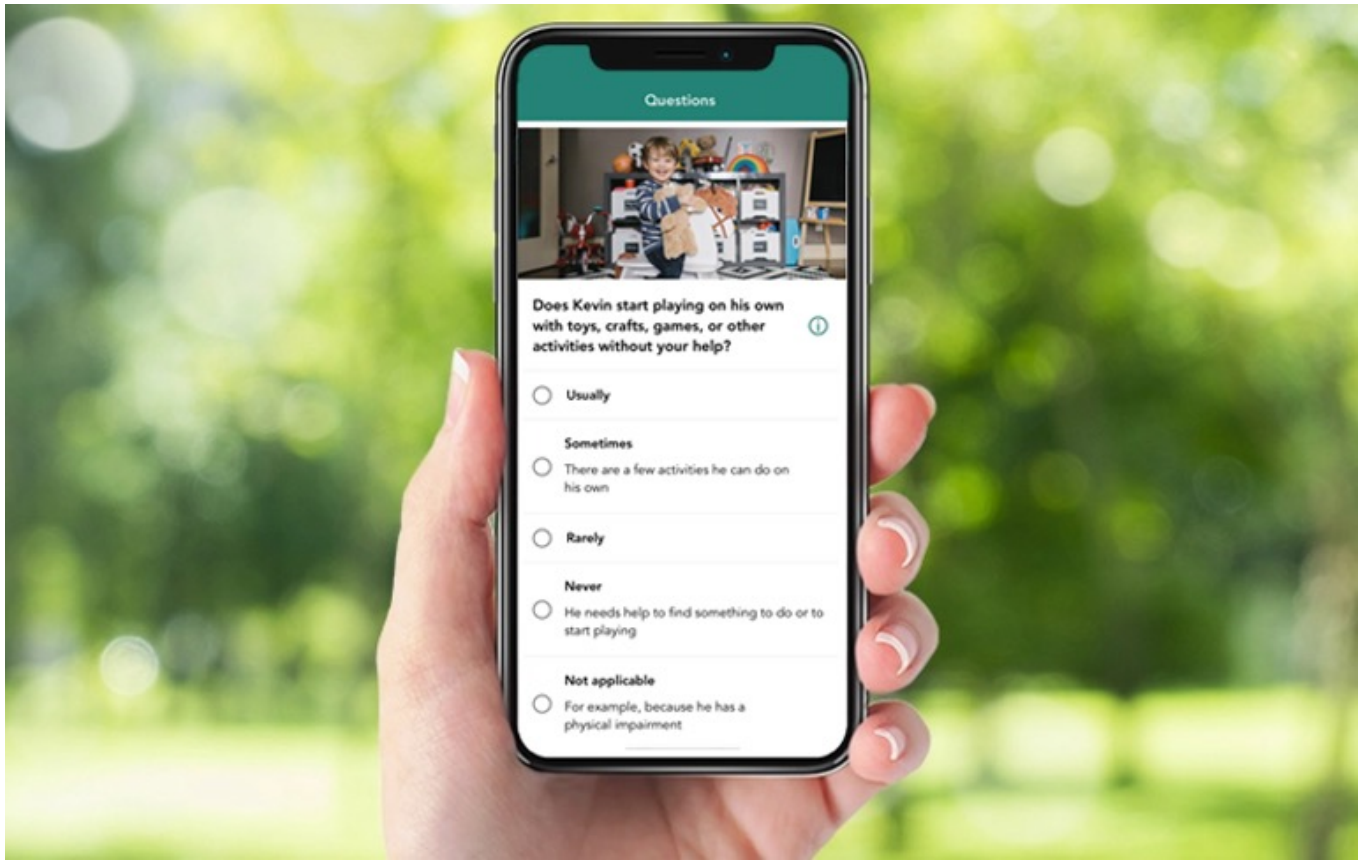
f(X)

Evaluating workers

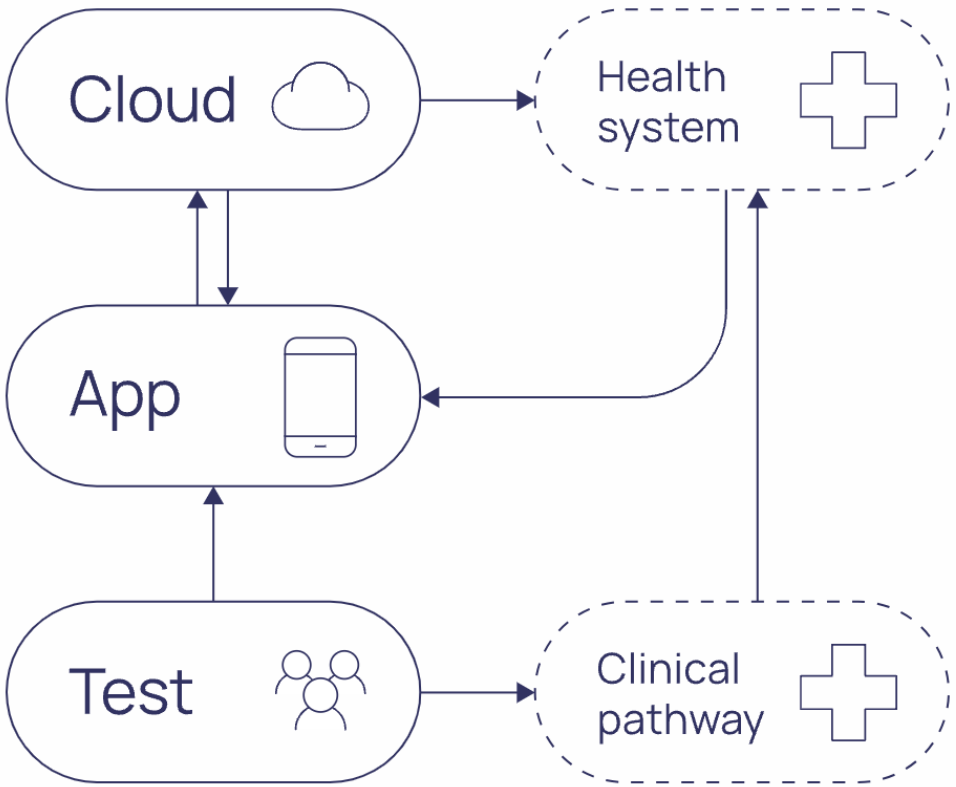


Exciting Companies

cognoa


Questions
Does Kevin start playing on his own with toys, crafts, games, or other activities without your help?
Usually
Sometimes
There are a few activities he can do on his own
Rarely
Never
He needs help to find something to do or to start playing
Not applicable
For example, because he has a physical impairment

PocDoc

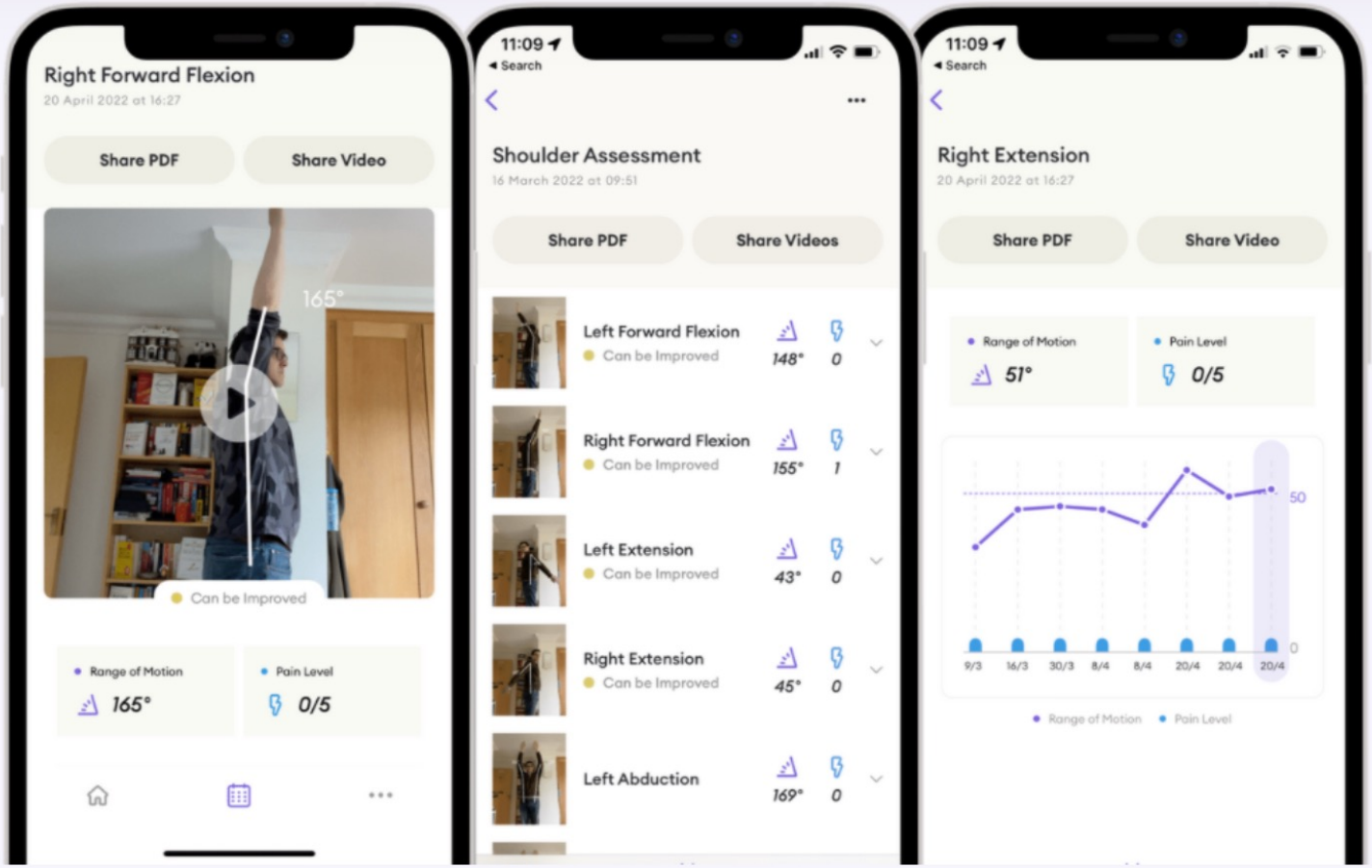


PocDoc is a digital platform – from test to app to cloud – that provides results, risk assessment and access to follow on treatment from your

- Test yourself using any PocDoc tests at home at your convenience
- Checks key heart health measures, including blood test in under 10 minutes
- Available on iOS and Android
- Clear explanation of your results, overlayed with risk factors
- Real time connection to clinical advice, follow on support and potential treatments

You're 5 Minutes from Improving Your Shoulder Health

Your phone is the only tool you need to understand your current mobility.



DIGITAL DIAGNOSTICS
AI the right way.®

We are Digital Diagnostics

Digital Diagnostics Inc. is a pioneering AI diagnostics company on a mission to benefit patients by transforming the accessibility, affordability, equity, and quality of global healthcare through the application of technology in the medical diagnosis and treatment process.

Diagnostic tools expedite and expand access to specialty care.

Chronic disease management supports remote patient monitoring.

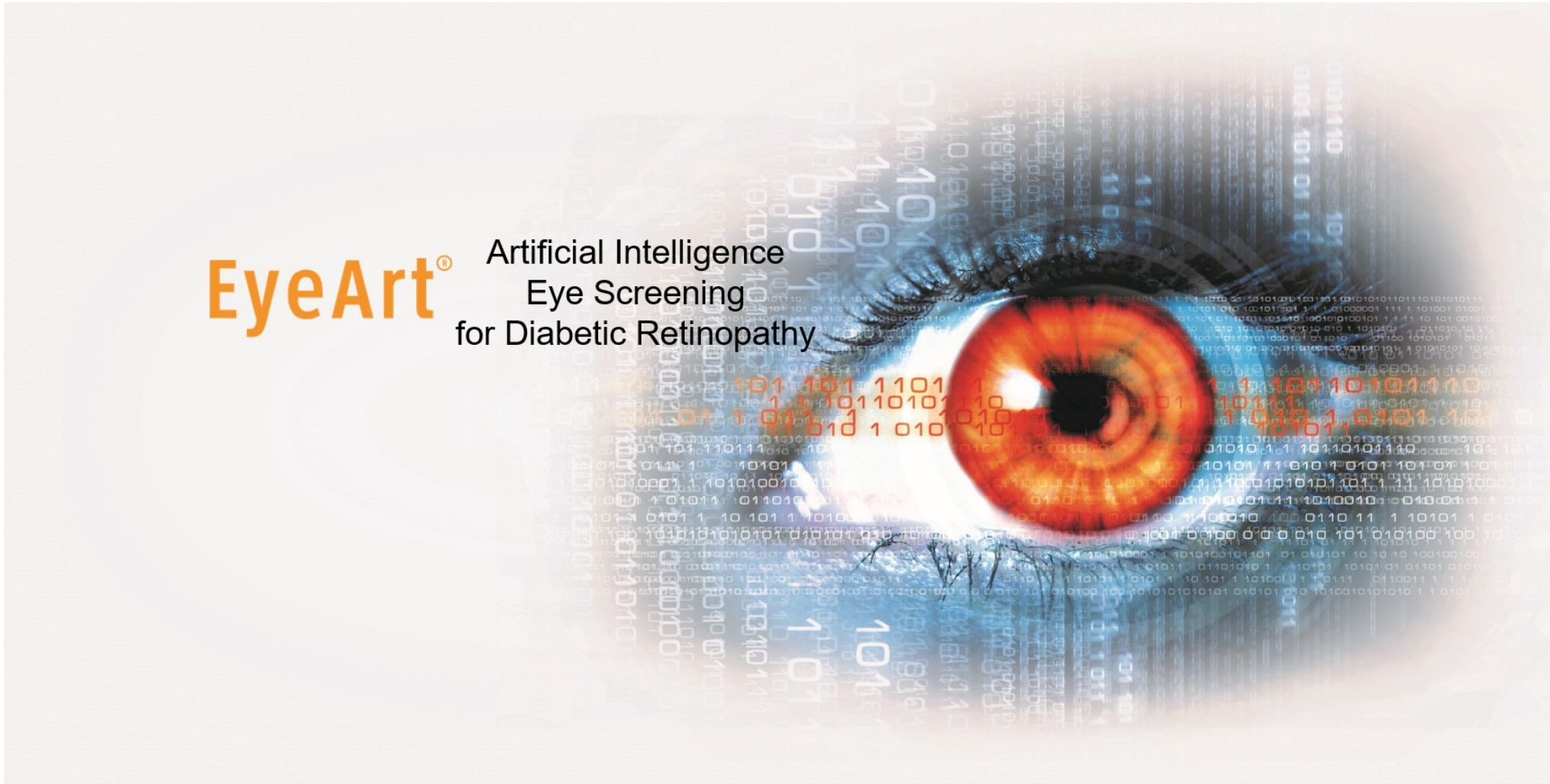
Life sciences applications enable trial and therapy monitoring.

skin
analytics

EYENUK™

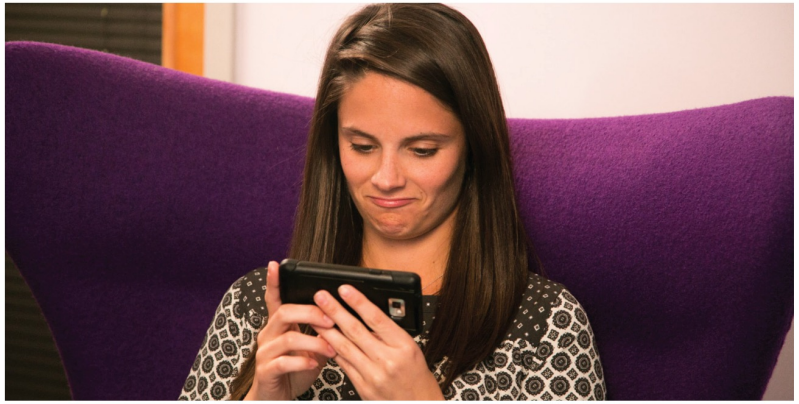
EyeArt®

Artificial Intelligence
Eye Screening
for Diabetic Retinopathy



:) Affectiva

a smart eye company



PUBLICATION

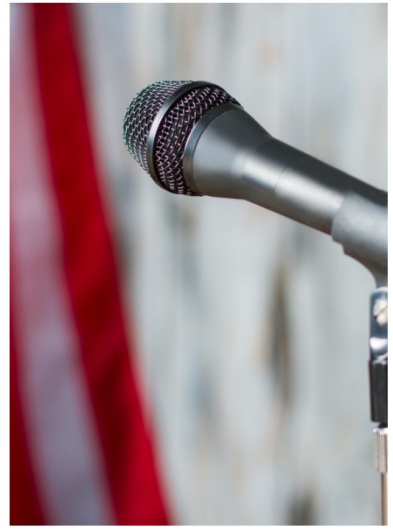
Supervised Learning Approach to Remote Heart Rate Estimation from Facial Videos

Following the success of researchers at the MIT Media Lab estimating t...

PUBLICATION ADVERTISING MEDIA

Predicting Online Media Effectiveness Based on Smile Responses Gathered Over the Internet

To determine whether a viewer liked a piece of media and would like t...



PUBLICATION MEDIA

Measuring Voter's Candidate Preference Based on Affective Responses to Election Debates

Political debates cover emotive issues that impact people's lives. T...

AEYE Health

COGNITA Labs

FDA CLEARED

iRhythm

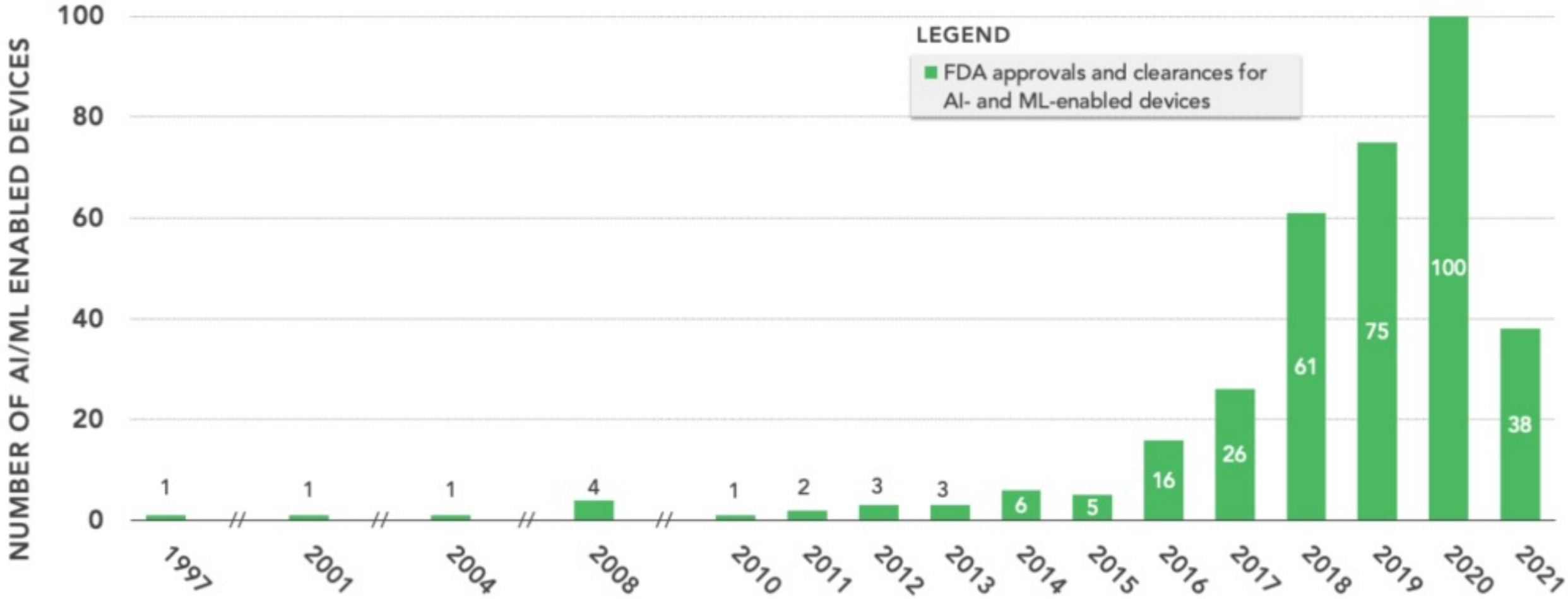
Google Health

GE Healthcare

AI/ML-ENABLED DEVICES OVER TIME

FDA approvals and clearances from 1997–2021[1]

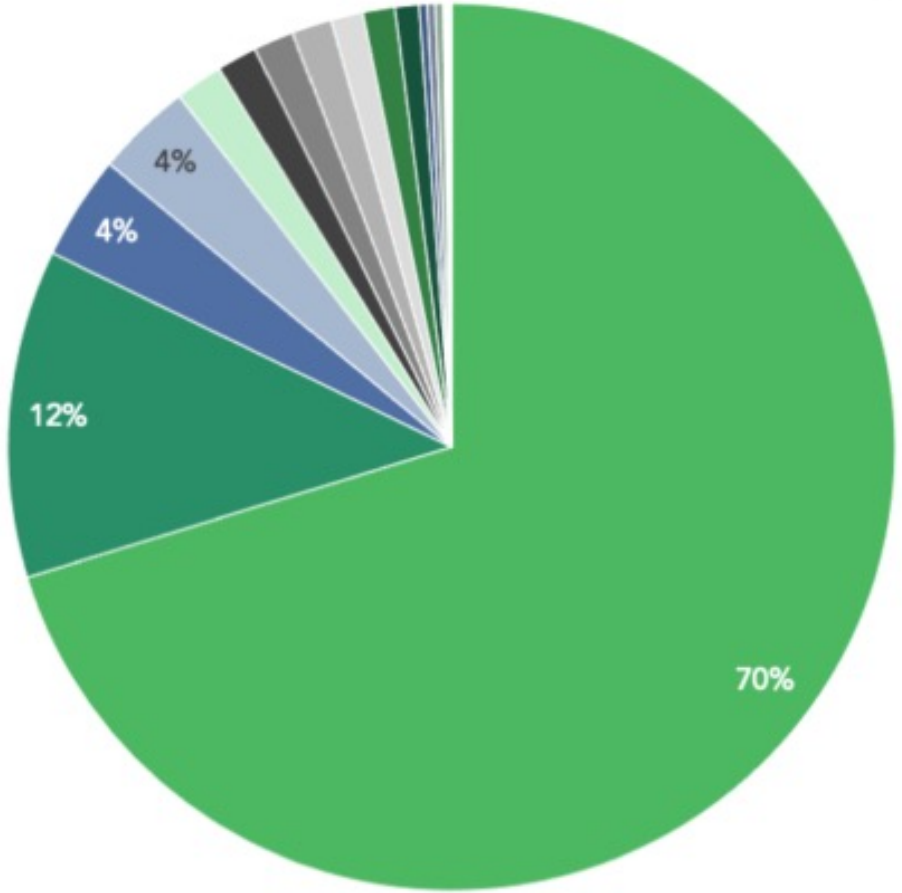
ROCK HEALTH



Note: 1. 2021 includes FDA approvals and clearances for AI- and ML-enabled devices through June 17, 2021
Source: FDA list of Artificial Intelligence and Machine Learning (AI/ML)-Enabled Medical Devices as of 09/22/2021

AI/ML-ENABLED DEVICES BY THERAPEUTIC AREA

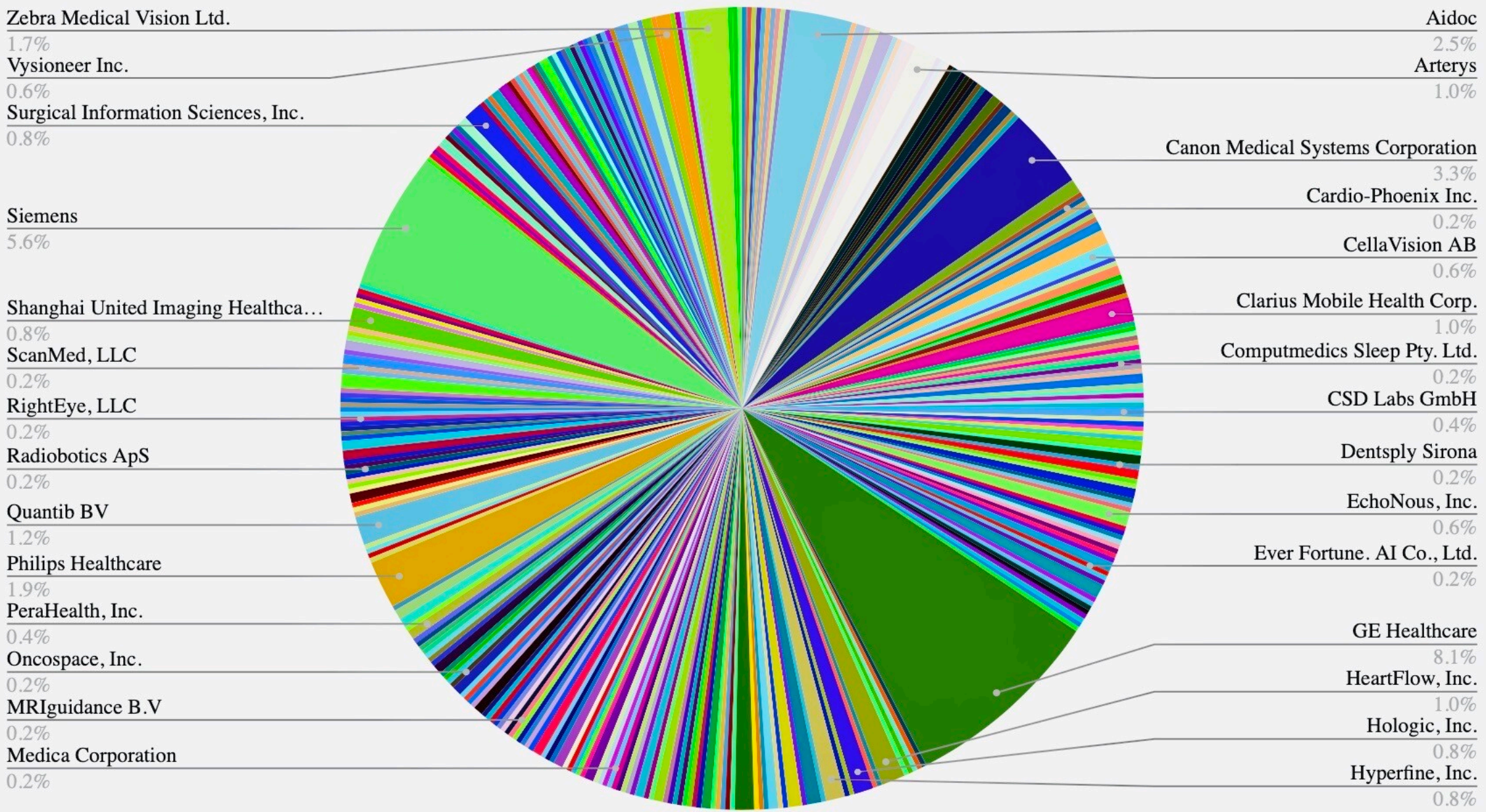
FDA approvals and clearances from1997–2021[1]



LEGEND

- Radiology
- Cardiovascular
- Hematology
- Neurology
- Ophthalmic
- Clinical Chemistry
- General And Plastic Surgery
- Microbiology
- Gastroenterology-Urology
- Anesthesiology
- General Hospital
- Obstetrics And Gynecology
- Pathology
- Dental
- Orthopedic

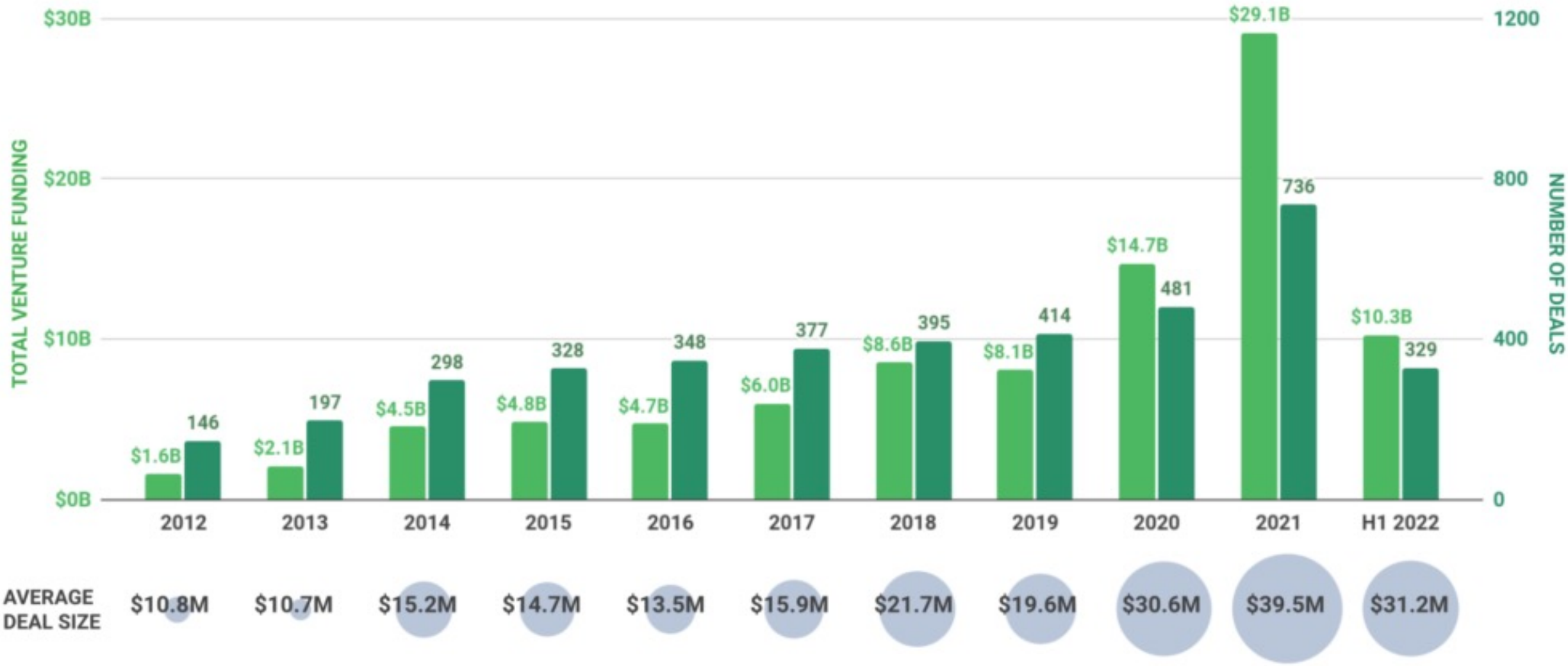
Note: 1. 2021 includes FDA approvals and clearances for AI- and ML-enabled devices through June 17, 2021
Source: FDA list of Artificial Intelligence and Machine Learning (AI/ML)-Enabled Medical Devices as of 09/22/2021


Zebra Medical Vision Ltd.
1.7%
Vysioneer Inc.
0.6%
Surgical Information Sciences, Inc.
0.8%
Siemens
5.6%
Shanghai United Imaging Healthca…
0.8%
ScanMed, LLC
0.2%
RightEye, LLC
0.2%
Radiobotics ApS
0.2%
Quantib BV
1.2%
Philips Healthcare
1.9%
PeraHealth, Inc.
0.4%
Oncospace, Inc.
0.2%
MRIguidance B.V
0.2%
Medica Corporation
0.2%
Aidoc
2.5%
Arterys
1.0%
Canon Medical Systems Corporation
3.3%
Cardio-Phoenix Inc.
0.2%
CellaVision AB
0.6%
Clarius Mobile Health Corp.
1.0%
Computmedics Sleep Pty. Ltd.
0.2%
CSD Labs GmbH
0.4%
Dentsply Sirona
0.2%
EchoNous, Inc.
0.6%
Ever Fortune. AI Co., Ltd.
0.2%
GE Healthcare
8.1%
HeartFlow, Inc.
1.0%
Hologic, Inc.
0.8%
Hyperfine, Inc.
0.8%

U.S. DIGITAL HEALTH FUNDING AND DEAL SIZE

2012-H1 2022

ROCK HEALTH



Note: Includes U.S. deals >$2M; data through June 30, 2022
Source: Rock Health Digital Health Venture Funding Database

Next time, we will talk about digital **therapeutics** research and companies