
LUXEMBOURG
INSTITUTE
OF HEALTH
Voice for Health
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Voice is the new Blood

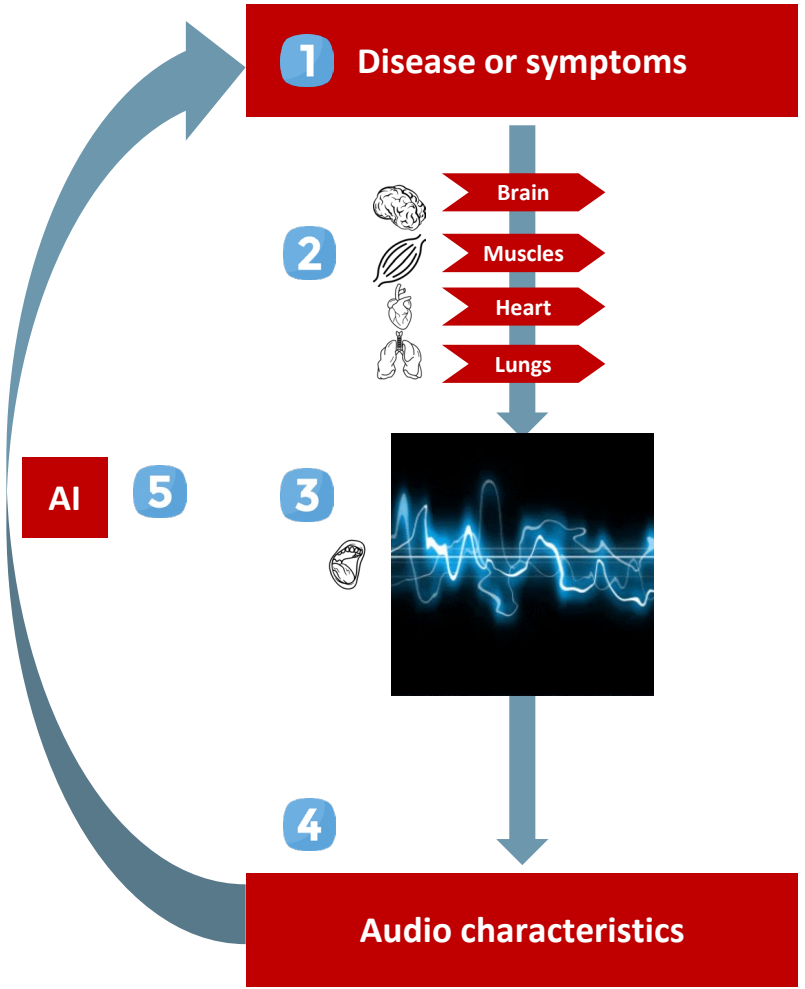
Why Voice?

- **Voice is the most natural, energy-efficient way of interacting with each others**
- **Easy to collect**: **only need a microphone**
- Cheap & widely available digital source (a majority of people have a smartphone or vocal assistant)

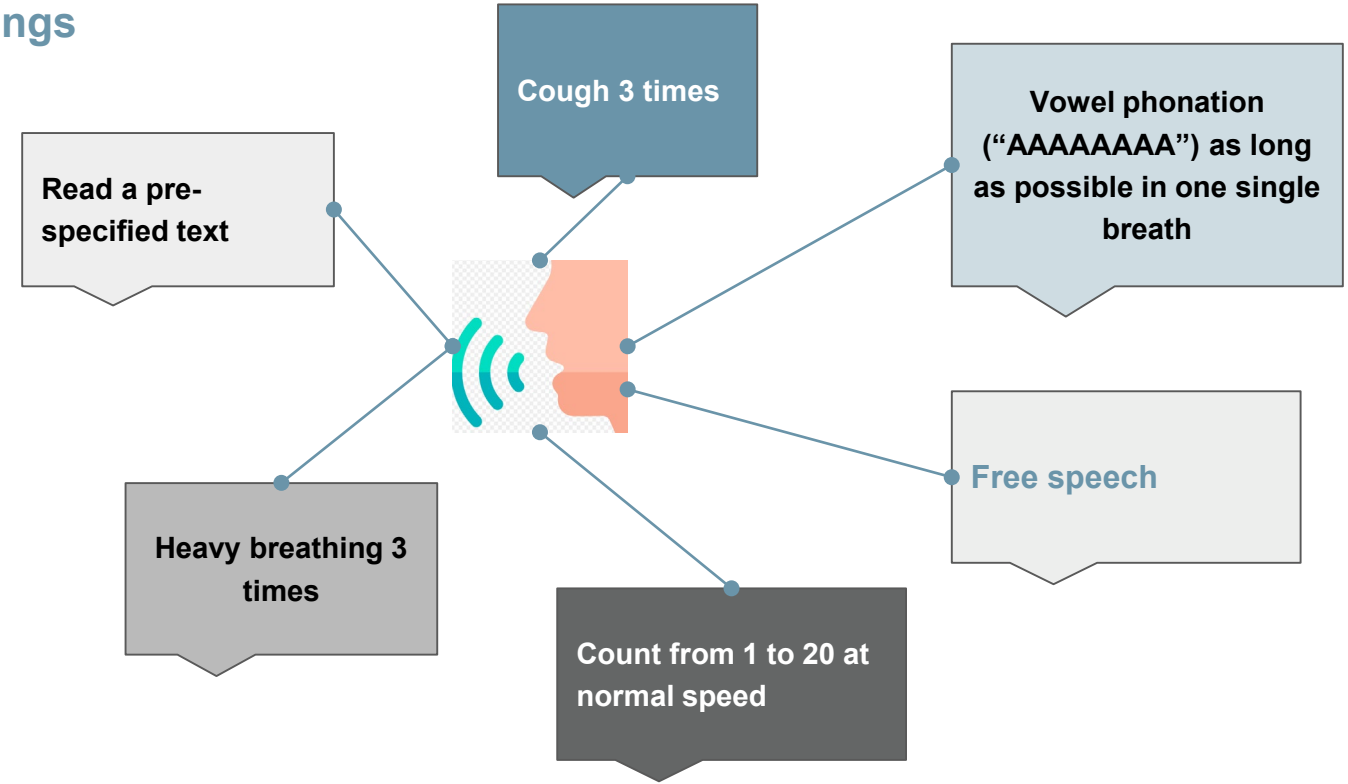
Vocal biomarker = combination of features from the audio signal of the voice that is associated with a disease or a symptom.

Which characteristics?

- Articulation
- Pitch of voice
- Rhythm of speech
- Loudness
- Text content
- Many characteristics not perceptible to human ears



Different types of audio recordings



In practice

Different health issues:

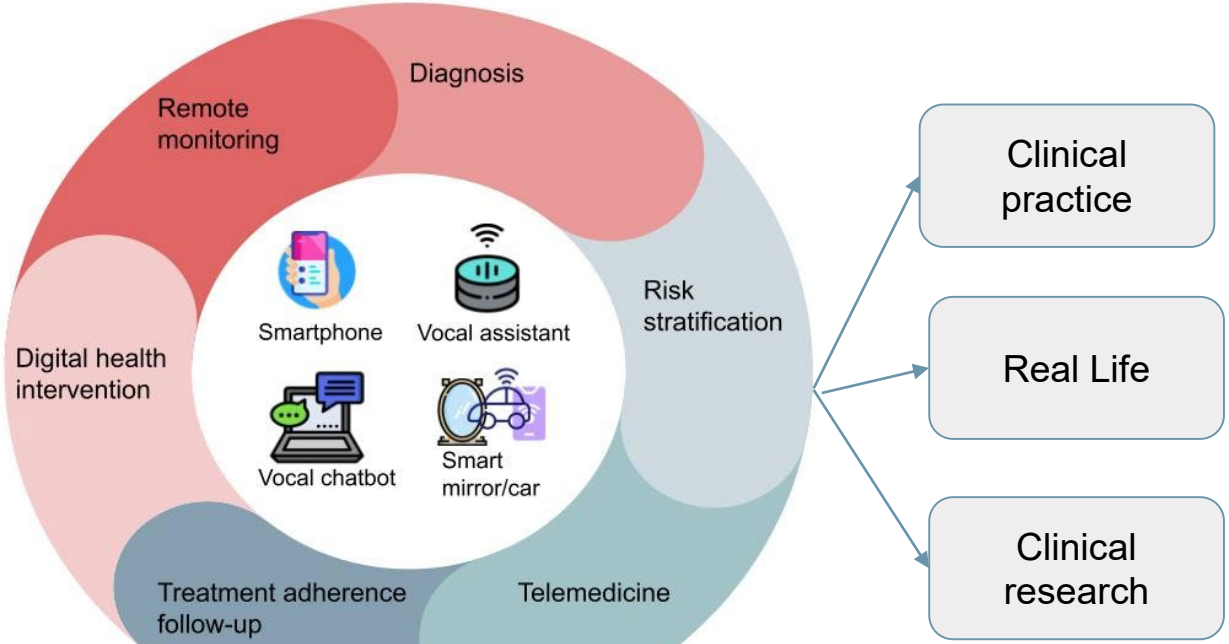
COVID-19 and Long COVID

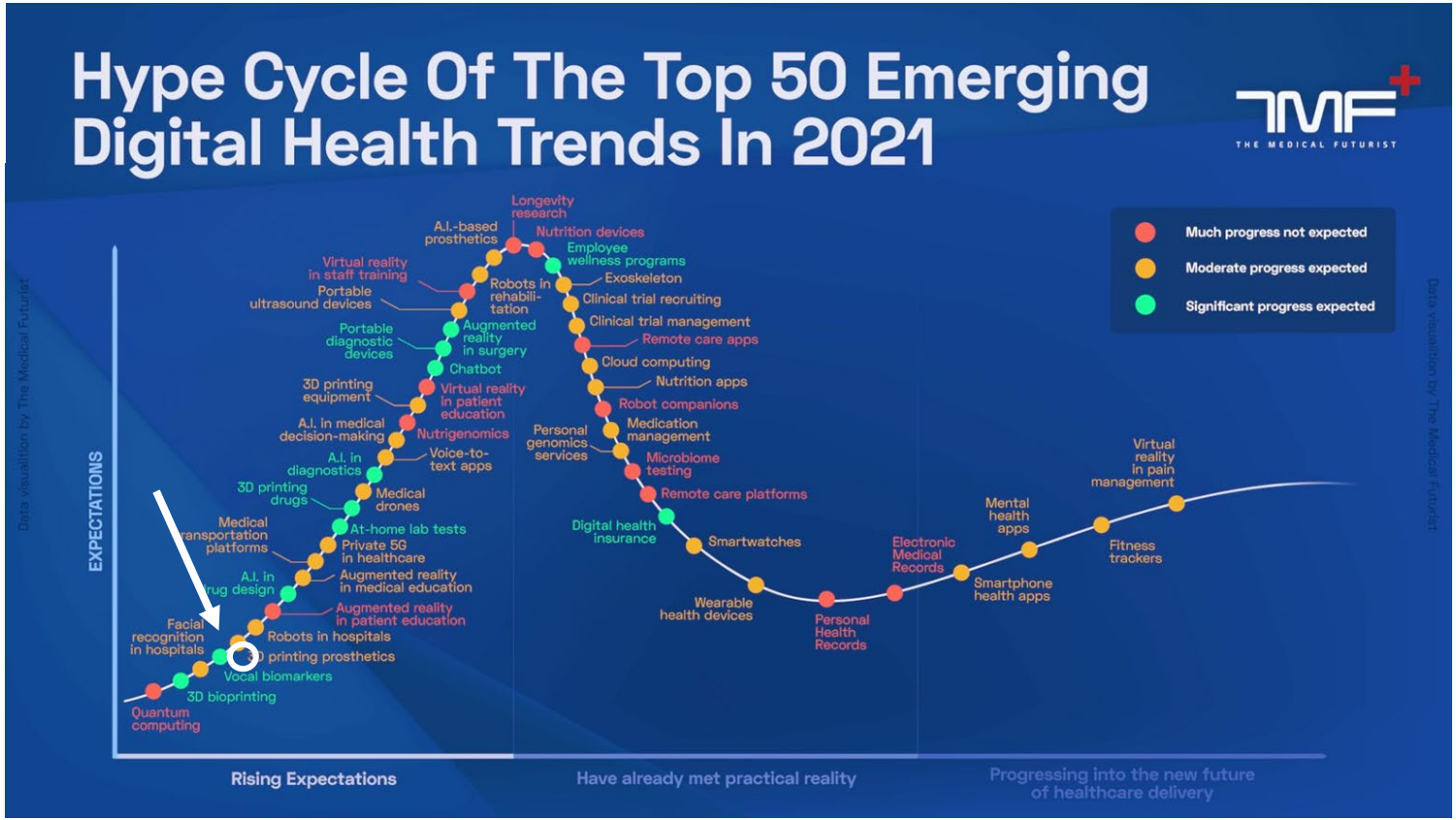
Mental health

Neurodegenerative diseases

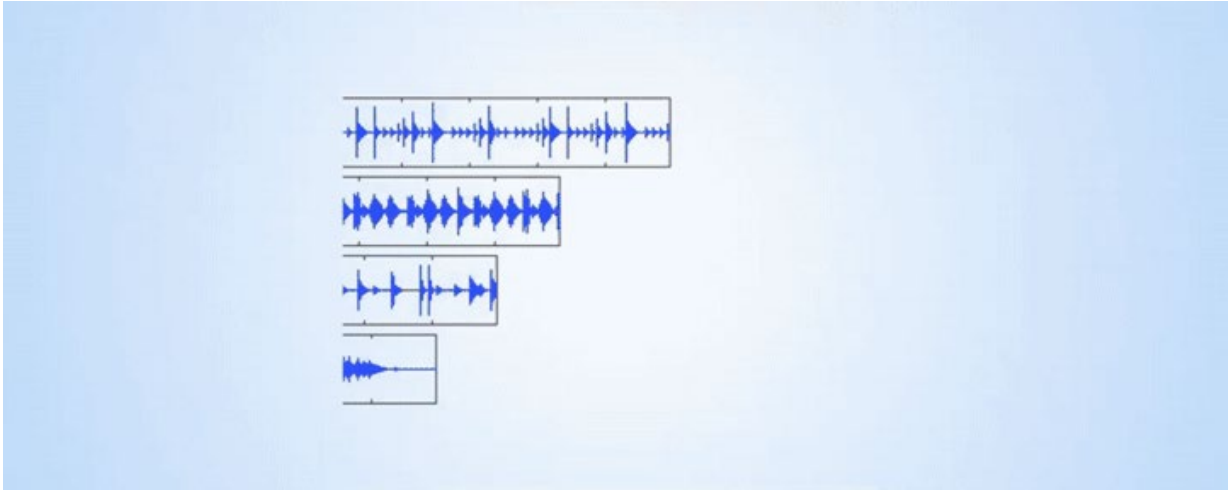
Cancer

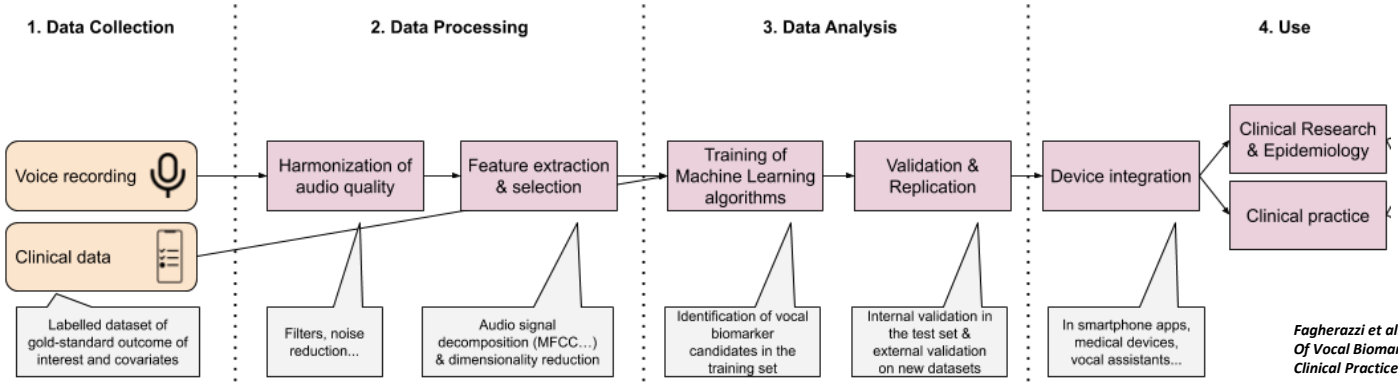
Cardiometabolic diseases




Hype Cycle Of The Top 50 Emerging Digital Health Trends In 2021
THE MEDICAL FUTURIST
Much progress not expected
Moderate progress expected
Significant progress expected
EXPECTATIONS
Data visualition by The Medical Futurist
Quantum computing
3D bioprinting
Vocal biomarkers
3D printing prosthetics
Facial recognition in hospitals
Robots in hospitals
Augmented reality in patient education
Augmented reality in medical education
A.I. in drug design
Private 5G in healthcare
Medical transportation platforms
At-home lab tests
Medical drones
3D printing drugs
A.I. in diagnostics
Voice-to-text apps
Nutrigenomics
A.I. in medical decision-making
3D printing equipment
Virtual reality in patient education
Chatbot
Augmented reality in surgery
Portable diagnostic devices
Portable ultrasound devices
Virtual reality in staff training
A.I.-based prosthetics
Longevity research
Nutrition devices
Employee wellness programs
Exoskeleton
Robots in rehabili-tation
Clinical trial recruiting
Clinical trial management
Remote care apps
Cloud computing
Nutrition apps
Robot companions
Medication management
Personal genomics services
Microbiome testing
Remote care platforms
Digital health insurance
Smartwatches
Wearable health devices
Personal Health Records
Electronic Medical Records
Smartphone health apps
Mental health apps
Fitness trackers
Virtual reality in pain management
Rising Expectations
Have already met practical reality
Progressing into the new future of healthcare delivery

Pipeline to convert voice recordings into vocal biomarkers





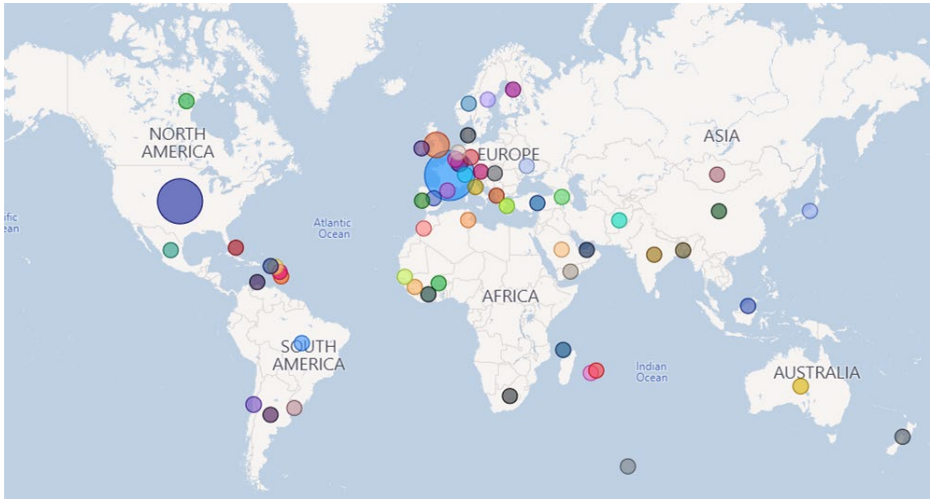
Fagherazzi et al. Voice For Health: The Use Of Vocal Biomarkers From Research To Clinical Practice. Digital Biomarkers 2021

TWO MAIN DATA SOURCES

ColiveVoice
BY LUXEMBOURG INSTITUTE OF HEALTH

A **worldwide, multi-lingual**, online survey to collect voice recordings and health data to develop vocal biomarkers:

Diabetes, Cancer, Cardiovascular Disease, COVID-19, Mental Health…



www.colivevoice.org

Colive Voice web app

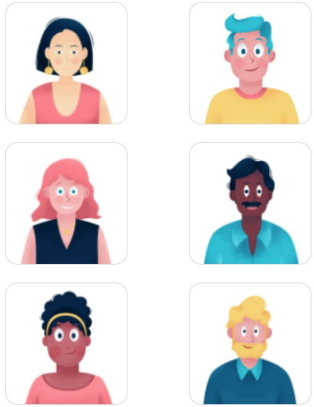
ColiveVoice
BY LUXEMBOURG INSTITUTE OF HEALTH

- Everyone can participate
- English, French, German, Spanish, Portuguese
- Short: 20-30mn on average

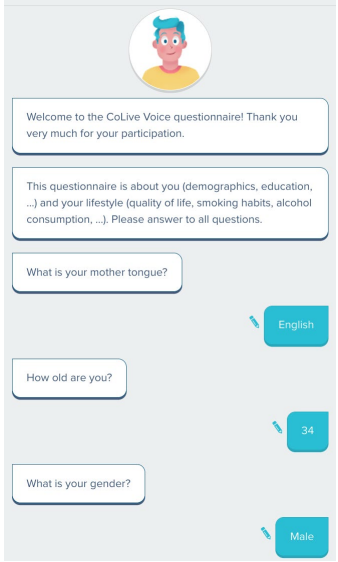
1. Consent & Avatar selection

Pick your Avatar

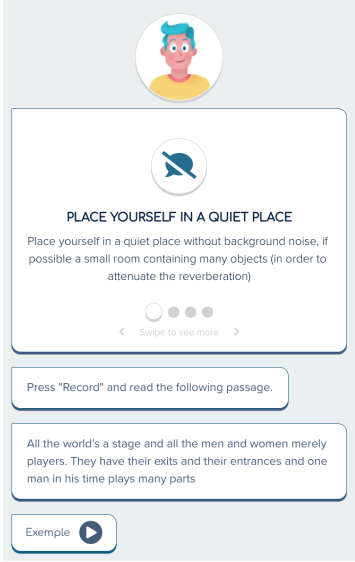
He will follow you on your journey



2. Health questionnaires



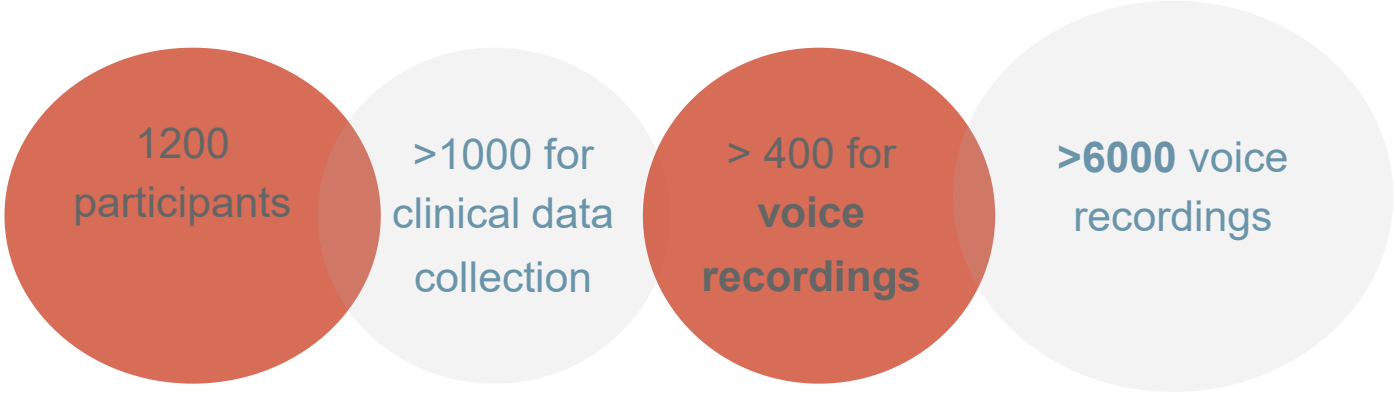
3. Recording session



/Predi-COVID/

RESEARCH LUXEMBOURG

- Luxembourgish cohort of people diagnosed with COVID-19
- Followed over time for max 24 months
- Regular online questionnaires (symptoms, health status..) + voice recordings at the same time
- Vocal tasks : Say Aaaaah + read a short paragraph of the human right declaration



/Predi-COVID/

RESEARCH LUXEMBOURG

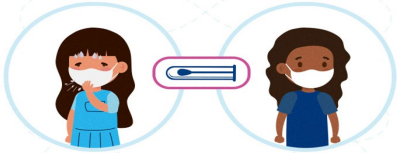
Several vocal biomarkers candidate

Respiratory problems

Mental Health

Loss of taste and smell

Fatigue

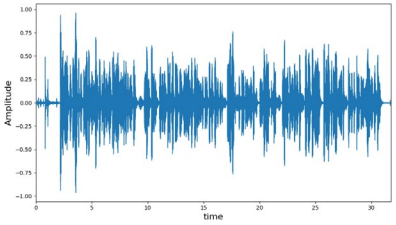


Symptomatic or asymptomatic status

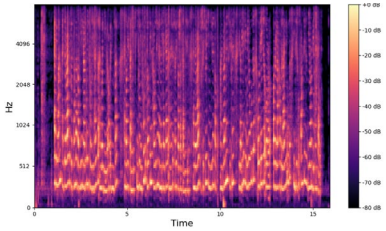
3 vocal biomarkers candidates

Monitoring fatigue

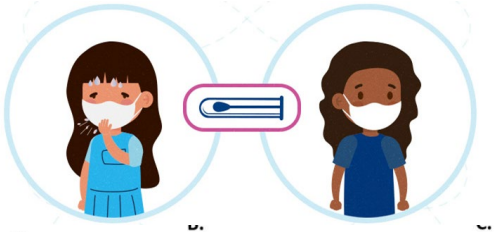
Audio signal

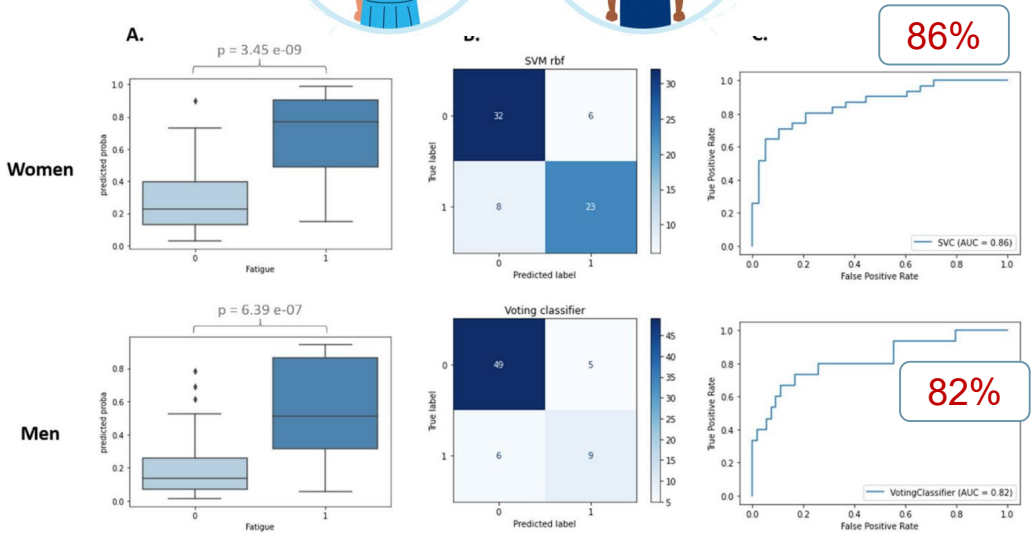


Spectrograms



Voice recordings were converted into images (spectrograms) before analysis.
Features were extracted from the images and used to train the algorithms



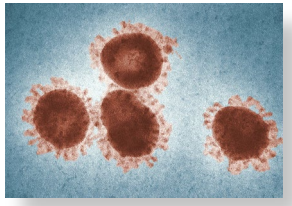


Different representations of VB performances

How to implement Vocal Biomarkers in real life or in clinical practice?

USE-CASE: Long COVID

10-20% people with COVID-19 experience persisting symptoms grouped in a so-called “Long COVID syndrome”



Symptoms can be fluctuant, affect many organs
Most frequent = fatigue, respiratory problems, anxiety, sleep disorders etc.

High impact on daily life + difficulties to obtain a recognition of disease

UpcomingVoice study

AIM

Develop a smartphone app to:

- Monitor symptom evolution
- Improve quality of life of people living with Long COVID

Involve end-users (people with Long COVID + HCPs) to ensure to develop a useful and clinically relevant solution (from study design to study participation)

HOW

1. Assess needs, fears and expectancies regarding voice use
2. Co-design app specifications
3. Develop and obtain feedback on a first prototype

UpcomingVoice study: Mixed-method study

Recruitment

- Long COVID consultation networks
- Long COVID patient associations

QUANTITATIVE PART

Online survey

Min 100 PWLCs + HCPs

Objective: Collect opinions regarding

- **Acceptability of voice use**
- **Information to include**
- **Engagement (personnalisation, interaction..)**
- **Aesthetic of app**
- **Functionalities expected**

QUALITATIVE PART

Semi Structured individual interviews

20 PWLCs + HCPs

Objectives:

- **Deeply discuss survey findings**
- **Define prototype**

Focus groups

Panel of PWLCs + HCPs

Objective: **Collect feedbacks on prototype**

PWLC = People with Long COVID
HCP = Healthcare professionals in charge of Long COVID patients

UpcomingVoice survey: Key results

71% of PWLC declared that access to specialized healthcare was difficult or very difficult

89.8% of PWLC did not retrieve the same level of professional or leisure activities than before COVID-19

Need for a tool:

- for managing and monitoring Long COVID in daily life
- to improve quality of life

UpcomingVoice survey: Key results

77.6% **PWLCs were interested or very interested in a smartphone app based on vocal biomarkers to monitor their health**

78% **HCPs think that a smartphone app would be useful for PWLC regardless if they are already in specialized care or not**

High interest both from PWLC and HCPs

CONCLUSIONS - TAKE-AWAY

Vocal biomarkers are a promising tool

- Non-invasive and well accepted
- Mirror of our health - could complement blood samples
- Improve quality of life and care of patients
  - replace questionnaires
  - limit travels for medical appointments
  - allow people with disease to monitor themselves their health status
- Development telemedicine and digitization of healthcare system

THANK YOU!

Questions?

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colivevoice.org