RE-SAMPLE

RE-SAMPLE|University of Twente|
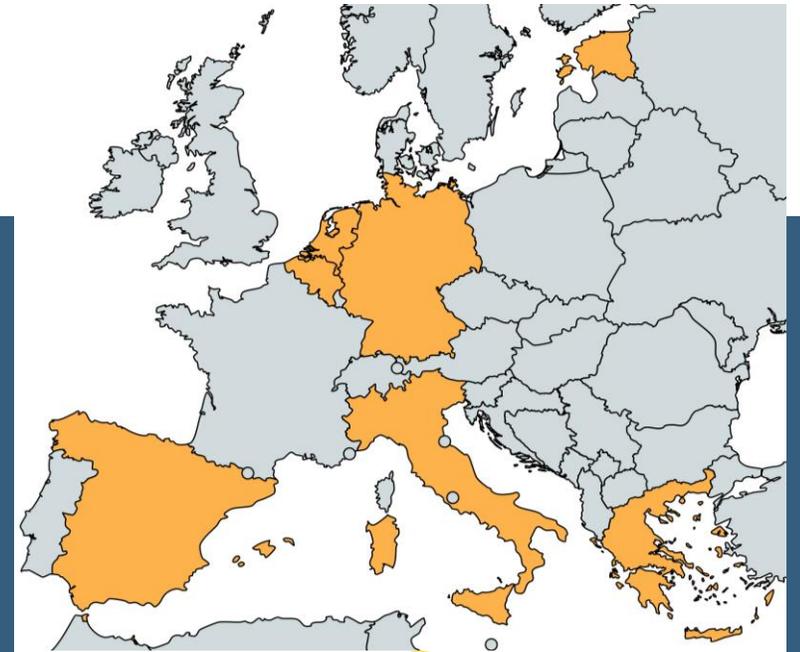
RE-SAMPLE Overview

| Dr.ir. Monique Tabak| coordinator | University of Twente

In this video about Maria, a patient with COPD with other chronic conditions, the rationale for and idea of the RE-SAMPLE project is explained. The video can be found here: https://youtu.be/lu44UotdmM0

RE-SAMPLE Overview

PROBLEM ADDRESSED

- More (complex) chronic conditions, multiple CCCs
- COPD high-impact disease, 3rd cause of death
- Long-term complex care, exacerbations detection
- Progression: Focus on prevention & lifestyle

Adaptive, predictive, personalised (self)care needed

SOLUTION PROPOSED

1. RWD monitoring ecosystem from heterogeneous, multimodal and changing data sources
2. Real-time personalised prediction of multi-morbid exacerbations
3. Secure and privacy-preserving user data management platform for tailored decision making
4. Virtual companion for personalised interventions in self-care
5. Cross-care path integrated care system in healthcare

PROJECT OBJECTIVES

To identify individual multi-morbid CCC exacerbations and develop tailored referral to a multi-disciplinary, adaptive virtual companionship programme for patients with COPD and CCCs

EXPECTED IMPACTS

- less (severe) exacerbations, accelerated recovery

>> reduced healthcare utilisation, better QoL, empowerment

- digital transformation of healthcare:
  - Adoption of privacy-preserving AI for health innovations
  - equally empowering technology, HCP and patient
  - care delivery substitution to home-based support

>> disruption of guidelines and daily care practice

RE-SAMPLE Scientific/Medical problem

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Medical Problem

Clinical Requirements

1. What is known? (clinical guidelines, literature reviews, retrospective data)

2. Who are our users? What are the (clinical) needs? (personas, scenarios, patient journeys etc)

Expected improvements in clinical workflow

Expected improvements for patients

Example User requirements
- Patients shall be informed about an identified exacerbation risk and see which factors lead to this higher risk
- Trends and red flags are used for communication during consult (not real-time alarm)
- Suitable for people with low literacy (general, health, digital)
- System is integrated and interoperable with the local healthcare system
- System allows patients to opt-out of data collection / reduce frequency

Pilot overview

Continuous user involvement in 3 pilot sites!
- End-user walkthroughs, online surveys, interviews, workshops, iterative prototype testing

Multi-center **observational cohort** 710 patients (started)
- 159 patients for virtual companionship (end 2023)

Scientific Problem

Background Motivation

- <u>parameters are unavailable, unknown and/or distributed</u> among different data sources/representations
- effective <u>privacy protection of personal data</u> and access control needed
- ML: <u>heterogeneous, incomplete, complex, multimodal, smaller</u> datasets
- physicians <u>overwhelmed by amount of data</u> for decision making, patients rarely involved
- <u>One size fits all</u>: most studies do not comprise tailoring, and exclude multi-morbid chronic conditions
- <u>Inequity</u> in access to and use of eHealth

Real World Data Insights

- insights in the <u>course and interrelationships</u> between (bio) markers, lifestyle characteristics, and clinical and well-being parameters for the onset and progression of CCC exacerbations;
- knowledge in <u>timely detecting exacerbations</u> to start preventive treatment effectively;
- definition of clinical endpoints to identify and monitor individual patients for <u>tailored coaching in self-management</u>
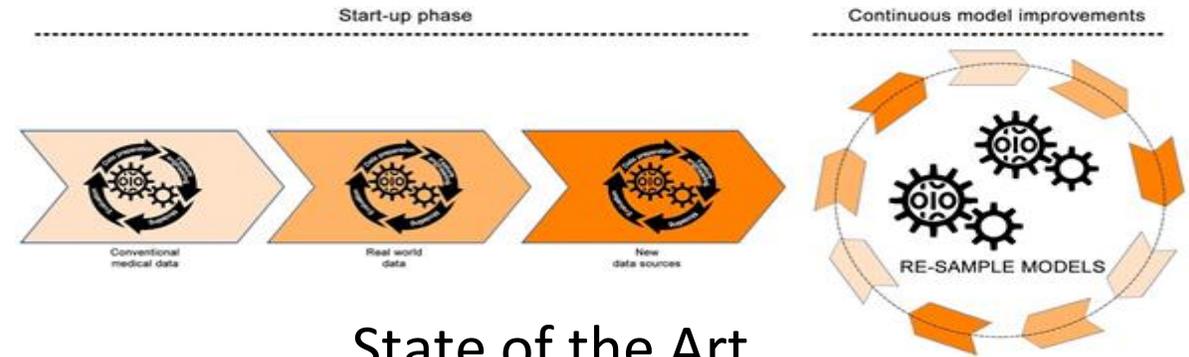
State of the Art

- <u>integration of multimodal data sources</u> to drive continuous assessment of progression and risk
- a cross-disciplinary, interactive ML approach to provide a <u>data-driven, evidence-based</u> ICT process to assess and derive clinical endpoints
- <u>privacy-preserving ML</u> based on secure multiparty computation
- a personalised medicine approach with phenotypes of patients for <u>tailored proactive patient-centered care and coaching</u>
- <u>shared-decision-making</u> between 1) patients with CCCs, 2) healthcare professionals and 3) data, to support self-care behaviour and well-informed decisions
- deployment of the virtual companionship programme in a <u>pan-European service model</u> from institution-centred to home-centred approach

RE-SAMPLE Technical Solution

| Dr. Serge Autexier | Technical Coordinator | DFKI

Technology

Approach

- Multi-modal multi-source data: EHR data (Hospital), activity, questionnaires (Healthentia), air quality and weather (third party based on ZIP codes)
- Edge nodes in Hospital Premises
- Federated learning
- Learning using secure multi-party computation

Models

- Federated learning:
  Glassbox models: explainable boosting machines
- Secure Multi-Party Computation: under investigation
- Explanations for exacerbation risk predictions
- ML models for suggestions for shared decision making

Architecture

Microservice Architecture

Firewall-compliant connection initiation

Docker containers
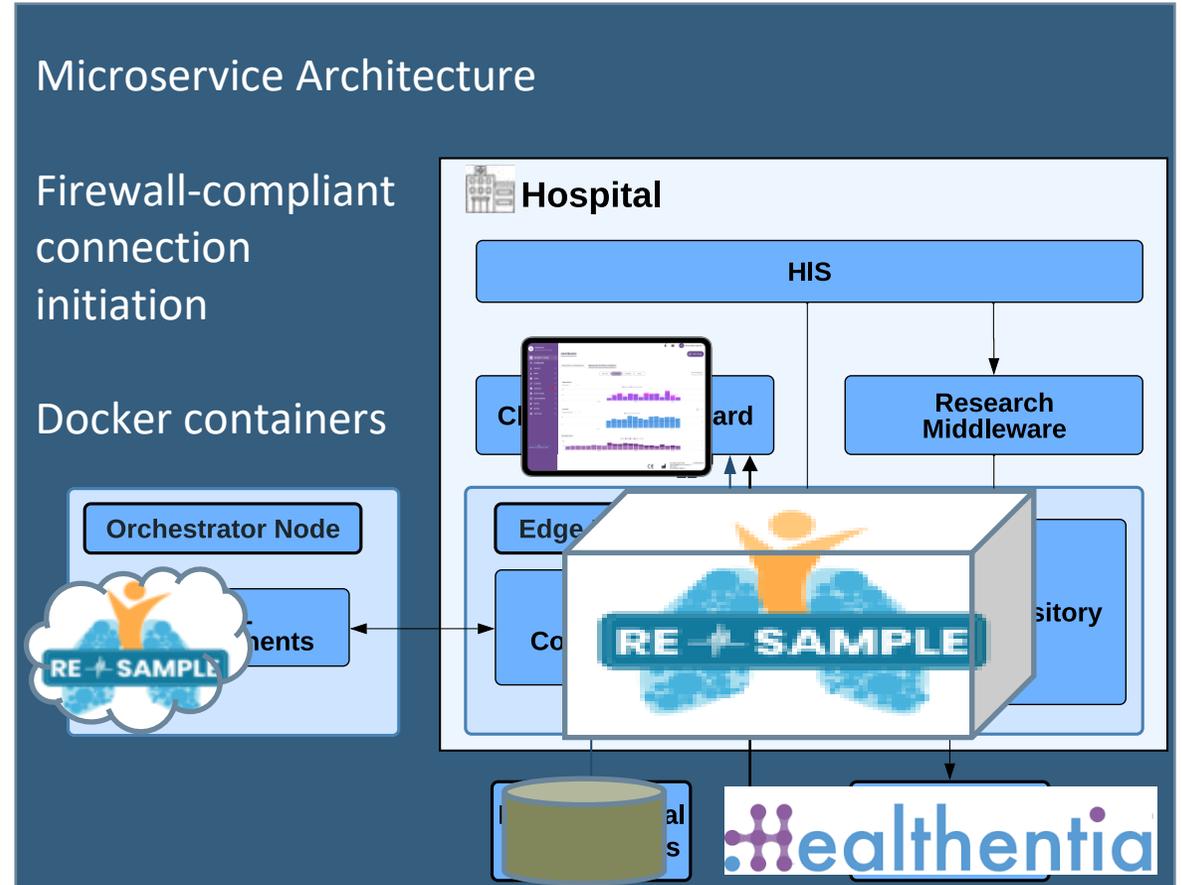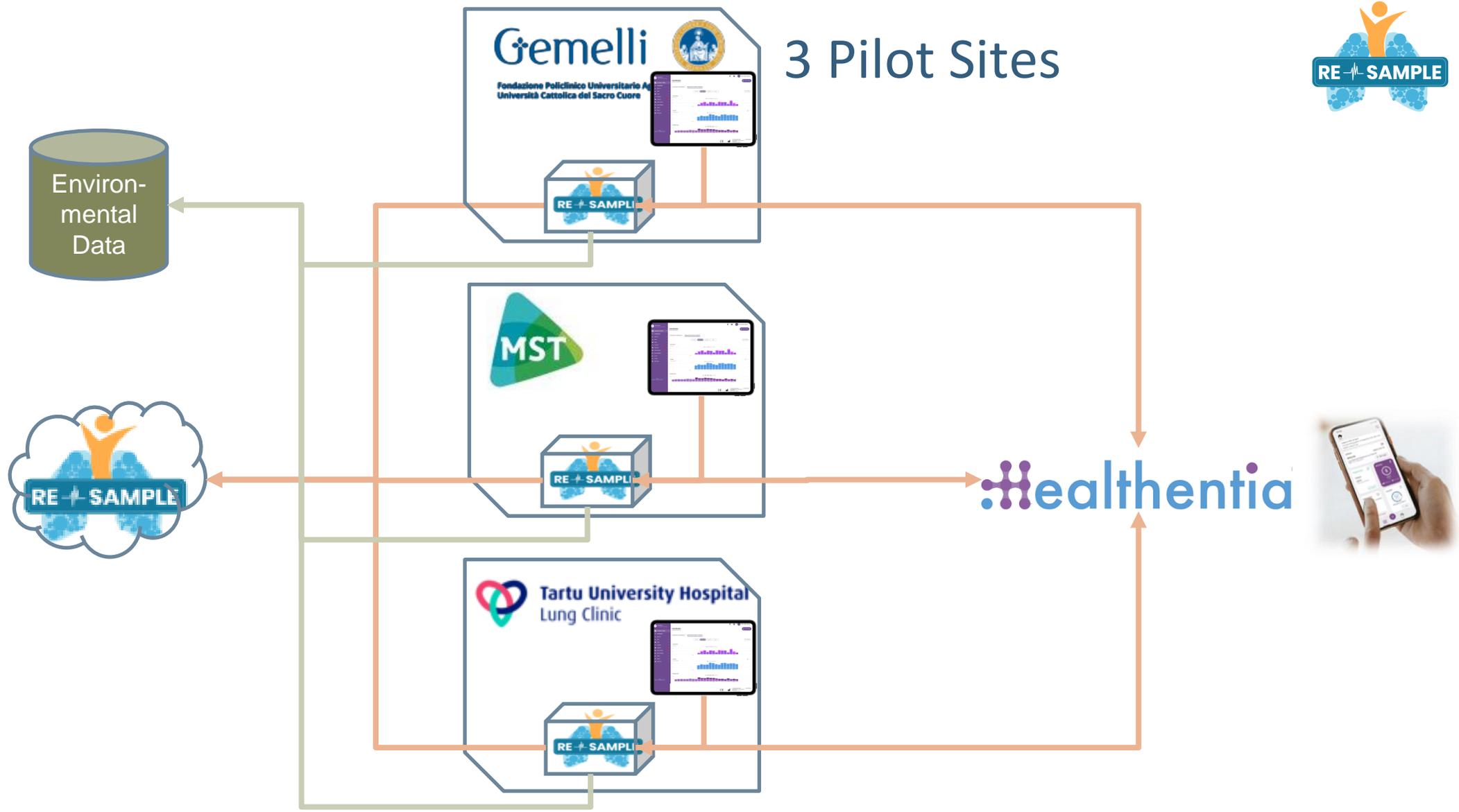
Standards

Standards Adopted

- HL7 FHIR
- SNOMED CT
- LOINC
- UCUM for units standardization
- Open API 3.1.0

Contribution to Standards evolution

- Possibly extensions to HL7 FHIR

Privacy

- GDPR compliance
- Pseudonymization
- Additional de-identification: internal in edge nodes
- Differential Privacy
- Federated Learning
- Secure-Multi-Party-Computation

Security

- Service level authorization based on secure tokens or API keys

Thank you!

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