IOTWeek

Dublin —— June 20-23, 2022

How to address data heterogeneity in Chronic Disease Management towards massive deployment of IoT solutions

Moderator: Ms. Paula Currás (Medtronic Ibérica S.A.)

Speakers:

- Dr. Giuseppe Fico (UPM)
- Dr. Dave Raggett (W3C)
- Dr. Eleni Georga (UoI)
- Ms. Pilar Sala (Mysphera)

GLOBAL VISION:
IoT TODAY AND BEYOND

IOTForum

Session Speakers

IOTWeek
Dublin — June 20-23, 2022

Moderator:

Ms. Paula Currás – IHS Project Specialist, Medtronic Ibérica

Speakers:

Dr. Giuseppe Fico
Assistant Professor of Biomedical Engineering, UPM

Dr. Dave Raggett
Senior Researcher, W3C

Dr. Eleni Georga
PhD, University of Ioannina

Mrs. Pilar Sala
EU Project Manager, Mysphera

GATEKEEPER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 857223

Session Agenda

1. The GATEKEEPER Project
2. The GATEKEEPER HL7 – FHIR Implementation Guide
3. The Web of Things model in GATEKEEPER ecosystem
4. AI based pipelines for solution design
5. Real world data acquisition API

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The GATEKEEPER project

Ms. Paula Currás – Medtronic Ibérica

GATE KEEPER

GATEKEEPER project

The flagship project of the EU to foster large-scale deployment of integrated digital solutions, mainly AI and Big Data, in the Health Care domain

→ For personalized risk detection, advanced health monitoring and early interventions

→ Across multiple scenarios of smart living environments

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GATEKEEPER project

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70 partners

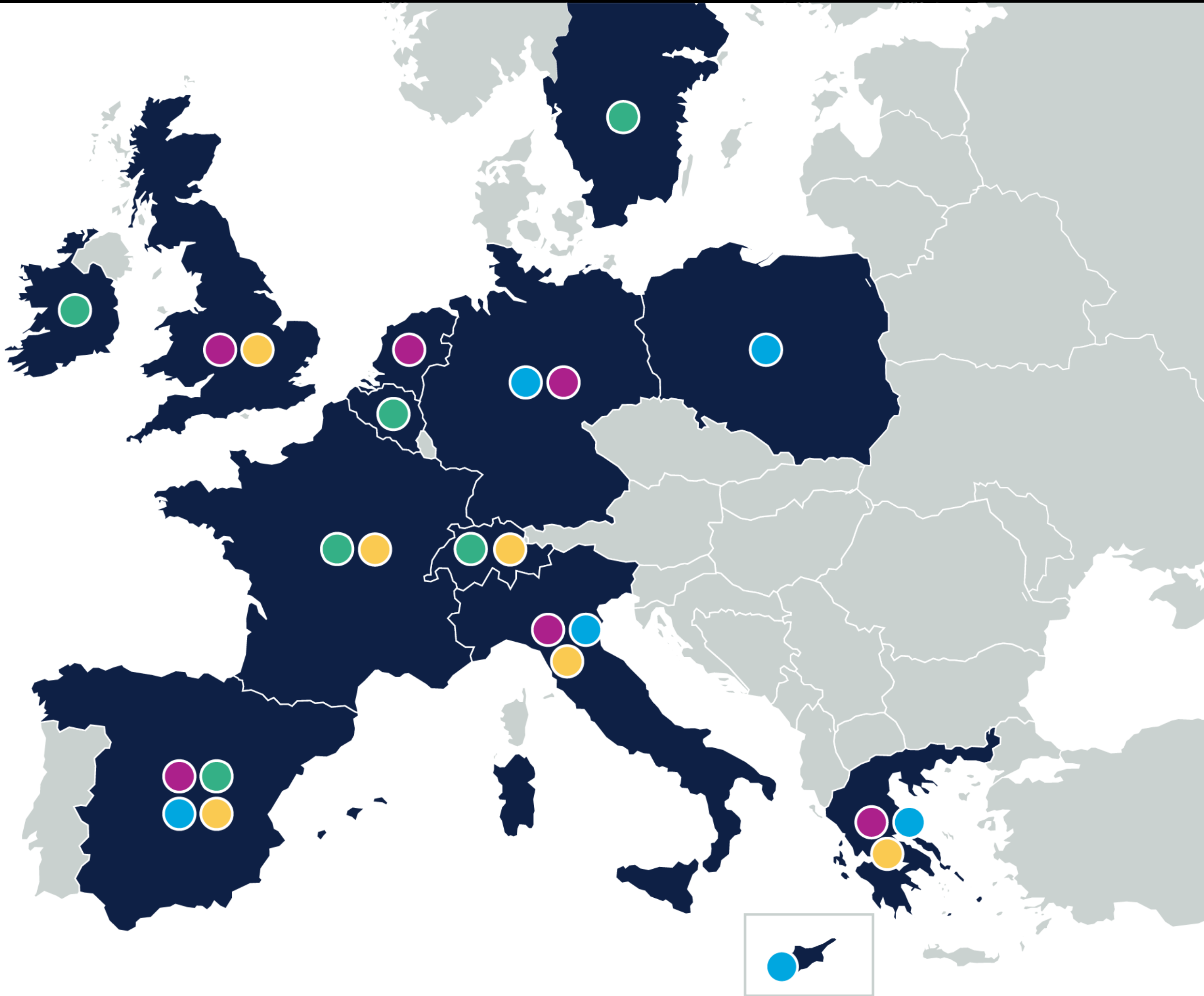
16 countries

21M€ Budgets

40k individuals

8+3 medical pilots

9 Use cases for Chronic conditions



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The Gatekeeper HL7-FHIR Implementation Guides for Chronic Disease Management

Dr. Giuseppe Fico - UPM

What is Gatekeeper?

A trustable, privacy preserving and secure platform to foster large-scale deployment of interoperable AI solutions for Chronic Disease Management.

How we build it?

FHIR

WEB OF THINGS

BLOCK CHAIN

docker + kubernetes

Semantic Ontology

CERTIFICATE AUTHORITY

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How we connect IoT device?

We aim at connecting IoT devices with asynchronous and synchronous API

Data are gathered into the platform through connector with a site-to-site VPN connection

Data are semantically annotated with JSON-LD integrated into Web of Thing – Thing Descriptor

Data are directly sends from IoT medical devices in GK-FHIR format

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How we build trustiness?

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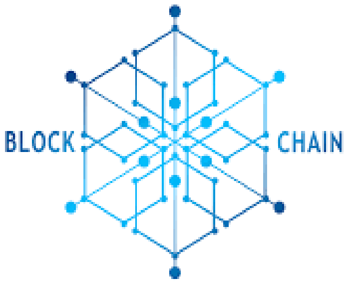
We aim to do that by using Certification Authorities and blockchain



In GK we have a Gatekeeper Trust Authority that has the objectives of:

- Certify different levels of trustiness of GK Things
- Provide traceability, non repudiation of Gatekeeper things
- Provide automatic validation of several aspects of a GK thing
  - Such as compliance with **Gatekeeper FHIR IG**

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What is FHIR?

HL7 FHIR (Fast Healthcare Interoperability Resources) Specification is the HL7 outstanding standard for exchanging healthcare information electronically

…… but is not limited to this…

The basic building block in FHIR is a **Resource**. Everything in FHIR is a resource.

FHIR resources aim to define the information contents and structure for the **core information set** satisfying **the majority of common use cases**.

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How was used FHIR in Gatekeeper?

Our methodology for Gatekeeper FHIR IG definition

Phase 1

Pilot data schema collection

Phase 2

Terminology Mapping

SNOMED CT
The global language of healthcare

LOINC®
from Regenstrief

ICD-10

Phase 3

Resource Definition and Mapping

FHIR

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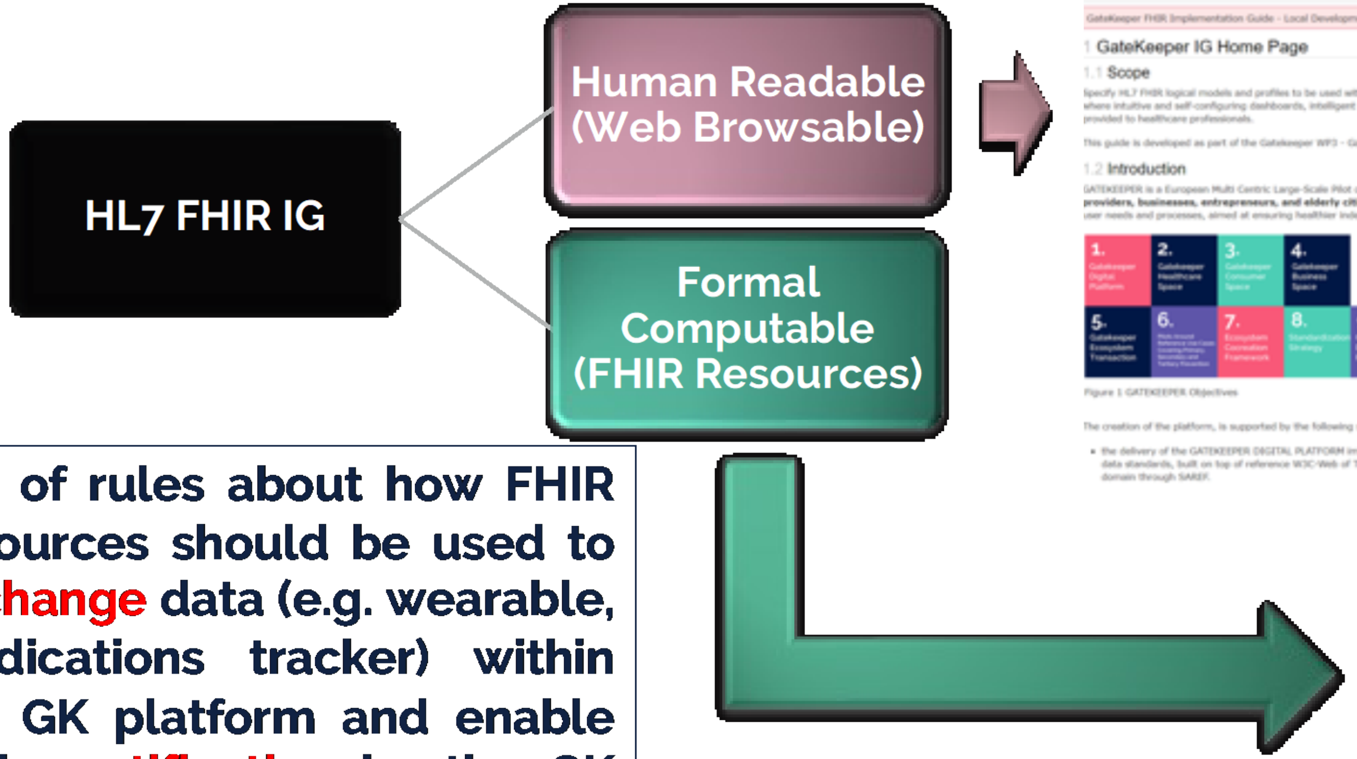
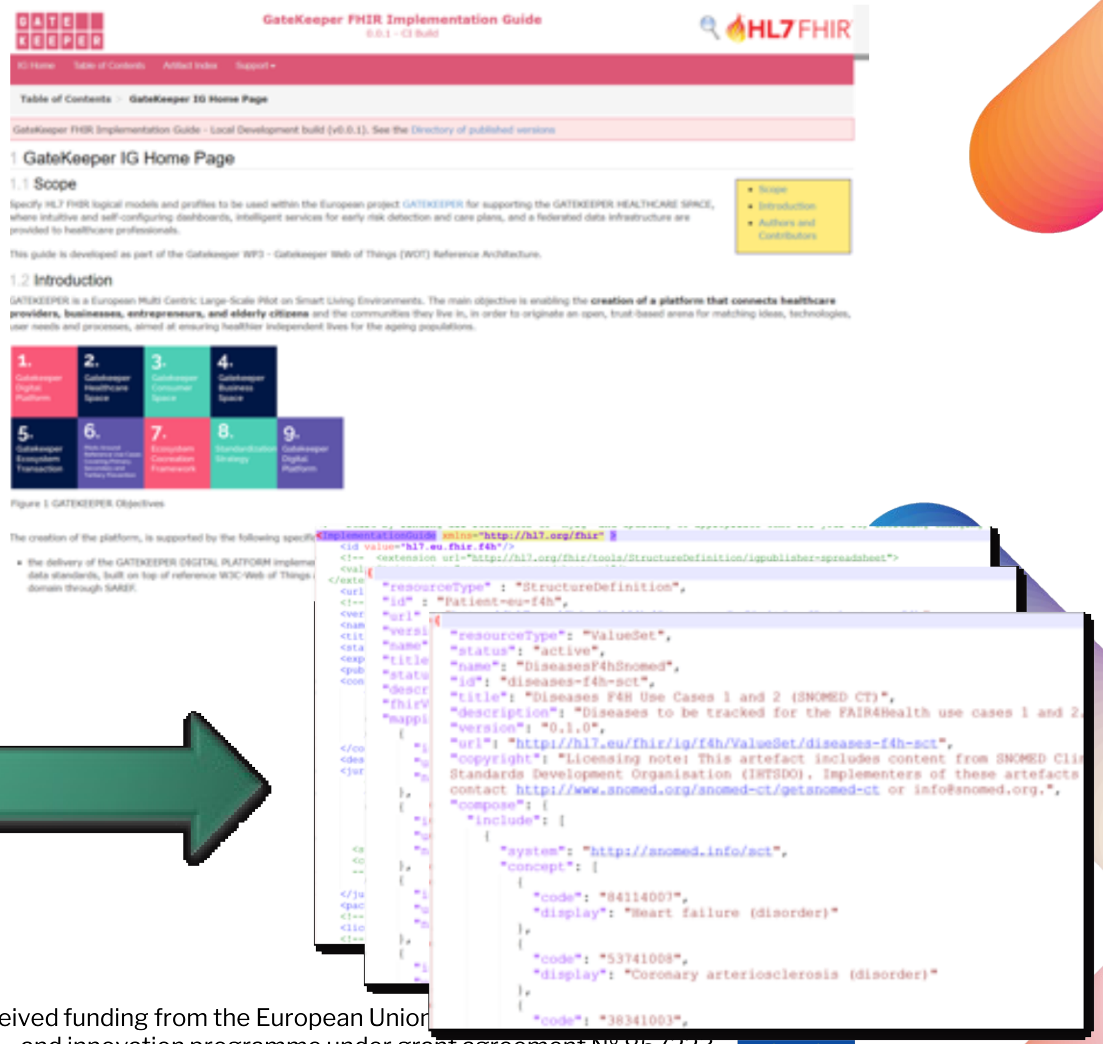
Gatekeeper FHIR IG





Set of rules about how FHIR resources should be used to exchange data (e.g. wearable, medications tracker) within the GK platform and enable their certification by the GK trust authority

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The role of FHIR in Gatekeeper – Data Cap

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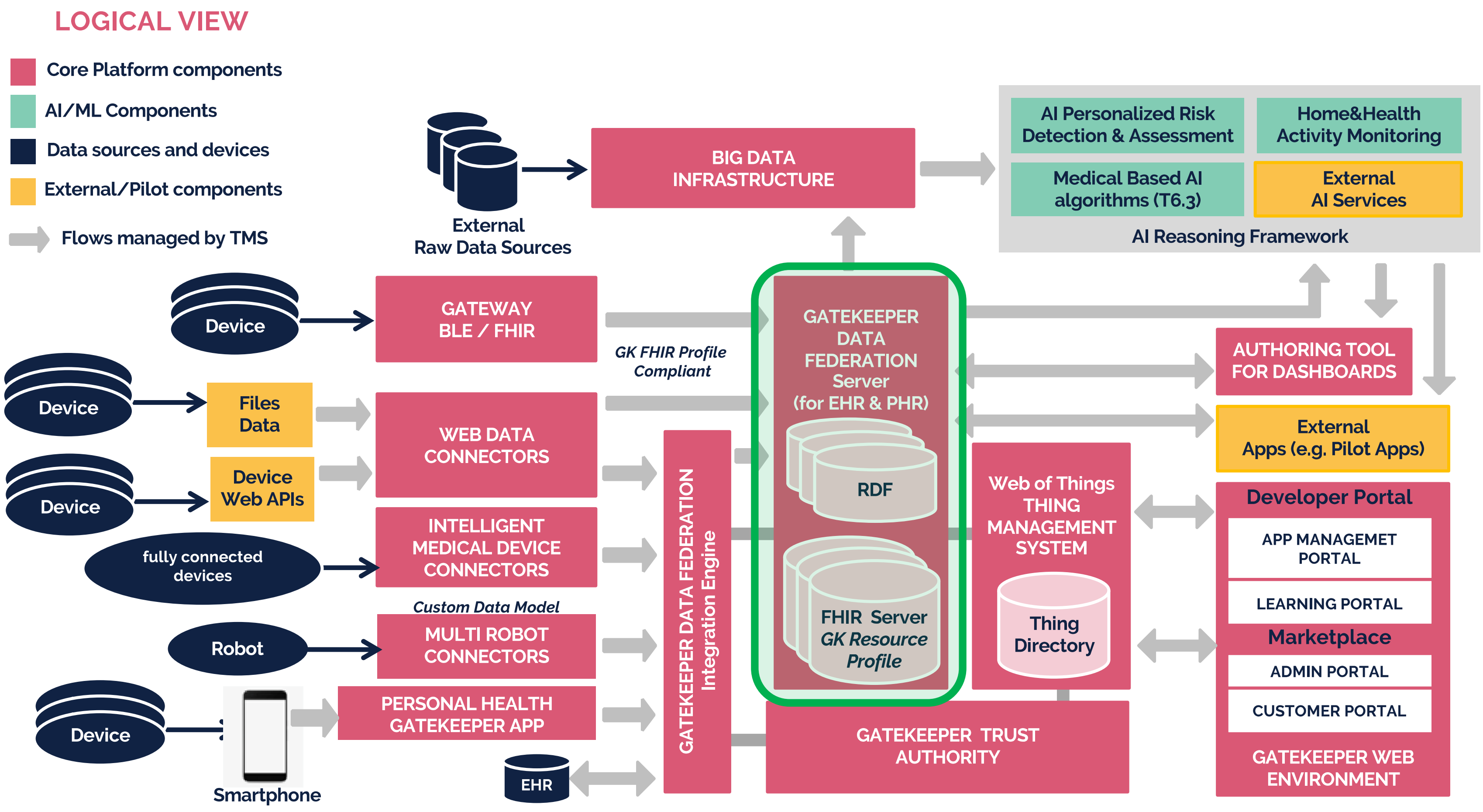

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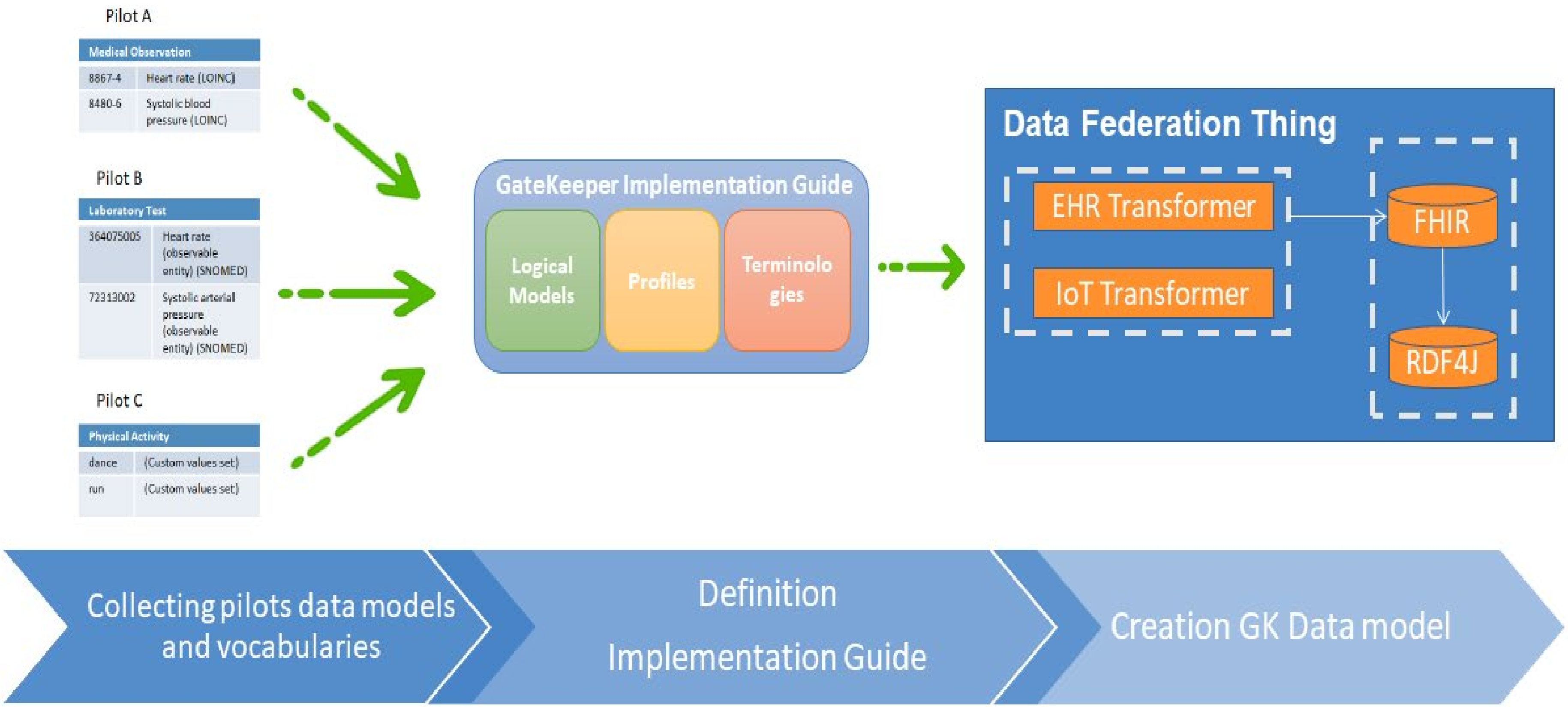
The role of FHIR in Gatekeeper – Data Cap

IoT & Data



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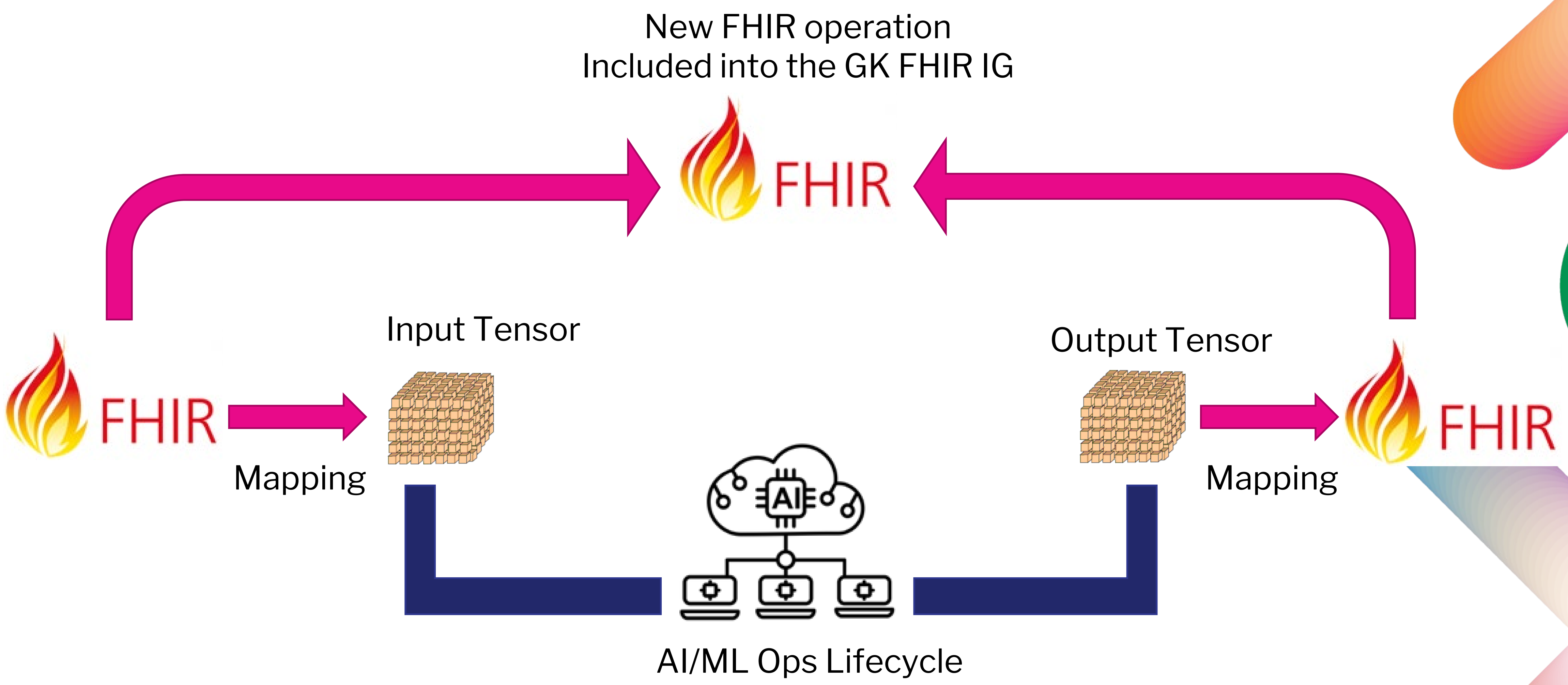
The role of FHIR in Gatekeeper - AI



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FHIR as mediator for federated AI

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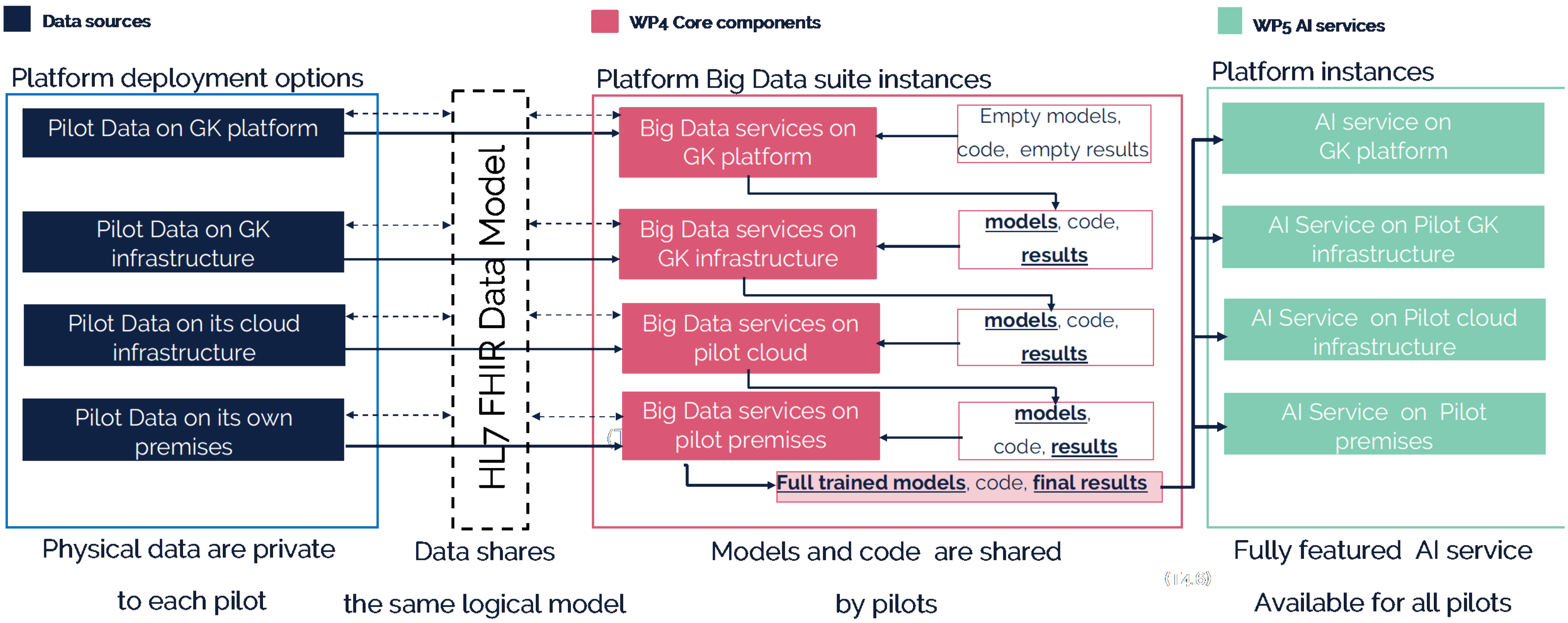

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What we have testing?

22 Experimental Designs

Declining each RUC in each pilot considering also patient complexity (low/moderate/severe)

+100 KPIs

We know how to measure clinical impact in each/every pilot

Best practice exchange

Each pilot gave 1+ webinar, bil.at meetings

Asian Pilots

Start the analysis for their proactive inclusion

ALL EXPERIMENT DEFINED

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Gatekeeper and EHDS

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HL7 FHIR and Data Federation provide access to FAIR compliant data that follows the public GK FHIR-IG.

GTA is providing **anonymization** and **pseudonymization** functionalities for implement the "**data permit**" for secondary use of data.

The **privacy preserving AI approach** provide a proof of concept of "**data request**" for secondary use of data when analysis needs access to personal data.

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The Web of Things model in GATEKEEPER ecosystem

Dr. Dave Raggett – W3C

GATEKEEPER Mission

To enable researchers to work with health data in a way that is beneficial whilst preserving patent privacy

- Using AI/ML to improve individual patient care by studying records for many patients

For the most part we are relying on FHIR for data collection

- FHIR is a de facto standard with JSON based APIs

The GATEKEEPER marketplace supports public and privileged access, subject to terms & conditions restricting the kinds of processing and sharing of information*

- Clients can download, transform and upload data & metadata into forms more useful to other clients

* e.g. forbidding deanonymisation of anonymised patient data

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Fast Healthcare Interoperability Resources (FHIR)

HL7® FHIR®

HL7's FHIR builds upon familiar tooling and technologies
- XML, JSON, HTTP, SSL, OAUTH, REST API + Search
- Based on W3C and ISO data types
- 80% rule – only expose what most will use

Open Source code libraries

Validation services

Related standards include SNOMED, ICD, openEHR, CIMI, ISO 13606, IHE, DICOM

FHIR Resources for, e.g.
- General
- Care Provision
- Medication & Immunization
- Diagnostics

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FHIR Example

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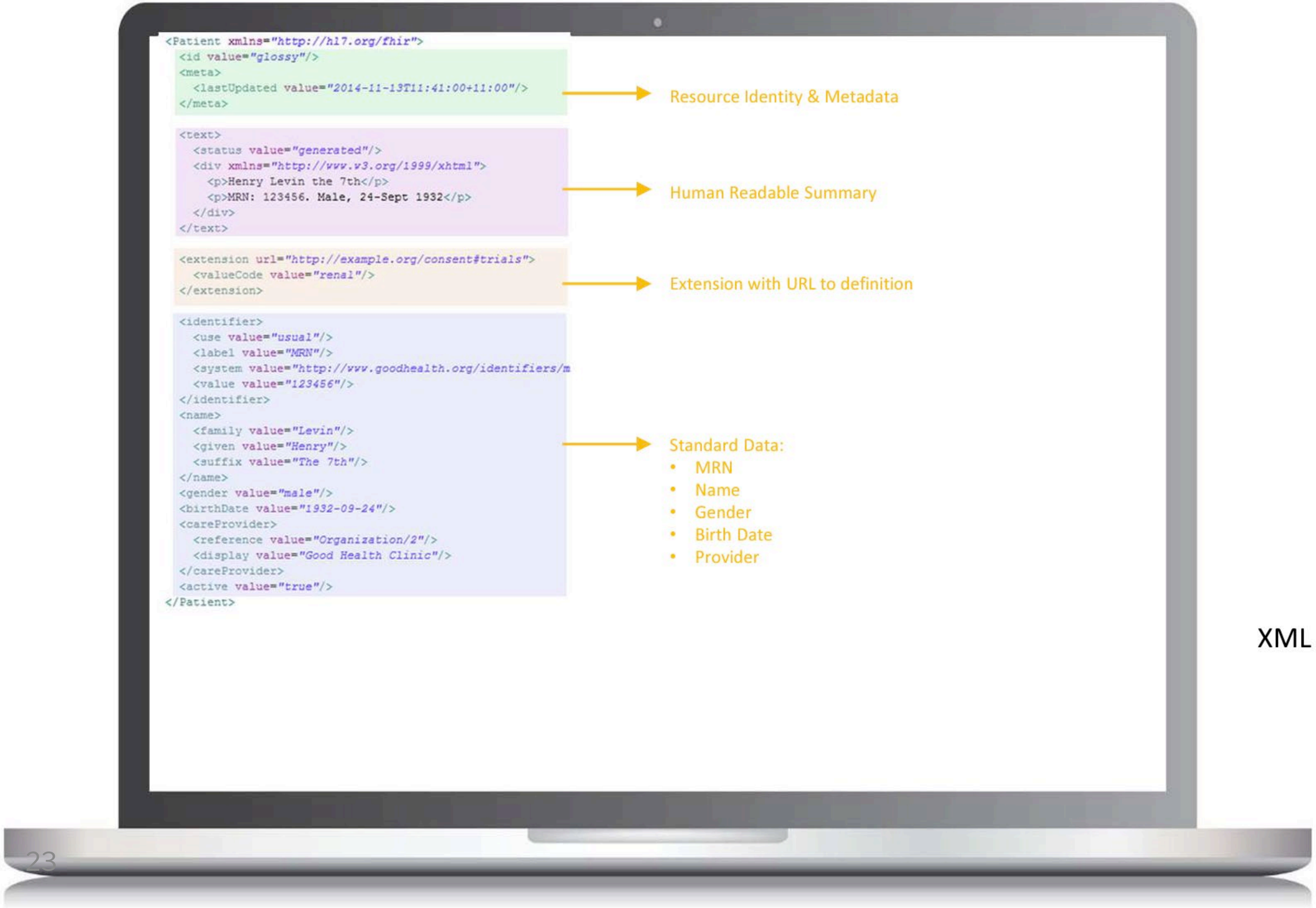

XML and JSON

Courtesy of Viet Nguyen

GATEKEEPER and Data Spaces

- IDSA and GAIA-X are promoting data spaces as a means for safe secure data sharing ecosystems
  - Ensuring sovereignty for data owners
  - Accessed via IDSA Connectors
- The GATEKEEPER marketplace aligns with the data space principles, e.g.
  - Strong authentication for data providers and data consumers, etc.
  - D2A – download data to be locally processed with an algorithm
  - A2D – upload the algorithm to be processed remotely with the data
  - Use of RDF for metadata along with validation
- FHIR API is one way to enable remote access to data
- GATEKEEPER also supports W3C's Web of Things standard

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GATEKEEPER and Anonymisation

- Anonymisation is handled by the GATEKEEPER Trust Authority
  - In keeping with goals of **European Health Data Spaces** proposal
  - Is not applied to a data set if data controller or a third party has access to the original data
- Anonymisation is data processing, so it requires a *legal basis:* data subject's consent, further processing for research etc.
  - See GDPR Art. 6 – responsibility of the data controller
- Direct identifiers and most quasi-identifiers must be masked irrespective of technique
  - Details available in the FHIR Implementation Guide for Gatekeeper
- Anonymisation techniques including K-anonymity, L-diversity, differential privacy, etc.

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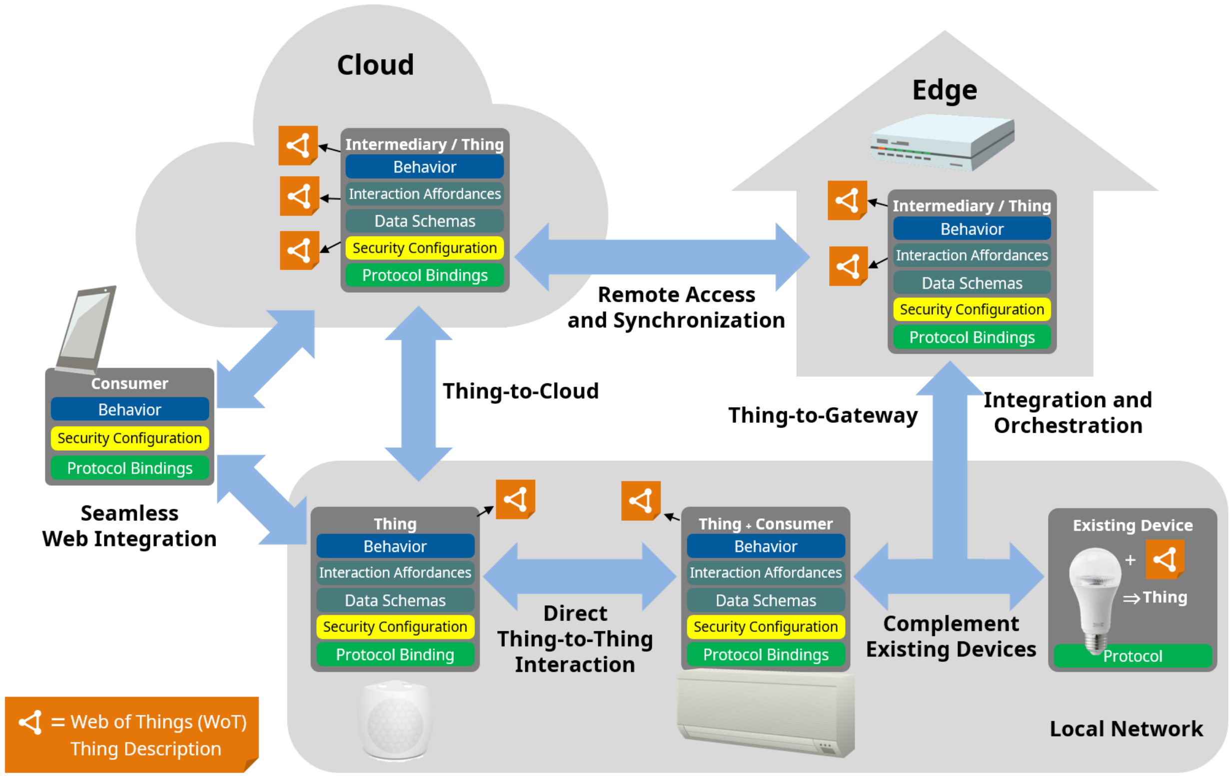
W3C Web of Things (WoT)



Abstraction for digital twins that decouples applications from the complex details of large variety of IoT protocols

- Standardizes technical building blocks as a means to increase interoperability for the IoT

Digital Twins expose "thing descriptions" using JSON-LD*

- Interaction affordances as properties, actions and events, along with data models, and semantics
- Communication metadata with security configuration and protocol bindings

Links to external ontologies for semantic models

* JSON based RDF serialisation

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Web of Things is Protocol Agnostic

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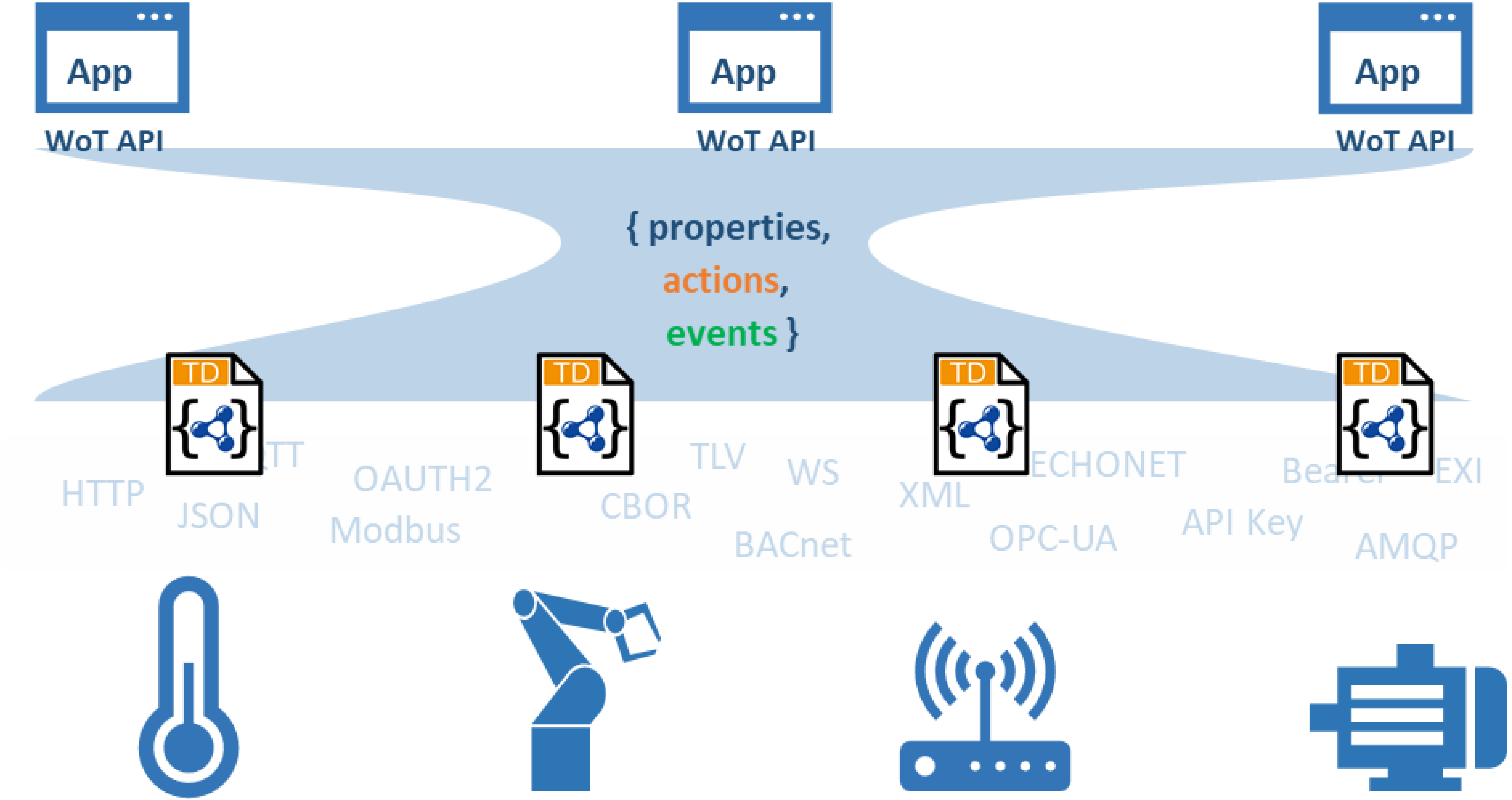

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WoT Thing Description Example

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```
{
    "@context": [
        "https://www.w3.org/2019/wot/td/v1",
        { "saref": "https://w3id.org/saref#" }
    ],
    "id": "urn:dev:ops:32473-WoTLamp-1234",
    "title": "MyLampThing",
    "@type": "saref:LightSwitch",
    "securityDefinitions": {"basic_sc": {
        "scheme": "basic",
        "in": "header"
    }},
    "security": ["basic_sc"],
    "properties": {
        "status": {
            "@type": "saref:OnOffState",
            "type": "string",
            "forms": [{
                "href": "https://mylamp.example.com/status"
            }]
        }
    },
    "actions": {
        "toggle": {
            "@type": "saref:ToggleCommand",
            "forms": [{
                "href": "https://mylamp.example.com/toggle"
            }]
        }
    },
    "events": {
        "overheating": {
            "data": {"type": "string"},
            "forms": [{
                "href": "https://mylamp.example.com/oh"
            }]
        }
    }
}
```


See: W3C Thing Description Specification and Thing Description Ontology

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Web of Things compared with Open API

OpenAPI is another standard for describing RESTful APIs

- Web of Things (WoT) – thing descriptions (TD's) as RDF
- Includes data types and rich semantics
  - Modelling both devices and the context they reside in
- Not restricted to HTTP
  - e.g. MQTT, OPC UA, Modbus, Web Sockets, CoAP

- Open AI (formerly Swagger) with RESTful APIs described in JSON or YAML
  - JSON based scripting model
  - REST: Roy Fielding's work on representational state transfer
- Includes data types but lacks rich semantics
- Can be translated into WoT TD's

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Open Questions

- Digital Twins for the human body?
  - Past, present and future, along with reasoning on personalised treatments
- Describing FHIR resources with Web of Things TDs?
  - WoT binding templates* provide a means to express protocol bindings
  - But do health records fit with WoT properties, actions and events?
- Web of Things TD's focus on REST based protocols – what about:
  - Non IP-based protocols?
    - work on support for CAN and Modbus
  - Multi-channel telemetry?
- Standardised access to past data?
  - **actions** are application dependent

* https://w3c.github.io/wot-binding-templates/

- RDF and the Semantic Web are based upon description logics
- But mathematical logic isn't suited for use with imperfect knowledge*
  - Knowledge subject to uncertainties, incompleteness and inconsistencies
- Combining symbolic knowledge with subsymbolic metadata enables plausible reasoning
  - Based upon pioneering work by Allan Collins and others in the 1980's, plus earlier work starting in Ancient Greece
  - Mimics human reasoning
- Intelligent healthcare assistants?
  - Opportunities for future work on personalised health assistants

* First international workshop on imperfect knowledge

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Azure Digital Twins and Web of Things?

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Microsoft's Azure Digital Twins* exposes IoT devices to cloud-based client applications in terms of properties, telemetry, relationships and components

Digital Twin models are expressed using JSON-LD

Semantics through DTDL ontologies

Twins in Azure Digital Twins are conceptual representations that can store user-defined insights about a device or many related devices

Microsoft recently joined the W3C Web of Things activity

W3C's Web of Things exposes IoT devices to edge or cloud based client applications in terms of properties, actions and events

Thing Descriptions are expressed using JSON-LD

Semantics through RDF-based ontologies

W3C's suite of standards for data, e.g. OWL, SPARQL, SHACL, …

Security & communications metadata for integration with heterogeneous IoT device protocols

Additional work on discovery, scripting and protocol bindings

* Learn about twin models and how to define them in Azure Digital Twins

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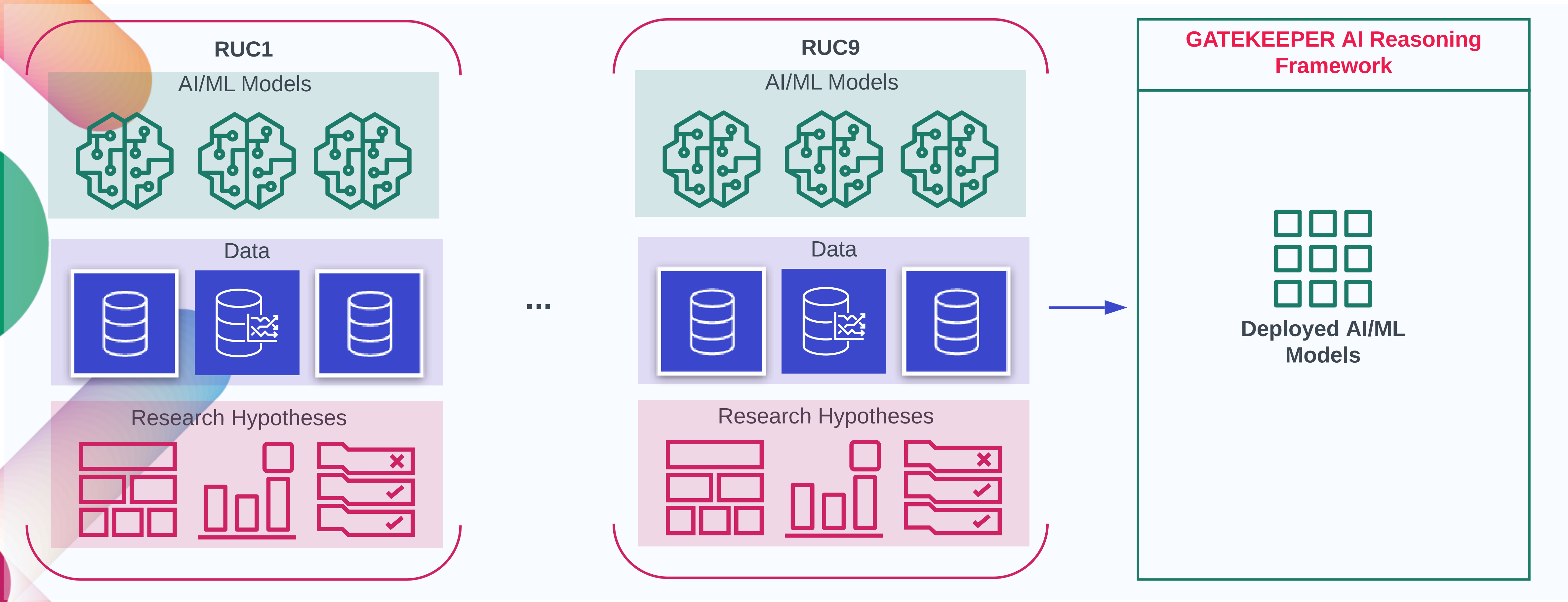
AI based pipelines for solution design

Dr. Eleni Georga - UoI

GATEKEEPER – AI Reasoning Framework



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GATEKEEPER – Medical AI/ML Services

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	AI SERVICES	INPUT SPACE	OUTPUT SPACE
ARAGON RUC 2, 5, 7 MODERATE AND HIGH COMPLEXITY	• Prediction of exacerbations for people with COPD, or heart failure or polymedicated people 	☑ **Medical device data:** Oxygen saturation, blood pressure, heart rate, respiratory rate, body temperature, ECG, dyspnoea degree, blood glucose ☑ **EMR data:** e.g., demographics, medication, clinical activity, comorbidities ☑ **Questionnaires:** Barthel, PAM, Barber, EQ5D	☑ Prediction of an acute exacerbation event of COPD, HF or multimorbid condition over a predifined time interval ☑ Prediction of emergency room visit or hospitalisation because of an exacerbation over a predifined time interval
BASQUE COUNTRY RUC 3, HIGH COMPLEXITY	• Long-term prediction of cardiovascular events in people with type 2 diabetes • Short-term prediction of hypoglycaemia-related cardiac arrythmias in people with type 2 diabetes 	☑ **Medical device data**: Intermittently scanned continuous glucose monitoring (isCGM), blood pressure, heart rate, ECG ☑ **Non-medical-grade monitoring** of health (e.g., heart rate, blood pressure) and fitness (e.g., activity, sleep) ☑ **EMR data**: e.g., chronic conditions, age, gender, therapy prescription	☑ Prediction of the probability of a short-term cardiac arrythmia event, conferred by hypoglycaemia, based on ECG recording ☑ Prediction of the probability of a cardiovascular event over a predifined time-interval
GREECE – CENTRAL GREECE RUC 3, HIGH COMPLEXITY	• Hypoglycaemia predictive modelling in type 2 diabetes 	☑ **Medicall device data:** Real-time continuous glucose monitoring (rt-CGM), pulse rate, heart rate variability, electrodermal activity, skin temperture, blood pressure ☑ **Additional data from e-CRF of the trial**, intergrated into Diabetes Management Platform by CERTH ☑ **Questionnaires:** PAID, HFS-II, EQ-5D-3L / EQ VAS	☑ Short-term (up to 60 minutes) prediction of hypoglycaemia, defined considering the interstitial or capillary blood compartment of glucose measurement

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GATEKEEPER – Medical AI/ML Services

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	AI SERVICES	INPUT SPACE	OUTPUT SPACE
CYPRUS RUC 7, HIGH COMPLEXITY	• Use Case 1: Explaining depression and anxiety levels in people with dementia • Use Case 2: Recognition of data patterns associated with PROMs for advanced cancer patients 	☑ **Non-medical-grade monitoring of health and fitness**, e.g., heart rate, step count, stress, respiration rate, SpO2, sleep ☑ Use Case 1: EuroQol- 5 Dimension (EQ-5D-3L), Global Deterioration Scale (GDS) ☑ Use Case 2: EORTC Quality of Life Questionnaire Core-30 (EORTC QOL C30), Hospital Anxiety and Depression Scale (HADS)	☑ Use Case 1: Geriatric Anxiety Scale (GAS), Geriatric Depression Scale (GDS) ☑ Use Case 2: Index of a patient's status and disease worsening based on the Integrated Palliative care Outcome Scale – Patient Version (IPOS)
BANGOR RUC 7, HIGH COMPLEXITY	• Emerging prognostic and diagnostic patterns connecting cancer symptoms • Risk prediction of cancer symptoms and recurrence 	☑ **Non-medical-grade monitoring of health and fitness,** e.g., heart rate, step count, blood pressure, sleep ☑ **EMR data:** e.g., age, sex, BMI, cancer primary, TNM stage, concominant diseases, concominant medications	☑ Edmonton Symptom Assessment System (ESAS) ☑ UK Oncology Nursing Society (UKONS) Oncology/Haematology 24 Hours Triage Scale

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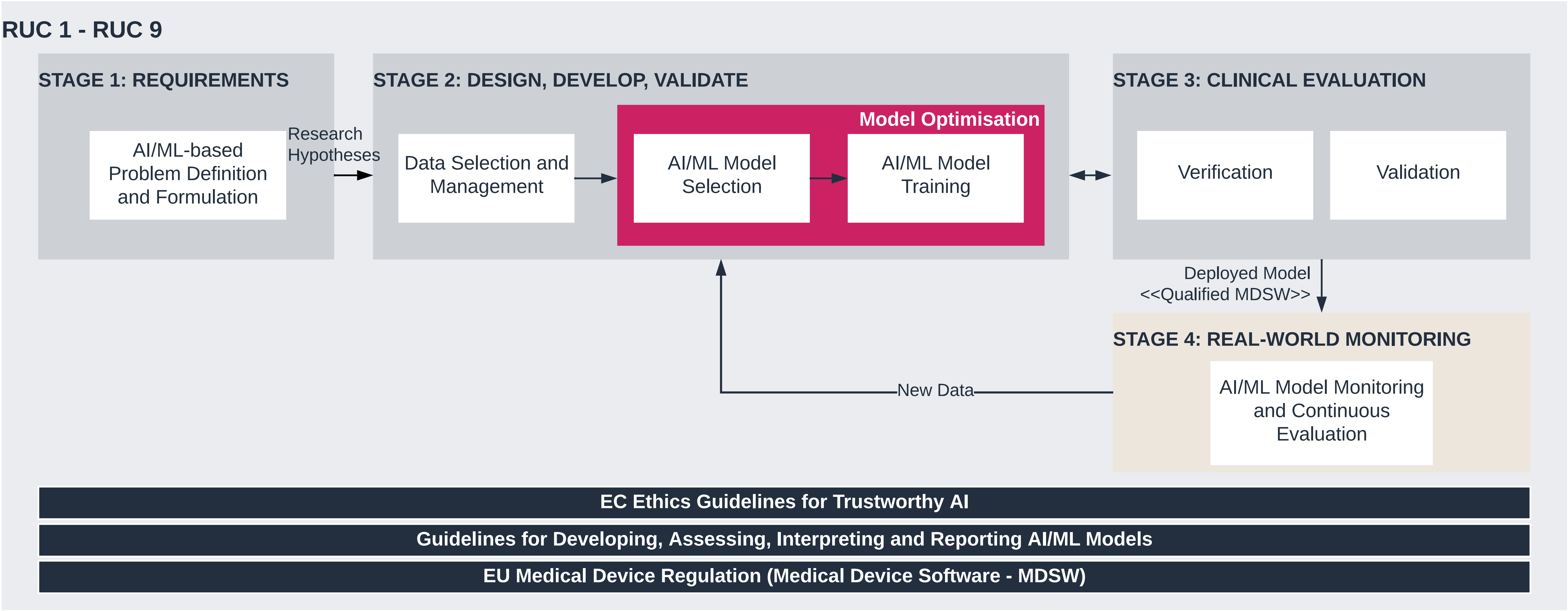
GATEKEEPER AI/ML Strategy



Collins, G. S, et al., Annals of internal medicine, 162, pp.55-63, 2015.
Wolff, R.F., et al., Annals of internal medicine, 170(1), pp.51-58, 2019.
Collins, G.S., et al., BMJ open, 11(7), p.e048008, 2021.
EC, Ethics guidelines for trustworthy AI, 2019, https://data.europa.eu/doi/10.2759/346720
EU, MDR Regulation, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R0745

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GATEKEEPER AI/ML Strategy

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Transparent Reporting of a Multivariable Prediction Models for Individual Prognosis or Diagnosis (TRIPOD): **The TRIPOD Statement**

Research Problem	Dataset	Input Space	Output Space	AI/ML Methods	AI/ML Testing and Validation	AI/ML Architecture and Topology	Results	Deployment Context
MEDICAL CONTEXT AND RATIONALE OBJECTIVES	SOURCE OF DATA PARTICIPANTS SAMPLE SIZE	PREDICTORS EMR-Data Medical PHR Data No-Medical PHR Data	OUTCOME	AI/ML ANALYSIS PIPELINE	TESTING METHODOLOGY CORRECTNESS METRICS	CENTRALISED OR FEDERATED LEARNING	PARTICIPANTS MODEL DEVELOPMENT MODEL SPECIFICATION MODEL PERFORMANCE MODEL UPDATING	CLINICAL USE

Collins, G. S, et al., Annals of internal medicine, 162, pp.55-63, 2015.
Wolff, R.F., et al., Annals of internal medicine, 170(1), pp.51-58, 2019.
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GATEKEEPER AI/ML Strategy

EVALUATION PATTERN 1

Pilot Study Running Phase 1	Pilot Study Running Phase 2
Technical Performance Evaluation - Internal Validation	Silent Evaluation of Ecological Validity Technical Performance Verification - External Validation Real World Monitoring

EVALUATION PATTERN 2

Pilot Study Running Phase
01/2021 - 03/2023

Technical Performance Evaluation - Internal Validation

Collins, G. S, et al., Annals of internal medicine, 162, pp.55-63, 2015.
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EU, MDR Regulation, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R0745

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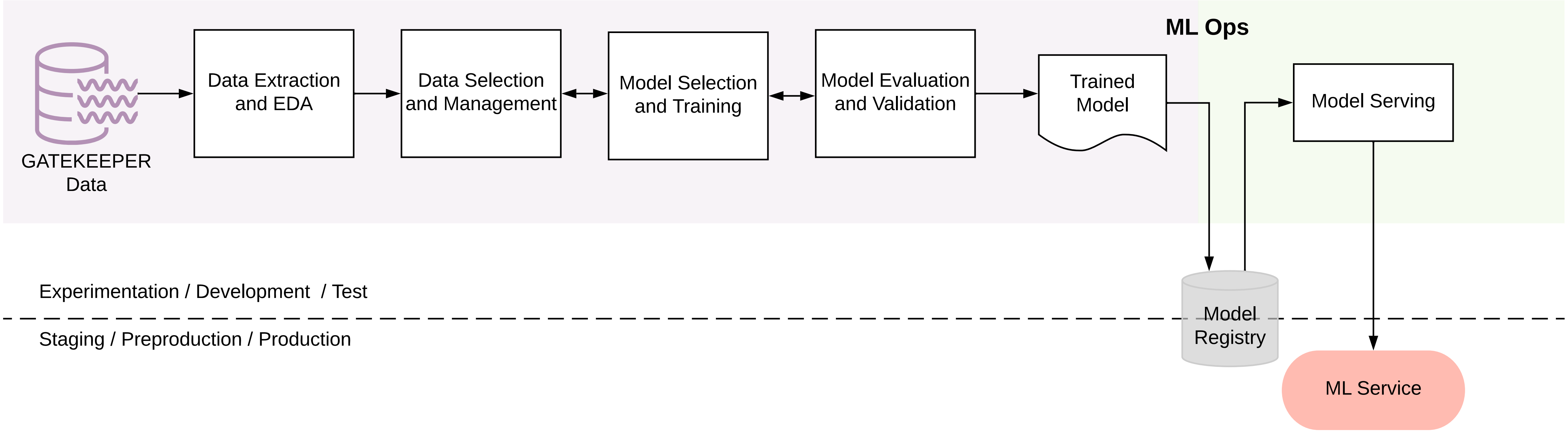
ML Pipeline

MLOps



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https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning
Zhang, J. M., et al., IEEE Trans. Softw. Eng., 2020.

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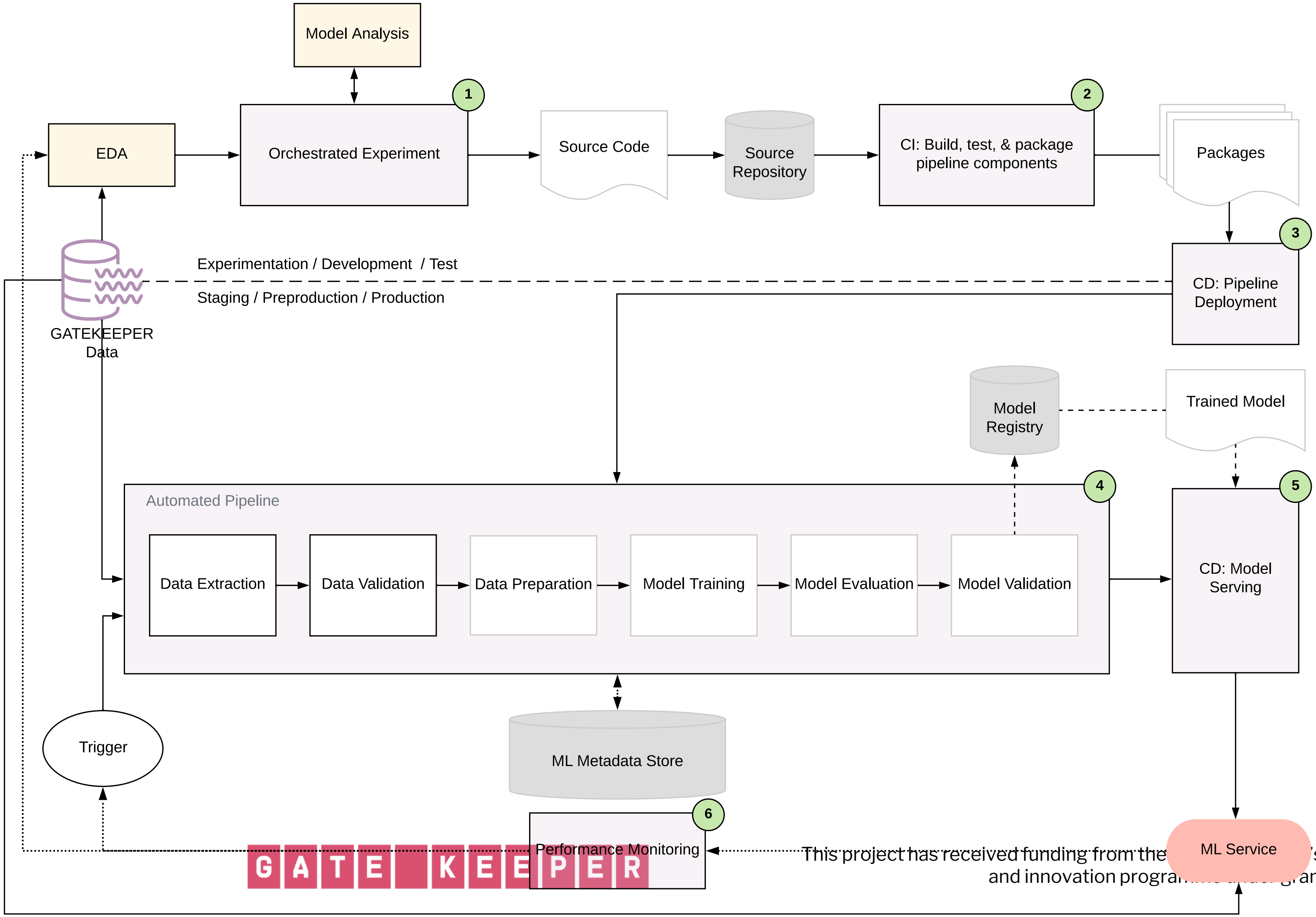
MLOps



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https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning

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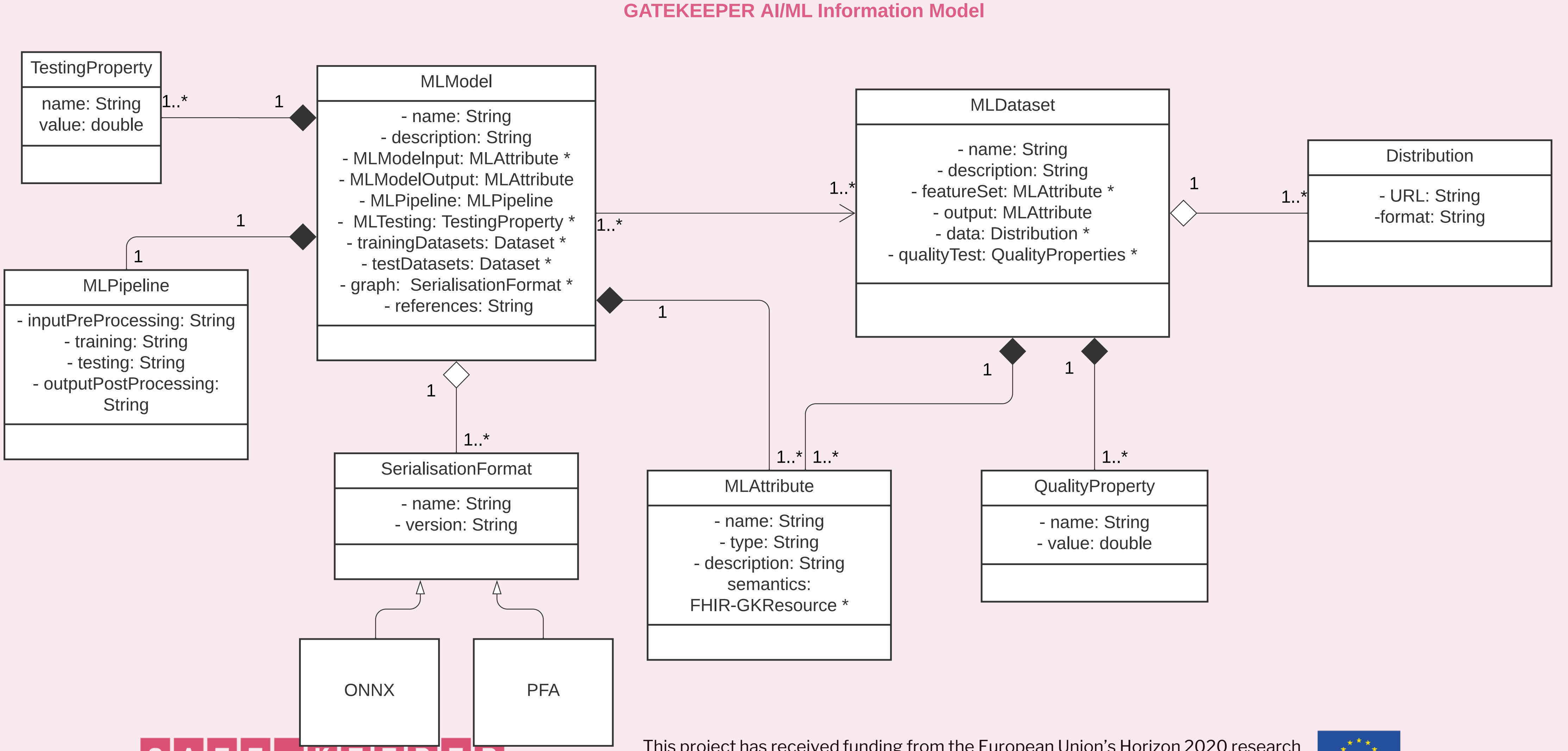
GATEKEEPER AI/ML Information Model



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GATEKEEPER RUC + PILOTS = Medical AI Services

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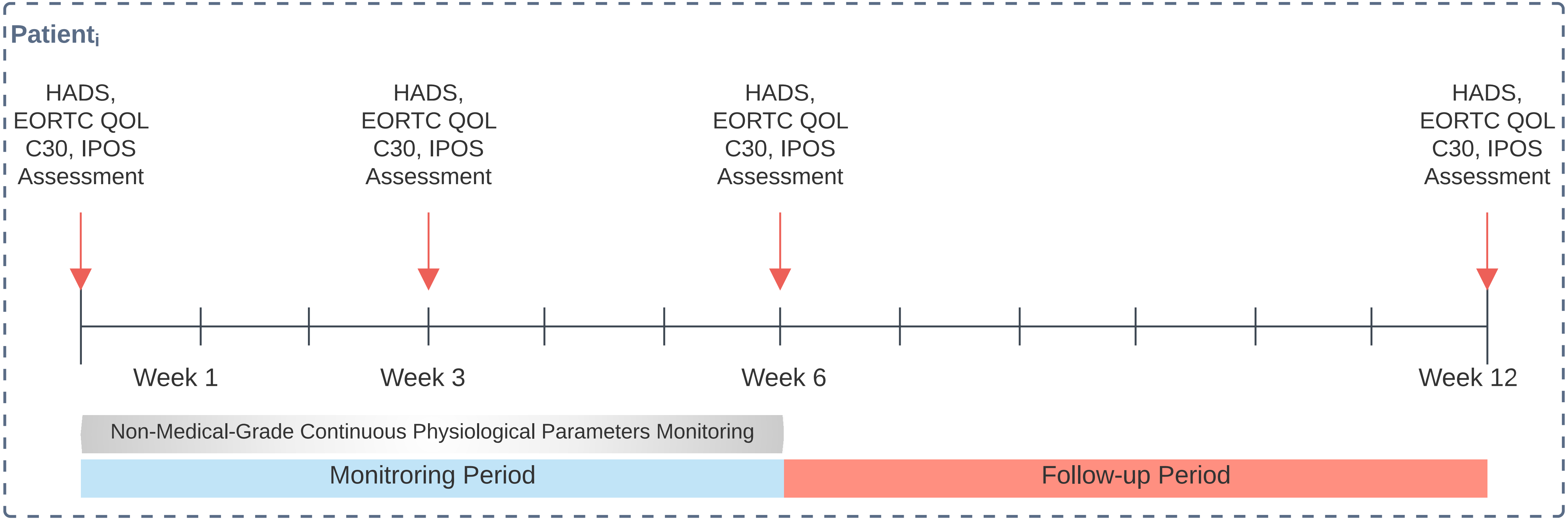
RUC7, CYPRUS - PASYKAF

Recognition of data patterns associated with PROMs for advanced cancer patients



HADS: Hospital Anxiety and Depression Scale

EORTC QOL C30: EORTC Quality of LIfe Core-30

IPOS: Integrated Palliative Care Outcome Scale - Patient Version

Physiological parameters e.g. heart rate, step count, stress, SpO2, sleep

GATEKEEPER

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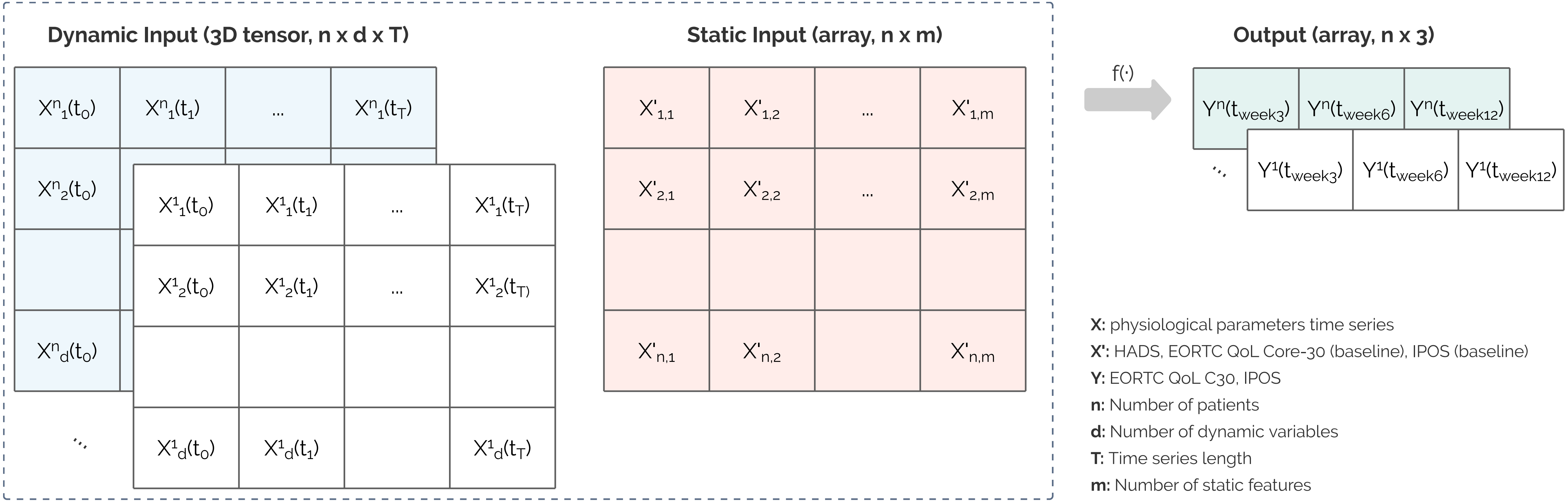
GATEKEEPER RUC + PILOTS = Medical AI Services

IOTWeek
Dublin — June 20-23, 2022

RUC7, CYPRUS - PASYKAF

Recognition of data patterns associated with PROMs for advanced cancer patients



X: physiological parameters time series
X': HADS, EORTC QoL Core-30 (baseline), IPOS (baseline)
Y: EORTC QoL C30, IPOS
n: Number of patients
d: Number of dynamic variables
T: Time series length
m: Number of static features

Ruiz, A. P., et al., Data Min. Knowl. Discov., 35(2), 401-449, 2021.
Spadon G., et al., IEEE Trans. Pattern Anal. Mach. Intell., doi: 10.1109/TPAMI.2021.3076155.
Shaker El-Sappagh, et al., Neurocomputing, 412, pp.197-215, 2020.
Li Y., et al., Briefings in Bioinformatics, 19(2), pp. 325–340, 2018.

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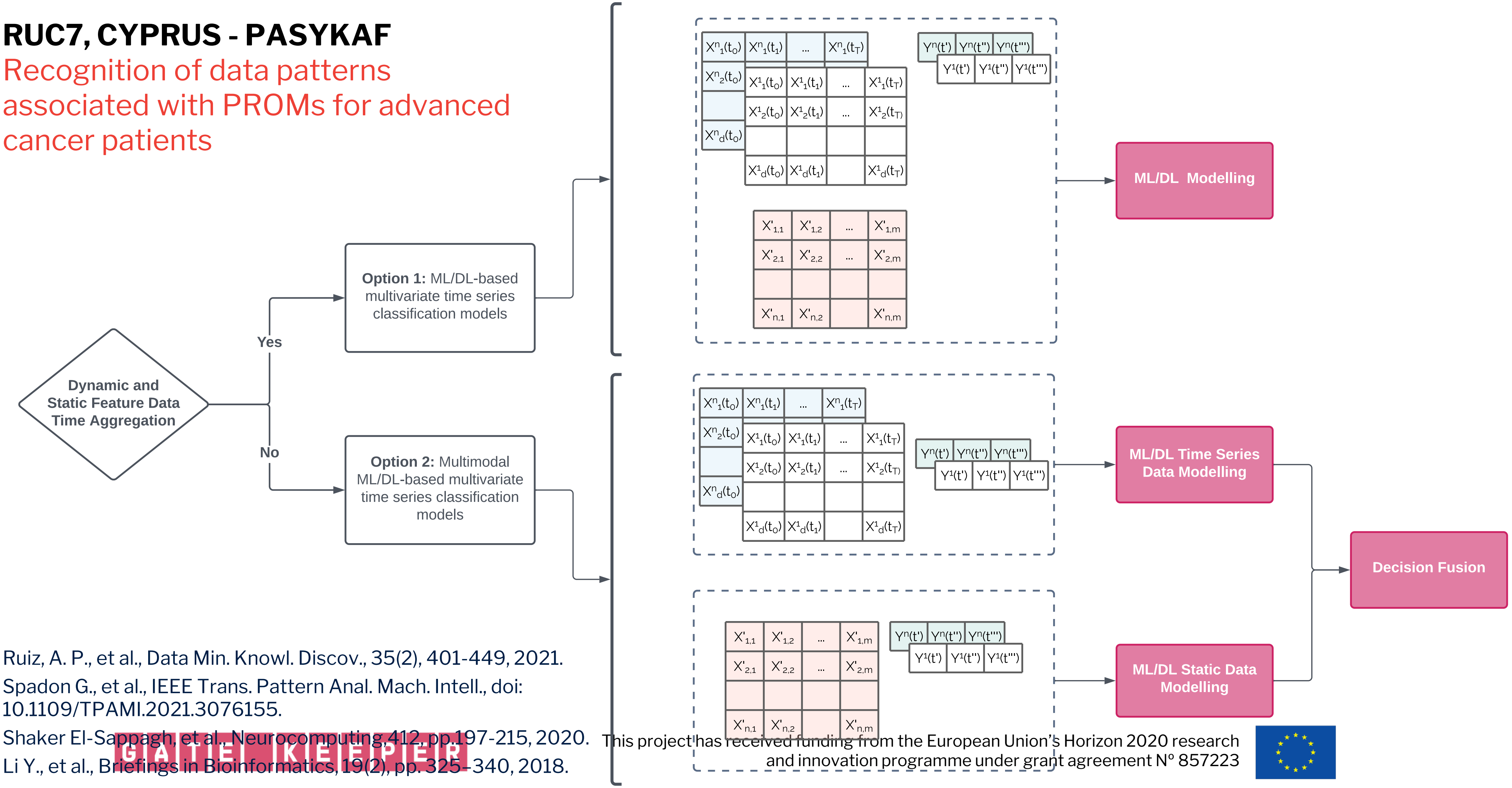

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Good Practices for Medical AI/ML-based Software

- Embracing guidelines for reporting (TRIPOD, TRIPOD-AI) and assessing the quality (PROBAST, PROBAST-AI) of multivariate prediction models towards developing transparent, reproducible, and unbiased medical AI/ML-based models.
- Implementing a rigorous model selection and testing procedure, inclusive of functional and non-functional requirements, towards trustworthy medical AI/ML-based models.
- Adhering to MLOps principles as a significant step towards the fluent integration of AI/ML-based software into medical decision support systems.
- Embracing SPIRIT-AI and CONSORT-AI statements in AI/ML-based interventions towards demonstrating clinical effectiveness.
- Embracing ethics frameworks towards the clinical translation of medical AI/ML outcomes.

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IOTWeek

Dublin — June 20-23, 2022

Real world data acquisition API

Mrs. Pilar Sala - Mysphera

Real world data acquisition – data sources

IOTWeek
Dublin — June 20-23, 2022

WEARABLE AND MEDICAL DEVICES

Physical activity (RUC1,2,3,5,6,7)

Sleep patterns (RUC1,2,3,4,7)

SAMSUNG
S3 Active Watch
S10 Smartphone

BIOASSIST
Compliant with
iHealth, Beurer, Phillips,
Ascensia, MIR, Jumper

BIOBEAT
Smartwatch

Blood pressure (RUC1,2,3,4,5,7)

BIOBEAT
Smartwatch
Patch

BIOASSIST
Compliant with
iHealth, Beurer, Phillips,
Ascensia, MIR, Jumper

MEDISANTÉ
BP800

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Real world data acquisition – data sources

WEARABLE AND MEDICAL DEVICES

Weight & body composition (RUC1,2,3)

BIOASSIST
Compliant with
iHealth, Beurer, Phillips,
Ascensia, MIR, Jumper

MEDISANTÉ
BC800

Glucose (RUC3)

BIOASSIST
Compliant with
iHealth, Beurer, Phillips,
Ascensia, MIR, Jumper

MEDISANTÉ
BP800
BG800

Univ.IOANNINA
Continuous
glucose
monitoring
system

Parkinson sensor (RUC4)

SENSE4CARE
STAT-on

LST-UPM
Hoop
sensors

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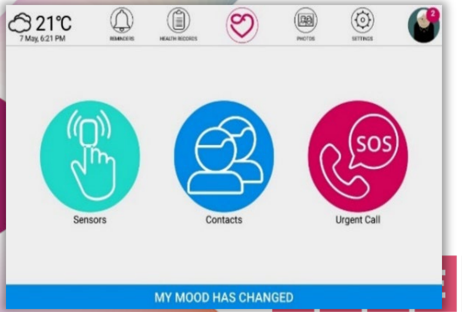
Real world data acquisition – data sources

IOTWeek Dublin June 20-23, 2022

APP FOR PATIENT / CUSTOMER

BIOASSIST

Alerts, Notifications, Messages, Videoconference, Supervision and Surveillance, Serious Games, Affective Services, Helpdesk, Emergency Button, Infotainment, Multimedia Sharing

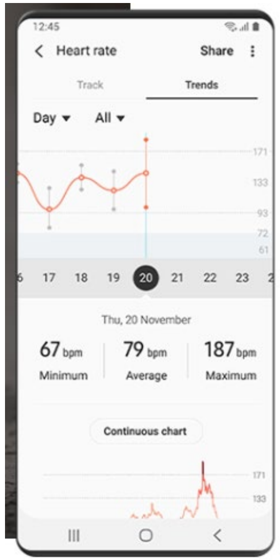


BIOBEAT

Self-management
Real-time monitoring…

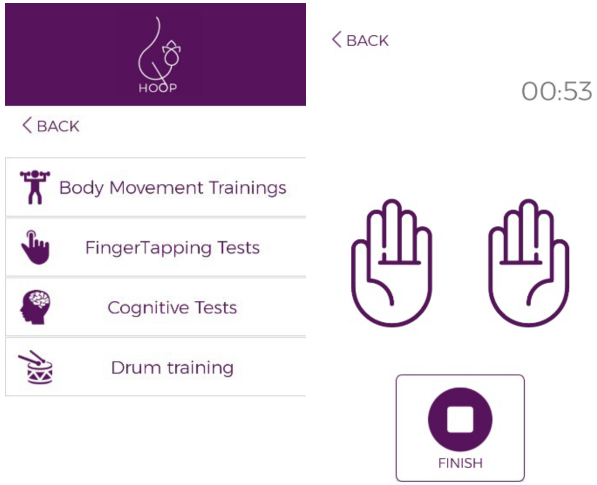
SAMSUNG

Samsung health
Samsung ACTIVAGE (Home monitoring, Emergency Trigger and Reducing Social Isolation)



LST-UPM

HOOP – self-management and rehabilitation of Parkinson



KEEPER

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Real world data acquisition – data sources

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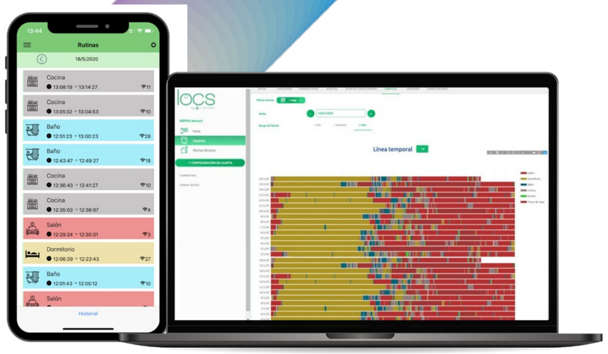
APP/DASHBOARD FOR PROFESSIONAL / INFORMAL CAREGIVERS

MYSPHERA

LOCS solution, app for relatives, dashboard for professionals. Real-time monitoring, alerts, historic & trends

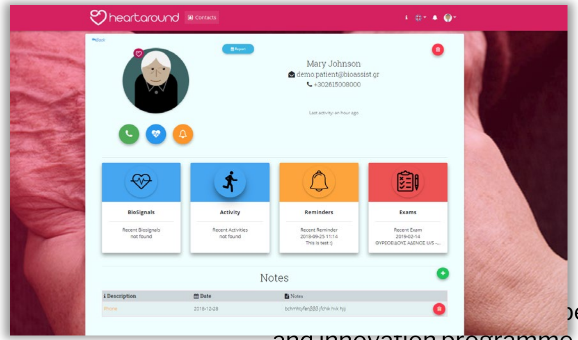


ENGINEERING

DMCoach (diabetes)
Personalized advices, patient management, real-time parameters monitoring

BIOASSIST

Alerts, Notifications, Messages, Videoconference, Supervision and Surveillance, Serious Games, Affective Services, Helpdesk, Emergency Button, Infotainment, Multimedia Sharing



BIOBEAT

Cardio-pulmonary supervision system
patient assessment, care-plans, real-time parameters monitoring

Score	3	2	1	0	1	2	3
Respiration Rate (BrPM)	≤8		9-11	12-20		21-24	≥25
%SpO$_2$ (Scale 1)	≤91	92-93	94-95	≥96			
%SpO$_2$ (Scale 2, use with hypercapnic respiratory failure)	≤83	84-85	86-87	88-92 ≥93 on Air	93-94 on Oxygen	95-96 on Oxygen	≥97 on Oxygen
Supplemental Oxygen?		Yes		No			
Systolic Blood Pressure (mmHg)	≤90	91-100	101-110	111-219			≥220
Heart Rate (BPM)	≤40		41-50	51-90	91-110	111-130	≥131
Consciousness (ACVPU)				Alert			CVPU
Temperature (°C)	≤35		35.1-36	36.1-38	38.1-39	≥39.1	

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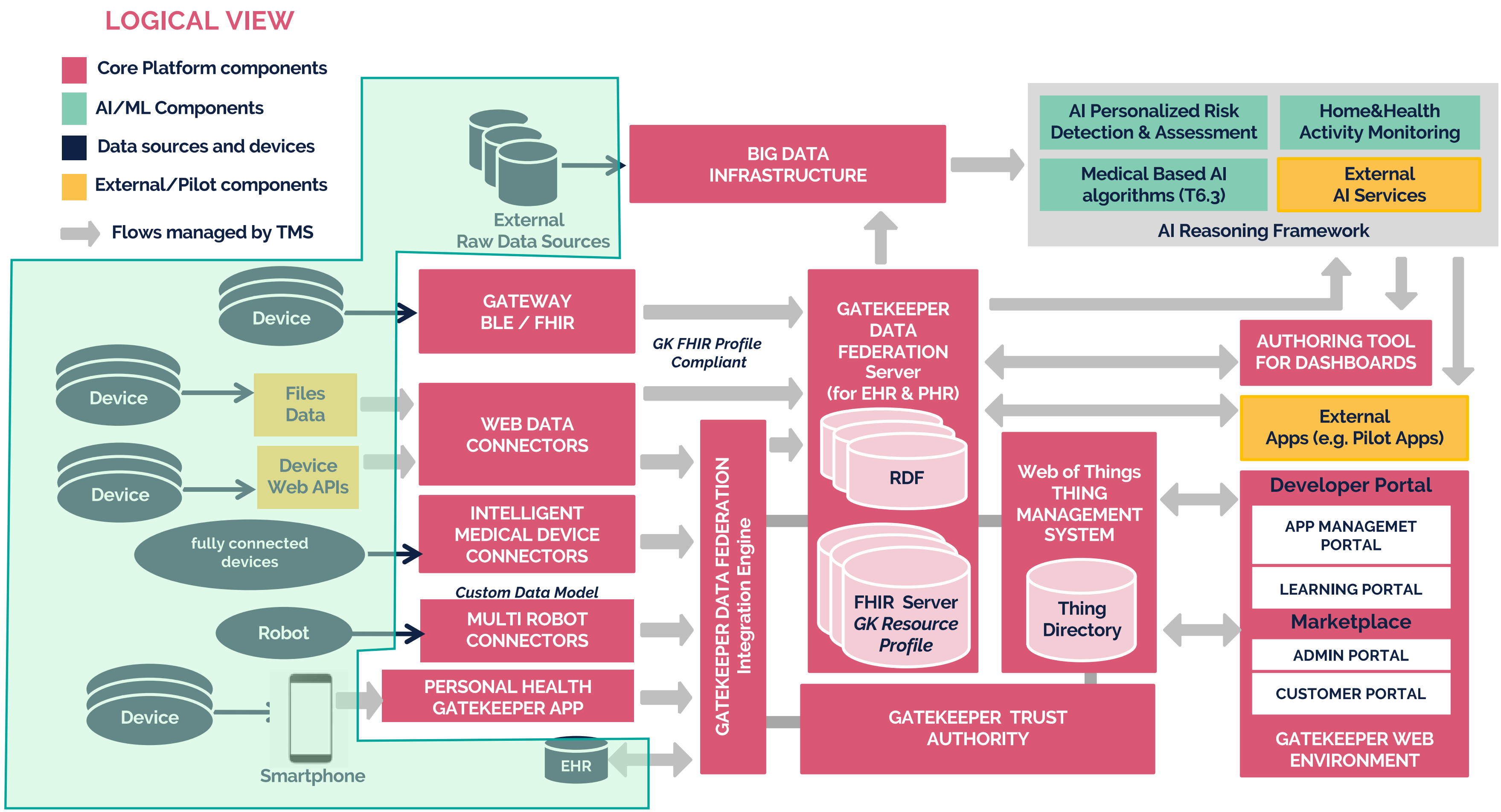
ean Union's Horizon 2020 research and innovation programme under grant agreement N° 857223

Real world data acquisition – data sources



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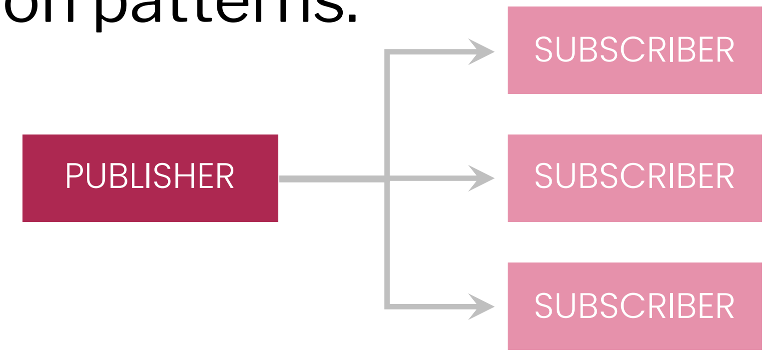
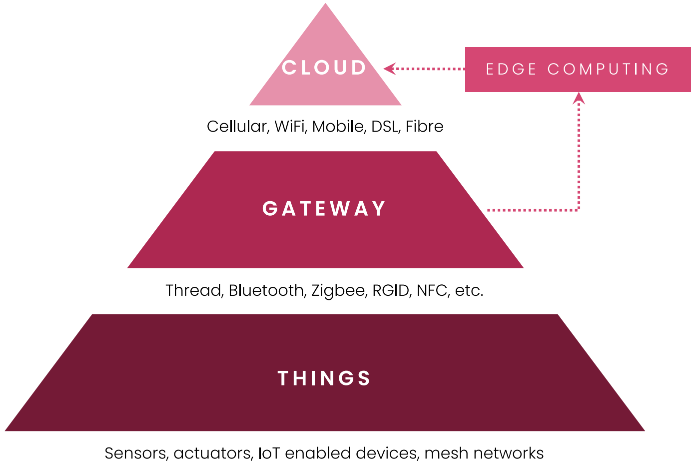
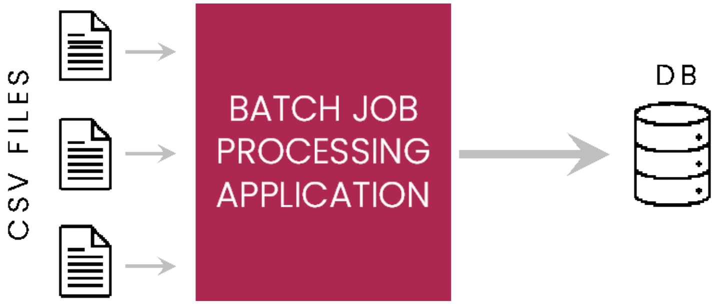
Real world data acquisition - connectors

GATEKEEPER connectors are independent pieces of software that allow the communication of device and/or external platform by implementing different communication patterns.







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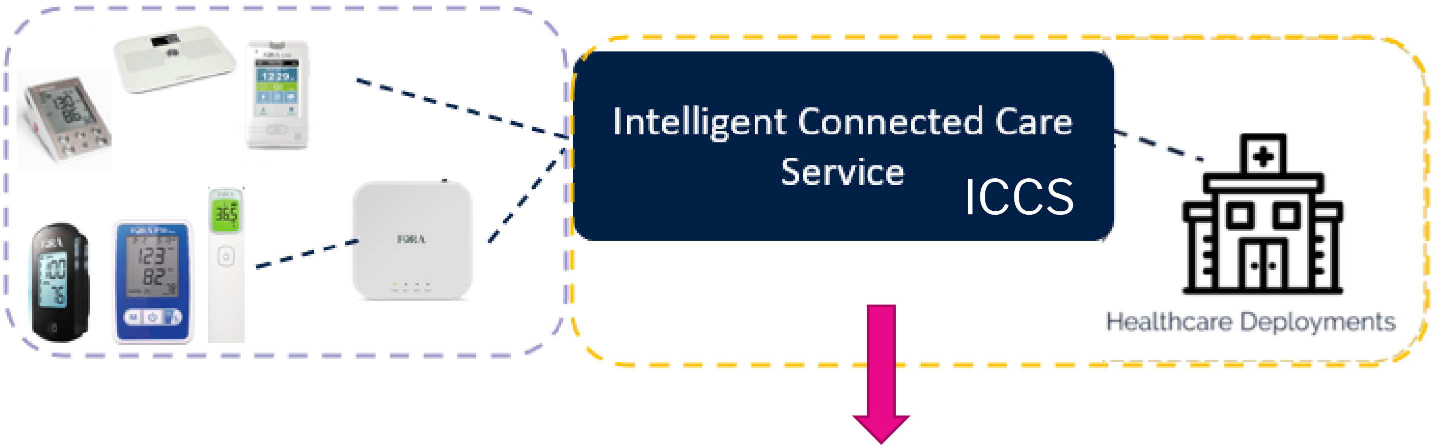
Intelligent care connector

“publish subscribe communication” pattern



FHIR REST API to push information from medical devices with embedded SIM card connected to ICCS to the Data Federation

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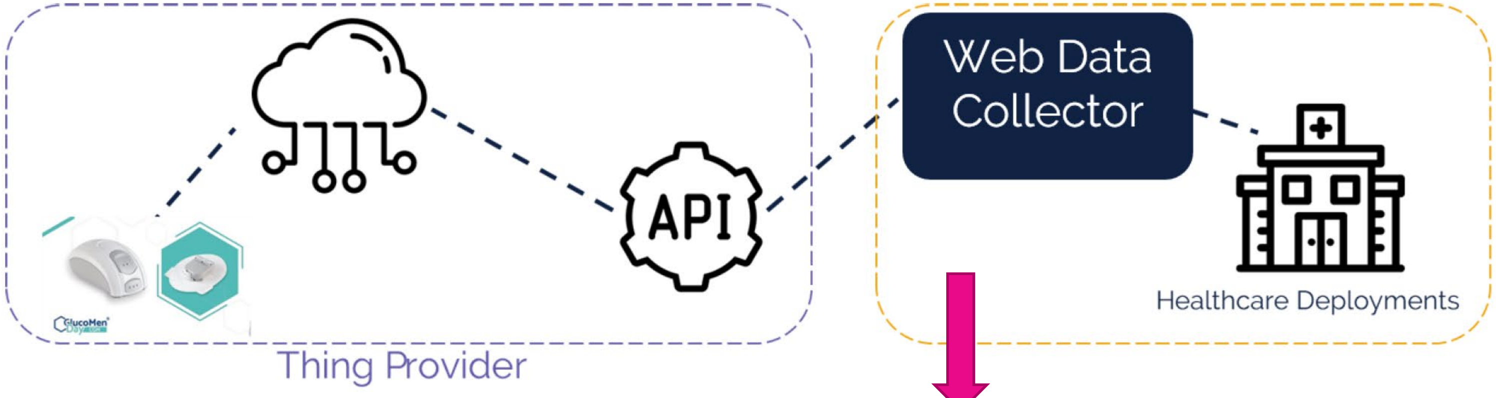
IoT Web connector

"request response" pattern



provides an abstraction of this IoT system to Web Thing

web API collector → near real time data and historical data can be queried

remote file collector → large quantities of data in a specific format can be received and digested

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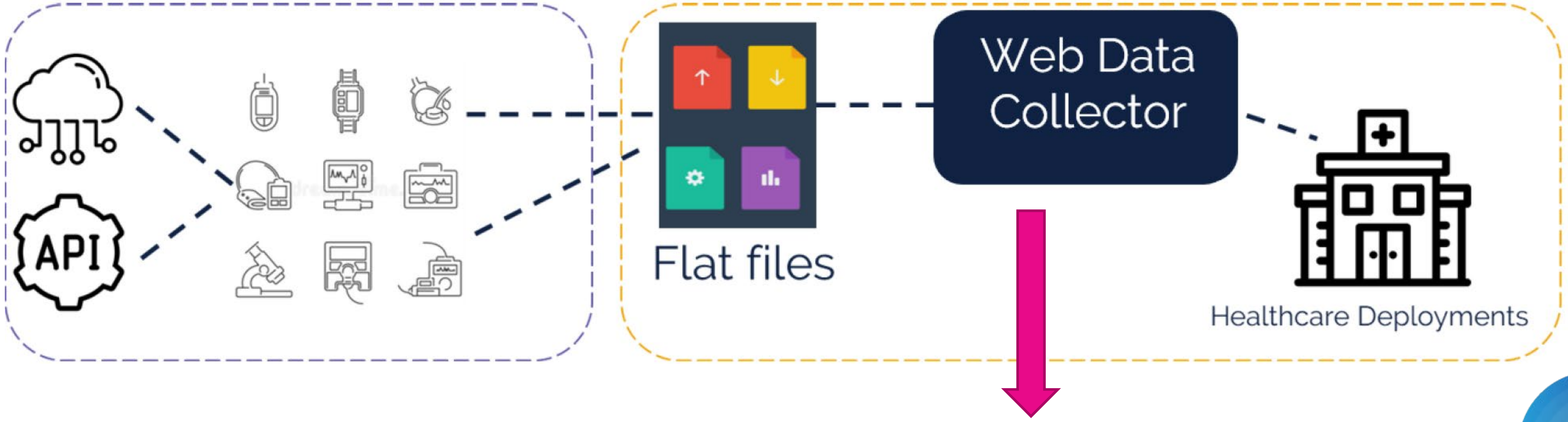
Legacy IoT connector

"Asynchronous batch data upload" pattern



Based on ETL processes, allows uploading data from legacy systems, such EHR or proprietary applications that provides export functionalities

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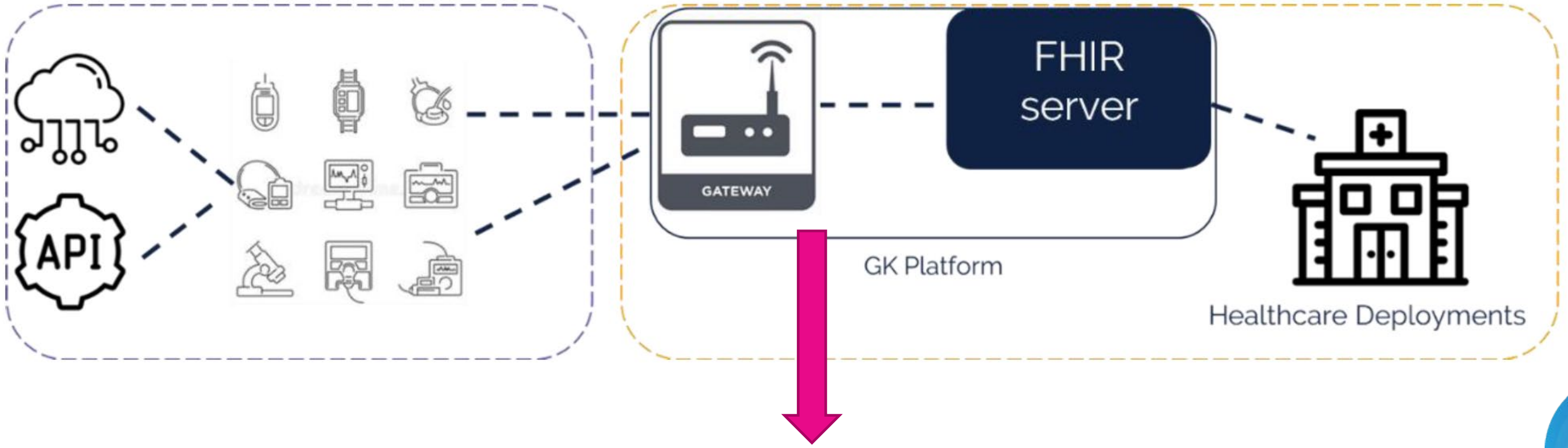
Smart IoT Gateway connector

"Edge-based integration" pattern



connection of devices based on BLE into a physical gateway able to gather data from BLE layer to HTTP layer using FHIR format and with intrinsic security and AI edge capabilities

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IOTWeek

Dublin June 20-23, 2022

Thank you!

Find more:

https://www.gatekeeper-project.eu/

iotweek.org

Questions Giuseppe Fico

IOTWeek Dublin June 20-23, 2022

Why have you used FHIR for modelling your domain?

Because it is the most promising technologies nowadays for addressing the fragmentation of the data in healthcare. It provides open documentation of data, services and interactions and it is compliant with the FAIR principle.

How IoT data and connector are managed in Gatekeeper?

Gatekeeper is deployed in a militarized zone and the services access is only grant via VPN. Connectors and intelligent ioT devices need to provide a X509 certificate released by the GTA in order to push data into the platform.

GATEKEEPER

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Questions Eleni Georga

- **Question 1:** Which are the main elements emphasized in guidelines related to the development and quality assessment of medical AI prediction models? Most importantly, how these elements encourage and pave the way towards the implementation of AI-based interventions by complementing related guidelines in the field, such as the CONSORT-AI?

- **Question 2:** Which aspects should be taken into consideration during real-world testing of both technical and clinical performance of an AI prediction model service?

- **Question 3:** Which are the core ethical principles of research that should be considered in the ML pipeline?

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