InteropEHRate

EHR in people's hands across Europe



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THE INTEROPEHRATE PROJECT



Centre

EXISTING SOLUTIONS

National and international standards:

- monolingual and multilingual terminologies (SNOMED CT, UCUM, EDQM);
- international coding systems (ICD, LOINC, ATC);
- information models (HL7, CDA, FHIR, OMOP);
- there is progress on adoption on both local and governmental levels, but it remains limited.

Supporting technology:

- terminology servers: increasingly used;
- Extract-Transform-Load (ETL) tools: graphical UI for file conversions, schema mappings, data transformations, sometimes code mappings: widely used;
- information extraction tools: never in care, somewhat in research, more often for accounting.



ADOPTING STANDARDS IS HARD

Healthcare standards are very complex



=> it is easier to build custom ad-hoc systems than full support for e.g. FHIR.

HEALTHCARE IS EVOLVING

Standards, tools, and even our knowledge of healthcare is constantly changing

=> the system must be agile to support this evolution.

AUTOMATION REDUCES PRECISION (AND VICE VERSA)

Care and research require ~100% precision and explainability in data processing. But human input does not scale well over large quantities of data.

DEEP SEMANTIC INTEGRATION

"Deep and semantic" means that every single data value (relevant to the task) is understood, made explicit, and represented in a formal, language-independent manner.



DEEP SEMANTIC INTEGRATION

Starting from a correct and complete knowledge graph, **in-depth adaptation** (conversion, translation) can be automated in a robust way.



COMPONENTS AND HIGH-LEVEL METHODOLOGY Data Manager CURATION MAINTENANCE SETUP HEALTH DATA PROCESSING Local Health Data ഹ്റ FAIR In-Depth In-Depth Interoperable Understanding Adaptation Knowledge **Health Data** Graph Al-based inf. extr. Sc **Terminology server** a Interactive Operations **3rd-party machine** with reasoning (term and linking for data mapping translation service mulitilingual and transformation and code mappings, Technologies (local and remote) translations) prescriptions tool Knowledge Language Models Terminologies Schemas Rules Code ICD9, ICD10, Pre-trained Italian Data FHIR, CDA, Code snippets for SNOMED CT, ATC, and French models, mappings SumEHR and data transformations. LOINC, UCUM, fine-tuned for and trans-FHIR JSON generator local schemas local codes formations prescription annotation **KIIOWIEUge Wallage**r 1 \

A HUMAN-CENTRED, YET AUTOMATED METHODOLOGY

For correctness, human supervision is essential.

- Knowledge manager: setup, curation, and maintenance of knowledge (term bases, schemas, language models, rules, code snippets).
- Data manager: setup, curation, and maintenance of the data mapping and transformation process.

How to reconcile human supervision and scalability?

Through a set of knowledge and data management tools, integrated into a single GUI.

INNOVATIVE TOOLS AND METHODOLOGY

The graphical ETL paradigm is extended by

multilingual information extraction and knowledge graph building.

The InteropEHRate semantic health tools have been primed twice by the EC Innovation Radar as outstanding innovation.

Prescription -	Prescr:DrugIngre dient_1 -	Prescr:DrugIngre dient_1 Concepts	Prescr:DrugProdu ct_1 ▼	Prescr:StrengthVa lue_1 -	Prescr:StrengthU nit_1 ▼	Prescr:StrengthU nit_1 Concepts •	Prescr:Form_: S	Suggest pr:Form_1	Prescr:PeriodUnit _1▼	Prescr:Note_1
				and an		— —	1	I	186258 Cpr orodisp	
Lansoprazolo (Lansox) 15 mg cpr. orodisp. /die (ore 8)	Lansoprazolo	590947-Lanso	Lansox	15	mg	65218-Mg 584523-Mg	cpr orodisp	186258-Cpr or	Forma farmaceuti compressa orodis More Detail	persibile
Atorvastatina (Torvast) 20 mg cp.riv. /die (ore 22)	Atorvastatina	593834-Atorva	Torvast	20	mg	65218-Mg 584523-Mg	cpr riv	186257-Cpr riv		
Nebivololo (nobistar) 5 mg 1/2 cpr/die (ore 8)	Nebivololo	594606-Nebivo	nobistar	5	mg	65218-Mg 584523-Mg	cpr	186546-Cpr	die	ore 8

IN-USE EXPERIENCE FROM INTEROPEHRATE







NATURAL-	Italian	French	Italian, French, Greek, Romanian			
LANGUAGE TEXT	Codification of NL terms, information extraction fro	m prescriptions	Official translations of code definitions, machine translation of longer text			
TERMS AND CODES	HL7 service codes, ICD9- CM, LOINC, ATC	Local codes <i>,</i> ICD10-CM, ATC	ICD10-CM, LOINC, ATC, SNOMED CT, UCUM			
SCHEMAS	CDA	SumEHR (IPS) + local schemas	FHIR directly used by HCP Application			
FHIR RESOURCES	Patient, Practitioner, Encounter, Condition, CarePlan, Medication, MedicationStatement, Observation, DiagnosticReport, Media, AllergyIntolerance					

CONCLUSIONS AND LESSONS LEARNT FROM PILOTS

- Over health data, full interoperability is hard and will always be.
- Standards and supporting tools are necessary but not sufficient.
- We try to reconcile precision and automation through methodological innovation.
- In the InteropEHRate pilots, human effort was still crucial:
 - local data experts (Fondazione Monasterio, CHU de Liège);
 - methodology expert (University of Trento);
 - standardisation expert (Fraunhofer Institute).
- Knowledge and data mapping rules are onerous to bootstrap but lightweight to maintain.
 - => Lots of initial testing datasets help us foresee data heterogeneity.