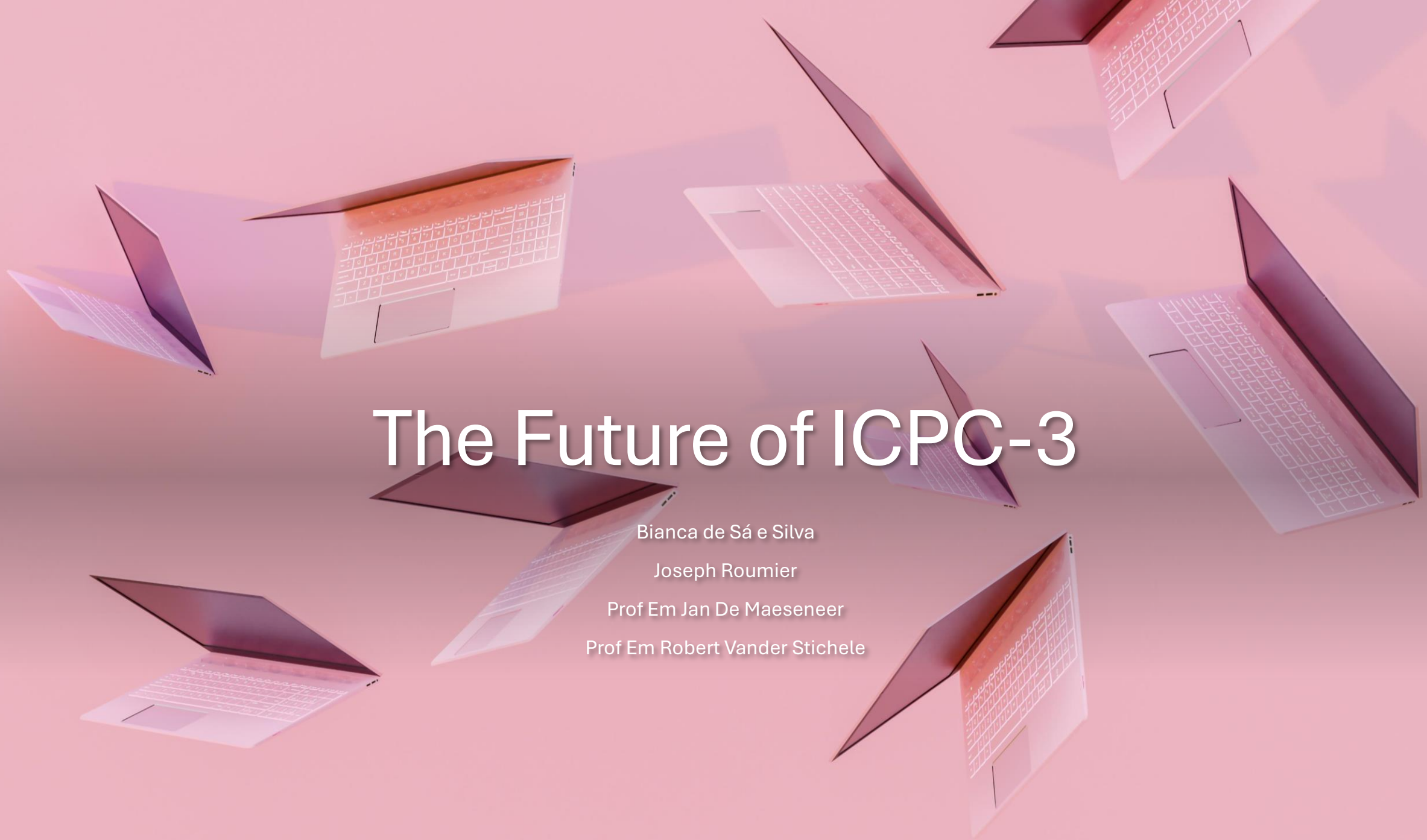

# The Future of ICPC-3

Bianca de Sá e Silva

Joseph Roumier

Prof Em Jan De Maeseneer

Prof Em Robert Vander Stichele

# CONFICT OF INTEREST (COI)

In accordance with criterion 13 of document UEMS 2023/07 “EACCME® Criteria for the Accreditation of Live Educational Events (LEEs)”, all declarations of perceived or actual conflicts of interest for the last 3 years, whether due to a financial or other relationship, must be provided to the EACCME® upon submission of the application.

**IF YOU DON‘T HAVE ANY CONFLICT, PLEASE DELETE THE CONFLICT-OF-INTEREST REPORT POINTS BELOW**

- I have the following potential conflict(s) of interest to report
  - Receipt of grants/research supports:

Our team is funded by the Belgian Federal Public Service (FPS) Health, Food Chain Safety and Environment, Centre for Terminology, National Release Centre for IHTSDO SNOMED International on a project for mapping SNOMED CT to 3 different medical classifications

# Overview

- The current state of Electronic Health Records
- The SNOClass Project and ICPC-3
- The Belgian Integrated Health Record (BHIR)
- AI and ICPC-3
- Conditions for the survival of ICPC
- Discussion

# The current state of Electronic Health Records

# Changing context for medical documentation

- Complete informatisation of Health Care
- eHealth Agencies governing the digital transformation of the health care system
- The quest for interoperability
- The principle of “entry once, multiple use”
- Health data as a source for research, both RCTs and Real-World Data
- The growing importance of Standard Developing Organisations (SDOs)
- The advent of SNOMED CT as a reference terminology
- The ontologies of the WHO Family of International Classifications: WHO-FIC (= ICF, ICHI, ICD-11, not ICPC and ATC)
- The transition from ICPC-2 to ICPC-3

# The context for the deployment of ICPC-3

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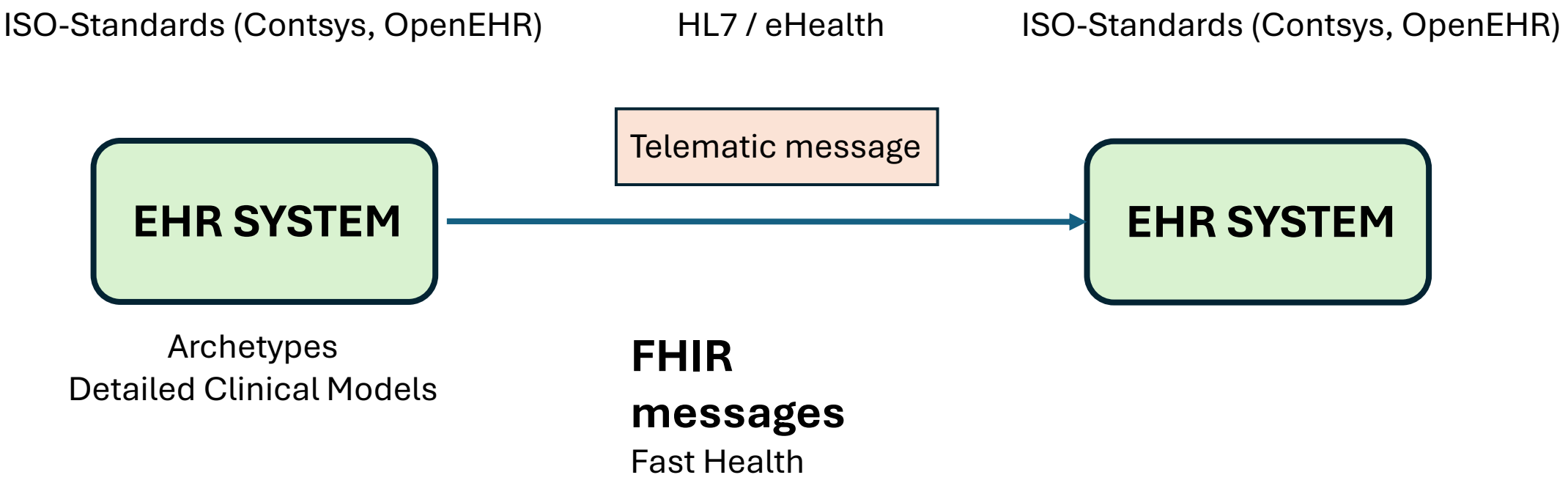
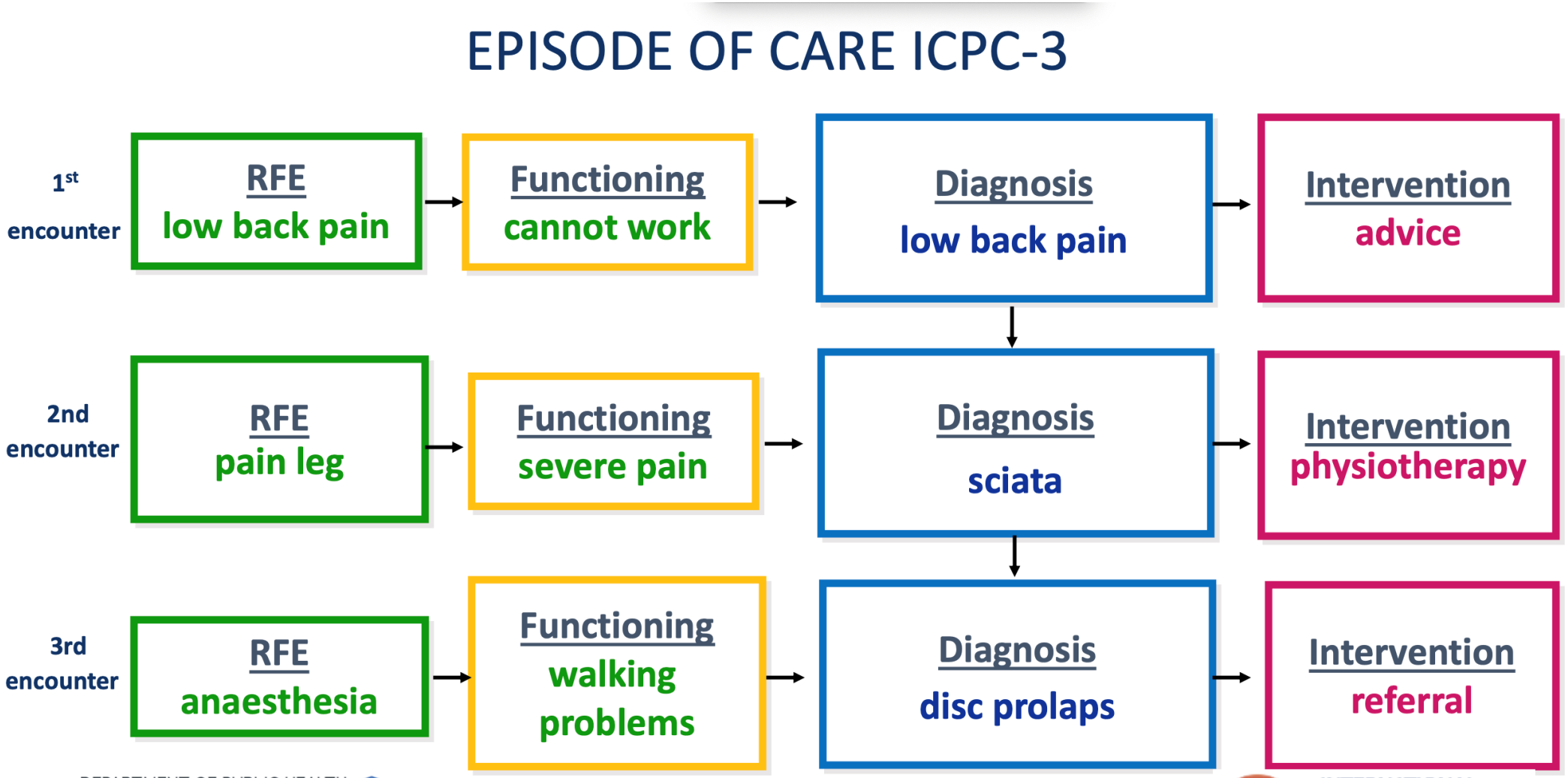
# The quest for interoperability

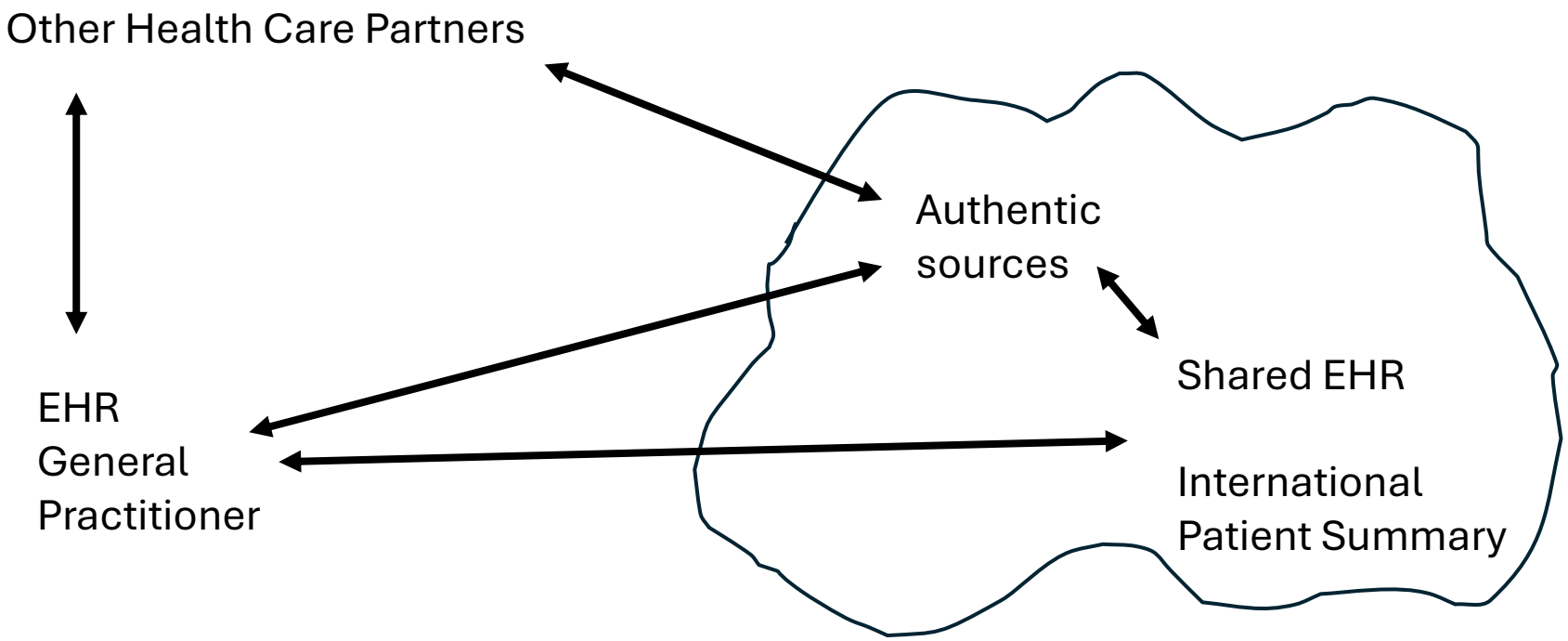



Standardized concepts, bound to standardized terminologies, embedded in standardized structures , to achieve technical and semantic interoperability

# Requirement in primary care to work methodically within encounters and link encounters to episodes of care



# From a proprietary, closed Electronic Health Record to a shared Electronic Record




Belgian Integrated Health Record

# The principle of “entry once, multiple uses”

Single entry at the point-of-care

- Recall at the next visit
- Communication with colleagues in group practice
- Communication with the patient
- Communication with hospital care
- Gateway to evidence-based medical information and decision support
- Case finding for clinical trials
- Longitudinal epidemiological research
- Big Data and Real-World Data

This requires for the data-entry at the point-of-care to be as specific as possible

# The advent of SNOMED CT

Governed by IHTSDO, now SNOMED International with 50 country members
Aiming at clinical care
Aiming at comprehensiveness
    360.000 concepts and growing
Aiming to perfect the internal machine-readable structure
    Allowing application of semantic web techniques
Pushed by governments, eHealth agencies, IT personnel
Complex for the end-user to handle
Ready for AI applications

# The endangered future of classifications

- Only supported by domain experts

- Pushed aside by SNOMED CT
  “If you only have a hammer, everything looks like a nail”

- Discarded by false promises of mapping from the classification to the reference terminology

- Perceived as becoming obsoleted by AI

## How will the end-user be supported, entering data into medical record systems

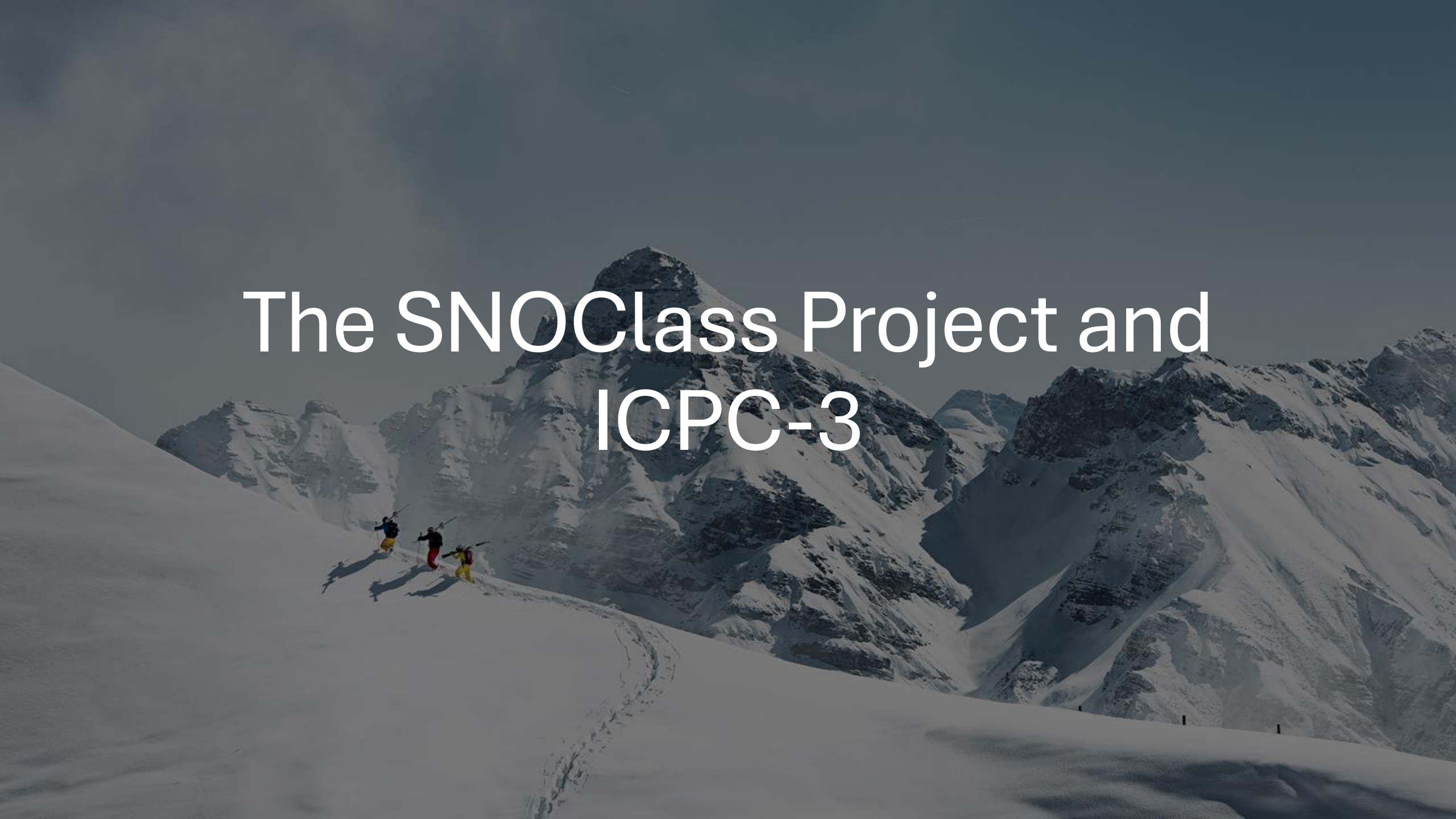
- Deal with the lack of training
- Deal with the lack of sophisticated IT systems
- Struggle with administrative burden leading to burnout
- Deal with the enormity of SNOMED CT
- Deal with the possibility of not being able anymore with the classification of the domain, with which there is (was) acquaintance
- Reluctant to rely on AI

Risk of disruption in longitudinal collection of data

- Medical histories of patients
- Malfunction for decision support
- Biased and not trustable big data
- Morbidity / Mortality statistics

# The transition from ICPC-2 to ICPC-3

- Long expected and finally there
- Transition is always a risk of disruption
- An update remediating “childhood diseases”
- ICPC-3 is on paper and in a browser, available as a ClaML resource, but not as an ontology (with explicit, machine-readable relations between concepts)
- The position of ICPC-3 within the WHO Family of International Classifications (WHO-FIC) is unclear



# The SNOClass Project and ICPC-3

# Introduction

- We form relationships through language
  - With each other
  - Between concepts
- Medical reasoning is rooted in the language we use
  - Need for standardization
  - The role of medical classifications and clinical terminologies

# What is the difference?

**Classification**: ‘an exhaustive set of mutually exclusive categories to aggregate data at a pre-prescribed level of specialization for a specific purpose’

**Clinical terminology**: ‘terminology required directly or indirectly to describe health conditions and healthcare activities’

*ISO 17115 (International Standards Organization 2007)*

# What is the difference?

**Classification**: = data aggregation

**Clinical terminology**: = description

**SNOClass - a Belgian project for mapping SNOMED-CT to 3 medical classifications:**

- International Classification of Functioning, Disability and Health (ICF)
- International Classification of Health Interventions (ICHI)
- International Classification of Primary Care (ICPC-3)

Department of Rehabilitation Sciences, Occupational Therapy Research Unit
Department of Public Health and Primary Care, Unit Medical Informatics and Statistics
Department of Public Health and Primary Care, Unit Family Medicine
WHO Collaborating Centre on Family Medicine and PHC - Ghent University

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*Funded by the Belgian Federal Public Service (FPS) Health, Food Chain Safety and Environment, Centre for Terminology, National Release Centre for IHTSDO SNOMED International*

# SNOMED CT

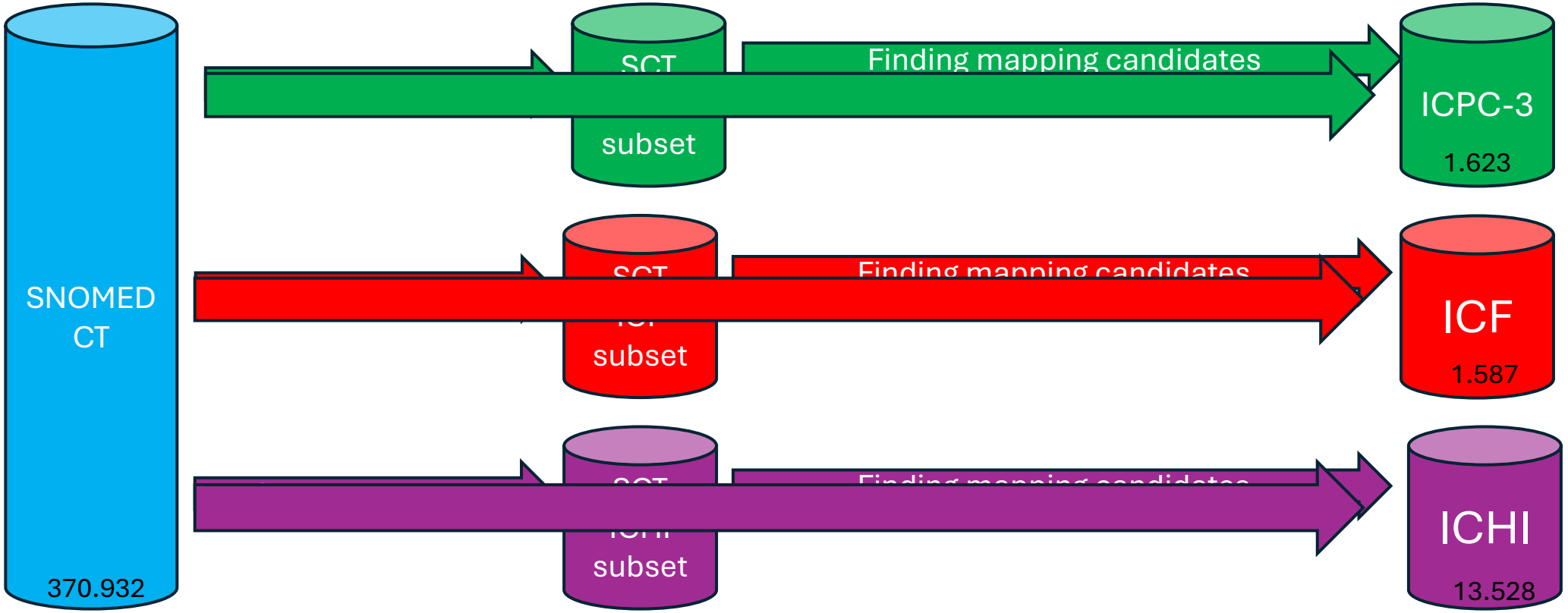
- Multilingual Medical Terminology
  - Started in UK and US, now funded by 50 countries
- >360 000 medical concepts
- Aims at covering all aspects of the medical domain to **support all medical activities**
- Source for EHR and other tools

# Mapping

Creating connections between concepts, represented by labels

Information recorded in one can be understood in the other

# Mapping: origin and target




Large mismatch in level of aggregation and coverage: need to find a subset

# The Belgian Bicoded Bilingual Thesaurus (3BT)

An example of a linguistic-conceptual resource (bridging human language to digital concepts)

An example of an end-user terminology, supporting health care providers with data entry at the point-of-care

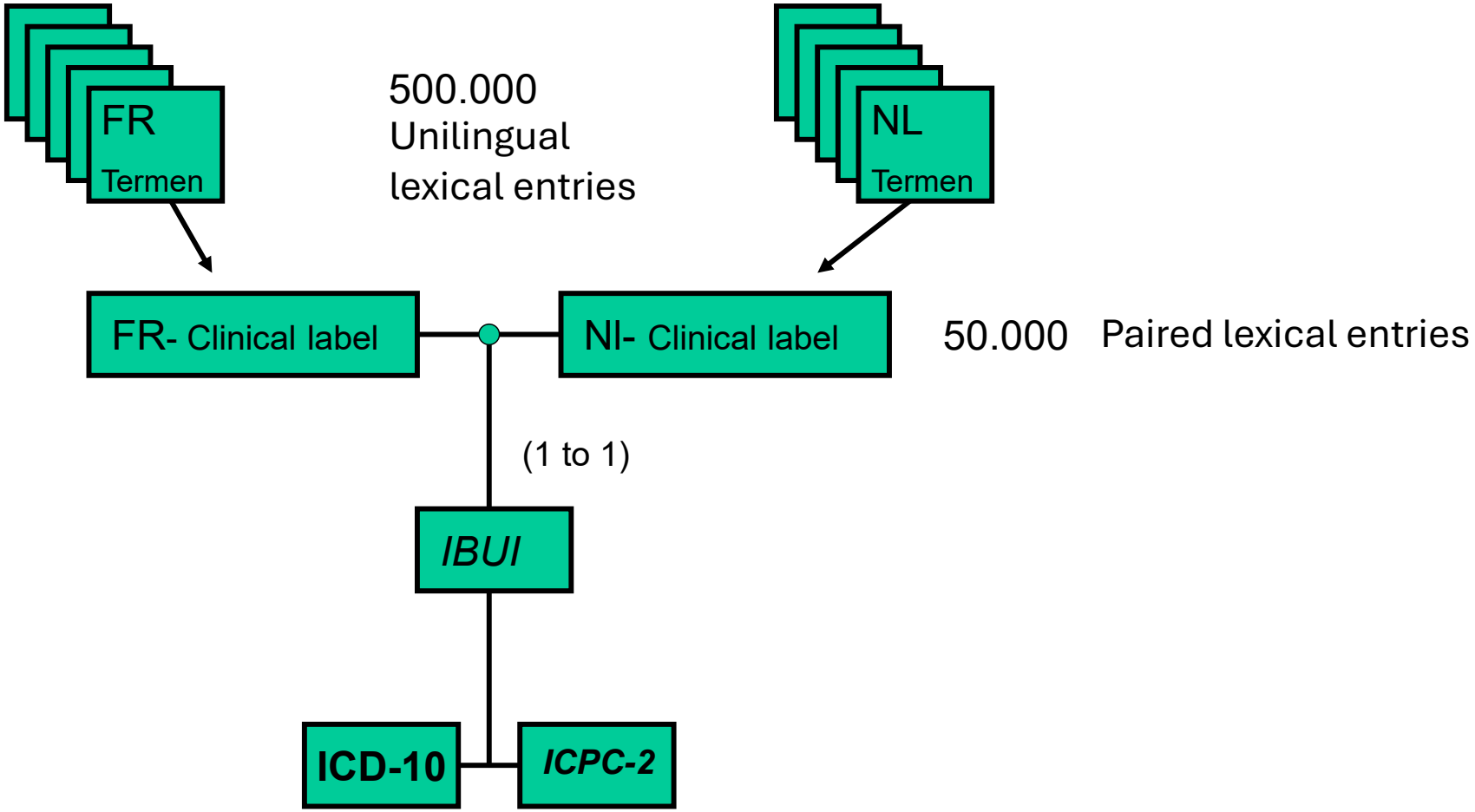
A similar initiative exists in Australia (ICPC-2 PLUS), linking language to SNOMED CT and ICPC.

The basis of successful longitudinal epidemiological research for more than 2 decades

In great need of an update (updated: 2011)

In need of modernisation

# The Belgian Bilingual Bicoded Thesaurus (3BT)



# A first step in modernisation: Linking 3BT to SNOMED CT

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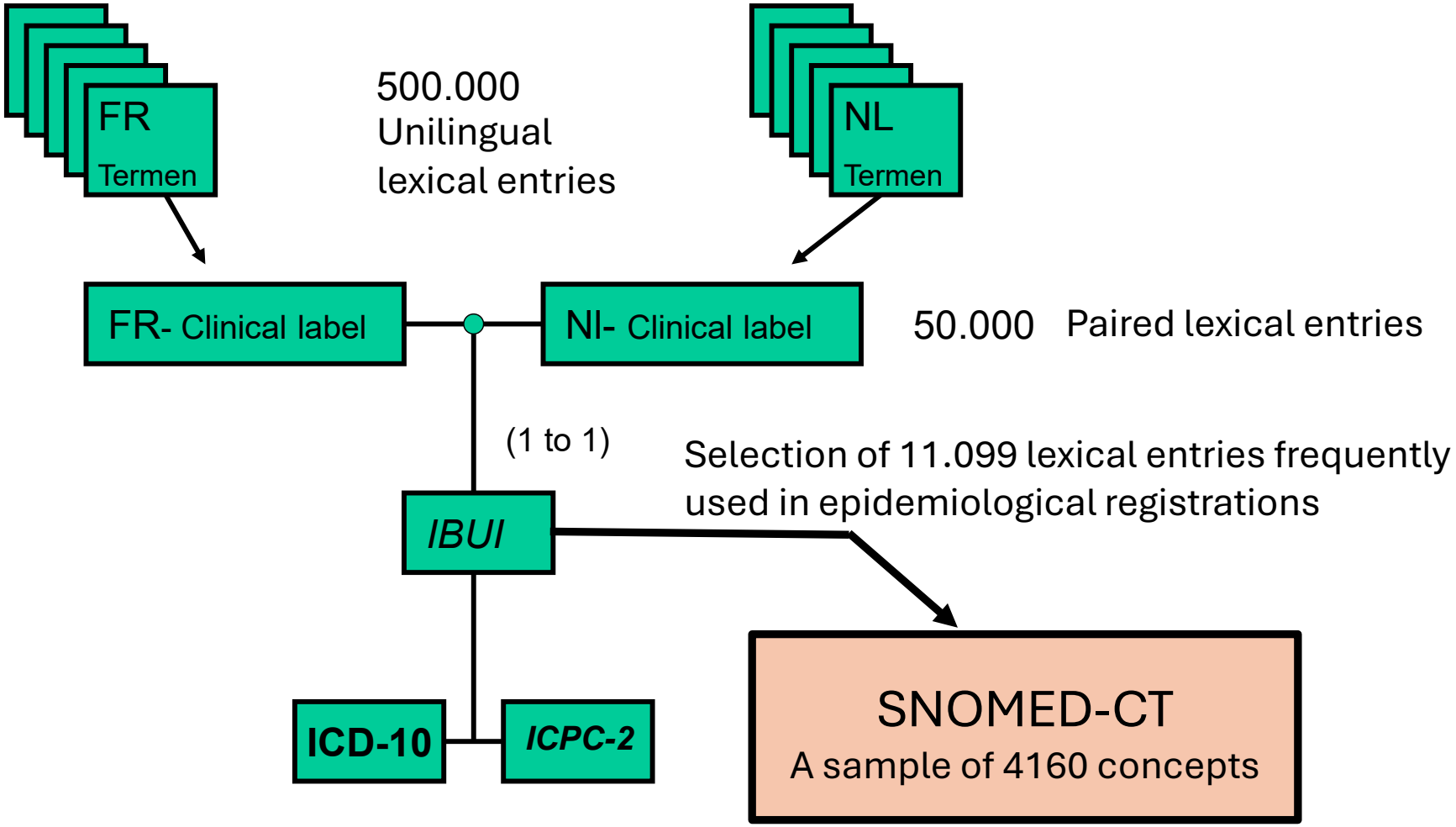
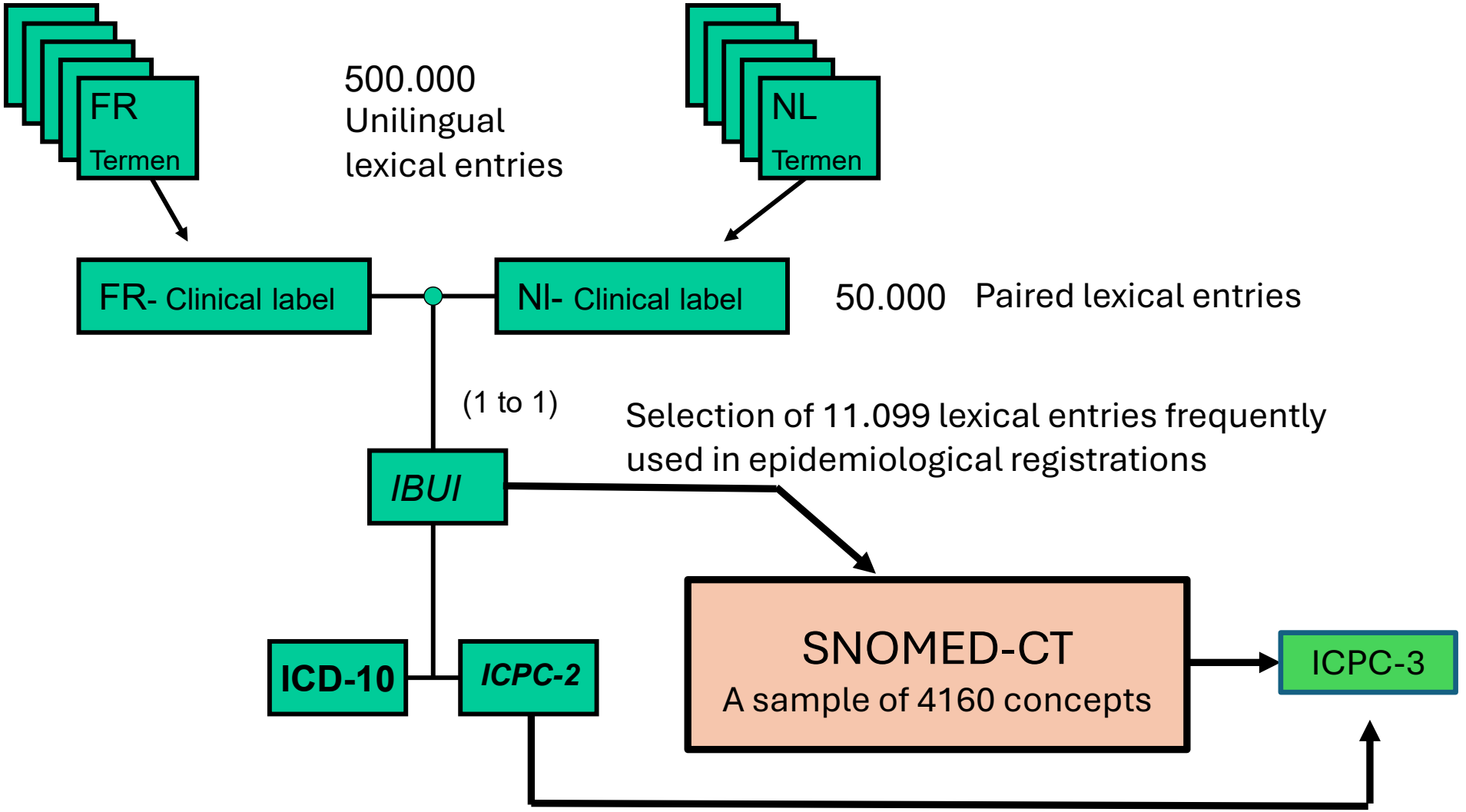
# The Belgian Bilingual Bicoded Thesaurus (3BT)

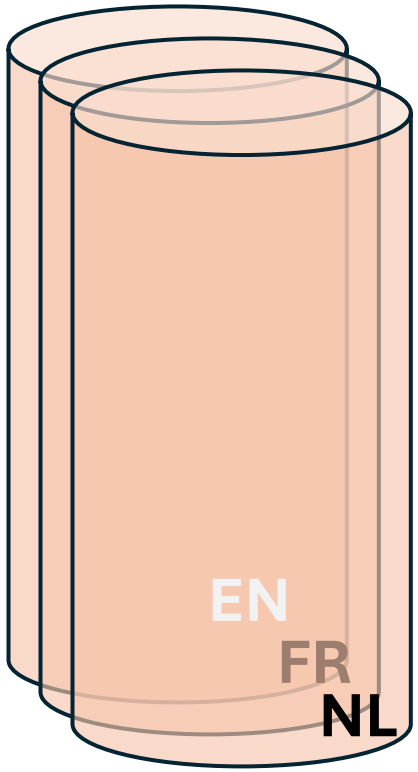


# Approach in the SNOClass Project

# The Belgian Bilingual Bicoded Thesaurus (3BT)



# Modern, Multilingual Enduser Terminology




Human Language | Computer Language

**Reference Terminology**

SNOMED CT

**Classifications**

ICF

ICD-11

ICPC-3

ICHI

**Multilingual Medical Dictionary**

**Language-independent maps**

Linguistic systems

Conceptual Systems


Why?

# Belgian Integrated Health Record

Prof Em Jan De Maeseneer

DEPARTMENT OF PUBLIC HEALTH AND PRIMARY CARE

WHO Collaborating Centre
Family Medicine and Primary Health Care

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# Belgian Integrated Health Record: an opportunity for ICPC-3 ?


- **Prof.em. Jan De Maeseneer, MD, PhD**
- **Head of WHOCC on Family Medicine and PHC – Ghent University**

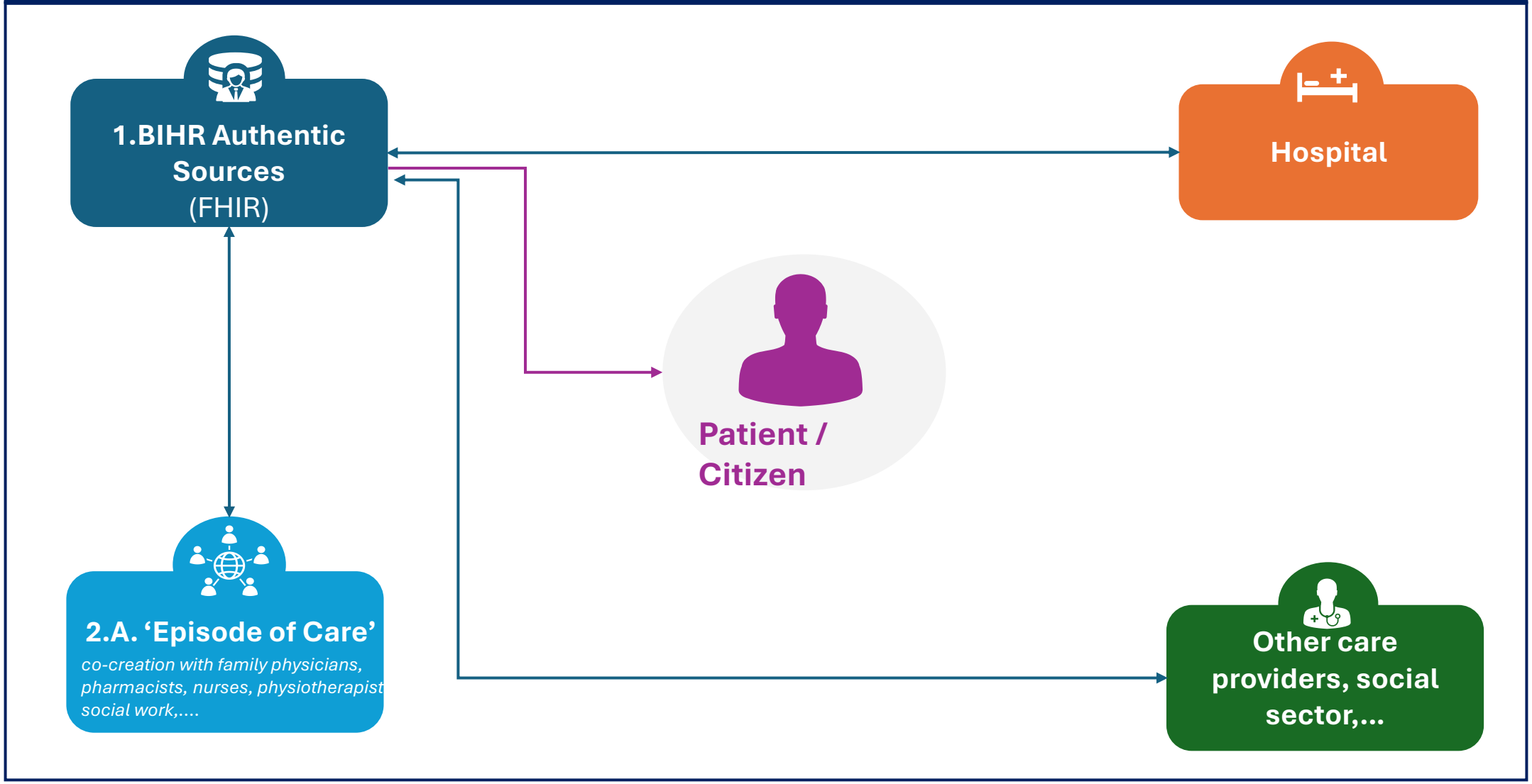
# 1.BIHR Authentic Sources:

The **“authentic sources”** are data relating to care for a person's well-being and health, which are published by the care provider in a consistent and standardized manner and are accessible to the care providers who have a therapeutic relationship with the person, and to the person themselves .

All data are in a FHIR (Fast Healthcare Interoperability Resources) compatible format.

| | | |
|---|---|---|
| **Problem list (health & wellbeing) evolving to IPS** | **Clinical data (linked → Problems) as ‘Caresets’** | **Laboratory** |
| **Imaging** | **Medication-overview** | **Vaccinations** |
| **Allergy** | **Telemonitoring-data** | **Social Factors** |
| **Family Context** | **Life-goals** | **Care-Plan & Care-Team** |
| **Belrai** | **Patient Will** | **Implants** |

# Relation between 1. ‘BIHR Authentic Sources’ and 2.‘BIHR Work Environment’ in different settings



# 2.BIHR Work Environment :

A. **“Episode of Care”:** An “Episode of Care” is documented by the records (by the healthcare providers involved and the patient, possibly also the informal caregiver) that relate to a specific condition/health problem, from the moment the patient first asks for professional help up to and including last contact for this condition/health problem.“

Lawrence Weed, 1971 https://www.youtube.com/watch?v=qMsPXSMTpFI

THIS IS WORK IN PROGRESS

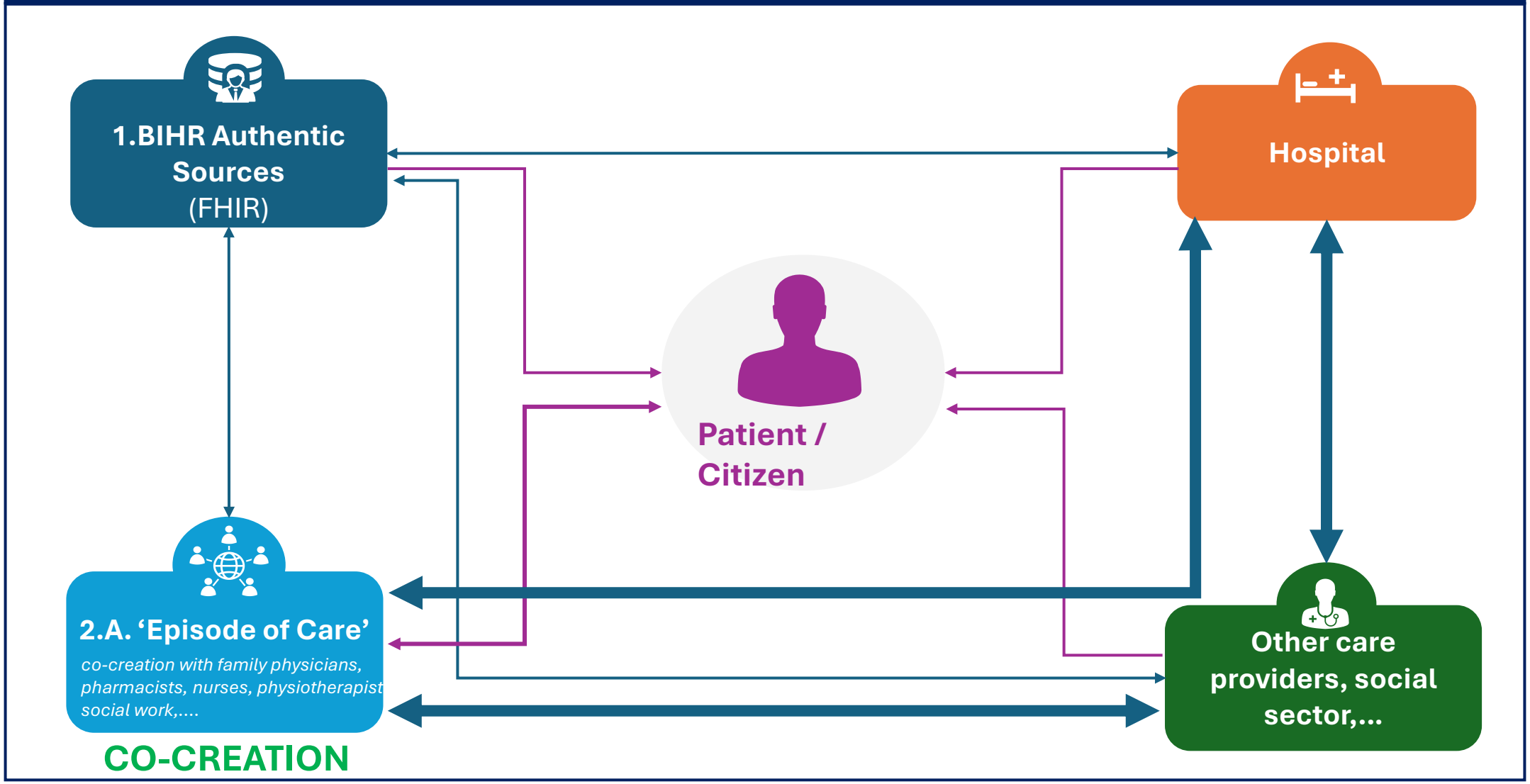
# 2.BIHR Work Environment :

A. **“Episode of Care”:** An “Episode of Care” is documented by the records (by the healthcare providers involved and the patient, possibly also the informal caregiver) that relate to a specific condition/health problem, from the moment the patient first asks for professional help up to and including last contact for this condition/health problem.
B. **“Linking pathways”** are agreed electronic processes and formats that ensure the secure transfer of referral and prescription documents and associated information relating to a person on the one hand, and records and reports on the other, between health (care) practitioners who have a therapeutic relationship with this person.

https://www.youtube.com/watch?v=qMsPXSMTpFI

THIS IS WORK IN PROGRESS

# Relation between 1. 'BIHR Authentic Sources' and 2.'BIHR Work Environment' in different settings




Structured FIHR-compatible information transfer

2.B. Linking Pathways

Patient/citizen can read and add information according to a user-friendly and safe procedure.

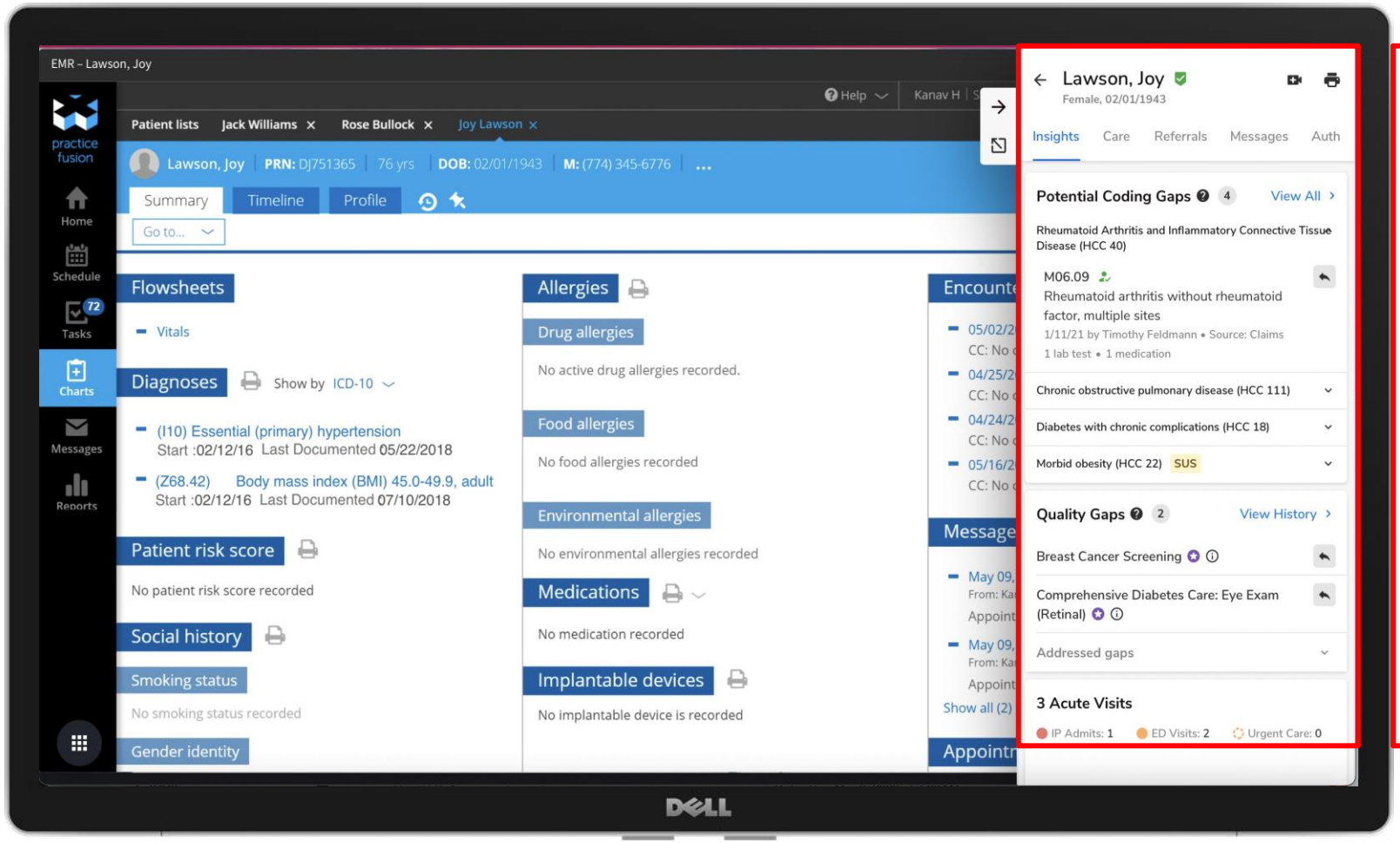
Patient/citizen can read information (f.ex. through Patient Health Viewer)

# BIHR Work Environment : USER-FRIENDLY INTERACTION : 'SCREEN- PERSON – PROVIDER'

## Quality outcomes with point of care insights

***Consolidates patient information, in-network co-creation of information (family physicians, pharmacists,nurses, physiotherapists), and helps in engaging the physicians and primary care providers to put in practice integrated goal-oriented care and population health management.***

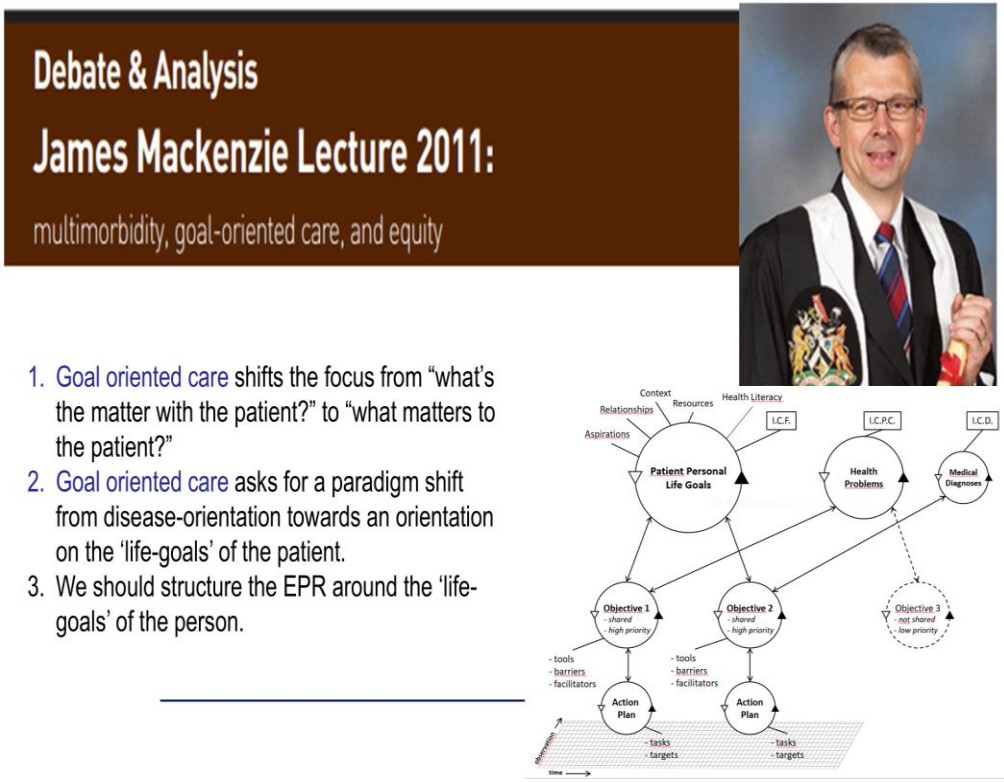
The BHIR Work Environment (BWE) uses Clinical Decision Support, interacting in real-time with the patient data (e.g. AB-prescription and renal function, medication-interactions,...). Moreover AI (LLM) will support the coding process, the 'creation' of the relevant clinical data 'Careset',the problem-list,...




During the consultation,there is a continuous analysis of information 'in the background', producing 'warnings, reminders, follow-up information, …

# BIHR Authentic Sources:

1. **Problem list** (health & wellbeing) evolving to IPS / **Probleemlijst** (gezondheid en welzijn) evoluerend naar IPS
2. **Clinical data** (linked → Problems) as 'Caresets' / **Klinische Data** (gelinkt → Problemen)
3. **Laboratory / Labo**
4. **Imaging / Beeldvorming**
5. **Medication-overview / Medicatie-overzicht**
6. **Vaccinations / Vaccinaties**
7. **Allergy / Allergie**
8. **Telemonitoring-data / Telemonitoring-data**
9. **Social Factors / Sociale Factoren**
10. **Family Context / Familiale Context**
11. **Life-goals / Levensdoelen**
12. **Care-Plan & Care-Team / Zorgplan & Zorgteam**
13. **Belrai**
14. **Patient Will**
15. **Implantaten**



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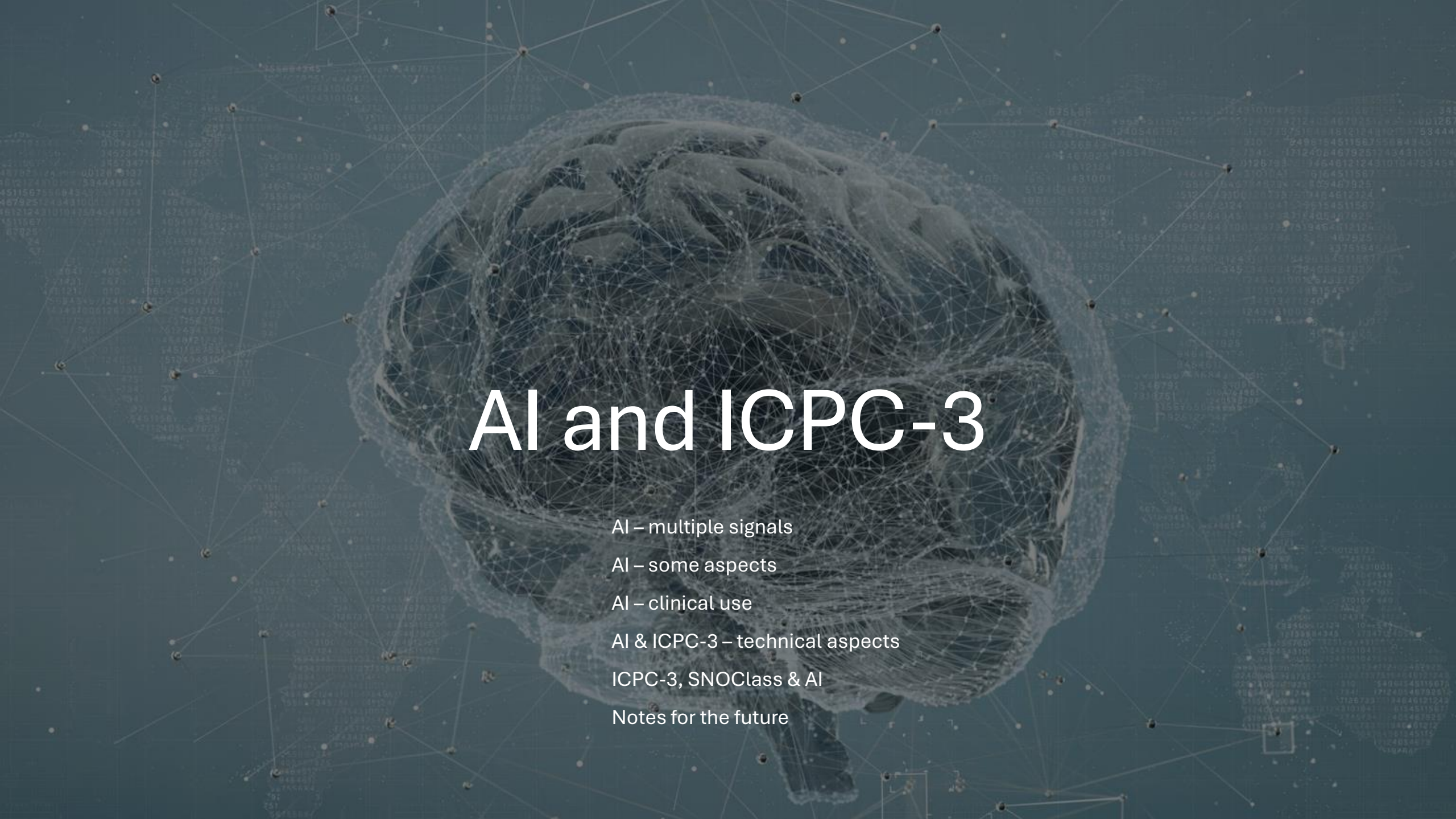

# AI and ICPC-3

AI – multiple signals

AI – some aspects

AI – clinical use

AI & ICPC-3 – technical aspects

ICPC-3, SNOClass & AI

Notes for the future

# AI – multiple signals

PubMed®

ai artificial intelligence[MeSH Terms]

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40,740 results

Page 1

RESULTS BY YEAR

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2024-2026

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1 Cite

Prediction Model of Intradialytic Hypertension in H on Machine Learning.

Wang Y, Zhou H, Guo Q, Wang K, Luo Y, Luan S, Tang D, Dong S

J Med Syst. 2025 Sep 11;49(1):112. doi: 10.1007/s10916-025-02

PMID: 40932673

2 Cite

Comparative Transcriptomic Analysis Reveals Key Alternative Splicing Events in Siniperca scherzeri.

Xu H, Jin J, Li Y, Wu Y, Cheng Z, Wang M, Ye X, Lai M, Zhang D.

Mar Biotechnol (NY). 2025 Sep 11;27(5):137. doi: 10.1007/s1012

PUBLICATION DATE

- 1 year
- 5 years

The GenAI Divide
STATE OF AI IN BUSINESS 2025

*"Despite $30–40 billion in enterprise investment into GenAI, this report uncovers a surprising result in that 95% of organizations are getting zero return."* – NANDA July 2025

AI · EYE ON AI

## Sam Altman's AI paradox: Warning of a bubble while raising trillions

BY SHARON GOLDMAN
AI REPORTER

August 19, 2025 at 1:32 PM EDT

openAI/ChatGPT

# AI – some aspects

**Jobs**: According to “State of AI in business 2025”, Healthcare & Pharma are not “disrupted” by AI beyond documentation/transcription pilots. *“Healthcare executives […] express no expectation of reducing physician or clinical staff hiring.”*

**Bias**: *“ChatGPT recognizes only 10–20% of sentences written in Hausa, a language spoken by 94 million people in Nigeria.”*

Environmental issues & concentration of technical and economical resources

Wild S. AI models are neglecting African languages — scientists want to change that. Nature. 2025 July 29;d41586-025-02292–5. https://www.nature.com/articles/d41586-025-02292-5

https://news.mit.edu/2025/explained-generative-ai-environmental-impact-0117

# AI – clinical use

WONCA World 2025 keynote on **“Family Medicine and Artificial Intelligence – A Human Touch”** by Seyma Handan Akyon.

- A search in the programme shows 29 communications citing AI
- Multiple domains: training, literature review and research, ambient scribe, diagnostic…
- 2 by Vinicius Anjos de Almeida et al. specifically on ICPC-2 coding supported by LLM/AI

**Notes:**

- Family medicine demands long term memory and paying attention to details whereas AI is built on large datasets (still with bias) and tooling up to now don’t build on local information
- Most AI integration pilots succeed when outsourced, assigned a specific task and continuously improved
- Ambient AI requires patient agreement
  - See “Ethical use of Artificial Intelligence in primary care: position statement developed by the Working Party on Ethics and Professionalism” - Tania Moerenhout presented during WONCA 2025
- Landscape is quickly evolving

Soroush A, Glicksberg BS, Zimlichman E, Barash Y, Freeman R, Charney AW, et al. Large Language Models Are Poor Medical Coders — Benchmarking of Medical Code Querying. NEJM AI [Internet]. 2024 Apr 25 [cited 2025 Aug 18];1(5). Available from: https://ai.nejm.org/doi/10.1056/AIdbp2300040

De Almeida VA, Van Der Haring EJ, Van Boven K, Lopez LF. International Classification of Primary Care (ICPC-2) and search engines: an exploration of three algorithms for information retrieval to aid medical coding. J Med Artif Intell. 2025 Dec;8:40–40.

# AI & ICPC-3 – technical aspects

- Use ICPC-3 with LLM/generative AI
  - Assign precise tasks, careful prompting by providing tailored input/output (see de Almeida)
  - ICPC-3 in a RAG [Retrieval-augmented generation]
    - Mitigate LLM hallucination by specifying where to find the correct answer.
  - ICPC-3 fine-tuning:
    - Use existing LLM build to perform comparable tasks/data and train it with ICPC-3 as additional data. See coding tool by Diogo Carapito
  - ICPC-3 lexical units embedding to improve search
  - Build on ICPC-3 structure
    - Language models to integrate hierarchical/ontological structure into language models. [Yang et al. 2025] – Identify gaps and inconsistencies

https://text-to-icpc2demo.streamlit.app/ - Diogo Carapito

Yang H, Chen J, He Y, Gao Y, Horrocks I. Language Models as Ontology Encoders [Internet]. arXiv; 2025 [cited 2025 Sept 15]. Available from: https://arxiv.org/abs/2507.14334

# ICPC-3, SNOClass and AI

- SNOClass project builds a mapping between large coverage clinical terminology SNOMED CT and 3 classifications, including ICPC-3.
  - Belgium is moving towards general SNOMED CT coding. SNOClass provides the bridge to ICPC-3.
- Pre-existing “Bilingual Bicoded Belgian Thesaurus” [3BT] for General Practice constitutes a rich language oriented clinical resource carefully mapped to SNOMED CT, ICPC-2, ICD10 and now ICPC-3
- Generative AI builds on data and increasingly structure.
- 3BT extended to SNOMED CT and with SNOClass to ICPC-3 is a collection of lexical representations of concepts associated to conceptual entities that can be used to improve automated, AI supported, coding of General Practice, through SNOMED CT to ICPC-3.

# ICPC-3 formalism

From XML to OWL

SNOMED CT & ICD-11

ICPC-3 in OWL

# From XML to OWL

- ICPC-2 and now ICPC-3 are distributed as XML files following ClaML guidelines, close to ICD-10 format.
- The Web Ontology Language [OWL] is at the convergence of web standards, including XML, description logics [DL] and Frames [Horrocks, 2003], and an important piece of the Semantic Web.
- BioPortal references 1426 biomedical ontologies, internally and externally linked to other biomedical resources.

Horrocks I, Patel-Schneider PF, Van Harmelen F. From SHIQ and RDF to OWL: the making of a Web Ontology Language. Journal of Web Semantics. 2003 Dec;1(1):7–26.

https://bioportal.bioontology.org/

# SNOMED CT and ICD-11

- SNOMED CT relationships are now formalized using OWL 2 [Web Ontology Language version 2], relying on formal logic (Description Logics) and reasoning services for development and maintenance.
    - https://docs.snomed.org/snomed-ct-specifications/snomed-ct-owl-reference-set-specification/introduction/1-introduction
- WHO ICD-11 has been developed using OWL, and the WHO Family of International Classifications (inc. ICF and ICHI) is being harmonized into a Foundation Component developed and maintained in OWL.

Tu SW, Almborg AH, Martinuzzi A, Della Mea V, Giannangelo K, Chute CG, et al. Linking Health Terminologies: A Unified Approach to the WHO Family of International Classifications. In: Mantas J, Hasman A, Demiris G, Saranto K, Marschollek M, Arvanitis TN, et al., editors. Studies in Health Technology and Informatics [Internet]. IOS Press; 2024 [cited 2025 Sept 15]. Available from: https://ebooks.iospress.nl/doi/10.3233/SHTI240659

# ICPC-3 in OWL

- ICPC-2 is formalized in OWL, linked to ICD-10 and other resources for consumer healthcare [Cardillo, 2009]
- ICPC-3 can be formalized
  - Benefiting from OWL formalism for consistency checking, development and maintenance
  - Facilitating mapping and alignment when appropriate to WHO-FIC and other biomedical resources
  - Use SSSOM for standardized mapping between ontologies

Cardillo E. A Lexical-Ontological Resource for Consumer Heathcare. In: Bernstein A, Karger DR, Heath T, Feigenbaum L, Maynard D, Motta E, et al., editors. The Semantic Web - ISWC 2009 [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2009 [cited 2025 Sept 15]. p. 949–56. (Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, et al., editors. Lecture Notes in Computer Science; vol. 5823). Available from: http://link.springer.com/10.1007/978-3-642-04930-9_60

Matentzoglu N, Balhoff JP, Bello SM, Bizon C, Brush M, Callahan TJ, et al. A Simple Standard for Sharing Ontological Mappings (SSSOM). Database. 2022 May 25;2022:baac035.

# Conditions for the survival of ICPC

# Conditions for the survival of ICPC-3

- Addressing comments on the first version of ICPC-3
- An ontology for ICPC-3
- Dedicated support of the profession and WONCA to WICC
- Renewal of the bonds with WHO-FIC
- Mapping from SNOMED CT to ICPC-3
- Attention to the aspects of natural language of primary care in end-user support
- Support from national eHealth Systems

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