Mapping SNOMED-CT to ICF: report

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Summary

The SNOCLASS ICF project developed a pilot version of a transparent and reproducible methodology to link SNOMED CT concepts to the WHO International Classification of Functioning, Disability and Health (ICF). This bridge is essential for integrating functioning data into electronic health records and supporting multidisciplinary assessments that address not only work capacity and social protection but also daily functioning and participation in society. It enables consistent reuse of data for policy, planning, and reporting in line with international standards. The pilot applied a hybrid approach combining rule-based parsing and expert validation, and introduces an innovative use of ICF qualifiers (capacity vs. performance) in SNOMED CT parsing.

Introduction

Functioning as a universal dimension of health

The International Classification of Functioning, Disability and Health (ICF), adopted by the World Health Organization in 2001, provides the global conceptual framework for describing and classifying human functioning, disability and health (WHO, 2001). The ICF complements the International Classification of Diseases (ICD) by shifting the focus from *what is the matter with a person* to *what matters in a person's life*—that is, how individuals function in their daily activities and participation, and how contextual factors influence this (Fayed et al., 2011; Heerkens et al., 2004; WHO, 2002).

Functioning is defined as a multidimensional construct encompassing body functions and structures, activities and participation, and environmental and personal factors, interacting dynamically with a person's health condition (Bickenbach et al., 1999; Stucki & Melvin, 2007). This model is increasingly recognized as a cornerstone for rehabilitation, occupational therapy, social protection, and value-based care, and underpins the WHO's *Rehabilitation 2030 – A Call for Action* (Cieza et al., 2002; Cieza et al., 2020). Functioning data thus form the "third health indicator," complementing mortality and morbidity to describe population health and inform resource allocation (Bickenbach et al., 2016; Maritz et al., 2017).

In Belgium, as in many European countries, policymakers and clinicians have recognized the need to systematically document functioning in routine care, social insurance, and health policy. Reliable, structured functioning information is essential for equitable access to rehabilitation, long-term care, and work capacity assessments, and for cross-sector data sharing between clinical, social and occupational systems (Vreeman & Richoz, 2015).

SNOMED CT as a reference terminology in Belgian health data governance

SNOMED CT is the world's most comprehensive clinical reference terminology, maintained by SNOMED International. It provides over 350 000 active, hierarchically structured concepts for representing clinical findings, observable entities, body structures, procedures, situations, and contexts (Alahmar & Benlamri, 2020; Bhattacharyya, 2015; Donnelly, 2006; Lee et al., 2014).

Belgium is an official SNOMED International member through the Federal Public Service of Health, Food Chain Safety and Environment (FPS Public Health), which hosts the Belgian Terminology Centre within the Directorate-General for Health Care (DGGS). The BTC coordinates the implementation, localization, and governance of clinical terminologies, including SNOMED CT, LOINC and ICD, as part of the national eHealth and interoperability strategy (FPS Public Health, 2024). Its mission is to ensure that clinical data recorded in electronic health records (EHRs) can be meaningfully exchanged, aggregated, and reused across systems, disciplines, and policy domains (Cornet et al., 2017; Jamoulle, 2010; Kim et al., 2020; Lee & Lau, 2025; Thys et al.).

Within this national framework, SNOMED CT serves as the semantic backbone for structured health information exchange in Belgium. Yet, to enable the meaningful reuse of clinical data beyond the care setting—e.g. for rehabilitation outcomes, social insurance adjudication, and public health reporting—data expressed in SNOMED CT must be translated into reference classifications such as ICF. Mapping between these systems ensures that rich, detailed clinical information remains interpretable in the policy and statistical frameworks that underpin WHO-FIC and European health data spaces (SNOMED CT | FOD Volksgezondheid).

Complementary but distinct: SNOMED CT and the ICF

Although both SNOMED CT and the ICF describe aspects of functioning, they differ fundamentally in design and purpose (Gongolo, 2015; Maritz et al., 2017; Tu et al., 2015; WHO, 2001). SNOMED CT is a reference terminology, polyhierarchical and fine-grained, intended for clinical documentation, interoperability, and decision support. It enables clinicians to record very specific statements such as *"needs assistance to dress self"*, *"unable to climb stairs safely"*, or *"reduced confidence walking outdoors"* (Tu et al., 2015; Vreeman & Richoz, 2015).

ICF, by contrast, is a classification, monohierarchical and exhaustive, designed for standardised reporting and policy use. It represents functioning through combinations of:

- **Activities and Participation (d-codes)**, e.g. *d450 Walking*, *d540 Dressing*, *d640 Doing housework*;
- **Qualifiers** (0 = no problem, 1 = mild, … 4 = complete problem);
- and, where relevant in terms of functioning, **Environmental Factors (e-codes)** such as *e115 Assistive products* or *e310 Immediate family*.

Structure and components of the ICF

The International Classification of Functioning, Disability and Health (ICF) is one of the three core classifications of the WHO Family of International Classifications (WHO-FIC), complementing the International Classification of Diseases (ICD) and the International Classification of Health Interventions (ICHI). The ICF provides a standardised language and framework for describing health and health-related states, emphasising functioning as an interaction between a person's health condition and contextual factors (Nguyen et al., 2018; WHO, 2001).

ICF coding structure

Each ICF category is represented by a letter followed by one to five numeric digits. The letter denotes the component (WHO, 2001):

- **b** = *Body Functions*
- **s** = *Body Structures*

- **d** = *Activities and Participation (domains)*
- **e** = *Environmental Factors*

For example:

- **b280** = *Sensation of pain*
- **s730** = *Structure of upper extremity*
- **d450** = *Walking*
- **e115** = *Products and technology for personal use in daily living*

Each component is organised hierarchically into chapters, domains, and categories at different levels of detail:

- **Level 1**: chapter (b1–b8, s1–s8, d1–d9, e1–e5);
- **Level 2–4**: progressively more specific subcategories.

In total, the ICF contains 1 424 categories distributed across its four components:

- **Body Functions (b):** 531 categories
- **Body Structures (s):** 329 categories
- **Activities and Participation (d):** 552 categories
- **Environmental Factors (e):** 197 categories

Body Functions (b)

This component covers the physiological functions of body systems, including psychological functions. It is divided into eight chapters, ranging from mental functions to skin and related structures:

Chapter	Range	Description
b1	b110–b139	Mental functions
b2	b210–b299	Sensory functions and pain
b3	b310–b399	Voice and speech functions

Chapter	Range	Description
b4	b410–b499	Functions of the cardiovascular, haematological, immunological and respiratory systems
b5	b510–b599	Functions of the digestive, metabolic and endocrine systems
b6	b610–b699	Genitourinary and reproductive functions
b7	b710–b789	Neuromusculoskeletal and movement-related functions
b8	b810–b899	Functions of the skin and related structures

Body Functions are typically used in rehabilitation and medical assessments to describe impairments at the level of body systems (e.g. *b730 Muscle power functions*, *b710 Joint mobility functions*).

Body Structures (s)

This component represents the anatomical parts of the body such as organs, limbs, and their components. It mirrors the Body Functions component and is organised into eight parallel chapters:

Chapter	Range	Description
s1	s110–s199	Structures of the nervous system
s2	s210–s299	The eye, ear, and related structures
s3	s310–s399	Structures involved in voice and speech
s4	s410–s499	Structures of the cardiovascular, immunological and respiratory systems
s5	s510–s599	Structures related to the digestive, metabolic and endocrine systems
s6	s610–s699	Structures related to the genitourinary and reproductive systems
s7	s710–s799	Structures related to movement
s8	s810–s899	Skin and related structures

Each structure can be coded with an additional *qualifier* to indicate **the nature and extent of impairment**, such as total absence, partial damage, or abnormality.

Activities and Participation (d)

The Activities and Participation component is the core of the ICF for rehabilitation, occupational therapy, and social integration, as it describes what people *do* in daily life and in society. It includes 552 categories, grouped into nine domains, spanning simple self-care activities to complex social roles.

Chapter	Range	Domain
d1	d110–d199	Learning and applying knowledge
d2	d210–d299	General tasks and demands
d3	d310–d399	Communication
d4	d410–d499	Mobility
d5	d510–d599	Self-care
d6	d610–d699	Domestic life
d7	d710–d799	Interpersonal interactions and relationships
d8	d810–d899	Major life areas (education, work, economic life)
d9	d910–d999	Community, social and civic life

Each activity or participation code can be rated by qualifiers that describe the extent of difficulty experienced in performance or capacity. The standard qualifier scale is:

Code	Qualifier description
0	No problem (0–4%)
1	Mild problem (5–24%)

Code	Qualifier description
2	Moderate problem (25–49%)
3	Severe problem (50–95%)
4	Complete problem (96–100%)
8	Not specified
9	Not applicable

Three perspectives are always distinguished:

- Capacity: the person's ability to execute a task or action in a *standardised or optimal environment*;
- Performance: what the person actually does in *their real-life environment*, with existing facilitators or barriers.
- Participation: when the person is actually involved in activity of daily life, within a range of restrictions and functionings.

For example:

- *d450 Walking* (capacity = 1; performance = 2) indicates that a person walks with mild difficulty in an ideal environment, but with moderate difficulty in daily life due to environmental constraints.

Because occupational therapy, rehabilitation and medico-social assessments focus on daily life performance and societal participation, the Belgian SNOMED CT → ICF mapping project concentrates specifically on this component (*d-codes*). Activities and Participation best capture what clinicians record in SNOMED CT as functional findings or limitations—e.g. *"needs assistance to bathe"*, *"difficulty walking up stairs"*, *"unable to manage household tasks"*—and therefore provide the most direct bridge between clinical terminology and ICF-based reporting.

Environmental Factors (e)

The Environmental Factors component identifies the physical, social and attitudinal context in which people live and conduct their lives. It includes 197 categories across five chapters:

Chapter	Range	Domain
e1	e110–e199	Products and technology
e2	e210–e299	Natural environment and human-made changes
e3	e310–e399	Support and relationships
e4	e410–e499	Attitudes
e5	e510–e599	Services, systems and policies

Each environmental factor can act as a barrier (negative impact) or facilitator (positive impact) to functioning. For example, *e310 Immediate family (+3)* indicates strong family support, whereas *e310 (−3)* indicates lack of family support as a major barrier.

Although the Belgian mapping primarily focuses on *Activities and Participation*, Environmental Factors are recognised as essential modifiers for interpreting functioning data—particularly in occupational therapy, where context, assistive devices, and social support profoundly influence capacity and performance.

Focus of the Belgian SNOMED CT → ICF mapping project

The Belgian SNOMED CT → ICF mapping project deliberately concentrates on Activities of Daily Living (ADL), which are central to the *Activities and Participation* component of the ICF (d-codes). ADL functioning reflects the essential, observable aspects of human performance that determine a person's independence, autonomy and participation in daily life. In rehabilitation and occupational therapy, ADL are often categorized into:

- **Basic ADL (BADL)** — self-maintenance tasks such as bathing (*d510*), dressing (*d540*), eating (*d550*), toileting (*d530*), and transferring oneself (*d420–d430*);
- **Instrumental ADL (IADL)** — more complex activities required for independent living, such as household tasks (*d640–d649*), preparing meals (*d630*), managing finances (*d860*), using transportation (*d470–d475*), or caring for others (*d660*).
- **Advanced ADL (aADL)** — activities that go beyond basic self-care and household management, reflecting a person's ability to engage in social roles, community life and meaningful occupations. These include tasks related to productivity and employment (d840–d859), social and civic participation (d910–d920), leisure and recreational activities (d930–d999), volunteering, sports, or maintaining social relationships. aADL are often the

first domain to decline when functional or cognitive capacity decreases, making them an important indicator of reduced autonomy, resilience, and intrinsic capacity.

Within the ICF structure, ADL activities are primarily located in chapters 4–6 of the *Activities and Participation* component:

Chapter	Domain	Typical ADL examples
d4	Mobility	walking (*d450*), climbing stairs (*d455*), using transportation (*d470–d475*)
d5	Self-care	washing (*d510*), dressing (*d540*), eating (*d550*), toileting (*d530*)
d6	Domestic life	preparing meals (*d630*), doing housework (*d640*), managing daily routine (*d230*), caring for household objects (*d650*)

These domains are the most directly represented in clinical terminology and are routinely documented by healthcare professionals using SNOMED CT concepts such as *"needs assistance to bathe"*, *"difficulty dressing upper body"*, or *"unable to climb stairs safely"*. Consequently, ADL provides the most concrete bridge between the clinical granularity of SNOMED CT and the structured conceptualisation of functioning within ICF.

While Body Functions (b) and Environmental Factors (e) influence ADL performance and are conceptually acknowledged, they were not part of the initial mapping phase because of differences in granularity and formal structure. This present project therefore centers on the *Activities and Participation* codes directly describing observable functional tasks.

Purpose and Use Case of the Mapping

The SNOMED CT → ICF mapping aims to establish a semantically transparent bridge between detailed clinical documentation and the standardized description of functioning and participation as defined by the International Classification of Functioning, Disability and Health (ICF). Where SNOMED CT provides fine-grained clinical concepts that describe symptoms and functional findings in electronic health records, the ICF offers a structured framework for interpreting *what individuals actually do*, *how they participate*, and *which contextual factors influence their daily life functioning*. For this study, we decided to choose for two use cases, one small use case on Obesity, specifically with the intention to show the possibility to map SNOMED-CT to ICF and one overarching Use Case on Low Back pain in which the map SNOMED-CT has been made with ICF, ICHI and ICPC3 showing the interdependency between the three classifications.

Why these two cases

Obesity has become a key public health priority at international, European, and national levels, driven by its high and increasing prevalence, its strong association with multiple chronic conditions, and its substantial impact on health systems, social participation, and labour market outcomes. Contemporary policy frameworks increasingly recognise obesity not merely as an individual lifestyle issue, but as a complex, chronic, and socially patterned condition shaped by biological, behavioural, environmental, and socioeconomic determinants. As a result, policy attention has progressively shifted toward prevention across the life course, integrated care models, and interventions that address participation, functioning, and equity rather than weight reduction alone. In this context, obesity is increasingly framed as a condition with far-reaching consequences for daily functioning, work ability, self-management, and social inclusion, making it highly relevant for first-line care, rehabilitation, and welfare services.

In addition, from a methodological perspective, obesity constitutes a particularly suitable **use** case for operationalising and validating mapping rules between SNOMED-CT and the ICF, because of its functional perspective.

Low back pain (LBP) was selected as a representative use case for the three overarching classifications (ICF, ICHI and ICPC3, see other reports) because it is among the most prevalent and disabling health conditions worldwide, with major societal and occupational impact (Hartvigsen et al., 2018; Hoy et al., 2014). It is a typical example of a condition where body function impairments (pain, reduced mobility, muscle weakness) interact directly with activity limitations (bending, lifting, dressing) and participation restrictions (work, domestic roles). LBP thus provides an ideal clinical model for demonstrating how SNOMED CT terminology and ICF categories can be integrated to represent functioning in a comprehensive, comparable, and policy-relevant manner (Nicol et al., 2016).

Organizational aspects of the SNOMED-CT to ICF project

Team

Dr. Ellen Cruyt

Dr. Ellen Cruyt is a postdoctoral researcher in occupational therapy at Ghent University. Her work focuses on meaningful activities, participation, and self-management in people with chronic conditions. She combines clinical expertise with research on neurophysiological measures and rehabilitation strategies, contributing to innovative assessment tools and international collaboration.

She was responsible for the day to day practical work of the mapping procedure

Prof. dr. Dominique Van de Velde

Prof. Dr. Dominique Van de Velde is a full professor of occupational therapy at Ghent University, and associate professor at KU Leuven and UHasselt. His research focuses on measuring and promoting participation according to WHO standards, especially in rehabilitation, primary care, and return-to-work contexts. He leads the Occupational Therapy Research Unit and has and extended expertise in ICF. he is member of the NIHDI Knowledge centre of work incapacity, he is member of the Royal Academy of Medicine and is research fellow at the European Academy of Physical and Rehabilitation Medicine.

He was PI of the SNOMED CT – ICF mapping project and the spokesperson for the commissioning body

Dr. Stijn De Baets

Dr. Stijn De Baets is a postdoctoral researcher in rehabilitation sciences at Ghent University and Vrije Universiteit Brussel. His work centers on daily functioning and participation of people with chronic conditions—particularly labor and societal engagement—combining clinical assessments like Functional Capacity Evaluation with qualitative research. He also holds healthcare management training and contributes to policy-relevant OT projects.

He was supervising the mapping procedure as an expert and ensured credibility.

Drs. Joseph Roumier

Joseph Roumier is a health informatics specialist with expertise in clinical terminology standards and interoperability. He contributes to projects that align SNOMED CT and WHO classifications, focusing on structured data exchange and semantic mapping to support integrated health information systems.

He was responsible for the IT-support and automatization of the mapping

Prof Dr. Robert Vander Stichele

Robert Vander Stichele is a practicing family physician in Ghent, Belgium, since 1978. He combines his clinical practice with research projects since 1982 He obtained his PhD (in medical sciences) in 2004, and was appointed as teaching professor in the department of Pharmacology in the University of Ghent. Currently, he works as an expert in European of the Department of Medical Informatics at the University of Ghent on medical terminology and electronic product information for medicines.

He was responsible for coordinating and ensuring alignment across the three research projects (ICF, ICHI and ICPC3).

Website

As part of the SNOCLASS ICF project, a dedicated website was developed at http://www.snoclass.be. The site serves as a central hub for information about the project, including its objectives, methodology, and key results. It provides resources for professionals and stakeholders, such as downloadable materials, updates on outreach activities, and links to relevant standards. The website also supports transparency and engagement by offering easy access to project documentation and contact information for collaboration.

Scope of the Mapping

The SNOMED CT → ICF mapping focuses on the alignment of functioning-related concepts between both systems. The mapping aims to define how data recorded in clinical and rehabilitation settings using SNOMED CT can be translated into ICF categories that are meaningful for functional assessment, reporting, and policy use.

Conceptual Scope

The mapping covers the semantic domain of human functioning — specifically the observable and reportable aspects of what a person *does* in daily life and *how* environmental factors influence this. This scope corresponds to the Activities and Participation (d) component of the ICF, which represents the execution of tasks and involvement in life situations. The mapping therefore concentrates on the ICF chapters most relevant to Activities of Daily Living (ADL) and social participation:

ICF Chapter	Domain	Typical Examples
d4	Mobility	walking, standing, climbing stairs
d5	Self-care	bathing, dressing, eating, toileting
d6	Domestic life	preparing meals, household management
d7	Interpersonal interactions	maintaining relationships, communication
d8	Major life areas	work, education, economic life
d9	Community, social and civic life	recreation, civic engagement, community activities

Within these domains, emphasis was placed on functional performance in daily life, in line with Belgium's national priorities regarding integrated care, work ability and independent living. These domains are most frequently described in clinical narratives and are directly actionable in rehabilitation and social-insurance decision-making.

Terminological Scope

The project started from a reference subset (refset) of SNOMED CT concepts related to "Activities of Daily Living" (ADL), originally developed by the UK National Health Service (NHS). This UK

"Activity of daily living related to physical function findings" simple reference set contains pre-identified SNOMED CT concepts describing observable aspects of functional performance and self-care (e.g. walking, dressing, eating, toileting, domestic activities). This refset was selected as the starting point for the Belgian mapping because it was, at the time of the project, the only publicly available and thematically relevant SNOMED CT reference set focusing specifically on functional performance and ADL. It therefore offered the most suitable and structured entry into the SNOMED CT hierarchy for developing a reproducible mapping methodology.

The choice was motivated by three main considerations:

1. Clinical alignment: it captures real-world functional abilities consistent with the ICF *Activities and Participation* component (particularly chapters d4–d6).

2. Methodological consistency: it provides a curated and validated set of SNOMED CT concepts intended for use in functional assessment and rehabilitation documentation.

3. International comparability: it enables interoperability with other WHO-FIC and SNOMED using countries, facilitating benchmarking and reuse of mapping methods.

Level of Mapping

The mapping operates primarily at the second and third hierarchical levels of ICF (chapter + domain + specific activity), also called STEM code. These levels provide an optimal balance between semantic precision and practical usability for clinical and policy purposes. Highly granular ICF categories (4th level) were only used where necessary to distinguish specific ADL activities, such as *d5401 Putting on clothes* vs. *d5402 Taking off clothes*. Each mapping relation has been selected according to its semantic correspondence:

Relationship Type	**Definition**	**Example**
Exact match	SNOMED CT concept equals ICF meaning	"Walking independently" → *d450 Walking (no difficulty)*
Broader match	SNOMED CT concept covers more content than ICF category	"Independent mobility" → *d450 Walking* + *d455 Moving around*
Narrower match	SNOMED CT concept expresses a subset of the ICF category	"Difficulty climbing stairs" → *d4551 Climbing*

Relationship Type	Definition	Example
Partial/contextual match	SNOMED CT concept includes mixed elements (activity + environment)	"Needs help with bathing" → *d510 Washing oneself* + *e310 Immediate family*

Mapping Methodology

The SNOMED-CT - ICF project developed a pilot methodology to create a structured and reproducible link between SNOMED CT concepts and ICF categories. The approach was designed to ensure semantic accuracy, interoperability, and alignment with WHO standards, while addressing challenges such as differences in granularity and qualifiers (capacity vs. performance). The methodology combines rule-based (qualifier mapping) and semantic logic, expert validation, and transparent documentation (Cieza et al., 2002; Kieft et al., 2018; Rodrigues et al., 2009; Tu et al., 2015; Vreeman & Richoz, 2015).

Mapping Design Principles

The design of the SNOMED-CT - ICF mapping methodology was guided by five core principles:

1. Transparency and Reproducibility: Transparency and reproducibility were prioritised as foundational principles to ensure that the mapping can later be scaled, audited, and sustainably integrated into Belgium's terminology governance ecosystem. The pilot required a methodology that was not only technically correct but also open, traceable, modifiable, and future-proof (Hong et al., 2022; Kieft et al., 2018; Kieft et al., 2017; Thandi et al., 2021).

All steps of the mapping pipeline are therefore comprehensively documented, including:

- The selection logic used to derive the working set of SNOMED CT concepts (e.g., extraction criteria from the UK ADL refset, functional filters, exclusion criteria).
- The lexical (semantic) parsing rules for detecting activity-related terms, functional verbs, qualifiers, and contextual keywords.
- The semantic decision rules guiding how concepts were interpreted, decomposed, and mapped to ICF stem codes.
- The mapping rationale for each individual SNOMED CT → ICF relation, representing the conceptual logic behind the linking.
- The validation outcomes, including any uncertainties, disagreements, or borderline cases flagged for future refinement.

Each mapping relation was enriched with detailed metadata, including:

- The identity and role of the mapper (e.g., data analyst, occupational-therapy expert);
- The date of mapping and versioning information;
- The validation status (e.g., single review, dual review, consensus reached).

2. Alignment with WHO-FIC Standards: The approach adheres to international best practices for health terminology mapping, ensuring consistency with WHO Family of International Classifications principles. This alignment supports global interoperability and facilitates secondary use of data for policy and reporting. The mapping approach was designed to comply with principles of the WHO Family of International Classifications (WHO-FIC), ensuring semantic consistency and interoperability across health information systems. This alignment supports standardized data exchange and facilitates secondary use of functioning data for policy, planning, and international reporting. The methodology also draws on the widely recognized framework proposed by Cieza et al. (2005) for linking health information to the ICF. This framework emphasizes (Cieza et al., 2019; Cieza et al., 2005; Fayed et al., 2011):

- Identification of meaningful concepts in source terminologies
- Application of standardized linking rules to ensure conceptual equivalence
- Transparent documentation of decisions and rationale
- Expert validation to confirm accuracy and relevance

By integrating these principles, the SNOCLASS ICF mapping process ensures that mappings are not only technically correct but also clinically meaningful and aligned with global best practices (Cieza et al., 2002; Cieza et al., 2019; Cieza et al., 2005; Fayed et al., 2011; Rauch et al., 2008).

3. Clinical Relevance: Clinical relevance was a central design principle in the development of the SNOCLASS SNOMED CT → ICF mapping methodology. Because this work constitutes a national pilot project aimed at strengthening the representation of functioning in Belgium's health-information ecosystem, the mapping focused explicitly on SNOMED CT concepts that describe functioning, activities, and participation, rather than disease entities or anatomical abnormalities.

A core priority was the representation of Activities of Daily Living (ADL), as these activities—such as washing, dressing, toileting, walking, stair climbing, preparing meals, or carrying out household tasks—are essential determinants of independence, autonomy, and quality of life.

By linking SNOMED CT expressions like *"requires assistance to bathe"*, *"difficulty dressing lower body"*, or *"unable to climb stairs"* to the corresponding ICF categories, the pilot ensures that everyday clinical observations can be translated into structured, standardised functional data.

This focus directly supports the needs of rehabilitation professionals, particularly occupational therapists, who require precise information about a patient's performance in daily life to set functional goals, monitor progress over time, and evaluate the effectiveness of interventions. The ICF provides a shared conceptual framework for this reasoning, and the mapping enables

SNOMED CT–based documentation in electronic health records to be connected to that framework in a consistent, interpretable way.

4. Qualifier Operationalization: A distinguishing feature of the ICF (and one that is central to its clinical and policy relevance) is its use of qualifiers to describe the *extent* of difficulties experienced in functioning. Essential to this framework is the conceptual difference between capacity, performance and participation, which captures how functioning varies across environments *(WHO, 2001)*.

The SNOMED CT - ICF mapping explicitly integrates these qualifiers into the interpretation of SNOMED CT expressions. Many SNOMED CT concepts inherently contain implicit qualifiers, even though SNOMED CT does not structure them formally. Expressions such as *"difficulty climbing stairs"*, *"unable to walk long distances"*, or *"requires assistance to bathe"* embed notions of severity, dependency, and environmental influence. The pilot methodology therefore developed semantic parsing rules to detect these implicit elements, distinguishing whether a statement primarily reflects a capacity limitation (e.g. reduced physical ability), a performance issue (e.g. environmental constraints), or a combination of both.

For instance, the SNOMED CT expression *"needs supervision for transferring"* maps to the ICF stem code *d420 Transferring oneself*, but the semantic content also indicates a performance qualifier (dependence on another person) and an associated environmental factor (*e340 Personal care providers*, acting as a facilitator). Likewise, *"able to walk independently indoors but not outdoors"* indicates divergent qualifiers across contexts—highlighting how environmental complexity (surface, distance, obstacles) modulates performance.

Integrating these qualifiers within the mapping ensures that the ICF code alone does not stand in isolation. Instead, the mapping captures the functional nuance embedded in clinical documentation. This is crucial for accurate problem formulation, rehabilitation goal setting, and interdisciplinary communication: the difference between "can walk independently in therapy" and "cannot walk independently at home" is clinically meaningful and directly relevant to discharge planning, assistive device provision, and long-term support decisions (Billiet et al., 2024; Dos Santos et al., 2022; Hennaert et al., 2022; Okochi et al., 2005; Rauch et al., 2008).

5. Granularity Management: Managing differences in granularity between SNOMED CT and the ICF was a critical methodological requirement in this pilot project. Although both systems describe aspects of health and functioning, they do so with very different levels of detail, structure and semantic intent. SNOMED CT is a highly expressive, fine-grained clinical terminology capable of capturing nuanced functional observations, contextual details and pre-coordinated statements. In contrast, the ICF is a hierarchical classification system, intentionally broader and designed to support international comparability in rehabilitation, public health, disability assessment and social-care reporting.

The mapping method therefore needed a strategy that preserved the clinical richness of SNOMED CT while ensuring semantic coherence within the ICF structure. This was essential to maintain the usefulness of the mappings for clinical practice, rehabilitation reasoning, policy reporting and long-term national interoperability.

In many cases, SNOMED CT concepts described highly specific functional details—for example, "difficulty buttoning a shirt," "requires assistance with lower-body dressing," or "unable to maintain kneeling position for more than 30 seconds." These micro-activities reflect real-world clinical observations, but the ICF represents such details under broader categories such as *d540 Dressing* or *d410 Changing basic body position*. In these situations, the methodology aggregated the detailed SNOMED CT concept into the appropriate ICF stem category while documenting the clinical nuance in mapping notes. This prevents semantic loss while respecting the classification logic of the ICF, which is not designed to encode every micro-movement separately.

Conversely, certain SNOMED CT concepts expressed very broad functional limitations, such as "mobility limitation" or "difficulty performing daily activities." In these cases, the ICF contains multiple relevant categories, including *d450 Walking*, *d455 Moving around*, *d465 Moving around using equipment*, or *d230 Carrying out daily routine*. To avoid overgeneralisation, the methodology applied clinical reasoning and expert judgement to determine whether a concept should be mapped to one ICF category or represented across several. Each decision was transparently justified to ensure consistency and traceability during future expansions of the mapping.

A further challenge involved SNOMED CT's pre-coordinated composite expressions, which often embed multiple dimensions of functioning and context within a single concept—for example, "requires assistance to bathe due to poor balance," which simultaneously expresses:

- an activity (washing oneself),
- a qualifier (assistance required),
- an underlying impairment (balance), and
- an environmental factor (presence of a caregiver).

Because the ICF requires atomic representation, such concepts were systematically decomposed into their constituent elements: an ICF activity code (e.g. *d510 Washing oneself*), the appropriate capacity or performance qualifier, and, where relevant, additional codes from Body Functions (*b235 Vestibular functions*) or Environmental Factors (*e310 Immediate family*). This decomposition preserves the multidimensional meaning of SNOMED CT without violating the structural rules of the ICF.

To ensure comparability, all mappings were anchored at the ICF stem-code level—the stable, core concept level underlying the ICF hierarchy. This prevents over-interpretation, reduces mapping fragility when new ICF subcategories are introduced, and facilitates future multilingual implementation in Belgium. Operating at stem-level also aligns the mapping with routine clinical practice, where clinicians rarely document fourth-level ICF granularity.

Every granularity-related decision—aggregation, decomposition, or partial mapping—was thoroughly documented with rationale, ensuring transparency, the possibility of external audit, and the ability to refine the mapping as SNOMED CT evolves or as Belgium extends the pilot into a national terminology service. This documentation ensures that granularity management becomes a learning and iterative system, enabling future teams to understand prior decisions, maintain consistency and continuously improve the mapping quality.

Stepwise Process

The workflow is structured around five main steps, each of which incorporates the detailed sub-processes previously conceptualised in the SNOMED CT – ICF presentation logic: parsing, subject mapping, qualifier integration, rule-based mapping, merging, validation and use case integration.

Extraction of SNOMED CT Concepts

The first step in the mapping workflow involved the systematic extraction of SNOMED CT concepts that describe functioning, activities and participation. Because this project is a Belgian pilot, the extraction phase was designed to be comprehensive, transparent, and fully reproducible, ensuring that future extensions (e.g., to environmental factors or body functions) can build on a clear methodological foundation.

Rationale for Selecting an ADL-Focused Starting Set

A key methodological decision in Step 1 was the selection of a validated functional subset of SNOMED CT to serve as the starting point for the Belgian pilot. After reviewing all internationally available SNOMED CT refsets, the project team identified only one subset that explicitly and systematically targets functional performance and Activities of Daily Living (ADL):

Activity of Daily Living Related to Physical Function Findings Simple Reference Set

SIMPLE_REFSET	Activity of daily living related to physical function findings simple reference set (foundation metadata concept)	1351

- **SNOMED CT concept ID:** 1351
- **Publisher:** NHS England
- **Source:** UK SNOMED CT Edition
- **Browser link:** https://termbrowser.nhs.uk

This reference set, classified as a **SIMPLE_REFSET** under *foundation metadata concepts*, contains concepts representing:

- observable functional performance
- difficulties or limitations in ADL
- self-care and mobility tasks
- physical functioning findings relevant for rehabilitation

The refset is formally listed under the UK Edition metadata, described as:

"Activity of daily living related to physical function findings simple reference set (foundation metadata concept)" (NHS England, UK Edition, v20250924)

It is the only SNOMED CT reference set internationally available that focuses explicitly on ADL and functional performance. This makes it uniquely suitable as a starting set for an ICF mapping pilot.

Two hundred and forty-three concepts were excluded because they are specific to the United Kingdom, as indicated by the UK flag displayed alongside each concept. A total of 1108 concepts remained.

Semantic Evaluation

Semantic evaluation ensured that each concept was correctly interpreted before mapping, resolving ambiguity, context, and implicit meaning.

Parsing into Meaning Units

In alignment with step 1 of the mapping methodology, concepts were decomposed into:

- **Subject term** (the core activity or participation domain: *play*, *dress*, *clean*, *walk*)
- **Qualifier term** (degree of ability, difficulty or participation: *able to*, *difficulty*, needs assistance with, does not participate in)

Exploratory trials showed that single-level subject-only mapping was insufficient. Both literature and the pilot work demonstrated that two-level parsing is essential.

Example:

- SNOMED CT code "able to play"

  → Subject: *play* → ICF: *d9200 Playing*

  → Qualifier: *able to* → ICF: capacity 0

Assignment to ICF Domains (D/E/B/S)

Using rule-based logic:

- **D – Activities & Participation:** Core domain for ADL-related SNOMED CT concepts: selection of the Activity of Daily Living Related to Physical Function Findings Simple Reference Set, contextualized to the Belgian situation.
- **E – Environmental Factors:** No direct refset available in SNOMED CT. Environmental meaning was inferred based on context (e.g., "needs help from family" → *e310* facilitator)
- **B – Body Functions:** Mapped from SNOMED CT *clinical finding* + *observable entity* tags (e.g., balance issues, endurance problems)
- **S – Body Structures:** Based on SNOMED CT anatomy structure & part association refset (N=325)

Expert Validation workflow

The expert validation process followed a structured, multi-layer workflow designed to ensure high semantic accuracy, clinical relevance, and methodological robustness of the SNOMED CT → ICF mappings. After each step, the research team convened to review and discuss the results. The procedure combined internal expert review with an external comparison using the Portuguese ADL-functioning ICF mapping set (Figure 1).

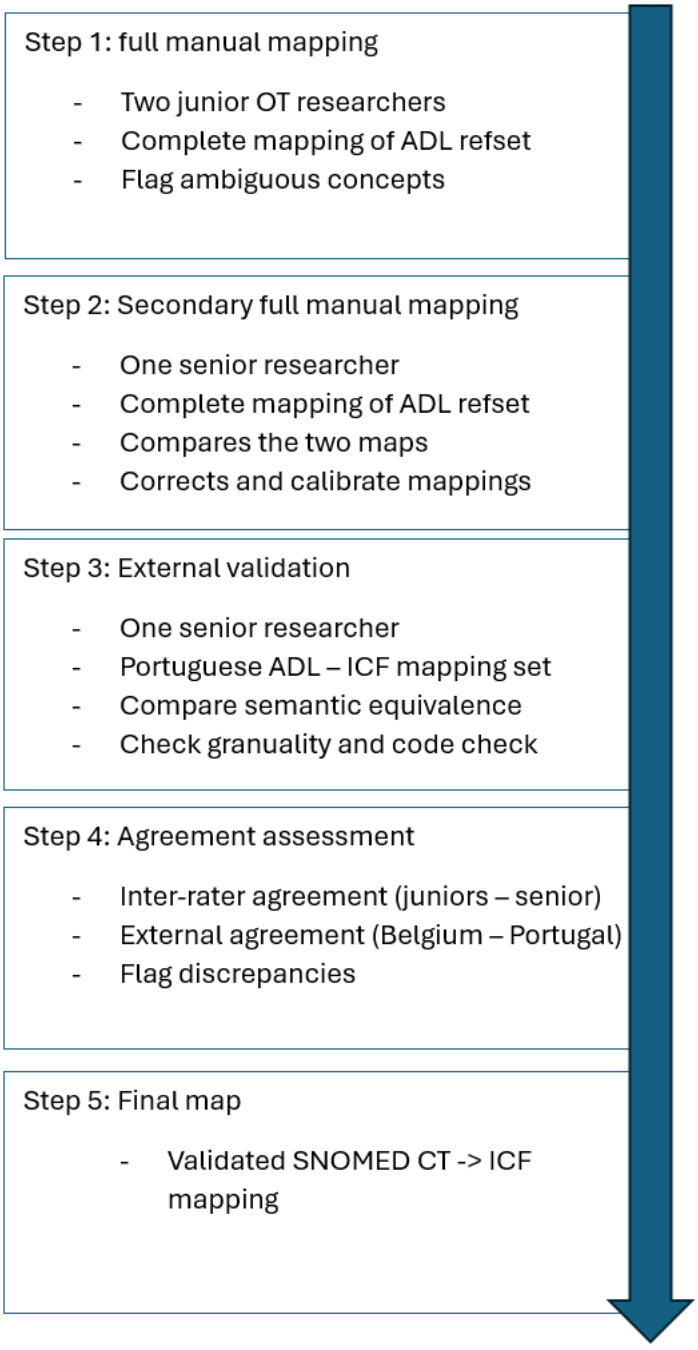


Figure 1. Summary of validation flow

Step 1: Primary mapping by two junior researchers

Two junior researchers (Master of science in Occupational Therapy) independently conducted each 50% of mapping of the UK Activity of Daily Living Related to Physical Function Findings Reference Set. Their responsibilities included:

- Interpreting the functional meaning of each SNOMED CT concept;
- Identifying the underlying activity or participation construct;
- Assigning the corresponding ICF category;
- Documenting uncertainties and ambiguous interpretations.

This ensured that the entire ADL refset was mapped thoroughly using consistent logic and trained clinical judgement.

Step 2: Secondary mapping of one senior researcher

A senior researcher performed independently the total mapping of the UK Activity of Daily Living Related to Physical Function Findings Reference Set. She had no knowledge of the ICF codes created by the primary researchers. Upon completion, the senior researcher assessed the inter-rater agreement by calculating the percentage to which the junior researchers' ICF codes aligned with the researcher's own ICF coding.

Step 3 — External validation using the Portuguese ADL–ICF Mapping Set

To strengthen semantic accuracy and cross-national interoperability, a parallel comparison was performed using the Portuguese SNOMED CT → ICF ADL-functioning mapping set. Within this set, 33 SNOMED CT codes also appear in the UK Activity of Daily Living Related to Physical Function Findings Reference Set. These SNOMED CT codes, together with the corresponding ICF codes provided by the Portuguese colleagues, were subsequently compared with the senior researcher's codes from Step 2.

For each concept, the team evaluated:

- Whether the Belgian mapping and the Portuguese mapping selected the same ICF category;
- Differences in granularity, specificity, or interpretation of semantic units;
- Potential linguistic or contextual reasons for discrepancy;
- Alignment in the interpretation of qualifiers (difficulty, independence, assistance).

This step served as an external semantic benchmark, enabling triangulation of results and early detection of mapping errors or conceptual mismatches.

Step 4 — Agreement Analysis

The results of the internal (junior ↔ senior) and external (Belgium ↔ Portugal) comparisons were analysed to determine:

- Inter-rater agreement;
- Recurrent divergence patterns;
- Concepts requiring additional clarification;
- Structural causes of disagreement (granularity differences, multi-unit expressions, ambiguous SNOMED CT terms).

Concepts with discrepancies were flagged for deeper review in the next step.

Step 5 — Consensus Meeting Between Three Senior Researchers

Three senior researchers conducted a structured consensus session to resolve all items flagged during the previous steps.

During this meeting:

- Each flagged mapping was re-evaluated;
- Alternative ICF codes were considered when necessary;
- The semantic rationale for the final mapping choice was documented;
- Disagreements were resolved through expert discussion grounded in clinical practice, semantic interpretation, and ICF definitions.

The consensus outcomes were incorporated into the final validated mapping dataset.

International Expert Panel Validation

To ensure international methodological alignment and to strengthen the scientific validity of the SNOMED CT–ICF mapping methodology, the project established an International Advisory Board composed of experts from multiple European countries. The panel was convened during the early phases of the project and provided methodological input at a key moment in the development of the pilot.

The board included specialists with backgrounds in the ICF, SNOMED CT, health classification systems, terminology governance, rehabilitation science, and health services research. Experts were invited across national institutions, WHO-FIC collaborating centres, SNOMED CT release centres, academic universities, and national ministries of health. Participation represented a broad European context, with the following approximate distribution:

- **Belgium:** 6 experts (universities, hospitals)
- **Netherlands:** 1 expert (national terminology authority)
- **Germany:** 4 experts (national classification and terminology centre)
- **Denmark:** 1 expert (national occupational therapy association)
- **Sweden:** 1 expert (clinical and professional advisory body)
- **Austria:** 2 experts (rehabilitation and ergotherapy)
- **Estonia:** 1 expert (national e-health and terminology governance)
- **Portugal:** 1 expert (ICF implementation and functional assessment)
- **Switzerland:** 1 expert (WHO ICF Research Branch)

This composition ensured a sufficiently diverse set of perspectives, covering both clinical-functional expertise and terminological/mapping expertise, while also allowing comparison across health systems that have already undertaken ICF- or SNOMED-related implementation work.

The International Expert Panel served an advisory function rather than an operational one. Its members did not perform mappings themselves, but instead contributed to the conceptual, methodological and quality-assurance dimensions of the project. Their role included evaluating the coherence of the Belgian mapping approach, assessing its alignment with WHO-FIC principles, and ensuring that key methodological components—such as semantic parsing, qualifier interpretation, and post-coordination strategies—were consistent with international standards. The panel also provided guidance on the use of external benchmarking sources, to evaluate semantic agreement and to detect potential discrepancies across national interpretations of functional concepts.

The group met virtually for a two-hour advisory meeting the 26th of September 2025, during which the Belgian team presented the methodological workflow, the rationale for selecting an ADL-focused reference set, preliminary results of the semantic evaluation, and challenges encountered during rule-based and mixed-methods mapping. The panel offered constructive

feedback that informed subsequent refinements, particularly regarding semantic consistency, cross-national comparability and longer-term maintainability of the mapping framework.

Perfect — hieronder staat de definitieve, korte paragraaf, op zichzelf staand, klaar om als aparte paragraaf in je rapport op te nemen:

SNOMED CT does not explicitly distinguish between activities and participation as conceptualised in the ICF, but represents functioning primarily through observable findings. In this pilot, the interpretation of participation was therefore anchored to the ICF framework to ensure consistent classification within the Activities and Participation component. Qualifier information embedded in SNOMED CT expressions (e.g. difficulty, assistance, limitation) was translated into ICF capacity and performance qualifiers based on semantic meaning rather than structural equivalence. This approach and its underlying assumptions were discussed and aligned with SNOMED International to ensure conceptual coherence and compatibility with SNOMED CT modelling principles.

Mapping Techniques

The mapping phase operationalized the semantic evaluation outcomes into concrete SNOMED CT → ICF relations. Consistent with the logic presented in the *Logic Mapping* framework, three complementary mapping techniques were used: lexical mapping, manual expert mapping, and computational mapping. These techniques were subsequently merged into a single coherent mapping output.

Lexical (Subject - Based) Mapping

This technique involved direct text matching between SNOMED CT terms and ICF activity descriptions.
Examples:

- *"to dress"* in SNOMED CT → *d540 Dressing*
- *"washing hands"* → *d510 Washing oneself*

Lexical mapping served as a first filter, enabling rapid identification of plausible ICF target categories and supporting efficient downstream review by experts. The established rule among the researchers who mapped was to map on three digits (e.x., d510) in the ICF since it was a first exploratory map.

Manual Expert Mapping (Activities & Participation)

Manual mapping was central in this ADL-focused pilot. Guided by Step 3.1 of the presentation, two junior occupational therapists independently mapped all concepts from the:

UK "Activity of Daily Living Related to Physical Function Findings Simple Reference Set" (N = 1112)

Computational Mapping (Full SNOMED CT → Full ICF)

In addition to the manual and expert-driven mapping procedures used in this pilot, a computational mapping layer was implemented to assess the potential for large-scale, automated identification of correspondences between SNOMED CT and the ICF. This computational step functioned as a complementary quality and completeness check, designed not to replace manual mapping, but to detect lexical correspondences that might otherwise remain unnoticed.

The automated procedure followed a strictly lexical exact-match approach, comparing the full lexical surface forms of all SNOMED CT concepts—including their preferred terms and all available synonyms—with the official titles of all ICF categories across components (D, E, B and S). In total, the pipeline processed 1,655,280 SNOMED CT lexical representations and compared them with the 1,755 official ICF titles, generating a deterministic and reproducible search for exact matches, independent of conceptual hierarchy or semantic reasoning.

This approach differed from manual mapping in that it did not rely on semantic parsing, interpretation of meaningful units, or mapping rules. Instead, it operated purely on string-level identity, identifying cases where a SNOMED CT term and an ICF category share precisely the same wording. As such, it provided a unique vantage point for detecting potential anchors or reference points between both systems.

The automated search resulted in **167 exact lexical matches**. These matches represent instances where the textual label of a SNOMED CT concept—whether a preferred term or a synonym—was identical to the title of an ICF category, regardless of the ICF component in which the category resides. Although the number of matches is small relative to the full size of both terminologies, the presence of these exact correspondences offers important insight into the lexical alignment between SNOMED CT and the ICF.

To ensure the reliability of these automated findings, **21% (35 of the 167) of the matches were manually reviewed by the senior researchers**. This quality-control step verified whether the lexical match also represented a valid conceptual match, given that identical wording does not necessarily guarantee identical semantic scope. The manual review confirmed that several lexical matches indeed reflected true conceptual overlap, while others served as useful markers for assessing divergences between everyday clinical terminology (as expressed in SNOMED CT) and the more formal, classificatory structure of the ICF.

Overall, this computational layer enriched the pilot by providing a complete, system-wide lexical scan that extends beyond the targeted ADL-focused refset used for manual mapping. It confirmed that exact lexical alignment between SNOMED CT and the ICF is limited but not absent, and that combining automated search with expert validation can reveal potentially valuable correspondences that may inform future methodological refinements and mapping expansions.

Integration and Merging of All Mapping Techniques

As outlined in the logic model, all mapping outputs were merged into a single validated dataset:

- subject mapping (activities)
- qualifier mapping (capacity/performance/participation)
- computational mapping outputs
- expert corrections and consensus decisions

The merging phase ensured internal consistency and resolved differences between manual and computational mapping routes.

Granularity Reconciliation

Granularity reconciliation was a central methodological requirement in ensuring that SNOMED CT concepts could be meaningfully aligned with the ICF framework. SNOMED CT is a highly fine-grained, clinically oriented terminology that frequently captures micro-activities or highly specific functional behaviours, whereas the ICF uses broader, hierarchical categories intended for international comparability. As a result, many SNOMED CT concepts conveyed a level of detail that exceeded what the ICF is designed to represent. In these cases, the mapping process identified the most appropriate ICF stem code while retaining the finer semantic nuances of the original SNOMED CT concept through systematic annotation. This prevented any loss of clinically relevant detail while ensuring compliance with ICF structure.

In other situations, SNOMED CT concepts were formulated more generally than the ICF categories. A broad SNOMED CT expression referring to a global functional limitation could correspond to several ICF activities or participation domains. To avoid oversimplification, the mapping team examined whether multiple ICF codes were necessary to capture the full scope of the concept. When appropriate, the mapping was distributed across several ICF categories, thereby reflecting the multidimensional nature of functioning grounded in the ICF model.

A further challenge occurred when SNOMED CT expressions combined several types of information, such as an activity, the degree of difficulty, an underlying functional cause, or a contextual dependency. These composite concepts were systematically deconstructed into their constituent semantic units so that each could be represented within the ICF according to its atomic coding principles.

Mapping Tools and Environment

The technical environment used in this pilot project combined a deliberately simple operational core with several high-quality international terminology tools. Although a wide range of digital resources was consulted, Microsoft Excel served as the primary environment in which all

operational mapping work was executed. Excel functioned as the central workspace for semantic analysis, mapping registration, quality assurance, and version management. Its transparent tabular structure allowed the project team to systematically apply ICF linking rules, document mapping rationales, store reviewer comments, and track iterative modifications across the full mapping lifecycle. All SNOMED CT → ICF mapping decisions—manual, computational, validated or corrected—were recorded exclusively in the Excel environment.

To support this core workflow, several complementary tools and platforms were used for terminology consultation, semantic clarification and computational assistance. For SNOMED CT content, the project relied primarily on the SNOMED International Browser (International Edition) and the UK SNOMED CT Browser, the latter being essential for accessing the "Activity of Daily Living Related to Physical Function Findings Simple Reference Set," which served as the starting point of the pilot. These browsers offered detailed information such as hierarchical placement, synonyms, semantic tags and historical associations, enabling researchers to refine the semantic interpretation of each concept before mapping it to the ICF.

For the ICF, the team made extensive use of the WHO ICF Browser (https://apps.who.int/classifications/icfbrowser/), which provides authoritative concept definitions, inclusion and exclusion criteria, and the hierarchical structure of the Activities and Participation component. This browser ensured that mappings adhered strictly to the conceptual boundaries of the ICF and supported accurate differentiation between related activity categories, which was essential given the granularity differences between SNOMED CT and the ICF.

The environment also incorporated WHO's modern terminology ecosystem, including the experimental WHOOSH platform—WHO's unified semantic health classification tool for WHO-FIC systems. WHOOSH was used primarily as a reference environment to verify cross-classification relationships and to explore how the ICF aligns with ICD-11 and other WHO classifications. Although the pilot did not rely on WHOOSH for operational mapping, it played an important role in checking consistency with broader WHO-FIC logic and in anticipating interoperability needs for future phases.

In addition, the project consulted the WHO ICD API (https://icd.who.int/icdapi), not for ICD-mapping itself, but to understand the technical structure of WHO's modern API-based classification services. Familiarity with the ICD API framework informs future interoperability ambitions, particularly in light of the Belgian Terminology Centre's emerging infrastructure, which will eventually need to exchange structured mapping tables, qualifiers, and classification metadata across WHO-FIC systems.

Usage Validation

Usage validation assessed how the SNOMED CT → ICF mappings performed when applied in realistic functional assessment scenarios. Whereas earlier validation steps focused on semantic

correctness and expert agreement, usage validation examined *how the mappings behave in practice*. In this pilot project, the Obesity a Low Back Pain (LBP) use case served as the primary and foundational phase of usage validation. This scenario was chosen because LBP is one of the most common conditions encountered in rehabilitation, with a well-documented profile of functional limitations in Activities of Daily Living (ADL), making it ideally suited to test an ADL-focused mapping pilot.

LBP Use Case as the Central Validation Scenario

Both the Obesity and the LBP use case contains detailed descriptions of everyday functional problems, such as difficulties with bending, lifting, sitting, standing, walking, self-care routines, household tasks, and work-related activities. These domains overlap strongly with the content of the ADL refset used in this pilot, making LBP an ideal stress test for the mapping logic.

In the first phase of usage validation, each functional description within the cases was matched to the corresponding SNOMED CT concepts present in the chosen refset. The resulting concepts were then mapped to ICF categories using the established mapping rules and templates. This process served as an empirical test of the method's capacity to:

- identify relevant ICF Activities and Participation codes for common functional impairments,
- ensure that parsed meaning units (e.g., "difficulty bending," "limited endurance," "unable to sit for prolonged periods") were consistently mapped,
- correctly interpret qualifiers such as severity or assistance needs within the context of real-world functioning,
- and prevent semantic drift when SNOMED CT concepts cluster around the same functional domain (e.g., repeated variations of "difficulty lifting").

The cases thus provided an immediate, practice-oriented demonstration that the mapping framework can accurately represent functional limitations typical in musculoskeletal rehabilitation.

Results and Analysis

Subject Mapping

The map started with 1108 concepts in the UK Refset that could be mapped. Ten SNOMED CT codes were excluded since they did not expressed functioning (e.g. eastern - Cooperative Oncology Group performance status - grade 0 or self - medication assessment - high risk). In total, 1098 concepts in the UK Activity of Daily Living Related to Physical Function Findings Reference Set remained in the final map.

A comparison between the map of the junior researchers and the map of the senior researcher showed an inter-rater agreement of 71,03% which entails exact matches (59,3%) and matches on a different level but same STEM code with two digits (11,73%)(e.g. d470-d4702). There was an 5,14% match with same stem code but different deeper level (e.g. d530-d570), and 10.2% no match.

In step three, the external validation using the Portuguese ADL-ICF mapping set showed 33 overlapping SNOMED CT with our refset. The Portuguese set did not parse into qualifiers, only on the subject. There was an inter-rater agreement of 81,24% which entails exact matches (59,37%) and matches on a different level but same STEM code with two digits (21,87%). There was an 15,62% match with same code but different level and 3,12% no match.

Qualifier mapping

Thirty-seven potential qualifier terms were parsed in the refset. Twinty-one SNOMED CT codes could not be parsed since they could not be seen separated (e.g. Mixes medication with alcohol).

Three were excluded due to several reasons:

- ‘disability’: because the ICF in general is about disability, so this term focuses on the four main domains of ICF.
- Poor compliance: not specified in the diagram
- ‘Refuses to’ and ‘dissatisfaction’: personal factor, not categorised in icf

The final qualifier mapping ended with 34 SNOMED CT ‘qualifiers’ that were mapped to ICF qualifiers. See the tab ‘Rule-Based mapping’ in the Excel file. Those qualifier decisions were multiple times discussed with the senior researchers, the international expert panel and experts of the SNOMED CT board.

A final map was made where the subject mapping and qualifier mapping were put together, see tab ‘final mapping’ in the Excel file.

Identified Gaps and Unmappable Concepts

Some general reflections can be made. First, it appeared that, due to the parsing, several terms repeated themselves, for example: 'does-**play**' and 'difficulty to **play**'. However, we included them in the mapping since the end mapping file needs to contain the full map. At the end of the mapping process, we compared all those overlapping SNOMED CT subjects towards the chosen ICF category and decided to not change them since they reflect the one-to-many concept.

Secondly, some SNOMED-CT codes often contain an environmental factor (e.g. put on prosthesis: e) or a body function (patient unhappy with medication regime: unhappy is an emotion so b152 emotional function). The decision was made to not include the body functions since this would take us too far. For the environmental factor, we set up the rule that when it has an impact on the performance, then it is relevant in rehabilitation and in this subset. So if the environmental factor was an aid, we added the e-code. In total, 61 codes contained a e-code of the ICF. In addition, we initially put forward d4, d5, d6 as ICF domains to code, but some SNOMED CT codes could also be matched with d2 (eg. d2102: undertaking a single task independently? This was the case when the code was difficult to map with an ICF code) and d3 (eg. D360 using communication devices and techniques). To end, the main struggle was the lack of definition to interpret the SNOMED CT code when doubting and the broadness in the code (eg. Patient does not understand why taking all medication - matched with - looking after one's health).

The Use case of obesity.

This use case shows the results of the mapping and the parsing as described in the previous paragraphs.

As the direction of the linking is from SNOMED CT to ICF it has been described in this way. First, a real-life case of a person with obesity has been described in SNOMED CT 'language' followed by a description of the same case in ICF 'language'. Finally, a table is presented showing the map between both system, including the parsing.

SNOMED-CT 'language'

An 18 year old man, suffering Obesity.

The person is **able to perform personal hygiene activities (**284780004). He **does bathe self (284805002)**, **does shower self (284794003).** However, he has **difficulty drying self (284832007).**

The person is **able to perform dressing activity (284968001)** and **does dress (284975000)**, but experiences **difficulty adjusting clothing (285013006)** and **difficulty adjusting clothing for toilet (284936009)** . He **does put on footwear (284981008),** but has **difficulty tying shoe laces (303489008)**.

The person is **able to perform toileting activities (282952006).** He **does use toilet (284909007), does flush toilet (285967002),** and **does clean self after toilet (284952007)**, but reports **difficulty squatting at toilet (303457004)** and **difficulty standing at toilet (284948007).**

In domestic life, the person is **able to perform domestic activities (1144842001).** He **does prepare meals (286491009), does cook food (286516000), does prepare drinks (286504006),** and **does set meal table (286181009)**, but has **difficulty following recipe** (286512003) and **difficulty preparing food hygienically (286536004)**. He **does not do laundry** (1071641000000109). and **needs assistance with housework (129051008).**

The person is **able to manage medication** (285034004) and **does take medication (715035002).**

Regarding mobility and transport, the person is **able to travel on foot** (300613008) short distances and **does cross the road (300672006),** but has **difficulty traveling on foot** (300618004) over longer distances. He **does not drive a car** (300637008) but **does use public transport** (300623004).

The person is **able to participate in community social life** (870708003) and **does participate in leisure activities** (300740003) that are sedentary. However, he has **difficulty participating in sporting activities** (300802007).

Same case but added with the ICF 'language' including the categories, the description and the qualifier on the level of capacity or performance.

An 18 year old man, suffering Obesity.

The person is **able to perform personal hygiene activities** *(d510/d520/d530 – washing oneself / caring for body parts / toileting -capacity qualifier 0))*. He **does bathe self** *(d510 – washing*

oneself – performance qualifier 0). However, he **has difficulty drying self** *(d5102 – drying oneself - Capacity qualifier 1,2 or 3)*.

The person is **able to perform dressing activity** *(d540 – dressing – capacity qualifier 0)* and **does dress** *(d540 – dressing – performance qualifier 0)*, but experiences **difficulty adjusting clothing** *(d540 – dressing – capacity qualifier 1,2 or 3)* and **difficulty adjusting clothing for toilet** *(d540 – dressing - capacity qualifier 1,2 or 3)*. He **does put on footwear** *(d5402 – putting on footwear – performance qualifier 0)*, but has **difficulty tying shoe laces** *(d5402 – putting on footwear)*.

The person is **able to perform toileting activities** *(d530 – toileting – capacity qualifier 0)*. He **does use toilet** *(d530 – toileting – performance qualifier 0)*, **does flush toilet** *(d530 – toileting – performance qualifier 0)*, and **does clean self after toilet** *(d530 – toileting performance qualifier 0)*, but reports **difficulty squatting at toilet** *(d4101 – squatting – capacity qualifier 1,2 or 3)* and **difficulty standing at toilet** *(d4104 – standing – capacity qualifier 1,2 or 3)*.

In domestic life, the person is **able to perform domestic activities** *(d640 – doing housework – capacity qualifier 0)*. He **does prepare meals** *(d630 – preparing meals – performance qualifier 0)*, **does cook food** *(d630 – preparing meals - performance qualifier 0)*, **does prepare drink** *(d630 – preparing meals - performance qualifier 0)*, and **does set meal table** *(d630 – preparing meals - performance qualifier 0)*, but has **difficulty following recipe** *(d630 – preparing meals - capacity qualifier 1,2 or 3)* and **difficulty preparing food hygienically** *(d630 – preparing meals - capacity qualifier 1,2 or 3)*. He **does not do laundry** *(d6400 – washing and drying clothes and garments – performance qualifier 4)*, and **needs assistance with housework** *(d640 – doing housework - capacity qualifier 1,2 or 3)*.

The person is **able to manage medication** *(d5702 – maintaining one's health - capacity qualifier 0)* and **does take medication** *(d5702 – maintaining one's health – perfromance qualifier 4)*.

Regarding mobility and transport, the person is **able to travel on foot** *(d450 – walking - capacity qualifier 0)* short distances and **does cross the road** *(d4602 – moving around outside the home and other buildings – performance qualilfier 0)*, but has **difficulty traveling on foot** *(d450 – walking - capacity qualifier 1,2 or 3)* over longer distances. He **does not drive a car** *(d4751 – driving motorized vehicles – performance qualifier 4)* but **does use public transport** *(d4702 – using public motorized transportation – performance qualifier 0)*.

The person is **able to participate in community social life** *(d910 – community life – particiaption qaulifier 0)* and **does participate in leisure activities** *(d920 – recreation and leisure - participation qualifier 0)* that are sedentary. However, he **has difficulty participating in sporting activities** *(d9201 – sports – participation qualifier 1,2 or 3)*.

The final map for this case:

Concept	SNOMED-CT	ICF	ICF description	Qualifier & level
Able to perform personal hygiene activities	284780004	d510/ d520/ d530	Washing oneself / Caring for body parts / Toileting	0 – capacity
Does bathe self	284805002	d510	Washing oneself	0 – performance
Does shower self	284794003	d510	Washing oneself	0 – performance
Does wash upper body	284846001	d5100	Washing body parts	0 – performance
Does wash lower body	284846001	d5100	Washing body parts	0 – performance
Difficulty drying self	284832007	d5102	Drying oneself	1–3 – capacity
Difficulty standing in bath	248234009	d4104	Standing	1–3 – capacity
Needs assistance with cutting own toenails	284853004	d5204	Caring for toenails	1–3 – performance
Able to perform dressing activity	284968001	d540	Dressing	0 – capacity
Does dress	284975000	d540	Dressing	0 – performance
Difficulty adjusting clothing	285013006	d540	Dressing	1–3 – capacity
Difficulty adjusting clothing for toilet	284936009	d540	Dressing	1–3 – capacity
Does put on footwear	284981008	d5402	Putting on footwear	0 – performance
Difficulty tying shoe laces	303489008	d5402	Putting on footwear	1–3 – capacity
Able to perform toileting activities	282952006	d530	Toileting	0 – capacity
Does use toilet	284909007	d530	Toileting	0 – performance
Does flush toilet	285967002	d530	Toileting	0 – performance
Does clean self after toilet	284952007	d530	Toileting	0 – performance
Difficulty squatting at toilet	303457004	d4101	Squatting	1–3 – capacity
Difficulty standing at toilet	248234009	d4104	Standing	1–3 – capacity
Able to perform domestic activities	1144842001	d640	Doing housework	0 – capacity
Does prepare meals	286491009	d630	Preparing meals	0 – performance
Does cook food	286516000	d630	Preparing meals	0 – performance
Does prepare drink	286504006	d630	Preparing meals	0 – performance
Does set meal table	286181009	d630	Preparing meals	0 – performance
Difficulty following recipe	286512003	d630	Preparing meals	1–3 – capacity
Difficulty preparing food hygienically	286536004	d630	Preparing meals	1–3 – capacity
Does do laundry	284878007	d6400	Washing and drying clothes and garments	0 – performance
Does fold laundry	284878007	d640	Doing housework	0 – performance
Needs assistance with housework	129051008	d640	Doing housework	1–3 – performance
Able to manage medication	285034004	d5702	Maintaining one's health	0 – capacity
Does take medication	715035002	d5702	Maintaining one's health	0 – performance
Difficulty managing medication regimen	284901005	d570	Looking after one's health	1–3 – capacity
Patient forgets to take medication	248234001	d570/ b144	Looking after one's health / Memory functions	1–3 – performance
Able to travel on foot	300613008	d450	Walking	0 – capacity
Does cross the road	300672006	d4602	Moving around outside the home and other buildings	0 – performance
Difficulty traveling on foot	300618004	d450	Walking	1–3 – capacity
Does not drive a car	300637008	d4751	Driving motorized vehicles	4 – performance
Does not use public transport	284842003	d4702	Using public motorized transportation	4 – performance
Able to participate in community social life	870708003	d910	Community life	0 – participation
Does participate in leisure activities (sedentary)	300740003	d920	Recreation and leisure	0 – participation
Difficulty participating in sporting activities	300802007	d9201	Sports	1–3 – participation
Limited participation	284921000	d9	Community, social and civic life	1–3 – participation

Lessons Learned and Future Directions

The pilot mapping between SNOMED CT and the ICF yielded several important methodological, conceptual and operational insights that can shape the future development of functioning-related terminology infrastructure in Belgium. As a first national proof of concept, the project demonstrated that the mapping of SNOMED CT functional concepts to ICF Activities and Participation categories is both feasible and clinically meaningful, provided that the mapping process follows a structured methodology and incorporates expert validation at multiple levels.

Lessons Learned

A key lesson learned concerns the importance of structured semantic parsing of SNOMED CT concepts. Many concepts contained multiple layers of meaning—activity, degree of difficulty, causal factors, or contextual dependencies—that had to be decomposed before meaningful ICF mapping was possible. The pilot showed that this decomposition is essential not only for semantic accuracy but also for maintaining internal consistency within the mapping workflow.

The project also highlighted the value of starting from a focused, clinically relevant refset, in this case the UK ADL-oriented reference set. This limited the scope to a manageable subset while ensuring that the content was meaningful for rehabilitation, insurance medicine and functional assessment contexts. The refset-based starting point proved particularly useful for a pilot environment where methodological testing was more important than full dataset coverage.

Another important lesson was the need for strong quality assurance safeguards. The combination of full manual mapping by junior researchers and senior researcher with senior researchers review, and the external comparison with the Portuguese ADL–ICF mapping set created a multi-layered validation structure that significantly increased reliability. The consensus reviews between senior experts further demonstrated the need for iterative refinement steps to reach stable mapping decisions.

The pilot also demonstrated that real-world usage validation is indispensable. Mapping behaviour must be tested on realistic cases—such as the low back pain use case used here—to ensure that conceptual mapping rules translate into practical interpretability. Without this step, a mapping may appear correct on paper but fail when confronted with complex clinical narratives.

Finally, the project revealed that Excel remains an effective and transparent working environment for early-stage mapping. Its flexibility, traceability and simplicity supported manual, computational and consensus workflows without the need for more complex terminology software. However, this also underlined the need for future migration to more robust collaborative systems as the mapping grows in scale.

Future Outlook

Looking ahead, the pilot mapping lays the foundation for a broader national and international development trajectory. The methodology can be extended beyond Activities and Participation to include the Body Functions, Body Structures, and Environmental Factors components of the ICF. In particular, the decomposition rules for composite SNOMED CT concepts will be essential for enabling full post-coordination across all ICF components.

A natural next step is the integration of the mapping methodology into a national governance structure will allow iterative updates, quality-controlled versioning, and broader stakeholder engagement, including clinical, administrative and eHealth actors.

Future phases will also focus on improving interoperability with WHO-FIC ecosystems, including alignment with WHOOSH, the ICD API environment, and potential participation in international mapping harmonisation efforts. Establishing automated pipelines that can transform mapping outputs into WHO-FIC-compliant formats will further support international exchange.

In addition, the project should evolve towards more advanced tooling, including collaborative terminology platforms, rule-based engines, or machine-learning–supported mapping assistance. While Excel sufficed for this pilot, future large-scale mappings will require more sophisticated systems with multi-user access, automated validation rules, and audit trails integrated at platform level.

An additional and clinically relevant contribution of this SNOMED CT–ICF mapping lies in the domain of vocational rehabilitation and work-ability assessment, as well as in the broader context of integrated care. In Flanders and internationally, the ICF is widely used as a reference framework to describe functioning, participation and contextual factors across health, social care and employment-related services. Several work-oriented assessment procedures and decision-making processes are explicitly ICF-based and focus on individuals' functional capacities, activity limitations and participation opportunities rather than on medical diagnoses alone.

By linking functional observations and clinical findings recorded in electronic health records using SNOMED CT to ICF categories, a shared semantic language is created between healthcare professionals, vocational rehabilitation specialists and employment support services. This facilitates consistent, transparent and transferable communication about functioning across disciplines and sectors. In the context of vocational rehabilitation, such an approach enables the structured reuse of information on daily activities, work-related tasks and participation restrictions within trajectories coordinated by organisations such as VDAB and GTB.

Beyond vocational rehabilitation, the importance of the SNOMED CT–ICF linkage is closely aligned with current ambitions for integrated care in Belgium, as articulated in the interfederal integrated

care policy. Integrated care requires continuity and coherence of information across care levels, sectors and policy domains. By connecting SNOMED CT–based clinical documentation to the ICF, functioning data can be meaningfully shared and reused across healthcare, social support, long-term care and employment-related systems, thereby supporting person-centred, goal-oriented and coordinated care trajectories.

Importantly, the relevance of the ICF as a cross-sectoral framework is further reinforced by its established integration within the BelRAI system, which is widely used in Belgium to assess functioning, care needs and support requirements across health and social care settings. Existing links between BelRAI and the ICF illustrate how functioning data can be operationalised consistently for assessment, care planning, intervention and follow-up. This underscores that the ICF plays a key role not only in rehabilitation and return-to-work trajectories—including domains such as obesity and chronic conditions—but also in the assessment and monitoring of frailty, multimorbidity and complex care needs across the life course.

The present mapping benefits from the specific expertise of the research group in BelRAI, the ICF and SNOMED CT, which provided a clear methodological advantage. This combined expertise enabled nuanced interpretation of functional concepts, informed handling of qualifiers and contextual information, and alignment across clinical, rehabilitative and socio-administrative perspectives. By explicitly distinguishing between capacity and performance, in line with the ICF model, the mapping supports a shift from a predominantly medicalised approach towards a functional and participation-oriented perspective, in which individuals' real-life functioning and possibilities to participate—including (re)engagement in work—are central.

In this way, the SNOMED CT–ICF mapping functions as a key bridging mechanism between clinical documentation, integrated care, rehabilitation practice, social assessment frameworks and labour-market-oriented services, contributing to more coherent, interdisciplinary and participation-focused trajectories for individuals with functional limitations.

Finally, the pilot opens pathways for real-world implementation studies, where mappings are tested in clinical workflows, disability assessments, insurance-medicine contexts and digital health applications. These studies will be critical for assessing utility, scalability and long-term maintenance needs.

Outreaching activities

The SNOCLASS ICF project implemented a set of outreach activities to disseminate results, engage stakeholders, and promote awareness of the methodology and its implications:

1. **Oral Presentation – SNOMED CT Expo, Antwerp.** The project team delivered an oral presentation at the SNOMED CT Expo in Antwerp, introducing the pilot methodology for mapping SNOMED CT concepts to the ICF. The session highlighted the rationale for interoperability, the mapping approach, and its relevance for clinical practice and policy.

2. **Poster Presentation – SNOMED CT Expo, Antwerp:** A scientific poster was presented at the same event, visually summarizing the project's objectives, methodology, and key findings. The poster facilitated informal discussions and knowledge exchange with international experts.

3. **International Feedback Committee:** An international feedback group was established to review the pilot methodology and provide expert input. Members included specialists from WHO-FIC collaborating centers and SNOMED International communities, ensuring alignment with global standards.

4. **Brochure – ICF for a Lay Audience:** A brochure was developed to explain the ICF framework in accessible language for the general public. It introduces the concept of functioning, participation, and environmental factors, emphasizing the relevance of ICF in daily life and health care.

5. **Presentation – ICF for a Lay Audience:** A simplified presentation was created for non-technical audiences, focusing on what ICF is, why it matters, and how it supports person-centered care and social inclusion. The presentation uses clear visuals and practical examples to engage a broad audience.

6. **LinkedIn page:** To strengthen visibility and professional networking, the SNOCLASS ICF project created a dedicated LinkedIn profile. This channel is used to share project updates, highlight outreach activities, and engage with the international health informatics and rehabilitation community. It supports knowledge exchange beyond academic settings and fosters collaboration with stakeholders and experts worldwide.

   https://be.linkedin.com/company/snoclass

7. **Steering committee FOD:** Four steering committees were planned between the complete research team (ICF-ICHI-ICPC-3) and the FOD Volksgezondheid
   1th: 3th of December 2024
   2th: 6th of May 2025

3th: 16th of September 2025
4th: 19th of December 2025

8. **SNOCLASS meeting:** Biweekly meetings were established among researchers from the ICF, ICHI, and ICPC-3 teams. These meetings aimed to provide mutual updates, discuss methodological challenges and approaches, and coordinate dissemination activities.

Conclusion

This pilot project demonstrates that a structured and methodologically rigorous mapping between SNOMED CT and the International Classification of Functioning, Disability and Health (ICF) is both feasible and valuable for enhancing the representation of functioning data within the Belgian health information landscape. By focusing on Activities and Participation, and using a clinically meaningful, ADL-oriented SNOMED CT reference set, the project established a robust foundation for linking everyday functional descriptions to internationally standardised ICF categories.

The results show that the mapping methodology—built around semantic parsing, consistent mapping rules, structured quality assurance and expert validation—produces mappings that are technically coherent, clinically interpretable and compatible with WHO-FIC standards. The Low Back Pain use case confirmed that the mapping performs reliably under real-world conditions, capturing functional limitations in a manner that aligns with clinical reasoning in rehabilitation and insurance medicine.

Through the involvement of an international expert advisory board, the project ensured alignment with international approaches and heightened the conceptual credibility of the method. The mapping environment, centred around a transparent and version-controlled Excel workflow, proved effective for piloting purposes and provides a solid operational base for future scaling.

Overall, this project represents a significant step forward for the development of functioning-related terminology infrastructure in Belgium. It demonstrates how SNOMED CT and the ICF can be integrated to support better assessment, documentation, and secondary use of functional data across healthcare, social security, and policy environments.

Future research

Several avenues for future research emerge from this pilot. First, the mapping should be expanded beyond Activities and Participation to include the ICF components Body Functions, Body Structures and Environmental Factors. The pilot already identified cases where SNOMED CT concepts contain embedded information about impairments or contextual facilitators/barriers; capturing these systematically will be crucial for achieving a complete functioning ontology.

Second, future work should explore automated and semi-automated mapping techniques, including natural language processing and rule-based engines, to assist with large-scale mapping activities. While manual mapping remains essential for clinical nuance, computational tools can support scalability and consistency.

Third, additional use cases should be tested in domains such as neurological rehabilitation, chronic conditions, frailty and ageing, and insurance medicine. These tests will help refine the mapping logic and ensure applicability across diverse functional profiles.

Fourth, integration into the Belgian Terminology Centre (BTC) will require research on governance models, update cycles, interoperability frameworks, and technical formats (e.g., RF2-based mapping tables, WHO-FIC compliant structures). Understanding how the mapping behaves in live digital systems—EHRs, assessment tools, disability evaluations—will be essential for real-world implementation.

Fifth, international comparison should be deepened. The initial contrast with the Portuguese ADL–ICF mapping opens the door to broader collaboration with other countries undertaking similar work. Cross-national semantic alignment will be increasingly important as WHO-FIC initiatives evolve.

Finally, future research should focus on evaluating the impact of functioning mappings on clinical practice, data quality, reporting, and decision-making. Understanding how these mappings help clinicians, policymakers, and insurers interpret functioning in a consistent and meaningful way will inform the long-term value and sustainability of the framework.

Appendices

Appendice 1: Mapping tables (see Excel)

SNOMED CT QUALIFIER PARSING	Interprets_Capacity	Interprets_Value_Capacity	Interprets_Performance	Interprets_Value_Performance	Attribute1_Value_Participate	Attribute_2_Value_Participate	ICF QUALIFIER VALUE
Does not participate					Ability to participate	does not (717896003)	4
Does participate					ability to participate	does (385640009)	0
Difficulty participating					Ability to participate	able with difficulties (371157007)	1 2 3
Able to participate					Ability to participate	able (371150009)	0
Unable to participate					Ability to participate	unable (371151008)	4
Able to perform	Able to...	able (371150009)					0
Unable to perform	ability to...	unable (371151008)					4
Able to	ability to...	able (371150009)					0
unable to	ability to...	unable (371151008)					4
difficulty ...	ability to...	able with difficulty (371157007)					1 2 3
deficit /deficient	ability to	deficient (260372006)					1 2 3 (4)
needs assistance to	ability to...	assisted (371152001)					1 2 3 4
deficient (zelfde als hierboven, aanpassen)	ability to...	deficient (260372006)					1 2 3 (4)
impaired	ability to...	able with difficulty (371157007)					1 2 3
dependent	ability to ...	dependent (371154000)					1 2 3 4
independent with/for/in	ability to ...	independent (371153006)					0
improvement in ability to	ability to...	improved (385425000)(quatifier value)					4 3 2 1 0
independently able to	ability to...	independent (371153006)					0
does			ability to...	does (385640009)			0
does not			ability to...	does not (717896003)			4
Does perform			ability to...	does (385640009)			0
does not perform			abiliy to...	does not (717896003)			4
difficulty performing			ability to...	able with difficulty (371157007)			1 2 3
uses			ability to use	does (385640009)			0
needs help with			ability to	not specified			1 2 3 4
Apraxia of			ability to	abnormal (263654008(qualifier value))			1 2 3 4
Assistence to /assisted			ability to	assisted (371152001)(qualifier value)			1 2 3 4
Non-compliance with			compliance	does not (717896003)			4
complience with			compliance to	does (385640009)			0
co-operates			ability to ...	/			1 2 3
Helps with			ability to ...	/			1 2 3
improper			ability to...	/			1 2 3 4
inadequate			ability to	inadequate (71978007)			1 2 3 4
ineffective			ability to ...	/			

Appendice 2: Oral Presentation – SNOMED CT Expo, Antwerp

Some relevant slides from the oral presentation:

GHENT UNIVERSITY | GHENT UNIVERSITY RESEARCH GROUP OCCUPATIONAL THERAPY | DEPARTMENT OF PUBLIC HEALTH AND PRIMARY CARE

SNOCLASS : A Belgian terminology project for mapping relevant SNOMED CT concepts to WHO Family of Classifications in 3 domains

Selecting relevant SNOMED CT concepts to consider for mapping to three classifications using hierarchy (semantic) tags

Robert Vander Stichele, Joseph Roumier

Department of Public Health and Primary Care, Ghent University, Belgium

Funded by the Belgian Federal Public Service (FPS) Health, Food Chain Safety and Environment
National Release Centre for Terminology, SNOMED CT EXPO, Antwerp, October24, 2025

Presentation of the project team

(Ghent University, Faculty of Medicine and Health Sciences)

For the International Classification of Primary Care (ICPC-3)

Unit of Primary Care, Department of Public Health and Primary Care

Oliver Van Hecke, Diego Schrans, Victor Maes

WHO Collaborating Centre for Primary Care and Family Medicine

Bianca De Sá e Silva, Jan De Maeseneer

For the International Classification of Health Interventions (ICHI)

Unit of Medical Informatics and Statistics,
Department of Public Health and Primary Care

Pascal Coorevits, Filip Ameye

For the International Classification of Functioning, Disability, and Health (ICF)

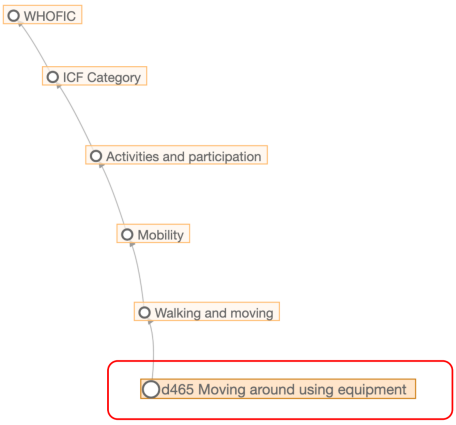
Research Unit for Occupational Therapy

Dominique Van de Velde, Ellen Cruyt, Stijn De Baets

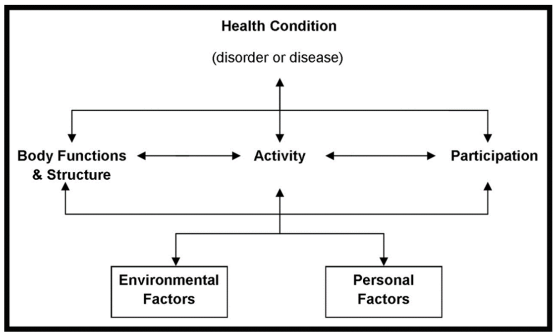
Coordination

Robert Vander Stichele, senior research coordinator
Joseph Roumier, IT and semantic web support

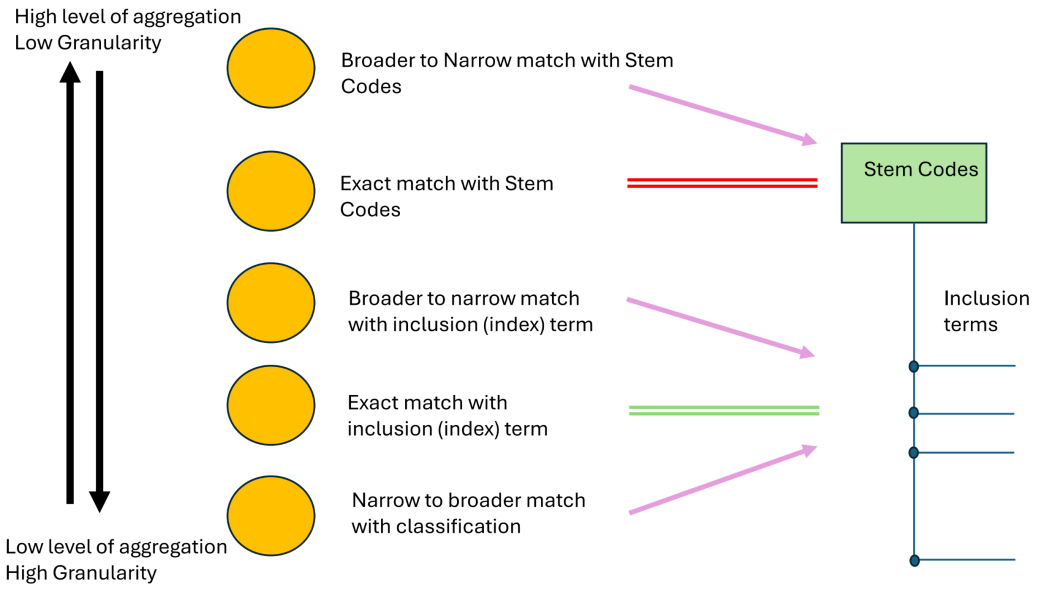
ICF linearisation



ICF-classification



Taxonomy of valid matchings from SNOMED CT to classifications (ICHI, ICF, ICPC-3)



ICF methodology and preliminary results

- Starting from the UK Activities of Daily Living (ADL) core set (N=1.108)
- Trying out several approaches to mapping to the codes of ICF
  - String search
  - Fuzzy search
  - Business rules
- Acknowledging that the mapping from SCT to ICF is not straightforward
  - SCT often precoordinates its functionality concepts, while ICF has activities, modulated by qualifiers (capacity and performance)
- Hence, preparatory work was needed to parse the Precoordinated SCT functionality concepts into activities and capacity or performance qualifiers.
- This allowed to solve the alignment of most of the ADL SCT core set codes with activities+qualifier

Results ICF

Examples;
SCT-concepts

Does not ride a bicycle (finding) | SCTID: 300649009
Difficulty performing gardening activities (finding) SCTID: 300754006
Difficulty walking (finding) | SCTID: 719232003

ICHI activities with qualifiers

Qualifier mapping	Subject mapping
Does not	Ride a bicycle
Difficulty performing	Gardening activities
Able with difficulty	To walk

See e-poster !

More details to discuss

Appendice 3: Poster Presentation – SNOMED CT Expo, Antwerp

GHENT UNIVERSITY
RESEARCH GROUP OCCUPATIONAL THERAPY

SNOClass

GHENT UNIVERSITY

Mapping SNOMED-CT to the WHO-ICF Classification, a use case on low back pain

Cruyt, E.[1], De Baets, S.[1], Ameye, F.[2], Roumier J.[2], Van Hecker, O.[2], De Sá e Silva, B.[2], Schrans, D.[2], Coorevits, P.[2], Vander Stichele R[2]., Van de Velde D.[1]

Introduction
Methods
Results
Discussion

Abstract

- Ghent University, commissioned by the Belgian government (**Belgian Health Terminology Center**), is mapping three classifications systems. One of them is SNOMED CT (**SCT**) to the WHO's **International Classification of Functioning, Disability and Health (ICF)** to improve semantic interoperability in healthcare data. Using **low back pain** as a representative case due to its widespread impact, the project seeks to align SNOMED CT concepts with ICF categories and qualifiers through a combination of automated tools and expert review. This integration aims to support **more comprehensive, person-centered clinical documentation** and enhance the use of functional health data in care planning, decision-making, and outcome evaluation. Ultimately, the effort contributes to global initiatives promoting interoperable, biopsychosocial health information systems.

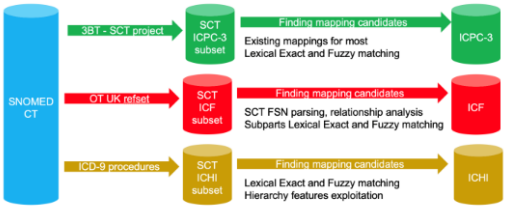
[1]Occupational Therapy Research Group, Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium

[2]Department of Public Health and Primary Care, Ghent University, Ghent, Belgium

SNOMED CT EXPO 2025
OCTOBER 22-24 | ANTWERP | ONLINE
Terminology for information driven integrated healthcare

Aims

- Focused on the use case of low back pain (LBP), the project aims to align relevant SNOMED CT concepts with corresponding ICF categories, including body functions and structures, activities and participation, and environmental factors.
- Through automating and expert-drive methods, the ultimate goal is to enhance semantic interoperability between clinical and functional health information systems, enabling the integrated use of SNOMED CT and ICF in clinical documentation, electronic health records, and health information exchange.



Three mappings, ICF follows the red line.

Introduction

Mapping SNOMED-CT to the WHO-ICF Classification, a use case on low back pain

Cruyt, E.[1], De Baets, S.[1], Ameye, F.[2], Roumier J.[2], Van Hecker, O.[2], De Sá e Silva, B.[2], Schrans, D.[2], Coorevits, P.[2], Vander Stichele R[2]., Van de Velde D.[1]

Introduction
Methods
Results
Discussion

Methodology

Step 0: Exploration
- Literature study
- Use of AI tools
- Writing the use case
- Selecting SCT subsets targeting relevant concepts for each classification domain

Step 1: Defining the matching level
- Cardinality

Step 2: Defining mapping rules
- Automatically identifying mapping candidates:
  - Exact Match
  - Fuzzy Match
  - Business Rules

Step 3: Mapping
- Mapping candidates are selected based on lexical exact and fuzzy match, concept properties, and business rules
- Domain expert coders validate mappings

Step 4: Use case

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Terminology for information driven integrated healthcare

Results

- Step 0: Exploration
  - **SCT** >370 000 concepts
  - **ICF** >1500 classes
- Step 1 & 2: Defining the matching level and mapping rules

In general: 167 exact matches identified between SCT and ICF (10%)
But: different semantic tags in SNOMED-CT
Solution: parsing (= Rule based mapping)

Qualifier mapping	Subject mapping
Does not	Ride a bicycle
Difficulty performing	Gardening activities
Able with difficulty	To walk

In the ICF there is a distinction between:

- The CAPACITY (what a person can do)
- The PERFORMANCE (what a person does)
- PARTICIPATION (involvement in a life situation)

Methods

Mapping SNOMED-CT to the WHO-ICF Classification, a use case on low back pain

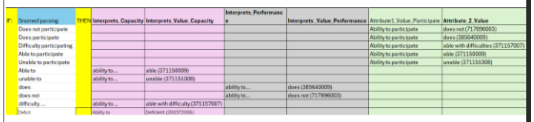
Cruyt, E.[1], De Baets, S.[1], Ameye, F.[2], Roumier J.[2], Van Hecker, O.[2], De Sá e Silva, B.[2], Schrans, D.[2], Coorevits, P.[2], Vander Stichele R[2]., Van de Velde D.[1]

Introduction
Methods
Results
Discussion

- Example of an exact match between SCT and ICF:

- Example of the use of qualifiers within SCT concept

- Business rules on qualifiers



SNOMED CT EXPO 2025
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Terminology for information driven integrated healthcare

Results

Mapping SNOMED-CT to the WHO-ICF Classification, a use case on low back pain

Cruyt, E.[1], De Baets, S.[1], Ameye, F.[2], Roumier J.[2], Van Hecker, O.[2], De Sá e Silva, B.[2], Schrans, D.[2], Coorevits, P.[2], Vander Stichele R[2]., Van de Velde D.[1]

Introduction
Methods
Results
Discussion

Use case (short example)

- A 52-year-old patient presents with **chronic low back pain** that significantly affects daily functioning and quality of life. The pain limits the patient's ability to perform physically demanding tasks such as **lifting** and **gardening**, while basic self-care activities like **undressing** remain unaffected. The patient is currently employed **full-time** in a construction company as a contractor.

Item	SNOMED CT CONCEPT, ID	ICF CATEGORY ICF qualifier
Chronic low back pain	Low back pain (finding), 279039007	Pain in back (b28013)
Lifting	Unable to lift (finding), 288332005	Lifting and carrying objects (d430) Capacity Qualifier 4 (complete problem)
Gardening	Unable to perform gardening activities (finding),300751003	Taking care of plants, indoors and outdoors (d6505) Performance Qualifier 4 (complete problem)
Undressing	Able to undress (finding), 284985004	Dressing (d540) Capacity Qualifier 0 (no problem)
Full-time employed	Employed (finding), 224363007	Remunerative employment (d850), No Qualifier

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Conclusions

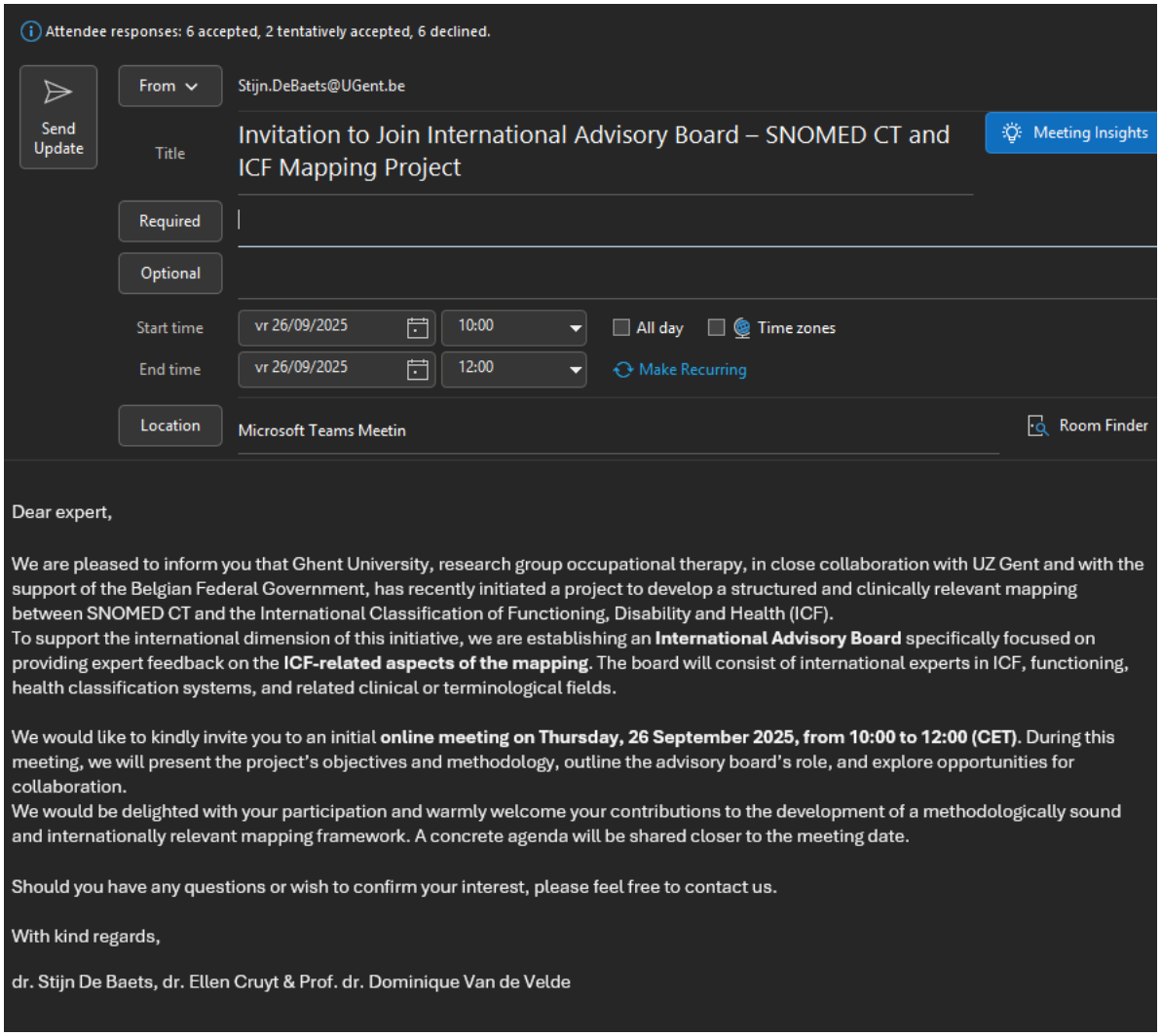
The mapping between SNOMED CT and the ICF demonstrates both the potential and the complexity of achieving semantic interoperability between clinical and functional health classifications. While a number of exact matches were identified, differences in semantic tags and conceptual granularity required a combined manual and computational mapping approach. The integration of ICF qualifiers represents a new and promising direction, though current SNOMED CT refsets, particularly for environmental factors, remain limited. Further research is ongoing to refine mapping rules, extend coverage to qualifiers, and implement the mappings in practical use cases such as low back pain, thereby advancing the use of interoperable, function-oriented health information systems.

Future Directions

The SNOClass project has entered the mapping validation phase, focusing on the low back pain use case. Future work will aim to consolidate the mapping methodology by leveraging terminological structures to better navigate hierarchies and enhance mapping precision. In addition, estimating the time and resources required to complete the mappings will be essential to ensure sustainable implementation and scalability. These next steps will support the establishment of a robust framework for integrating SNOMED CT and ICF within interoperable health information systems.

Discussion

Appendice 4: International Feedback Committee



Attendee responses: 6 accepted, 2 tentatively accepted, 6 declined.

Send Update

From: Stijn.DeBaets@UGent.be

Title: Invitation to Join International Advisory Board – SNOMED CT and ICF Mapping Project

Meeting Insights

Required

Optional

Start time: vr 26/09/2025 10:00 All day Time zones

End time: vr 26/09/2025 12:00 Make Recurring

Location: Microsoft Teams Meetin Room Finder

Dear expert,

We are pleased to inform you that Ghent University, research group occupational therapy, in close collaboration with UZ Gent and with the support of the Belgian Federal Government, has recently initiated a project to develop a structured and clinically relevant mapping between SNOMED CT and the International Classification of Functioning, Disability and Health (ICF).
To support the international dimension of this initiative, we are establishing an **International Advisory Board** specifically focused on providing expert feedback on the **ICF-related aspects of the mapping**. The board will consist of international experts in ICF, functioning, health classification systems, and related clinical or terminological fields.

We would like to kindly invite you to an initial **online meeting on Thursday, 26 September 2025, from 10:00 to 12:00 (CET)**. During this meeting, we will present the project's objectives and methodology, outline the advisory board's role, and explore opportunities for collaboration.
We would be delighted with your participation and warmly welcome your contributions to the development of a methodologically sound and internationally relevant mapping framework. A concrete agenda will be shared closer to the meeting date.

Should you have any questions or wish to confirm your interest, please feel free to contact us.

With kind regards,

dr. Stijn De Baets, dr. Ellen Cruyt & Prof. dr. Dominique Van de Velde

Stuurgroep 26/09

<u>Voorstelling:</u>

Stuurgroepvergadering – 26/09

Voorstelling van de deelnemers

Jesper Just Fabricius (Denemarken)
Vertegenwoordiger van een terminologiecentrum (rol nog nader te specificeren).

Jonas Callens
—

Krista Kart (Estland)
Werkzaam bij het Health Information System Center, een IT-organisatie onder het ministerie van Sociale Zaken. Actief als SCT NRC. Oorspronkelijk kinesitherapeut, momenteel data-analist met een achtergrond in ICF. Geen nationale implementatie van ICF in Estland, maar wel lopende discussies. SNOMED CT wordt vaker gebruikt; ICF wordt verkend en kan in de toekomst voordelen bieden voor samenwerking. Betrokken bij publicatie en vertaling van ICF via een terminologieserver.

Leen Vervaet (België)
Procesmanager bij UZ Leuven, met achtergrond als kinesitherapeut. Sinds 2015 wordt ICF gebruikt in patiëntendossiers binnen een internationaal dossier. Heeft uitgebreide kennis van ICF, minder vertrouwd met SNOMED CT.

Marjion Hackl (Oostenrijk)
Voorzitter van de Oostenrijkse beroepsvereniging voor ergotherapie. Betrokken bij een projectgroep rond implementatie in het elektronisch patiëntendossier; project bevindt zich in de opstartfase. Zes jaar geleden betrokken bij de vertaling van ICF en SNOMED CT. Er zijn geen overheidsrichtlijnen en zij is geen projectleider. Wil informatie verzamelen en doorgeven.

Michaela Coenen (Duitsland)
Werkzaam in München (LMU/ADAM U), psycholoog en expert in public health. Internationale expert in ICF en het linken van gezondheidsgerelateerde informatie aan ICF. Heeft meerdere projecten uitgevoerd rond toepassing van ICF bij gezondheidsproblemen.

Pieter Vaes (België)
Werkzaam bij GTB (Gespecialiseerd Team Bemiddeling). Begeleidt mensen richting werk. Gebruikt ICF in een zelfontwikkelde context om arbeidsgeschiktheid in te schatten. Ontwikkelde een eigen ICF core set. Oorspronkelijk ergotherapeut.

Katrien Vermeulen (België)
Psycholoog in de revalidatiezorg (UZ Gent). Betrokken bij een onderzoeksproject rond implementatie van ICF in vocational rehabilitation. Zoekt momenteel naar duurzame manieren om ICF verder te gebruiken.

Elza de Groot (Nederland)
Terminoloog bij het SNOMED CT Release Center Nederland. Actief binnen paramedische domeinen. Zoekt naar manieren om SNOMED CT en ICF gezamenlijk te gebruiken.

Discussie

Mapping van qualifiers tussen ICF en SNOMED CT
Jonas benadrukt dat het mappen van ICF-qualifiers naar SNOMED CT bijzonder complex is. Bijvoorbeeld: *"climbing stairs with mild difficulty"* laat zich moeilijk vertalen, aangezien SNOMED CT minder gradaties kent. Hierdoor dreigt informatieverlies. Het is belangrijk om mappingregels kritisch te evalueren om verlies van betekenis te beperken.

Vaak ontbreken de laatste vier qualifiers. Mogelijke oplossingen zijn het toevoegen van gradaties of het officieel aanvragen ervan. Aangezien ook Estland en Nederland gelijkaardige noden ervaren, kan dit onderbouwd worden. Katrien zal in een Excelbestand verzamelen welke elementen ontbreken.

Een voorstel is om een concrete **use case** te ontwikkelen, deze in SNOMED CT op te laden en te evalueren hoe snel en gemakkelijk beslissingen genomen worden.

Omgevingsfactoren
Voor omgevingsfactoren kan overwogen worden een eigen referentieset (refset) te maken voor de use case, of te analyseren welke ICF-categorieën het meest voorkomen (bijv. assistive technology).

Ervaringen met eerdere mapping (Elza de Groot)
Elza voerde vijf jaar geleden een mapping uit van SNOMED CT naar ICF. Dit resulteerde in een beperkte mapping, voornamelijk gericht op *findings*. Er werd ook een refset ontwikkeld voor verpleegkunde en gekoppeld aan ICF voor één ziekenhuis dat ICF gebruikte. Exacte matches bleken beperkt.

Mapping is arbeidsintensief en zou daarom niet nationaal, maar internationaal moeten worden aangepakt. Daarnaast werd het onderscheid tussen *content* en *appreciation* benadrukt. Output zou idealiter gerapporteerd worden via een standaardrapportage.

Internationale noden en positionering (Katrien Vermeulen)
Katrien stelt dat internationale noden in kaart moeten worden gebracht en teruggekoppeld naar SNOMED CT om de kans op nieuwe projecten te vergroten. De focus mag niet uitsluitend Belgisch zijn; use cases uit andere landen zijn essentieel.

Brug tussen theorie en praktijk (Pieter Vaes)
ICF-gebruik start bij componenten en biedt een helikopterview. Voor verdieping is het nodig om naar categorieën te gaan. De vraag wordt gesteld of SNOMED CT eveneens een dergelijke helikopterview kan bieden. Lived experience is essentieel om te bepalen of informatie werkelijk over functioneren gaat.

Validatie en onderzoek (Jesper Just Fabricius)
Jesper bespreekt een realistische validatiestudie rond lage rugpijn. Hij stelt voor om een use case of populatie te definiëren als validatie-instrument. Zijn onderzoeksgroep gebruikt ICF voor registratie in gezondheidsdata en onderzoekt mappingmogelijkheden, maar ervaart veel beperkingen. Er wordt gewerkt met een functioning index.

Linking rules en methodologie
Katrien wijst op het belang van relevantie bij linking: hoofdconcept versus aanvullende concepten. ICF-qualifiers zijn niet bedoeld om alle informatie te capteren; een evenwicht is nodig tussen behouden en loslaten van informatie.

Er wordt verwezen naar de linking rules van Cieza (bottom-up linking naar ICF). Deze moeten verder bekeken worden, met aandacht voor structuur en proces (expertise van Michaela Coenen).

Praktische afspraken

- Krista bezorgt informatie over GP's in Wenen (trial-and-error ervaringen).
- Krista deelt haar PowerPointpresentatie.
- Mapping zou idealiter een officieel SNOMED CT-project worden.

Knelpunten in gebruik (Leen Vervaet)
Leen ervaart moeilijkheden met ICF, met name de subjectiviteit van qualifiers. De vraag wordt gesteld of metingen gekoppeld kunnen worden aan mentale functies als qualifier, aangezien gebruikers hier niet vertrouwd mee zijn. Ook het onderscheid tussen *activities* en *participation* blijft onduidelijk.

Mapping tools
Katrien bespreekt **TransmEd**, een mappingtool ontwikkeld aan UGent. Hoewel functioneel, creëert deze afhankelijkheid van Ottignies en verloopt de communicatie moeizaam. Er zijn exportproblemen en veel manueel werk. Door een brand zijn back-ups verloren gegaan. Mogelijk kan Joseph een alternatieve tool ontwikkelen, onafhankelijk van Olivier.

Alternatieven voor TransmEd zijn mappingtools van SNOMED CT en CSIRO (mogelijk gratis).

Aanwezigheid

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Appendice 5: Brochure – ICF for a Lay Audience

UNIVERSITEIT GENT

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF)

BROCHURE

Faculteit Geneeskunde en Gezondheidswetenschappen
SnoClass Mapping Project

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1 IN SHORT

The International Classification of Functioning, Disability and Health (ICF) is a framework for structuring and describing information related to functioning and disability of an individual. It provides a standardized language (inter)nationally and a conceptual foundation for defining and assessing health and disability. It extends across professional groups and professional fields.

2 HISTORY OF THE ICF

The ICF was officially endorsed by the World Health Assembly in May 2001. It represents a shift in how health and disability are conceptualized, emphasizing not just the medical diagnosis but also the broader social and environmental factors that influence functioning. The ICF replaced the International Classification of Impairments, Disabilities, and Handicaps (ICIDH), which was first introduced in 1980 but faced criticism for its linear and deficit-focused approach. The ICF was developed over several years, incorporating feedback from stakeholders worldwide, including health professionals, researchers, and policymakers. Its development reflects a paradigm shift toward a more holistic understanding of health, grounded in the biopsychosocial model.

3 DEVELOPMENT OF THE ICF

The World Health Organization (WHO) spearheaded the development of the ICF to create a universal language for describing and measuring health and disability. Key milestones in its development included:

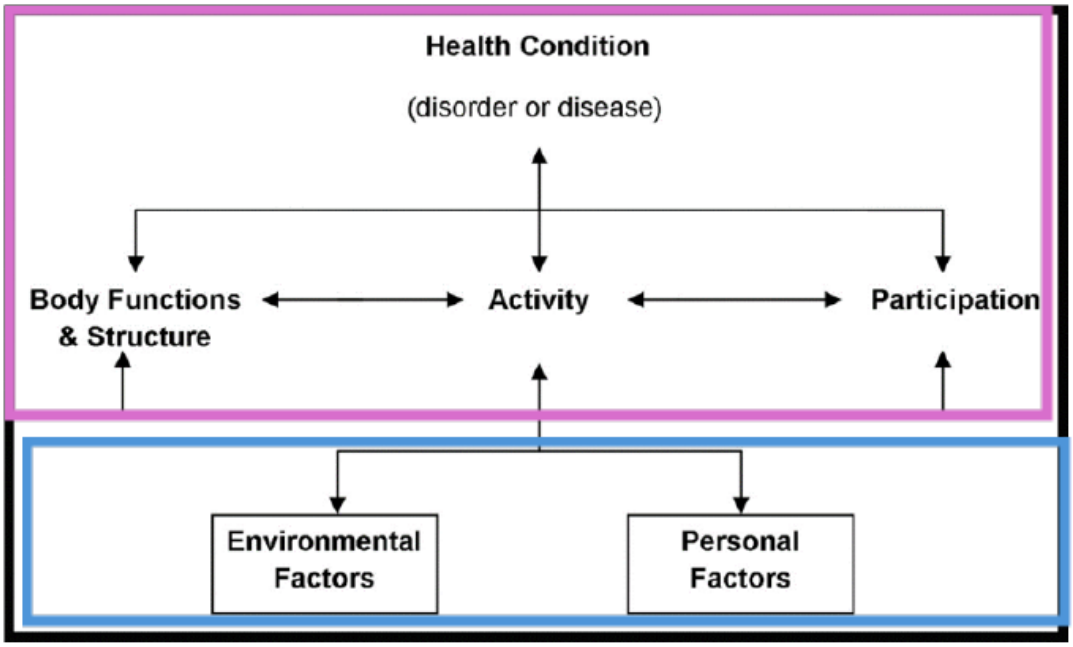
- Extensive international consultations to ensure inclusivity and relevance across cultures and settings.
- Collaboration with experts in medicine, rehabilitation, and social sciences to ensure multidisciplinary input.
- Piloting the framework in diverse healthcare settings to refine its usability and applicability. The result was a classification system that integrates biological, psychological, and social dimensions of health, aligning with the WHO's broader vision of health as a state of complete physical, mental, and social well-being.

Despite these milestones and updates, there is still some criticism of ICF. As the 'disease/condition' is visually situated at the top, the biomedical still seems to be dominant. In response to this criticism, there are alternative ICF schemes that give participation a prominent place or include disease-related factors

under 'personal factors'. Furthermore, A Dutch translation was conducted in 2002 and an update followed in 2007.

The WHO constructed also the ICF-CY (International Classification of Functioning, Disability, and Health for Children and Youth) as an extension of the ICF, specifically designed to capture the unique aspects of child and adolescent development. It considers how growth, learning, and environmental influences shape functioning over time, emphasizing temporary or evolving impairments. The ICF-CY maintains the core structure of the ICF but includes additional categories relevant to childhood, such as play, school participation, and caregiver support. It is widely used in healthcare, education, and rehabilitation to assess needs, design interventions, and track developmental progress, ensuring a holistic approach to supporting children with disabilities or health conditions.

3.1 Structure of the ICF



The ICF is organized into two main parts, each with specific components:

1. **Functioning and Disability**

- **Body Functions and Structures**: Describes the physiological functions of body systems and anatomical structures.
- **Activity and Participation**: Focuses on the execution of tasks and involvement in life situations.

2. Contextual Factors

- **Environmental Factors**: Includes external influences such as societal attitudes, physical surroundings, and policies.
- **Personal Factors**: Encompasses individual attributes like age, gender, and lifestyle, though these are not classified in detail within the ICF.

Each *component* is broken down into *domains* and include *categories* describing various aspects of functioning and disability. Let's take a look into the domains and categories:

Domains: Within each component, there are specific domains. More concrete; in the "Body Functions" component (b), domains include Mental Functions (b1), Sensory Functions and Pain (b2), Voice and Speech Functions (b3), Functions of the Cardiovascular/Haematological/Immunological/ Respiratory systems (b4), Functions of the Digestive, Metabolic, and Endocrine systems (b5), Genitourinary and Reproductive functions (b6), Neuromusculoskeletal and Movement-related Functions (b7), Functions of the Skin and Related Structures (b8).
In the "Activities and Participation" component (d): Learning and Applying Knowledge (d1), General Tasks and Demands (d2), Communication (d3), Mobility (d4), Self-Care (d5), Domestic Life (d6), Interpersonal Interactions and Relationships (d7), Major Life Areas (d8), Community, Social, and Civic Life (d9)
For the "Environmental Factors" component (e): Products and Technology (e1), Natural Environment and Human-Made Changes to Environment (e2), Support and Relationships (e3), Attitudes (e4), Services, Systems, and Policies (e5).
For the "Body structures" component (s): Structures of the Nervous System (s1), The Eye, Ear, and Related Structures (s2), Structures Involved in Voice and Speech (s3), Structures of the Cardiovascular, Immunological, and Respiratory Systems (s4), Structures Related to the Digestive, Metabolic, and Endocrine Systems (s5), Structures Related to the Genitourinary and Reproductive Systems (s6), Structures Related to Movement (s7), Skin and Related Structures (s8).

Categories: These are more specific units within the domains that further define in detail particular aspects of functioning or contextual factors. For example, within the domain of "Self-Care (d5)," categories are: Washing oneself (d510), Caring for body parts (d520), Toileting (d530), Dressing (540), Eating (d550), Drinking (d560), Looking after one's health (d570), Self-care, other specified (d598), Self-care, unspecified (d599).

3.2 Use of Qualifiers in the ICF

Qualifiers are an essential feature of the ICF, providing a standardized way to measure the extent of impairment, activity limitation, or participation restriction. They are numerical codes that indicate the severity or extent of a problem.

There are different qualifiers for the Body Functions and Structures, and for the Activities and Participation.

Qualifiers for Body Functions and Structures:
This 7-point scale measures the presence and severity of an impairment. The following qualifiers are used:

- **0**: No problem (0–4%)
- **1**: Mild problem (5–24%)
- **2**: Moderate problem (25–49%)
- **3**: Severe problem (50–95%)
- **4**: Complete problem (96–100%)
- **8:** Unspecified
- **9:** Not applicable

For Body Structures, an additional qualifier is used to describe the nature of the structural change, while a third qualifier specifies the location of the impairment. The nature of the change is classified as follows: 0 (no change), 1 (total absence), 2 (partial absence), 3 (extra part), 4 (abnormal dimensions), 5 (discontinuity), 6 (misalignment), 7 (qualitative structural changes, including fluid accumulation), 8 (unspecified), and 9 (not applicable).

Qualifiers for Activities and Participation:
A negative and positive scale assess both barriers and facilitators, indicating the degree of influence a factor has.
Barriers are rated as follows:

- 0 (no barrier),
- 1 (mild barrier),
- 2 (moderate barrier),
- 3 (severe barrier),
- 4 (complete barrier),
- 8 (unspecified barrier),
- 9 (not applicable).

Facilitators are rated with a positive scale:

- +0 no facilitator,
- +1 is a mild facilitator,
- +2 is moderate,
- +3 is substantial,
- +4 is a complete facilitator,
- +8 is a facilitator unspecified.

Qualifiers can also denote the extent to which environmental factors act as barriers or facilitators. For example, a supportive family environment might be coded as a facilitator, while inaccessible public transport could be a barrier. This nuanced coding system allows healthcare professionals to capture the complexity of functioning and disability in a standardized way, facilitating communication and comparison across settings.

The qualifier scale for activities and participation can be further defined using two key constructs: 'performance' and 'capacity'. These concepts help assess how a person's environment affects their

ability to engage in activities and participate in daily life, as well as how modifying the environment could enhance their functioning.

- **Capacity** refers to what an individual is capable of doing in a standardized setting, often assessed in a clinical environment.
- **Performance** reflects what the person actually does in their everyday environment.

The difference between capacity and performance highlights the impact of environmental factors on functioning. This gap serves as an indicator of potential environmental changes that could enhance an individual's performance.
Additionally, several optional qualifiers can provide further insights, such as evaluating performance without assistance and capacity with assistance, which are particularly relevant in institutional settings. In the future, a qualifier for involvement or subjective satisfaction in activities and participation may also be introduced.

3.3. ICF coding system

As you might have noticed, each layer of the ICF has its own code forming an alphanumeric code. The deeper you go in the hierarchy, the longer and more specific the code becomes:

- First level (Component): These are represented by a single letter (b, s, d, or e) followed by a single digit, indicating the broadest category.
- Second level (Domain): A second digit is added to specify a more detailed category within the broad group.
- Third Level (Categorie): A third digit further refines the classification.
- Fourth Level: A fourth digit provides an even more precise description of the function, structure, activity, or environmental factor.

Example of how the code extends:

- *b1* → Mental functions
- *b110* → Consciousness functions
- *b1102* → Reduced consciousness

- The last digit(s) in an ICF code is the qualifiers, it quantifies the severity of an impairment, difficulty, or influence.
- Additional digits can specify structural changes, location, or level of assistance.
- Environmental factors use positive values (+) for facilitators and neutral/negative values for barriers.

Example of how the qualifier is used:

- *d450.3* → Indicates a severe difficulty in walking (*d450* = *Walking*).
- *e150+3* → Indicates a substantial facilitator (*e150* = *Design, construction, and technology of buildings*).

3.3 Use Case: ICF in Rehabilitation

The ICF is widely used in rehabilitation to guide assessment, goal-setting, and intervention planning. By using the ICF, the team ensures a holistic and patient-centered approach, addressing not just medical needs but also social and environmental factors.

Consider a patient recovering from a stroke:

- Assessment: Using the ICF framework, the rehabilitation team assesses impairments in body functions (e.g., reduced muscle strength) and activity limitations (e.g., difficulty walking). They also evaluate participation restrictions, such as the inability to return to work, and contextual factors like family support or workplace accessibility.
- Goal-setting: Goals are framed in terms of improving functioning, such as regaining independence in self-care activities or enhancing mobility.
- Intervention: Interventions are tailored to address the identified issues, such as physiotherapy to improve strength, occupational therapy to modify the home environment, and counseling to address emotional well-being.

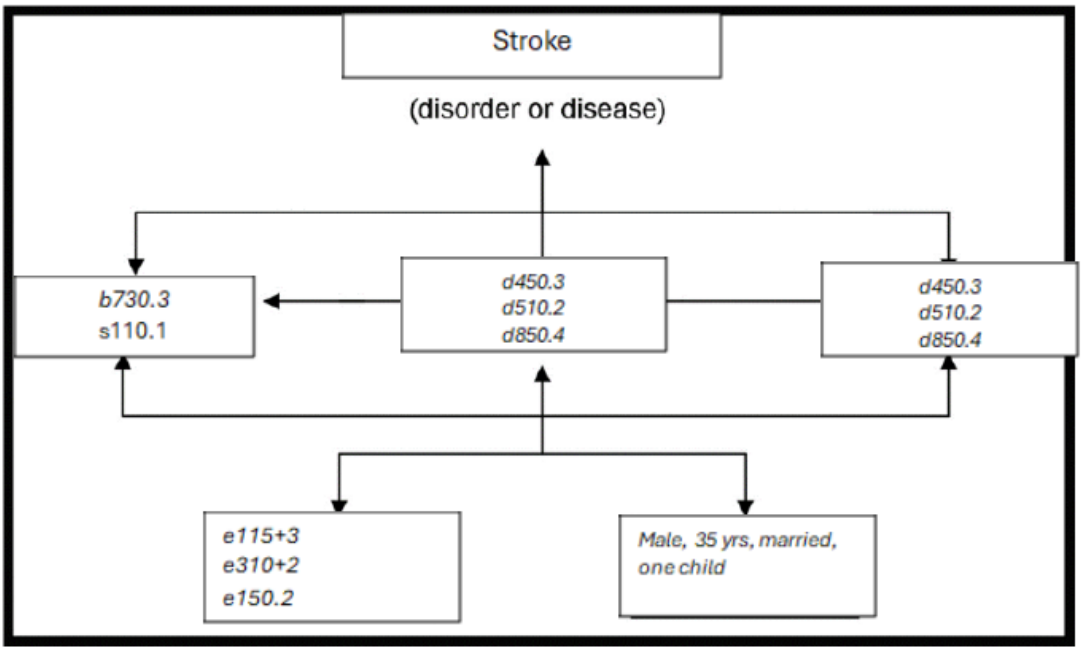


Figure 2. An example of a use case in the ICF

Legend:
b730.3 – Severe impairment in muscle power functions
s110.1-Mild impairment in brain structure
d450.3 – Severe difficulty walking.
d510.2 – Moderate difficulty with self-care tasks, such as dressing.
d850.4 – Complete restriction in employment (unable to return to work).
e115+3 – Substantial facilitator: use of assistive products for mobility (e.g., a walking aid).
e310+2 – Moderate facilitator: family support aiding in daily activities.
e150.2 – Moderate barrier: inaccessible workplace environment

3.4 Conclusion

The ICF is a framework that has transformed how health and disability are understood and addressed. Its comprehensive structure, emphasis on contextual factors, and standardized use of qualifiers make it an invaluable tool across healthcare disciplines. In rehabilitation, it fosters a holistic and client-centered approach, ensuring that interventions are tailored to the unique needs and circumstances of each individual. As healthcare systems continue to evolve, the ICF remains a cornerstone for promoting inclusive and effective care.

3.5 Links

ICF browser: https://apps.who.int/classifications/icfbrowser/
WHO-FIC classifications with Dutch ICF browser: https://class.whofic.nl/

Appendice 6: Presentation – ICF for a Lay Audience

Some relevant slides are shown below. The full presentation is also available.

FACULTEIT GENEESKUNDE EN GEZONDHEIDSWETENSCHAPPEN

VAKGROEP REVALIDATIEWETENSCHAPPEN
ONDERZOEKSGROEP ERGOTHERAPIE

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH

Dr. Ellen Cruyt, Dr. Stijn De Baets, Prof Dr. Dominique Van de Velde

UNIVERSITEIT GENT

INTRODUCTION:

- The ICF has become an **internationally-accepted** standard for **classifying** and **assessing** functioning (WHO),
- There has been a push for its **implementation in rehabilitation, in healthcare and welfare** (Guttenbrunner, 2015).
- It facilitates **comparisons** of health and health-related data within and **across rehabilitation settings** (and beyond) (Cieza, 2014).

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21/11/2025

World Health Organization. WHO Global Disability Action Plan 2014-2021: Better health for all people with disability. Sixty-seventh World Health Assembly 4 April 2014: World Health Organization; 2014; Available from: http://www.who.int/disabilities/actionplan/en/.
3. Gutenbrunner C, Negrini S, Kiekens C, Zampolini M, Nugraha B. The Global Disability Action Plan 2014-2021 of the World Health Organisation (WHO): a major step towards better health for all people with disabilities. Chance and challenge for Physical and Rehabilitation Medicine (PRM). Eur J Phys Rehabil Med. 2015;51(1):1-4.
Cieza A, Oberhauser C, Bickenbach J, Chatterji S, Stucki G. Towards a minimal generic set of domains of functioning and health. BMC Public Health. 2014;14(1):218.

GHENT UNIVERSITY
RESEARCH GROUP OCCUPATIONAL THERAPY

SNOClass

GHENT UNIVERSITY

GEZONDHEID: PARADIGMASHIFT VAN EEN MEDISCH NAAR EEN BIO-PSCYHO-SOCIAAL MODEL.

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Gezondheid – WHO - 1948

- ***"Health** is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (1948)*
- *"**Gezondheid** is een toestand van volledig lichamelijk, geestelijk en maatschappelijk welzijn en niet slechts de afwezigheid van ziekte of andere lichamelijk gebreken."*

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Naar een meer dynamische DEFINITIE VAN GEZONDHEID?

- Gezondheid = **mogelijkheid om zich aan te passen aan veranderende eisen op sociaal, lichamelijk en emotioneel vlak.**
- Dwz. niet de aandoening/ziekte (of afwezigheid ervan) staat centraal maar wel het **aanpassingsvermogen** van personen en het vermogen tot **zelfmanagement** wanneer men te maken krijgt met problemen en uitdagingen op sociaal, lichamelijk en emotioneel gebied.
- Veranderd perspectief op interventies van medici, paramedici en anderen van zorg naar **ondersteuning van zelf-management** (door coaching persoon / omgeving).
- **NOOD AAN EEN SYSTEEM DAT DAAR AAN VOLDOET: een bio-psycho-sociaal kader, met als voorbeeld de ICF**

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HET CONCEPTUEEL KADER: DE ICF

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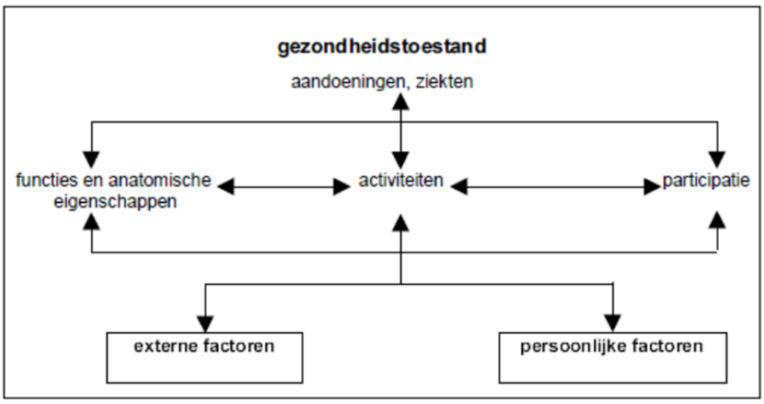
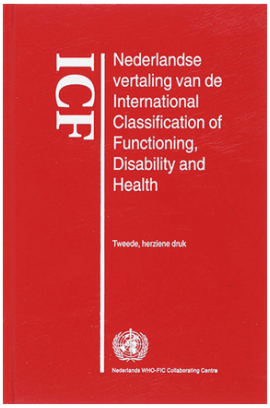
De ICF: Een classificatiesysteem op basis van een bio-psycho-sociaal model





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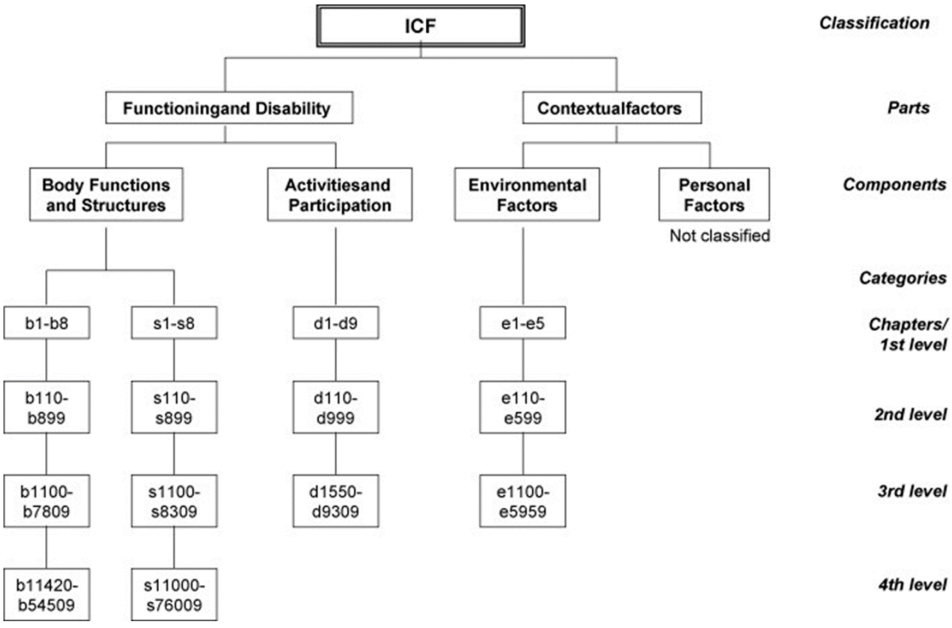

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EEN VOORBEELD VAN FUNCTIES

- **Categorie b134:** slaap
- **Beschrijving**: Algemene mentale functies gerelateerd aan het zich periodiek, reversibel en selectief fysiek en mentaal terugtrekken uit de eigen onmiddellijke omgeving, hetgeen gepaard gaat met karakteristieke fysiologische veranderingen.
- **Eenvoudige intuïtieve beschrijving:** patroon, kwaliteit en hoeveelheid slaap

b134.**0** GEEN stoornis (geen, afwezig,, ...) 0-4%
b134.**1** LICHTE stoornis (gering, laag, ...) 5-24%
b134.**2** MATIGE stoornis (tamelijk, ...) 25-49%
b134.**3** ERNSTIGE stoornis (aanzienlijk, hoog, ...) 50-95%
b134.**4** VOLLEDIGE stoornis (totaal, ...) 96-100%

b134.**8** niet gespecificeerd
b134.**9** niet van toepassing

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b134.**4** VOLLEDIGE stoornis (totaal, ...) 96-100%

b134.**8** niet gespecificeerd
b134.**9** niet van toepassing

b134.3

EEN VOORBEELD VAN ACTIVITEITEN EN PARTICIPATIE

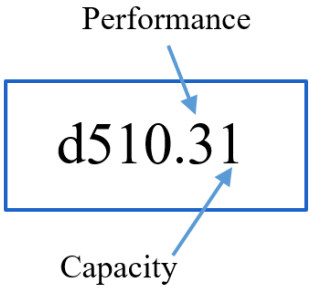
- **Categorie d510:** zich wassen
- **Beschrijving**: Wassen en afdrogen van het gehele lichaam, of lichaamsdelen, met gebruik van water en geschikte was- en droogmaterialen of methoden, zoals baden, douchen, wassen van handen en voeten, gezicht en haar, en met een handdoek drogen
- **Eenvoudige intuïtieve beschrijving:** Zich wassen en afdrogen (bijvoorbeeld het gehele lichaam, lichaamsdelen of haar).

d510.0 GEEN beperking/participatieprobleem 0-4%
d510.1 LICHTE beperking/participatieprobleem 5-24%
d510.2 MATIGE beperking/participatieprobleem 25-49%
d510.3 ERNSTIGE beperking/participatieprobleem 50-95%
d510.4 VOLLEDIGE beperking/participatieprobleem 96-100%
d510.8 niet gespecificeerde beperking/participatieprobleem
d510.9 niet van toepassing

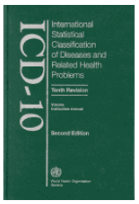
EEN VOORBEELD VAN ACTIVITEITEN EN PARTICIPATIE

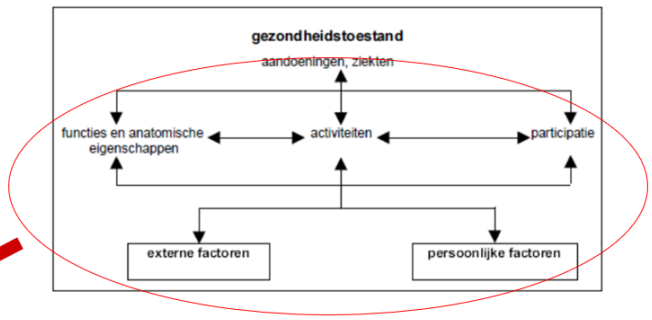
- **Categorie d510:** zich wassen
- **Beschrijving**: Wassen en afdrogen van het gehele lichaam, of lichaamsdelen, met gebruik van water en geschikte was- en droogmaterialen of methoden, zoals baden, douchen, wassen van handen en voeten, gezicht en haar, en met een handdoek drogen
- **Eenvoudige intuïtieve beschrijving:** Zich wassen en afdrogen (bijvoorbeeld het gehele lichaam, lichaamsdelen of haar).

d510.0 GEEN beperking/participatieprobleem 0-4%
d510.1 LICHTE beperking/participatieprobleem 5-24%
d510.2 MATIGE beperking/participatieprobleem 25-49%
d510.3 ERNSTIGE beperking/participatieprobleem 50-95%
d510.4 VOLLEDIGE beperking/participatieprobleem 96-100%
d510.8 niet gespecificeerde beperking/participatieprobleem
d510.9 niet van toepassing



De ICF: Een classificatiesysteem op basis van een bio-psycho-sociaal model





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Domeinen van activiteiten en participatie	
1	Leren en toepassen van kennis
2	Algemene taken en eisen
3	Communicatie
4	Mobiliteit
5	Zelfverzorging
6	Huishouden
7	Tussenmenselijke interacties en relaties
8	Belangrijke levensgebieden
9	Maatschappelijk, sociaal en burgerlijk leven

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Oefenen?

- https://www.icf-elearning.com/wp-content/uploads/articulate_uploads/ICF%20e-Learning%20Tool_V3%20-%20Storyline%20output/story.html

ICF Research Branch

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