Learning from others - CIMs

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Inhoudsopgave

Executive summary

This study provides valuable insights from interviews with various countries on their approaches to clinical information modelling (CIM) and the use of standards such as HL7-FHIR and openEHR. The findings are intended to guide and strengthen the Dutch zib-transition and guide strategic decisions aligned with international developments.

1. International approaches and collaboration

- Most countries acknowledge the importance of structured clinical information models, but implementation strategies vary significantly due to differences in legislation, healthcare governance, and historical IT investments.
- Countries such as Canada, the Czech Republic, and Estonia have expressed interest in international collaboration in this area.
- There is a shared belief that modelling in HL7-FHIR and/or openEHR should ideally be done through international cooperation.

2. Use of HL7-FHIR and openEHR

- Some countries (e.g., Sweden and Estonia) are shifting towards FHIR due to adoption challenges with openEHR.
- Others (e.g., Norway, the UK, and Finland) are combining openEHR for data storage with FHIR for external interoperability.
- Finland is seen as a frontrunner thanks to its integrated approach supported by legislation, vendor engagement, and national training and awareness campaigns.

3. Positive perception of the Dutch approach

- The Dutch strategy of using conceptually neutral, implementation-independent logical models is positively viewed internationally.
- The separation between data capture (registration) and data exchange is seen as forward-thinking and well-structured.

4. Importance of flexibility and local applicability

- International experience underscores the need for models that support both standardization and adaptability.
- In healthcare systems where institutions have significant autonomy (the Netherlands), national data storage standards should be designed in a way that promotes consistency and interoperability, without restricting the ability of local organizations to innovate or manage their care processes independently.

5. Challenges in stakeholder engagement and resourcing

- Many countries struggle to involve clinicians and policymakers in the modelling process, especially when using complex tools like UML.
- Countries such as Finland, the Czech Republic, and Australia have adopted creative and accessible methods like mindmaps, Excel-based models, and lightweight training programs to improve engagement.
- Having large contested models decreases the uptake
- Sustainable funding and long-term stakeholder involvement are key to success. Finland is seen as a strong example of structured national investment and coordination across legal, technical, and vendor domains.

6.Relevance for the Netherlands

- The insights from this study can help shape the Dutch zib 2.0 transition.
- By learning from international best practices and seeking collaboration with international Standards Development Organizations (SDOs) and other countries, the Netherlands can further strengthen its digital health infrastructure.
- It is essential to maintain a balance between standardization, practical usability, and adaptability within the Dutch healthcare system.

Conclusion:

The importance of structured clinical information models is broadly acknowledged. The Dutch zib strategy stands to benefit greatly from international experiences, provided it is implemented with attention to national context, collaboration, and sustained stakeholder engagement.

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Introduction

The Dutch Ministry of Health, Welfare and Sport found that the reuse of information in Dutch healthcare, despite the use of Dutch clinical modelling principles, was falling short of expectations. In 2022, they therefore commissioned a study into the challenges in the implementation of the clinical models, called zibs, for the reuse of healthcare information in the Netherlands. This study revealed over 50 findings divided into 6 themes[1]. Based on these results, Nictiz was asked to shape the so-called 'zib-transition'[2] based on a transition approach in order to find solutions for the identified problems[3]. One of the deliverables of the zib-transition is advice to the Ministry of Health on the positioning and future vision for the zibs in relation to international standards. In this advice, Nictiz has outlined a vision and positioning for the zibs, which can be summarized as outlined below.

Clinical information models, such as healthcare information building blocks (zibs), are essential for digital information exchange in Dutch healthcare. They ensure that healthcare data is recorded in a uniform, structured way, making it easier to share, interpret, and reuse across different systems, organizations, and settings. By using a shared language and consistent data definitions, zibs reduce ambiguity, support interoperability, and enable better continuity of care, clinical decision-making, and secondary use of data. The usability of zibs increases through more intensive use and collaboration with common international standards such as openEHR and HL7-FHIR. The Ministry of Health, Welfare and Sport is advised to focus on harmonizing zibs with international standards and more intensive collaboration with the organizations behind these standards. Zibs must be further developed into information models containing the Dutch agreements for the application of international standards, so-called zibs2.0. A migration strategy for zibs is needed to realize this further development. Zibs will remain important for the coming years to support data availability in the Netherlands. The further development of zibs, based on international models (zibs2.0), will determine developments in healthcare IT systems. The report refers to the need to distinguish between data processing and data exchange, since these are different processes with different needs. This approach aims to create a structured, implementation-neutral model for healthcare information. From a technical point of view a distinction is made between healthcare data registration/storage (persistence) and data exchange. Different technical standards are available for these two processes (openEHR for registration and storage and HL7-FHIR for data exchange). Questions have arisen regarding this distinction between capturing data versus exchanging data, and whether this is really needed? Stakeholders in the Netherlands are questioning whether this approach is a very Dutch thing and whether the added value is sufficient.

To gain a deeper understanding of how other countries are modelling healthcare information, how they are using these models, and which standards they use, the Nictiz ‘Learning from’

[1] 2 https://www.rijksoverheid.nl/documenten/rapporten/2022/12/15/melius-helath-informatics-transitieplan-van-zib-compliance-naar-hergebruik-van-zorginformatie

[2] Zib is Dutch for zorginformatiebouwsteen and can be translated as healthcare information model (HCIM)

[3] Zib-transitie

team was asked to conduct a comparative study of international approaches to CIMs, including their experience with FHIR and/or openEHR.

This research builds on previous *Learning from other countries*[4] and *Learning from other sectors*[5] initiatives by Nictiz, which explored how different countries and industries address data standardization and interoperability. Previous topics were personal health records, national testing strategy, and national agency.
This study focuses on how various national health systems structure their clinical information models, whether they separate data registration/data persistence from data exchange, and how they govern the adoption of standards like FHIR and openEHR. The research also aims to uncover the challenges different countries face when implementing these models and to identify best practices that could improve the Dutch approach.

[4] Rapport learning from other countries: *Learning from other countries*
[5] Rapport learning from other sectors: Learning from other sectors

Scope and Methodology

The research was conducted through a combination of desk research and structured interviews with healthcare experts and policymakers from seven countries: Sweden, the United Kingdom, Estonia, Norway, Canada, Australia, Germany, Finland and Czech Republic. These countries were selected based on their advanced healthcare IT infrastructures, diverse approaches to clinical data modelling, and ongoing initiatives related to FHIR and openEHR. Additionally, we had pre-existing connections with professionals from most of these countries within our network, which facilitated data collection.

The interviews included representatives from government agencies, standardization bodies, academic institutions, and industry stakeholders, ensuring a comprehensive view of national strategies and implementation challenges.

The main talking points of the interview were:

- Do countries have clinical information models? If so, what place do these have in the landscape of health data exchange?
- Do these countries embrace the vision of the importance of making a distinction between data capture/persistence and data exchange?
- What is the uptake of these models/standards, and is adherence voluntary or mandated?
- Do they employ centralized or decentralized methods for clinical data management?
- What standards are used in health data exchange?
- Have national choices been made for the way data is stored? If so, what standards have been chosen for the storage of data?
- How do other countries and projects use FHIR and openEHR in relation to CIMs?

What challenges do they encounter in harmonizing clinical information models across different healthcare providers and regions?

Results

Sweden – ehalsomyndigheten

Context and Approach: Sweden operates within a decentralized, regional government model, where healthcare management is delegated to self-governing regions. These regions fund their healthcare services primarily through locally collected taxes, with minimal national funding. While there is a national framework for healthcare policies, the Swedish healthcare structure allows significant regional autonomy, which can complicate data standardization. Recently, Sweden has started initiatives such as an interoperability board, aimed at fostering collaborative projects and addressing these challenges.

There is a difference between data capturing and data sharing. Data capture and persistence are different requirements compared to sharing data. From the standpoint of the government agency, the ability to share data is the main concern, for primary as well as for secondary use. A lot of vendors do use openEHR, and a major vendor has pledged to move towards openEHR. The ultimate architecture for projects going forward is that Sweden manages the data exchange using HL7 FHIR and captures data in openEHR. One of the reasons why the focus was mostly on the exchange of data is because there is a clear mandate for parties when reporting to registries. Over decades Sweden has had a national patient summary (PS) and procedures for electronic prescription. The national PS contains different datasets, is collected from different sources and contains a lot of free text. As all organizations are doing their own thing on clinical modelling, standardizing data collection is difficult.

For the time being, vendors in Sweden will not be prescribed how to organize their data model, but advice can be given on how to standardize. It is important that data that is written down is done well. It doesn't make sense from an architectural standpoint to store the same data three times. There used to be a Swedish version of zibs called NIMs. The uptake was zero. In Sweden a more methodological approach was tried, starting with process modelling, then concept modelling, and increasing the level of detail further down in the process. The negatives of this process were the amount of time it takes and reaching consensus with the large amount of variation that exists between healthcare professionals. The primary problem in Sweden is coordination. Collaboration platforms were started 3-4 months ago, consisting of stakeholders from different health regions, SDOs like HL7 and openEHR, vendors, and academia, with the goal of creating standard artefacts and joint prioritization.

One issue might be that building blocks are used, but there is no overarching conceptual model that describes the concepts. They might not mean the same thing in different places. An overarching model, tying the concepts together, would be ideal.

Perspective on zibs and Future Vision: Sweden sees potential in the clinical information modelling methodology as an approach to bridging clinical and technical domains. They acknowledge the Dutch system's clear vision on persistent data storage and exchange, but point out that regional differences in data registration could hinder direct adoption. Sweden is currently focused on HL7 FHIR for data exchange and openEHR for data storage, aiming to develop a technology-neutral architecture that aligns with both. However, they are cautious about applying zibs on a national scale due to concerns around local adaptability and the substantial variability across healthcare providers. Sweden's future vision includes exploring how technology-neutral solutions like zibs could play a role, while prioritizing collaborative efforts among healthcare regions to enhance interoperability and data continuity.

United Kingdom - CHIME, UCL

Context and Approach: The UK's National Health Service (NHS) is divided into trusts that have historically used their own, localized solutions. Recently, there has been an increased push for national standardization, driven by a desire for more integrated data sharing across the NHS. Several initiatives, such as collaborative cancer projects and regional networks, have aimed at improving data exchange. The NHS has been moving towards incorporating openEHR and FHIR standards as part of its broader goal of achieving consistent interoperability. The Professional Record Standards Body (PRSB) has been central to this initiative, working to develop standards for clinical records that balance precision with broad applicability across different types of clinical data.
The PRSB sits in the same space as the zibs. Clinicians are encouraged to take ownership of these building blocks, which are implementation-neutral, have a minimal reference model, and (try to) follow ISO13606. The PRSB is a mixture of well- and poorly modelled entities, with ART-DECOR being utilized as tooling. Initial drafts are constructed using background research, but big webinars are needed to tighten up the models. This allows for the creation of a generic model and codes like SNOMED. GP systems are very SNOMED-driven and dependent. When consulting vendors about the SNOMED codes to be used, the question often becomes which SNOMED codes are, or could be expected to be, used in systems.
The concrete models in FHIR (condition/medication/allergies) are quite similar to openEHR. openEHR is bending towards FHIR, with the biggest difference being observation/questionnaire, which are very generic. openEHR FHIR collaboration should enable the use of openEHR and concrete models for end-of-life models. The FHIR logical model is where this can come together. Clinical modelling in openEHR is preferred because it has tight-focused scripts, asynchronous work capabilities, great archetypes, and excellent tools.

Perspective on zibs and Future Vision: The UK perceives technology-agnostic logical models as promising models for creating standardized, implementation-neutral healthcare data structures that can unify clinical and technical fields. The NHS recognizes the potential of zibs to establish a “single source of truth” in data management, which aligns with their goal of a unified healthcare information model. However, there is awareness that achieving this in practice is complex, especially given the need to integrate various existing standards. The UK envisions a hybrid model where FHIR logical models are combined with zibs and PRSB standards, allowing them to better address clinical needs while facilitating interoperability. The NHS also aims to strengthen its approach by fostering alignment between the openEHR and FHIR communities, ultimately looking to achieve more seamless data flow across the healthcare spectrum.

Estonia – TEHIK

Context and Approach: Estonia launched its national health information system, ENHIS, in 2008. Initially based on CDA documents, the system is now transitioning to FHIR to facilitate more modular and real-time data exchange. Estonia's healthcare information framework integrates several key national systems, such as the patient portal, which allows patients to access their health records and manage their healthcare online; the eBooking system, which enables online scheduling of medical appointments; and the Social Insurance Fund, responsible for managing health insurance and social welfare benefits. While the connection to ENHIS is standardized, hospitals, GP, and other healthcare sectors are free to choose their own solutions. Recognizing the limitations of their document-based approach, Estonia has prioritized moving to an event-based, open-source architecture. This new direction is designed to enable better interoperability, near real-time data exchange, and enhanced flexibility in meeting healthcare providers' data needs. Estonia is conducting business analyses of CDA documents, transforming these into business models, and then using these models to create FHIR standards. Information models connect the world of clinicians and technology, making a difference in the saving and exchange of data, and require a description of models in between.
Estonia finds technology-agnostic modelling more promising than the openEHR methodology due to its shortcomings in some areas. Data models should be wider and more usable than the openEHR offers. Different mapping tools are being considered to integrate solutions into the database, ensuring that core data is built up properly. The transition from CDA to FHIR is aimed at moving from more free text to more structured data. Efforts are also being made to make information models machine-readable, with consideration given to the use of FHIR logical models.

Perspective on zibs and Future Vision: Estonia finds the zibs conceptually valuable for developing interoperable data models that can bridge clinical and technical requirements. However, there is some scepticism regarding logical models' applicability to their specific context, as Estonia has adopted FHIR as the preferred model for data exchange and views openEHR as somewhat limited. Estonian stakeholders see the need for a broader, more flexible data infrastructure that surpasses the capabilities offered by logical models, focusing on national consistency while remaining adaptable to international standards. Estonia's approach emphasizes the importance of clinician input in developing these models and envisions a future where data structures are built to accommodate both national and cross-border interoperability. Since there is no standard for information modelling. We need a modelling community on an international level. It is not a good idea to have a lot of different choices in modelling.

Norway - Helse Vest IKT

Context and Approach: Norway's healthcare system is structured locally and regionally, with regional authorities managing hospitals and municipalities overseeing primary care like general practices. This structure creates a fragmented environment, especially since Norway has over 300 municipalities, many of which are too small to implement sophisticated data systems independently. In this context, openEHR is prioritized for clinical data storage, while HL7 standards are used for administrative and demographic information. Clinical modelling involves 10-15 full-time equivalents (FTEs) who are mostly sourced from hospitals. The governance process includes national and international collaboration with an editorial board to ensure the quality and standardization of archetypes. The number of people involved in this work is growing, with additional individuals assisting with governance and review. Clinicians participate in the review process, utilizing tools like mindmaps and tables to facilitate their involvement, ensuring that models meet clinical needs. Legacy data exchange remains limited and is mainly conducted vertically between hospitals and specialized care providers. Since most patients stay within the same municipality when consulting care, widespread data sharing is not a significant problem. Though the system currently does not support extensive data sharing, trials are ongoing to establish structured and standardized data registries. The legacy method involved sending data to registries via paper forms; now it is done through web forms, making it one of the world's most expensive copy-paste processes.

Perspective on zibs and Future Vision: Norway appreciates zibs as a potential approach to clinical data modelling, but emphasizes that openEHR is better suited to their national needs for data storage. For Norway, zibs offer a pathway towards standardized clinical functionality, but they believe a more cohesive openEHR-based system will provide better consistency and scalability. The Norwegian approach to future data management involves focusing on a seamless, interoperable clinical information infrastructure, particularly within hospital systems, while considering zibs as a supplementary tool that might enhance interoperability in specific cases. Norway envisions a gradual integration of international standards to enhance their national system, with openEHR remaining a core component for clinical data management.

Canada - Canadian Institute for Health Information (CIHI)

Context and Approach: Canada's approach to healthcare data standardization is structured around the Pan-Canadian Health Data Content Framework, led by the Canadian Institute for Health Information (CIHI). This framework aims to unify data standards across provinces, focusing on interoperability and the development of common core data models in tandem with Fast Healthcare Interoperability Resources (FHIR). Canada Health Infoway is building the FHIR specifications, and the framework includes a collaborative workspace called InfoCentral, which allows users to download draft data architecture artifacts. This collaborative approach ensures that data architecture is developed with input from various stakeholders, including business and technical experts. The framework also emphasizes the importance of separating data storage persistence and data exchange, ensuring that different standards are used for different purposes. Starting with a conceptual model that outlines high-level concepts, attributes, and their relationships is beneficial. However, initially, the logical model was reverse engineered to create the conceptual model.

Professionals are consulted using PowerPoint, and sometimes Excel, to support conversations regarding data elements and value sets. Positioning passionate group members as experts helps involve them in the co-creation process. This collaborative approach fosters a sense of involvement and motivation. Canada faces challenges related to data fragmentation due to its reliance on various vendors and a non-governmental, collaborative approach to data management. The framework includes the Common Core Data for Interoperability (CACDI) initiative, which defines essential data elements to support seamless data sharing across provinces and healthcare providers.

Perspective on zibs and Future Vision: Canada sees the zib vision (distinction between persistence and exchange) and methodology as a valuable model for facilitating international interoperability, especially in achieving standardized data content that meets both clinical and administrative needs. Canada's approach emphasizes the separation of data storage and data exchange, with FHIR serving as the preferred model for data exchange. The zib approach is being considered as part of Canada's ongoing efforts to align with international standards, while balancing the specific needs of their national data infrastructure. Canada envisions a future where neutral logical models might play a role in supporting data consistency across provinces, complemented by a robust governance model to maintain alignment with CIHI's interoperability goals.

Australia - Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Context and Approach: Australia has been actively developing a National Digital Health Strategy, which includes a focus on implementing FHIR as the primary data exchange standard with Sparked, the initiative for accelerating FHIR. Strong support from both industry and government has been observed for this strategy, with major international vendors playing a key role. The industry suggested to the government to adopt FHIR, as vendors had already started implementing FHIR due to global sensibilities. This convergence between government and vendors has proven beneficial. Besides the use of FHIR, Australia is also looking at the Australian Core Data for Interoperability (AUCDI). Meetings are organized where over 100 individuals from across the healthcare sector — including healthcare professionals, vendors, and government employees — gather to provide input on clinical models. These discussions between clinicians and vendors have been highly valuable, as the technical community benefits greatly from consulting with clinicians while making profiles. For example, technical provisions included an option for 'test for menstruation,' which is not common practice in healthcare. Mindmaps are utilized to facilitate these meetings, focusing on the data clinicians need and prioritizing development accordingly. Once the necessary data is assessed, technical teams can begin using or developing FHIR resources. Vendors participate in both the clinical and the technical developments to help bridge the gap. openEHR incorporates clinical input and shares the benefits with national bodies and clinicians. Using openEHR archetypes as the basis and creating mindmaps to define minimal data sets have proven beneficial. The community remains motivated by ensuring that the initial model contains non-contentious elements and gradually introducing more complex components.

Perspective on zibs and Future Vision: Australia recognizes technology-agnostic clinical information modelling as a useful tool for bridging the gap between data storage and data exchange, especially as they work towards implementing interoperability standards at a national level. The Australian Core Data for Interoperability (AUCDI) serves as a foundational dataset for FHIR-based interoperability, which aligns with Australia's vision of standardized clinical data that supports efficient data sharing. Technology-independent clinical models are viewed as a promising addition that could complement FHIR by providing a more structured approach to clinical data modelling. Australia's vision includes a balanced model where FHIR handles the exchange of data, while openEHR or similar structures could enhance data consistency, helping to meet both clinical and technical needs in a comprehensive digital health framework.

Finland

Context and Approach: Finland has a long-standing national document-based sharing infrastructure, *Kanta*, which has been operational since 2010. Through this system, both public and private healthcare providers can share clinical documents — primarily CDA-based — across organizations, given patient consent. The legal framework in Finland strongly supports this data-sharing model, providing a solid foundation for interoperability. While the core infrastructure is document-centric, Finland is actively modernizing its ecosystem by integrating FHIR wrappers and exploring more structured forms of data exchange.
In parallel, Finland has seen a significant uptake of openEHR. There are currently over 15 openEHR clinical data repositories in use, many of which originated from vendor-driven initiatives. Tietoevry, Finland's dominant EHR vendor, plays a major role in this ecosystem by promoting open platforms that span both health and social care. Finland's unique approach includes merging clinical and social data under a unified openEHR-based infrastructure, supporting both storage and secondary use of data.
The country is also taking steps to gradually transform legacy systems into openEHR-based platforms, often using implementation guides developed by consultancy firms. Innovation centres play a key role in encouraging adoption and vendor collaboration. Awareness and education are central to the Finnish approach; large-scale training sessions and awareness courses have been developed, including online e-learning formats, to involve healthcare professionals, vendors, and even policymakers in openEHR adoption.
Finland's modelling strategy is practical and iterative. Modellers often start with international archetypes, localize them via templates for national use cases, and escalate missing elements to openEHR International where possible. However, in practice, local additions are sometimes necessary to keep pace with implementation needs. Finland's modelling community works under the umbrella of HL7 Finland, fostering collaboration across FHIR and openEHR domains. Increasingly, openEHR is being used for modelling wellness data, PREMs, PROMs, and personal health data, with a strong push to involve clinicians in the process.

Perspective on zibs and Future Vision: Finland views the Dutch approach to CIMs positively as it has the ambition to standardize clinical information across diverse care domains. There is an ongoing effort by Finnish stakeholders — particularly the national institute THL — to map their own national "zibs" to openEHR templates, including areas like vaccinations. This mapping has shown that queries and data retrieval are more efficient with openEHR's structure. Finland appreciates the idea of neutral, reusable information models, but highlights that clarity is needed about what constitutes a zib — particularly whether it refers to a conceptual model or a technical implementation (e.g. template).
The future vision in Finland includes tighter integration of openEHR and FHIR, with each fulfilling complementary roles: openEHR for structured storage and internal data management, and FHIR for interoperability and external exchange. Finland's Valo project, which is part of its preparation for the European Health Data Space (EHDS), leverages OMOP for secondary data use and cohort identification. THL is actively working to align quality register data collection with OMOP, noting that a common openEHR foundation across source systems would simplify mappings and enhance data consistency.
Finland's three key success factors are legal readiness, strong vendor engagement, and widespread awareness of standards. These elements have enabled broad experimentation, from Nordic openEHR hackathons to national training programmes used in over 20 countries. Finland's experience underlines the importance of involving clinicians in modelling processes

and building trust through clear education and inclusive governance structures. While the path has had challenges, the country continues to move towards a modern, open, and interoperable health IT infrastructure — where zib-like models could serve as a bridge between national consistency and international alignment.

Germany - GEMATIK

Context and approach: Germany employs a decentralized approach to clinical information modelling. The country follows an agnostic modelling approach that is not initially bound to FHIR or any specific standard, allowing subject matter and modelling experts to define concepts before FHIR teams create implementation guides. While some hospitals experimented with openEHR, most transitioned to FHIR due to the nationwide infrastructure supporting FHIR-based data exchange. However, there is no central governance around FHIR, leading to competing FHIR profiles and implementation guides from different sources, which makes harmonization challenging. Governance is split between different authorities, with GEMATIK overseeing hospital environments and KBV regulating aspects of primary care. Although Germany has adopted R4 for interoperability, European-level developments in R4/R5 will have a significant impact on future strategies. The electronic patient case file (EPA) serves as a patient-driven data-sharing mechanism, but privacy regulations prevent centralized vendor-level access.

Germany's Perspective on zibs and future vision: German stakeholders see value in the structured approach of CIMs, but note that the absence of a central governing body in their own system creates difficulties in harmonizing FHIR profiles and implementation guides. They acknowledge the benefits of having core profiles that are mandatory for all stakeholders, as seen in countries like the USA and Australia, and express interest in a similar approach for Germany. While Germany focuses on specific legal requirements that dictate mandatory data elements, they recognize that a more standardized clinical modelling approach, such as the one used in the Netherlands, could improve interoperability and governance. The reliance on UML and logical FHIR models in Germany aligns with Dutch practices, though the lack of enforcement mechanisms in Germany leads to discrepancies in implementation across vendors and care settings. There is an understanding that a more structured and enforceable approach, such as the Dutch CIMs, could mitigate some of these fragmentation issues.

Czech Republic - Ministry of Health of the Czech Republic

Context and Approach: The Czech Republic has historically relied on proprietary national standards for clinical information modelling, with DASTA being a widely used format. However, recent initiatives, particularly those linked to EU projects like x-eHealth and Xt-EHR, have driven a shift towards more standardized and interoperable approaches. The Czech Republic's involvement in European initiatives has influenced its strategy, leading to increasing adoption of HL7 FHIR and interest in broader clinical modelling methodologies.
Within Xt-EHR, efforts are being made to define obligations for different actors in healthcare information exchange. A key goal is to capture clinical knowledge in a structured model, using different tools such as FHIR Logical Models, UML, and ontology-based approaches. Czech stakeholders recognize the importance of clinical modelling, but emphasize that models should be adaptable to different use cases rather than being tied to a single standard.
One of the main challenges in the Czech Republic has been the lack of long-term planning and stable funding for healthcare IT projects. While national eHealth plans have been developed, their implementation has often been delayed due to inconsistent financial support. This has resulted in reliance on EU-funded initiatives, which provide more continuity than domestic programmes.
In terms of methodology, the mindmap approach has been introduced within Xt-EHR to make clinical models more accessible to different stakeholders. Traditional modelling approaches, such as UML diagrams, proved difficult for physicians and policymakers to interpret, whereas Excel-based representations have been more effective in engaging non-technical stakeholders.
Furthermore, the Czech Republic has faced challenges in community-building for clinical information modelling, with only a small number of professionals actively working in this domain. Despite this, efforts such as the x-eHealth laboratory data modelling initiative have successfully brought together experts from multiple countries to standardize datasets.

Perspective on zibs and Future Vision: The Czech Republic acknowledges the value of structured clinical models and sees zibs as a promising approach for achieving a consistent and structured approach to data representation. In the Czech Republic a form of the zibs is used. Czech stakeholders recognize the need for a technology-agnostic approach that can transcend specific implementation standards like FHIR or openEHR. They emphasize that the goal should be to capture clinical knowledge first, and then derive different technical representations based on the needs of specific use cases.
While there is a strong preference for HL7 FHIR due to existing expertise and tooling, Czech experts recognize that different levels of modelling are necessary — ranging from conceptual models to implementation-ready structures. They also highlight the need for a knowledge repository, where different expressions of clinical models (such as FHIR Logical Models, UML diagrams, and ontology-based descriptions) can be stored and accessed as needed.
In terms of governance and standardization, Czech experts express interest in a joint European approach to clinical modelling, emphasizing the importance of aligning national efforts with EHDS (European Health Data Space) developments. They also acknowledge the need for a more structured and enforceable clinical modelling approach, similar to the Dutch zib methodology, to improve interoperability and governance.
However, they also recognize key differences between zibs and their own national initiatives. Whereas zibs emphasize conceptual modelling that remains as neutral as possible, Czech projects like Xt-EHR have a stronger focus on defining maturity models and obligations for

different actors in the healthcare system. This means that, while the principles behind zibs are aligned with their goals, adaptations may be necessary to fit the Czech regulatory and technical landscape.

Looking forward, the Czech Republic aims to continue aligning with EU projects and build stronger communities around clinical modelling, ensuring that their work remains relevant beyond short-term national funding cycles. The success of cross-border initiatives, such as laboratory data standardization, has demonstrated the feasibility of international collaboration, and Czech stakeholders believe that a structured, multi-level approach to clinical modelling — similar to zibs — can play a key role in the future of healthcare interoperability.

Findings

The interviews revealed that, while most countries recognize the value of structured clinical information models (CIMs), their implementation strategies vary widely due to differences in healthcare governance, legal frameworks, and historical investments in health IT. Some countries — such as Sweden and Estonia — have explored openEHR but faced barriers to widespread adoption, leading them to focus more heavily on FHIR for data exchange. Others, like Norway, the United Kingdom, and Finland, continue to invest in openEHR-based storage solutions while using FHIR for external interoperability. Finland in particular has made significant progress in aligning health and social care data through openEHR, supported by a favourable legal environment, strong vendor engagement, and national awareness efforts, including large-scale training programmes.

Across the board, countries are cautious about standardizing data storage at a national level. However, interviewed countries do see the value of making a distinction between data registration and data exchange. While most accept the importance of data consistency, many view mandating storage formats as politically sensitive and practically complex. Standardizing what data should be exchanged is generally seen as more feasible than prescribing how data should be stored. In several cases, the push to standardize storage emerged only after realizing that unstructured or inconsistent data capture was undermining the goals of data exchange.

Standardization remains a common challenge. Countries like Australia, Germany, and Finland are working towards defining core FHIR profiles or structured openEHR templates that could be adopted more widely. Yet even in these contexts, competing initiatives and fragmented governance continue to pose hurdles. The ambition behind the Netherlands' structured approach using neutral logical models was viewed positively by many interviewees, especially for its clear separation between data capture and data exchange from a standards point of view. However, concerns were raised about how standardizing storage might adapt to more decentralized or federated healthcare systems, where standardization must be carefully balanced with local flexibility. Nevertheless, flexible implementation-neutral models that balance standardization and adaptability have been emphasized across multiple countries, supporting the idea that logical models should remain conceptually neutral while ensuring practical applicability in diverse healthcare systems.

Concerns were raised about how standardizing storage might adapt to more decentralized or federated healthcare systems, where standardization must be carefully balanced with local flexibility. Nevertheless flexible implementation-neutral models that balance standardization and adaptability has been emphasized across multiple countries, supporting the idea that logical models should remain conceptually neutral while ensuring practical applicability in diverse healthcare systems.

Stakeholder engagement, particularly among non-technical professionals, was also identified as a challenge. Several countries emphasized the difficulty of involving clinicians and policymakers in the modelling process using traditional tools like UML. Finland, the Czech Republic, and Australia have taken creative approaches to address this, using methods such as mindmaps, Excel-based models, or lightweight training programmes to build understanding

and support. Finland's awareness-building strategy was cited as an effective way to promote openEHR understanding across different roles and regions.

Finally, resource constraints were a recurring theme. While Australia and Finland have successfully mobilized large, sustained communities for clinical modelling, other countries struggle with limited funding, short project cycles, or lack of long-term national support. In the Czech Republic, EU-funded initiatives have filled this gap, illustrating how international collaboration can provide continuity and momentum when national investments fall short. Finland's structured investment in legal readiness, vendor alignment, and open platforms stands out as a strong example of how sustained, multi-stakeholder involvement can accelerate adoption and maturity in clinical modelling.

Recommendations

This sample study provides insights into how other countries are structuring their clinical information models and using them as input for processing and storing healthdata. By analysing international experiences, the Netherlands can refine its own approach in the zib-transition, ensuring that it aligns with both national healthcare needs whilst following global standards development. The findings will be used to feed discussions within the zib community and provide strategic guidance for the future development of Dutch healthcare data models.

The study also highlights potential areas for deeper investigation, such as (global) governance for CIMs, the role of logical models and strategies for ensuring clinician engagement in data standardization efforts. The shared experience of resource constraints in the field of clinical information modelling is something multiple countries have emphasized. This includes countries that rely on EU collaborations to sustain long-term standardization efforts. In regard to transitioning to zibs 2.0, where international collaboration with SDO's becomes increasingly important, the ability to collaborate in clinical information modelling can be greatly beneficial. Canada, Czech Republic, and Estonia have stated that they would like to collaborate in clinical information modelling. All countries have stated that modelling work in FHIR and/or openEHR should be done in international collaboration and several interviewees have extended an invitation to follow up on clinical information modelling.

By learning from international best practices, the Netherlands can enhance its digital health infrastructure, aligning it with international standards and developments. The importance of flexible implementation-neutral models that balance standardization and adaptability has been emphasized across multiple countries, supporting the idea that zibs should remain conceptually neutral while ensuring practical applicability in diverse healthcare systems.

Nictiz is the Dutch centre of expertise for digital information in healthcare.

Nictiz develops a vision for the healthcare information system and the architecture that supports it. We develop and maintain standards that enable digital information exchange and ensure that healthcare information can be recorded and shared unambiguously.

In addition, we provide advice and share knowledge about digital information systems in healthcare. In doing so, we not only focus on developments within the Netherlands, but also look at what is happening internationally.

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