TREAT

Transforming Healthcare Through Semantic Interoperability and Self-Efficacy

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Glossary

Abbreviation / acronym	Description
AI	Artificial Intelligence
API	Application Programming Interface
ECG	Electrocardiogram
EHR	Electronic Health Records
FHIR	Fast Healthcare Interoperability Resources standard
GDPR	General Data Protection Regulation
HL7	Health Level Seven set of standards
ML	Machine Learning
NCD	Non-Communicable Disease
NLP	Natural Language Processing
SaaS	Software as a Service
SpO2	Oxygen saturation
TREAT	Transforming Healthcare Through Semantic Interoperability & Patient Self-Efficacy
VLM	Vision-Language Model
XAI	Explainable AI

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1 Introduction

The TREAT project was established to address key challenges in the digital transformation of healthcare, particularly in the management of chronic non-communicable diseases (NCDs). The project focuses on improving the continuity, accessibility, and personalization of healthcare services by facilitating the secure exchange and effective use of health information across heterogeneous systems, technologies, and care environments. By combining semantic interoperability, artificial intelligence (AI), wearable monitoring technologies, and patient-centred digital services, TREAT seeks to strengthen patient self-efficacy while supporting healthcare professionals in delivering more informed and coordinated care.

Over the course of the project, the international consortium has undertaken collaborative research, development, integration, and validation activities to translate these objectives into demonstrable technological solutions. The work has addressed several complementary dimensions of digital healthcare, including the acquisition and processing of patient-generated health data, integration with clinical information systems, AI-supported analysis and recommendations, remote patient monitoring, and the development of interoperable services. Particular emphasis has been placed on enabling information generated across different healthcare settings to be exchanged and reused, while considering the requirements of data protection, clinical relevance, and responsible AI implementation.

The project's technical and functional outcomes are represented through six healthcare demonstrators . These demonstrators cover patient-centric digital ecosystems, integrated support for osteoarthritis patients, personalized recommendation services, diabetes monitoring, distributed diagnosis and home healthcare, and AI-powered remote monitoring for NCD management. Each demonstrator addresses a specific healthcare context and provides tangible results in the form of software components, integrated data workflows, monitoring and visualization capabilities, AI-supported functionalities, and validated technical processes. Together, they illustrate how the technologies developed within TREAT can be applied to different clinical requirements and healthcare delivery models.

Beyond the individual use cases, an important outcome of the project is the development of the **TREAT Complete demonstrator**, which brings together contributions from multiple national consortia within a shared, cross-platform healthcare ecosystem. Building on interoperable data exchange mechanisms, including HL7 FHIR-based information structures and message-based communication, TREAT Complete demonstrates the potential to connect independently developed healthcare solutions and support the exchange of patient information across organizational and geographical boundaries. This integrated approach illustrates how the complementary capabilities of the individual demonstrators can contribute to a more connected patient journey, combining monitoring, data analysis, personalized support, and clinical follow-up.

This deliverable, presents a consolidated account of the principal results achieved throughout the TREAT project. It documents the contributions of the individual demonstrators, with particular attention to the activities performed, technological components developed, integration and validation outcomes, and the status of the resulting solutions. The report also describes the TREAT Complete demonstrator as a collective integration outcome, highlighting the interoperability capabilities established through collaboration among the participating partners. In addition, it identifies potential pathways for further development, clinical evaluation, technological reuse, and exploitation of the project results beyond the project duration.

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2 Patient-centric Digital Ecosystem demonstrator

The Canadian use case focuses on a patient-centric digital ecosystem that connects lifestyle and patient-generated health data with clinical information to support people living with cardiometabolic conditions, particularly type 2 diabetes. Data from wearable devices and patient assessments are integrated with electronic medical record (EMR) data, creating a more complete and continuously updated view of the patient's health, behaviours and care needs.

This interoperability enables patient information to move between clinical systems and My Viva Plan using standardized data structures, including HL7 FHIR. Rather than relying on manual patient creation and fragmented data entry, the workflow supports automated patient creation and the population of relevant patient information from connected clinical and lifestyle-data sources.

The Canadian demonstrator adapts TREAT Complete (previously TREAT Lite) to a Canada-only implementation. Within My Viva Plan, the connected information is used by Yaro, a conversational AI agent, to provide personalized patient support informed by wearable data, patient assessments and available clinical information.

The workflow is bidirectional. Summaries of relevant Yaro conversations are returned to clinicians for review and to support updates to the patient's care, alongside other clinician summaries generated through My Viva Plan. This closed-loop exchange was tested and demonstrated through integration with BeWell's platform.

2.1 Main Activities Performed

The Canadian partners made substantial contributions to the design, development, integration and testing of **TREAT Complete**, the platform previously referred to as TREAT Lite, while adapting its capabilities to the Canadian healthcare context and deploying them within My Viva Plan.

The main activities included:

- Contributing to the development and testing of the TREAT Complete platform, including its interoperability architecture, integrated workflows, and AI-supported functions.
- Designing and implementing the Canadian data architecture required to connect EMR information with patient assessments, wearable-device data, lifestyle information and My Viva Plan services.
- Developing the interfaces, data mappings and end-to-end flows needed to exchange information among clinical systems, BeWell's platform, TREAT Complete, and My Viva Plan.
- Implementing automated patient creation and population of relevant patient information from connected clinical and patient-generated data sources.
- Undertaking extensive development of Yaro's AI architecture so that the conversational agent can effectively understand and securely use connected clinical, assessment, wearable and lifestyle data to provide contextually relevant patient support.
- Integrating the work by TU/e as an AI-driven recommender engine for guiding the topics and clinical support within Yaro's conversations.
- Following constitutional AI and alignment work by TU/e, developing and applying internal safety checks for Yaro, including controls governing how connected information is used, how patient-facing interactions are generated and how clinically relevant information is summarized for professional review.
- Developing the return pathway through which summaries of relevant Yaro conversations and other My Viva Plan clinical summaries are provided to clinicians for review and potential care updates.
- Conducting extensive internal testing of the integrated product, data flows, AI functions and safety controls before permitting use within the clinical implementation study.

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- Testing the bidirectional workflow through integration with BeWell's platform, including the movement of information into My Viva Plan and the return of clinician-facing summaries.
- Designing and initiating the Yaro clinical implementation study, securing ethics approval, operationalizing the study protocol and beginning participant data collection.
- Coordinating across the Canadian and wider TREAT consortium partners to align the implementation with TREAT's objectives for interoperable, patient-centred and AI-supported healthcare.

2.2 Key Project Results Achieved

The Canadian use case produced a technically integrated, production-deployed and clinically active implementation of TREAT Complete within My Viva Plan. Its principal tangible results are:

- **A production-ready Canadian adaptation of TREAT Complete**, incorporating interoperability, AI-supported patient engagement and bidirectional communication with clinical systems.
- **A functioning interoperability layer and end-to-end data flow** connecting EMR information, patient assessments, wearable-device data and lifestyle information with My Viva Plan.
- **Automated patient creation and record population**, reducing manual onboarding and duplicate entry while allowing the patient's digital experience to be informed by connected information.
- **Production deployment of Yaro**, supported by an extensively developed AI architecture that can use connected data to learn about the patient then provide more personalized and context-aware patient interactions.
- **Implemented AI safety controls and internal validation processes** that were completed before Yaro and the integrated workflow advanced into clinical implementation.
- **A closed-loop clinician communication workflow** that returns summaries of relevant Yaro conversations alongside other My Viva Plan clinical summaries for clinician review and potential care updates.
- **Successful integration and workflow testing with BeWell's platform**, demonstrating the bidirectional exchange of patient information and clinician-facing summaries.
- **A clinical implementation study that is well underway**, with ethics approval secured, the study initiated and participant data currently being collected.
- **A validated pathway from platform development to clinical implementation**, demonstrating that the integrated product, interoperability workflow, AI functions and safety controls can operate together within a controlled Canadian healthcare study.

These results represent a significant progression beyond a standalone technical demonstrator. They establish an operational clinical implementation in which connected clinical and lifestyle data support automated onboarding and AI-assisted patient engagement, while relevant information generated through My Viva Plan is returned to clinicians to support continuity of care.

2.3 Demonstration and Current Status

The Canadian demonstrator is a production-deployed clinical implementation of TREAT Complete, adapted specifically to the Canadian healthcare context and embedded within My Viva Plan.

Before entering clinical implementation, the integrated workflow underwent substantial internal development and testing with clinicians. This included verification of data interoperability and integrations, end-to-end information flows, automated patient creation, Yaro's AI architecture, patient-facing functions, clinician-summary generation and the safety controls governing the use of connected patient information.

The workflow was also tested through integration with BeWell's platform, demonstrating both the movement of clinical information into My Viva Plan and the return of Yaro conversation summaries and other My Viva Plan clinical summaries for clinician review.

The implementation has progressed beyond internal technical testing. Ethics approval has been obtained, the clinical implementation study has been initiated, and participant data are currently being collected. Yaro

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and the integrated workflow are therefore operating in the My Viva Plan production environment under controlled study conditions.

The demonstrator is technically functional, production-deployed and undergoing active clinical implementation evaluation. Access remains controlled through the approved study while the project assesses implementation, workflow performance, user experience, AI-supported interactions, safety processes and the usefulness of clinician-facing information. It is ready for final project demonstration, while wider deployment will be informed by the study findings and subsequent clinical and implementation decisions.

2.4 Exploitation and Future Use Potential

The project results are already being exploited through their incorporation into My Viva Plan. The Canadian implementation converts the extensive development undertaken through TREAT Complete into practical platform capabilities that strengthen My Viva Plan as an interoperable, AI-supported component of healthcare delivery.

The principal exploitation opportunities are:

- **Integration into Canadian clinical pathways:** The developed interoperability architecture enables My Viva Plan to exchange information with EMRs and clinical platforms rather than operating as an isolated patient-support application.
- **Scalable clinical onboarding:** Automated patient creation and record population can reduce administrative workload and make it more practical to deploy My Viva Plan through clinics, health systems and other healthcare partners.
- **Connected and personalized AI support:** Yaro can use clinical, assessment, wearable and lifestyle data to provide support that reflects the patient's circumstances and care pathway.
- **Closed-loop clinical communication:** Relevant Yaro conversation summaries and other My Viva Plan clinical summaries can be returned to clinicians, allowing patient activity between appointments to contribute to professional review and potential care-plan updates.
- **Reusable interoperability infrastructure:** The integrations, mappings and data flows developed through the project provide a foundation for connecting additional EMRs, clinical platforms, wearable technologies and patient-monitoring services.
- **Evidence-informed wider deployment:** The active clinical implementation study will generate evidence regarding implementation, workflow performance, patient experience, AI-supported engagement, safety and clinical usability before wider rollout.
- **Commercial healthcare deployment:** The resulting capabilities strengthen My Viva Plan's potential for deployment through clinics, healthcare organizations and population-health programs requiring interoperable and scalable lifestyle-care support.
- **Expansion to additional care pathways:** The platform architecture can be adapted to other cardiometabolic and chronic-disease programs in which clinical information, patient-generated data, AI-supported engagement and clinician oversight must operate together.
- **Continued research exploitation:** The production implementation creates a foundation for further studies of AI-supported care, clinical interoperability, implementation outcomes and the relationship between clinical information and patients' daily lifestyle behaviours.

The exploitation value therefore extends beyond the individual demonstrator components. The project has created an integrated and clinically active platform capability that allows My Viva Plan to connect with healthcare systems, automate patient onboarding, support patients through Yaro, return meaningful information to clinicians and generate implementation evidence to guide scaling after TREAT.

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3 Integrated System for Osteoarthritis Patients demonstrator

The goal of the use case is to realize an integrated system for osteoarthritis patients which can be used by physical therapists and lifestyle coaches to administer and remotely monitor interventions/training programs, supported by automated personalized coaching. This use case supports TREAT's overall goals of improving individualized clinical care, specifically focusing on long-term adherence of individuals with diabetes mellitus and osteoarthritis to norms of healthy physical activity. This process will be optimized through remote physical monitoring, semantic interoperability and the use of AI for personalized recommendations. Each partner of the consortium will provide their expertise to work on this common goal.

3.1 Main Activities Performed

Within WP3, TU/e built the clinical AI governance layer. This clinician-driven layer allows clinicians to move from being passive observers of AI behavior to active participants who leverage their expertise in local clinical knowledge to author and monitor AI behavior that meets local patient needs and adheres to clinicians' ethical and clinical obligations. The work produced one methodology and two working systems.

- **COMPASS Methodology** (Constitutional Methodology for Patient-facing AI System Safeguards) lets clinicians codify ethical and clinical principles in an AI constitution, validate it, load it into a language model at run time, measure the model's per-principle adherence, and audit the model's governance rationale for each answer.

- **The TREAT federated-services platform** runs 19 containerized services. These services collect wearable and patient context data, derive clinical trends, exchange observations with MedRecord's data store, provide patients with a constitution-governed chat, offer patient- and clinician-facing dashboards, and provide a system observability dashboard.

- **The COMPASS validation toolkit** tests the robustness of the constitutionally aligned language model. It deploys 1,000 adversarial prompts, scores each answer against each principle, and tests whether the audit rationale is consistent with the patient data.

TU/e also ran validation sessions with eight clinicians recruited through TU/e, Maastricht University and Beweeghuis.

Maastricht University and Johan Sports connected their sensor devices to the medrecord platform and chat bot, which makes exercise and daily life activity data available for TUe's language model.

3.2 Key Project Results Achieved

Clinicians approved the constitution, and tests showed that it measurably changed the language model's behavior.

- A panel of eight clinicians spanning family medicine, neurology, psychiatry, infectious diseases and physiotherapy judged all 10 medical-ethics principles appropriate for a patient-facing assistant. The panel used an Appropriateness Level Metric adapted from the RAND/UCLA method. Of 160 ratings, 129 scored 7 or higher on its 9-point scale.

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- Using the toolkit, we submitted 1,000 adversarial prompts to gpt-oss-120b across 12 runs, producing 12,000 responses. Using Claude Haiku 3 as the judge, the evaluation found that attack success fell from 32.4% without the constitution to 0.4% with it.

- On 294 held-out prompts, the toolkit's per-principle entailment scorer (ABNLI) measured how often the system recovered the principles upheld by a reference answer. Averaged over 14 principles, recall rose from 0.095 to 0.358.

- During the adversarial test, the constitutionally aligned language model provided a governance rationale for 95.8% of its answers. In all 19 counterfactual tests, the rationale changed correctly when one fact in the patient's data was altered, demonstrating the self-consistency of the model's stated governance rationale.

The clinician sessions surfaced five new principles for the next revision of the constitution. This finding illustrates a central design principle of the COMPASS methodology: to respond to the evolving needs of clinicians and local patient populations, clinical AI governance frameworks must support agile, iterative refinement.

3.3 Demonstration and Current Status

The TREAT federated-services platform and the COMPASS validation toolkit are at TRL 4: validated in the lab. In research and clinical demonstration scenarios, the platform ran end to end, carrying data from Garmin wearables, patient health records, and daily diaries through MedRecord's cloud-based data backend and our biometric analytics pipelines to our clinician- and patient-facing dashboards, which host the constitutionally aligned language model. This distributed federation provides the empirical data and AI governance the system needs to infer patient-specific recommendations that are ethically and clinically sound. Its services are packaged as containers that can be deployed to a cloud host.

- TU/e demonstrated the governed chat live using two synthetic patient personas, Ria (62) and Joep (55), who live with osteoarthritis and type 2 diabetes, respectively, together with real wearable data collected by the researcher. Clinicians see each answer alongside its audit record.

- Access is limited to the TU/e research team. The chat API rejects calls without a login, and testing has used no patient data.

- Eight clinicians participated in live, 90-minute demonstration sessions with the system. TU/e's ethical review board approved these sessions. No patient has used the system.

- The Dutch use case is validated in focus groups in which physical therapists and lifestyle coaches reviewed output from the governed chat. These sessions are the next validation step before the final demonstration.

3.4 Exploitation and Future Use Potential

Our AI constitution has been adopted by TREAT partners outside TU/e: Almende and MyViva incorporated the TU/e constitution into their deployments, which form part of TREAT Complete. COMPASS is broadly adoptable. It achieves its governance effects through prompting techniques, not model retraining, so a care organization can use it with a stock language model and constitutionally align that model without specialized machine-learning expertise or hardware.

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More specifically, COMPASS is suitable for healthcare organizations with defined clinical-governance responsibilities and the capacity to conduct independent validation, such as those at or above Level 3 of the Healthcare AI Governance Readiness Assessment (HAIRA) (Hussein et al. 2026).

TU/e's dissemination activities include:

- Presenting COMPASS at the Pervasive Health 2025 conference in Eindhoven, Netherlands.
- Publishing "Constitutional AI and Behavior Change: Ethical Frameworks for Trust and Adoption in Clinical LLM Deployment" (T. C. Hankins, Pervasive Health 2025, LNICST vol. 694, pp. 209–214).
- A full paper on COMPASS is in preparation for EICS 2027.
- The principal investigator's work on COMPASS and constitutional AI governance forms the core of his PhD thesis at TU/e.
- We have also presented this work at Jheronimus Academy of Data Science (JADS) and TU/e workshops, including industry partner collaboration days.
- The validation toolkit is available upon request to TREAT consortium partners who wish to rerun the validation on their own deployments.

When the EICS paper is published, TU/e will release all system code repositories, test suites, reference answers and data, as well as the full validation toolkit.

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4 Recommender SaaS Platform demonstrator

This use case considers the integration of data from various sources (diet, pharmacological treatment, out-of-hospital monitoring, care pathways) into a platform which is able to provide personalized recommendations and improve the effectiveness of treatment for patients with chronic non-communicable diseases. (NCDs). This will include collaboration between health professionals, pharmacists and advanced artificial intelligence (AI) technologies. The platform will be provided through an API, which will allow us to offer it as a Software as a Service (SaaS) solution, allowing its use by other entities and facilitating its integration into various health platforms.

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5 Diabetes Monitoring demonstrator

This use case will focus on a diabetes-specific solution aimed at enhancing self-efficacy and improving clinical workflows. The solution will provide a multi-layered framework, including collecting data from patients using two types of wearable devices, measuring the glucose level in the blood and record the electrical signals in the heart, which will be processed using AI on the platform for semantic operability.

5.1 Main Activities Performed

Throughout the TREAT project, the Türkiye consortium, carried out research, development, integration, and testing activities within the Diabetes Monitoring use case. The activities focused on developing an AI-supported healthcare monitoring system integrating wearable technologies, data processing, clinical decision support, and semantic interoperability.

ARD Group contributed to the development of backend services and data processing components for collecting, managing, and analysing measurements, particularly ECG signals obtained from wearable devices. The technical work included implementing ECG signal processing functionalities to extract relevant health indicators, developing secure API interfaces, and conducting integration tests with E-Kalite's health intelligence and visualization platform.

In collaboration with LiveWell, E-Kalite, and Anadolu Sigorta, the consortium worked on integrating wearable devices, health data, AI-supported analytics, and visualization components. Additional activities included defining functional and technical requirements, developing interoperable data exchange mechanisms, testing system components, and addressing data privacy and security requirements in accordance with GDPR and KVKK.

The Türkiye consortium also contributed to the preparation of the TREAT Complete demonstrator, supporting cross-platform data exchange and the integration of the Türkiye use case into the broader TREAT ecosystem. These activities supported the project's objectives of improving chronic disease monitoring, enabling personalized healthcare, and strengthening AI-assisted clinical decision-making.

5.2 Key Project Results Achieved

The Türkiye consortium achieved several technical results within the TREAT Diabetes Monitoring use case, establishing the foundation for an integrated, AI-supported healthcare monitoring and clinical decision support system.

ARD Group developed backend services and data processing components to support the collection, management, and analysis of wearable sensor data. Key results included ECG signal processing functionalities for extracting relevant health indicators, structured data management capabilities, and secure API-based interfaces supporting integration with other healthcare platforms.

In collaboration with LiveWell, progress was achieved in integrating the wearable ECG smart t-shirt with the data processing infrastructure. Initial integration activities established the technical workflow for transferring physiological measurements from wearable devices to backend services for further analysis.

E-Kalite developed the health intelligence and visualization layer of the Turkish demonstrator on its TURBOARD platform. Three dashboards are in production: a Data Quality Dashboard, an Alert Dashboard and a Risk Tracking Dashboard, each tailored to healthcare professionals, data professionals and administrators. On top of these, a conversational analytics interface allows users to query clinical data in natural language, with a multi-LLM architecture and a persona management system that adapts the depth and language of responses to the user type, including a plain-language persona for patients and the public. AI-generated risk scores produced on the data processing side are visualized directly in the dashboards.

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A public awareness dashboard built on WHO Global Health Observatory data, with AI-generated plain-language summaries, is embedded in the TREAT project website.

Together, these results established the main technical components and integration workflows of the Turkish demonstrator, supporting secure health data exchange, AI-assisted clinical analysis, and personalized diabetes monitoring. The developed components also provide a foundation for integration with the broader TREAT ecosystem and the TREAT Complete demonstrator.

5.3 Demonstration and Current Status

The Türkiye Diabetes Monitoring demonstrator has progressed through the development and integration of its main technical components, including wearable data acquisition, signal processing, backend services, AI-supported analytics, and healthcare visualization functionalities.

The demonstrator is presented through an integrated workflow connecting LiveWell's ECG smart t-shirt, ARD Group's backend processing services, and E-Kalite's health intelligence platform. Initial integration tests have been conducted to evaluate secure data transmission, physiological data processing, and communication between system components. The wearable device prototype and associated software components provide the foundation for further end-to-end testing and validation.

E-Kalite's visualization platform has reached an operational stage, providing dashboards and AI-assisted analytical functionalities for different user profiles. Anadolu Sigorta's medical document processing and semantic knowledge graph components have also undergone initial technical evaluation. For demonstration purposes, a local environment using synthetic patient data is available, allowing project partners and reviewers to examine the developed functionalities without exposing sensitive patient information.

Türkiye use case demonstrator has successfully completed its planned development and integration activities, achieving the project's technical objectives. The integrated system demonstrates interoperability across components, reliable wearable data processing workflows, and alignment with data protection requirements. With the completion of the TREAT project, the demonstrator represents a consolidated outcome of the development and validation efforts, providing a foundation for future exploitation and potential real-world deployment.

Türkiye use case demonstrator has also successfully completed the integration into the TREAT Complete demonstrator. This integration enables the Turkish TreatApi platform to receive and process cross-platform patient vital signs through the existing RabbitMQ-based messaging infrastructure and HL7 FHIR interoperability framework. Clinical measurements, including blood pressure, heart rate, oxygen saturation, and body temperature, are processed through the existing analysis pipeline to generate clinical risk assessments and alerts for the Türkiye insurance dashboard. With the completion of the TREAT project, this integration demonstrates cross-platform interoperability, the reuse of existing clinical data processing capabilities, and the contribution of the Türkiye use case to the unified TREAT Complete patient journey, providing a foundation for future exploitation and real-world deployment.

5.4 Exploitation and Future Use Potential

The results achieved within the Türkiye Diabetes Monitoring use case provide a strong foundation for the further development, exploitation, and potential deployment of AI-supported healthcare monitoring and clinical decision support solutions. Throughout the TREAT project, the Türkiye consortium developed backend services, data processing components, secure integration interfaces, and healthcare visualization functionalities to support the collection, analysis, and presentation of patient-related health information. These components establish a reusable technical infrastructure that can be further enhanced and adapted to different healthcare environments and clinical monitoring requirements.

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A significant outcome of the project is the successful integration of the Türkiye use case into the TREAT Complete demonstrator. This integration enables the Türkiye TreatApi platform to receive and process measurements, including blood pressure, heart rate, oxygen saturation, and body temperature, through the shared RabbitMQ-based messaging infrastructure and HL7 FHIR interoperability framework. The processed measurements support clinical risk assessment and alert generation within the Türkiye insurance dashboard, demonstrating the potential of cross-platform healthcare data exchange and integrated patient monitoring.

Following the completion of the project, further development activities may focus on improving ECG signal processing capabilities, validating AI-supported health indicators, and expanding interoperability with hospital information systems and electronic health records. Additional pilot studies involving wearable devices, monitoring and data analysis could support the evaluation of system reliability, usability, and clinical applicability in real-world healthcare environments. Particular attention may also be given to strengthening data protection, secure communication, and compliance with relevant healthcare regulations.

The modular architecture and API-based integration capabilities offer opportunities to scale the developed solutions and integrate them into existing digital healthcare infrastructures. Potential applications include remote patient monitoring, diabetes management platforms, clinical decision support services, and healthcare data analytics systems. The developed technologies may also be adapted to other chronic disease monitoring scenarios, particularly those requiring continuous physiological monitoring and early identification of health risks.

From an exploitation perspective, ARD Group and the Türkiye consortium partners can build upon the project results to develop reusable software components, healthcare integration services, and AI-supported monitoring solutions for hospitals, healthcare providers, insurance companies, and digital health technology providers. Potential commercialization opportunities include software licensing, customized platform integration, and technology partnerships. Further research collaborations, clinical validation activities, and participation in national and international R&D initiatives may support the technological maturity and market readiness of these solutions.

E-Kalite will carry the TREAT-specific clinical decision support capabilities (persona-driven conversational analytics, data quality monitoring and risk tracking) into its commercial TURBOARD offering for hospitals, insurers and public health institutions in Türkiye and abroad, building on its existing user base in the Turkish healthcare sector.

Overall, the completed TREAT project has established a valuable technological foundation for future digital healthcare innovations. The integration of the Türkiye Diabetes Monitoring use case into TREAT Complete demonstrates the potential for interoperable, scalable, and secure healthcare monitoring solutions, creating opportunities for continued research, industrial exploitation, and potential real-world deployment.

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6 Distributed Diagnoses and Home Healthcare demonstrator

This use case pertains to distributed diagnoses and home healthcare, aiming to develop economically efficient methods for user-centred and home-based systems. These systems focus on monitoring health-related quality of life, particularly for patients with chronic diseases. In this context, the integration of personal devices (such as smartphones and wearables) with hospital information systems allows for remote patient monitoring. The system collects data from sensors, patients, families, and primary care professionals, integrating it with information from the hospital's individual personal care system. This integration enables the development of various services, including information dissemination, coaching, analysis, and alarming.

6.1 Main Activities Performed

The Portuguese partners combined clinical pathway definition, software development, institutional integration and validation with healthcare professionals. ULSTMAD provided the clinical setting and multidisciplinary teams, ByMe developed the ICP and its integration with institutional systems, PLUX contributed to the home-monitoring device work, and ISEP contributed expertise in data interoperability and recommendation systems.

The main activities included:

- **Clinical co-creation and pathway modelling:** working with the cardiac rehabilitation, paediatric obesity and paediatric diabetes teams to map existing processes, review requirements and define the information needed by each professional. Meetings and observation of rehabilitation sessions identified priorities for shared records, standardised forms and automatic data import.
- **ICP development and configuration:** configuring a common platform for the three programmes, with role-specific forms, clinical parameters, questionnaires and consultation pathways. Development included comparisons across assessment time points, graphical views and automatically generated reports.
- **Institutional interoperability:** integrating the ICP with SONHO, SClínico, bHealth and SR SIGA to import administrative and clinical information and support referral and follow-up workflows across hospital and primary care services.
- **Iterative testing and validation:** making the preliminary demonstrator available in clinical use, incorporating professional feedback into form-comparison algorithms and interface improvements, and conducting final workflow acceptance and end-to-end walkthroughs with clinical teams.
- **Conceptual interoperability design:** defining the approach for exchanging standardised clinical measurements between the ICP and the wider TREAT ecosystem.

6.2 Key Project Results Achieved

The principal result is a shared clinical platform configured for three care programmes and integrated with ULSTMAD's institutional systems. Its main tangible outputs are:

- **A multidisciplinary patient record:** standardised forms make information available to the professionals involved in each programme, with access differentiated by professional profile. The paediatric workflows cover nursing, nutrition, psychology and paediatrics, while cardiac rehabilitation supports the relevant clinical and administrative roles.

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- **Digital cardiac rehabilitation workflows:** Phase I session parameters are recorded directly in the ICP, replacing paper records. Phase II referral, consultations, examinations and in-hospital training parameters are also recorded, with progress comparisons and automatic PDF reports.
- **Structured paediatric care workflows:** the demonstrator supports obesity referral and triage, sequential multidisciplinary consultations and recording of clinical, family and behavioural history. For paediatric type 1 diabetes, role-specific clinical forms and documentation of education for children and caregivers were validated at workflow level; longitudinal multidisciplinary follow-up is still pending deployment.
- **Integration with existing information systems:** administrative and clinical information is imported into the ICP without manual re-entry, linking the shared care plan to the institutional records used by healthcare professionals.
- **Conceptual mapping for external measurements:** identifying how measurements such as blood glucose, heart rate, weight and oxygen saturation could be represented using HL7 FHIR and mapped to the ICP data model. This defines a potential interoperability approach with TREAT Complete.

6.3 Demonstration and Current Status

The ICP is hosted on ULSTMAD infrastructure. The preliminary demonstrator was used in a real clinical context during 2025–2026, allowing professional feedback to inform development. Final workflow acceptance involved 13 professionals across four profiles. The maturity of individual functions varies: the core clinical workflows and institutional integrations have been validated, while several functions needed for continuous home follow-up remain under development or require further validation.

For the final project review, clinical professionals carried out end-to-end walkthroughs using the hospital systems in a sandbox environment with synthetic patient data. Cardiac rehabilitation was presented through an adult patient journey covering referral and Phases I and II, recorded with an adult volunteer. Paediatric obesity and diabetes were presented through narrated screen recordings of synthetic patient journeys.

Integration with TREAT Complete remains conceptual. The scope and implementation status of connectivity with PLUX wearables is planned to continue, with validation past project. Completion of the patient app and validation with patients and caregivers also remain open.

6.4 Exploitation and Future Use Potential

The exploitation strategy centres on extending ByMe's existing hospital software towards an Individual Care Plan spanning hospital, primary care and home settings. Public and private hospitals and primary care units are the principal target customers. ByMe plans to promote adoption through its existing customer base, using platform licensing, integration services and support. The ULSTMAD implementation provides the initial clinical setting for further development and evaluation.

The main opportunities for future use are:

- **Expansion of integrated care:** reusing the ICP's configurable forms and workflows for additional multidisciplinary and chronic disease programmes, with integration into the information systems already used by healthcare providers.
- **Home-based follow-up:** defining the device integration approach, including the role and connectivity of PLUX wearables, and developing and validating the required links with the ICP and the patient app. Potential functions include remote measurements, communication, reminders and patient feedback, subject to validation with patients and caregivers.
- **Interoperable services:** developing the conceptual FHIR mapping into an implemented exchange with external monitoring platforms and the TREAT ecosystem. This would require interface implementation, patient identity matching and technical and operational validation before routine use.
- **Clinical analytics and personalised support:** further developing dashboards and AI-supported recommendations, including nutritional guidance, as envisaged in the exploitation plan. These remain

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development and validation opportunities rather than established clinical outcomes of the demonstrator.
- **Continued evaluation and research:** using the shared care workflows and integration experience to study usability, care coordination, patient engagement and the clinical value of remote follow-up, and to support further research and technology transfer.

Wider deployment will depend on defining and implementing the home-monitoring and cross-platform integrations, completing the patient app, and obtaining evidence of usability, security, reliability and clinical value in the intended care settings. The shared ICP and institutional integrations provide the basis for this progression after TREAT.

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7 Enhancing Patient Self-Efficacy and NCD Management through AI-Powered Remote Monitoring demonstrator

The Well@Home platform will integrate AI assistance to streamline patient management for healthcare professionals. This will be achieved in three phases: 1) Enhancing data visualization and obtaining the required dataset, 2) Implementing a predictive AI assistant for patient diagnosis, and 3) Adding a prescriptive AI assistant to optimize content labelling and delivery timing. The goal is to improve the patient's self-efficacy, treatment adherence and decrease healthcare costs by reducing the reliance on healthcare professionals.

7.1 Main Activities Performed

BeWell Innovations carried out the Belgian use case within its Well@Home telemonitoring platform, which is already used by hospitals to follow up patients at home. Because the Belgian consortium started later than the international project, the work concentrated on building the AI foundations and integrating them into the existing platform and clinical workflows, rather than on a standalone prototype.

The main activities included:

- **Requirements and co-creation:** defining the requirements for the predictive and prescriptive AI assistants together with healthcare professionals, clinical stakeholders from BeWell's customer base and technology partners, prioritised with the MoSCoW method.
- **Enhanced visualisation:** designing and implementing trend-based monitoring for longitudinal patient measurements in the Clinical Command Center (CCC) and the Alerts Dashboard, including step-based and slope-based trend representations.
- **Early Warning Score:** adding the Early Warning Score (EWS) as a measurement type within the existing measurement framework, with dashboard visualisation and manual measurement workflows for healthcare professionals and patients.
- **Data for AI:** setting up the data structure, processing pipeline and quality assurance protocols needed to train AI models on anonymised data from a partner hospital, with training carried out on the hospital's own infrastructure so that patient data does not leave the hospital environment.
- **Predictive AI:** designing the machine learning pipeline and developing models that identify elevated risk for non-communicable diseases based on disease codes (ICD), starting with an unsupervised risk-scoring model.
- **Prescriptive AI:** designing the recommendation protocol and a recommendation engine in the Well@Home education module, supported by a patient tagging system based on questionnaire data and patient information, and by article sets that can be matched to disease codes.
- **Wearables and devices:** extending the platform with data from connected medical devices and consumer wearables, so that both clinical vital parameters and lifestyle and activity data are available for monitoring.
- **Interoperability:** setting up and hosting the shared TREAT interoperability backbone (RabbitMQ message exchange with HL7 FHIR as the clinical data format) and supporting partners in connecting their platforms to it.
- **Privacy, security, ethics and regulation:** carrying out security, privacy and ethics checks on the AI work, and analysing how the AI functionalities are affected by the EU AI Act and the Medical Device Regulation, within BeWell's ISO 13485-certified quality management system.
- **Consortium coordination:** shaping the TREAT Complete patient journey with the consortium partners and testing the bidirectional exchange with My Viva Plan.

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7.2 Key Project Results Achieved

The Belgian use case produced the following tangible results:

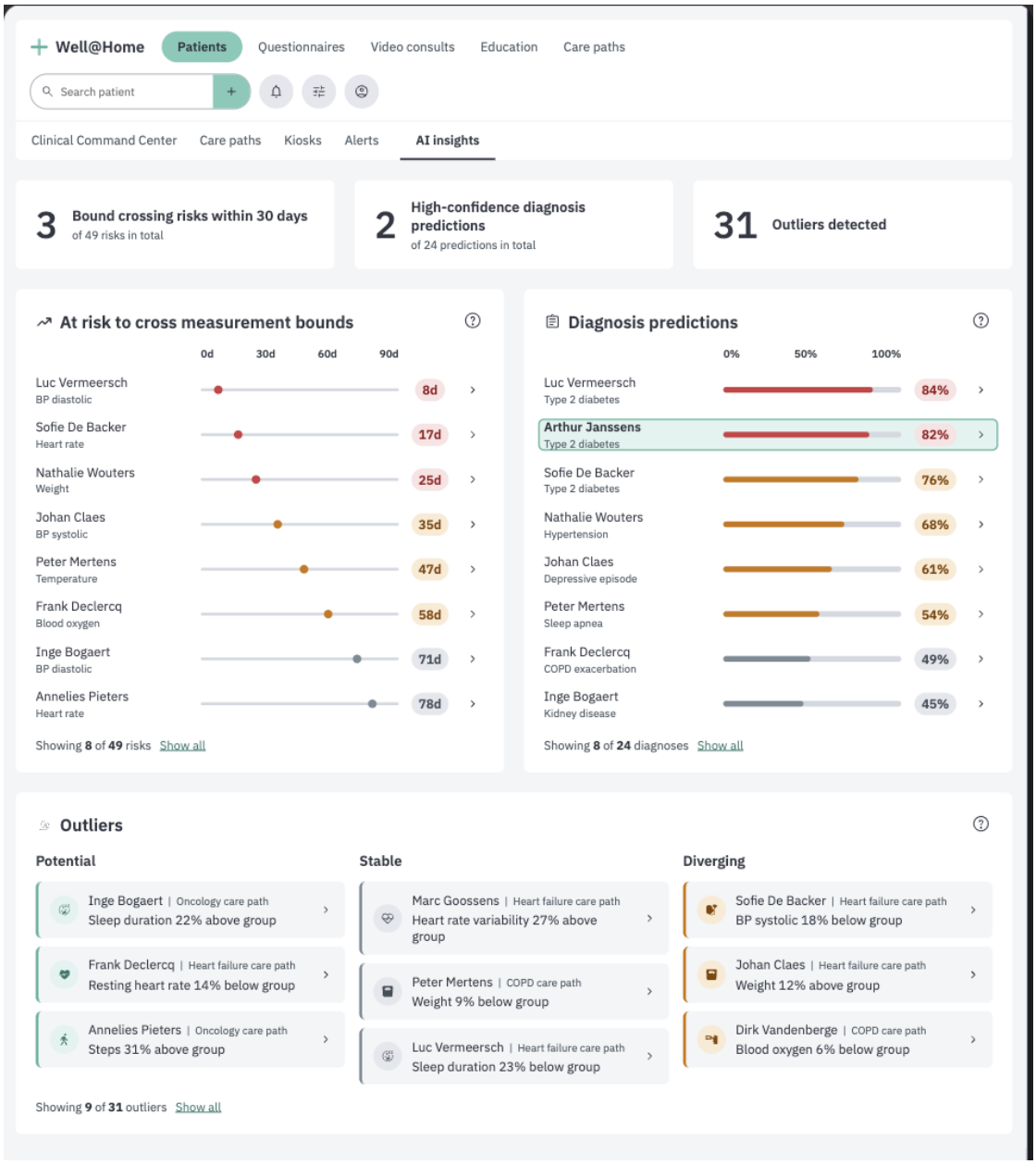
- **Trend-based monitoring in clinical workflows:** trend insights are surfaced through the Alerts Dashboard, so that measurements likely to cross acceptable thresholds in the near future are brought to the attention of healthcare professionals within the workflow they already use, instead of in a separate view.
- **Early Warning Score in the platform:** EWS is available as a measurement type, showing that new AI-related measurements can be added to the existing dashboards and task workflows without disrupting current measurement handling.
- **Machine learning pipeline:** an ML pipeline architecture for predictive models, designed and validated in a controlled test environment, and a first unsupervised risk-scoring model implemented.
- **Recommendation foundations:** a recommendation protocol with working disease-code (ICD-10) detection, a patient tagging system, and assignable article sets that link educational content to disease codes.
- **Human oversight by design:** all AI-generated recommendations and educational suggestions require validation by a healthcare professional before they reach the patient, and AI predictions are presented so that they remain clearly distinguishable from confirmed diagnoses.
- **Shared interoperability backbone:** a message-based, FHIR-based exchange layer, hosted by BeWell, that connects Well@Home with partner platforms in Canada, the Netherlands, Türkiye, Spain and Portugal in the TREAT Complete demonstrator.
- **Closed-loop exchange with My Viva Plan:** successful integration testing of the bidirectional workflow, in which patient information moves from Well@Home to My Viva Plan and clinician-facing summaries return to Well@Home.
- **Multilingual platform:** the AI-related functionality is delivered within a platform available to patients and healthcare professionals in English, Dutch and French.

7.3 Demonstration and Current Status

The demonstrator is developed as an integrated component of the Well@Home platform rather than as a separate application. Healthcare professionals access its functionalities through the existing platform environments: the Clinical Command Center, Alerts Dashboard, patient profiles, measurement workflows and education module. Patients access assigned educational articles, measurements and notifications through the existing Well@Home patient app.

The visualisation, EWS and interoperability components are integrated in the platform, and the interoperability backbone is operational for the TREAT Complete demonstrator. The predictive and prescriptive AI components remain in the research phase: models are being trained and evaluated on anonymised partner-hospital data, and the AI dashboard views exist as validated designs that are being refined in a dedicated design iteration.

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Access to the AI and recommendation functionalities is limited to controlled project use, testing and validation within the TREAT project environment, and no AI output is shared with patients without review by a healthcare professional. The required components are expected to be in place for the final project review, where they will be shown as part of the TREAT Complete patient journey. Because of the later start of the Belgian consortium, part of the work will continue after the formal end of the international project, in particular validation of the models on real patient data, feedback from healthcare professionals and usability evaluation.

7.4 Exploitation and Future Use Potential

BeWell will exploit the results by bringing them into the Well@Home platform used by its hospital customers. Market introduction of the AI functionalities is foreseen approximately two years after the end of the project, subject to clinical validation and the applicable regulatory requirements for medical device software.

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The main exploitation opportunities are:

- **Clinical decision support for remote monitoring:** trend-based alerts, risk indications and EWS help care teams prioritise patients and act earlier, which supports following up more patients per healthcare professional.
- **Personalised patient education:** matching educational content to a patient's conditions and profile supports self-management and treatment adherence, with the healthcare professional remaining in control.
- **Broader clinical context:** the platform looks at the patient's overall clinical picture rather than a single specialty, which makes the approach transferable to other chronic and multimorbid care pathways.
- **Interoperable ecosystem:** the FHIR-based exchange layer gives Well@Home a reusable way to connect with hospital systems, wearables and partner platforms, in Belgium and across borders.
- **Regulatory readiness:** building the AI work inside an ISO 13485 quality management system, with human oversight and a clear separation between AI suggestions and diagnoses, prepares the functionalities for the medical device and EU AI Act requirements they will face when placed on the market.
- **Research continuation:** the data infrastructure and ML pipeline built with the partner hospital provide a basis for further model development and validation studies after TREAT.

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