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FINLAND – A TREASURE TROVE FOR REAL-WORLD EVIDENCE RESEARCH

Explore Finland's exceptional resources of health and social data, collections of biological samples, forerunning collaborators, and efficient operating environment for RWE research.

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PREFACE

Business Finland has prepared an all-inclusive document for the international marketing of the exceptional Finnish real-world evidence (RWE) research ecosystem.

The purpose of this document is to illustrate the wealth of opportunities Finland has to offer to companies who are looking for extraordinary data sources, an efficient operating environment, and forerunning collaborators.

The document comprises real-life use cases, visualizations of the Finnish RWE research ecosystem, information on national health registries and biobanks, and practical descriptions of the different phases and various applications of RWE projects.

The document also presents Finnish world-class service providers, Finland's strengths as a business environment and provides answers to the most relevant questions regarding data opportunities, application processes and RWE capabilities.

This document has been produced in close collaboration with the leading experts within the Finnish RWE field.

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- Service providers

Efficient Operational Environment

- Legislation and data access policies
- High-quality healthcare
- Data infrastructure (biobanks, hospital datalakes and national registries)

Figure 1 Thanks to extraordinary data opportunities, an efficient operational environment, and forerunner collaborators, Finland is a unique place for groundbreaking medical research.

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1. FINLAND OFFERS EXTRAORDINARY DATA OPPORTUNITIES

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Finland has exceptionally comprehensive and high-quality resources consisting of health and social data and collections of biological samples, which together offer globally unique opportunities for real-world evidence (RWE) research.

Finland has a long history of collecting and managing nationwide health and social data, which has resulted in exceptional data resources in terms of both quality and quantity. Today, all Finnish national registries are digitized and there are considerable ongoing efforts to further optimize and harmonize the data structures. This will continually improve the use of registry data for research in the future. All citizens have a unique personal ID number (introduced in 1964), which allows combining individual-level data from different data sources and enables longitudinal data collection.

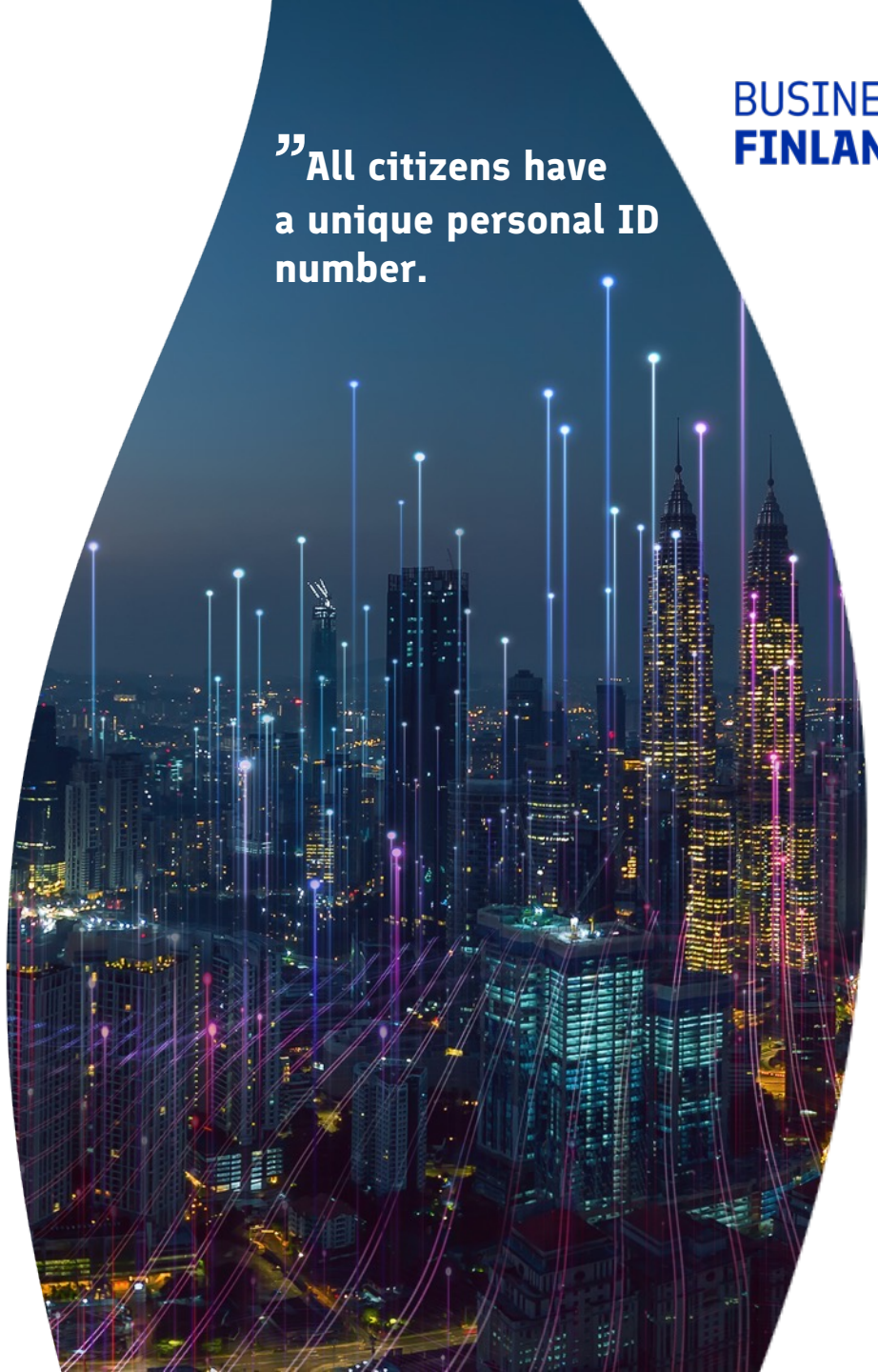
Finland's data infrastructure offers several unique benefits for RWE research:

- Whole population coverage
- Detailed clinical data
- Extensive longitudinal data
- Versatile collection of biological samples
- Interconnectivity of all data sources

Finnish national registries have whole population coverage

Finnish national registries have complete population-wide coverage: all citizens are included in these registries regardless of social status, income, or insurance.

Therefore, the data are representative of the entire population with minimal selection bias, which offers a major benefit compared to the registries that rely on, for example, insurance or survey data.



The Digital and Population Data Services Agency keeps up-to-date records of basic information on all 5.5 million Finnish citizens and foreign persons residing in Finland on a permanent or temporary basis. The national registries most commonly used for RWE research include the Care Register for Health Care (Finnish Institute for Health and Welfare), the Drug Reimbursement Register (Social Insurance Institution), the Social Benefits Register (Social Insurance Institution), and the Cause of Death Register (Statistics Finland).

Finnish national registries contain detailed clinical data

For many research questions, highly specific individual-level clinical data, such as laboratory records, imaging data, or patient chart texts are essential. However, information at this level of detail is often challenging to find. While Finnish national registries contain core clinical information, such as ICD-10 codes, prescription data, or dates and causes of death, highly detailed clinical data is available through hospital data lakes and biobanks, clinical quality registries, and national laboratory databases. Furthermore, the availability of different omics data is increasing every year.

Data lakes are storage repositories that hold vast amounts of raw data. Hospital data lakes collect all the data from different operational sources in one centralized storage repository. They contain enormous amounts of structured, semi-structured, and unstructured data, such as patient chart texts, laboratory records, imaging data, operations data, and healthcare resource use data, which can be accessed both by data queries and sophisticated text mining tools. Therefore, essentially all data collected by the hospitals are available for research purposes.

”Highly detailed clinical data is available through hospital data lakes, clinical quality registries, and laboratory databases.

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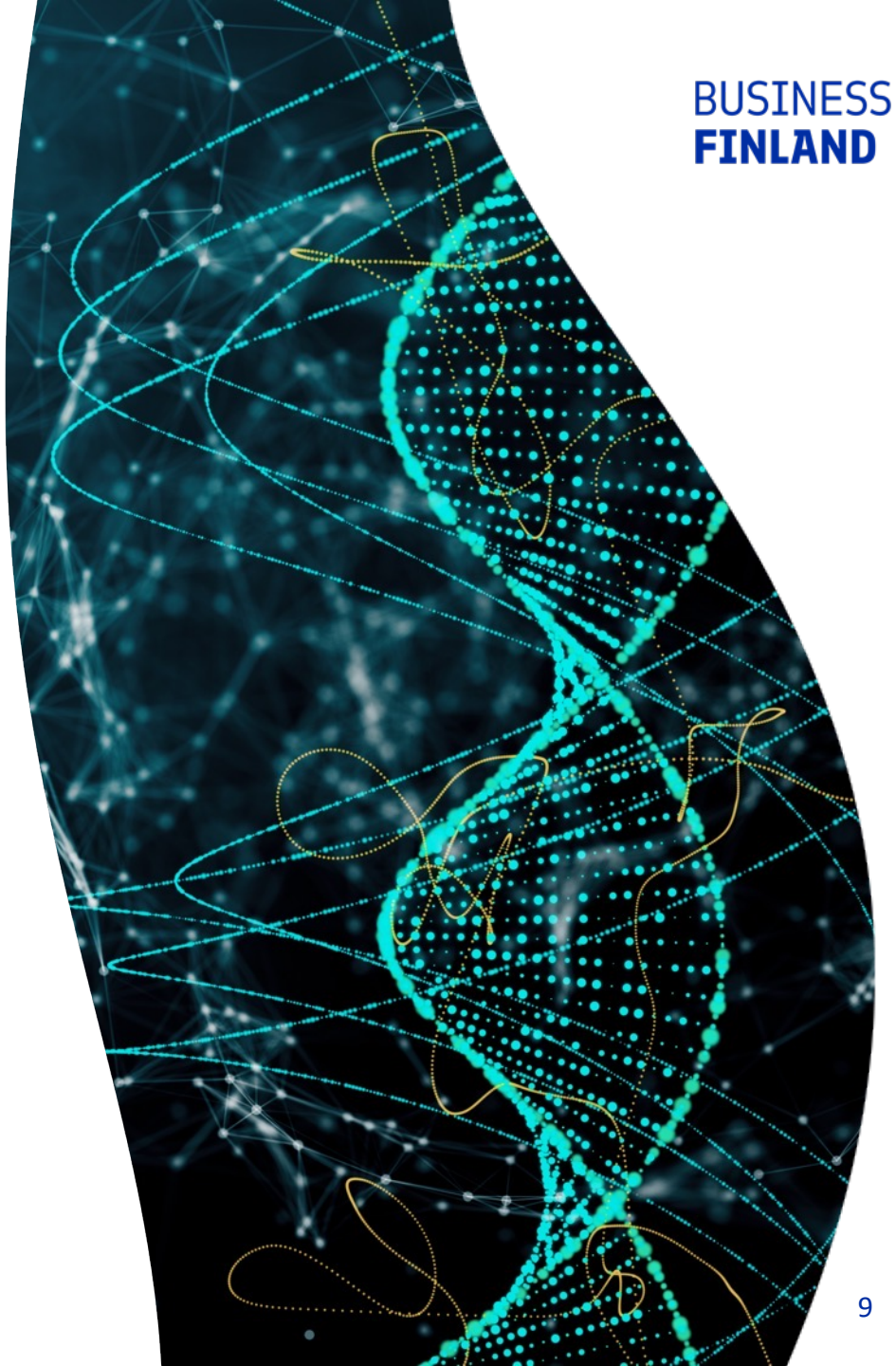
The hospital data lakes are based at the university hospitals (tertiary healthcare provided by 5 university hospital districts: TYKS, HUS, TAYS, KYS, and OYS) and increasingly also contain data from the central and regional hospitals (secondary healthcare provided by hospital districts) as well as from primary healthcare (primary healthcare offered by health centers). Each data lake is operated by a clinical informatics team, which organizes and harmonizes raw data for the users. They also offer a secure data analysis platform, which can be accessed via remote connection.

The purpose of the clinical quality registries is to provide a tool to monitor treatment outcomes and report quality of care. They may focus on specific diseases or on specific areas of health services, such as intensive care or emergency treatment. Typically, the data is collected structurally by a healthcare professional during a patient's visit to the clinic. The most advanced platforms have integration with electronic health records (EHR), which allows the seamless flow of data between the EHR system and the registry. In some cases, patient-reported outcome measures (PROM) are collected directly from patients via mobile or web application.

Diagnostic laboratory data are available in electronic format via hospital data lakes and laboratory service providers. The five main laboratory service providers in Finland (HUSLAB, TYKSLAB, ISLAB, NORDLAB, and FIMLAB) cover diagnostics in 18 out of 21 hospital districts of Finland, which have population coverage of approximately 90%. Laboratory service providers run diagnostic tests from blood, urine, and fecal samples. They also perform electrocardiogram measurements and have a major role in national cancer screening programs.



FINNISH DATA SOURCES

Figure 2 Finland has exceptionally comprehensive and high-quality resources consisting of health and social data and collections of biological samples, which together offer globally unique opportunities for real-world evidence (RWE) research. Read more about partnering opportunities from the RWE providers section. Access to biobank data can be applied for through the Fingenious® service.

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Extensive longitudinal data available for each Finnish individual

Every health or social care contact, such as an encounter with a nurse or doctor, a prescription for medication, or admittance for disability benefits, generates data on health and well-being. These data are recorded digitally in various health and social care registries or EHRs. As a result, an extensive history of each Finnish individual is available from the registries. Population information has been registered for the needs of both the civil authorities and the church since the 16th century, and several key registries have been computerized as early as the 1960s. The Finnish Cancer Registry was established in 1952, the Care Register for Health Care in 1969, and the Cause of Death Register in 1969. The first biological samples available for research were collected in the 1960s. Therefore, with Finnish data, it is possible to create study cohorts in which the data covers entire lifespan of all patients.

Finnish biobanks host versatile collections of biological samples, biodata and study participants for recontacting

Finnish biobanks collect and store biological samples and health data for medical research. They host remarkable collections of population and disease-specific cohorts, including over 11 million biological samples, such as blood, urine, cells, DNA, RNA, FFPE samples, fresh frozen tissue, and liquid biopsies. In addition, the biobanks contain extensive sample-related data, such as genomic, metabolomic, and laboratory data, as well as donor lifestyle information collected by frequent nationwide health surveys. Longitudinal clinical data collected from EHR can be linked to biobank samples. This data includes for example hospital visits, medication administered in the hospital, imaging data, procedure codes, operations and treatments. Finland hosts eleven biobanks altogether, of which the Finnish Biobank Cooperative (FINBB) connects all six university hospital biobanks as well as two national biobanks.

Finnish biobanks operate according to high-quality standards and legislation with state-of-the-art sample collection, management, storage, and sharing methods. Sample donors have given broad consent allowing the use of their samples and associated data in biobank research. This means that no additional consent is required from the patients for each research project separately. In addition, biobanks have pre-pooled samples with the possibility for recontacting donors for future studies. The majority of biobank sample donors have provided their consent to be recontacted for biomedical studies. FINBB's unique Fingenious® biobank service enables recontacting patients with, for example, a specific genotype-phenotype combination.

The Fingenious® online service provides a digital gateway to Finnish biobank samples and data, and a single point of contact for conducting feasibility studies, applying for study permits, and accessing data. There are over 11 million samples, nearly 500,000 samples genotyped, and pre-pooled patients for recontacting. This first-in-class service in Europe is built to serve academic and industry researchers and to advance medical research globally.

After each study, sample-specific raw data and results are returned to the biobank and the collected data, such as genomics, metabolomics, and laboratory measurements, are available for use in new projects. For example, the ongoing FinnGen study aims to produce close to complete genome variant data of 500,000 sample donors using GWAS genotyping, and the resulting individual-level genotype data linked with health registry data is returned to the biobank for future research. This positions FINBB among the world's largest repositories of genome data. Due to the unique heritage of the Finnish population, genomic data can be analyzed faster and more effectively than in populations of more heterogenous origins — significantly improving the chances of breakthrough findings.

"There are over 11 million samples, nearly 500,000 samples genotyped, and pre-pooled patients for recontacting – all accessible through the Fingenious® service.

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FINNISH BIOBANKS CONTAIN 4 MILLION PATIENTS WITH 13 MILLION SAMPLES*

SAMPLES

- DNA
- Plasma
- Serum
- Buffy coat
- Other sample types: FFPE tissue (>11M samples), RNA, cells, CSF, liquid biopsies (cfDNA), FF tissue, whole blood.

DATA

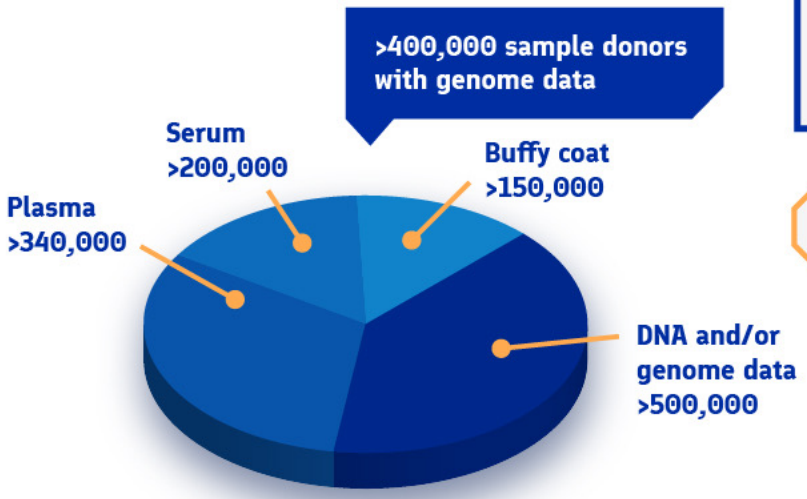
A majority of the available clinical data is longitudinal EHR data.

- Genome data
- Basic demographic data (age, gender, diagnosis, etc.)
- Data related to sample collection
- Laboratory values
- Hospital visits and stays
- Procedure codes
- Medication (administered or prescribed at the hospital)
- Imaging
- Lifestyle data
- Questionnaire data
- Data returned to the biobanks from research projects

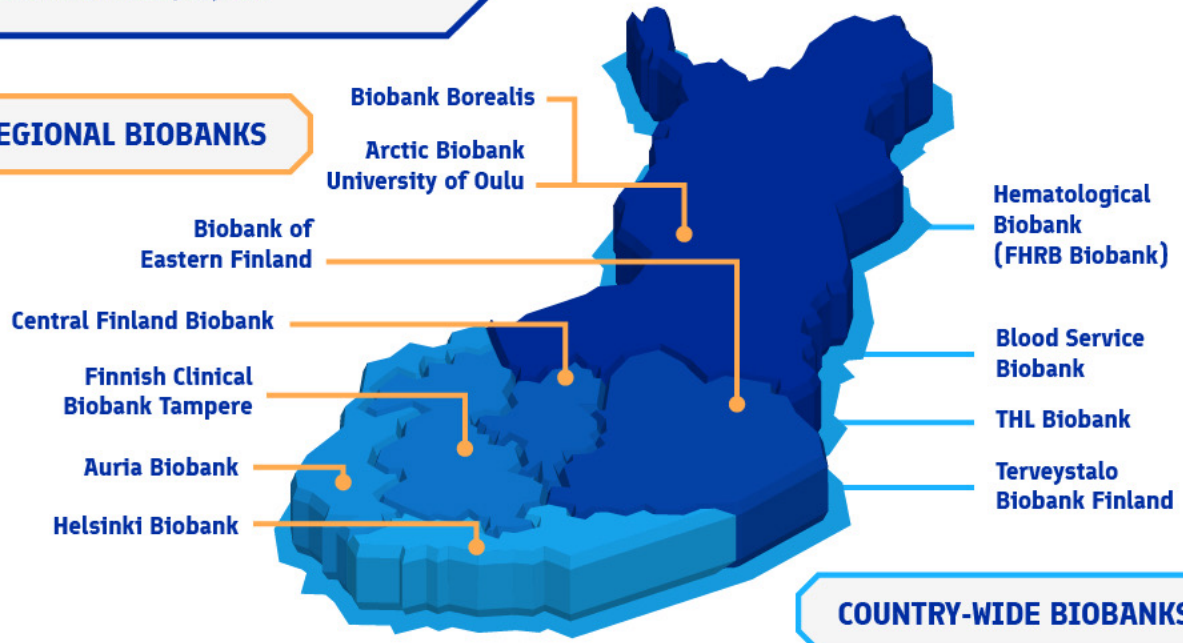
PATIENTS

- **POSSIBILITY FOR RECONTACTING DONORS**
  Pre-screened patients with phenotype and genotype deep data can be recontacted for new biomedical studies. Up to 95% of all biobank donors give consent to be recontacted.
- **NATIONAL PATIENT RECALL SERVICE**
  Over 300,000 patients available for recontacting through FINBB's unique Fingenious® biobank service.
- **MULTIDISCIPLINED NETWORK OF EXPERTS**
  Biobanks work in close collaboration with a network of clinicians covering all therapeutic areas.

EXAMPLES OF SAMPLES STORED IN FINNISH BIOBANKS



REGIONAL BIOBANKS



COUNTRY-WIDE BIOBANKS

Figure 3 The Finnish biobanks offer a diverse range of samples and associated data for research. *All Finnish biobank operations are regularly supervised by the Finnish Medicine Agency (FIMEA).

FFPE = Formalin-Fixed Paraffin-Embedded, CSF = Cerebrospinal fluid, cfDNA = circulating cell-free DNA, FF = fresh-frozen, EHR = electronic health record.

SAMPLES AND DATA IN THL BIOBANK

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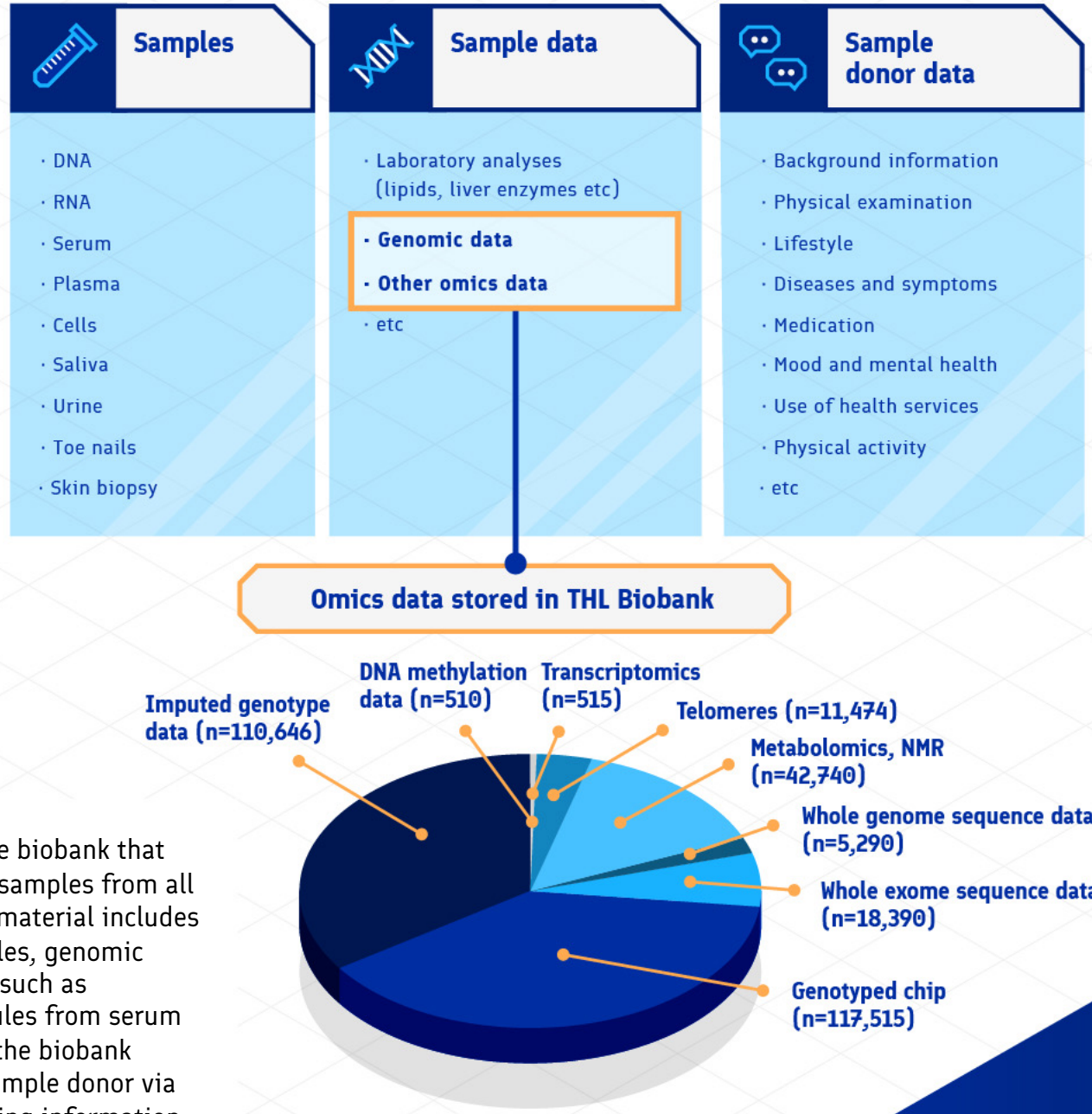

Figure 4 THL Biobank is a nationwide biobank that collects and stores valuable research samples from all over Finland. THL Biobank's research material includes more than one million research samples, genomic data, and other extensive omics data such as measurements of hundreds of molecules from serum samples (metabolome). In addition, the biobank stores information provided by the sample donor via interviews and questionnaires, including information on lifestyle and disease history.

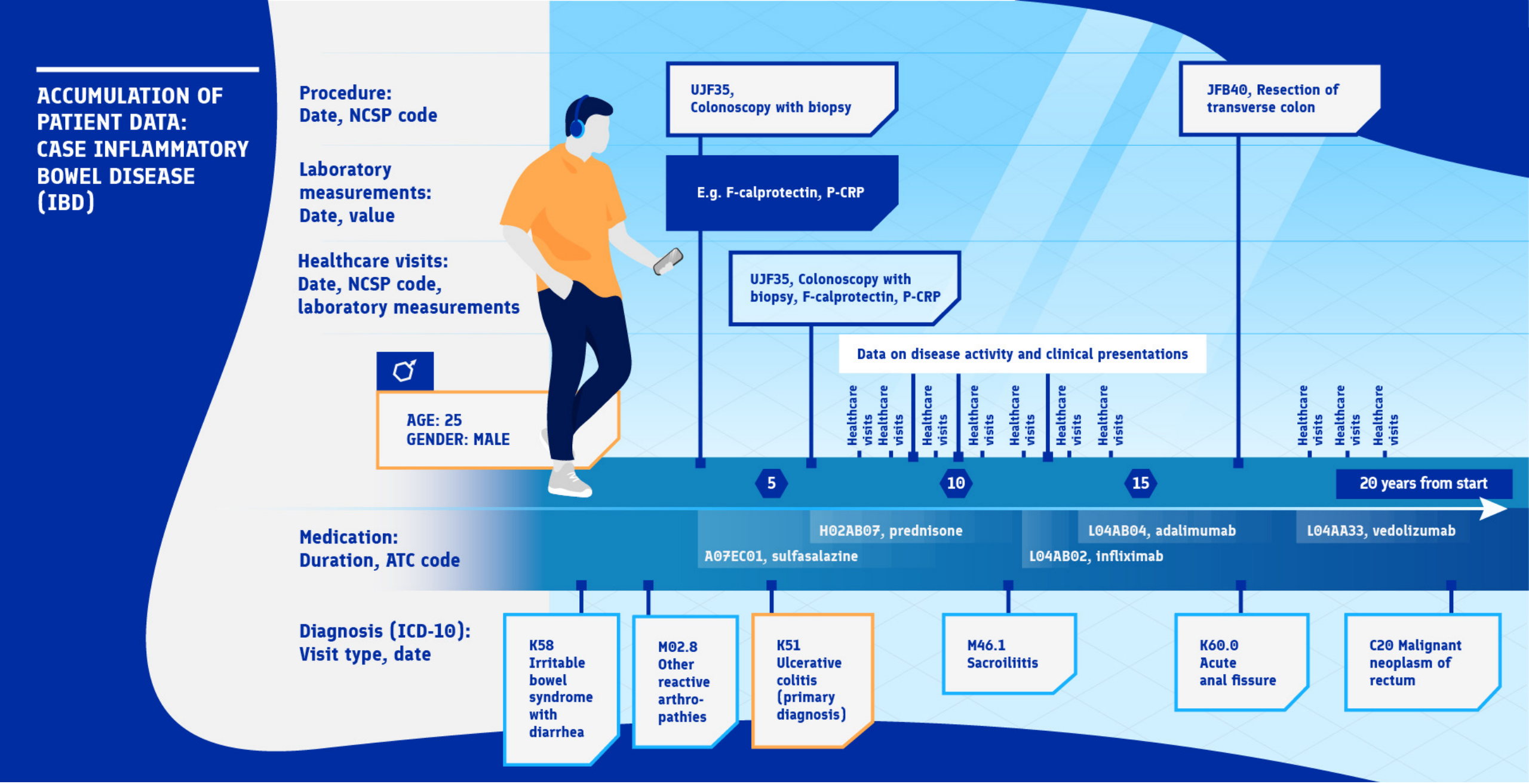

Figure 5 Health data based on longitudinal national electronic health registers and hospital data lakes provide a unique possibility for data mining and reconstruction of disease evolution and past events instead of a single-point snapshot.

A unique personal ID enables interconnectivity of all data sources

Easy, accurate, and unambiguous linkage of data from different sources is essential for generating rich, high-integrity data sets for medical research. All citizens have a unique personal ID number, which allows combining individual-level data from various data sources reliably and enables longitudinal data collection. For example, the data collected from hospital data lakes can be enriched by linking data from external sources, such as the Drug Reimbursement Register, the Care Register for Health Care, and the Cause of Death Register. Similarly, the data generated from the biobank samples can be linked with the detailed clinical data of hospital data lakes and national registry data.

”Data generated from the biobank samples can be linked with the detailed clinical data of hospital data lakes and national registry data.

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INTER-CONNECTIVITY OF DATA SOURCES

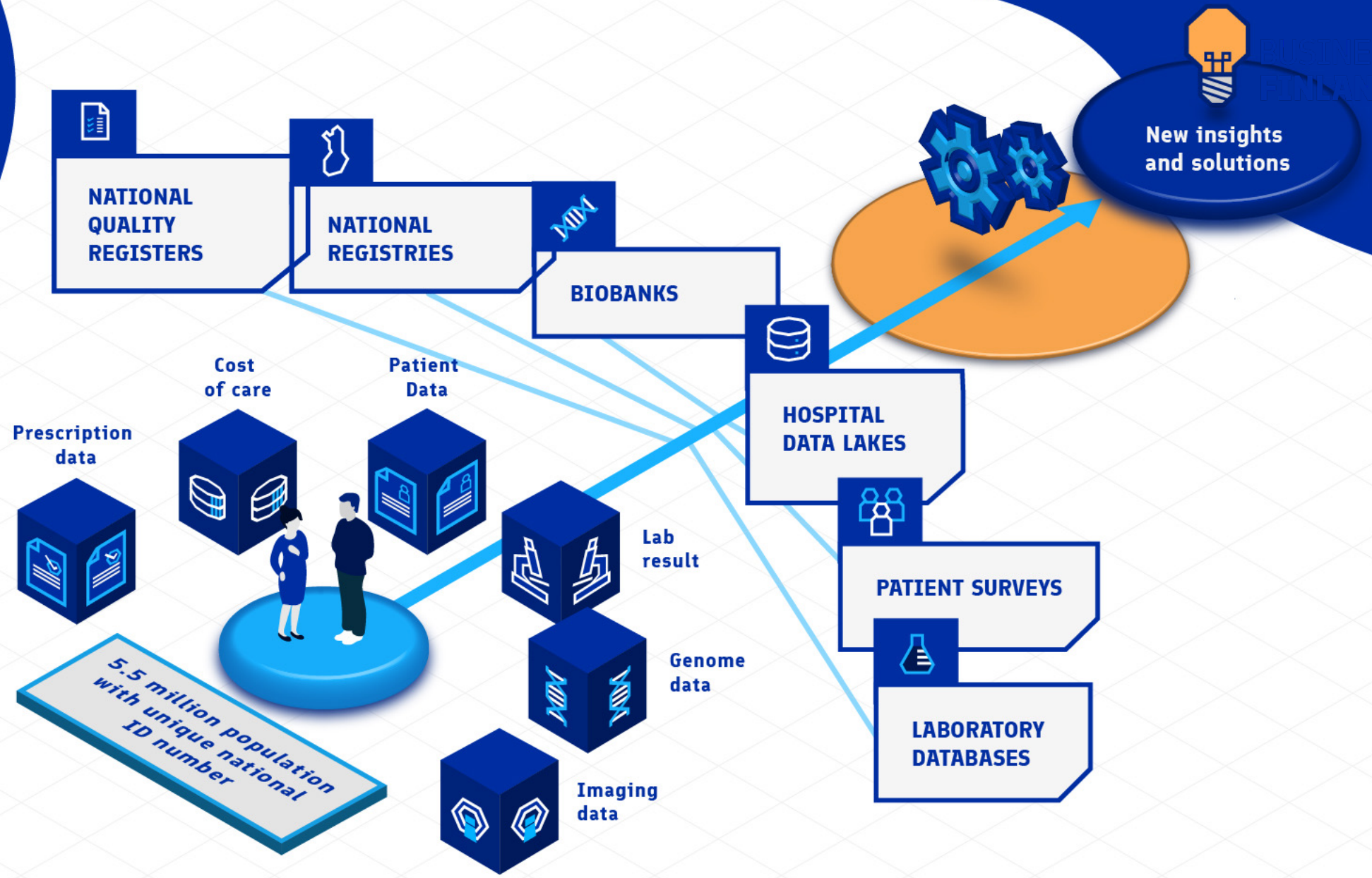

Figure 6 All citizens have a unique personal ID number, which allows combining individual-level data from various data sources reliably and enables longitudinal data collection. There is a significant overlap between different data sources, which is essential for generating high-integrity data sets for medical research.

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2. EFFICIENT OPERATING ENVIRONMENT

Finland has systematically built a dynamic operating environment to facilitate the use of its invaluable health and social data resources in medical research. The main aim of the Finnish Health Sector Growth Strategy has been to create a pioneering research environment for global businesses in the healthcare sector. The key activities have involved the preparation of pioneering legislation and regulatory practices for data use and building an advanced data infrastructure. In international assessments, Finland has been consistently ranked as one of the leading countries in the overall potential for secondary data use.[1–3]

Finland is a front-runner in setting groundbreaking legislation and data access policies

The Finnish government has recently introduced several local laws which aim at expanding the utilization of health and social data by providing easier access while adhering to the highest standards of data privacy.

The globally unique Finnish Act on the Secondary Use of Health and Social Data, which has been effective since 2019, applies to data collected in social and healthcare organizations and governs the secondary use of data for scientific research, innovation and development, and other activities. The main goals of the legislation are to provide a single point of contact for data permits, to provide quick access to data, and to ensure secure processes for data handling.

The Finnish Social and Health Data Permit Authority, Findata, is the single point of contact for issuing permits for the secondary use of health and social data. Findata also works with registry holders to collect the study data and provides a secure analysis platform, which can be accessed remotely. Individual-level pseudonymized data is available for scientific research conducted by both academic and industry researchers, while anonymous aggregate-level data can be used for a broader set of purposes.

”Finland has been consistently ranked as one of the leading countries in the overall potential for secondary data use.

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The Finnish Biobank Act, which has been effective since 2013, is among the most progressive in the world. Its aim is to improve the accessibility and availability of data and samples while maintaining high standards for data privacy and ethics. Biobank research is based on broad consent, which means that biobank samples and data can be used for future research without obtaining separate consent from the participants for each study. Sample-related data can be linked with personal data, such as clinical data obtained from the hospital data lakes and national registry data. All data generated during the study are returned to the biobank and made available for future use. It is also possible to re-contact sample donors and invite them to follow-up studies, such as scientific surveys or targeted clinical trials.

The Finnish Biobank Cooperative (FINBB) is a unique biobank service which provides researchers centralized access to the collections and services of Finnish biobanks. FINBB's Fingenious® online service provides a catalog of Finnish biobank samples and data, and functions as a gateway for conducting feasibility studies, applying for study permits, and accessing data. There are over 11 million samples in total, nearly 500,000 of which are genotyped, and pre-pooled patients for recontacting. This service is built to serve academic and industry researchers and to advance medical research globally. It is the first of its kind in Europe.

Universal high-quality health care creates a favorable framework for RWE research

Finland has publicly-funded, universal, high-quality healthcare, which provides an optimal environment for conducting real-world evidence research. There are three different healthcare systems which receive public funding: municipal healthcare, private healthcare, and occupational healthcare. Municipal healthcare is comprised of primary healthcare offered by health centers, secondary healthcare provided by hospital districts, and tertiary healthcare provided by university hospital districts.

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Because of the high standards of healthcare and the tax-funded healthcare system, even the latest treatments are generally available for all patients. Treatment practices are shared across the country through close-knit communities of specialists, continuous training of healthcare professionals, and implementation of national guidelines (see Current Care Guidelines). Registry data is generated systematically as part of standard procedures by using similar approaches across the country. Therefore, the Finnish setting allows collecting data that reflects up-to-date treatment practices, represents the entire population, and is minimally biased towards any particular social, geographical, economic, or age group.

Finns have an exceptionally high level of trust in authorities and public institutions, including public social welfare and healthcare. Several studies have also indicated that Finns have a highly positive attitude towards science and willingness to participate in medical research. For example, 95% of biobank sample donors have given consent for use of their samples and data for research.

Finland's advanced data infrastructure supports secure and effective use of data

There are several factors which present high demands for data infrastructure in modern medical research. These include the need for highly specific data or massive quantities of data, analysis complexity, and data privacy requirements. In recent years, major advances have been made in the Finnish data ecosystem to respond to these demands.

Finland has a long history of collecting and managing health and social data in digital format. Several registers have been computerized as early as the 1960s, and currently all Finnish national registries are in digital format. Clinical data is stored in electronic health records (EHR), and the latest EHR systems and clinical quality registries advance data recording in a structured format. In some cases, patient-reported data can be collected directly from patients using mobile applications that are connected to electronic health records or clinical quality registries.

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Modern hospital data lakes further enhance the data use of data for medical research. Advanced tools, such as natural language processing text mining methods and artificial intelligence image analytics, also allow efficient use of unstructured EHR data. In addition, there are currently major ongoing efforts to harmonize the EHR data according to the common OMOP (Observational Medical Outcomes Partnership) data model.

Findata and several university hospitals provide modern, secure, and audited analysis environments for researchers, which comply with the highest security standards. Academic and industry researchers can access the data via remote connection.

Finland also hosts one of the world's most powerful supercomputers, the completely renewable-energy-powered LUMI (550 petaflops), as well as a 5-qubit quantum computer with the ultimate goal to build an even more powerful 50-qubit computer by 2024.

References

1. Statistics Finland. (2018, December 5) Finland among the best in the world. Hundred-year-old Finland in the light of statistics. Retrieved from https://www.stat.fi/tup/satavuotias-suomi/suomi-maailman-karjessa_en.html

2. Open Data Institute (ODI). (2021, September) Report: Secondary use of health data in Europe. How well is your country doing on policy for secondary use of health data? Retrieved from https://secondary-use-health-data.theodi.org/

3. Frost & Sullivan 2018. Growth Insights – Real World Evidence Analytics Solutions Market.

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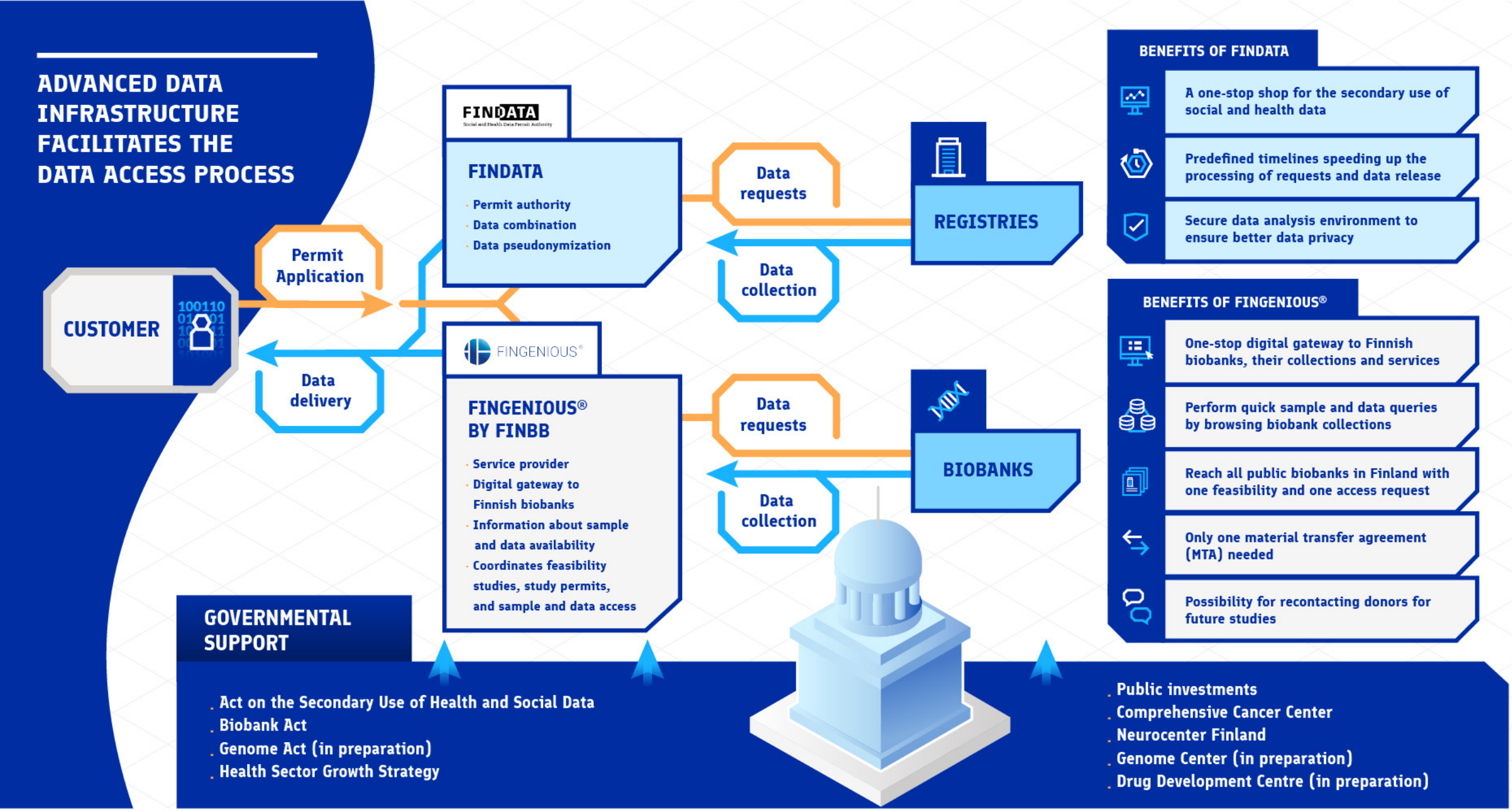

Figure 7 Finland's advanced data infrastructure supports secure and effective use of data. The customer may be an RWE service provider or a pharmaceutical company, for example.

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3. FORERUNNING COLLABORATORS

Finnish data sources offer exceptional opportunities for real-world evidence (RWE) research. However, effective use of the data collections requires in-depth clinical expertise and analytics skills, as well as an understanding of local treatment practices, data recording practices, and data content. To make most of the data, Finland offers a research ecosystem that provides opportunities to collaborate with world-class scientists, clinicians, and service providers. Typically, RWE projects involve a tight collaboration between local clinical experts, registry holders, service providers, and the customer.

Public-private cooperation and competence development are among the key focus areas of the Finnish Health Sector Growth Strategy. This means that there are many ongoing endeavors to develop funding and regulation in the health sector, to invest in continuous learning and skills, and to create new partnership models between the public and private sectors. As an example, new types of national cooperation networks for research and treatment, the Comprehensive Cancer Center Finland and Neurocenter Finland, have already been established and the founding of Genome Center and Drug Development Centre is currently in preparation.

Finland is a well-known harbor for leading clinical institutions and advanced data science expertise

Finland has invested public funds in high-quality academic medical research and research-based education in medical sciences for decades, with excellent results. As an example, the Academic Medical Center Helsinki is ranked among the top 10 medical campuses in Europe and among the top 50 globally. The Medical Faculty of the University of Helsinki was ranked fifth in a survey of top European institutions in clinical medicine based on the

> **”Finland offers a research ecosystem that provides opportunities to collaborate with world-class scientists, clinicians, and service providers.**

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number of citations per publication dealing with clinical medicine. The academic research and education of medical sciences are centered around the five university hospitals (Helsinki, Tampere, Turku, Kuopio, and Oulu) across the country. Finnish clinical experts are willing to enter into research collaborations with private partners and the university hospitals have developed models for building such collaborations in practice (for example, HUS Testbed, Health Campus Turku, HealthHUB Tampere). The university hospitals have also built clinical informatics units with the top-notch data science expertise required for data mining of hospital data lakes and other data sources. Furthermore, hospital biobanks associated with the university hospitals collect various types of biological samples for ongoing and future research. The Finnish Biobank Cooperative (FINBB) connects all six university hospital biobanks as well as two national biobanks.

The Institute for Molecular Medicine Finland (FIMM) is an independent translational research institute, which is recognized as one of the global leaders in human genomics and precision medicine. Its mission is to perform innovative research on patients and populations to generate a better understanding of drivers of health and disease, through utilization of molecular, genomic, and health data. FIMM is a central partner in a large public-private partnership FinnGen, which aims to collect and analyze genome and health data from 500,000 Finnish participants, identify the genetic drivers of numerous diseases, and address the global need for large datasets that enhance drug target identification and prioritization. FIMM employs more than 230 professionals representing tens of nationalities.

The Finnish Institute for Health and Welfare (THL) studies, monitors, and develops measures to promote the well-being and health of the population of Finland. THL is a preferred partner in domestic and international research with more than 800 articles published in world-class scientific journals each year. THL is also responsible for developing and maintaining many of the key national registries, such as the Care Register for Healthcare.

”FINBB connects all six university hospital biobanks as well as two national biobanks.

THL Biobank hosts several significant population-based cohorts, disease-specific collections, and other nationally significant sample collections, including high-quality samples, a wide variety of information about sample donors, genomic data, and other data measured from the samples.

The Finnish Biobank Cooperative (FINBB) supports researchers by providing centralized access to collections and services of the Finnish biobanks and their background organizations. FINBB develops and maintains the digital Fingenious® service, which offers access to Finnish biobank samples, data, study participants and expertise. The purpose of the service is to benefit biomedical research by serving academic researchers and researchers from various industries such as the pharmaceutical industry nationally and internationally. The Fingenious® service enables fast access to biospecimen, biodata and study participant recruitment from all the public biobanks in Finland through only one contract.

The Fingenious® service provides researchers with a one-stop service for feasibility studies, sample and data requests, study coordination, and contract services. The service also includes support for choosing the right partners and experts needed. The Fingenious® service provides a view to Finnish public biobank data and makes it possible to find the right study participants for the study with the help of a unique recruit service. The service saves researchers time and resources by automating and standardizing searches of Finnish biobank data.

Partner with world-class service providers

Several local and international service providers with world-class research competence, top-notch data science expertise, and understanding of local data and practices are partnering with pharmaceutical companies to conduct research in Finland. Read more about partnering opportunities from the RWE providers section.

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4. USE CASES

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Bayer's Future Clinical Trials project leverages external control arms to advance clinical development

Bayer's Future Clinical Trials project develops innovative ways to exploit external control arms as part of randomized controlled trials (RCTs) by utilizing real-world data and advanced algorithms. The aim is to reduce or eliminate the need to enroll control participants. The most promising application is for early-stage trials where the desire to minimize the number of patients on the placebo is paramount.

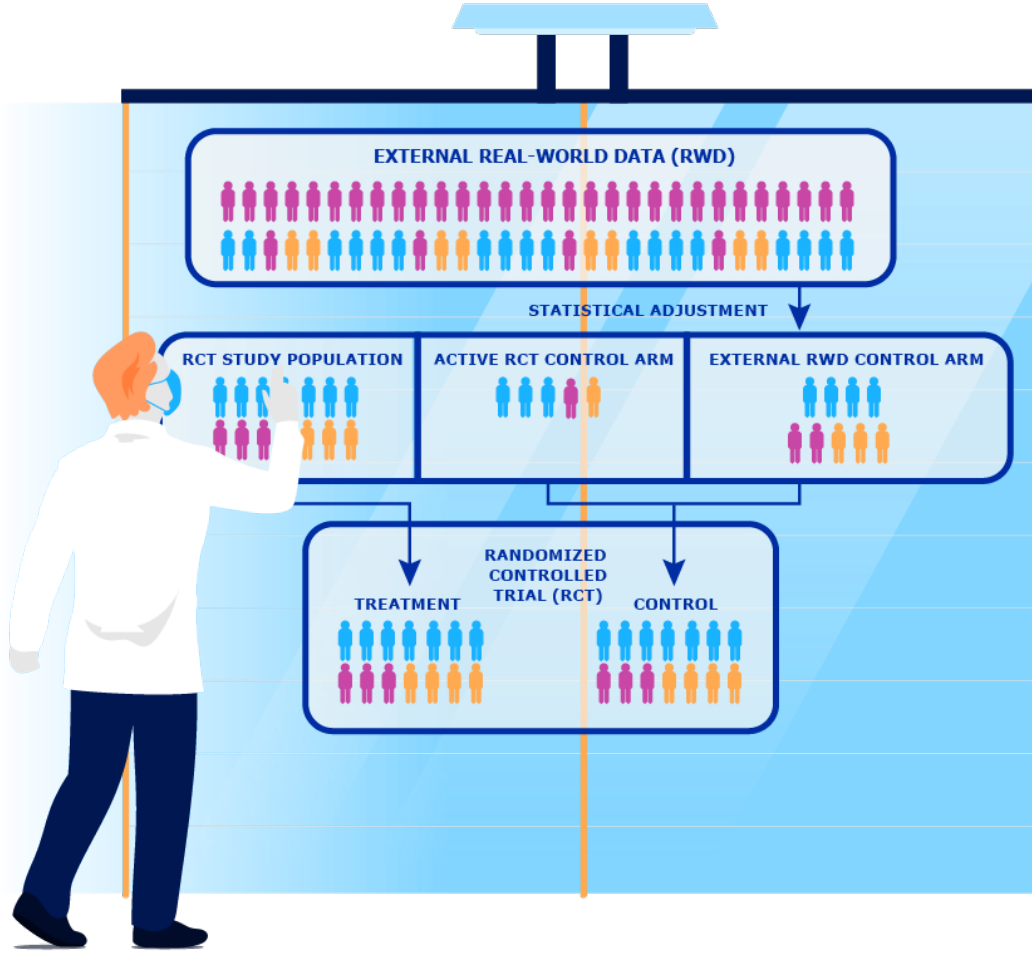
Patient recruitment and retention in clinical trials are major challenges in the development of new medicines. A pioneering study within the Bayer Future Clinical Trials collaboration framework aims to evaluate the strengths and weaknesses of replacing primary data collection control arms in randomized controlled trials with external control arms formed utilizing existing Finnish real-world data (RWD).

The study population for the external control arm will be identified by Auria Clinical Informatics, which manages the data lake of the Hospital District of Southwest Finland. Additional RWD will be collected from the Finnish national healthcare registers. The primary data collection source for this study is an ongoing clinical trial comparing a new investigational drug to an active control arm.

The data management, harmonization, and anonymization processes are planned to serve as a proof-of-concept for the use of pseudonymized and anonymized RWD as external controls.

The data generated in the Future Clinical Trials study may advance utilization of external control arms in clinical trials thereby increasing efficiency, reducing delays, and lowering costs in the evaluation of new therapies.

"Patient recruitment and retention in clinical trials are major challenges in the development of new medicines.



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Background

Replacing primary data collection control arms in randomized controlled trials (RCTs) with external control arms formed from existing real-world data (RWD) can increase efficiency, reduce delays, and lower costs in the evaluation of new therapies by reducing or eliminating the need to enroll control participants.

Objectives

This retrospective Future Clinical Trials study aims to evaluate whether Finnish RWD is an adequate source for creation of an external control arm for an RCT. This study will provide valuable information on the feasibility of replacing primary data collection control arms in RCTs with external control arms using existing RWD.

Methods

The RWD study population will be identified via Auria Clinical Informatics covering the Regional hospital data lake of Southwest Finland. Additional RWD will be collected from the Finnish national healthcare registers.

The primary data collection source is an ongoing clinical trial comparing a new investigational drug to an active control arm. Matched users in the RWD external control arm are compared to the primary composite endpoint in the active RCT arm.

Results

The results from this study are estimated to be available during the year 2022.

”The study will provide valuable information on the feasibility of replacing primary data collection control arms in RCTs with external control arms using existing RWD.

Future Clinical Trials framework

Future Clinical Trials is a collaboration research project initiated by Bayer with the aim to transform the way clinical trials are planned and conducted in the future.

Developing a new prescription medicine is becoming increasingly expensive. The aim of the Future Clinical Trials project is to leverage digital technologies and data to find innovative solutions to the major challenges facing medicine development, and to improve health outcomes and reduce the burden on patients, doctors, and overall costs of healthcare.

Future Clinical trials aims to build a thriving health ecosystem in Finland, as Finland offers an excellent environment to co-design and test data-driven solutions that have the potential to become global innovations. The project has received funding from Business Finland.

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Investigated treatment: Investigational drug and control drug

Participants: 8,255 patients (RWD external control arm)

RWD Sources: Regional hospital data lake of Southwest Finland via Auria Clinical Informatics (study population identification and data collection); the nationwide healthcare registers - Care Registers for Healthcare (Hilmo and Avohilmo) by Finnish Institute for Health and Welfare (THL) (data collection); the nationwide cause of death register by Statistics Finland (data collection), ant the Prescription Centre and Drug Prescription Registry by Social Insurance Institution of Finland (Kela) (data collection)

Time span: 11/2020–12/2024

Funding: Bayer and Business Finland

Partners: Bayer, MedEngine, Veil.AI, and Medisapiens

”Finland offers an excellent environment to co-design and test data-driven solutions that have the potential to become global innovations.

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The colossal FinnGen project combines genome data with digital healthcare data from over 500,000 Finns

The FinnGen study is an unprecedented personalized medicine project representing one of the largest studies of this type. The 10-year project aims to collect and analyze genome information and digital healthcare data from over 500,000 Finnish biobank participants (close to 10% of the population). The data created will be used to drive new disease biology, and for prioritising drug targets based on genomic information, enabling more efficient drug development pipelines and better individualized drug treatment choices.

Access to the unique combination of longitudinal phenotypic and genome data has attracted researchers from the pharmaceutical industry and several international companies have decided to partner with FinnGen.

The public-private collaboration is internationally exceptional as FinnGen brings together Finnish universities, hospitals and hospital districts, the Finnish Institute for Health and Welfare (THL), the Finnish Red Cross Blood Service, various biobanks and international pharmaceutical companies, and hundreds of thousands of Finns.

The current FinnGen dataset contains combined genotype and health registry data from 392,000 Finnish sample donors, and samples are available from more than 500,000 donors.

FinnGen aims to construct a world-class resource that can be applied to future studies. The ultimate goal is to identify new therapeutic targets and diagnostics based on genomic information.

”Access to the unique combination of longitudinal phenotypic and genome data has attracted researchers from the pharmaceutical industry.

“Finland has a strong history in technology development and investment. What’s more, you already have the right legal structure. This is often a prerequisite for scientific breakthroughs in our field.”

– MARK DALY, DIRECTOR OF THE INSTITUTE FOR MOLECULAR MEDICINE FINLAND (FIMM)

BUSINESS FINLAND

Background

FinnGen capitalizes on Finland's decades-long investments in healthcare, health registries, epidemiological research, and biobanks. Recent modernization of the regulatory environment (for example, the Biobank Act and the The Act on the Secondary Use of Health and Social Data) enables extensive utilization of national sample cohorts to advance medical research, patient care, and drug development.

Objectives

The FinnGen study aims to 1) produce medical innovations by combining health registry and genome data; 2) support Finland to become a pioneer in biomedicine and personalized healthcare; 3) create a model for cooperation between the public sector and the healthcare industry; and 4) provide early access to new personalised treatments and health innovations for all Finns.

Code of conduct

The genomic data produced during the project will be returned to Finnish biobanks and remain available for researchers and companies, providing the basis for new academic studies, industrial partnerships, drug trials, monitoring studies, and other private-public projects.

The current budget of the project is over €92 million and the implementation is based on the cooperation agreement between the parties and the approved research plan. The Coordinating Ethics Committee of the Helsinki and Uusimaa Hospital District has evaluated the project. The research project applies the permissions to utilize the register data for research purposes from national authorities, and complies with existing legislation – in particular the Biobank Act and the Data Protection Act. The EU Data Protection Regulation has been taken into account.

University of Helsinki is the official data controller of the study. Each sample is coded so that individuals cannot be identified when biobank samples are used for FinnGen research. A key feature of the project is that an individual's data will not be released. Instead, de-identified data is analyzed within a secure, monitored environment. The data privacy and security of the project has been evaluated by external parties and the risk of data misuse is minimal.

Returned data use case | Genome data returned to the Finnish biobanks is a valuable resource

Genome data returned to the biobanks from research projects are of utmost importance for new genomic studies. The utilization of genomic data in prevention and treatment of common chronic diseases is being studied in the national Genomics to Healthcare (P6) project coordinated by THL. "The project assesses the genetic risk of developing specific common diseases. Analyses have already been executed to assess the polygenic risk score for coronary heart disease, venous thrombosis, and type 1 and type 2 diabetes," says leading researcher Kati Kristiansson from the Finnish Institute for Health and Welfare.

The project aims at determining whether the polygenic risk score can be used to identify diabetic patients at increased risk of complications, and whether polygenic risk score predicts the occurrence of a venous thrombosis. "Prevention and early healthcare are crucial opportunities for future healthcare," Kristiansson says.

BUSINESS FINLAND

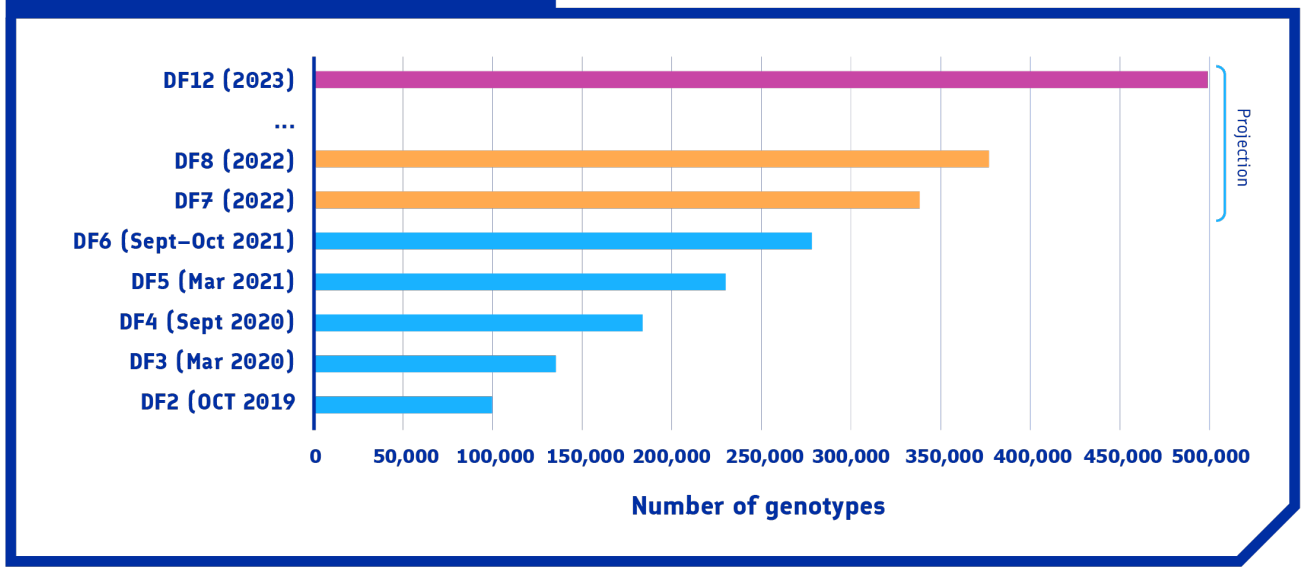
The Fingenious® service provides a one-stop access point for genome data returned to the public Finnish biobanks. The latest batch of returned FinnGen genome data is from data freeze 6 (DF6), which contains genotypes for almost 280,000 sample donors covering nine biobanks in total. The Fingenious® service currently offers access to genome-wide data from seven public biobanks together with biobank samples and sample donor associated phenotype data.

”Genome data returned to the biobanks from research projects are of utmost importance for new genomic studies.

“Shortening the development curve to bring effective medicines to the market is vital for modern society.”

— AARNO PALOTIE, SCIENTIFIC DIRECTOR OF FINNGEN

FINNGEN GENOTYPES RETURNED TO BIOBANKS



Recall use case | FinnGen study participants invited for clinical examinations in a sub-project on Alzheimer’s disease

The first sub-project of the FinnGen study to invite participants for further clinical examinations began in eastern Finland in late 2021. A total of 150 sample donors (from the Biobank of Eastern Finland) with Alzheimer's disease, or other less severe memory disorders, were invited for clinical examinations. The project explores methods that are suitable for investigating disease progression. The aim is to improve early diagnostics of Alzheimer's disease and to increase understanding of its pathogenesis.

Among the FinnGen samples analyzed so far, approximately 9,600 people have been diagnosed with dementia syndrome, and 5,300 with Alzheimer’s disease.

“FinnGen is becoming one of the largest and most comprehensive research cohorts for Alzheimer’s disease in the world. However, further in-depth clinical examinations are needed to describe the stage and progression of dementia,” Neurologist Valtteri Julkunen from the University of Eastern Finland and Kuopio University Hospital says.

BUSINESS FINLAND

The objective is to explore optimal ways for collecting more detailed memory disorder data from patients. Computer and tablet-based software measuring memory and functional ability will be compared to neuropsychological examinations carried out by healthcare professionals.

By combining clinical data collected from patients during their visits with FinnGen's genetic data and health record information, researchers seek to explore biological mechanisms that lead to the development of Alzheimer's disease. A blood sample taken from the study participants will enable possible identification of new biomarkers of Alzheimer's disease.

"The study also serves as a test for a project that requires seamless collaboration between several partners and that extensively combines genetics, existing health data, register data, biomarkers and cognition research," Julkunen says.

Finding study participants among sample donors for further biomedical studies is enabled by the biobanks and the Fingenious® service.

"FinnGen is becoming one of the largest and most comprehensive research cohorts for Alzheimer's disease in the world.

Current status: The current FinnGen dataset contains combined genotype and health registry data from 392,000 Finnish sample donors, and samples are available for more than 500,000 donors.

Target study sample: 500,000 Finnish biobank donors

Genotyping: ThermoFisher Axiom custom array

Samples: ~200,000 legacy samples and ~300,000 prospective samples

Time span: 2017–2027

Budget: EUR 92 million

Funding: Business Finland, Abbvie, AstraZeneca, Biogen, Boehringer Ingelheim, Bristol-Myers Squibb, Genentech (a member of the Roche Group), GlaxoSmithKline (GSK), Janssen, Maze Therapeutics, MSD (Merck & Co., Inc, Kenilworth, NJ USA), Novartis, Pfizer and Sanofi.

Partners: Public-private partnership between Finnish universities, biobanks, hospital districts, and several international pharmaceutical companies

Please note that FinnGen is not an open access resource and the individual-level data is only accessible to the researchers representing the consortium partners. You can get more information about the access request process by contacting Risto Kajanne (risto.kajanne@helsinki.fi). The summary statistics and GWAS results are made publicly available every 6 months.

FinnGen genome data will be returned to the biobanks and access to the data can be applied through the Fingenious service.

BUSINESS FINLAND

Finnish PreMed biobank study identified genotype-health outcome associations in patients using antithrombotic therapy

The PreMed biobank study extensively utilized Finnish real-world health data resources by linking genotype data from Finnish biobanks with national registry data in the context of antithrombotic therapy. The genotype-phenotype associations identified in the study may be used in the optimization of treatment practices and guidelines.

In the framework of the PreMed ecosystem project by the Technical Research Centre of Finland Ltd (VTT) the biobank study investigated pharmacogenomics of antithrombotic drugs. The study assessed the clinical and economic relevance of using genome data in guiding decisions on best drug and drug dose for patients using antithrombotic therapy.

In the retrospective PreMed biobank study, data from three Finnish biobanks, national registries, and laboratory data from primary and secondary care were integrated. The study exploited FinnGen genome data, clinical data, and healthcare resource use data from Finnish biobanks and hospital data lakes.

The study found associations between genotypes and health outcomes in patients using warfarin and direct oral anticoagulants (DOACs). Genetic associations between genotype and international normalized ratio (INR) parameters and thromboembolic outcomes were reported for Warfarin. For DOACs associations between genotype and bleeding events (apixaban) and thromboembolic events (rivaroxaban) were reported.

The unique Finnish data resources and infrastructure were successfully exploited for a real-world data study in pharmacogenetics. The results facilitate the identification of individuals with suboptimal response to antithrombotic medication, and decision-making on new care practices and guidelines. The biobank study also paves the way for industry-driven research using health data resources.

”The unique Finnish data resources and infrastructure were successfully exploited for a real-world data study in pharmacogenetics.

Background

Earlier pharmacogenetic studies have identified a number of gene variants associated with the metabolism of antithrombotic drugs. For example, the anticoagulation effect of warfarin can be stronger based on the genotype, thereby leading to a higher risk of bleeding caused by the drug therapy. Earlier studies have found associations between genetic variability and plasma levels of DOACs, but it is unclear whether these associations translate into clinical outcomes.

Objectives

The PreMed biobank study aimed to analyze associations of genetic variants with the occurrence of bleeding or thromboembolic events in warfarin, dabigatran, apixaban, and rivaroxaban users.

Materials and methods

The retrospective real-world study linked genotype data from three Finnish biobanks with national registry data on drug dispensations and healthcare encounters. Several single-nucleotide variants (SNVs) potentially associated with bleeding or thromboembolic events were investigated: the *VKORC1* and *CYP2C9* genes in warfarin users, and *ABCG2*, *ABCB1*, *CES1*, and *CYP3A5* genes in DOAC users.

Cox regression models were used to compare the incidence of clinical outcomes between carriers and noncarriers of the SNVs or haplotypes.

Results

The cohort of warfarin-treated patients consisted of 2,508 participants (45% women, mean age of 69 years). Based on the different variant alleles 65% of the patients were categorized as normal responders and 35% sensitive or highly sensitive responders. Compared to normal responders, sensitive and highly sensitive responders had fewer INR tests below 2 and more above 3. The incidence of bleeding outcomes was 5.4 for normal responders and 5.6 for the sensitive and highly sensitive responder group. The incidence of thromboembolic outcomes was 4.9 and 7.8, respectively.

The cohort of DOAC-treated patients consisted of 1,806 patients in total. The *ABCB1* c.3435C>T single nucleotide variant (SNV), and 1236T- 2677T- 3435T haplotype were associated with a reduced risk for thromboembolic outcomes in rivaroxaban users. The *ABCB1* 1236C-2677G-3435C and 1236T-2677G-3435C haplotypes were associated with an increased risk for thromboembolic outcomes in rivaroxaban users. The *ABCB1* c.2482-2236G>A SNV was associated with a lower risk for bleeding events in apixaban users.

Conclusions

In a real-world setting, genetically sensitive and highly sensitive responders to warfarin had more high INR tests and required a lower daily dose of warfarin than normal responders. However, the risk for bleeding events was not increased in sensitive and highly sensitive responders. Interestingly, the risk of thromboembolic outcomes was lower in normal responders compared to the sensitive and highly sensitive responders.

In the cohort of DOAC-treated patients, *ABCB1* variants were reported as potential factors affecting thromboembolic events in rivaroxaban users and bleeding events in apixaban users.

BUSINESS FINLAND

PreMed project – Data-driven precision medicine ecosystem

The overarching PreMed project aimed to promote the development of a data-driven precision medicine ecosystem in Finland and to catalyze co-operation between stakeholders in Finland and abroad. PreMed's main objectives were to collect and disseminate information of ongoing national and international activities, assess precision medicine ecosystem needs and bottlenecks, identify new business strategies and models, and provide recommendations to public bodies.

The PreMed project provided an overview of the Finnish infrastructure, stakeholders and business potential in the field of data-driven precision medicine. Particular focus was on opportunities opened by secondary use of health-related data as enabled by healthcare registers and biobanks.

By providing information and experiences of the healthcare data access processes, PreMed aimed to lower the threshold for companies to exploit healthcare data and results from retrospective studies in their business.

"Particular focus was on opportunities opened by secondary use of health-related data as enabled by healthcare registers and biobanks.

References

Vuorinen, A.-L. et al. Pharmacogenetics of Anticoagulation and Clinical Events in Warfarin-Treated Patients: A Register-Based Cohort Study with Biobank Data and National Health Registries in Finland. Clin. Epidemiol. Volume 13, 183–195 (2021). https://doi.org/10.2147/CLEP.S289031

Lähteenmäki, J. et al. Pharmacogenetics of bleeding and thromboembolic events in direct oral anticoagulant users. Clin. Pharmacol. Ther. cpt.2316 (2021). https://doi.org/10.1002/cpt.2316

Lähteenmäki, J. et al. Integrating data from multiple Finnish biobanks and national health-care registers for retrospective studies: Practical experiences. Scand. J. Public Health 140349482110044 (2021). https://doi.org/10.1177/14034948211004421

PreMed biobank study

Objective: The determination of the clinical and economic relevance of genome data in guiding treatment decisions for patients using antithrombotic therapy.

Outcome: The identified novel genotype-phenotype associations support the optimization of treatment practices and guidelines.

Investigated anticoagulants: Warfarin, DOACs (Dabigatran, Rivaroxaban, Apixaban)

Participants: 2,508 patients (Warfarin), 1,806 patients (DOACs)

RWD sources: Genome data from Helsinki Biobank, Auria Biobank, and THL Biobank. Register data from THL (Hilmo & Avohilmo) and Kela (drug dispensations). Laboratory data from primary and secondary care.

Time span: 10/2018–04/2021

Budget: EUR 1.166 million (overall PreMed ecosystem project)

Funding: Business Finland (46%), VTT (44%) and companies (10%)

Partners: Avaintec Oy, Finnish Biobank Cooperative – FINBB, Crown CRO Oy, Oy Karl Fazer Ab, Medaffcon Oy, Mediconsult Oy, Novartis Finland Oy, Pfizer Oy, Roche Diagnostics Oy

BUSINESS FINLAND

Rare Complement Factor I variants in age-related macular degeneration

Finnish Biobank Cooperative, FINBB, helped Gyroscope Therapeutics identify samples across the Finnish public biobanks

Gyroscope Therapeutics Limited, a clinical-stage gene therapy company, initiated a research project with Finnish biobanks and Finnish Biobank Cooperative (FINBB) to screen samples from patients with dry age-related macular degeneration (AMD). The goal was to find carriers of rare variants of Complement Factor I (*CFI*) gene.

Background

AMD is a leading cause of permanent vision loss in developed countries (1). Dry AMD is the most common form, impacting approximately 90% of people with AMD (1). As dry AMD advances it leads to geographic atrophy (GA), an irreversible degeneration of retinal cells, causing a gradual and permanent loss of central vision. There are currently no approved treatments for dry AMD.

An estimated nearly 3.5 million people in the US and EU5 European countries have GA (2, 3).

The hallmark of early-stage AMD is progressive macular accumulation of drusen deposits under the retina, consisting of hard protein aggregates that cause cellular damage (4). Among the main constituents of drusen are complement proteins, the accumulation of which is hypothesized to be caused in part by an overactive complement system.

Complement Factor I serves as a down-regulator of the overactivated complement system associated with AMD. It is believed that increasing CFI production will dampen the system's overactivity and reduce inflammation, with the goal of reducing disease progression.

Rare genetic variants within the *CFI* gene lead to an impaired down-regulation of this cascade, therefore, carriers of the genetic variants are at an increased risk of developing dry AMD (5).

Objectives

The initial objective was to identify individuals who carry particular rare *CFI* variants by targeted sequencing across the *CFI* gene in a cohort of individuals with dry AMD identified in Finnish public biobanks.

BUSINESS FINLAND

Materials and methods

The Fingenious® service managed by FINBB helped Gyroscope identify over 900 samples stored across the Finnish public biobanks, which were sourced from patients with dry AMD. The aim was to identify people with GA who have rare variants in their *CFI* gene.

It is estimated that approximately 3% of people in the European AMD population carry these rare variants [Gyroscope internal data]. Interestingly, the FinnGen project has also identified particular rare *CFI* non-coding variants that in homozygosity are associated with AMD in the Finnish population.

The likelihood of identifying *CFI* variant carriers in the Finnish AMD population was increased by utilizing data on European *CFI* variant frequency together with the expected number of individuals homozygous for the Finnish non-coding AMD risk variant.

The DNA samples were screened using targeted genetic sequencing to identify carriers of rare *CFI* variants.

This study was enabled by the biobanks and the Fingenious® service. The analyzed samples and *CFI* data have been returned to the biobanks and are available through Fingenious® service.

”The likelihood of finding *CFI* variant carriers is increased in the Finnish AMD population.

References

1. Zajac-Pytrus et al. Adv Clin Exp Med, 2015, 24: 1099–1104

2. Friedman et al. published correction appears in Arch Ophthalmol, 2011, 29(9):1188. Arch Ophthalmol, 2004, 122(4): 564-572

3. Rudnicka et al. Am J Ophthalmol, 2015,160: 85-93

4. Anderson et al. Prog Retin Eye Res, 2010, 29(2): 95–112

5. DeJong et al. Hum Mol Genet, 2020, 29 (14): 2313–2324

FINGENIOUS®

Your Gateway to Finnish Biobanks and Biomedical Research

Rationale: Carriers of rare genetic variants within the *CFI* gene are at an increased risk of developing dry age-related macular degeneration (AMD). The likelihood of identifying *CFI* variant carriers in the Finnish AMD population was increased by utilizing data on European *CFI* variant frequency together with the expected number of individuals homozygous for the Finnish non-coding AMD risk variant.

Objective: Find carriers of particular rare variants of Complement Factor I (CFI) gene

Participants: >900 patients with dry AMD and geographic atrophy (GA)

Data sources: Finnish public biobanks

Samples: DNA

Screening: Targeted genetic sequencing across the CFI gene

Partners: Gyroscope Therapeutics Limited, Finnish public biobanks and Finnish Biobank Cooperative – FINBB

BUSINESS FINLAND

5. RWE PROJECTS IN PRACTICE

Real-world evidence (RWE) can answer a variety of evidence needs throughout a product's lifecycle. Typically, RWE projects involve close collaboration between registry holders, clinical experts, regulatory authorities, and RWE service providers. Local vendors can take care of the practical study conduct all the way from the study design to reporting of results.

Study design and protocol preparation

The starting point for a successful research project is a clear vision of the purpose of the study and a preliminary plan of how the study results will be used in practice. This helps to formulate the study objectives and generate a preliminary study concept.

The first step to understanding the available data sources is a feasibility assessment. In this phase the number of study subjects, availability of variables, and quality of data from the selected data sources are evaluated to provide a solid foundation for the final study design. Feasibility studies are typically based on aggregate data collected from the registries combined with insights provided by the registry holders.

Local clinical experts have an important role in the study design phase. They can provide insights on data recording practices, local treatment practices, as well as availability and validity of the variables. In addition, feedback from clinical experts with a deep understanding of the therapeutic area is essential for developing the final study concept and preparing the study protocol.

The study protocol will be prepared utilizing the information obtained through the feasibility assessment and clinical expert consultation. Typically, some other documents, such as a statistical analysis plan and a variable list required in the data permit procedure, are prepared at this stage as well.

BUSINESS FINLAND

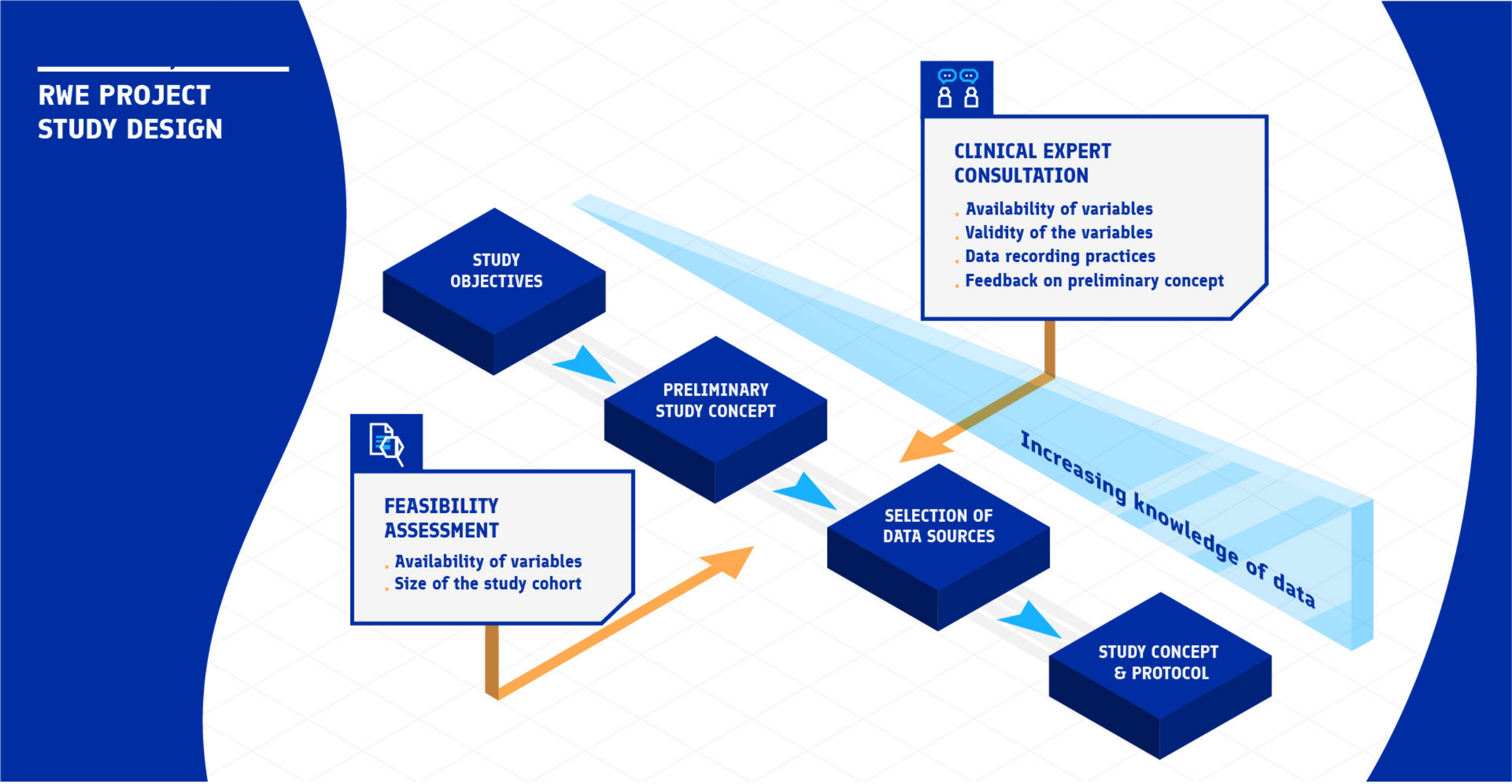


Figure 8 Flowchart of the RWE study design and protocol preparation.

BUSINESS FINLAND

Data permits and data collection

The Finnish Social and Health Data Permit Authority, Findata, is the single point of contact for issuing permits for the registry data. A data permit can be applied for using an online form available on Findata's website and, according to the Act on the Secondary Use of Health and Social Data, the data permit handling by Findata needs to be completed within 3 months. Before the final decision, Findata provides the applicant a maximum cost estimate, which consists of data permit fee, data extraction costs by the registry holders and Findata's data processing costs. Ethics approval or informed consent from the participants is not needed for the retrospective use of health and social data.

After approval of the data permit, Findata requests the data from the registry holders, combines and pre-processes the received data, and delivers it to a secure analysis environment for the data permit holder. Processing of data should be completed within 60 working days from the study permit approval. If, however, data is extracted in several steps the overall data procession time will be longer than 60 days. Fingenious® service is a digital portal provided by the Finnish Biobank Cooperative (FINBB), which provides a catalog of Finnish biobank samples and data, and functions as a gateway for conducting feasibility studies, applying for study permits, and accessing biobank data. According to The Finnish Biobank Act, biobank research is based on broad consent, which means that biobank samples and data can be used for future research without obtaining separate consent for each study from the participants. Biobank studies are evaluated in the Scientific Steering Committees. However, ethics approval is required if the access request applies to Helsinki Biobank, if the study includes re-contacting of sample donors, or if it is an interventional study. An average timeline for granting data access is 4–8 weeks after the submission.

Only a single contract is required with the data holders in both registry and biobank studies: Findata handles the permits concerning registry data and FINBB coordinates the contracting process in biobank studies.

Data management, analysis, and reporting

Data management and analyses are conducted in pseudonymized format in a secure analysis environment. The key data management activities are to ensure that correct data has been delivered, to check that there are no errors in the data, and to conduct the necessary data clean-up processes. The data analyses are performed according to the study protocol and statistical analysis plan and as post hoc analyses when needed. Only anonymous study results can be exported from the secure analysis environment. Permits for accessing individual-level pseudonymized data can be granted for scientific research, but not for commercial purposes such as market research. Publishing of study results is one of the key criteria for scientific research and therefore, the study results need to be published in some format. Typically, the study results are reported as a final report and one or more peer-reviewed scientific articles. Local clinical experts are important partners in interpreting the results and preparing the publications.

”Local clinical experts are important partners in interpreting the results and preparing the publications.

BUSINESS FINLAND

REAL-WORLD EVIDENCE (RWE) PROJECT PATH AND TIMELINE

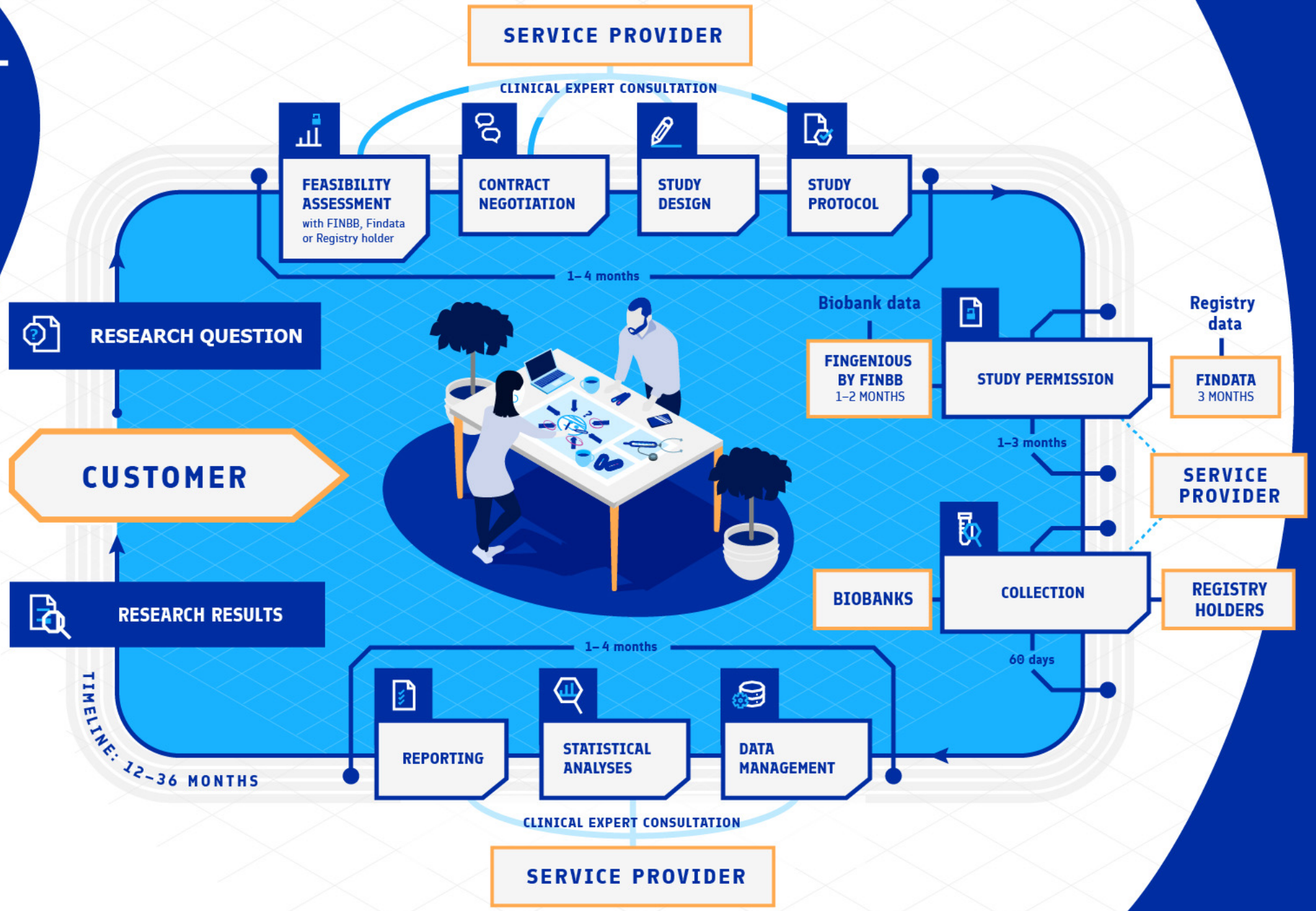


Figure 9 Real-world evidence (RWE) projects involve close collaboration between registry holders, clinical experts, regulatory authorities, and RWE service providers. Local vendors can take care of the practical study conduct all the way from the study design to reporting of results. Read more about partnering opportunities from the RWE providers section.

BUSINESS FINLAND

6. RWE APPLICATIONS

Real-world evidence (RWE) is being increasingly used by pharmaceutical companies in all stages of a product's lifecycle. Common RWE applications include early-stage drug development acceleration, clinical trial design optimization, market access support, patient outcomes improvement, and compliance to post-marketing requirements.

Pre-clinical development

Finnish biobanks collect and store biological samples and health data for medical research. This kind of data repository provides an optimal starting point for biomarker discovery and lead identification. Easy access to biological samples and associated health data can be used to accelerate early-stage drug development and reduce the cost of research at the preclinical stage. Finland has long traditions and advanced capabilities in genomics research. For example, the ground-breaking FinnGen study aims to genotype altogether 500,000 Finnish sample donors, and the resulting individual-level genotype data is linked with national health registry data.

"Common RWE applications include early-stage drug development acceleration, clinical trial design optimization, market access support, patient outcomes improvement, and compliance to post-marketing requirements.

Clinical development

Real-world data (RWD) is transforming the way clinical trials are conducted. This will have a significant impact on clinical development in the near future. Innovative RWE approaches enable clinical research in rare diseases and other patient populations where randomization may not be feasible or ethical, or where the number of patients is very limited. New approaches for clinical development also have the potential to considerably enhance overall clinical research productivity.

RWD brings understanding to the disease area and patient population of interest. Such information can be used to optimize trial design and patient selection in feasibility assessment. Real-world data can be used as

an efficient tool in targeted patient recruitment for clinical trials as well. As an example, Finnish biobanks have unique pre-pooled samples with the possibility for re-contacting donors for future studies based on genotype, phenotype, and questionnaire information. RWD can also be used to create "external control arms", which may supplement or replace traditional control arms in a clinical trial. In the external control arm setting, matched controls for patients in a treatment arm are identified from the electronic health records and other health registries, and data collected from the treatment arm are compared with registry data. Such approaches may enable clinical development for indications, which would be otherwise very difficult or impossible to conduct. These methods have the potential to reduce the number of patients required in traditional control arms, which helps to decrease study cost, reduce the time to result, and boost the overall attractiveness of clinical trial participation for prospective patients. Additional information on external control arms can be found in the Bayer FCT Use Case.

Commercialization

RWE has traditionally been most extensively used at the launch phase of the product. It allows evaluation of disease burden on both patients and the healthcare system, identification of treatment patterns of existing treatment, and information on disease epidemiology. These are essential information for market access, medical affairs, and commercial teams during the commercialization of a new product.

RWE can be used to demonstrate quality of life, healthcare resource utilization, as well as direct healthcare costs and indirect costs resulting from loss of productivity. These data can be used to model cost-effectiveness to health technology assessment groups and payers, which are essential steps towards market access. The emergence of innovative value-based pricing models emphasizes the importance of real-world data for market access even further. Compelling data is the cornerstone for value demonstration and communication with payers and other stakeholders.

In addition to payers, physicians also have a great need for RWE at the launch of a new therapeutic option. RWE is essential for demonstrating the outcomes of existing treatments, how the new product will fit in the current clinical practice, and in helping to identify undiagnosed patients or specific subgroups of patients. A profound understanding of the therapeutic area is also key to developing successful commercial strategies.

Post-Marketing Phase

At the post-marketing phase, RWE can provide information on patient profiles and the real-world effectiveness and safety of the product. The accumulating information can be used to optimize the therapeutic value of the product by targeting the right patients at the right time with the right dose. Leveraging modern technologies, such as machine learning-based methods, may provide a better understanding of what drives the outcomes and assist in identifying subgroups of patients that receive an optimal benefit from the new therapeutic option. Evidence on comparative effectiveness and safety is required for guiding the treatment choices in real-world clinical practice.

Regulatory authorities are increasingly understanding the value of RWE in evaluation of a product's safety. Post-authorization safety studies (PASS) are an important tool to actively study safety concerns or to ensure the effectiveness of measures of risk management in the real-world setting, where a significantly broader group of patients have been treated with a product compared to clinical trials. These studies can be either voluntary or an obligation from regulatory authorities for the marketing authorization holder.

RWE APPLICATIONS – EVIDENCE GENERATION THROUGHOUT A PRODUCT'S LIFECYCLE

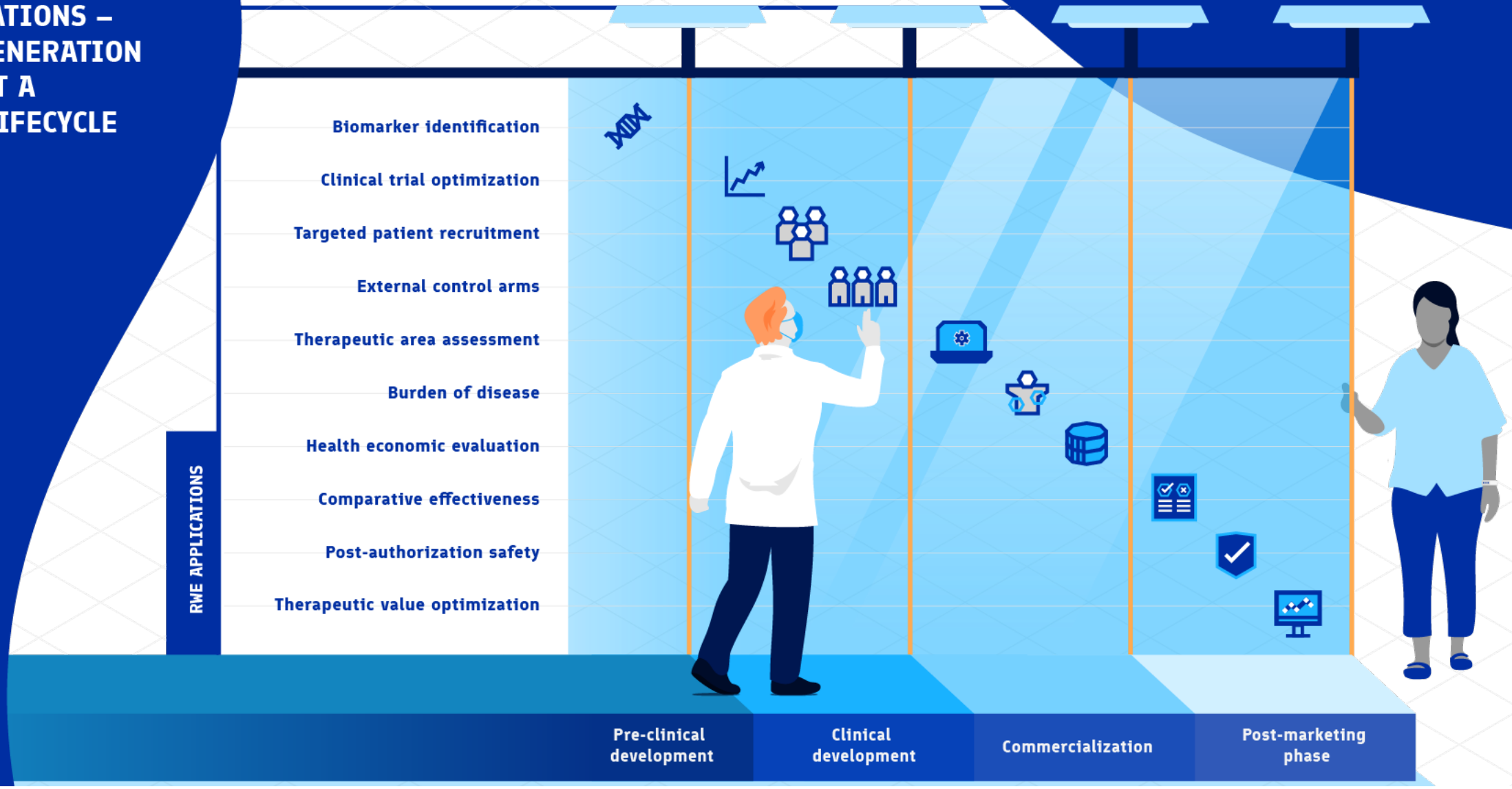


Figure 10 Real-world evidence (RWE) is being increasingly used by pharmaceutical companies in all stages of a product's lifecycle. Common RWE applications include early-stage drug development acceleration, clinical trial design optimization, market access support, patient outcomes improvement, and compliance to post-marketing requirements. Read more about partnering opportunities from the RWE providers section.

BUSINESS FINLAND

7. RWE PROVIDERS

Findata is the Finnish Social and Health Data Permit Authority, and its activities are based on the Act on the Secondary Use of Health and Social Data (552/2019). Findata promotes secondary use of Finnish social and health care data, facilitates data permit processing, and improves data protection for individuals.

Findata operates in conjunction with the Finnish Institute for Health and Welfare but separately from the Institute's other activities. The authority's operations were first initiated in 2020 and are launched stepwise.

Findata is responsible for processing all the applications that concern: 1) combined data from several different public controllers; 2) data from one or more private social or healthcare providers; and 3) data that are stored in Kanta services.

Data governed by Findata can be used for scientific research, statistics, development and innovation operations, planning and reporting duties of an authority, education, and knowledge management (all purposes specified in the Act on the Secondary Use of Health and Social Data). Access to datasets is subject to a data request and a data utilization plan.

Findata may provide anonymized or pseudonymized data for use in a remote access system for a fixed period of time.

Contact

Help desk: info@findata.fi

https://findata.fi/en/

The Finnish Biobank Cooperative, FINBB, was established in 2017 as part of the implementation of the Finnish National Health Sector Growth Strategy to build an internationally high-standard biobank network in Finland.

FINBB's mission is to enhance the competitiveness of Finnish health and biomedical research by providing worldwide researchers a centralized point of access to the collections and services of Finnish biobanks. FINBB aims to harmonize the infrastructure, functions, and practices of public biobanks. Moreover, FINBB is developing effective cooperations with various centers of expertise, such as the Cancer and Neuroscience Center and the forthcoming Genome Center and Drug Development Center. Protection of the sample donor's privacy and rights, trust, transparency and cooperation, and accessibility are all core values of biobank members of FINBB.

FINBB is a cooperative owned by the six largest hospital districts and universities in Finland, and the Finnish Institute for Health and Welfare (THL). FINBB has eight member biobanks: Arctic Biobank, Auria Biobank, Biobank Borealis of Northern Finland, Helsinki Biobank, Biobank of Eastern Finland, Central Finland Biobank, Finnish Clinical Biobank Tampere, and THL Biobank.

There are over 11 million samples, nearly 500,000 genotyped samples, and pre-pooled patients for recontacting, and sample collections are continuously expanding and diversifying through biobanking activities.

FINBB also manages the Fingenious® service, which is a unique one-stop digital gateway providing academic and industry researchers access to samples and data in all public biobanks in Finland. Through Fingenious® service researchers can browse the biobank collections and obtain access to all public biobanks with a centralized feasibility and access request.

Contact

Johanna Mäkelä, PhD, Director of Research and Services
johanna.makela@finbb.fi
+358 50 5162 844

Marco Hautalahti, CEO
marco.hautalahti@finbb.fi
+358 40 0493 613
www.finbb.fi
www.fingenious.fi

BUSINESS FINLAND

FINBB

Testimonials

"Working with FINBB through Fingenious® service has allowed us to identify useful cohorts of patient samples across a range of diseases."

"Especially when dealing with large populations, finding patients for clinical studies is not easy. You cannot typically go back to a person, so a recall service such as FINBB's, is important. I got to learn that Finland's unique and powerful biobank law enables this."

"Our company's collaboration with FINBB was unique and beneficial to both parties. We value the importance of national collaboration and coordination in enabling and facilitating biomedical research in Finland."

"The Finnish Biobank cooperative (FINBB) has headquarter-level research agreements with Roche, Bayer, Adaptive Biotechnologies and Gyroscope Therapeutics Limited. The goal of these research agreements is to generate insights to inform drug development and to advance practices for personalized medicine."

BUSINESS FINLAND

ESiOR

ESiOR Oy creates insights from data and evidence. They provide expert services in social and health economics and outcomes research (SHEOR), data science and evidence generation (DSEG), and market access (MA), neatly packaged together.

ESiOR's DSEG services range from compiling existing scientific evidence (systematic literature reviews and meta-analyses) to generating new understanding through real-world evidence (RWE) studies, interface modeling, and applications. Depending on the research questions, RWE studies can be carried out as registry studies, biobank studies, patient chart reviews, or surveys directed at relevant stakeholders.

ESiOR's market access services include landscaping, application consultancy and preparation, as well as conditional reimbursement strategies. The comprehensive SHEOR services, in turn, cover effectiveness and cost-effectiveness studies, health economic assessments, service process evaluations, profiling, predictive modeling, and risk-sharing. Through evidence-based modeling, ESiOR helps their clients to formally assess and predict the economic and health consequences of different choices in healthcare.

ESiOR has broad experience with all stakeholders in the healthcare system and a strong track record of client success, with well over 500 projects, over 350 scientific publications, and more than 20 innovations and awards. The experts at ESiOR are driven by data, aim at credible insight, and leave no stone unturned when working to find the best solutions for developing and communicating their clients' competitive advantages. The company also takes part in multiple European Health Data Space (EHDS) development projects such as Tehdas.

Contact

Erkki Soini, CEO, Health Economist
erkki.soini@esior.fi
+358 40 0533 971
https://esior.fi/en/

Taru Hallinen, Managing Partner
taru.hallinen@esior.fi
+358 50 5681 894
https://esior.fi/en/

Testimonial

"We really needed a health economist to convince decision makers about the full economic impact related to COVID-19."

IQVIA capitalizes on data, technology, advanced analytics, and human expertise to support their customers in driving healthcare and human health forward. Having access to more than 1 million data feeds, IQVIA is strongly positioned to operate at all stages of the drug product lifecycle — from late phase research through commercial execution.

IQVIA Nordics provides a full range of services in the RWE space, ranging from feasibility assessment and protocol development to research reports and publications. Most contracted services are retrospective database studies and post-authorization safety studies for pharmaceuticals. IQVIA Nordics offers commercial services exemplified by pharmaceutical sales data, HCP reference data, primary market research, market insights, and forecasting reports.

IQVIA Nordics services clients with in-house data assets including, for example, sales data covering close to 100% of all wholesales, a pharmacy panel with multiple data feeds (sell-out sales, anonymized prescription data, anonymized patient data), and an HCP database. IQVIA uses carefully cultivated expertise to combine both internal (IQVIA-proprietary) and external databases and deliver suitable solutions for all life science and healthcare stakeholders both locally and globally.

For more information, please visit
www.iqvia.com/nordics

Contact

Jeroen ter Borg
Head of Nordic Real World & Analytics Solutions
Jeroen.Borgter@IQVIA.com

Tuula Tolvanen
Business Development Manager
Tuula.tolvanen@iqvia.com

Testimonial

"The Finnish IQVIA consultants demonstrated great project management skills, understood our business need, and presented deliverables effectively, to the point, and in our own language."

Medaffcon's core service offerings include long-term strategic real-world evidence (RWE) planning, RWE workshops, execution of RWE studies, and project management, FastTrack data requests, data-driven Interactive Value Tools as well as HEOR and market access evidence generation. In other words, all aspects of RWE generation from planning to execution, publication, and beyond.

Medaffcon provides strategic RWE input identifying data gaps and needs as well as the best opportunities to show value – whether for payer negotiations, clinical decision making, or post-marketing real-world effectiveness assessment.

Medaffcon's services for RWE generation entail defining study objectives, identifying data sources, and determining the most suitable study design. Also, project management, protocol development, study approval application, data analysis, scientific writing, and content creation belong to their service portfolio. Further, Medaffcon supports its clients in making the most of their data with Interactive Value Tools.

Medaffcon has extensive experience in conducting RWE studies since 2013. Medaffcon's RWE studies are closely related to clinical outcomes, epidemiology, and health economic perspectives on interventions – including AI and machine learning solutions. Their expertise is especially sought-after in health economics, market access, and affiliated services. In addition to Finland, Medaffcon also provides services in other Nordic countries through its network of close collaborators. Medaffcon is also closely involved in supporting and developing data sources unique to Finland.

Medaffcon is subsidiary of Tamro Oyj, and a part of the Europe wide Phoenix Group.

Contact

Mariann Lassenius, PhD, RWE Lead
mariann.lassenius@medaffcon.fi
+358 50 3452 393
www.medaffcon.fi

BUSINESS FINLAND

medaffcon

Testimonials

”We have a global project and this Finnish project on the same subject. My global colleagues sometimes question whether this Finnish project will really match the global one, but indeed this data lake data, combined with national registries, will match and even surpass the global one.”

”Finland seems to be role modeling the RWE approach by making these data available and the concept is written very professionally – congrats”

”Very well written concept and great to see that the team is capitalizing on Findata with an elegantly designed study.”

BUSINESS FINLAND

MedENGINE

MedEngine provides a full range of class-leading services in real-world evidence (RWE) research, health economics, and regulatory RWE studies, including post-authorization safety studies (PASS). The strong suits of this trailblazing company include artificial intelligence and machine learning solutions and virtual control arms for clinical trials, to name a few. In addition to the real-world data-driven solutions, MedEngine provides its customers with all-encompassing market access and digital engagement services.

MedEngine is known as a premium partner for the pharmaceutical industry. A substantial part of MedEngine's RWE-driven projects are executed for Nordic, European or Global pharma clients, to whom MedEngine's in-depth data know-how, cross-functional strategic capabilities and presence at the Nordic level is invaluable.

MedEngine's team consists of approximately 40 leading scientists with extensive expertise and years of experience in RWE research. The team is based in Helsinki, Copenhagen and Stockholm, and is therefore able to master data sources and study processes across the Nordic countries.

Thanks to its expertise with Nordic RWE, MedEngine is able to seek out optimal data sources and propose the best approaches to answer each research question. Projects are run with the highest quality of research, with sophisticated analytics solutions, top-notch documentation, and solid privacy practices.

Owing to MedEngine's cross-functional team — which possesses profound medical affairs, market access and commercial expertise — the company is equipped to design and execute data-driven activities, from the study concept to digital stakeholder engagement. This ensures maximal benefits from the RWE-investment to all stakeholders: patients, physicians, payers, and the product.

Contact

Tero Ylisaukko-oja, CEO, Founder
tero@medengine.fi
+358 40 9012 975
www.medengine.fi

BUSINESS FINLAND

MedENGINE

Testimonials

"MedEngine excels in real-world evidence research. They know how to design and execute RWE projects to meet customer's strategic priorities. What's more, they are already elegantly exploiting the state-of-the-art research tools such as machine learning, artificial intelligence, and external control arms."

"Considering stakeholder ventures, MedEngine has the ability to leverage research data to build patient-centric and customer engaging activities, which improve healthcare practices and have major importance on society."

"Our goal is to speed up drug development and increase safety by forming an ecosystem that is built on world-class artificial intelligence, unique health data sets, and specialized technology providers. To establish a trusted environment in the development of this work, we have selected MedEngine to assist us with real-world data (RWD) collection and processing, and to evaluate whether Finnish RWD is an adequate source for creation of an external control arm for a randomized controlled trial."

Nordic Healthcare Group

Nordic Healthcare Group (NHG) helps its clients to develop affordable and effective health and social services for the future. Their research services include cost-effectiveness studies for medicines and technology, health economic studies, predictive modeling using machine learning tools, and qualitative research and evaluations. NHG's studies are most commonly based on retrospective data collection from national registries and provider electronic medical records, but they also have the capability to do prospective data collection, especially for qualitative data through interviews and patient-reported outcome measures through surveys.

Nordic Healthcare Group's comprehensive research services include protocol writing, handling research permit applications, data processing and analysis, and scientific writing. They also provide proposal writing services for research funding.

Thanks to their consultancy services, NHG has gained an in-depth understanding of the Finnish social and healthcare system as well as the service provision processes and recording practices in different organizations. They have a vast contact network within the service system in Finland and employ contract research partners and clinical experts across the Nordics as well.

Contact

Riikka-Leena Leskelä, Research Director
riikka-leena.leskela@nhg.fi
+358 50 4100 737
https://nhg.fi/en/services/research/

Oriola is a health and wellbeing company operating in the Nordic countries. Driven by the purpose 'Health for life', 4,300 professionals at Oriola are committed to make a difference in health and wellbeing — every day.

Oriola operates in the core of the healthcare value chain and offers warehousing and distribution of pharmaceuticals and other health and wellbeing products, dose dispensing services and expert services for pharmaceutical companies.

Expertise throughout the entire lifespan of a pharmaceutical

As a strategic partner for pharmaceutical companies, Oriola supports its customers with a wide range of research services including feasibility studies, patient surveys, drug utilization studies, phase IV studies (PASS and PAES), patient recruitment for clinical trials, data for health economic models, and market research and landscape analyses to support market entry and pricing. Additionally, Oriola provides pharmaceutical companies with services in regulatory affairs, pricing and reimbursement, pharmacovigilance and medical information.

Enhancing patient quality of life

Oriola has a unique approach to health data collection. By combining the patient perspective from patient reported outcome (PRO) studies with register data, a more comprehensive view of disease burden, real-world evidence (RWE), is available to improve treatment outcomes and the patient quality of life.

To support transparent and fair data usage in medical research, and to gather patient reported outcomes, Oriola has developed a unique GDPR-compliant digital platform based on strong authentication and digital dynamic consent. Patient reported outcome data is collected via Oriola's Research Pharmacy Network (around 180 pharmacies in Finland), Oriola's Kronans Apotek pharmacy chain (around 330 pharmacies in Sweden), as well as in collaboration with patient organizations and private healthcare providers. Real-world data is collected from national registries and hospital data lakes including medical record data of public and private healthcare providers.

BUSINESS FINLAND

Oriola

The RWE experts at Oriola are highly experienced in post-doctoral research, pharmacoepidemiology, registry studies (including EMA and FDA PASS), nutrition research, hospital data lakes, as well as biobanks (including genome data). They are skilled in working with nation-wide data in Nordic countries and come from backgrounds in CROs, big pharma, universities, university hospitals, pharmacies, regulatory bodies and national agencies. Working closely with in-house experts in pharmacovigilance, medical translations and clinical trials, Oriola's RWE team delivers value to customers, society and to patients.

Contact

Tuire Prami
Real World Evidence Team Lead
tuire.prami@oriola.com
+358 50 546 8459
https://www.oriola.com/

BUSINESS FINLAND

8. FINLAND, IN A LEAGUE OF ITS OWN

BUSINESS FINLAND

Finland offers a predictable and stable business environment with modern and enabling legislation and broad research and development activities. Finland has been ranked #1 most stable country in the world – for the 16th year in a row.

Finland's economy is based on free trade and openness to investment. Finland provides international companies excellent business opportunities, and the same governmental support and incentives as domestic companies.

In addition to being the most stable country, Finland is known for its superior educational system and being the happiest place on earth, fourth year running. What's more, Finland is ranked as the world's leader in future health innovations and availability of the latest technologies.

Set out below are the many ways Finland can contribute to the success of your business!

Universal, high-quality healthcare

Finland is a global leader in value-for-money healthcare and in quality and equality of healthcare services. In Finland, healthcare is provided for all citizens and there are three different healthcare systems which receive public funding: municipal healthcare, private healthcare, and occupational healthcare. The municipal healthcare is comprised of primary healthcare offered by health centers, secondary healthcare provided by hospital districts, and tertiary healthcare provided by university hospital districts.

Strong growth in health tech

Health technology is Finland's largest high-tech export, and Finland ranks #1 in availability of scientists, engineers, and the latest technologies. Over the last two decades, the value of Finland's health tech exports has increased five-fold to over €2.4 billion. In 2020, spurred by COVID testing, exports of in vitro testing rocketed 27.3% to reach €830 million.

BUSINESS FINLAND

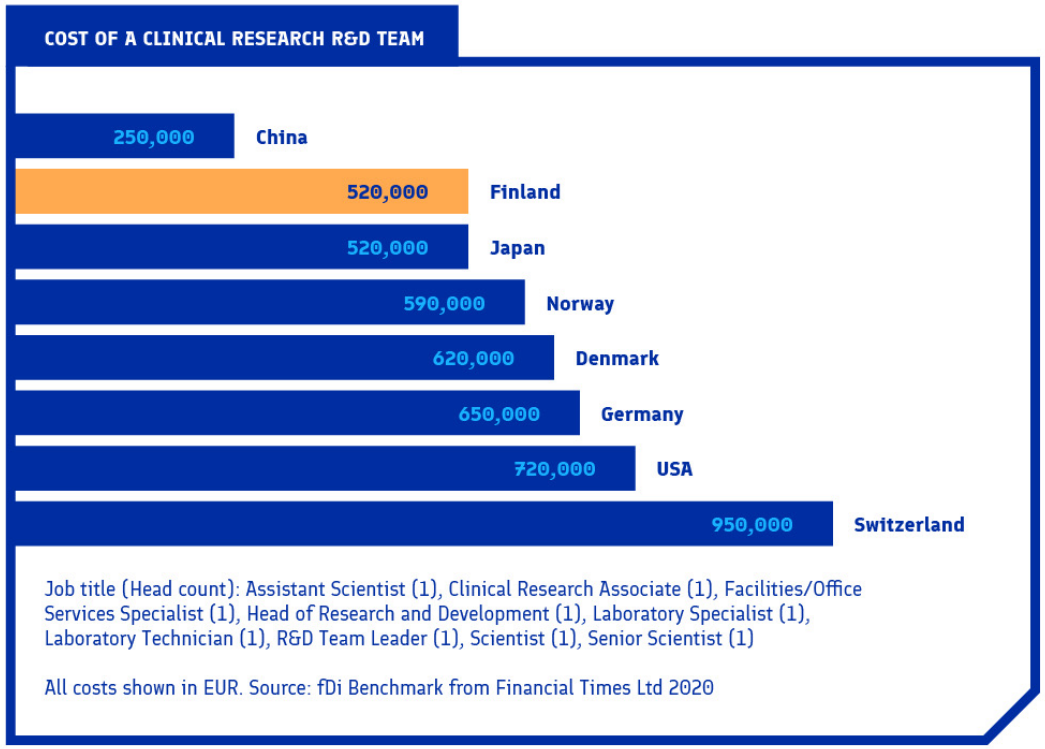
Perfect location for R&D

In 2020, Finland was ranked Europe's second most attractive country for setting up R&D operations.

Finland is also one of the world's most cost-efficient locations for R&D activities. In fact, and maybe to the surprise of many, Finland offers the best price in all of Europe – with half the labor cost of a typical Swiss set-up.

"Finnish health tech expertise is very much anchored in hard science: We've had a lot of spin-off companies emerge from university campuses. Furthermore, the health tech companies have always been able to grow and adapt with the times, always looking for new opportunities."

– SAARA HASSINEN, MANAGING DIRECTOR, HEALTHTECH FINLAND

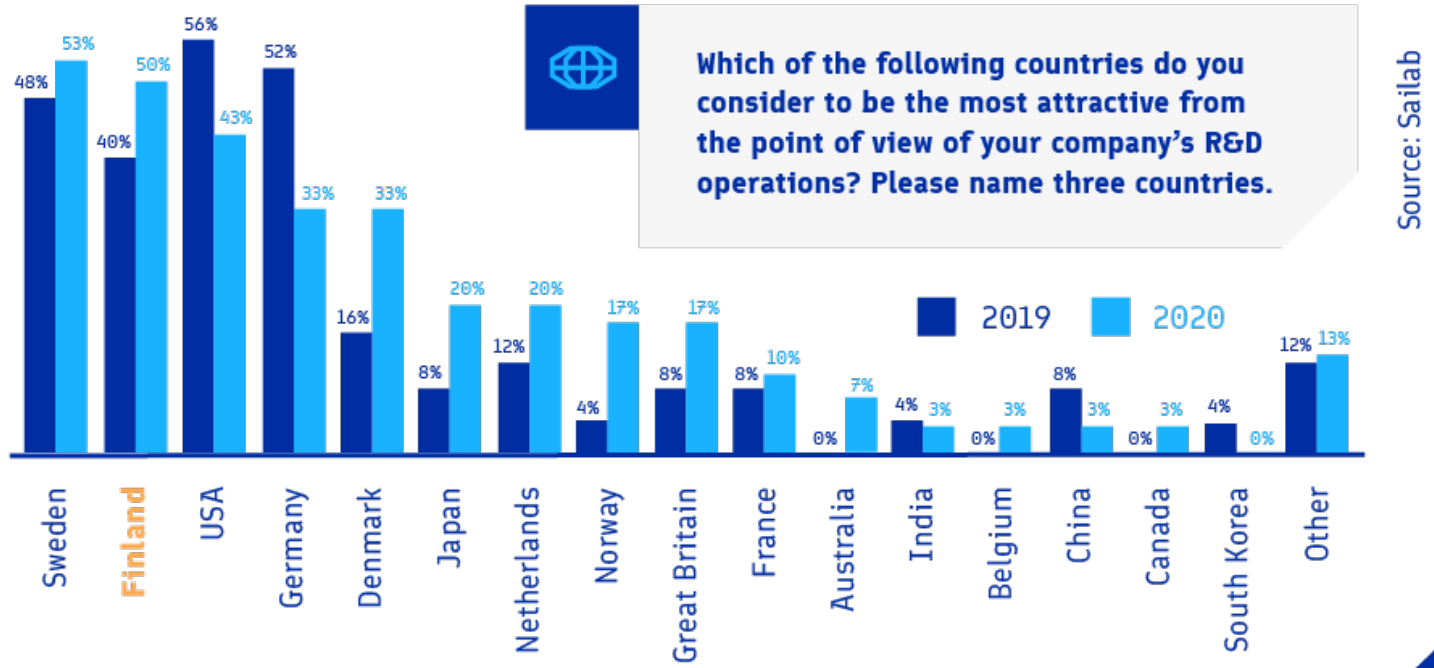


8. Finland, in a league of its own

Finland offers a well-functioning healthcare system which creates a solid platform for all activities. Universal healthcare is provided for all citizens.

The Finns themselves are engaged and committed to the improvement of healthcare and are very much pro-science and tech-savvy.

ATTRACTIVENESS OF FINLAND FOR SETTING UP R&D



Source: Sailab

As a result, digital health solutions are rapidly advancing in Finland. Innovation is often rooted in valuable information and Finland's genomic data biobanks offer a treasure trove that many other countries can only dream of. The FinnGen study capitalizes on Finland's decades-long investments in Finnish healthcare, health registries, epidemiological research, and biobanks with the aim to collect and analyze genome and health data from 520,000 Finnish biobank participants by 2023.

Added to the mix is solid and long-term government backing which ensures that capable industry players can thrive, be they big or small.

"From an international pharmaceutical company's point of view, Finland is a good environment for production of new products and R&D, due to an enabling legislative base and a predictable and stable operating environment. Finland also comes out on top in many rankings relating to stability, education, innovation, and openness to digitalization."

— MIRIAM HOLSTEIN, CEO, NORDIC REGION BAYER, GERMANY

Leading the digital revolution

Finland is a forerunner in digital health with an availability of scientists, engineers, and the latest technologies that is the best in the world. Finnish life-saving innovations utilize exponential technologies — like artificial intelligence, extended reality, Internet of Things, robotics, and 3D modeling — now more extensively and creatively than ever.

Finland has data registries dating back to 1953 and biobank data from the 1960s, all fully digitized and readily accessible. It has 100% EMR (electronic medical record) penetration and is the only EMR system in the world where clinical, social care, prescriptions, patient reported outcomes, and social determinants of health can be fully integrated.

Unique opportunities for biobanking

Finland's Biobank Act is unique internationally, and makes clinical data obtained from the hospital data lakes and national registries available for all researchers.

BUSINESS FINLAND

Finland has exceptional conditions for whole population genetic research. What's more, Finns share a unique genetic heritage which allows faster and more effective analysis of genomic data compared to populations of more heterogeneous origins. This setting significantly improves the chances of breakthrough findings. For example, Gyroscope Therapeutics Limited, a clinical-stage gene therapy company, has initiated a research project with Finnish biobanks to screen samples from over 900 patients with dry age-related macular degeneration (AMD). This unique set-up increases the likelihood of finding carriers of rare CFI gene variants who are at an increased risk of developing dry AMD.

The Finnish Biobank Cooperative (FINBB) connects all six university hospital biobanks as well as two national biobanks. The Fingenious® service by FINBB is a unique one-stop gateway to access the samples and data in practice. There are over 11 million samples, nearly 500,000 samples genotyped, and pre-pooled patients for recontacting. Access to biospecimens and associated health data are available for public and commercial R&D, after ethical approval of the project application.

A pioneer in personalized healthcare

Finland was ranked #1 in personalized health in an independent study of 34 European countries funded by the global pharma giant Roche. The study measured health information, health services, personalized technologies, and policy context. Indeed, Finland is an ideal piloting environment for personalized health solutions.

For several decades significant public funds have been invested in health research, as a result Finland frequently sits at the top of international life sciences rankings. The Finnish government is driving innovation in personalized medicine, with a world-class biobank ecosystem at its core. The Health Sector Growth Strategy for Research and Innovation (2014) relies on the biobank ecosystem and other national competencies such as cancer research, genetic data, and drug development.

BUSINESS FINLAND

BUSINESS FINLAND

Top research to boost innovation

Finland has four national Centers of Excellence, whose top-notch research fuels innovation in the health sector: the Genome Center, the Comprehensive Cancer Center, Neurocenter Finland, and the Drug Development Center. These Centers of Excellence are rooted in the progressive national growth strategy, which has the objective that Finland will be a forerunner in personalized healthcare in the 2030s, and an attractive country for health sector investments.

Unique legislation and government support

Finland has pushed through significant new legislation on healthcare, including a first-of-its-kind law on the secondary use of social and health data, and the genome law.

The Act on the Secondary Use of Health and Social Data enables companies to access and utilize digital health data for developing data-driven health innovations, quite often jointly with leading hospitals and research institutions in Finland. This gives Finland a very competitive advantage from an international perspective.

The purpose of this legislation is to facilitate access to the personal social and health data for steering, supervision, research, statistics and development in the health and social sectors. A second objective of the law is to guarantee an individual's legitimate expectations as well as his/her rights and freedoms when processing personal data.

"Internationally speaking, the Act on the Secondary Use of Health and Social Data is a unique law that allows companies to use health data for R&D and innovation purposes."

— SAARA HASSINEN MANAGING DIRECTOR, HEALTHTECH FINLAND

BUSINESS FINLAND

Multi-disciplined healthcare expertise

Finland has an excellent life sciences talent pool with a great mix of experienced and younger talent, as well as multi-skilled competence. Nine percent of the workforce in Finland has technical health tech skills. Bioinformatics, gene therapy, personalized medicine and digital health are key growth priorities in Finland. Health tech professionals have good technical knowhow in other fields too, such as cleantech, IT, and engineering.

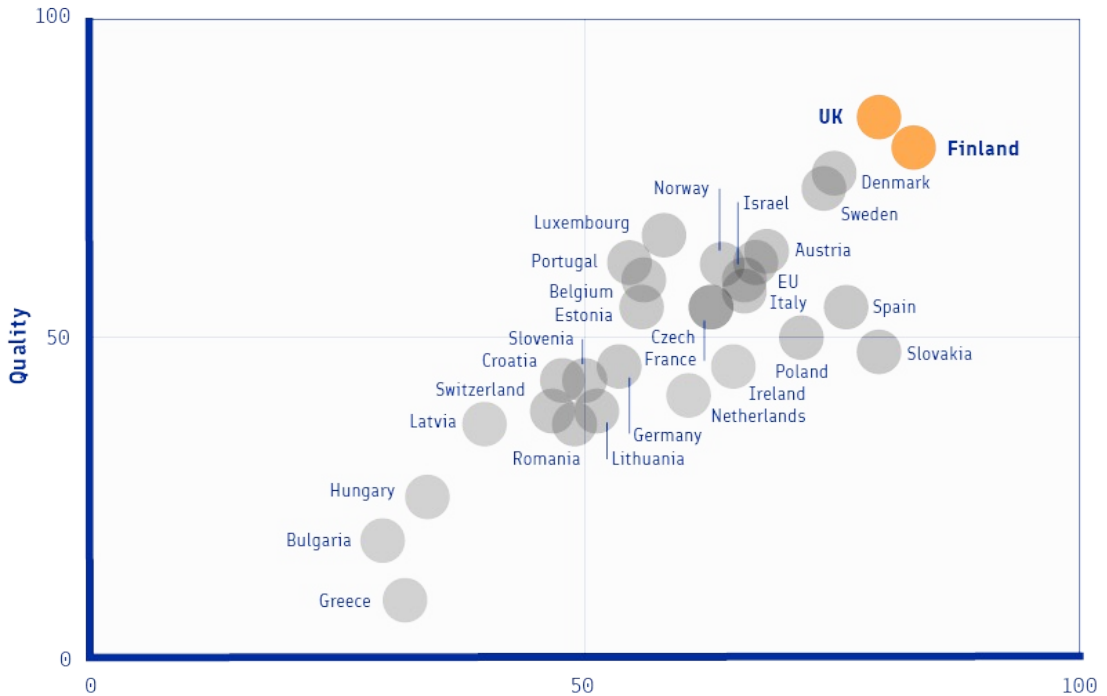
Finland and UK foster best policies for secondary use of health data

In September, 2021 Finland and the UK were ranked as the leaders in the country policy groupings by the Open Data Institute (ODI). This first-of-its-kind report scrutinized the policy readiness of European countries in the

BUSINESS FINLAND

secondary use of health data, and identified good practices across the region. In the ODI report, Finland was acknowledged for: 1) recognising the value of secondary use of health data for innovation, personalized healthcare, improved diagnostics; 2) working towards improving health-data infrastructure and ecosystems for reusing data; and 3) incorporating use of real-world data and real-world evidence into health systems.

SECONDARY USE OF HEALTH DATA IN EUROPE: COUNTRY POLICY RANKINGS



The ODI report states that Finland has an admirable infrastructure, with initiatives such as FinnGen, and the work of Sitra, enabling greater community and patient involvement in decision-making.

Invest in Finland by Business Finland enables your business to prosper

As the country's official investment promotion agency, Invest in Finland offers a wide range of useful services to support international companies and investors all the way. Their mission is to help international companies and investors to set up businesses, find new opportunities, and grow and develop in Finland. The professional services of Invest in Finland are confidential and complimentary.

Industry experts at Invest in Finland offer valuable information about Finnish industry clusters, companies, research institutes and universities, as well as expertise on different kinds of investments, mergers and acquisitions, research partnerships and access to Finland's lively innovation ecosystems.

"The ODI report states that Finland has an admirable infrastructure, with initiatives such as FinnGen, and the work of Sitra, enabling greater community and patient involvement in decision-making.

References:

1. Statistics Finland. (2018, December 5) Finland among the best in the world. Hundred-year-old Finland in the light of statistics. Retrieved from https://www.stat.fi/tup/satavuotias-suomi/suomi-maailman-karjessa_en.html
2. United Nations Sustainable Development Solutions Network 2021. The World Happiness Report.
3. World Economic Forum's Global Competitiveness Report 2017-2018. Availability of latest technologies.

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Reasons to expand to Finland

#1 IN GLOBAL LEADERSHIP FOR HEALTH
Commitment to Development Index 2021

#1 BEST BUSINESS ENVIRONMENT IN THE WORLD
GLOBAL INNOVATION INDEX 2019

#1 HIGHEST DIGITAL COMPETITIVENESS IN THE EU
DIGITAL ECONOMY AND SOCIETY INDEX 2019

#1 LEADER IN NUMBER OF FDI PROJECTS IN THE NORDIC COUNTRIES
EY'S NORDIC ATTRACTIVENESS SURVEY 2019

#1 IN AVAILABILITY OF LATEST TECHNOLOGIES
WEF GLOBAL COMPETITIVENESS REPORT 2017–2018

#1 IN DIGITAL ECONOMY AND SOCIETY
DESI 2020

#1 IN HUMAN CAPITAL
The Lancet, Measuring human capital: a systematic analysis of 195 countries and territories, 1990–2016

#2 MOST SKILLED WORKFORCE IN THE WORLD
WORLD ECONOMIC FORUM, GLOBAL COMPETITIVENESS REPORT 2019

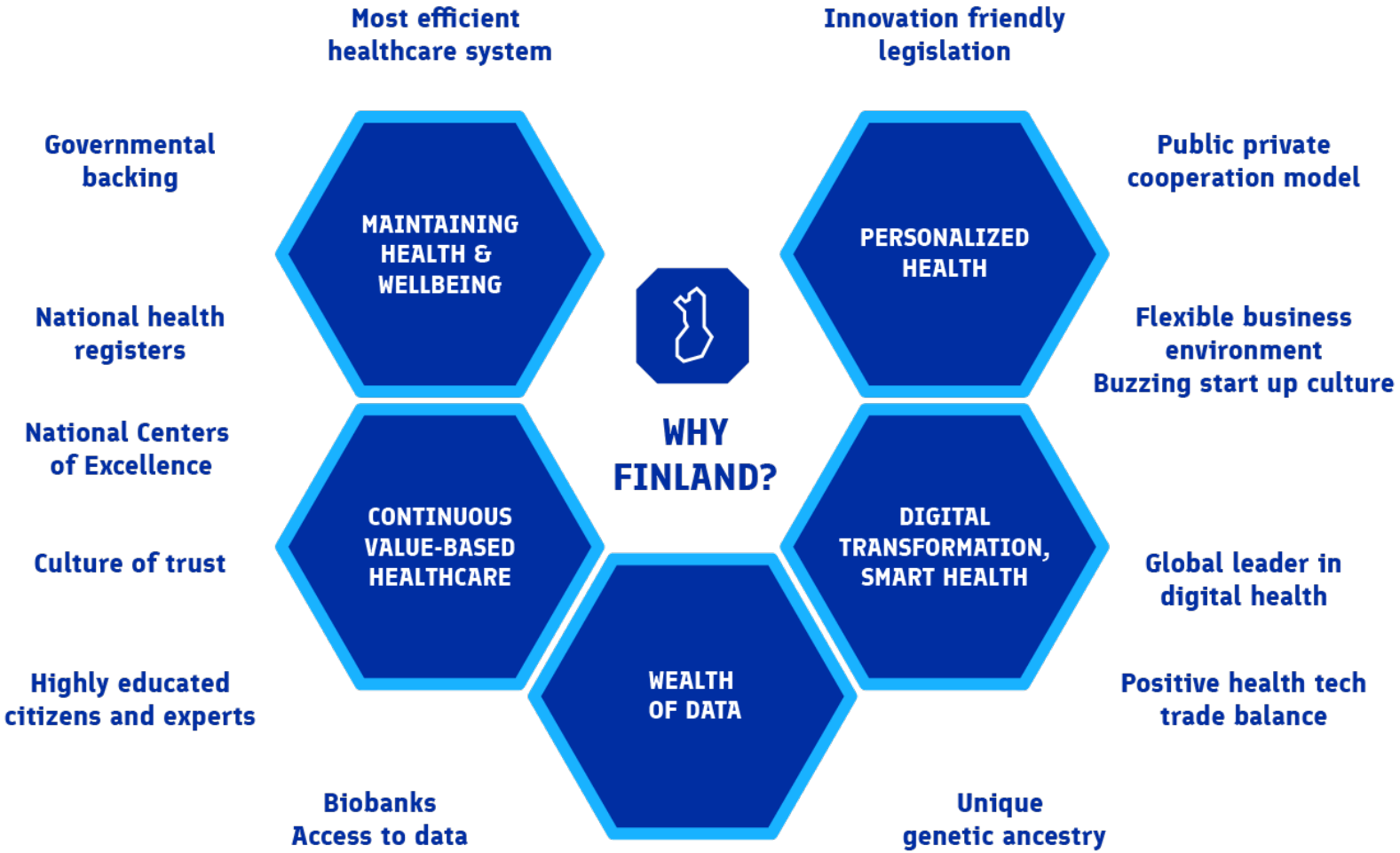
#1 IN PROVIDING FUTURE-SKILLS EDUCATION FOR YOUTH
THE ECONOMIST INTELLIGENCE UNIT & YIDAN PRIZE, WORLDWIDE EDUCATING FOR THE FUTURE INDEX 2018

ONE OF THE TOP OECD COUNTRIES IN EDUCATION
OECD, Better Life Index: Education

BEST DIGITAL PUBLIC SERVICES IN THE EU
European Commission, The Digital Economy and Society Index (DESI) 2018: Finland

INNOVATION CHAMPION
CONSUMER TECHNOLOGY ASSOCIATION 2019

8. Finland, in a league of its own



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9. FAQ

BUSINESS FINLAND

1. What kind of real-world healthcare data is available in Finland, what is the data coverage like, and what is the data availability?

Finland currently has a population of 5.5 million, and all data collected during any healthcare visit is collected in an electronic healthcare record (EHR) and stored in the national registries The data is maintained by different data controllers: national institutions (e.g., the Finnish Institute for Health and Welfare or the Social Security Institution of Finland), hospital districts, or individual service providers.

The public healthcare system covers the entire Finnish population and the data of all individuals who have used healthcare services are included in national registries. Every health or social care contact, such as an encounter with a nurse or doctor, a prescription for medication, or admittance of disability benefits, generates data of health and well-being. These data are recorded in various health and social care registries or electronic health records in a digital form.

Detailed histories of each Finnish individual are available throughout their lives from the registries. Population information has been registered since the 1530s and several key registries have been computerized as early as the 1960s. As an example, the Finnish Cancer Registry was established in 1952, the Care Register for Health Care in 1969, and the Cause of Death Register in 1969. The first biological samples available for research were collected in the 1960s. Therefore, with Finnish healthcare data, it is possible to create study cohorts in which the data covers entire lifespan of all patients.

Access to data for secondary use is allowed under several legislations: for example, the Act on the Secondary Use of Health and Social Data, the Biobank Act, or the Tissue Act.

The available real-world data is dependent on the register. The most commonly used registers are:

BUSINESS FINLAND

Register/data source	Description
The Care Register for Health Care (Hilmo, secondary healthcare) **and the Register of Primary Health Care Visits** (Avohilmo, primary care)	• **Register holder:** The Finnish Institute for Health and Welfare (THL) • **Key data content:** Outpatient visits, inpatient visits and number of inpatient days (hospitalizations), ER visits (urgency of admissions), ICU visits and length of stay, diagnoses (ICD-10 and ICPC-2), operations and other procedures (NCSP codes), healthcare costs, service provider • **Data availability:** Care Register for Health Care since 1994, Register of Primary Health Care Visits since 2011
e-Prescription Centre	• **Register holder:** The Social Insurance Institution of Finland (Kela) • **Key data content:** Information on all electronic prescriptions: e.g., ATC codes, product names (based on VNR), prescription dates, specialty area of the prescribing physician, dose, quantity • **Data availability:** Since 2010, became mandatory for public and private healthcare in 2017
Register for Reimbursed Drugs	• **Register holder:** The Social Insurance Institution of Finland (Kela) • **Key data content:** Information on purchases of reimbursed drugs: reimbursement code, ATC codes, product name (VNR), purchase date, number of packages, strength, package size, and costs • **Data availability:** Since 1994

Register/data source	Description
Hospital Data Lakes/Information Services: HUS, KYS, OYS, TAYS, TYKS	• **Register holder:** Hospital Districts of Helsinki and Uusimaa, Northern Savo, Northern Ostrobothnia, Pirkanmaa, and Southwest Finland • **Key data content:** All demographic and clinical data in patient health records that can be combined with data from different operational sources of the secondary care Data consists of enormous amounts of structured and unstructured data, including patient chart texts, laboratory records, imaging data, prescribed medications (including hospital-administered), data on HCRU and related costs, diagnoses (ICD-10) and procedures • **Data availability:** Availability for variables varies between the hospitals
Cause of Death Register	• **Register holder:** Statistics Finland • **Key data content:** Date and cause of death (ICD-10 codes), age, sex, and other demographic factors • **Data availability:** Since 1969

BUSINESS FINLAND

2. Are biological samples available, and what sample types?

Finnish biobanks collect samples and donor-related health information from consented sample donors, typically during regular laboratory and hospital visits or for specific research cohort collections. Biobanks grant access to samples and the associated data for high-quality scientific research projects and product development aiming at understanding disease mechanisms and disease prevention and in developing new diagnostics and treatments. After each biobank study, sample-specific raw data and analyzed results are returned to the biobank, which further enriches the information connected to the samples and serves subsequent research projects.

Through the Fingenious® service, you can apply for all sample types available at biobanks (availability can vary between biobanks):

- FFPE (formalin-fixed, paraffin-embedded) tissue
- TMA (tissue microarray) slides/blocks
- FF (fresh frozen) tissue
- Whole blood
- Serum
- Plasma
- Buffy coat
- Urine
- DNA
- ctDNA (circulating tumor DNA)
- Digitized/scanned slides
- CSF (cerebrospinal fluid)
- Certain cell types available at some biobanks, e.g., PBMC (peripheral blood mononuclear cells), B-lymphocytes and skin fibroblasts
- RNA

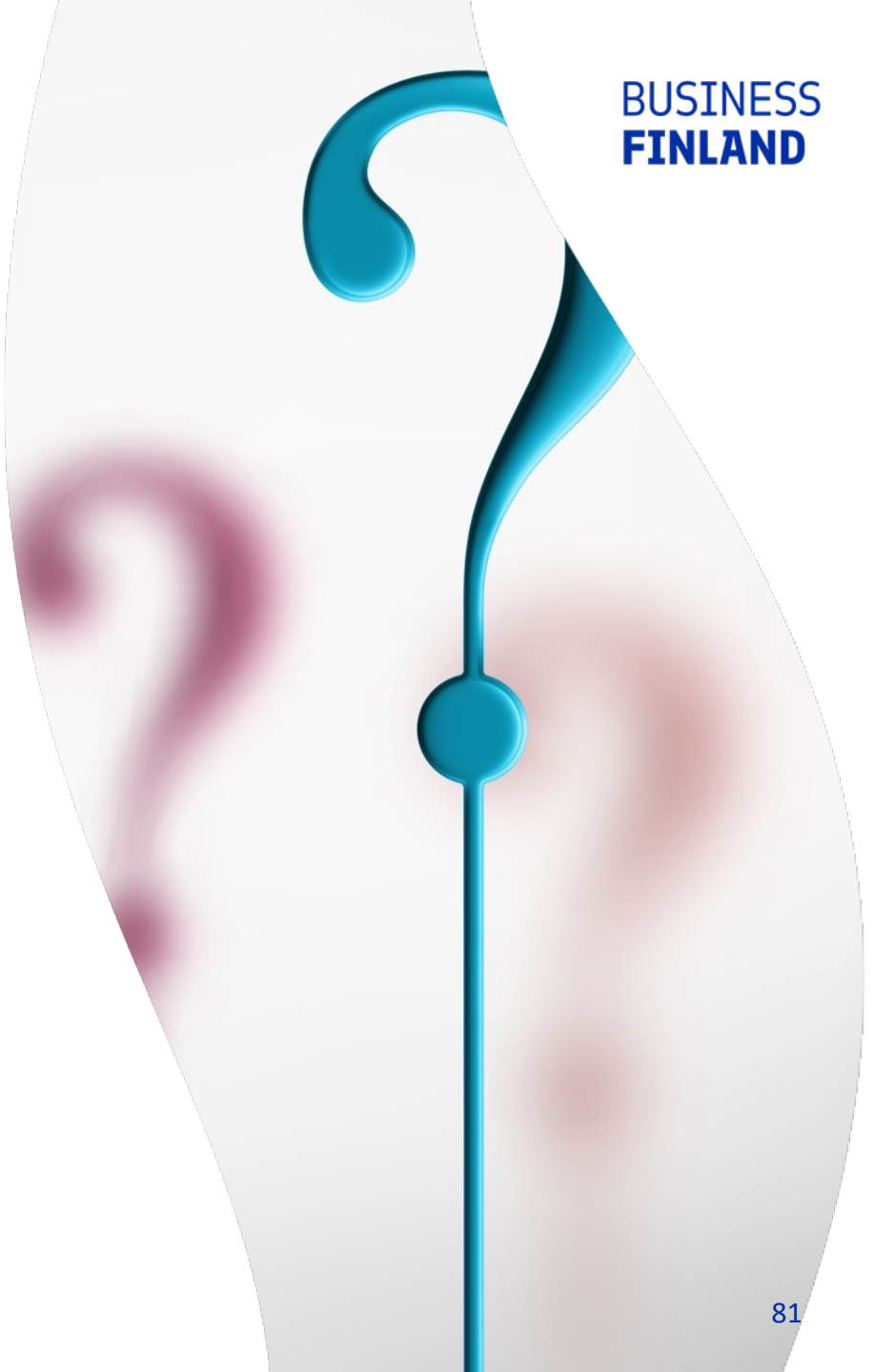
If the sample type needed in your research is not included in the above list, do not hesitate to describe all your needs in the feasibility request. Biobanks develop their processes continuously, and occasionally new sample types are added to their collections.

3. What is the total amount of genome data contained in Finnish biobanks?

FinnGen is a large public-private partnership aiming to collect and analyze genome and health data from 500,000 Finnish biobank participants by 2023. The FinnGen dataset already contains genotype and health data from more than 350,000 Finns. The amount of data increases throughout the project, with 40,000–50,000 individuals added every six months. The Fingenious® service provides a one-stop access point to genome data returned from FinnGen to the public Finnish biobanks.

4. How can the number of patients with a certain diagnosis be assessed? How can this patient population be identified?

Finding out the number of individuals with a specific diagnosis typically requires conducting a feasibility assessment from the desired data source as the first step. Effective use of the data collections requires in-depth clinical expertise and analytics skills, as well as an understanding of local treatment practices, data recording practices, and data content. To make the most of the data, Finland offers a research ecosystem that provides opportunities to collaborate with world-class scientists, clinicians, and service providers. Typically, real-world evidence projects involve a tight collaboration between local clinical experts, registry holders, the service provider, and the customer. Local vendors can take care of the practical study conduct all the way from the study design to reporting the results.



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BUSINESS FINLAND

5. Is it possible to link data from different sources within Finland and across countries?

In Finland, the Social and Health Data Permit Authority Findata is responsible for data permits, data requests, and data delivery in cases where the data is being combined from multiple controllers from the following list:

- Public and private service providers of social welfare and healthcare
- Finnish Institute for Health and Welfare (does not apply to data collected for statistical purposes)
- Social Insurance Institution of Finland (benefits and prescriptions)
- Data saved in Kanta services
- Applications related to medical record data processed by Findata in the Kanta services, together with applications related to e-prescription
- Finnish Centre for Pensions (work and earnings data, benefits and the basis for them)
- National Supervisory Authority for Welfare and Health Valvira
- Finnish Medicines Agency Fimea
- Finnish Institute of Occupational Health (occupational illnesses, exposure tests, and patient registers)
- Regional state administrative agencies (matters relating to social welfare and healthcare)
- Population Register Centre (individual's basic details, family relations, place of domicile, and building details)
- Statistics Finland (to the extent that access is required to data covered by the act on the investigation of the causes of death)

Under the EU's Data Protection Regulation, data can be transferred within the European Economic Area (EU countries and Norway, Liechtenstein, and Iceland) on the same grounds as within Finland. Finnish data can be combined with data from other Scandinavian countries relatively easily, the process depends on the countries and data controllers involved. If Denmark is one of the countries, all the data is collected on the secure remote environment maintained by Statistics Denmark.

Data can be transferred out of the European Union and European Economic Area if the European Commission has issued an adequacy decision for the country ('adequacy decision', Article 45 of the GDPR).

6. Can data generated from the biobank samples be linked with clinical data?

Access to samples and sample-associated data of seven Finnish public biobanks can be applied for via the Fingenious® service after registration. The sample-related data at the six hospital biobanks originate mostly from longitudinal electronic health records. To an increasing extent, the sample-related data at the biobanks also consist of data returned to the biobanks from research studies contributing to the continuous accumulation of both phenotypic and genotypic information.

The nationwide THL Biobank hosts population and disease-specific research cohorts. The sample-related data collected includes a large amount of demographic, genomic, metabolomic, laboratory, and lifestyle data obtained from sample donors.

Some biobanks have data from different types of questionnaire-based surveys. These data can originate from both patient-reported outcome surveys, such as surveys on lifestyle or psychosocial well-being, or surveys executed by healthcare professionals, such as cognitive tests.

The vast majority of 'omics' data in the Finnish biobanks is genotype data returned to the biobanks from the projects that have genetically analyzed the biobank samples. In addition to genomics, other 'omics' data, such

as metabolomics, returned from research studies is available at some of the biobanks, in particular THL Biobank.

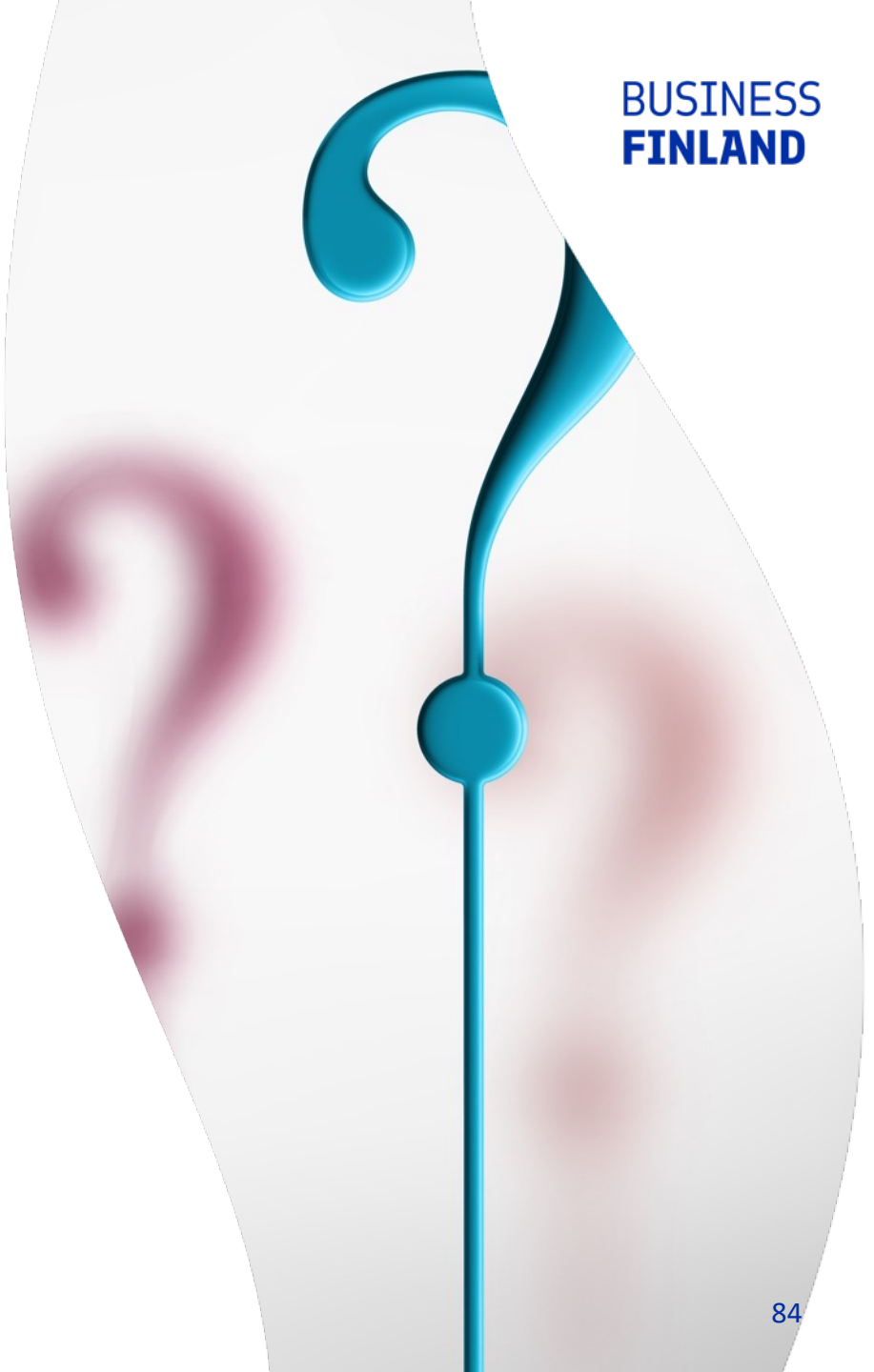
Data from Finnish national registries or hospital data lakes can be linked to biobank sample donors by a separate application process via Findata (Finnish Data Permit Authority).

7. Is it possible to recontact the sample donors?

Finding study participants among sample donors is enabled by the biobanks. When a person gives his or her biobank consent they can also give consent to being recontacted by their biobank for future biomedical studies. Contacting sample donors via biobanks can be used, for example, as a means for targeted patient recruitment for clinical and other biomedical studies based on genotype and/or phenotype or distribution of questionnaires. Finding study participants among sample donors for further biomedical studies is enabled by the Fingenious® service.

8. What is the estimated timeline for an RWE project?

The project timeline depends on the study setting. Typically, it takes from 12 to 36 months to conduct an RWE study which is based on Finnish registry data sources. See page 45 for more information on the RWE project path and timeline.



9. Can we identify cancer patients with a specific mutation?

If the mutation screening is performed as a part of the clinical practice, the result is recorded in the EHRs and is accessible through hospital data lakes and information Services.

If the mutation of interest is not screened routinely, access to biological samples and related data can be achieved via Finnish Biobanks (see, Questions 2 and 5).

10. What is the data application process like in Finland and how much does everything cost?

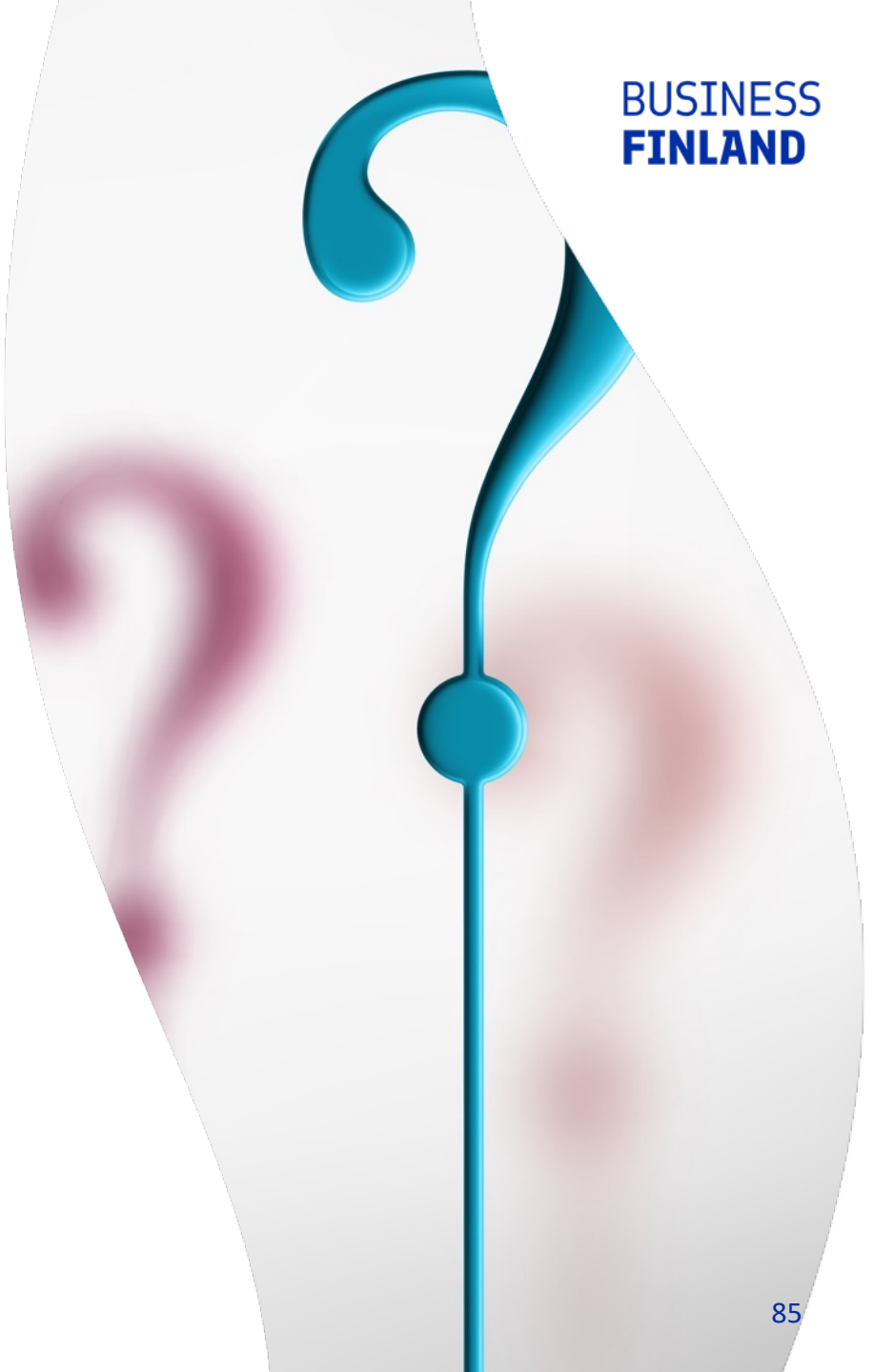
If data from multiple data controllers are needed, the Social and Health Data Permit Authority Findata is responsible for data permits (see Question 4). When data from a single data controller is needed, the data controller in question will grant the data permit.

Through the Fingenious® service, you can apply for all sample types available at biobanks

In the case of Findata, data permit applications are submitted by completing an online form which is available at https://lupa.findata.csc.fi/. You can log in to the system using Suomi.fi e-Identification.

Once the data permit has been granted, Findata will submit the data gathered from different registers to a secure remote access environment for analysis. The basic principle is that Finnish registry data is always handled in Findata's operating environment Kapseli or other audited operating environments, which fulfill the requirements stated in the Act on Secondary Use of Social and Health Data.

The price of Findata's service consists of the following components:



- A fee for the decision
- Costs incurred by data controllers for the extraction and delivery of data, based on each controller's own regulation (the maximum cost estimate for extracting the necessary data will be established during the processing of data permit application)
- An hourly fee for Findata's services in combining and processing the data
- Remote access environment charge (depending on the computing capacity required)

For Findata fees, please consult https://findata.fi/en/pricing/

11. What are Finland's strengths among other Nordic countries in terms of secondary use of health data and RWE capabilities?

Finland is one of the global leaders in the secondary use of health data. Among the Nordic countries, Finland stands out with its extraordinary data opportunities, efficient operating environment, and forerunning collaborators. Health data based on longitudinal national electronic health registers (see question 1) provide a unique possibility for data mining and reconstruction of disease evolution and past events instead of a single-point snapshot.

Finland has special strengths in the accessibility of detailed clinical data through hospital data lakes as well as to biological data through the extensive biobank network. Finland has also been a global forerunner with the health data-related legislation and related practices – the Act on the Secondary Use of Health and Social Data and The Finnish Biobank Act being the prime examples.

The internationally unique Biobank Act secures the rights of the donor and authorizes the collection of samples and biodata with the donor's consent to be saved in biobanks and used for future research purposes. It is also possible to re-contact sample donors and invite them to follow-up studies, such as scientific surveys or targeted clinical trials. Supported by long-term government backing, the Finnish research ecosystem is highly positive towards public-private research collaboration and provides opportunities to work with world-class scientists, clinicians, and service providers.

In September 2021 Finland and the UK were ranked as the leaders in the country policy groupings by the Open Data Institute (ODI). In the ODI report, Finland was acknowledged for recognizing the value of secondary use of health data for innovation, personalized healthcare, improved diagnostics, working towards improving health-data infrastructure and ecosystems for reusing data, and incorporating use of real-world data and real-world evidence into health systems. The ODI report states that Finland has an admirable infrastructure, with initiatives such as FinnGen, and the work of Sitra, enabling greater community and patient involvement in decision-making.

CONTACT INFORMATION

Business Finland

Sampo Sammalisto, Head of Personalized Health Finland
+358 50 584 1100
sampo.sammalisto@businessfinland.fi

Tarja Enala, Senior Advisor, Health and Wellbeing, Invest in Finland
+358 40 733 2708
tarja.enala@businessfinland.fi

Outi Tuovila, Senior Advisor, Personalized Health Finland
+358 50 339 2542
outi.tuovila@businessfinland.fi

Rauni Korolainen, Program Coordinator, Business Ecosystems
+358 50 475 4746
rauni.korolainen@businessfinland.fi

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