PERSONALIZED CARE WITH MASS-PRODUCTION EFFICIENCY

Design Principles of a Virtual Care Operator

MASSE FINAL REPORT

A" **Aalto University**

HEMA Institute of Healthcare Engineering, Management and Architecture

UNIVERSITY OF HELSINKI

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MASSE – Personalized Care with Mass-Production Efficiency

Final Report

This report was compiled by the MASSE Project Group:

Project Management Team:

Paul Lillrank

Paulus Torkki

Satu Kaleva

Henni Tenhunen

Research Team:

Fares Khalil

An Chen

Iiris Hörhammer

Annika Bengts

Perttu Kontunen

Erik Haapatalo

Miika Linna

Laura Pitkänen

Jyri Niskanen

Riikka-Leena Leskelä

Olli Halminen

Teressa Lyly

Sanna Virkkunen

Georg Ostrovski

Ruusu Nurmi

Tuukka Pallonen

Master's Theses:

Antero Taimiaho

Anu Vehkamäki

Katri Valtonen

Ilmari Huttunen

Emilia Knaapi

Inka Sylgren

Maria Misukka

Krista Hanhikangas

Annina Sipilä

Tommi Gröhn

Lalli Nurmi

Henna Pirskanen

Juuso Heinonen

Aaro Hämeri

Maikki Messo

Matleena Tyni

Bachelor's Theses:

Iida Haukilahti

Julius Hagelstam

Sanni Hyytinen

HEMA
Institute of Healthcare
Engineering, Management
and Architecture

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The Institute of Healthcare Engineering, Management and Architecture (the HEMA Institute) is a unique research group that combines service research and industrial engineering with the development of social and health services

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MASSE

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DESIGNERS OF THE VIRTUAL CARE OPERATOR

MASSE Consortium

In addition to the HEMA Institute of the Department of Industrial Engineering and Management at Aalto University, the project consortium consisted of the Faculty of Medicine of the University of Helsinki, the Hospital District of Helsinki and Uusimaa (HUS), Orion Corporation, the Pharmaceutical Information Centre Ltd, Suomen Fysiogeriatria Oy, PatientSky Finland Oy, Suomen Terveystalo Oy, Klinik Healthcare Solutions Oy, and VitalSignum Oy.

INTRODUCTION

Caring for chronically ill and multimorbid patients is expensive. These patients account for one-tenth of all patients but consume four-fifths of healthcare resources. The standard and effectiveness of care vary, patients often do not have an actual care plan, and the patient journey is disjointed.

This is not a new or unknown problem. Organizational structures and information systems are known to be partly to blame. Numerous projects have been run to tackle the problem, with fragmented and mixed results.

MASSE – Personalized Care With Mass-Production Efficiency – is bringing new perspectives into play. The solution needs to feel personal and be tailored to each patient's needs, but it also needs to be cost-effective, compatible with existing (information) systems, and financially sustainable.

Finding the ideal solution is not possible without first understanding the problem, and seeing the big picture requires first identifying each of the constituent elements.

MASSE employs a service engineering and design science approach. It has defined a specific organizational functionality, called "looking after", and identified the absence of the looking-after function in specialized multi-provider environments as the core of the problem. The looking-after function needs to be recreated by means of control information in order for each operator to know what they need to do at each step along the patient journey.

This calls for service design to coordinate information and service systems.

The solution proposed by MASSE is called a ***Virtual Care Operator (VCO)***. Its technological heart consists of (1) a real-time personalized ***Patient Card***, which acts as a platform for combining care plans and a variety of apps, and (2) a ***Service Card***, which draws and catalogs information about available services of relevance to the patient. The VCO must be financially sustainable, which means that it must be self-sufficient and finance itself by being cost-effective.

MASSE has formulated the basic design principles of the VCO, established a technical blueprint for building the Patient and Service Cards, and outlined a business and revenue model for the solution. The next step is to build a prototype and test it.

This report outlines the basic design principles of the VCO. Summaries of case studies are appended to the report.

CONTENT

RESEARCH PROBLEM – COORDINATION OF COMPLEX PATIENT JOURNEYS

Empirical context

The objective of the Virtual Care Operator (VCO) is to provide a solution to a problem. To do that, the first step is to understand what the problem is. Every problem has an empirical context and is associated with a set of phenomena that together make up its *conceptual construct*[1].

The problem that MASSE set out to solve concerns three groups of patients: **co- and multimorbid, chronically ill, and pre-diagnostic** cases. What these groups have in common is that the health problems are complex and require the expertise of professionals from multiple different fields.

Multimorbidity is very expensive for society. A two-year longitudinal study that began in 2017 found that 85% of healthcare costs in Finland were due to patients who were multimorbid or became multimorbid during the course of the study. Typical causes of multimorbidity include cardiovascular diseases, mental health problems, musculoskeletal disorders, cancers, and diabetes. (Linna, 2022)

The problems are manifested as **patient journey disruptions**, which are a significant drain on resources. To understand them, it is necessary to first examine different types of processes.

Patient pathway and its constituent elements

The aim is to treat patients according to a clinically justified care plan, which lays down the **patient pathway**. The patient pathway is a plan produced in the service provision system according to which the patient's care progresses. The method of documenting the plan varies. In simple cases, a verbal instruction is enough ("here is your prescription; please take one pill a day for one week"); in more complex cases, the instructions are recorded using a template and saved in the patient's file. This is what should happen – but often does not in practice.

> **PATIENT PATHWAY =**
> **CLINICAL PATHWAY + CARE PATHWAY**

The patient pathway has two elements. At its core is the **clinical pathway**. The clinical pathway is based on one or more diagnoses and the decisions made on that basis, and describes the clinical interventions or therapies, further tests, and

follow-up that the patient is to undergo. The clinical pathway corresponds to the industrial concept of *value chain*, which is the step-by-step transformation of an idea into a finished product..
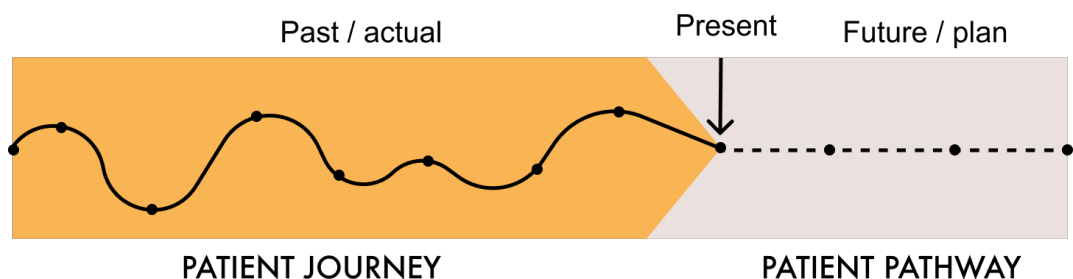
The clinical pathway is not an automatic process; it needs to be actively pursued by means of what we call the **care pathway**. The care pathway includes the schedules, appointments, and transportation of the patient, the information, advice, and self-care instructions provided to the patient, the contact and communication channels to be used and the rules associated with each channel, the role of the patient's loved ones, support activities during inpatient care and at home, as well as the coordination of the roles and clinical pathways or different service providers. This is also where the concept of *looking after*, to which we will return later, comes into play.

> Making a distinction between the clinical pathway and the care pathway can be tricky in practice. For example, while the prescribing of a particular drug is clearly an element of the clinical pathway, its administration falls on the borderline between the two, as it includes both clinical and care elements. Distinguishing between the two concepts is nevertheless important, because their mechanisms are different and they are based on different information and competence resources. The clinical pathway is designed and implemented within the limits set by medicine, the available resources, and the patient's medical condition, and cannot always produce the desired result. The care pathway is based on nursing sciences, but it is influenced not only by resources but also by organization, management, motivation, tradition, and interaction.

The patient pathway, with all its components, is above all a "plan". A parallel in the world of commercial services would be, for example, a tour operator's brochure that sets out the itinerary and describes how the service will be delivered in practice[2].

As service providers come together and start to implement the plan with the patient, it translates into reality, which consists of actions, events, transitions, experiences, and emotions. These elements together make up what is known as the **patient journey**, which describes what each actor did for the patient and what happened to them.

Service engineering and design usually make a distinction between the perspectives of the service provider and the customer. It is important to note that the patient journey consists of actions, observations, and experiences of both the patient and the professionals caring for the patient.

From patient pathway to patient journey

While the patient pathway is a plan, the patient journey is what actually happens to the patient when the plan is implemented.

The patient journey is essentially a **process**: a series of two or more *steps* that are connected by *handovers*[3] and *setups*[4]. **Coordination** means organizing these steps into meaningful entities.

The patient pathway is described, analyzed, and evaluated with the help of statements and documents. Information about the patient journey is obtained through event descriptions, database entries, referrals, prescriptions, reports, and surveys. In both cases, data are collected from the perspective of both the service provider and the patient.

> **THE PATIENT JOURNEY DESCRIBES WHAT HAPPENS AND HOW THE CARE EVENTS ARE PERCEIVED**

Management of care relationships in multi-provider environments

At the heart of the patient journey is what we call the **care relationship**. The patient is a person with a health problem. The service provider is a professional person or team with the ability and opportunity to help. The relationship comes with reciprocal rules, rights, obligations, and responsibilities. The patient participates to varying degrees in both the preparation of the care plan and its implementation. The role of the patient can vary from passive (unconscious trauma patient) to an active contributor to their own health (lifestyle change). The care relationship is embodied by the concepts of **co-creation of health**, **adherence** (the degree to which a patient correctly follows medical advice), and care responsibility – the question of who is responsible for the patient at any given time.

> **COMPLEX PATIENT JOURNEYS IN COMPLEX SERVICE SYSTEMS**

The patient journey consists of interactions between multiple *actors*. Actors in this context include not just medical professionals but also the patient and potentially members of their family, who should ideally be able to all work together. Three states of affairs can be distinguished with respect to the methods and degree of these actors' working together. Firstly, there is an **ecosystem**, which can be defined

as a set of actors who have a common purpose (the well-being of a particular patient or group of patients) but who may not necessarily interact with each other or even be aware of each other's existence. An ecosystem turns into a **network** when the participants become aware of and connected to each other. The actors in the network ("nodes") are equal in as far as they negotiate with each other and agree on courses of action. When power relationships (supervisor – underling) are added, a network turns into a **hierarchy**.

A service system is what gives care relationships their organization, resources, and direction. Service systems are complex multi-provider environments several actors having different competencies. Complexity is a natural consequence of specialization, which enables the formulation and implementation of more targeted clinical pathways and the attainment of better treatment outcomes in specific patient groups.

Balancing the pros and cons of specialization is a two-part management task. **Coordination** means the organization of the different elements of a complex body or activity so as to enable them to work together effectively. **Integration** means the fusion of two or more elements into a new entity that no longer can be separated into its components. The process of diagnosing a medical condition and preparing a care plan involves coordinating the perspectives of multiple actors and integrating them into a common understanding. Complex systems can easily become siloed. Relationships between actors are unpredictable due to different rules and practices. It can be difficult to tell whether the whole is an ecosystem, a network, or a hierarchy.

> **INTEGRATION FUSES ELEMENTS INTO A NEW ENTITY; COORDINATION KEEPS THE ENTITY ORGANIZED**

A patient's health issue and its context make up what is termed the **case**. The output of the service system is a treated case. Cases range from easy to difficult. The more concomitant health problems there are, the more complex is the case. In long-term cases, continuity of care can be difficult to achieve. There are also cases that are difficult to get to grips with. When there is no clear diagnosis, it is also not possible to prepare an efficient care plan. The patient is left in limbo between caregivers. In multi-provider environments, it is difficult to form an overall picture of complex cases which is an information system problem.

Patient journey disruptions

Adverse events are events that have a negative impact on a patient's health and well-being. Not all negative outcomes count as adverse events in this context. The concept of patient journey disruptions (PJD) only includes those outcomes that were caused by *agency*: something that someone did or failed to do. Accidents and happenstances are not in themselves disruptions, as they are unintended. Failing

to properly address them (negligence), however, constitutes a PJD. The realization of a known risk (unsuccessful surgery, a side effect to a drug) is not a PJD as the risk was known when the care plan was prepared. Failure to meet the patient's unrealistic expectations is also not patient journey disruption.

PATIENT JOURNEY DISRUPTIONS ARE MANAGEMENT PROBLEMS

Weaknesses in the clinical pathway can result in *medical errors.* Medical errors are not addressed in this report as they are a separate issue that belongs to clinical medicine. The patient journey disruptions discussed in this report are management problems that are ultimately attributable to the care pathway and its implementation. The Patients' own actions can naturally also disrupt their journey.

Patient journey disruptions have consequences that impact the patient's health, functional capacity, experience, emotions, and attitude. PJDs can be categorized into different types based on their consequences and causes.

Firstly, a PJD can damage the care relationship. The patient's commitment to the care plan (adherence) can weaken if they feel that they are not listened to or if unpleasant side effects of their medication are not properly addressed. The patient may stop taking their medication, which leads to new negative effects. The patient's adherence can drop to zero, causing the care relationship to break down and the patient journey to be interrupted for no good reason. Fragmentation is an example of a structural disruption. Fragmentation happens, for example, when a patient has two or more clinical pathways that have not been integrated, i.e. the pathways have been designed independently of each other and contradict each other in a harmful way, such as by prescribing unnecessary or incompatible medications (polypharmacy).

Secondly, patient journey disruptions can damage the stability of the patient journey. With the therapeutic balance shaken, the patient develops symptoms that are not addressed in their care plan and ends up in the emergency room. The emergency room becomes congested with patients who should not really be there. A significant portion of the demand in healthcare services is what is known as *failure demand*[5], which occurs when a patient's problem is not dealt with properly and the patient is forced to come back. These kinds of patient journey disruptions are the result of unclear divisions of responsibility and failures to follow care plans

According to a doctoral dissertation study on patient journey disruptions (Bengts, 2022), which was conducted in the MASSE project, patients with Parkinson's disease commonly felt that they were left alone with their illness and everything that it entails. Many patients found it extremely distressing. Care coordination was weak according to respondents. This appeared as patients being continuously referred from one caregiver to another without anyone claiming responsibility for the big picture.

Looking after

One category of patient journey disruptions that is particularly interesting from the perspective of MASSE is the absence of "looking after".

Human beings are naturally predisposed to look after one another. Traditionally it was the family doctor who would follow their patient through all phases of the care pathway. Looking after is a function of social interaction. The one looking after is like a guardian angel who understands the goals and the circumstances, who keeps an eye on the situation but only intervenes if and when necessary, and who is there to issue warnings and prompts, reprimands and reminders. Looking after is a responsibility that some people take upon themselves alongside their other duties.

In multifaceted and complex multi-provider environments, however, the looking-after function tends to weaken or disappear. While each specialist performs their role, usually to an excellent standard, no one is in charge of looking after the patient journey as a whole.

> ## PATIENTS MUST BE LOOKED AFTER

In order to correct this, the patient pathway must incorporate not just the clinical pathway and the care pathway but also the looking-after function. In its simplest form, the **looking-after function** means assigning one actor to be in charge of the patient case as a whole. Many patients or their next of kin are willing and capable of taking charge of the looking-after function, but this is not always possible.

The phenomenon is especially well illustrated in cases involving pediatric patients. Losing a child is one of the most traumatic events that a human being can experience. It therefore naturally follows that parents are prepared to do whatever it takes to look after their child along a complex patient journey.

For a service system overwhelmed by a lack of resources, such a deeply committed caregiver could be a valuable addition – or not. There are no uniform practices.

Many parents do not know what to do, whom to talk to, and who is responsible for what. Social welfare and healthcare professionals do not necessarily like parents interfering in their work.

One expression of the VCO could be a **role constructed specifically** for parents of pediatric patients. To enable this, each pediatric patient would need a care plan that identifies the actors responsible for the various elements of the case. The role of parents would be built by configuring access privileges, obligations, and responsibilities, by agreeing on the rules that everyone needs to follow, and by assigning contact persons and communication channels. Those parents who have the capability and willingness to take on the role would be given an information package and asked to consent to following the rules. (Knaapi, 2021)

The most important task of the looking-after function is to keep track of integration – to ensure that the care plan addresses all the issues that are relevant from the perspective of the patient's overall situation and that the plan is amended as the

situation changes. The second most important task is to oversee coordination – to ensure that the agreed steps are taken on time and that information is communicated to those who need it.

The mission of MASSE is to develop operating models and technologies that enable personalized care to be delivered effectively in a **multi-provider environment.** When everyone involved in a patient's case has all the latest information, they can look after the case without anyone being specifically in charge, as if following the instructions of a "synthetic guardian angel".

BASIC PRINCIPLES OF THE SOLUTION

Patient journey disruptions are a significant problem. Disruptions occur when the looking-after function fails. Looking after needs to be made straightforward and integrated into routine work with the help of IT solutions.

If recreating the looking-after function were easy, it would have been done already

The tangle of problems associated with multimorbid and chronic cases has long been known. Numerous solutions have been attempted. Finland's social welfare and healthcare reforms have tried to address the problem. However, macro-level projects that are motivated by policy, organization, power, and money have no chance of succeeding without an understanding of what needs to happen in terms of service provision. The system should provide support and make it possible to do the right things.

> Antero Taimiaho wrote a master's thesis (Taimiaho, 2022), in which he examined the history and outcomes of Finnish social welfare and healthcare system reforms that have focused on information technology. The care of chronically ill patients is based on clinical recommendations and regional care pathways that determine the division of responsibilities between different actors. It appears that current practices, which are based on these recommendations, are not effective in delivering continuity of care or enabling coordination. The current practices also do not automatically produce information about the effectiveness of care. Information systems and operations are poorly coordinated. Patient information systems are often used simply as electronic health records and not as a tool for operations management. The systems that currently exist are not capable of tracking processes across organizational boundaries or of coordinating operations.
>
> The same problems plague IT projects time and time again. Many are regional endeavors that lack coordinated direction on a national level, which means that local successes are not mainstreamed on a larger scale. Most are technology-driven – based on the misguided notion that some new information technology is capable of solving problems without understanding what the problem actually is, which is a consequence of poor end-user engagement. These kinds of projects also tend to have a fixed budget and run on a pilot basis. Without a financially sustainable business model, any solutions that are developed cannot finance themselves and will simply wither away. (Taimiaho, 2022)

What the VCO is and is not

MASSE provides a non-mainstream solution. The idea is not new, and most of the technical and operational components of the solution are well known. What has not been done before, however, is integrating the components.

In a multi-provider environment, the looking-after function can be performed by a **Virtual Care Operator** (VCO).

The VCO is a conceptual construct. When put into practice, it becomes a solution.

The basic-level (level 1) principles define what the VCO is and is not, and what it does and does not do. They lay down the foundations for the level-2 blueprints of

the Patient Card and Service Card, as technical platforms as well as a business model to establish the economic and operational framework.

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THE VCO PROVIDES
THE LOOKING-AFTER FUNCTION

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What the VCO does and does not do

YES	NO
recreates the looking-after function	diagnoses medical conditions and prescribes therapies – the VCO is not a new chain of medical clinics
produces control information - *know what to do*	manages resources and incentives (motivation, attitudes)
is virtual – multifaceted	acts as a central organization
operates in a multi-provider environment	interferes with care pathways that are coordinated by a single producer or with established multi-provider processes
delivers mass-production efficiency using modular IT solutions	relies on resource-intensive solutions (e.g. case manager)
sees every patient as an individual and is therefore customizable	is based on standardized digital care pathways that are designed for the average patient
is interoperable	constitutes a new social welfare and healthcare system or a new patient information system
is financially sustainable and has commercial value-based financing	is a fixed-term project with a set budget

Looking after with control information

The VCO coordinates care but does not actually treat patients – it is not a new chain of medical clinics.

The VCO's role is to recreate and reinforce the looking-after function in environments where it has been weakened or lost altogether. Looking after does not have to be a specific task assigned to a specific person; it can be thought of as a function that actors – individuals or teams – can incorporate into their job descriptions and roles. MASSE is aiming for a solution that can be integrated into the routine work and processes of healthcare organizations. The various actors involved in the various processes would get their instructions from a "virtual guardian angel", which would ensure that the patient journey becomes an integrated entity.

For this to be possible, everyone who comes into contact with the patient needs to know what to do in each situation.

Control information enables actors to "know what to do". As long as everyone has access to the same, up-to-date control information, different actors can work together (in an integrated way) and thereby provide the looking-after function regardless of whether they make up an ecosystem, a network, or a hierarchy.

Control information is a research and development subject in industrial engineering and management.

THE LOOKING-AFTER FUNCTION MUST BECOME ROUTINE WORK FOR ORGANIZATIONS

Purposeful human action has three preconditions:

- **Can do**: The actor must have the capability to perform the task. This requires competence, skills, technology, capital, resources, and administrative permits.
- **Want to do**: The actor must have the willingness to do what needs to be done. For this they need incentives, motivation, a mission, and a vision.
- **Know what to do**: The actor needs to be able to determine, in each situation that they encounter, what needs to be done and decided, and subject to what limitations and conditions. They therefore need control information.

If any of these preconditions is not satisfied, the entire endeavor fails.

The VCO provides the know what to do control information subject to the presumption that the other preconditions for purposeful human action are satisfied.

In order to enable care relationships based on co-creation of the patient's health, both professionals and patients need access to control information (Huttunen, 2022).

The interface between the service provision system and the information system that guides its operation is defined by the question: Who must know what to do the right things? This is a question for service engineering, and it can be broken down into the following components:

The care of chronically ill patients in the healthcare system could be likened to what

WHO	responsibilities, roles
MUST	roles, standards, management
KNOW	have the ability to understand
WHAT	appropriate, targeted control information
TO DO	competence, resources
THE RIGHT THINGS	goals, plans, adjustments

the world of business calls customer relationship management (CRM) (Hagelstam, 2022).

The concept of "virtual"

The VCO is "virtual" in the sense that it has no given organizational embodiment or form. The looking-after functionality can be deployed in various ways, and so can the VCO. It could be a room similar to an air traffic control tower with walls lined with monitors and human case managers wearing headsets. It might be an operations center where specialized nurses give instructions and communicate with all Finnish patients who have diabetes and heart failure concomitantly. The VCO can be programmed to automatically update patient records and upload the next house call's agenda to home helpers' smartphones. A special button for accessing the VCO's Patient and Service Cards could be incorporated into the Apotti home screen.

Moreover, there is no reason why the technical solutions that make up the VCO could not run on different platforms and retrieve data from different sources.

Dutch researcher Steven de Waal at the European Health Management Association (EHMA) conference in Dipoli on June 17, 2019.

Personalized mass-production efficiency in a multi-provider environment

Not everyone needs specially arranged care. Many patients are perfectly capable of looking after themselves, and others have a family member who is more than happy to take on the role of "guardian angel". No particular direction is needed in simple and straightforward cases that have a clear end goal. The VCO is only deployed when necessary, and the need for VCO-coordinated looking after is determined by a special gatekeeper. Patients are added to the VCO environment one by one, and looked after on a personalized basis.

The integration and coordination of multimorbid patients could be achieved the old-fashioned way, with pen and paper and landline telephones – if only there were enough staff. The Finnish healthcare system, like its counterparts in other developed countries, is suffering from a chronic shortage of resources too severe for any foreseeable economic growth or tax increase to remedy. Even if the money could somehow be secured (in practice, borrowed), just having enough hands on deck would still not solve the problem as a certain level of intelligence is also required. Expensive and especially labor-intensive solutions must be ruled out. However, it is likely that manual solutions will need to be used in the VCO prototype phase before these can be automated. The current approach to multimorbid cases wastes a lot of resources. Suitable resources need to be identified among this wastage and reassigned to running the VCO prototype.

Mass-production efficiency is not about working harder; it is a special type of efficiency. The basic mechanism of mass production is the relation between setup and execution. Setup refers to all the mental and physical activity that needs to happen before the value-generating work (performance, processing, transformation) can begin. The setup stage is when control information is utilized. The setup is a time-consuming and resource-intensive stage, which although necessary, has no value in itself. (For example, preparing the operating room and the patient for surgery counts as the setup, and the execution begins from the first incision and ends with the final stitch. If the preparations are made but the surgeon does not show up, the setup will have no use and will in fact be waste or resources.) If a single setup can be duplicated to produce one thousand identical executions, the setup will account for one thousandth of the production costs of a single produced unit. In health services efficiency is increased by faster and more accurate setups, which require control information to match.

One of the limitations of traditional mass production is that the process is only capable of outputting a single kind of product. However, customers want products that are personalized according to their wishes and needs. The solution to this dilemma is to use standardized control information and modules. The ability to produce a personalized setup automatically in the blink of an eye translates into personalization of products with mass-production efficiency. Systems supporting clinical decision-making can help to speed up the process and provide more detail to the diagnostic component of the system (Hyytinen, 2022).

In the context of healthcare services, mass-production efficiency means having instant access to all the information and decision-making capability needed to produce patient-specific setups and the ability to communicate the control information following from the setups to the relevant actors in real time. The effectiveness of multi-professional teams comes from having an effective setup. A team whose members are physically together making decisions about each patient's setup – i.e. the care plan – is much more effective and integrated than a team of isolated experts sending messages to each other from their respective silos.

An extreme example of personalization with mass-production efficiency is configuring apps on a smartphone. Each user can download the apps they want on a standardized platform (iPhone, Android, etc.) and customize them as they wish. With little cost, each user can build an entity that is tailored just for them (hypervariety).

Interoperability

The economic framework into which the VCO will need to fit means that the VCO cannot double up on or contradict (at least to any significant degree) the work of existing service and information systems. Large national databases, such as Kanta and HILMO, are used to record service events and to compile electronic patient histories. The interoperability of different databases and systems is critical to the viability of the VCO concept as explored in the context of the MASSE project. The VCO is not meant to be a new patient information system. The current systems will still be the ones used to input information. The VCO will take the patient data that it needs from existing sources of information. However, the data will need to be standardized to conform to a common data model (Misukka, 2022).

Interoperability domains (Vuokko et al., 2022)

Interoperability domain	
Legal	Efforts to harmonize operations on the basis of regulations and their implementation.
Organizational	Alignment of organization-specific objectives, operating models, and processes to achieve commonly agreed and mutually beneficial goals.
Semantic	Preservation of the meaning of exchanged data and information throughout exchanges between parties.
Technical	Design and configuration of information systems in a manner that enables the transmission of data between them with the help of, for example, harmonized standards, open interfaces, and integration services.

Levels of semantic and technical interoperability are relatively high in Finland thanks to a long history of standardization across organizational boundaries. Challenges associated with legal interoperability involve, for example, information security standards and the GDPR. Organizational interoperability refers to the ability of organizations to work together despite having different internal structures and processes. (Virkkunen, 2022)

Financial and operational sustainability

The VCO ties up resources during both the investment phase and the operation phase. Projects with fixed budgets tend to collapse when the funding runs out. The VCO needs to finance itself by producing results that someone is willing to pay for. This calls for a business and revenue model.

A VCO's cost-effectiveness has been simulated in a special case study in which another concept named "Prevention Clinic" is considered as a comparable solution to the VCO, focusing on a specific group of patients. In this scenario, responsibility for the care of cardiovascular disease (CVD) cases would, after acute treatment of the initial cardiovascular (CV) event in specialized care, shift not to primary healthcare but to a specialized Prevention Clinic. The Prevention Clinic would focus on gradually lowering the patient's low-density lipoprotein cholesterol (LDL-C), which is the main cause of CVD in accordance with European (ESC/ EAS) guidelines, until the treatment objective is achieved. The simulated scenario can be used as a basis for estimating the cost-effectiveness of the Prevention Clinic. (Nurmi, 2022)
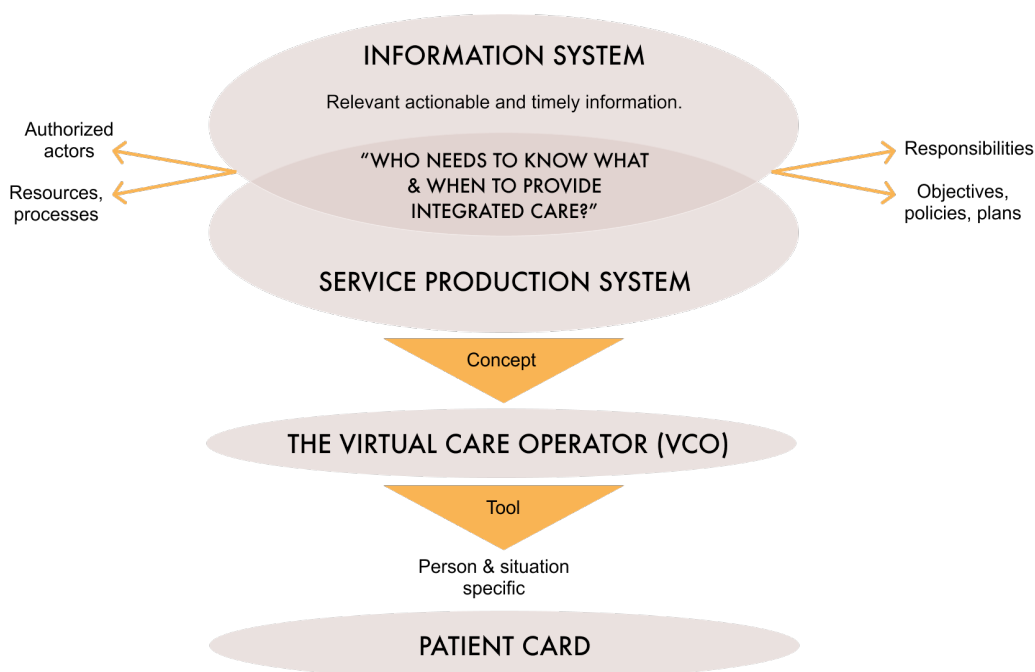
VCO DESIGN PRINCIPLES AND PATIENT CARD

An information system makes control information available to a user who can and wants to use the information to do the right things, i.e. deliver an integrated and coordinated patient journey.

This section describes the design principles of the VCO information system.

Information and service system

Information systems produce control information that tells actors in the service provision system what to do, decide, or find out in each situation.

INFORMATION SYSTEM

Relevant actionable and timely information.

Authorized actors

Resources, processes

"WHO NEEDS TO KNOW WHAT & WHEN TO PROVIDE INTEGRATED CARE?"

Responsibilities

Objectives, policies, plans

SERVICE PRODUCTION SYSTEM

Concept

THE VIRTUAL CARE OPERATOR (VCO)

Tool

Person & situation specific

PATIENT CARD

Information and service system integration

Patient Card

The VCO's role is to produce for the ecosystem coordinating the patient journey the control information that it needs. The Patient Card is the interface, or display, via which the information is provided to the ecosystem actors.

The Patient Card gathers the latest information with relevance to the patient's care and looking-after needs from different databases and systems and displays it all in one place.

Analytics, data processing, and artificial intelligence are used to compile a visually and structurally consistent picture of the patient's condition from the information

pooled from different sources in the Patient Card.

> Control information needs to satisfy four conditions
> - All the actors in the ecosystem need to have access to consistent (not contradictory) information, although not everyone needs to know everything
> - The information must be up-to-date (not outdated)
> - Different (relevant) data types / contents must be presented in one place where all the information can be viewed at a single glance on a single screen (i.e. integrated)
> - Information concerning each patient must be arranged hierarchically according to the purpose for which the information is needed – only the most important facts should be shown, and always in order of importance (hierarchy of information)

The idea for the Patient Card was born in a focus group ran in the course of the MASSE project for stakeholders and professionals working with people diagnosed with Parkinson's disease (Lillrank et al., 2022). Versions of a similar concept had been previously proposed in interview surveys (Sylgren, 2022) and discussed with actors in the social welfare and healthcare sector.

> The Patient Card concept has a prehistory.
>
> Erik Björn-Rasmussen, an internist at Karolinska Institutet in Sweden, decided to tackle the quagmire of multimorbid patients in 1984. Specialized medical care providers operated in siloes, dealing only with their respective specialties. No one wanted to touch the multimorbid patients.
>
> MediKliniken Curamus Ab, a publicly funded but privately run company, set about sorting out the cases with new approaches.
>
> When a patient came to see a doctor for the fifth time, a special appointment was booked for them. The doctor would go through the patient's entire medical history with the patient and then draw up a summary, which the patient would sign. Every patient file ultimately had as its cover sheet a one-page (A4) summary. The patients were given a copy of the summary to carry with them, which proved useful when patients ended up in the emergency room or were referred to a specialist. In the space of two years, five hundred complex cases turned into simple follow-up patients for family doctors.
>
> Despite its proven cost-effectiveness, this early version of the Patient Card was never taken up on a more widespread scale[7].

The picture shows an example of the functions and design of the Patient Card.

MASSE

Palvelukortti
- Palvelut
- Sosiaalietuudet

Diagnoosit
- Sydämen vajaatoiminta
- Eteisvärinä
- Alzheimerin tauti
- Aiemmat diagnoosit

Hoitosuunnitelmat

Hoitokontaktit

Lääkitys

Rokotukset

Riskitiedot

Yhteydenotot

Toimenpiteet

Sairaudet suvussa

Huolenpitosuunnitelmat

Akuutti

Etunimi	Sukunimi	Postitoimipaikka	Henkilötunnus	Sosiaalinen tukiverkosto	Ammatti
Hilja Anneli	Virtanen	Espoo	121039-XXXX	XX	Eläkeläinen

Hoitolinjaukset

1) DNR päätös	2) pyritään hoitamaan omassa palvelutalossa, suonensisäisiä hoitoja voidaan harkita

Potilaan oma raportointi

Väsymystä 1 pv sitten	Verenpaine koholla 3 pv sitten	Ei nukuta 3 pv sitten

Diagnoosit ja hoitosuunnitelmat

Sydämen vajaatoiminta
asetus pvm, voimassaolo tarkistettu

Eteisvärinä
asetus pvm, voimassaolo tarkistettu

Alzheimerin tauti
asetus pvm, voimassaolo tarkistettu

Säärihaava
asetus pvm, voimassaolo tarkistettu

Valokuvat aikajanalla

Terveydentila
- Potilaan raportoima
- Omaisen raportoima
- Ammattilaisen raportoima

Hauraus luokitus
6   1 kk sitten
RAI, MMSE

Hälytykset ja seurannat
1   2   1   5

Lisätietoa sijainnista

Potilaan sijainti / asumismuoto
Koti

Riskitiedot

Taipumus aggressiiviseen käyttäytymiseen	Lidocain –puuduteallergia

Hoitopolku, 3 päivää

Potilaan raportoima kokemus omasta voinnistaan, 3 päivää
Patient-Reported Experience Measures, PREM

25

15

5

0

Potilaan raportoimat mittaukset omasta terveydestään, 3 päivää
Patient-Reported Outcome Measures, PROM

25

15

5

0

Ensihoidon kirjaus ja ensihoidon ottama sydänfilmi

Functions and design of the Patient Card

The Patient Card is personalized separately for each patient who needs one. The needs assessment process would be similar to that currently used by Social Services (*Sosiaalipalvelujen saatavuus*, n.d.).

FUNCTIONS OF THE PATIENT CARD:

- **PERSONAL INFORMATION**
- **TREATMENT GOALS**
- **CARE PLAN**
- **SYMPTOMS**
- **DIAGNOSES**
- **CLINICAL PATHWAY (EVENTS)**
- **REPORTS AND SELF-MONITORING**
- **MEDICATION**
- **OVERALL STATUS**
- **ALERTS**

The following example of the operation of the Patient Card was prepared under the guidance of geriatrics specialist Dr. Perttu Kontunen and is for illustration purposes only. In constructing the VCO, careful consideration must be given to what information each user needs and how the information should be presented and in what order.

A Patient Card is created for a patient called Hilja

Hilja is an 83-year-old retired school teacher. She was widowed eight years ago and still lives in her own home in an apartment building. She has two children: Her son, Pekka, lives on the other side of town, and her daughter lives further away. Hilja has three grandchildren.

Hilja has always taken care of her health, and she enjoys long walks and gardening. Recently, however, she has started to find it more difficult to get around. She was diagnosed with atrial fibrillation and heart failure as well as pre-clinical Alzheimer's disease a few years ago. She was prescribed an anticoagulant and a diuretic as well as memory medication.

Nurse Sirkka is looking at Hilja's laboratory test results in connection with an e-consultation. It appears that Hilja also has an underactive thyroid. GP Tuulikki consults geriatric specialist Perttu, and a decision is made to refer Hilja to the VCO and create a Patient Card for her.

Tuulikki books a one-hour appointment for Hilja. When Hilja comes to her appointment, Tuulikki opens the VCO dashboard on her computer and clicks on "Create Card". A template for creating a new Patient Card appears on the screen. The system asks for Hilja's personal identity code and quickly retrieves her basic data from Kanta (national health archives), placing them neatly in the header with Hilja's diagnoses listed in the left sidebar.

The system asks whether the user would like to input treatment goals. Hilja tells Tuulikki that she wants to stay in her own home for as long as possible and be able to go to the shops and see her grandchildren. Tuulikki enters these goals in the system. Hilja has already made a living will, which is recorded in the Patient Data Repository; this is shown in the goals section.

The system now asks about Hilja's own assessment of her health. She feels alright in general but sometimes gets very tired.

Hilja has four diagnoses, of which heart failure is the biggest concern at the moment. Tuulikki selects an app developed by Health Village from the VCO platform and uploads it to Hilja's Patient Card. The app sets out a clinical pathway for treating heart failure and recommends starting Hilja on a beta-blocker to lower her heart rate. Tuulikki checks in the Medication Management add-on that there are no contraindications in Hilja's case, and types up a prescription. The system populates the information in the Medication section of Hilja's Patient Card. The clinical pathway app recommends that Hilja be fitted with a bracelet to monitor her heart rate. The data collected by the bracelet will be synchronized with her Patient Card.

The system is asking who will be involved in Hilja's care. Hilja wants to stay in charge of her own health for as long as possible, but her son, Pekka, is also happy to help. Tuulikki is named as the doctor in charge, Perttu as the specialist, and Sirkka together with the rest of the local team as the nurse in charge of the case.

The system asks which individuals will need personalized access to the Patient Card and how the displays should be formatted. Tuulikki will need access to all of Hilja's records; she can also get the information from the electronic patient record system Effica, but she asks the system to compile a quick-access summary showing only the most important data. Hilja gets her own display configuration, which she can access via her iPad. She will be able to see all her upcoming appointments, medications, the heart rate readings taken by her wearable device, communication channels and an emergency button, as well as a multiple-choice field that Hilja can use to input information about how she is feeling and add comments about her health using voice commands. Hilja's son, Pekka, will also have his own display configuration which shows an overview of Hilja's situation. Pekka's configuration includes a special button that he can use to contact a nurse, Tuulikki, or the emergency room. The VCO identifies Pekka as Hilja's active next of kin.

Finally, the system configures a special emergency access profile to associate with Hilja's Patient Card. If something happens to Hilja and she is taken to the emergency room, the triage nurse will be able to quickly access all of Hilja's basic information and a summary of her circumstances.

The process has taken 52 minutes; Tuulikki logs out of the system, and Hilja goes home with peace of mind.

Hilja uses her Patient Card

Hilja is now 85 years old. The swelling in her legs is getting worse. She has been hoping that the problem will go away on its own. Her wearable device, which measures her heart rate and heart rate variability, nevertheless sends an alert to Hilja's iPad and to Pekka via Hilja's Patient Card. Hilja completes the multiple-choice questionnaire (a structured AI survey) about her health that pops up on her screen, and her answers are uploaded to the self-monitoring section of her Patient Card. The system asks Hilja to weigh herself so that her weight, too, can be added to her Patient Card. The learning algorithm notes, based on Hilja's previously reported measurements, that this latest development could be an indication that her heart failure is worsening. A button instructing Hilja to "call the non-emergency helpline on 116 117" pops up on the screen. Hilja presses the button. Soon she is talking to a nurse, who can see Hilja's Patient Card on his screen. The nurse notes that Hilja's regular doctor, Tuulikki, has authorized a dose increase for Hilja's diuretic medication. The nurse discusses the next steps with Hilja, and together they go through Hilja's symptoms and wishes regarding her care going forward. Having been given clear instructions and an AI recommendation, Hilja takes an extra dose of her medication and reduces her water intake a little over the coming days. Hilja also gets the instructions in writing on her iPad. In addition, the system reminds Hilja that if her condition deteriorates, she can contact the local mobile unit at any time or call 112 in an emergency.

Hilja's Patient Card is amended

Hilja's health keeps deteriorating. She has a dizzy spell and ends up in hospital. The swelling in her legs has also resulted in a venous leg ulcer. An assessment of her care needs is performed as she is being discharged. Hilja can still manage at home, but she needs a home helper to visit her three times a day, an appointment with a nurse once a month, and eight sessions of physiotherapy.
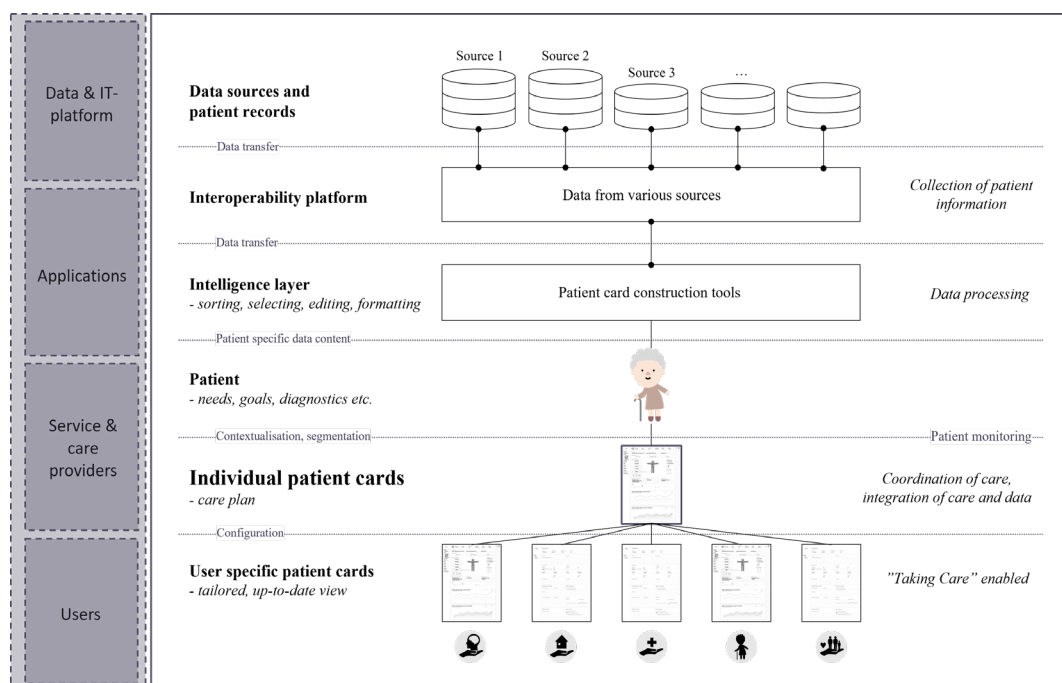
Tuulikki books a 30-minute appointment for Hilja and calls Saara, who is Hilja's case worker in Social Services. Hilja's situation has changed, and her Patient Card needs to be amended.

Tuulikki opens the Service Card. She assigns the case to an experienced home helper in Hilja's neighborhood. The search function in the Service Card makes it possible to also identify a competent physiotherapist nearby who has availability. Saara signs off on the budget, and the bookings are confirmed. The details of the selected service providers are automatically added to Hilja's Patient Card, and the caregivers are issued cards that show Hilja's current status as well as the steps that have already been taken and what the plan is going forward.

The information technology behind the Patient Card

The Patient Card retrieves patient data from different sources, such as Kanta, Effica, or the RAI system. The Patient Card could, in theory, function as a user interface for My Kanta Pages.

As a rule, however, the Patient Card would be read only, and the existing patient information system would be used for inputting information as before. The data entered into the patient information system would be retrieved from there and imported to an interoperability platform where they would be harmonized and a patient-specific file would be created.

Functions and design of the Patient Card - example 1

There would be a standardized Patient Card construction tool. The Patient Card algorithm would retrieve the selected data from the interoperability platform and sort, organize, and format them to match the Patient Card layout. This would be the basic-level Patient Card that would primarily be a tool for the patient's regular doctor. The doctor would have the power to specify which data to present on the card and in what order, so as not to have to retrieve them from the patient information system separately every time.

The basic-level Patient Card could then be customized for different users to produce displays showing only the information that each user needs. These displays, too, can incorporate an input functionality that allows the patient, their next of kin, or their physiotherapist, for example, to add notes.

Patient Card structure and backend systems – example 2

An intelligence layer can be incorporated into the Patient Card design to coordinate the various elements and select what information to show to each user. There is potential in using artificial-intelligence and machine-learning applications to make the different elements of the Patient Card communicate with each other. More detailed research and development is nevertheless needed in these respects, which is why they are not discussed any further in this report.

The VCO is a platform

The VCO is a combination of an information system and the service system that uses it. The virtual nature of the VCO means that no special service organization is necessary, and instead, the Patient Card would simply be incorporated into the relevant elements of the existing system. Dedicated service centers focusing on, for example, the provision of remote guidance to a specific group of patients can naturally be established.

Information systems

IT back office

Costruction tools

VCO SERVIECS

Service card deck

VCO PLATFORM

VCO applications

Patient card

Service card

Digital health applications store*

Service card platform

User-specific patient cards

VCO patients   Service events   Service providers

Social and healthcare service production system

digitherapies, patient pathway management, self-care programs, information services etc.

VCO as a platform

The Patient Card can be seen as a platform onto which various applications, or apps, can be downloaded similar to iPhone and Android smartphones. There are a wide range of health apps on the market, designed for both end users and professionals. Examples include digital therapies (e.g. Orion's digital therapeutics software solution for chronic pain, see annex (Gröhn, 2022)), digital diagnosis-specific clinical pathways (e.g. StellarQ's solution, see annex (Huttunen, 2022)), Vilja Care Ltd's goals-of-care app, MealLogger weight management tool, VitalSignum's heart condition monitoring solution (see annex (Pirskanen, 2022; Sipilä, 2022)), and the Pharmaceutical Information Centre's pharmaceutical information service. These kinds of tools can all be brought together in an app store for healthcare services. A deck of Service Cards would be created to enable service customization and access to information about services.

Service Card

The Patient Card concept is based on a scenario where a patient has a care relationship with a specific healthcare organization (health center, hospital) even if they do not always see the same person or team. The concept also assumes that there is a care plan in place, which specifies what needs to be done about each ailment. There are situations where these assumptions do not hold true, however.

The Service Card concept is intended to address issues relating to information sharing and the multitude of services. There is not enough information about the services that exist, or the information is difficult to find, which makes it harder not only for social welfare and healthcare professionals but also customers themselves to identify the service that they need.
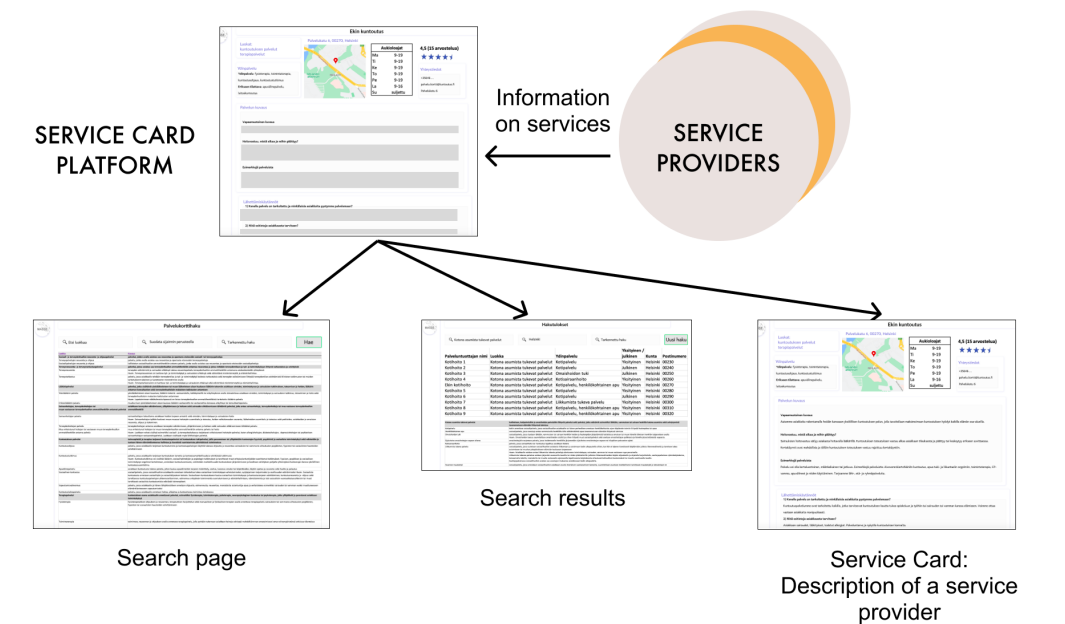
The Service Card acts as an integrated services catalog.

The Service Card would have a standardized layout for presenting information about individual service providers. The full deck of Service Cards would be accessible via the VCO dashboard. There would be a search function with filters for identifying the relevant services and linking them to the relevant Patient Card.

What makes the Service Card platform so useful is its ability to give social welfare and healthcare professionals standardized, structured, and reliable information about all the services available across the ecosystem. From the patients' perspective, the platform provides valuable information based on which they can choose the services most suitable to them.

The Service Card platform also benefits the service providers themselves, as it would give private and third-sector operators in particular more visibility, a new channel for interacting with customers, and a wider market. The layout would be standardized, which would make it easy to add new Service Cards to the deck.

The Service Card platform consists of three components: The **search page** could be used by social welfare and healthcare professionals to search for suitable services using a variety of filters such as service category and location of the service provider. The **search results** would be a list of services that match the search criteria, including basic details such as the name and type of the service, terms and conditions, availability, and contact information. The **Service Card** would give each service provider an opportunity to introduce themselves in a manner that gives social welfare and healthcare professionals the information that they need to refer patients to the service provider.

Search page

Search results

Service Card:
Description of a service
provider

Service Card platform

PRINCIPLES OF THE VCO BUSINESS MODEL

If MASSE were a normal social welfare and healthcare IT project, this would be the end of the road. The last of the budget would be spent, a pilot scheme would be set up, a report would be written, and the team would go in search of a sponsor for their next project. However, the thinking behind MASSE has always been to build a sustainable solution to the problems currently plaguing patient journeys. "Sustainable" in this context refers to both financial and operational feasibility. The VCO has to finance itself by demonstrating its value to paying customers. It needs to become a necessity similar to non-emergency helplines and mobility aids centers. This is why the VCO needs its very own business and revenue model.

At this stage of the project, it is not possible to produce a business model with every detail taken into account. This section outlines the most important issues for drawing up and implementing the VCO business model that the parties involved will have to consider.

Benefits of the VCO – value proposition

The purpose of the VCO is to reduce the incidence of patient journey disruptions along complex patient journeys. With fewer patient journey disruptions, high-quality care can be provided with fewer resources and with less effort. The questions that need to be answered are how much, at which point, over what period of time, and on what terms.

Caring for chronically ill and multimorbid patients currently eats up four-fifths of healthcare resources (Linna, 2022). It is impossible to know exactly how much of this is attributable to preventable patient journey disruptions.

It can, however, be demonstrated that there is a lot of potential for improvement in the current approaches. The Foundation for Municipal Development has published a study on the efficiencies of different hospital districts. If the poorest-performing districts could be brought up to the average level, a billion euros would be saved. If everyone followed best practices and were as efficient as the most efficient district, five billion euros less would have to be spent on the provision of services each year.

Let us assume, very conservatively, that adverse events are to blame for one-quarter of all costs (four billion euros) and the VCO could eliminate a quarter of these. This would make the VCO's potential cost-effectiveness one billion euros.

The top level of the Finnish Government evaluates efficiency and cost-effectiveness in accordance with the international model of value-based care[9].

Productivity refers to the relationship between the input (resources) and the output (procedure), and measures efficiency relative to the cost of producing a specific output. Productivity can be improved by means of Lean methods. Effectiveness of procedurerefers to the relationship between the output and the health impact achieved. This is measured by metrics such as survival rate, functional capacity, satisfaction, or second visits. These are subject to competence, evidence-based medicine and prioritization.

Cost-effectiveness or value is the ratio of the resources consumed (i.e. the input) to the health impact achieved. It can be measured separately for individual cases or across whole populations by asking, for example, how much has been invested in the care of a specific group of patients in a specific area and what is the average health like in this group.

Cost-effectiveness materializes through various mechanisms. In the case of a new system or method, a comparison of before and after can be useful. A few examples are given in the annexes to this report (Hämeri, 2022; Heinonen, 2021). Among them is a control system for MS patients, which saves resources by (a) reminding patients of their appointments, thereby reducing the number of no-shows; (b) monitoring the therapeutic balance and only recommending a control when necessary; and (c) helping to anticipate exacerbations of the disease, which can then be addressed in a systematic manner without visits to the emergency room. (Huttunen, 2022)

If it is not possible to calculate cost-effectiveness directly, proxy metrics can be used. Lalli Nurmi wrote his master's thesis on comorbid patients with cardiovascular disease and type 2 diabetes (CV + T2D). The biggest cost driver is a new attack. New attacks can be anticipated on the basis of patients' therapeutic balance and adherence. These are measurable metrics based on which it is possible to calculate the probability of a new attack and therefore the effect on costs in different kinds of service processes (Nurmi, 2022).

It is not always possible to calculate the (cost-)effectiveness of individual service system components. For example, a customer service center can facilitate access to treatment, but the value this has depends on numerous other factors. In such cases, it makes more sense to measure productivity (Messo, 2021).

Cost-effectiveness calculations generally need to take into account the input. This can be calculated by measuring the time that each resource spends on performing a specific function. When the unit cost of the resource is known, the time can be converted into money. An input analysis also facilitates international comparisons.

Entities & relations of Value-based Health Care (VBHC)

Systems, devices, and methods do nothing by themselves. The impact is created through the changes in service provision practices. These do not materialize without determined leadership.

A reduction in the resources needed per case (input) is a quantifiable measure. Money can only be saved by cutting the number of staff. With the entire sector suffering from a shortage of labor, increasing efficiency in this way is not an option. The focus should instead be on identifying the freed resources and reassigning them to more meaningful tasks. Information systems, process models, and hardware are not capable of making these kinds of judgement calls. Repatriating savings requires active management. Without proper leadership, the freed capacity is soon wasted.

The VCO has potential to influence not just costs but also value. Potential benefits to different actors are illustrated in Table X. A reduction in patient journey disruptions benefits both professionals and patients. This has been proven in a number of case studies, which paint a picture of how the solution would work in practice. The best way to understand the big picture is to analyze registry data in before and after scenarios. The benefits to patients can be measured using surveys such as PROM (Patient-Reported Outcome Measure) and PREM (Patient-Reported Experience Measure).

Benefits of the VCO to different actors

Beneficiary	Value proposition
State	Fit labor force, tax revenue, social insurance
Social welfare and healthcare system	Service structure optimization, analytics, patient population management
Service providers (health centers, clinics)	Productivity and cost-effectiveness, continuity of care, reduction of patient risk, new services and functions, integration and coordination of care, forecasting, prevention, streamlined processes
Professionals	Higher efficiency, overview of customer status, patient journey management
Patients, next of kin	Transparency of care pathways, empowerment, contact and communication channels, self-care monitoring
Technology suppliers	Collaboration opportunities, sales through the platform, piloting
Patient information system developers	Cooperation, usability, development opportunities, data-related revenue potential
Pharmaceutical and insurance companies	Monitoring data, analytics

VCO actors and roles

Someone has to run the VCO. This can be a single operator or a consortium of operators. In theory, it would take just one operator, such as a social welfare and healthcare organization, to build and run the VCO. In practice, however, having just one operator in charge would not be sensible, as the concept relies on a variety of

technically specialized operators, and mobilizing these within a single organization would be difficult. The VCO concept comes with a number of essential tasks and roles. One or more of them can be assigned to a single operator, or a role can be shared between members of a consortium.

VCO roles and tasks

Role	Task	Example
Owner/principal	Corporate governance, orchestration	State, social welfare and healthcare organization, IT company, purpose-built operator
Investor	Investments	State, social welfare and healthcare organization, venture capitalist
Paying customer	Operating expenses	Social welfare and healthcare organization, insurance company
Builder(s)	Building of the platform and cards	IT companies
IT infrastructure	Source systems, interoperability platform, consents	Social Insurance Institution of Finland, DigiFinland, UNA Ltd, patient information system developers
Operator	Day-to-day operation management, maintenance, development	VCO Co. Ltd DigiFinland
Software developer	Development of apps and content for the platform	Pharma, medtech, health app developer, the Finnish Medical Society Duodecim, the Pharmaceutical Information Centre
User (professionals, service providers)	Use of the VCO as a tool	Health center, specialized medical care, social services, occupational health, well-being services, new roles
End user (patient, next of kin)	Co-creation of health	
Beneficiary	Making use of the knowledge and experience generated	Central government developers, statistical authorities, patient organizations

The VCO requires investment on the one hand and generates capital, including brand value, on the other. Someone has to pay for the system, and someone has to own it. Building the technology in the first place and then running, maintaining, and developing the system all cost money. There a several alternative ownership models. The VCO could be integrated into the line organization. However, setting up a new limited company with its own books would undoubtedly be a more sustainable solution.

In a tax-funded environment such as Finland, paying for the system falls most naturally on the social welfare and healthcare organization that adds the VCO to its service portfolio and covers its running costs. It is also possible that funding can be secured from another source, such as the central government's development funds. The paying customer is also the party that should have the keenest interest in the operation of the system and the results that it is capable of delivering. It is also conceivable for an insurance company, a private service provider, or a large corporation's occupational health organization to decide to build a VCO for its own purposes.

The IT platform needed to run the VCO does not yet exist and needs to be built. This calls for one or more competent IT companies. The VCO is not an automated system. It needs an operator to keep it running, oversee the day-to-day process, and monitor, maintain, repair, and develop the system together with the users and end users. Software developers play a role in designing various kinds of digital care pathways, smart content, self-care support systems, and sensors that can be linked to the Patient Card.

The functional core of the VCO is made up by its users, doctors, nurses, and other professionals, who can use the Patient and Service Cards to boost the productivity and value of their work. The VCO's end users are patients and their next of kin. The impact of the VCO materializes through changes in their health, service experiences, and behavior. The operation of the VCO generates experience and data that can be used for a multitude of purposes such as operations management and development, research, and planning.

The Patient Card is a platform that can feature a wide range of apps performing specialized tasks and responding to all kinds of needs. Someone must design these, however.
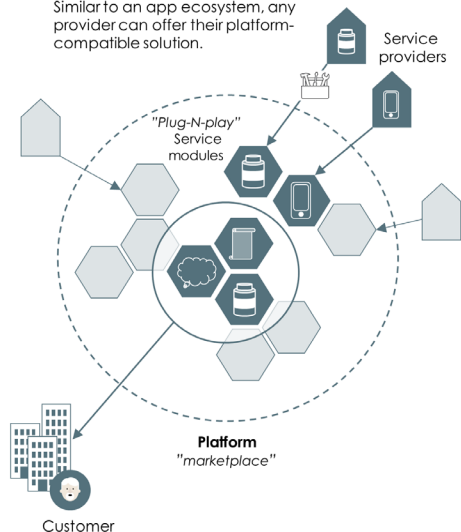
This is where the VCO consortium will need to make a critical strategic decision between an open and a closed system.

In a closed system, all the key roles are performed and all the apps produced by a single actor, who therefore has full control over the solution. An open system would be a platform to which all eligible operators can add content subject to standardized user interfaces and agreed rules. This naturally increases choice and encourages innovation. It is undoubtedly more advantageous for app developers to be involved in a shared platform than to offer stand-alone solutions. However, an open system is more challenging from a management point of view and requires a high degree of control from the operator. In the case of the VCO, a relatively closed system would

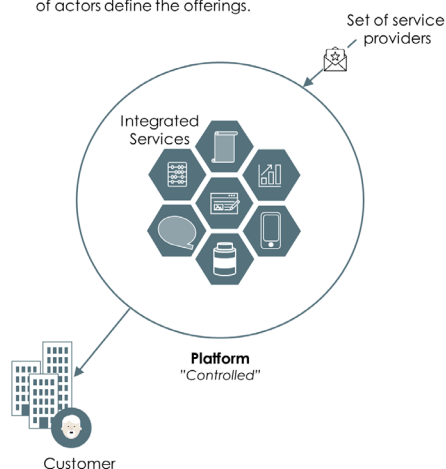be a good starting point, which could then be gradually opened.

Loosely Orchestrated "Open" platform
Similar to an app ecosystem, any provider can offer their platform-compatible solution.

Service providers

"Plug-N-play" Service modules

Platform "marketplace"

Customer

Tightly Orchestrated "Closed" platform
Similar to other SaaS integrated solutions, a keystone actor or limited set of actors define the offerings.

Set of service providers

Integrated Services

Platform "Controlled"

Customer

Closed vs. open system

At this point, it is important to determine the target audience of the services available via the VCO. The social welfare and healthcare organization that owns and pays for the system will naturally want to introduce the concept to its own patients first, but the VCO can of course also be marketed as a service to outsiders, and even internationally.

Revenue model

Once the identity of the paying customer has been established, it still remains to determine how, on what basis, and how much the payments will be. Answering these questions calls for a revenue model. A revenue model establishes (1) what the payment is for (proof-of-service), (2) how payment is taken, and (3) how the incoming revenue is distributed between different operators within the system.

The starting point in the case of the VCO is that the proof-of-service is the operations management service that the VCO provides and that promises to boost cost-effectiveness. If a decision is made to go down the open platform route, a number of revenue models can be considered, such as platform usage fees. The VCO generates data that can be useful to many operators.

At least a few textbook revenue models can be identified:

- Annual budget based on forecast volume (similarly to emergency services)
- Charge per user (membership fee, license fee)
- Charge per unit (created Patient Card)
- Charge per usage transaction (similarly to a phone bill)
- Charge per unit of time (monthly/annual fee)
- Charge per delivered impact. This would require a detailed contract similar to a social impact bond (SIB) to agree how impact would be defined and measured, and how any potential savings in resources and other benefits would be monetized and shared

Often revenue models are actually hybrids, combining a number of different financing channels, such as a small annual budget to cover fixed costs, supplemented by a usage fee, and topped up by a value-based bonus.

The simplest solution would be for the social welfare and healthcare organization to be the paying customer. The paying customer would pay the VCO in accordance to some combination of revenue models, and the VCO would then pay the various technology suppliers and service providers on the basis of some other model or combination of models.

NEXT STEPS

This presentation of the design principles of the VCO completes MASSE's mission. Building the VCO will be a task for a consortium that has the necessary competencies. The prototype will need to be tested and developed in a real-life context. However, this process of technological development needs to be supported by further theoretical research. The members of the consortium will need to agree on the way forward and the methodology among themselves. The steps set out below, however, must be taken in any case.

Roadmap for building the VCO

1. Setting up a consortium with a shared vision and the necessary competencies.
2. Identifying a suitable multimorbid patient population, form of therapy, and area to run through the prototype.
3. Identifying the data, service type, resources, and capabilities needed based on the chosen target population.
4. Building an interoperable data repository and obtaining any necessary permits and licenses.
5. Identifying and engaging a suitable testing platform ("Living Lab"), such as a health center and a team of professionals.
6. Identifying the relevant care pathways, Current Care Guidelines, applications, and other similar clinical content.
7. Building a working prototype of the Patient Card (Minimum Viable Product, MVP).
8. User training, commissioning, monitoring, development, standardization.
9. Expanding the range of services and/or the area.

Research tasks

Building the VCO requires information that does not yet exist (*known unknown*). The information therefore needs to be generated through scientific methods. The research tasks are as follows:

1 Patient Card design

The idea of the Patient Card is to provide a quick overview of the patient's situation and upcoming tasks. Not everyone needs to know everything, however, which is why different versions need to be developed for different users and different situations. The research questions are therefore as follows:

- Who are the main professional users and end users?
- What are the typical use cases for each user?
- Who needs what information and for what purpose (actionable vs. nice-to-know)?
- Hierarchy of information (personalization logic): What information is the most important for each type of user?
- Sorting: How should the information be sorted into different categories?

- Formatting: In what format should the information be presented?
- How does the user customize the Patient Card?
- How are the user experience and usability optimized?

This research task is user-centered and use case-driven. The outcomes will be continuously and iteratively reviewed with technology developers and users: What functionalities are important and feasible?

2 VCO deployment, organization, and management

The assumption at the core of MASSE is that the problems associated with the care of multimorbid patients are ultimately caused by a lack of control information ("know what to do"). Once this information becomes available, what happens next? Information in and of itself does not change anything.

- How will the solutions be deployed? What training is required?
- How must the tasks, roles, responsibilities, processes, and practices of the service organization change in order for the desired outcomes to materialize?
- How can these changes be standardized and incorporated into routine work?

3 Financial and operational sustainability

There are likely to be issues related to the business and revenue model of the VCO that cannot be known in the early stages. A prerequisite for a financially sustainable business model is that the investment and production costs of the VCO are known and that the value that it will deliver can be measured.

- How should the deployment of the VCO be viewed as an investment?
- How is the cost-effectiveness of the VCO defined and measured?
- Which cost-effectiveness indicators affect the revenue model and how?

4 International marketing

The VCO prototype will be built with the Finnish healthcare system in mind. The ultimate goal, however, is to export the concept.

- How should the concept be packaged and configured to make it work in different environments where the context is different due to, for example, different information systems, funding models, or laws? See annex (Hörhammer, 2022).
- What are the most exciting and likely export markets?

ENDNOTES

[1] *Construct* is a set of logical relationships of concepts describing a phenomenon (A consists of a and b; A occurs before B). *Model* adds a dynamic dimension (there is a 0.35 correlation between a and b).

[2] The clinical pathway and the care pathway usually go hand in hand, but there are exceptions. There are hospitals in India that only provide the clinical pathway and its implementation, and all the care elements are left to the patient's family. There are also cases where there is no clinical pathway, as no medical condition has been diagnosed and the person simply needs looking after due to some other reason, such as loneliness. This is what the conceptual pairing of health/help is about.

[3] *Handover* refers to the transfer of the "flow unit", i.e. the subject of the process, such as the patient or the patient's file, from one operator or workstation to another. Included in the handover must be all the information that is needed for the next step, which is what makes this a vulnerable time for communication errors.

[4] *Setup* refers to the cognitive (what was this again?) and physical (what does this require?) preparations that are required for the actor or workstation to be able to complete the task.

[5] *Failure demand* is a common problem in service industries. It is estimated to account for between 40% and 80% of total demand. See Seddon, J. (2008). Systems thinking and the public sector. Triarchy, Axminster. Walley, P. (2013). "Does the public sector need a more demand-driven approach to capacity management?". Production Planning and Control, Vol. 24 No. 10–11, pp. 877–890.

[6] Service engineering refers to the discipline concerned with the systematic development and design of services. For the purposes of this report, the concept of service engineering is understood broadly to cover everything from the structural and technical design of service provision systems to the design of servicescapes and customer interfaces.

[7] Björn-Rasmussen, Erik (2019). Läkekonstens lönsamhet – Varför politikerstyrning inte fungerar. Care2Care, Riga.

[8] Kinnula, Petra, Malmi, Teemu, Vauramo, Erkki (2017). Mitä tunnuslukuja sote-alueen johtamisessa tarvitaan? The Foundation for Municipal Development.

[9] Porter M. E., & Teisberg, E.O. 2006. Redefining healthcare - Creating value-based competition for results. Boston, MA: Harvard Business School Press.

ANNEX: CASE STUDIES

CONTEXT OF THE VCO

Limitations and enablers of the VCO concept in the Finnish social welfare and healthcare system

BACKGROUND

Antero Taimiaho's master's thesis (Taimiaho, 2022) set out to explore the shortcomings of information systems and production control that hinder the smooth and recommended treatment of long-term patients. The study also sought to establish what changes are needed in information systems and operations management to support the achievement of long-term disease treatment goals.

MATERIALS AND METHODS

The study was based on the Design Science method. The data set was collected by means of a literature review, an analysis of the success factors of previous national social welfare and healthcare projects, and expert interviews.

RESULTS

The care of chronically ill patients is currently based on clinical recommendations and regional care pathways that determine the division of responsibilities between different actors. The root cause of the problems of continuity and coordination of care is the lax implementation of care processes for people with long-term illnesses, which consequently do not work as an efficient production process. Recommendations alone are not enough to achieve appropriate care of chronic cases – more precise definitions of care processes and support for monitoring these processes are needed. The current practices also do not automatically produce information about the effectiveness of care. The care process needs to be defined with more precision along its entire length and turned into a controllable production process.

Information systems and service operations are also poorly coordinated. Patient information systems are often used simply as electronic health records and not as a tool for operations management. The systems that currently exist are not capable of tracking processes across organizational boundaries or of coordinating operations.

The thesis outlines design principles of the VCO that have links to production control and information systems and that could help to solve problems of continuity and coordination of care. These include putting the preparation and implementation of the patient's care plan at the center and ensuring that all those involved in the provision of care have a common goal to pursue. The actors involved in the implementation of the care plan, including the patient, also all need to be able to access the plan in real time to see what is supposed to take place, what has already been done, and what comes next.

Enablers and limitations of the VCO concept in the Finnish social welfare and healthcare system

Dimensions in Sittig and Singh's (2010) socio-technical model	Enablers	Limitations / potential challenges
Hardware and software computing environment	Patient information systems are used comprehensively. Most of the information technology required for the solution, such as patient portals, remote appointments, and appointment booking facilities, already exists. There are a number of nationwide services that can act as sources of information for the VCO, including Kanta (national health archives), information systems of the Digital and Population Data Services Agency, and Omaolo.	There are many information systems in use. There are challenges relating to the interoperability of these systems. While the starting point should be to take advantage of existing services, building a functional whole from these separate pieces will be difficult.
Clinical content	A comprehensive set of instructions on how to draw up health and care plans already exists. The Kanta Services provide access to patient records from different organizations.	Not all patient information has been migrated to the Kanta Services, however, and older records are only kept in local patient information systems. There may be problems with the quality of the information held in the Kanta Services.
User interface	Patients as well as professionals are used to digital services. The Toivo Program is looking to develop solutions to support knowledge management.	There may be a shortage of competent digital service developers. The development task requires understanding of both the subject area and the potential of information technology. It is important to involve a sufficiently representative group of users in the development process. The issue with care plans at the moment is that creating them is a labor-intensive process.
People	Patients as well as professionals are used to digital services. The Toivo Program is looking to develop solutions to support knowledge management.	There may be a shortage of competent digital service developers. The development task requires understanding of both the subject area and the potential of information technology. It is important to involve a sufficiently representative group of users in the development process. The issue with care plans at the moment is that creating them is a labor-intensive process.

Workflow and communication	The prerequisites for designing the care process are good: The Current Care Guidelines are widely consulted, and a number of care pathways have been prepared. The technology needed for communication is already in place: secure communication, remote appointments, e-consultations, etc.	Developing the care process is the biggest challenge, as it involves changing established practices. Harmonizing procedures across organizational boundaries can be difficult.
Internal organizational policies, procedures, and culture	The Toivo Program is looking to develop solutions to support knowledge management.	Implementing changes requires good leadership and management-level commitment. The care process must be compatible with the organization's policies. The principles of the development process need to be agreed together: agile methods, phased development.
External rules, regulations, and pressures	There are a number of enterprise architectures in the social welfare and healthcare sector that must be observed and that can potentially facilitate the development process. The external requirements are well known.	Some aspects of regulation can be rather strict, which may create cost pressures. The Finnish Act on Public Procurement and Concession Contracts may complicate the process of selling the solution. There are still a lot of uncertainties due to the ongoing health and social services reform.
System measurement and monitoring	The Toivo program is planning and developing solutions to support knowledge management in the new health and welfare regions that are being set up, coming up with new ways for national authorities to produce and share information, as well as creating nationwide information management solutions.	There are a number of challenges, and decisions need to be made as to what should be tracked and what should be measured. Problems may arise with respect to human resources if staff feel that the harmonization of procedures reduces their professional autonomy and freedom to use their own judgement.

Key takeaways

The care of chronically ill patients is currently not organized as an efficient production process.

There is a gap between information systems and operations management. The preparation and implementation of care plans must be at the heart of the VCO.

All those involved in the provision of care must have access to the care plan in real time.

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Barriers to a VCO platform ecosystem

BACKGROUND

A study by Fares Khalil and An Chen (Khalil & Chen, 2022) set out to identify barriers or hindrances to the building of the VCO platform ecosystem. Taking these factors into account and anticipating them is important for the implementation of the VCO concept.

MATERIALS AND METHODS

The research data were collected by means of semi-structured interviews with stakeholders (N = 25). The interviewees were leaders or experts involved in healthcare and information systems who were deemed to have vision, drive, or capabilities related to the VCO platform ecosystem. The data were analyzed thematically using an abductive approach.

RESULTS

The study identified several barriers to developing and implementing the VCO platform ecosystem. There are a number of general barriers that stem from the ***platform architecture***: its complexity, the open vs. closed system attributes, difficulties in securing access to the necessary data, and problems relating to technological integration. Barriers to ***building the ecosystem*** relate to, for example, cooperation with the public sector and administrative actors, the actors' motivation and competing incentives for participating in the ecosystem, as well as the potentially suffocating effect of large actors' involvement in the ecosystem.

Managing the platform ecosystem can prove challenging simply because multi-party risk management requires considerable forecasting and resourcing as well as factoring data management into every decision. Partnerships can also be difficult to build if there is any uncertainty over requirements and standards.

Further collaboration in ***developing the platform solution*** can be jeopardized by a lack of a common vision and business idea, difficulties in getting customers and users involved, and problems in generating high usage volumes and return on investment.

The ***VCO functionalities and implementation*** come with a number of risks, such as a fragmented user interface experience, costly integrations with patient information systems, difficulties in automating care processes, and complexities related to addressing patient needs. Resourcing also poses a challenge in its own right: Development funding can be difficult to secure, and problems can arise relating to liability issues and data-driven business models. Finally, needed HR competencies may be scarce such as technical and relational capabilities.

Key takeaways

There are barriers to the VCO platform ecosystem that relate to the platform architecture, building the ecosystem, managing the platform ecosystem, developing the platform solution, the VCO functionalities and implementation, and resources.

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Integration of patient-reported data into care management

BACKGROUND

Iida Haukilahti's bachelor's thesis (Haukilahti, 2021) compared Finland's national electronic health information system with its Estonian and Danish counterparts, focusing on how much of the health data held in these systems is sharable by the data subjects themselves. Denmark and Estonia were chosen for the comparison because both countries, like Finland, have a national electronic health information system.

For the purposes of the study, a "national electronic health information system" was defined as an information system that can be accessed by both patients and healthcare professionals regardless of whether the service provider is a public-sector or private-sector organization. All citizens have access to the system to view their personal health record and prescriptions. These kinds of systems are currently being developed in numerous different countries, but progress has been slower than anticipated. Several countries already have an electronic health information system of some kind, but many are not nationwide and only operate, for example, in a certain part of the country.

MATERIALS AND METHODS

The thesis was written as a literature review. Source data for the study were retrieved from the Scopus reference database and websites associated with the health information systems of different countries.

RESULTS

To guarantee a high standard of healthcare, it is important that health information reported by patients themselves can be integrated into official health information systems. Many countries are now working on providing this functionality. The functionality is already available in the Finnish, Estonian, and Danish systems, albeit to varying degrees. The analysis identified a number of differences between attributes of national health information systems, relating to, for example, parents' access to their children's health data, as well as similarities, such as the possibility of viewing one's personal health record.

There is still a lot of room for improvement in national electronic health information systems to maximize their potential in, for example, improving the standard of remote appointments and enabling continuous monitoring of the general health of chronically ill patients. This kind of monitoring is not yet possible In Finland, Estonia, or Denmark. Finland has succeeded in keeping pace with other countries in system development.

Use of patient-reported health data in Finland, Denmark, and Estonia. (Kanta Personal Health Record - Citizens, n.d.; Philips, Nordic Healthcare Group and Meditsiinigrupp Will Support Stroke Patient Pathway Pilot in Estonia - NHG EN, n.d.; PRO – Patient Reported Outcome - PRO, n.d.).

Attribute	Finland	Denmark	Estonia
View your personal health record	✓	✓	✓
Book appointments	✗	✓	✗
Order repeat prescriptions	✓	✓	✓
Browse prescriptions	✓	✓	✓
View hospital waiting times	✗	✓	✓
Access your child's information	✓	✗	✓
Make a living will	✓	✗	✗
Register your organ donation decision	✓	✓	✓
View hospital quality ratings	✗	✓	✗
See who has accessed your record	✓	✓	✓
Block access by other service providers	✓	✗	✓

Use of patient-reported health data in Finland, Denmark, and Estonia. (Kanta Personal Health Record - Citizens, n.d.; Philips, Nordic Healthcare Group and Meditsiinigrupp Will Support Stroke Patient Pathway Pilot in Estonia - NHG EN, n.d.; PRO – Patient Reported Outcome - PRO, n.d.).

Attribute	Finland	Denmark	Estonia
Save readings and measurements	✓	✗	✗
Fill out forms/questionnaires	✓	✓	✓
Make self-care plans	✓	✗	✗

Key takeaways

Finland, Estonia, and Denmark are all working to integrate health data into their respective national health information systems.

Continuous monitoring of the general health of chronically ill patients is not yet possible in the countries examined in the thesis.

All of the examined systems have the functionality that enables patients to view their personal health record.

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Export potential of the VCO

BACKGROUND

Iiris Hörhammer's inquiry (Hörhammer, 2022) compared the implementation of interoperable health information systems in Austria and Finland and explored the contextual export potential of the VCO.

MATERIALS AND METHODS

Literature review, results of a My Kanta Pages user survey, and consultations with experts at the University for Health Sciences, Medical Informatics and Technology in Tirol, Austria and at the dHealth conference in Vienna, Austria.

RESULTS

At least the following factors must be taken into consideration when assessing the export potential of the VCO:

- interoperability with the EHR systems of the destination country
- operation of primary care health centers:
  - joint health information technology acquisitions and adaption
  - in-service education
  - multi-professional collaboration
- healthcare professional education (patient autonomy, professional rules)
- trust in "the system":
  - My Kanta Pages is the second most valued web brand in Finland (with the Finnish Tax Administration's Vero.fi service in tenth place and Google in fifth)
- willing and able users, good usability, clear task

Key takeaways

Compared to Austria, Finnish patients rely much more heavily on the national digital health information system (1.4% vs. 20–50%).

Factors to take into consideration when assessing the export potential of the VCO include interoperability with existing EHR systems, the way in which primary healthcare is organized, healthcare professional education, patients' trust in the service and information system, and user motivation and capability, usability of the solution, and clear tasks.

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VCO USE CASES AND PATIENT GROUPS

Perspectives on patient journey disruptions in the healthcare service ecosystem – Case: Parkinson's disease

BACKGROUND

Annika Bengts' doctoral dissertation study (Bengts, 2022) explored Patient Journey Disruptions (PJD) from the perspectives of different healthcare service ecosystem actors (stakeholders, care professionals, patients, and family members). The increase in long-term illnesses is exposing structural weaknesses in existing healthcare service production systems. Due to the rise of ecosystem thinking, digitization and connectivity in modern business, organizations must consider the actions of several different stakeholders in their operations. Often, their logics and goals differ or conflict greatly. The study was structured on the basis of the concept of a mission-based ecosystem. Service Design and Healthcare Operations Management (HOM) principles were used to study the problems of multi-provider environment dealing with chronic illnesses.

Parkinson's disease (PD) was used as a case illness. Many PD patients have comorbidities, which are treated in a multi-provider environment. The primary goal of healthcare is to produce health for the benefit of patients in a cost-effective manner and on medical grounds. The specialization of medical professionals and the standardization of practices are prerequisites for effectiveness, while these features, in the end, complicate the integration of care and the realization of care plans as seamless patient journeys. For Masse, this study sought to 1) understand what PJDs are, 2) understand what role the VCO should take to ensure that care is delivered as planned.

MATERIALS AND METHODS

- Customer/patient journey mapping based on the Current Care Guidelines and interviews with professionals
- Literature reviews
- Interviews with stakeholders, patients, and family members (N = 39)
- Workshops with service ecosystem actors x 3 (N = 49; N = 29; N = 11)
- Data analysis using inductive qualitative methods (qualitative coding, categorization, thematic analysis)

RESULTS

Role of the VCO in the care of Parkinson's disease. Lack of integration between administration, information, service provision, and service events became a central theme in the study. Thus, VCO should respond to these commonly known problems. Weaknesses in user interfaces and the accessibility of data complicated the integration of care from the service providers perspective. VCO should be able to guide up-to-date information to the right service provider at right time.

The patient's own active participation in their care was recognized as important (adherence and motivation to care). This could be partly achieved through clear communication of the care plan. In summary, three top-level tasks were identified for the VCO: (1) sharing of up-to-date patient information in real time between different actors in the service ecosystem, (2) communicating up-to-date patients' care plans (including medication plan) and communicating changes, and (3) providing a shared communication channel for different service providers as well as patients and family members.

> **Key takeaways**
>
> Role of the VCO in the care of PD patients:
>
> • sharing of up-to-date patient information in real time between different actors in the service ecosystem
>
>   - e.g. first information on Parkinson's disease, neurologist-reported information, patient-reported information, information reported by family member, and information reported by home care or other caregivers
>
> • communicating up-to-date patients' care plans (including medication plan) and communicating changes
>
>   - ensuring that all interested parties have access to the care plan
>
> • providing a shared communication channel for different service providers as well as patients and family members

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Discontinuity in the care of chronic abdominal patients

BACKGROUND

In Finland, chronic abdominal diseases are becoming a national health issue. One in ten people in Finland – more than half a million Finns – suffer from irritable bowel syndrome. Approximately 40,000 adults live with inflammatory bowel disease. Intestinal ailments rarely cause sudden deaths, which is why these conditions do not tend to get prioritized in the allocation of healthcare resources. With healthcare systems on the whole being primarily built for dealing with acute health issues and not life-long conditions, the risk of patient journey disruptions is typically higher with chronic cases.

Anu Vehkamäki's master's thesis (Vehkamäki, 2021) set out to explain on a descriptive level the reasons why chronic care discontinuity occurs and how to mitigate it. For the purposes of the study, "continuity" was taken to mean the continuity of care and especially the care plan. "Discontinuity" occurs when care is not continuous and the care plan is not implemented as intended for one reason

or another.

MATERIALS AND METHODS

A mixed-methods approach was used to collect data in the study in three ways: a focus group with care professionals (N = 7), a patient survey with chronic abdominal patients (N = 71), and interviews with care professionals (nutritionists N = 3, primary care physicians N = 4, nurses N = 3). Results from the different methods were analyzed through grounded theory and combined to form the holistic framework on discontinuity of chronic care (DoCC) and a chronic care plan management process. The DoCC framework describes the risk factors, indications, reasons, and consequences related to chronic care discontinuity.

RESULTS

The Finnish Act on the Status and Rights of Patients states that, "as necessary, a plan concerning examinations, treatment, medical rehabilitation, or comparable shall be drawn up" (section 4a of Act 857/2004 of September 17, 2004), but the form and content of such care plans are not generally standardized and differences in how professionals use care plans make it difficult to monitoring progress in real time and by automated means. The ambiguity of the law can also lead to a situation where no care plan at all is drawn up for a chronic case.

The study identified the following reasons for care plan failures:

1. patient-specific situational factors such as time or financial constraints

2. patient-specific internal psychological factors such as fear of medical procedures

3. technological reasons such as incompatibility of information systems

4. reasons related to the work of care professionals, such as inadequate appointment length

5. process-related reasons, such as lack of care plan standardization and unclear job descriptions and division of labor between key caregivers

The reasons can be further divided into two main categories: lack of clarity in the division of responsibilities relating to the care plan, and failure to monitor the implementation of the plan. It is important to clearly define the roles of professionals and the patient in order to avoid confusion over who is responsible as well as to standardize care plans and make them as consistent as possible to enable continuous care and symptom monitoring. Standardized diagnosis-specific care plans would promote the entire concept of care plans: It would become clearer to professionals what is expected of care plans, and patients would be able to see their personal care plan in black and white. Defining the patient's role in the process is also crucial. Specifying the patient's responsibilities (what is expected of them) and laying them out in black and white would make it more likely for the patient to succeed in their role.

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Identifying care disruptions and defining VCO use cases in type 2 diabetes care

BACKGROUND

The constantly increasing prevalence of chronic conditions such as type 2 diabetes is a global challenge. The treatment of chronic diseases differs in many ways from the treatment of acute conditions: Significant differences exist in, for example, the intensity and length of treatment and the patient's self-care responsibilities.

Phenomena such as care fragmentation and care discontinuity are common issues for patients with chronic illnesses. Greater integration between different actors, better coordination of care, and functional information systems have been identified as critical for delivering efficient and effective care. Various kinds of digital solutions are showing significant potential in solving the problems associated with fragmentation and continuity of care.

Katri Valtonen's master's thesis (Valtonen, 2022) set out to study how care fragmentation, discontinuity, and possible other care disruptions occur in type 2 diabetes care in Finland. The findings were then used to identify use cases for the VCO in type 2 diabetes care.

MATERIALS AND METHODS

The study was based on a mixed-methods approach, and the data set was compiled through semi-structured interviews with healthcare professionals and experts (N = 8) and through a survey distributed to patients with type 2 diabetes (N = 54).

Four main challenges in type 2 diabetes care in Finland were identified: (1) unclear communication toward the patient, (2) challenges in the patient–caregiver relationship, (3) unclear responsibility for care continuity, and (4) challenges in supporting self-care and lifestyle changes. Four use cases for the VCO were proposed: digital care plan, digital channels for easy and low-threshold contacting, automated appointment booking, and digital tools to support lifestyle changes and diabetes self-care.

Key takeaways

Inadequate communication toward the patient, challenges in the patient–caregiver relationship, unclear division of responsibilities, and lack of support for self-care and lifestyle changes were identified as the main challenges in type 2 diabetes care in Finland.

Four use cases for the VCO are proposed based on the findings: digital care plan, digital channels for easy and low-threshold contacting, automated appointment booking, and igital tools to support lifestyle changes and diabetes self-care.

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Elicitating the Initial Program Theory in the context of MS patients

BACKGROUND

The cost of MS treatment per patient in Finland amounts to EUR 47,000 on average per year (Ruutiainen et al., 2016). Digital interventions in healthcare can provide solutions for developing therapies, but measuring their value is difficult. ***Ilmari Huttunen's master's thesis*** (Huttunen, 2022) set out to test the potential of the so-called Initial Program Theory (IPT) developed by Smeets et al. The theory was applied to a digital intervention by StellarQ, which is designed to improve the care of MS patients at Turku University Hospital (TYKS). Three functionalities of the intervention were studied: digital patient reminders of upcoming neurologist follow-up appointments, digital patient reminders for self-reporting questionnaires, and the MyMS digital symptom checker for patients who suspect that their condition is deteriorating.

The IPT was supplemented by findings of a model called PROVE-IT, developed by Lillrank et al. (2019), based on which the final IPT was formulated to predict the likely mechanisms of the intervention. The mechanisms identified with the help of the PROVE-IT model can be divided into three different categories that describe the origin of the value of the intervention. The mechanisms can provide the actor with new resources (can do) or more detailed information (know what to do), or

change the actor's motivation (want to do).

MATERIALS AND METHODS

The thesis was based on ten semi-structured interviews with the target groups of the intervention: patients as experts by experience, and representatives of medical staff, management, and StellarQ.

RESULTS

The primary mechanism of the intervention is expected to be a more advanced "know what to do" function providing more accurate information to patients and medical staff. The activation of the know what to do mechanism can reduce no-shows at neurologist follow-up appointments and increase the volume of patient-reported information, which is vital for monitoring progress and the effectiveness of treatment. From the perspective of medical staff, the activation of the know what to do mechanism can improve the accuracy of therapeutic decisions, enable faster identification of the need to adjust medication, and make it possible to revise the number of neurologist follow-up appointments.

The intervention can also activate the can do mechanism and provide patients and medical staff with new resources. The activation of this mechanism can lead to significant improvements in the therapeutic process, especially with respect to the reporting of worsening symptoms, as it can make it easier for patients to report symptoms and make it possible for some of the work associated with the deterioration phase to be performed by digital means.

In the long term, the intervention can be expected to improve the cost-effectiveness of care by enabling more accurate therapeutic decisions and by making it possible for some of the monitoring and treatment responsibilities associated with the deterioration phase to be discharged by digital means.

Key takeaways

The primary mechanism of action of the intervention is expected to be an improvement in know what do (control information), which can raise the standard of care for MS patients by providing more accurate information to patients and medical staff and improve the long-term cost-effectiveness of MS treatment.

The know what to do mechanism is one of the essential mechanisms of action of digital healthcare interventions and the most essential mechanism in the case of the VCO.

The activation of the can do mechanism can lead to significant improvements in the therapeutic process, especially with respect to the reporting of worsening symptoms.

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Involvement and role of parents of chronically ill pediatric patients

BACKGROUND

Emilia Knaapi's master's thesis (Knaapi, 2021) set out to study the involvement of parents of chronically ill pediatric patients of the New Children's Hospital in Helsinki as well as challenges related to parental involvement, and to devise a purpose-constructed role for parents on this basis. For the purposes of the study, "role" was defined as the various ways in which parents participate in the care of their sick children and the categorization of different types of parents in this respect. Two different medical conditions were explored: infantile spasms and anus atresia. The topic was studied from the point of view of medical staff.

MATERIALS AND METHODS

- Literature review focusing on the involvement and role of parents of chronically ill pediatric patients
- Qualitative interview survey in which all the interviewees were nursing professionals
  - Interviews focusing on care pathway design (N = 2)
  - Interviews focusing on parental involvement and role (N = 8)
- Design and analysis of care pathways

RESULTS

The study resulted in the formulation of care pathways through these illnesses. This made it possible to identify points along the pathways that can affect parental involvement. One of the key findings in terms of parental involvement was that the more information parents are given initially, the more involved they are likely to be in the treatment process. This is linked to the finding that medical staff's preference is for parents to spend as much time as possible on the ward with their children.

The study revealed that the biggest barriers to parental involvement are parents' lack of language skills, living far away from the hospital, and having multiple children, as well as medical staff's not having enough time. The study also suggests that in communicating initial information to parents, it is important to make the parents feel heard and understood. Two types of parents could be distinguished based on the level of involvement: active parents and passive parents. The level of involvement and the need for support were different depending on the parent type.

Comparison of active and passive parents

	Active parents	Passive parents
Number of questions	Ask a lot of questions, want to know a lot, are actively involved in everything	Have few questions, need time to reflect on the information provided, are satisfied with what they are told by professionals
Resources	Have a strong support network and plenty of resources, have the ability to accept realities	May not have a support network and have limited resources, may have a history of depression, may have a fear of hospitals, etc.
Attitude	Are energetic, dynamic, and eager to move things along, have realistic expectations	Need time, need repetition, and tend to be "worriers" by nature
Self-education	Study, find things out, and read a lot	Rarely bother to educate themselves, rely on what professionals tell them
Involvement in treatment and joint decision-making	Get involved and want to be actively involved	Are cautious, need encouragement, may not actively participate themselves
Advantages from the perspective of professionals	Are proactive, communicate effectively, and take an active role	Are unlikely to make hasty decisions or waste staff's time by constantly asking questions
Disadvantages from the perspective of professionals	Have a tendency to trouble staff with endless, often unrealistic questions and may refuse to accept that not all illnesses have a clear cause	Need a lot of support and encouragement to get involved, keep asking the same questions
Points for professionals to bear in mind	Enough time must be reserved for answering questions, and staff need to stay in charge despite the parents' active role	Slow pace is important, and these parents need to be given time to process news as well as gentle encouragement to get involved in the treatment process and joint decision-making
Need for support	Mainly need support during the acute phase	Need a lot of and many kinds of support at various points of treatment

The way in which parents are initially informed of their child's condition greatly affects how involved they will be in the child's treatment, and a poorly handled first contact can significantly damage the relationship between parents and staff. Identifying different types of parents helps staff to interact better with parents and to provide them with support tailored to their needs. It is important that the information and guidance given to parents is systematic and not dependent on staff personalities or competence. The next step should be to explore the parents' views so that the perspective of parents and that of staff can be aligned.

Key takeaways

The way in which parents are initially informed of their child's condition plays a significant role in shaping the relationship between the parents and staff.

Identifying the type of parents (active vs. passive) helps staff to support parents more effectively.

The information and guidance given to parents need to be systematic and consistent regardless of the source of information.

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Acute care needs and services for the elderly

BACKGROUND

A study by Perttu Kontunen and Erik Haapatalo (Kontunen & Haapatalo, 2022) set out to explore the acute care needs and services for the elderly. The need for emergency care increases with age and especially after the age of 75 years. The incidence of chronic illnesses also increases with age, which creates challenges for the coordination of care. Inadequate supply of care needs assessment and treatment services in primary care (health centers, home care) causes over-demand in paramedic care (i.e. ambulance services) and in the emergency room. Information about prescriptions, care plans, etc. is not communicated reliably between the emergency room and other caregivers.

MATERIALS AND METHODS

- literature review of models for improving the acute care of multimorbid patients
- interviews with emergency patients, next of kin, and professionals
- analysis of data compiled by the Academy of Finland's IMPRO research team on the 11 largest cities in Finland based on the Finnish Institute for Health and Welfare's Hospital Discharge Register (HILMO) between 2015 and 2019
- focus group with healthcare professionals on the most important features of the Patient Card
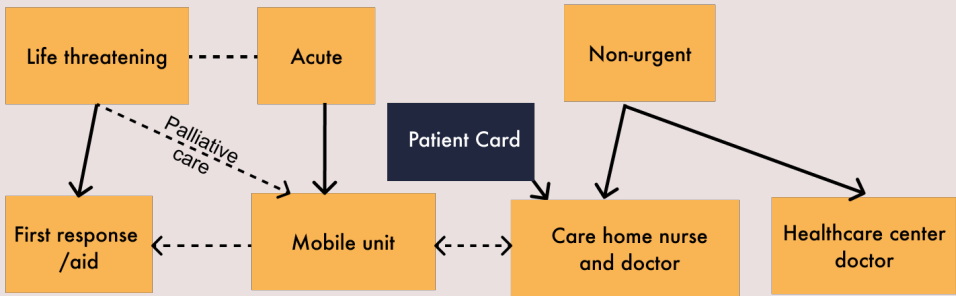
RESULTS

Based on the literature review, successful continuity of care reduces the need for emergency care among elderly (multimorbid) patients by 20% to 31%, regardless of the diagnosis. The HILMO data suggests that the potential for reducing emergency room and hospital inpatient demand could be at least of a similar magnitude.

There is considerable variation in elderly people's use of emergency services in Finland: The variance in emergency room visits due to chronic lung diseases is as high as 80% among people over the age of 75 years (with the lowest levels in Turku, Tampere, and Kuopio, and the highest levels in Jyväskylä, Lahti, and Helsinki). The number of emergency room visits by patients diagnosed with dementia is three times higher in Lahti than in Turku (in 2017). Confusion caused by alcohol consumption accounts for approximately one-seventh of the workload of emergency rooms and inpatient wards compared to memory disorders.

Interviews with patients revealed issues with overcrowding in emergency rooms, which discourages visits, and patients' being unsure about the significance of symptoms and consequently choosing to monitor their symptoms for several days in some cases before seeking medical attention. According to healthcare professionals, the non-emergency helpline 116 117 has largely eliminated unnecessary emergency room visits. It can be difficult to diagnose a memory disorder or a severe mental illness in time. Based on the interviews, the most difficult conditions to diagnose are oral and dental issues. Loneliness and alcohol contribute to the number of emergency room visits, but these reasons do not appear in diagnostic records. Medical professionals estimate that conditions that could be dealt with without a visit to the emergency room include, in particular, back pain without severe symptoms, oral infections that can be treated with antibiotics, arthritis, and joint problems.

Based on the literature review, the use of mobile units improves the standard of care in the case of multimorbid patients. Mobile units, i.e. mobile-integrated healthcare (MIH) or mobile-integrated healthcare / community paramedicine (MIH-CP), provide a means to take healthcare physically to where patients are. MIH-CP was originally a service model for remote areas, which focused on chronic diseases and social problems. More recently, the model has also been successfully applied in urban environments and to deliver more urgent healthcare. (Choi et al., 2016)

Situational awareness

Situational Awareness

The success of all of the aforementioned operating models requires that the professionals who make the assessment of the need for treatment and who provide the treatment have reliable real-time information about the patient's previous illnesses, prescriptions, and current situation – regardless of whether the patient's most recent clinical contact was with a private home care provider or a hospital outpatient clinic. In an optimal scenario, this situational information is always up to date and quickly available. This is what the Patient Card enables. The Service Card can aid in finding the right service provider for both acute and non-emergency cases.

Diagnosis-specific and service-specific segmentation

Based on an analysis of the data and the interviews, the target groups among multimorbid or elderly patients that are most in need of more timely and better-coordinated emergency care are those suffering from dementia-related symptoms, infections, heart failure, and atrial fibrillation. In the case of dementia, it is often an acute illness or a sudden change in circumstances (such as an infection or dehydration) that causes a rapid deterioration in the patient's condition, and quickly identifying and treating the root cause is paramount. This need can be met by mobile units. Advanced dementia is also associated with patients becoming increasingly unable to look after themselves, and flexible scaling up of daily assistance along with short-term intensive monitoring of patient well-being and strengthening their sense of security could allow patients to cope at home instead of needing hospitalization.

It appears that some emergency room visits could be avoided by timely intervention in elevated heart-rate episodes in atrial fibrillation patients – or by identifying and treating the underlying cause. An example of a technical solution for this is a tool called Beat2Phone. A quick response to signs of heart failure (changes in weight and general well-being, breathing, swelling) can also prevent emergency room visits and hospitalizations. Technological monitoring solutions, the Patient Card,

Key takeaways

Successful continuity of care reduces the need for emergency care among elderly, multimorbid patients by 20% to 31%.

To help coordinate elderly care: Services delivered to the patient combined with a system that provides a looking-after function that improves the continuity of care (Patient Card) and group-based digital care pathways.

Sufficient and continuous post-deployment training and reminding of all those involved (as well as co-development) are paramount in the deployment of new operating models.

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and efficient communication can allow heart failure patients to regulate their own therapy with healthcare professional assistance. There is also potential for arranging the proactive or intensified care of long-term lung diseases (and musculoskeletal disorders) in a manner that eliminates the need to visit the emergency room. For example, expiratory flow rate monitoring (e.g. PEF measurement, nitric oxide levels combined with perceived well-being) could be used for early identification of changes in long-term lung disease.

Services for home care customers

BACKGROUND

The typical home care customer is an elderly person with multiple medical conditions. Home care services vary according to the customer's physiological/cognitive abilities and individual needs. Most of the services are provided by local authorities, but the private sector and third sector also play a part. The network needed to enable regular care and service provision consists of the service providers, the customers, and their next of kin. Customers also sometimes require acute inpatient care.

In most cases, information sharing between home care providers and other caregivers, especially healthcare services, is based on electronic health records. *Inka Sylgren's master's thesis* (Sylgren, 2022) set out to study how efficient this information sharing is among service providers, especially in the event of changes along the patient journey. The goals were (1) to identify the services available to home care patients, (2) to identify disruptions in the continuity of care, and (3) to come up with solutions to bridge those discontinuities. The thesis studies the continuity of care from the perspective of both home care service providers and customers.

MATERIALS AND METHODS

The study involved interviewing home care professionals (N = 10) and home care patients / next of kin (N = 5) as well as a focus group of healthcare experts (N = 9). The interviews were semi-structured, and they sought to identify services that are used concurrently with home care and disruptions in the continuity of care and service provision as well as how the various processes associated with home care are organized and the continuity of care promoted. Once coded, the identified disruptions were abstracted, and a thematic analysis was conducted. The focus group with healthcare professionals helped in confirming the results, identifying the most critical discontinuities, debating their likely root causes, and brainstorming for ways to fix the problems.

RESULTS

Based on the interviews, 39 different discontinuities were identified, which

were categorized by theme as follows: (1) reliable flow of patient data, (2) care responsibility, (3) patients' knowledge of services, and (4) discontinuity of home care. Adverse events relating to the discontinuity of home care were excluded from subsequent analyses. Of the analyzed discontinuities, 27 related to the flow of information, responsibility for patient care, and patients' familiarity with home care services.

The issues identified by customers were different from those identified by professionals. From the professionals' perspective, the most frequently encountered problems were not being able to get hold of the doctor in charge of the patient, division of responsibility for patient care, inadequate familiarization with patient records, and not having enough information about patients or not having access to patient records, proper planning of patient care is not possible, or there are significant delays in obtaining the information. The patients complained about not fully understanding their relationship with their home care service provider, inadequate information sharing between professionals, and inefficient division of responsibility for patient care. Both groups agreed that the provision of care and services works well on a daily basis, but the experts warned that these kinds of issues can lead to significant problems in the provision of care that take a long time to unravel. When asked how well home care and other services work together, both professionals and patients gave a median score of 8/10.

In terms of the services themselves, each patient had a unique network of service provision consisting of healthcare and support services. The healthcare services were mainly provided by local authorities, albeit some patients had been given a service voucher for specialized medical care in the private sector. Support services were sourced from private service providers and used by customers who had no close relatives.

Scalable solutions proposed by the focus group included (1) improving existing customer/patient information systems, including patient care summaries, (2) enabling alerts for whenever the nature of care changes, (3) redesigning care in a more holistic manner over a longer period of time instead of fragmented care episodes, (4) assigning a case manager who knows the patient to coordinate their care, and (5) improving the transparency of care decision-making from the customer's perspective.

Key takeaways

Many of the issues relate to inadequate information sharing. Lack of communication between home care and other service providers and healthcare services in particular can increase the risk of patient journey disruptions.

The Patient Card could improve the flow of information and continuity of care.

The range of services offered to individual home care customers varies considerably. The Service Card seems to be a useful solution for finding a suitable mix of services and coordinating them.

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VCO STRUCTURE AND SOLUTIONS

Customer relationship management (CRM) as a tool in coordinating the care of multimorbid patients

BACKGROUND

Coordinating the care of multimorbid patients can be likened to customer relationship management (CRM), which has long been used in the world of business to build long-term customer relationships and as a tool for service customization.

Julius Hagelstam's bachelor's thesis (Hagelstam, 2022) sought to establish what information would be needed of multimorbid patients to coordinate care from the perspective of CRM. The findings were used to define the contents of the Patient Card that is being developed for coordinating the care of multimorbid patients.

MATERIALS AND METHODS

The thesis is by its nature a literature review, which means that the contents of the Patient Card were mostly established on the basis of CRM literature and literature relating to clinical workflow support systems.
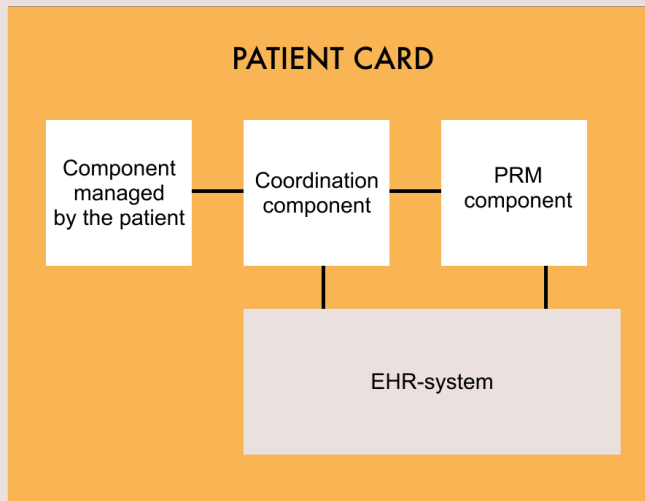
RESULTS

The thesis proves that CRM correlates well with the coordination of care. The contents of the Patient Card were established by comparing CRM data with the information presented in the Patient Card.

CRM data equivalents in the Patient Card

	CRM-data	**Patient Card data**
Basics	Customer size, type, location, contact information	Patient's diagnoses, location, contact information
Events	Order history, contracts, feedback collected from the customer	Treatments performed, medical history, feedback collected from the patient
Contacts	Date, topics discussed, decisions taken, and persons involved in the decisions	Date, topics discussed, decisions taken, and persons involved in the decisions

The proposed contents of the Patient Card consist of three components, which are (1) a component corresponding to CRM data ("PRM"), (2) a component managed by the patient, and (3) a component that ensures coordination.

PATIENT CARD

Component managed by the patient — Coordination component — PRM component

EHR-system

Patient Card components in light of the literature

Key takeaways

Customer relationship management (CRM) compares well with the coordination of multimorbid patient care.

The proposed contents of the Patient Card consist of three components: (1) a component corresponding to CRM data, (2) a component managed by the patient, and (3) a component that ensures coordination.

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Technological solutions to support integrated care planning

BACKGROUND

The success of multimorbid patient care hinges on integrating the tasks of different actors. *Sanni Hyytinen's bachelor's thesis* (Hyytinen, 2022) set out to establish the current status of clinical decision support systems (CDSS) and their suitability for the integrated care of chronic patients. The aim of the study was to first identify what kinds of CDS systems exist. The thesis also deepens understanding of the nature of integrated care plans, their requirements, and how CDS systems could support the preparation of integrated care plans in the context of the VCO Patient Card.

MATERIALS AND METHODS

The thesis is by its nature a literature review, based on academic literature on medicine and industrial engineering and management as well as medical journals. The literature analyzed for the study mostly consisted of articles published in

Finnish and English that are included in the Web of Science reference database. The records were retrieved in early 2022.

CDS systems that have relevance from the perspective of integrated care were divided into four categories as follows: (1) systems supporting the assessment of the need for care, (2) systems supporting the patient's goals, (3) systems supporting integrated care, and (4) systems supporting polypharmacy. Of these, systems supporting polypharmacy can be further divided into clinical rule-based and pharmacogenetic-based CDS systems.

Based on the study, there would be opportunities to link CDS systems to the Patient Card to support integrated care planning. The systems in the first two categories could be particularly useful when a Patient Card is first created for a patient, and the systems from the latter two categories could be useful in the course of the provision of care. Patients could benefit from the use of CDS systems in the Patient Card through, for example, a reduction in risks and adverse effects, and improvements in the continuity of care and adherence to treatment, while caregivers could benefit from the improvements in information management, instructions, procedures, and patient monitoring that CDSSs potentially enable.

Key takeaways

From the perspective of multimorbid patients the CDS systems with potential are those that support the assessment of the need for care, the patient's goals, integrated care, and polypharmacy.

CDS systems that support the assessment of the need for care and the patient's goals can be useful when the Patient Card is first created. Systems that support integrated care and polypharmacy are essential for keeping track of the patient's care through the Patient Card.

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Standardization of electronic health records to advance secondary use of hospital data lakes

Health data that are collected from patients outside controlled clinical trials are called real-world data. Real-world data represent a powerful tool in, for example, drug development, as they can help to reduce ethical concerns, bring in more diversity, and lower the cost and time spent on research. Using real-world data in practice can sometimes be difficult due to the lack of standards in real-world data structure and content.

Maria Misukka's master's thesis (Misukka, 2022) set out to harmonize a large set of real-world data from the Hospital District of Helsinki and Uusimaa data lake into the Observational Medical Outcomes Partnership (OMOP) common data model (CDM).

MATERIALS AND METHODS

The original data set included data from over 900,000 patients in six different tables, containing nearly 340 million variables.

RESULTS

In the thesis, a large set of data from a hospital data lake was harmonized into the OMOP CDM because using a standard format improves the quality of data, increases their value, and makes them more suitable for different secondary use purposes. The harmonization was performed using bash scripts. A total of six main scripts were designed, each taking one original data table as input and outputting the data in the OMOP CDM. Additional mapping files and a script were also utilized in the process. When transferring real-world data into the OMOP CDM, particular attention must be given to mapping the original data content into the correct, standard OMOP concepts that belong to the correct domain.

Real-world data standardization is important, because if the majority of data providers would use the same, standardized data model, the easier, faster, and more effortless it would be to combine, compare, and analyze data coming from multiple systems. The more standardized real-world data sources, the more useable the data would be to enhance people's well-being everywhere around the world.

Key takeaways

A large set of patient data from a hospital data lake (N = 900,000) was harmonized into the OMOP CDM because using a standard format improves the quality of data, increases their value, and makes them more suitable for secondary use.

From the perspective of the VCO, it would be valuable if the majority of the data providers used the same standardized data model, as it would make it easier, faster, and more effortless to combine, compare, and analyze data coming from multiple systems.

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Value of an interoperability platform for customer guidance in social services

BACKGROUND

Krista Hanhikangas' master's thesis (Hanhikangas, 2022) set out to examine the effects of an interoperability platform called UNA Tilannekuva, which has been deployed in the Customer Guidance Unit of Tampere Social Services (in home care customer guidance and dependent care support). The current status is that information is scattered and needs to be retrieved from multiple different IT systems to support decisions and actions concerning customers. This wastes time, and there is a risk of missing essential facts. UNA Tilannekuva gathers the necessary information from different systems and presents it to the customer advisor in one view.

The aim of the thesis was to create a preliminary understanding of how the deployment of the interoperability platform can be studied from the perspective of productivity. The goal was to find aspects that also bring functional benefit and to facilitate decision-making by the Customer Guidance Unit's customer advisors. From the perspective of the MASSE project, the aim was to examine the functionalities of the VCO Patient Card by studying a system comparable to the VCO.

MATERIALS AND METHODS

The effects of the interoperability platform were examined through three different research methods: work measurements, observation, and interviews. Work measurements and observation were used to map the work of customer advisors in dependent care support using the systems that existed before the interoperability platform compared to working with the interoperability platform. Interviews with dependent care support staff were used to study customer advisors' experiences of the interoperability platform and its perceived benefits. Interviews with home care customer guidance advisors focused on the use of different systems to prepare for house calls and to making decisions. This provided tentative information on the benefits derived from the deployment of the system.
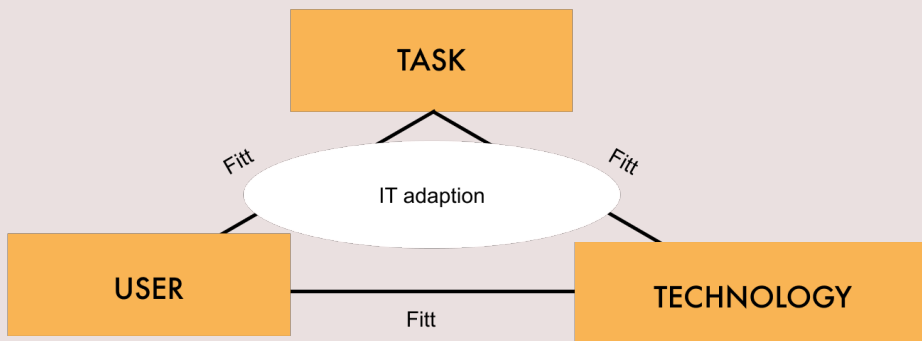
RESULTS

When comparing the interoperability platform with the use of other systems, it could be observed that a wider data base helps to form a better overview of the customer. This was also seen to have an effect on saving time during house calls. On the other hand, the extensive data base brought by the interoperability platform was seen as a disadvantage in the case of customers who rely heavily on home care services. Gathering all the information needed for house calls can be time-consuming.

The interoperability platform allows staff to also see the other caregivers involved in the customer's care. This helps to avoid the provision of duplicate services, which also affects costs. The interoperability platform was seen to facilitate a general

understanding of the customer's situation with the help of the compiled view. However, in social work, decisions concerning customers cannot be made solely based on information found in information systems, instead they must also reflect each customer's ability to function.

VCO Patient Card design

The findings were analyzed with the help of the FITT model developed by Ammenwert et al. (2006). The model can be used to describe the essential role of interoperability between technology, the individual, and the task in allowing a system to deliver effects on quality and productivity.

FITT model developed by Ammenwert et al. 2006)

The study shows that user-friendliness and training facilitate the deployment and use of information systems. Technology must support the task. Processes also need to be adapted to reflect new technologies. An excessive quantity of data is not useful, and instead the information that can be obtained from the system must be fit for purpose and necessary for the task. The perceived usefulness of data depends in part on the educational background of the customer advisor. Different configurations of the Patient Card could be displayed to users with different educational backgrounds, even if the tasks were similar.

The work experience of the test group needs to be taken into consideration during testing, as more than half of the customer advisors interviewed for the study felt that more familiarization with the customer's information is needed if the advisor does not have much work experience. About the Patient Card, the structuring of data in a way that factors in the user's needs plays an important role in making information as easy to find as possible. Each customer advisor's personal style of working and their experiences with using the interoperability platform affected the way in which they chose to search for information. With limited user experience, the easiest way to find information was to revert to old habits. User training at the deployment stage plays a significant role in practicing how to find relevant information.

Key takeaways

The benefits of the interoperability platform were a wider data base and saving time during house calls in the case of normal customers. In the case of customers who rely heavily on home care services, the extensive data base brought by the interoperability platform was seen as a disadvantage, as preparing for house calls became a time-consuming task.

Concerning the Patient Card, the structuring of data in a manner that makes the relevant information as easy to find as possible plays an important role.

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Usability of a heart health monitoring solution

BACKGROUND

Early intervention plays a crucial role in the prevention of serious heart diseases and stroke. Long-term electrocardiogram recordings can be used to study cardiac activity and the incidence of arrhythmias in different situations. Remote monitoring solutions and wearable technologies can facilitate the monitoring of symptom progression and help to identify those patients who need more attention and care. Wearable technologies also increase understanding of the impact of everyday events on patients. Currently, there can be months between hospital appointments, and assessments are quick and provide a narrow picture of patients' symptoms. Remote monitoring solutions can help in providing a more comprehensive understanding and view of different situations and time periods.

Annina Sipilä's master's thesis (Sipilä, 2022) set out to examine the attitudes and views of healthcare professionals on the use and usability of the Beat2Phone ECG monitoring solution in the care of atrial fibrillation patients at the HUS Department of Neurology.

MATERIALS AND METHODS

The principal method of the study was semi-structured thematic interviews conducted at the HUS Department of Neurology. The study population also included 12 patients who monitored their own health with Beat2Phone following a period of hospitalization (an average of 17 recordings per patient).

RESULTS

The results suggest that professionals prefer methods that save time (automation). Patient self-monitoring solutions are considered useful. Adequate support, guidance, and resources are prerequisites for the adoption of new methods. There are several factors that need to be taken into consideration in the implementation:

problems in the handover situations, new layer of work for nurses, increased activities at the ward, lack of available resources, overlapping of training courses and holiday periods, and motivation. The challenges encountered in the deployment of Beat2Phone related to navigation, pairing sensors and mobile devices, and transferring data to the cloud. The solutions identified to overcome these challenges included guidance and clear roles (handover instructions and coordination), the role of the process owner (management), sufficiently precise patient selection (diagnosis), an instructions manual (training), and technical support.

> ### Key takeaways
>
> Factors that need to be taken into consideration in the deployment of patient self-monitoring solutions include problems in the handover situations, new layer of work for nurses, increased activities at the ward, lack of available resources, overlapping of training courses and holiday periods, and motivation.
>
> The VCO's role is to ensure that the following have been factored into the deployment process: guidance and clear roles, the role of the process owner, sufficiently precise patient selection, an instructions manual, and technical support.

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Assessing wearable data of chronic lower back pain patients

BACKGROUND

There is a high need for measuring fear of movement automatically of chronic lower back pain patients. Firstly, the Tampa Scale for Kinesiophobia and other scales to measure fear of movement require the patient to fill out questionnaires. These forms keep reminding the patient of their ailment, which is far from ideal. Secondly, automatic kinesiophobia measurement techniques would also be an easy, objective, and passive way to personalize the treatment of pain.

Tommi Gröhn's master's thesis (Gröhn, 2022) describes an algorithm to automatically detect fear of movement out of wearable data. The patients' and the control group's movement data were collected in the course of a study called PainLab, which involved treating the negative effects of pain by means of digital therapy in a game-like virtual reality environment developed by Orion. The PainLab data set enabled finding differences between these two groups.

MATERIALS AND METHODS

Exploratory data analysis was conducted to detect which statistical features differentiate the patients and the control group. The players' time series data were

automatically segmented with hidden Markov models, and the segmentation was carefully investigated. The segments were then integrated into a completely new model using the findings of the exploratory data analysis. The created methodology was tested with data.

RESULTS

Classifying the players into lower back pain patients and healthy individuals was done reliably with the PainLab data set. The study produced promising results with regard to capturing the patients' development between therapy sessions. Moreover, the segmentation with hidden Markov models functioned well, which may be helpful for further development of the algorithm. The findings are a major step toward automatic classification of fear of movement. A sub-study related to the development of digital therapy for chronic pain by Orion found that algorithm-based pain identification can detect differences in pain patients. Furthermore, the study confirmed the potential of the created methodology as a digital biomarker of chronic lower back pain.

Key takeaways

The methodology succeeded in reliably distinguishing the movement data of lower back pain patients from those of healthy individuals.

The automatic pain detection algorithm provides the VCO with essential solutions that are based on the patient's movement data and are an objective, non-distracting metric. They provide the patient with information about their own development and allow the caregiver to track the patient's progress. The game-like therapy automatically determines the level of difficulty.

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VALUE-BASED VCO

Potential cost savings created by the VCO in coordinating services for multimorbid Parkinson's disease patients

BACKGROUND

This register-based investigation into the costs of Parkinson's disease (PD) patient care (Linna, 2021) sought to establish whether there are systemic savings to be made in the care of multimorbid PD patients. The study involved estimating the effects of more efficient use of resources and services.
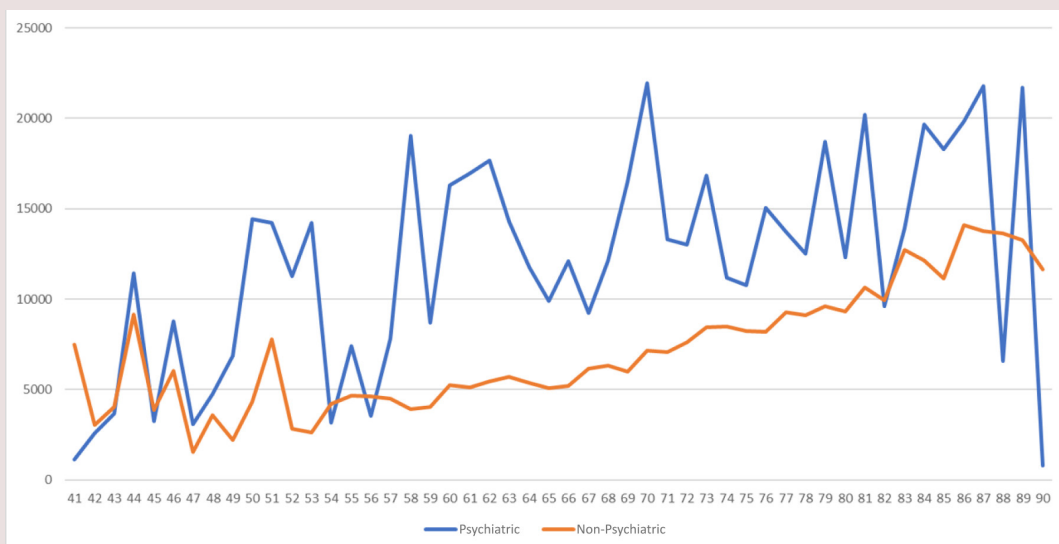
MATERIALS AND METHODS

The data set consisted of the research database of the Academy of Finland's IMPRO research project, which included data on patient use of healthcare services (contacts, costs). In order to identify regional differences, patient risk factors (e.g. multimorbidity) were controlled for, and a model was created based on a risk-standardized estimate of differences in care practices to evaluate the magnitude of potential savings.

RESULTS

The cost of care of multimorbid PD patients varies between health and welfare regions (hospital districts). The cost associated with recently diagnosed cases varies the most.
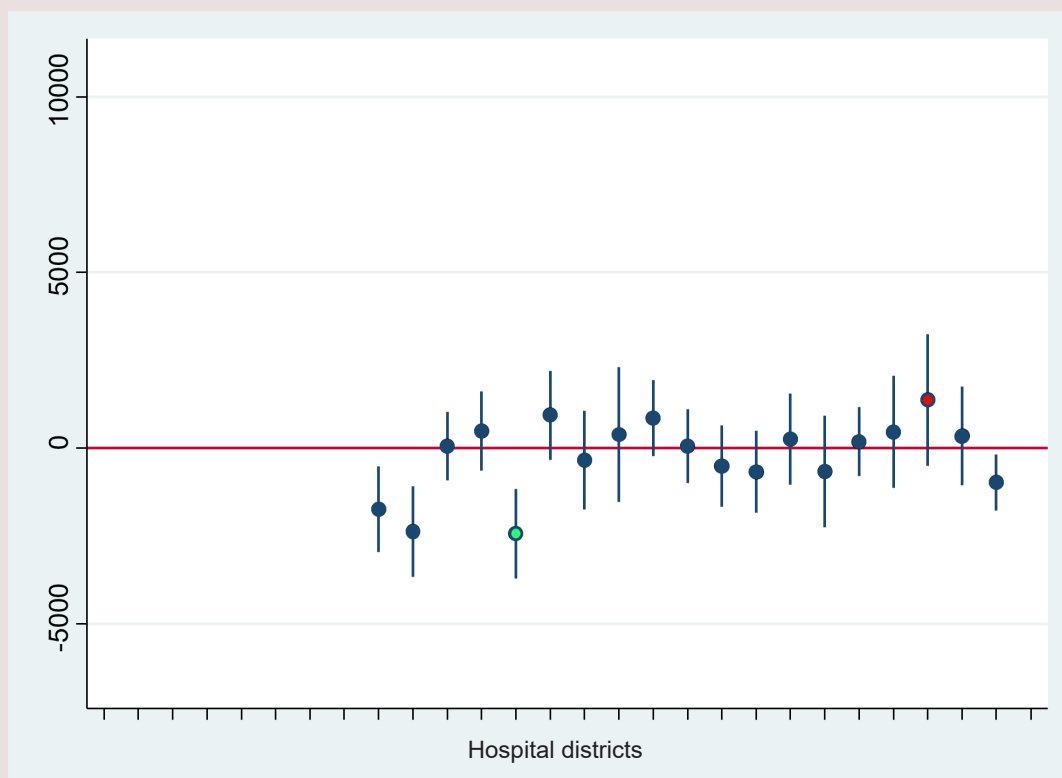
The multivariate analysis revealed that clearly higher healthcare costs were associated not only with multimorbidity but also age, assistance from home care services, and previous use of psychiatric services.

Multimorbidity results in significant additional costs and variation in the care process. The graph provides an example of the effects of psychiatric comorbidity on annual costs across all multimorbid age groups on a national level.

Healthcare costs per patient by age in two groups

If (with the help of the VCO) all health and welfare regions were to achieve the lowest average cost level in the care of multimorbid PD patients, this would cut costs by EUR 18 million per year. If the VCO made it possible for the health and welfare regions that currently have higher-than-average costs to achieve the average cost level, the savings would amount to EUR 3.1 million per year.

Differences between hospital districts in terms of the cost of care of multimorbid PD PA patients

Key takeaways

Comorbidities cause significant additional costs in the case of patients with Parkinson's disease.

If all health and welfare regions were to achieve the lowest average cost level, this would cut costs by EUR 18 million per year.

If the VCO made it possible for the health and welfare regions with higher-than-average costs to achieve the average cost level, the savings would amount to EUR 3.1 million per year.

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Simulating the cost-effectiveness of the VCO in CVD secondary prevention of multimorbid patients

BACKGROUND

Cardiovascular diseases (CVD) remain the biggest cause of mortality and one of the most notable causes of morbidity. They cause a lot of direct and indirect costs for societies. Multimorbid patients use most of the money allocated to health services. A great proportion of these patients do not have a care plan, partly due to fragmentation of the healthcare system, and thus the care of these patients is often suboptimal. Poor adherence to treatment is an issue, but a complex and fragmented system makes it worse. CVDs are present in a large share of multimorbid patients, and cholesterol targets of CVD are not often achieved.

A virtual care operator (VCO) is suggested as a solution to mitigate the problem. *Lalli Nurmi's master's thesis* (Nurmi, 2022) describes a CVD secondary prevention (SP) concept, called the Prevention Clinic, likened to the VCO, and estimates its cost-effectiveness. The Prevention Clinic requires a change in the treatment paradigm of CVD SP in Finland: After acute treatment of a cardiovascular (CV) event in specialized care, the responsibility of SP would shift to the Prevention Clinic instead of primary care. In accordance with European (ESC/EAS) guidelines, the Prevention Clinic would focus on gradually lowering the patient's low-density lipoprotein cholesterol (LDL-C), which is the main cause of CVD, until the treatment objective is achieved.

MATERIALS AND METHODS

Data on all patients with index CV events in Finland in 2017 were obtained, resulting in a cohort of 40,712 patients. Their healthcare costs was obtained from the research data set of the Academy of Finland's IMPRO project from 2015 to 2020. The IMPRO project's Work Package 5 combined the incidence cohort with the costs associated with the use of services. Recurrent CV events were recognized from 2017 to 2020. Type 2 diabetes (T2D) was present in 30% of the patients. Using this data

set, probabilities and costs of the recurrent CV events were determined. Quality-adjusted life-year (QALY) losses for the recurrent CV events were modeled based on the data and literature. The main cost elements were identified and modeled. Finally, the cost-effectiveness of the Prevention Clinic was simulated with regard to its two main effects: CV event risk reduction and adherence improvement.

RESULTS

The potential of the Prevention Clinic to improve adherence was estimated to increase cost-effectiveness through lower risks for endpoint events. The cost-effectiveness was shown with even more feasible pairs in a separate examination of CVD patients with T2D, due to higher probabilities and higher costs of recurrent CV events for the group. The findings suggest that the treatment paradigm in CVD SP should be changed toward the Prevention Clinic-based system.

Key takeaways

The potential of the Prevention Clinic to improve adherence was estimated to increase cost-effectiveness through lower risks for endpoint events.

The Prevention Clinic and the VCO show significant cost-effectiveness potential in the case of multimorbid CVD patients with T2D, who have a higher risk of recurrent CV events and are associated with high treatment costs.

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Cost implications of heart monitoring after ischemic cerebrovascular events

BACKGROUND

Atrial fibrillation is a significant risk factor for ischemic cerebrovascular events, i.e. ischemic strokes and transient ischemic attacks. The current heart monitoring methods used in healthcare can detect only a fraction of sporadic atrial fibrillation during the diagnostic work-up after an ischemic cerebrovascular event. Novel mobile technologies provide possibilities for longer 1-lead electrocardiograph monitoring and increased probability of detecting occult atrial fibrillation, which leads to improved secondary preventive treatment.

Henna Pirskanen's master's thesis (Pirskanen, 2022) set out to examine the influence of integrating a new monitoring method on the patient pathway, the detection and outcomes of atrial fibrillation, as well as costs.

MATERIALS AND METHODS

The thesis is a qualitative single-case study focusing on a single-channel monitor, Beat2Phone ECG, used in the neurology department of HUS Meilahti. The data set was compiled through interviews and by searching prior literature for estimates.

RESULTS

The results imply that the workload of the neurology department would increase, but the patient pathway would become more efficient overall, as there would be less of a drain on other department resources. The longer electrocardiograph monitoring could lead to six fewer strokes as well as cost savings amounting to approximately EUR 100,000 in one year. The findings support implementing mobile technology for screening atrial fibrillation after an ischemic event.

Effects related to the care pathway include, among others, the interpretability of the results during monitoring and an increase in monitoring possibilities (monitoring process impact). The patient's involvement increases along with demands on their motor and cognitive skills (impact on the skills and role required of the patient).

Key takeaways

Longer-term mobile monitoring promises to deliver cost savings subject to certain conditions. The workload of the neurology department would increase, but the patient pathway would become more efficient overall, as there would be less of a drain on other departments' resources.

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Cost mechanisms of an AI triage solution

BACKGROUND

There exists an increasing number of applications relying on artificial intelligence (AI) in healthcare, yet limited evidence of their cost-effectiveness. One of the applications of AI is providing decision support in triaging primary care patients and suggesting preliminary diagnoses. The diagnostic accuracy of these "symptom checkers" is well covered in existing literature, but there are few studies on large-scale practical implementations and effects on health service use.

Juuso Heinonen's master's thesis (Heinonen, 2021) set out to study the cost-effectiveness and cost mechanisms of a digital triage and patient flow software solution called "Klinik Access". It is an online alternative for contacting the local health center while providing decision support for the healthcare professional.

Aaro Hämeri's master's thesis (Hämeri, 2022) sought to describe how the value
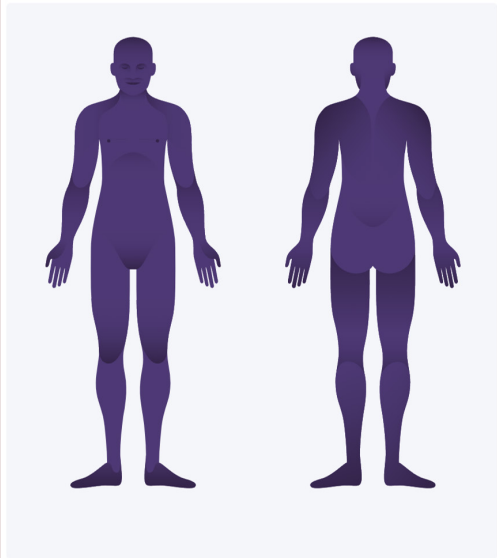
of the Klinik tool is being perceived from the professionals' point of view.

MATERIALS AND METHODS

Heinonen's thesis is based on 14 months of patient registry data after the deployment of Klinik in a primary health center in Myyrmäki, Vantaa in 2017. The data were used to compare patients who used Klinik and those who contacted the health center by phone as well as their care episodes.

Hämeri's thesis is based on interviews conducted with the staff of four Vantaa-based health centers (doctors, nurses, management). The thesis analyzes the interview data by qualitative methods (grounded theory, Gioia).

Klinik Access patient interface

RESULTS

According to Heinonen's research, Klinik users tend to be younger and female. They had fewer new health concerns during the analyzed period, and were less likely to need other services following the triage process. Furthermore, certain disease groups, such as skin diseases, diseases of the urinary and genital organs, and mental disorders, were overrepresented in Klinik contacts. When comparing phone-initiated and Klinik-initiated care episodes in a regression analysis, Klinik was associated with a cost saving of between EUR 8 and EUR 20 per episode. The probable main cost mechanism was "proper competence level of care", as fewer physicians and more nurses were utilized in Klinik episodes. In Vantaa, the service was offered only to non-urgent patients, and its uptake was relatively low at 16% which limits the total cost saving. The findings suggest that Klinik Access is a cost-effective way for patients to seek medical attention in the studied context.

Hämeri's thesis concludes five themes that act as domains for value creation from

the professionals' point of view: configuration, individuals' work, system, applicability, and data. The study suggests that there could be value to be harnessed by changes in the tool configuration in the system as well as the healthcare organization's processes.

Summary of domains for value creation and its restrictions

	Individuals' work	Patient	Operations management system
Domains for value creation	Reduction in workload and perceived pressure. Reduction in manual recording of symptoms. Potential benefits of structured data. Potential of the generated prognoses to act as prompts.	Potentially lower threshold for some patient groups to seek medical attention. Potential of the lack of schedule constraints to facilitate seeking medical attention. Ability to report symptoms without time pressure.	Better capacity management through time-related work processes. Higher potential for making work location-independent (better opportunities for remote work). Increased flexibility in operational management. Better access to resources, such as colleagues or background information, during the triage process. Transferal of symptom recording responsibility to patients. Potentially faster processing compared to phone.
Restrictions for value creation	Learning of a more complex work process (multiple systems and tasks). Systemic lag: Possibility of information being out of date at the time of triage.	Systemic lag: Incompatibility with certain use cases.	Systemic lag (e.g. loss of real-time information): incompatibility with certain use cases. Potential for more patient journey interruptions right at the beginning of the process. More complex operational management ensemble. Lack of a feedback loop for diagnostic suggestions.

Key takeaways

Algorithm-assisted self-assessment of patient health can be a cost-effective way for patients to seek medical attention and to improve the effectiveness of triage. In addition to the modeled cost savings (between EUR 8 and EUR 20 per episode), Klinik-based triage was faster than phone-based triage. A key difference compared to other contact channels was Klinik's ability to produce a structured overview of the patient's condition, which was considered useful.

The VCO must be capable of identifying the situations and patients where the tool can be used, and it must ensure access to care by alternative means in other scenarios.

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Modeling the effectiveness of healthcare frontline customer guidance

BACKGROUND

Maikki Messo's master's thesis (Messo, 2021) set out to analyze the effectiveness of a healthcare frontline customer guidance center (customer service center), which is under development. Value-based healthcare, where value is measured in health outcomes, aims to tackle resource scarcity. Effectiveness has been defined in a multitude of ways in literature, and there is no unambiguous definition for it in the context of healthcare. Based on the literature review, a range of definitions was evaluated, one of which was chosen for the context of the thesis. Effectiveness is the ratio of net health outcomes to output.

MATERIALS AND METHODS

One of the methods used was a realistic evaluation fusing the PROVE-IT model (Lillrank et al., 2019), the IOOI framework, and levels of effect. In addition, the current frontline guidance was analyzed through interviews.

RESULTS

The interviews confirmed the observation from literature that effectiveness is understood in many ways. Additionally, it was found that nursing staff working on rotating shifts perceive telephone-based work as both challenging and unpleasant. This unexpected finding of low work engagement should be considered when implementing the customer service center, by focusing on work motivation and staff well-being.

The result from the realistic evaluation was that effectiveness, within the definition of the thesis, cannot be measured for the customer service center as frontline guidance is a component of a larger healthcare system. The customer service center can nevertheless pursue the principles of value-based healthcare. The thesis outlines a set of indicators for the customer service center that are aimed at achieving holistic well-being from the perspective of both customers and nursing staff.

Key takeaways

Effectiveness, within the definition of the thesis, cannot be measured for the customer service center as frontline guidance is a component of a larger healthcare system.

Nursing staff working on rotating shifts perceive telephone-based work as both challenging and unpleasant, which must be factored into the design of the VCO.

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Value-based rehabilitation of elderly people

BACKGROUND

Rehabilitation is not used enough in the case of elderly people with memory disorders despite its potential to improve functional capacity and thus delay the need for more intensive services. The problems for effectively targeting rehabilitation include: (1) its value has not been systematically measured and services are organized on an accrual basis; and (2) rehabilitation is only integrated into the social welfare and healthcare system in a few special cases.

A study by Laura Pitkänen and Jyri Niskanen (Pitkänen & Niskanen, 2022) set out to create a framework for measuring the value of rehabilitation, the feasibility of which could then be studied in a pilot environment. The study involved

- designing a service pathway for promoting/improving functional capacity.

- examining potential integrations of the VCO by

  - exploring how suitable candidates for rehabilitation could be identified based on the Patient Card (automated prompts),

  - exploring how the right intervention could be identified for patients based on a systematic functional capacity assessment, and how the Service Card could be used in the choice of a suitable provider of longer-term interventions,

  - creating a framework for measuring functional capacity and running a pilot for the measuring of the everyday value of functional capacity interventions. With the assistance of the Patient Card and information about the value of interventions, this will make it easier to identify suitable candidates for rehabilitation and to refer them to a suitable functional capacity intervention.

MATERIALS AND METHODS

Based on the literature, a framework for measuring value was created using four measurement categories: (1) patient-reported (PROM & PREM), (2) clinician-reported (ClinROM), (3) objective metrics, and (4) goal attainment. The starting point for the design was that the metrics must be as easy as possible for staff to use and sufficiently sensitive to demonstrate the value of rehabilitation. The metrics were chosen with the help of the TOIMIA Functioning Measures Database and its recommendations for measuring functional capacity in elderly people.

Framework for measuring the value of rehabilitation

Category	Metric	Before	After
Goal attainment	GAS (Goal Attainment Scaling)		X
Patient-reported metrics	PROMIS Global Health (PROMIS-10)	X	X
	PASS (Patient Acceptable Symptom State)	X	X
	Self-assessed memory, concentration, and ability to learn new things.	X	X
	GRC (Global Rate of Change)		X
	NPS (Net Promoter Score)		X
	Customer satisfaction survey		X
Clinician-reported metrics	ADL (Activities of Daily Living)	X	X
Objective metrics	SPPB (Short Physical Performance Battery)	X	X
	Grip Strength	X	X

The subjects were asked to fill out questionnaires, and measurements were taken both before and after the course of rehabilitation. The course was three months long. A total of 16 subjects were recruited for the feasibility study: 10 in Espoo and 6 in Lapinjärvi.

RESULTS

The subjects were more cognitively limited than expected. The subjects were unable to fill out the questionnaires themselves, many had trouble grasping a five-level Likert scale, and the majority failed to answer questions about their perceived health during the surveyed timeline. Some subjects were assisted by their next of kin whose views on the subject's functional capacity sometimes contradicted the subject's own spontaneous answer. Some of the metrics were clearly not sensitive enough, including ADL, PASS, and pain VAS. The short physical performance battery (SPPB) appears to have some potential as a useful metric.

It seems that more simply worded and straightforward questionnaires are needed when dealing with people with even a mild memory disorder. Monitoring the use of services, which was not part of this study, could be a good way to collect information about the value of interventions over a longer term. Using the International Classification of Functioning, Disability and Health (ICF) to systematically measure functional capacity enables automatic monitoring.

Changes in the patient-reported metrics appear to reflect more the (potentially coincidental) difference between the first and last days' measurements than an indication of change over the three-month period. This is likely due to the subject inability to reflect on their own health over a longer period. The results of the customer satisfaction survey that the subjects filled out at the end of the rehabilitation course are not fully reliable, as the subjects were assisted in this exercise by the physiotherapist who ran the course.

Key takeaways

A framework for measuring value has been designed and its feasibility has been tested in the course of rehabilitation for the elderly. The metrics included in the framework can be used to demonstrate value on an individual level.

The Patient Card could be used to identify those patients/customers who would benefit the most from rehabilitation. Going forward, it may also be possible to use the framework to identify the most effective rehabilitation interventions for specific patient segments. By monitoring the use of services by patients, the cost-effectiveness of interventions can be examined and resources can be reallocated where they have the most value.

The Service Card can be useful in finding the best service provider for each patient according to their intervention needs. More information that could facilitate the matching of patients and interventions can be collected by instructing service providers to measure value.

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Impact analysis on a VR rehabilitation system

BACKGROUND

Transient ischemic attack (TIA) is one of the costliest medical conditions in Finland, costing society almost EUR 1.1 billion every year. Treatment processes are inconsistent due to regional differences and rehabilitation methods, and far from all the patients who would benefit from rehabilitation actually get the rehabilitation they need. Digital interventions hold potential as a solution to the rehabilitation of TIA patients in the future. **Matleena Tyni's Master's thesis** (Tyni, 2022) set out to study a VR rehabilitation system developed by a company called Vireamed and its value in rehabilitating TIA patients. The study involved eliciting an initial program theory (IPT) to model hypotheses for the system's functionality and cost-effectiveness. The IPT can be used to broaden understanding of the operating environment of the intervention as well as its effects without informative data.

MATERIALS AND METHODS

- Literature review related to the rehabilitation of TIA patients in Finland, costs, and VR technology
- Interviews with healthcare professionals (doctors, rehabilitation center managers, physiotherapists) as well as experts by experience to develop the IPT
- Excel modeling of potential cost-effectiveness

RESULTS

The thesis describes two different program theories: one from the perspective of patients and one from the perspective of medical staff. Together, these two include six hypotheses about the functionalities of the system and their potential mechanisms of action. The most significant mechanisms of the hypotheses are a shortening of patients' rehabilitation day programs, an improvement in patients' quality of life and functional capacity, an increase in patients' motivation and exercise intensity, a release of physiotherapist resources to other tasks, and benefits to be derived from the rehabilitation data. Metrics were defined for these factors that could be used to monitor effectiveness going forward. The hypotheses that appealed the most to the interviewees were the ones freeing physiotherapists to other tasks, which has a direct cost benefit for society, as well as the utilization of data in the rehabilitation process.

According to the modelling exercise, a successful deployment of a VR system can translate to savings of 10 to 30 minutes of working time per patient per day, which would save between approximately 0.003 and 0.01 person-years in resources. Moreover, in the best-case scenario, the time spent in rehabilitation by a patient would be shortened. For example, a seven-day reduction in the average length of time in rehabilitation would cut costs by between EUR 2.4 million and EUR 4 million, depending on the user group, which is equivalent to between 0.24% and 1% of the total cost of treating TIA patients in Finland.

Key takeaways

The most significant potential benefits of a VR rehabilitation system are a shortening of patients' rehabilitation day programs, an improvement in patients' quality of life, an increase in exercise intensity, a release of physiotherapist resources, and the utilization of data.

Physiotherapists' access to data to to analyze the effects of rehabilitation afterwards improves the coordination of care. This rehabilitation method has a lot of potential in terms of cost-effectiveness, which could be demonstrated with the created metrics when using the system.

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