Personalized care with mass production efficiency: integrating care with a virtual care operator

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Abstract

Purpose – This article aims to describe the thinking behind MASSE, a project in Finland that helps address the fragmentation of care and patient journey disruptions for long-term care. It outlines the conceptualization of an information technology (IT)-assisted solution and presents preliminary findings and research problems in this ongoing project.

Design/methodology/approach – The project employs a service engineering and design science approach with the objective of addressing chronic and multimorbid patients in specialized multiprovider environments. It does this by applying information and communication technologies and organizational design. The project has been a cocreative effort with ongoing interviews and workshops with various stakeholders to inform the conceptualization of a solution, an intermediary step before the implementation phase.

Findings – Patient journey disruptions occur when caregivers do not know what to do in specific situations. A potential solution is a virtual care operator (VCO) with a personalized patient card that would enable service ecosystem actors to integrate and coordinate their tasks. This article presents the basic design principles of such a solution.

Research limitations/implications – Conceptual ideas and preliminary results only indicative.

Practical implications – Systemic integration efforts like those ongoing in Finland can benefit from the VCO concept encouraging a more collaborative way of thinking about integrative solutions and opening up new avenues of research on business implications and ecosystem strategies.

Introduction to the problem

It is a dark and lonely night at a care home in the city of Vaasa in Western Finland. At 2:30 a.m. nurse NN finally can take a break with a cup of tea. Suddenly an alarm goes off. It is patient PP, a recently moved in older adult with Alzheimer's disease, atrial fibrillation, and orthostatic hypotension. Nurse NN rushes to the scene and finds the patient on the floor, disoriented, with pulse 90/min. Nurse NN doesn't know the patient well. Anxiety rising, he is afraid the patient may die on his watch.

He does not know what else to do and calls an ambulance.

Patient PP is taken to the local ED. The triage doctor has not the time to check the voluminous health record. To get over with it she orders a few tests and leaves the patient under observation. The following afternoon the test results do not show anything definitive. Medication is slightly adjusted and patient PP, increasingly confused, is sent back to the nursing home in a worse state than before.

What happened and why? Purposeful human action has three preconditions (Hackman and Oldham, 1976; Lillrank, 2018):

- Want to do (willingness, motivation and incentives)

- Can do (capabilities, skills and resources)

- Know what to do (situational assessment, plans, rules and control information)

Nurse NN was willing and capable but lacking care instructions and background information; he did not know what to do. Sensibly enough he outsourced the problem to the emergency services. Consequently, the patient journey was disturbed by a stressful and costly visit to the ED that brought more harm than benefit to the patient. The nurse did not know what to do.

Soon thereafter the nursing home implements a service provided by Doctagon, a private medical care provider. A geriatric specialist, doctor DD conducts a comprehensive assessment of all patients. It is documented together with care guidelines detailing what to do in predictable incidents.

The next time something happens the nurse can check the instructions. If the situation remains unclear, he may contact doctor DD or a colleague on call who has access to the documentation. Together they decide what to do. The nurse can relax. This is possible because there is an integrated view of the patient's condition documented in an easily accessed care plan, and an established way for professionals to coordinate their actions.

The Doctagon case demonstrates that patient-level integration and coordination in specific situations can be accomplished with rather modest means. The Doctagon system in Vaasa significantly reduced ED visits from elderly care institutions. The accompanying cost savings during the first year of implementation was close to one million euros Lindh, 2015). The question remains, can the principles behind this simple solution be applied and expanded to different situations, adapted at various levels of specialization and scaled up in a cost-efficient way?

To answer these questions the research and development project MASSE – personalized care with mass production efficiency – was initiated by Aalto University Department of Industrial Engineering and Management, Helsinki University School of Medicine, and a consortium of companies in medtech and health services, and funded by Business Finland, a national funding agency. This was not to be an information technology (IT) project. The methodological approaches were service engineering (Karwowski *et al.*, 2009) and design science (Denyer *et al.*, 2008). A blueprint for a solution was to be built starting from the service perspective asking "*who needs to know what in order to do the right things?*" The results were to be expressed as design principles, upon which public or private actors might develop viable businesses.

This article describes the thinking behind MASSE, and the virtual care operator (VCO) reports some preliminary findings, and outlines research problems in this ongoing project. The context is Finland, where about three quarters of health service provision and financing is public. Primary care is organized in large municipal health centers and specialist care in regional units. There are no designated family doctors. Major reform is underway leading to regional administrative integration of health and welfare services.

Integration and coordination of care plans and patient journeys

Integrated care (IC) has many definitions (Goodwin *et al.*, 2021). Leijten *et al.* (2017) define IC as "*structured efforts to provide coordinated, pro-active, person-centered, multidisciplinary care by two or more well-communicating and collaborating care providers either within or across sectors*" (p. 13). The IC literature presents several conceptualizations, such as the rainbow model presenting several system levels from macro to micro (Valentijn *et al.*, 2013).

Here, the focus is on patient-centric integration, although the implications carry over to wider organizational levels (Goodwin *et al.*, 2021; Litchfield *et al.*, 2022). Integration is accomplished when all relevant information on a patient's condition from various sources is at hand and duly considered when a professional or a team attempts to develop a shared understanding of a patient case (Litchfield *et al.*, 2022). Sources of patient information can be numerous such as different medical specialties, family members and social care. Technically speaking integration means the fusion of two or more elements into a new entity that no longer can be separated into its components. For example, if a patient has neurological, orthopedic and gastrointestinal conditions, and information on these is integrated, the neurologist then cannot ignore the orthopedic constraints on the patient's mobility. Integration is typically expressed as a set of diagnoses and assessments upon which a care plan can be formulated, documented, communicated and implemented (Lillrank, 2012).

Patient-centric integration can be said to have happened when an integrated diagnosis and care plan is produced. A care plan is a document specifying what should be done to and by a patient (Takeda *et al.*, 2020). A patient journey is what actually happens.

For patient-centric integration to be possible, some degree of administrative and organizational integration is necessary (Litchfield *et al.*, 2022). All relevant patient records must be available through interoperable IT systems. The involved caregivers from different specialties must be allowed and able to agree on their roles, responsibilities and routines, including who pays the patient's bills. Furthermore, any digital facilitation of process integration must include careful consideration of existing working arrangements and systems used. Caregivers are often overburdeneded, and redundant technologies with competing interfaces should be avoided to minimize resistance (Follen *et al.*, 2007; Gorman *et al.*, 2000).

Coordination happens when two or more parties execute a care plan, schedule appointments and treatments and adjust service components in order to facilitate a smooth process flow (Bohmer, 2009; Hughes *et al.*, 2020). Coordination is successful when the patient journey – what actually happens to the patient – corresponds with the care plan.

Ongoing patient-centric integration and coordination should lead to continuity of care (Gallo *et al.*, 2020). It is manifest at three levels (Haggerty *et al.*, 2003; Guthrie *et al.*, 2008). Individual or relational continuity means that the same persons are continuously involved in a patient case. Managerial continuity refers to the coherence of clinical decisions. Informational continuity happens when patient information is comprehensive and up to date. Obviously, individual continuity is preferred, however, in specialized multiprovider environments with high personnel turnover; this is difficult to accomplish.

The more complex the cases, i.e. chronic and multimorbid conditions, the more demand there is for integrated and coordinated care (Karam *et al.*, 2021).

Lacking integration, coordination and continuity, a patient journey is disrupted. A typical disruption is a fragmentation (Hughes *et al.*, 2020); several parallel unintegrated care plans lead to overlapping examinations, contradictory therapies and polypharmacy. Another type of disruption is an interruption (Campos *et al.*, 2019); a patient journey grinds to a halt without proper reason.

Disruptions can happen for a multitude of reasons, such as lack of resources or motivation. Here, the focus is on situations where key actors are competent and willing but lack situational awareness and control information informing the right thing to do in a particular situation.

Recreating "looking after"

Integration typically is done at the beginning of or at a major junction in a patient journey. However, with new developments, a care plan may become obsolete or there may be disturbances in its execution. Considering such issues, MASSE identified and defined a specific organizational functionality, here called "looking after".

Looking after happens when one or several actors watch over a patient, and see to it that the care plan is followed, that things get done, that the patient's situation is monitored, the proper action is taken at incidents, and the care plan is adjusted as appropriate. Metaphorically speaking, it is what guardian angels are supposed to do, understand goals and objectives, follow situations, issue warnings and provide alerts, but not necessarily get directly involved.

Looking after is a functionality that naturally occurs when individuals cocreate their own health, families look after their members and family doctors follow their patients through episodes of illness. This function, however, tends to weaken or disappear in highly specialized and therefore organizationally fragmented health service systems (Lillrank, 2018). There may not be a competent actor (e.g. loneliness and dementia), or the overall situation with multiple specialized caregivers becomes too complicated for any single actor to comprehend, know what to do and be capable of acting accordingly.

The easy solution would be to go for individual continuity of care and assign a personal case manager to look after each patient (Monaco *et al.*, 2020). It would, however, be prohibitively expensive. A solution should be personalized but work with mass production efficiency using standardized platforms and modular solutions (Chaudhuri and Lillrank, 2013). The looking after function needs to be recreated using socio-technical arrangements of workflows and information support. Each caregiver and patient would act as if there were a personal care manager instructing what to do.

The looking after function is adapted via digital tools to meet each patient's evolving care needs and goals. Therein, patient segmentation is key since the individual needs and goals of each patient vary along with their capability to self-manage.

The objective of MASSE is to recreate the looking after function for chronic and multimorbid patients in specialized multiprovider environments by applying information and communication technologies and organizational design.

Service engineering

The looking after functionality has been implemented in the industry. Condition-based maintenance is an innovation in industrial management (Li *et al.*, 2020; Quatrini *et al.*, 2020). The maintenance of machines and buildings can be reactive (when it breaks, fix it) or predictive (calculate the life cycle; then, fix it). Both are ineffective, as the former causes downtime (undercare), the latter loss of capacity (overcare). Condition-based maintenance is based on sensor and communication technologies that can record and report on key parameters indicating the condition of a piece of equipment, such as elevators and machine tools. Then adjustments can be done and maintenance scheduled optimally (Teixeira *et al.*, 2020).

A special case of condition-based maintenance is network operations service providers who employ networks operation centers (NOC) that monitor, manage and coordinate complex networks. Telecom networks and electric power grids are dynamic entities whose behavior cannot be perfectly modeled and predicted to the extent where control could be fully automated. Therefore, an NOC with computer and AI-assisted human operators is necessary. In a similar vein, a care operation center can be conceived as a platform to look after various patient populations (Lillrank and Särkkä, 2011).

Many initiatives to integrate care have been driven by IT. While essential, IT is only one side of the story. Service engineering asks which service acts should be performed by whom and when, with which resources, qualifications, and control information, and how they should be combined. This boils down to the question, who must know what and when to do the right things? More specifically

- Who: assigned actors in a service system

- must: roles and responsibilities

- know what: condition and control information

- when: real-time data

- to do: capabilities and resources

- the right things: care plans, objectives, shared values and logics.

The objective is an information system conveying actionable information to the various actors involved in a patient case. This hypothetical entity is called the VCO.

The virtual care operator

"Virtual" here means that there is no given organizational embodiment or form. The looking after functionality may be deployed in various ways. It could be a health service NOC with monitors, dashboards, checklists and human case managers. It might be built into patient information systems and workflows so that looking after is integrated into routine work. It might also be a tool that empowers patients and families to take care of themselves and communicate effectively with care providers.

The operator here means an actor that receives information, processes it and provides information about what to do to relevant parties. In this respect, the VCO supports informational and managerial continuity of care (Haggerty *et al.*, 2003; Guthrie *et al.*, 2008).

The relevant parties can be described as a service ecosystem formed around a patient. An ecosystem here is defined as a set of actors with a common purpose and shared logic, i.e. an understanding of how the world works and what should be done, but without explicit organization (Baldissera and Camarinha-Matos, 2016). Several such patient-centric ecosystems can be aggregated into larger ecosystems (Thomas and Autio, 2014; Adner, 2017). An ecosystem

turns into a network when participants become aware of and connected to each other. It may further evolve into an organization when formal rules, roles and reporting relations are added (Möller and Halinen, 2017).

The service ecosystem concept is essential as the VCO needs to offer actionable information, based on a shared logic (Banoun *et al.*, 2016) to actors who are not necessarily connected.

The VCO is not a clinic or a doctor's office; it does not touch patients; it does not deliver therapies. Its primary task is to enable the looking after functionality by providing actionable information to the service ecosystem that information needs to be integrated into onetime and relevant view.

Interoperability

The ongoing research and development task of MASSE is to formulate the design principles of a VCO and establish its technical and economic feasibility. The basic blueprint is presented in Figure 1.

The Finnish health IT situation, like in most developed countries, is fragmented lacking national standards. There is a plethora of regional and single-purpose software. There are, however, large national databases, such as Hilmo which registers all care contacts, and Kanta (national health archives) which is the national repository for social and healthcare data retrieving and storing electronic patient records from all relevant service providers (Kanta, 2022; Valvira, 2022).

A basic requirement of a VCO must be that it should neither add to the IT clutter nor replace existing patient information systems. Patient data would be entered into current systems as usual. As Figure 1 illustrates, an interoperability platform gathers and presents information from existing sources (Iroju *et al.*, 2013). Interoperability is a necessary requirement for a VCO. Such integrative platforms have recently been developed (UNA, 2022), but not put into broader use. Nevertheless, it is technically possible to draw information from various sources and combine it. It follows that the core element of a VCO, the patient card, can be developed based on this integration.
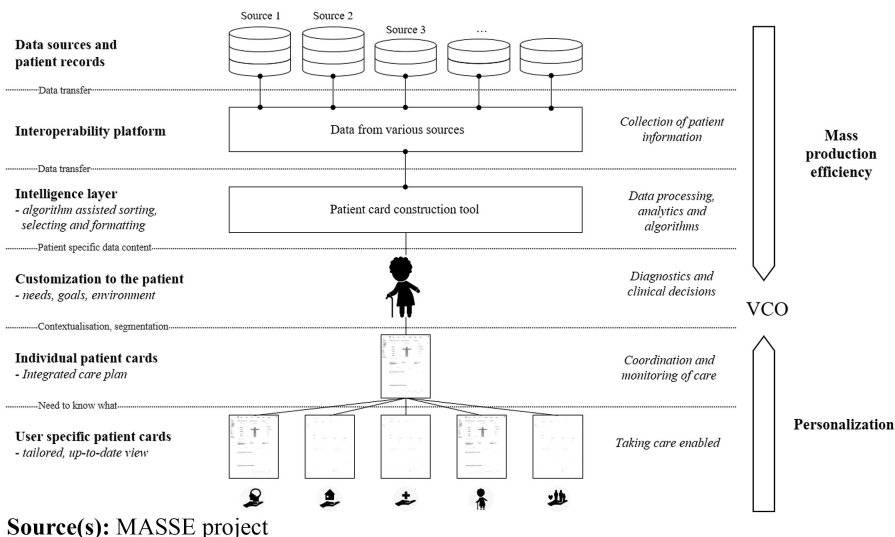

Source(s): MASSE project

The patient card

The VCO looking after function centers on the collection and organization of data from all relevant sources into what we term the patient card. The information that enables an actor to know what to do in specific situations needs to be available in a personalized and actionable form. Most actors in most situations do not have the time to read extensive patient records. Therefore, the data must be selected, sorted, summarized, formatted and presented on compact displays. To this effect, the core of a VCO is the real-time patient card. Its design principles are described in Table 1.

The patient card concept not only acts like an information hub for a given patient, but it also extends to include the various components needed for the different VCO functionalities. To accomplish patient centricity the patient card will be built individually for each patient deemed to need the care of the VCO. It is tailored to each case using standard components, technically doable like downloading and configuring apps on a smartphone. Thus, there should be tools for professionals to structure care plans and assemble patient cards from various components.

A basic patient card needs to include personal information, objectives, patient-originated goals and circumstances. A professional customizes a patient's card by using generic features and specific modules, such as medication management, a patient portal for self-reporting and communication, diagnosis-specific apps including particulars for the corresponding condition, monitoring using wearable devices, schedules, alerts, reminders, instructions for incident management and specific digital therapies. The card can be seen as a platform open to special-purpose apps from independent developers in a business ecosystem (Cusumano et al., 2019).

It is assumed that a patient is surrounded by an ecosystem of more or less connected actors ranging from a lone individual to a community. These may be the primary care doctor in charge, various specialists, nurses, home helpers, physiotherapists, volunteers and family members. The variety of professionals and organizations involved underlines the need for more inter-professional and inter-organizational integration as defined in Table 1. Integrated clinical decision-making and care plan design obviously presuppose a full set of patient information. For those executing the care plan, more focused need-to-know information is required. User-specific patient cards can be designed for various actors and purposes. Returning to the Doctagon case, Nurse NN would have a focused display on Patient PP's status, predictable incidents and corresponding guidelines, while Doctor DD would have one with links to all relevant clinical information. And for the emergency department's triage personnel, a quick overview of the patient's condition would be available including medication, recent history and prospectus (Figure 2).

Research problems

With the basic design requirements of a VCO patient card in place, there are some known unknowns to be solved before more detailed requirements can be specified.

As the project moves into implementation it will be further researching implementation issues including how the solution might be embedded into the practices and workflows of clinicians and other users. Preliminary findings indicate that solutions cocreated within the clinical setting with continuous iteration between technical and implementation issues, are more likely to be successfully adopted by professionals. Similarly, preliminary findings show that designing with patients and in their lived context ensures implementation does not prioritize technical aspects over human aspects.

The VCO – the patient card is supposed to provide know what to do information to the service ecosystem so that patient journey disruptions can be avoided. To this effect, more needs to be known about disruptions, what types exist, how they emerge and their

IC Dimension	Definition	Design principle	VCO solution element
Person-focused Patient-centric integration	*Coordination of person-focused care in a single process across time, place and discipline*	Enable taking care	Individualized patient card Integrated diagnosis and integrated care plan
Continuous care (Guthrie *et al.*, 2008)	*How an individual's care is connected over time*		
Informational continuity	*Formally recorded, and tacit patient information sometimes held in clinician's memory*	All patient data in one place Visible, up-to-date data	Includes patient social context, preferences and goals Ongoing monitoring and updated patient card
Management continuity	*Shared plans and protocols and explicit responsibility for follow-up and coordination*	"know what to do"	Integrated diagnosis and integrated care plan
Relationship continuity	*Built on knowledge of patient and interpersonal trust over time*	Clear roles and relations	User/task-specific patient cards
Comprehensive care	*Availability of a wide range of services and their appropriate provision*	All relevant caregivers/ service providers in service ecosystem	Interoperability platform Integrated services catalog (service card) Variety of apps
Coordination	*Linking of healthcare events and services to ensure appropriate patient care for all health problems, physical, mental and social*	Agreed roles, responsibilities and schedules "who needs to know what" condition monitoring and patient data Responsiveness	Visible scheduling User/task-specific patient cards Sensors and patient self-reporting Automated notifications/ alerts
Population focused Professional integration	*Extent to which professionals coordinate services across various disciplines*	Management of multimorbidity Facilitate inter-professional coordination	Diagnosis-specific apps colocated on the patient card User/task-specific patient cards allowing shared views and a potential communication channel
Organizational integration	*Extent to which organizations coordinate services across different organizations*	Service ecosystem Data-driven decision making	All services visible on the patient card Integrated data architectures and modular design
System integration	*Alignment of structures, rules and policies within a system*	All patient data in one place Shared logics and a common vision	Interoperability platform VCO as a shared resource dictating rules for participation in the ecosystem

Note(s): References key IC dimensions from the literature – namely, the IC rainbow model (Valentijn *et al.*, 2013) and a model of continuity of care (Guthrie *et al.*, 2008). It accordingly maps out the design principles and corresponding VCO elements which are manifested primarily via the patient card. The VCO concept bridges between patient-level and wider contexts with the potential to contribute equally to how care is organized at the population level (Table 1 beyond the scope of this paper)

Table 1. Integrated care, design principles and corresponding VCO solution
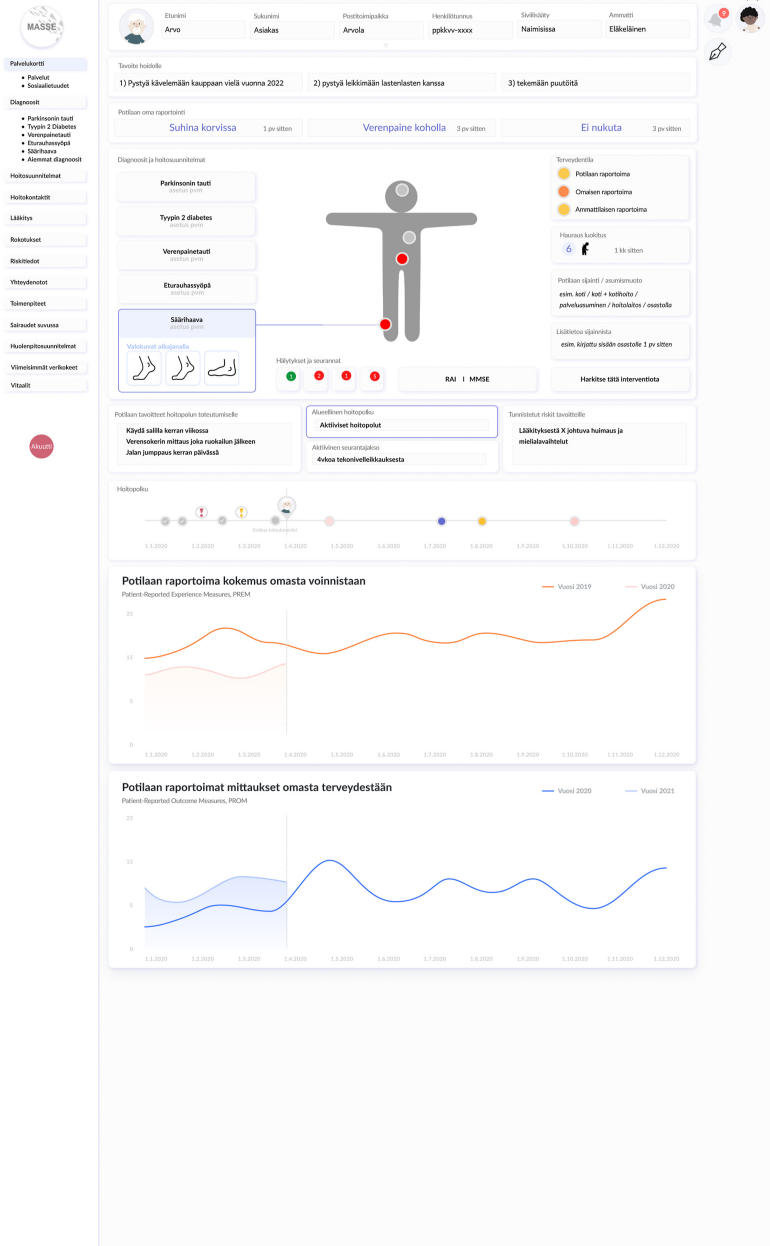
Figure 2.
Illustration of patient
card organizing
different patient details
and showing the
various patient
diagnoses

consequences. If common disruption types can be identified and analyzed, the know what to
do information can be specified.

Given that the patient card should be personalized and actionable, there is a limit to how
much information can be presented. Prioritization rules need to be developed. The same

applies to the design of the user-specific cards. While the doctor in charge needs to know a lot, there is a narrower range of useful information for home helpers, physiotherapists and family members.

The patient card consolidates information from various sources. To what extent this can be done under different regulatory regimes and different data management and privacy guidelines, needs to be established. Even with the SOTE (healthcare and social welfare services) reform in Finland (Kela, 2022; Sote, 2022) which connects social and health data across the country and to the centralized system, current regulations prevent sharing and a combined utilization of social, primary care and specialist data, unless explicit consent is given by the patient, and the process is not straightforward. Furthermore, even though the centralization of data is mandated by regulations, it only requires feeding the central repository with rudimentary patient/citizen information which is made visible in a relatively unstructured form preventing more sophisticated and real-time usage which the VCO presupposes. More valuable data thus remain locked into siloes in individual care provider electronic record systems. Therefore, the interconnectivity needed at the infrastructure level is still a matter for further exploration, and at least a couple of paths are being considered such as future developments within a public–private partnership or lead by an entrepreneurial actor in collaboration with incumbent actors. Relatedly, the right incentives must be aligned for actors to collaborate and open up their electronic health record (EHR) systems to allow a bidirectional flow of data. Data management issues arise such as data ownership, determining the value of data, and defining the potential for secondary data utilization.

On the another front, the components needed to construct a VCO and its patient card already exist in the health IT ecosystem. But as highlighted by de Jong et al. (2018), a frequent problem is that most digital health applications serve a single or limited function, often within a single speciality. They therefore fall short when addressing complex care needs spanning multiple providers and disciplines. Just like care fragmentation, technological fragmentation generates frustration and dropout for both patients and caregivers (Kawamoto et al., 2021). It follows that more research is needed on how the VCO and its patient card as a platform can balance an open and innovative ecosystem while offering a streamlined user experience with a coherent set of standardized components.

Building a VCO with patient cards will require substantial amounts of capital, competencies and political attention. It is common knowledge that the current care of chronic and multimorbid patients is not cost effective (Soley-Bori et al., 2021). The looking after functionality has obvious appeal. Nevertheless, the potential value of a VCO needs to be established with sufficient precision. One way is estimating the economic and human costs of patient journey disruptions to build a base case against which the potential benefits of a VCO can be evaluated. Detailed activity-based costing studies on the microlevel should be used to find out how care provision, workflows and patient behavior might change when everybody knows what to do. In addition, comparative research on an aggregate level is needed. Given the sorry state of chronic and multimorbid care, a cost-benefit analysis is likely to produce positive results.

If the potential value of a VCO can be justified, the next research questions would need to address business and revenue model formulations as well as professional, organizational and system-wide implications.

Conclusion

Digital solutions are revered to have the potential to relieve some of the burden from caregivers allowing a more optimal use of their time (e.g. Iyengar et al., 2016). This is crucial to address the shortage in human resources and the increasing load on healthcare systems (Snavely, 2016). Within the call for integrated care, there is potential for new coordinating

roles to be defined such as "link workers" (NHS England) or "health promotionists" (Spring *et al.*, 2019). The VCO supplements or augments coordinating roles allowing a more efficient and effective management of large populations of chronic and multimorbid patients within a personalized approach.

The VCO is an information-focused approach to the integration, coordination and continuity of care. While applicable to episodic medical issues with an end in sight, the primary target is complicated long-term conditions. Not every patient needs a VCO.

The basic assumption is that caregivers are capable and willing to provide services that consider patients' total situation and whole person needs. The weak or missing element that the VCO addresses is assumed to be situational awareness and the know what to do information required for the looking after functionality to be realized. Should major problems lie elsewhere, such as in poor incentives or insufficient resources and capabilities, information alone is unlikely to prevent patient journey disruptions.

The patient card is technically feasible in environments where patient information is recorded and where interoperable platforms are available. In siloed health service systems where patients do not own their data and where inter-professional or inter-organizational data sharing is limited, a VCO may be applicable only within a silo.

The idea of a patient card acting like an information hub to enable the looking after functionality and empower both patients and caregivers is intuitively appealing. In our experience, the VCO concept has been well received by health service organizations and policymakers. The remaining questions are practical, how to build and implement it.

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