Elaborating on modular interfaces in multi-provider contexts

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Abstract

Purpose – This study examines how modular interfaces manifest in multi-provider contexts and how they can improve coordination and customization of services. The aim of the study is to describe interfaces in multi-provider contexts and elaborate on how they support the delivery of integrated patient care.

Design/methodology/approach – A qualitative, multiple case study was conducted in two multi-provider contexts in healthcare services: one representing paediatric Down syndrome care in the Netherlands and one representing home care for the elderly in Finland. Data collection involved semi-structured interviews in both contexts.

Findings – This study provides insight into several types of interfaces and their role in multi-provider contexts. Several inter- and intra-organizational situations were identified in which the delivery of integrated patient care was jeopardized. This study describes how interfaces can help to alleviate these situations.

Originality/value – This study deepens the understanding of interfaces in service modularity by describing interfaces in multi-provider contexts. The multi-provider contexts studied inspired to incorporate the inter-

organizational aspect into the literature on interfaces in service modularity. This study further develops the typology for interfaces in modular services by adding a third dimension to the typology, that is, the orientation of interfaces.

Keywords Interfaces, Service modularity, Integrated patient care, Health services

Paper type Research paper

1. Introduction

Services are increasingly delivered by a multitude of service providing entities producing service components (Avlonitis and Hsuan, 2017; Brax *et al.*, 2017). In these multi-provider contexts, rapid and effective coordination and communication among the service providing entities are crucial (de Blok *et al.*, 2014; Brax *et al.*, 2017) for the delivery of service packages that meet the needs and requirements of customers. This is especially important because responsibilities are shared between multiple autonomous entities, and each entity has different resources and practices that need to be aligned (Auschra, 2018). A promising approach for the delivery of coordinated yet customized services in multi-provider contexts is service modularity (Brax *et al.*, 2017). Modularity refers to the decomposition of a complex service system into smaller subsystems (Baldwin and Clark, 1997). By recombining independently functioning subsystems, a variety of customer needs and requirements can be fulfilled.

Interfaces make sure that the independent subsystems are coordinated (Voss and Hsuan, 2009). They are the linkages in the configuration of modular services and allow for interaction and communication. Interfaces allow for the mixing and matching of subsystems and ensure the formation of a functional, coherent whole (Baldwin and Clark, 1997). Without interfaces, a service offering would simply collapse (Peters *et al.*, 2018). This is certainly true for multi-provider contexts in which services are delivered over a long period of time and typically involve multiple service providing entities (Tax *et al.*, 2013; Avlonitis and Hsuan, 2017). Interfaces are especially important in healthcare services because the treatment of patients requires input from multiple healthcare professionals and organizations (Meijboom *et al.*, 2011). Poor coordination and communication could potentially lead to health risks for patients in terms of overlapping or missing treatments (Singer *et al.*, 2011).

Furthermore, patients underline the need for their voices to be heard, and they call for healthcare services tailored to their needs (Silander *et al.*, 2017; Minvielle, 2018). This can be achieved by setting the patient at the centre of care provision (Berwick, 2009) and engaging in customization, which can be defined as the development of tailored services to meet customers' diverse needs (Minvielle, 2018). However, this is challenging due to the necessary involvement of multiple service providing entities in healthcare services. In modular services, individualized modular packages can be created by mixing and matching subsystems by means of interfaces (Voss and Hsuan, 2009). As a result, a customized modular package can be provided that is tailored to the needs of each individual. In doing so, interfaces enable coordination and customization in modular services. Coordination and patient-centredness are key elements in the delivery of integrated patient care (Singer *et al.*, 2011) and modular services.

This study examines modular interfaces in multi-provider contexts to improve the coordination and customization of services. As such, the aim of the study is to describe interfaces in multi-provider contexts and elaborate on how they can support the delivery of integrated patient care in multi-provider contexts. Thus, this study addressed the following two research questions:

RQ1. How can interfaces be described in a multi-provider context?

RQ2. How can interfaces support the delivery of integrated patient care in a multi-provider context?

A multiple case study into multi-provider contexts in two healthcare contexts was conducted: one representing paediatric Down syndrome (DS) care in the Netherlands, and one

representing homecare for the elderly (HCE) in Finland. These contexts were chosen because of the modular nature of the cases, meaning that the cases make use of a structure that enables them to combine a large variety of independently functioning care and service components into customized care packages (Fransen *et al.*, 2019). In this study, the words "patient" and "customer" are used synonymously since theory uses the word customer and patient simultaneously.

The contribution of our study is two-fold. First, this study contributes to the service modularity literature by explicating the importance of interfaces in multi-provider contexts. We specifically make a contribution by adding a third dimension, the orientation of interfaces (inter-organizational vs intra-organizational), to the existing interface typology of de Blok *et al.* (2014). This moves the discussion on interfaces in service modularity from an intra-organizational level (single-provider context) to an inter-organizational level (multi-provider context). Second, we empirically investigate the implications of modular interfaces for the delivery of integrated patient care in multi-provider contexts. As such, this study responds to calls for research on service modularity in multi-provider contexts (Brax *et al.*, 2017).

The paper is structured as follows. We first review the relevant literature on interfaces in service modularity and integrated patient care and provide a conceptual synthesis of these two concepts. Next, we explain the case study methodology. We then describe our empirical results and offer a discussion of the findings while developing propositions for future research. Finally, we present our conclusions, including scientific and managerial implications.

2. Theoretical background

Modularity is essentially related to the decomposition of a complex service system into independent modules (Baldwin and Clark, 1997). Each of these modules consists of separate components: the smallest elements in which a service can be meaningfully decomposed (de Blok *et al.*, 2014). The components and modules can be flexibly configured into unique modular packages without losing functionality (Baldwin and Clark, 1997). The compatibility of the modular package is enabled by means of interfaces, since they manage interaction and communication within the modular package (Voss and Hsuan, 2009). In previous years, studies have concentrated on product interfaces while the literature concerning interfaces in service modularity remains scarce (Peters *et al.*, 2018). Two complementary interface dimensions are distinguished: interfaces at the content dimension and interfaces at the people dimension (Voss and Hsuan, 2009). The people dimension distinguishes interfaces in services from interfaces in products. The interface typology in modular services by de Blok *et al.* (2014) elaborates on the suggested dimensions of Voss and Hsuan (2009).

The typology of de Blok *et al.* (2014) is based on two dimensions: interface entity and interface aim. The interface entity refers to the decomposition level – content (components/modules) or people (service providers) – while the interface aim can be either providing variety or coherence (de Blok *et al.*, 2014). By combining the two dimensions – interface aim and interface entity – a typology of four interface categories is created. Variety on the component level creates open-customer interfaces and allows for reconfiguration of service packages and strives for individual adaptation. Coherence on the component level is related to closed-customer interfaces aiming at the customer's safe and smooth flow within service processes. Open-information interfaces enhance the variety of service providers and aim to guide the dissemination of information among them. Finally, closed-information interfaces ensure coherence between service providers by means of standardized arrangements and reduce the amount of information to be exchanged (de Blok *et al.*, 2014). The four interface categories enhance the flow of information and customers in modular service provision; they enable interaction and communication between the components and providers involved.

The current literature on interfaces in service modularity does not acknowledge that most services cannot be provided by the same service provider (Peters *et al.*, 2018; de Pourcq *et al.*, 2020) despite the acknowledgement of the emergence of multi-provider contexts (Brax *et al.*, 2017). Service providers can create modular packages where all service components are delivered by the same service provider (single-provider context). However, most services are provided by two or more service providing entities (Tax *et al.*, 2013; Brax *et al.*, 2017) who produce service components for the delivery of a modular package (multi-provider context). When two or more service providing entities (e.g. hospital and paramedical practice) are involved, rapid and effective coordination and communication become even more important (Brax *et al.*, 2017). Delivering uncoordinated services could lead to inefficient service provision and unnecessary duplications, in terms of gaps or overlap in service delivery. Conceptually, interfaces have the potential to manage and guide interactions among service providing entities in a multi-provider context. However, the role of interfaces in multi-provider contexts has been overlooked in the present service modularity literature (Peters *et al.*, 2018). Previous research provides clues for the potential of interfaces in these contexts, but also points out that certain characteristics of multi-provider contexts can constrain the potential of interfaces (Broekhuis *et al.*, 2017; Silander *et al.*, 2017; de Pourcq *et al.*, 2020). Research demonstrates that standardization is a prerequisite for modular services (Silander *et al.*, 2017), but the number and the heterogeneous nature of different service providers in multi-provider contexts could constrain the standardization of interfaces (Broekhuis *et al.*, 2017; Silander *et al.*, 2017).

2.1 Integrated patient care

Healthcare is considered a multi-provider context since it consists of multiple providers, possibly stemming from different organizations with professionals representing different specialties and disciplines (Vähätalo and Kallio, 2015; Meijboom *et al.*, 2011). As a result of the involvement of multiple providers, health services have been accused of being fragmented (Stange, 2009). Fragmentation causes ineffectiveness, resulting in low customer satisfaction and low outcome quality. The integration of services is often put forward as the opposite of service fragmentation and is said to have multiple benefits, for example, greater efficiency (Kodner, 2009). In health services, integration is described by means of the concept of integrated care. Essential elements of integrated care are coordination and cooperation between providers participating in care provision and the aim of integration is to provide customers an experience of continuous, comprehensive and flexible services (Kodner and Kyriacou, 2000; Somme *et al.*, 2014). Leadership and managerial-related issues, such as multidisciplinary teamwork and staffing professionals, have been widely recognized as crucial in organizing integrated health services (González-Ortiz *et al.*, 2018). However, it is not only important to have services organized fluidly; it is essential to put the patient at the centre of care provision (Berwick 2009; Singer *et al.*, 2011; Minvielle, 2018). For this reason, we address the fact that health services are typically delivered by multiple professionals and organizations, and we follow Singer *et al.* (2011) in suggesting that integrated patient care should be "*coordinated across professionals, facilities, and support systems; continuous over time and between visits; tailored to the patients' (and family members') needs and preferences; and based on shared responsibility between patient and caregivers for optimizing health.*" p. (113).

Singer *et al.* (2011) emphasize the aspects of coordination and patient-centredness and acknowledge that it is challenging to achieve both in delivering integrated patient care. Even more so in multi-provider contexts where different organizations, providers and disciplines are involved (Sun *et al.*, 2014). Challenges in these contexts are related to, for example, regulations, lack of collective interests, communication, technical standards, different professions being involved and issues of confidentiality (Auschra, 2018).

2.2 Theory synthesis: modular interfaces in integrated patient care
We elaborate on the concepts of interfaces in service modularity and integrated patient care. In doing so, we address how interfaces can support the delivery of integrated patient care in multi-provider contexts.

2.2.1 Coordination of care. Singer *et al.* (2011) argue that coordination refers to the interaction across professionals, facilities and support systems within and across organizations. The aim of coordination is to deliver consistent and informed patient care. Singer *et al.* (2011) argue that the coordination of care often seeks to achieve automation, efficiency and simplicity. This form of coordination is closely related to the concept of coherence (de Blok *et al.*, 2014; Broekhuis *et al.*, 2017). We argue that closed-information interfaces and closed-customer interfaces can improve coordination across professionals, facilities and support systems by standardizing the flow of information between components and service providers (Silander *et al.*, 2017; de Regge *et al.*, 2019), which is also an essential aim of integrated patient care (Somme *et al.*, 2014). As a result, these interfaces support coherence and unity both among people and among components within modular packages (de Blok *et al.*, 2014). Both interface types diminish the amount of information exchange required, since the interactions between professionals or components can be prescribed via these types of interfaces (de Blok *et al.*, 2014; Silander *et al.*, 2017). This is especially important in multi-provider contexts (Brax *et al.*, 2017) because there is a higher probability for uncoordinated care when care is delivered by two or more organizations (Meijboom *et al.*, 2011). Based on the ability of both interface types to provide predictability and coherence, we argue that they can improve coordination across professionals, facilities and support systems.

2.2.2 Continuous proactivity and familiarity. Care that is continuous over time is linked to the extent to which service providers are continuously familiar with the patient's current needs (continuous proactivity) as well as their medical history (continuous familiarity) (Singer *et al.*, 2011). Continuous familiarity includes, but is not limited to, each provider's familiarity with the care they and others have provided to the patient. When providers update care plans, they should account for factors contributing to previous hospitalizations and the treatments at discharge. However, this requires standardized interfaces between information systems as well as established documentation protocol (Silander *et al.*, 2017; de Regge *et al.*, 2019). Moreover, familiarity also assesses the extent to which patients receive outreach, including phone calls and home visits, to ensure appropriate follow-up (Berwick, 2009). Closed-information interfaces are related to continuous familiarity as these interfaces ensure that all professionals have access to the information they need to provide coherent services; interfaces guide and stimulate information exchange about the patients' situation (Fransen *et al.*, 2019). Continuous proactivity enables responsiveness of service providers to incoming requests from patients, and this helps to identify gaps in care. Internal arrangements that allow for predictable interactions in the modular package could support this responsiveness (Fransen *et al.*, 2019). When such arrangements are in place, providers could act proactive based on standardized actions (Silander *et al.*, 2017). The closed-customer interfaces could account for this by ensuring a safe and smooth patient flow.

2.2.3 Tailored to the patients' needs and preferences. Tailoring care to the patient's needs and preferences can be supported by fluent information exchange between the service provider and the patient, as well as between providers (Silander *et al.*, 2017; Fransen *et al.*, 2019). Mixing and matching standardized components with the help of interfaces are a way of responding to customer's individual needs and preferences (Pekkarinen and Ulkuniemi, 2008; de Blok *et al.*, 2010). Moreover, it is important to develop or build a good relationship between the service provider and the patient (Gulliford *et al.*, 2006) to get a better understanding of the needs and preferences of patients. Open-information interfaces can support this process, since they allow for the recognition of (changes in) patients' needs and preferences and make adaptations possible (de Blok *et al.*, 2014; Soffers *et al.*, 2014).

2.2.4 Shared responsibility between patient and provider. Patients and providers may indicate some changes during care delivery. The extent to which patients are informed and engaged by providers in making care-related decisions determines whether the desired changes can be truly addressed (Berwick, 2009; Singer *et al.*, 2011). When the desired changes have been indicated, open-customer interfaces can support realizing these changes. These interfaces provide a structure that enables the (re)combination of components (de Blok *et al.*, 2014); it enables adaptation of the modular package to the patient's desired changes based on an aligning rather than a rigid structure (Soffers *et al.*, 2014). Such interfaces ensure that providers can better present the available components to patients and could allow patients to make better informed decisions (Fransen *et al.*, 2019). As a result, patients and providers are better informed and share responsibility about making changes.

To conclude, we posit that interfaces can support the delivery of integrated patient care in multi-provider contexts, and we use our empirical data to support our reasoning. Table 1 provides an overview of the concepts from the modularity and integrated patient care literature and is used as starting point for the analysis of our empirical data. Our two empirical cases are not used for comparative purposes, but instead they both provide illustrative examples of how interfaces can support the delivery of integrated patient care in multi-provider contexts.

3. Methodology

We used a qualitative multiple case study design to describe modular interfaces in the delivery of integrated patient care in multi-provider contexts. Case study research design was chosen since this method is the most appropriate when, amongst other things, contextual conditions are believed to be very pertinent to the phenomenon being studied (Yin, 2003). We identified two general theories, service modularity and integrated patient care, which we used to approach our empirical contexts. This methodological approach to case research is defined as theory elaboration (Ketokivi and Choi, 2014). We elaborate on these theories by conducting an investigation of the relationships – interfaces in service modularity and dimensions of integrated patient care – among the concepts.

3.1 Study context

For the purpose of this study, we used theoretical sampling and chose two different cases which both are extreme examples of multi-provider contexts (Eisenhardt, 1989; Gummesson, 2000). Both cases represent a context where a number of services are offered by providers

Interface type	Dimension of integrated patient care
Open-information interface	(1) Tailored to patients' needs and preferences
Closed-information interface	(1) Coordination across professionals (representing different organizations, disciplines and specialities)
	(2) Continuous familiarity (about patients' medical history, including family situation)
Open-customer interface	(1) Shared responsibility between patient and professionals (representing different organizations, disciplines and specialities)
Closed-customer interface	(1) Coordination across facilities (representing information systems, enterprise resource planning, administrative practice) and support systems (representing voluntary workers, family members, community resources)
	(2) Continuous proactivity

Table 1.
Interface types supporting the delivery of integrated patient care

representing multiple disciplines and organizations. In both cases, the providers' aim is to respond to heterogeneous and constantly changing needs of customers. Multi-provider characteristics of both cases are described in more detail further and in Table 2. Consequently, the multi-provider characteristic is particularly transparently observable in both cases (Eisenhardt, 1989). To evaluate the trustworthiness of the results, we deliberately chose the healthcare provision for children with DS in the Netherlands and HCE in Finland. Collecting two data sets from different patient groups and from different countries supported the transferability of the results and consequently, increased the trustworthiness of the study

Case: Down syndrome		Case: Home care for the elderly	
Interviewee	Organization	Interviewee	Organization
Audiology assistant	Paramedical practice	Assistant nurse	Public home care unit
Contact parent	National patient organization	CEO and 1 assistant	National rheumatism association
Ear, nose and throat doctor	Hospital	CEO and 2 assistant nurses	Company offering cleaning services for elderly
Dietician	Hospital	CEO and 2 assistant nurses	Support for Elderly Association
Doctor for the mentally handicapped	Healthcare organization for people with an intellectual disability	CEO and 2 counsellors	The Alzheimer society Finland
Ophthalmologist	Hospital	CEO and 2 social workers	Carers Finland association
Orthoptist	Hospital	Deacon	Local church
Parent of child with Down syndrome	–	Founder of the voluntary work unit	Public voluntary work
Parent of child with Down syndrome	–	Geriatrician	Public hospital
Parent of child with Down syndrome	–	Head of voluntary work unit	Public voluntary work
Parent of child with Down syndrome	–	Pharmacologist	Pharmacy
Paediatrician	Hospital	Preventive care nurse	National heart association
Physiotherapist	Hospital	Preventive care nurse	Company offering home nursing services
Speech therapist	Paramedical practice	Registered nurse	Company offering home nursing services
Secretary	Hospital	Registered nurse	Public preventive care unit
		Registered nurse	Company offering cleaning and home help services
		Registered nurse	Public home care unit
		Service coordinator	Public home care unit
		Service coordinator	Public home care office
		Social worker	Public social office
		Supervisor	Public home care office
		Top manager	Public home care office
		Voluntary work coordinator	Red cross
		Voluntary work organizer	Public preventive care unit

Table 2.
Participants
interviewed

(Eriksson and Kovalainen, 2008). The uniqueness of each case is presented in more detail in the following paragraphs to show how each case serves as an extreme example of a multi-provider context (Eisenhardt, 1989).

DS is a complex congenital condition. Individuals with DS share a typical appearance, intellectual disability and delayed motor development (Weijerman and de Winter, 2010). However, each individual with DS is affected differently. In the Netherlands, paediatric outpatient clinics organize multidisciplinary team appointments. These so-called Downteams include a visit to various healthcare professionals, all on the same day (Fransen *et al.*, 2019). The different "professionals" of the multidisciplinary team provide subsequent consultations for the children with DS, so that they can visit multiple professionals on a single day. These specialists represent different specialties (e.g. ophthalmology, pediatrics) and different types of organizations (e.g. hospital, paramedical practice).

HCE consists of services aiming to support living at home as long as possible. Many of the elderly have multiple health problems as well as age-related frailty. However, each combination and severity of problems are unique and require customization of service packages. Although rehabilitation is undertaken, the need for assistance is likely to increase over the years. The services supporting elderly people who live at home are numerous and are delivered by multiple providers, representing not only different types of organizations (public, private and NGO) but also represent various types of services (e.g. pharmacy, housing, psychological support). In addition, the customer's family and relatives are typically involved in care provision.

Given the aforementioned case descriptions, greater service needs combined with functional difficulties make children with DS and HCE ideal populations for studying integrated care. It is also said that people with chronic illnesses and disabilities are the ones who benefit most from integrated care (Kodner and Kyriacou, 2000; Sun *et al.*, 2014).

3.2 Data collection

We collected our main data by interviewing providers who conduct and manage care for children with DS and HCE. We used documentation as secondary data in both cases. It was obtained by collecting relevant internal and external documents and consisted of printed and electronic documents such as care plan sheets and forms used, process descriptions and service descriptions. These documents were used to complement the interviews and provided a better understanding of existing practices. The triangulation of primary and secondary data strengthened the reliability of the study as it offered possibilities to cross-check information (Eriksson and Kovalainen, 2008) and provided stronger substantiation of the propositions presented based on the results (Eisenhardt, 1989).

In the DS case, data was collected from one Downteam in the Netherlands. This Downteam was chosen based on its availability and the fact that this team is well known in the field. We conducted a total of 15 interviews by means of purposive sampling of the interviewees. We conducted interviews with all healthcare professionals involved in the Downteam and with the carers of children with DS who visit the Downteam. We reached data saturation, meaning that marginal utility after additional interviewees became low (Gummesson, 2000), after 14 interviews, but decided to include one more interview for confirmation sake.

In the HCE case, data was collected from one municipality in Finland. In this municipality, HCE is mainly delivered by public providers and supplemented by private and NGO providers. As this is the most common way of organizing care for the elderly in Finland, this municipality was considered suitable for the purposes of the study. In addition, one of the researchers had access to it. Interviewees represented providers from different disciplines and different organizations. First, four interviewees were suggested by the top manager in service provision for the elderly. From that point, in order to ensure the representativeness of

the sample, interviews continued on the basis of the snowball technique to involve other public providers, NGOs and private providers. HCE case interviews were conducted mainly with one interviewee at a time, although some interviews involved two or three colleagues from the same organization. Data saturation was reached after 24 interviews. The interviewees of both cases are represented in Table 2.

In both cases, we applied a semi-structured interview approach which enabled us to address topics that had to be covered while leaving room for interviewees to tell their own story. The topic list for the interviews was compiled as a result of our literature review on interfaces in service modularity and integrated patient care. Interviewees were asked first about the content that made up the services (e.g. "Could you tell us about your role and the service you provide in your team?") and how these services were coordinated ("e.g. Which important handovers take place within your team and beyond?"). Questions related to continuous familiarity explored how well providers knew patients' history (e.g. "Is the information that is shared between providers available, sufficient, up-to-date, and accurate?"), whereas questions related to continuous proactivity concentrated on follow-up of care (e.g. "How are the appointments/examinations for patients planned?"). The tailoring of services was investigated with questions related to the customization of services (e.g. "Which parts of the service are standardized and which are customized?"). The questions related to shared responsibility focus on the patient's role in care provision (e.g. "How do patients participate in care planning?"). Interviews were audio-recorded and transcribed verbatim.

To meet ethical concerns related to data collection, ethical approval for the Dutch case was obtained from the Ethics Review Board of Tilburg University [EC-2017.60t]. In the Finnish case, ethical approval was obtained from the head of the public health services. Written and oral informed consent was obtained from all respondents prior to participation.

3.3 Data analysis
Data analysis was conducted using abductive reasoning, which starts with reference to the general theories (service modularity and integrated patient care) while leaving room to discover new ideas and information that emerge from the data (Ketokivi and Choi, 2014). The data analysis of the two cases was conducted using the three-step method as described by Miles and Huberman (1994): (1) data reduction; (2) data display; and (3) drawing conclusions. This is a systematic data reduction process built on the reading of transcripts, document summaries and theoretical memos, segmentation of sentences and phrases, codification of text segments, generation of themes and categories and identification of relationships (Miles and Huberman, 1994). In the HCE case, NVivo12 software was used for codification of the text segments while the software was not used for further analysis. The data in the DS case was coded manually. To increase the transparency of our data analysis, examples of this process are presented in Table 3 for RQ1 and RQ2. To illustrate: we used the interface description by Voss and Hsuan (2009) for identifying possible interfaces: "*Interfaces are the linkages between subsystems that allow interaction and communication between those subsystems.*" (p. 186). When we identified all the individual interfaces, we collated them as a generic interface and allocated the specific interface type, based on de Blok *et al.* (2014) to the generic interface. In Table 3, the first column presents an authentic quote, the second column presents the individual interface/observed challenge and the third column presents the generic interface/ challenge. By showing the logical link between our observations and categories in Table 3, we aim to increase the credibility of the results (Eriksson and Kovalainen, 2008). For confirmability purposes, the links between findings and interpretations are presented with authentic quotes in the empirical results section (Eriksson and Kovalainen, 2008).

Author 1 coded all the transcribed interview data from the Finnish case, Authors 2 and 4 coded all the data from the Dutch case. The coding for both data sets was guided by our

Interfaces in multi-provider context		
Quote	Interface	Interface collated
"I go there alone and suggest that the customer invites their relatives to join, and often they will. I interview the customer and carry out some tests, then I discuss, first with the relative and then all together, what services would be best for the customer." (Care coordinator)	Initial care plan meeting at home	Multidisciplinary meeting
"We go to a new customer and knowing that they have not yet been provided with any services, we immediately start to put the service puzzle together, not only concentrating on loneliness." (NGO worker)		
"I make the care plan which I type up on the computer and send to the home care team . . . then within the month, when the nurses to be responsible for this particular customer have been chosen, they go through the care plan and evaluate whether it is still valid and if something has changed or needs to be added." (Care coordinator)	Care plan evaluation meetings	
"If there is a care meeting at the ward, there is a doctor, nurses from the ward, relatives and me. If it is necessary, we discuss [about services] when discharging from the ward to home." (Care coordinator)	Meetings at ward	
"After the child has visited all the members of the Downteam, we come together and discuss the outcomes of the separate visits. In doing so, we combine all our knowledge and make sure nothing has been forgotten." (Physiotherapist)		
"I participate every six months, or sometimes more often, in their team meetings and we discuss home care customers and whether they [the team] need my help in deciding how to cope with the customer." (Care coordinator)	Home care team meeting	
"We have a meeting in which all the care coordinators participate and we discuss our practices or have some training, for example about the criteria for moving a customer to housing services." (Care coordinator)	Team evaluation meeting	
"Every six months I sit together with my team and I look at what is going well and what can be improved. We evaluate ourselves" (Paediatrician)		

Challenges relates to the delivery of integrated patient care		
Quote	Observed inter/intra-organizational challenge	Observed inter/intra-organizational challenge collated
"When customers talk about the services they need, they do not talk about our home care or social services but services for day-to-day living, such as a hairdresser, shopping, transportation. We professionals do not know about these services" (Social worker)	Missing overview of care content	Lack of transparency
"We could always use more information, there is never enough" (Public home care worker)		
"You are not aware of the kind of activities that other disciplines perform" (ENT-doctor)		
"I once did not want to visit the physiotherapist because my son does not have any issues related to this discipline. However, this was not possible and we found it inconvenient" (Carer)		

Table 3.
Coding examples with exemplary quotes for the data analysis for RQ1 and RQ2

preliminary coding framework. This framework was discussed continuously and tested during the coding of the interviews. During the analytical phase, Authors 1, 2 and 3 discussed and assessed regularly the outcomes of the analysis. For example, sometimes it was unclear whether a piece of text was part of the "between components in care package" code or "between service providers in care package" code. These issues were resolved through discussion until agreement was achieved among the researchers. The fact that multiple authors participated during the analysis had two advantages. First, multi-author team has complementary insights which provides opportunity to catch the novelty and richness of the data. Second, convergence of the observations supports the credibility of the findings while simultaneously conflicting perceptions between team members prevented a premature closing of the analysis (Eisenhardt, 1989). We created data displays (see Results section; Tables 4 and 5) that helped to identify patterns in the data. Credibility of the results was supported by the observation that only minor differences in interfaces occurred between two contexts (Eriksson and Kovalainen, 2008).

4. Empirical results
In both the DS case and the HCE case, service providers typically offer their patients a modular care package that consists of care and related services, including components and modules that concern medical needs (e.g. taking medication, wound care), social care (e.g. financing, housing) and psychological concerns (e.g. loneliness, depression), among others. Since each patient differs in their care needs and preferences, each modular care package is unique. The needs and requirements of patients are likely to alter as a result of the chronic condition of the patients. As such, the modular care package needs to be consistent with each individual's needs and requirements, and it requires to be coordinated over time. Interfaces should be in place that guide interaction and communication in healthcare provision and make sure that the modular care package is coordinated and meets the needs and requirements of patients.

4.1 Interfaces in multi-provider contexts
We recognized various examples of interfaces and we classified them in Table 4. To illustrate the interfaces found in both cases, we provide examples of each cell in the following sections. In this section, we do not distinguish between inter- and intra-organizational interfaces. This is in line with RQ1, because we elaborate on how interfaces can be described in multi-provider contexts according to the typology of de Blok et al. (2014). In Section 4.2, we take the inter- and intra-organizational perspective into account as we describe the interfaces supporting the delivery of integrated patient care.

4.1.1 Open-customer interface. The national guidelines set by the Dutch Paediatric Association and for elderly care by The Finnish Ministry of Social Affairs and Health serve as examples of open-customer interfaces. The different sections of the guidelines can be used to adapt care in collaboration with customers according to their individual needs and wishes. In other words, the modular package for each patient can be adjusted, so that the different needs of individual patients can be accounted for. In HCE, a vast number of services are available from different providers and organizations for different purposes. In order to respond to heterogeneous needs and let the customer arrange their own care, home care workers stated that they *". . . always carry leaflets about all service providers and their numbers. We* [home care workers] *leave it* [the leaflet] *for them* [the customer] *and with the help of their close relatives they start to call"*. Interviewees highlighted that they provided information about services, social benefits, health promotion and so on, and customers made the relevant decisions, often together with their relatives. The open-customer interfaces highlight the importance of

	Aim	Between components		Between service providers	
		O-C interfaces		*O-I interfaces*	
	Variety	DS case	HCE case	DS case	HCE case
		(1) Guideline	(1) Law and national recommendations	(1) Electronic health record	(1) Electronic health record
		(2) Protocol	(2) List of associations and their services	(2) Multidisciplinary team meeting	(2) Care plan
		(3) Screening form	(3) List of private providers and their services	(3) Transition letter	(3) Multidisciplinary meeting
			(4) List of public providers and their services		(4) Telephone consultation
		C-C interfaces		*C-I interfaces*	
	Coherence	DS case	HCE case	DS case	HCE case
		(1) Planning rules	(1) Check-up call	(1) Electronic health record	(1) Background and other information form
		(2) Planning scheme	(2) Check list	(2) Division of labour	(2) Care plan
		(3) Checklist	(3) Enterprise resource planning	(3) Multidisciplinary team meeting	(3) Informal progress book
			(4) Telephone consultation	(4) Work schedule	(4) Electronic health record
			(5) Process description		(5) Enterprise resource planning
			(6) Work description		(6) Work description

Interacting entities

Table 4.
Interfaces identified in each case

service transparency in supporting the possibility of providers and customers creating appropriate service packages.

4.1.2 Open-information interfaces. The multidisciplinary team meeting serves as an example of an open-information interface. It allows providers to discuss the outcomes of their individual consultations and further tailor the care according to the customer's individual needs. The information gathered by all the disciplines and providers involved is discussed and leads to a joint outcome. Within HCE, multidisciplinary team meetings are organized mostly by the public providers while NGOs and private providers are not always invited. However, they are consulted by phone. The identified open-information interfaces illustrate the importance of obtaining and transferring information across the organizations and providers involved, while tailoring the services and changing components within the service packages.

4.1.3 Closed-customer interfaces. The planning scheme and the consultation scheme are examples of closed-customer interfaces. These schemes are structured in such a way that a continuous flow of patients is created by matching the agreements of the various providers involved: "*For the eye drops to kick in, it takes about three-quarters of an hour. In the meanwhile, another professional could provide his consultation, making sure that the patient does not have to wait.*" (Ophthalmologist). This ensures that the flow of patients is smooth through the system. The enterprise resource planning (ERP) system represents a planning scheme in which the public provider creates the date and time for each service. The aim is to distribute all services delivered by different providers evenly in each day, as a care coordinator described: "*Meal service is one visit more to check that everything is all right. Our meal drivers are so caring that if customer does not open the door, or if they detect something unusual, they call and ask if we can go and check the situation.*" Evenly allocated services also serve the purpose of alleviating the loneliness of elderly, as illustrated by a church deacon in the following extract: "*We* [NGOs and public providers] *try to organize so that we do not all go at the same time but providers should be allocated evenly, particularly for lonely customers*". The ERP planning scheme is available only for public-service home care workers but, for each customer, an individual care plan is agreed upon in a multidisciplinary meeting or providers are informed in other ways, for example, by phone. The closed-customer interfaces described earlier illustrate the way in which service components are coordinated across care teams representing different disciplines and different organizations, as well as across support systems such as community recourses (e.g. voluntary workers).

4.1.4 Closed-information interface. The work schedule and division of labour are examples of closed-information interfaces. They serve as internal arrangements that allow for predictable interactions between providers, based on a clear specification of tasks and responsibilities. Additionally, the electronic health record (EHR) reduces the amount of information that needs to be transferred between the providers, making sure that a coherent service is offered. In HCE, customers have an individual care plan on the basis of which the care is implemented. This individual care plan is a combination of EHR and ERP, and it allows providers to check the care plan at any time. The care plan is structured and well established and serves particularly well for coordination purposes among public home care teams and also among other public providers (social worker, hospital etc.), while less so among private and NGO providers. The EHR ensures that all public providers can be aware of a patient's medical and service history. Since not all providers, such as NGOs, have access to EHR, an informal progress book at the home of the elderly person serves the same purpose and works as a closed-information interface, as the following quote illustrates: "*Often there is a notebook at a customer's home. Voluntary workers write what they have done with the customer and whether the customer is having a good day. Some relatives are really active and write in detail, and they ask that home care workers record some particular observations.*" (Care coordinator). The identified closed-information interfaces show how providers coordinate care across different professionals and support each other's familiarity with a customer's situation.

4.2 Interfaces supporting the delivery of integrated patient care

The respondents in our study mentioned a number of inter- and intra-organizational situations in which the delivery of integrated patient care was jeopardized. We elaborate on examples of inter- and intra-organizational challenges, as well as the way in which these challenges are related to the dimensions of integrated patient care. The corresponding challenges are presented in square brackets, both in text and in Table 5. We also provide

Observed challenge in integration of services	Dimension of integrated patient care	Type of interface		Interface orientation		Interface supporting integration of services	
[Lack of protocols] Lack of protocols for interaction between service providers	Coordination across facilities and support systems	(1)	C-C interface	(1)	Intra-organizational	(1)	Planning rules
		(2)	C-C interface	(2)	Intra-organizational	(2)	Planning scheme
[Overlap in services] Not enough knowledge about other service providers causing overlapping	Coordination across facilities and support systems	(1)	C-C interface	(1)	Inter-organizational	(1)	Work description
		(2)	C-C interface	(2)	Inter-organizational	(2)	Service description
[Lack of information transfer] Lack of tools for information transfer	Coordination across professionals	(1)	C-I interface	(1)	Inter- and intra-organizational	(1)	National IT protocol
		(2)	C-I interface	(2)	Inter-organizational	(2)	Open software
[Lack of proactive actions] Service providers do not actively check with customers whether services are still up to date	Continuous proactivity	(1)	C-C interface	(1)	Inter-organizational	(1)	Check-up call
		(2)	C-C interface	(2)	Inter-organizational	(2)	Needs assessment
[Lack of awareness] Service providers are not aware of the medical history of a customer	Continuous familiarity	(1)	O-I interface	(1)	Inter-organizational	(1)	Multidisciplinary meeting
[Lack of shared professional language] The information exchanged is documented in a language that is not understood by other service providers involved	Continuous familiarity	(1)	O-I interface	(1)	Inter-organizational	(1)	Standard documentation format
[Lack of common goal] Lack of common goals for care across the providers	Tailored to the patient's needs and preferences	(1)	O-I interface	(1)	Inter-organizational	(1)	Shared care plan
		(2)	O-I interface	(2)	Inter-organizational	(2)	Multidisciplinary meeting
[Lack of transparency] Overview of care content is missing	Shared responsibility	(1)	O-C interface	(1)	Inter- and intra-organizational	(1)	Overview of available components and modules

Table 5.
Observed challenges in the delivery of integrated patient care

improvements, that is, examples of how interfaces can alleviate these challenges (Table 5), which were suggested by the respondents.

4.2.1 Challenges related to coordination across facilities and support systems. In both cases, it appeared that interactions between providers take place on the basis of their professional work experiences, but not substantively on the basis of protocols or guidelines [Lack of protocols]. As a result, providers have expectations about certain service processes or service content but find out that they have been changed according to providers' professional experience. Sometimes also the lack of protocols and guidelines leads to unstandardized behaviour, as the following quotation from HCE illustrates: *Client, relatives and home care workers cancel the visits of voluntary workers [if customer is sent to hospital] but these check-up call volunteers are sometimes forgotten.* (Public worker coordinating voluntary work)

It is also the case that proceeding on the basis of experience and not protocols has led to overlapping services [Overlap in services]. This challenge becomes even more severe if the same facilities, such as information systems, are not communicating. For example, if the content of the work was not described properly or could not be seen by everybody, different providers would end up doing the same thing, as illustrated by the following quote: *"It is possible that a deacon from the church, a voluntary helper from the Red Cross, and a private physiotherapist are all visiting the customer and doing same thing without knowing it."* (Top manager HCE). We also observed this in the DS case, when overlap occurred when two providers were measuring the weight and height of a patient. This certainly does not enhance efficiency. One way of addressing this challenge is to introduce several closed-customer interfaces: planning rules, planning schemes, work descriptions and service descriptions. This ensures that providers are well informed about what every provider is doing, when they are doing it and why they are doing it.

4.2.2 Challenges related to coordination across professionals. We observed that coordination between providers was often lacking due to information being missing. Currently, information about the patient is not readily accessible, since, for example, the EHR of the general practitioner is not accessible to the paediatrician [Lack of information transfer]. Interfaces such as e-mail or formal letters can be used to overcome this lack of information transfer. Information transfer was also restricted when several different EHR systems are applied by different providers and the relevant information about the customer is not available for all providers. Challenges related to information flow had led to various problems such as poor continuity of care. Although it is extremely important to guarantee the security of medical and social records, changes made in relation to the legislation governing information transfer practices could enhance information flow. Challenges related to coordination between providers from different organizations can be alleviated by closed-information interfaces, such as national IT protocols and open software, since that would allow providers access to information systems.

4.2.3 Challenges related to continuous proactivity. Although in the HCE case continuous proactivity was achieved by check-up calls, this was not so clear in the DS case [Lack of proactive actions]. Customers argued that they would appreciate it if providers would check with them, before the consultation, whether they had specific needs or requirements. Also, a lack of proactivity was observed and attributed to there being little interaction between the providers from secondary care (e.g. pediatrician) and providers from primary care (e.g. general practitioner). This could lead to situations where the needs and requirements of the patient are unknown prior to the consultation. Both healthcare professionals and carers expressed this: *"There is actually no contact between our speech therapist in primary care and the speech therapist of the Downteam. When we visit the Downteam, we have to explain what our own speech therapist is working on"* (Carer) and *"I often only hear during the consultation whether the child has had speech therapy and if there is any possible information available from this speech therapist"* (Speech therapist). A check-up call and needs assessment, which we

define as closed-information interfaces, would help providers to be better prepared for care provision and ensures that the needs and preferences of patients are retrieved.

4.2.4 Challenges related to continuous familiarity. Furthermore, it became apparent that the providers are not always aware of the (medical) history of the patient [Lack of awareness]: *"I know the last time I visited the ENT-doctor, I thought that he was not quite familiar with what he had done before. Because [patient's name] had tubes and he asked how long he had been using them"* (Carer). Although open-information interfaces can ensure improvements in this respect, for instance, a multidisciplinary meeting prior to the consultations, better preparation by the specialists themselves is also required. Moreover, in relation to the information documented and exchanged across providers, it is important that the information exchanged is documented in a language that is also standardized and can therefore be understood by other relevant providers [Lack of shared professional language]: *"If the ophthalmologist writes about plus and minus, I do not know exactly what the consequences for the visual acuity or depth perception are."* (Physiotherapist). A similar problem occurred in HCE. As pointed out in the following comment, home care workers did not always keep records in the manner recommended by the standardized Finnish Care Classification: *"Home care workers could write summaries every now and then, there are too many entries which are not clear."* (Geriatrician). The expectation is that the development of two interfaces, multidisciplinary team meetings and standard documentation formats, will lead to providers being better acquainted with the medical history and needs of patients.

4.2.5 Challenges related to tailoring services according to patients' preferences. Service packages in HCE were not always tailored by involving all of the providers delivering the care. The result is a lack of common goals for care delivery when it comes to the customer's care package. [Lack of common goal]. Typically, public providers were the ones to organize care meetings, for example, when customers were discharged from the hospital. However, it was mainly public sector providers who participated in these meetings and NGOs or private providers were not always invited. This was usually justified by citing the confidentiality of information, but often invitations were just forgotten. Confidentiality problems are illustrated as follows: *"Discharging is complicated because of privacy protection issues. We can invite public home care workers but can we invite a private provider? And what we can tell them about the patient? Tricky questions."* (Hospital's social worker). Due to this, information that would have been useful for tailoring services was not received from all providers. This gap was partially compensated for with phone calls, but it was often the case that poor collaboration resulted in several care plans being created by each provider, with a single shared care plan not produced. The same challenge was observed in DS where providers only had multidisciplinary meetings after the patient had left the hospital. In these meetings, they often said that they wished they had been in possession of certain information beforehand. To illustrate: *". . .During the consultation I heard that the child had issues at school. If I had known that beforehand, I could have tailored my consultation towards this issue. . ."* (Contact parent). This information could have been shared if a multidisciplinary meeting had taken place before the patient arrived at the hospital. If this had been the case, all providers could have been quickly briefed about prevailing issues and they could have adapted their consultations accordingly. Challenges related to tailoring services to patients' preferences could be alleviated by introducing multidisciplinary meetings and common care plans, which serve as examples of open-information interfaces.

4.2.6 Challenges related to shared responsibility. It was unclear to both providers and customers exactly what services they could choose from because there was no overview of the services available. This demonstrated a lack of transparency in terms of service or work descriptions and information folders: *". . .you are not fully aware of the kind of activities that other disciplines perform. . ."* (ENT doctor). If the healthcare elements are not clear for the

providers involved, that is, if the transparency of service offerings is poor, it leads to a situation where providers have insufficient knowledge about services available [Lack of transparency] and it becomes impossible to make health-related decisions together with the customers. Home care workers stated that they "*could use more information, it is not enough*" (Public home care worker). Transparency was particularly poor over so-called supportive services such as lawn mowing and relief of loneliness: "*When customers talk about services they need, they do not talk about our home care or social services but services for day-to-day living, such as hairdresser, shopping, transportation. We professionals do not know about these services*" (Social worker). Also, it is not always clear to patients and relatives why they need to visit certain providers. One relative stated: "*I once called the secretary to make adjustments to the schedule. They said that this was not possible, because this schedule is mandatory. I felt frustrated, because I should be the one to decide what my child needs.*" (Carer). Shared responsibility is not promoted, and it should therefore be clear for patients why such requests are denied. The introduction of an open-customer interface, namely an overview of the available components and modules of the providers involved, would promote service transparency. If this were to be done, this interface could support patients and providers make care-related decisions together.

5. Discussion
This study had a two-fold agenda. First, the study described interfaces in multi-provider contexts. Second, we analysed how interfaces can support the delivery of integrated patient care in multi-provider contexts. Based on these insights, we offer directions for future research in the form of tentative propositions.

5.1 The role of interfaces in multi-provider contexts
We have described interfaces in two multi-provider contexts in health services. Most of the interfaces identified in this study were in line with those identified by de Blok *et al.* (2014), such as planning rules (closed-customer interface) and work division (closed-information interface). Something that was not mentioned by de Blok *et al.* (2014), but which is observed in our study, is that interfaces can simultaneously cover both types of interface entities (components and providers) and both types of interface aims (variety and coherence). In that sense, the interface categories do not rule each other out: in other words, they are not mutually exclusive. The care plan, for example, is created in multidisciplinary meetings and has the aim of creating tailored service packages for customers (open-information). However, once done, it serves the further aim of diminishing the need for information exchange between providers (closed-information). Therefore, the care plan first serves as an open-information interface by allowing for reconfiguration of care packages and individual adaptations which is considered as an essential element in service modularity (Pekkarinen and Ulkuniemi, 2008; Fransen *et al.*, 2019). Second, the care plan serves as a closed-information interface. This interface type directs the flow of information and is mentioned as typical for interfaces in service modularity (Voss and Hsuan, 2009). We also observed this phenomenon in relation to interface entities. On the one hand, the ERP contains the predefined information about the order of the service components (closed-customer). On the other, it also automatically creates the schedule for providers and reduces the need for information exchange, that is, the need to negotiate the distribution of work among the providers (closed-information). This dual role of interfaces needs to be taken into account when describing them. Based on the aforementioned, we formulate the following proposition:

P1. Interfaces can cover both interface entities and interface aims and in doing so can serve a dual role in service provision.

We propose that in multi-provider contexts, interfaces coordinate and manage interactions on three analytically distinct dimensions. The first two dimensions, interface entities (Figure 1. x-axis: components or service providers) and interface aims (Figure 1. y-axis: variety or coherence), are captured in the typology of de Blok *et al.* (2014). The third dimension, which we define as the interface orientation (Figure 1. z-axis: inter-organizational or intra-organizational), explains whether interfaces manage interactions within the same organization or across organizations. This shows that modular packages can be created either (1) when all service components are delivered by the same service provider, which requires intra-organizational interactions (single-provider context), or (2) when service components are delivered by two or more service providing entities which requires inter-organizational interactions between the service entities involved (multi-provider context). The current typology of de Blok *et al.* (2014) does not capture the interface orientation dimension. Although there is a vast amount of literature in the operations and supply chain management domain that acknowledges the importance of intra- and inter organizational relationships (e.g. Das and Teng, 1998; Vanneste and Puranam, 2010; Zhang *et al.*, 2016; Halkjær; Lueg, 2017), this is overlooked in the literature on interfaces in service modularity. By adding a third dimension, we further develop the existing typology by de Blok *et al.* (2014). In doing so, we move the discussion on interfaces in service modularity from an intra-organizational level (single-provider context) to an inter-organizational level (multi-provider context).

Figure 1 presents a classification of eight interface categories. The first four intra-organizational interface categories are unchanged. The last four interface categories (inter-organizational open-customer, inter-organizational open-information, inter-organizational closed-customer and inter-organizational closed-information) are the newly discovered interface categories in multi-provider contexts.

First, inter-organizational open-customer interfaces provide a structure that enables combination and adaptation of components and modules across organizations. They support the transparency of service provision because they describe precisely the available services that each organization can deliver (Brax *et al.*, 2017). This offers providers opportunities for specialization, which is especially important for healthcare organizations since they feel pressure to increase specialization (Halkjær and Lueg, 2017). Second, inter-organizational open-information interfaces offer a structure that brings service providers together from different organizations, and in doing so, enables information exchange across organizations.
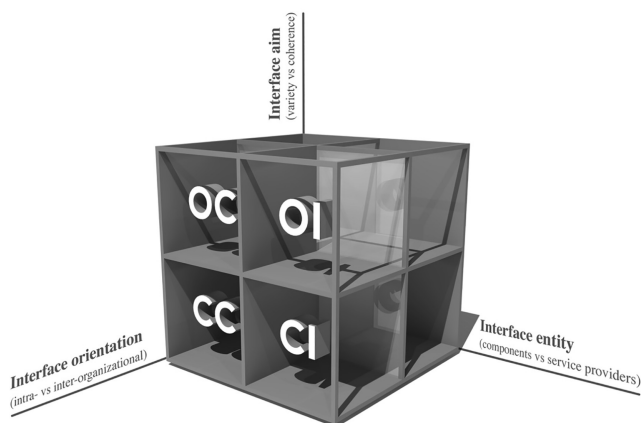

Figure 1.
A three-dimensional typology of interfaces in service modularity

These interfaces can enable gains from specialization (Halkjær and Lueg, 2017), because in multi-provider contexts the formation of inter-organizational open-information interfaces can be motivated when less efficient in-house operations are abandoned and are able to be substituted by other providers (Hoetker, 2006). For example, a hospital can decide to hire a certain specialist because they do not possess that type of in-house knowledge. In this way, service providers can be relatively easily replaced by others, allowing for efficient mixing and matching of the service offering. This kind of lateral exchange of competencies is possible in integrated supply chains (Vanneste and Puranam, 2010). Hoetker (2006) has already shown the possibilities of this in the laptop industry. Third, inter-organizational closed-customer interfaces arrange components and modules so that they can work together in a predictable way, making sure that the customer can flow between one organization and another without hindrance. These interfaces make the impact of actions taken in one organization on another as predictable as possible, so that mutual adjustment can take place in a coherent way, relying on rules, procedures and standards instead of discussion and negotiation. In doing so, they provide clear descriptions of the adequate outputs of each service provider and each organization, which can help in terms of reducing overlap in services. Last, inter-organizational closed-information interfaces diminish the amount of information exchange between service providers from different organizations by making interactions predictable. This requires standard information transfer practices which also facilitate the interoperability of services in multi-provider contexts (Zhang *et al.*, 2016). These interfaces require the electronic sharing of information between different information systems and service providers, improving the ease with which providers can offer and coordinate their services and customers can move smoothly through the system (Auschra, 2018). An example of such an interface can be a cross-organizational information system (e.g. interoperable EHR). To summarize, we developed the following proposition:

P2. While inter-organizational interfaces make inter-organizational coordination easier, they are more difficult to specify than intra-organizational interfaces.

5.2 Matching modular interfaces and integrated patient care
We empirically investigated the implications of modular interfaces for the delivery of integrated patient care in multi-provider contexts. By applying the typology on modular interfaces in healthcare by de Blok *et al.* (2014) and combining this with the dimensions of integrated patient care by Singer *et al.* (2011), we were able to show how modular interfaces support the delivery of integrated patient care. Although these theoretical perspectives, modular interfaces and integrated patient care use different concepts, they reflect two sides of the same coin. First, integrated patient care emphasizes coordination, whereas interface typology speaks of coherence. Both of them aim at supporting fluidity of services and smooth flow of customers in service processes. Second, integrated patient care highlights patient-centredness, whereas interface typology addresses it as variety. Both of them focus on allowing choices to be made to deliver a customized service offering that fits the needs and requirements of the customer. Customization is a highly topical issue in healthcare because customers increasingly expect customization in their services (Berwick, 2009; Minvielle, 2018). The interface typology aims to meet this requirement by pointing out the linkage between subsystems, namely interfaces, which support variety and customization of services. Integrated patient care also considers customization important and introduces practices to tailored care and the engagement of patients in planning their services (Singer *et al.*, 2011).

The results of this study shed a light on the discussion in healthcare between standardization and customizations. We found several guidelines and protocols that were missing, their absence causing confusion among providers and even uncoordinated services. Furthermore, although guidelines and protocols existed in some cases, providers did not

always follow them. This caused even more confusion when unexpected practices were encountered and outcomes of procedures unexpected. In these cases, providers were acting on the basis of their professional work experience and not on the basis of protocols, something also observed in other healthcare modularity studies (Silander *et al.*, 2017). The needs of individual customers are highly heterogeneous and might change unexpectedly (Vähätalo and Kallio, 2015). Adapting protocols to changing situations requires good professional knowledge and long clinical experience which both are essential elements of professionalism. Standard guidelines and protocols would be particularly beneficial in multi-provider contexts where predicting professionals' behaviour across disciplines is highly challenging (de Regge *et al.*, 2019). However, the extent to which standardization in multi-provider contexts is possible can be questioned, since standardizing too extensively might jeopardize important adaptations of services based on professional work experience. We formulate the following proposition:

P3. Extensive interface standardization in multi-provider contexts jeopardizes customization based on professional expertise.

6. Conclusion
This study offers a detailed perspective on modular interfaces in multi-provider contexts in healthcare services. Our case research provides insight into several types of modular interfaces in multi-provider contexts. Furthermore, we provide examples of inter- and intra-organizational situations in which integrated patient care was jeopardized and how modular interfaces can support the delivery of integrated patient care. Future research is needed to assess the further potential of our findings in the wider context of service operations.

6.1 Theoretical contribution
This study applies the typology for interfaces by de Blok *et al.* (2014) for explicating the importance of interfaces in multi-provider contexts. Although the typology of de Blok *et al.* (2014) provided a useful framework for scrutinizing interfaces in modular services, it did not capture the inter-organizational element of multi-provider contexts. By adding a third dimension, the orientation of interfaces (intra-organizational vs inter-organizational), to the typology of de Blok *et al.* (2014), we specifically contribute by further developing the typology for interfaces in modular services. In doing so, we move the discussion on interfaces in service modularity from an intra-organizational level (single-provider context) to an inter-organizational level (multi-provider context). This is essential for improving the theoretical underpinnings of service modularity (Brax *et al.*, 2017). Furthermore, this study investigated the implications of modular interfaces for the delivery of integrated patient care in multi-provider contexts. These implications provided more insight on the complicated nature and role of interfaces in multi-provider contexts. As such, we address the call for more research on service modularity in multi-provider contexts (Brax *et al.*, 2017).

6.2 Managerial and practical implications
Despite all the existing research, many managerial and operational challenges related to the delivery of integrated patient care remain unsolved (González-Ortiz *et al.*, 2018). Although these challenges might vary from context to context, the general idea of modular interfaces provides a holistic approach and helps managers to understand the importance of interfaces in health services that are delivered by a variety of professionals and organizations. We identified various interfaces that allow for interaction and communication in multi-provider contexts and showed that these interfaces can help managers to overcome managerial and

operational challenges. By highlighting the available interfaces and introducing work and service descriptions that are available for every professional, functional silos can possibly be broken down. This can lead to less fragmentation between professionals and organizations and increased common goals. Moreover, we point out that inter-organizational interfaces (e.g. shared EHR) are particularly important when enhancing coordination and patient-centredness in the delivery of integrated patient care. Inter-organizational interfaces ensure a safe and smooth patient flow and allow for tailored services across healthcare organizations. In other words, the patient will not experience any hindrance, in terms of missing or overlapping treatment, while moving from one organization to the other. The results of this study can inspire managers to invest resources in developing and improving interfaces in multi-provider contexts. In this way, they have the opportunity for realizing the full potential of integrated patient care. Our results could also be relevant for many other types of services (e.g. legal services, tourism services) that operate in a multi-provider context.

6.3 Limitations and future research
The results of this study were based on two cases representing multi-provider contexts in two different countries. Although countries are different, they both represent publicly financed healthcare systems. This can be considered a limitation, because the findings in other types of healthcare systems might be different. For example, it would be worth studying whether the organizational background of healthcare providers has an effect on the creation of interfaces and their functioning. In both of our cases, services were provided by public, private and NGO providers which are all different, for example, having different institutional logics. Cultural differences are likely to impede collaboration among providers (Auschra, 2018). Although these differences were not central to our study, previous literature indicates that it would be worth studying whether different organizational backgrounds affect the functioning of interfaces. Last, despite the fact that the customer's role in services is increasing, we did not incorporate interfaces with customers into our study. As such, this study might not provide an accurate representation of the customer's role in multi-provider contexts. We suggest that future research should address interfaces between service providers and customers in multi-provider contexts. This will further improve our understanding of interfaces in service modularity.

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