Medication administration at the patient's home

Master Thesis

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INDUSTRIAL ENGINEERING & MANAGEMENT

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Preface

Dear reader,

In front of you is my master thesis: “Medication administration at the patient’s home”, which I wrote to complete my master’s degree in Industrial Engineering and Management at the University of Twente. Even though I performed most of this research from home due to the COVID-19 restrictions, I have gained valuable knowledge and experience during this study.

My graduation assignment was part of the medication@home project of mProve. I would like to thank all members of the medication@home working group for their assistance during my research. In particular, my supervisor Jan Gerard Maring who supported me in this research and always introduced me to the right people. Further, I want to thank all employees of Isala and Rijnstate that have participated in the brown paper sessions, interviews, or value stream analyses. Thank you all for answering my questions!

Furthermore, I want to thank my supervisors Erwin Hans and Anke Lenferink for their feedback and valuable input during this research. They helped me to construct this research in the right way and lift it to a higher level.

Finishing my master’s degree required more than academic support alone. Therefore, I would like to sincerely thank my family and friends for their support during my study and this graduation assignment.

Carlijn de Kunder
Enschede, October 2021

Management summary

Introduction

This research is part of the medication@home project of the mProve hospitals. The project aims to offer parenteral medication administration at the patient's home as a standard part of regular care. Several mProve hospitals have already some experience with administering medication at home. Still, to expand the number of medicines administered at home, they want to learn together how the medication care at home can be organised best. The idea of transferring hospital care to home is not new. However, to the best of our knowledge, no research has been performed on moving the medication care to the patient's home without transferring other hospital care.

Research goal

The medication@home project started in March 2020. However, almost a year later, the mProve working group had not defined the project planning and process yet. As a result, the project approach was unclear to the project stakeholders. Besides, the working group had no overview of the mProve hospitals' experiences with medication administering at home, making it challenging to evaluate the current processes. Therefore, the goal of this research is two-folded:

> "This research aims to support mProve in a systematic project approach and assess the current processes for administering medication at home."

Method

We performed a systematic literature review and an informal search to find frameworks that can support the working group with a systematic approach of the medication@home project. We searched for frameworks that support the (re)designing of a product's or service's business model. These searches resulted in a list of 29 frameworks, and we used the Simple Multi-Attribute Rating Technique (SMART) to select the best one. When the working group implemented the framework, we evaluated whether it supported the working group by interviewing three working group members on the implementation, use, and future role.

To provide the working group with an overview of the current processes for medication administration at home, we organised a brown paper session in Isala and Rijnstate with pharmacists and employees of various hospital departments. In these sessions, we created an overview of the process steps. However, these overviews do not show whether a process is effective and efficient. Therefore, we analysed the effectiveness and efficiency using Lean value streams. We selected the medicines Vancomycine, Pembrolizumab and Furosemide in Isala to demonstrate this method.

Results

Based on SMART, we selected the Practical Business Design Canvas (PBDC) of Kumaraswamy (2017) as the best framework to support mProve in the project approach of medication@home. This framework consists of five phases: strategic model, change, business model, operating model, and key performance indicators (KPIs). It is remarkable that SMART selected the PBDC as the best framework, as it is not discussed in scientific literature before. So, from both a practical as a scientific point of view, it was interesting to check whether the PBDC supported the working group in practice. Our evaluation showed that the PBDC supported the group by, for example, fulfilling the group's need to list the project's outlines and agreements.

For Isala and Rijnstate, we created an overview of all the processes they use for administering medication at home. These overviews showed that Isala has seven processes and Rijnstate six. Besides,

at least eleven parties are active in these processes. The outpatient pharmacy, the clinical pharmacy, transfer agency and the day treatment department are the parties that have a role in most processes. Remarkable is that in Isala, no party has a complete overview of all home administration. In Rijnstate, the outpatient pharmacy has this overview.

The value stream analyses in Isala showed several opportunities for improving the effectiveness and efficiency of the processes. Most bottlenecks in the value stream of Vancomycine are related to meeting deadlines, filling in forms correctly, and proper communication between parties. While in the value stream of Pembrolizumab, several bottlenecks are related to the lack of programs or apps that can support the process. The most significant bottlenecks in the value stream of Furosemide are the cassettes stock and the discharge procedure.

How to continue?

We have several recommendations for the mProve hospitals. Our main advice is that each mProve hospital should designate one party to overview all home administrations. This directing centre must overview all processes for home medication and when each patient receives which medicine at home. This will make the collaboration and transfer of knowledge between the involved parties easier. The directing centre can stay informed on all processes by, for instance, organising two meetings per year where the various processes are discussed with all stakeholders. Besides, we recommend each mProve hospital to select one method for registering patients who receive home medication. The directing centre can, for example, create one virtual department in HiX to record all home administrations.

Furthermore, we advise mProve to continue using the PBDC in the medication@home project since the evaluation showed that the PBDC supports the medication@home working group in a systematic project approach. Besides, the canvas is a suitable tool to explain the project to new stakeholders.

Besides recommendations, we also identified several aspects that require further research. For instance, we suggest that researchers investigate whether the PBDC is also suitable for other (re)design projects in healthcare, like the connected care services in Isala. Besides, future research can investigate how Isala should solve the bottlenecks in the value streams of Vancomycine, Pembrolizumab and Furosemide, making these processes as effective and efficient as possible.

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1. Introduction

This graduation assignment is part of the medication@home project of the mProve hospitals. The project aims to move (a part of) the medication administered in the hospitals to the patient's home (mProve, 2020a). In this way, patients receive care in a comforting environment. While simultaneously, the number of hospital beds needed reduces, which can lower health care costs in the long run (Levine, et al., 2018; mProve, 2020a). With the medication@home project, the mProve hospitals want to determine how medication administering at home can be organised best. This thesis contributes to this project by supporting mProve in a structured project approach.

In this chapter, we start by explaining the research motivation (Section 1.1). Subsequently, we further introduce the mProve network and Isala and Rijnstate in particular (Section 1.2). Then Section 1.3 explains the research goal and approach. Finally, the research scope is defined in Section 1.4.

1.1 Research motivation

The mProve hospitals aspire to organise care as close to the patient as possible and not unnecessarily in the hospital (mProve, 2020a). Therefore, mProve started the medication@home project in March 2020 with the ambition to offer parenteral medication administration at home as a standard part of regular care. Several mProve hospitals have already some experience with administering medication at home. Still, to expand the number of medicines administered at home, they want to learn together how the medication care at home can be organised best. The University of Twente supports mProve in this research since January 2021. In February 2021, five graduation assignments started within medication@home, including this research.

The idea of transferring hospital care to home is not new. For example, Jeff, et al. (1999) described a home hospital model for acutely ill patients, who can receive physician and nursing care, medicines, appropriate diagnostic, and therapeutic technologies at home. Also, other studies showed the potential of transferring hospital care to home, as it can result in higher patient satisfaction, more physical activity by patients and lower cost (Leff, et al., 2005; Levine et al., 2018). However, to the best of our knowledge, there is no research performed on moving the medication care to the patient's home without transferring other hospital care, making the medication@home project valuable.

mProve started the medication@home project almost a year ago. However, they have no project planning or project outlines defined yet. As a result, the project approach is unclear to the project stakeholders. Besides, the medication@home working group currently has no overview of the mProve hospitals' experiences with medication administering at home, making it challenging to evaluate the current processes. Therefore, this research will support mProve in a systematic project approach and assess the current processes for administering medication at home.

1.2 mProve network

mProve is an innovative network of seven clinical hospitals in the Netherlands (mProve, 2020b). The participating hospitals are:

- Albert Schweitzer (Dordrecht, Zwijndrecht)
- Isala (Zwolle, Meppel)
- Jeroen Bosch Ziekenhuis ('s-Hertogenbosch)
- Máxima Medisch Centrum (Veldhoven, Eindhoven)
- Noordwest Ziekenhuisgroep (Alkmaar, Den Helder)
- Rijnstate (Arnhem, Zevenaar)

- Zuyderland Medisch Centrum (Heerlen, Sittard-Geleen)

The mission of mProve is to provide considerably better care for patients by combining forces (mProve, 2021). Their vision is to take the lead in medical, technological, and social innovations, share experiences, and compare results within the mProve group.

mProve focusses on three topics: “Connected Care”, “Merkbaar Beter”, and “Data Analytics” (mProve, 2020c). Connected Care stands for innovative care using digital solutions. While "Merkbaar Beter" is about care-related quality improvement. The last topic, "Data Analytics", supports the other two topics by building a shared data platform. Within these three topics, mProve works on several projects. There is a working group for each project that consists of at least one employee and/or medical specialist from each hospital (mProve, 2020b). One of the projects within the topic "Connected Care" is medication@home (mProve, 2020a).

1.2.1 Isala

The main focus in this study will be on mProve hospital Isala. Isala is one hospital organisation with five locations in Zwolle, Meppel, Steenwijk, Kampen and Heerde (Isala, 2021a). They deliver care to patients in Southwest Drenthe and Northwest Overijssel. Besides standard hospital care, Isala also offers top clinical care for cardiac and neurosurgery and dialysis. Isala's location in Zwolle is the largest top clinical hospital in the Netherlands, with over 5.500 employees and 776 beds (STZ, n.d.).

An important focus point of Isala is to stimulate the transfer from delivering care in the hospital to the patient's home (Isala, 2021b). Their goal is to provide 25% of all hospital care at home in 2025 (mProve, 2021). This transfer is supported by the Connected Care Center (CCC) of Isala, established at the beginning of 2019 (Isala, 2021b). The CCC focuses on three services to support the care transition to home: education and self-management, monitoring, and Isala@home (Figure 1). Education and self-management is the service that focuses on the implementation of apps for patient information or video calling between patients and healthcare professionals. Patients can measure relevant health factors at home with the monitoring service. The Isala@home service contains the care that healthcare providers provide at the patient's home. Part of this is medication care at home.

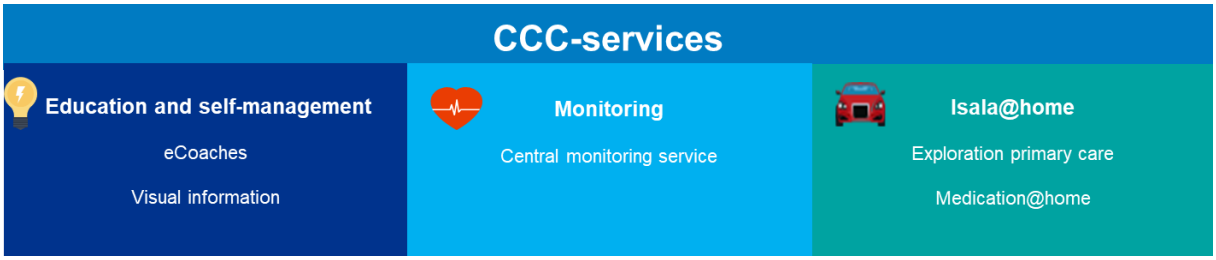


Figure 1: Services of Connected Care Center in Isala

1.2.2 Rijnstate

The other hospital we focus on in this study is Rijnstate. They deliver care to patients in the region of Arnhem, Rheden and de Liemers (Rijnstate, 2021a). Rijnstate is one hospital with two locations in Arnhem and one in Zevenaar and Velp, and they have around 5000 employees and 766 beds (Rijnstate, 2021b). The central location in Arnhem is a top clinical hospital (Rijnstate, 2021c).

One of the four focus points of Rijnstate is to "have the right care at the right place" (Rijnstate, 2021d). This means that the care is provided at the location where the care is most efficient and in line with the patient's needs (Rijnstate, 2021e). Therefore, Rijnstate started several pilots where care is transferred to the patient’s home, like monitoring at home.

1.3 Research goal

As explained in Section 1.1, this research aims to support mProve in a systematic project approach and assess the current processes for administering medication at home. To meet this goal, we will answer the following research questions:

1. What are the current processes for administering parenteral medication in Isala and Rijnstate?
2. What framework supports mProve in a systematic approach for the medication@home project?
3. How does the selected framework support the medication@home project?
4. How can the effectiveness and efficiency of the current processes for administering parenteral medication at home be improved?

We start this research by analysing the current process for administering medications in Isala and Rijnstate (Chapter 2). The goal of research question 1 is to create an overview of the current process steps and the involved parties. Besides, we will examine the drugs' volumes to determine how frequent each process step is performed. We will create these overviews based on pharmacy data and brown paper sessions with pharmacists and employees of various hospital departments.

When the current situation is known, we can investigate which framework is suitable to support mProve in a systematic project approach for medication@home (research question 2). Since mProve has no project planning and process defined yet for this project. We will select a framework based on a systematic literature review and an informal search (Chapter 3).

In Chapter 4, we evaluate the framework that we select in Chapter 3. In this evaluation, we examine whether the framework is indeed helpful for mProve and if the implementation of the framework succeeds (research question 3). We will base this evaluation on interviews with mProve members that work with the framework.

When the medication@home project approach is clear for all stakeholders, we will begin assessing the current processes for administering medication at home (Chapter 5). By creating Lean value streams of medicines administered at home, we can determine how to improve the current processes' effectiveness and efficiency (research question 4). Besides, the value streams can provide mProve with an initial insight into which type of process they prefer.

1.4 Research scope

As mentioned in Section 1.2, the mProve network consists of seven hospitals. However, due to the time constraint of six months, this research only focuses on two hospitals: Isala and Rijnstate. We selected Isala and Rijnstate because both hospitals already have some experience with administering parenteral medicines at home.

The medication@home project is about parenteral medication. However, many parenteral medicines can potentially be administered at home. Therefore, mProve investigated which drug characteristics could influence the administering process for medicines at home. These characteristics are the complexity of the drug administering, the need for electronic medication administration registration (eMAR), and the drug's stability (shelf life). Based on these characteristics, mProve defined six medication types (Table 1), with an "example medicine" for each type (Table 2). As these medicines represent the different medication types, we only focus on the example medicines in this research.

Table 1: Medication types for parenteral medications (mProve, 2021)

Type	Complexity administration drug	Electronic Medication Administration Registration (eMAR)	Stability of the drug
A	Low	Optional / Not needed	>2 days
B	Low	Required	>2 days
C	Medium-High	Optional / Not needed	Less than 48 hrs
D	Medium-High	Required	Less than 48 hrs
E	Medium-High	Optional / Not needed	>2 days
F	Medium-High	Required	>2 days

Table 2: The seven medicines selected as representative of their medication type by mProve

Type	Medication name	Department	Form of administration
A	Pegfilgrastim	Oncology	Subcutaneous/ Intramuscular
B	Trastuzumab	Oncology	Subcutaneous/ Intramuscular
C	Flucloxaciline	Orthopaedics	Intravenous with pump
D	Bortezomib	Haematology	Subcutaneous/ Intramuscular
E	Furosemide	Cardiology	Intravenous with pump
E	Immunoglobuline	Neurology	Intravenous with pump/ subcutaneous
F	Pembrolizumab	Oncology	Intravenous with pump

2. Current situation

In this chapter, we analyse the current process for administering parenteral medication at home in Isala and Rijnstate. We investigate which parties are involved in the process of medication prescription till the administration at home. Besides, we examine how often the various processes are used. In this analyse, we address the following question:

- Which hospital departments or organisations are involved in the process of medication prescription till the administration at home?
- What are the tasks of the involved parties?
- Which pathways for administering medication are frequently used?

Section 2.1 explains how the current situation is analysed. Subsequently, Section 2.2 gives an overview of the current pathways for administering parenteral medication in Isala, and Section 2.3 describes this for Rijnstate. Finally, Section 2.4 answers the first research question.

2.1 Method for analysing processes

Currently, Isala and Rijnstate administer more than thirty parenteral medications at home. However, the processes of these medications are not unique for each drug, as drugs of the same type often follow the same pathway. Therefore we used seven medication examples selected by mProve as a basis for creating an overview of the existing pathways (Section 1.4). In addition, for Isala, we added the drugs Gosereline and Vancomycine to have a complete overview of the various processes (Table 3).

To create an overview of the pathways, we organised a brown paper session with a clinical pharmacy employee in Isala and an outpatient pharmacy employee in Rijnstate. A brown paper session is an interactive meeting where the participants jointly map out existing processes (Kort, 2021). After the brown paper session, we sent the flowchart of the processes to the two employees to verify whether it was complete. In Isala, we also checked the flowchart with an employee of the transfer agency, outpatient pharmacy, day treatment department and chance-at-home department. This was needed because the clinical pharmacy employee did not knew all pathways' details, as the clinical pharmacy is not involved in each process. The outpatient pharmacy in Rijnstate, however, is part of all the pathways in Rijnstate.

Table 3: Overview of the medications used for analysing the current pathways

Medication Type	Pathway notation	Medication example
A	A_1 or A	Pegfilgrastim
A	A_2	Gosereline
B	B	Trastuzumab
C	C_1 or C	Flucloxaciline
C	C_2	Vancomycine
D	D	Bortezomib
E	E_1	Furosemide
E	E_2	Immunoglobuline
F	F	Pembrolizumab

2.2 Current processes in Isala

In Subsection 2.2.1, we explain the various processes for administering medication at home in Isala. Then we examine the frequency with which these pathways are used (Subsection 2.2.2).

2.2.1 Processes

Figure 2 shows a flowchart of the various processes that Isala uses for administering parenteral medication at home. There are eight processes[1], including the medicine Immunoglobuline, that is currently administered in the hospital only. Besides, in total, at least eleven parties are involved in the processes of medication prescription till the administration at home. These parties are the chance-at-home department, clinical pharmacy, day treatment department, home care organisation, MediqTefa, outpatient pharmacy, patient, pharmaceutical companies (e.g., Eurocept), physician, transfer agency and the transport team. In the remainder of this section, we explain how these parties are involved in the various pathways.

The first step of the process is the same for all drugs, as it starts with a physician prescribing the medication in HiX. HiX sends the Pegfilgrastim (A_1) and Gosereline (A_2) prescription to the outpatient pharmacy that prepares these drugs. Subsequently, in the case of Pegfilgrastim, Isala's transport team delivers the medicine at the day treatment, where the patient receives it after the oncological treatment. The patient can then self-administer the medication at home. In the case of Gosereline, the patient collects the drug at the outpatient pharmacy in the hospital, or a pharmaceutical nurse from Eurocept or PreventCare picks it up. However, in both situations, the pharmaceutical nurse administers the drug at the patient's home. The last process step is the same for all drugs: the nurse registers the administration time in HiX when needed. For some medications, this time is essential information for the physician when side effects occur. For Pegfilgrastim and Gosereline, the precise administration time is not crucial.

The day treatment department receives the prescription of Trastuzumab (B), Bortezomib (D) and Pembrolizumab (F), and they order these medications by the clinical pharmacy. When the clinical pharmacy has prepared the drug, the transport team brings it to the day treatment. The day treatment nurse then brings the drug to the patient's home to administer it there. Immunoglobuline (E_2) follows this same pathway, except it is administered at the day treatment department instead of the patient's home.

The pathway for Furosemide (E_1) is similar to that of the oncology drugs (e.g., Trastuzumab). The day treatment's tasks are performed by chance-at-home, a project for administering cardiology medicines at home, organised by the cardiology department. This project already exists for seventeen years.

When the physician prescribes Flucloxaciline (C_1) or Vancomycine (C_2), a nurse copies the prescription from HiX to the program Point so that the transfer agency receives the prescription. Then, the transfer agency arranges a home care organisation in consultation with the patient. In the case of Flucloxaciline, the preparation and delivery are outsourced to MediqTefa. For Vancomycine, the transfer agency sent the prescription to the outpatient pharmacy, which then orders the drug by the clinical pharmacy. When the clinical pharmacy has prepared the medicine, the outpatient pharmacy receives it and then gives it to an external delivery company that delivers the drug at the patient's home. Finally, a nurse from the selected home care organisation administers the medication.

[1] All nine medications listed in Table 3 have their own process, except for Trastuzumab, Bortezomib and Pembrolizumab, who follow the same pathway. Only, there are two delivery options for Gosereline, which leads to eight process.

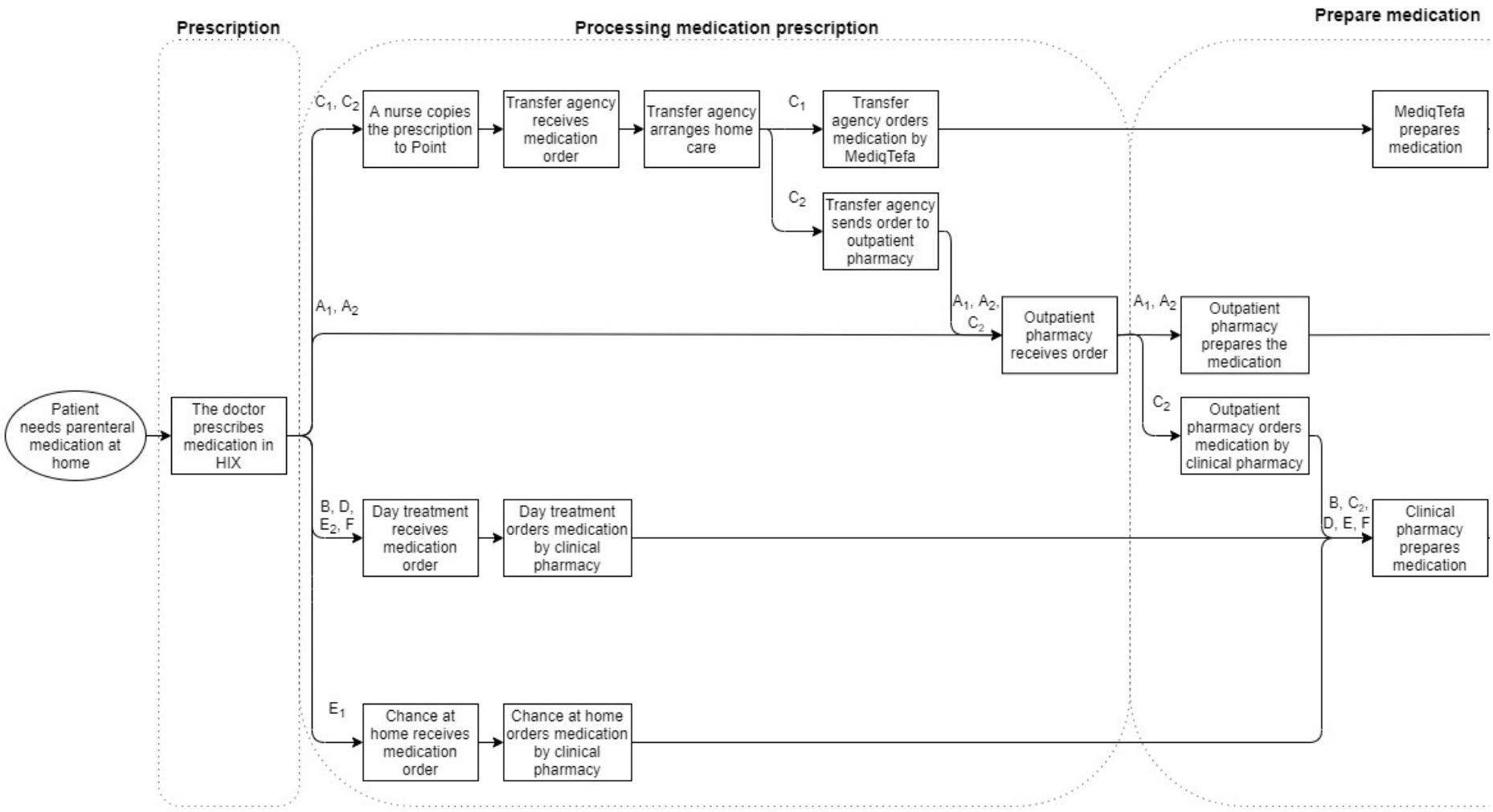


Figure 2a: Processes for medication at home in Isala

Legend: Pegfilgrastim (A_1), Gosereline (A_2), Trastuzumab (B), Flucloxaciline (C_1), Vancomycine (C_2), Bortezomib (D), Furosemide (E_1), Immunoglobuline (E_2), and Pembrolizumab (F).

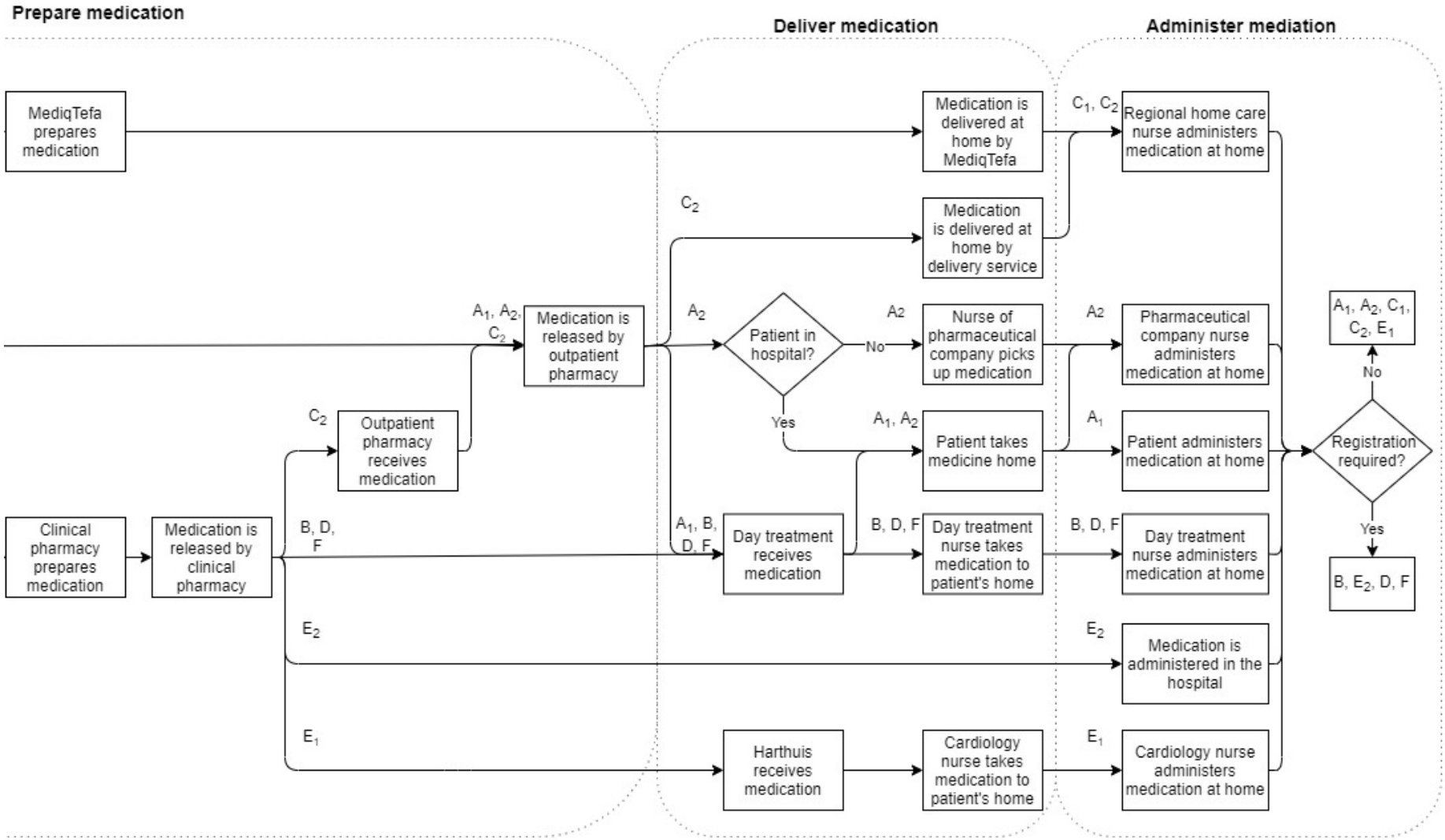


Figure 2b: Processes for medication at home in Isala

Legend: Pegfilgrastim (A_1), Gosereline (A_2), Trastuzumab (B), Flucloxaciline (C_1), Vancomycine (C_2), Bortezomib (D), Furosemide (E_1), Immunoglobuline (E_2), and Pembrolizumab (F).

The processes described above all start with the prescription of the medicine by the physician. However, when a patient needs a drug for several weeks, the pathway is partially repeated, as patients only receive sufficient medication for one or two weeks. The repetition starts at the order/prepare step by MediqTefa, the outpatient pharmacy, the day treatment, or chance-at-home.

2.2.2 Volumes per process

Figure 3 shows a simplified representation of Figure 2 for the processes where a nurse administers the medication at home. The arrows in Figure 3 indicate the approximate number of administrations per pathway in 2020 for Isala. We based the thickness of the arrows on all parenteral administrations performed through a process, not only on the example medication listed in Table 2. As a result, Figure 3 shows how frequent Isala used the various processes in 2020. The path Gosereline follows is the most commonly used pathway and that of Vancomycin the least, with respectively around 3826 and 1323 administrations in 2020. In total, there have been about 10,000 administrations in 2020.

We created Figure 3 based on data from the appointment calendars of the day treatment and chance-at-home. We only included appointments for administering medications at home, so no blood draws at home or telephone consultation. Further, we used data from the outpatient pharmacy, which showed the number of administrations they prepared for their patients per medicine. To determine the number of medications prepared by MediqTefa, we combined the patient list in Point with the administration period listed for these patients in HiX. Since no data was available on the administration frequency in this period, we assumed it was once every day.

2.3 Current processes in Rijnstate

In this section, we explain the various processes for administering parenteral medication at home in Rijnstate. Due to the time constraint of this research, it was not possible to determine the frequency with which these pathways are used.

2.3.1 Processes

Figure 4 shows the various processes that Rijnstate uses for administering parenteral medication at home. There are nine pathways[2], including three processes where the drugs are administered in the hospital. Besides, at least twelve parties are involved in the pathways. These parties are 2care, clinical pharmacy, day treatment, patient, physician, Eurocept, heart failure nurse, home care organisation, MediqTefa, outpatient pharmacy, Eurocept, and the transfer agency. In the remainder of this section, we explain how the parties are involved in the various processes.

All processes, except the pathway of Furosemide, start with a physician prescribing the medication in HiX. The oncology nurse receives the prescriptions of Pegfilgrastim (A) and orders this drug by the company 2care. 2care then prepares, delivers, and administers this drug. However, this process will change in 2021 (Figure 5). In the new situation, the oncology nurse sends the medication prescription to the transfer agency and the outpatient pharmacy. The transfer agency arranges a home care organisation when needed, and the outpatient pharmacy prepares the drug and delivers it to the day treatment.

[2] Each row in Figure 4 represents a unique process, except for the two rows of Furosemide (E_1). These two rows are executed in parallel and form one pathway.

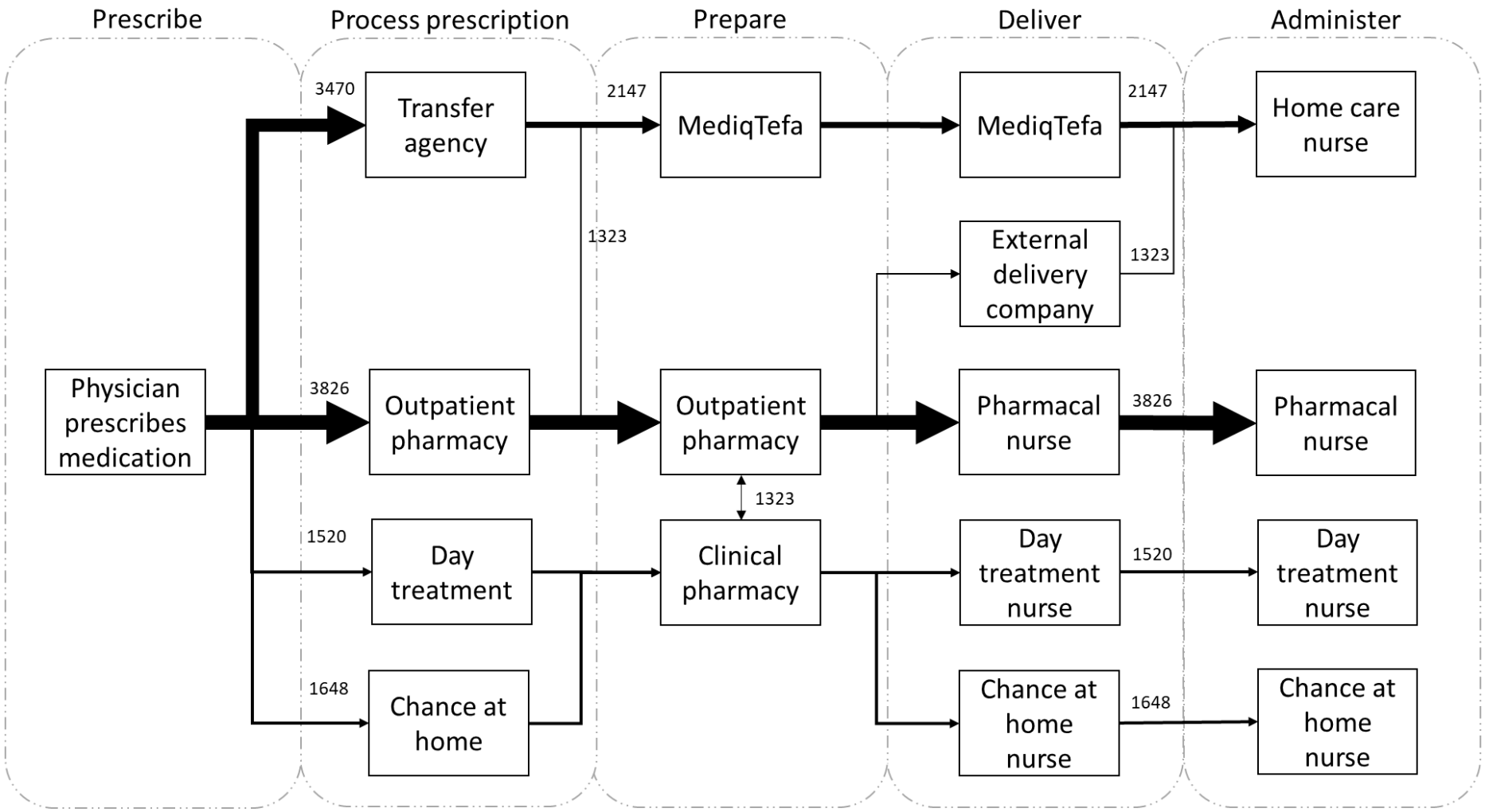


Figure 3: Approximate number of administrations per process in 2020 in Isala

On the day treatment, the patient receives the medicine after the oncological treatment. The patient can then self-administer the medication at home, or a nurse of the home care organisation administers it when the patient prefers this. The last process step is the same for all drugs: the nurse registers the administration time when needed. The medicines that need registration are the same for Rijnstate and Isala.

The coordination nurse of the day treatment receives the prescription of Trastuzumab (B), Bortezomib (D) and Pembrolizumab (F). This coordination nurse makes an overview that shows the locations of the drug administrations: the hospital or the patient's home. If the medicine will be administered at home, the nurse registers the patient by Eurocept. Currently, Bortezomib can only be administered in the hospital. For Trastuzumab and Pembrolizumab, both locations are possible. Regardless of the location, the coordination nurse sends the prescription to the clinical pharmacy's production department that prepares the medicine. When the drug is administered in the hospital, the clinical pharmacy delivers the drug at the day treatment where it is administered. Otherwise, the drug is brought to the outpatient pharmacy, where Eurocept collects it. A nurse of Eurocept then administers the medicine at the patient's home. However, these last two steps will change (Figure 5). From May 2021, the Rijnstate@home team administers Pembrolizumab to patients living within a radius of 25 km from Rijnstate. Eurocept will then only administer Pembrolizumab to patients residing outside this radius. Later in 2021, also Trastuzumab will follow this new pathway.

When the physician prescribes Flucloxaciline (C), the transfer agency receives the prescription. They arrange a home care organisation and send the prescription to the outpatient pharmacy. The outpatient pharmacy orders the drug from the clinical pharmacy's production department. When the clinical pharmacy has prepared the drug, the outpatient pharmacy receives the drug. Flucloxaciline is given as a continuous drip. The first connection of the drip is performed in the hospital by a home care nurse. Later, the home care nurse renews the drip at the patient's house. The outpatient pharmacy delivers these drips to the patient's home.

The outpatient pharmacy receives the Immunoglobuline (E2) prescription and registers the patient when needed by MediqTefa. Then the outpatient pharmacy prepares the medication and delivers it to the patient's house. The patient can then self-administer the drug at home when the subcutaneous version of Immunoglobuline is used. Otherwise, a nurse of MediqTefa administers the medicine at home. However, there is also the option to administer Immunoglobuline in the hospital on the day treatment department. In this case, the clinical pharmacy prepares and delivers the drug to the day treatment.

A nurse specialised in heart failure prescribes Furosemide (E_1). The outpatient pharmacy and the transfer agency receive this prescription. The transfer agency arranges a home care organisation, and the outpatient pharmacy orders the drug at the clinical pharmacy. When the clinical pharmacy's production department has prepared the medicine, they give it to the outpatient pharmacy, which delivers it to the patient's house. A home care nurse will then administer the drug.

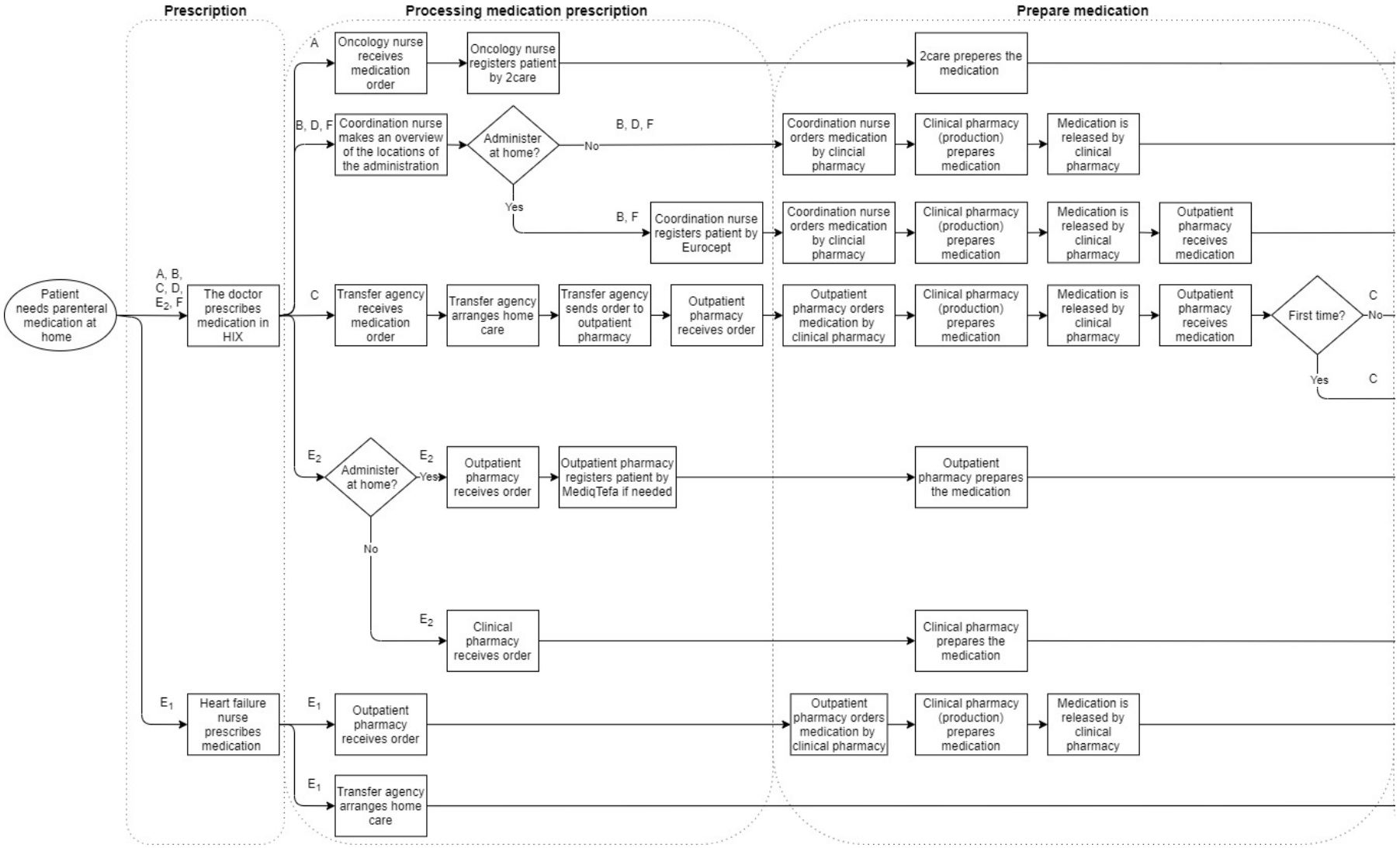


Figure 4a: Current processes for medication at home in Rijnstate

Legend: Pegfilgrastim (A), Trastuzumab (B), Flucloxaciline (C), Bortezomib (D), Furosemide (E_1), Immunoglobuline (E_2), and Pembrolizumab (F).

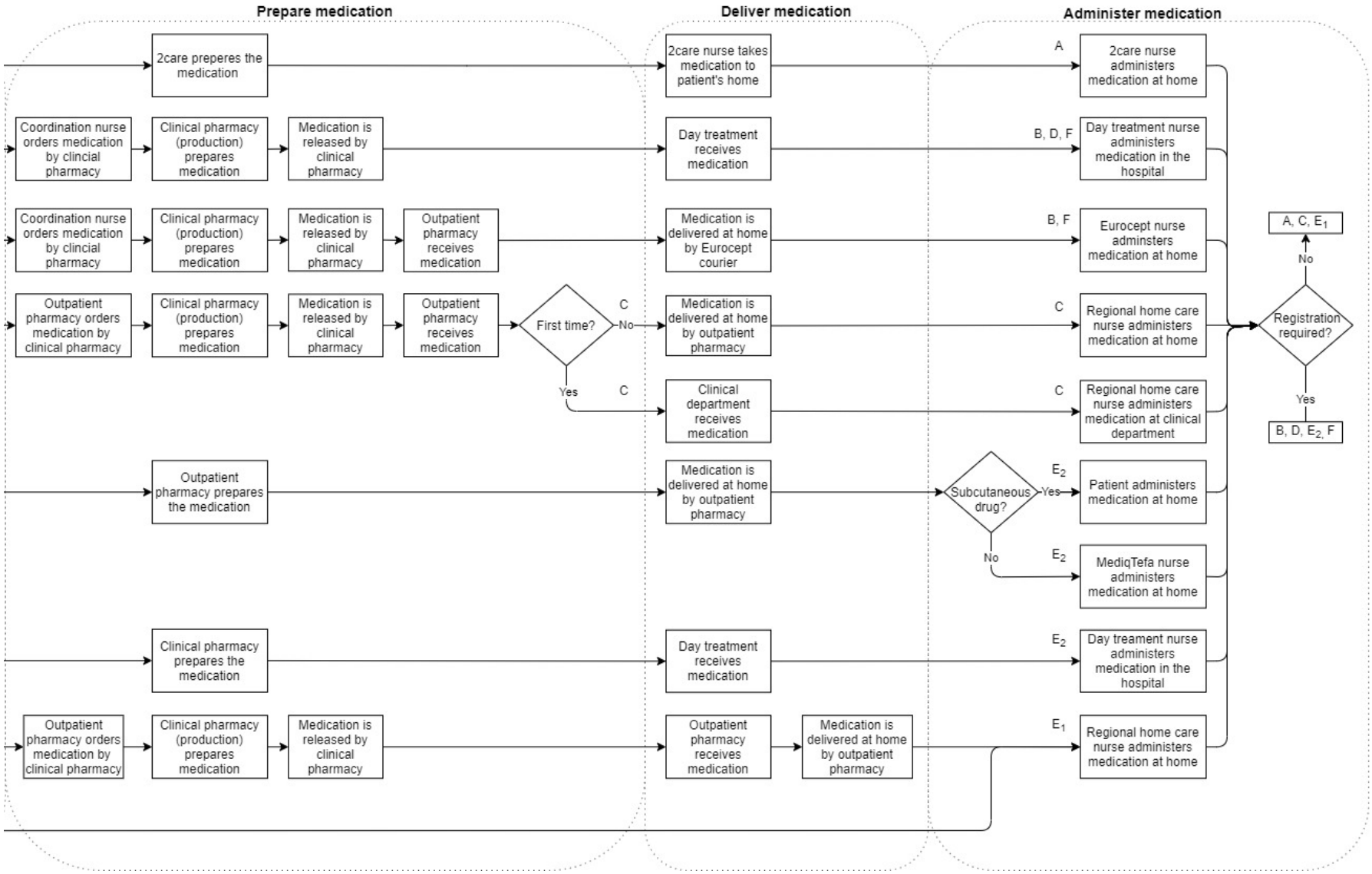


Figure 4b: Current processes for medication at home in Rijnstate

Legend: Pegfilgrastim (A), Trastuzumab (B), Flucloxaciline (C), Bortezomib (D), Furosemide (E_1), Immunoglobuline (E_2), and Pembrolizumab (F).

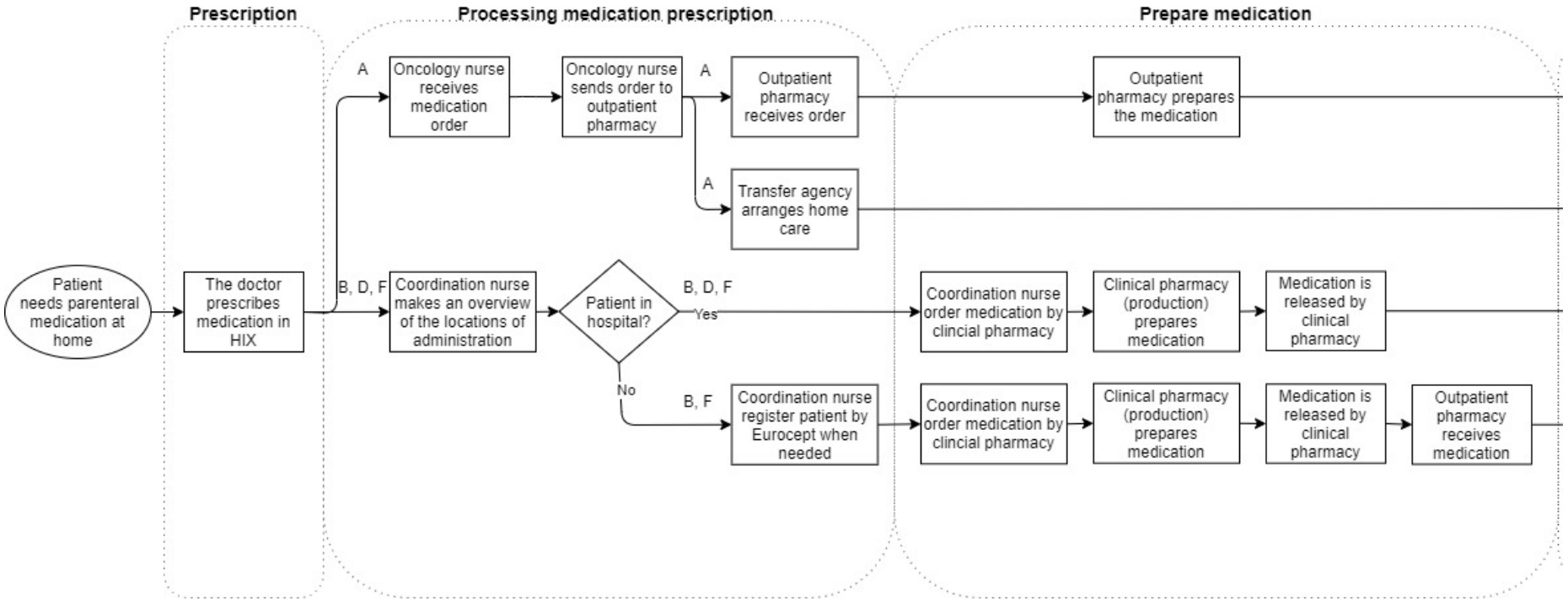


Figure 5a: New processes for medication at home in Rijnstate

Legend: Pegfilgrastim (A), Trastuzumab (B), Bortezomib (D), and Pembrolizumab (F).

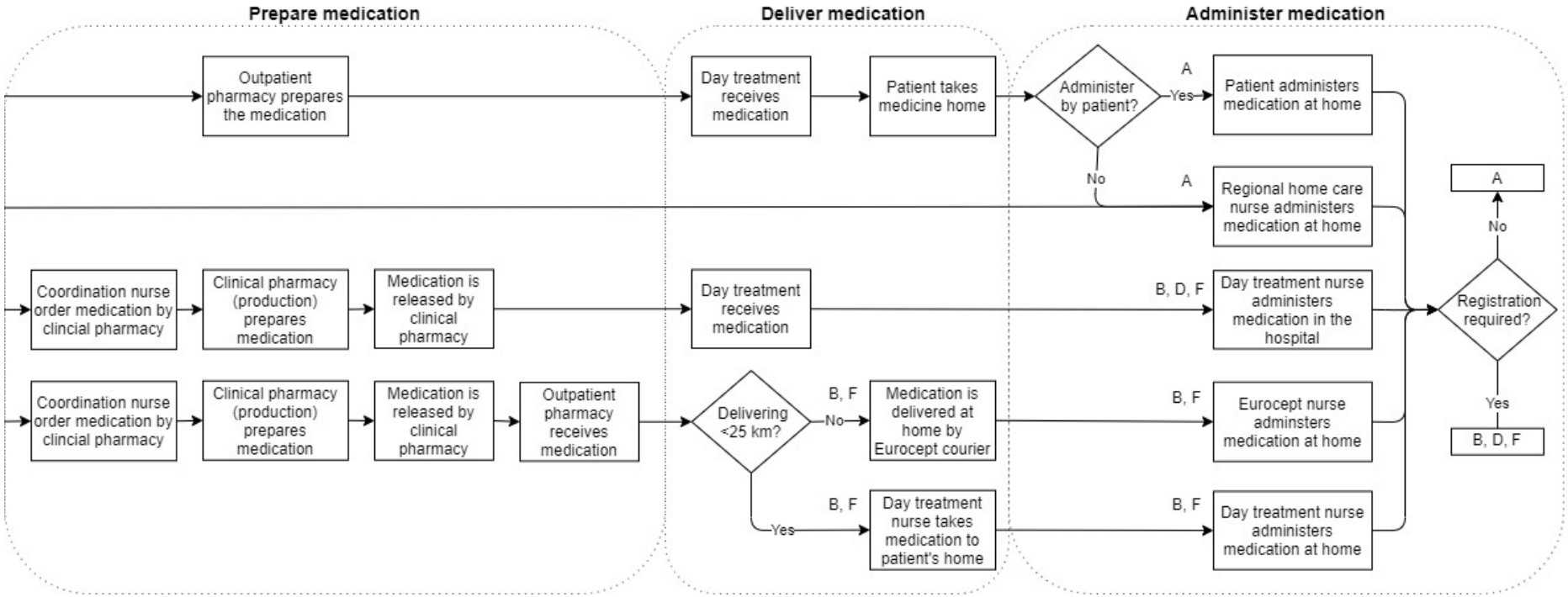


Figure 5b: New processes for medication at home in Rijnstate

Legend: Pegfilgrastim (A), Trastuzumab (B), Bortezomib (D), and Pembrolizumab (F).

2.4 Conclusion

In this chapter, we examined the first research question: What are the current processes for administering parenteral medication in Isala and Rijnstate? Figure 2 and Figure 4 show the various processes that Isala and Rijnstate use for administering parenteral medications at home. Isala has seven pathways and Rijnstate six, excluding the processes for medicines administered in the hospital. Together, at least eleven parties are active in these processes per hospital. The parties involved in most pathways are the outpatient pharmacy, the clinical pharmacy, transfer agency and the day treatment department.

When we look at the overview in Figure 2 and Figure 4, it stands out that there are multiple parties involved in the delivery and administration step. In contrast, fewer parties are involved in the other stages of the process. In the last two steps, there is contact with the patient, which means that it really depends on the specific medication, which healthcare providers the patient will be in contact with. Another striking matter is that in Isala, no party is involved in each process, which means no one has a complete overview of all administrations at home. In Rijnstate, the outpatient pharmacy is involved in each pathway when the new processes are implemented.

This chapter gave an overview of the current processes for administering parenteral medication in Isala and Rijnstate. Now that the current situation is known, we can investigate which framework is suitable for supporting the medication@home project in Chapter 3.

3. Framework for a systematic project approach

In this chapter, we analyse what framework is suitable to support mProve in a systematic approach of the medication@home project, which is done based on a systematic and informal literature search. Currently, mProve has not defined the project planning and process for the medication@home project. Therefore, the framework selected in this chapter should help mProve structure the project and support the communication about the project's progress.

This chapter addresses the following questions:

- Which frameworks are available in the literature?
- Which frameworks are made available by companies?
- Which framework is suitable to support mProve in a systematic project approach?

Section 3.1 describes the systematic literature review, and Section 3.2 the informal search. Then, we analyse the frameworks that we found with the searches in Section 3.3. Subsequently, Section 3.4 describes the canvas that we selected for mProve. Finally, Section 3.5 summarises this chapter and answers the second research question.

3.1 Systematic literature review

In this chapter, we focus on the second research question: What framework supports mProve in a systematic approach for the medication@home project? We can consider 'medication administering at home' as a new service of mProve or as an adjustment of the current medication care in the hospital. Therefore, we looked in the literature for frameworks meant to support the (re)designing of a product's or service's business model. For the search, we used the following definitions:

- A framework is a system of rules, ideas, or beliefs used to plan or decide something (Cambridge Dictionary, 2021).
- A systematic approach means that something is done according to a fixed plan in a thorough and efficient way (Collins, 2021).
- A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams (Osterwalder, Pigneur, & Tucci, 2005, p. 10).

We used the databases 'Scopus' and 'Business Source Elite' to find frameworks for (re)designing a product or service. Appendix A shows a log of all the search terms. For the search, we further used the following inclusion criteria:

- The source is written in English or Dutch.
- The researchers have full-text access to the source.
- The source describes a framework for (re)designing a product or service.
- The framework is designed for a company or (health care) organisation.

We found 697 unique sources with our literature search. 40 of these met the inclusion criteria and are therefore included in the study (Appendix A). These sources lead to 20 different frameworks for (re)designing a product's or service's business model (Table 4).

Table 4: Frameworks for (re)designing a product or service that we found with the systematic literature review

Framework	Source that explains the framework
A3	(Shook, 2008)
Business model canvas	(Osterwalder & Pigneur, 2010)
Canvas for two-sided platform business model innovation	(Taipale-Erävala, Salmela, & Lampela, 2020)
Demand response business model canvas	(Hamwi, Lizarralde, & Legardeur, 2021)
Digital service innovation canvas	(Rose, Holgersson, & Söderström, 2019)
DMADV approach	(Fahrul Hassan, et al., 2019)
Ecocanvas	(Daou, et al., 2020)
(Extended) DMAIC approach	(Kumar, Singh, & Bhamu, 2021)
Framework lean product development	(Hoppmann, Rebentisch, Dombrowski, & Zahn, 2011)
Innovation canvas	(Kline, et al., 2013)
Lean servitization canvas	(Rudnick, Riezebos, Powell, & Hauptvogel, 2020)
Service business model canvas	(Zolnowski, Weiß, & Böhmann, 2014)
Service dominant business model radar	(Turetken & Grefen, 2017)
Service logic business model canvas	(Ojasalo & Ojasalo, 2015)
Strategic lean six sigma framework	(Thomas, Francis, Fisher, & Byard, 2016)
Strategic model canvas	(Azevedo, Reis Filho, Freitas, & Silva, 2018)
The product service system lean design methodology	(Pezzotta, et al., 2018)
The reDesign canvas	(Kozlowski, Searcy, & Bardecki, 2018)
The service dominant strategy canvas	(Lüftenegger, Grefen, & Weisleder, 2012)
Triple layered business model canvas	(Furqon, Sultan, & Wijaya, 2019)

Table 5: Frameworks for (re)designing a product or service that we found with the informal search

Framework	Source that explains the framework
Canvas4change	(Sazama, 2021)
BASE board	(Duane, 2021)
Lean canvas	(Leanstack, 2021)
Mission model	(Osterwalder, 2016)
Practical business design canvas	(Kumaraswamy, 2017)
Project canvas	(Project Canvas, 2016)
Service model canvas	(UXM, 2020)
Social business model	(Social business model canvas, 2019)
The mobius loop	(Mobius, n.d.)

3.2 Informal search

In addition to the systematic literature study, we also looked for frameworks in grey literature, as several individuals and companies created their own framework. For this informal search, we used the same inclusion criteria for the frameworks as in Section 3.1. Roberts (2020) made an overview of 115

canvasses created by researchers, companies or individuals. This resulted in 9 additional frameworks for (re)designing a product's or service's business model (Table 5).

3.3 Selection of framework

Based on the systematic literature review and the informal search, we found 29 frameworks for (re)designing a product's or service's business model. In this section, we determine what framework is most suitable to support mProve in structuring the medication@home project and communicating about the project's progress. We divided the selection process into two phases as there are several frameworks that we can exclude for apparent reasons (phase 1). In phase 2, we used the Simple Multi-Attribute Rating Technique (SMART) to select the best framework.

3.3.1 Selection phase 1: Framework's focus

8 of the 29 frameworks we found in our literature search are not helpful for mProve due to their design focus. For example, three canvasses focus on designing a sustainable product or service: the eco canvas, the redesign canvas, and the triple-layered business model canvas (Daou, et al., 2020; Furqon, Sultan, & Wijaya, 2019; Kozlowski, Searcy, & Bardecki, 2018). These canvasses are variations on the business model canvas (BMC) to support companies to design closed-loop products. However, this is not the primary goal of the medication@home project. Two other canvasses support organisations with developing digital services. These are the digital service innovation canvas and the canvas for two-sided platform business model innovation (Rose, Holgersson, & Söderström, 2019; Taipale-Erävala, Salmela, & Lampela, 2020). As administering medications at home is a physical service, we do not use these canvasses for mProve.

Another framework that is not suitable for medication@home is the lean servitisation canvas, as this canvas focuses on after-sales service instead of the service itself (Rudnick, Riezebos, Powell, & Hauptvogel, 2020). Besides, we do not include the demand response business model canvas. Because with this canvas, the organisation must be able to modify the demand patterns, which is difficult to do in healthcare (Hamwi, Lizarralde, & Legardeur, 2021). We also do not include the BASE board framework for start-ups because the order of the framework's components does not match with the situation of mProve. With the BASE board, you first test your idea for a product or service and then develop a company vision and goals (Duane, 2021). However, the mProve hospitals already have a vision and goals, so the medication@home project should fit these.

3.3.2 Selection phase 2: SMART

We used SMART to determine which of the remaining 21 frameworks is the best framework for mProve. SMART is a formal multi-criteria decision analysis (MCDA) method that is fully compensatory (Jeffreys, 2004). In short, the SMART works as follows. The first step is to identify 'n' independent criteria and assign them a weight (w_i). Then one determines for each alternative 'a' the normalised scores on the criteria (V_i). The best alternative is the option with the highest average score (V) (Risawandi & Rahim, 2016).

$$V(a) = \sum_{i=1}^{n} w_i * V_i(a)$$

Identify criteria

We selected seven independent criteria for the SMART analysis. In this subsection, we explain the criteria. Osterwalder & Pigneur (2004) identified four pillars for business models, which are "what",

"who", "how", and "how much". We used these pillars as criteria to check whether the frameworks we found cover all the aspects of a business model.

- The "what" pillar describes what an organisation offers, also called the value proposition.
- The "who" pillar explains who the customers of the product or service are.
- The "how" pillar describes how the product or service is realised, also called the infrastructure.
- The "how much" pillar shows the financial aspects of the product or service.

In addition to these four criteria, we added the criterion "why". This criterion checks whether the frameworks consider the strategic model of the organisation when (re)designing a product or service, as a (new) product or service should fit with the organisation's vision and mission.

Criterion 6 is a "systematic approach". As indicated in the introduction of this chapter, the framework should support mProve in a systematic approach of the medication@home project. Based on Collins (2021) definition of a systematic approach, we identified two ways for a framework to support a systematic approach, by suggesting an implementation order of the framework's components and by describing the relationship between the components.

Criterion 7 is "key performance indicators (KPIs)", as one of the goals of the medication@home project is to define KPIs for medication care at home (mProve, 2020a). Therefore, it is helpful for mProve if the framework also includes KPIs.

Criteria weight

We determined the weights of the criteria by using SMART's swing approach (Table 6) (Risawandi & Rahim, 2016). The "systematic approach" criterion has the highest weight because the main goal of the framework is to support mProve in a systematic project approach. Subsequently, the four criteria that belong to the business model pillars received the same weight as they are equally important (Osterwalder & Pigneur, 2004). They have the second-highest weight because the framework should be able to support the design of a business model. The weight of criterion "why" has the same weight as the four pillar criteria because when there is no reason to design a product or service, it is also not interesting how or for who you create it. Finally, the criterion "KPIs" received the lowest weight because it is appreciated by mProve when KPIs are part of the framework, but it is not the main focus.

Table 6: Weight of the criteria for SMART analysis

Criteria	Weight
Systematic approach	0.21
What	0.15
Who	0.15
How	0.15
How much	0.15
Why	0.15
KPIs	0.04

We validated the weights in Table 6 by applying the Analytic Hierarchy Process (AHP) method. Besides, another researcher within the medication@home project, who was not involved in this selecting process, determined the weights using the SMART method. In both validations, the weight deviated 3% or less from the weights in Table 6. These deviations had no influence on which framework received the highest average score.

Assign scores

We used the uniform scale of SMART to assign a score to the criteria. 100 is the best score on this scale, and 0 is the lowest (Risawandi & Rahim, 2016). For all criteria applies that the more detailed the framework addresses the criterion's description, the higher the score. Table 7 shows all scores.

Table 7: Scores on 7 criteria for 21 frameworks (the date of the framework's source is shown in brackets).

Framework	Systematic approach (0.21)	What (0.15)	Who (0.15)	How (0.15)	How much (0.15)	Why (0.15)	KPIs (0.04)	Total score
Practical business design canvas (2017)	100	90	60	100	20	100	100	**81**
Service logic business model canvas (2015)	90	90	100	90	80	0	70	**76**
Service model canvas (2020)	60	70	70	60	70	0	90	**57**
Service dominant business model radar (2017)	0	100	60	80	100	0	0	**51**
Strategic model canvas (2018)	70	50	60	60	65	0	0	**50**
Innovation canvas (2013)	40	50	60	85	65	10	0	**49**
Lean canvas (2021)	10	70	80	50	65	40	0	**48**
Service business model canvas (2014)	0	80	70	70	90	0	0	**47**
Canvas4change (2021)	60	30	0	80	0	90	50	**45**
The product service system lean design methodology (2018)	60	50	90	30	0	0	90	**42**
Business model canvas (2010)	30	50	60	60	65	0	0	**42**
Social business model (2019)	0	60	60	60	65	0	0	**37**
Project canvas (2016)	20	30	40	40	0	70	80	**34**
A3 (2008)	80	0	0	20	0	60	60	**31**
The mobius loop (n.d.)	70	20	0	30	0	10	60	**26**
Mission model (2016)	0	50	0	60	45	0	0	**23**
The service dominant strategy canvas (2017)	0	40	60	50	0	0	0	**23**
Strategic lean six sigma framework (2016)	70	0	0	30	0	0	60	**22**
(Extended) DMAIC approach (2021)	60	0	0	10	0	30	60	**21**
DMADV approach (2019)	60	0	0	10	0	20	60	**20**
Framework lean product development (2011)	70	0	0	0	0	0	0	**15**

Best framework

Table 7 shows that the Practical Business Design Canvas (PBDC) has the highest average score, which means that, based on this SMART analysis, the PBDC is the best framework for mProve to (re)design the medication@home service. The table also shows that the PBDC has a lower score on the criteria

"who" and "how much". However, the Service Logic Business Model Canvas (SLBMC) scores high on these criteria. Therefore, mProve can use this SLBMC as additional support. Section 3.4 explains how the SLBMC can be used during the PBDC phases.

3.4 Selected framework: PBDC

As explained in Section 3.3, we selected the PBDC as the main framework to support the medication@home project approach. Kumaraswamy (2017) created this canvas to provide organisations with a simple structure to organise their business thoughts. We made some minor changes to Kumaraswamy's canvas to match the situation of the mProve hospitals, like changing "customers" to "patients". The PBDC consists of five phases (Figure 6). In phase 1, the organisation defines its strategic model, indicating what it wants to accomplish and why. Phase 2 focuses on the change, what are the plans to achieve the strategy model's objectives. Then, phase 3 explains these plans by filling in the business model, showing the product/service and the customers. How this product or service is delivered is described in the operating model (phase 4). Finally, the last phase defines the KPIs to measure the performance of the new plans. The KPIs will show if the strategy model's objectives are met. In the remainder of this section, we explain the five phases in more detail for the medication@home project.

The strategic model consists of five components. The mProve hospitals can start with defining their hospital's mission and vision. This explains what the business is and what the organisation wants its business to be. The drivers component describes the reasons why the organisation want or need to change their business. For example, pharmacists developed new medicines which are easy to administer at home. The mission, vision, and drives lead to the organisation's goals, where mProve explains what they want to achieve. The objectives make these goals specific by determining a measurable target.

When the strategy model's objectives are clear, the mProve can continue with the change phase. This phase consists of the components "course of action" and "programmes & projects". In the course of action, mProve can come up with several ideas or solutions to meet the objectives. Then they can set up programmes and projects for the courses of action they want to implement. It is helpful to assign specific success criteria to each program and project, as by defining these criteria up-front, it is clear how the change is meant to support the goals (Admin, 2017). Besides, the SLBMC can help to find suitable solutions and communicate them to get the project or program approved, especially when it comes to explaining the patient value and the financial aspects of the service (Section 3.3). Appendix B describes the SLBMC.

The third phase is the business model, which consists of four components. First, mProve can explain which service they will offer and which specific patient group it is meant for. Then, based on the service and the patient group, mProve can describe the customer journey. Here the hospitals explain their relationship and interaction with the patients. It is essential to be aware of the patient's expectations, needs and feelings throughout this process (Admin, 2017). Subsequently, the mProve can describe the capabilities. These are all the processes and actions an organisation needs to deliver the service. In this step, it does not matter who or how the activities are performed.

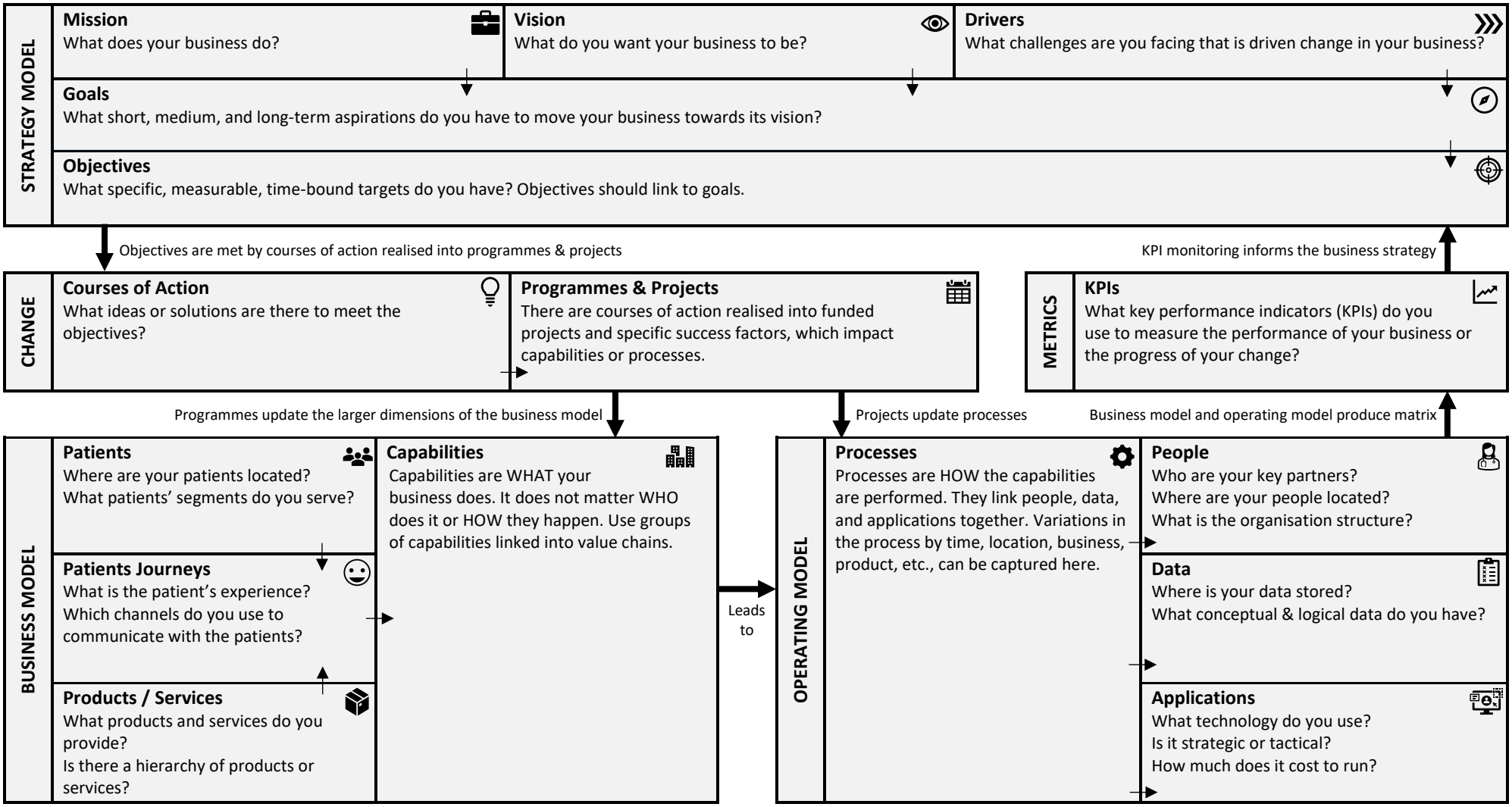


Figure 6: Adjusted Practical Business Design Canvas (Blanco canvas in Appendix C). Kumaraswamy (2017) created the original Practical Business Design Canvas.

The operating model then explains how an organisation performs its capabilities. The hospitals can describe their process step by step in the process component and include interesting process characteristics, like the time or locations. Subsequently, the hospitals can link each step to the people, data and applications that are needed. The people can be employees of the hospital, but also external partners. Hospitals can describe in the data component which data they store and how they do this safely. Finally, the application component shows which software applications are needed.

The last phase is the matrix, where mProve can define the KPIs. These KPIs inform the hospitals about if the strategy model's objectives are met. To easily keep track of the performance, hospitals can use a dashboard. When the project is started, mProve can use the Hoshin Kanri matrix to monitor whether the chosen objectives, programs, projects, and KPIs are still adequately aligned during the project's progress (Winasti, Merode, & Berrevoets, 2021). Appendix B explains the Hoshin Kanri matrix.

3.5 Conclusion

In this chapter, we answer the second research question: What framework supports mProve in a systematic approach for the medication@home project? To find this framework, we performed a systematic literature review and an informal search. This resulted in 29 frameworks for (re)designing a product's or service's business model. Based on the SMART method, we selected the Practical Business Design Canvas (PBDC) of Kumaraswamy (2017) as the main framework to support mProve in the project approach of medication@home. This framework consists of five phases: strategic model, change, business model, operating model, and KPIs. The KPIs close the loop by checking if the strategy model's objectives are indeed met.

The PBDC had a lower score on two criteria in the SMART analysis: the patient segment and the financial aspects of the service. However, the Service Logic Business Model Canvas (SLBMC) of Ojasalo & Ojasalo (2015) scored high on these criteria. Therefore, we advise mProve to use the SLBMC as additional support. mProve can use the SLBMC during phase 2 of the PBDC. Another model that mProve can use as additional support is the Hoskin Kanri matrix. During the PBDC phases, the user defines objectives, programs, projects, and KPIs. When the project progresses, mProve can use the Hoshin Kanri matrix to monitor whether these chosen objectives, programs, projects, and KPIs are still adequately aligned (Winasti, Merode, & Berrevoets, 2021).

We have now selected the PBDC framework for mProve. In the next chapter, we evaluate the PBDC within medication@home. In this evaluation, we examine whether the PBDC is indeed helpful for mProve and if the implementation of the framework succeeds.

4. Evaluation Practical Business Design Canvas

In this chapter, we evaluate the Practical Business Design Canvas that we selected in Chapter 3. During April and May 2021, the medication@home working group discussed the PBDC and filled it in. We have interviewed three working group members to examine whether the PBDC is indeed helpful for mProve and if the implementation of the framework succeeds.

This chapter addresses the following questions:

- Does the canvas support mProve in the medication@home project?
- What is the role of the canvas within the medication@home project from June 2021?
- How can the PBDC be further evaluated later in the medication@home project?

Section 4.1 describes how the PBDC supported mProve. Then, we examine how mProve will use the PBDC in the remainder of the medication@home project (Section 4.2). Subsequently, Section 4.3 explains how other researchers can evaluate the canvas in later phases of the project. Finally, Section 4.4 answers the third research question.

4.1 Implementing PBDC

In Chapter 3, we searched for a framework for mProve because there was no project planning or overview yet for the medication@home project. Therefore, we selected the PBDC to help the medication@home working group structure the project and support the communication about the project's progress. To examine whether the PBDC is indeed helpful for the working group and if the implementation of the framework succeeds, we interviewed three members of this group (Section 1.2). These were individual interviews, where we discussed the implementation, usefulness, and future role of the PBDC.

According to the interviewees, our introduction of the canvas came at the right time within the project. The medication@home working group had started to work on the project with enthusiasm. However, in February 2021, the group felt the need for an overview of the project's outlines and the agreements made so far. The PBDC met this need by providing a structured overview of the various project components, like the project's goal, actions and KPIs. According to two interviewees, the project leaders had already thought about all PBDC components, but not all group members knew the content of these components. Filling in and discussing the canvas ensured that all group members were aware of the project's outlines.

When filling in the PBDC, the group members followed the order indicated on the canvas and took the relationship between the different components into account. The members had already thought carefully about the mission and vision of the project, so these components gave no discussion. However, filling in the goals, objectives, and KPIs was more challenging, as they were not established before. Therefore, the interviewees found it helpful to discuss these components with all group members. One interviewee also said that defining the patients' journeys had been beneficial. By writing this down, instead of talking about it, the group was stimulated to properly consider the customer's perspective.

The working group made one change to the PBDC by replacing the "drivers" component with "preconditions". This was due to a small translation and interpretation error. The group defined preconditions as the criteria that must be met for the project to be viable. The interviewees find it helpful to keep the preconditions as part of the canvas. However, they disagree on whether "drivers" should be on the PBDC, but they decided to leave it out for now.

4.2 Future role PBDC

In May 2021, all working group members agreed on the canvas content, which resulted in PBDC version 1.0 (Appendix D). According to the interviewees, the project leaders find it important that the canvas stay up-to-date since the PBDC provides a structured project overview. However, the group did not make agreements yet to ensure that the canvas stays up to date. Further, the working group plans to use the canvas as the "backbone" of the project, which means that the PBDC will be the core document during discussions and decision-making about the project's progress. Besides, the project leaders want to use the PBDC to explain the medication@home project to new group members or other interested parties, like health insurers. They already used the canvas to clarify the medication@home project to the group members of the Noordwest Ziekenhuisgroep, who joined this project later.

4.3 Follow-up evaluation

Our evaluation of the PBDC is limited to the months in which the medication@home working group completed the canvas. The interviews showed that filling in the canvas in the first phase of the project was helpful for the working group. However, it is unknown if the PBDC also supports the group after May 2021. Besides, it is unknown if the PBDC is suitable for other (re)design projects in healthcare, like the connected care services in Isala (Subsection 1.2.1). Researchers can analyse this in about a year, as the CCC started implementing the PBDC in all connected care services. This allows researchers to evaluate the canvas more extensively and in a broader context.

The follow-up evaluation should focus on whether the canvas still supports the working group and if the canvas needs to be adjusted to match the project better. In particular, researchers can then check whether the component “preconditions” is indeed applicable and whether “drivers” should be part of the canvas again. Researchers can use the “program evaluation” framework of Milstein & Wetterhall’s (1999) to design the evaluation method for assessing the PBDC (Figure 7). The “program evaluation” framework explains six evaluations steps and a set of standards to evaluate the quality of evaluation activities (Milstein & Wetterhal, n.d.). The framework helps assess programs in the public health sector, where the term “program” describes the object or effort considered.

Figure 7: A framework for program evaluation (Milstein & Wetterhall, 1999)

4.4 Conclusion

In this chapter, we investigated the third research question: How does the selected framework support the medication@home project? We interviewed three members of the medication@home working group to examine whether the PBDC is helpful for mProve. The interviews showed that filling in the PBDC in the project's initial phase supported the working group. For instance, the PBDC fulfilled the group's need to list the project process and agreements by providing a structured overview of the various project components. Besides, filling in the goals, objectives, and KPIs was beneficial since the group members had not established this before.

Due to a small translation and interpretation error, the working group changed the "drivers" component into "preconditions". However, they decided to keep the precondition, as the group finds it helpful to have this on the canvas. A follow-up evaluation can analyse whether this was indeed beneficial. Besides, this evaluation can investigate whether the PBDC also supports the group after May 2021. Researchers can use Milstein & Wetterhall's (1999) framework for program evaluation to design the follow-up evaluation.

We have now evaluated the PBDC framework for the medication@home project, and there is currently no need to change the canvas. Therefore, we can analyse the value streams of several example medications in the next chapter. The value streams help mProve to evaluate their current processes for administering medication at home, which is the first action mentioned on their PBDC (Appendix D).

5. Value streams

In this chapter, we analyse the effectiveness and efficiency of three processes in Isala for administering parenteral medication at home. We do this by creating Lean value streams for the medicines Vancomycine, Pembrolizumab and Furosemide. The mProve hospitals want to assess their current processes because they want to know how to organise the medication care at home best, as they aspire to increase the number of parenteral medications administered at home (Section 1.1, Appendix D).

This chapter addresses the following questions:

- How can the Vancomycine value stream be improved on effectiveness and efficiency?
- How can the Pembrolizumab value stream be improved on effectiveness and efficiency?
- How can the Furosemide value stream be improved on effectiveness and efficiency?

Section 5.1 explains how we have created the value streams. Then, we show the results of the value streams in Section 5.2. Finally, Section 5.3 summarises this chapter and answers the fourth research question.

5.1 Method for creating value streams

In Chapter 2, we showed that Isala has several processes for administering parenteral medication at home. Due to the time restrictions of this research, we could not evaluate all pathways depicted in Figure 2. Therefore, we selected three example medications (Vancomycine, Pembrolizumab and Furosemide) whose processes variate from each other and together cover various process steps shown in Figure 2 to generate feedback for the actions.

The scope of the value stream analyses is the current administering process, starting when the physician considers home administration until the actual administration and registration at the patient's house. This is the same scope as we used in Chapter 2, but now we split the process into smaller steps. To create the value streams, we received assistance from a quality officer of the clinical pharmacy.

For each medicine, we have organised a meeting to draw the value stream together with all healthcare professionals listed for that medicine in Chapter 2. In the meetings, we discussed the administering process chronologically, and each professional explained their own actions. At the same time, the professional also explained any bottlenecks related to that action. We wrote the process steps and bottlenecks on post-its and placed them on a large piece of paper so that all participants could read the value stream. We also collected, where possible, the waiting time, preparation time, percentage “first time right”, and recovery time of each step. However, we asked the healthcare professionals to estimate this data due to time constraints.

After a meeting, we copied the paper value stream to an Excel format provided by the quality officer. We emailed this Excel sheet to the involved healthcare professionals and asked whether their actions were depicted correctly. Besides, we had a follow-up meeting with the healthcare professionals to finalise and discuss the value stream.

5.2 Value streams results

In this section, we discuss the results of the value stream analyses for the medicines Vancomycine, Pembrolizumab and Furosemide. The complete value streams are depicted in the confidential Appendix E, but Figure 8 gives an impression of the Vancomycine value stream. In the remainder of this section, we will first discuss the results per value stream and then compare the value streams.

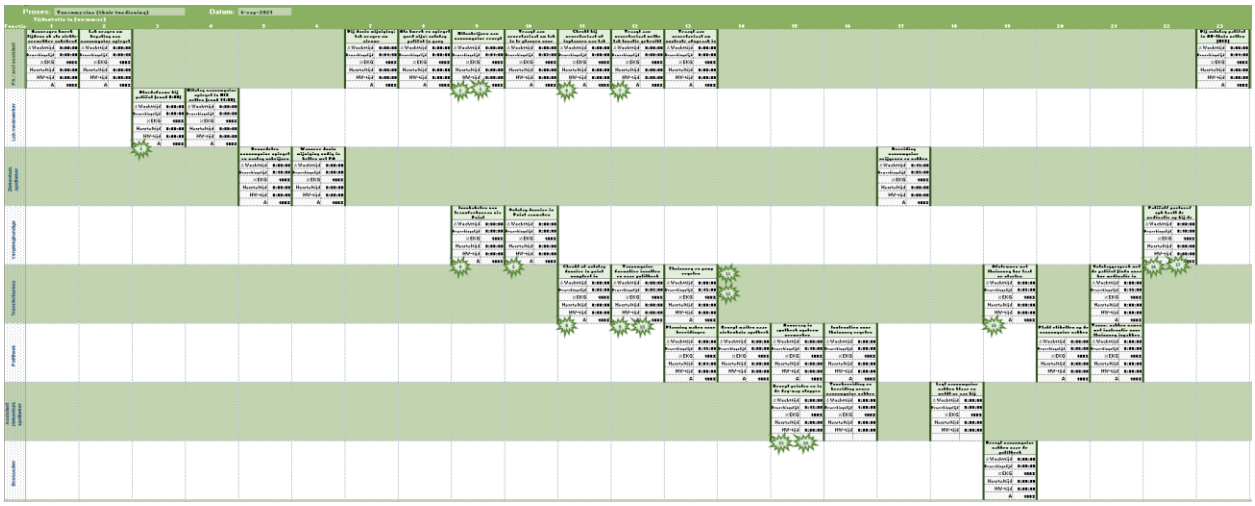


Figure 8: Impression of the value stream of the processes for administering Vancomycine at home[3]

5.2.1 Results value stream Vancomycine

The value stream analysis for Vancomycine has led to several new insights compared to the study described in Chapter 2. For instance, the research shows that besides the healthcare professionals mentioned in Figure 2, the laboratory and puncture centre of Isala also plays a role in the process. The physician needs to know the patient's Vancomycine level to assess whether the patient can go home. For this, a lab employee must draw blood from the patient and determine the level. The time the lab publishes this Vancomycine level in HiX is part of a series of bottlenecks in the process. The various parties involved in the process have mutually agreed on deadlines for specific steps. Before noon, the nurse must submit a complete discharge file in Point, including the Vancomycine level. Otherwise, the transfer agency postpones the discharge by one day because the outpatient pharmacy and clinical pharmacy must have enough time to complete their activities by 11 a.m. the following morning. In practice, this often means that if the lab employee does not draw blood in the round of 8 a.m., the deadlines later are not met, and the patient cannot go home the next day. A possible solution to this bottleneck could be that the physician requests an urgent lab when he thinks a patient can go home the next day, but the 8 o'clock round has already passed.

When the physician permits home administration, he must write a new prescription as the patient is no longer clinical. However, there are two types of prescription for Vancomycine: one for a dose below 1000 mg and one for higher doses. In approximately 20% of the cases, an (assistant) physician uses the wrong form, and then the pharmacy asks for a new prescription. Further, creating a new prescription consists of steps that do not add value, as the physician prints the new prescription to sign it and then a nurse needs to scan the prescription again to upload it in Point for the transfer agency. This process can be made more efficient if the physician could sign the prescription digital.

Another step in the value stream that does not add value is the check by the physician whether the secretariat scheduled the lab appointments correctly. When a patient receives Vancomycine at home, blood must be drawn once a week to check the Vancomycine level. Depending on the patient's medical situation, the blood can be drawn at home or at a puncture centre. However, the secretariat selects the wrong location in approximately 20% of the cases. Therefore, the physician feels compelled to check

[3]The value stream shows the actions of the various stakeholders in chronological order, where each row represents a stakeholder. The process steps where we have identified a bottleneck are marked with a star.

whether the lab is correctly scheduled. The establishing of a lab protocol might eliminate the physician's check.

Another bottleneck in the value stream is the Vancomycine form that the transfer agency fills in. When the nurse has uploaded all discharge information in Point, including the prescription and the Vancomycine level, the transfer nurse can fill in the Vancomycine form. Only this form is not always filled in correctly. Besides, during the value stream meeting, the healthcare professionals started a discussion about the usefulness of this form. They questioned whether the form is necessary or could be abolished when the prescription contains information on the Vancomycine level and duration of the treatment. Whether this is indeed possible is not known yet.

Furthermore, there are some bottlenecks related to arranging a home care organisation. The transfer agency explained that it is increasingly difficult to find a home care organization. Currently, it is still possible to find a home care organisation to administer Vancomycine, but they see the trend that it will become more difficult in the future. Sometimes it is already challenging to coordinate what time a home care nurse can connect the first pump. Since the patient is disconnected from the pump with Vancomycine in the hospital, the home care nurse must connect their pump within two hours. When a home care organization does not have a pump, the transfer nurse will arrange a pump by MediqTefa. However, the patient needs to find someone who can receive the pump, as it is delivered at home while the patient is in the hospital.

Another problem is that there is no agreement on who will collect the Vancomycine at the outpatient pharmacy when the patient goes home. Sometimes a nurse collects the medication, and otherwise, the patient or the patient’s family. Besides, not all nurses know that they can skip the queues at the outpatient pharmacy, resulting in a long absence from the nursing ward. Once the patient is home, the outpatient pharmacy checks the Vancomycine level every week. This check is unnecessary if the physician or the clinical pharmacist would always notify the outpatient pharmacy when the Vancomycine dose changes due to the Vancomycine level in the patient’s blood.

Finally, there are some bottlenecks related to the puncture centre. The staff members of the puncture centre are not qualified to draw blood from a PICC line. Therefore, they draw blood without using the PICC line, which is inconvenient for patients. Further, the secretariat does not always notify the puncture centre when a patient is suddenly hospitalized. As a result, an employee of the puncture centre goes unnecessarily to the patient's house. The puncture centre creates its routes by assigning zip codes to specific days in the week to restrict travel times. Only the physician asks to visit all Vancomycine patients on Monday, which increases the employees' travel time. When the puncture centre can divide the Vancomycine patient over two days, this bottleneck is solved.

5.2.2 Results value stream Pembrolizumab

The value stream analysis revealed that the first part of the Pembrolizumab process is more complicated than Figure 2 shows since the physician releases the prescription under reservation. This means that the physician permits the administration of Pembrolizumab at home. However, three additional checks are needed to determine whether the patient can receive medication care at home.

The oncology nurse performs the first check by verifying whether the patient meets all criteria for home treatment, like living within the maximum travel distance. When the patient meets all requirements, he can schedule the appointments with the secretariat, and the nurse publishes in HiX that the patient receives Pembrolizumab at home. However, this note disappears from the cover page in HiX after some

time, making it unclear to nurses which patients receive treatment at home. Furthermore, scheduling the appointments also results in bottlenecks since the secretary must select a suitable date for the home administration without support. Choosing a convenient day is complicated as both the treatment durations of all patients and travel times play a role. The efficiency of the planning, therefore, strongly depends on how the secretariat schedules the appointments. Another problem arising from this scheduling method is that patients receive a meaningless timeslot for the appointment by SMS or email. Isala automatically sends a few days for the appointment, a reminder by SMS or email mentioning the appointment's date and time. However, the secretariat determines the actual time slot of the appointment one day in advance when they make the route. The secretariat explains this situation to the patients, but it often leads to confusion, especially when family members receive the reminder.

As a second check to determine whether the home administration can continue, blood is drawn from the patient. Usually, the puncture centre performs this job. However, staff members of the puncture centre are not qualified to draw blood from patients with a VAB, PAC or PICC line, and about 10% of the Pembrolizumab patients have this. An oncology nurse visits these patients at home to draw blood. As a result, an oncology nurse can administer medication to fewer patients. If the staff members of the puncture centre can follow training on VAB, PAC and PICC line, they can help all patients.

The directing nurse performs the final check to decide whether Pembrolizumab can be administered at home. The day before the scheduled appointment, the directing nurse calls the patient to inform if the patient is feeling well. When this is the case, the administering can continue the next day. The directing nurse then removes the "reservation" checkmark from the prescription and publishes in HiX that the administration can continue. However, the directing nurse regularly forgets to remove the "reservation" checkmark. The oncology nurse then contacts the directing nurse to inform if the administration can continue or not.

In addition to the above supplements to the start of the Pembrolizumab process, we also identified other bottlenecks during the value stream analysis. For instance, when a nurse wants to administer medication to a patient, another nurse must always double-check and register this check in HiX. However, the difficulty is that HiX allows limited time between the registration of both checks. That is why the oncology nurses perform the double-check in the hospital before they go to the patient. They check whether the medication is correct, and they agree on the pump setting. The nurses also register the double-check in HiX, making it appear in HiX as if the patient has already received the medication. When the oncology nurse is at the patient's home, another double-check is performed. The oncology nurse calls the care coordinator in the hospital. In this call, the patient tells who he is, and the nurse mentions the medication. Besides, the oncology nurse sends a photo through WhatsApp to the care coordinator with the pump's settings without showing patient data. This double-check procedure could be simplified when, for example, the oncology nurse has access to an app or programme for secure video calls.

The last bottleneck in the process is the registration after the administration. The oncology nurses need to register the travel time and the treatment time per patient. To remember these times, the nurses write them on paper after each visit to a patient. At the end of the day, the nurses type the travel and treatment times in Word and send them by mail to the secretariat, who can then register the times in HiX. The "Word" step can be eliminated when the oncology nurses send a photo of the paper to the secretariat or write the times in HiX.

5.2.3 Results value stream Furosemide

The value stream analysis for Furosemide confirmed the Furosemide process depicted in Chapter 2. However, we identified several bottlenecks in this process. For instance, when the cardiologist permits home treatment for a patient, the chance-at-home nurse checks whether a cassette pump is available. If no pump is available, the nurse postpones the discharge. When a pump is available, the chance-at-home nurse checks whether they have Furosemide cassettes in stock. If this is the case, the chance-at-home nurse will directly connect the pump and cassette to the patient, and the patient can then go home. However, when there are no cassettes in stock, the chance-at-home nurse emails the order to the clinical pharmacy. Depending on the order time, the discharge is postponed by a few hours or even a whole day. The problem is that keeping cassettes in stock is complicated as cassettes are produced per patient, so there is a patient label on each cassette. Only when a patient needs fewer cassettes than expected, chance-at-home has a cassette in stock. As explained, a chance-at-home nurse emails a cassette order to the clinical pharmacy. An employee of the clinical pharmacy prints this email and then transfers the information to a form for the production department of the clinical pharmacy. If, for example, the chance-at-home nurse could fill in this form, then the “print and transfer” step can be eliminated.

Other bottlenecks in the process are related to the discharge procedure. When a cardiologist permits home treatment for a patient, a clinical pharmacy employee will adjust all non-cardiological medication to home medication in HiX. However, this employee also ends a Furosemide prescription in HiX. Therefore, a chance-at-home nurse can only add a Furosemide prescription in HiX after discharge. When a patient is discharged, the secretariat of the ward discharges the patient in HiX. However, in 50% of the cases, the secretariat processes the discharge later that day in HiX. While the chance-at-home nurse continuously checks whether the patient is already discharged in HiX because then the nurse can admit the patient to the virtual chance-at-home ward in HiX. The admission is essential as chance-at-home is responsible for the patient once he is discharged from the hospital. For the admission in HiX, the nurse fills the admission form and adds the Furosemide prescription. The cardiologist must approve this prescription in HiX within 24 hours since nurses can only prescribe medications when a physician gives consent within 24 hours. However, the chance-at-home nurses must always email the cardiologist to ensure that this is done in time.

Finally, the analysis revealed that the chance-at-home nurse also draws blood from the patient when visiting the patient at home. So, the chance-at-home nurse visits the patient every day to connect a new Furosemide cassette to the pump and to draw blood. After the nurse has seen all his patients, he brings the blood samples to the clinical chemistry lab of Isala. The lab must analyse these samples within two hours because the nurse must discuss the blood analysis results with the cardiologist before 5 p.m. Sometimes a lab employee does not realize that it is a blood sample of chance-at-home, and then the result is about 1.5 hours late.

5.2.4 Comparison of value streams

When we compare the value streams of Vancomycine, Pembrolizumab and Furosemide, several things stand out. For instance, the types of bottlenecks identified in the value streams variate from each other. In the value stream of Pembrolizumab, there is a need for programs or apps that make the process more efficient and professional. Like when planning the appointments, performing the double-check and the registration after administration. While with Vancomycine, bottlenecks are more related to meeting deadlines, filling in forms correctly, and proper communication between parties. Like informing the puncture centre that a patient is hospitalised again.

Some bottlenecks occur in multiple value streams. For example, in the value streams of Vancomycine and Furosemide, information sharing often happens via email since the different systems used by the various parties (e.g., HiX and Point) cannot communicate with each other. Therefore, healthcare professionals copy the information from the email into their system. Another bottleneck that occurs multiple times is that the puncture centre is not qualified to draw blood using a PICC line. Solving this problem would eliminate a significant bottleneck in the value streams of Vancomycine and Pembrolizumab.

Furthermore, we saw that there is almost no transfer of knowledge between the processes. For instance, a critical bottleneck in the value stream of Pembrolizumab is performing the double-check, as the oncology nurses need WhatsApp and a telephone call to do this. Besides, the registration in HiX cannot be done immediately after the administration. However, this is not a bottleneck in the value stream of Furosemide. The chance-at-home nurses have a hospital phone with skype and HiX in a secured environment to perform the double-check and registration. This could be a solution for the registration and double-check problems in the Pembrolizumab value stream.

5.3 Conclusion

In this chapter, we investigated the fourth research question: How can the effectiveness and efficiency of the current processes for administering parenteral medication at home be improved? We analysed this by drawing the Lean value streams of the medicines Vancomycine, Pembrolizumab and Furosemide in Isala. The value streams showed for all processes several opportunities for improving the effectiveness and efficiency.

In the value stream of Vancomycine, most bottlenecks are related to meeting deadlines, filling in forms correctly, and proper communication between parties. For instance, a critical bottleneck is the time when the Vancomycine level is published in HiX by the laboratory. When this is not done before noon, the transfer nurse will postpone the discharge by one day. Isala can investigate, for example, whether an urgent lab request could solve this bottleneck. The value stream of Pembrolizumab showed that there is a need for programs or apps that make the process more efficient and professional. Like when planning the appointments, performing the double-check and the registration after administration. The most significant bottlenecks in the value stream of Furosemide are the cassettes stock and the discharge procedure. If there are no cassettes in stock, the discharge can be postponed by one day.

We have now answered the four research questions of this study. In the next chapter, we will summarise our research results and provide recommendations for the mProve hospitals.

6. Conclusion and recommendations

In this chapter, we summarise the results and conclusion of our study in Section 6.1. Subsequently, we discuss our recommendations for the mProve hospitals (Section 6.2). Finally, we describe some interesting topics for further research in Section 6.3.

6.1 Conclusion

The aim of this study was two-folded: The first goal was to support mProve in a systematic project approach, as mProve had not defined the project planning and process for the medication@home project at the start of our research. This led to confusion about the project approach by the project stakeholders (Section 1.1). The second goal was to assess the current processes for administering medication at home because the working group had no overview of the mProve hospitals' experiences with medication administering at home. To meet these two goals, we have investigated the following research questions:

1. What are the current processes for administering parenteral medication in Isala and Rijnstate?
2. What framework supports mProve in a systematic approach for the medication@home project?
3. How does the selected framework support the medication@home project?
4. How can the effectiveness and efficiency of the current processes for administering parenteral medication at home be improved?

In Subsection 6.1.1, we describe the results and conclusions related to the systematic project approach. Then, we explain the findings associated with assessing the current processes for administering medication at home in Subsection 6.1.2.

6.1.1 Systematic project approach

We performed a systematic literature review and an informal search to find frameworks that can support mProve in a systematic approach of the medication@home project. These searches resulted in a list of 29 frameworks. Based on the SMART method, we selected the Practical Business Design Canvas (PBDC) of Kumaraswamy (2017) as the main framework to support mProve. The PBDC consists of five phases. In phase 1, mProve can define its strategic model, indicating what it wants to accomplish and why. Phase 2 focuses on the change, what are the plans to achieve the strategy model's objectives. Then, phase 3 explains these plans by filling in the business model, showing the product/service and the customers. How this product or service is delivered is described in the operating model (phase 4). Finally, the last phase defines the KPIs to measure the performance of the new plans. The KPIs will show if the strategy model's objectives are indeed met.

The SMART analysis showed that the PBDC has a limited focus on defining the patient segment and the financial aspects of the service. Therefore, we advise mProve to use the Service Logic Business Model Canvas (SLBMC) of Ojasalo & Ojasalo (2015) as additional support, especially during the second PBDC phase. Besides, mProve can use the Hoskin Kanri matrix as additional support to monitor whether the chosen objectives, programs, projects, and KPIs are still adequately aligned when the project progresses.

It is remarkable that SMART selected the PBDC as the best framework because, to the best of our knowledge, the PBDC is not discussed in scientific literature before. Therefore, from both a practical as a scientific point of view, it is interesting to know whether the PBDC performs well. So, we evaluated whether the PBDC is indeed helpful for mProve and if the implementation of the framework succeeds. For this, we interviewed three members of the medication@home working group. These interviews showed that filling in the PBDC at the project's initial phase supported the group. For instance, the PBDC fulfilled the group's need to list the project process and agreements by providing a structured overview

of the various project components. Besides, filling in the goals, objectives, and KPIs was beneficial since the group members had not established this before.

6.1.2 Assessing the current processes

Isala and Rijnstate administer more than thirty parenteral medications at home. However, the processes for prescription till the home administration of these medications are not unique for each medicine, as medicines of the same type often follow the same pathway. Therefore we used the seven medication examples selected by mProve as a basis for creating an overview of the existing processes (Table 3). Figure 2 and Figure 4, respectively, show the various pathways of Isala and Rijnstate for parenteral medications at home. We made these overviews based on a brown paper session in Isala and Rijnstate.

Figure 2 and Figure 4 show that Isala has seven processes for home administration and Rijnstate six. Besides, at least eleven parties are active in these processes per hospital. The outpatient pharmacy, the clinical pharmacy, transfer agency and the day treatment department are the parties that have a role in most pathways. Further, the figures show that many parties are involved in the delivery and administration step, while fewer parties are involved in the other stages. In these last two stages, there is contact with the patient, so which healthcare provider the patient will be in touch with really depends on the specific medication. Another striking matter is that in Isala, no party has a complete overview of all home administration. This makes the transfer of knowledge between processes complicated. In Rijnstate, the outpatient pharmacy has an overview of all home administrations when the new pathways of Figure 5 are implemented.

Figure 2 and Figure 4 provide an overview of the existing pathways in Isala and Rijnstate, but they do not show whether the processes are effective and efficient. This is valuable information for the mProve hospitals and scientists since, to the best of our knowledge, no research has been performed on moving the medication care to the patient's home without transferring other hospital care (Section 1.1). We analysed the effectiveness and efficiency of the processes using Lean value streams. To demonstrate this method, we selected the medicines Vancomycine, Pembrolizumab and Furosemide in Isala. The complete value streams of these drugs are shown in the confidential Appendix E.

The value streams showed for all processes several opportunities for improving the effectiveness and efficiency. In the value stream of Vancomycine, most bottlenecks are related to meeting deadlines, filling in forms correctly, and proper communication between parties. For instance, a critical bottleneck is the time when the Vancomycine level is published in HiX by the laboratory. When this is not done before noon, the transfer nurse will postpone the discharge by one day. The value stream of Pembrolizumab showed that there is a need for programs or apps that make the process more efficient and professional. Like when planning the appointments, performing the double-check and the registration after administration. The most significant bottlenecks in the value stream of Furosemide are the cassettes stock and the discharge procedure. If there are no cassettes in stock, the discharge can be postponed by one day. Finally, the value stream analyses in Isala also revealed that there is almost no transfer of knowledge between the processes.

6.2 Recommendations

We have several recommendations for the mProve hospitals. Some of these recommendations are based on data that we have collected in Isala. However, these recommendations are certainly helpful for other mProve hospitals when their situation is comparable to Isala in these respects.

Our main advice is that each mProve hospital should designate one party to overview all home administrations. This directing centre must overview all processes for home medication and when each

patient receives which medicine at home. The analysis in Chapter 2 showed that this overview lacks in Isala, as a result of which the knowledge about home administration is spread over several parties. This makes the communication and collaboration between parties from different processes complicated. However, this collaboration is crucial if a hospital wants to prevent that various nurses administer medication to the same patient at home. Besides the communication is needed to improve the transfer of knowledge between the parties. We believe that the directing centre can enhance the collaboration and transfer of knowledge between the parties by, for example, organizing a meeting twice a year where all parties involved in home medication are invited. In this meeting, the various parties can explain the bottlenecks they encounter, and others can tell how they solved them. When several parties experience the same problem, a solution can be sought together. Organising these meetings is also a way for the directing centre to stay informed on all processes.

We also recommend each mProve hospital to select one method for registering patients who receive home medication. The directing centre can, for example, create one virtual department in HiX to record all home administrations. When a hospital has different registration methods, it can become challenging to compare and improve the processes. For example, it was already complicated to collect data for Figure 3 on how many medicines were administered at home since the data registration differed per process.

Furthermore, we advise Isala to solve the bottlenecks in the Vancomycine, Pembrolizumab and Furosemide processes. In Chapter 5, we described solutions for some bottlenecks. However, more research is needed to find a solution for all problems (Section 6.3). Isala should eliminate the critical bottlenecks before using that process to administer more medicines at home. Besides, solutions should be shared between processes to learn from each other. For instance, there is a bottleneck related to performing the double-check in the Pembrolizumab value stream, while this is not the case for Furosemide.

Finally, we advise mProve to continue using the PBDC in the medication@home project. Since the evaluation in Chapter 4 showed that the PBDC supports the medication@home working group in a systematic project approach. Besides, a canvas is also a suitable tool to explain the project to new stakeholders (Coes, 2014). However, to do this, the canvas must remain up to date. Therefore, we recommend that the project leader checks the canvas twice a year and adjust it if necessary.

6.3 Further research

Besides recommendations, we also identified several aspects that require further research. We evaluated the PBDC based on three interviews with members of the medication@home working group. Our evaluation is, however, limited to the months in which mProve completed the canvas. Therefore, it is unknown if the PBDC also supports mProve after May 2021. Accordingly, we suggest that a follow-up evaluation focuses on whether the canvas still supports the working group and if it needs to be adjusted to match the project better. Later on, researchers can also investigate whether the PBDC is suitable for other (re)design projects in healthcare, like the connected care services in Isala. In Section 4.3, we discuss these suggestions for further research in more detail.

In Chapter 5, we created the value streams of Vancomycine, Pembrolizumab and Furosemide in Isala. Our value stream analyses are, however, limited to mapping and discussing the bottlenecks. To get a detailed overview of the extent to which various bottlenecks reduce the effectiveness and efficiency of the process, researchers can measure the waiting time, preparation time, percentage “first time right”, and recovery time of each process step. Subsequently, the researchers can investigate how Isala could solve these bottlenecks. Furthermore, it is still unknown how effective and efficient the other processes

described in Chapter 2 are. Finally, future research should focus on selecting suitable processes for home administration, as it is still unknown which (mix of) processes mProve hospitals can use best to administer medication at home.

References

Admin. (2017). *Canvas Guide*. Retrieved April 14, 2021, from Practical Business Design: http://practicalbusinessdesign.com/canvas-guide/

Almeida, T., Costa Avalone, M., & Fetterman, D. (2020). Building blocks for the development of an IoT business model. *Journal of Strategy and Management, 13*(1), 15-32. doi:10.1108/JSMA-07-2019-0130

Alowad, A., Samaranayake, P., Ahsan, K., Alidrisi, H., & Karim, A. (2021). Enhancing patient flow in emergency department (ED) using lean strategies–an integrated voice of customer and voice of process perspective. *Business Process Management Journal, 27*(1), 75-105. doi:10.1108/BPMJ-11-2019-0457

Anke, J. (2020). Enabling Design-Integrated Assessment of Service Business Models Through Factor Refinement. In S. Hofmann, O. Müller, & M. Rossi, *Designing for Digital Transformation* (pp. 394-406). Springer Nature Switzerland.

Azevedo, P., Reis Filho, P., Freitas, F., & Silva, S. (2018). Strategic Model Canvas: a tool proposition to optimize strategic planning. *Revista de Gestão e Projetos, 9*(3), 1-16.

Benjaminsson, F., Kronholm, T., & Erlandsson, E. (2019). A framework for characterizing business models applied by forestry service contractors. *Scandinavian Journal of Forest Research*, 779-788. doi:10.1080/02827581.2019.1623304

Burroni, L., Bianciardi, C., Romagnolo, C., Cottignoli, C., Palucci, A., Fringuelli, F.M., Biscontini, G., & Guercini, J. (2021). Lean approach to improving performance and efficiency in a nuclear medicine department. *Clinical and Translational Imaging, 9*, 129–139.

Cambridge Dictionary. (2021). *Cambridge Dictionary*. Retrieved April 26, 2021, from Framework: https://dictionary.cambridge.org/dictionary/english/framework

Carvalho, L., Galina, S., & Sánchez-Hernández, M. (2020). An international perspective of the business incubators' perception about business model canvas for startups. *Thunderbird International Business Review, 62*, 503-513. doi:10.1002/tie.22112

Coes, B. (2014). *Critically assessing the strengths and limitations of the business model canvas.* Master thesis Business Administration, University of Twente. Retrieved from https://essay.utwente.nl/64749/1/Coes_MA_MB.pdf

Collins. (2021). *Systematic approach*. Retrieved April 26, 2021, from Collins Dictionary: https://www.collinsdictionary.com/dictionary/english/systematic-approach

Cosio, L., Nieto-Hipolito, J., Garibaldi-Beltrán, J., Amaya-Parra, G., & Luque-Morales, P. (2016). Designing a Model of a Digital Ecosystem for Healthcare and Wellness Using the Business Model Canvas. *Journal of Medical Systems, 40*. doi:10.1007/s10916-016-0488-3

Daou, A., Mallat, C., Chammas, G., Cerantola, N., Kayed, S., & Saliba, N. (2020). The Ecocanvas as a business model canvas for a circular economy. *Journal of Cleaner Production, 258*.

Duane, J.-N. (2021). *All About That BASE: The Go-To Visual Guide for Building Your Business*. Retrieved May 5, 2021, from The startup equation: https://startupequation.com/2016/03/base-board-visual-guide-building-business/

Esfahlan, E., & Valilia, O. (2019). A Knowledge Oriented Framework to Enable New Service Development Using Axiomatic Design Theory: Focusing on Hotel Business Models. *Proceedings of 2019 15th Iran International Industrial Engineering Conference*, 267-273.

Fahrul Hassan, M., Chandra Mohan, T., Ismail, A., Taib, I., Mahmood, S., & Kafuku, J. (2019). Application of Design for Six Sigma (DFSS) in Sustainable Product Design: A Case Study on an Electric Kettle. *IOP Conference Series: Materials Science and Engineering, 607*. doi:10.1088/1757-899X/607/1/012002

Ferranti, E., & Jaluzot, A. (2020). Using the Business Model Canvas to increase the impact of green infrastructure valuation tools. *Urban Forestry and Urban Greening, 54*.

Fliegner, W. (2017). Analysis of the business model elements and their relationships. *Global Challenges of Management Control and Reporting*. doi:10.15611/pn.2017.474.05

França, C., França, G., Robèrt, K., Basile, G., & Trygg, L. (2017). An approach to business model innovation and design for strategic sustainable development. *Journal of Cleaner Production, 140*, 155-166.

Furqon, C., Sultan, M., & Wijaya, F. (2019). Business Development of Coffee Farmers Group Using Triple Layered Business Model Canvas. *Journal of Business & Economics Review (JBER), 4*(4), 163-170.

Grönroos, C. (2006). Adopting a service logic for marketing. *Marketing Theor, 6*, 317-333.

Hamwi, M., Lizarralde, I., & Legardeur, J. (2021). Demand response business model canvas: A tool for flexibility creation in the electricity markets. *Journal of Cleaner Production, 282*.

Hasan, A., Putri, N., Fithri, P., & Adzhani, S. (2020). Lassy dairy farm business development strategy using business canvas model method. *IOP Conference Series: Materials Science and Engineering, 1003*. doi:10.1088/1757-899X/1003/1/012049

Hoppmann, J., Rebentisch, E., Dombrowski, U., & Zahn, T. (2011). A Framework for Organizing Lean Product Development. *Engineering Management Journal, 23*(1), 3-15.

Isala. (2021a). *Over Isala*. Retrieved April 20, 2021, from Isala: https://www.isala.nl/over-isala/

Isala. (2021b). *Connected care*. Retrieved April 20, 2021, from Isala: https://www.isala.nl/over-isala/connected-care/

Iyede, R., Fallon, E., & Donnellan, P. (2018). An exploration of the extent of Lean Six Sigma implementation in the West of Ireland. *International Journal of Lean Six Sigma, 9*(3), 444-462. doi:10.1108/IJLSS-02-2017-0018

Jeffreys, I. (2004). The Use of Compensatory and Non-compensatory Multi-Criteria Analysis for Small-scale Forestry. *Small-scale Forest Economics, Management and Policy, 3*(1), 99-117.

Kajanus, M., Leban, V., Glavonijć, P., Krč, J., Nedeljković, J., Nonić, D., . . . Eskelinen, T. (2019). What can we learn from business models in the European forest sector: Exploring the key elements of new business model designs. *Forest Policy and Economics, 99*, 145-156.

Kline, W., Hixson, C., Mason, T., Brackin, P., Bunch, R., Dee, K., & Livesay, G. (2013). The innovation canvas - A tool to develop integrated product designs and business models. *120th ASEE Annual Conference and Exposition*.

Kort, E. (2021). *Wat is een brown paper sessie*. Retrieved June 21, 2021, from BrownPaperAudit.nl: https://brownpaperaudit.nl/wat-is-een-brown-paper-sessie/

Kozlowski, A., Searcy, C., & Bardecki, M. (2018). The reDesign canvas: Fashion design as a tool for sustainability. *Journal of Cleaner Production, 183*, 194-207.

Kucukaltan, B., Irani, Z., & Acar, A. (2020). Business model canvas for humanitarian operations of logistics service providers. *Production Planning & Control*.

Kumar, P., Singh, D., & Bhamu, J. (2021). Development and validation of DMAIC based framework for process improvement: a case study of Indian manufacturing organization. *International Journal of Quality and Reliability Management*. doi:10.1108/IJQRM-10-2020-0332

Kumaraswamy, T. (2017). *Practical Business Design*. Retrieved April 14, 2021, from practicalbuinessdesign.com: https://practicalbusinessdesign.com/

Leanstack. (2021). *What is Lean Canvas?* Retrieved May 5, 2021, from Leanstack: https://leanstack.com/lean-canvas

Leff, B., Burton, L., Guido, S., Greenough, W., Steinwachs, D., & Burton, J. (1999). Home Hospital Program: A Pilot Study. *JAGS, 47*(6), 697-702.

Leff, B., Burton, L., Mader, S., & Naughton, B. (2005). Hospital at Home: Feasibility and Outcomes of a Program To Provide Hospital-Level Care at Home for Acutely Ill Older Patients. *Annals of Internal Medicine, 143*(11), 798-808. doi:10.7326/0003-4819-143-11-200512060-00008

Levine, D., Ouchi, K., Blanchfield, B., Diamond, K., Licurse, A., Pu, C., & Schnipper, J. (2018). Hospital-Level Care at Home for Acutely Ill Adults: a Pilot Randomized Controlled Trial. *Journal of General Internal Medicine, 33*, 729-736. doi:10.1007/s11606-018-4307-z

Lüftenegger, E., Grefen, P., & Weisleder, C. (2012). The service dominant strategy canvas: Towards networked business models.

Mader, S., Medcraft, M., Joseph, C., Jenskins, K., Benton, N., Chapman, K., . . . Schutzer, W. (2008). Program at Home: A Veterans Affairs Healthcare Program to Deliver Hospital Care in the Home. *JAGS, 56*, 2317-2322. doi:10.1111/j.1532-5415.2008.02006.x

Marfuah, U., Nopianti, R., & Ambaria. (2019). Business development strategy with business model canvas approach at Pakdhe Mie chicken shop-Cimanggis, Depok. *International Journal of Scientific and Technology Research, 8*(2), 44-49.

Milstein, B., & Wetterhal, S. (n.d.). Introduction to Evaluation. In *Related Toolkits.* doi:https://ctb.ku.edu/en/table-of-contents/evaluate/evaluation/framework-for-evaluation/main

Milstein, B., & Wetterhall, S. (1999). Framework for Program Evaluation. *Centers for Disease Control and Prevention, 48*.

Mobius. (n.d.). *Outcomes over outputs*. Retrieved May 5, 2021, from Mobius: https://mobiusloop.com/

Moraes, A., Decarli, M., Westin, C., Soares, M., Vit, F., Jimenez, F., & Torre, L. d. (2019). Use of business model Use of business model canvas in bioprocesses engineering education at undergraduation level: Encouraging entrepreneurship and increasing motivation. *AIChE Annual Meeting, Conference Proceedings*.

mProve. (2020a). *Medication@home*. Retrieved February 9, 2021, from mProve: https://www.mprove.nu/projecten/medicatie-home/

mProve. (2020b). *Over mProve*. Retrieved February 9, 2021, from mProve: https://www.mprove.nu/over-mprove/

mProve. (2020c). *Thema's*. Retrieved February 9, 2021, from mProve: https://www.mprove.nu/thema-s/

mProve. (2021). Powerpoint presentation. *medication@home by mProve*. Retrieved February 1, 2021

NHS Foundation Trust. (n.d.). *UCLH@Home*. Retrieved June 7, 2021, from NHS University College Londen Hospitals: https://www.uclh.nhs.uk/our-services/find-service/medical-specialties-1/uclhhome

Ojasalo, J., & Ojasalo, K. (2018). Service Logic Business Model Canvas. *Journal of Research in Marketing and Entrepreneurship, 20*(1), 70-98. doi:10.1108/JRME-06-2016-0015

Ojasalo, J., & Ojasalo, K. (2020). Service logic business model canvas for lean development of SMEs and start-ups. In *Sustainable Business* (pp. 436-463).

Ojasalo, K., & Ojasalo, J. (2015). Adapting business model thinking to service logic: an empirical study on developing a service design tool. In J. Gummerus, & C. von Koskull, *The Nordic School: service marketing and management for the future.* Helsinki: CERS.

Oliveira, M. d., Sousa Mendes, G. d., Albuquerque, A. d., & Rozenfeld, H. (2018). Lessons learned from a successful industrial product service system business model: emphasis on financial. *Journal of Business and Industrial Marketing, 33*(3), 365-376. doi:10.1108/JBIM-07-2016-0147

Osterwalder, A. (2016). *The Mission Model Canvas: An Adapted Business Model Canvas For Mission-Driven Organizations*. Retrieved May 5, 2021, from Strategyzer: https://www.strategyzer.com/blog/posts/2016/2/24/the-mission-model-canvas-an-adapted-business-model-canvas-for-mission-driven-organizations

Osterwalder, A., & Pigneur, Y. (2004). An ontology for e-business models. In W. Currie, *Value Creation.* Butterworth-Heinemann.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation.* (T. Clark, Ed.) Hoboken, New Jersey: John Wiley & Sons, Inc.

Osterwalder, A., Pigneur, Y., & Tucci, C. (2005). Clarifying Business Models: Origins, Present, and Future of the Concept. *Communications of the Association for Information Systems, 16*. doi:10.17705/1CAIS.01601

Pezzotta, G., Sassanelli, C., Pirola, F., Sala, R., Rossi, M., Fotia, S., . . . Mourtzis, D. (2018). The Product Service System Lean Design Methodology (PSSLDM). *Journal of Manufacturing Technology Management, 29*(8), 1270-1295. doi:10.1108/JMTM-06-2017-0132

Project Canvas. (2016). *What is project canvas?* Retrieved May 5, 2021, from Project canvas: http://www.projectcanvas.dk/index.html

Ribbink, M., Gual, N., MacNeil-Vroomen, J., Ars Ricart, J., Buurman, B., & Inzitari, M. (2021). Two European Examples of Acute Geriatric Units Located Outside of a General Hospital for Older Adults With Exacerbated Chronic Conditions. *JAMDA*, 1-7. doi:https://doi.org/10.1016/j.jamda.2020.12.034

Ribbink, M., Macneil-Vroomen, J., van Seben, R., Oudejans, I., & Buurman, B. (2020). Investigating the effectiveness of care delivery at an acute geriatric community hospital for older adults in the Netherlands: a protocol for a prospective controlled observational study. *BMJ Open, 10*. doi:10.1136/bmjopen-2019-033802

Rijnstate. (2021a). *Over Rijnstate*. Retrieved April 21, 2021, from Rijnstate: https://www.rijnstate.nl/over-rijnstate/

Rijnstate. (2021b). *Cijfers en verslagen*. Retrieved April 21, 2021, from Rijnstate: https://www.rijnstate.nl/over-rijnstate/cijfers-en-verslagen/

Rijnstate. (2021c). *Topklinische zorg*. Retrieved April 21, 2021, from Rijnstate: https://www.rijnstate.nl/over-rijnstate/waar-staan-we-voor/topklinische-zorg/

Rijnstate. (2021d). *Rijnstate, voorop in de zorg voor jou*. Retrieved April 21, 2021, from Rijnstate: https://www.rijnstate.nl/vooropinzorgvoorjou

Rijnstate. (2021e). *De juiste zorg op de juiste plek*. Retrieved April 21, 2021, from Rijnstate: https://www.rijnstate.nl/over-rijnstate/waar-staan-we-voor/rijnstate-voorop-in-zorg-voor-jou/de-juiste-zorg-op-de-juiste-plek/

Risawandi, & Rahim, R. (2016). Study of the Simple Multi-Attribute Rating Technique For Decision Support. *Science and Technology, 2*.

Roberts, A. (2020). *Canvas collection - a list of visual templates*. Retrieved April 13, 2021, from Andi Roberts - Coach & Facilitator: http://masterfacilitator.com/canvas-collection-iii-a-list-of-visual-templates/

Rose, J., Holgersson, J., & Söderström, E. (2019). Designing innovative digital services for government: A business model canvas adaptation. *In Proceedings of the 27th European Conference on Information Systems (ECIS)*.

Rudnick, M., Riezebos, J., Powell, D., & Hauptvogel, A. (2020). Effective after-sales services through the lean servitization canvas. *International Journal of Lean Six Sigma, 11*(5), 943-956. doi:10.1108/IJLSS-07-2017-0082

Sawitri, D., & Suswati, E. (2019a). Strategy for Diversifying Typical Snacks of Trenggalek Products to Increase Competitiveness in the Era of SDGs by Using Business Model Canvas. *Advances in Economics, Business and Management Research, 100*.

Sawitri, D., & Suswati, E. (2019b). Trenggalek typical food diversification strategies for increasing competitiveness in the SDGS era by using a business model canvas. *International Journal of Innovation, Creativity and Change, 9*(4), 259-272.

Sazama, F. (2021). *canvas4change – visual change and innovation management*. Retrieved May 5, 2021, from canvas4change: http://canvas4change.de/

Shepperd, S., & Iliffe, S. (2005). Hospital at home versus in-patient hospital care (Review). *Cochrane Database of Systematic Reviews*(3). doi: 10.1002/14651858.CD000356.pub2.

Shepperd, S., Doll, H., Angus, R., Clarke, M., Iliffe, S., Kalra, L., . . . Wilson, A. (2014). Hospital at home admission avoidance. *Cochrane Database Syst Rev, 4*. doi:10.1002/14651858.CD007491

Sholichah, A., & Sutopo, W. (2020). Strategy Business of Battery Swap for Electric Vehicle Using Business Model Canvas. *IOP Conference Series: Materials Science and Engineering, 943*.

Shook, J. (2008). *Managing to Learn: Using the A3 management process to solve problems, gain agreement, mentor and lead.* Cambridge, MA, USA: The Lean Enterprise Institute.

Social business model canvas. (2019). *Jumpstart your social enterprise: get the social business model canvas*. Retrieved May 5, 2021, from Social Business Model Canvas: https://www.socialbusinessmodelcanvas.com/

STZ. (n.d.). *Isala*. Retrieved April 20, 2021, from stz ziekenhuizen: https://www.stz.nl/1306/over-ons/stzziekenhuizen/isala#:~:text=Isala%20in%20Zwolle%20is%20het,klinische%20opnames%20en%2051.000%20dagbehandelingen.

Sutrisno, W. (2019). Analysis of provider training business model development based on canvas business model approach. *IOP Conference Series: Materials Science and Engineering, 673*. doi:10.1088/1757-899X/673/1/012087

Taipale-Erävala, K., Salmela, E., & Lampela, H. (2020). Towards a New Business Model Canvas for Platform Businesses in Two-Sided Markets. *Journal of Business Models, 8*(3), 107-125.

Thomas, A., Francis, M., Fisher, R., & Byard, P. (2016). Implementing Lean Six Sigma to overcome the production challenges in an aerospace company. *Production Planning & Control, 27*, 591-603. doi:10.1080/09537287.2016.1165300

Turetken, O., & Grefen, P. (2017). Designing service-dominant business models. *In Proceedings of the 25th European Conference on Information Systems (ECIS)*, 2218-2233.

Turetken, O., Grefen, P., Gilsing, R., & Adali, O. (2019). Service-Dominant Business Model Design for Digital Innovation in Smart Mobility. *Business and Information Systems Engineering, 61*(1), 9-29.

UXM. (2020). *Introducing the service model canvas*. Retrieved from UXM: http://www.uxforthemasses.com/service-model-canvas/

Vargo, S., & Lusch, R. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing, 68*, 1-17.

Vargo, S., & Lusch, R. (2008). Service-dominant logic: continuing the evolution. *Journal of the Academic Marketing Science, 36*, 1-10.

Winasti, W., Merode, F. v., & Berrevoets, L. (2021). Het raamwerk en het proces van capaciteitsmanagement. In B. Berden, L. Berrevoets, F. v. Merode, & W. Winasti, *Capaciteitsplanning in de zorg* (pp. 23-39). Springer Media B.V.

Zolnowski, A., Weiß, C., & Böhmann, T. (2014). Representing Service Business Models with the Service Business Model. *47th Hawaii International Conference on System Science*. doi:10.1109/HICSS.2014.96

Appendix A: Systematic literature review

This appendix contains the log with all search terms for the literature study (Section A.1) and then describes how the sources for the literature study were selected (Section A.2). Finally, Section A.3 list all the sources that are part of the review.

A.1 Log of search terms

Table 8 shows the log with all search terms for the literature study.

Table 8: Log of the search terms for the literature review

Date	Database	Search term	Number of results
26-04-2021	Scopus	(Framework or Canvas) AND Design AND (product OR Service)	56228
26-04-2021	Scopus	“Framework” AND “Design” AND (product OR service)	55978
26-04-2021	Scopus	(Framework OR Canvas) AND "Design" AND "approach" AND (product OR Service)	23441
26-04-2021	Scopus	(Canvas) AND "Design" AND "approach" AND (product OR Service)	107
26-04-2021	Scopus	(Framework OR Canvas) AND "Business Design" AND (product OR Service)	46
26-04-2021	Scopus	"Design tool" AND (product OR service)	3820
26-04-2021	Scopus	"Design tool" AND "approach" (product OR service)	1120
26-04-2021	Scopus	"Design tool" AND "approach" (product OR service) AND (Canvas OR Framework)	191
26-04-2021	Scopus	"Business model canvas" AND "service logic"	2
26-04-2021	Scopus	"Business canvas" AND (Product or Service)	14
27-04-2021	Scopus	"Business model" AND (Design OR create) AND (Product OR Service)	4751
27-04-2021	Scopus	"Business model" AND (Design OR create) AND (Product OR Service) AND "approach"	1893
27-04-2021	Scopus	"Business model" AND (design OR create) AND (Product OR Service) AND "approach" AND (Canvas OR Framework)	526
27-04-2021	Scopus	"Business model" AND “Design” AND “Service” AND "approach" AND (Canvas OR Framework)	363
27-04-2021	Scopus	"Business model" AND (Design” AND “Service” AND "approach" AND “canvas”	45
27-04-2021	Scopus	(Framework OR Canvas) AND "create" AND (product OR service)	9324
27-04-2021	Scopus	(Framework OR Canvas) AND "create" AND "approach" AND (product OR service)	3286
27-04-2021	Scopus	Canvas AND "create" AND "approach" AND (product OR service)	36
27-04-2021	Scopus	(Framework OR Canvas) AND (design OR create) AND "Business"	20474
27-04-2021	Scopus	(Framework OR Canvas) AND (design OR create) AND "Business" AND "approach"	10583
27-04-2021	Scopus	“Canvas” AND (design OR create) AND "Business" AND "approach"	175

27-04-2021	Scopus	(Framework OR canvas) AND "Lean" AND (product or service)	1085
27-04-2021	Scopus	(Framework OR canvas) AND "Lean" AND (product or service) AND (design or create)	518
27-04-2021	Scopus	“Framework” AND "Lean" AND “service” AND (design or create) AND "approach"	176
27-04-2021	Business Source Elite	(Framework or Canvas) AND (Design OR Create) AND (product OR Service)	21797
27-04-2021	Business Source Elite	(Framework or Canvas) AND (Design OR Create) AND (product OR Service) AND "approach"	6321
27-04-2021	Business Source Elite	"Canvas" AND (Design OR Create) AND (product OR service) AND "approach"	29
27-04-2021	Business Source Elite	(Framework OR Canvas) AND "Business Design" AND (product OR service)	8
27-04-2021	Business Source Elite	"Design tool" AND (product OR service)	5780
27-04-2021	Business Source Elite	"Design tool" AND "approach" (product OR service)	863
27-04-2021	Business Source Elite	"Design tool" AND (product OR service) AND “Canvas”	15
27-04-2021	Business Source Elite	"Business model canvas" AND "service "	52
27-04-2021	Business Source Elite	"Business canvas" AND (Product or Service)	80
27-04-2021	Business Source Elite	"Business model" AND (Design OR create) AND (Product OR Service)	4482
27-04-2021	Business Source Elite	“Business model” AND (Design OR create) AND (Product OR Service) AND “approach”	937
27-04-2021	Business Source Elite	"Business model" AND (Design OR create) AND (Product OR Service) AND "approach" AND (Canvas OR Framework)	224
27-04-2021	Business Source Elite	"Business model" AND (Design) AND (Product or Service) AND “canvas”	26
27-04-2021	Business Source Elite	(Framework OR Canvas) AND (design OR create) AND "Business"	14579
27-04-2021	Business Source Elite	(Framework OR Canvas) AND (design OR create) AND "Business" AND "approach"	4266
27-04-2021	Business Source Elite	(Canvas) AND (design OR create) AND "Business" AND "approach"	46
27-04-2021	Business Source Elite	(Framework OR canvas) AND "Lean" AND (product or service)	567
27-04-2021	Business Source Elite	(Framework OR canvas) AND “Lean” AND (product or service) AND (design or create)	187
27-04-2021	Business Source Elite	(Framework OR canvas) AND “Lean” AND (product or service) AND (design or create) AND “approach.”	84

A.2 Source selection process

Table 9 shows how we selected the sources for the literature review. In total, we found 1132 sources with the search terms mentioned in Section A.1. By removing duplicates and assessing the sources, we found 40 suitable sources.

Table 9: Selection of sources for literature review

Search term	Scope	Date	Number of results
Database Scopus			
(Canvas) AND "Design" AND "approach" AND (product OR Service)	Title, keywords, abstract	26-04-2021	107
(Framework OR Canvas) AND "Business Design" AND (product OR Service)	Title, keywords, abstract	26-04-2021	46
"Design tool" AND "approach" (product OR service) AND (Canvas OR Framework)	Title, keywords, abstract	26-04-2021	191
"Business model canvas" AND "service logic"	Title, keywords, abstract	26-04-2021	2
"Business canvas" AND (Product or Service)	Title, keywords, abstract	26-04-2021	14
"Business model" AND "Design" AND "Service" AND "approach" AND "canvas"	Title, keywords, abstract	27-04-2021	45
"Canvas" AND "create" AND "approach" AND (product OR service)	Title, keywords, abstract	27-04-2021	36
"Canvas" AND (design OR create) AND "Business" AND "approach"	Title, keywords, abstract	27-04-2021	175
"Framework" AND "Lean" AND "service" AND (design or create) AND "approach"	Title, keywords, abstract	27-04-2021	176
Database Business Source Elite			
"Canvas" AND (Design OR Create) AND (product OR Service) AND "approach"	All	27-04-2021	29
(Framework OR Canvas) AND "Business Design" AND (product OR Service)	All	27-04-2021	8
"Design tool" AND (product OR service) AND "Canvas"	All	27-04-2021	15
"Business model canvas" AND "service"	All	27-04-2021	52
"Business canvas" AND (Product or Service)	All	27-04-2021	80
"Business model" AND "Design" AND (Product or Service) AND "canvas"	All	27-04-2021	26
"Canvas" AND (design OR create) AND "Business" AND "approach"	All	27-04-2021	46
(Framework OR canvas) AND "Lean" AND (product or service) AND (design or create) AND "approach"	All	27-04-2021	84
Total number of sources in Mendeley			**1132**
Removal of duplicates			435
Removed based on title and abstract			596
Removed due to no access (exclusion criteria)			15
Removed based on other exclusion criteria			46
Total number of sources selected for review			**40**

A.3 List of sources included in the review

Table 10 shows the 40 sources that we selected for the literature review in Section A.2.

Table 10: The 40 sources selected for the systematic literature review

Framework	Sources
A3	(Alowad, Samaranayake, Ahsan, Alidrisi, & Karim, 2021)
Business model canvas	(Almeida, Costa Avalone, & Fetterman, 2020) (Benjaminsson, Kronholm, & Erlandsson, 2019) (Carvalho, Galina, & Sánchez-Hernández, 2020) (Cosio, Nieto-Hipolito, Garibaldi-Beltrán, Amaya-Parra, & Luque-Morales, 2016) (Esfahlan & Valilia, 2019) (Ferranti & Jaluzot, 2020) (Fliegner, 2017) (França, França, Robèrt, Basile, & Trygg, 2017) (Hasan, Putri, Fithri, & Adzhani, 2020) (Kajanus, et al., 2019) (Kucukaltan, Irani, & Acar, 2020) (Marfuah, Nopianti, & Ambaria, 2019) (Moraes, et al., 2019) (Oliveira, Sousa Mendes, Albuquerque, & Rozenfeld, 2018) (Sawitri & Suswati, 2019a) (Sawitri & Suswati, 2019b) (Sholichah & Sutopo, 2020) (Sutrisno, 2019)
Canvas for two-sided platform business model innovation	(Taipale-Erävala, Salmela, & Lampela, 2020)
Demand response business model canvas	(Hamwi, Lizarralde, & Legardeur, 2021)
Digital service innovation Canvas	(Rose, Holgersson, & Söderström, 2019)
DMADV approach	(Fahrul Hassan, et al., 2019)
Ecocanvas	(Daou, et al., 2020)
(Extended) DMAIC approach	(Iyede, Fallon, & Donnellan, 2018) (Kumar, Singh, & Bhamu, 2021)
Framework lean product development	(Hoppmann, Rebentisch, Dombrowski, & Zahn, 2011)
Innovation canvas	(Kline, et al., 2013)
Lean servitization canvas	(Rudnick, Riezebos, Powell, & Hauptvogel, 2020)
Service business model canvas	(Anke, 2020)
Service dominant business model radar	(Turetken & Grefen, Designing service-dominant business models, 2017) (Turetken, Grefen, Gilsing, & Adali, 2019)
Service logic business model canvas	(Ojasalo & Ojasalo, Service Logic Business Model Canvas, 2018) (Ojasalo & Ojasalo, 2020)
Strategic lean six sigma framework	(Thomas, Francis, Fisher, & Byard, 2016)
Strategic model canvas	(Azevedo, Reis Filho, Freitas, & Silva, 2018)

The product service system lean design methodology (PSSLDM)	(Pezzotta, et al., 2018)
The reDesign canvas	(Kozlowski, Searcy, & Bardecki, 2018)
The service dominant strategy canvas	(Lüftenegger, Grefen, & Weisleder, 2012)
Triple layered business model canvas	(Furqon, Sultan, & Wijaya, 2019)

Appendix B: Additional Frameworks

This appendix explains the two frameworks that can support mProve during the PBDC phases. Section B.1 describes the Service Logic Business Model Canvas of Ojasalo & Ojasalo (2015). Then, we explain the Hoshin Kanri matrix in Section B.2

B.1 Service Logic Business Model Canvas

As explained in Section 3.4, mProve can use the SLBMC as additional support to find suitable solutions and communicate them quickly during the second PBDC phase. Besides, mProve can use the SLBMC to brainstorm about various business models. In this section, we first explain the basic principles of the SLBMC and then present the canvas's building blocks.

B.1.1 SLBMC principles

The SLBMC is developed by Ojasalo & Ojasalo (2015). They adapted the BMC to a canvas that takes the service logic principles into account. Here, the term "service logic" covers the basic principles of business logics that focus on customer value: service-dominant logic (SDL), service logic, and customer dominant logic (CDL) (Ojasalo & Ojasalo, 2015). The SDL believes that there is no value until the service is used and experienced by the customer, which means that the customer is always a co-creator of value (Vargo & Lusch, 2004; 2008). The service logic believes that the customer creates value by using the service/product in their daily activities (Grönroos, 2006). In the CDL, value emerges when a service becomes embedded in the customer's activities and the service company's activities (Ojasalo & Ojasalo, 2015). So, the general belief is that the value of a service is (co)created by the customer.

The SLBMC consists of nine building blocks, like the original BMC. The canvas gives a recommendation about the order of the blocks. However, the development of a business model is not a linear or straightforward process, but it is iterative. This means that the development of each block cannot happen in isolation from the development of the other blocks (Ojasalo & Ojasalo, 2015, p. 323). Each block includes the viewpoint of multiple stakeholders. In the original SLBMC, these are the company's and customer's perspectives, but we renamed these to hospitals' and patients' perspectives for mProve. However, in the fifth and the ninth block, we use the insurer's perspective instead of the patient's perspective. Because in the Dutch healthcare systems, the insurer and the hospital together determine the reimbursement amount. Figure 9 shows the adjusted SLBMC.

B.1.2 SLBMC building blocks

The first four blocks of the SLBMC focus on value creation. Block 1 is the patient's world and desire. Here the hospitals can analyse the patient's life in depth. According to the CDL, it is helpful to get a deep insight into the patient's activities, practices, and experiences (Ojasalo & Ojasalo, 2015). Because when the hospital understands what is essential to the patient, they can develop value propositions that correspond with the patient's needs (block 2). Block 3 focuses on how patients create value by using the value propositions to reach their goals. Hospitals can also analyse how their service becomes embedded in the patient's life (Ojasalo & Ojasalo, 2015). Then the "interaction & co-production" reflects how the patients participate in the hospital's service (block 4). Besides, this block analyses how the patients interact with the healthcare provider.

Block 5 is meant to list all the benefits and earnings that result from providing the service. Based on the value described in the first four blocks of the canvas, the hospitals and health care insurance can think of appropriate reimbursement. Besides the reimbursement, the hospitals can also list the other benefits of the service, for example receiving a quality certification.

<table>
<tr>
<td rowspan="2">Key Partners

From our point of view:
• Who are our key partners, and what are their roles?
• How do the partners benefit from the cooperation?

From patient's point of view:
• How does the patient experience our partners?
• What kind of partnership does the patient have with our partners?

7</td>
<td>Key Resources

From our point of view:
• What knowledge and skills do we need?
• What other materials and immaterial resources do we need?

From patient's point of view:
• Which skills or materials does the patient needs? 6</td>
<td rowspan="2">Value Proposition

From our point of view:
• What value do we deliver to the patient?
• What are the elements of our health care service?

From patient's point of view:
• What value does the patient receive?
• Which problems or challenges are solved?

2</td>
<td>Value Creation

From our point of view:
• How can we help patients to reach their goals?
• How does our health care service fit into the patient's world?

From patient's point of view:
• How does the value in practice emerge in a patient's life? 3</td>
<td rowspan="2">Patient's world and desire

From our point of view:
• How do we get a deep insight and a holistic understanding of the patient's world?

From patient's point of view:
• Who are the patients, and how does their world look like?
• What are the needs of the patient?
• If there are no limits, what would the patient's ideal care situation be?

1</td>
</tr>
<tr>
<td>Mobilise partners & resources
From our point of view:
• How do we coordinate the value creation?
• How do we utilise partners and resources?

From patient's point of view:
• How can the patient utilise partners and resources? 8</td>
<td>Interaction & co-production

From our point of view:
• How can we support the interaction between the patient and us?

From patient's point of view:
• What are the patient's activities during the health care service? 4</td>
</tr>
<tr>
<td colspan="3">Cost structure
From our point of view:
• What are the costs related to our health care service?
• What are our sacrifices besides the costs?

From a health care insurer point of view:
• What costs are required from the health care insurer?
• What are other sacrifices for the health care insurer?

9</td>
<td colspan="3">Revenue Streams
From our point of view:
• Which reimbursement can we receive for our health care service?
• How can we apply value-based pricing?
• What valuable things do we receive besides the reimbursement?

From a health care insurer point of view:
• What is the financial value for the health care insurer?
• For which (additional) benefits is the health care insurer willing to pay? 5</td>
</tr>
</table>

Figure 9a: Adjusted Service Logic Business Model Canvas with questions

<table>
<tr>
<td rowspan="2">Key Partners

From our point of view:

From patient’s point of view:

7</td>
<td>Key Resources

From our point of view:

From patient’s point of view:

6</td>
<td rowspan="2">Value Proposition

From our point of view:

From patient’s point of view:

2</td>
<td>Value Creation

From our point of view:

From patient’s point of view:

3</td>
<td rowspan="2">Patient’s world and desire

From our point of view:

From patient’s point of view:

1</td>
</tr>
<tr>
<td>Mobilise partners & resources
From our point of view:

From patient’s point of view:

8</td>
<td>Interaction & co-production

From our point of view:

From patient’s point of view:

4</td>
</tr>
<tr>
<td colspan="3">Cost structure
From our point of view:

From a health care insurer point of view:

9</td>
<td colspan="2">Revenue Streams
From our point of view:

From a health care insurer point of view:

5</td>
</tr>
</table>

Figure 9b: Adjusted Service Logic Business Model Canvas without questions

Block six to eight of the SLBMC focuses on what is needed to provide the service. This starts in block 6 by describing the resources. The hospitals can create a list with the required skills, medical knowledge, and materials like a car or a drib. The partners that are needed to provide the service are described in block 7. This block then analyses the roles of the partners and how they create value. Subsequently, block 8 focuses on utilising and developing resources and partners (Ojasalo & Ojasalo, 2015). In block 9, hospitals can analyse the costs of using the resources and partners mentioned in blocks six to eight. Besides the direct cost, the hospitals can also list the disbenefits of providing the service. Hospitals need to analyse their cost structure carefully since cutting certain expenses may negatively impact the patient value (Ojasalo & Ojasalo, 2015).

B.2 Hoshin Kanri

During the five PBDC phases, the user defines objectives, programs, projects, and KPIs. When the project starts, mProve can use the Hoshin Kanri matrix to monitor whether these chosen objectives, programs, projects, and KPIs are still adequately aligned during the project's progress (Winasti, Merode, & Berrevoets, 2021). By filling in the Hoshin Kanri matrix regularly, mProve can, for example, early check if objectives are indeed achieved.

Figure 10 shows the Hoshin Kanri matrix. This matrix starts in the middle, where the vision for the next three to five years is described. Then the user can write the chosen objectives, programs, projects, and KPIs in the rows and columns of the four white blocks. The third step is to place an "X" at the intersections of objectives and programs that are connected. The same can be done for the intersections between the other blocks. The "X" between the projects and the results, for example, shows which projects contribute to which KPIs. The user can link an objective/program/project/KPI to several other objectives/programs/projects/KPIs in the matrix.

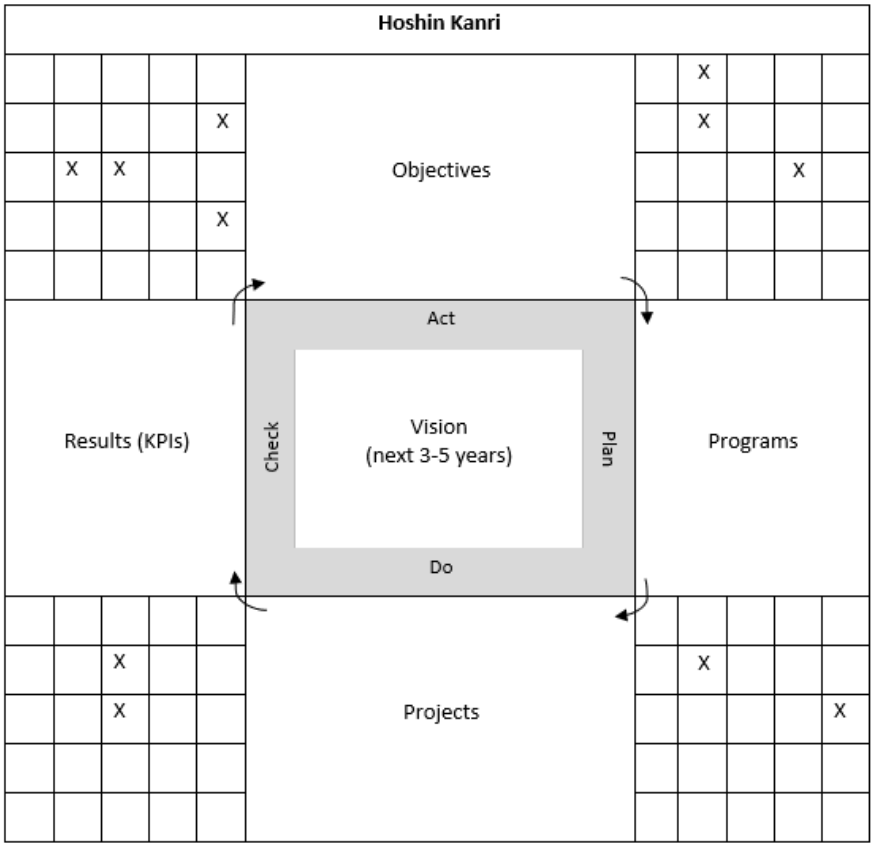
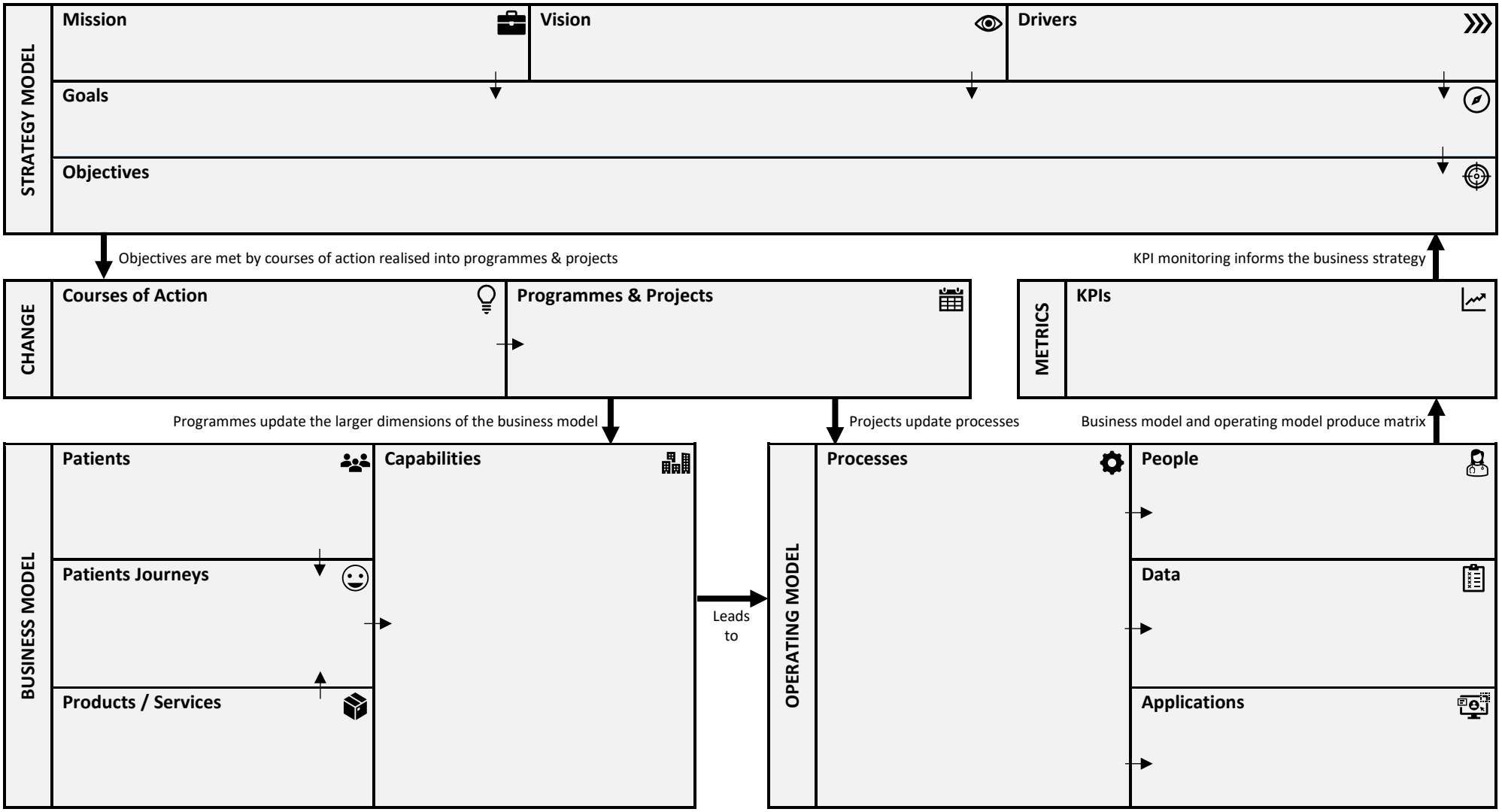


Figure 10: Hoshin Kanri matrix (Winasti, van Merode & Berrevoets, 2021)

Appendix C: Practical Business Design Canvas (adjusted)



Appendix D: Practical Business Design Canvas filled in by mProve

Confidential appendix

Appendix E: Value streams

Confidential appendix