An Analysis of the Cost-Effectiveness of an Extended Scope Specialist

Abstract

In this study, a cost-effectiveness analysis was conducted to assess the implementation of the Extended Scope Specialist (ESS) compared to usual care. Additionally, two different strategies within the ESS scenario were compared to usual care. Finally, the maximum allowable consultation rate for the ESS was determined using a decision tree model structure. The results were calculated through a probabilistic sensitivity analysis and a one-way sensitivity analysis. The findings of the study indicate an ICER outcome which is more in favor of the implementation of the ESS. Furthermore, it was observed that strategy two, which involves starting at the GP, is more cost-effective than strategy one, which begins directly at the ESS. However, it's worth noting that strategy two had a significantly smaller population. Additionally, the study suggests that the costs associated with the ESS can be increased up to 70 euros while still maintaining cost-effectiveness in favor of the ESS. It's essential to interpret these results with caution due to some uncertainties in the data input. Overall, this study contributes valuable insights into the cost-effectiveness of the ESS and provides guidance for the decision-makers in healthcare.

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S1737090

Master thesis Health Science

Word count: 12087

Date: 18-09-2023

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Content

Preface

First and foremost, I would like to express my gratitude to several individuals who provided invaluable assistance and support during the process of writing this thesis. I begin with my supervisors at the University of Twente. I extend my sincere appreciation to my primary supervisor, Dr. M.M.A. Kip, for guiding me throughout the entire research process and helping me achieve the best possible results. Additionally, I am grateful to my secondary supervisor, Prof. Dr. IR. H. Koffijberg, for his critical insights and support.

I would also like to acknowledge and thank my partners, NVES and the Diagnostic Center for Movement Care, for granting me the opportunity to delve into this subject and their invaluable assistance in obtaining the necessary data. Furthermore, I extend my appreciation to the participants and directors of the pilot study for generously providing their data for my research.

Last but certainly not least, I want to express my heartfelt gratitude to my friends, family, and roommates for their unwavering mental support throughout this journey.

I chose to study the implementation of the Extended Scope Specialist (ESS) due to its potential to significantly impact the healthcare system in the Netherlands. Additionally, I had previously conducted a stakeholder analysis on this topic, which yielded positive perspectives from the stakeholders regarding the ESS implementation. Encouraged by these findings, I was enthusiastic about further exploring the cost-effectiveness of this intervention, particularly in response to the partners' request to do so. The organization welcomed this initiative as it provided them with a more comprehensive understanding of the actual outcomes of the intervention, which could be instrumental in negotiations with other stakeholders.

My personal experience with ankle complaints added an extra layer of motivation to my research. It underscored the significance of the research process for me, as it could potentially lead to improved outcomes in addressing such issues.

Writing this thesis was not always a straightforward task. Challenges arose due to missing data and unfulfilled promises regarding data availability, making it difficult to collect the necessary information. This situation often necessitated the use of assumptions, which, in turn, slowed down the process. However, this experience taught me the valuable skill of making informed decisions when faced with data limitations.

I am hopeful that the knowledge I have gained through this study will prove beneficial in my new role as management trainee in a healthcare setting.

I would like to express my sincere gratitude for your interest in my research. I wish you an enjoyable reading experience and hope that the knowledge presented here will be of practical use.

Chapter 1: Introduction

In the Netherlands, there is increasing pressure on primary care due to the aging population and the increasing number of chronic ill patients (Bastiaens et al., 2021). This demographic shift has resulted in a substantial increase in patient numbers, consequently placing a heavier workload on General Practitioners (GPs), potentially compromising the quality of care they provide (Morken et al., 2019). The high demand for healthcare necessitates new innovations to achieve a more efficient healthcare system and prevent a decline in the quality of care provided by GPs, for instance. One particular inefficiency that has been identified in the health care provided by the GPs relates to unnecessary referrals within the musculoskeletal care domain (Schiphof et al., 2022). This problem leads to patients being unnecessarily directed to secondary care. As a result, there is an influx of patients in secondary care who do not require such specialized treatment, leading to unnecessary use of resources and extended waiting times within secondary care (Schiphof et al., 2022).

Currently, patients experiencing musculoskeletal issues have the option to seek treatment from either a physiotherapist or a GP (NHG, 2019). When a patient visits the GP, the GP attempts to provide an accurate diagnosis for the patient. Once a diagnosis has been established, the GP must decide whether the patient requires secondary care or if treatment can be provided in primary care. Thereby, the GP functions as a gatekeeper for secondary care. Nonetheless, owing to time constraints and their extensive familiarity with a wide array of medical concerns, they may lack in-depth specialized knowledge concerning certain issues, such as musculoskeletal issues (Morris et al., 2014). Therefore, GPs can struggle to diagnose patients accurately and will often refer a patient to a medical specialist for a more specialized knowledge. As a result, approximately 80% (Koeleman, 2022) of the patients, with musculoskeletal complaints, referred to a medical specialist do not require specialized care. Their treatment can be managed in primary care. This overburdens the secondary care system, leading to inefficiencies.

To address the issue of unnecessary referrals of patients with musculoskeletal issues to secondary care, a proposed innovation is the implementation of an Extended Scope Specialist (ESS) (Bastiaens et al., 2021). The ESS serves as a gatekeeper for primary care patients with musculoskeletal complaints. Operating as a primary care plus service, the ESS plays a crucial role in diagnosing patients with musculoskeletal complaints and bridging the gap between primary and secondary care. The primary goal of an ESS is to diagnose patients accurately and determine appropriate referrals ensuring that only those who truly require secondary care are referred (Bastiaens et al., 2021). This approach aims to reduce the number of patients unnecessarily referred to secondary care, thereby potentially lowering healthcare costs since primary care services are generally less expensive than secondary care (Landelijke Huisartsen Vereniging, 2023). By minimizing the number of patients directed to secondary care, the ESS strategy can also reduce the utilization of the own-risk deductible for patients and the high costs of medical specialists are avoided (De Jong et al., 2016). Additionally, the ESS has the capability to take over the care of patients with musculoskeletal complaints from GPs, thereby assisting in alleviating the GP's workload. Furthermore, by accurately diagnosing patients and ensuring appropriate referrals, the ESS helps prevent unnecessary and prolonged stays in the secondary care setting. This proactive approach reduces the strain on resources and allows secondary healthcare providers to allocate their attention and resources more efficiently to patients who genuinely require secondary care services.

The role of the ESS will be undertaken by a physiotherapist who has completed an additional education to become an ESS. Eligibility for this course requires a minimum of five years of experience as a master-level physiotherapist (NVES, 2023) (Eskes & Hallegraeff, 2021). Due to their specialized training and expertise specifically focused on musculoskeletal complaints (Bastiaens et al., 2021), an ESS possesses greater knowledge and experience in this domain compared to a GP, who typically has a broader but less specialized understanding of various medical conditions (Lebec & Jogodka, 2009). This expertise is one of the key motivations behind the implementation of the ESS, as they are expected to outperform GPs in terms of diagnosing patients with musculoskeletal complaints. Consequently, the ESS likely has the potential to reduce the current unnecessary referrals to a medical specialist.

The ESS was introduced in the Netherlands in 2017 (Sikkema, 2020), after being implemented in other countries for more than 20 years (Bastiaens et al., 2021). Despite its successful use in other nations, the ESS is still not widely implemented in the Netherlands. Currently, the ESS is only used in pilots and is not implemented yet in the Dutch health care system. The ESS has not yet received reimbursement from health insurers in the Netherlands, and it is still unclear how the ESS should be integrated into the healthcare system due to differences in interests between the health insurers and health care professionals. Nevertheless, there are comparable initiatives, such as in the field of ophthalmology, attempting to address similar issues in other specialties (van den Bogaart et al., 2021). Furthermore, there are healthcare centers that are also striving to provide expedited and appropriate care. In the UK, research has been conducted to compare patient satisfaction levels between treatment of an ESS, and an emergency nurse practitioner (McClellan et al., 2006). The study revealed a noteworthy contrast in patient satisfaction regarding the treatments they received from the two distinct roles, with the ESS (which in this paper is referred to as the ''Extended Scope Physiotherapist'') scoring higher at 55% compared to the emergency nurse practitioner at 39%. This finding highlights the positive impact that an ESS can have on patient experiences and further supports the potential benefits of implementing the ESS within the healthcare system.

To evaluate the effectiveness and identify the optimal implementation approach for the ESS, several pilot studies are currently being conducted (Bastiaens et al., 2021). These pilot studies aim to assess various aspects (Bastiaens et al., 2021) including the most effective referral structures, variations in tasks such as the permission for referral to secondary care and the application for additional diagnostic research, and settings for the ESS across different locations, such as placement within a hospital, a GP's practice, or a health center. One notable pilot was carried out at a GP's office, where the ESS was incorporated into the practice to assess patients with complex musculoskeletal complaints. Based on his diagnosis, the ESS determined whether a patient required referral to a physiotherapist or to a medical specialist. These ongoing pilot studies play a crucial role in gathering evidence on the impact of the ESS and informing the development of best practices for its implementation. This pilot is in Almelo, a city in the Dutch region Twente. It is set up in collaboration with the GPs' organization and the health insurer. This pilot study will also be used in this study as data source.

The results of the aforementioned pilot studies have indicated several notable advantages of implementing the ESS (de Boer et al., 2018). Firstly, patients experience an improvement in satisfaction due to reduced waiting times for care, as a result of the ESS implementation. Secondly, the accessibility of care improves as patients are referred to the appropriate specialist more efficiently, leading to shorter waiting lists and ensuring that patients receive timely assistance. This is further supported by the fact that inappropriate referrals are minimized due to the ESS's improved referral process. Consequently, patients are expected to receive the right care in timely manner which is in line with the plans of the Taskforce (Taskforce Juiste Zorg op de Juiste Plek, 2018). Thirdly, quality and efficiency of the Dutch healthcare system could be enhanced, potentially resulting in lower costs. Research conducted by Bastiaens et al. (2021) has demonstrated that the ESS is capable of achieving comparable or superior outcomes for patients with musculoskeletal complaints compared to a GP. The ESS's improved diagnostic accuracy and effective utilization of care resources contributes to patients receiving a more accurate and timely diagnosis, which can help prevent the progression of their condition (Pearse et al., 2006). In summary, the implementation of the ESS has been associated with advantages such as improved patient satisfaction, enhanced accessibility to care, and potential cost savings. The ESS's ability to provide accurate diagnoses, utilize care resources effectively, and prevent worsening of patients' conditions contributes to these positive outcomes.

A stakeholder analysis was conducted to determine the best way to implement the new ESS role in the Dutch healthcare system (Koeleman, 2022). This study focused on finding the best structure, the best location, the range of tasks, and manner of implementation. In the study of Koeleman (2022), there are different stakeholders interviewed, including physiotherapists, GPs, medical specialists, and health insurers, to gather their perspectives on the implementation of the ESS. The stakeholders were asked about factors that facilitate or hinder implementation, the conditions necessary for implementation, the ideal process for integrating the ESS into the healthcare system, the range of tasks that the ESS should perform, and the benefits of implementing the ESS.

The findings of the study (Koeleman, 2022) suggest that there is an interdependent relationship between the conditions for and barriers to implementation. Most stakeholders believe that the best way to implement the ESS is in primary care, outside of the hospital setting. According to the findings of the interviews conducted in the study, stakeholders hold the view that a GP's practice is the most suitable setting for the placement of an ESS. The stakeholders had varying opinions on the range of tasks that the ESS should perform, but most agreed that an independent role was crucial, although there was some disagreement on the specifics of the role. The stakeholders interviewed had differing perspectives on the tasks that an ESS should be allowed to perform. Some stakeholders believed that ESSs should be allowed to prescribe medication or request additional diagnostic testing, while others believed that these tasks should be reserved for medical doctors only. Lastly, stakeholders emphasized that ESS professionals must be well-educated and independent from their own physiotherapy practice. These findings are consistent with the choices made by the current pilots.

The ESS can operate from various locations, each with its own advantages. However, according to the pilot studies and the study from Koeleman (2022) the most common and convenient option thus far has been within a GP's practice. This option incurs the lowest costs as all facilities are already available, facilitating an easy implementation process. Other potential options, such as placing the ESS in a healthcare center or hospital, have been identified but are currently associated with too many drawbacks compared to the GP's practice. One of those drawbacks involves the higher costs of seeing a patient in secondary care while it is not needed (De Jong et al., 2016). When an ESS is based in a hospital, costs may be higher due to additional expenses of the own risk incurred by Dutch healthcare insurers. Another option is a healthcare center. This center must exist already, or the setup costs can be significant higher. Conversely, placing an ESS in a GP's practice can be cheaper as there are no additional expenses, and the facilities of the GP practice can be utilized. Therefore, there are numerous advantages to this approach. Therefore, in this study, the focus will be on one pilot which focuses on multiple musculoskeletal complaints in different body parts, such as the ankle, knee, and back located at a GP's practice. The selection of this pilot was based on the collaboration with the one major GP corporation in the Twente region and facilitated through support from a health insurer for the pilot study.

The pilot study is conducted in a GP practice where the GP's assistant is responsible for deciding whether to schedule an appointment with the GP or directly with the ESS. Consequently, two distinct structures have emerged in the pilot study: one where the patient starts with the GP and is subsequently referred to the ESS, and another where the patient is directly referred to ESS. In the scenario where the patient begins with the GP, the ESS can consider the GP's insights, potentially influencing the ESS's diagnosis.

Despite the positive results of various studies, making appropriate arrangements with health insurers remains challenging, which hinders progress in implementation (Dohmena & Van Raaij, 2018). One of the primary difficulties is agreeing on the hourly rate for ESS services. Health insurers are typically focused on reducing costs or increasing efficiency when implementing new interventions, and they have expressed concerns about the price of ESS services compared to other health professionals, such as medical specialists and general practitioners. Conversely, the ESS role represents an expansion of the current role of physiotherapists, with greater responsibilities and a wider range of tasks. As such, ESS practitioners believe they should be compensated at a higher rate than regular physiotherapists. This creates conflicting interests between the two stakeholders, making it challenging to reach an agreement.

To effectively convince health insurers of the benefits of implementing an ESS, it is essential to provide evidence of cost-effectiveness. Conducting a cost-effectiveness analysis becomes crucial in this context, as it allows for a comparison between the new approach with the ESS and the current situation without it. By conducting such an analysis, it becomes possible to determine whether the new approach is cost-effective compared to current practice. The cost-effectiveness analysis will assess the economic implications and effectiveness of implementing the ESS and compare it to the costs and effectiveness associated with the current situation. If the analysis yields positive results in favor of the ESS implementation, it strengthens the argument for persuading health insurers about the value and significance of the innovative model. Furthermore, the cost-effectiveness analysis can also help to determine the maximum fee at which the ESS is still cost effective compared with the current situation (i.e., without the ESS). Identifying the optimal ESS fee enables balancing implementation costs with potential savings and benefits from improved patient outcomes and resource use. In essence, conducting a cost-effectiveness analysis can persuade health insurers of an ESS's value when the outcomes demonstrate its positive impact. It allows comparing ESS and usual care, offering evidence for cost-effectiveness and fee discussions. Therefore, the goal of this study is to evaluate the cost-effectiveness of implementing an ESS in the healthcare system for patients with musculoskeletal complaints compared with current practice (i.e., without the ESS). The ESS will function as a gatekeeper between primary and secondary care, with the aim of reducing unnecessary referrals to secondary care.

To assess the cost-effectiveness of the ESS, a cost effectiveness analysis will be conducted using data from the pilot study. The aim is to obtain a holistic comprehension of the impacts and outcomes associated with the implementation of the ESS in the various scenarios, starting by the GP or go directly to the ESS. The main research question is: *''Is the implementation of the ESS cost-effective in comparison to the current situation without ESS?''.* Next to that, two sub-questions will be addressed:

1. *Which referral structure of the ESS is the most cost-effective?*
2. *When the outcome of the cost-effectiveness analysis is in favor of the ESS, what will be the maximum costs for the ESS in order to remain cost-effective?*
3. *When the outcome of the cost-effectiveness analysis is NOT in favor of the ESS, at which maximum costs for the ESS would the ESS become cost-effective?*

The first sub-question will explore the different ways in which referrals can be structured, such as starting with the GP or being directly referred to the ESS by the GP's assistant to assess the influences of the insights of the GP. The second and third sub-question will assess the sensitivity of the cost-effectiveness of the innovation to variable of the costs of the ESS, which means the hourly rate for the ESS. Since this has caused some tension between the ESS and the health insurer.

Ultimately, the results of this study will provide valuable information for key stakeholders, including health insurers, for making the right decision of implementing the ESS and for which price.

Chapter 2: Methods

In this chapter will outline the methodology used to address both the primary research question and the subordinate research questions. First the research context will be explained. Then the model structure of the decision tree that is used to calculate the ICER will be shown. Afterwards the data collection and data analysis will be explained. Finally, ethical considerations are provided. Furthermore, in this study ChatGPT is used as a search method support.

2.1 Research context

In this study, the pilot will be seen as the innovation with the implementation of the ESS and will be compared with the current situation. These situations will be compared with each other on their cost-effectiveness.

Figure 1a illustrates the current process for patients with musculoskeletal complaints, which involves four types of healthcare professionals. Patients start with an appointment at either a GP through the assistant GP or a physiotherapist. From that start they can follow the different paths that are shown in the figure.

Figure 1b illustrates the integration of an ESS into the existing process as an additional gatekeeper for secondary care. The ESS plays a role in assessing patients with musculoskeletal complaints and determining whether they require treatment in secondary care or can be effectively managed in primary care, thereby potentially reducing unnecessary referrals and healthcare costs. The pilot study is separated in two different strategies The patient will be referred to the ESS directly or will go first to the GP and then to an ESS. These strategies will be compared with each other and with usual care. When a patient with musculoskeletal complaints contacts the GP's assistant, the assistant can determine, based on a set of questions, whether the patient is better suited for an ESS rather than the GP. The ESS can collaborate with the GP to determine a treatment plan or prescribe medication. However, the ESS is not authorized to administer injections or prescribe medication.

Figure 1a

Usual Care for patients with musculoskeletal complaints

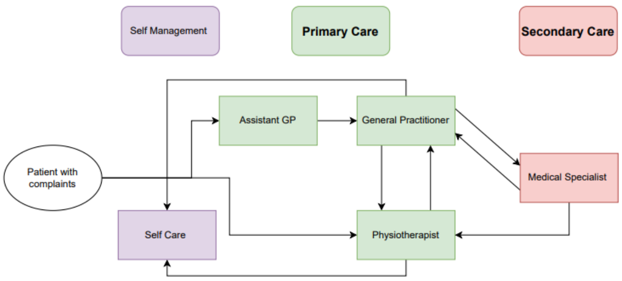


Figure 1b

Pilot situation 1 with implementation of ESS, strategy 1: starting directly with the ESS.

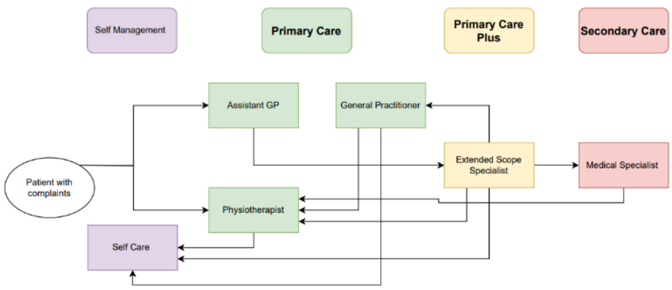
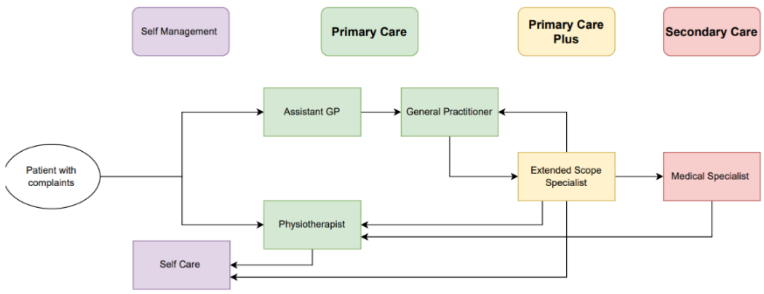


Figure 1c

Pilot situation 2 with implementation of ESS, strategy 2: starting with the GP then ESS.



2.2 Model structure

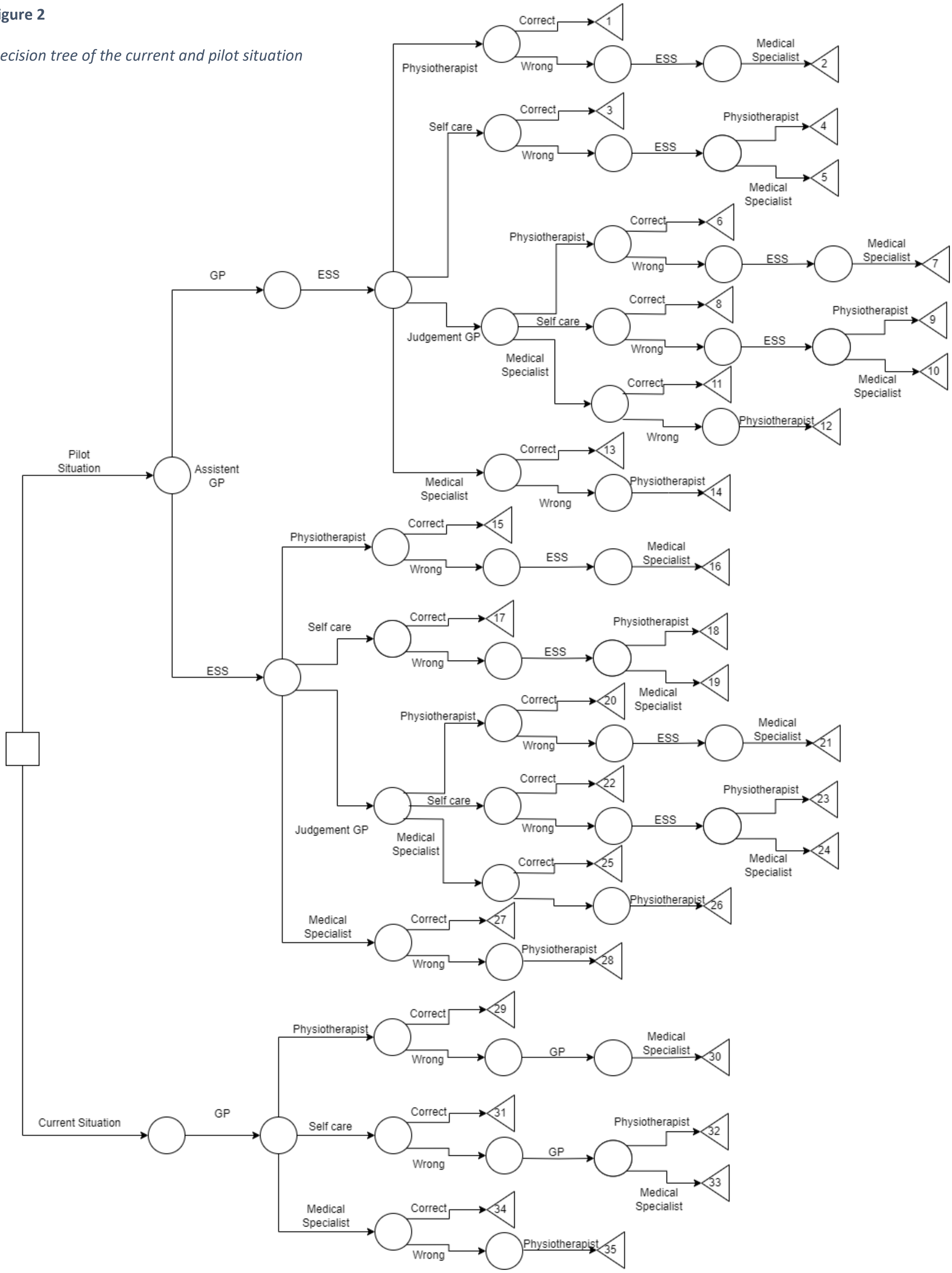
For calculating the cost-effectiveness, a decision tree framework is used. The decision tree shows the different possibilities a patients referral process can look like. Figure 2 (shown on the next page) visually represents the different potential pathways that can be taken within the pilot situation, with the two strategies, and the current situation (usual care). At each stage of the healthcare process, healthcare professionals are tasked with making choices regarding the patient's referral. The pathway continues until the correct referral is made. If the patient is not referred correct, the patient will be referred to another healthcare professional within the decision tree framework until they receive the necessary care.

The model structure incorporates some assumptions derived from pre-research interviews with key stakeholders, including pilot directors, NVES (Dutch federation for Extended Scope Specialist), and Diagnostic Centre Twente. The following assumptions guide the decision tree construction:

1. In the pilot scenario, if a referral is unsuccessful, the patient is initially redirected to the ESS, responsible for deciding whether to refer the patient to the appropriate healthcare professional. This assumption is based on pilot directors' input and the clients. These stakeholders include the practice manager at the location where the pilot is being conducted, the physical therapists who are actively involved, as well as associations such as NVES and the diagnostic center movement care.
2. After an incorrect referral, the most probable referrals are considered. While alternative referrals are conceivable, their likelihood is negligible. For instance, if the ESS initially referred a patient to a physiotherapist, and it was later determined that this referral was incorrect, the primary recourse would be to refer the patient back through the ESS to the medical specialist. In practice, self care is theoretically possible but is rarely pursued. Consequently, the decision tree excludes these fewer probable scenarios.
3. Another assumption made is that in the pilot situation, when a referral was incorrect, the patient will always return to the ESS first, unless they were initially referred to a medical specialist who is deemed capable of making the correct decision.

Figure 2

Decision tree of the current and pilot situation



2.3 Data collection

The data of the current process was obtained by a thorough examination of the available literature. Due to privacy legislations, health insurers were unable to provide precise data regarding the current referral numbers in the existing situation. In addition, the knowledge of various experts, including health insurers, board members of the ESS associations, physiotherapists, GPs, and medical specialists are used. Furthermore, the data for the study for the probabilities of the current situation is also gathered from organizations such as Nivel (Nivel, 2023), which served as an additional source of data.

In contrast, for the pilot situation, data acquisition is centered around analyzing the outcomes and discoveries from a pilot study. The data exists of patient information and referral information noted by ESS during the pilot. The data that is collected is as follows: date of treatment, ICPC (which is a code that specifies the body part in which they have complaints), whether they have had a consult from a GP beforehand or not, advice of the ESS, supervision of the GP after of the ESS, and if they came back within 6 months with the same complaint. Alongside, an extensive review of existing literature in the field was conducted.

The data collection includes three essential parameters for a cost-effectiveness analysis: probabilities, costs, and effectiveness. These parameters will be explained after the inclusion and exclusion criteria.

By using the data and insights from the pilot study and supplementing them with relevant literature, and the knowledge of experts, a comprehensive dataset is formed. This data can facilitate a thorough assessment of the cost-effectiveness of implementing the ESS in healthcare system in the Netherlands.

2.3.1 Inclusion and exclusion criteria

The data for this study is collected for the pilot situation and the current situation. The in- and exclusion criteria are different for the two situations. In the pilot situation, 343 of the 379 patients have been included. The remaining 36 patients were excluded due to missing data in one of the variables. The study period encompasses the entire duration of the patient's pathway until they receive the appropriate treatment. The maximum duration of the follow up of the patients is six months, aligning with the timeframe used in the pilots. Furthermore, the period of the pilot is from July 2022 until April 2023.

On the contrary, the data for the current situation is not based on a specific population. The data of the current situation is primarily based on data from the year 2019. This particular year was selected to ensure the exclusion of any unusual trends or patterns resulting from the COVID-19 pandemic, which may have impacted healthcare sector data in subsequent years, so these years are excluded from the analysis. Due to Covid-19 a lot of non-acute care was postponed. So, treatments like surgeries were postponed. But there was also a time that it was not possible to go to a physiotherapist. This can have biased the data reflecting the current situation, because there are probably less referrals due to Covid-19.

2.4 Data Analysis

The cost-effectiveness analysis is performed using R, a programming environment. Within RStudio, the Incremental Cost-Effectiveness Ratio (ICER) is calculated to assess the cost-effectiveness of the ESS compared with usual care. The ICER is calculated using the following formula:

$$\frac{\text{(Costs ESS - Costs Usual Care)}}{\text{(Effectiveness ESS – Effectiveness Usual Care)}} = \text{ICER}$$

This formula compares the difference in costs between the pilot and current situation with the difference in their respective effectiveness outcomes. In the calculations of the ICER, the two strategies are first examined combined, which means that the results of both cost-effectiveness are added up. Afterwards these strategies are examined separately to answer the first sub question. So, this means that that the pathways are calculated separately for these situations with their own parameters. The outcomes are added up into the total costs and total health outcomes for the pilot situation and the current situation.

2.4.1 Calculation of the costs

To calculate the costs of the pilots and the current situation, probabilities for each pathway are first determined. This involves multiplying the probabilities associated with each step within a pathway. For example, in the pilot:

*Expected probability pathway 1 = probability GPxESS * probability Physiotherapy * probability referral corrects*

The result of this calculation is then multiplied by the total costs associated with each pathway. The total costs are determined by summing up all the costs incurred within a pathway. The pilot population is segmented into two strategies, and the probabilities for these strategies are determined by assigning values based on the pilot data. For the probability of strategy two (starting at the GP), it is derived directly from the data. The probability for strategy one is calculated as one minus the probability of strategy two. divided into the two strategies. This process is repeated for each pathway per strategy in the pilot. The same approach is applied to the current situation. By subtracting the expected costs of the current situation from the costs of the pilot, the incremental costs can be calculated.

2.4.2 Calculation of the effectiveness

To calculate the effectiveness of the ESS and usual care, a similar approach is followed. The expected probability per pathway is multiplied by the effectiveness per pathway. The effectiveness is calculated by summing up the effectiveness values for each healthcare professional within a pathway. Effectiveness in this context is quantified by the number of days the referral process consumes. Consequently, incremental effectiveness refers to the difference in the number of days between the ESS and usual care.

By subtracting the expected effectiveness of the current situation from the expected effectiveness of the pilot, the incremental effectiveness can be determined. Another necessary step in calculating the ICER involves multiplying the incremental cost-effectiveness by -1, as it depends on the reduction in effectiveness days compared to the alternative situation. This step is essential because the effectiveness is expressed in terms of the number of days required, and the reduction in days is a crucial factor to consider.

2.4.3 Probabilistic Sensitivity analysis

To assess the impact of the uncertainty on the model outcomes, a probabilistic sensitivity analysis (PSA) is conducted (O'Hagan et al., 2006). This analysis aims to account for the inherent uncertainties in the variables and parameters used in health economic models for calculating cost-effectiveness. To perform this PSA, the Monte Carlo method is used. This means that the model will run many times by using randomly sampled values per parameter. This variation allows for a more robust evaluation of the decision model and provides insights into the potential effects on the ICER outcome, which will be explained in this paragraph.

By considering these uncertain parameters and conducting a PSA, the decision model can reflect the range of possible outcomes. This analysis allows for the calculation of different ICERs, considering the varying values of costs, probabilities, and effectivities. The Monte Carlo method in this study uses 10,000 iterations. The output of this analysis will be shown in an Incremental Cost-Effectiveness Plane (ICEP).

2.4.3.1Parameter probabilities

Probabilities serve as key inputs in a decision tree analysis. These probabilities are assigned to the branches and nodes within the decision tree in figure 2 to reflect the likelihood of the different events occurring. At each decision point, the assigned probabilities represent the chances of different options being chosen. Along each subsequent pathway, probabilities determine the likelihood of the specific outcome, the event of interest is whether the referral was correct.

Table 1 provides the probabilities associated with each position in the pathway. The probabilities for the pilot situation are derived from the provided data. It is based on the percentage of patients that is referred to a certain health care professional of the total patients 343 patients included in the pilot study. However, the probabilities for the current situation are based on percentages of 2019 from the Nivel organization. The determination of whether a referral was correct in the pilot study is based on the number of patients who presented with the same complaints after a 6-month period. Re-presenting after 6 months is considered an indication that they did not receive the right treatment and have therefore been referred again. This probability is utilized due to a lack of more detailed information regarding the outcomes following the referral. Therefore, referrals that resulted in errors within the span of 6 months are excluded from consideration. This information is not available for the current situation. This information is collected from Koeleman (2022), where interviews are held with experts.

Table 1 can be interpreted as depicting probabilities for the pilot, which are determined based on the proportion of all patients directed to a specific step in the process. For instance, the value 0.08 for "first to the GP than to the ESS" indicates that 8% of all pilot patients initially visited the GP at the assistant's recommendation and were subsequently referred to the ESS by the GP. Consequently, this implies that the remaining 92% of patients in the pilot began their journey directly at the ESS, as indicated in table 1. This immediately highlights the distinction between the two distinct groups within the pilot situation, which are subsequently compared.

The probabilities are defined using beta distributions. The randomized numbers are sampled by a beta range with an alpha and a beta. This is done with all the probabilities. The distribution for usual care is based on a population of 100 because there is no actual population, because due to privacy legislation, the right information is not available. This number for the population is chosen to be a comparable group to the population of the pilot study which is localized in Almelo in the region Twente.

In table 1, aside from displaying probabilities, the 95% confidence intervals are also provided. These intervals stem from 1,000,000 iterations utilizing the beta distribution. The interval is employed for a one-way sensitivity analysis. The analysis involves incorporating the lowest and highest values within this interval to calculate the outcomes of cost-effectiveness. This process yields both a minimum and maximum ICER, which is visualized in a tornado diagram to depict the range of possible results under varying conditions.. Furthermore, the table includes the alpha and beta parameters, instrumental for incorporating probabilities into the PSA.

Table 1

Probabilities of the decision model

Probabilities	Value	2.5% Cis	97.5% Cis	Alpha	Beta	Source
Pilot strategy 2: Start GP						
First GP -> ESS	0.08	0.0596	0.119	30	315	Data Pilot
Self Care	0.38	0.227	0.562	12	19	Data Pilot
Physiotherapy	0.41	0.254	0.594	13	18	Data Pilot
Judgement GP	0.14	0.0564	0.307	5	26	Data Pilot
Secondary Care (Medical Specialist)	0.07	0.0211	0.220	3	28	Data Pilot
After 6 months back with the same complaints	0.34	0.199	0.528	11	20	Data Pilot
Pilot strategy 1: Start ESS						
ESS	1 - first GP -> ESS	0.881	0.940	315	30	Data Pilot
Self Care	0.32	0.266	0.369	100	216	Data Pilot
Physiotherapy	0.47	0.414	0.523	148	168	Data Pilot
Judgement GP	0.04	0.0245	0.0695	14	302	Data Pilot
Secondary Care (Medical Specialist)	0.18	0.137	0.221	56	260	Data Pilot
After 6 months back with the same complaints	0.13	0.101	0.176	43	272	Data Pilot
Current situation						
Self Care	0.16	0.103	0.249	17	83	Nivel (2023)
Physiotherapy	0.63	0.489	0.672	64	46	Nivel (2023)
Secondary Care (Medical Specialist)	0.21	0.145	0.306	22	78	Nivel (2023)
Referral wrong	0.80	0.728	0.880	81	19	Koeleman (2022)

2.4.3.2 Parameter effectiveness

The effectiveness of the different pathways within the decision model is quantified based on the average number of days it takes for a patient to have an appointment with the appropriate healthcare professional.

Table 2 provides the parameters for the effectiveness, specifically in terms of the average number of days it takes for a patient to have their appointment. These parameters are derived from existing literature and serve to quantify the effectiveness of the various pathways considered within the decision model. They provide insights into the expected time difference associated with the different options in terms of accessing the appropriate healthcare professional. All the values are based on a mean of the number of days it can take to get an appointment.

The effectiveness input is also subject to variation for testing the sensitivity of the model. The effectiveness measure in this model does not remain constant and can vary in terms of the number of days. To avoid excessive influence from outliers, each parameter’s effectiveness is normalized by dividing it by a 50% margin. This approach is adopted because there are various factors affecting the effectiveness parameter that cannot be precisely measured. For instance, the current availability of healthcare professionals is among these uncertain factors. Furthermore, the minimum and maximum values are used to provide a one-way sensitivity analysis. The minimum and maximum values also provide the minimum and maximum ICER outcomes. These results are provided in a tornado diagram.

Table 2

Effectivity for the decision model

Effectivity	Value (workdays)	Min	Max	Source
Assistant to GP	3	1.5	4.5	Patiëntenfederatie Nederland (2023)
GP to Physiotherapist	7	3.5	10.5	Barten & Verberne (2015)
GP to Self Care	0	0	0	-
GP to ESS	7	3.5	10.5	Data Pilot
GP to Medical Specialist	14	7	21	Medisch Spectrum Twente (2023)
Assistant to ESS	7	3.5	10.5	Data Pilot
ESS to Physiotherapist	7	3.5	10.5	Barten & Verberne (2015)
ESS to Self Care	0	0	0	-
ESS to GP	3	1.5	4.5	Patiëntenfederatie Nederland (2023)
ESS to Medical Specialist	14	7	21	Medisch Spectrum Twente (2023)

2.4.3.3 Parameter costs

The data collected on costs encompasses various components related to consultations and treatments throughout the patient pathway. These costs comprise expenses associated with consultations with different healthcare professionals, including the GP, assistant GP, ESS, medical specialist, and physiotherapist. Moreover, this study considers societal costs, specifically travel expenses incurred by patients when visiting these healthcare professionals. Nonetheless, some costs like the loss of workdays, which hold limited relevance to the analysis, are not explicitly accounted for in the study. It's worth noting that most musculoskeletal complaints don't lead to a significant impact on productivity.

The costs per consultation or referral considered in this study remain consistent for both the current situation and the new situation, except for the costs associated with the involvement of the ESS. Nevertheless, the probabilities are different which can result in different outcomes. Since the ESS is seamlessly integrated into an existing GP office, there are no additional implementation costs incurred when there is enough space for the ESS. This was the case in the pilot study and therefore these costs are not included in this study.

Table 3 presents the costs associated with the decision model. In each situation, the costs attributed to every healthcare professional are assumed to be the same, because the number of consultations stay the same. In the pilot situation starting at the GP, the costs of the GP and the ESS are combined. The costs for the ESS are based on the costs in the pilot situation agreed with the health insurer. The costs of the medical specialist are a mean of a consult and treatment. The costs for a physiotherapist are limited to the first consult, assuming the patient is then at the right place. Travel costs are determined based on the guidelines provided by the Dutch Institute National Health Care (Zorginstituut Nederland)(2016), which take into account the average distance to a healthcare professional. A rate of 0.19 cents per kilometer is applied to calculate the total costs associated with travelling to each healthcare professional.

Table 3

Costs for the decision model

Costs	Definition	Value (euro)	Source
Assistant GP	Cost of a phone call with the assistant	5.75	Landelijke Huisartsen Vereniging (2023)
GP	Consult of 10-20 minutes	25.21	Landelijke Huisartsen Vereniging (2023)
ESS	Consult of 60 minutes	37.30	Data pilot
Physiotherapist	One starting consult	60.06	Menzis (2023)
Self Care	Doing exercises at home	0	-
Medical Specialist	Consult in hospital	500	CZ (2023)
Travel costs Hospital per visit	Cost included parking and going back as well	5.66	Dutch Institute National Health Care (Zorginstituut Nederland), (2016)
Travel costs Physiotherapy per visit	Cost included parking and going back as well	3.84	Dutch Institute National Health Care (Zorginstituut Nederland), (2016)
Travel costs GP per visit	Cost included parking and going back as well	3.42	Dutch Institute National Health Care (Zorginstituut Nederland), (2016)

2.5 Analyzing the different influences from different scenarios.

To address the first sub question, the PSA is executed separately. The two strategies within the pilot are separately compared to usual care. So, in the first strategy all patients went directly to the ESS. In the second strategy, all the patients of the pilot went to the GP and then to the ESS. In the first strategy, the probabilities for the GP and then to the ESS are set to 0, effectively excluding them from the PSA. In the second strategy, the pilot situation is only including the population which started at the GP and are then referred to the ESS. The probabilities associated with the ESS are therefore adjusted to 0.

The second and third sub question explores the optimal costs associated with the ESS, both strategies of the pilot study are here combined again. This investigation involves conducting a PSA with varying ESS cost inputs. The process begins at 30 euros and incrementally increases by 10 euros each time. This approach facilitates identifying the point beyond which the ESS becomes (not) cost-effective in comparison to usual care. These cost ranges were determined through dialogues with key stakeholders, including the NVES and health insurers.

By calculating different ICERS, decision-makers can gain insights into the cost-effectiveness of different options within the decision model under various scenarios. This information enables informed decision-making, considering the uncertainties and potential trade-offs associated with different pathways and interventions.

2.5 Ethical Considerations

The ethical considerations of this study are about the data that is collected for the pilot situation. These data came directly from the GP practice where the pilot is held. The data is not traceable back to individual patients and is anonymously processed. The only data that is visible is the kind of complaint like a knee complaint. Next to that, the referral to another health care professional is shown.

Chapter 3: Results

In this chapter the results will be reported about the cost-effectiveness of the implementation of the ESS.

The results are divided into the three research questions. Firstly, the main research question will be tackled. Then the two sub research questions will be tackled.

3.1 Scenario 1: the complete cost-effectiveness analysis

In this paragraph the outcomes of the PSA are given for the main research question. In this scenario all the possible parameters are tested on its variety. The results are given in figure 3 in an Incremental Cost-effectiveness Plane (ICEP). Figure 3 depicts the ICEP, generated by assigning random numbers to the specific parameters per scenario mentioned in the method. By incorporating randomness into the parameter values, this outcome provides a comprehensive view of the potential range of ICER values and highlights the uncertainty surrounding the cost-effectiveness estimates. The range of ICER values are visualized in the ICEP by the different circles.

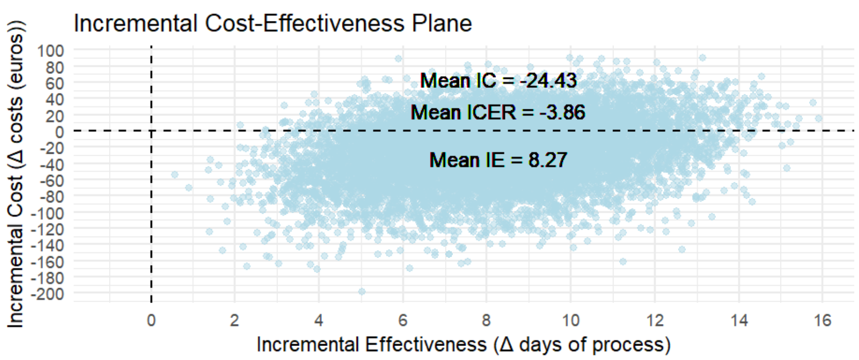
3.1.1 Probabilistic Sensitivity Analysis

In figure 3, the ICEP shows that most data points are situated in the south-east quadrant. This indicates that, when considering both costs and effectiveness, the ESS generally exhibits greater cost-effectiveness than usual care. Additionally, a subset of data points is situated in the north-east quadrant, implying that the ESS could be more cost-effective due to its superior effects. However, this outcome hinges on the allocated budget.

The incremental costs reflect a decrease of -24.43 euros, while the incremental effectiveness is 8.27. Both outcomes were in favor of the ESS. This results in a mean ICER of -3.86, which consequently indicates that the ESS is not only less expensive but also more effective. This translates to cost reduction of 3.86 euros per patient for each day a process within the ESS scenario takes less time.

Figure 3

ICEP Scenario 1



3.1.2 One-way Sensitivity analysis

Next to the PSA a one-way sensitivity analysis is executed. This is done for the effectiveness and the probabilities. This is done to assess the uncertainty in the parameters. The resulting analysis reveals which parameter has the most significant influence on the outcome of the ICER. In figure 4 and 5, the results of the one-way sensitivity analysis for the probabilities and the effectiveness are shown.

Table 4 displays the results of the one-way sensitivity analysis regarding the probabilities. The parameter associated with usual care, where the GP refers to the medical specialist (p. current_MS), exhibits the widest range in terms of ICER. The lowest value is -13.72, while the highest value is 2.97. interestingly, the referral from the ESS to the medical specialist (p.ESS_MS) also demonstrates a broad range in the ICER outcome. However, the distinction lies in the fact that the outcomes for the p.ESS_MS consistently favor the ESS, whereas p. current_MS can yield outcomes in favor of usual care as well. Moreover, there are two probabilities within usual care where the ICER outcome can potentially favor usual care. These probabilities involve the GP referring either to a medical specialist or to physiotherapy.

Figure 4

Tornado diagram of the variation in probabilities

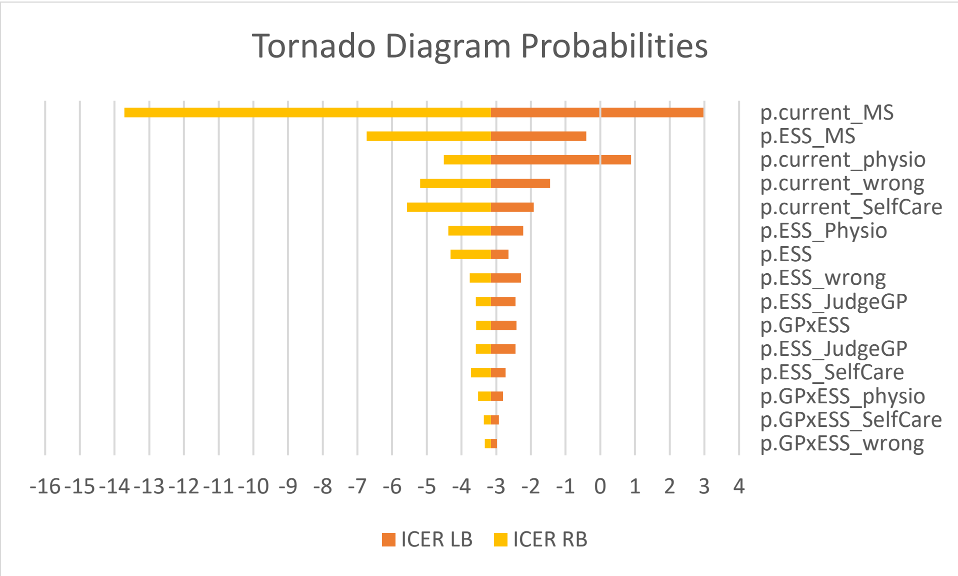
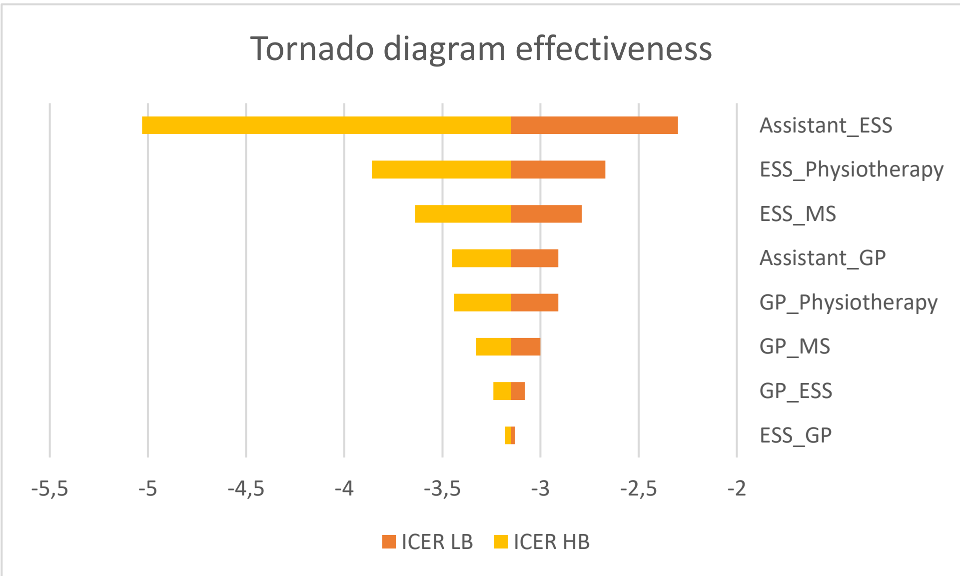


Table 5 shows that the parameter of effectivity based on assistant to ESS has the biggest difference in ICER outcome. This means that this parameter of effectivity is the parameter for effectivity has the biggest influence on the outcome of the ICER. However, the outcomes are still positive for the ESS.

Figure 5

Tornado diagram of the variation in effectivity



3.2 PSA based on the outcomes of the separate strategies in the pilot compared usual care.

In this paragraph, the outcomes of the comparison between the two distinct strategies in the pilot are examined. Firstly, the results of strategy 1, starting directly at the ESS is shown. Figure 6 depicts the ICEP, where most data points are situated in the south-east quadrant. Which means that the ESS has a better effectivity and cheaper costs than the usual care. The ICER outcome is better than the whole group. The ICEP shows that the incremental cost of -24 and the incremental effectiveness of 8.07 are both in favor of the ESS. The outcome of the ICER is -4.05, which is better than the combination. However, looking at the IC and the IE these results are almost the same as the combination. This already indicates that the influence of the GP is very small.

Figure 6

ICEP strategy1: only including the ESS.

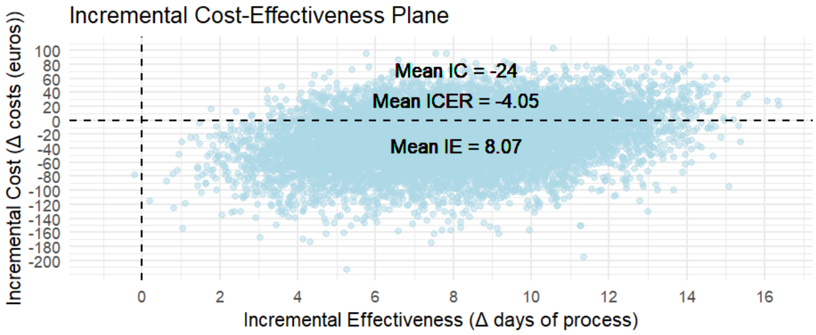
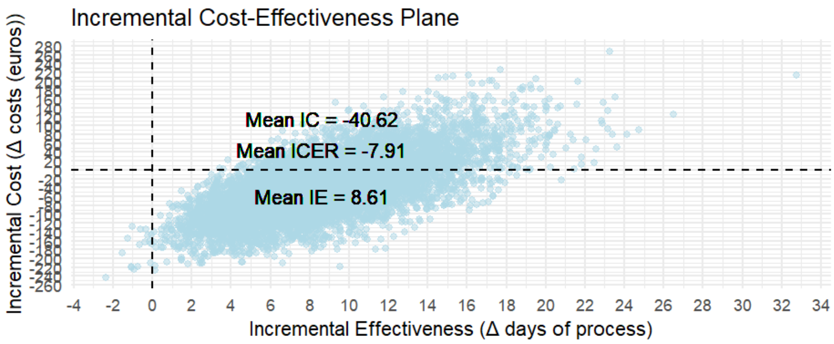


Figure 7 displays the outcomes of beginning with the GP visit and subsequently being referred to the ESS. The mean IC of -40.62 and the mean IE of 8.61 are both more in favor than the strategy one and the two strategies combined. This results consequently in a better outcome of the ICER at -7.91.

Figure 7

ICEP strategy 2: including the GP than ESS.



So, both ICEPs indicate positive outcomes for the ESS. However, the expectation that the influence of the GP would slow down the process and result in lower effectiveness for the ESS is not supported by the results. In fact, the results are even more favorable than strategy one and the combination of the strategies. Nevertheless, the influence of the second strategy is small. This can be attributed to the limited population of 29 patients compared to 314 patients for strategy one, that opted for this strategy in the combined PSA shown in figure 3. Another contributing factor to the limited influence is that, in the separate PSA for the strategies, all patients go through the GP, while in the combined PSA, these probabilities are adjusted by the distribution of the GP to the ESS, and the probability for the ESS is derived as one minus the probability of strategy 2.

3.3 Answer to sub question 2 and 3: Results of comparing different costs for the ESS.

In this paragraph, the results of testing the influence of ESS costs are presented. The ESS costs in the pilot were 37.30 euros per consultation.

Table 4 shows the results of using different costs for the ESS in the PSA. The effectivity stayed almost the same which is a consequence of no different input of the effectivity. If only looking at the Incremental costs, the costs of the ESS can be maximum 60 euros. However, looking at the mean ICER, the costs of the ESS can be increased to 70 euros.

Table 4

Results different costs inputs of the ESS.

Costs of the ESS (euros)	Mean Incremental Costs	Mean Incremental Effectiveness	Mean ICER
30	-33.7	8.11	-5.25
40	-23.96	8.11	-3.2
50	-13.02	8.32	-2.34
60	-3.78	8.35	-1.16
70	0.79	8.07	-1.65
80	6.23	7.86	0.21
90	14.37	7.82	1.44
100	28.41	8.08	3.23

Chapter 4: Discussion

4.1 Summary of the most important findings

The answer to the main research question: *''Is the implementation of the ESS cost-effective in comparison to the current situation without the ESS?''.* According to the results of the PSA, the ESS is more cost-effective than the usual care. The ICER ratio is -3.86, which means that the ESS is both cheaper and more effective than the usual care. This corresponds to a cost reduction of 3.86 euros per patient for every day a process within the ESS scenario is expedited. For instance, with a yearly influx of 52,800 new patients experiencing knee complaints, speeding up their referral process by 8.27 (IE) multiplied with 52,800 is 436,656 days of reduction. Next to that, it can reduce the costs by 24.43 euros multiplied with 52,800 is a reduction of costs of 1,289,904 euros. This further strengthens the argument for the implementation of the ESS, as it demonstrates the likelihood of positive results.

The results of the one-way sensitivity analysis on the probabilities reveal that the probability in usual care for referring to the medical specialist has the most significant influence, followed by the ESS referring to the medical specialist. This influence may be attributed to the high costs and effectiveness in the data input. A higher likelihood of referring to a medical specialist corresponds to a longer referral process in terms of the number of days it takes and higher costs for a referral.

Additionally, the outcomes of the one-way sensitivity analysis on the effectiveness indicate that the effectiveness of the assistant to the ESS has the most substantial impact. This influence may stem from the number of times the assistant is required to make the decision to refer to the ESS within the decision tree.

The positive outcomes for the ESS can influence the decision-making process of the important stakeholders. It may speed up the process of implementing the ESS. Moreover, the negotiations regarding costs could be expanded further, potentially leading to increased satisfaction among the physiotherapists who will execute the new ESS function.

Answering the first sub question: "*Which referral structure of the ESS is the most cost-effective?".* According to the PSA outcomes, strategy two commencing patients through the GP to the ESS is more cost-effective than strategy one which go directly to the ESS. The ICER for the ESS first strategy is -4.05, representing a cost reduction of 4.05 euros per patient for each day within the ESS process. The ICER for strategy two is -7.91.

This outcome contradicts the initial expectations. To elucidate this phenomenon, one possible cause could be the lower probability of patients in strategy two going to a medical specialist compared to strategy one, which leads to reduced costs and shorter duration of the referral process. This is plausible because, in the separate PSA, all patients go through strategy two, whereas in the combined PSA, the population of strategy one is significantly smaller with 29 patients compared to strategy 2 with 314 patients. Consequently, the influence of strategy two in the combined PSA appears to be relatively minor, as indicated by the results.

Answering the second/third sub question: *Is it possible when the outcome of the cost-effectiveness analysis is in favor of the ESS, to increase the costs for the ESS to still have a favorable outcome?* According to the results of the PSA, it is possible to extend the costs of the ESS up to 70 euros per consult to remain more cost-effective than usual care. The third sub question is excluded, because the results of the PSA where in favor of the ESS.

However, the exact cost-effectiveness of the ESS compared to the usual care cannot be precisely determined due to the uncertainties associated with the data input for the calculations. Due to health insurers who were not able to share their data and the pilot study which did not have the complete data that was needed.

The study recognizes the limitations in the available data, which may introduce some level of uncertainty in the findings. However, the one-way sensitivity analysis shows some variation, but all effectiveness parameters have results in favor of the ESS. The effective parameter for the referral between the assistant and the ESS has the most influence on the outcome. Furthermore, the one-way sensitivity analysis of the probabilities has some more distribution. Two of them resulted into maximum ICER outcomes which are in favor of the usual care. These distributions were based on the referral to usual care. Consequently, while the finding indicates a favorable outcome, it is essential to interpret them with caution, considering the potential impact of these uncertainties on the overall cost-effectiveness assessment.

4.2 Comparison with other studies

In the context of this study, there is no comparable study with the same subject conducted in the Netherlands. Despite the absence of identical studies in the Netherlands, a comparison can still be made with research conducted in other countries. By examining the findings from studies conducted elsewhere and considering the structure of the Dutch healthcare, it becomes evident that this study aligns with the existing body of evidence. In 1999 a study was conducted by Daker-White et al. (1999) in the UK, this study demonstrates that the ESS was more cost-effective, primarily attributed to reduced hospital costs. This was achieved by decreasing the number of referrals to radiology, among other factors. Considering the year in which this study is conducted, it's important to acknowledge that direct comparability might not be feasible due to various altered factors, such as the evolving healthcare landscape impacted by an aging population. Additionally, as systematic review by Stanhope et al. (2022) has been carried out on the role of the ESS. This review also demonstrates that the ESS is both more effective and cost-saving compared to usual care. However, these conclusions were drawn individually, without amalgamating both factors as done in this present study. Stanhope et al. (2022) study arrived at these conclusions through a systematic review of the existing studies.

Although no identical studies exist within the Netherlands, the alignment of this study's results with international research supports the notion that implementing the ESS in the Dutch healthcare system would likely result in increased cost-effectiveness compared to the current situation. It's worth noting that comparing healthcare systems between different countries, including the Netherlands, should be approached with caution due to potential significant differences. The interpretation of such comparisons should be taken circumspectly. However, the individual factors in isolation do indicate this trend.

4.3 Interpretation of the results

The lack of sufficient practical evidence and the absence of comparable studies posed challenges in obtaining necessary information. Accessing crucial data was hindered by privacy regulations imposed by health insurers, preventing the collection of the exact data. These circumstances necessitated certain assumptions to be made within the study. Firstly, the costs used in the analysis were derived from the literature. However, it is important to acknowledge that costs can fluctuate over time due to various influences such as changes in healthcare policies, inflation, or variations in resource utilization. Furthermore, due to limited data availability of cost components, certain assumptions have been made. Only the costs for the initial consult are included, while the number of required treatments can vary greatly depending on the injury. It's important to acknowledge that these assumptions introduce a degree of uncertainty to the ICER outcomes. However, this conservative estimate might even potentially underestimate the positive results of the ESS. For instance, if a patient is inaccurately referred to a physiotherapist or medical specialist and undergoes more treatments than necessary, the costs could be higher, accentuating the cost-effectiveness of the ESS.

Secondly, the ESS is integrated in the GP practice in the pilot situation. According to the organization of the pilot, there were no additional costs for implementing the ESS. So, these costs are not considered in this study. However, it may occur that there is not enough room in a GP's practice, then room needs to be made for the ESS. This could result in additional costs which have to be considered for the cost-effectiveness analysis, which can influence the ICER outcomes unfavorably.

Thirdly, the probabilities associated with the pilot situation were based on a pilot study involving 343 patients. While the pilot study can provide valuable insights, it is important to recognize that it was conducted in one GP's practice in one Dutch city. This may limit the generalizability of the findings and introduce potential biases. The city's population stands at approximately 72,000 residents. Additionally, it is a healthcare center that is not frequently utilized in the Netherlands. Furthermore, the population boasts a lower educational attainment, with 33.5% being classified as low-educated. This city also registers one of the lowest average incomes in Overijssel, with an annual gross income mean of 22,400 euros. The results may therefore be biased and may not fully capture the variability and complexities that could encountered in a larger-scale implementation of the Extended Scope Specialist. The interpretation of the probabilities should, therefore, be cautious and consider the need for further research to validate and expand upon these findings.

Fourthly, the determination of whether a referral was correct in the pilot study is based on the number of patients who presented with the same complaints after a 6-month period. This could mean that they did not receive the right treatment and must be referred again. This probability is utilized due to a lack of more detailed information regarding the outcomes following the referral. So, referrals that went wrong in within the 6 months are not included. Because the probability for a wrong referral in the pilot is set for people returning with their complaint after 6 months. This can also have potential influence on the ICER outcome because it is not certain what happened within these 6 months. If the number is higher because the wrong referrals within 6 months are included, it can have a negative impact on the ICER for the implementation of the ESS. Because the referral process can take longer. However, when examining the impact of this parameter in the one-way sensitivity analysis, it may not have a substantial impact. Next to that, the probabilities for the correctness of the referrals in usual care are based on interviews taken in a previous study. So, these are not exact numbers, which therefore may influence the results of the ICER either more positively or negatively for the ESS.

In contrast, the probabilities associated with the usual care were based on the literature. However, it is worth noting that the accuracy and reliability of these numbers may be uncertain since the exact data from health insurers, which could provide more accurate estimates, were not available for this study. The absence of precise information from health insurers introduces a level of uncertainty in the probabilities associated with the current situation. Next to that, the data of the current situation is not based on numbers of the same GP practice before implementing the ESS. Those results could have given a better comparison between the pilot situation and current situation. However, this data was also not available. This means that when the probabilities are not right, it influences the outcome. For instance, a higher volume of referrals to secondary care is highly likely to result in a more favorable ICER for the ESS, primarily due to the typically elevated costs associated with medical specialists. As a result, the interpretation of the results regarding the current situation should be treated with caution, recognizing the potential limitations in the available data sources.

Furthermore, in the PSA, the effectiveness margins have been standardized to a consistent 50%. This approach is employed to mitigate the impact of significant outliers. Additionally, uncertainty surrounds the effectiveness due to its reliance on the availability of healthcare professionals, a factor not quantified and subject to variability over time. Consequently, factoring this into calculations becomes impractical.

Furthermore, the comparison between the two different structures of the pilot situation needs also be treated with caution. The population of the pilot study is divided in a group 29 patients starting at the GP and a group of 314 patients starting directly at the ESS. This difference is assessed through a beta distribution analysis, revealing that the distinct groups still exert a substantial impact on the ICER outcome. Only when these two groups are combined does it become evident that the ESS truly achieves greater cost-effectiveness. This suggests that the GP's influence may persist, yet the size of the group is insufficient to ensure certainty regarding the influence.

Next to that, despite efforts to incorporate uncertainties and variations through a PSA, there may still be unaccounted factors or sources of uncertainty that could influence the results. The study assumptions and model structure might not capture all relevant variables or interactions that could impact the cost-effectiveness outcomes. These unaccounted factors might encompass elements like societal costs and external influences that impact the effectiveness, such as mobility issues hindering appointment attendance or the amount of health care professionals available. These factors could introduce biases and potentially compromise the study's validity.

Lastly, the study may be limited to assess the long-term effects and sustainability of the implementation of the ESS. The focus on short-term outcomes and the absence of extensive follow-up data may not capture the potential long-term benefits or challenges associated with the implementation of the ESS. The positive effects shown in different research show signs that the results of this study may be underestimated. However, the data input data of the usual care is very uncertain. However, interviews with different stakeholders implicate that the results of the ESS are better.

4.4 Explanation of the found patterns.

The decision of whether to refer to secondary care or not depends also on the patient's insurance coverage for physiotherapy. If a patient is not insured, the GP is more likely to refer them to a medical specialist, because secondary care is included in the insurance coverage. In some cases, patients who are not insured for physiotherapy or do not trust the GP's opinion may still be referred to secondary care, resulting in higher healthcare costs. These patients probably still end up with physiotherapy on the advice of the medical specialist. This results only in higher costs of healthcare. So, it is necessary to explain this phenomenon to patients to prevent this from happening.

The difference in effectiveness, based on the number of days it takes to get an appointment with a health care professional, can be small, this can be a consequence of the extra step that can be made in the pilot situation for the ESS. In the pilot situation, the patients need to be seen by an ESS. But when the patient has started at the GP, he needs to take an extra step in the process which results in extra days of waiting time for the patient. However, the probability of referring correct needs to make the difference in cost-effectiveness, because the pilot shows that the ESS is referring more correct than the usual care.

4.5 Implications and future research

These findings of this study provide initial positive indications for the new situation involving the ESS. However, there should be considered several implications and directions for future research. Firstly, to obtain more precise and reliable results, future research should focus on obtaining more complete and accurate data. If health insurers can establish collaboration, it becomes feasible to utilize more precise data for input in the cost-effectiveness analysis pertaining to the current situation. This will enhance the validity of the outcomes.

Secondly, the study's reliance on one pilot study conducted in single GP practice. To achieve greater generalizability of the study findings, it is necessary to involve a larger and more diverse population. As well as future studies may include more parameters to calculate the cost-effectiveness more accurately/with less uncertainty.

Thirdly, given the limitations of the study in assessing long-term effects, which was not possible yet to include in this study, future research should focus on conducting extended follow-up evaluations. This would provide insights into the sustainability and long-term benefits of implementing the ESS. In future research an ESS must be implemented in the Dutch health care system or results of different location must be available. So, the results can be more generalizable. Furthermore, the data of the usual care must be accessible. Also, more information is needed about what happens exactly with every patient. So, what happens within the 6 months. All this information together must result in better validity of the study.

Chapter 5: Conclusion

In summary, the ESS demonstrates to be more cost-effective than the usual care. Moreover, the referral structure of the ESS can commence with either strategy one or two, although the impact of strategy two in the combined PSA is relatively limited. Additionally, the study suggests that the costs associated with the ESS could be increased to 70 euros and still maintain cost-effectiveness compared to usual care.

These findings present favorable outcomes regarding the implementation of the ESS. However, it is imperative to approach these results with caution. Several uncertainties exist within the data input, stemming from various sources such as the distinct data origins for the ESS and usual care, unavailable data from the health insurers, the population of the pilot is located around one city in the Netherlands, assumptions made in the data input, and differences in population groups in the two strategies. Consequently, further research is necessary to validate the consistency and generalizability of these results.

In conclusion, while the current study offers initial positive conclusions, further research is warranted to refine and strengthen the understanding of the new situation involving the ESS. Conducting studies with more comprehensive data, larger and diverse populations, long-term evaluations, and data from the same source will contribute to a more precise and holistic assessment of the intervention's cost-effectiveness. This would inform the decision makers from the health insurers better by understanding the impact of the innovation.

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