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Erasmus University Rotterdam
Making Minds Matter

Leveren, meten en belonen van waarde

Een doorontwikkeling van waardegedreven zorg
in de integrale geboortezorg in Nederland

Maud van den Berg

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Leveren, meten en belonen van waarde
Een doorontwikkeling van waardegedreven zorg in de integrale geboortezorg in Nederland

Delivering, Measuring and Rewarding Value
Advancing value-based healthcare in integrated maternity care in the Netherlands

Proefschrift

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Chapter 1

General introduction

BACKGROUND

If our healthcare system were a patient, it would be diagnosed as critically ill, showcasing clear symptoms of dysfunction. First, because healthcare costs are rising while outcomes of care remain stagnant, meaning that the increases in expenditures are failing to leverage improved quality of care [1]. Second, there is a growing imbalance between the demand and supply of care: ageing populations and innovations drive up demand, while persistent workforce shortages reduce supply [2]. Third, despite being designed to enhance population health, our healthcare system contributes significantly to global warming, which exacerbates health inequalities [3, 4]. Lastly, although the prevention of care can be a powerful tool in dealing with increasing demand for care, traditional reimbursement models reward curative productivity, thus hindering widespread implementation of prevention strategies [5].

Given the abovementioned challenges, it is alarming that some scholars claim that the scarce resources supplied in care delivery do not always effectively contribute to better health outcomes [6]. This implies that some healthcare resources are misused, indicating a structural inefficiency within the healthcare system. Therefore, there is a need for strategies that prioritise both efficiency and quality of care to ensure a more sustainable use of healthcare resources. This is where value-based healthcare (VBHC) comes into play. VBHC has been suggested as the strategy that will address current deficiencies in healthcare [7]. It is an approach to steer the system's focus on to what matters most, maximising value for patients, by improving outcomes at reasonable costs. The premise is that if value improves, all stakeholders will benefit while the economic sustainability of the system increases [8]. However, this requires a total restructuring of how healthcare delivery is currently organised, measured and reimbursed.

VALUE-BASED HEALTHCARE

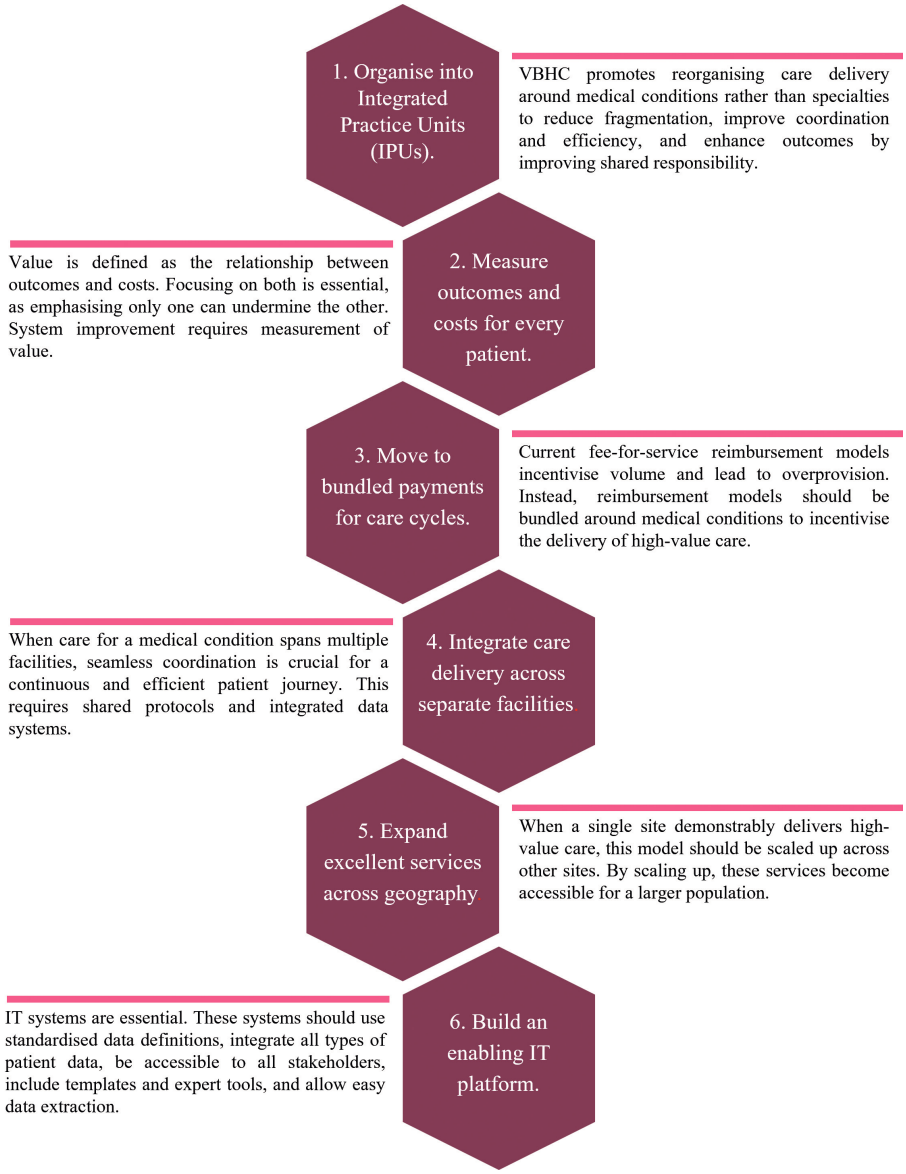
VBHC was introduced by the American scholars Michael Porter and Elizabeth Teisberg in 2006. Their work sought to address the paradox of rising healthcare costs without a corresponding improvement in the quality of care. They identified the following contributory factors. First, the stakeholders involved have conflicting objectives resulting in a misalignment of interests and activities. Second, organisation by specialty results in fragmented care delivery. Third, quality of care is defined by process indicators (number of treatments delivered) rather than by outcome indicators (health status achieved). Fourth, the cost accounting system adopted by healthcare providers is predominantly based on reimbursement budgets rather than the actual costs of care delivery. Fifth, traditional

reimbursement models reward quantity of care delivered rather than quality of care. Sixth, IT systems are fragmented and thereby hinder comprehensive data analysis. To overcome these problems, VBHC was introduced as a fundamentally new strategy, with patient value at its core [1, 7].

Within the VBHC paradigm, value is defined as the health outcomes achieved per dollar spent. This ratio is referred to as **the value equation**. Outcomes refer to clinical outcomes, patient-reported outcome measures (PROMs) and patient-reported experience measures (PREMs). Together, these outcomes provide insight into the result of a care process (the change in a patient's health). Importantly, these outcomes also represent what matters to the patient population [8]. The costs of care provide insight into the inputs required to deliver this care process. These costs should cover the full cycle of care: from diagnosis to cure. Total costs are represented when all the supplied resources are incorporated, such as personnel, medicine, equipment, real estate, overheads and support services. Including both components (outcomes and costs) when determining value is critical: achieving cost savings without considering effects on health outcomes can be dangerous. Simultaneously, supplying ever more resources to achieve good outcomes is unsustainable. Value can be improved in various ways: by improving outcomes and reducing or maintaining costs, or by reducing costs and keeping outcomes stable [9].

Delivering value needs a supporting environment in terms of the organisation and reimbursement of healthcare. To guide this transition, **a value agenda** was published by Porter and Lee in 2013. This agenda presents six, interdependent and mutually reinforcing, items, as summarised in Figure 1.

***Figure 1**: The Value Agenda, adapted from Porter & Lee (2013)*



Since its introduction, the VBHC concept has had a widespread influence, with over 1200 articles published on the topic [10]. Based on extensive experience, the value agenda has also been complemented with four new items: **(7) setting up value-based quality improvement**, which relates to value-improving actions following cost- and outcome analysis; **(8) integrating value in patient**

communication, meaning that outcomes should be incorporated in general information provision for patients; **(9) investing in a culture of value-delivery**, such that evaluating the value of care in multidisciplinary teams becomes daily practice; and **(10) building learning platforms for healthcare professionals**, which relates to the worldwide exchange of knowledge, experiences and lessons learnt among stakeholders to prevent "reinventing the wheel" [11].

VBHC in practice

Although the concept of VBHC and its accompanying strategic agenda seem straightforward, VBHC has been conceptualised in many different ways, suggesting a high level of interpretative variability [12]. Despite its popularity, there seems to be no consensus on the application of VBHC, which results in diverse, selective and fragmented implementations [13–16]. This is very evident in the Netherlands, where VBHC has inspired national healthcare programmes such as 'The Right Care in the Right Place', 'Outcome-Based Health Care', and 'Appropriate Care'. Communities that are focused on further implementation of VBHC, like the Linnean Initiative (www.linnean.nl), have been established, and networks of collaborating hospitals driven by VBHC principles, such as Santeon (www.santeon.nl), have been developed. Additionally, many local institutions are organising value-based teams, programmes, interventions and innovations. Although clear improvements have been made in terms of organising care around the patient, standardised outcome measurement and shared decision-making, it is notable that some critical agenda items remain underdeveloped:

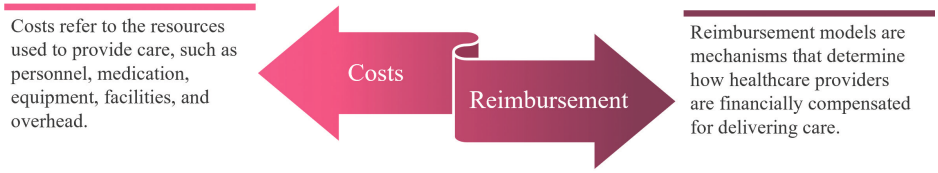
- Organising integrated care delivery based on medical conditions is falling behind [17, 18],
- Our understanding of costs and their relation with outcomes remains low [10, 12, 19–22],
- Provider payment models are still largely focused on volume [23, 24].

Overall, Dutch applications of VBHC have been selective in what they incorporate and omissions from the original concept are evident. Despite significant efforts, the cost side of VBHC has been largely neglected [25].

The cost side of VBHC

The cost side of VBHC relates to the costs of delivering patient care and the compensation of healthcare providers for their incurred costs, referred to as reimbursement. Costs and reimbursement are often confused. This confusion creates problems since the two concepts are distinct, as shown in Figure 2.

***Figure 2**: Difference between costs and reimbursement*



Calculating costs in healthcare is exceptionally difficult; patient trajectories are complex and highly variable, and involve a large variety of different services, departments and organisations. Reimbursement models should be designed to cover healthcare provider's costs as accurately as possible. However, studies have shown that these models are often based on aggregated averages and, consequently, fail to reflect the exact resources used in delivering specific services [26, 27]. Despite this, hospitals rely on their internal budgeting practices in determining on how much they are to be reimbursed, instead of the resources used. As a result, neither healthcare payers nor healthcare providers have accurate insight into the actual cost of delivering patient care [28]. This limits the opportunity to improve resource utilisation or to eliminate activities that do not improve outcomes. In other words, actionable knowledge to improve value is lacking. As such, efforts are needed to better understand the costs of care delivery. In the VBHC paradigm, Time-Driven Activity Based Costing (TDABC) is proposed as the gold standard for calculating healthcare costs [28].

Time-Driven Activity Based Costing

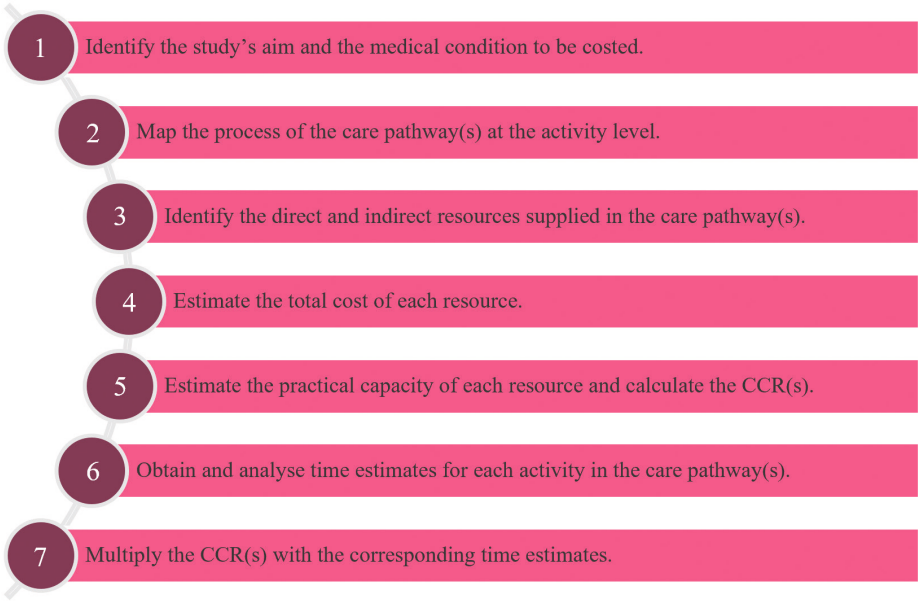
To reflect the actual cost of care, cost estimations should cover the patient's full cycle of care (from diagnosis to cure) and should include both direct and indirect costs. The reason why calculating healthcare costs is difficult stems from allocating these indirect costs [29]. It is more straightforward to allocate direct costs (such as medicines and supplies) to cost objects (the product or service to be costed) directly, since their causal relation to the cost object is self-evident. However, indirect costs (such as real estate, overheads and support costs) do not have these clear relationships with cost objects, and therefore require allocation keys [30].

TDABC (and its predecessor Activity Based Costing, or: ABC) provides a pragmatic yet accurate structure for allocating indirect costs [28]. TDABC was originally developed for manufacturing contexts in order to understand resource use in variable processes [31]. TDABC allows pragmatic indirect cost allocation as a single allocation key is used: time. In healthcare, most care activities are primarily determined by the amount of time for which specific resources are

utilised. Examples include time spent in an MRI scanner, a surgical procedure, or consultations with physicians. As such, TDABC is also a suitable approach in the healthcare context [32].

The cost object for TDABC in VBHC applications is 'the care pathway', which covers all activities needed to deliver care for a specific medical condition [33–35]. The method starts by mapping the care pathway at the activity level. Next, all the resources used in the care pathway are identified and the costs of these resources are divided by their practical capacity. As such, a Capacity Cost Rate (CCR) is calculated. When time estimates are obtained for all activities, these are multiplied by their CCR(s) to calculate the costs of the activities. Summing all the activities' costs provides the total cost of the care pathway [36]. The seven steps of TDABC are presented in Figure 3.

***Figure 3**: TDABC steps, adapted from Kaplan & Porter (2011)*



Uptake of TDABC in VBHC

Although TDABC has been proposed as the gold standard in calculating costs of care delivery, the uptake of TDABC in VBHC applications remains low. A systematic review by Leusder et al. (2022) found that only 14% of the studies reporting VBHC applied TDABC. These findings indicate that the field of TDABC is still young. Nevertheless, the motives behind previous applications show that TDABC is suitable for facilitating VBHC, as they have entailed the identification of

cost drivers, comparison of costs, calculating cost savings and measuring care pathway improvements [21, 37]. As such, TDABC can be seen as a suitable method for providing actionable knowledge to understand and improve the value of care.

Measuring value

In the VBHC paradigm, cost- and outcome data should be combined in the value equation to determine the overall value of care. While the value equation serves as the conceptual cornerstone of VBHC, real-world applications remain scarce and varied [38]. Applications of the equation in empirical studies differ in the inputs included [39, 40] as well as the techniques used to present value. Some apply visual tools such as radar charts. In these charts, outcomes and costs are scaled from 0-100 and allow comparisons among treatments [41, 42]. Some studies apply quantitative formulas to calculate value (for example, by dividing outcome improvements by costs [43–47], while others rely on comparative pre- and post-evaluations [48]. Overall, experiences with combining both cost and outcome data remain limited, with no consensus on a standard approach. This diversity illustrates the exploratory nature of current value assessments and highlights the need for further insights into combining costs and outcomes in a meaningful way.

Rewarding value

As previously noted, the cost side of VBHC not only relates to calculating the costs of care delivery, but also the reimbursement models. Clearly, a better understanding of costs could lead to a change in reimbursement levels, as healthcare providers would be better able to accurately price their services. However, according to the value agenda, the method for reimbursement also requires modification [7]. Before diving into the technicalities of reimbursement models, a short overview of the Dutch healthcare system is provided in Textbox 1.

In 2006, the Netherlands implemented regulated competition in the healthcare system, in which private health insurers contract care from competing providers on behalf of their clients. Specifically for hospitals, a payment system based on diagnosis-treatment combinations (DTCs) was introduced [49]*. This model was introduced to provide greater insight into the hospital services provided* [50]*. The model classifies episodes of care into standardised product groups, which serve as the basis for reimbursement tariffs* [51]*. Each year, providers and insurers negotiate contracts that specify volumes, prices and performance agreements. Providers submit claims to insurers based on the delivered DTCs, and insurers reimburse according to the contracted terms* [49]*.*

Textbox 1*: The Dutch healthcare system*

The DTC system was introduced to improve transparency by linking payments to specific hospital care products, which was seen as essential for a functioning managed competition system [52]. The DTC system is an example of a provider payment model that is labelled 'fee-for-service', meaning that every service provided is reimbursed. Consequently, within these models, hospitals carry limited financial risk [53]. Scholars criticise fee-for-service models as they lead to prioritisation of curative productivity over investment in VBHC when this entails redesigning, optimising preventing care [24, 54]. Since payments are volume-based, providers are financially disincentivised from downscaling output [55]. Consequently, VBHC urges for transitioning to alternative payment models containing incentives for delivering high-value care [28].

The VBHC paradigm suggests bundled payments would provide a payment model that is better aligned with value. In such models, a single payment covers all activities performed in the full cycle of care for a specific patient population including multiple participating providers [28]. Furthermore, the payment depends on performance, as measured by outcomes that matter to patients [56, 57]. In theory, these models incentivise cost-conscious behaviour, better coordination of care and task relocation since part of the financial risk is transferred to the provider [53, 58, 59].

Although bundled payment approaches are increasingly implemented, evidence of their effects is mixed and shows only moderate success [24, 60]. It is notable that outcomes, especially clinical outcomes and patient-reported outcomes, are not always an integral part of these models [24, 61]. As a result, contracting practices between healthcare insurers and providers are still largely focussed on prices and volume. To more explicitly incentivise the attainment of good outcomes and improved patient value, there is a growing interest in incorporating outcomes in provider payment models. When such payment models are, at least to an extent, dependent on outcome indicators, we label these as outcome-based payment models (OBPMs) [56, 57].

Despite the increased interest, parties are struggling to develop and implement provider payment models that are more closely aligned with value, especially when it comes to incorporating outcome indicators. This can relate to more practical challenges, such as inadequate outcome measures and limited data availability, or more cultural challenges, such as a lack of trust and misaligned views between healthcare insurers and providers [62–64]. As such, a cultural shift seems necessary, given that payers and providers are used to approaching contracting practices from different perspectives. Consequently, payment innovation will entail more than the mere introduction of a new contracting model

[65]. Due to encountering such challenges, the development and implementation of payment models that are better aligned with value remains limited.

KNOWLEDGE GAPS

Despite international and national efforts to improve the value of care, the implementation of VBHC remains far from complete. In the Netherlands, meaningful progress has been made in areas such as shared decision-making, care pathway development and the implementation of standardised outcome sets that increasingly include patient-reported outcomes rather than only clinical outcomes. However, a critical component of VBHC – the cost dimension – is still largely absent. Insight into the actual costs of care, and how these costs relate to health outcomes, remains limited. This lack of transparency and understanding of how costs are linked to outcomes hinders informed decision-making by both providers and payers and makes it difficult to effectively steer towards greater value. Consequently, the development and the implementation of payment models aligned with value remains challenging, and current reimbursement systems, which prioritise volume over value, continue to dominate.

The selective implementation of VBHC elements has contributed to a fragmented and partial understanding of the concept in practice. This not only constrains opportunities for learning and reflection but also limits the potential improvement of a healthcare system. Together, these limitations emphasise a need for empirical research that bridges the gap between VBHC principles and practice, particularly focussed on the integration of cost and outcome data for meaningful decision-making and the development and implementation of OBPMs.

AIM OF THE DISSERTATION

While these knowledge gaps present significant challenges, they also create opportunities to advance the VBHC agenda. In the Netherlands, certain healthcare providers operate under conditions that are particularly favourable for further advancing VBHC. These organisations already deliver integrated care to defined patient populations, such as those receiving maternity care, diabetes care or stroke care, through multidisciplinary teams and are reimbursed through bundled payment arrangements. Such settings provide a unique opportunity to address the underdeveloped elements of VBHC.

This dissertation is a report on the lessons learnt from a two-year research project in close collaboration with a leading integrated care provider and a healthcare

insurer. Our collective efforts to advance VBHC in practice focused on optimising care delivery, systematically collecting and evaluating cost and outcome data, and using these insights to develop an OBPM. Through these efforts, this dissertation aims to provide practice-based insight into how VBHC principles can be comprehensively applied to healthcare delivery and reimbursement.

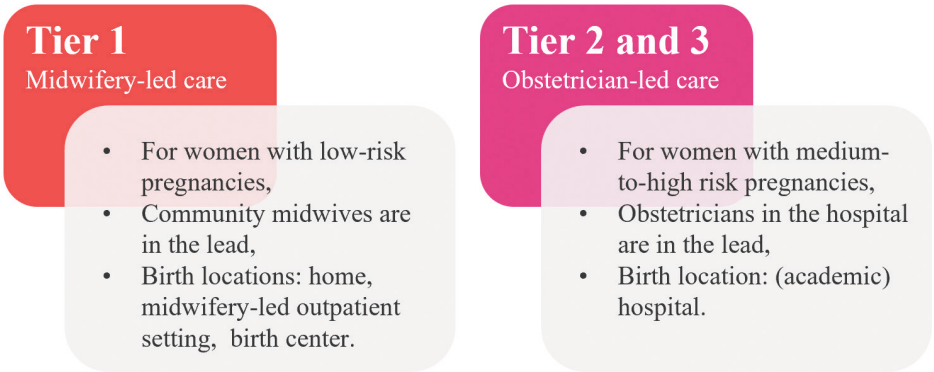
The overarching research question is: *How can cost and outcome data be systematically collected and integrated to measure the value of care and inform the design of an outcome-based payment model?*

DOMAIN OF INTEREST

The domain of interest for this dissertation is the maternity care setting in the Netherlands. Maternity care encompasses the care for women during pregnancy, childbirth and post-partum. The Dutch maternity care system is unlike maternity care systems in many other countries [66]. It is known for its predominantly physiological approach to pregnancy and childbirth through having a strong position for community midwifes [67]. Moreover, unlike most Western countries, women can opt to give birth at home. The Dutch home birth culture is officially recognized as part of the country's intangible cultural heritage [68]. In 2021, 14% of pregnant women gave birth at home [69].

Dutch maternity care is fragmented across three tiers (Figure 4). In the first tier, community midwifes from independent practices provide primary obstetric care for women with low-risk pregnancies. In the second tier, obstetricians provide care for women with medium risk pregnancies in a local hospital. Where there is high risk, women receive care in an academic hospital, which is labelled the third tier [70]. Referrals from midwifery-led care to obstetrician-led care are possible during several phases of the maternity care pathway. In 2021, approximately 90% of pregnant women started their care trajectory in midwifery-led care. During pregnancy, approximately 50% were referred to obstetrician-led care. The referral rates during labour and birth differ between nulliparous (women who have not previously given birth) and parous (women who have given birth) women. Of the nulliparous women, approximately 65% in midwifery-led care are referred to obstetrician-led care, compared to approximately 25% of the multiparous women [69]. This difference stems from the increased risk of birth complications for nulliparous women [71]. The main reasons for intra-partum (during childbirth) referral are requests for pain relief and emerging risk factors for adverse outcomes, such as meconium-stained liquor, failure to progress during labour or prolonged ruptured membranes without contractions [72]. Referral rates have increased over time, contributing to the so-called medicalisation of maternity care [73].

***Figure 4**: Separation in Dutch maternity care system*



Integrated maternity care

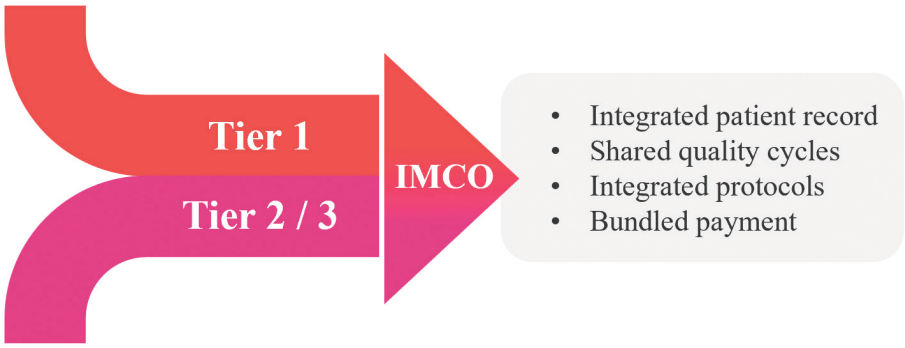
While the Dutch maternity care system is praised internationally, the European Perinatal Health Report published in 2008 showed that the Netherlands performed relatively poorly in terms of overall perinatal mortality compared to other European countries [74, 75]. This raised concerns about the quality of Dutch maternity care [76]. In response, the Minister of Health at that time established a Pregnancy and Childbirth Steering Group, with the task to study and report on how to improve the quality of Dutch maternity care. One of its conclusions was that the separation of midwifery-led and obstetrician-led care might be a factor contributing to the relatively high rate of perinatal mortality. This fragmentation was supposedly resulting in discontinuity in care, increasing the risk of miscommunication and consequently jeopardising the quality of care [77, 78].

The steering group recommended enhancing interprofessional collaboration between midwives and obstetricians by integrating the two tiers, which led to the establishment of Obstetric Care Networks (OCNs). These networks are local collaborations where hospitals, community midwife practices and post-natal maternity nursing organisations collaborate to deliver high quality maternity care. Currently, there are approximately 70 OCNs operating in the Netherlands. Since 2016, eight of these networks have evolved into Integrated Maternity Care Organisations (IMCOs) [79, 80]. The key distinction is that IMCOs are legal entities functioning as network organisations of primary- and secondary maternity care providers (Figure 5). Furthermore, providers involved in IMCOs work with an integrated patient record, shared quality cycles, integrated protocols and care pathways and a bundled payment structure [81]. Unlike the fragmented, fee-for-service model prevalent in OCNs, providers within IMCOs receive collective payments through bundles that encompass all activities during pregnancy,

childbirth and the post-partum period [82]. Given the significant time, resources and required level of already existing interprofessional trust, IMCOs are rather unique in the Netherlands [83].

The IMCO structure provides favourable conditions for advancing VBHC as it is intended to function as an IPU (Figure 1). The integrated structure facilitates the redesign of care pathways, such as reallocating tasks and responsibilities from obstetricians to community midwives, thereby reducing referrals during labour and birth. The bundled payment structure further supports these innovations by ensuring that community midwives and obstetricians are compensated collectively [58]. Furthermore, the integrated patient record facilitates comprehensive data collection, enabling a thorough evaluation of the impact on patient value. Despite these promising opportunities, the integration of VBHC principles within IMCOs is not yet part of daily practice. It is therefore highly relevant to investigate how VBHC can be further advanced in this setting and address existing knowledge gaps, particularly concerning comprehensive cost- and outcome data collection and the incorporation of outcomes into the payment model.

***Figure 5**: IMCO structure in Dutch maternity care*



DATA SOURCES

This dissertation is based on a study conducted at IMCO Annature Geboortezorg. This IMCO was developed in 2016 and is one of the eight IMCO's in the Netherlands [84]. Annature Geboortezorg is a network of primary care midwife practices, post-natal maternity nursing organisations, an obstetrics/gynaecology medical specialist enterprise and the obstetric department of a top clinical teaching hospital (Amphia hospital). It is located in Breda and caters for approximately 4000

childbirths per year. The primary goal of Annature Geboortezorg is to enhance the quality of care for expectant parents and their newborn.

Study 'BUZZ-2': Paying for Maternity Care Outcomes

The study was called 'BUZZ-2: Bekostigen Uitkomsten Zorg van de Zwangere' (Paying for Maternity Care Outcomes) and was conducted from July 2021 until September 2023. The study was funded by the Netherlands Organisation for Health Research and Development (Project Number 516008006). It was one of the studies under line 3 (outcome-based organization and reimbursement) in the programme Outcome-Based Health Care of the Dutch Ministry of Health (2018-2022). The goal of this work package was to collect and analyse best practices concerning the incorporation of outcomes in contracting practices.

In the study, IMCO Annature Geboortezorg, healthcare insurer CZ, Erasmus School of Health Policy and Management and Erasmus Medical Centre all collaborated in designing an OBPM for two redesigned maternity care pathways using cost- and outcome data. A pathway-driven approach was selected to enable experimentation with OBPM design on a small scale. The care pathways studied encompassed the prenatal (during pregnancy) care pathway for gestational diabetes mellitus (GDM) and the natal (during labour) care pathway for pain relief during labour. Both care pathways were redesigned to improve value for the IMCO's population and the redesigned interventions were implemented during the study period. A pre- and post-measurement of costs and outcomes was carried out to gain insight into the added value of these interventions. Moreover, these data were subsequently used to develop the OBPM where the aim was to design a model that explicitly rewarded value-improving behaviour.

The study was inspired by the principles of action research. Action research serves two main purposes: solving a problem and contributing to science. It is characterised by its contextual nature, participatory approach, iterative processes and focus on action [85, 86]. The development of the OBPM required close engagement with practice, the integration of diverse perspectives, and an adaptive process that combined elements of change, learning and knowledge generation. Drawing on action research as a guiding perspective enabled the team to remain responsive to practical challenges while also generating insights of broader relevance relating to translating VBHC into practice.

Program 'Wensen en Grenzen'; Future-Proof Maternity Care: Preferences and Limits

This dissertation is complemented by a study conducted during a three-year healthcare transformation programme called 'Wensen en Grenzen, Toekomstbestendige Geboortezorg' (EN: Preferences and Limits, Future-Proof

Maternity Care) also funded by funded by the Netherlands Organisation for Health Research and Development (Project Number 10100162210010). The aim of the programme was to tackle current capacity issues in maternity care by facilitating joint innovation and streamlined care delivery involving multidisciplinary maternity care providers (10 hospitals, 70+ community midwife practices, 20+ maternity nurse organisations) in the region of Southwest Netherlands. During this programme, a Q-methodology study was conducted to gain a better understanding of the main preferences of women during labour and birth. The findings established a benchmark for future innovations in the region, ensuring that women's voices are integrated into these decisions. These insights are included in this dissertation as they underscore the importance of comprehensively understanding what is important, and including this in determining patient value.

OUTLINE

This dissertation is organised in two parts, addressing the overarching research question: *How can cost and outcome data be systematically collected and integrated to measure the value of care and inform the design of an outcome-based payment model?*

Part I delves into studies on **delivering and measuring the value** of care, including both methodological and empirical work related to interventions implemented to improve the value of care and the collection, analysis and interpretation of cost and outcome data to study the impact of these interventions. It addresses the research question: How can cost and outcome data be systematically collected and integrated to measure the value of care?

Part I: Delivering and Measuring Value

Chapter 2	Exploring Cost Changes with Time-Driven Activity-Based Costing after Service Delivery Redesign in Dutch Maternity Care.
Chapter 3	Value-based Evaluation of Gestational Diabetes Mellitus Care Pathway Redesign by Using Cost and Outcome Data.
Chapter 4	Value-based Evaluation of Nitrous Oxide for Pain Relief during Labour by Using Cost- and Outcome Data: A Prospective, Observational Cohort Study.
Chapter 5	Women's preferences for Care Delivery During Labour and Birth in Dutch Hospitals: A Q-methodology study.

Part II focuses on studies addressing **rewarding value**, featuring a case study that outlines the design of the OBPM and a viewpoint paper that critically reflects on the role of relational governance throughout this process. It answers the question: How can cost and outcome data be applied to inform the design of an outcome-based payment model?

Part II: Rewarding Value

Chapter 6	Successful Design of an Outcome-Based Payment Model for Maternity Care.
Chapter 7	Beyond the Contract: the Role of Relational Governance during Outcome-based Payment Design in Health care.

It is important to note that studies 2, 3, 4, 6, and 7 are products of the BUZZ-2 research project. The Q-study (5), conducted independently in a different context, is included in Part I because it provides unique insights into women's preferences during labour and birth, thereby offering a valuable perspective on how women perceive value in maternity care.

Part I

Delivering and measuring value

02

Chapter 2

Exploring cost changes with time-driven activity-based costing after service delivery redesign in Dutch maternity care

M.A. van den Berg
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Health Services Management Research (2024)

ABSTRACT

The implementation of Value-Based Healthcare (VBHC) has spread across international healthcare systems, aiming to improve decision-making by combining information about patient outcomes and costs of care. Time-Driven Activity-Based Costing (TDABC) is introduced as a pragmatic yet accurate method to calculate costs of care pathways. It is often applied to demonstrate value-improving opportunities, such as interventions aimed at service delivery redesign. It is imperative for healthcare managers to know whether these interventions yield the expected outcome of improving patient value, for which TDABC is also suitable. However, its application becomes more complex and labour intensive if the intervention extends beyond activity-level changes in existing care pathways, to the implementation of entirely new care pathways. The complexity arises from the potential influence of such interventions on the costs of related care pathways. To fully comprehend the impact of such interventions on organizational costs, it is important to include these factors in the cost calculation. Given the substantial effort required for this analysis, this may explain the limited number of prior TDABC studies with similar objectives. This methodological development paper addresses this gap by offering a pragmatic enrichment of the TDABC methodology. This enrichment is twofold. First, it provides guidance on calculating a change in costs without the need for a total cost calculation. Second, to secure granularity, a more detailed level of cost-allocation is proposed. The aim is to encourage further application of TDABC to conduct financial evaluations of promising interventions in the domain of VBHC and service delivery redesign.

INTRODUCTION

In times of continuously growing healthcare expenses, healthcare managers are pressured to increase patient value by improving health outcomes while reducing costs [28]. This aim is defined as Value-Based Healthcare (VBHC) [1]. To practice VBHC comprehensively, managers need insight into their organization's performance, including capacity utilization and costs [87]. These costs are not always easily observable; indirect and overhead costs are significant, but often remain unaddressed. Time-Driven Activity-Based Costing (TDABC) is presented as a pragmatic yet precise methodology to calculate all relevant costs in a healthcare setting [28]. TDABC is often applied to value improvement opportunities, such as service delivery redesign [33]. The extent of redesign can range from optimizing existing care pathways on activity level to introducing entirely new care pathways.

TDABC is suitable to calculate the costs of care pathways. Its main benefit is that the model is relatively easy modified after adjustments on activity level, which makes it straight-forward to look for value-improving opportunities and calculate their impact [33, 36]. It becomes more complicated when new care pathways are implemented. The complexity arises from the potential influence of these interventions on the costs of related care pathways and their typical patient flow. To fully comprehend the impact of such interventions on organizational costs, it is important to include these factors in the cost calculation. This requires an extensive application of TDABC, potentially explaining the limited prevalence of its application for these purposes.

It is imperative to evaluate whether redesign of service delivery yields the expected outcome of improving value. Frameworks have been published to support TDABC applications [88], but none of these address the hurdle of financially evaluating implemented redesign interventions. Therefore, this methodological development paper's aim is twofold: first, it describes a real-world application of TDABC aimed at calculating a granular change in costs after introduction of a new care pathway, without having to calculate the total cost of care. This approach is thorough yet pragmatic as it provides insight into the absolute difference in organizational costs pre- and post-intervention. It maintains the real-world applicability of calculating the financial impact, without having to calculate the total cost of the studied care pathways. Second, emphasis has been placed on experienced, practical obstacles during application of TDABC. It offers guidance for practitioners, managers and academics who aim to financially evaluate value-based interventions with TDABC.

The paper follows a structured format delineated as follows: firstly, an exposition of prior TDABC studies is presented; secondly, an elaboration on the

methodological background and the proposed development is provided; thirdly, a comprehensive description of the procedural steps is offered, applied specifically to the presented case; and finally, the paper concludes with a discussion and overarching conclusions.

BACKGROUND

VBHC intersects with management accounting by underscoring the significance of informed decision making, evaluating both financial and non-financial performance indicators. A predominant focus on improving health outcomes is observable in VBHC research and implementation, with a notable gap in comprehending associated costs [89, 90]. Kaplan and Porter tried to break this cost impasse by introducing TDABC to healthcare as a relatively easily implemented yet accurate cost-accounting method [28]. TDABC has been applied increasingly to several health care settings, such as specialized medical procedures, surgical services, chronic- and long-term care and diagnostic services [89].

Prior TDABC studies frequently exhibit a comparative nature, by focussing on either contrasting the costs of different care episodes [91–96] and/or benchmarking them against reimbursement tariffs [93, 97]. Some studies also present opportunities for cost savings [93–95]. Only a few studies calculated the costs of care pathways that were adapted or implemented with the aim to improve value. Marx et al. (2023) compared the value of care for patients presenting with an acute respiratory disease between a walk-in clinic and an emergency department [98]. Other studies compared the costs of innovative care pathways with conventional ones [99] or the costs of virtual clinic visits with in-person ones [100].

These studies show a growing trend in the application of TDABC in healthcare, yet applications to evaluate the added value of substantial redesign interventions remain scarce. Anticipating a growth in such applications with the expanding implementation of VBHC, this paper holds relevance by providing methodological support for future TDABC studies.

METHODS

Context

This real-world TDABC application was part of a 2-years action research conducted in Breda, Noord-Brabant (NL), which was aimed at designing an outcome-based payment model after redesign of maternity care delivery processes concerning pain relief during labour. The Dutch maternity care system works as a two-tier model. For low-risk pregnancies, community midwives and

maternity nurses provide primary care, allowing women to choose between home delivery or delivery in an outpatient setting. In the context of labour within this primary care setting, complications and/or the requirement for pain relief can lead to a referral to the hospital. Women with medium to high-risk pregnancies start their care trajectory in a clinical care setting and give birth in the hospital under responsibility of the gynaecologist [101].

The services concerning pain relief during labour were subject to redesign as a new form of pain relief was implemented in October 2021. In 2010–2013, pain relief usage among nulliparous (first-time childbearing) was at most 43% and respectively 27% for multiparous women in the region Noord-Brabant [102]. Before the intervention, women in labour had to be referred by their community midwife to the clinical obstetric team in the hospital to receive pain relief (epidural analgesia or intravenous remifentanil). Now, community midwives are authorized to provide nitrous oxide (an inhalational form of analgesia) as pain relief during labour. Several reasons were identified to indicate the potential of this intervention to increase value to the patient. Firstly, previous work proves the efficacy of nitrous oxide and no significant increase in maternal and neonatal complications, furthermore women express positive experiences [103, 104]. Secondly, intra-partum referrals, which are associated with negative birth experiences, can be prevented [105]. Thirdly, prior TDABC studies have documented notable variations in personnel salaries, suggesting that the intervention could lead to cost reduction as specialist maternity care time is substituted. Additionally, the utilization of fewer clinical resources and less hospital-related overhead costs further supports potential for cost savings [27, 106].

Research site

The setting is an integrated maternity care organisation (IMCO) 'Annature' located in the Breda, Noord-Brabant. A single site was studied as this offered in-depth knowledge of their care delivery processes and employment of costs. The IMCO is organized as a network with partners: 13 primary-care midwife practices, six maternity nursing organisations, an OB/GYN (Obstetrics & Gynaecology) medical specialist enterprise, and the obstetric department of a top clinical teaching hospital (Amphia Hospital in Breda). As such, the traditional two-tiers are defragmented: the maternity care professionals collaborate in multidisciplinary care pathways, have access to an integrated electronic medical record and are reimbursed through bundled payments. The integrated structure of care delivery and reimbursement at the IMCO stimulates and facilitates the redesign of care pathways.

METHODOLOGICAL DEVELOPMENT

TDABC was introduced as a manageable method to understand resource use in highly variable processes, such as healthcare [36]. TDABC is suitable for this context as most care activities are primarily determined by the amount of time that specific resources are utilised for [32]. It is a bottom-up costing approach that departs from the patient journey, which is conceptualised by care pathways that cover all activities needed to deliver care. Two types of resource costs are utilized in care pathways. First, direct resource costs are utilized, such as medicines and supplies, which can be allocated to care pathways directly. Second, indirect resource costs are utilized, such as overhead (e.g., the rent of a unit, the depreciation of general medical equipment, IT) and support costs (e.g., administrative personnel salaries), which require allocation keys to be allocated to care pathways [36].

In TDABC, time is the single key for allocating indirect resource costs. These are allocated to care pathways based on capacity cost rates (CCRs). Capacity cost rates are a ratio of costs to capacity: the numerator is the sum of the costs of the indirect resources supplied, and the denominator is the sum of the capacities of the supplied resources. Capacity cost rates are calculated on 'departmental level' or 'process level'. The first is most pragmatic but only feasible if the supplied resources are similar for all activities in the care pathway. The second is necessary when the supplied resources differ: the departmental level is then broken down into processes [36].

Although we aimed to follow the TDABC framework as closely as possible [Table 1], we propose an enrichment of the method that met our study's aim. First, the aim was to determine how the introduction of nitrous oxide as a new form of pain relief impacted the costs for all pain relief processes. This was defined as the delta: the difference in costs for pain relief pre- and post-intervention. Normally, TDABC aims to calculate the costs of the full care cycle, but we incorporated only the direct and indirect costs utilized for pain relief, in combination with patient flow, as these were subject to change due to the intervention. Second, we propose a more detailed level for cost allocation in the model: the actor-level. The reasoning behind this is that salary costs differ between primary – and clinical care professionals. Preventing intrapartum referrals alters the time investment of these professionals (from here: actors) resulting in a change in their related costs. These adaptations were needed to ensure feasibility but also incorporate granularity to calculate the changes in costs precisely.

Table 1. *Seven-step framework for TDABC.*

1) Identify the study's aim and the medical condition to be costed.
2) Map the process of the care pathways at the activity level.
3) Identify the direct and indirect resources supplied in the care pathways.
4) Estimate the total cost of each resource.
5) Estimate the practical capacity of each resource and calculate the CCR.
6) Obtain and analyse time estimates for each activity in the care pathways.
7) Calculate the cost of the care pathways by multiplying the capacity cost rates by the corresponding time estimates.

Methodological challenges and solutions

In this section, a comprehensive description of the TDABC steps applied to the pain relief case is provided. Each step is elaborated and its application to the case is presented, with a particular focus on practical methodological challenges.

Step 1: Identify the study's aim and the medical condition to be costed

It was expected that intrapartum referrals for medical pain relief (epidural and remifentanil) would decrease after the introduction of nitrous oxide. Thus, to determine the change costs, a pre- and post-measurement was carried out. Costs were determined by multiplying the number of patients per care pathway (denoted as 'Q' in Table 2) by the pain relief related costs per care pathway (denoted as 'C' in Table 2) pre- and post-intervention. The cost-comparison is illustrated in Table 2. Note that the information in the table is simplified for illustrative purposes.

Table 2. Conceptual cost-comparison.

	Pre-intervention			**Post-intervention**		
	Q	**C**	**Q*C**	**Q**	**C**	**Q*C**
Epidural	1200 (80%)	€X	1200*€X	1275 (85%)	€X	1275*€X
Remifentanil	300 (20%)	€Y	300*€Y	150 (10%)	€Y	150*€Y
Nitrous oxide				75 (5%)	€Z	75*€Z

Two assumptions were made. First, the three care pathways were three separate cost objects due to differing supplied resources. The costs for each care pathway were calculated by TDABC, resulting in values denoted as €X, €Y and €Z. Second, despite the differing costs of the care pathways, we assumed that these costs remained constant. That is, the epidural and remifentanil processes were not changed after the introduction of nitrous oxide. The delta was determined based on the following:

$$Pre-intervention\ (1200 * €X\ +\ 300 * €Y)\ vs.\ Post-intervention\ (1275 * €X\ +\ 150 * €Y\ +\ 75 * €Z)$$

***Figure 1**. Care pathways at activity level. (1/2)*

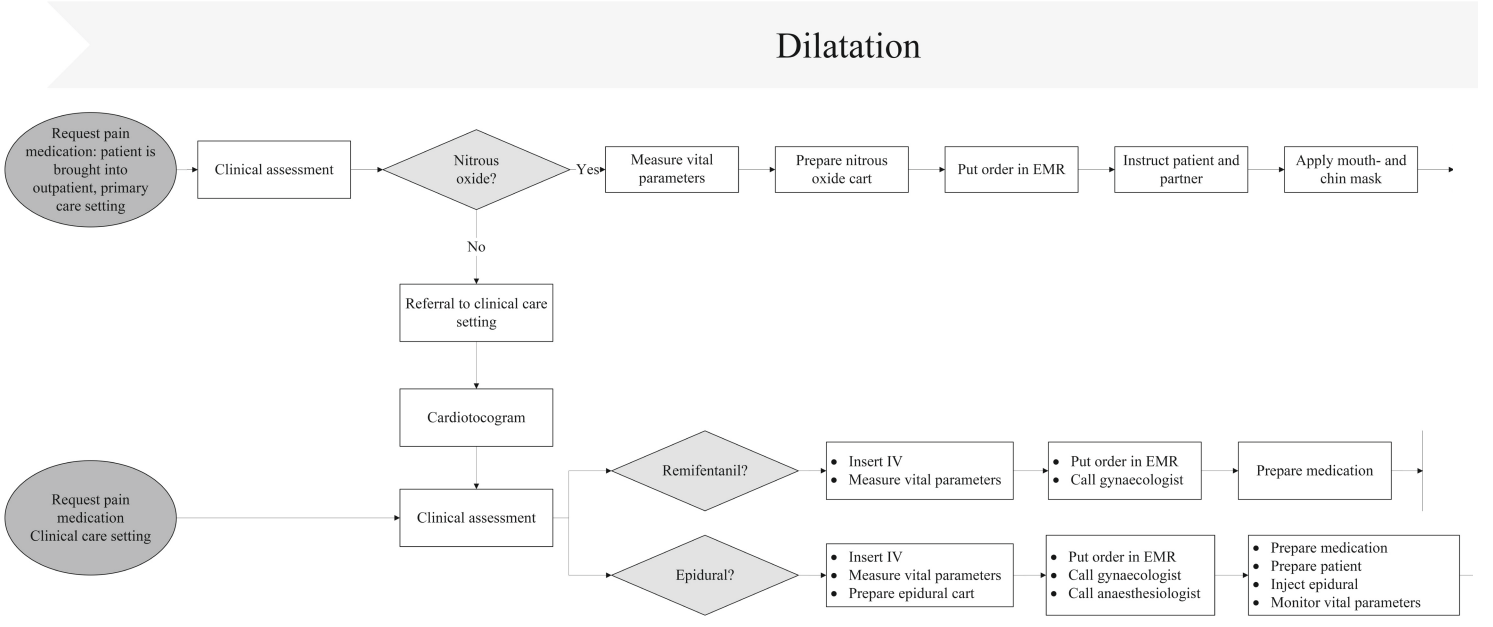
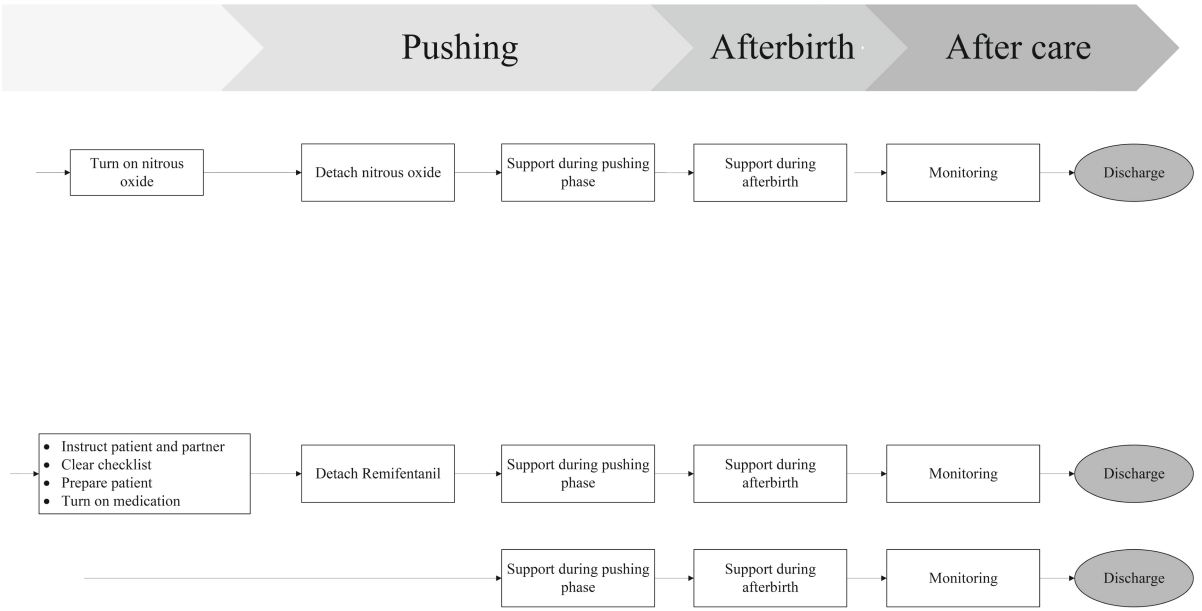


Figure 1. *Care pathways at activity level. (2/2)*



Step 2: Map the process of the care pathways at the activity level

The pain relief care pathways were mapped at the activity level, a simplified version is presented in Figure 1. This information is needed to guide the identification of the resources used (Step 3) and time consumed (Step 6). Normally, all activities of the full cycle are mapped in a care pathway [28]. The full cycle of maternity care covers the antenatal, intrapartum, and postpartum phase. Yet, our mapping efforts exclusively targeted activities within the intrapartum phase, as the intervention impacted this sub-cycle directly. That is, the period from when a woman in labour enters the delivery unit with a request for pain relief until discharge from the delivery unit. Given the specific focus on pain management, activities and costs related to complications (e.g., caesarean sections) were excluded. Basic process maps were constructed based on protocols and guidelines. Actors with a principal role in the care pathways evaluated the basic process maps during individual interviews.

Step 3: Identify the direct and indirect resources supplied in the care pathways

Supplied resources were identified based on interviews and observations [Figure 2]. Resources were distinguished as direct or indirect resources to determine what resource costs could be directly linked to the care pathways and what resource costs needed to be allocated using CCRs. Frontline personnel salary, medicine, disposables, reusables, and ancillary services were perceived as direct costs. Frontline personnel were perceived as direct resources due to their principal role in the intervention and the expectation that this would be a large cost driver. Figure 3 presents the involved actors per care pathway.

***Figure 2**. Supplied direct and indirect resource costs per care pathway (*gyn = gynaecologist, an = anaesthesiologist).*

	Epidural	***Remifentanil***	***Nitrous oxide***
Direct resource costs			
Frontline personnel			
• Community midwife	✓	✓	✓
• Maternity nurse	✓	✓	✓
• OB/GYN nurse	✓	✓	
• Clinical midwife	✓	✓	
• Gynaecologist	✓	✓	
• Anaesthesiologist	✓		
• Anaesthesia nurse	✓		
Other direct resource costs			
• Medicine	✓	✓	✓
• Disposables	✓	✓	✓
• Reusables	✓	✓	✓
• Ancillary services			✓
Indirect resource costs			
Indirect primary care resource costs			
• Delivery room related costs	✓	✓	✓
• Practice-related overhead costs	✓	✓	✓
Indirect clinical care resource costs			
• 24/7 availability GYN & AN*	✓	✓	
• Administrative and support personnel costs	✓	✓	
• General unit-related costs	✓	✓	
• Unit-related overhead costs	✓	✓	

***Figure 3**. Involved actors per care pathway. (1/2)*

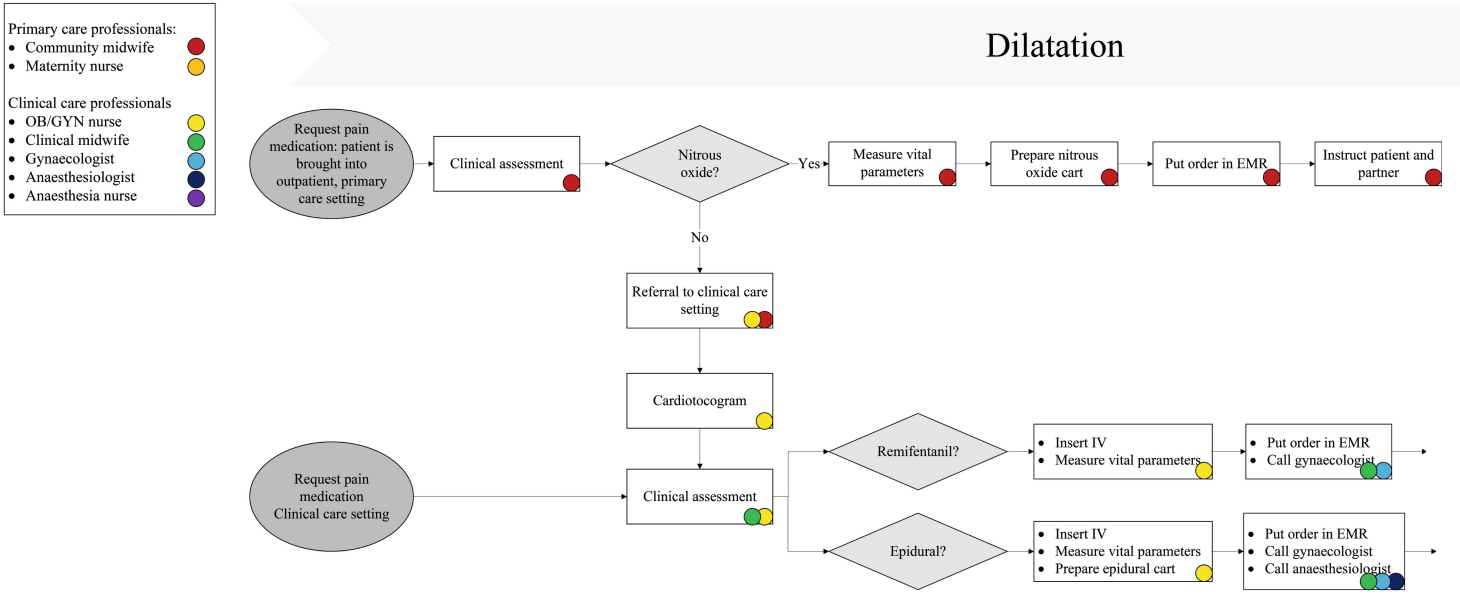
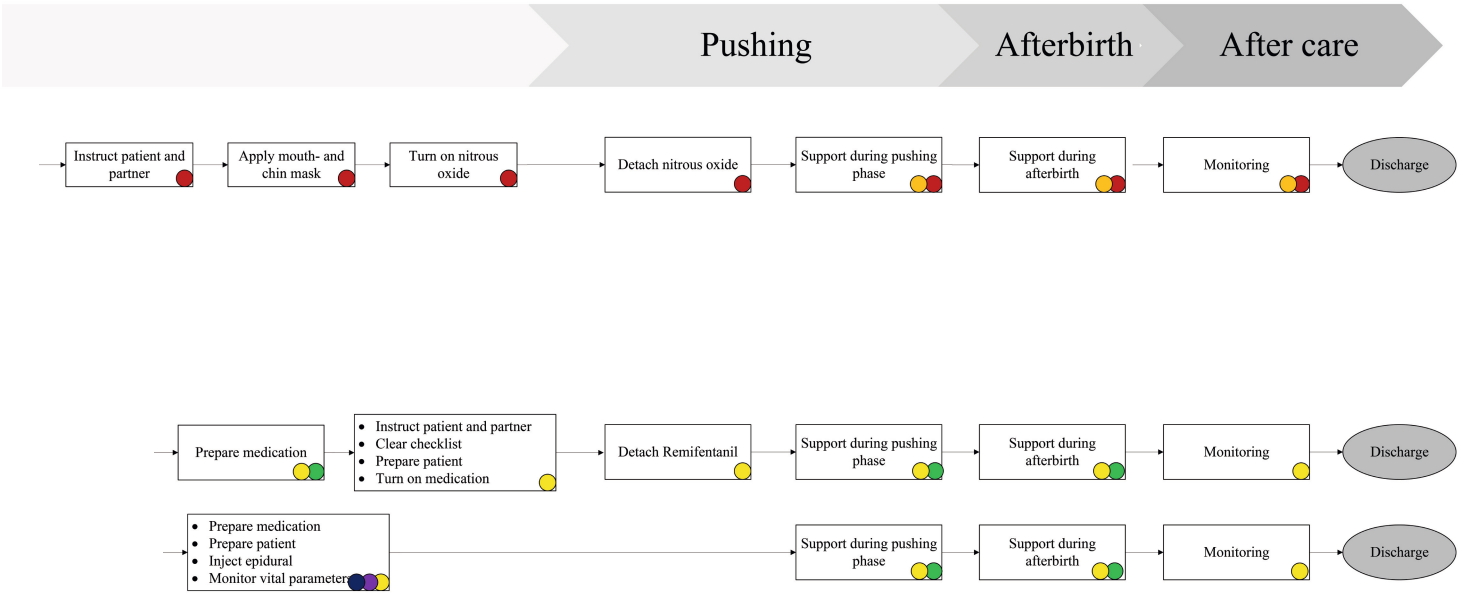


***Figure 3**. Involved actors per care pathway. (2/2)*



Concerning the indirect resources, we differentiated between indirect primary care resources and indirect clinical care resources. Although the studied care pathways take place in the same unit, the indirect resources supplied differed between the primary- and clinical care pathways. The indirect resources supplied for the nitrous oxide pathway comprised the delivery room itself in the form of rent, but not all the other clinical care related resources. For example, cardiotocographs are available in every delivery room but are not employed in that care pathway. The overhead costs associated with community midwifery practices were allocated to nitrous oxide as this drug was administered by the community midwife, the principal actor in this care pathway. Note that some women in the epidural and remifentanil care pathways have been referred intra-partum and therefore also supply costs in the primary care setting.

Step 4: Estimate the total cost of each resource

After identifying the resources supplied, cost data were obtained to allocate these either directly or via a CCR to the care pathways. Direct costs were obtained from the hospital's financial database and HR system. For the indirect clinical resource costs, we relied on the internal, bundled cost price of a clinical childbirth. Indirect resource costs on departmental level were unavailable as the hospital works with internal cost prices on diagnosis-related group (DRG) level for reimbursement purposes. On a note of caution, incorporating indirect costs based on internal cost prices has limitations since the hospital's internal cost prices are based on aggregated cost calculations, sometimes resulting in a misrepresentation of actual costs [27]. The cost price was built out of the following cost pools: frontline personnel costs, administrative and support staff personnel costs, general unit-related costs (restaurant and hotel services, regular medicines, regular medical materials and medical equipment, and maintenance contracts) plus overhead costs (depreciation of buildings and inventory, maintenance, energy contracts, leases, and interest). All costs were included except the frontline personnel costs as these were allocated separately on actor-level (Step 5). For indirect primary care resources related to the delivery room, we relied on the national tariff for delivery in an outpatient setting calculated by the Dutch Healthcare Authority (NZa). The included pooled costs were overhead costs, material costs and other costs. Frontline personnel costs, as explained above, were excluded. Incorporating indirect costs based on national tariffs is undesirable as these are selling rather than cost prices and therefore do not represent the actual costs. The used annual overhead costs of midwifery practices were based on an external study of average primary midwifery practice costs in the Netherlands, commissioned by the Dutch Healthcare Authority [107]. It was experienced that applying Step 4 is challenging when high-quality cost data are not available. Second-best cost data should always be handled cautiously. A different allocation technique had to

be employed for the indirect costs related to the hospital and the delivery rooms as described in the next step.

Step 5: Estimate the practical capacity of each resource and calculate the CCR

Frontline personnel costs

The frontline personnel costs were allocated separately. This study was motivated by the expected cost savings achieved by substituting care from the relatively expensive hospital personnel to less expensive primary care personnel. We differentiated between types of 'actors' to incorporate this level of granularity and calculated a CCR per profession (based on their differing salary costs). CCRs were calculated based on total cost of a profession per year, divided by the practical capacity of that profession per year. We defined practical capacity as the net time available to provide patient care in minutes.

Indirect resource costs

The CCR metric to allocate hospital- and delivery-room-related indirect costs was not feasible because indirect resource costs on departmental level were unavailable. To overcome this hurdle, cost prices and tariffs on episode of care level had to be used. A different technique to proportion these costs was deployed. We decided to use average labour time as the allocation basis rather than process time (i.e., duration of activities) due to the nature of the indirect costs: the longer a delivery room is occupied, the longer these resources are supplied.

Concerning the clinical care pathways, It is known that the average labour time is longer for nulliparous (first-time childbearing) compared to multiparous women (women who have given birth before) [108]. The epidural population consists of a higher percentage of nulliparous women compared to the remifentanil population. Consequently, the average hospital-related indirect costs were allocated proportionally.

Concerning the primary care pathway, two types of indirect costs were allocated: (1) delivery-room-related and (2) average overhead of a midwifery practice. For (1), the delivery-room-related costs per patient were divided by the average labour time, resulting in a cost per minute rate for bed occupancy. For (2), the CCR for the overhead costs of midwifery practices was calculated by dividing the annual costs by the annual practical capacity of an average midwifery practice in the region.

Step 6: Obtain and analyse time estimates for each activity in the care pathways

Kaplan and Anderson offer a rule-of-thumb for determining time estimates: standard times are appropriate for short, inexpensive activities with minor

variations. For long, expensive and/or variable activities, durations should be estimated [36]. In healthcare, most activities are variable. Methods used to obtain actual durations vary, but data from EMR timestamps or hospital systems are most credible [88]. When these are not accessible or registered, time duration data can be collected through Time and Motion studies (TMS) using direct observations, interviews, or surveys. We combined different data collection methods to enable cross-validation.

The following strategy was applied: first, the actors interviewed to develop the process maps were also asked to provide rough indications of time durations; second, direct observations of the actors were carried out to record the times needed to perform clinical and non-clinical activities within the care pathways. Direct observations are subject to the variability of clinical practice. Variations are due to three forms of variability: clinical variability (different patients have different characteristics and different needs), flow variability (uncertain and random patient arrival times) and professional variability (variance due to non-uniform work methods) [109]. Therefore, a second round of interviews was held, during which the observation data were presented (the range, average and median estimates) and the actors were asked to validate the representativity and generalisability of these estimates.

Discrepancies between the observations and the process maps were investigated. This could result in a modification to the process maps. For activities that could not be observed, simulations and/or self-registrations were employed. Simulations are demonstrations of activities whereas self-registration is when actors note the duration of an activity themselves. Time data were stored in Microsoft Excel. The data analysis and synthesis was done in collaboration with care professionals to ensure a match with practice, a procedure that is advised in other TDABC frameworks and protocols [110].

Step 7: Calculate costs of the care pathways by multiplying the capacity cost rates by the corresponding time estimates

The costs of the care pathways were calculated as follows. First, the total time duration of the activities per actor were multiplied by the actor's CCR. Second, the costs of direct supplies were added. Third, hospital-related indirect costs were proportionally allocated to the epidural and remifentanil pathways. Indirect costs related to the delivery room were allocated to the nitrous oxide pathway based on the average duration of a delivery with nitrous oxide. Practice-related overhead costs were allocated based on the process time of the community midwife. After the costs for each care pathway were allocated, these were multiplied by pre-intervention and post-intervention cohorts to calculate overall pain relief costs, which were compared to determine the delta.

DISCUSSION

The aim of this paper was to provide insight into the application of TDABC to determine a change in costs after service delivery redesign. Furthermore, this paper provided an enrichment of the method to pragmatically calculate the financial impact of the implementation of new care pathways. This paper offers practical guidance for future TDABC studies that aim to take the implementation of VBHC to the next level by evaluating implemented care delivery redesign.

IMPLICATIONS

One of the objectives of VBHC is to combine cost- and outcome information during decision-making. It is imperative to know which activities contribute to value [1]. TDABC proves to be suitable for understanding the costs associated with care. Previous studies have concentrated on comparing costs across different episodes of care to identify opportunities for value improvement [93–95]. However, there is a limited body of research evaluating whether these interventions deliver the anticipated outcomes [98–100]. We address this gap by providing lessons learned, which could stimulate future TDABC research to not only focus on identifying value-improving opportunities, but also the financial evaluation of these. Moreover, it equips healthcare managers with tools to apply TDABC, addressing the often-limited understanding of healthcare costs and thereby enhancing decision-making capabilities.

LIMITATIONS AND FUTURE RESEARCH

Our paper has several limitations and suggestions for future research. First, we chose not to calculate the total cost of the maternity care cycle, which provided insight into the impact of the intervention on the most prominent short-term and tangible costs. As such, TDABC was suitable for assessing how healthcare costs can change in the short-term. However, costs of complications were not included while these could also impact resource use, as this was not feasible within the scope of the research project. Future studies should complement ours by determining the costs of complications related to the studied care pathways and including these in the model.

Second, we aimed to incorporate a deeper level of detail to achieve a more comprehensive understanding of the impact of substituting care between care settings. While calculating costs at the departmental level is most pragmatic [36], we argue the separate allocation of frontline personnel costs. While this creates a deeper understanding of resource use, it requires a trade-off between pragmatism and granularity. Therefore, future TDABC studies should reflect on their study's aim and apply the method accordingly.

Third, the reliance on time as single allocation key is feasible, but also subjective. Striving for near-perfect time estimates by applying Time and Motion studies would likely be cumbersome. Kaplan and Anderson (2007) advise an accurate rather than perfect estimate. Therefore, we offer a three-step method to achieve a sufficiently accurate estimate based on TMS that includes cross-validation. However, feasibility is questionable when applied on a larger scale. Future studies should therefore explore other data collection methods that facilitate the application of TDABC, such as fuzzy logic [27], robotic process automation or apps [88].

CONCLUSIONS

This paper provides guidance on the application of TDABC to determine a change in costs after adaptations in care delivery processes. The novelty of our study is multifaceted. First, we show how the method can be applied to determine a change in costs without having to calculate total costs. Second, we suggest how to incorporate a primary focus on healthcare professionals by proposing the actor-level to allocate frontline personnel costs. Third, we elaborate on the encountered challenges when applying TDABC in practice and how to handle these. Finally, we believe our study facilitates future TDABC applicators and contribute to its uptake.

03

Chapter 3

Value-based evaluation of gestational diabetes mellitus care pathway redesign by using cost and outcome data

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is a common complication of pregnancy. Implementation of Value-Based Healthcare (VBHC) to GDM care is worthwhile as traditional GDM care is fragmented and fails to meet the needs of women with GDM. Value of care can be improved through optimization and redesign of the care pathway and implementation of an outcome-based payment model. This study was conducted to perform a value-based evaluation of GDM care pathway redesign by using cost- and outcome data.

Methods: This study was designed as a single center, prospective, observational cohort study. In January 2022, GDM care was redesigned by substituting GDM care activities from an Internal Medicine Department (IMD) to an Integrated Maternity Care Organization (IMCO) in the Netherlands. Women diagnosed with GDM in 2021 were assigned to a pre-intervention cohort (N = 264) and those diagnosed in 2022 to a post-intervention cohort (N = 407). The impact of the intervention on value of care for women with GDM was evaluated by comparing clinical outcomes, patient-reported experience measures (GDM Responsiveness questionnaire), and costs (Time-Driven Activity-Based Costing) between the cohorts.

Results: Referrals to the IMD for GDM decreased by 84.8% (pre-intervention: 100%, post-intervention: 15.2%, $p < .001$), patient-reported experiences significantly improved (Mean responsiveness pre-intervention: 3.46, post-intervention: 3.63, p: 0.00). Initiation of insulin treatment decreased by 46.8% (pre-intervention: 25.0%, post-intervention: 13.3%, $p < .001$). Maternal- and neonatal clinical outcomes were not different after redesign. Weighted average costs per GDM treatment were 9.7% lower post-intervention (pre-intervention: €168,37, post-intervention: €151,97).

Conclusions: The redesign of GDM care positively impacted value through decreased referrals and improved patient-reported experiences while clinical outcomes remained constant. By de-fragmenting GDM care, cost savings were realized. This study contributes to the improvement of care delivery, particularly in pregnancy and childbirth, by promoting the adoption of comprehensive, value-based evaluations of redesign initiatives and supports the further uptake of VBHC in maternity care.

BACKGROUND

Gestational diabetes mellitus (GDM) is a common complication of pregnancy defined as 'diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation'[111]. The occurrence of GDM is associated with short- and long-term adverse outcomes for both mother and neonate [112]. Global prevalence is 14% but varies between continents due to diverging diagnostic criteria and heterogeneous population characteristics [113, 114]. Prevalence is increasing, which makes GDM a global public health issue [115–117]. An unhealthy lifestyle, in terms of inadequate nutrition and exercise, is associated with the development of GDM [118, 119]. Primary strategies for controlling GDM are therefore aimed at nutrition and exercise [114, 118, 120]. When these fail to be effective, pharmacological treatment with insulin is needed [121, 122]. This is required for 15–30% of the women with GDM [123].

Studies have shown that the traditional GDM care pathway is fragmented and fails to meet the needs of women with GDM, highlighting the potential for improving value of care for women with GDM [124–126]. Value-Based Healthcare (VBHC) is concerned with maximizing value for patients. Value is defined as 'the health outcomes achieved per dollar spent' and is improved by enhancing outcomes at comparable or lower cost or achieving comparable outcomes at lower cost [1, 8]. Healthcare providers can enhance value by implementing interventions aimed at redesigning care pathways, such as substituting care from a secondary care setting to a primary care setting [33, 127–129]. Additionally, outcome-based payment models can be designed to reward healthcare providers for improving value and further incentivize the practice of VBHC [58, 130, 131]. Implementation of VBHC depends on insight into resource utilization and quality of care using cost- and outcome data [28, 33]. However, practical experiences with comprehensively collecting, analyzing, and evaluating these data are scarce [10].

This study was conducted to perform a value-based evaluation of GDM care pathway redesign by using cost- and outcome data. Costs were calculated with Time-Driven Activity-Based Costing and outcomes were collected using clinical outcomes and patient-reported experience measures. This study was part of a 2-year action research project conducted at an Integrated Maternity Care Organization (IMCO) in the Netherlands. The research project was aimed at designing outcome-based payment models for redesigned maternity care delivery pathways based on cost- and outcome data. This study contributes to the improvement of care delivery, particularly in pregnancy and childbirth, by promoting the adoption of comprehensive, value-based evaluations of redesign initiatives and supports the further uptake of VBHC in maternity care.

METHODS

Study aim

This study's aim was twofold. First, state-of-the-art methods were applied to collect cost- and outcome data of GDM care. Second, the collected cost- and outcome data were comprehensively evaluated to determine the impact of redesigning the GDM care pathway on value for women with GDM.

Study design

To compare the value of care before- and after the intervention, the study was designed as a single center, prospective, observational cohort study. The intervention was implemented 1st of January 2022. Two cohorts were created based on a dataset containing clinical outcome data of women who gave birth at the IMCO between 2021 and 2022. The pre-intervention cohort includes women diagnosed with GDM between June 2021 and December 2021, and who gave birth in either 2021 or 2022. The post-intervention cohort includes women diagnosed with GDM between January 2022 (date of implementation) and December 2022, and who gave birth in 2022. Women who were diagnosed with GDM in 2022 and gave birth in 2023 were not included. Both cohorts were compared using clinical outcomes and patient-reported experiences. Clinical outcomes were derived from electronic medical records. Patient experiences were measured with a GDM Responsiveness Questionnaire.

Study setting

The Dutch maternity care system works as a two-tier model. For low-risk pregnancies, community midwives of independent practices in the neighborhood are in the lead. In this midwifery-led setting, women are allowed to choose to give birth at home or at a midwifery-led outpatient setting in a hospital. Referrals to the obstetrician in the hospital are possible for medical reasons during the antenatal, intrapartum, and post-partum phase. Women with medium to high-risk pregnancies receive obstetric care in an obstetrician-led setting within the hospital [72].

At the IMCO (Annature Geboortezorg in Breda, the Netherlands) women are still allocated to a midwifery-led or obstetrician-led setting based on their estimated risk, but the traditional two tiers are organizationally integrated. It is organized as a network with partners: 13 community midwife practices, 6 maternity nursing organizations, an OB/GYN (Obstetrics & Gynecology) medical specialist enterprise, and the obstetric department of a top clinical teaching hospital (Amphia Hospital in Breda, the Netherlands).

The IMCO is paid via bundled payments, meaning that one single payment encompasses all the services required instead of separate payments for each provider and service [24]. While a bundled payment structure is already considered an innovative provider payment model, the overall research project aimed to develop a shared-savings model explicitly linked to cost and outcome data. In this approach, the IMCO can be rewarded for value-improving efforts and is motivated to continuously optimize care pathways.

Redesign of GDM care

In the Netherlands, GDM is diagnosed by the obstetric care professional (midwife or obstetrician) using a 75 g oral glucose intolerance test (OGTT). Usually, this is at 16 weeks in case of GDM in a previous pregnancy or between 24 and 28 weeks when risk factors are present, such as body mass index > 30 kg/m2, previous history of GDM, previous infant born > 95th centile, family history of diabetes, high-risk ethnic group, polycystic ovary syndrome, polyhydramnios or suspected macrosomia. GDM is diagnosed if fasting glucose is ≥ 5.1 mmol/L, 1-hour glucose ≥ 10.0 mmol/L, or 2-hour glucose ≥ 7.8 mmol/L. Primary strategies for controlling GDM are aimed at lifestyle management through nutrition therapy and exercise. Nutrition therapy entails a personal diet to regulate carbohydrate intake, designed by a dietician. Frequent monitoring is done to check whether this adequately controls blood sugars. In case of persistent hyperglycemia (fasting glucose ≥ 5.3 mmol/L or postprandial glucose ≥ 7.0 mmol/L in at least two separate measurements) despite adherence to lifestyle changes, treatment with insulin is necessary [132, 133]. Insulin therapy is required for 15–30% of the women with GDM [123]. In the Netherlands, metformin and other oral hypoglycemic agents are not routinely used for the treatment of GDM [134].

Before the redesign intervention, women diagnosed with GDM were referred to the IMD of the hospital to receive GDM care from the internal medicine specialist and diabetes nurse. This was perceived as a burden, as it resulted in two separate care pathways: a perinatal care pathway at the IMCO and a GDM care pathway at the IMD. To overcome this, the obstetric care professionals of the IMCO were trained to deliver GDM care and became responsible for blood sugar monitoring. The IMD is involved only when therapy with insulin is needed, as this requires specific expertise. The criteria for initiating insulin therapy remained consistent with established standards. The intervention improved continuity of care for women with diet and exercise-controlled GDM, as referrals to the IMD are no longer necessary. It was expected that this intervention would lead to a 50% reduction of referrals to the IMD while quality of care and patient experiences remained constant or would improve.

OUTCOME MEASUREMENT

Primary outcome

The primary outcome was the number of referrals to the IMD, whether related to initiation of insulin therapy or not.

Secondary clinical outcomes

Clinical outcomes are categorized into: (1) delivery related outcomes: birth location at start- and end of birth, delivery type, induction of labor, (2) maternal outcomes: excessive maternal weight gained [135], polyhydramnios (amniotic fluid index greater than 24 cm), preeclampsia, gestational hypertension, hemorrhage (blood loss>1000 ml) and, (3) neonatal outcomes: neonatal weight at delivery (grams), gestational age at delivery (weeks), macrosomia (birth weight equal to or greater than the 90th percentile), preterm birth, Apgar score of less than 7 at 5 min after birth, small-for-gestational-age (birth weight less than the 10th percentile), shoulder dystocia, perinatal death and involvement of pediatrics after birth. Hoftiezer's centiles for birth weight were used, which are based on actual birth weight distributions from a large Dutch perinatal dataset. The centiles were adjusted for sex and gestational age at birth [136].

Secondary patient-reported experiences

The GDM Responsiveness Questionnaire was developed to measure patient experiences with GDM care. The questionnaire was based on the validated Responsiveness in Perinatal and Obstetric Health Care Questionnaire (ReproQ). Responsiveness focusses on the non-clinical part of quality of care and patient experience [137]. The ReproQ was developed to measure responsiveness specifically for perinatal and obstetric care based on the domains: Dignity, Autonomy, Confidentiality, Communication, Prompt attention, Social considerations, Basic amenities and Choice and continuity.

To specifically measure experiences with GDM care, a specification of the ReproQ was carried out by a multidisciplinary team of clinical experts and an epidemiologist. Several questions were added to fit the nature of GDM care. The response rate was 38% in the pre-intervention cohort and 31% in the post-intervention cohort. Questionnaire construct validity was assessed by Harman's single factor test and reliability tests (% variance explained, Cronbach's alpha). For all domains, the explained variance was >0.50%, which was considered acceptable. Cronbach's alphas ranged between 0.53 and 0.84 and everything above 0.70 was considered acceptable [138]. Two domains resulted below this metric. Cronbach's alpha has a lower result when the number of items is limited [139]. In that case, interitem correlations can be calculated, which remained within the acceptable range of 0.20-0.40 [140].

Analysis

Clinical outcomes and patient-reported experiences were analyzed in SPSS version 29 (IBM Corporation Inc. Armonk, NY, USA). Descriptive statistics were performed to compare sociodemographic information per cohort. For dichotomous variables, univariate Chi-square tests were performed. For continuous variables, independent-samples T-test or Mann-Whitney U-tests were applied, depending on normal distribution. The GDM Responsiveness data were analyzed on the following levels: overall mean questionnaire score, mean score per domain and mean score per item. Independent samples T-tests were applied when Skewness and Kurtosis remained within the acceptable range of +/- 3 and respectively +/- 10 [141]. Means, standard deviations, mean difference and Cohen's D are reported. Thresholds for Cohen's D are 0.2 for small, 0.5 medium and 0.8 large effect [142]. P-values below 0.05 were considered significant, values below 0.1 were perceived moderately significant. Nonparametric tests were conducted to ensure robustness, and these tests yielded comparable results.

COST MEASUREMENT

Time-Driven Activity-Based Costing (TDABC) is a cost-accounting method to calculate the costs of care pathways [36]. The method departs from the patient journey and allocates supplied costs to care pathways with time as allocation key [87]. This is done through the calculation of 'capacity cost rates' (CCR); the ratio of costs to practical capacity (time available to provide patient care) [89]. TDABC fits the variable nature of healthcare as the costs of most care activities are primarily determined by the amount of time that specific resources are utilized for [32]. Through this bottom-up approach, TDABC aims to be accurate and pragmatic [35]. The method is applied by following a seven-step method, which is detailed below [36, 61].

Step 1 is the identification of the study's aim and the medical condition to be costed. It was the aim to compare the costs of the GDM care pathway before and after the intervention. To determine this accurately, a three-level differentiation was applied. Firstly, we differentiated between pre- and post-intervention. Secondly, we differentiated between responsible maternity care setting (midwifery-led or obstetrician-led) at the time of GDM diagnosis. Note that women allocated to the midwifery-led setting can be referred to the obstetrician-led setting at different times during pregnancy due to different kinds of medical indications. To not further complexify the cost calculation, these referrals were not incorporated in the cost calculation. This means that women allocated to the midwifery-led group remained in that group even though they were referred later in pregnancy. Thirdly, we differentiated between GDM treatment with diet and exercise therapy

or insulin therapy, as these care processes differ. This led to eight (2*2*2) care pathways to be costed.

Direct observations and interviews before- and after the intervention were conducted to guide step 2 and 3. During Step 2, the process of the GDM care pathways before- and after the intervention were mapped at the activity level. Due to the specific focus on costs of GDM care, all non-GDM related obstetric care activities in the overall maternity care pathway were left out. During Step 3 the supplied resources in the care pathways before- and after the intervention were identified. These were divided between direct (frontline personnel) and indirect resources (building and general unit/practice related overhead costs and non-clinical, administrative and support staff personnel costs).

Step 4 is the estimation of the total cost of each resource, which was done by extracting cost data from the hospital's and IMCO's financial database, the hospitals' HR system and the database of the Dutch Healthcare Authority (NZa). Hospital-related overhead costs were incorporated using the hospital's internal cost pricing for GDM care, as indirect cost data at the departmental level were unavailable. Step 5 is the calculation of the CCRs. CCRs were calculated to allocate frontline personnel costs and overhead costs. For the frontline personnel costs, CCRs were calculated on actor-level (per profession) based on total cost per profession per year divided by their practical capacity per year in minutes. For the overhead costs, a hospital-related overhead costs CCR (similar for IMD and IMCO's obstetrician-led setting) and a midwifery-led setting-related overhead costs CCR were calculated.

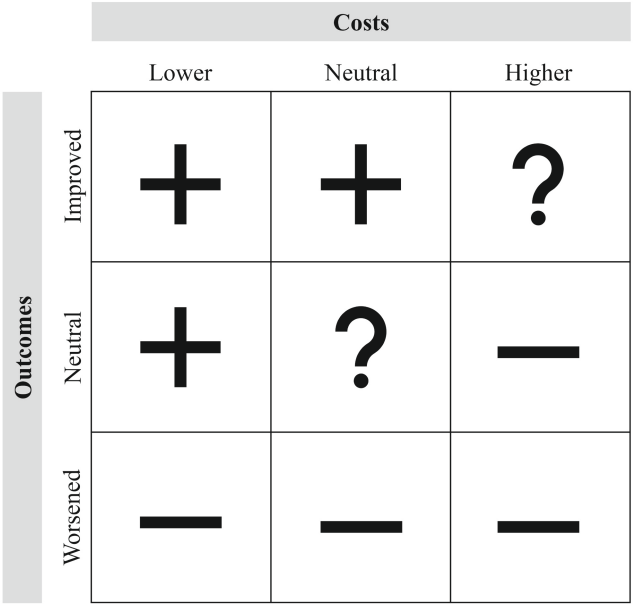
Step 6 is the collection of time estimates for all care activities in the GDM care pathways, which were obtained with direct observations and interviews. The estimates were validated by expert opinions. Time data collection was carried out before and after intervention. Step 7 is the calculation of the costs of the GDM care pathways by multiplying the CCRs with the corresponding time estimates of the activities in the care pathways and allocating the direct costs.

For comparison, the Weighted Average Costs (WAC) of GDM treatment pre- and post-intervention were calculated. This is a cost estimate in which the costs of the differentiated care pathways are combined and weighted based on their proportion in the cohort. Percentual change in costs was determined by comparing the WAC of GDM treatment before and after the intervention.

VALUE-ASSESSMENT

A value-assessment matrix (Fig. 1) was developed to visually combine the impact on costs- and outcomes and perform the value-based evaluation of the implemented GDM care pathway redesign. The columns represent the change in costs calculated with TDABC and the rows represent the change in outcomes, which is a combination of the clinical outcomes and patient-reported experiences. Three types of evaluations were possible, namely a positive impact on value (+), a negative impact on value (-) and an unconvincing impact on value (?). In this study, the neutral outcome change / neutral cost change and the improved outcome change / higher costs scenarios were considered unconvincing. In these cases, the intervention did not have a negative nor positive impact. A repeated evaluation after a specific time is then suggested.

***Figure 1**. Value-assessment matrix and corresponding evaluations per scenario.*



RESULTS

Sociodemographic characteristics of the pre- and post-intervention cohorts are presented in Table 1, which shows that there are no significant differences between the two groups.

***Table 1**: Patient characteristics pre- and post-intervention cohorts.*

	Pre-intervention	**Post-intervention**	**p**
Participants, *n*	264	407	
Age, *mean*	32 ± 4,5	32 ± 4,8	0.97
Para, *n (%)*			
Nulli	107 (40.5)	179 (44.0)	0.38
Ethnic background, *n (%)*			
Other than Caucasian	66 (25.0)	102 (25.1)	0.98
Proficiency (speaking) Dutch, *n (%)*			
Not sufficient	22 (8.3)	45 (11.1)	0.25
Neighborhood, *n (%)*			
Underprivileged	24 (9.1)	42 (10.3)	0.60
Body mass index, *n (%)*			
< 25	83 (31.4)	132 (32.5)	0.85
25 – 29.99	83 (31.4)	132 (32.5)	
> 30	90 (37.2)	142 (35.0)	

Primary outcome

After the intervention, the number of referrals to the IMD decreased significantly from 100% to 15.2%. Furthermore, the number of women treated with insulin decreased significantly from 25% to 13.3% (Table 2).

Table 2: *Primary and secondary clinical outcomes pre- and post-intervention cohorts.*

	Pre-intervention (N=264)	Post-intervention (N=407)	p
Primary outcomes			
Referral to internal medicine, *n (%)*	264 (100.0)	62 (15.2)	<.001
Insulin therapy for GDM, *n (%)*	66 (25.0)	54 (13.3)	<.001
Secondary outcomes			
Delivery related outcomes			
Birth location: start of birth, *n* (%)			0.55
IMCO: midwifery-led	76 (28.8)	125 (30.9)	
IMCO: obstetrician-led	188 (71.2)	279 (69.1)	
Birth location: end of birth, *n* (%)			0.88
IMCO: midwifery-led	40 (15.2)	60 (14.7)	
IMCO: obstetrician-led	224 (84.8)	352 (85.3)	
Delivery type, *n* (%)			0.71
Spontaneous vaginal	190 (72.0)	281 (69.0)	
Assisted vaginal	17 (6.4)	30 (7.4)	
Caesarean section	57 (21.6)	96 (23.6)	
Caesarean section, *n* (%)			0.79
Planned	27 (10.2)	43 (10.6)	
Unplanned	30 (11.4)	53 (13.1)	
Induced labor, *n* (%)	125 (47.5)	190 (46.7)	0.83
Maternal outcomes			
Excessive Gestational weight gain, *n* (%)	86 (32.6)	117 (28.9)	0.30
Polyhydramnios, *n* (%)	13 (4.9)	16 (3.9)	0.54
Preeclampsia, *n* (%)	1 (0.4)	3 (0.7)	-
Gestational hypertension *n* (%)	12 (4.5)	17 (4.2)	0.82
Hemorrhage (>1000 ml), *n* (%)	22 (8.3)	23 (5.7)	0.18
Neonatal outcomes			
Neonatal weight, g *(mean ± SD)*	3459 ± 512	3466 ± 526	0.54
GA, weeks *(mean ± SD)*	38.8 ± 1.3	38.7 ± 1.6	0.74
Macrosomia (>p90), *n* (%)	40 (15.2)	58 (14.3)	0.75
Preterm birth (<37 weeks), *n* (%)	12 (4.5)	26 (6.4)	0.31
5-minute APGAR (<7), *n* (%)	8 (3.0)	11 (2.7)	0.81
SGA (<p10), *n* (%)	23 (8.7)	35 (8.6)	0.96
Shoulder dystocia, *n* (%)	2 (0.8)	4 (1.0)	-
Perinatal death, *n* (%)	0 (0.0)	2 (0.5)	-
Pediatrics involvement, *n* (%)	193 (73.1)	269 (67.1)	0.10

IMCO (Integrated Maternity Care Organization), GA (Gestational Age), APGAR (Appearance, Pulse, Grimace, Activity and Respiration), SGA (Small for Gestational Age)

Secondary clinical outcomes

The redesign of the GDM care pathway had no significant impact on birth-related and clinical outcomes for mother and neonate (Table 2). Regarding the perinatal death cases, one stillbirth was associated with severe preeclampsia (25 weeks of gestation), and the other stillbirth resulted from placental failure due to extensive perivillous fibrin deposition (34 weeks of gestation). These outcomes are unlikely to be linked to the redesign of the GDM care pathway, as these complications are more directly related to underlying (placental) pathology than altered GDM care delivery.

Secondary patient-reported experiences

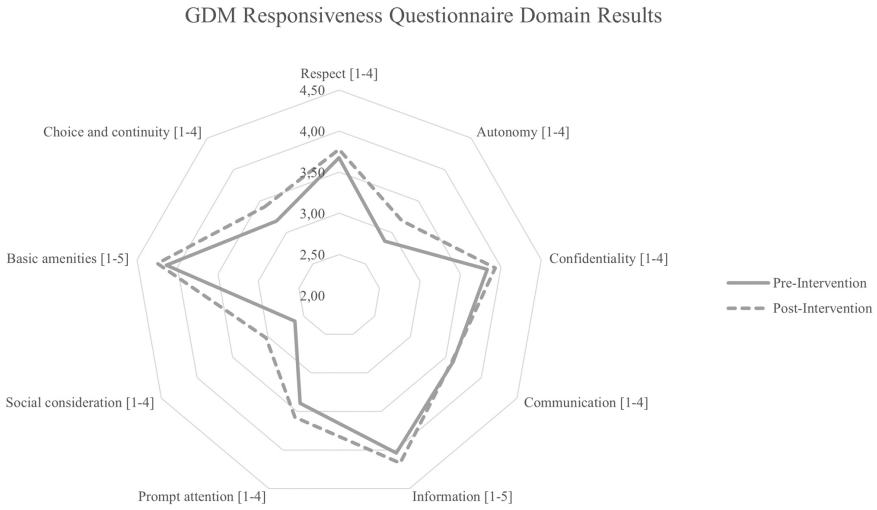
The analysis revealed a significant improvement (p =.00) in overall responsiveness for the women in the new GDM care pathway (μ = 3.63, n = 137) compared to women in the old GDM care pathway (μ = 3.46, n = 100) (Table 3; Fig. 2). The intervention had the largest, significant, positive impact on the domain Social consideration as compared to the other domains. Other significant positively impacted domains are Autonomy, Confidentiality, Choice and continuity and Prompt attention. However, the effect sizes of these differences were small to medium. A moderately significant improvement was found for the domains Respect, Information, and Basic Amenities. No significant difference was found for the domain Communication. Scores and test results per item are provided in the appendix (Appendix 1). Patient demographics of responses per cohort were compared between responders pre- and post-intervention, revealing no significant difference. A similar comparison between responders and non-responders indicated significant differences in the determinants of ethnic background and Dutch language proficiency. The results are shared in (Appendix 2).

***Table 3**: GDM Responsiveness Questionnaire results pre- and post-intervention cohorts.*

	Pre-intervention (N=100)	Post-intervention (N=137)	Mean Difference	*P*	Cohen's D
Domain scores [range]	(mean, ±SD)	(mean, ±SD)			
Respect [1-4]	3,68 ± 0,45	3,78 ± 0,38	0,10	0.07*	0,2
Autonomy [1-4]	2,86 ± 0,87	3,19 ± 0,77	0,32	0.00**	0,4
Confidentiality [1-4]	3,83 ± 0,37	3,93 ± 0,22	0,10	0.02**	0,3
Communication [1-4]	3,60 ± 0,50	3,59 ± 0,47	-0,02	0.80	0,0
Information [1-5]	4,04 ± 0,58	4,17 ± 0,61	0,13	0.10*	0,2
Prompt attention [1-4]	3,39 ± 0,58	3,58 ± 0,47	0,18	0.01**	0,3
Social consideration [1-4]	2,62 ± 0,61	3,03 ± 0,71	0,41	0.00**	0,6
Basic amenities [1-5]	4,14 ± 0,55	4,25 ± 0,59	0,11	0.14*	0,2
Choice and continuity [1-4]	3,19 ± 0,73	3,41 ± 0,65	0,23	0.01**	0,3
Overall score (mean, ±SD) [1-4,2]	3,46 ± 0,45	3,63 ± 0,40	0,17	0.00**	0,4

P-values < 0.05 were considered significant (**), P-values < 0.1 were perceived moderately significant (*)

***Figure 2**: GDM Responsiveness Questionnaire Domain results.*



Costs of GDM care

TDABC was applied to calculate the costs of providing GDM care per patient pre- and post-intervention. Based on this analysis, the change in costs of GDM care due to the intervention was determined. Before the intervention, the WAC per GDM care pathway was €168,37 and after the intervention it was €151,97, which is 9.7% lower. Table 4 provides a detailed overview of the calculated costs of the eight separate care pathways and the calculation of the WAC pre- and post-intervention (process maps are provided in Appendix 3).

Table 4: *TDABC cost calculation GDM care pre- and post-intervention.*

	Pre-intervention				Post-intervention			
	ML-diet	**OL-diet**	**ML-ins**	**OL-ins**	**ML-diet**	**OL-diet**	**ML-ins**	**OL-ins**
Time estimates								
IMCO: midwifery-led (min)	11	0	11	0	75	0	65	0
IMCO: obstetrician-led (min)	0	5	0	5	0	70	0	60
IMD: physician-led (min)	51	51	121	121	0	0	90	90
Total time estimates	62	56	132	126	75	70	155	150
Direct costs								
IMCO: midwifery-led								
Community midwife (€1,14/min)	€ 12.54	-	€ 12.54	-	€ 85.50	-	€ 74.10	-
IMCO: obstetrician-led								
Doctors-assistant (€0,53/min)	-	-	-	-	-	€ 26.60	-	€ 26.60
Specialised nurse/Physician assistant (€0,94/min)	-	-	-	-	-	€ 14.14	-	-
Obstetrician/Physician assistant (€1,37/min)	-	€ 6.85	-	€ 6.85	-	€ 6.85	-	€ 13.70
IMD: physician-led								
Doctor's assistant (€0,53/min)	€ 5.85	€ 5.85	€ 5.85	€ 5.85	-	-	-	-
Specialised nurse (€0,72/min)	€ 21.63	€ 21.63	€ 72.10	€ 72.10	-	-	€ 57.68	€ 57.68
Internal medicine specialist (€2,58/min)	€ 25.83	€ 25.83	€ 25.83	€ 25.83	-	-	€ 25.83	€ 25.83
Total direct costs	€ 65.85	€ 60.16	€ 116.32	€ 110.63	€ 85.50	€ 47.59	€ 157.61	€ 123.81
Indirect costs								
IMCO: midwifery-led (€0,45/min)	€ 4.99	-	€ 4.99	-	€ 34.03	-	€ 29.49	-
IMCO: obstetrician-led (€1,27/min)	-	€ 6.36	-	€ 6.36	-	€ 88.97	-	€ 76.26
IMD: physician-led (€1,27/min)	€ 64.82	€ 64.82	€ 153.80	€ 153.80	-	-	€ 114.39	€ 114.39
Total indirect costs	€ 69.81	€ 71.18	€ 158.79	€ 160.16	€ 34.03	€ 88.97	€ 143.88	€ 190.65
Total cost of separate care pathways	€ 135.66	€ 131.34	€ 275.11	€ 270.79	€ 119.53	€ 136.56	€ 301.49	€ 314.46
Average cost of diet and insulin care pathways	€ 133.50		€ 272.95		€ 128.05		€ 307.98	
Weighted average cost of GDM care pathways	€ 168.36				€ 151.98			

Costed care pathways at moment of diagnosis of GDM: ML-diet (midwifery-led, diet), OL-diet (obstetrician-led, diet), ML-ins (midwifery-led, insulin), OL-ins (obstetrician-led, insulin). Physician-led care is applicable in all pre-intervention pathways and only in the case of ML-ins and OL-ins post-intervention. IMCO (Integrated Maternity Care Organization), IMD (Internal Medicine Department).

DISCUSSION

This study was conducted to perform a value-based evaluation of GDM care pathway redesign by using cost- and outcome data. The intervention of transferring the majority of GDM care to the IMCO resulted in a significant 84.8% reduction in referrals to the IMD and a significant improvement of patient-reported experiences, while clinical outcomes remained stable. Moreover, a cost savings of 9.7% was realized. These findings indicate that the intervention had a positive impact on value of care for women with GDM.

In current literature, comprehensive, value-based evaluations of redesign initiatives in GDM care are scarce. Syrop et al., (2021) redesigned care delivery for insulin-requiring women with GDM by incorporating remote glucose monitoring. Their study showed improved maternal and neonatal clinical outcomes, lower length of stay and costs [127]. In Australia, a digital model of care for GDM has also been implemented, showing similar outcomes to standard, traditional care [143]. Furthermore, it had a positive cost implication for the population [144]. Notably, patient-reported experiences were not an integral part in these evaluations. Redesign initiatives can be successful in terms of cost savings or improved clinical outcomes, but when patient experiences unknowingly deteriorate, the impact on patient value is questionable.

It is key to incorporate outcomes that matter to patients in value-based evaluations. Studies have shown that women with GDM desire a holistic approach in the care process, characterized by emotional, social, and economic components [124, 126]. In the new model of GDM care in this study, these needs were better met. The results of the GDM Responsiveness Questionnaire indicate that women with GDM appreciate the new care pathway. Since the intervention, women feel more empowered in terms of autonomy and choice and appreciate the perceived accessibility of the IMCO's obstetric care professionals. These professionals provide GDM care in a way that moves beyond the traditional medical approach in terms of attention for the women's personal situation and social support system. That is because obstetric care professionals are in the unique position to build a partnership with women during pregnancy and thereby are able to better address these needs [145, 146].

The significant decrease in insulin therapies was an unexpected outcome. If this reduction were due to a decline in quality of GDM care provided by the obstetric care professional during pregnancy – for example by inadequate blood sugar monitoring – an increase in GDM-related complications might be expected, such as polyhydramnios and macrosomia. Since we did not observe such an increase, we assume that quality of care was not affected and glycemic control

during pregnancy remained adequate. However, as our study was not specifically powered to assess non-inferiority of clinical outcomes, these findings should be interpreted with caution. Further research is needed to formally establish non-inferiority. Perhaps the improved continuity of care positively impacted adherence to the diet and exercise therapy which resulted in a decrease of the number of women in whom insulin therapy was indicated [147]. However, this also requires further research.

The application of TDABC helped to unravel the inherent complexities of organizational costs involved with various healthcare professionals contributing to the GDM care pathway. Even though application of TDABC can be time-consuming, it provides invaluable insights. For example, it is often assumed that transferring care activities from a clinical care setting to a primary care setting has the potential to realize cost savings as the primary care setting is typically less expensive [148–150]. We observed that while the average costs associated with diet therapy provided by the IMCO were indeed lower, the costs for insulin therapy were higher due to the combined efforts required from both the IMCO and the IMD. Notably, the overall cost savings were primarily driven by the significant reduction in the number of insulin therapies.

The value-assessment matrix applied in this study is an intuitive and pragmatic tool to map the impact of interventions on value. Furthermore, it necessitates the incorporation of both critical inputs, as the impact on value cannot be determined when cost- or outcome data are omitted. The matrix also supported this research project in creating unity of language. The overall research project was aimed at designing an outcome-based payment model, which required interdisciplinary collaboration between managers, medical professionals, healthcare insurers and policy makers. The matrix supported in creating a shared understanding of the value concept and the evaluation of the redesign initiative.

Our study has several strengths. Firstly, studies describing real-world cases of extensive redesign of care delivery services are scarce. Therefore, this paper contributes to current literature on the impact of service delivery redesign on value, specifically for GDM care. Secondly, studies performing value-based evaluations with the use of clinical outcomes, patient-reported experience measures and costs of care are limited. This study applied state-of-the-art methods such as a validated questionnaire to specifically measure the experiences of women with GDM care and TDABC to calculate an accurate estimate of costs of GDM care. Thirdly, this study developed and applied an intuitive and pragmatic value-assessment matrix to determine the impact of (redesign) interventions on value which supports the uptake of VBHC in practice.

Our findings must be interpreted within the limitations of this study. First, the GDM Responsiveness questionnaire was only available for Dutch speaking women. Analysis of demographic determinants between responders and non-responders showed a significant difference for determinants ethnic background and non-Dutch speaking women. This might result in bias, as the experiences of these women remain unheard. Second, we did not calculate the costs of the full maternity care pathway, which covers the prenatal, intrapartum, and post-partum period. Larger cost savings could have been detected when including also the intrapartum and post-partum period. Future studies could also expand the cost calculation by including the impact on long-term costs. Third, it was the aim of this study to gain insight into the impact of redesigning GDM care on value on the level of the GDM population. This paper illustrates how cost- and outcome data can be evaluated for this end. The impact on societal value was beyond the scope of this study. Future studies could explore different methodologies to address this aspect, such as a cost-effectiveness study.

Our study has several implications. Firstly, as GDM is a serious public health problem due to its impact on short- and long-term outcomes of mother and neonate, it is of paramount importance to strive for a model of care that improves these outcomes [112, 121]. Furthermore, prevalence of GDM is increasing worldwide [115, 116]. Countries are struggling with growing healthcare costs; therefore, it is necessary to allocate resources efficiently. This study shows that redesigning services results in lower costs while outcomes remain stable, offering an efficient solution. Secondly, this study shows the importance of comprehensively evaluating redesign initiatives. Inputs such as outcomes, patient-reported experiences and costs need to be included in this evaluation. From an organizational perspective, the evaluation could be expanded by also including data on workforce pressures and work satisfaction. Due to the intervention, the IMCO's professionals have more responsibilities, while these professionals' time is already under pressure. Therefore, it is important to also consider such factors in the value equation. However, this would complicate the assessment of the overall impact. Therefore, future studies could investigate how the value equation can be expanded by including factors beyond costs and outcomes.

CONCLUSION

Gestational diabetes mellitus (GDM) care pathway redesign had a positive impact on value of care for women with GDM. The transfer of low-risk GDM care from the outpatient clinic of the Internal Medicine Department (IMD) to an Integrated Maternity Care Organization (IMCO) resulted in an 84.8% reduction in referrals to the IMD, a 46.8% reduction of initiated insulin therapies and significantly improved

patient experiences. Quality of care, measured with clinical, birth-related, maternal, and neonatal outcomes, remained stable. By de-fragmenting the care pathway, cost savings of 9.7% were realized. This paper shows how redesign initiatives have the potential to improve value of care and how state-of-the-art methods can be applied to perform a comprehensive, value-based evaluation. This should support the further uptake of Value-Based Healthcare (VBHC) in maternity care.

04

Chapter 4

Value-based evaluation of nitrous oxide for pain relief during labour by using cost- and outcome data: A prospective, observational cohort study

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Manuscript under review

ABSTRACT

Objective: To evaluate the implementation of nitrous oxide for pain relief during labour in a midwifery-led setting, aiming to reduce intrapartum referrals for pain relief in an obstetrician-led setting, by using cost data and outcome data and following the principles of Value-Based Healthcare.

Design and setting: Prospective observational cohort study at an Integrated Maternity Care Organisation (IMCO).

Participants: Women starting labour in a midwifery-led setting who made use of pain relief during labour, comparing pre-intervention (N=523) and post-intervention (N=514).

Interventions: Introduction of nitrous oxide as a pain relief method during labour in a midwifery-led care setting (October 2021).

Primary and secondary outcome measures: Primary outcome was the reduction in obstetrician-led pain relief usage (epidural anaesthesia and remifentanil). Secondary outcomes included maternal and neonatal clinical outcomes, patient-reported experience measures using the ICHOM standard outcome set for Pregnancy and Childbirth, specifically the Birth Satisfaction Scale – Revised, and costs calculated with Time-Driven Activity-Based Costing. Comparisons were made between pre- and post-intervention cohorts, with a sub-analysis of comparing nitrous oxide and alternative pain relief methods.

Results: The introduction of nitrous oxide led to a 10% reduction in pain relief use in obstetrician-led care (pre-intervention: 100%, post-intervention: 90%, p=<.001). Clinical maternal and neonatal outcomes either significantly improved (fewer instrumental deliveries, fever during birth and involvement paediatrics) or remained stable. Overall satisfaction with care moderately improved (pre-intervention: mean=3,1, post-intervention: mean=3,4, p=.06). Total score for birth satisfaction remained unchanged. Weighted average costs for pain relief were €1.617,26 pre-intervention and €1.607,17 post-intervention, indicating a cost reduction of 0,62%.

Conclusions: Our study suggests a neutral to positive overall added value of nitrous oxide. This study underscores the need for comprehensive evaluations of value-improving initiatives and highlights the challenges of applying VBHC in the intrapartum phase. It contributes to the body of knowledge on VBHC in practice and informs future applications.

INTRODUCTION

The Dutch maternity care system is distinctively segmented into primary, midwifery-led and secondary, obstetrician-led care. In midwifery-led-care, it is the goal to maintain a physiological approach to pregnancy and childbirth compared to the primary medical focus in obstetrician-led care [67]. Referrals from midwifery-led to obstetrician-led care are common and are often linked to poorer birth experiences and outcomes [151–153]. To overcome this, regional midwifery-led and obstetrician-led maternity care providers have been experimenting with establishing Integrated Maternity Care Organisations (IMCOs) [154, 155]. IMCOs are characterized by integrated, multidisciplinary maternity care pathways, a shared medical file and a bundled payment structure [81]. These traits encourage the further implementation of Value-Based Health Care (VBHC), an approach focusing on maximizing patient outcomes (clinical outcomes and patient-reported outcomes) against reasonable costs, which can be achieved by healthcare delivery- and payment reform [1, 58].

There is significant potential for value improvement in preventing intrapartum referrals (i.e. referrals during childbirth) by adjusting pain relief services, as a request for pain relief is one of the top three reasons for referral during labour in the Netherlands [72, 125]. A promising intervention is the introduction of inhalational nitrous oxide for pain relief. Traditional forms of pain relief, such as epidural analgesia or intravenous remifentanil, are always administered in obstetrician-led settings and require a referral. Nitrous oxide can be administered in a midwifery-led setting, foregoing the need to 'upscale' to obstetrician-led care [156]. Studies have demonstrated that nitrous oxide is effective and well-received by women during childbirth [157–159]. Furthermore, there is a potential for realizing cost savings when admissions to obstetrician-led care can be prevented [149, 160].

From a VBHC perspective, it is essential to evaluate whether interventions, such as the introduction of nitrous oxide, add value. This requires comprehensive analysis of cost- and outcome data [8]. These data remain poorly understood in daily practice, especially in complex and unpredictable care settings like obstetric care [161, 162]. Moreover, prior literature predominantly focusses on clinical outcomes, while insight into patient-reported outcomes (such as experiences) and costs are also needed to fully determine the impact on value [10, 21]. For this study, data on clinical outcomes, patient-reported experience measures (PREMs) and costs were collected and evaluated to determine the added value of nitrous oxide. Through this study, we contribute to a better understanding of the impact of value-improving initiatives. Additionally, we provide insight into the application

of comprehensive, value-based evaluations in practice and thereby contribute to the further uptake of VBHC.

METHODS

Study aim

It was the aim of the study to collect cost- and outcome data (clinical outcomes and PREMs) to determine the added value of nitrous oxide as a new care pathway for pain relief in a midwifery-led care setting. It was expected that the introduction of nitrous oxide reduces pain relief use in obstetrician-led care and thereby leads to lower costs of care while clinical outcomes and patient-reported experiences improve or remain similar.

Study design and setting

This study is part of a 2-year action research project conducted at IMCO 'Annature Geboortezorg'. The IMCO is organized as a network with partners from (primary) midwifery-led- and (secondary) obstetrician-led care providers in the region Breda, the Netherlands. The aim of the overall research project was to design an outcome-based payment model for two care pathways. The introduction of nitrous oxide is one of the studied care pathways, results of which are presented in this paper. This study is designed as a prospective observational cohort study with a focus on women starting labour in a midwifery-led care setting (at home or in an outpatient setting) and using pain relief.

Nitrous oxide was implemented on October 17th, 2021. A pre- and post-measurement of costs and outcomes was performed for two cohorts, consisting of women who started birth in a midwifery-led setting and used pain relief before the intervention (date of giving birth between January 1st 2021 until October 16th, 2021) and after the intervention (date of giving birth between January 1st 2022 until October 16th, 2022). The pilot phase (October-December 2021) was not included, as this served as a training phase. A sub-analysis was conducted to compare the clinical outcomes and PREMs of the nitrous oxide group with those of the remifentanil, epidural analgesia, and no pain relief groups. This comparison aimed to provide a better understanding of the clinical profile of nitrous oxide and to help interpret the PREMs.

OUTCOME MEASUREMENT

Primary outcome

The primary outcome is the change in pain relief usage in obstetrician-led care.

Secondary outcomes

Clinical outcomes
Clinical outcomes were analysed to evaluate the impact of the introduction of nitrous oxide on quality of care. Outcomes were extracted from the electronic medical record. Outcomes potentially impacted by the intervention were selected for the analysis. The outcomes are categorized in *pain relief use, place of birth, maternal clinical outcomes* and *neonatal clinical outcomes*. Pain relief use comprises midwifery-led (nitrous oxide), or obstetrician-led (epidural analgesia or remifentanil) pain relief use and is differentiated between single type use or the use of multiple types, for example when the first type of administered pain relief is not effective. Place of birth is either in midwifery-led or obstetrician-led care. Maternal outcomes consist of delivery mode (instrumental or caesarean section), augmentation of labour (yes/no), haemorrhage blood loss >1000ml (yes/no), and fever during birth (yes/no). Neonatal clinical outcomes are gestational age (weeks), birth weight (grams), Apgar score more or less than 7 at 5 minutes after birth (yes/no), perinatal death (yes/no), involvement of paediatrics after birth (yes/no) and admission to the neonatal unit within 28 days after birth (yes/no).

Patient-Reported Experience Measures (PREMs)
PREMs were measured using the standard outcome set for Pregnancy and Childbirth (PCB) developed by the International Consortium for Health Outcomes Measurement (ICHOM) [163]. The set has been translated and validated for the Dutch maternity care setting [101]. The PCB set contains a variety of (internationally validated) measurement domains, which, for example, measure quality of life (PROMIS-10), postnatal depression risk (EPDS), incontinency (Wexner) or birth satisfaction (BSS-R). The PCB set has a timeline for assessment, meaning that patient experience data is collected at different timepoints in pregnancy and postpartum [164]. The IMCO implemented the set in 2020. For this study, women's answers to the fourth questionnaire, which is send 4 weeks postpartum, have been assessed. This specific questionnaire captures patient-reported experiences with care received during childbirth, which are relevant for the evaluation of nitrous oxide. The domains included in the analysis were: Satisfaction with care and Birth Satisfaction Scale-Revised (BSS-R).

Satisfaction with care
This single item (How satisfied are you with the provided care during labour?) measures degree of satisfaction with care during childbirth on a 5-point Likert scale. This item was selected as nitrous oxide could improve overall satisfaction with care because of improved continuity of care.

Birth Satisfaction Scale-Revised (BSS-R)
The BSS-R domain measures women's perceptions across three areas: (1) quality of care provision, (2) women's personal attributes and (3) stress experienced during labour [165]. The domain comprises of 10 items, rated on a 5-point Likert scale, with individual item scores ranging from 0 to 4. For positively framed items, a score of 4 indicates "agree", and 0 indicates "disagree". For negatively framed items, the scoring is reversed: 4 indicates "disagree", and 0 indicates "agree". Higher scores reflect more positive experiences. The original (unreversed) item scores can be summed to calculate a total BSS-R score, ranging from 0 to 40. A total score below 25 is considered alarming.

ANALYSIS

Clinical outcomes and PREMs were analysed in SPSS version 29 (IBM Corporation Inc. Armonk, NY, USA). Descriptive statistics were performed to compare sociodemographic factors. Clinical outcomes and PREMs were compared between two groups (pre-intervention, post-intervention) and a sub-analysis was done between nitrous oxide and epidural analgesia, remifentanil and no pain relief separately. For dichotomous variables, univariate Chi-square tests were performed. For continuous variables, independent-samples T-test or Mann-Whitney were used, based on normal distribution. Parametric tests were done when Skewness and Kurtosis remained within the acceptable range of +/- 3 and respectively +/- 10 [141]. P-values are reported to indicate statistical significance, p-values <0.05 were considered significant and p-values <0.1 were perceived moderately significant.

COST MEASUREMENT

Time-Driven Activity-Based Costing (TDABC) is a cost-accounting method applied to calculate costs of care pathways by including direct and indirect resource costs. A simplified step-by-step application of TDABC for this study is provided in a methodological development paper. We provide key issues of our application below to ensure interpretation of the results, but refer to the forementioned paper for a detailed description [29].

Key issue 1: relevant costs were calculated (intrapartum phase of the maternity care cycle excluding complications and neonatal care).

It was the aim to determine the change in costs for pain relief after introduction of nitrous oxide. This required the calculation of costs of the following care pathways: nitrous oxide, epidural and remifentanil. While VBHC advocates to calculate the costs of the full care pathway (i.e. the entire maternity care pathway, covering

the prenatal, intrapartum and postpartum phase), we exclusively focused on the *relevant costs* for our research question. The relevant costs in this study are the costs made during the intrapartum phase, as pain relief is provided during this phase. In our study, the intrapartum phase ranges from the first visit of the community midwife at home during contractions until departure of the community midwife or discharge from the hospital. Costs of complications or medical interventions (such as caesarean section, augmentation of labour or involvement of paediatrics) were left out to reduce complexity and variability in the care pathways. Therefore, the results do not aim to represent the total cost of childbirth.

Key issue 2: a change in costs is determined by combining cost- and cohort data.

Two assumptions were made regarding the execution of the cost calculation. First, it was assumed that the costs per pain relief care pathway - nitrous oxide, epidural and remifentanil - would differ due to different resources consumed. For example, the epidural care pathway is the only trajectory that requires time from anaesthesiology professionals. Therefore, TDABC was applied to gain insight into the costs per care pain relief care pathway. Second, it was assumed that the introduction of nitrous oxide alters patient volume of the other pain relief care pathways. Therefore, patient volume data was included in the analysis. Due to unequal cohort sizes, the percentual change in costs for pain relief was calculated using a weighted average costs (WAC) structure.

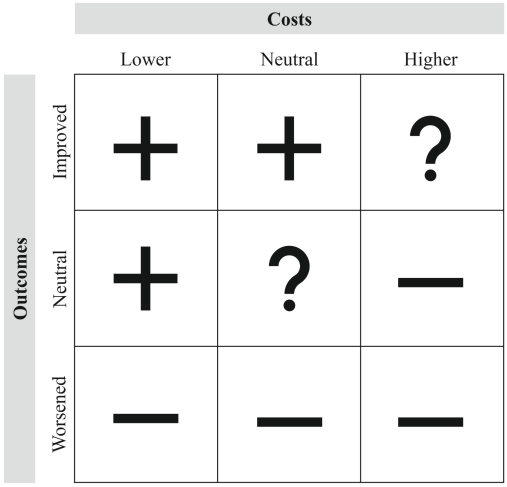
Key issue 3: the care pathways are broken down into processes to facilitate variability.

According to the TDABC methodology, a care pathway is divided into processes if consumed resources differ considerably [36]. In our case, a referral from midwifery-led to obstetrician-led care causes a change in supplied resources. Particularly the costs related to frontline personnel and overhead. Women can be referred to obstetrician-led care during three phases of labour: during dilatation of the cervix until full dilatation (1st stage), during pushing (2nd stage), and during the post-partum period from delivery of the placenta (3rd stage). This means the later the referral, the less obstetrician-led resources are consumed. It was the aim to incorporate this variability in the cost calculation. Therefore, frontline personnel- and indirect resource process costs were differentiated based on setting (midwifery- or obstetrician-led) and stage of labour (1st, 2nd or 3rd). These process costs functioned as building blocks which were accumulated in different combinations to incorporate variability and eventually calculate the costs of the care pathways and determine the change in costs after introduction of nitrous oxide.

VALUE ASSESSMENT

To support the value assessment of nitrous oxide, a 3 by 3 matrix was applied in which the outcome- and cost data are combined (Figure 1). Three types of evaluations were possible, namely a positive impact (+), a negative impact (-) and an unconvincing impact (?). In this study, the neutral outcome change / neutral cost change and the improved outcome change / higher costs scenarios were considered unconvincing. In these cases, the intervention did not have a negative impact but also did not yield the expected results. A repeated evaluation after a specific time could be suggested, as outcomes and costs might change in the future.

Figure 1. *Value-assessment matrix*



PATIENT AND PUBLIC INVOLVEMENT STATEMENT

Post-partum women were perceived as key stakeholders during multiple stages of this study. It was the aim to evaluate nitrous oxide by including data on patient-reported experiences. ICHOM developed the PCB set in close collaboration with patient representatives [163]. As the PCB set covers multiple potentially relevant domains, interviews (N=3) were conducted with women who gave birth with nitrous oxide to gain insight into the domain or outcome most important to them. Based on these interviews, the BSS-R was used for evaluation. Third, post-partum women were invited as key stakeholders to project meetings to collectively assess the cost- and outcome data to determine the added value of nitrous oxide.

RESULTS

Cohort selection

Figure 2 presents the selection of the study groups. Before the intervention, N=1585 women started labour in midwifery-led care of which N=1062 (67%) did not use pain relief. Of the women using pain relief pre-intervention (N=523), 100% used pain relief in obstetrician-led care. After the intervention, N=1021 (66%) did not use pain relief. Of the women using pain relief post-intervention (N=514), 90% used pain relief in obstetrician-led care and 10% in midwifery-led care. These results are also reported in Table 2. Analysis of sociodemographic characteristics of both cohorts show no significant differences, see Table 1.

Figure 2. *Flow diagram for patient selection in study cohort and primary outcome comparison.*

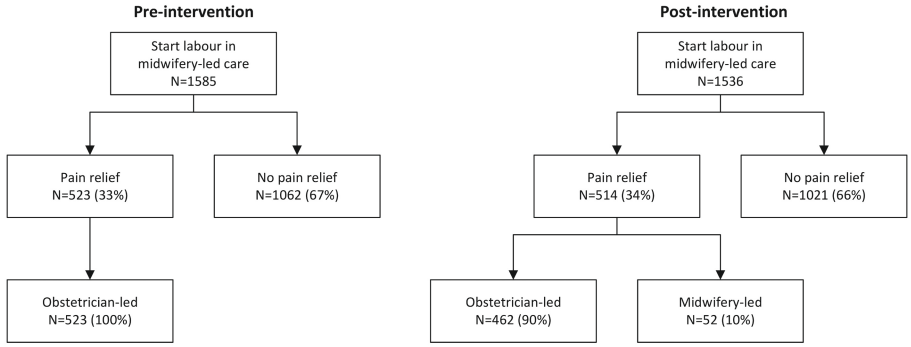


Table 1*. Patient characteristics of women starting labour in midwifery-led care pre- and post-intervention and using pain relief.*

	Pre-intervention (N=523)	**Post-intervention (N=514)**	**p**
Age *(mean ± SD)*	31 ± 4,1	30 ± 4,1	0.12
BMI, *n (%)*			
<25	322 (61.9)	303 (58.9)	0.53
25-29,99	132 (25.4)	146 (28.4)	
>30	66 (12.7)	65 (12.6)	
Primiparous, *n (%)*	388 (74.2)	406 (79.0)	0.13
Ethnic background, *n (%)*			
Other than Caucasian	72 (13.8)	72 (14.0)	0.97
Proficiency (speaking) Dutch, n *(%)*			
Not proficient	43 (8.2)	33 (6.4)	0.27

Chi-square or Independent samples T-test.

Outcome comparison pre- and post-intervention

Table 2 provides a comparison of outcomes pre- and post-intervention. As mentioned above, pain relief use in obstetrician-led care significantly reduced by 10% (pre-intervention: 100%, post-intervention: 90%, p=<.001). The percentage of epidural use remained similar, and the percentage of remifentanil use decreased significantly (pre-intervention: 20%, post-intervention: 10%, p=<.001). Combinations of nitrous oxide with other forms of pain relief were less than 1%. Considering place of birth, 100% of the women who used pain relief before introduction of nitrous oxide gave birth in obstetrician-led care. After the intervention, this significantly decreased (pre-intervention: 100%, post-intervention: 92%, p=<.001). Regarding maternal and neonatal clinical outcomes, percentage of caesarean sections remained similar, but percentage of instrumental deliveries moderately decreased (pre-intervention: 19%, post-intervention: 15%, p=.08). Percentage of augmentations of labour and haemorrhages remained similar. Percentage of fever during birth significantly decreased (pre-intervention: 9%, post-intervention: 7%, p=.00). Neonatal outcomes remained unchanged, apart from involvement of paediatrics, which significantly decreased (pre-intervention: 69%, post-intervention: 60%, p=.00).

ICHOM 's PCB set was completed by 10% (N=41) of the women pre-intervention and 27% (N=115) of the women post-intervention. When evaluating the results of the PREM (Table 3), a moderate significant difference in satisfaction with care is observed between the groups (pre-intervention: 3,12, post-intervention: 3,41, p=.06). The total score of birth satisfaction did not differ between both groups. Concerning the single items of the BSS-R, a significant difference was found for the 5th item relating to the perceived support from the staff during labour (pre-intervention: 3,1, post-intervention: 3,4, p=.05). A moderate significant difference was found for the 8th item relating to the feeling of being out of control during labour (pre-intervention: 2,0, post-intervention: 2,4, p=.06). Both results indicate a more positive experience for the post-intervention group. The other items contained no significant differences.

***Table 2**. Primary and secondary outcomes of women starting labour in midwifery-led care and receiving pain relief pre- and post-intervention.*

	Cohort pre-intervention (N=523)	Cohort post-intervention (N=514)	p
Pain relief use, *n (%)*			<.001
Midwifery-led	-	52 (10)	
Nitrous oxide	-	52 (10)	
Obstetrician-led	523 (100)	462 (90)	
Remifentanil	102 (20)	50 (10)	
Epidural	414 (79)	405 (79)	
Remifentanil and epidural	6 (1)	3 (1)	
Nitrous oxide end remifentanil	-	2 (0)	
Nitrous oxide and epidural	-	2 (0)	
Place of birth, *n (%)*			<.001
Midwifery-led	0 (0)	41 (8)	
Obstetrician-led	523 (100)	473 (92)	
Maternal clinical outcomes			
Delivery mode, *n (%)*			
Instrumental	100 (19)	77 (15)	0.08
Caesarean	82 (16)	87 (17)	0.59
Augmentation of labour, *n (%)*	381 (73)	380 (74)	0.69
Haemorrhage > 1000 ml, *n (%)*	47 (9)	35 (7)	0.19
Fever during birth, *n (%)*	36 (7)	15 (3)	0.00
Neonatal clinical outcomes			
Gestational age, weeks *(mean ± SD)*	40 ± 0,99	40 ± 1,17	0.09
Birth weight, gram *(mean ± SD)*	3486 ± 393	3472 ± 424	0.36
5-minute APGAR (<7), *n (%)*	12 (2)	12 (2)	0.60
Perinatal death, *n (%)*	1 (0)	0 (0)	-
Paediatrics involvement, *n (%)*	358 (69)	308 (60)	0.00
Admission neonatal unit, *n (%)*	260 (50)	252 (49)	0.83

Chi-square or Independent samples T-test.

***Table 3**. PREM scores per domain of cohorts pre- and post-intervention*

	Cohort pre-intervention		Cohort post-intervention		
	N	**Mean ± SD**	**N**	**Mean ± SD**	**P**
Satisfaction with care, score [0-4]	41	3,12 ± 1,0	111	3,41 ±.79	0.06
Birth Satisfaction Scale-Revised, total score [0-40]	34	26,4 ± 6.5	104	27,6 ± 5,4	0.29
Birth Satisfaction Scale-Revised, item core [0-4]					
1. I came through childbirth virtually unscathed (+)	41	2,7 ± 1,1	114	2,9 ± 0,9	0.39
2. I thought my labour was excessively long (-)	41	1,3 ± 1,3	115	1,4 ± 1,2	0.83
3. The delivery room staff encouraged me to take decisions about how I wanted my birth to progress (+)	41	3,0 ± 0,9	115	3,1 ± 0,8	0.73
4. I felt very anxious during my labour and birth (-)	41	2,1 ± 1,0	115	2,2 ± 1,1	0.64
5. I felt well supported by staff during my labour and birth (+)	41	3,1 ± 0,8	115	3,4 ± 0,8	0.05
6. The staff communicated well with me during labour (+)	41	3,2 ± 0,8	115	3,4 ± 0,7	0.11
7. I found giving birth a distressing experience (-)	41	2,5 ± 1,1	115	2,6 ± 1,2	0.56
8. I felt out of control during my birth experience (-)	41	2,0 ± 1,2	115	2,4 ± 1,1	0.06
9. I was not distressed at all during labour (+)	41	2,4 ± 1,2	115	2,5 ± 1,1	0.63
10. The (delivery) room was clean and hygienic (+)	34	3,6 ± 0,5	104	3,7 ± 0,5	0.64

Independent samples T-test. (+) Item positively framed [4=agree, 0=disagree], (-) Item negatively framed [4=disagree, 0=agree], higher scores indicate more favourable outcomes.

Outcome comparison between types of pain relief

A sub-analysis of demographic and clinical outcomes and PREM was performed between nitrous oxide and remifentanil, epidural and no pain relief separately. The results are presented in Appendix 4 and 5. The sub-analysis was performed to gain insight into the clinical profile of nitrous oxide and to help interpret the PREMs. Regarding demographics, we compared parity (primiparous) between the groups, which indicates the number of women who gave birth for the first time. The percentage of primiparous in the nitrous oxide group (46%) was similar to the remifentanil group (47%, p=.88) and no pain relief group (34%, p=.17), but differed significantly from the epidural group, in which 84% was primiparous (p=<.001). Regarding clinical maternal outcomes, some groups were too small to detect significant differences (delivery mode, fever during birth, Apgar score and perinatal death). Augmentation of labour was significantly less in the nitrous oxide group (12%) compared to remifentanil (55%, p=<.001) and epidural (81%, p=<.001). Of the neonatal clinical outcomes, significant differences were found for involvement of paediatrics, which was significantly less in the nitrous oxide group (29%) compared to remifentanil (58%, p=<.001) and epidural (68%, p=<.001), and admissions to neonatal unit, which was also significantly less in the nitrous oxide group (17%) compared to remifentanil (35%, p=.02) and epidural (54%, p=<.001).

Regarding the PREMs, satisfaction with care in general differed significantly between nitrous oxide and epidural (nitrous oxide: μ=3,64, epidural: μ=3,23, p=<.001) and nitrous oxide and no pain relief (nitrous oxide: μ=3,64, no pain relief: μ=3,60, p=.04), indicating a higher satisfaction for the nitrous oxide group. The total score of birth satisfaction differed only significantly between nitrous oxide (μ=30) and epidural (μ=27, p=0,02), indicating a higher satisfaction among the nitrous oxide users. When comparing the single items between nitrous oxide and remifentanil, a moderate significant difference is found for item 3 (feeling encouraged to take decisions), indicating a trend towards a more positive experience in the nitrous oxide group compared to remifentanil (nitrous oxide: μ=3,5, remifentanil: μ 3,1, p=.1). When comparing the single items between nitrous oxide and epidural, (moderate) significant differences were found for item 1 (unscathed), 2 (long), 3 (feeling encouraged to take decisions), 5 (feeling supported) and 6 (communication), with the nitrous oxide group showing more positive results. When comparing the single items between nitrous oxide and no pain relief, a moderate significant difference is found for item 1 (unscathed), with no pain relief indicating a more positive experience than nitrous oxide (nitrous oxide: μ=3,2, no pain relief: μ=3,5, p=.07).

TDABC cost comparison

Figure 3 shows the studied variety of care pathways for women after starting labour in a midwifery-led setting (home or outpatient) and subsequently opting for pain relief. In total, 13 variations of care pathways were possible. The care pathways mapped on activity level are provided in Appendix 6. All separate care pathways were costed with TDABC to calculate costs per care pathway and eventually determine the change in costs after matching with cohort data. The costs per care pathway are presented in table 4. Note that costs of complications (such as caesarean section, augmentation of labour and neonatal care) were excluded, meaning that the results do not reflect the total cost of childbirth. Cost ranges per care pathway are, nitrous oxide [€1.095,30 - €1.891,99], remifentanil [€1.262,35 - €1.323,06] and, epidural [€1.656,79 - €1.717,51]. To determine the change in costs, the weighted average costs (WAC) pre- and post-intervention were calculated by combining costs per care pathway and patient volume data. The results are presented in Figure 5. The WAC pre-intervention is €1.617,26 and the WAC post-intervention is €1.607,17. This indicates a percentual cost decrease of 0,62% since introduction of nitrous oxide.

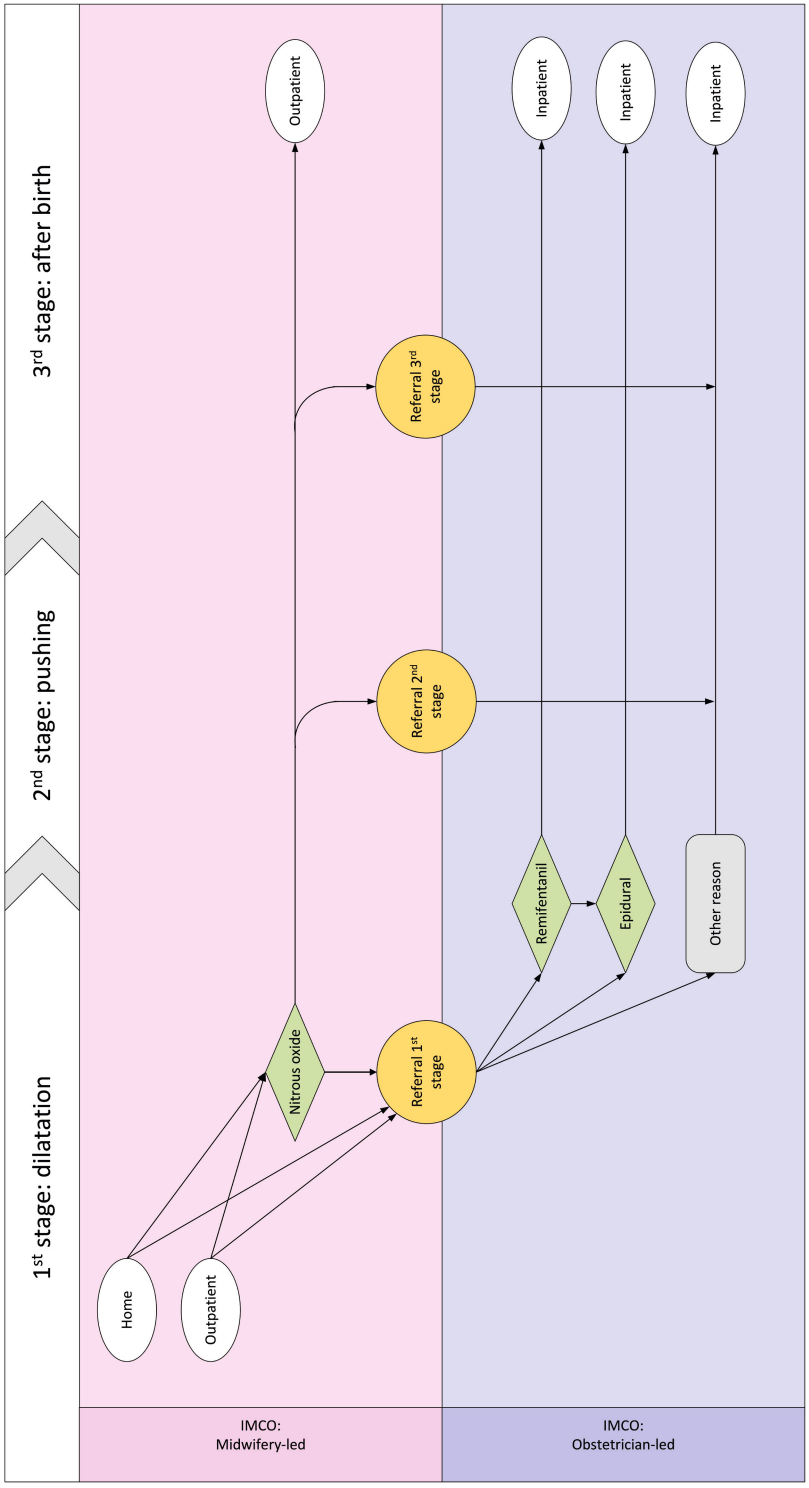


Figure 3. *Overview of intrapartum referral process and variability of care pathways*

Table 4. *Cost breakdown per care pathway, excluding costs for complications*

	Cost breakdown					
		Midwifery-led		***Obstetrician-led***		
Care pathways	*Material*	*Personnel*	*Overhead*	*Personnel*	*Overhead*	**Total**
Nitrous oxide						
Nitrous oxide, no referral						
Home	€ 179.91	€ 563.19	€ 352.21	€ -	€ -	€ 1,095.30
Outpatient setting	€ 179.91	€ 563.19	€ 412.92	€ -	€ -	€ 1,156.01
Nitrous oxide, referral						
1st stage, remifentanil	€ 198.62	€ 264.97	€ 151.85	€ 312.75	€ 569.37	€ 1,497.55
1st stage, epidural	€ 211.41	€ 264.97	€ 151.85	€ 560.66	€ 703.11	€ 1,891.99
1st stage, other reason	€ 179.91	€ 264.97	€ 151.85	€ 218.97	€ 514.07	€ 1,329.76
2nd stage	€ 179.91	€ 321.79	€ 219.67	€ 173.43	€ 387.10	€ 1,281.91
3rd stage	€ 179.91	€ 365.21	€ 238.90	€ 119.91	€ 354.38	€ 1,258.30
Remifentanil						
Home	€ 18.71	€ 264.97	€ 96.56	€ 312.75	€ 569.37	€ 1,262.35
Outpatient setting	€ 18.71	€ 264.97	€ 157.27	€ 312.75	€ 569.37	€ 1,323.06
Epidural						
Home	€ 31.50	€ 264.97	€ 96.56	€ 560.66	€ 703.11	€ 1,656.79
Outpatient setting	€ 31.50	€ 264.97	€ 157.27	€ 560.66	€ 703.11	€ 1,717.51
Remifentanil and epidural						
Home	€ 50.21	€ 264.97	€ 96.56	€ 630.49	€ 703.11	€ 1,745.33
Outpatient setting	€ 50.21	€ 264.97	€ 157.27	€ 630.49	€ 703.11	€ 1,806.04

Table 5. *Change in weighted average costs pre- and post-intervention.*

		Pre-intervention			Post-intervention		
Care pathways	*Costs*	*N*	*%*	*WAC*	*N*	*%*	*WAC*
Nitrous oxide							
Nitrous oxide, no referral							
Home	€ 1,095.30	0	0%	€ -	0	0%	€ -
Outpatient setting	€ 1,156.01	0	0%	€ -	35	7%	€ 78.72
Nitrous oxide, referral							
1st stage, remifentanil	€ 1,497.55	0	0%	€ -	2	0%	€ 5.83
1st stage, epidural	€ 1,891.99	0	0%	€ -	2	0%	€ 7.36
1st stage, other reason	€ 1,329.76	0	0%	€ -	11	2%	€ 28.46
2nd stage	€ 1,281.91	0	0%	€ -	3	1%	€ 7.48
3rd stage	€ 1,258.30	0	0%	€ -	3	1%	€ 7.34
Remifentanil							
Home	€ 1,262.35	34	7%	€ 82.22	18	4%	€ 44.21
Outpatient setting	€ 1,323.06	68	13%	€ 172.35	32	6%	€ 82.37
Epidural							
Home	€ 1,656.79	171	33%	€ 542.74	155	30%	€ 499.62
Outpatient setting	€ 1,717.51	243	47%	€ 799.53	250	49%	€ 835.36
Remifentanil and epidural							
Home	€ 1,745.33	3	1%	€ 10.03	1	0%	€ 3.40
Outpatient setting	€ 1,806.04	3	1%	€ 10.38	2	0%	€ 7.03
Total		522	100%	€ 1,617.26	514	100%	€ 1,607.17
				Absolute difference			€ -10.09
				Percentual difference			-0.62%

DISCUSSION

Our study aimed to evaluate the added value of nitrous oxide for pain relief in a midwifery-led setting by analysing cost- and outcome data. Our study suggests a neutral to positive overall added value of nitrous oxide. We showed a 10% reduction in pain relief usage in obstetrician-led care while clinical and patient-reported outcomes remained similar or moderately improved and costs remained similar (-0,62%). After the intervention, 10% of the women opted for nitrous oxide, primarily replacing remifentanil. A (moderate) significant decrease was observed for the percentage of instrumental deliveries, fever during birth and involvement of paediatrics. All other clinical outcomes remained similar, which indicates that overall quality of care remained stable. After introduction of nitrous oxide, satisfaction with care in general improved, but overall birth satisfaction remained similar. A significant improvement was found regarding the single item measuring perceived support by the healthcare professionals, which indicates a trend towards improved experiences. When applying these inputs to the value-assessment matrix, the overall added value of nitrous oxide is neutral to positive.

Our study is one of the few combining clinical outcomes, PREMs and cost data to evaluate the added value of a care pathway. Regarding the clinical outcome comparison, the decreases in instrumental deliveries, fever during birth and involvement of paediatrics are improvements of quality of care. It is notable that the overall pre- and post-intervention comparison did not show a difference in the percentage of neonatal unit admissions, whereas the sub-analysis revealed a significant difference between the nitrous oxide and remifentanil groups. Given that nitrous oxide primarily replaced remifentanil, one would expect this difference to be reflected in the pre- and post-intervention comparison. If the availability of nitrous oxide reduces the need for neonatal admissions, this represents a meaningful improvement in the quality of care. However, further investigation is needed to confirm this.

Regarding the PREM comparison, our study is one of the first to apply the BSS-R to measure birth satisfaction for different methods of pain relief. When interpreting these data, it is important to consider underlying mechanisms influencing experiences. For example, previous studies showed that women with a relatively negative birth experience had a significantly higher proportion of primiparous women, which is also recognized in our study [166, 167]. The nitrous oxide and remifentanil groups were comparable in terms of the percentage of primiparas. When comparing birth satisfaction between these groups, the results were surprisingly similar. It was assumed that nitrous oxide would enhance birth satisfaction by assuring continuity of care. However, our findings do not support this assumption. It is plausible that the questionnaire may not fully capture this nuance, that the limited sample size (N) constrains the statistical power to detect differences, or that birth satisfaction is less influenced by continuity of care. This warrants the need for further research to explore the role of continuity of care during labour.

It was anticipated that the introduction of nitrous oxide could potentially realize cost savings by preventing admission to the hospital. However, our findings indicate that no significant savings were achieved. This is related to the fact that nitrous oxide does not prevent referrals in a later stage for other reasons, such as meconium-stained liquor or prolonged labour. Although the costs of the nitrous oxide care pathway in a midwifery-led setting are lower compared to the remifentanil and epidural care pathway in an obstetrician-led setting, the costs increase significantly when women who used nitrous oxide are referred in a later stage. These increases are substantial as the direct costs (medicine and supplies) of nitrous oxide are relatively high. Additionally, the lion's share of both cohorts consists of women using epidural, which is the most expensive form of pain relief. Therefore, targeting this group would be most effective in terms of cost savings.

The application of Time-Driven Activity-Based Costing (TDABC) in obstetrics and maternity care has been limited up to now. This study is the first to use TDABC to calculate the costs associated with various forms of pain relief during labour and the impact on costs after implementing a new pain relief care pathway. Dubron et al. (2021) conducted the first comparative TDABC cost analysis of vaginal delivery versus caesarean section in Belgium, with the aim of accounting for how patient and disease characteristics influence cost variations. Their findings revealed that cost fluctuations in vaginal deliveries were linked to patient- and disease characteristics, as these impacted the time required to provide care [108]. These complexities highlight the challenges involved in calculating the costs of a single care pathway. When estimating cost changes by integrating patient volume data with costs of care pathways, additional difficulties are encountered. This is due to the significant variability in patient journeys. In the Dutch context, this is even more paramount because of the segmentation in midwifery- and obstetrician-led care and the different stages of referral. Although TDABC is proposed as a method well-suited to capture the complex nature of healthcare, its application in obstetrics presents significant challenges and implementing the method in this context necessitates trade-offs between feasibility and detail.

Our study has several strengths. First, our study is the first to comprehensively evaluate the added value of nitrous oxide as pain relief care pathway in a midwifery-led setting using cost- and outcome data. While previous work predominantly focusses on effectiveness of nitrous oxide compared to other forms of pain relief, our study allowed for an extensive evaluation following the principles of VBHC. Second, our study is one of the first to apply the standardized and validated PCB set of ICHOM to the case of pain relief during labour. As such, we gained insight into patient-reported experiences and satisfaction, which is still limited in practice [168–170]. Furthermore, the BSS-R 10 is recommended as the main tool for measuring women's experiences of childbirth [171]. Third, applications of TDABC in combination with cohort data to determine a change in costs are limited. Furthermore, applications of TDABC to intrapartum care are scarce. Therefore, we contribute to the further uptake of TDABC in challenging and complex settings with the aim to evaluate value-improving initiatives.

Our findings should be interpreted considering our study's limitations. First, the uptake of nitrous oxide was lower than anticipated, which may have limited its perceived added value. It would be beneficial to replicate the study after the adoption period has fully matured and compare the results, as this may yield different outcomes. Second, the response rate of the ICHOM questionnaire was low, which might introduce bias to the results. It is important that professionals encourage clients to fill in the questionnaire to evaluate future innovations of care delivery. Furthermore, the ICHOM questionnaire was only available for

Dutch speaking women. Therefore, the experiences of non-Dutch speaking women remain unheard. It is important to provide the questionnaire in multiple languages in the future. Third, although the TDABC application encompassed a significant portion of the intrapartum period, the calculated costs do not reflect the total costs of childbirth as costs associated with complications and medical interventions were excluded. In case the decrease in instrumental deliveries, fever during birth and involvement of paediatrics are related to the introduction of nitrous oxide, the actual cost savings are greater than currently estimated, as these factors are linked to increased resource use. This requires monitoring, and future research should build upon our findings by further analysing this.

In VBHC, cost and outcome data are paramount in assessing the value of care delivery and should guide decision-making regarding care delivery. While value is often defined in a seemingly simple manner—as outcomes relative to costs—applying this concept in practice is far from straightforward. This study demonstrates that the added value of nitrous oxide is neutral to positive, based on a patient population-level analysis. However, when viewed at the individual patient level, the availability of nitrous oxide might make a substantial difference for the woman who uses it. When considering the continuation of nitrous oxide, it would be essential to gain deeper insights into women's preferences and specific experiences with its use, as current questionnaire results may not fully capture these nuances. When zooming out to the organizational level, the added value of nitrous oxide extends beyond costs and outcomes and includes factors such as workforce pressures, work satisfaction, and carbon footprint. Obstetric care departments face significant capacity challenges due to staff shortages [172–175]. By preventing referrals to the obstetrician-led setting, nitrous oxide alleviates these pressures. Furthermore, it contributes to work satisfaction of community midwifes as nitrous oxide enables them to complete more births in a midwifery-led setting. Regarding carbon footprint, it is known that healthcare contributes to climate change and research has shown that inhaled forms, such as nitrous oxide, contribute to global warming and ozone depletion [176, 177]. As healthcare providers are currently encouraged to reduce their carbon footprint, this could influence decision-making regarding the availability of certain services. This illustrates how the meaning of 'value' differs depending on the perspective taken, adding complexity to informed decision-making. Future studies should contribute to VBHC in practice by sharing experiences in collecting and analysing cost and outcome data and demonstrating how these insights can guide decisions.

CONCLUSION

The added value of nitrous oxide as pain relief in a midwifery-led care setting was evaluated, guided by the principles of VBHC, by using clinical outcomes, PREMs and cost data. Our study suggests a neutral to positive overall added value of nitrous oxide. We showed a 10% reduction in pain relief usage in obstetrician-led care while clinical outcomes and PREMs remained similar or moderately improved, and costs remained similar. This paper is the first to comprehensively apply the VBHC principles to pain relief during labour and therefore contributes to further uptake of VBHC in practice. While the intrapartum phase is challenging for the application of VBHC, this study emphasizes the need for comprehensive evaluations of value-improving initiatives.

05

Chapter 5

Women's preferences for care delivery during labour and birth in Dutch hospitals: A Q-methodology study

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ABSTRACT

Problem: Women's preferences regarding care delivery during labour and birth remain insufficiently understood. Obtaining a clear understanding of these is important to realise a maternity care system that is future-proof and person-centred.

Background: Dutch maternity care deals with capacity issues due to staff shortages. Despite expected stable birth rates in the coming decades, this situation jeopardises the provision of care during labour and birth that is responsive to women's preferences.

Aim: To systematically study a variety of women's preferences for care delivery during labour and birth in Dutch hospitals using Q-methodology.

Methods: Q-methodology is a mixed methods approach. Thirty individual interviews were conducted with women living in the south-western Netherlands, during which they ranked 29 statements about their labour and birth preferences from least to most important. By-person factor analysis was performed to identify factors (viewpoints). Interpretation of the viewpoints was done using the qualitative interview data.

Findings: Four viewpoints emerged from the study sample: 1) The personal approach, 2) The empowering approach, 3) The expert approach and 4) The needs-based approach. Consensus statements show a shared preference for respectful interaction. The study cohort emphasises continuity of adequate information provision, while continuity of care professional is deemed less important.

Discussion: Our study was the first to apply Q-methodology to capture women's preferences for care delivery during labour and birth in Dutch hospitals. Although preferences are individual, they share commonalities in four viewpoints.

Conclusion: The viewpoints provide valuable guidance for the allocation of scarce resources to ensure a maternity care system that is responsive to women's preferences.

INTRODUCTION

Healthcare systems worldwide are experiencing capacity constraints due to staff shortages and scarce resources [173, 178–180]. Dutch maternity care is specifically under pressure due to increasing shortages in the nursing profession, high turnover of community midwives of relatively young age and maternity nurses reaching retirement ages [174, 181]. Although Statistic Netherlands (CBS) does not expect a significant increase in the number of births in the Netherlands in the coming decades, the current problems indicate that the same number of births are being supervised by fewer staff [182]. This is problematic and requires managers and care professionals to implement restructuring efforts to realise a future-proof maternity care system [172, 175, 183].

According to the WHO (World Health Organization), women's preferences should be the principal focus of care delivery [184]. However, women's preferences regarding care delivery during labour and birth remain insufficiently understood, as findings of previous studies are variable. This might indicate that women's preferences vary [185]. For example, one might prioritise shared-decision making and availability of pain relief [186], while others prioritise continuity of care [187]. Furthermore, differences might be due to the application of diverse research methodologies in different contexts [187–189]. There is a lack of studies considering the different types of preferences, if and how these vary among women in different contexts and whether they share commonalities. To inform future restructuring efforts in Dutch maternity care, a comprehensive understanding of women's preferences in the Dutch context is needed.

In this study we aimed to systematically explore a variety of women's preferences for care delivery during labour and birth in Dutch hospitals using Q-methodology. Our research question was: what are the different perspectives of childbearing women living in the south-western Netherlands on what is important during labour and birth in a Dutch hospital? A better understanding of women's preferences facilitates the practice of person-centred care (PCC). This concept aims to put the person in the centre of care delivery by focussing on their preferences, needs and experiences. It aims to move away from the traditional passive role in care delivery, to a more active role [190–192]. As preferences can take on many forms and types, a broad spectrum of preferences was included in this study [193]. Therefore, the insights of this study may enable a better understanding women's preferences for care delivery during labour and birth to realise a future-proof, person-centred maternity care system.

PARTICIPANTS, ETHICS AND METHODS

Study aim and design

Q-methodology was applied to systematically study a variety of women's preferences for care delivery during labour and birth in Dutch hospitals. Q-methodology helps to systematically identify patterns in individual opinions (e.g. viewpoints) on a subject using qualitative and quantitative data collection methods [194]. In Q-methodology, participants rank a set of statements on the subject on a distribution grid according to the degree of importance to them, followed by interviews to explore their reasoning. The ranked statements are statistically compared using by-person factor analysis to identify 'factors', which represent a shared viewpoint. These are interpreted using qualitative data from the interviews to construct a narrative per viewpoint.

Ethics approval

Ethical approval for this study was obtained from the medical ethics committee of the Erasmus Medical Centre, Rotterdam, the Netherlands, under reference number MEC-2023–0474. Participants gave informed consent to participate in the study before taking part.

Study setting

This study focusses on birthing in a hospital setting, which in the Dutch context can be a midwife-led (outpatient) setting or an obstetrician-led (inpatient) setting. The Dutch maternity care system is characterised by the allocation of women to one of two tiers: midwife-led primary care and obstetrician-led secondary or tertiary care. Low-risk women receive care from an independent, community midwife. Possible birth settings are at home or in a midwife-led hospital setting [195]. If complications arise, women are referred to obstetrician-led care in the hospital [196]. Medium to high-risk women receive care from the obstetrician in the hospital throughout their pregnancy and childbirth. In daily practice, approximately 40 % of this care is fully managed by a clinical (hospital) midwife [197]. Obstetricians become actively involved only when there are additional risks or complications, such as fetal distress or the necessity for an operative childbirth [77]. All women are recommended to construct a birth plan, which contains information about their wishes concerning childbirth [198].

Application of Q-methodology

Statement set development

The first phase of Q-methodology entails the development of the set of statements (Q-set) on the topic of interest. It is the aim to cover the topic with a representative set of statements [199]. A first set of statements was constructed based on peer-reviewed literature on women's preferences and experiences [183,

186, 188, 200–208] and expert opinions. Next, these statements were structured and categorised using the eight domains of patient-centred care [193]. This model was chosen due to its fit with the different types of preferences and provides a robust framework for understanding and operationalising care preferences. This study consistently employs the term 'person-centred care' instead of 'patient-centred care', as women giving birth are not perceived as patients.

The domains were operationalised and interpreted to fit care delivery during labour and birth in Dutch hospitals. The domain 'Personal preferences' relates to respect to women's values, preferences and expressed needs in care delivery during labour and birth. 'Physical comfort' is aimed at minimising pain and discomfort, for example through the availability of pain relief. 'Coordination of care' relates to clear organisation of care. Originally, 'Continuity and transition' is operationalised as continuity in information flow. However, in our study, continuity of care is interpreted as continuity in terms of supervision during labour and birth, for example seeing 'the same face' throughout labour. The 'Emotional support' domain focusses on the support provided by care professionals to comfort and reduce anxiety. 'Access to care' is aimed at ensuring accessibility to care services before labour, during labour and birth and post-partum. 'Information and education' relates to the timing and the provision of information. Finally, the domain 'Family and friends' entails policies concerning the presence of loved ones [193, 209, 210]. The structured set of statements were evaluated and altered based on expert opinions. To ensure comprehensibility, two pilot interviews were conducted. This led to several statements being merged or adapted and resulted in a final set of 29 statements with 3–5 statements per domain.

Participant recruitment

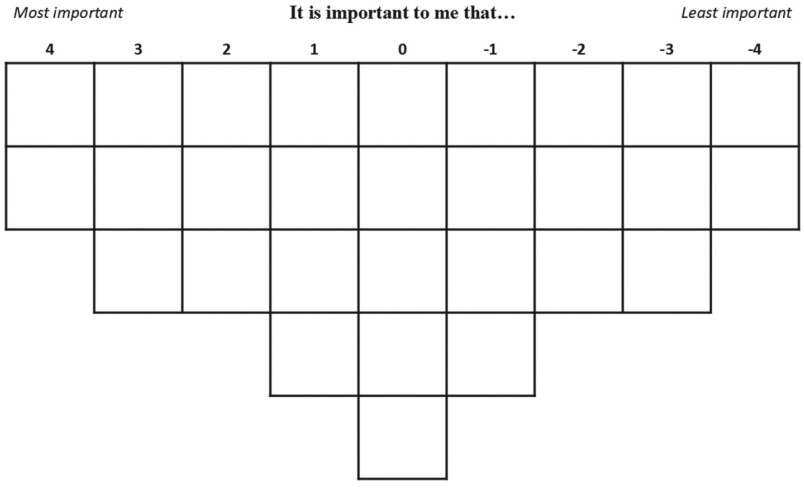
In Q-methodology, representativeness is achieved by the development of the Q-set, and by including a diverse group of participants which capture a variety of viewpoints on the topic [185, 194]. Therefore, purposive sampling is done by selecting participants based on specific characteristics. In this study, diversity was represented in terms of age, education, country of birth of mother, parity, pregnant or post-partum and induced labour. Based on previous studies, it was expected that these characteristics could influence women's preferences [188, 196, 211]. Participants were recruited in the southwest region and part of central Netherlands through maternity care providers, social media, and the authors' personal networks. Participants were included guided by the following criteria: currently pregnant (with a gestational age of at least 23 weeks) and wishing to give birth in a midwife- or obstetrician-led hospital setting or have given birth in a midwife - or obstetrician-led hospital setting (no longer than twelve months ago). Q-sorts from women who gave birth over twelve months ago were included if their birth experience was still vivid (e.g., due to traumatic experiences). In

this way, the preferences of the women could be viewed from the perspective before childbirth and after childbirth. Reading and speaking Dutch or English was a precondition. Women who underwent planned caesarean sections or who gave birth at home were excluded because of the distinct course and/or setting compared to the included childbirths in the study. It was anticipated that the nature of their childbirth would influence the ranking of the statements and potentially introduce bias. An exception was made where a woman who underwent a planned caesarean section was included unintentionally. The final Q-sort aligned with previous ones and therefore did not introduce bias.

Data collection

Individual interviews were conducted by the first three authors (MB, MV and EB) either at the participants' homes (30 %) or online (70 %). The interviews were recorded and lasted between 45 and 90 minutes. A topic list was used to ensure consistency. Every interview started with a short introduction to the study, followed by a short but in-depth interview about the participants' experience with maternity care. Next, the researcher explained the procedure of ranking the statements (Q-sorting). The participants were asked to rank the 29 statements from "most important" to "least important" on a sorting grid [Fig. 1] while reasoning out-loud. Participants were permitted to adjust the ranked statements if necessary. After sorting, the reasoning for the final Q-sort was summarised by the researcher to realise member check. Data saturation was reached when no additional answers or explanations were expressed by participants during interviews. The Q-sorts and interview transcripts were securely stored in accordance with the guidelines set by the medical ethics committee of Erasmus Medical Centre.

***Figure 1**: Sorting grid*



Data analysis

Analysis was done by employing the PQ Method software. The Q-sorts of all participants were compared to each other by measuring a correlation of association. Next, the correlations were included in a by-person factor analysis to reduce the data to factors. Factors are based on a comparable ranking of the statements among groups of participants and therefore represent a common viewpoint on the study's topic. The software computes an average ranking of the statements per viewpoint, which is called a factor array. This represents an ideal Q-sort for each viewpoint. Multiple factors can be extracted, but it is the aim to explain as much variance with the least number of factors. In this study, a four-factor solution was decided to be the most appropriate after employing the criteria described by Watts and Stenner [194]. The factor arrays are used as a basis for factor interpretation. First, the statements that were ranked most important (4, 3) and least important (-4, −3) were studied. Second, the statements ranked relatively more or less important compared to the other factors (distinguishing statements) and the statements that were ranked similar to other factors (consensus statements) were studied. Next, the qualitative data from the interviews with participants defining the factor were analysed in Atlas.ti (version 23). It was the aim to support the interpretation of the factors and consistency by comparing the provided explanations during the ranking procedure.

RESULTS

Participants

In total, 30 women were interviewed. Sample demographics are presented in Table 1. The by-person factor analysis resulted in a four-factor solution with an explained total variance of 53%. As Table 2 shows, factors 1 and 2 are defined by nine Q-sorts and factor 3 and 4 by three. Three Q-sorts (10%) were confounded, and three Q-sorts (10%) did not load on any factors. Factor arrays are presented in Table 3.

Table 1. *Sample demographics (n=30).*

		N (%)
Age (years)		
30 and younger		15 (50%)
31 and older		15 (50%)
Education		
Secondary vocational and below		13 (43%)
Higher professional and university		15 (50%)
Unknown		2 (7%)
Country of birth		
Netherlands		26 (87%)
Other		4 (13%)
Pregnant or post-partum		
Pregnant		9 (30%)
Post-partum		21 (70%)
Parity		
Primiparous		18 (60%)
	Current pregnancy	5 (17%)
	Post-partum	13 (43%
Multiparous		12 (40%)
	Current pregnancy	4 (13%)
	Post-partum	8 (27%)
Induced labour		
Yes		8 (27%)
No		13 (43%)
Planned		3 (10%)
Not (yet) planned		6 (20%)
Maternity care provider		
Midwife-led care		11 (37%)
	Current pregnancy	6 (20%)
	Post-partum	5 (17%)
Obstetrician-led care		19 (63%)
	Current pregnancy	3 (10%)
	Post-partum	16 (53%)
Total		30 (100%)

Table 2. *Q-sorts defining the factors.*

Factor	Q-sorts loading on the factors	Total number of Q-sorts per factor	Eigen values	% explained variance
1	7, 8, 9, 18, 21, 25, 26, 27, 28	9	10,65	36%
2	2, 4, 6, 10, 12, 17, 19, 20, 30	9	2,16	7%
3	1, 3, 23	3	1,53	5%
4	5, 24, 29	3	1,51	5%
Confounded	Factor 1 with 3: 22 Factor 2 with 3: 13, 15	3		
Non-significant	11, 14, 16	3		

Table 3. *Statements and factor arrays.*

Statements	Factor arrays per viewpoint			
	The personal approach	**The empowering approach**	**The expert approach**	**The needs-based approach**
Personal preferences				
1 I am treated with dignity and respect	**4**	**3**	**3**	**2**
2 The care professional(s) take my personal situation, beliefs and/or culture into account	1	-1*	-3*	1
3 The care professional(s) take my wishes and/or needs into account	1	4	-1**	3
4 The care professional(s) involve me in decision-making during labour	3	4	-1	-1
Physical comfort				
5 I can get pain relief 24/7	0	-2	1	-1
6 I can choose between primary care and clinical care forms of pain relief	0	-3	0	-2
7 The delivery (birth) room has a homey atmosphere	-3	0**	-4	-2
8 The delivery (birth) room is quiet (as little in and out as possible)	-1	3*	-1	0*
9 I can give birth in a birthing pool	-4*	1**	-2	-3
Coordination of care				
10 Care is well coordinated between care professionals	4	1	4	0
11 It is clear to me who is in charge of care	0	0	0	-4**
12 The care professionals provide me similar information	2	0*	4	3
Continuity and transition				
13 I do not have to be moved during labour when referred to secondary care	-3**	-2**	3	2
14 A care professional is in the delivery (birth) room with me non-stop	-4	-4	-3	-2
15 I am supervised by one and the same person (like my own community midwife)	**-1**	**-1**	**-2**	**0**
16 My own community midwife supervises the birth	-2	-3	-4	-3

Emotional support					
17	I receive emotional support from the care professional(s)	-2	1	0	-3
18	I feel heard and seen by the care professional(s)	3	3	1	1
19	I feel supported and reassured by the care professional(s)	**1**	**2**	**3**	**1**
Access to care					
20	I do not have to travel to the hospital for more than 30 minutes during labour	0	-1	2	4
21	I can give birth in my own region	-3	-2	1*	-4
22	I can come to the hospital early (3 cm dilation)	0	-3*	0	-1*
23	I don't have to go home within 2 hours after giving birth	-1	0	-1	4**
Information and education					
24	I receive timely information during labour	**3**	**2**	**2**	**2**
25	Information is shared with me in an appropriate and understandable manner	**1**	**1**	**2**	**3**
26	I am communicated with in a pleasant way	**2**	**2**	**1**	**0**
Family and friends					
27	The care professionals are attentive to my (birth) partner	**-1**	**-1**	**-2**	**-1**
28	My (birth) partner is involved in making decisions	2	0	0	1
29	In addition to my (birth) partner, one or more persons are allowed to be present	-2*	-4	-3	0**

- *p=<0,05
- **p=<0,01
- **Bold** represents consensus statement

VIEWPOINTS

Interpretation of the factors resulted in the construction of four distinct viewpoints on preferred care delivery during labour and birth, namely: the personal approach, the empowering approach, the expert approach, and the needs-based approach. The results are indicated by the statement's number (1 to 29) and corresponding value (-4 to 4), along with quotes for illustration.

Viewpoint 1: the personal approach
Women with this viewpoint emphasise the need for respectful interaction as they fear being treated as "the next one in the assembly line" (statement 1, 4). They want to be treated as a human being, who is about to experience a life-event. This is perceived as a personal approach, through which the women feel heard, seen and therefore treated with respect.

The personal approach also comes about through well-coordinated care (statement 10, 4). For example, it is important for these women that care professionals are up to date about their personal situation based on their medical file and birth plan (statement 2 and 3, 1). Furthermore, continuity of information flow and medical advice is important (statement 12, 2).

> *"[…] there's quite a bit of turnover in staff, people dropping out, changes in responsible care professionals. And that just makes it difficult because you're talking about your most precious possession, bringing your child into the world. And that doesn't always feel comfortable. It sometimes really feels like we were all just a case number, and not everyone was always informed about everything." (Participant 27)*

Adequate information provision is emphasised as this supports anticipation on events during labour. The women with this viewpoint desire to take on a reactive role in the decision-making process, as they want to be kept up to date about events and give consent when needed.

> *"[…] You see, to get information at all, that's obviously very important, that you're aware of what's being done. And the timeliness, of course, is absolutely relevant, so that you know in time what they're going to do to you, what you can expect, what's going to happen. So you're not going to be surprised." (Participant 27)*

Geographical location (statement 21, -3) and the specific facilities of the hospital (statement 9, -4, statements 5 and 6, 0) are deemed less important. The preferences of women with this viewpoint are therefore considered less tangible.

In summary, this viewpoint emphasises a personal approach to care delivery during labour and birth. The key factor lies in ensuring that women receive respectful treatment, combined with well-coordinated care and timely information flow.

Viewpoint 2: the empowering approach

Within this viewpoint, maintaining autonomy is crucial and is accomplished by actively involving women in decision-making (statement 4, 4). They stress the importance of respecting the preferences of women during labour, as many have a clear vision they intend to realise (statement 3, 4).

> *"But for us, it's more about having our own wishes. When you take a course [hypnobirthing], you also gain a bit more knowledge, a bit more backbone, so to speak, to be able to say yes or no to certain things. You don't have to blindly obey. Of course, if there is a real danger to the life of the mother or child, then it's a different story." (Participant 11)*

Examples of women's preferences are a peaceful (statement 8, 3) and homey atmosphere (statement 7, 0) and the option to give birth in a birthing pool (statement 9, 1). They value the ambiance of the birth room and try to preserve peace. This clarifies why they are particularly opposed to the continuous presence of visitors (statement 29, −4) or care professionals (statement 14, −4). This further explains why early admission is not preferred, as they feel most comfortable at home (statement 22, −3).

> *"I actually want as much peace in the room as possible, not too many people constantly coming in and out. I want to be able to indicate what I need myself, and not have them constantly asking. That way, you're actually disturbed all the time, and I'm told that it just takes you out of your concentration, so to speak, or your own atmosphere. And then, well, it's just not pleasant." (Participant 11)*

Medical pain relief is not a shared preference within this viewpoint (statement 5, −2 and statement 6, −3). The women expressed their critique on the medicalisation of maternity care. According to them, childbirth is a physiological process that needs to be preserved. Natural forms of pain relief are therefore valued, such as the birthing pool.

In summary, within this viewpoint, an empowering approach is valued. This is realised by considering the wishes and needs of the women and including them as equals in the decision-making process.

Viewpoint 3: the expert approach

The women with this viewpoint favour the expert approach because they have confidence in the maternity care system and trust the care professionals involved in their care. However, this trust needs to be reinforced through the experience of well-coordinated care (statement 10, 4) and consistent information delivery (statement 12, 4).

> *"[…] it gives you comfort. […] It was the obstetrician, she was basically in the lead, but they did everything in consultation with a supervisor at a distance, yeah, and it feels like that, yeah, it gives a kind of confidence that there is someone watching and […] a supervisor who has given approval for certain steps." (Participant 3)*

The expert approach also relates to the perception of the birth plan, which is rather perceived as a formality. Therefore, the women with this viewpoint put less emphasis on the domain personal preferences. They prefer care professionals to focus on delivering care instead of their personal wishes and needs. Moreover, they prefer to put medical decision making in the hands of the professionals but appreciate to be kept up to date in a timely (statement 24, 2) and understandable way (statement 25, 2).

> *"I didn't have a birth plan. Some people like certainty, I thought it was a bit silly. It goes as it goes. […] The people who help me give birth do it 10 times a day, so they have more knowledge than we do." (Participant 1)*

Within this viewpoint, minimising or preventing transport during labour is a key preference. They emphasised the discomfort experienced during transport, which explains the preference for not being transported for referral (statement 13, 3), to travel no longer than 30 minutes (statement 20, 2) and to give birth in their own region considering travel time and geographical location (statement 21, 1).

In summary, the women holding this viewpoint emphasise the expert approach as they are confident in the clinical expertise of the professionals. They wish a primary focus on their health and safety. They expect high-quality care, which for them counts as well-coordinated care.

Viewpoint 4: the needs-based approach

Women with this viewpoint prioritise responsiveness from care professionals and the maternity care system to their needs during labour and birth. This is translated into a needs-based approach, where the focus is on meeting their essential needs rather than their wishes, which they consider secondary. For example, women with this viewpoint need to be in a hospital within 30 minutes (statement 20, 4), and

therefore are less concerned about the exact location of the hospital (statement 21, −4).

> *"[.], it's about where I am at that moment, if I'm not in my own region… I don't necessarily have to go to my own region, I don't have time for that." (Participant 25)*

Another aspect of accessibility needed within this viewpoint is the option to recover post-partum (statement 23, 4). Certain hospitals adopt a policy of discharging women two hours post birth, if possible, to manage capacity. Women with this viewpoint find this challenging and express a need for an extended post birth stay to rest and recover. They accentuate the post birth discomfort and pain.

> *"I had a strong feeling of being rushed. And I experienced that as very unpleasant. Yes, you have two hours and then you must leave. […] And I was also pushed like 'come on, you have to take a shower.' But in my head, I was still processing the childbirth, and it was just going way too fast." (Participant 30)*

Next, these women need uniform provision of information from health care professionals. They consider it important that the information is being shared appropriately and understandably (statement 25, 3). When health care professionals give the same information, it takes away stress from the woman giving birth and timeliness allows the woman and her partner to prepare for decisions to be made. It is noticed, however, that the manner of communication does not necessarily have to be pleasant, so the preference is particularly placed on the clarity and timing of the information.

In summary, within this viewpoint, a needs-based approach in care delivery is preferred. This entails a quick, effective and supportive response to the specific needs of the women in labour and birth. This relates to a trait of the maternity care system, in terms of accessibility, as well as the maternity care professional, in terms of recognising women's needs and acting upon them.

DISCUSSION

This study was undertaken to systematically study a variety of women's preferences for care delivery during labour and birth. Our findings suggests that women's preferences are multi-faceted, as the studied domains are not equally important within this study sample. The application of Q-methodology revealed four distinct viewpoints, namely: the personal approach, the empowering approach, the expert approach, and the needs-based approach.

These viewpoints stem from diverse expectations women have of the maternity care system. Those inclined towards the personal approach trust the system but fear being reduced to mere case numbers, emphasising their desire for individual recognition. Advocates of the empowering approach seek to maintain control, wishing to be active decision-makers rather than passive recipients. Those favouring the expert approach prefer to delegate decision-making to professionals, prioritising a primary focus on safety. Lastly, women with the needs-based approach expect a quick, effective and supportive response to their needs. The emerged viewpoints underscore the importance of clinical, physical, socio-cultural and psychological aspects of care, which aligns with previous work [188, 189]. In the context of person-centred care, which aims to activate persons in care delivery, it appears that women also have different perspectives on their desired role in the process. These preferences should be recognised in future advancement of person-centred care.

The viewpoints are constructed with a primary focus on the relative ranking of the individual statements rather than the overarching domains. It is relevant to also study the relative importance given to the domains, based on the ranking of the statements corresponding with the domains. First, 'information and education' is deemed important consistently across all viewpoints. As shown by the consensus statements [Table 3]. The entire sample expressed a need for adequate information provision. The most frequently provided explanation was the reliance on the expertise of the care professionals during labour and birth. It is desired to be informed about the progress of childbirth and to receive clear guidance. Within the domain, timeliness is mostly valued, together with an appropriate and understandable provision of information, which is supported by previous work on preferred maternity care services [183].

The second most important domain is 'personal preferences', also shown by a consensus statement [Table 3]. The study cohort emphasises unanimously the importance of respect during care delivery during labour and birth. The importance of appropriate interaction is described in recent work showing similar findings in terms of respect and communication among Dutch women [200, 212]. Respect encompasses more than simple politeness; it is about genuine emotional availability [188]. Previous work shows how respectful and empathetic interaction is often prioritised over factors related to possibilities for pain relief and interventions [213–215]. This underscores the powerful influence of appropriate interaction.

Notably, the ranking of the other statements within the domain 'personal preferences' show mixed opinions. For example, it shows how women look differently upon being included in decision-making, ranging from an active to a

passive role. In previous work, shared decision-making is often reported as an important preference of women during labour [186, 201, 202, 208]. Scholars claim that attention for women's autonomy falls short in current client-care provider interaction in the Netherlands [200]. While it may be assumed that all women desire active involvement in decision-making, our study reveals a preference among some women to entrust these decisions to care professionals.

The domains that were considered of less importance across all viewpoints were 'family and friends', 'physical comfort' and 'continuity and transition'. Most of the participants appreciated the inclusion of the partner during decision-making but desired a primary attention of the professionals on themselves. Also, the presence of other family members, friends or other individuals was not prioritised. The findings regarding physical comfort were unexpected in comparison with previous studies, specifically regarding the availability and accessibility of pain relief. Previous studies highlight the importance of pain relief, while our study sample perceives this subject as less important [183]. A potential explanation could be the relatively lower pain relief use in the Netherlands compared to other countries [216].

The findings concerning the domain 'continuity and transition' also contrast previous work on continuity of care during labour [72, 105, 183, 187, 188, 216–218]. In our study, the domain 'continuity and transition' captures continuity of care professional. Continuity of information and policy is captured by the domain 'coordination of care' and continuity of location by 'access to care'. Previous work emphasises the importance of continuity of care professional for women in Australia [187]. Surprisingly, our study cohort puts less emphasis on this type of continuity. Instead, continuity of information and policy was perceived most important. Our cohort detaches continuity of information and policy from continuity of care professional. The participants expressed that continuity of care professional is not always feasible, which – for them – is acceptable when continuity of information and policy can be assured, and respectful interaction can be counted on. This is in line with previous studies that describe the benefits of continuity of professionals and recognize these factors, but also state that continuity of professionals is not easily achievable in practice [219, 220].

Our study has several strengths. Firstly, the statement set was constructed based on previous work on the study topic and categorised using eight domains. This approach ensured the inclusion of a representative set of relevant statements. Furthermore, this structured approach ensured a balanced inclusion of different types of preferences based on the categorisation using the different domains. As such, we gained a comprehensive understanding of women's preferences for care delivery during labour and birth.

Secondly, in contrast to methodologies applied in previous work, which are predominantly characterised by survey instruments, the application of Q-methodology stands out for its ability to delve into the nuanced aspects of individual perspectives on a specific topic. Furthermore, it is able to identify commonalities in these. Even though preferences are unique and based on previous experiences, the systematic approach of the method abstracts shared opinions. Survey instruments do not allow for this. Therefore, the application of Q-methodology provides a unique understanding, which is not thoroughly achieved by previously applied methodologies. This provides invaluable insights for day-to-day work [189].

Thirdly, the application of Q-methodology allows for the inclusion of a diverse group of participants. This is particularly relevant considering preferences evolve throughout a women's life. For instance, it varies between pregnancy and childbirth, and between giving birth for the first time and subsequent times [211]. Our sample is diverse in terms of participants currently pregnant, post-partum and parity. Therefore, the viewpoints are built on a wide range of experiences.

Our findings must be interpreted within the limitations of this study. Firstly, our objective was to include a heterogeneous group of participants to encompass diverse viewpoints on the subject. Diversity was achieved for the determinants age, education, parity, pregnant or post-partum and induced labour. The results concerning the mother's country of birth are ambiguous, as they include women born in the Netherlands whose parents have a migration background. Since it is possible that some viewpoints may be underrepresented, future research could be conducted with women from different countries of birth and potentially different cultural backgrounds to confirm or supplement the results of this study.

Secondly, we aimed for comprehensiveness in the statement set by a thorough literature study, by structuring the statements using the eight domains, organising expert opinions and pilot interviews. It is possible that statements on the subject were overlooked that could have altered the ranking results. To mitigate this, participants were explicitly queried about any omitted topics at the end of every interview. Their responses indicated that they did not miss any statements, which indicates sufficient coverage of the topic.

Thirdly, it is important to interpret the findings with caution. While the results highlight the varying importance of statements from different viewpoints, it's important to note that ranking some statements as less important does not diminish their actual significance. The distribution grid used in the process compels participants to make choices between statements, potentially resulting

in a ranking that might inaccurately portray statements as less important when they could hold equal importance.

This study was conducted to systematically study a variety of women's preferences for care delivery during labour and birth. It was the aim to inform future restructuring of maternity care to improve the experienced capacity issues. Based on our findings, we suggest two solutions to this problem. First, the study cohort puts less emphasis on continuity of care professional, which provides flexibility in staffing. If women can count on respect, sympathy, and adequate information provision, this is a plausible solution. Second, women seem to attach less value to the specific location of birth if travel time remains below 30 minutes. Therefore, agreements about sharing capacity between different hospitals within a geographical area might be plausible. For example, in the form of agreements for diverting to a neighbour hospital in times of capacity constraints. The findings provide a first step in understanding what women prefer during labour and birth. The next step would be to include them in the design of future restructuring efforts.

CONCLUSION

This study is the first to apply Q-methodology to systematically study a variety of women's preferences for care delivery during labour and birth. This resulted in the emergence of four distinct viewpoints, namely the personal approach, the empowering approach, the expert approach, and the needs-based approach. Furthermore, the study reveals a uniform preference for respectful interaction and adequate information provision. The findings help to gain a better understanding of what is most important during this life-event. This provides valuable insights for future restructuring of maternity care and the prioritisation of limited resources. Furthermore, the findings support maternity care professionals in recognising the needs of women in labour and to be responsive to these needs.

Part II

Rewarding value

06

Chapter 6

Successful Design of an Outcome-Based Payment Model for Maternity Care

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ABSTRACT

An integrated maternity care organization, involving primary and secondary maternity care providers, working with the insurer, redesigned two maternity care pathways — one for gestational diabetes mellitus and one for pain relief during labor — to develop an outcome-based shared-savings model, building on an existing bundled payment arrangement. The care pathways were evaluated using time-driven activity based costing, process indicators, clinical outcomes, and patient-reported outcomes. The new pathway for gestational diabetes mellitus led to fewer referrals to internal medicine, reduced need for insulin therapy, improved patient-reported experiences, and substantial cost savings. The new pathway for pain relief led to a reduction in obstetrician-led pain relief use, but clinical outcomes, patient-reported experiences, and costs remained largely unchanged. Given the savings achieved in the diabetes pathway, a shared-savings model was developed, with the allocation of savings based on meeting an outcome-based benchmark. This model demonstrates how outcomes can be incorporated into payment models to reward value-improving behavior. Despite the successful development of the model, there were significant challenges, including aligning cost data with existing reimbursement structures. Nonetheless, the collaboration built a foundation for future innovations in value-based maternity care delivery and payment reform.

THE NEED FOR PAYMENT MODELS THAT BETTER INCENTIVIZE VALUE-BASED MATERNITY CARE

Value-based care (VBC) challenges health care providers to optimize care pathways to improve patient outcomes and lower the costs of care. However, traditional fee-for-service payment models hinder VBC implementation and scaling [54]. One major obstacle is that optimizing care pathways to deliver the right care in the right place often leads to shifting care delivery from the hospital to primary care settings [125, 221], causing a loss of revenue for the hospital or other secondary care providers [222, 223].

In addition, shifting activities to primary care settings often leaves hospitals managing the more complex and costly cases without getting the offsetting revenue from handling the simpler cases. This necessitates complex negotiations between providers and insurers to enable such transitions. As a result, promising care improvement ideas often do not go forward.

VBC has a greater chance of success when provider payment models are reformed and aligned to support its principles [28, 61]. The most frequently implemented alternative provider payment model is bundled payment. A bundled payment encompasses all services required in the full cycle of care. This theoretically incentivizes cost-conscious behaviors such as task reallocation and efficient coordination of care [58].

Although bundled payments are innovative payment models, there is currently no robust evidence that this model produces better patient outcomes and cost savings [24, 60]. Furthermore, current models often lack an explicit link with value as measured by costs and outcomes.

A theoretically preferable payment model aligned with value consists of two components. The first component is a relatively large base payment with an implicit link to better patient outcomes and reduced total spending, such as in bundled-payment models. The second component is a relatively small payment that explicitly rewards measurable aspects of value, such as shared-savings or pay for-performance models [54, 131]. This requires detailed information about outcomes and costs of care. But these types of measures are still relatively underdeveloped in practice, resulting in a lack of payment models with an explicit link to value [10].

Our case study presents the development of an outcome-based shared-savings model using cost and outcomes data within an integrated maternity care organization (IMCO) named Annature Geboortezorg, based in Breda, the

Netherlands. IMCOs are network organizations in which primary midwife-led and secondary obstetrician-led maternity care providers collaborate in integrated obstetric care pathways, share patients' medical records, and are paid by insurers via a bundled-payment arrangement [81, 154].

Although the transition from the traditional fee-for-service model to this bundled-payment structure represents a major step forward, a payment that explicitly rewards measurable aspects of value is lacking. Therefore, Annature Geboortezorg and CZ, a large health insurer, sought to experiment with developing a payment model that explicitly rewards delivering the right care in the right place and incentivizes value-improving interventions in the future.

This is particularly relevant because the Dutch bundled-payment system for maternity care currently pays more for complex specialty care than for primary care. The system is divided into nine separate bundles that cover the prenatal, intrapartum, and postpartum phases. Within each phase, bundles are categorized under regular or complex care. Complex care covers the use of an operating room or hospital admissions lasting 5 days or longer [224]. The complex care bundle is associated with a higher per-patient bundled payment. This means that the IMCO loses revenue when it improves outcomes, such as the cesarean section rate. This highlights the necessity for payment models that reward providers for improving patient value.

COLLABORATING TO IMPROVE VALUE IN MATERNITY CARE

Annature Geboortezorg and CZ collaborated on a 2-year research project (funded by ZonMw, The Netherlands Organization for Health Research and Development [grant number 516008006]), which took place between July 2021 and September 2023. The project team was composed of a diverse group of stakeholders. From Annature Geboortezorg, a community midwife and a gynecologist represented the maternity care professionals. Annature Geboortezorg's director of operations and financial controller contributed to the payment model's design. From CZ, a maternity care purchaser was involved, representing the insurer's interests. Policy makers from the Dutch Healthcare Authority played a supporting role in the design of the payment model. Experts in VBC, health services research, and cost accounting also participated.

It was the research project's aim to design an outcome-based payment model (OBPM) for two specific care pathways: gestational diabetes mellitus (GDM) and pain relief during labor. These were selected for several reasons. First, both offered

clear opportunities to improve patient value by shifting care from secondary to primary care, delivering the right care in the right place. Second, the pathways differ substantially in nature, providing experience in applying outcome-based payment structures across a range of care types. Third, limiting the project's scope to two pathways kept the study feasible. A pathway-driven approach enabled experimentation with an OBPM design on a small scale.

GDM is a common complication of pregnancy defined as any degree of glucose intolerance with onset or first recognition during pregnancy [111]. Global prevalence is 14% [113]. Primary strategies for controlling GDM are aimed at nutrition and lifestyle. When these lifestyle adaptations are not effective, pharmacological treatment with insulin is needed [118, 122]. Such treatment is necessary for 15%–30% of women with GDM [123].

The GDM care pathway was redesigned to improve continuity of care by integrating previously fragmented care delivery across settings. Before the redesign intervention, GDM care was provided by the internal medicine department of Amphia Ziekenhuis in Breda, while obstetric care was provided by Annature Geboortezorg. To enhance continuity of care, Annature Geboortezorg's obstetric care professionals were trained to handle low-complexity GDM care, shifting that care away from the hospital's internal medicine department. Women requiring insulin therapy, which involves more intensive monitoring, continued to be referred to the internal medicine department. This redesign was launched in January 2022, serving a population of about 500 women per year.

> *"To enhance continuity of care, Annature Geboortezorg's obstetric care professionals were trained to handle low-complexity gestational diabetes mellitus care, shifting that care away from the hospital's internal medicine department."*

Regarding the care pathway for pain relief during labor, in the Netherlands, women with low risk pregnancies have the option to give birth either at home or in an outpatient setting led by a community midwife [67]. Referrals to the obstetrician in a hospital setting during labor are common. On average, about 50% of women who begin labor in a midwife-led care setting are referred to an obstetrician, with a request for pain relief being one of the top three reasons for referral [72, 73]. Intrapartum referrals are associated with more negative birth experiences [151, 153]. To address this, nitrous oxide, an inhalational form of pain relief that can be administered by the community midwife in an outpatient setting, was introduced. This averts the need for referral to an obstetrician to access pain relief and thus advances continuity of care [225]. The new pain relief pathway was launched in October 2021, with the expectation of serving about 100 women per year.

"Nitrous oxide, an inhalational form of pain relief that can be administered by the community midwife in an outpatient setting, was introduced. This averts the need for referral to an obstetrician to access pain relief."

DEVELOPMENT OF THE OUTCOME-BASED PAYMENT MODEL

The study was conducted in four phases: preparation, data collection, evaluation and design, and negotiation and implementation.

Preparation

Before the selected care pathways were redesigned, the team decided that accessibility of the new pathways had to be ensured for all patients. Dutch care providers contract with multiple insurers. It was deemed unethical to limit access to the new care pathways solely to the clients of the participating insurer. Therefore, securing the commitment of other insurers was critical.

To formalize this commitment, the IMCO requested the establishment of a temporary payment model during the study period to cover the newly provided services until full implementation of the OBPM took place. The insurers agreed to cover the new care pathways on the condition that total spending would not increase. Consequently, the financial risk of additional spending was borne by the provider.

"The insurers agreed to cover the new care pathways on the condition that total spending would not increase. Consequently, the financial risk of additional spending was borne by the provider."

Data Collection

After implementing the redesign, data were collected to evaluate and determine whether the redesign interventions yielded the desired result of improving value as measured by costs and outcomes [1, 8]. Data collection included pre- and post-measurement for both care pathways. The change in costs was calculated using time-driven activity-based costing (TDABC) [36].

TDABC is a patient-level cost accounting method that is respected among VBC experts for its ability to deal with the complex nature of health care and the accurate allocation of costs to care pathways [29]. By applying TDABC, the team was able to gain detailed insight into the resources used in the two selected care pathways, including personnel, materials, medications, and overhead, and to calculate the impact of shifting care activities between providers.

The outcomes analysis was based on process indicators, clinical outcomes, and patient-reported outcomes. The standard set of outcomes for pregnancy and childbirth of the International Consortium for Health Outcomes Measurement had been adopted earlier by the Annature Geboortezorg, allowing insight into patient-reported outcomes and experiences [163]. To specifically measure patient experiences with GDM care, the Responsiveness in Perinatal and Obstetric Health Care Questionnaire was adapted and implemented.

Evaluation and Design

Annature Geboortezorg and CZ collaboratively reviewed the cost and outcomes data to determine the impact of the redesign on patient value. A value assessment matrix was developed to support these meetings, indicating a positive, neutral, or negative impact on outcomes and costs.

> *"New gestational diabetes mellitus pathway improved outcomes and lowered costs, with less clear results for the pain relief pathway."*

The matrix demonstrated significant improvement in value for the GDM pathway, meaning improved outcomes and lower costs. Specifically, the redesigned care pathway for GDM led to fewer referrals to internal medicine and a reduced need for insulin therapy. Women with GDM reported improved experiences, clinical outcomes remained stable, and the intervention contributed to substantial cost savings.

> *"The redesigned care pathway for gestational diabetes mellitus led to fewer referrals to internal medicine and a reduced need for insulin therapy. Women with gestational diabetes mellitus reported improved experiences, clinical outcomes remained stable, and the intervention contributed to substantial cost savings."*

The impact of the nitrous oxide pathway was neutral to positive. It led to a reduction in pain relief use within obstetrician-led care. Clinical outcomes and patient-reported experiences showed moderate improvement or remained unchanged. No substantial cost savings were realized, but costs did not increase.

Detailed results from the cost and outcome analyses for each pathway are reported in separate research articles [226, 227].

Given the improved outcomes and cost savings associated with the new GDM pathway, Annature Geboortezorg and CZ moved forward with developing an outcome-based shared-savings model for this service.

As no cost savings were achieved during the study period for the pain relief pathway, Annature Geboortezorg and CZ did not pursue the development of a shared-savings model for that pathway. They agreed, however, to extend the temporary payment model and to reevaluate the nitrous oxide pathway at a later stage, because the evaluation was affected by low patient volumes.

Designing and Negotiating an Outcome-Based Payment Model for Gestational Diabetes Mellitus Care

With the support of the Dutch Healthcare Authority, the team explored how the collected cost and outcomes data could guide the design of the shared-savings model for the GDM pathway. A shared-savings model was determined to be the most appropriate design due to its clear connection to costs and outcomes and its ability to financially reward Annature Geboortezorg for improving patient value [56, 228, 229].

An explicit connection to value was a prerequisite for the model's design, leading to the following principles. First, the savings would be determined by the change in costs of providing care, calculated with TDABC.

Second, the share of savings would depend on meeting a benchmark consisting of a clinical outcome and a patient-reported experience measure. The clinical outcome selected was macrosomia, a key complication associated with GDM that serves as an indicator of GDM care quality.

The patient-reported experience measure was an item measuring whether patients felt their provider took their personal situation into account, such as family, work, and daily activities. This measure reflects the added value of the intervention by capturing the improved social support and consideration provided by the obstetric care professional. The benchmark was set on the outcomes achieved pre intervention, which were then compared with the outcomes achieved post intervention to monitor whether the improved quality of care could be maintained by Annature Geboortezorg.

For the GDM shared-savings model, Annature Geboortezorg and CZ negotiated the duration and allocation of the savings (Table 1). The negotiated model for this service consisted of two components: (1) a per-patient base payment, calculated using TDABC, which was incorporated into the prenatal bundle price to account for this new service; and (2) the shared-savings component to allocate the realized savings.

Under the negotiated shared-savings arrangement for GDM care, Annature Geboortezorg and CZ agreed that the provider would initially receive a larger

share of the savings when the outcomes benchmarks are met, as a reward for maintaining quality of care after redesign. If the benchmark is not met, the IMCO still receives a portion of the savings, although this is less than if the benchmark had been achieved. Over the course of 4 years, the provider's share gradually decreases while the insurer's share increases, reflecting a transition from innovation to the standard care model. Thus, by year 4, the shared-savings allocation stabilizes. At that point, the majority of savings flow to the insurer, which uses them to reduce premiums.

This shared-savings design is not suggested as a blueprint for future OBPMs. Rather, it reflects the outcome of the negotiations between Annature Geboortezorg and CZ in this specific situation.

OVERCOMING HURDLES IN DESIGNING A SHARED-SAVINGS MODEL

The hurdles faced by the team in doing this research project included aligning calculated costs and reimbursement structures, rewarding value while maintaining budget neutrality, handling potential long-term cost savings, using viable cost and outcomes data measures, and designing pathway-driven models.

Cost and Reimbursement Misalignment

Shared-savings arrangements are often based on billing data. Insurers and providers agree on a virtual budget, including all anticipated expenditures, and then the difference between the anticipated and actual expenditures determines the savings [228, 230]. While pragmatic, this approach undermines a key principle of VBC, which is understanding the actual cost of care [28]. Reimbursement rates, such as those in the Diagnosis-Related Group (DRG) system, are based on average resource use, which typically does not reflect the actual costs of care, and, therefore, are an inadequate proxy [26, 27]. As a result, using billing data to design a shared-savings model can result in misleading conclusions about cost savings and value.

> *"Using billing data to design a shared-savings model can result in misleading conclusions about cost savings and value."*

In our study, TDABC was used to conduct a pre- and post-measurement of costs of care delivery in order to assess how care pathway optimization affected actual costs. Regarding the GDM care pathway, the TDABC results revealed lower costs than the DRG rate for GDM. This can be attributed to the fact that DRG rates are

often calculated at a highly aggregated level, whereas TDABC is derived at the individual care pathway level [26].

When GDM care activities were transferred from Amphia Ziekenhuis to Annature Geboortezorg a key issue emerged: should the hospital's budget be reduced based on the larger DRG payment rate or the lower TDABC-calculated costs? Amphia Ziekenhuis advocated for the latter, arguing that other care expenses were probably offset by this margin. Eventually, the parties agreed to reduce the hospital's budget based on the TDABC-calculated costs of GDM care before the intervention, and to set a new payment rate for Annature Geboortezorg based on the decreased TDABC calculated costs after the intervention. The difference between these costs formed the basis for shared savings.

In terms of scalability, adding incentives to existing reimbursement structures, such as a shared-savings structure based on anticipated versus actual billing data, is easier to implement. But this sidesteps the critical issue of tracking actual costs of care, which is necessary from a VBC perspective. Although Annature Geboortezorg's bundled-payment structure allows it to retain savings from efficiency gains, it lacks the insight needed for value-based decision-making. Despite requiring more effort, TDABC facilitates a core VBC principle of making costs transparent.

Rewarding Value While Maintaining Budget Neutrality

Budget neutrality was the insurer's primary condition for participating in the study. A shared-savings model could therefore only be implemented when there were actual cost savings. To address this, the payment model was designed as a one-sided shared-savings model, with the downside risk borne by the provider. If the new care pathways led to increased costs, Annature Geboortezorg's budget would remain unchanged, which created a financial risk for the provider. This structure is unlike previous one-sided shared-savings models, in which the downside risk was often borne by the insurer [53, 228]. The increased financial risk might make other providers hesitant to pursue such innovations. Nevertheless, Annature Geboortezorg was willing to carry this risk due to its belief in the beneficial value of the interventions.

The "Wrong Pocket" Issue

This problem refers to a disconnect between the parties that invest in care delivery innovations and those benefiting from the resulting improvements. When care pathway redesign improves patient outcomes, this can result in long-term health benefits. When these improvements reduce preventable utilization of care, significant cost savings can be achieved. The insurer typically pockets these

savings, while the provider that invests in these improvements does not benefit. This is known as the wrong pocket issue [231].

Addressing this in shared-savings models requires an understanding of long-term outcomes and costs. For example, improved GDM care may reduce babies' long-term risk of developing diabetes or becoming overweight. However, the GDM shared-savings model was based on immediately tangible short-term benefits and costs. Incorporating long-term benefits and costs into shared-savings models could more effectively motivate providers to invest in care pathway redesign.

Cost and Outcomes Data Collection

Collecting cost and outcomes data for the design of a shared-savings model can be challenging. Outcomes data, specifically for patient-reported outcomes, are necessary for evaluating the perceived quality of care delivered. However, the collection and reliable analysis of these data depend on the implementation of validated questionnaires, reliable response rates, and mature data infrastructures. Our study benefited from the previously implemented pregnancy and childbirth standards set, which measures patient-reported outcomes and experiences using validated questionnaires at multiple time stamps during pregnancy and postpartum.

For the cost data, TDABC is well suited to calculate the costs of care pathways and provides valuable opportunities to detect potential cost savings. Using TDABC, however, can be a labor intensive process. In this study, the change in costs rather than the total cost of the maternity care cycle was calculated, making the process simpler [29]. The time needed to apply TDABC limits scalability for more significant payment reform, since this would require a more extensive application of the method.

Pathway-Driven Payment Model Design

Generally, the development process for OBPMs begins with selecting a specific outcome to improve, followed by designing targeted interventions for improving the outcome [232]. In this project, however, the team deliberately started with two care pathways rather than with targeted outcomes. This approach was chosen because it offered clear opportunities to improve patient value by shifting care from secondary to primary care, allowed for payment development across different types of care, and kept the study feasible and manageable. A pathway-driven approach enabled experimentation with OBPM design on a small scale.

While pragmatic, this pathway-first approach made it more difficult to define payment agreements up front, as it was not clear in advance which outcomes would be affected or suitable for the benchmarking in the shared-savings model.

Thus, the intervention first had to be implemented and evaluated before the shared-savings model could be finalized. As a result, Annature Geboortezorg was primarily incentivized to maintain the quality level achieved post intervention rather than to pursue continuous improvement.

NEXT STEPS FOR ANNATURE GEBOORTEZORG

Annature Geboortezorg is taking several steps to build on the insights gained through this project. A key priority is improving the data infrastructure to support more robust and timely outcomes analysis, which is essential for further advancing VBC efforts. Annature Geboortezorg continues to collect and use patient-reported outcomes and patient-reported experience measures to evaluate care delivery and identify opportunities for improvement within existing pathways. In addition, a client panel has been established to organize direct participation of Annature Geboortezorg's patient population during these steps.

Although further design of OBPMs is not currently on the organization's agenda, largely due to the substantial time and effort required, Annature Geboortezorg remains committed to aligning care delivery with value-based principles through ongoing care pathway optimization and outcomes monitoring.

WHAT IT TAKES TO MAKE PAYMENT REFORM WORK

While VBC's principles sound intuitive, actual translation to practice remains difficult, particularly when the existing payment models hinder meaningful change. This case study shows how the team navigated through various challenges to make outcome-based payment work in practice. Comprehensively collecting and integrating cost and outcomes data were crucial for determining the impact on patient value. The project required close collaboration between people in different disciplines. A significant level of trust and partnership between the provider and insurer was needed for transparency into costs and outcomes. Although developing OBPMs remains complex, this project illustrates that, under the right conditions, it is possible to take meaningful steps toward aligning care delivery and payment with value.

07

Chapter 7

Beyond the Contract: The Role of Relational and Contractual Governance in Outcome-Based Payment Models

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INTRODUCTION

Outcome-based payment models cannot be developed and implemented without effectively combining contractual and relational governance, including transparency, trust and formal contracts.

Value-based healthcare (VBHC) aims to enhance the quality of care as measured by outcomes, while maintaining costs at reasonable levels [1]. However, transitioning into a VBHC system demands substantial effort, as it requires restructuring both care delivery and provider payment models [7]. Traditional provider payment models, such as fee-for-service, are based on rewarding volume instead of value. Providers experience strong financial disincentives when implementing interventions designed to enhance value when this entails avoiding high-cost interventions or task shifting from secondary to primary care [233, 234].

Hence, reforming payment structures is a priority for VBHC. Outcome-based payment models (OBPMs) are praised as a promising avenue to pursue such reforms. In OBPM, payment (partly) depends on performance as measured by outcomes of care. Ideally, these models incentivize healthcare providers to attain better outcomes, induce cost-effective innovation, and prevent overtreatment of patients. As such, OBPMs contribute to an effective VBHC system [235, 236].

The transition into OBPMs is complex; it demands a cultural shift in how healthcare providers and insurers govern their relationships. Current provider-insurer relationships are largely dominated by control and accountability, while OBPM development and implementation requires trust and collaboration (as well) [62, 65, 237].

In this viewpoint, we argue that OBPMs can only be developed and implemented by effectively combining contractual and relational governance. This combination is effective when the two forms interact in a complementary relationship - reinforcing each other's strengths and compensating for the limitations of the other [238]. Such an effective combination is indispensable for the successful development and implementation of OBPMs because relational mechanisms, such as trust and relational norms, are instrumental in enabling transparency, flexibility, and collaboration [239]. However, these mechanisms can be fragile [240], and therefore must be safeguarded through formal agreements [241]. Drawing on key insights from practice, we argue the effective combination of both governance types in the development of OBPMs in healthcare.

TRANSPARENCY AND TRUST

A critical condition for OBPMs is transparency in outcome indicators, as these provide information about the quality of care delivered [236]. However, current healthcare provider-insurer relationships often lack information sharing due to a lack of trust between parties [63, 236]. This is rooted in a history of intensive monitoring and conflicts [242]. Consequently, providers are hesitant to share sensitive data due to fear of potential repercussions and negotiation disadvantages [243]. To overcome this barrier, insurers and providers must invest in building a trusting relationship [235–237, 243, 244]. Establishing trust helps overcome information asymmetry and enables the incorporation of outcome indicators in purchasing contracts. This interplay – where trust facilitates contractual specifications – is known as the complementary relationship between relational and contractual governance, as elaborated in the following section [239, 240].

CONTRACTUAL AND RELATIONAL GOVERNANCE

Governance defines how inter-organizational relationships are managed. With contractual governance, relationships are (almost) exclusively governed by formal contracts, whereas relational governance relies (primarily) on trust and relational norms as governing mechanisms. Around 1990, both types of governance were assumed to substitute for each other, implying that formal contracts signal distrust and, conversely, that a strong trusting relationship reduces the need for a formal contract. In 2002, a new perspective challenged this, namely that both forms of governance complement, interact and fortify each other [238]. For example, a well-drafted formal contract mitigates risks and consequently promotes trust, and facilitates relationship-building. Also, trust can fill the gaps left by rigid formal contracts [239, 240]. These concepts provide a relevant conceptual foundation for better understanding the governance requirements for further developing and implementing OBPMs.

KEY LEARNINGS FROM PRACTICE

This viewpoint's statement is empirically grounded on key insights from a Dutch case involving a healthcare insurer and provider who collaborated closely to develop an OBPM. The two parties had already established a trusting relationship through a previous experience of payment reform (introduction of bundled payment). A few years later, the desire to integrate outcomes in the payment model emerged. Both parties decided to jointly explore opportunities for designing an OBPM and dedicated time, resources, and data to achieve this goal.

The following three phases demonstrate how the complementary relationship between relational and contractual governance unfolded.

Phase 1. Formal Agreements as a Safety Net: Formal Agreements Create Room for Collaboration

It was the aim to design an OBPM for two new care pathways (i.e. the care activities for specific patient populations). In the Netherlands, providers are contracted by multiple insurers. Although only one insurer was directly involved in the OBPM design, the support of the other insurers was necessary to ensure accessibility to the new services for all clients in the region. This required collective approval for a temporary payment arrangement to cover the OBPM design period. The healthcare provider drafted a letter-of-intent proposing the temporary payment agreement and details about the OBPM design. In their communication, the provider explicitly emphasized the common goal of the project: *"Measuring outcomes, let alone using outcomes for reimbursement, is largely absent in maternity care. Outcome-based maternity care offers many opportunities to deliver the best possible care to pregnant women and achieve further quality improvements."*

The insurers agreed to the temporary payment arrangement on the condition that, in the event of increased costs, the provider's maximum budget would not be increased. Therefore, the risk of overspending was borne by the provider. The provider accepted this risk, explicitly stating in the formal agreement that they would bear the risk of overspend. Moreover, the provider promised to be fully transparent about outcomes and costs. Once the letter-of-intent was collectively signed, the project officially commenced.

This phase exemplifies the interaction between contractual and relational governance. On the one hand, contractual governance facilitated relational governance, as the formal agreement (letter-of-intent) provided a foundation for continuity and cooperation. Drafting and finalizing the agreement required interaction between all parties, ensuring a shared understanding of the project's objectives. On the other hand, relational governance promoted contractual governance. By presenting the initiative as a unifying objective and an opportunity for innovation, the provider secured commitment to collaborate on developing the OBPM.

Phase 2. Collective Development of the Contract: Transparency and Co-Creation in Practice

To develop the OBPM, the parties established a taskforce responsible for exploring design opportunities. This group comprised of representatives of both parties and experts in the field. Initially, the task force aimed to build a shared understanding of OBPM's development, as varying interpretations of the model's purpose and

use surfaced. Next, policy frames and legal restrictions were examined to define design freedom. The group then explored different OBPM methods, such as pay-for-performance and shared savings constructions. Finally, cost and outcome data were collected and analyzed to identify potential savings and select suitable outcome benchmarks. These insights were addressed in dedicated meetings aimed at synthesizing and formalizing the OBPM. The provider described the approach as: *"I propose a hybrid model. What I think we are doing now is putting the elements from the task force on the table, and you and I are going to figure out how to make it work. We're doing this with more insight than usual; it's more transparent."*

Although the parties already had a trusting relationship, the provider occasionally felt hesitant to share cost data, fearing negotiation disadvantages by disclosing private information about the costs of treatments. Nevertheless, the provider acknowledged that full transparency was indispensable for project success, and mentioned: *"[...] If you have already agreed that you want to contract based on outcomes, then the healthcare provider and insurer must form a partnership in which you are transparent and have a good understanding of each other's interests and the necessary conditions. Yes, my conclusion was that you need [...] to put the cost data on the table."* The provider actively involved the insurer in the cost calculation and illustrated complexities and limitations encountered. To prevent misinterpretations, the provider drafted and shared a disclaimer detailing the cost calculation's limitations.

Both governance forms effectively interacted in this phase. The existing trust enabled transparency in cost and outcome data, which was essential for co-creating the contractual elements. Simultaneously, the process revealed that transparency entails risks as well; it can induce fear or perceived risk and thus demands formal safeguards – such as disclaimers – to protect the parties involved.

Phase 3. Bridging Conflicting Interests: Relational Governance as Key to Consensus

During negotiations, a tension surfaced. One of the care pathways resulted in cost savings, creating an opportunity for a shared savings model. A conflict of interest emerged over how to distribute these savings between the provider and the insurer. The provider argued that shared savings constructions must adequately reward providers for pursuing value-enhancing interventions, proportional to the time and effort invested: *"The distribution of savings must do sufficient justice to the fact that healthcare providers make great efforts to improve care delivery, which is labor-intensive, and the distribution of savings should incentivize healthcare providers to continue investing in more appropriate [value-based] care."*

Conversely, the insurer insisted the shared savings model to be temporary and the savings distribution to be balanced, as their primary objective is to control healthcare costs. The insurer mentioned: *"As a healthcare insurer, our responsibility is to control healthcare costs. […]. The savings we achieve flow back to our clients in the form of reduced premiums. After all, care is funded by premiums. In our opinion, the scheme you propose is insufficient to meet our social responsibility."*

Through intensive dialogue and integrative negotiation (approaching the disagreement as a win-win) the parties developed an allocation model. The provider receives a larger share of savings upon achieving specified outcomes, which gradually decreases over time, shifting the share toward the insurer. The insurer acknowledged that this solution was only feasible given the strong existing relationship. The provider remarked: "*A healthcare provider that initiates healthcare improvements and manages to achieve a saving in the process contributes to the social responsibility of reducing healthcare costs. In our opinion, it is important to provide maximum incentives for healthcare providers to do so*."

Again, this phase demonstrates how relational and contractual governance interact effectively. The relationship enabled flexibility and adaptability to reach a contractual consensus. Trust and open communication allowed the parties to resolve tensions and reach a workable model that accommodates both parties' interests.

IMPLICATIONS

We argue that the successful development and implementation of OBPM depends on effectively combining contractual and relational governance, which interact and reinforce each other. An exclusively contractual approach fails to manage the complexity of outcome-based contracting. Overreliance on control mechanisms, audits and monitoring limits room for coordination, innovation and flexibility. Conversely, exclusive reliance on relational governance is vulnerable, as trust can take time to build, [245] and can easily be disrupted by e.g. personnel changes or conflicts [246].

In contexts where trust is low or underdeveloped, the implementation of OBPMs may be premature. Investing in building relational capital is imperative. Initial steps include formulating shared goals and identifying areas of common ground. From there, parties can experiment with collectively interpreting outcome data. This process can reveal specific outcomes requiring improvement, which offers a concrete and relevant entry point for the introduction of an OBPM.

The presented case shows how both governance forms were effectively combined in practice without a predefined framework. To guide future collaborations, we advocate the use of '*formal relational contracts*' [247]. Developed by scholars, this contract specifies "*mutual goals and establishes governance structures to keep the parties' expectations and interests aligned over the long term*" [241]. We argue that, in order to advance the implementation of OBPMs and the VBHC agenda, combining contractual and relational governance must become central to governance strategies in provider-insurer relationships.

08

General Discussion

INTRODUCTION

This dissertation opens with a critically ill patient as a metaphor for the current state of healthcare systems. Costs are rising while quality stagnates, demand is growing while the workforce shrinks, and healthcare's waste significantly contributes to the climate crisis and consequently health inequalities [1–4]. Moreover, healthcare expenditure with volume-driven reimbursement arrangements, is predominantly directed towards curative care rather than impactful preventive care [5]. Like its patients, the healthcare system is in urgent need of intervention.

One proposed intervention is Value-Based Healthcare (VBHC), introduced by Porter and Teisberg as a strategy to enhance both the quality and the efficiency of healthcare, and to ensure a more sustainable use of resources. The guiding star in this approach is the combined use of cost and outcome data that matter to patients, since these together determine the value of care. To effectively steer on value requires a complete restructuring of how healthcare is currently organised, monitored for quality and reimbursed [1, 7].

Since its introduction in 2006, VBHC has gained international traction. It is notable that implementations vary widely and adoption has been selective [248]. A critical shortcoming is the frequent neglect of the cost dimension. As such, insight into the actual costs of care, and how these costs relate to health outcomes, is limited [25]. Furthermore, reimbursement models that reward value-improving behaviour remain scarce [24]. This hinders the ability to effectively steer towards greater value, and for VBHC to achieve its full potential [249].

Throughout this dissertation, I address this cost-dimension gap, in particular by demonstrating how cost and outcome data can be collected and integrated to define the value of care, and how these inputs can be used to develop a provider payment model that is better aligned with value. This dissertation's domain of interest is Dutch maternity care. In essence, this domain is organised as follows: in tier 1 (primary care), women with low-risk pregnancies receive care from community midwives in independent practices while in in tiers 2 and 3 (secondary/tertiary care), women with medium-to-high risk pregnancies receive care from obstetricians in (academic) hospitals [70].

The main study for this dissertation was conducted in an Integrated Maternity Care Organisation (IMCO), a legal entity functioning as a network organisation of both primary and secondary maternity care providers. IMCOs are rather unique organisations in that there are only eight in the Netherlands [80]. The providers in these networks share an electronic patient record, collaborate in integrated care pathways and are paid through a bundled payment system. The IMCO

structure provides favourable conditions for advancing VBHC. First, it facilitates the redesign of care pathways, such as shifting tasks from obstetricians to community midwives. Second, the bundled payment system supports these innovations by ensuring collective compensation for both community midwives and obstetricians. Lastly, the integrated patient record aids comprehensive data collection.

During the study, two maternity care pathways were redesigned by shifting care activities from secondary to primary maternity care, aiming to deliver the right care in the right place. It was expected that these interventions could improve patient value as less costly resources would be used and continuity of care would improve. To determine if the interventions yielded the expected results, cost and outcome data were collected and analysed. Furthermore, these inputs were used to develop an outcome-based payment model (OBPM) to reward and incentivise such value-improving behaviour. This dissertation provides valuable insight into how the VBHC principles can be advanced in practice. Specifically, these lessons add to the limited body of knowledge about the cost dimension of VBHC.

CHAPTER OUTLINE

This chapter has two parts: **delivering and measuring value** and **rewarding value**. Both parts contain a description of the main findings, their implications and consequent recommendations. Furthermore, general limitations and suggestions for future research are discussed. The chapter finishes with concluding remarks.

PART I: DELIVERING AND MEASURING VALUE

Main findings

In VBHC, the value of care is determined by a combination of cost and outcome data. However, in practice, the value of care remains largely unmeasured and misunderstood. This mostly stems from the persistent use of inadequate metrics. The quality of care is predominantly assessed using process measurements, such as the number of consultations or procedures [1, 7]. However, in VBHC, the quality of care is determined by the outcomes achieved as a result of these care processes, including both clinical outcomes and, patient-reported outcomes such as perceived health and patient-reported experiences such as those with the care process. This shortcoming presents a clear challenge since improving outcomes requires an understanding of which processes contribute to improved health and which do not. This is far more complex than simply tracking activities and processes [8, 11, 250].

Using cost data in defining the value of care introduces a second challenge. Our understanding of costs in health care delivery is surprisingly narrow [61]. Billing data is often used as a proxy for healthcare costs, while numerous studies have shown that billing data inaccurately reflect actual resource use [26, 27]. Reimbursement tariffs are often historical and based on average resource use [7]. From a VBHC perspective, cost estimations should include all the costs involved in a patient's care for a medical condition, from diagnosis to cure [8].

Experiences with combining costs and outcomes in a way that fits the principles of VBHC remain limited in practice [19–21, 251]. In this dissertation, I have attempted to apply these principles in evaluating the impact of interventions in the form of maternity care pathway redesigns on patient value by using cost and outcome data. Time-Driven Activity-Based Costing (TDABC) was used to calculate the costs of care delivery and determine the financial impact of a redesign, and the impact on quality of care was assessed using a combination of process indicators, clinical outcomes and, patient-reported outcomes.

Below, the main findings of Chapters 2 to 5, together forming **Part 1: delivering and measuring value** of this dissertation are presented.

Chapter 2: methodological considerations regarding calculating healthcare costs

When preparing to apply TDABC to our case, I was surprised by the lack of studies providing detailed insight into the application of the method in practice. Many reports failed to address the fundamental decisions made in collecting cost and time data, or glossed over the challenges encountered. Consequently, we compiled a methodological development paper detailing all the steps taken, the decisions made and the lessons learned, which is presented in **Chapter 2**. The aim of this paper is to contribute to the further uptake of cost calculation studies in VBHC, specifically when the objective is to calculate a change in costs after redesigning a care pathway.

Chapter 2 thus describes the application of TDABC to explore cost changes after a substantial redesign of care pathways by conducting pre- and post-measurements. We offer guidance on calculating the change in costs – the delta – without the need for a total cost calculation. This approach contributes to increasing the feasibility of healthcare costing studies. Furthermore, we suggest incorporating extra granularity in the calculation by proposing a more detailed level of cost allocation, namely on the actor-level. This level of granularity is relevant when the redesign initiative entails a shift of tasks between different actors and supports in gaining a detailed insight into the financial impact of such initiatives [29].

This methodological development paper leads the readers by the hand as we share the practical application of every step in our case. By providing insight into the lessons learnt and the challenges encountered, we support future TDABC appliers, particularly as these insights remain underreported in most empirical research papers.

Chapters 3 and 4: analysing cost- and outcome data to determine the value of care

Chapters 3 and 4 present the results of the investigated redesign interventions on patient value. The redesigning involved two separate care pathways: gestational diabetes mellitus (GDM), which is a pregnancy complication, and the use of nitrous oxide as a method for pain relief during labour. To determine the impact of the redesign interventions, the studies were designed as prospective, observational cohort studies involving pre- and post-measurements of costs (calculated using TDABC) and process and outcome measures (clinical and patient-reported). For GDM, patient-reported experiences were measured using the GDM Responsiveness Questionnaire. For nitrous oxide use, the standard outcome set for Pregnancy and Childbirth (PCB) developed by the International Consortium for Health Outcomes Measurement (ICHOM) was used [163].

The inputs were combined in a 3x3 value-assessment matrix to determine whether value had improved. The matrix combines the change in costs (lower – neutral – higher) and the change in outcomes (worsened – neutral – improved). Applying the matrix requires the inclusion of both aspects, as the impact on value cannot be assessed if either cost or outcome data are omitted. Three evaluation outcomes were possible, namely a positive impact on value, a negative impact on value or an unclear impact on value.

In **Chapter 3**, the results of the GDM case are described. GDM is a pregnancy complication, marked by glucose intolerance that begins or is first recognised during pregnancy [111]. It affects 14% of pregnancies worldwide, though prevalence varies between continents [113]. GDM is mainly managed through nutrition and lifestyle modifications. Insulin therapy is required for 15-30% of cases [118, 122, 123]. Before redesign, GDM care was provided by the hospital's internal medicine department in parallel with the IMCO providing obstetric care. To improve continuity of care, low-complexity GDM care activities were shifted to the IMCO. The findings show that the value of care for women with GDM was improved in that, after the redesign, fewer patients were referred to the IMD and the need for insulin therapy reduced. Improved experiences were reported, clinical outcomes remained stable, and substantial cost savings were achieved [226].

In **Chapter 4**, the results of providing nitrous oxide as a method for pain relief during labour are presented. In the Netherlands, about 50% of women who begin labour in a midwife-led care setting are referred to obstetrician-led care in a hospital, with a request for pain relief being one of the top three reasons [72, 73]. It is known that referrals during labour are associated with more negative birth experiences [151, 153]. To address this, the IMCO introduced a nitrous oxide option as a form of pain relief that could be administered by a community midwife in an outpatient setting to avoid hospital referrals to access pain relief [225]. The findings show that the value of care to women starting labour in a midwifery-led setting requiring pain relief was moderately improved. After the introduction of the nitrous oxide option, use of pain relief in obstetrician-led care (epidural and remifentanil) was reduced. Clinical outcomes remained largely unchanged, patient-reported experiences showed moderate improvement, and while no substantial cost savings were realised, costs did not increase. As such, this redesign intervention, improved value but only moderately.

Chapter 5: understanding what is valued during labour and birth
While the redesign interventions implemented during the main study can be justified by the numerous studies highlighting continuity of care as a critical factor in creating quality, there is a lack of a thorough understanding of what and why certain elements of care delivery are valued during pregnancy and childbirth [105, 218, 252, 253]. As improving outcomes that really matter to patients is a cornerstone of VBHC, it is crucial to understand what elements of care delivery are perceived as most important. Therefore, this dissertation incorporated a study designed to gain a better insight into this.

Chapter 5 describes how Q-methodology was applied to systematically explore the variety in women's preferences for care delivery during labour and birth in hospitals in the southwest of the Netherlands. Q-methodology is helpful in systematically identifying patterns in individual opinions (or viewpoints) on a subject using qualitative and quantitative data collection methods [185, 254]. As preferences can take on many forms and types, a broad spectrum of preference types were included in this study. These were categorised into eight separate domains: personal preferences, physical comfort, coordination of care, continuity and transition, emotional support, access to care, information and education and, family and friends. Four viewpoints emerged from sample studied: 1) the personal approach, 2) the empowering approach, 3) the expert approach and 4) the needs-based approach. The findings reveal that women's preferences are diverse and multifaceted, with the studied domains not being perceived as equally important by those in the study sample. Nevertheless, respectful interaction and adequate information provision were unanimously highlighted as relatively important. In contrast, continuity of care professionals and attention to the partner were

considered relatively less important by the sample [253]. The findings provide a first step in understanding what matters to women during labour and birth, and should inform future value-improving interventions. Even though the findings cannot be directly generalised to the IMCO's entire population, the insights are relevant for achieving a better understanding of what is valued during labour and birth.

Implications and recommendations

The findings of the chapters presented in 'Part I: Delivering and Measuring Value' have several implications and let to recommendations which are presented below, structured in four categories 'Cost measurement', 'Outcome measurement', 'Value measurement' and 'Value improvement'.

Cost measurement

The method used for cost calculation in our research project was TDABC. Although TDABC is often promoted as pragmatic and accurate, its application in maternity care proved challenging and required substantial medical and cost-accounting expertise. Difficulties arose from the variability within and between maternity care pathways and the fragmentation of the providers involved; multiple providers with distinct cost structures and accounting systems complicated cost allocation. Furthermore, the collection of time estimates was demanding and required a constant trade-off between granularity, scope and feasibility. By calculating a cost delta, rather than total costs, the feasibility of this approach was increased and by allocating costs at the actor level, granularity was improved. We contribute to the empirical evidence base on costing within VBHC by sharing our methodological considerations and real-world applications,.

The question remains whether TDABC can achieve its intended purpose given the intensity of the labour inputs required. Kaplan and Porter (2011) have argued that the method itself is not inherently complex, rather that challenges arise from applying the method in traditional specialty-based healthcare. Conversely, when care is delivered in a single, condition-focused centre by a dedicated team, an accurate cost calculation is more feasible due to minimal resource overlap with other related or unrelated care pathways [28]. Since it is unlikely that traditional healthcare providers, such as specialty-based hospitals, will fully reorganise into condition-focused centres in the near future, TDABC applications will continue to be influenced by traditional care settings.

To increase the uptake of TDABC given the abovementioned challenges, I recommend the development of an international, open-access database of previous studies containing time estimates and resource costs across different specialties and settings. Furthermore, developing standard formats and reference

models that provide the opportunity to tailor them to the specific context might ease implementation and facilitate the necessary customisation.

Outcome measurement
Another essential element in pursuing VBHC is the use of outcome measures. These metrics are fundamental to understanding the impact of care redesign from both a medical and patient perspective. The meaningful use of outcomes depends on certain structural and technical conditions in combination with knowledge of population preferences.
First, the providers involved in the IMCO structure share a patient record, meaning that data of the entire maternity care population are collected in the same system. In regions where providers do not share a patient record, which is the status quo for Dutch maternity care, comprehensive outcome collection and analysis requires a substantial effort, which could impede implementation and upscaling [255].

Second, the meaningful use of outcomes requires the integration of surveys in patient records, a mature data infrastructure and analytical capacity. Moreover, detecting the effects of care pathway redesign depends on the availability of large patient groups. In the GDM study, the cohorts were sufficiently large to detect meaningful changes. However, the uptake of the nitrous oxide option was too limited to be able to observe meaningful effects, which makes evaluation complex, and necessitating a longer observation period.

Third, the interpretation of outcomes requires a critical and nuanced perspective, informed by an understanding of patient values. Two examples illustrate this point. First, research has shown that the item measuring *satisfaction with results of care* in the ICHOM set for Pregnancy & Childbirth is almost always answered positively, even when other outcomes show less positive results [256]. Second, a low rate of experienced shared decision-making could be perceived as a negative outcome. However, our Q-study, reported in Chapter 5, showed that shared decision-making was not particularly prioritised by the entire population [253]. Thus, such a result may not necessarily indicate a quality problem. Using outcomes for quality improvement therefore requires not only the right structural and technical conditions, but also an understanding of population preferences and what different groups within the patient population consider valuable.

To increase the meaningful use of patient-reported outcome data in maternity care, I recommend implementing the ICHOM Pregnancy and Childbirth set. This set includes various relevant domains, supports monitoring and enables benchmarking. Two crucial steps are the establishment of a shared patient record among providers and the integration of the set into the electronic patient record,

as this enables the linkage of patient-reported data with process and clinical outcome data. Such integration supports a comprehensive assessment of the quality of care.

Value measurement
While measuring costs and outcomes provides essential insights, interpreting them jointly to determine the value of care introduces a new layer of complexity. In the VBHC paradigm, the value of care is determined by the value equation: outcomes divided by costs. While this equation serves as the conceptual cornerstone of VBHC, real-world applications remain scarce and varied [38]. Some studies favour a mathematical approach and the calculation of a single figure to determine value [43–47, 257]. In our study, we opted for a more intuitive and interpretative approach by using a value-assessment matrix. This enabled stakeholders to collectively discuss and interpret the available cost and outcome data, a process that supported a shared understanding. This collective exercise revealed several implications:

- **Beyond costs and outcomes**: The exclusive focus on costs and outcomes may be too narrow for coming to a decision on the added value of a care pathway redesign. For example, an intervention might improve outcomes and reduce costs but also increase environmental waste, or it may only slightly increase costs while alleviating staff burden. Given the current challenges within healthcare systems, these dimensions should also be weighted in value assessments.
- **Accounting for heterogeneity in what matters**: A population-level evaluation of value runs the risk of overlooking the fact that what matters during care delivery differs between groups and individual patients. Value assessments should therefore pay attention to these differences, and not assume that value is a uniform construct.
- **Recognising value as dynamic**: A one-time value assessment overlooks the possibility that value might evolve or diminish over time. Improvements observed in the first year do not guarantee sustained value over time. This underscores the need for longitudinal monitoring.

Together, these implications show that value is multidimensional, perspective-dependent and dynamic, which highlights the need for inclusive, interpretative, and longitudinal approaches when assessing the value of care. Therefore, I recommend actively integrating the perspectives of all stakeholders involved. Most importantly, patient representatives need to be involved to ensure that their perspectives are considered during this process. The proposed value-assessment matrix can be a powerful tool to support such collaborative discussions in workshops or co-creation sessions.

Value improvement
Apart from the measurement of value, our study also revealed implications regarding the approach taken to improve the value of care. In our study, the redesign interventions were designed and implemented under the assumption that they could enhance the value of care by improving continuity of care. However, this approach overlooks an important principle of VBHC: to measure and then implement process or organisational changes to improve outcomes. This step is challenging for providers as it requires an understanding of how processes contribute to outcomes [11, 250]. This understanding is crucial to ensure that resources are invested in areas where improvements are most needed and valued by the population.

I therefore recommend value improvement initiatives to start with an analysis of baseline outcomes to identify where improvement is most needed. This exercise requires a point of reference, such as a trend analysis or national benchmarks. This also calls for actively involving patient representatives in identifying improvement priorities to ensure that any initiatives align with outcomes that matter. A good example of an outcomes-first strategy is the Santeon initiative in the Netherlands, where seven hospitals engage in coordinated data collection, continuous benchmarking, clinical process comparison, care pathway optimisation and, consequently, outcome improvement [13]. Another approach described by Depla et al. (2023) involves professionals jointly reviewing aggregated outcome data, discussing cases and identifying improvement opportunities. To make such outcome-first approaches sustainable, I encourage investing in support teams that contain a clinical lead, project leaders and data analysts, since the time constraints on healthcare professionals remain a key barrier [258, 259].

PART 2: REWARDING VALUE

Main findings

Transitioning to a VBHC system requires not only rethinking care delivery but also contextual factors such as provider payment models [28]. Traditional provider payment models, such as fee-for-service, reward volume rather than value. As a result, healthcare providers encounter significant financial disincentives to implementing interventions designed to enhance value, especially if these involve preventing high-cost services or shifting tasks from secondary to primary care, since this can lead to a loss of revenue [233, 234]. As such, payment reform is a critical enabler of further VBHC advancement [28, 61].
In VBHC, bundled payments are advocated as a payment model better that is aligned with value, as these involve a single payment covering all the care activities provided by the care providers involved and are linked to performance

as measured by outcomes important to patients [61]. In theory, this model encourages cost-effective behaviour, improved care coordination and task redistribution [58]. Despite the increased implementation of bundled payments, the evidence of their effectiveness is mixed showing only moderate success [24, 60]. Notably, the outcomes of care are not yet included in most bundled payment models, resulting in a missing link to performance [61]. To more explicitly steer towards value, there is a need to incorporate outcome indicators in payment models. When payment models are at least partly dependent on outcome indicators, we refer to them as outcome-based payment models (OBPMs) [56, 57].

Given the theoretical promise of financial incentives based on outcomes indicators of the care provided, there is a growing interest in developing and implementing OBPMs. Currently, practical experience, especially in the Netherlands, is scarce [57]. Parties face challenges with technical issues, such as limited data availability, as well as cultural issues such as a lack of trust and transparency between involved stakeholders [62–64]. In our study, we aimed to address this gap by experimenting with the design of an OBPM for the redesigned care pathways within the already implemented bundled payment system of the IMCO. The goal was to design a model that explicitly rewards value-improving behaviour. **Chapters 6 and 7** cover this part of the research project.

Chapter 6 is a case study with a predominantly practical nature, describing the development and implementation of the OBPM. The development trajectory is presented in an accessible format to provide practitioners with the tools they need to confront similar problems, and researchers with the valuable insights needed for advancing their understanding of OBPMs. As such, this chapter actively bridges science and practice. In the chapter, we detail, given the savings achieved, how we developed an outcome-based shared-savings model for the GDM care pathway. The model developed consists of two components: (1) a base tariff per patient, determined by the TDABC cost calculation which was included in the overall bundle price; and (2) a shared savings model to distribute the savings between the insurer and the provider. Contingent on meeting an outcomes-based benchmark consisting of a clinical outcome and a patient-reported experience measure, the savings are distributed between the provider and insurer. This model demonstrates how outcomes can be incorporated in provider payment models to reward value-improving behaviour.

Chapter 7 is compiled as a conceptual point-of-view paper. During the development of the OBPM, we realised that payment reform encompasses more than incorporating outcome indicators in the contract and payment model. It requires a cultural change as well, as providers and insurers have to collaborate more intensively and have to operate from a foundation of trust to facilitate

transparency in the contracting practice [62, 63, 244]. Current relationships between providers and insurers are predominantly transactional, governed by formal contracts, which is conceptually defined as *contractual governance* [239]. Such relationships are often characterised by low trust and information asymmetry [236]. As any transition into OBPM adoption requires transparency of the quality and the costs of care, the relationship between providers and insurers needs to develop into a trusting, collaborative one [65], which is conceptually defined as *relational governance* [239]. In this chapter, we argue that OBPMs can only be developed and implemented by effectively combining contractual and relational governance. This combination is effective when the two forms interact in a complementary way, meaning that they reinforce each other's strengths and compensate for the limitations of the other [239, 240]. This viewpoint is substantiated by key insights from our study.

Implications

The findings of the chapters presented in Part 2: 'Rewarding Value', have several implications which are presented below, structured under four categories 'Incentives', 'Inputs', 'Contribution' and 'Governance', followed by associated recommendations.

Incentives

In this study, care pathway redesign served as the medium for developing an OBPM. This approach was chosen to keep the study feasible, manageable and low-risk, allowing for experimentation with OBPM design on a small scale. However, this design choice also introduced complexity. Given that the effects of the redesign on costs and outcomes were unknown in advance, the OBPM could only be developed *after* the intervention had been implemented and evaluated. As a result, the resulting payment model primarily rewards the quality level achieved through the redesign, rather than stimulating *further* improvement across the broader population [55].

This incentive structure differs from models described in previous studies. For example, van Veghel et al. (2018) developed and implemented an OBPM for cardiac interventions that financially rewards measurable quality improvements by providing a bonus for improved outcomes on a timely basis. Such models create incentives for ongoing organisational and process improvements. As a result, a cycle of learning and improvement develops.

While our model represents a step forward in aligning provider payment models with value, it demonstrates the limitations of retrospective, pathway-driven design. To achieve the ultimate goal of continuous improvement for the entire population, future OBPMs should be designed prospectively, to ensure that incentives encourage ongoing learning and improvement.

Inputs
In experimenting with a payment model that is better aligned with value, we explored how cost and outcome data could inform an OBPM. While cost data are critical for determining the value of care, we did not initially wish to incorporate cost indicators in the model. Nevertheless, both the provider and the insurer recognised the importance of understanding the financial impact of care pathway redesign. The TDABC-derived cost data served to quantify the financial impact, namely whether savings or increased expenditure were achieved. Consequently, these data defined the scope of the OBPM.

In our payment model, outcomes were used to measure performance. Critics of OBPMs are cautious about including outcomes in payment models, because some outcomes cannot be directly influenced by providers [260, 261]. However, since our model was developed after implementation and evaluation, it was possible to identify which outcomes had demonstrably improved and thus were appropriate to include as performance indicators.

However, this process also revealed an important tension. The comprehensive value evaluation described in Part I included a broad range of outcomes and indicators, capturing the multidimensional and contextual nature of value. In contrast, the OBPM included only two outcome measures to ensure simplicity and manageability. This necessary simplification highlights a tension in the operationalisation of value in OBPMs.

Contributions
While we achieved our goal of developing a payment model that explicitly rewards value-improving behaviour, the model does not resolve a structural issue resulting from innovating care delivery in the traditional, fragmented care setting with volume-based reimbursements. In this context, a provider who scales down productivity experiences financial loss [234]. In the GDM case, this applied to the internal medicine department, which is not part of the IMCO network. This department delivered fewer consultations after the GDM redesign but was not included in the shared savings model. In this specific instance, the issue was limited because the GDM component represented a small proportion of the hospital's overall budget, and the freed-up capacity was quickly filled by patients on waiting lists. However, if such redesigns were to have a larger financial impact, the payment model would need to be restructured to make these interventions financially attractive to all the involved parties. Our payment model operates most effectively in integrated care settings, such as the IMCO, where all the involved providers can benefit from improvements in care delivery.

In theory, bundled payment models contain incentives for value improvement, as the provider will benefit from creating a larger margin between the bundle tariff and its internal costs [61]. However, the Dutch bundled payment system for maternity care is currently divided into nine sub-bundles, with complex specialty care reimbursed at higher tariffs [262]. While this structure presents progress over fee-for-service payment models, it still creates financial disincentives to improve value when such improvements move across bundle boundaries [82]. Our model helps to overcome this issue by enabling the IMCO and the insurer to share potential savings achieved by preventing the need for specialty care, and, within the IMCO, to distribute these savings among the involved providers. In this way, improving value becomes a joint effort and is rewarded accordingly.

However, integrated structures like the IMCO remain the exception rather than the norm in Dutch maternity care, where both care delivery and payment are predominantly fragmented into two separate tiers [83]. Overcoming this fragmentation is therefore essential for the further advancement of VBHC and the implementation of OBPMs.

Governance
Finally, beyond the technical implications of OBPMs, their successful development and implementation depend on how healthcare insurers and providers govern their relationship [65]. Our study shows that a transition to OBPMs requires an effective combination of contractual and relational governance, in which transparency, trust and formal contracts interact and complement each other.

Transparency in outcome indicators is essential as these provide insight into the quality of the care delivered and should form the foundation of the payment model. However, many healthcare provider-insurer relationships suffer from limited trust and information asymmetry. Building a trust-based relationship is therefore required [244]. Without strengthening the relational governance between insurers and providers, the adoption of OBPMs will remain limited [62].

Recommendations

Building on the previously discussed implications, the following recommendations address how the lessons learnt from our study can inform future policy and practice. Our study demonstrates that payment innovation is possible within current constraints but also exposes the limits of working within these boundaries. Furthermore, the findings show that payment innovation involves more than incorporating outcomes in the payment model, it entails a cultural change as well. Based on this work, I recommend using pathway-driven OBPM designs both strategically and functionally.

- **Strategically**: the study shows that trust, close collaboration, transparency, and a cooperative mindset between providers and insurers, are critical for developing and implementing OBPMs. Provided incorporating outcomes in provider payment models is a shared goal, the pathway-driven approach allows for small-scale experimentation with limited financial risk, which could help in building a trust-based relationship [63].
- **Functionally**: the payment model designed in this study provides a temporary solution for overcoming the immediate financial barriers when redesigning care pathways in integrated care settings with multiple sub-bundles. This approach works best with relatively large, predefined patient groups, such as the gestational diabetes care pathway, as this enables one to detect changes in outcomes [261].

While strategic and functional motivations can be justified, developing separate OBPMs for every redesigned pathway is unlikely to be feasible or efficient. Rather, reimbursement models should operate at a higher level to incentivise and facilitate local care delivery innovations, such as care pathway redesign, rather than being individually tailored to each case. Otherwise, OBPMs risk narrowing attention to specific processes and sub-populations, whereas the broader ambition of VBHC is to incentivise high-value care and continuous improvement using outcome data, across the entire patient population. Furthermore, the administrative burden would increase significantly and hamper further upscaling.

In line with previous scholars, I agree that ensuring that the base payment functions optimally is most important [57, 131]. The Dutch bundled payment system in maternity care has been intensively evaluated. The findings show modest changes in utilisation, slower spending growth, and no substantial changes in outcomes [262, 263]. Rather than abandoning the use of bundled payments based on these results, I recommend a gradual refinement and close monitoring to ensure optimal functioning. A promising route could be consolidating the sub-bundles into a single bundle to reduce the risk of income loss when implementing substantial value improvements. In addition, an outcome-based component could be introduced to directly incentivise high-quality care. Ideally, the selected outcome set should find a balance between feasibility, the diverse nature of value and patient preferences, while ensuring that outcomes remain within the provider's sphere of influence.

LIMITATIONS

Study-specific limitations and suggestions for future research are provided in the individual chapters. Here, I discuss broader limitations regarding the study design. The design was inspired by the principles of action research, which is characterised by its contextual nature, participatory approach, iterative processes, focus on action, and finding solutions to social problems [85, 86]. This approach offers a unique opportunity to thoroughly generate valuable learning directly from practice, but it also presents limitations.

First, regarding the contextual nature, the study was conducted in Dutch maternity care. This setting differs significantly from maternity systems in other countries [66]. Furthermore, even within the Netherlands, the IMCO structure diverges from the far more common form of fragmentated primary and secondary maternity care [83]. These contextual differences limit the generalisability of the findings. Nevertheless, the setting was highly favourable for further advancing VBHC in practice and provided a unique opportunity to address the currently underdeveloped elements of VBHC.

Second, from a philosophy of science perspective, some argue that participatory approaches compromise the validity and reliability of results. In positivist research, objectivity is essential to ensure valid results, and is achieved by isolating the researcher from the phenomenon [264]. From this perspective, the participatory nature of action research threatens objectivity. Action research suggests other ways to achieve validity, namely through openness and equality in relationships between researchers and practitioners and transparency in data collection and interpretation [265, 266]. Nevertheless, close engagement carries the risk of "going native", with the researchers becoming too closely aligned with participants, thereby potentially risking a critical evaluation of study results. In this study, that risk was present, as I sometimes aligned closely with the involved stakeholders' interests. I mitigated this risk by organising separate reflection meetings with the supervising researchers, which is a recommended strategy in action research [267].

Third, action research typically starts with a problem encountered in everyday practice and primarily aims to improve that practice, while also generating insights that inform both practitioners and researchers [86]. This approach differs from studies driven by a clearly defined gap in the academic literature, where the contribution to theory and existing research is more straightforward. When research begins from a practical problem, identifying a suitable scientific gap and situating the study within existing debates requires additional effort from the researcher. This challenge was amplified by the broad nature of the VBHC

paradigm. Consequently, it is possible that some relevant studies have been overlooked. To mitigate this risk, we predominantly relied on highly cited and widely recognised publications to guide our review of the literature.

Lastly, on a more personal note, conducting an action-research-inspired study places additional demands on researchers. As Kislov (2019, p.A5-6) described it, researchers in this position deal with "'Being 'too academic' for practitioners and 'not academic enough' for fellow researchers; Compromising research rigor in order to quickly produce results fed back to non–academic partners; Achieving a balancing act between being critical (in an academic way) and constructive (in a practice–oriented way); Maintaining your own voice while truthfully reflecting the (often conflicting) voices of multiple stakeholders." [267]. I recognise these dilemmas from our own study, and even though this approach places greater demands on researchers, I believe that bridging science and practice is necessary if one is to generate knowledge that is both academically robust and practically relevant.

SUGGESTIONS FOR FUTURE RESEARCH

In the context of **delivering and measuring value**, and specifically assessing the value of care, research should first work towards developing a standardised framework for value assessment. Current studies adopt widely varying approaches, resulting in limited opportunities for comparing value across providers, settings or countries [38]. Such standardisation would enhance comparability of the value of care. Based on insights from this dissertation, it is important that any standard framework also acknowledges the variable and contextual nature of value.

Second, future research should broaden the conceptual scope of value by integrating factors on workforce and environmental sustainability. Studies could explore how these factors can be systematically integrated into value assessments. For example, by reconceptualising them in the form of "costs" or "outcomes", or by applying multi-criteria decision analysis (MCDA) to quantify and weigh these dimensions. Integrating these aspects would more closely align VBHC with the challenges facing contemporary healthcare systems.

Third, research should explore how to adopt a long-term perspective when assessing value. Especially in maternity care, where care pathway improvements can have long-term effects on both maternal and neonatal health and, consequently, on future healthcare utilisation. To fully capture the added value of care pathway improvements, these effects need to be considered. Future research could address this by using claims data. Initiatives such as DIAPER, which is a data

infrastructure that combines maternity care claims data, quality and utilisation of maternity care information and data from municipal registries [268], show the potential of such approaches. If also combined with cost calculations, this would provide a valuable infrastructure for gaining insight into the long-term effects of value improving initiatives.

In the context of **rewarding value**, future research should examine the impact of OBPMs on organisational performance and clinical practice. OBPMs are built on the theoretical assumption that linking reimbursement to patient outcomes motivates providers to improve care quality. However, it is still unclear what happens after the implementation of an OBPM, and how these incentives play out. This requires a longitudinal or mixed-methods form of research. For instance, the realist evaluation approach can be a powerful method to evaluate complex interventions that seem to work, but lack an understanding of how they work, why they work, whom they work for and under what circumstances [269].
Lastly, as this dissertation argues that the successful uptake of OBPMs depends on the governance nature of the healthcare insurer and provider relationship, further empirical research is needed to understand how this transition can be supported. Currently, studies applying relational and contractual governance frameworks to healthcare purchasing are scarce. Longitudinal qualitative case studies would be particularly valuable for identifying what both parties need to build trust, transparency, and alignment throughout this transition.

CONCLUDING REMARKS

VBHC is often presented as a critical intervention that can ensure the sustainability ('health') of healthcare systems. Moving towards a value-based system requires a fundamental reorganisation of how care is organised, measured and reimbursed. Despite its apparent global popularity, VBHC has only been selectively and partially implemented. In particular, the costs and reimbursement dimensions have so far been largely neglected. This dissertation sought to address this gap by examining how cost and outcome data could be systematically collected and integrated to measure the value of care and inform the development of an OBPM.

The research demonstrates that, while the logic of combining cost and outcome data to determine value appears straightforward, its practical application in maternity care is complex. The collection of cost data is challenged by the highly variable and unpredictable nature of maternity care, and, furthermore, the use of outcome indicators is complicated by the diversity of what stakeholders consider valuable. Interpreting these various inputs to determine the value of care is further complicated by the fact that value is multidimensional, perspective-dependent and dynamic. Moreover, translating these insights into an OBPM to reward value-

improving behaviour proved possible, albeit constrained by contextual realities. The design process revealed that incorporating health outcomes into contracting practices is not merely a technical challenge but also a cultural one, requiring trust, collaboration and a willingness to change.

This dissertation shows that the translation of VBHC principles into practice reveals that the strategy presumes certain contextual, structural and cultural conditions that are often absent. As a complete reorganisation of healthcare systems seems unlikely in the near future, VBHC will continue to be implemented within the existing context with its implicit boundaries and will therefore not realise its full potential. Consequently, whether VBHC is indeed the intervention that is capable of "saving" our entire healthcare system remains an empirical question. Nevertheless, this should not lead to withdrawal or apprehension. Rather, attempts to implement VBHC expose where the system falls short and highlights where meaningful change is needed. This can help in identifying what changes are necessary for our healthcare system to become future-proof.

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Summary
Samenvatting

INTRODUCTION

This dissertation examines how the concept of Value-Based Healthcare (VBHC) can be translated from principle into practice. Using integrated maternity care in the Netherlands as a case, it explores how VBHC can be advanced across three dimensions: delivering, measuring and rewarding value. VBHC was introduced in 2006 as a strategy for a more sustainable use of scarce healthcare resources by prioritising both the quality and the efficiency of care. Within this paradigm, 'value' is defined as the outcomes achieved relative to the costs incurred in delivering those outcomes. Outcomes include clinical outcomes, patient-reported outcome measures (PROMs) and patient-reported experience measures (PREMs). Importantly, these outcomes matter to patients. The costs are those related to all the resources used to deliver these outcomes, e.g. personnel, medicine, materials, equipment and overheads. What is essential is that these costs cover the full cycle of care, from diagnosis to cure. Maximising value creation in healthcare requires a fundamental restructuring of how healthcare is organised, measured and reimbursed.

There is still only a limited understanding of how the VBHC principles can be fully translated into practice. This dissertation aims to address this gap. The research was conducted in the context of integrated maternity care in the Netherlands, and carried out in close collaboration with a leading integrated maternity care organisation (IMCO) and a healthcare insurer. IMCOs are unique legal entities functioning as network organisations of primary and secondary maternity care providers. The providers in these networks share an electronic patient record, collaborate in integrated care pathways and are paid through a bundled payment system. As such, the IMCO structure provides favourable conditions for advancing VBHC. Together, the studies reported in this dissertation explore how VBHC can be advanced through redesigned care delivery, systematic measurement of costs and outcomes, and the development of a provider payment model that is better aligned with value.

Chapter 1 introduces the VBHC concept and reviews its implementation to date. It shows that, although VBHC has gained global traction, its adoption has been selective and partial. In particular, the cost dimension remains underdeveloped: there is only limited insight into the actual costs of care, how these relate to outcomes, and reimbursement models that reward value-improving behaviour remain underdeveloped. Consequently, this dissertation investigates how cost and outcome data can be systematically collected and integrated to measure the value of care and inform the design of an outcome-based payment model (OBPM).

The dissertation is structured in two parts. Part I (Chapters 2–5) presents studies on delivering and measuring value, including methodological and empirical work on collecting, analysing and integrating cost and outcome data. Part II (Chapters 6–7) focuses on rewarding value, featuring a case study of OBPM design and a critical reflection on the role of governance throughout this process.

PART I: DELIVERING AND MEASURING VALUE

Delivering and measuring value relates to efforts to improve patient value by redesigning and implementing new care pathways and evaluating these interventions based on VBHC principles. During the research, two maternity care pathways were optimised. The first redesign addressed the care for gestational diabetes mellitus (GDM), which is a common pregnancy complication, and the second concerned the introduction of nitrous oxide as a form of pain relief during labour. Both interventions aimed to improve the continuity of care and deliver the right care in the right place.

Chapter 2 presents a methodological contribution by applying Time-Driven Activity-Based Costing (TDABC) to calculate healthcare costs. TDABC is a cost accounting method that is often proposed as the gold standard for calculating healthcare costs because it enables a pragmatic but accurate inclusion of all costs associated with the supplied resources. In particular, it provides a feasible method to include indirect costs (such as overheads), which although significant often remain unaddressed. Despite the method's potential, practical applications remain limited. This chapter details the steps, decisions and lessons learnt from implementing TDABC in an integrated maternity care setting to calculate cost changes after care pathway redesign. It offers guidance for future studies aiming to measure cost changes following value-improving interventions.

Chapters 3 and 4 present value-based evaluations of the two redesigned maternity care pathways. Both studies employed a prospective pre- and post-intervention cohort design, combining cost data (using TDABC) with clinical- and patient-reported outcomes and process indicators to determine whether patient value had improved.

In the GDM pathway (**Chapter 3**), low-complexity GDM care activities were shifted from the hospital's internal medicine department to the IMCO, aiming to improve continuity of care. The results demonstrate enhanced patient value: after redesign, there were fewer referrals to internal medicine, there was a reduced need for insulin therapy, patient experiences improved significantly, and substantial cost savings were achieved while clinical outcomes remained stable.

In the nitrous oxide pathway (**Chapter 4**), community midwives were trained to administer nitrous oxide in an outpatient setting to reduce referrals for obstetrician-led pain relief (epidural and remifentanil) in the hospital. The introduction of this new care pathway led to a moderate improvement in patient value: obstetrician-led pain relief use was reduced, patient experiences improved moderately, and overall costs remained stable. Clinical outcomes were largely unchanged.

To better understand how patient value can be further improved in the future, it is important to gain insight into what matters to women during the maternity care pathway and which aspects of care are most valued. **Chapter 5** applies Q-methodology to explore women's preferences for care delivery during labour and birth. Four main viewpoints emerged: (1) the personal approach, (2) the empowering approach, (3) the expert approach, and (4) the needs-based approach. These findings highlight that women's preferences are diverse and multidimensional, providing insights into what constitutes value from their perspective. This knowledge is essential for (re)designing care pathways that reflect their priorities.

PART II: REWARDING VALUE

Part II explores how provider payment models can be developed to reward value-improving behaviour. Transitioning to a VBHC system requires rethinking not only care delivery, but also provider payment models. Traditional volume-based payment models, such as fee-for-service, create financial disincentives to invest in VBHC when this involves preventing high-cost services or shifting tasks from secondary to primary care, since this can lead to a loss of revenue. As such, payment reform is a critical enabler of VBHC. During the research project, the IMCO and the insurer collaborated to design an OBPM for the redesigned care pathways to reward such value-improving behaviour. In an OBPM, payment (partly) depends on performance as measured by outcomes of care.

Chapter 6 presents a case study on the development and implementation of the OBPM. The model was specifically designed for the GDM care pathway, given the savings achieved. The payment model consisted of two components: (1) a base tariff per patient, based on TDABC-calculated costs, which was included in the bundled payment, and (2) a shared-savings mechanism that distributed cost savings between the IMCO and the insurer, contingent on meeting an outcome-based benchmark. This benchmark consists of a GDM-related clinical outcome and a PREM. The study demonstrates that it is possible to integrate outcomes into provider payment models so as to reward value-improving behaviour, but also reveals practical challenges in translating the VBHC principles into a payment model.

Chapter 7 shifts attention from the technical conditions needed to upscale OBPMs to more cultural aspects, particularly the healthcare provider – insurer relationship. It critically examines what type of governance is necessary for developing and implementing OBPMs in practice. It argues that successful implementation depends on an effective combination of contractual governance (formal agreements, rules, and incentives) and relational governance (trust, transparency, and shared norms). If these mechanisms interact in a complementary manner, they create a suitable environment for value-based payment innovation. Drawing on insights from the case study, this chapter illustrates how this interplay in practice shaped the design and implementation of the OBPM, showing that rewarding value is not merely a technical exercise but also a process of building trust and alignment between stakeholders.

CONCLUSIONS

Chapter 8 synthesises the overarching implications, recommendations, and limitations. First, regarding delivering and measuring value, the dissertation concludes that measuring value is not as straightforward as often presented. Collecting, analysing and interpreting cost and outcome data in maternity care is challenging. Moreover, value in maternity care is a multidimensional, perspective-dependent, and dynamic construct. As such, value cannot be fully captured through static metrics. Rather, value assessment requires an inclusive, interpretative and longitudinal approach. Furthermore, future VBHC initiatives are encouraged to adopt an outcomes-first approach to direct resources towards areas where improvement is most needed and meaningful to the treated population.

Second, regarding rewarding value, the findings show that translating VBHC principles into payment innovation is possible but contextually constrained. The OBPM developed is most effective in integrated care settings and can be used strategically as well as functionally. While the OBPM designed in this study represents a step forward in innovative payment models, it also highlights the importance of developing overarching reimbursement models that facilitate value creation across care pathways. Moreover, the process of incorporating outcomes into contracts has not only technical but also cultural aspects, as it requires trust, collaboration and a willingness among stakeholders to invest in new governance approaches.

Overall, this dissertation demonstrates that advancing VBHC in practice depends on the specific contextual, structural and cultural conditions. As long as VBHC is only implemented within the boundaries of the current healthcare system, its full

potential will remain unrealised. However, the efforts reported here reveal where the system falls short and point towards where changes are required for a more future-proof healthcare system.

SAMENVATTING

Met dit proefschrift is onderzocht hoe het concept van Waardegedreven Zorg (WGZ) in de praktijk kan worden bevorderd. WGZ stelt de waarde voor de patiënt centraal: het streven is naar betere gezondheidsuitkomsten en ervaringen tegen lagere kosten.

Als casus is gekozen voor de integrale geboortezorg in Nederland, waarin zorgverleners uit de eerste en tweede lijn – zoals verloskundigen, gynaecologen en kraamzorg – samenwerken binnen een Integrale Geboortezorg Organisatie (IGO) om de zorg rondom zwangerschap en geboorte beter te coördineren. IGO's zijn in Nederland uniek omdat de aanbieders binnen de IGO een elektronisch patiëntendossier delen, in integrale zorgpaden samenwerken en worden betaald via integrale bekostiging. Deze context biedt bij uitstek een geschikte setting om te onderzoeken hoe WGZ verder vooruitgeholpen kan worden zodat de waarde van zorg verhoogd kan worden.

Het onderzoek richt zich op drie dimensies van WGZ: het leveren, meten en belonen van waarde. In het eerste deel zijn twee zorgpaden herontworpen om de waarde van zorg te verhogen: één voor vrouwen met zwangerschapsdiabetes en één voor vrouwen die gebruik maken van pijnstilling tijdens de bevalling. Beide interventies hadden als doel om de continuïteit van zorg te verbeteren en de juiste zorg op de juiste plek te bieden. Beide interventies zijn geëvalueerd aan de hand van kosten en uitkomsteninformatie volgens de principes van WGZ. De evaluaties laten zien dat het herontwerpen van zorg de ervaringen van vrouwen kan verbeteren en, in het geval van zwangerschapsdiabetes, ook kan leiden tot een kostenbesparing zonder negatieve effecten op klinische uitkomsten.

Het tweede deel van het proefschrift richt zich op de vraag hoe zorgaanbieders beloond kunnen worden voor het verhogen van waarde. Hiervoor is een uitkomstgericht bekostigingsmodel ontwikkeld, waarin de IGO een basisvergoeding ontvangt en een deel van de gerealiseerde besparingen mag behouden wanneer zij goede uitkomsten behalen. De resultaten tonen aan dat het mogelijk is om uitkomsten te integreren in de bekostiging van zorg, maar dat dit vraagt om vertrouwen, transparantie en een nieuwe vorm van samenwerking tussen zorgverzekeraars en zorgaanbieders.

Dit proefschrift laat zien dat het bevorderen van WGZ in de praktijk haalbaar is, maar wordt beperkt door contextuele, structurele en culturele factoren. Binnen de huidige kaders blijft het potentieel beperkt. De studies maken duidelijk waar aanpassingen nodig zijn om de zorg toekomstbestendig te maken.

Dankwoord PhD Portfolio

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PHD PORTFOLIO

Peer-reviewed publications

- **van den Berg, M.**, van Elten, H., Spaan, J., Franx, A., & Ahaus, K. (2024). Exploring cost changes with time-driven activity-based costing after service delivery redesign in Dutch maternity care. Health Services Management Research, 38(4), 219–227.
- **van den Berg, M.**, Spaan, J., van der Kooy, J., et al. (2025). Value-based evaluation of gestational diabetes mellitus care pathway redesign by using cost and outcome data. BMC Pregnancy and Childbirth, 25, 608.
- **van den Berg, M.**, van der Voorden, M., Bossenbroek, E., Ernst-Smelt, H., Ahaus, K., & Franx, A. (2025). Women's preferences for care delivery during labour and birth in Dutch hospitals: A Q-methodology study. Women and Birth, 38(1), 101842.
- **van den Berg, M.**, van Elten, H.J., Spaan, J., Klerkx, M., Nijenhuis, L., Franx, A., Ahaus, K. (2025). Successful Design of an Outcome-Based Payment Model for Maternity Care. NEJM Catalyst, 6(9).
- **van den Berg, M.** , van Elten, H., Ahaus, K. (2026) Beyond the contract: The role of relational and contractual governance in outcome-based payment models. International Journal of Health Policy and Management;15:9433.

Papers in progress

- **van den Berg, M**., Spaan, J., van der Kooy, J., et al. (under review). Value-based evaluation of nitrous oxide for pain relief during labour by using cost and outcome data: A prospective, observational cohort study. *Manuscript under review*.

Research projects

- 'BUZZ-2: Bekostigen Uitkomsten Zorg van de Zwangere' (Paying for Maternity Care Outcomes), funded by ZonMw (Project Number 516008006)
- 'Wensen en Grenzen, Toekomstbestendige Geboortezorg' (Future-Proof Maternity Care: Preferences and Limits), funded by ZonMw (Project Number 10100162210010)

International academic conference presentations

Conference	Presentation	Year
International Consortium for Health Outcomes Measurement	Oral, poster	2023
European Health Management Association Conference	Oral	2023

Teaching activities

Course	Role	Years
Bachelor Course Management van Zorginstellingen	Tutor	2021
Bachelor Thesis Health Care Management	Supervisor	2021
Pre-master Financial Management	Tutor	2023
Bachelor course Value-Based Health Care	Lecture	2024

Courses

Course	Institution
ISS - Professionalism and integrity in research	Erasmus Graduate School of Social Science and the Humanities (EGSH)
ISS - How to manage your PhD Project	
ISS - How to get your article published	
ISS - Shut up and write	
Public Speaking	
Philosophising your research	
Microlab: Group dynamics	Risbo
Microlab: How to supervise thesis students	
Workshop Stand up and Reach out	Erasmus School of Health Policy and Management (ESHPM)
English academic writing for PhD candidates	EUR Language & Training Centre
Data Management Plan Workshop	Erasmus Medical Center
Proefschriftschrijfdriedaagse	Louter Promoveren
Career Swifters	THRIVE Institute
Women in Academia	Erasmus Centre for Women and Organisations (ECWO)

Appendix

APPENDIX 1

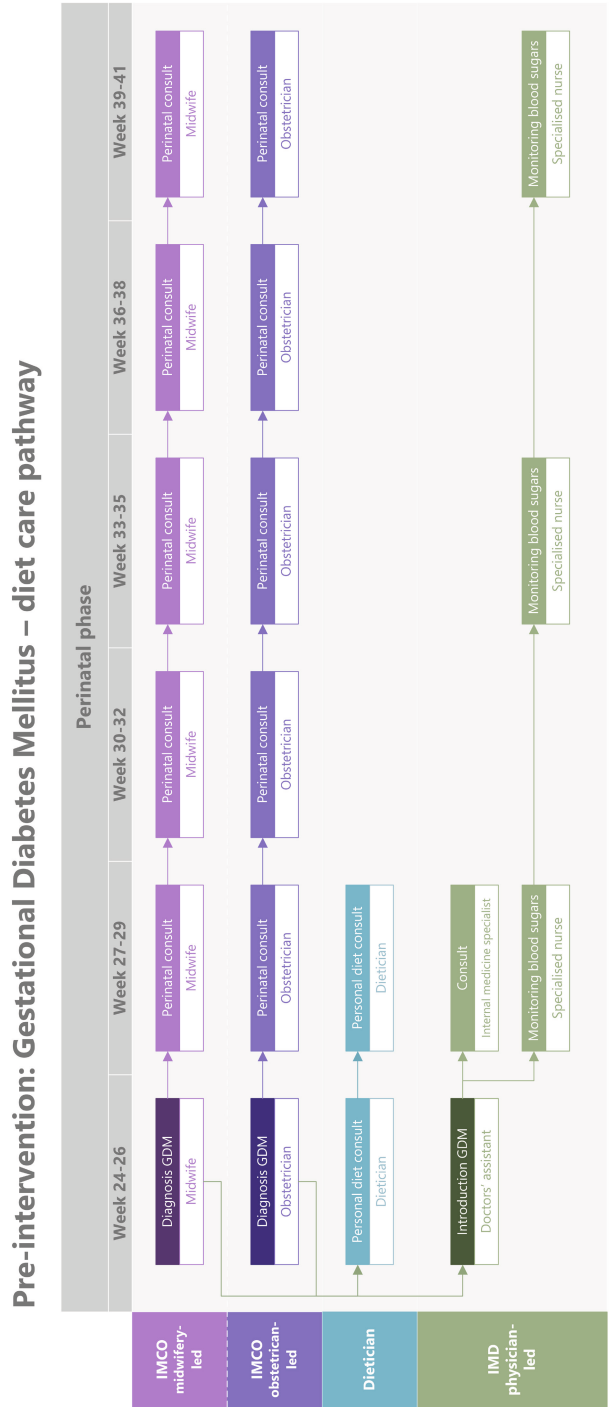
		Pre-Intervention			Post-intervention					
Domains	**Items per domain**	**N**	**M**	**SD**	**N**	**M**	**SD**	**p**	**Mean Difference**	**Cohen's D**
Respect	Did your healthcare professionals treat you with respect?	100	3.87	0.37	137	3.92	0.27	.254	0.050	0.2
	Did your healthcare professionals treat you kindly?	100	3.80	0.45	137	3.85	0.40	.400	0.047	0.1
	Did you feel that you could tell your healthcare professionals everything?	100	3.56	0.72	137	3.67	0.56	.196	0.112	0.2
	Did you receive personal attention from your healthcare professionals?	100	3.51	0.69	137	3.74	0.51	.005	0.235	0.4
	Did your healthcare professionals take your wishes and customs regarding pregnancy into account?	100	3.64	0.63	137	3.71	0.58	.392	0.068	0.1
Autonomy	Did you participate in deciding on your treatment for gestational diabetes if possible?	100	2.91	1.10	137	3.16	0.96	.064	0.251	0.2
	Were you sufficiently involved in discussing blood sugar values?	100	3.21	1.04	137	3.52	0.75	.012	0.308	0.3
	Were you able to refuse a proposed treatment for your gestational diabetes?	100	2.47	1.20	137	2.88	1.16	.008	0.413	0.3
Confidentiality	Did your healthcare professionals take your privacy into account?	100	3.83	0.43	137	3.93	0.28	.034	0.104	0.3
	Did your healthcare professionals handle your medical information and records carefully?	100	3.81	0.42	137	3.93	0.25	.009	0.124	0.4
	Could you discuss important matters with your healthcare professionals without others hearing?	100	3.85	0.44	137	3.92	0.27	.160	0.070	0.2
Communication	Did your healthcare professionals answer your questions about gestational diabetes?	100	3.65	0.61	137	3.73	0.49	.282	0.080	0.1
	Did you understand the explanation from your dietitian?	100	3.83	0.43	137	3.75	0.54	.215	-0.078	-0.2
	Did you understand the explanation from your healthcare professional about gestational diabetes?	100	3.69	0.56	137	3.71	0.54	.804	0.018	0.0
	Did you understand the explanation from your healthcare professionals about monitoring blood sugars?	100	3.74	0.56	137	3.72	0.58	.744	-0.025	0.0
	Did your healthcare professionals give the same advice?	100	3.35	0.80	137	3.34	0.78	.891	-0.014	0.0
	Did your healthcare professional have enough time to explain the different treatment options?	100	3.40	0.95	137	3.45	0.82	.696	0.045	0.1

	Did your healthcare professional tell you what to do if your blood sugar was too high or too low?	100	3.57	0.81	137	3.43	0.85	.203	-0.139	-0.2
Information	How did you find the clarity of the written information (information leaflet) about gestational diabetes?	95	4.08	0.66	129	4.15	0.66	.482	0.063	0.1
	How did you find the clarity of the animation about gestational diabetes?	50	3.90	0.65	86	4.12	0.60	.052	0.216	0.3
	How did you find the user-friendliness of the app for tracking your blood sugar values?	23	4.17	0.65	109	4.30	0.73	.433	0.129	0.2
Prompt attention	Did your healthcare professionals have time for you if you asked for it?	100	3.48	0.70	137	3.64	0.55	.057	0.162	0.3
	Could you quickly make an appointment if it was urgent?	100	3.34	0.81	137	3.64	0.63	.002	0.302	0.4
	Could you easily make an appointment if it was not urgent?	100	3.29	0.83	137	3.53	0.62	.015	0.243	0.3
	Were you quickly seen at your appointment?	100	3.26	0.79	137	3.47	0.65	.023	0.214	0.3
	Was your dietitian easily accessible?	96	3.63	0.58	130	3.52	0.74	.249	-0.102	-0.2
	Was your healthcare professional for gestational diabetes easily accessible?	100	3.38	0.79	137	3.63	0.64	.011	0.248	0.3
Social consideration	Did your healthcare professionals take your situation into account, such as your family, work, and daily activities?	100	2.71	0.98	137	3.11	0.98	.002	0.399	0.4
	Did you feel supported by your partner, family, or others?	100	3.61	0.63	137	3.64	0.62	.761	0.025	0.0
	Were your partner or family involved in the care for your gestational diabetes?	100	1.55	0.97	137	2.34	1.26	.000	0.793	0.7
Basic amenities	Were the waiting room and consultation room in the midwifery practice comfortable?	84	4.36	0.63	131	4.43	0.66	.438	0.070	0.1
	Were the waiting room and consultation room in the hospital comfortable?	78	4.01	0.75	110	4.13	0.83	.331	0.114	0.1
	How did you find the availability of glucose strips and glucose meters?	100	4.06	0.85	137	4.14	0.91	.500	0.079	0.1
Choice and continuity	Did your healthcare professionals give the same advice about your gestational diabetes?	100	3.38	0.74	137	3.40	0.76	.828	0.021	0.0
	When there was a change of healthcare professionals, was your new healthcare professional well informed about your situation?	100	3.31	0.90	137	3.43	0.81	.280	0.121	0.1
	Was it always clear who was in charge of the care you received for gestational diabetes?	100	2.67	1.15	137	3.23	1.00	.000	0.556	0.5
	Was your health and that of your baby monitored?	100	3.38	0.94	137	3.58	0.70	.069	0.204	0.2

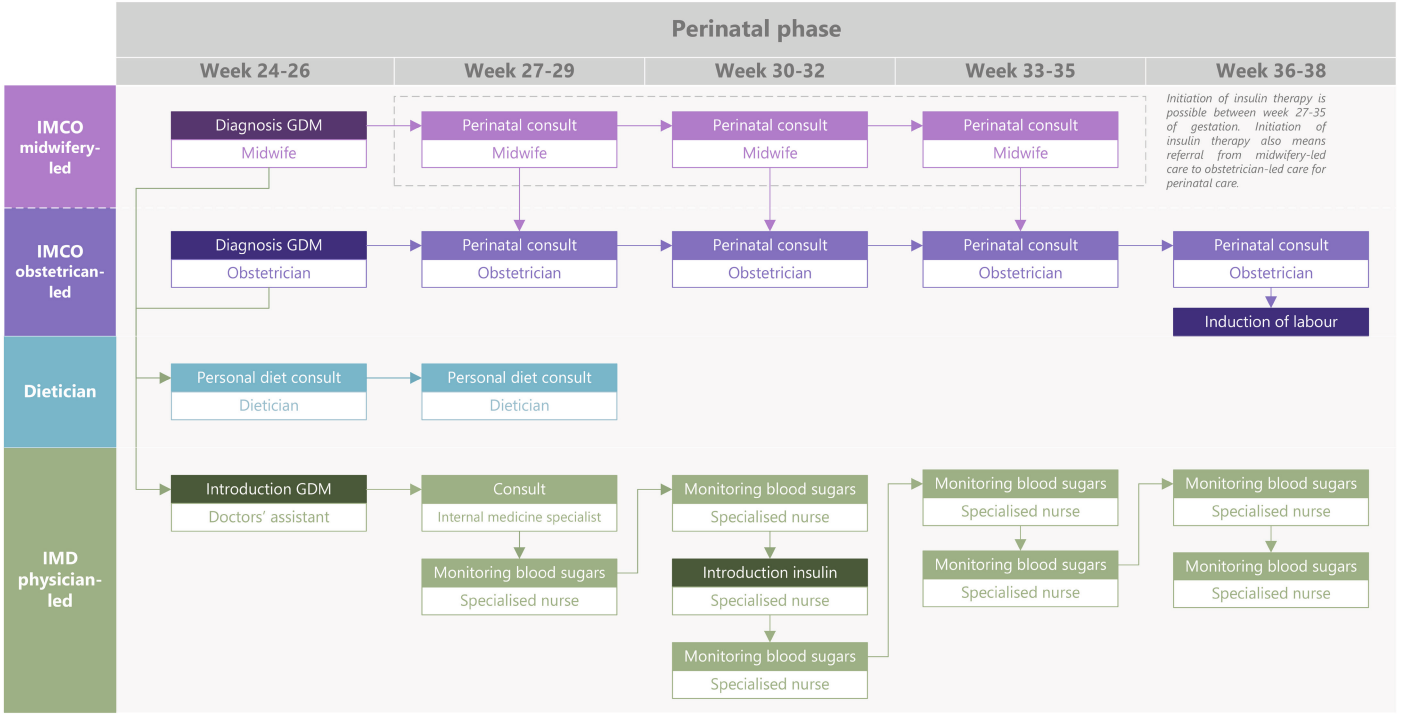
APPENDIX 2

	Non-responders	Responders	p
Participants, *n*	504 (100)	166 (100)	
Age, *mean*	32	33	.015
Para, *n* (%)			
Nulli	204 (40.5)	82 (49.4)	.044
Ethnic background, *n* (%)			
Other than Caucasian	153 (30.4)	15 (9.0)	<.001
Proficiency (speaking) Dutch, *n* (%)			
No	61 (12.1)	5 (3.0)	<.001
Neighborhood, *n* (%)			
Underprivileged	55 (10.9)	11 (6.6)	.108
Body mass index, *n* (%)			
<25	168 (33.4)	47 (28.3)	.304
25-29,99	163 (32.4)	52 (31.3)	
>30	172 (34.2)	67 (40.4)	

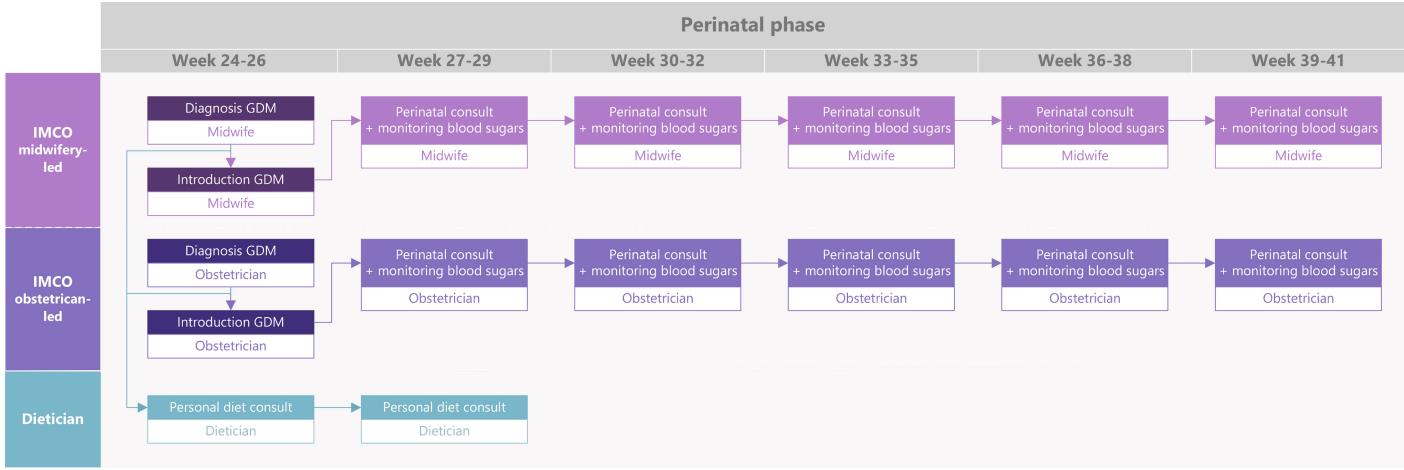
APPENDIX 3


Pre-intervention: Gestational Diabetes Mellitus – diet care pathway
Perinatal phase
Week 24-26
Week 27-29
Week 30-32
Week 33-35
Week 36-38
Week 39-41
IMCO midwifery-led
IMCO obstetrician-led
Dietician
IMD physician-led
Diagnosis GDM
Midwife
Perinatal consult
Midwife
Diagnosis GDM
Obstetrician
Perinatal consult
Obstetrician
Personal diet consult
Dietician
Personal diet consult
Dietician
Introduction GDM
Doctors' assistant
Consult
Internal medicine specialist
Monitoring blood sugars
Specialised nurse
Monitoring blood sugars
Specialised nurse

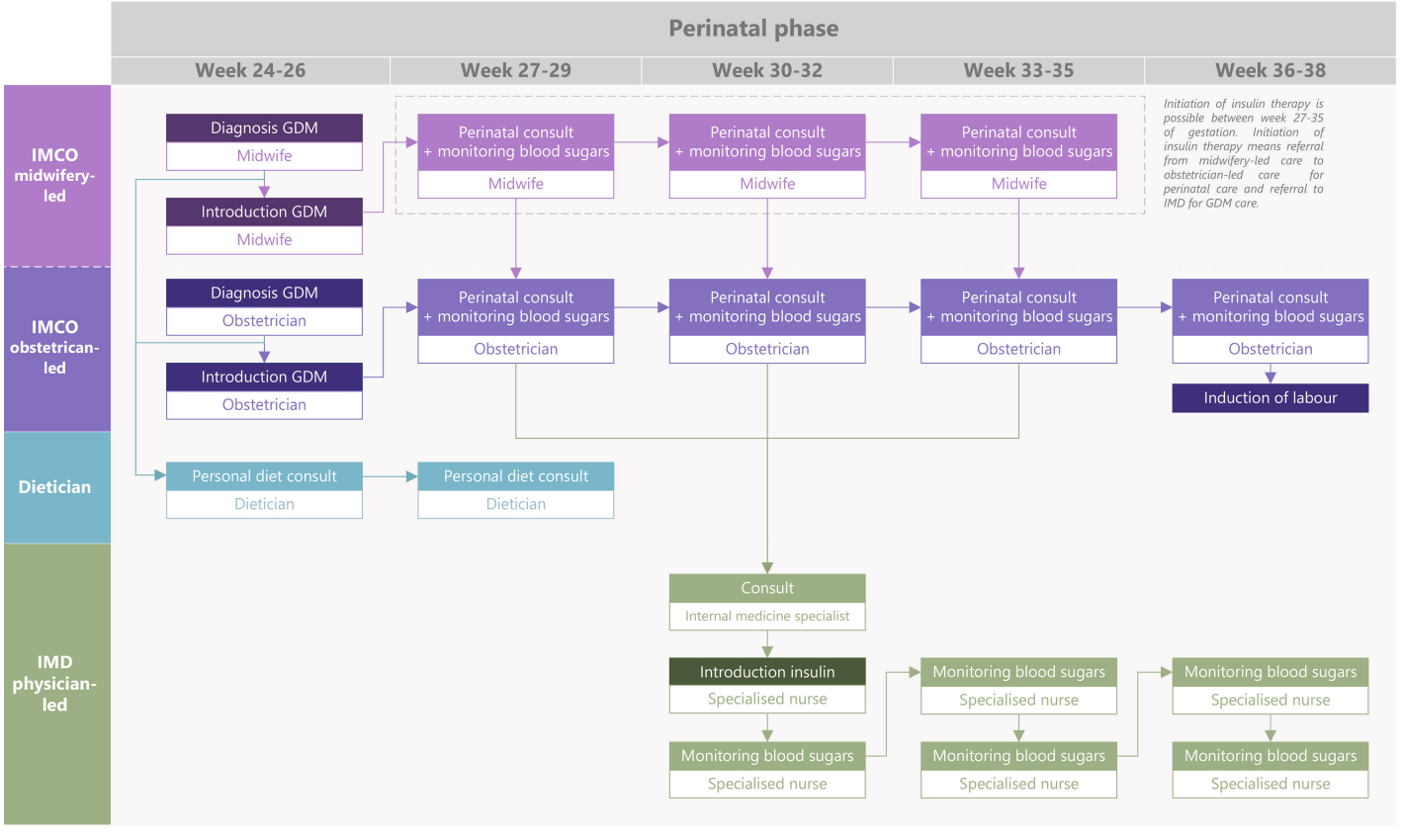
Pre-intervention: Gestational Diabetes Mellitus – insulin care pathway



Post-intervention: Gestational Diabetes Mellitus – diet care pathway



Post-intervention: Gestational Diabetes Mellitus – insulin care pathway



APPENDIX 4

	A. Nitrous oxide	B. Remifentanil		C. Epidural		D. No pain relief	
	N=52	N=152	p (A vs. B)	N=819	p (A vs. C)	N=2083	p (A vs. D)
Demographic outcome							
Primiparous, n (%)	24 (46)	72 (47)	.88	688 (84)	<.001	769 (37)	.17
Maternal clinical outcomes							
Delivery mode, n (%)							
Instrumental	1 (2)	17 (11)	-	157 (19)	-	97 (5)	-
Caesarean	2 (4)	10 (7)	-	152 (19)	-	35 (2)	-
Augmentation of labour, n (%)	6 (12)	83 (55)	<.001	661 (81)	<.001	223 (11)	.75
Haemorrhage > 1000 ml, n (%)	6 (12)	14 (9)	.63	61 (7)	.28	159 (8)	.30
Fever during birth, n (%)	1 (2)	0 (0)	-	47 (6)	-	8 (1)	-
Neonatal clinical outcomes							
Apgar <7 at 5 min, n (%)	0 (0)	2 (1)	-	22 (3)	-	19 (1)	-
Perinatal death, n (%)	0 (0)	0 (0)	-	1 (0)	-	1 (0)	-
Paediatrics involvement, n (%)	15 (29)	88 (58)	<.001	554 (68)	<.001	693 (33)	.50
Admission neonatal unit, n (%)	9 (17)	53 (35)	.02	442 (54)	<.001	398 (19)	.74

Chi-square test

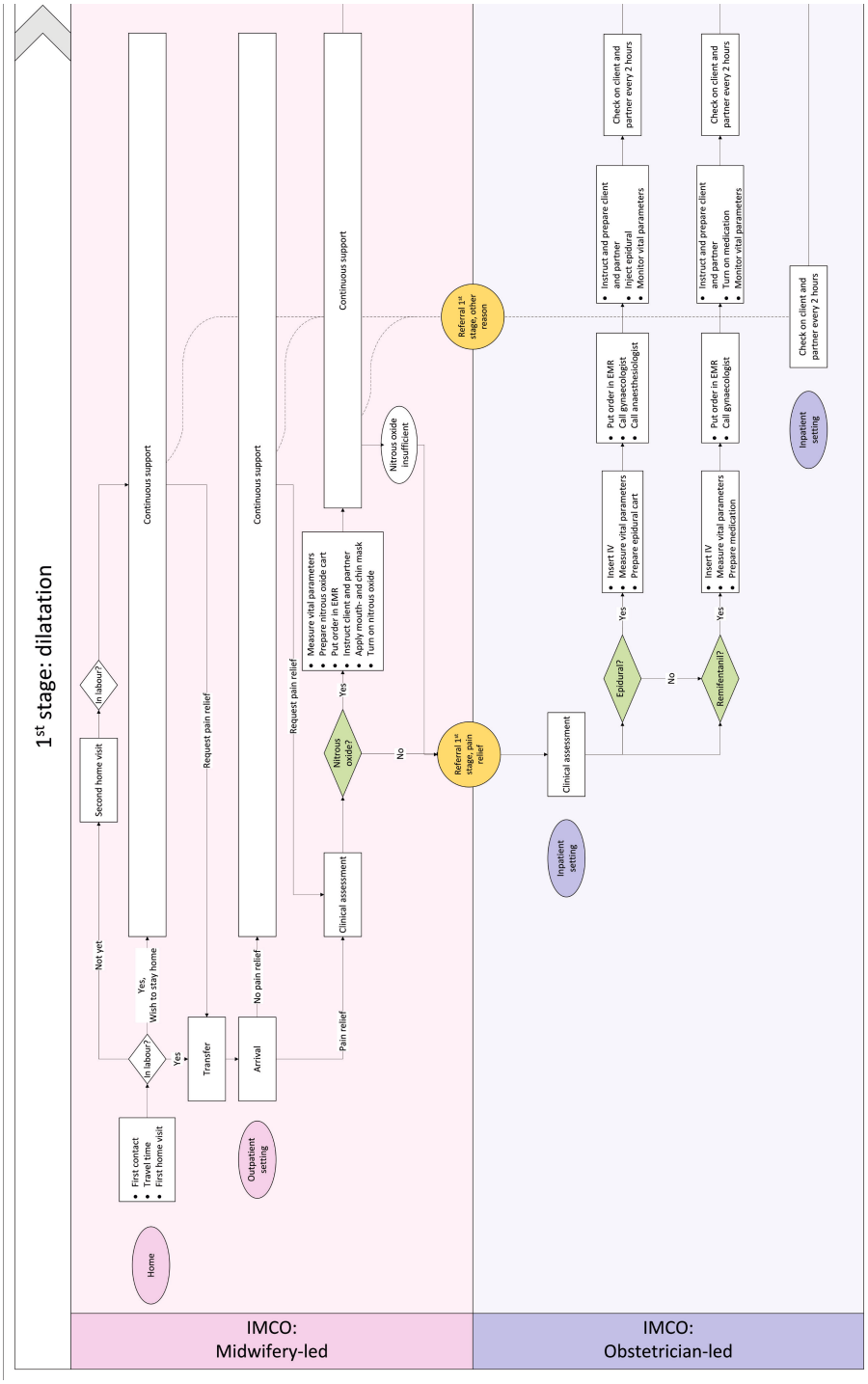
APPENDIX 5

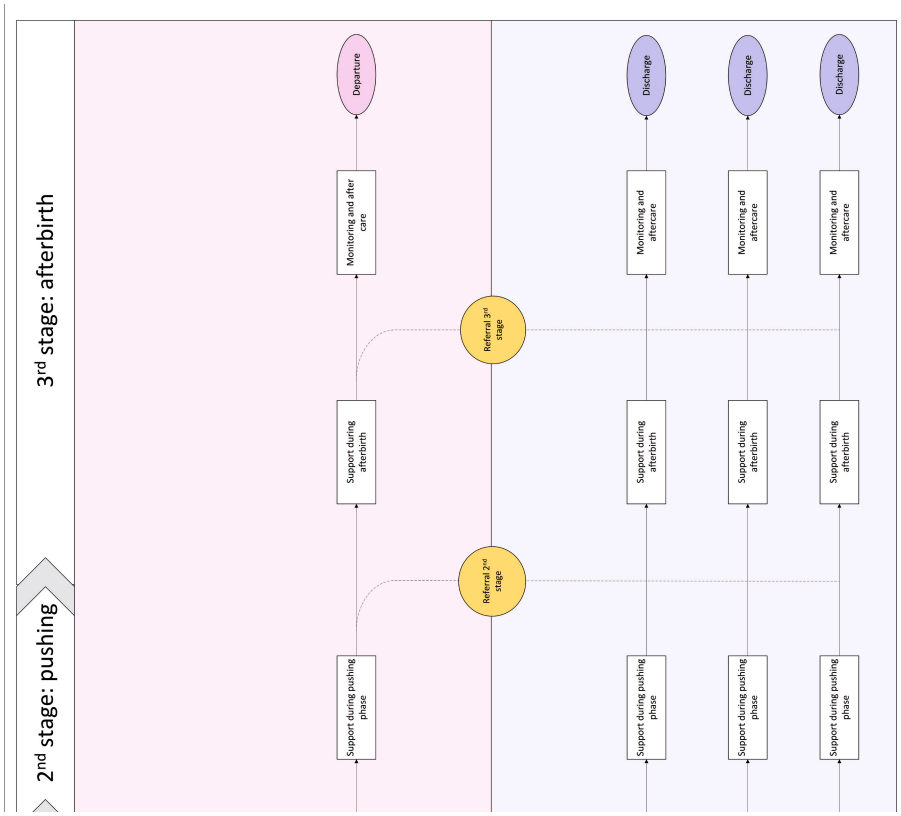
	A. Nitrous oxide	B. Remifentanil		C. Epidural		D. No pain relief	
	N=17 (33%)	N=15 (10%)	p (A vs. B)	N=122 (15%)	p (A vs. C)	N=304 (15%)	p (A vs. D)
Satisfaction with care (mean, SD)	**3,82 ± 0,4**	**3,64 ± 0,6**	**.339**	**3,23 ± 0,9**	**<.001**	**3,60 ± 0,6**	**.040**
BSS-R (mean, SD)							
T) Total score	30 ± 5,5	30 ± 4,1	.823	27 ± 5,6	.024	32 ± 5,2	.286
1) I came through childbirth virtually unscathed (+)	3,2 ± 0,7	3,4 ± 0,6	.364	2,8 ± 1,0	.090	3,5 ± 0,7	.070
2) I thought my labour was excessively long (-)	2,3 ± 1,3	2,2 ± 1,3	.838	1,1 ± 1,1	<.001	3 ± 1,1	.012
3) The delivery room staff encouraged me to take decisions about how I wanted my birth to progress (+)	3,5 ± 0,5	3,1 ± 0,8	.096	3,0 ± 0,9	.035	3,2 ± 0,8	.199
4) I felt very anxious during my labour and birth (-)	2,3 ± 1,2	2,0 ± 0,9	.438	2,2 ± 1,1	.623	2,7 ± 1,1	.136
5) I felt well supported by staff during my labour and birth (+)	3,6 ± 0,5	3,5 ± 0,6	.789	3,2 ± 0,8	.082	3,5 ± 0,6	.775
6) The staff communicated well with me during labour (+)	3,7 ± 0,5	3,6 ± 0,6	.592	3,3 ± 0,7	.017	3,5 ± 0,7	.214
7) I found giving birth a distressing experience (-)	2,8 ± 1,1	2,7 ± 1,0	.811	2,5 ± 1,2	.335	3,1 ± 1,0	.182
8) I felt out of control during my birth experience (-)	2,5 ± 1,2	2,4 ± 1,1	.759	2,2 ± 1,2	.267	2,7 ± 1,1	.501
9) I was not distressed at all during labour (+)	2,4 ± 1,2	3,0 ± 0,7	.158	2,5 ± 1,1	.883	2,9 ± 1,1	.128
10) The (delivery) room was clean and hygienic (+)	3,7 ± 0,6	3,6 ± 0,5	.828	3,6 ± 0,5	.881	3,6 ± 0,5	.635

Independent samples T-test

(+) Item positively framed [4=agree, 0=disagree], (-) Item negatively framed [4=disagree, 0=agree], higher scores indicate more favourable outcomes.

APPENDIX 6


1st stage: dilatation
IMCO: Midwifery-led
IMCO: Obstetrician-led
Home
First contact
Travel time
First home visit
In labour?
Yes, Wish to stay home
Not yet
Second home visit
In labour?
Transfer
Arrival
Outpatient setting
Continuous support
Request pain relief
No pain relief
Pain relief
Clinical assessment
Nitrous oxide?
Yes
No
Measure vital parameters
Prepare nitrous oxide cart
Put order in EMR
Instruct client and partner
Apply nasal mask and mask
Turn on nitrous oxide
Nitrous oxide insufficient
Referral 1st stage, pain relief
Referral 1st stage, other reason
Inpatient setting
Clinical assessment
Epidural?
Yes
No
Remifentanil?
Yes
Insert IV
Measure vital parameters
Prepare epidural cart
Put order in EMR
Call gynaecologist
Call anaesthesiologist
Instruct and prepare client and partner
Insert epidural
Monitor vital parameters
Check on client and partner every 2 hours
Insert IV
Measure vital parameters
Prepare medication
Put order in EMR
Call gynaecologist
Instruct and prepare client and partner
Turn on medication
Monitor vital parameters
Check on client and partner every 2 hours
Check on client and partner every 2 hours
Inpatient setting


2nd stage: pushing
3rd stage: afterbirth
Support during pushing phase
Support during afterbirth
Monitoring and after care
Departure
Referal 2nd stage
Referal 3rd stage
Support during pushing phase
Support during afterbirth
Monitoring and aftercare
Discharge
Support during pushing phase
Support during afterbirth
Monitoring and aftercare
Discharge
Support during pushing phase
Support during afterbirth
Monitoring and aftercare
Discharge