From Department of Learning, Informatics, Management and Ethics

TIPPING THE SCALE OF RESOURCES

– DE-IMPLEMENTATION OF LOW-VALUE CARE FROM AN OPERANT PERSPECTIVE

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Karolinska Institutet

Stockholm 2023

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Published by Karolinska Institutet.
Printed by Universitetsservice US-AB, 2023
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ISBN 978-91-8016-944-8
Cover illustration: Saga Karlén

Tipping the scale of resources – De-implementation of low-value care from an operant perspective

THESIS FOR DOCTORAL DEGREE (Ph.D.)

By

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The thesis will be defended in public at Inghesalen, Widerströmska huset, Tomtebodavägen 18, on March 13th at 9:00 AM.

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To my family, for helping me remember what is important in life. And for putting up with me.

POPULAR SCIENCE SUMMARY OF THE THESIS

Resources within health care are often being used for examinations and treatment that do not benefit patients. This is called low-value care (LVC). Common examples of LVC include laboratory tests, imaging, and X-ray examinations where the information gained is not relevant for patient treatment. Other examples are prescription of antibiotics where there is no indication and prescription of a group of medications that are potentially harmful to patients above 65 years of age. Several guidelines have been developed to reduce LVC, but this does not seem to be sufficient to solve the problem. This thesis is about factors influencing use of LVC and how strategies for de-implementation, i.e., reducing the use of LVC, can be developed. Four studies have been conducted to understand the issue better. The first study was an overview of the literature on factors that influence health care professionals to use LVC and on de-implementation, the process of reducing LVC. The second study was a qualitative study where physicians within primary care were asked to discuss factors influencing their use of LVC. The third study was also a qualitative study, where managers and other key stakeholders within primary care were interviewed on what strategies were being used from a management perspective to reduce use of LVC and the fourth study was an intervention study where two strategies were developed and implemented to reduce unnecessary use of X-ray examinations to diagnose knee arthrosis.

The findings from the studies showed that many factors influenced use of LVC. These could be divided into factors external to the health care organization (e.g., a primary care organization or hospital), factors within the organization that created processes influencing use of LVC, and factors in the immediate environment of individual health care professionals. Health care organizations can be influenced to use LVC when this results in payment or reduced costs. Processes within organizations such as lack of continuity and standard ordering sets can also lead to LVC. Individuals may feel encouraged to use LVC through perceived pressure from others such as patients or other health care professionals, but also by their own desire to do something for the patients, even when the best course of action is doing nothing. To balance these factors, health care professionals could benefit from clearer guidelines on what practices are LVC and feedback on how well they follow them. Organizational processes can be designed to reduce use of LVC. Examples of this include removing practices from standard ordering sets or improving continuity between patients and their health care providers. Strategies external to the health care organizations could be clarifying that they are expected to continuously work with processes to reduce use of LVC. Furthermore, some financial strategies could benefit from an overview to remove financial incentives that may inadvertently increase use of LVC.

POPULÄRVETENSKAPLIG SAMMANFATTNING (SVENSKA)

Hälso- och sjukvårdens resurser används ibland till undersökningar och behandlingar som inte är till nytta för patienterna. Detta kallas på engelska för low-value care och på svenska för lågvärdevård. Exempel på lågvärdevård kan vara onödiga laboratorieprover, röntgen- och bildundersökningar där informationen från provsvaren och undersökningarna inte är nödvändig för att hjälpa patienterna med deras symptom. Andra exempel är förskrivning av antibiotika för patienter där det inte finns någon klinisk indikation för sådan behandling eller av en grupp läkemedel som är olämplig för personer över 65 år gamla. Ett stort antal riktlinjer har tagits fram både internationellt och i Sverige, men det verkar inte räcka för att komma till rätta med problemet. Den här avhandlingen handlar om vad som påverkar användandet av lågvärdevård och hur man kan ta fram strategier för att de-implementera, det vill säga minska förekomsten av lågvärdevård. Fyra studier har genomförts. Den första var en litteraturgenomgång av studier som undersöker faktorer som bidrar till användande och de-implementering av lågvärdevård. Den andra var en kvalitativ studie där läkare inom primärvården fått diskutera vilka faktorer som gör att de använder lågvärdevård. Den tredje var en kvalitativ studie där chefer och andra nyckelpersoner inom primärvården intervjuades om vad det finns för styrning och uppföljning som har till syfte att minska användandet av lågvärdevård och hur de upplever att de strategierna fungerar. Den fjärde var en interventionsstudie där två strategier utvecklades och implementerades för att minska användande av onödig röntgen vid knäledsartros.

Slutsatsen från avhandlingen var att det finns en mängd faktorer som påverkar användandet av lågvärdevård. Dessa kunde delas upp i faktorer som påverkar hela sjukvårdsorganisationer, såsom en primärvårdsorganisation eller ett sjukhus, faktorer inom organisationen, såsom processer och rutiner som påverkar användandet av lågvärdevård, och faktorer i den närmaste miljön kring enskilda sjukvårdsanställd som leder till användande av lågvärdevård. Hälso- och sjukvårdsorganisationer kan påverkas att använda lågvärdevård när det är kopplat till ekonomisk ersättning eller besparingar. Processer inom en organisation såsom brist på kontinuitet eller standardbeställningar av prover kan påverka. Enskilda sjukvårdsanställda kan påverkas av en upplevd press från patienter och annan sjukvårdspersonal att använda lågvärdevård, men också av en egen önskan om att göra någonting för patienten även när rekommendationen utifrån riktlinjerna är att inte göra någonting. Personalen kan därför ha nytta av tydligare riktlinjer kring vad som räknas som lågvärdevård och återkoppling på hur väl de följer dessa. Processer inom organisationen kan behöva förändras för att minska användandet av lågvärdevård exempelvis genom att förbättra kontinuiteten mellan sjukvårdspersonal och patient eller ta bort onödiga laboratorieprov från standardbeställningar. Faktorer utanför hälso- och sjukvårdsorganisationen som kan påverkas kan vara att ställa krav om att de kontinuerligt ska arbeta för att minska sitt användande av lågvärdevård och stödja personalen i detta. Dessutom kan en del av den ekonomiska styrningen behöva ses över eftersom den oavsiktligt kan leda till ökat användande av lågvärdevård.

ABSTRACT

Background: The overarching goal within the field of implementation science is to generate knowledge that can contribute to bridging the gap between research and practice. Most studies focus on how to implement research findings, with the aim of using evidence-based interventions. However, it has increasingly been recognized that working in accordance with evidence not only requires implementation of research findings but also the "opposite," i.e., de-implementation of so called low-value care (LVC).

LVC makes up between 11 and 30 percent of all care provided, depending on type of LVC and study population. To address the issue of LVC, several guidelines have been published – but this does not seem to be sufficient to influence its use. Like implementation, de-implementation of LVC requires behavior changes among professionals within health care. The difference is that whereas implementation most often involves increasing certain behaviors, de-implementation involves both decreasing and increasing behaviors. In implementation, strategies are designed by identifying factors influencing behavior, identifying theoretically or empirically validated change methods to address those factors, and developing or choosing strategies that use those methods. However, it is not known what factors influence use and de-implementation of LVC. It is also not known if the same theories, models, and frameworks are relevant for de-implementation as for implementation or what de-implementation strategies are effective. Applied behavior analysis (ABA) is the only theory within psychology and sociology that discriminates between processes for increasing and decreasing behavior suggesting that this could be a valuable theory to use to understand factors influencing the use of LVC and to design de-implementation strategies.

The overarching aim of the thesis was to generate new knowledge and insights concerning use and de-implementation of LVC. To achieve this aim, the four studies of the thesis have had the following objectives:

- To identify factors that influence use and de-implementation of LVC (Study I).
- To understand why physicians in primary care use LVC (Study II).
- To understand which management strategies are being used to de-implement LVC and possible mechanisms for those strategies using concepts from ABA (Study III).
- To demonstrate how ABA can be used to understand contingencies related to use of LVC and how de-implementation strategies can be developed by arranging alternative contingencies (Study IV).

Method: Four studies were conducted: one scoping review, one qualitative study with physicians within primary care, using a grounded theory approach, one qualitative study with managers and key stakeholders within primary care on management strategies for de-implementation, and one intervention study where two strategies for de-implementation were developed based on applied behavior analysis to reduce use of unnecessary X-ray examinations for knee arthrosis.

Results: The scoping review showed factors influencing the use and de-implementation of LVC related to both the outer and the inner context, the professionals, the LVC itself, the process of de-implementation, and the patients and their relatives. The qualitative study showed three factors that influenced use of LVC: uncertainty and disagreement about what not to do, perceived pressure from others, and a desire to do something for the patients. The qualitative study on management strategies showed eight different management strategies: financial systems, scorecards, quality assurance systems, guidelines, lectures, local process strategies, discussions about guidelines, and local lectures. The intervention study provided an analysis of factors influencing the unnecessary use of X-ray examinations for knee arthrosis: a rule stating that X-ray examinations are beneficial for diagnosing arthrosis and patients expressing expectations of being referred to an X-ray examination and showing appreciation for being referred for one. Two strategies were developed: A lecture aiming at introducing a new rule stating that X-ray examinations are not beneficial for diagnosing arthrosis and feedback meetings providing consequences encouraging diagnosis of arthrosis without the use of an X-ray examination. The strategies were perceived as helpful by the physicians who participated in the study.

Conclusion: This thesis has provided knowledge about factors that influenced use of LVC as well as an understanding of how strategies for de-implementation could be developed. Factors external to the health care organizations seem to create a demand for LVC, mostly inadvertently through financial conditions that provide payment or reduce costs in relation to LVC. Factors within health care organizations, such as lack of continuity and standard ordering sets for laboratory tests, can also influence use of LVC, as can factors in the immediate environment of the individual health care professionals, such as problems with guidelines, pressure from others, and a desire to do something for patients.

Thus far, de-implementation strategies developed at a local level seem to have the greatest potential to influence use of LVC. These strategies can be better adapted to local contextual factors. One way of doing so is by using ABA to understand local contextual factors or in ABA terms – contingencies. Strategies that influence processes, such as improved continuity or removing unnecessary laboratory tests from standard ordering sets, also have the potential to reduce use of LVC. Lastly, there is a lack of strategies involving factors external to the health care organizations, even though these factors influence use of LVC.

Keywords: Low-value care, De-implementation, primary care, physicians, applied behavior analysis.

LIST OF SCIENTIFIC PAPERS

This thesis is based on the following papers, which are referred to in the text by Roman numerals.

I. Augustsson H, **Ingvarsson S**, Nilsen P, von Thiele Schwarz U, Muli I, Dervish J, Hasson H. Determinants for the use and de-implementation of low-value care in health care: a scoping review. Implementation Science Communications. 2021;2(1):13–13.

II. **Ingvarsson S,** Augustsson H, Hasson H, Nilsen P, von Thiele Schwarz U, von Knorring M. Why do they do it? A grounded theory study of the use of low-value care among primary health care physicians. Implementation Science: IS. 2020;15(1):1–93.

III. **Ingvarsson S**., Hasson H, Augustsson H, Nilsen P, von Thiele Schwarz U, Sandaker I. Management strategies to de-implement low-value care—an applied behavior analysis. Implementation Science Communication; 3:69 (2022).

IV. **Ingvarsson S**, Sandaker I, Nilsen P, Hasson H, Augustsson H, von Thiele Schwarz, U. Strategies to de-implement low-value care – an applied behavior analysis using single case design. *Manuscript submitted*.

CONTENTS

LIST OF ABBREVIATIONS

LVC	Low-value care
ABA	Applied behavior analysis
BSA	Behavior systems analysis

LIST OF DEFINITIONS

Low-value care	Practices within health care that lack clinical effectiveness, are not supported by adequate evidence, and have a poor risk-benefit profile
De-implementation	The process of reducing use of low-value care
Operant learning theory	Theory originally developed by B.F. Skinner focusing on how factors in the environment influence human behavior
Applied behavior analysis	Practical application of operant learning theory
Organizational behavior management	Applied behavior analysis within an organizational context
Behavior systems analysis	Applied behavior analysis with a systems perspective
Knee arthrosis	Degeneration of cartilage within the knee capsule resulting in pain and problems with mobility

1 PREFACE

Growing up with parents who were both teachers, asking and debating scientific questions has always been important in my home. What support do we have for the conclusions we draw? Do we really know that this is the case? Such discussions were not uncommon around the dinner table. When I started my education to become a psychologist at Stockholm University, I struggled with understanding how some of the theories used had been developed and evaluated. In the final years of the education, when cognitive behavioral therapy was introduced as a method for treating psychiatric disorders, I finally encountered something that I felt made sense. The methods used to evaluate the theoretical underpinnings of the treatment, as well as the treatment results, resonated well with my perspective on science. Furthermore, in my training, I got to experience firsthand how my patients were helped by the methods. Noticing improvements and receiving appreciation from the patients was an amazing experience and something that I have continued to strive for during my entire career. The chance to make a difference. To influence people's lives for the better.

I got my psychologist degree and after a short time working within psychiatry, I joined a company which supported organizations in improving their work environment and their employees' mental health. It became apparent to me how much an employee's health was influenced by their workplace. Based on my previous positive experiences with cognitive behavior therapy for individuals, I wanted to learn a method for improving the work environment based on the same theoretical approach. That was when I discovered organizational behavior management, an organizational approach based on operant learning theory or applied behavior analysis as it is usually called nowadays. This was the second time that I encountered a theory or method that made sense and I again got the opportunity to experience how people's work situations could be improved through use of a scientific method. I changed track in my career and began to focus solely on work with improving organizations and helping managers improve their leadership. To learn more, I read scientific journals on the topic and attended international scientific conferences. I also got the opportunity to teach the method to psychology students at several universities.

When I started as a Ph D student, in a project focusing on de-implementation of low-value care, it felt natural to continue to use the method that I had then been using for almost two decades in my career as a psychologist. A method that had been used for similar challenges within organizations. That is, changing behaviors, implementing new ways of working or reducing behaviors that were not beneficial for the employees or the organization.

I have learned a lot during my doctoral studies, both regarding the theories, models, and frameworks traditionally used within the scientific field of implementation science and regarding how to provide a convincing rationale for using a theory not commonly used in that field. Ultimately, I hope that this thesis will provide a valuable contribution, both to the field of implementation science, thanks to its somewhat new perspective on why health care

professionals use low-value care and how strategies can be designed, and to the field of applied behavior analysis, regarding application of the theory within a scientific field that also deals with behavior change.

2 INTRODUCTION

The overarching goal within the field of implementation science is to generate knowledge that can contribute to bridging the gap between research and practice. Most of the studies focus on how to implement research findings into real-world practice, with the aim of using evidence-based interventions (Eccles & Mittman, 2006). However, it has increasingly been recognized that working evidence-based not only requires implementation of research findings – but also the "opposite," i.e., de-implementation of so-called low-value care (LVC) (Foy et al., 2015).

There are numerous definitions of LVC. One commonly used definition, from the National Institute for Health and Care Excellence, describes LVC as practices which are 1) "not clinically effective (and therefore not cost effective)," 2) "have a poor risk-benefit profile," or are 3) "not supported by adequate evidence" (Garner & Littlejohns, 2011). Examples of LVC related to all three parts of the definition can be found:

Lack of effectiveness involves patients receiving practices that cost money for society without being helpful. Examples include laboratory tests where the results are not informative related to a patient's symptoms or diagnosis (Bejjanki et al., 2018), prescriptions of antibiotics for viral infections (Craddock et al., 2020), and cortisone inhalers for mild chronic obstructive pulmonary lung disease (Dalbak et al., 2013). Reducing the use of such practices would enable better use of the resources within health care, i.e., for evidence-based practices.

Examples of LVC with a poor risk-benefit profile include unnecessary imaging, which is not only costly but can lead to an increased risk for developing cancer due to radiation exposure (de Gonzalez et al., 2010). Another example often mentioned in the literature is the unnecessary use of urine catheters, increasing the risk of urinary tract infections (Warren, 2001). Yet another example is inappropriate medication to the elderly, which can cause negative health effects, such as the use of benzodiazepines with a resulting increased risk of fall accidents (Christian et al., 2004). Reducing such practices would limit the potential health risks for patients.

Practices not supported by adequate evidence include those that have had minor benefits in smaller studies but that have not been verified in larger studies or meta-analyses or those for which studies show mixed results. One example of this is the cardiac stress test (Gertz et al., 2016). Reducing such practices would ensure that patients are receiving the best possible care.

LVC can also have negative effects on society. One example of this is the over prescription of antibiotics. This causes antibiotic resistance which in the long term will undermine the ability to fight infectious diseases (US Department of Health and Human Services, 2013). Antibiotics are often overprescribed to patients with viral infections where the treatment has no effect (Gonzales et al., 2001). Other examples include usage of broad-spectrum antibiotics where narrow-spectrum antibiotics should be used (Steinman et al., 2003) and using antibiotics for bacteria in cases where there are no health benefits for the patients. Another

example of this type of LVC is the prescription of malaria medication. There is a similar threat as for antibiotics, that the parasite develops resistance to antimalarial medication and jeopardizes the health of the local populations (Hastings & Watkins, 2005). Patients with fever and malaria-like symptoms receive malaria medication without further testing, despite guidelines recommending that treatment be based on a diagnostic test that verifies that the patient is suffering from malaria (Ansah et al., 2010). Reducing such practices would not only be helpful for the patients, who would avoid unnecessary treatments but could also limit the negative impact on society of treatment-resistant bacteria and parasites.

One complicating factor related to LVC is that few practices can be considered of low value to *all* patients. For example, computer tomography is relevant for severe, but not minor, head trauma (Engineer et al., 2018; Jagoda MD et al., 2008), antibiotics are relevant for pneumonia, but not for upper respiratory tract infections (Magin et al., 2018), vitamin D tests are relevant for rickets, but not for being tired (Vugt et al., 2021)). This means that one cannot simply remove low-value practices from the health care system since they are considered evidence-based in some cases. Instead, there is a need for more information on factors influencing use of LVC and on how de-implementation can be performed.

3 BACKGROUND

3.1 DEFINITIONS AND TERMINOLOGY FOR LVC AND DE-IMPLEMENTATION

The topic of LVC has a long history within many clinical areas, ranging from microbiological research concerning antimicrobial resistance to geriatric medicine research on potentially inappropriate medication for the elderly. The various clinical research areas often use different terminologies and publish in a broad range of journals. This makes the research field of LVC difficult to review, summarize, and synthesize for more general conclusions. The term "low-value care" has been used in implementation science but is only one of many different terms used to describe the phenomenon. Other terms include "unnecessary care" (e.g., Hong et al., 2017), "inappropriate care" (e.g., Singh et al., 2016), "over-use" (e.g., Kachalia et al., 2015), "over-diagnosis" (e.g., Kwon et al., 2016), "potentially inappropriate care" (e.g., Schubert et al., 2013), and "ineffective care" (e.g., Scherer et al., 2013).

Further complicating the study of LVC is the fact that different authors define the same term differently. For instance, LVC has been defined as limited "net benefit, which takes into account the likelihood of benefit for a specific population, the size of potential benefits or harm, existing alternatives, and costs" (Colla et al., 2017) and "potential for harm exceed[ing] the possible benefit" (Chassin, M. R., & Galvin, 1998). I will use the National Institute for Health and Care Excellence's definition of LVC in this thesis, with LVC being practices that are "not clinically effective (and therefore not cost effective)," "have a poor risk-benefit profile," and/or are "not supported by adequate evidence."

The same confusion regarding terminology exists for the term de-implementation. A scoping review (Niven et al., 2015) found no less than 43 different terms describing the process of reducing use of LVC. The authors of the review chose to use the term "de-adoption" defined as "the discontinuation of a clinical practice after it was previously adopted." The most common term found in the review was "disinvest." Other examples of terms were "decreased use," "discontinue," "abandon," "reassess," "obsolete," "medical reversal," and "de-list." Among the 109 articles found in the review, the term "de-implementation" was used in only four.

The term "disinvest" can be described as the withdrawing of resources from practices (Elshaug et al., 2007). "De-implementation" has been defined as the abandonment of medical procedures (Prasad & Ioannidis, 2014). In an article by Van Bodegom et al. (2017), the authors argued for a distinction between the different terms, where decreased use and withdrawal only suggest a direction, without any described activities. "Undiffusion," "discontinuance," and "de-adoption" were mentioned as processes planned by a clinician and "disinvest" and "de-implement" as managed processes that would require various activities. Davidoff (2015) instead suggest the term "undiffuse" as the best, since it could be seen as a mirror image of the term "diffuse" suggested by Rogers et al. (2019).

In implementation science, the term “de-implementation” has gained increasing acceptance. Therefore, I will adopt this as the main term in this text, using the definitions of Van Bodegom et al. (2017), according to whom de-implementation involves a structured and planned process using a set of activities to reduce or stop use of LVC. It is noteworthy that this definition includes two outcomes (reducing and stopping). This is appropriate, since not all practices labelled as LVC are of low value to all patients, as previously mentioned.

3.2 PREVALENCE OF LVC

LVC makes up a considerable part of health care: somewhere between 11 and 30 percent of all care provided (Badgery-Parker et al., 2019; Braithwaite et al., 2020; Niven et al., 2015), depending on type of LVC and study population. Twelve to fifteen percent of patients receive at least one LVC during the course of a year (Charlesworth et al., 2016). A total of 72 percent of physicians in one study stated that they delivered a practice considered to be LVC each week (Research/Communication, 2014). Thus, LVC is prevalent and reducing its use is important for patients and health systems alike. According to an OECD rapport, the prevalence of LVC in Europe is not yet fully quantified (Publishing, 2017), but it is considered a sizeable problem warranting its own section in the report on wasteful spending within health care.

In all the guidelines on LVC, the focus is on a combination of factors, both reducing costs and using resources based on the best available evidence. However, it should be noted that LVC does not have to be expensive practices. An analysis of health care spending in the US in 2014 concluded that low-cost LVC was delivered far more frequently than costly LVC practices, but added up to a far larger part of the total amount of spending (65% versus 35%) (Mafi et al., 2017). One example of high-volume spending is low-cost preoperative laboratory testing for low-risk patients undergoing low-risk surgery (McWilliams & Schwartz, 2017).

One challenge in studying the prevalence of LVC is a lack of consensus on how to measure prevalence. Three different types of prevalence measures have been proposed (Chalmers et al., 2017): prevalence based on a patient group that runs the risk of receiving a specific practice (e.g., non-indicated imaging for patients with low-back pain), on an entire patient population (e.g., non-indicated imaging for patients with low-back pain out of all patients covered by the insurance Medicare), or on a service (e.g., non-indicated imaging for patients with low-back pain out of all imaging for low-back pain). The suggestion is to use all three types of prevalence figures if possible and, if not, to clearly state which types of calculations have been used, to make it easier to understand any differences in prevalence between studies.

Another aspect of prevalence measures is that some practices are listed as LVC for certain patient groups, but not for all. The most common way of measuring prevalence of LVC is using a so-called indirect measure or volume, which translates to the total number of times a practice is used, whereas a direct measure or value translates to how many patients have

received a practice they should not have received. The most correct way to measure prevalence would be with a direct measure, but such measures rely on an evaluation of the unique clinical circumstances of each eligible patient and are much more complicated to access than indirect measures (Baker et al., 2013).

In Sweden, studies on prevalence of LVC are limited. One exception is data on antibiotic resistance, where Sweden has shown a low use in comparison with other European countries (European Centre for Disease Prevention and Control., 2021) and over time has reduced such use (Veterinary & Institute, 2021). There have also been ambitions to improve the de-implementation of LVC practices, starting around 2010 (Roback et al., 2016), mainly with the goal of reducing health care-related costs.

One challenge in studying the prevalence of LVC in Sweden is the lack of specific data. In a report by the Swedish Agency for Health and Care Services Analysis from 2015 (*Lång Väg till patientnytta – en uppföljning av nationella riktlinjers inverkan på vården i ett decentraliserat system*, 2015), the prevalence of do-not-do practices was measured. Do-not-do practices (in Swedish: "icke-göra", practices that are advised against using for a specific patient population) have been defined by the National Board of Health and Welfare in their guidelines. Out of the 214 practices in the list, only six could be evaluated. The others lacked indicators in clinical databases. Out of the six practices, only one showed any improvement, i.e., the use of that practice decreased after it being recommended against. There were also some indications that practices that were listed as do-not-do in the national guidelines issued by the National Board of Health and Welfare had increased in the preceding years (*Lång väg till patientnytta – en uppföljning av nationella riktlinjers inverkan på vården i ett decentraliserat system*, 2015).

3.3 GUIDELINES

Several guidelines have been published to describe practices defined as LVC and address this issue. The Choosing Wisely campaign was initiated in the US by the physician Howard Brody in 2010, as part of the Obama administration's Affordable Care Act (Brody, 2010) and underscoring the medical societies' ethical responsibilities to limit the costs of health care. The Choosing Wisely guidelines list the top five diagnostic tests or procedures that are commonly ordered within each specialty, but that are expensive and do not, according to current available evidence, provide any benefits for patients. The article by Brody inspired medical societies in the US and around the globe, with more than 550 recommendations having been published, and Choosing Wisely being spread to more than 20 countries (ABIM Foundation, 2020).

Similarly, the National Institute for Health and Care Excellence in the United Kingdom, besides issuing guidelines on the best available evidence, also provides guidance on practices that they recommend should be discontinued completely or should not be used routinely via so-called do-not-do recommendations, with the ambition to reduce practices that "do not provide value for money" (Donaldsson, 2005).

In Sweden, as previously mentioned, the National Board of Health and Welfare regularly publishes national guidelines for management of different diagnoses. These guidelines include a ranking system for different practices ranging from 1 (highly recommended) to 10 (least recommended) with the addition of the categories "research only" (for practices that should not be routinely used but can be used for research purposes to further knowledge on their effects) and "do-not-do." In December 2021, they also published a compilation of the 71 most common practices categorized as do-not-do. Before that, health care professionals had to sift through all the guidelines to find which practices were defined as do-not-do. Regardless, publishing guidelines does not seem to be sufficient to influence use of LVC (Rosenberg et al., 2015).

3.4 STRATEGIES FOR DE-IMPLEMENTATION OF LVC

Implementation strategies has been defined as methods or techniques used to enhance the adoption, implementation, and sustainability of a clinical program or practice (Curran et al., 2012). Many studies have used similar strategies to de-implement LVC as have been used to implement new practices (Ingvarsson et al., 2022). One of the most common strategies is training and educating stakeholders, which includes development of information materials to specific target groups and providing interactive training. Other common strategies are to use evaluative and iterative strategies, for instance regularly reviewing the prevalence of LVC and providing feedback on LVC use.

Many studies have used a combination of strategies for de-implementation (Raudasoja et al., 2022), an approach which shows promising results (Colla et al., 2017). For example, feedback to health care providers may be combined with education targeting the providers and/or the patients (e.g., Chinnaiyan et al., 2012). However, there is limited information on which strategies or which combination of strategies is most effective (Alishahi Tabriz et al., 2022; Colla et al., 2017; Rietbergen et al., 2020).

Within the field of implementation, there is a hypothesis that implementation strategies are more effective if tailored based on local contextual factors (Waltz et al., 2019). This involves: 1) identifying factors influencing behavior, 2) identifying theoretically or empirically validated change methods to address those factors, and 3) developing or choosing strategies that use those methods (Kok et al., 2016). The influencing factors for implementation have been described in various theories, frameworks, and models (Nilsen, 2015) such as the Promoting Action on Research Implementation in Health Services (Rycroft-Malone, 2010), the Consolidated Framework for Implementation Research (Damschroder et al., 2009, 2022), The Theoretical Domains Framework (Michie et al., 2005), the COM-B (Fishbein et al., 2000), and the Knowledge to Action Framework (Graham & Tetroe, 2010). However, it is not known if the same theories, models, and frameworks are relevant for de-implementation. Furthermore, there is a need to know more about which factors influence use and de-implementation of LVC. There is also a lack of studies where de-implementation strategies have been chosen based on an analysis of factors that influence use of LVC (Alishahi Tabriz et al., 2022; Ingvarsson et al., 2022). To further the understanding of implementation

strategies, increasing attention has been directed at studying not only which strategies are effective, but also which mechanisms underlie the strategies (Lewis et al., 2018, 2020). A mechanism describes how a strategy influences events or processes that produce a change (Kazdin, 2008). Similarly, understanding which factors influence use of LVC could promote identification of strategies that target those factors, which could be a way to improve the effectiveness of de-implementation strategies.

3.5 DESIGNING STRATEGIES TO DE-IMPLEMENT LVC – UNDERSTANDING BEHAVIOR CHANGE

Like implementation, de-implementation of LVC requires behavior change among professionals within health care. The difference is that whereas implementation most often includes increasing certain behaviors, de-implementation involves both decreasing and increasing behaviors (Nilsen et al., 2020). For instance, reducing unnecessary use of malaria medication involves both increased use of rapid diagnostic tests for malaria and decreased prescription of anti-malaria medication (Leslie et al., 2017).

Understanding the process of de-implementation involves understanding both factors that increase the likelihood of some behaviors and those that decrease the likelihood of others. Consequently, strategies for de-implementation need to influence events and processes that have both effects. Using theories, models, or frameworks is a way to reach an understanding of both factors influencing behaviors related to use of LVC and how strategies can influence those behaviors (ICEBeRG, 2006).

3.6 SOCIAL COGNITIVE THEORIES TO UNDERSTAND BEHAVIOR CHANGE

Social cognitive theories have been widely used within implementation science (Nilsen, 2015). Those theories view behavior as the result of deliberative and rational cognitive processes, involving an evaluation of a behavior based on some combination of utility, risk, capabilities, attitudes, and social influences before forming and acting on an intention (Godin et al., 2008).

Social cognitive theories to develop de-implementation strategies have also been used. For example, de-implementation strategies based on the Theory of Planned Behavior were developed to reduce physical restraints within 12 hospital wards at a hospital in Kuala Lumpur (Eskandari et al., 2018). An educational strategy was developed based on the findings. The results included changed scores on a survey related to knowledge, attitudes, and practice, and decreased use of physical restraints.

Another study used qualitative data on the Theoretical Domains Framework to develop a set of strategies to de-implement LVC in treatment of infants with bronchiolitis (Haskell et al., 2021). Factors influencing use of LVC were, among others, beliefs about consequences and lack of knowledge. The strategies developed included identifying champions for the change, using a train-the-trainer method to educate personnel, holding stakeholder meetings to inform about the project, using reminders to help the professionals remember the guidelines, and

reviewing and giving feedback (at a group level) on their use of the target LVC, including comparison with other participating clinics. However, there are only a few studies that have used theories, models, or frameworks to understand factors influencing the use and de-implementation of LVC (Nilsen et al., 2020). It is thus unclear if social cognitive theories are the most suitable theories related to de-implementation.

3.7 APPLIED BEHAVIOR ANALYSIS AS A THEORY TO UNDERSTAND BEHAVIOR CHANGE

One aspect indicating that social cognitive theories are not the most suitable theories for de-implementation is that they do not discriminate between factors for decreasing and increasing behaviors, which could be important in de-implementation (Patey et al., 2018). Operant learning theory is the only theory within psychology and sociology that does discriminate between these two processes (Patey et al., 2018). Hence, this could be a potential theory for understanding de-implementation. Operant learning theory has been successful in changing behaviors in a variety of application ranging from treatment for small children with autism to improving safety in the workplace (Cooper et al., 2019). The roots of operant learning theory can be traced to the work of B.F. Skinner (1963), but the theory has been developed further. The current term used for practical application of the theory is applied behavior analysis (ABA; Baer et al., 1968).

The common assumption within ABA is that behavior is a product of its environment (Daniels, 2000; Pierce & Cheney, 2017). Thoughts and emotions are recognized, but are not seen as determinants of behavior, rather as behaviors in themselves that are also influenced by our environment (Cooper et al., 2019). ABA has previously been used within health care to change behaviors (Cunningham & Geller, 2008). For example, in a study by Gravina et al. (2008), behaviors related to morning preparation among physical therapists were targeted. The analysis showed that a lack of information, equipment, and feedback influenced the behaviors of the physical therapists. An intervention was developed that included task clarification, equipment manipulations, and visual feedback which resulted in an increase in completion of preparation tasks. Stephens and Ludwig (2005) analyzed factors influencing behaviors related to universal precautions to avoid exposure to blood-borne pathogens among anesthesia nurses. The behaviors targeted were hand sanitizing, glove wearing, not recapping catheter needles (or recapping with one hand), and immediately discarding catheter needles. The intervention included training, goal setting, and feedback and resulted in an increase in targeted behaviors, including recapping catheter needles with one hand. Gravina et al. (2021) showed increased adherence to a standard rounding procedure at two hospital in-patient units. The analysis revealed a lack of information, lack of areas to communicate around patients, and lack of feedback. The strategies included task clarification, feedback, and weekly huddles (short meetings) and resulted in increased adherence to the rounding procedure.

3.7.1 The three-term contingency

A key concept in ABA is the *three-term contingency* (Skinner, 1938). The concept includes the *antecedents* that precede *behaviors,* and the *consequences* that follow the behaviors. In several experimental studies, the combination of antecedents and consequences has been shown to predict future behaviors either by increasing the likelihood for the behavior (reinforcement) or by decreasing the likelihood for a behavior (punishment) (Wiley Blackwell Handbook of Operant and Classical Conditioning, 2014) (see Table 1). It should be noted that the word punishment is simply a way of describing a function (something that reduces the likelihood for a behavior) and should not be interpreted as in lay language. Behaviors under the influence of a the three-term contingency, i.e., that over time have been increased or decreased in likelihood due to experiencing consequences, are called "contingency-shaped behaviors." Routinely performed behaviors can be described as behaviors that have been reinforced over time (Furrebøe et al., 2019).

Table 1

Types of three-term contingencies and their effects on future behavior.

Type of three-term contingency	Effect on behavior
Reinforcement	Increases likelihood of future behavior
Punishment	Decreases likelihood of future behavior

3.7.2 Rule-governed behavior

Not all behaviors are shaped by experiences of real-life contingencies. Some behaviors are *rule-governed* instead (Skinner, 1974). People learn early in life to follow rules such as "don't put your fingers in the electrical outlet or you will get an electric shock," "always look both ways before crossing the road or you may be hit by a car," "raise your hand if you have a question and you will get heard" and so forth. Over time, we not only learn to follow specific rules, but rule-following becomes a generalized behavior that makes it easier to learn new rules (Catania et al., 1989). There are many benefits to rule-governed behavior since it can speed up learning and be helpful when we want to avoid real-life experiences of potential consequences. For instance, physicians learn advanced medical procedures during their medical education without making fatal mistakes with real patients and pilots in training learn how to deal with many problems without risking the lives of passengers. However, rule-governed behaviors can make us less flexible in dealing with real-life experiences and we may maintain behaviors that are no longer needed (Harte et al., 2020). This could be one reason why LVC is used: An ingrained rule about a practice being beneficial will continue the use of said practice, despite there being no evidence of positive outcomes related to that practice.

3.7.3 ABA and strategies for de-implementation

It has been suggested that the two concepts *the three-term contingency* and *rule-governing* are relevant for developing strategies to de-implement LVC (Farmer et al., 2020). Proposed mechanisms for strategies based on ABA are: removing consequences that previously maintained use of LVC such as funding for LVC (extinction), adding consequences for not using LVC, such as providing funding for alternative practices or other reinforcing consequences for not using LVC (differential reinforcement), increasing the amount of effort needed to use a practice, for instance by making LVC less accessible in prescription or ordering systems (increased response effort), and adding consequences that reduce the likelihood for a behavior by for instance creating sanctions for or removing sponsorship from organizations that use LVC (punishment) (Farmer et al., 2020). Strategies designed based on knowledge about rule-governed behaviors include written or verbal instructions on which behavior is expected and what consequences can be expected by following the rule (Catania et al., 1989).

Various forms of reinforcement are the most commonly recommended strategies in general for changing behaviors in ABA because extinction, punishment, and response effort all have negative side effects. Examples of such side effects are an initial increase in behavior and spontaneous recovery in the case of extinction (Wiley Blackwell Handbook of Operant and Classical Conditioning, 2014) and escape, avoidance, or disloyal behaviors in the case of punishment (Cooper et al., 2019; Daniels, 2000). Furthermore, increased response effort can in some cases have similar functions as punishment (Friman & Poling, 1995). Thus, strategies based on reinforcing behaviors related to not using LVC (differential reinforcement) and strategies based on rule-governing could be potential strategies for de-implementation (Farmer et al., 2020).

3.7.4 Behavior systems analysis

ABA can also be used for analyzing factors influencing entire health care systems (Diener et al., 2009; McGee & Crowley-Koch, 2021). This is called behavior systems analysis (BSA) and has previously been used within health care (e.g., Camden & Ludwig, 2013; Kelley & Gravina, 2018). The analysis involves looking at so-called meta-contingencies (Glenn, 1988; Malott, 2003), which encompass three components: 1) interlocking behavioral contingencies, 2) aggregate products, and 3) receiving system demands.

Interlocking behavioral contingencies involve at least two people's behaviors, where any part of a three-term contingency or the outcome of a behavior for one person influences the three-term contingency for another person. For instance, a patient expressing expectations to receive a practice defined as LVC can serve as an antecedent for a physician to perform that practice. Aggregate products are the main outcomes of an organization, such as delivering health care to patients for a health care organization. Receiving system demands are factors external to the organizations that influence what outcomes are beneficial for the organization to produce. In BSA, the assumption is that the individual should not be blamed as long as the

system does not support the “right” behaviors (Rummler & Brache, 2012). Translated to LVC, this suggests that LVC is an aggregated product that is delivered due to a demand for LVC from the receiving system. This creates interlocking contingencies within the organization that influence health care professionals to use LVC. The results of this thesis will be discussed in relation to BSA, to understand factors that influence the health care system.

3.8 SUMMARY OF KNOWLEDGE GAPS

In summary, LVC is a prevalent problem within health care. There is a lack of knowledge about factors that influence use and de-implementation of LVC. Previous research has been performed within a variety of clinical fields. This makes it important to synthesize and generalize findings concerning factors influencing the use and de-implementation of LVC. There is also a need for a deeper understanding of *how* these factors influence the behaviors of health care professionals, from both an individual and a systems perspective. Lastly, there is a need to identify relevant strategies for de-implementation. Concepts from ABA could potentially be useful to understand both factors influencing use of LVC and how strategies for de-implementation can be developed.

4 RESEARCH AIMS

The overarching aim of the thesis was to generate new knowledge and insights concerning use and de-implementation of LVC. To achieve this aim, the four studies of the thesis had the following objectives:

- To identify factors that influence use and de-implementation of LVC (Study I).
- To understand why physicians in primary care use LVC (Study II).
- To understand which management strategies are being used to de-implement LVC and possible mechanisms for those strategies using concepts from ABA (Study III).
- To demonstrate how ABA can be used to understand contingencies related to use of LVC and how de-implementation strategies can be developed by arranging alternative contingencies (Study IV).

5 MATERIALS AND METHODS

5.1 DESIGN

The thesis consists of four studies. Study I was a scoping review, Study II was a qualitative study using a grounded theory approach, Study III was a qualitative study using ABA, and Study IV was an intervention study using single case design.

5.2 THE SWEDISH PRIMARY HEALTH CARE SYSTEM

All studies except the scoping review were conducted within the Swedish primary care system. Sweden consists of three levels of government: central government, 21 county councils called regions, and 290 municipalities. Swedish health care is tax-funded, with universal coverage. It is nationally regulated, but managed locally, within the regions. Most of the funding comes from regional taxes (Glenngård, 2020). Primary care comprises around 17 percent of all health care in Sweden and encompasses around 1,200 health care centers, of which 60 percent are owned by the regions and the rest are privately owned.

The main form of primary care practice is team-based, with teams including physicians, nurses, physiotherapists, and psychologists. Provider fees are set by each region and vary between 60 and 95 percent in fixed capitation payment, 5–38 percent in fee-for-service payment, and 0–3 percent in performance-related payment. Primary care is defined in the Health and Medical Services Act (2017:30) as outpatient care provided without limitations in terms of diseases, ages, or patient groups.

Table 2

Information about the four studies.

	Study I	**Study II**	**Study III**	**Study IV**
Aim	To identify factors that influence use and de-implementation of LVC	To understand why physicians in primary care use LVC	To understand which management strategies are being used to de-implement LVC and possible mechanisms for those strategies using concepts from ABA	To demonstrate how ABA can be used to understand contingencies related to use of LVC and how de-implementation strategies can be developed by arranging alternative contingencies
Study design	Scoping review	Qualitative	Qualitative	Single case design
Data sources	101 published empirical articles 2013–2018	Six focus group discussions with 31 physicians within primary care	12 interviews with managers and medically responsible physicians within primary care	Financial data, quality assurance data and four interviews with physicians within one primary care center
Data collection	2018	2018–2019	2021	2021–2022
Data analysis	Content analysis	Grounded theory approach	Inductive analysis using content analysis and deductive analysis using ABA	Visual analysis of single case data from the financial system and the quality assurance system, inductive analysis using content analysis, and deductive analysis using ABA of the interviews

5.3 STUDY I

Scoping review is a method to overview previous research and synthesize the existing body of knowledge (Arksey & O'Malley, 2005). Scoping reviews have a broader aim than systematic reviews and usually do not assess the quality of the included studies. They can have a broader scope and serve as an overview of current literature on a chosen topic. Furthermore, a scoping review allows for including different types of research designs in the same study, such as both quantitative and qualitative studies. The process outlined by Arksey and O'Malley (2005) consists of five steps: 1) identifying the research question, 2) identifying relevant studies, 3) selecting studies, 4) charting the data, and 5) collating, summarizing, and reporting the results.

5.3.1 Research question

The research question in the scoping review was which determinants (i.e., influencing factors) had been found for the use and de-implementation of LVC.

5.3.2 Protocol and registration

The study was originally described in a study protocol (Hasson et al., 2018).

5.3.3 Eligibility criteria and search strategy

The search strategy was used to find scientific articles published in peer-reviewed journals and written in English. The PCC mnemonic (Population, Concept, Context) was applied to identify the main aspects of interest in the review, where the concepts were determinants for use and/or de-implementation of LVC and the context was health care (including dental care and social care). No population was specified, since all personnel within the context was of interest. Both qualitative and quantitative studies were included. The definition of LVC meant that the study should refer to some sort of guideline recommending against the practice, relying on experts in each field rather than the evaluation of the study authors. All eligibility criteria are reported in Table 3. Four databases were used (MEDLINE, Embase, CINAHL, and Web of Science).

Keywords used in the search were discussed and decided among the authors of the study and stakeholders identified as knowledgeable within the field. The search string was further developed in collaborations with librarians at the Karolinska Institutet Library.

The search included studies published in the time frame from January 1, 2013, to June 4, 2018.

Table 3

Eligibility criteria for inclusion in Study I.

1. English language
2. Published between January 2013 and June 2018
3. Published in peer-reviewed journal
4. Empirical study
5. **P**opulation: not specified
6. **C**oncept: Determinants for use of LVC, Determinants for de-implementation of LVC (NB. Studies about determinants for use of LVC needed to refer to a recommendation [e.g., Choosing Wisely] or a guideline [e.g., clinical guideline] stating that a practice was not recommended)
7. **C**ontext: Health care setting (including primary care, hospital care, community care, and mental health)

5.3.4 Selection of sources of evidence

All citations found in the search were imported to Rayyan, a web-based and mobile application that organizes and facilitates screening of abstracts and collaboration between reviewers (Ouzzani et al., 2016). The eligibility criteria were tested several times between the reviewers to ensure consistency. All abstracts were reviewed independently by two reviewers and conflicting decisions were discussed. In cases where disagreement or uncertainty existed, the entire reviewer group discussed this until consensus was reached. A similar process was then used for full-text review based on the included abstracts.

5.3.5 Data charting

A data charting form was created to extract data from the selected studies. Data related to title, journal, authors, year published, country of origin, type of health care setting, methods, study design, method to assess the determinants (e.g., interviews, record review, survey), study participants, type of LVC, guideline/recommendation, de-implementation determinants, and use of LVC determinants were charted.

5.3.6 Content analysis

An inductive content analysis was applied to the extracted data related to determinants. The inductive approach was used because of the limited knowledge concerning determinants for use and de-implementation of LVC. It was not known if determinants previously found to influence implementation were also relevant for de-implementation. The data were coded and discussed among the authors.

5.4 STUDY II

Study I concluded that there was a need for more information from the health care professionals' perspective related to use of LVC. The aim of Study II was to identify factors that influenced use of LVC, using a grounded theory approach. Grounded theory is an inductive qualitative method with the purpose of constructing a middle range theory grounded in data (Corbin, 2015). An inductive analysis was chosen since little was known regarding which theories, models, or frameworks would be suitable for understanding why physicians use LVC (Nilsen et al., 2020). Grounded theory was chosen to begin to build a middle range theory related to use of LVC.

5.4.1 Setting

Study II was conducted within primary care in the Region Stockholm, the Swedish region with the largest population.

5.4.2 Participants

The research team used a purposeful sampling method to recruit participants from health care centers with varied use of LVC. The aim was for a large variety of participants in the focus groups and it was believed that this could be accomplished within one region. Data on three types of pre-defined low-value practices were used to select centers with a high or low rate of these practices to capture a variety of participants related to both use of LVC and other contextual factors such as small and large centers and socioeconomic factors of the patient population. The chosen practices were sedimentation rate, a liver test (AST), and vitamin D test. All 66 public primary health care centers within Region Stockholm were invited to participate in the study and 17 agreed to do so. Out of these, six centers were chosen based on their use of the selected laboratory tests.

5.4.3 Focus group discussions

The focus group discussions were held in connection to the physicians' regular weekly meetings except at one center. The sixth center's meetings were often attended by more physicians than was feasible for a focus group discussion, so a separate meeting was held, to which all physicians were invited. A smaller number chose to participate, making this more feasible for a focus group discussion.

A semi-structured interview guide was used to moderate the discussions. The structure included some general questions related to views on LVC, what the participants perceived influenced their use of LVC, and what factors they saw as helpful for reducing their use of LVC at an individual, center, and regional level. The guide then narrowed in on questions related to the specific examples of LVC used for recruitment, to get more specific examples of what influenced their use of LVC and what could be helpful. The participants were instructed to discuss the various topics, with help from the moderator to keep the discussion going.

5.4.4 Qualitative analysis using a grounded theory approach

Since it was unknown if the same factors were relevant for de-implementation and implementation, an inductive analysis was performed. All data from the discussions were transcribed verbatim and coded in accordance with a grounded theory approach (Corbin, 2015). The transcripts were read several times to get a sense of the data. The data were then coded using a line-by-line coding strategy. The codes were grouped into preliminary categories and sub-categories. In parallel with the coding, memos were written to capture thoughts and interpretations of the data. The ideas were tested by returning to the data to validate or discard theories. A conceptual model was constructed based on the developed theories to illustrate the categories and sub-categories and their relationships.

5.5 STUDY III

Study II showed that there was a lack of support for de-implementation at a systems level. The third study therefore aimed to improve the understanding of which management strategies were being used to reduce LVC and possible mechanisms for those strategies based on concepts from ABA. The data were analyzed using both an inductive analysis and a deductive analysis.

5.5.1 Setting

Study III was conducted within both private and public primary care in Region Stockholm, Uppsala, and Halland in Sweden. Variation was sought regarding the primary care setting to obtain as rich information as possible, from both public and private actors and from different regions in regards to size and patient population. All primary care centers (both publicly and privately owned) are publicly financed, but locally managed (Glenngård, 2020). Thus, differences in the management strategies used could be related to the region in which a center was located or the organization they were part of.

5.5.2 Participants

Participants were recruited in two steps. First, key stakeholders within primary care (both public and private) were recruited to provide information on what management strategies were being applied to influence use of LVC. They were recruited purposefully, to find participants with information on management strategies. In the second step, managers and medically responsible physicians were recruited through snowball sampling with the help of the previously recruited key stakeholders.

5.5.3 Interviews

All interviews were booked by e-mail for a time and date that suited the participants. The interviews were held via Zoom or telephone and lasted between 30 and 45 minutes. The interviews included an introductory question about the participant's general views on LVC. This was followed by questions about what type of management strategies they used to influence use of LVC. To guide the participants, a few examples of performance indicators,

guidelines, and education were provided, but the participants were encouraged to think for themselves about strategies they were using that could influence use of LVC. There was also a question related to their view on who was responsible for use of LVC: the individual health care practitioner, the center, or the regional management. The interview guide for the participants in the second step of interviews covered the types of management strategies identified in the first step, to get the participants' views on how well the previously identified strategies worked. The participants were encouraged to think about other, not previously identified strategies that they perceived as potentially influencing use of LVC. Influence was defined as increasing or decreasing use of LVC.

5.5.4 Data analysis

The interviews were transcribed verbatim and then analyzed in two steps. The first step was an inductive content analysis, where answers regarding strategies were coded into categories and subcategories. The inductive categories were then analyzed deductively to identify the possible mechanisms underlying the different strategies, based on concepts from ABA (the three-term contingency and rule-governed behavior).

5.6 STUDY IV

The conclusion from Study III was that locally developed strategies at a center had the greatest potential to influence behaviors related to use of LVC. It was also concluded that there were no current strategies that focused on differential reinforcement of behaviors related to use of LVC. The aim was to demonstrate how ABA could be used to understand contingencies related to use of LVC and how de-implementation strategies could be developed by arranging alternative contingencies.

5.6.1 Setting and participants

The study was conducted at a primary health care center in Region Stockholm. The center was recruited via Study III, with all managers involved in that study invited to participate in Study IV. Three managers showed interest and were invited to an information meeting. Only one manager accepted the invitation and chose to participate in the study. The center was publicly owned, had approximately 12,500 listed patients, and 12–13 physicians employed. The center was slightly above average in size for a primary care center in Region Stockholm. During the study, a total of 23 different physicians worked at the center.

5.6.2 ABA procedure

The research team followed a six-step process for developing and evaluating strategies based on ABA (see Table 4), to analyze factors influencing use of LVC and to design and evaluate strategies (Wilder et al., 2009). All steps were conducted in collaboration with the physicians and the manager at the center. This was done to combine their local knowledge about the context with the researchers' knowledge about LVC use, de-implementation, and how to use ABA.

Table 4
Process for developing and evaluating strategies based on ABA (adapted for de-implementation).

1. Specify which LVC practice to de-implement.
2. Identify specific behavior changes related to the use of that practice.
3. Develop an accurate and reliable means of measuring key results and/or behaviors.
4. Conduct an analysis of the contingencies influencing behaviors related to the selected results.
5. Develop and implement strategies targeting those contingencies.
6. Track and evaluate the effects of the strategies.

5.6.2.1 Step 1. Specify which LVC practice to de-implement

The LVC practice chosen for the study was unnecessary X-ray examinations for knee arthrosis. The practice was chosen in collaboration with the physicians and the manager at the center. A meeting was held with all physicians at the center to discuss possible LVC for the study, at which ten physicians participated. This was followed by a meeting with the manager, at which the practice unnecessary X-ray examinations for knee arthrosis was chosen. This was chosen since new guidelines clarifying that X-ray examinations were not needed to diagnose knee arthrosis had recently been published (Socialstyrelsen, 2021) and the center showed a higher use of this practice than other centers in the area.

Knee arthrosis is a degenerative disease where cartilage in the knee capsule decreases over time, causing problems with movement and pain. It can be diagnosed based on a combination of a description from the patient of how the symptoms have developed over time, in which situations they notice their symptoms, and a physical examination of the knee. It is possible to see the effects in an X-ray examination at a late stage, where the lack of cartilage eliminates the gap between the two joints in the knee. However, in addition to the cost of the X-ray examination and the patient exposure to radiation, using an X-ray examination to diagnose arthrosis will delay diagnosis and treatment. The new guidelines thus state that it is not necessary to use an X-ray examination to diagnose the disease and that X-ray examinations should only be used before a referral to orthopedic surgery (Socialstyrelsen, 2021).

5.6.2.2 Step 2. Identify specific behavior changes related to the use of that practice

Three behaviors were identified related to the unnecessary use of X-ray examinations: referring patients to an X-ray examination (should decrease), diagnosing patients with general knee pain (a diagnosis used while waiting for the results of the X-ray examination (should decrease)), and diagnosing patients with knee arthrosis without using an X-ray examination (should increase). The behaviors were identified in collaboration with the manager and medically responsible physicians at the center.

5.6.2.3 Step 3. Develop an accurate and reliable means of measuring key results and/or behaviors

Data to measure key results were extracted from the center's financial system (number of X-ray examinations ordered) and their quality assurance system (number of patients receiving the diagnosis general knee pain or knee arthrosis). All data were at the center level since it was not possible to extract data at an individual level. The choice of data was made in collaboration with the manager at the center and a financial controller for the center.

5.6.2.4 Step 4. Conduct an analysis of the contingencies influencing behavior related to the selected results

Two concepts from applied analysis – the three-term contingency and rule-governed behavior were used to analyze behaviors influencing the chosen results. The data used for the analysis was a combination of information received at the initial meeting with all physicians and a discussion with the manager at the center.

5.6.2.5 Step 5. Develop and implement strategies targeting those contingencies

Strategies were developed based on the analysis in step 4 and discussions with the physicians and the manager at the center. The aim was that they would both target the analyzed contingencies and be feasible in normal practice.

5.6.2.6 Step 6. Track and evaluate the effects of the strategies

To evaluate the developed strategies, the identified key results were gathered on a monthly basis by the financial controller (financial data on number of ordered X-ray examinations) and the medically responsible physician at the center (quality assurance data on number of patients receiving a diagnosis of general knee pain or knee arthrosis). It was not possible to extract information on how many patient visits were related to knee arthrosis, for which reason only number of X-ray examinations ordered and diagnoses per month were used. Data were graphed using a single case design including four phases: a baseline phase of six months, an intervention phase of three months following introduction of the first strategy, a second intervention phase of three months following introduction of the second strategy, and a follow-up phase of three months. Further, interviews were conducted with four of the participating physicians to gather information on their perceptions of the effects of the strategies, how the different strategies influenced them more specifically, and the feasibility of the process of using ABA to develop and evaluate strategies for de-implementation.

5.6.2.6.1 Analysis of single case data

A graphical presentation of the single case data was visually analyzed in accordance with the standards for single case design (Cooper et al., 2019; Kratochwill et al., 2013). A detailed description of the method for analysis and the results can be found in the study manuscript.

5.6.2.6.2 Analysis of the interview data

The interview data were transcribed verbatim, coded line-by-line, and underwent inductive content analysis. The codes were grouped into categories based on the three different parts of the study aim. Answers related to the physicians' perception of the effect of the two strategies, their perceptions of how the strategies influenced their behavior and their perceptions of the feasibility of using ABA to develop and evaluate strategies for de-implementation were analyzed separately. The physicians' answers on their perceptions of how the two strategies influenced their behavior were analyzed in two steps: first inductively (Graneheim & Lundman, 2004) and then deductively using the two concepts from ABA –, the three-term contingencies and rule-governed behavior – with a similar process as in Study III.

5.7 ETHICAL CONSIDERATIONS

All studies followed principles for ethical standards and good research practice.

5.7.1 Ethical approvals

Study I was not submitted to ethical approval as it was a scoping review based on published literature. Studies II and III were approved by the regional ethical board at Karolinska Institutet at Stockholm (reference 2017/2211-31/5) and Study IV was approved by the Swedish Ethical Review Authority (reference 2021-03529).

5.7.2 Risk, burdens, and benefits

When planning for and executing the studies, including recruiting participants, the effects on the participants were carefully considered. The topic of de-implementation of LVC can be controversial since the studies focused on use of practices that should not be used within health care. Both Study II and Study III involved explicitly asking participants about reasons for using LVC and what could be done to de-implement LVC. This could be perceived as criticism of the participants and even a threat to their way of working. This risk also existed in Study IV, where two strategies were implemented to reduce the use of a specific LVC practice. To balance these risks, great care was taken with both written descriptions and in the communication with the participants to convey the researchers' curiosity and interest in their perspectives and that the ambition was to find strategies that would be helpful for them. Further, Study IV had a strong co-creation element in that both LVC practices and strategies were chosen in collaboration with the primary health care center. The risks of the study were evaluated as low in relation to its benefits. The study involved changes in health care procedures which would have been made even without the study as the procedures were based on the latest guidelines from the National Board for Health and Welfare. Furthermore, the study was likely to provide benefits to the quality of health care as the knowledge generated in the study was related to increasing knowledge on how LVC could be de-implemented.

5.7.3 Informed consent

Studies II–IV all included written consent form, where the participants were informed about the purpose of the studies, that participating is voluntary, and that they could drop out of the study at any time, without fear of repercussions.

5.7.4 Privacy and confidentiality

All recordings from focus group discussions and interviews in Studies II, III, and IV were stored without personal data included. The participants in the focus group discussions were not completely anonymous to their managers, since they were the ones who invited them and scheduled the discussions. However, who said what during the discussions was not revealed to the managers. The quotes used in the studies excluded information that could reveal who made the comments. The participants in Study III were not known to their managers or other people within their organization. In Study IV, the participants were not anonymous when participating in the meetings and the medically responsible physician assisted in the scheduling of interviews. However, participating in the interviews was voluntary and who participated in the interviews was not known to the manager.

6 RESULTS

The results of the four studies will be presented in a shortened format. More extensive information about the results can be found in the separate manuscripts.

6.1 STUDY I

In Study I, the scoping review, several influencing factors were found related to the use and de-implementation of LVC. Most studies presented factors related to use of LVC (n = 92) and fewer related to de-implementation (n = 9). The factors were categorized into six categories and 30 sub-categories. The categories were: LVC practice, de-implementation process, professionals, patients, inner context, and outer context. See Table 5.

Table 5

Categories and subcategories of factors influencing the use and de-implementation of LVC.

Categories	Subcategories
LVC practice	Evidence
	Characteristics of the LVC practice
	Negative consequences of reducing LVC for the professional
	Characteristics of alternative practice
De-implementation process	Strategies
	De-implementation process
Professionals	Professional characteristics
	Professional knowledge of LVC
	Professionals' expectations, attitudes, and behaviors
	Professionals' memory
Patients	Patient characteristics
	Patient health condition
	Patient expectations
	Patient knowledge
	Expectations from relatives
Inner context	Setting characteristics
	Work/care process
	Staff composition
	Organizational structures related to the LVC
	Interactions between professionals
	Culture
	Patient-provider communication/interaction
Outer context	Location
	Economy
	Outer context characteristics
	Patient volume
	Policy and political support
	Marketing
	Time
	Pressure from suppliers

6.1.1 Factors related to the LVC practice

Within the category LVC practice, there were four subcategories. The subcategory *Evidence* was an influencing factor for use of LVC and included how clear guidelines were in advising against a practice and how convinced professionals were of the lack of support for a specific

practice. *Characteristics of the LVC practice* was how easy the LVC practice was to administer, where easy administration led to more LVC. *Negative consequences of reducing LVC for the professional* included fear of losing expertise by not using the practice. *Characteristics of alternative practice* involved how easy an alternative practice was to provide, with a more complicated alternative practice leading to more LVC.

6.1.2 Factors related to the de-implementation process

The category de-implementation process encompassed two subcategories. The subcategory *Strategies* involved various de-implementation strategies such as auditing and feedback, clinical decision support, and education for patients and providers, which all reduced use of LVC. The sub-category *de-implementation process* was related to the quality of the process of de-implementing LVC, such as its complexity, pace, and planning – where simple processes were beneficial for de-implementation compared with complex ones.

6.1.3 Professional factors

The category professionals included four sub-categories. *Professional characteristics* was related to the professionals' background data, such as age, gender, and education. *Professional knowledge of LVC* included factors such as lack of cost awareness or lack of knowledge about guidelines advising against a practice, which led to more LVC. *Professionals' expectations, attitudes, and behaviors* were related to, e.g., fear of malpractice, a desire to meet patients' requests, fear of litigation, a desire to reassure patients, self-efficacy in discussing LVC with patients, and self-efficacy in denying patients LVC. *Professionals' memory* was simply related to professionals forgetting to check indications for a practice, leading to patients receiving LVC despite there being no indication for the practice.

6.1.4 Patient factors

The category patients encompassed five sub-categories. *Patient characteristics* were related to the gender, ethnicity, and socioeconomic factors of the patients. *Patient health condition* were factors related to the severity of the patients' conditions and multimorbidity, which could lead to more or less LVC. *Patient expectations* related to patients having expectations to receive a specific LVC practice, which led to more LVC. However, *patient knowledge* about a practice being seen as LVC could lead to less LVC. Lastly, *expectations from relatives* was a factor that could lead to more LVC.

6.1.5 Inner context factors

Inner context factors included influencing factors related to the health care organizations (e.g., hospitals or primary care organization), with seven sub-categories. *Setting characteristics* referred to differences in use of LVC between different types of health care settings such as hospital-based practices compared with community-based practices. For instance, these were similar regarding prescription of antibiotics, but hospital-based practices had a higher use of certain imaging and X-ray examinations. Several factors were related to increasing use of LVC: *Work/care processes*, which focused mainly on a lack of continuity,

but also on lack of decision support and too much individual decision making. *Staff composition,* including inadequate staffing and solo practices. *Organizational structures,* such as ownership of necessary equipment or having a simple system for ordering examinations and laboratory tests, were processes that facilitated use of LVC. *Interactions between professionals* encompassed both requests from others to use LVC and a lack of communication – both aspects could lead to more LVC. *Culture* was related to both the specific local culture, encouraging or discouraging use of LVC, and a general culture such as a hierarchical culture or lack of cost-consciousness, which could lead to more LVC. Contrary, the factor *patient-provider communication/interaction* could reduce use of LVC if there were high-quality communications and interactions between a patient and health care professional.

6.1.6 Outer context factors

Outer context factors included influencing factors related to the social, political, and geographical surroundings of the health care organizations, with eight sub-categories. Several outer context factors influenced use of LVC: the *location* of the health care service (metropolitan, suburban or rural), the *economy* of the health care provider, including how healthcare was financed and various types of financial incentives, and *outer context characteristics* related to the society surrounding the health care provider. *Patient volume* was a factor that could lead to increased use of LVC. Low patient numbers could lead to more LVC at an organizational level, whereas high patient numbers could lead to more LVC at an individual level. While *policy and political support* could reduce use of LVC through clear policies against overuse of LVC, lack of political support could increase use of LVC. *Marketing* of LVC to both consumers and professionals led to increased use of LVC. *Time* was a factor that described unexplained fluctuations of LVC use over time in several studies. Lastly, *pressure from suppliers* could increase use of LVC.

6.2 STUDY II

In Study II, based on focus group discussions with primary care physicians, a model was developed using the grounded theory approach (see Figure 1). It showed three main reasons for performing LVC: *uncertainty and disagreement about what not to do, perceived pressure from others* and *a desire to do something for the patients.*

6.2.1 Uncertainty and disagreement about what not to do

Uncertainty and disagreement about what not to do was related to being unaware of the LVC status of a practice, guidelines being perceived as conflicting, guidelines being perceived to be irrelevant for the target patient population, or a lack of trust in the guidelines.

6.2.2 Perceived pressure from others

Perceived pressure from others concerned patient pressure, pressure from other physicians, or pressure from the health care system to perform unnecessary tasks. This category also included a lack of counterpressure from the system to not use LVC, meaning that the effort of not using LVC fell on the individual physician.

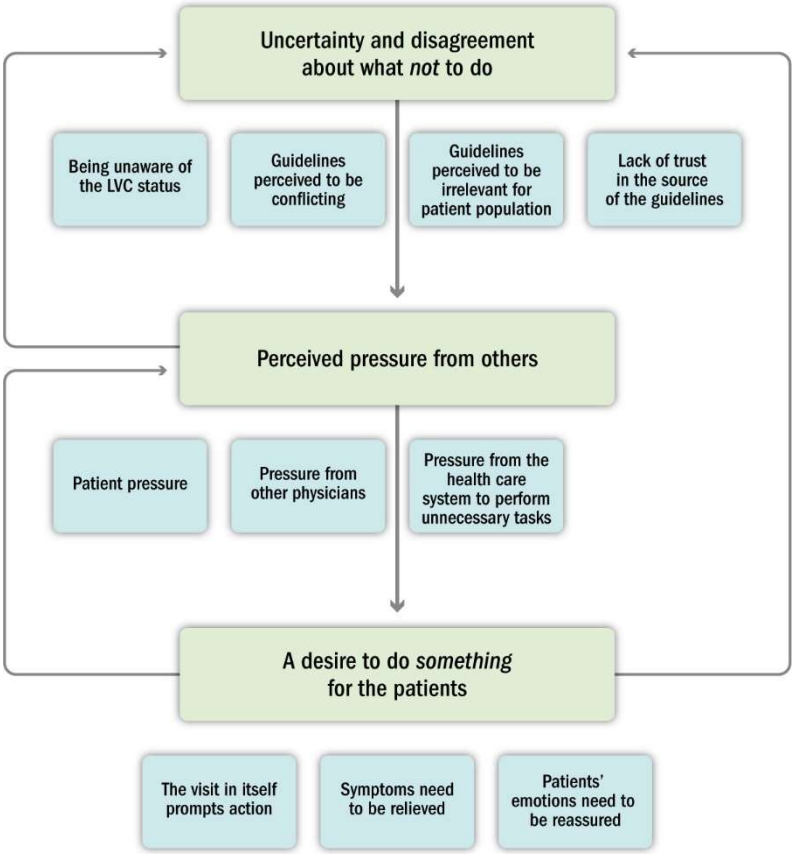
6.2.3 A desire to do something for the patients

A desire to do something for the patients was associated with the fact that a visit prompts action, reveals symptoms to relieve and emotions that need to be managed.

The three reasons are interdependent. Uncertainty and disagreement about what not to do make it more difficult to deal with pressure from others and to refrain from doing something for the patients. Pressure from others and the desire to do something for the patients enhances the uncertainty and disagreement about what not to do. Furthermore, pressure from others influences the desire to do something for the patients.

Figure 1

Interdependent reasons that combined explain the use of LVC (Ingvarsson et al., 2020). *Reproduced with permission from the publisher.*



STUDY III

In Study III, the analysis of the interviews with managers and key stakeholders within primary care resulted in eight different management strategies intended to influence LVC.

6.2.4 Regional management strategies

Five of the strategies were developed at a regional level. Those were scorecards, financial systems, quality assurance systems, guidelines, and lectures. The first three were not interpreted as influencing the health care professionals' behavior directly but were described as something that sometimes initiated local strategies in each health care center, which in turn could influence use of LVC. The other two of the regional strategies were interpreted as influencing behavior through rule-governing.

6.2.5 Local management strategies

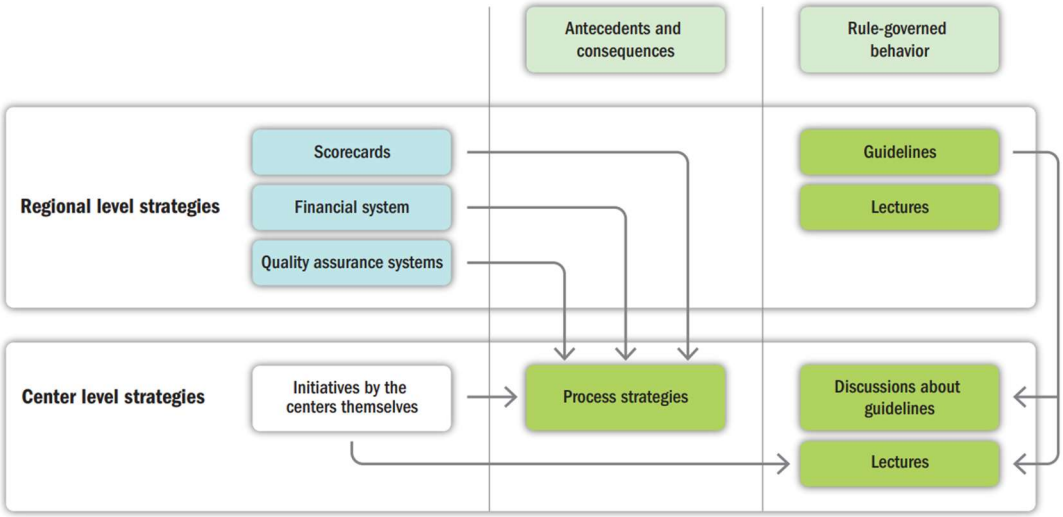
Three of the strategies were developed at the local level at each primary care center. Those were process strategies, discussions about guidelines, and local lectures. The process strategies at the local level were the only type of strategies interpreted as influencing behavior through the three-term contingency. Most of the process strategies involved an increased response effort, i.e., making it more difficult to perform the behavior that had previously been reinforced, such as removing unnecessary laboratory tests from the standard laboratory test groups in the ordering system, making it more difficult to find them in the system or requesting an extra signature from a senior physician for junior physicians when ordering imaging and X-ray examinations. The other two local strategies, discussions about guidelines and local lectures, were interpreted as influencing behavior through rule-governing.

6.2.6 Possible mechanisms for the management strategies

A model describing the mechanisms of the eight different management strategies can be seen in Figure 2. In the model, the strategies are grouped both by the level of the organization that is using the strategy (regional or local) and by the direct mechanism related to influencing behavior they were interpreted to involve. Three of the strategies (financial systems, scorecards, and quality assurance systems) were not interpreted as influencing behavior directly and are therefore in a separate column with no mechanism.

Figure 2

Strategies divided by where they are initiated (regional or center level) and by how they influence behavior (through antecedents and consequences or rule-governed behaviors) (Ingvarsson, Hasson, Augustsson et al., 2022). *Reproduced with permission from the publisher.*



6.3 STUDY IV

A short summary of the results from the qualitative data in Study IV is presented in this section. All results, including the analysis of the single case data, can be found in the manuscript for Study IV.

6.3.1 Analysis of contingencies and development of strategies

In Study IV, the discussions with the physicians at the primary care center and the manager resulted in an analysis of contingencies related to the unnecessary use of X-ray examinations for diagnosing knee arthrosis. The ABA showed that behaviors were influenced by both the three-term contingency and rule-governing. The three-term contingencies were mainly related to interaction with patients. An antecedent could be a patient expressing expectations of being referred to an X-ray examination of their knee and expressing relief or gratitude when the physician ordered an X-ray examination. The rule-governing could be a rule stating that a diagnosis of knee arthrosis could be made through an X-ray examination.

Based on the ABA, two strategies were developed. The first was a lecture aiming at introducing a new rule to govern the physicians' behavior. The lecture included information about the new guidelines, why ordering an X-ray examination was not necessary, and how to diagnose arthrosis without using an X-ray examination. The second strategy was feedback meetings were the physicians received feedback on how many X-ray examinations they had ordered and how many patients received the diagnosis general knee pain or knee arthrosis at the center level. The meeting also included discussions among the physicians on how to support each other in diagnosing knee arthrosis without using an X-ray examination.

6.3.2 The physicians' perception of the effect of the strategies

The physicians perceived that the two strategies had influenced their behaviors related to the use of X-ray examinations for knee arthrosis. They suggested that the strategies had decreased the use of X-ray examinations, increased their communication with patients about why they did not need an X-ray examination, and improved their ability to diagnose knee arthrosis without using an X-ray examination. However, they also mentioned that it could not be unequivocally stated that the strategies had had an effect.

6.3.3 The strategies' influence on contingencies

The analyses revealed that the two strategies had approximately the expected functions. The lecture influenced behaviors through a rule clarifying why physicians should not use X-ray examinations for diagnosing knee arthrosis and how to diagnose knee arthrosis without an X-ray examination. The feedback meetings were also perceived as providing consequences that reinforced diagnosing knee arthrosis without using an X-ray examination. Additional contingencies were described by the physicians as affecting their behaviors through both strategies. The physicians described how both the lecture and the feedback meetings provided them with strategies to communicate with patients. This resulted in reinforcing consequences from the patients, who expressed relief and gratitude even when no X-ray examination was ordered. The physicians also stated that the feedback meetings reminded them why they should not use X-ray examinations for diagnosing knee arthrosis, thus also functioning as a rule-governing behavior.

6.3.4 The feasibility of using ABA to design and evaluate strategies for de-implementation

Using ABA to design and evaluate strategies for de-implementation was perceived as feasible by the physicians. They appreciated the types of strategies developed and that they were delivered during regular meetings. They also provided several examples of how the developed strategies could be used for other types of LVC. The physicians also provided suggestions on how the strategies could be improved. They suggested using the lecture to further clarify the rule of why they should not use X-ray examinations for diagnosing knee arthrosis. They also suggested that the lecture could have included an opportunity to practice diagnosing knee arthrosis without ordering an X-ray examination. Furthermore, they suggested having more focused discussions during the feedback meetings, to provide the physicians with more strategies on how to diagnose knee arthrosis without using an X-ray examination and to communicate to patients why they were not being referred for an X-ray examination. Finally, the physicians stated that the feedback provided at the feedback meetings could have been more precise. They would have preferred feedback at an individual level instead of at the center level and feedback clarifying the proportions of correctly ordered X-ray examinations (for patients who were being referred for orthopedic surgery) and others (for patients who were not).

7 DISCUSSION

7.1 SUMMARY OF ALL FOUR STUDIES

The studies generated knowledge about factors that influence the use and de-implementation of LVC. The studies also illustrated different mechanisms for de-implementation strategies and how strategies could be developed using ABA. In Study I, 101 studies were identified related to influencing factors for use and de-implementation of LVC. Out of these, 92 were related to use of LVC and only 9 to de-implementation. Six main categories of factors influencing use and de-implementation of LVC were identified. They were the LVC practice, the de-implementation process, the professionals, the patients, the inner context, and the outer context. In Study II, three categories were found related to use of LVC. They were uncertainty or disagreement about what not to do, perceived pressure to use LVC, and a desire to do something for the patients. In Study III, eight management strategies were found. Those were scorecards, financial systems, quality assurance systems, guidelines, lectures, local process strategies, discussion about guidelines, and local lectures. Lastly, in Study IV, two types of contingencies were identified related to the use of a specific LVC (unnecessary use of X-ray examinations for knee arthrosis). The first was a rule stating that the use of X-ray examination was a good way to diagnose arthrosis. The second was three-term contingencies related to the use of X-ray examinations for diagnosing knee arthrosis in terms of patients expressing expectations of being referred to an X-ray examination (antecedent) and gratitude for being referred (consequence). Two strategies were developed based on the analysis: a lecture intended to present a new rule that X-ray examinations were not beneficial for diagnosing knee arthrosis and feedback meetings intended to provide consequences, encouraging the physicians to diagnose knee arthrosis without using X-ray examinations. The two strategies were perceived by the physicians to be helpful and feasible and similar contingences were described as expected when developing the two strategies.

7.2 FACTORS INFLUENCING USE OF LVC

Taken together, the findings concerning use of LVC in the four studies showed that both factors external to the health care organization, factors within the organization, and factors in the immediate environment of the individual health care professional influenced such use. The factors will now be discussed in relation to both BSA and the related LVC literature.

7.2.1 Factors external to the health care organization

All four studies identified factors external to the health care organizations that could influence use of LVC. In Study I, the category outer setting included for example financial incentives for the health care organization that could promote LVC. Study II revealed a subcategory called perceived pressure from the system to perform unnecessary tasks. This included decisions from politicians to provide certain interventions to patients that were sometimes perceived as LVC. In Study III, the financial system (mainly related to how care was financed) was in part defined by decisions made outside the organization and was

perceived as influencing use of LVC. On the one hand, when a larger proportion of financing was in the form of a fixed payment based on number of patients listed at the center, retaining listings became important and this led to more LVC that patients expressed expectations to receive. On the other hand, the previous financial system was tied to the number of patients visiting each physician, which was also perceived to increase some types of LVC because of physicians meeting more patients. Lastly, in Study IV, other aspects of the financial system (the relatively low cost for X-ray examinations) was described as influencing unnecessary use of X-ray examinations.

These results all indicate what within BSA is called a demand from the receiving system (Glenn, 1988; Malott, 2003). In this case, a demand for LVC. For a private company, a demand for a specific product or service would not pose a problem. This would rather provide an opportunity, where the organization could adapt to the demand. However, for publicly funded health care system, this is a problem since it is not expected to provide LVC despite this demand. This dilemma for the health care system has been shown in other studies. Activities that are not in line with guidelines are likely to occur when payment or reduced costs are provided (Saini Dr et al., 2017). Payment structures that emphasize volume over value, influence from companies which market their products, and health care professionals who fear malpractice lawsuits (Verkerk et al., 2021) are all factors external to the health care organizations that influence use of LVC. Furthermore, in the Swedish context, differences in payment structures has previously been shown to influence the use of antibiotics (Glenngård, 2022).

The patient choice reform within Swedish primary care was carried out with the belief that competition over patients should influence primary care centers to become more efficient and compete for patients based on quality, as the financial system would be equal for all providers. However, this have not had the intended effect because patients find it hard to compare primary care centers based on quality and still seem to value centers close to their homes more (Dahlgren et al., 2021).

Publishing national guidelines is an activity with the goal of providing guidance for quality in health care, including what practices are LVC. Guidelines can thus serve as a way of balancing the effects of financial systems that run the risk of focusing more on sound finances for a health care organization than on quality of care. However, both Study I and Study II found problems with guidelines. Health care professionals were not aware of guidelines and guidelines were perceived as conflicting or not applicable to their patient population. This suggest that there is room for improvement related to both the financial system in health care and the development of guidelines.

7.2.2 Factors within the organization

Studies I, II, and III all showed various factors influencing use of LVC within organizations (e.g., a primary care organization or hospital). These factors can be understood as interlocking behavioral contingencies (Glenn, 1988; Malott, 2003) influencing use of LVC.

This means that one person's antecedents, behaviors, consequences, or outcomes of their behaviors can serve as antecedents or consequences for another person's behaviors. For example, in study I, organizational culture, work/care process and interaction between professionals can all be seen as examples of interlocking behavioral contingencies. Both Study I and Study II also showed examples where health care professionals requested LVC, which might act as an antecedent for other health care professionals' use of LVC.

Organizational context was also found to be the second most common factor in a recently published systematic review where available resources, organizational structures, work routines, and work processes were found to influence use of LVC (van Dulmen et al., 2020). The presence of factors within the organizations is not surprising since interlocking behavioral contingencies within an organization often develops to adapt to a demand in the receiving system (Glenn, 1988). Nevertheless, this emphasizes the need for conscious plans within organizations to investigate how their processes may inadvertently lead to more LVC and how these processes can be improved to reduce this effect.

7.2.3 Factors in the immediate environment of the individual

All four studies also showed factors that influenced use of LVC based on factors in the immediate environment of the individual. This could be interpreted either as influencing the three-term contingencies related to use of LVC or as rule-governing behaviors related to use of LVC.

7.2.3.1 Three-term contingencies influencing behaviors related to use of LVC

Study I showed that professional factors influenced use of LVC. For instance, using LVC to avoid a malpractice lawsuit which in ABA is described as negative reinforcement (Cooper et al., 2019). Study I also found a desire to satisfy patients' requests influencing use of LVC which could be interpreted as antecedents and consequences provided by patients for health care professionals use of LVC. Study II showed pressure from patients to receive LVC as a subcategory i.e., antecedent for using LVC. It also had the category *desire to do something for the patient*, which showed that the patient could serve as an antecedent for using LVC without expressing any expectations regarding a specific practice and that having done something could be a consequence that encouraged use of LVC.

All four studies within this thesis highlighted the importance of patients as a factor influencing health care professionals to use LVC. In Study I, patients made up one category; in Study II, patient pressure was a subcategory. In Study III, keeping patients satisfied to make sure that they remained listed at the center became important due to the financial system. In Study IV, expectations of being referred to an X-ray examination and expressed gratitude were antecedents and consequences encouraging use of LVC. Patients were thus a more influential factor for use of LVC than for implementation. The Consolidated Framework for Implementation Research includes patients in the individuals domain together with health care professionals (Damschroder et al., 2009, 2022), and most implementation theories, models, and frameworks do not emphasize patients as an influencing factor (Nilsen,

2015). There is strong support for the conclusion that patients is a more influential factor related to de-implementation. Similar findings have also been shown in other studies on de-implementation, for instance a literature review by van Dulmen et al. (2020), where patients was the third most important factor, after individual provider and organizational context.

Patients being a more influential factor is perhaps not surprising, since they, like health care professionals, can have previous experiences of specific practices and be interested in receiving them again. This is contrary to implementation, where patients do not have previous experiences of a new practice that should be implemented and thus will not have a strong opinion about it. Social reinforcement is one of the more influential consequences that encourages behavior (Cooper et al., 2019) and since patients are among the people the health care professionals interacts with most, they will influence their behavior.

However, it is noteworthy that patients were not the only factor that influenced use and de-implementation of LVC and that health care professionals did not use LVC for everything that patients express expectations on. For instance, Study I showed that practices lacking perceived negative consequences were more likely to be used and Study II showed that a desire to do something for the patients was a factor influencing use of LVC even when patients did not express expectations regarding a specific practice. This has been showed in previous research and discussed as something to incorporate more in medical education, to help health care professionals refrain from using unnecessary practices (Ayanian & Berwick, 1991; Keijzers et al., 2018). There seems to be a culture among both health care professionals and the public to expect that the patient receives some kind of examination or treatment when contacting health care (Verkerk et al., 2021). Seeing the results of one's work is a consequence that has been shown to reinforce behaviors (Daniels, 2000). Furthermore, health care professionals seem to overestimate the benefits of ordering unnecessary laboratory tests to reassure the patients (Takada et al., 2020). In practice, unnecessary tests do not seem to have that effect on patients (Rolfe & Burton, 2013).

7.2.3.2 Rule-governed behavior related to LVC

Both Study I and Study II showed that unclear or competing guidelines influenced use of LVC. This can be understood as either a lack of rules governing behaviors related to not using LVC or as competing rules governing behaviors related to using LVC. The ABA before developing the strategies in Study IV showed that there was a rule ("Use of X-ray examinations is a good way to diagnose knee arthrosis") governing behaviors related to the unnecessary use of X-ray examinations for knee arthrosis. Problems with guidelines not being specific enough to work as rules governing behavior could explain why they are not sufficient to influence use of LVC (Rosenberg et al., 2015).

7.3 STRATEGIES FOR DE-IMPLEMENTATION

The strategies for de-implementation in this thesis could be divided into strategies external to the organization, strategies within the organization, and strategies in the immediate environment of the individual health care professional. Without changing the three-term

contingencies or the rules governing behavior for the individual professionals, no real change can take place (McGee & Crowley-Koch, 2021). Therefore, the following section starts from the individual perspective and then moves outward.

7.3.1 Strategies influencing factors in the immediate environment of the individual

Strategies found in the studies were related to both the three-term contingency and rule-governing.

7.3.1.1 Strategies influencing three-term contingencies

In Study I, decision support, sometimes integrated in electronic health records, was described as a strategy for de-implementing LVC. According to ABA, decision support can be seen both as an antecedent making it clearer when a practice is considered LVC and as a consequence, by providing feedback on use of LVC. In Study III, removing LVC laboratory tests from standard ordering sets and not allowing junior physicians to order imaging examinations without approval from a senior physician were strategies to increase response effort, i.e., making it more difficult to reach the consequence that previously reinforced the behavior. Strategies that make it more difficult to use a LVC have also been found in previous studies (Ingvarsson et al., 2022; Patey et al., 2021). One such example is accountability tool, where professionals are not allowed to use LVC before being held accountable for their use either by documenting their reason for using the practice in the electronic health record or by describing it to a specialist (Ingvarsson et al., 2022).

In Study III, it was also concluded that strategies developed at a local level had the greatest potential, since they were the only ones interpreted as influencing the three-term contingencies related to use of LVC. This is not surprising, since it is in the environment close to the individual that the three-term contingencies exist and information about the immediate work environment is necessary to change them (Wilder et al., 2009).

Lastly, in Study IV, use of monthly feedback meetings was one of the strategies used to create consequences reinforcing the behavior of diagnosing arthrosis without using an X-ray examination. A process of differential reinforcement was used, where diagnosing arthrosis without the use of X-ray examinations was reinforced, leading to use of X-ray examinations being less reinforced with the intended effect of reducing unnecessary use of X-ray examinations. Furthermore, in the interviews with the participating physicians, both strategies were described as influencing the three-term contingency in an additional way. The discussions at both the lecture and the feedback meetings provided the physicians with new ways of communicating with patients about why they were not being referred for an X-ray examination. By changing their behavior when communicating with patients, the consequences expressed gratitude and relief from patients could be achieved without unnecessary use of X-ray examinations. This is another example of differential reinforcement. Educational and feedback strategies have been used in previous studies on de-implementation (Alishahi Tabriz et al., 2022; Colla et al., 2017; Ingvarsson et al., 2022;

Rietbergen et al., 2020; Takada et al., 2020). Identifying and encouraging replacement behaviors instead of behaviors related to use of LVC is a strategy similar to differential reinforcement and has been suggested by others for de-implementation (Patey et al., 2022). The use of ABA provided additional information about the mechanisms of the strategies, improving the possibilities to tailor them to the local context.

An interesting finding related to strategies for de-implementation was seen in the description of how feedback could be improved given by physicians in Study IV. They would have preferred more detailed feedback. In the study, they could only see how many X-ray examinations for knees had been ordered and how many patients were diagnosed with one of the two diagnoses at the center level. They would have preferred individual feedback on whether or not an X-ray examination was ordered correctly or incorrectly, and the same with the two diagnoses. Since ordering an X-ray examination would be correct behavior if a patient was being referred to an orthopedic surgeon for knee surgery, feedback only on number of ordered X-rays would include both patients for whom this was the correct course of actions and patients for whom it was not. This points to a problem with strategies based on differential reinforcement. Most examples of LVC are not practices that should never be used (Baker et al., 2013). If strategies using differential reinforcement were successful, this would result in practices never being used, which could be problematic. For instance, we want to de-implement the use of non-indicated antibiotics, but not of indicated antibiotics.

The fact that practices are rarely LVC for all patients can be interpreted as suggesting a need for strategies based on another principle from ABA: stimulus control. This involves behaviors occurring after certain antecedents, but not after others. To establish stimulus control, a process called discrimination training is used, where a behavior is only encouraged when a certain antecedent has occurred. Discrimination training includes providing consequences that encourage correct responses both for the use of a practice when it is consistent with guidelines and for not using a practice when it is not recommended. Examples of consequences can be feedback or rewards (e.g., Lerman et al., 2010).

The more specific feedback that the physicians in Study IV requested would be an example of discrimination training where they would receive feedback on having ordered X-ray examinations based on correct indications and having diagnosed patients with knee arthrosis without the use of an X-ray examination. Clinical decision support integrated into electronic health records would have a similar effect. This is a de-implementation strategy that has been shown to be effective (Alishahi Tabriz et al., 2022). De-implementation strategies based on providing a replacement behavior (Patey et al., 2022) may work, but need to be incorporated into the principles of stimulus control, so that the replacement behavior is only encouraged when the practice is considered LVC, not when it is recommended. The example of how to communicate with patients that treatment may be delayed by waiting for an X-ray examination could also function as discrimination training, since the argument would only work for patients not eligible for orthopedic surgery. Other outcome measures could also be relevant in studies on strategies based on stimulus control. Baker et al. (2013) divided

outcome measures into direct and indirect measures, where direct measures were measures of not only the volume of the use of a certain LVC, but also the value of the practice, i.e., how many patients should and should not have received the practice. This type of measurement has rarely been used in intervention studies. Most studies on de-implementation strategies use indirect measures to evaluate effects (Kjelle et al., 2021).

Even though patients' expectations are not the only factor influencing health care professionals to use LVC it could be relevant with strategies targeting these expectations. So far, strategies targeting only patients have not been effective (Alishahi Tabriz et al., 2022; Colla et al., 2017; Rietbergen et al., 2020). However, there is still a lack of studies on strategies targeting patients (Kjelle et al., 2021).

7.3.1.2 Strategies influencing LVC by using rule-governing

In Study III, it was found that guidelines were perceived as influencing behaviors which could be in the form of rule-governing. Since it is known that simply publishing guidelines recommending against a practice is not enough (Rosenberg et al., 2015), this suggests that guidelines need to have certain features to influence behavior. The regional guidelines in Study III were published on a webpage which described how they were connected to the health care system in that region. They were described by the physicians as a work tool that they often consulted while working with patients. The usefulness of the guidelines could be a reason why guidelines was found to be an effective standalone de-implementation strategy to reduce unnecessary imaging (Kjelle et al., 2021).

Short lectures to inform health care professionals and give them the opportunity to discuss the guidelines (Studies III and IV) is another way of implementing guidelines as a rule governing behavior. In Study IV, one of the physicians stated that one of the benefits of the lecture was that it became clearer that by waiting for an X-ray examination result, treatment for patients could be delayed, thus clarifying the rule "do not order an X-ray examination for diagnosing arthrosis as you may delay treatment." Short lectures are also one of the most common types of de-implementation strategies used (Ingvarsson et al., 2022). It has been concluded that educational strategies can be effective for de-implementation if combined with other strategies, but not as a single component strategy (Kjelle et al., 2021).

7.3.2 Strategies influencing factors within the organization

In Study I, several strategies influencing factors within the organization were found. Examples of these were processes and routines for managing LVC issues (e.g., meetings, reviews, and communication with care recipients and relatives) and managerial priorities for non-pharmacological management. In study I, how the de-implementation process was conducted was also described where strength of executive and clinical leadership and clarity of specific aims and objectives influenced de-implementation. In Study III, encouraging primary care centers to work with quality improvement could be seen as a strategy influencing factors within the organization. Data provided by the quality assurance system encouraged similar activities based on benchmarking data from other primary care centers.

Both strategies can be seen as creating an interlocking behavioral contingency, where working with quality improvement (behavior) could create better processes (outcome of behavior). The new processes would in turn provide antecedents and consequences influencing behaviors related to LVC.

It is worth mentioning that the principle used for strategies influencing the three-term contingencies would probably be worth considering when planning for strategies that influence interlocking behavioral contingencies. The focus should not be a general reduction of the use of a specific practice. As an example, it has been found that for-profit organizations, which are usually highly cost-conscious, do not show a lower use of LVC. On the contrary, fostering a cultural norm of avoiding LVC seems to be more important (Greenwood et al., 2016). Furthermore, reducing only high-cost LVC should not be the goal, since it has been shown that low-cost LVC makes up a large part of all LVC (Mafi et al., 2017).

7.3.3 Strategies influencing factors external to the organization

Studies I and III showed strategies influencing factors external to the organization. In Study I, a policy suggesting restrictive use of LVC and having a clear rationale for change could lead to lower use. Study III showed that strategies developed at a local level had the greatest potential to influence use of LVC but that the financial systems, scorecards, and quality assurance systems partly influenced development of local strategies. The financial systems, scorecards and quality assurance systems was in turn partly set by decision makers outside the primary care organizations, suggesting that such strategies can be effective.

Policy and regulation are also strategies that have been used for de-implementation (Ingvarsson et al., 2022). One successful example is a national strategy to reduce the use of antibiotics that has been implemented in Sweden, which resulted in reduced use of non-indicated antibiotics (Mölstad et al., 2017). Information campaigns is another strategy that has been used to inform the public on LVC (Ingvarsson et al., 2022). Information campaigns to the public was one of the more effective strategies for de-implementing unnecessary laboratory tests within primary care (Takada et al., 2020).

However, there seems to be a general lack of strategies influencing factors external to health care organizations related to de-implementation (Augustsson et al., 2022). What is known is that financial incentives are ineffective in improving compliance with guidelines in general (Flodgren et al., 2011). In Sweden, audit and feedback at an organizational level have been used in relation to use of antibiotics and potentially inappropriate medications for the elderly. Such feedback was given only on a yearly basis and was not perceived as helpful by the health care professionals, whereas strategies close to the daily operations were perceived as more influential in changing behaviors (Glenngard & Anell, 2021). Unsuccessful strategies for influencing factors external to the organization can also have a negative impact on the general motivation levels among health care professionals (Lang et al., 2022).

Similar challenges exist related to strategies targeting the public or the financial incentives of organizations since the goal is rarely to entirely remove the use of the practices. Caution has been urged regarding relying too much on indirect measures of LVC, since this creates a risk of reducing the use of the practice for patients for whom it is evidence-based and masking unnecessary use behind a generally low use of a practice (Baker et al., 2013). For example, the UK had a low use of coronary artery bypass grafting, but a substantial proportion of procedures were still judged to be inappropriate (Bernstein et al., 1993). A suggestion based on Study III is not to expect health care organizations to reduce their use in absolute numbers, but to continually work with improving their routines to avoid using practices that are LVC. Baker et al. (2013) suggested that clinical decision support that provides feedback based on direct measures could be a potential strategy for de-implementation (Baker et al., 2013). Another way is to use feedback based on indirect measures combined with peer comparison (e.g., O'Connor et al., 2022).

7.4 METHODOLOGICAL CONSIDERATIONS

All research has limitations, including the four studies of this thesis. In Study I, an arbitrary time limit was added to the search strategy based on a subjective evaluation of which year the number of studies started to increase. This was done to make the number of studies feasible to work with but may have resulted in missing earlier studies. The purposeful sampling method in Study II could also have been problematic. The LVC practices selected for sampling and as examples to discuss during the focus group discussion may have influenced the discussions and made the results relevant only to the selected laboratory tests. To limit that effect, the examples of LVC were not mentioned until more than half of the discussion had past, to first obtain information on the physicians' general perspective on LVC and what influenced its use. In Study III, the number of interviews was limited. This was related to the timing of the study during the COVID-19 pandemic. The interviews were conducted during the initial phase of vaccinations when the primary care centers were busy with vaccinations of patients in risk groups, which made it hard to recruit participants. However, according to Guest et al. (2006), twelve interviewees should be sufficient if the informants are knowledgeable about the subject, data quality is satisfactory, and the aim is to understand common perceptions and experiences rather than to assess variation between groups. We estimated that the criteria proposed by Guest et al. were fulfilled, and the two final interviews did not provide any contradictory or new data. Study IV was a small-scale study, and the results should be interpreted with caution. The lack of individual data makes the results difficult to interpret, since it is not known if they were affected by the physicians who had participated in the intervention or others. However, the small study also made it possible to study the interventions more closely, understand which factors may have influenced use, and gather data from the physicians on how the interventions could be further improved.

7.4.1 Trustworthiness of qualitative findings

All studies used qualitative methods, either solely or in combination with other methods. The validity, reliability, and generalizability of the qualitative findings will now be discussed.

Different aspects of trustworthiness will be described using the concepts credibility, dependability, and transferability (Graneheim et al., 2017; Graneheim & Lundman, 2004).

7.4.1.1 Credibility

Credibility is related to how well the qualitative data and data analysis fit the aim of the study (Graneheim & Lundman, 2004). In Study I, the research team used the methods of a scoping review to overview the field of de-implementation. An inductive analysis of the data was conducted which was described in detail in the manuscript to make the process as transparent as possible. All co-authors were involved in the data analysis. In Study II, the research team used a purposeful sampling method to get a large variation in uses of LVC. We then conducted semi-structured focus group discussions that allowed the physicians to have an open discussion among themselves, to get a full picture of their perceptions. The number of centers included in the study was estimated to be sufficient (Guest et al., 2017). In Study III, the research team used a combination of purposeful sampling and snowball sampling. The purposeful sampling was done to find participants with a sound understanding of the different management strategies used within each of the organizations participating in the study. We also aimed at having participants from a variety of organizations, both public and private, and from different regions. Snowball sampling was then used through the purposefully sampled participants, who suggested ways of contacting managers or key stakeholders within their own organizations. The data analysis was performed in two steps, first an inductive analysis and then a deductive analysis. All co-authors were involved in the analysis. Lastly, in Study IV, four interviews were conducted with physicians who had been part of the two strategies. All physicians were invited to participate in the interviews, but only those who felt they had participated in all or most of the strategies agreed to participate. This may have resulted in limited information. However, those who participated were well-informed physicians who provided rich data. The data analysis was again performed in two steps, first an inductive analysis and then a deductive analysis. All co-authors were involved in the analysis.

7.4.1.2 Dependability

Dependability is related to the degree by which data change over time and how consistent data collection is (Graneheim & Lundman, 2004). This was promoted by using interview guides in all the studies and by reviewing the data analysis process among the co-authors.

7.4.1.3 Transferability

A way to enhance the understanding of a study's transferability, i.e., to what extent findings can be transferred to other groups or settings, is by providing a detailed description of the participants, the setting, the data collection, and the data analysis process (Graneheim & Lundman, 2004). These aspects have been described within the methods section and in the methodological considerations for the studies. In Studies II and III, we sought to include a variety of settings to enhance transferability. However, the Swedish setting is unique and the extent to which the results can be transferred to other nations remains unclear.

7.4.1.4 Reflexivity, reciprocity, and confirmability

Reflexivity is related to the researchers' own processes in gathering and analyzing data. Different preconceptions can influence data interpretation and it is important to both be aware of them in so far as possible and to question and re-evaluate the conclusions (Patton MQ, 2015). This has been done both individually and through repeated discussions among the co-authors of the studies.

Reciprocity is related to the interaction between researchers and participants (Patton MQ, 2015). Studies II, III, and IV all relied on active participation from health care professionals. All participation was voluntary and based on the participants' own interest. The participants underlined that they perceived the focus of the studies as important and hence valuable to participate in, to further the understanding of the research topic. In Study II, the focus group discussions were conducted during regular meetings to limit disturbances of their normal routines and light refreshments were provided. In Study II, all interviews were conducted via Zoom and scheduled as appropriate for the participants, to limit intrusion. In Study IV, all information was provided and gathered during regular physician meetings.

Confirmability is related to the extent to which results can be confirmed in other studies and be useful in clinical practice (Patton MQ, 2015). Since similar results can be found in all four studies, where Study I was a scoping review, there are indications that the results can be interpreted as confirmed. Based on the answers in the interviews in Study IV, they would also appear to potentially be useful in clinical practice.

7.4.2 Overall generalizability of thesis findings

All studies except the scoping review (Study I) were conducted within Swedish primary care. There are differences between different countries' health care systems. However, similar findings have been found in other international studies, suggesting that the findings could be relevant outside Swedish primary care. In Study III, three different regions were included, with Region Stockholm being the largest region in Sweden and Region Halland being one of the smaller. This suggests that the findings have relevance regardless of region size.

The studies focused predominantly on medical LVC practices. Most studies within Study I and Studies II to IV were related to medical examples of LVC. This means that other types of LVC practices such as psychosocial, physiotherapy, or dentistry practices were not addressed. It is not clear if findings for other LVC practices would be similar. Furthermore, Studies II, III, and IV all targeted physicians as a group, limiting the ability to generalize to other professional groups.

7.5 ETHICAL IMPLICATIONS OF STUDIES ON LVC

Some ethical implications are relevant to the topic of this thesis. First, de-implementing LVC should be discussed not only as a theoretical dilemma, but also as an ethical issue. The perceptions of the physicians found in Study II are noteworthy. They sometimes preferred to use a LVC practice to avoid something that they considered to be a low-value process

(unnecessary patient visits or spending time convincing a patient of a specific practice's lack of benefits). This points to potential goal conflicts. It also raises questions about what the most important goals are for health care organizations and in what ways they can best use their limited resources to serve the public. Should they avoid LVC even if this increases costs? In the qualitative interviews in Study IV, this dilemma was probably mainly related to practices that were LVC but with low cost and low risk for patients. This suggests that the physicians were mainly focusing on alternative costs, i.e., the cost of the LVC practice versus the cost of the extra time spent on a patient visit. It could be worth considering adjusting the definition of LVC to incorporate the health care professionals' perspectives on the research-based definition of LVC.

Another ethical aspect was the perception that other management strategies could unintentionally influence use of LVC. In Studies II and III, these included reducing the waiting time for patients and the increased number of private health care providers that used marketing campaigns to recruit patients by encouraging patients with mild symptoms to seek health care. In the interviews in Study II, the physicians described feeling that both the efforts to reduce waiting times and marketing campaigns increased unnecessary visits since the message to the population was to expect short waiting times and to get health care for uncomplicated symptoms. Once the patients were at the center, the visits in themselves were perceived as leading to use of LVC.

Lastly, it is worth considering the patients' perspective. Patients seem to play an important role in what influences use of LVC both at an individual level, in their interactions with the health care professionals, and at an organizational level, by influencing organizations to provide LVC. This thesis has not explored what would influence patients not to expect LVC. It is interesting to consider what would happen if the use of LVC was explored from the patients' perspective. What would make them feel secure in the knowledge that they would receive evidence-based care?

8 CONCLUSIONS

This thesis has provided knowledge about factors that influenced use of LVC as well as an understanding of how strategies for de-implementation could be developed. Factors external to the health care organizations seem to create a demand for LVC, mostly inadvertently through financial conditions that provide payment or reduce costs in relation to LVC. Factors within health care organizations, such as lack of continuity and standard ordering sets for laboratory tests, can also influence use of LVC, as can factors in the immediate environment of the individual health care professionals, such as problems with guidelines, pressure from others, and a desire to do something for patients.

Thus far, de-implementation strategies developed at a local level seem to have the greatest potential to influence use of LVC. These strategies can be better adapted to local contextual factors. One way of doing so is by using ABA to understand local contextual factors or in ABA terms – contingencies. Strategies that influence processes, such as improved continuity or removing unnecessary laboratory tests from standard ordering sets, also have the potential to reduce use of LVC. Lastly, there is a lack of strategies targeting factors external to the health care organizations, even though these factors influence use of LVC.

9 POINTS OF PERSPECTIVE

Based on the conclusions of this thesis, some suggestions can be made for future research and practice.

9.1 IMPLICATIONS FOR RESEARCH

Future studies should focus on strategies for de-implementation not only from the health care professionals' perspectives, but also from the patients' perspectives. Through the studies in this thesis, patients have been shown to be a very important factor influencing use of LVC. More information is needed to understand why they ask for LVC and what strategies they would perceive as helpful for reducing use of LVC.

More research is also needed related to strategies for de-implementation of LVC. Ideally, strategies should target factors that influence use of LVC. That would imply that strategies dealing with factors external to health care organizations such as financial conditions, as well as strategies changing processes within organizations, could be tested. The findings from Study IV suggest that strategies based on both the three-term contingency and rule-governing behavior could be effective. These could be further improved by considering the principle of stimulus control where feedback is delivered based on so-called direct measures rather than indirect measures. Direct measures relates not only to the volume of use of a specific LVC, but also to how many patients receive the practice correctly versus incorrectly. Study III suggested that strategies at a regional level were needed alongside local strategies, but how such strategies should be designed could be the focus of future studies.

Furthermore, there is a lack of direct measures of LVC. This has been suggested as solvable by using clinical decision support integrated in electronic health records, which could provide both precise feedback to individual health care professionals on their use of LVC and prevalence data to health care organizations.

9.2 IMPLICATIONS FOR PRACTICE

To improve their work, organizations should consider looking into factors both external to the organization, within the organization, and close to the health care professionals. Inadvertent effects of financial conditions could be further investigated to develop strategies that eliminate or compensate for them as well as reviewing processes within the organizations that can lead to LVC such as patient and health care professional continuity and standard ordering sets. The findings of this thesis suggest that strategies developed at a local level have the best potential to influence behaviors related to use of LVC. Development of such strategies could be encouraged as part of the follow-up of health care organizations and by managers within the organization. Indirect measured of volume of LVC use can be problematic since practices are rarely LVC for all patients. Direct measures include value, i.e., for how many patients the use was considered LVC and for how many patients it was considered evidence based. However, direct measures are more difficult to collect. Instead, performance indicators could

be designed to measure how organizations work with continuous improvement related to LVC rather than how they use different LVC.

10 ACKNOWLEDGEMENTS

At the end of a long doctoral education, with all the stress related to finishing the thesis, I lost track of how most of my time as a student had been. I had to remind myself what a luxury this has been. Getting paid to study. Having the time to dive into the research literature, practice different research methodologies, to listen to experts, and discuss with colleagues. I have enjoyed it so much and it is a bit sad to realize that it is over. I have a lot of people to thank for this experience.

First, a big thank you to my main supervisor Henna Hasson. You wrote that I need to thank myself in the acknowledgements for coping with everything related to my studies – but I think that you deserve a thank you for coping with me. I know that I haven't been the easiest student to handle – full of my own ideas on what theoretical methods we should use for a project that you are responsible for. A teacher in one of my Ph D courses once said that you shouldn't recruit a doctoral student who is over 40 years old because they are too set in their ways. I think it may be true. Despite this, you have coped with me. You listened to my ideas and preferences and tried to accommodate them as much as possible. As a supervisor, you have been outstanding. Whenever I needed you, you made time for me. Even though you are a very busy person, you rescheduled and went on walks with me to discuss important issues related to my studies. When working with our manuscripts, you always kept the deadlines that you promised for reading, reviewing, or discussing everything related to the studies. You are one of the reasons that I have coped with everything during my studies. Thank you for inviting me to be part of your research projects.

Second, a thank you to my two excellent co-supervisors Hanna Augustsson and Per Nilsen. I have enjoyed all our meetings and e-mail interactions. Hanna, you have been a big support during these years and even though you were in Australia during the first year, you have always felt present. You have also been a hands-on supervisor with all the aspects of my studies, including the labor-intensive work with all the steps of the scoping review. You have also been an outstanding manager for our research group, creating a great scientific community as well as a welcoming and fun social environment. Per, I have enjoyed our discussions and you are a big part of raising the quality of my manuscripts. It is a great experience to see how something I have written comes back from you, revised with improved language without losing its meaning. You have also been my biggest supporter in using the theoretical perspectives that I have suggested including incorporating them into your own writing and teaching.

I also want to thank my mentor Lise Roll Pettersson. I have always enjoyed our discussions and some of the references you have provided have been crucial for my academic achievements. You are one of the reasons I am continuing to work within academia after my dissertation instead of going back to my consultant career.

Marta Roczniewska – together with Hanna, you have created a great research group. We have had so many great discussions on research topics, as well as doing fun activities together.

You are also one of the most caring managers that I have had. During the COVID-19 pandemic, whenever I had not been present during our daily check-ins on Teams for a couple of days, you reached out, asked me how I was doing, and made sure that I was okay. It was a privilege to have you as my manager.

To Ulrica von Thiele Schwarz, co-author in all my studies. You have been and still are a very important person for me. We have known each other for 27 years and have studied and worked together for many of those years. You chose the academic career long before I did, and I must admit that it was not that encouraging to arrive in a research group of which you were one of the founders. Until the moment I started working there, I had thought of myself as a fairly intelligent person. As a team, we had received a lot of praise for our work, both during our academic studies and when we worked together. When I started as a Ph D student and heard everyone discussing all your accomplishments, it dawned on me that perhaps I wasn't as intelligent as I thought. Perhaps I have only accomplished all my successes during all those years because you were there to create them, and I was only along for the ride. But you have never complained about that and in my four studies – especially the fourth one – you were a great sounding board for discussing all the findings, being so knowledgeable and encouraging.

To Ingunn Sandaker. I hope you read this. You are my savior. Before my half-time review, I felt so lost. I wanted so much to be able to integrate my theoretical background with my doctoral studies but had no experience of how to do that. My supervisors were supportive, but also lost regarding what would be the best way to do it. You stepped in and provided me with scientific articles describing how to use the theories in qualitative studies and how to design intervention studies using single case design. I have learned so much from you and felt so supported.

To Mia von Knorring, co-author of study II. In hindsight I know I reached for too much by doing a grounded theory approach instead of a content analysis. We spent numerous hours during the COVID-19 pandemic in conference rooms with the manuscript on a big screen to keep our distance while analyzing and discussing the data. I learned so much from the process both related to qualitative analysis and to scientific writing. You have also been a source of energy whenever I meet you at the office and I have always felt supported by you. Your feedback on this Kappa has been invaluable and I hope you feel that I made use of it.

To my past and present colleagues at Procome. Marie Dahlberg, Lina Wannheden, Emma Hedberg Rundgren, Ana Hagström, Annika Bäck, Veronica-Aurelia Costea, Ami Bylund, My Sjunnestrand, Charlotte Klinga, Clara Lindberg, Lana al Soufi, Anne Richter, Rebecca Mosson, Sara Korlén, Sara Ronja-Li Delilovic, Joel Freilich, Markus Saarijärvi, Håkan Uvhagen and Kamil Szymanski. We have had so much fun and so many valuable scientific discussions. It is interesting that when we listed what was important for our group, we focused only on the social aspects of our group. Still, a large part of the social climate of our group is being able to discuss our research with each other – even when we do not work with similar projects.

To past and present doctoral students. Linda Sturesson Stabel, Therese Scott-Duncan, Fanny Goude, Mimmi Åström, Cecilia Dahlgren, Emma Granström, Mairi Savage, Agnes Elmberger, Oliva Erntsson, Emma Spånberg, George Keel, Rafiq Muhammad, Anne Leppänen, Max Kleijberg, Philip Gedin, Cara Swain, Sophia Appelbom, Eva Lagging, Pernilla Lundh, Therese Johansson, Kenneth Hagström and Leo Kowalski. I have learned so much from you. Some of the more informal discussions we have had during fika, lunch, afterwork, or activities arranged by LDN have helped me with several complicated research problems. It has been a very supportive collective to be part of, where problems can always be discussed. We have also had a lot of fun.

To Rolf Olofsson. You know that this is all you fault. Almost 20 years ago, you introduced me to the scientific field of organizational behavior management. After that I was hooked. You have taught me almost everything I know, and you have been so generous in sharing clients and consultant projects.

To my colleagues outside LIME – Hanna Wijk, Kenneth Nilsson, Elisabeth Nilsson Ihrfelt, Constanze Eib, Marika Melin, and Maria Backman. During these years, working with you has been a nice break in my studies. You have always been curious about my thesis work and have provided an outside perspective that has been very helpful.

To all my friends but especially to Monika Kullberg and Åsa von Brömsen. You are my social heroes. I'm not that good at initiating social activities. You two have been superstars at spontaneous walks, drinks and dinners. I'm looking forward to more of that now that I am done with this thesis.

To my parents, Elisabeth Lindström and Hans Lindström. I wish you could have attended the public defense here at KI. I hope I have made you proud. To my brothers, Tomas Lindström and Magnus Lindström Kolterud. Thank you for spending time with me and asking curious questions about my research. I am privileged to have grown up in a home supporting academic achievement combined with a large social network.

To my family. Without you, I have nothing. You are my life, my warm hug that is always available, my high five when I succeed, my "you can do it!" when I struggle. I know, I have not been the easiest person to be around especially during these last six month. Still, you have persevered being in my presence and provided me with so much love and support. Cristian, going to the gym with you is one of the aspects that have kept me (well at least fairly) sane during my doctoral studies. I love spending time with you and can listen to the same stories from you over and over again. Our movie nights and nature excursions are treasured experiences and I look forward to more of those. Tova, I love talking with you about everything from reality tv shows to future career choices. Sometimes I wonder who the parent in our relationship is. You are such a wise and caring person. Henrik, I love you so much. We have built a lovely home together that (almost) always relaxes me. Thank you for all the dinners, cleaning, grocery shopping, clothes-washing and dishwasher-loading as well

as all the travel, concert and football bookings and restaurant and wine choosing. You are my anchor, keeping me grounded and the calming presence I need.

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