Quality and coordination in home care:
A national cross-sectional multicenter study – SPOT^{nat}

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TABLE OF CONTENTS

List of Abbreviations

ADUA	Administrative Daten und Anfrage (administrative data and query)
AE	Adverse events
AHRQ	Agency for Healthcare Research and Quality
AIC	Akaike Information Criterion
AITCS	Assessment of Interprofessional Team Collaboration Scale
ANOVA	Analysis of Variance
BScN	Bachelor in Nursing
CAHPS®	Consumer Assessment of Healthcare Providers and Systems
CC-MC	Patient-Perceived Continuity of Care from Multiple Clinicians
CFA	Confirmatory factor analysis
CFI	Bentler Comparative Fit Index
CHF	Swiss Francs
CI	Confidence Interval
CNAs	certified nurse assistants
COORA	Care Coordination framework
COPSOQ	Copenhagen Psychosocial Questionnaire
COVID	Coronavirus disease
CP	Client copayments
CPAT	Collaborative Practice Assessment Tool
CPCQ	Client Perceptions of Coordination Questionnaire
CSV	Comma Separated Values
DDI	Data Documentation Initiative
ECHO	Economic, Clinical and Humanistic Outcomes
ED	Emergency department
EHR	Electronic Health Records
EKNZ	Ethics Committee of Northwestern and Central Switzerland
FDR	False Discovery Rate
FSO	Federal Statistics Office
FTE	Full-time equivalent
HHCAHPS®	Home Health Care of the Consumer Assessment of Healthcare Providers and Systems Survey
HI	Health Insurance
HPSI	Health Professions Stress Inventory
IBenC	Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care
ICC	Intraclass Correlation Coefficient
INS	Institute of Nursing Science
IQR	Interquartile Range
IR	Incidence Rate
IRR	Incidence Rate Ratio
IST	Information Technology Services
KVG	Federal Health Insurance Act
KLV	Swiss ordinance on health-care insurance benefits (Krankenpflege-Leistungsverordnung)

LPNs	Licensed Practical Nurses
n	Number
N/A	Not Applicable
NAs	Nurse Aides
NASA TLX	NASA task load index
NFI	Normed Fit Index
Obsan	Swiss Health Observatory
OECD	Organization for Economic Co-operation and Development
OR	Odds Ratio
PES-NWI	Practice Environment Scale of the Nursing Work Index
PREM	Patient-reported experience measures
PROM	Patient-reported outcome measures
QI	Quality Indicator
RAI-HC	Resident Assessment Instrument – Home Care
RCS	Relational Coordination Scale
RF	Residual Financing
RN	Registered Nurse
RN4CAST	Nurse forecasting in Europe study
RRR	Relative Risk Ratio
SAQ	Safety Attitude Questionnaire
SD	Standard Deviation
SHURP	Swiss Nursing Homes Human Resources Project
SO	service obligation
SOP	Standard Operating Procedure
SPOT	Spitex work environment pilot study
SPOT^{nat}	Spitex Koordination und Qualität - eine nationale Studie (homecare coordination and quality – a national study)
SRMR	Standardized Root Mean Square Residual
U.S.	United States of America
VIF	Variance Inflation Factor
WHO	World Health Organization
WLC	Work-Life Climate
β	Beta coefficient estimate

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Summary

Homecare services include a wide range of medical treatments and therapies, basic care (e.g., personal hygiene), domestic services (e.g., household support) and social services. However, it has been neglected in most countries compared to hospitals and nursing homes, especially regarding healthcare research. As a result, while many countries see high-quality, sustainable care at home as a high-value goal, there are many knowledge gaps in the homecare setting. For agencies, challenges include an increasing demand combined with a workforce shortage, constant cost pressure, and issues with both care coordination and care quality.

Problematically, owing to a long shortage of research, knowledge of these elements is scant. In this sector, large-scale studies that consider macro-, meso-, and micro-level factors and incorporate multiple perspectives and measurements to capture coordination and quality of care are extremely rare. When the SPOT^{nat} study (Spitex Koordination und Qualität - eine nationale Studie (homecare coordination and quality – a national study)) began, no published study had examined how homecare agencies perform regarding care coordination. More importantly, though, none had determined which factors are associated with care coordination in the homecare setting. Moreover, across the entire health sector, no clear, accepted concept was available either of what exactly constitutes coordination, or of what it entails.

This dissertation is embedded in the SPOT^{nat} study. Preparing it, the overall goal was to deepen our understanding of the homecare sector regarding care coordination and quality. Therefore, a preliminary goal was to clarify the concept of care coordination. Later goals included describing the various financial and regulatory mechanisms operating in the Swiss homecare setting. That information made it possible to explore how those factors relate to homecare agencies' structures, processes, and working environments, how system and agency factors are related to care coordination, and ultimately how care coordination is related to quality of care.

CHAPTER 1 presents the background, the target research gap and the rationale behind this dissertation. We look closely at the unique challenges of the homecare setting, particularly regarding coordination and care quality.

In **CHAPTER 2** we establish a theoretical basis for care coordination and explain how the concept of coordination can be understood and measured. Our newly-constructed COORA (care coordination) framework differentiates clearly between coordination as a process—i.e., tasks people perform to coordinate versus coordination as a state, i.e., the desired outcome

of the coordination process. Applying this distinction to both measurement and interpretation of results helps avoid misleading conclusions.

The COORA theoretical framework is based on the full range of influential coordination literature. Iteratively developed in consultation with healthcare professionals, patients and their relatives, it considers the complex relationships between the many factors influencing coordination (as an outcome), and is applicable not only to homecare but across healthcare settings. However, measurement of both care coordination and quality of care remains a challenge. Further research will be necessary to develop and validate a questionnaire that reliably measures care coordination as an outcome.

CHAPTER 3 presents the research protocol for the SPOT^{nat} study, a national multi-center cross-sectional survey in Swiss homecare settings. That study included 88 homecare agencies. Using public records and data from questionnaires sent to those agencies' 3323 employees (including managers and homecare staff), 1508 clients and 1105 relatives of those clients, the SPOT^{nat} research team gathered data on homecare financing mechanisms, agency characteristics and homecare employees' working environments and coordination activities, as well as staff- and patient-level perceptions of coordination and quality of care.

CHAPTER 4 discusses our analyses of how regulatory and financial mechanisms explain differences in agency structures, processes and work environments. Based on the mechanisms acting on the participating agencies, we divided them into four groups. Our analyses showed considerable inter-group differences, especially in the range and volume of services provided, but also regarding their employment conditions and cost structures. The most prominent inter-group differences related to the conditions of their cantonal and municipal service agreements. Alongside such details, financial incentives must harmonize the care goals, i.e., achieving and maintaining accessible, high-quality homecare, with the regulatory goals, i.e., assuring the quality and financial sustainability of that care.

CHAPTER 5 includes an analysis of how selected explicit and implicit agency-level coordination (process) mechanisms are linked to successful coordination (as an outcome). The results revealed that several implicit mechanisms, i.e., communication/information exchange, role clarity, mutual respect/trust, accountability/predictability/common perspectives, and knowledge of the health system, all correlate with employee-perceived coordination ratings. We also found that certain coordination mechanisms mediated the effects both of agency characteristics (i.e., staffing/ workload and overtime) and of external factors (i.e., regulations).

In **CHAPTER 6**, the final included study gives insights regarding how both homecare employees' and clients' coordination-relevant perceptions relate to one another's quality-of-care ratings. Our analyses indicate that employee-perceived care coordination ratings

correlate positively with their own ratings of their quality of care, while client-perceived care coordination problems correlated inversely with client-reported quality of care. Client-perceived coordination problems also correlated positively with hospitalizations and unscheduled urgent medical visits, but not significantly with emergency department visits. No associations were found between employee-perceived coordination and either healthcare service utilization or client quality-of-care ratings. Alongside these relationships, various coordination deficiencies, for example, poor information flow, also became apparent.
To conclude, **CHAPTER 7** provides a synthesis of the main findings and discusses the results in relation to practical, political and research implications. While contributing further to the understanding of care coordination via the COORA framework, this dissertation also raises various methodological issues. From a practical perspective, measuring and operationalizing both coordinating processes and quality of care outcomes remain challenging issues. While our qualitative results suggest that improving coordination will lead to higher-quality care, testing and ultimately exploiting any such relationship will require not only improved financial and technical structures, but the abandonment of outmoded siloed attitudes regarding the entire homecare sector.

CHAPTER 1

Introduction

Homecare

Homecare is defined as „health service provided in the patient's place of residence for the purpose of promoting, maintaining, or restoring health or minimizing the effects of illness and disability“ [1]. It can include a wide range of medical treatments and therapies, basic care (e.g., personal hygiene), domestic services (e.g., household support) or social services. Demand for these services has soared in recent years and will continue to do so. While this sector faces unique challenges, it has been neglected in most countries compared to hospitals and nursing homes.

The level of neglect is particularly high regarding homecare research. Even though many healthcare administrators voice support for sustainable, high-quality care at home, few resources have been allocated to answer questions about how the homecare sector works. As a result, especially in relation to coordination and quality, its influencing factors have been poorly studied.

This dissertation’s overall aim was to deepen the understanding of the homecare sector regarding care coordination and quality. After discussing how the pressure on healthcare systems is increasing, this chapter highlights the importance of the homecare sector and its specific challenges. Subsequently, it describes the challenges to defining and measuring quality of care in the homecare sector. This is followed by an overview of available evidence concerning relevant aspects of care quality. Then, after describing the concept of care coordination—which is fundamental to quality and an overarching theme of homecare—it unpacks many of this field’s contextual complexities. This section concludes by outlining the Swiss homecare context, the research gap this dissertation attempts to bridge, and other objectives not only of this dissertation but also of the SPOT^{nat} project in which it is embedded.

Growing pressure on healthcare systems

Globally, 2018 was a serious demographic landmark: It was the first year in history that persons over 65 years of age outnumbered children under five [2]. By 2050, the 65-and-older demographic will include every fourth person living in Europe and North America. Meanwhile, the number of persons aged 80 and older is expected to triple, from 143 million in 2019 to 426 million in 2050 [2]. This increase in age will accompany increases in the numbers of chronically ill and/or multimorbid people (i.e., those with two or more chronic conditions). Thus, a higher prevalence of care dependency is to be expected [3-5]. In 2013, the prevalence of multimorbidity was 76.6% among people aged 65 years or older in Switzerland [6]. And in 2020, the estimated prevalence of multimorbidity in the U.S. was 50% of the total population of all ages [7].

These developments pose new problems for healthcare systems. One weakness many systems share is that, despite an increasing need to focus on the long-term management of chronic diseases and symptoms across the population [4, 5, 7], most remain focused on acute care. In addition, with the current rate of technological advancement, diseases are becoming more manageable [8, 9]. However, these advancements have led to increases not only in healthcare systems' complexity, but also in their costs [7, 9-11]. In addition, patients with chronic disease have gradually-increasing unmet needs and often rapidly-increasing out-of-pocket healthcare expenses [10, 12]. Therefore, healthcare systems around the world are looking for ways to reduce healthcare costs and ensure high-quality, sustainable care systems [13]. To optimize health system performance, they aim to reach the quadruple aim: improve patient-level care experiences, population-level health, and healthcare providers' work life, while reducing costs [14].

The increasing importance of homecare

Within the context of increasing numbers of older, multimorbid people and the high cost of acute-care hospital stays, homecare is often a cost-effective alternative. As such, it is promoted by many national governments [15-19]. Further, the individualization of patient care and homecare clients' desire to live as independently and autonomously at home for as long as possible—to be cared for and supported in their own homes and, if possible, to grow old and die at home—have led to a growing demand for homecare [17, 20, 21]. The number of homecare clients is steadily increasing. In Switzerland, with around 8.7 million inhabitants, just under 410,000 persons—roughly 5% of the total Swiss population—received homecare services in 2021 [22]. Between 2019 and 2040, that number is expected to increase by 52%. That will mean 101,921 more clients, or a yearly increase of 4,853 clients until 2040 [23]. Similar trends are observable across other OECD countries [21].

As the homecare workforce adapts to meet its clients' care needs, the importance of its role is increasing. Between 2012 and 2019, the number of Swiss homecare workers increased by 39%, to roughly 41,000 [24]. By 2029, matching the projected demand will require another 19% [24]. To complicate matters, though, the current nursing shortage is expected to become increasingly severe.

Challenges to homecare

With homecare's increasing popularity, care workers are confronted not only with rising numbers of homecare clients but also with more complex service needs [25-28]. Clients are older and sicker, often with multiple chronic conditions. This includes a higher prevalence not only of physical disabilities but also of cognitive impairment than they dealt with 10 years ago [25]. In addition, as clients are discharged earlier from hospitals, their homecare must include more complex treatments and care [7, 29]. At the same time, as in other healthcare sectors, despite increases in both demand and complexity, homecare agencies are bound by ever more stringent financial constraints [13].

Although the homecare sector faces similar challenges to other branches of care, providing care at home is fundamentally different from doing so in care institutions such as hospitals or nursing homes. Compared to their institutional colleagues, care workers typically work alone, with little direct contact with physicians or other health professionals. As a result, possibilities for quick support in critical situations are very limited [30-32]. Their working takes them into their clients' home, the streets and their local homecare office. Because homecare is provided in the client's living environment, where care workers are "visitors," the clients are more involved than institutional patients in decisions that influence their well-being [30].

In addition, while every home is unique, resources such as equipment and supplies (e.g., nursing beds, patient lifts, dressing trolleys, pain medications) are typically less available than in institutions [33-35]. And homecare is delivered not continuously over 24 hours, but rather at intervals (e.g., once per week). The rest of time, the homecare nurses have very limited influence regarding the client's actions [30].

In many cases, homecare workers work alongside informal caregivers, but have neither decisional authority, e.g., regarding how those informal caregivers carry out their care tasks, nor the opportunity to observe the quality of the care they provide [30, 36]. Compared to institutional care providers, homecare workers are commonly faced with more administrative duties, especially regarding reimbursement [34, 36].

Although homecare workers' direct contact with other healthcare providers is limited, this does not mean they are isolated with their clients: while they go alone to clients' homes, they commonly work alongside other occupational groups, including voluntary services and relatives [32, 33]. Depending on which other health professions are involved in their clients' care, they also participate in a network of interactions and interdependencies on other service providers. These commonly include general practitioners, specialist practitioners, pharmacies, social workers, non-governmental organizations (in Switzerland, e.g., the Red Cross, Pro Senectute, the Lung League), daycare centers, nursing homes, hospitals, rehab centers and the full range of therapeutic services, e.g., physio- or ergotherapy, diabetes counseling, wound consultations, etc. [37]. As the number of patient-provider relationships grows, care coordination becomes more and more important. In fact, it has become a key feature of homecare services.

Care Coordination

Over recent decades, attitudes toward healthcare have tipped from volume to value. That is, successful care depends not only on the number of hours of care and the specific tasks fulfilled, but whether the care provided is appropriate and timely, and how well the necessary tasks are performed [38]. As the numbers and frequencies of treatments and therapies rise, it becomes increasingly important to understand and efficiently align the involved disciplines and professionals. The right care services need to be delivered to the right person and at the right time [29, 39], not only to prevent negative patient outcomes but also to prevent resource waste. Poor care coordination has repeatedly been associated with greater likelihoods of hospitalization, emergency department visits [40-42], medical, medication or laboratory errors [43], conflicting information, unnecessary medical tests and information gaps between primary physicians and specialists [40-42].

As the positive impact of care coordination has been recognized, various nations' governments have named it as a policy priority [44]. In a 2016 strategic directive for healthcare delivery, the Swiss Federal Office of Public Health focused strongly on coordination, defining "coordinated care" as "the totality of procedures designed to improve the quality of care provided to patients throughout the treatment chain" [45].

Still, even though the importance of care coordination is recognized, only 7% of healthcare directors, managers or clinicians consider their patients' care to be fully coordinated across healthcare settings [46]. The National Academies of Sciences [47] stated that in many countries, healthcare activities are siloed as independent activities, i.e., lacking inter-setting connections. Healthcare professionals are also trained differently, often lacking the know-how for true teamwork and coordination; and patients often stay passive even when their situations call for active involvement. To make matters worse, service providers and payers often either compete or work directly against each other rather than seeking out and developing synergies.

The challenging concept of care coordination

Two main challenges are the conceptualization and operationalization of care coordination. First and most importantly, conceptualization—or rather the confusion surrounding it—is a major issue: neither the definition, the description nor the associated activities of the coordination concept are clearly described in the literature. This is especially true in healthcare contexts [48, 49]. Second, and as a consequence of the issues with conceptualizing care coordination, the concept has been operationalized in widely varying ways [50]. I.e., considering that validity, reliability and accuracy are vital to measure, compare, and evaluate the concept of care coordination, it suffers from a number of problems that severely impede research on it.

The first problem is the many definitions of care coordination. While there is an abundance of literature on care coordination, it has no widely-accepted definition. Even in 2007, McDonald et al.[51] found over 50 different definitions of it. To narrow their focus, they identified five core elements:

(1) It involves numerous participants;
(2) It is necessitated by interdependence among participants and activities;
(3) It requires knowledge of others' roles and resources;
(4) It relies on information exchange; and
(5) It aims to facilitate appropriate healthcare delivery.

Based on these five elements, McDonald's research team defined care coordination as

> "the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of healthcare services. Organizing care involves the marshalling of personnel and other resources needed to carry out all required patient care activities, and is often managed by the exchange of information among participants responsible for different aspects of care" (p. 41) [51].

Unfortunately, this definition is very broad. In practice, this would leave considerable room for interpretation, making it difficult to evaluate [52-54].

The second problem is that **many terms are used to signify care coordination**. These include *integrated care* or *case management* [53], but actually denote quite different things. In addition, mixing care coordination with other, sometimes overlapping concepts such as *cooperation*, *collaboration*, or *the care process* are all very common in the literature [52].

The third problem lies in elements related to care coordination: The literature contains abundant elements that are in some sense related to care coordination, e.g., *relationships*, *teamwork*, *leadership*, *knowledge and skills*, *competencies* and many more. However, the question remains as to how firmly these elements relate to the concept of coordination and how they are related within the concept.

The fourth problem lies in the different perspectives of care coordination. As different healthcare professions (e.g., nurses, physicians, clients, family members) might have different understandings and perspectives regarding care coordination, they might focus on different aspects. For example, some limit care coordination to a specific role, i.e., a care coordinator. Some assume that coordination only relates to collaboration within one's own organization or professional group; or they only consider very specific aspects, e.g., a handover report, to be coordination. In surveys that measure overall coordination simply by asking how *coordination* or *care coordination* is perceived, such varied understandings cause problems, as each respondent refers to a different aspect of coordination when answering the question.

The fifth problem involves measurement. Because diverse understandings and conceptualizations of care coordination are in play, a large number of measurement instruments are available to capture *care coordination* [54, 55]; however, it is argued in this thesis that most of the measurement instruments that purport to measure care coordination actually measure care continuity or other constructs. To complicate matters further, there is no simple way to measure overall care coordination: Questions that ask about overall care coordination (usually with a single item) will generally give such a broad measurement error that the results are unusable. As such, a superordinate question on coordination would be inappropriate.

The final and probably most important point relates to whether care coordination is understood as a process (*coordinating*) or an outcome (*coordination*). In conceptualizing and measuring care coordination, this distinction is fundamental—especially if conclusions regarding quality of care are to be drawn. However, in the literature, researchers commonly make no distinction between the coordinating activities and coordination as a target outcome. This common lack was recognized in 2013 by Goodwin, who decried "a lack of evaluation and measurement against which to assess the performance of care coordination programs" [56].

Associating care coordination processes (i.e., coordinating) with quality of care, but without first examining whether those processes actually lead to successful coordination (i.e., the target outcome of those processes), is illusory. That is, any relationship between coordination processes (e.g., actions performed to coordinate the client’s meetings with all involved professionals) and quality of care outcomes (e.g., rates of avoidable rehospitalization or primary care physician visits) depend not on the coordinating activities themselves, but on how effectively those activities *improve* coordination of the patient’s various therapies. Therefore, in determining whether coordinating activities are useful, it is essential first to define and validate coordination levels as intermediate outcomes. Once there are stable bases upon which to evaluate coordination levels, it is useful to test for relationships between effective coordination and quality of care outcomes [57, 58]. In short, no direct relationship is possible between coordination processes and quality of care. Assuming that those processes are effective, their only direct influence is on levels of coordination (as an outcome). Those, in turn, may influence quality-of-care outcomes. However, without clear, stable conceptualizations both of coordination processes and of the resulting coordination levels, there is no way to assess those processes’ effectiveness.

Likewise, until well-defined outcomes and valid measurements of them are available, it will be impossible to reliably evaluate interventions to improve them.

This may explain the large number of varying or conflicting results available in the literature regarding interventions' effects on care coordination. For example, while reviewing studies on the effects of implementing care coordination models, Duan-Porter et al. [59], found unclear or mixed effects regarding hospitalizations, emergency department visits, and patient experience.

Care coordination on multiple health system levels

Even if we disregard these conceptual problems, some studies have investigated which components are included in the various elements of care coordination, as well as what facilitates or hinders it. Care coordination's influencing factors occur on the macro, meso and micro levels. The macro level is the policy level, the meso level includes non-governmental and community healthcare organizations, and the micro level is that of client-care worker interaction [60]. While care coordination is particularly important in homecare, studies in this area are scarce, are mostly qualitative and tend to involve overviews of practices of the entire field of primary care.

On the **system (macro) level,** depending on the types of treatment involved, poorly chosen incentives and complex financing arrangements for coordination activities (sometimes leading to inadequate compensation) can cause care coordination problems for homecare agencies [61]. For example, Garvin et al. [62] and Simpson et al. [63] reported that, while clear incentivization structures and accountable reimbursement impact care coordination critically, burdensome policies or procedures were all commonly named as causes of delayed or halted care coordination. Furthermore, Elliott et al. [64] reported that service providers are challenged to share information between institutions because of compatibility issues between the many electronic health record (EHR) systems. This was supported by Garvin et al. [62] systematic review, which highlighted ease of information exchange as a crucial element of care coordination. Many homecare workers report particular difficulties in achieving access to information. They considered such barriers unnecessarily time-consuming and problematic [32, 65, 66].

On the **meso level,** problems arising from the absence of standardized processes for identifying and referring patients for additional services have been recognized [64]. Regarding transfers from hospital to homecare, Agerholm et al. [65] identified missing regulations or guidelines, including a lack of clarity regarding responsibility for hospital discharge processes, as coordination barriers. Where guidelines were available, multiple versions or inconsistencies were mentioned as impediments to care coordination [67]. Not only standardized guidelines and processes, but also performance standards and teamwork goals were identified as critical requirements for care coordination [62, 68]. Problems with unclear roles that hampered coordination were reported several times [62, 64, 69, 70]. These can lead to problematic expectations regarding provider roles, and not only from patients: providers' expectations regarding for their own and other providers' roles were also affected [69, 71]. Agerholm et al. [65] reported that, due to strong feelings of responsibility for their clients, homecare nurses would commonly perform tasks that were outside their job descriptions. Conversely, accurate care worker knowledge regarding other actors in the system is considered a facilitator of care coordination [65].

Nonetheless, a lack of provider knowledge and education concerning services available in the community for older adults remains a problem [64]. Within care teams' work environments, adequate staffing, training, and resourcing are all particularly relevant to care coordination [62, 70, 72]. And last but not least, a strong emphasis is placed on inter-provider communication [48, 62, 72, 73]. For instance, studies found that, when information is missing and queries need to be made, homecare nurses consider unreachable primary care physicians especially challenging [65, 66].

On the **micro level**, six topics dominate patient-provider interactions regarding care coordination: building a trustful relationship by knowing the patient and caregiver; conducting meaningful communication; supporting patients' self-management goals; systematically assessing and aligning resources with patient needs; planning care; and helping patients navigate the system [68, 69, 74-76].

As noted above, the concept of care coordination is not only vaguely defined, but also quite complex. Still, as multi-level factors influence care coordination, a clear understanding of those factors is vital. And the scarcity of studies in the homecare setting means that, in order to improve coordination and derive appropriate measures, we need to develop first a clearer understanding of what care coordination means in homecare, and second, a deeper knowledge of which factors in homecare are related to care coordination and how. With those in place, we can examine the relationship between care coordination and its ultimate goal, which is improved quality of care.

Quality of care

The WHO defines quality of care as "the extent to which healthcare services are provided to individuals and patient populations to improve desired health outcomes." Care can be examined across six dimensions: it should be effective, efficient, accessible, acceptable/patient-centered, equitable and safe [77]. A healthcare system that includes all of these features not only has significant benefits for the health of the population, but also has a positive impact on rising costs [78]. In view of the limited resources and the population's future needs, quality has a high priority.

Furthermore, regarding Donabedian’s framework for assessing quality in care, quality can be evaluated in terms of structure, process and outcome: Structure includes the characteristics of the setting in which the care is conducted; process refers to the tasks done by both professionals and clients; and outcome refers to the activity’s effect or impact [79, 80]. High quality of care ensures that patients and their caregivers receive the care they need; low quality not only damages patients’ health, e.g., through adverse events, but also incurs additional costs for the healthcare system [78].

Homecare quality issues

Although it is recognized that high care quality is key to optimizing health system performance including the four aims of health system performance—improving patient experiences, maximizing population health, reducing costs, and improving the work lives of healthcare providers [14]—healthcare systems face a wide range of issues regarding care quality [60]. Setting aside the challenges of measuring homecare quality, up to now, quality of care research in the homecare setting has been rather limited. In addition, in many countries, the concept of quality has not been well-defined. Problematically, even in systems where quality standards are set, they are commonly vague and not set at a national level. This holds especially true for homecare [13].

The WHO has identified diverse macro-, meso- and micro-level healthcare system failures that affect the overall quality of care [60]. Many of these are also noted in homecare studies. As mentioned above, quality can be approached in terms of structure, process and outcome [80]. To date, homecare studies tend to report quality problems mostly in regard to outcome quality, particularly adverse events (AEs). In this context, AEs are defined as "events or occurrences which become apparent during the delivery of homecare services and which have a negative or potentially negative impact on patient care, patient outcomes, family or support care and resources utilization" (p.116) [81]. Both Masotti et al. [82] and Sears et al. [83] found that up to 15% of their participating homecare clients had experienced care-related AEs, of which one-third were regarded as preventable. The most frequently reported AEs during homecare were falls, injuries from falls and other accidents, and adverse drug events [82-84]. In light of these findings, a number of factors have been linked to quality issues identified in health systems’ micro, meso and macro levels. These issues also relate directly to the homecare setting.

Predominantly on the **macro level**, but to varying extents throughout the healthcare system, the WHO [60] criticizes the fact that, as healthcare administrators and researchers have traditionally focused on models of acute and episodic care at the expense of overall coordination, the result has been increasing fragmentation of care. Chronic care is not the only loser: funding sources are also fragmented, with incentives that not only hamper consistent and coordinated care but also penalize healthcare providers for engaging in innovation and health promotion [60]. Furthermore, the WHO report [60] stated that, in many areas, because accreditation, monitoring and quality assurance have been insufficiently applied, formal requirements for healthcare professionals to continue their education and training are now missing [60].

In the homecare setting, studies show that misguided incentives can lead to cost shifting, lack of inter-provider coordination, inefficient use of services and quality skimping [85-87]. Other threats to care quality for older people include accessibility to care [88], social inequities and high out-of-pocket healthcare costs for older persons with multimorbidity [29]. Further, significant quality of care differences were found between rural and urban homecare agencies. For example, compared to urban agencies, rural homecare providers had higher rates of hospitalization and emergency department (ED) visits; however, rural providers performed better regarding timely initiation of care [89]. In addition, rural homecare providers commonly face quality issues such as resource shortages, inadequate equipment and outdated facilities, while working in under-funded environments to meet community needs [90]. Chen et al. [91] found that the introduction of long-term care insurance led to enhanced physical health for its beneficiaries (especially those receiving high-quality homecare), reduced financial burdens on families, as well as greatly reduced lengths of hospital stay, hospitalization costs and medical insurance costs in tertiary hospitals. Chen and Fu [92] found that changes in regulations were reflected in service provision and offers. For example, in rural areas, more subsidies from the government and higher payment for services led to increased access to homecare services.

On the **meso/organizational level**, the WHO [60] mentions a lengthy list of quality issues that require more than money to fix. These included failures to plan care adequately, to provide personnel adequately skilled and equipped to perform their roles, to adapt scientific evidence guidelines into practice, to perform preventive und health-promotional activities, to use monitoring systems proactively regarding needs, and to establish formal connections to community resources.

In the homecare setting, a 2017 study found quality-of-care threats linked to problems in information exchange (incomplete, inaccurate or scattered information), including regarding skill deficits and limitations regarding systems’ and agencies’ capability to support older people [88]. Regarding organizational and work environment characteristics, factors commonly reported as AE contributors included issues in communication, coordination and collaboration, low team experience, training and knowledge, as well as a combination of high workload and inadequate patient monitoring [82]. Conversely, a positive work environment was repeatedly linked to higher care quality, e.g., enhanced client satisfaction, reduced falls, pressure ulcers, pain and hospitalizations, lower incidences of medication errors or uncontrolled pain and fewer clients who were unprepared at discharge [93-99].

On the **micro level**, the WHO [60] report focused on quality problems concerning communication and relationships between healthcare professionals and patients, as well as failures to develop environments that fostered and enhanced patient self-management. Information exchange issues such as mismatched or conflicting homecare-related information led to misunderstandings, false expectations and friction between homecare and other care professionals, patients and informal caregivers [88, 100]. In a field built around patient-provider relationships, a network of reciprocal trust between health providers, patients and informal caregivers is a crucial asset. Such a network enhances healthcare quality not only by supporting each actor's sense of self, but also by empowering and encouraging older clients to contribute increasingly actively to their own care [88, 101].

Moreover, patient characteristics seem to play a role in quality outcomes. Regarding AEs, researchers have concluded that gender and compliance, as well as the presence of co-morbidities, depression, and cognitive and functional impairments were all commonly reported as factors adding to the risk of AEs [82]. In addition, details of a patient's physical environment, e.g., lack of hand rails, poor lighting, slippery or uneven surfaces and living alone also increase the risk of at-home AEs [82, 102, 103].

As the evidence cited above shows, numerous issues and factors are related to care quality. Still, while it is clear that care coordination is related to the quality of care being provided to clients, we know little to date about how that relationship works. In addition, studies of macro-, meso- and micro-level factors that influence quality of care and coordination are not available. Still, as seen in the literature, these factors' levels are interconnected with care coordination and care quality.

Measuring homecare quality

Quality measurement is indispensable through every aspect of healthcare; however, measuring a vaguely-defined concept—and both homecare quality and care coordination fit this description—is difficult and yields limited results. Therefore, numerous quality indicators (QIs) have been identified as barometers of homecare quality. In a 2018 review, Joling et al. [104] listed over 500 QIs used regarding services provided to community-dwelling older people. QIs can be understood as "measurable elements of practice performance for which there is evidence or consensus that they can be used to assess the quality, and hence changes in the quality, of care provided" (p. 359)[105]. Campbell et al. [105] pointed out that, while it probably will never be possible to produce an error-free quality measurements, the more reliable QIs share at least three fundamental characteristics regarding their development and application:

(1) face / content validity
(2) acceptability, feasibility and reliability;
(3) sensitivity to change and predictive validity

One considerable issue that arises when searching for suitable QIs in homecare is that most have been developed for (acute-care) hospitals [105]. And even if Campbell and colleagues stated as early as 2002 that QIs are increasingly being developed and used for primary care in Europe and the U.S., a more recent literature review about quality of care for older people in geriatric care found that most of the literature focused on residential care; only a limited number of the reviewed studies were conducted in home or community settings [106]. Therefore, the identified QIs might not accurately represent homecare-relevant structures, processes, or outcomes.

In addition, a study on the conceptualization of care quality in nursing homes and homecare emphasized the importance of shedding light on the complexity of that concept without ignoring its "softer" dimensions, e.g., cooperation, common understanding, even though healthcare quality has become a strong driver of health policy with a number of “hard,” i.e., quantitative indicators such as rates of falls, hospitalization or mortality [107]. The same study emphasized that understandings of quality differ depending on the perspective of the evaluator [107]. Although quantitative measurements of clinical indicators are necessary to form a comprehensive understanding of quality of care, qualitative reports of care experiences and outcomes from the perspectives of homecare recipients are also vital [108, 109].

Regarding the measurement of homecare quality, services are deeply influenced by the interplay of the various stakeholders. Their web of connections and sometimes conflicting interests makes it tremendously difficult to define and capture the quality of homecare services. This means that, while homecare agencies are clearly responsible for certain client-level outcomes, they can by no means control them all. Janssen et al. [86] found that the adequate provision of homecare services—to which we attribute at least part of those services' quality—depends on the interplay of regulatory frameworks, financing mechanisms, communities, health insurance firms, care organizations, social networks and informal and formal caregivers. Nonetheless, three data sources are used most widely to measure the various aspects of homecare quality: 1) standardized assessments (routine data); 2) client reports; and 3) nurse reports.

Quality measurement with standardized assessment data

One of the most widely used standardized assessment tools in homecare is the Resident Assessment Instrument – Home Care (RAI–HC), which is used both in daily practice and for research purposes in numerous countries, e.g., Switzerland, Canada, Germany, Finland, Korea and New Zealand [110-115]. The RAI-HC (originally called the RAI), was first developed for daily nursing home use, but was later translated to the homecare setting [113, 116]. The current version is designed to assess a client’s condition and identify the main areas for nursing care; therefore, it is commonly used to help with the planning and evaluation of care interventions [116, 117]. The first assessment should take place when the client enters homecare. Reassessments should take place at least every six months or when care needs change. In some countries, RAI-HC data are routinely extracted and pre-defined items—for example on daily pain, instrumental and basic activities of daily living, negative mood, falls, and social isolation—are applied as QIs to assess and compare agencies’ homecare performance [113, 118].

Quality measurement with client-reported measures

Another approach to care quality measurement is to assess clients’ (or their relatives’) opinions. *Patient-reported outcome measures* (PROMs) and *experience measures* (PREMs) are increasingly valued as measures of quality [119-122]. Through a systematic review, Doyle et al. [123] found that patient experience is positively related both to clinical effectiveness and to patient safety; therefore, they strongly encourage the inclusion of PREMs as healthcare quality indicators.

Regarding homecare, when Lines et al. [124] developed a conceptual map of homecare client experience based on a qualitative analysis, they found 104 distinct domains of client experience. Major themes included the professionalism and competency of homecare agency staff, time spent with the patient and coordination/continuity of care, as well as staff members communication with one another, their interpersonal qualities (e.g., friendliness, sensitivity, respectfulness) and the ability to educate the clients and their relatives on their conditions. Still, the many domains of client experience raised the question of what exactly should be measured to assess and discuss the quality of homecare. In addition, concerning PROMs, different authors have highlighted critical issues. For example, they advise that patient reports on healthcare services should be used with caution: As PROMs represent subjective perceptions, they cannot replace validated outcome measurements [125, 126].

To date, the Home Health Care for the Consumer Assessment of Healthcare Providers and Systems Survey (HHCAHPS®) is one of the most used PREMs in the homecare setting [127]. It was developed by the Agency for Healthcare Research and Quality (AHRQ) in collaboration with the U.S. Centers for Medicare & Medicaid Services [128]. The CAHPS® is a standardized survey instrument intended to measure clients’ perspectives on the care they have received, including specific care issues, communication with providers, rating of care provided by the agency and their willingness to recommend the agency to friends and family. These data complement those collected by homecare agencies to support their internal services and quality improvement activities [128].

Quality measurement with nurse reported measures

The third common way to assess quality of care is through care worker opinions. A study in Dutch hospitals found a very strong correlation (r = 0.94) between nurse-sensitive quality measures (delirium, malnutrition, pain) and nurse-reported quality ("On a scale of 1 to 10, with 1 representing ‘dangerously low quality’ and 10 representing ‘very high quality’, how do you rate the quality of patient care in your own hospital unit?") [129]. McHugh and Stimpfel [130] reported similar results regarding nurse-reported quality in U.S. hospitals ("How would you describe the quality of nursing care delivered to patients in your unit?": Excellent, Good, Fair, Poor). In that study, nurse-reported items functioned as significant predictors of other quality measures: the higher the nurses rated the quality of care, the higher the ratings of process and outcome quality indicators (e.g., mortality), and of patient-reported quality. Unfortunately, to the best of our knowledge, no studies have yet examined this correlation in the homecare sector.

As for the challenges of the various quality measures, including those specifically affecting quality measurement in the homecare setting, assessing care quality with all three approaches is currently the most promising method to gather meaningful data, i.e., that which will allow more reliable observations and conclusions.

Homecare in Switzerland

Homecare in Switzerland is understood as formal care provided in the client's home, including not only medical care, but also “basic care,” i.e., assistance with body care, mobilization, toileting, eating/drinking and housekeeping support. Some agencies also offer additional services, including meal delivery, transportation, counseling, daycare centers, or even highly specialized support such as palliative or psychiatric care.

Characteristics of the Swiss homecare setting

In 2021, 966 homecare agencies were operating in Switzerland. Of these, 584 were non-profit and 382 for-profit [22]. The non-profit agencies, which cared for 75% of clients, had a mean staff size of 34.5 full-time equivalent (FTE) posts. The average for-profit agencies had fewer than one-third that number of staff, i.e., 10 FTEs. In total, the Swiss homecare sector included roughly 27,130 FTE posts in 2021, serving around 441,000 clients. Of those clients, 41% were aged 80 years or older. That year's total homecare service expenditures amounted to 2.98 billion Swiss francs, of which wages and other personnel costs accounted for 86% [22].

The numbers of employees, clients and agencies per canton vary remarkably. This variation reflects the cantons' areas, population densities and other characteristics, e.g., their rurality. As each canton administers its own healthcare system, Swiss healthcare is very fragmented. Therefore, inter-cantonal links between hospitals, nursing homes and homecare agencies are poorly developed [13].

Regulation and funding of homecare in Switzerland

Each canton has its own health laws and regulations [131]. Among other topics, these regulate the professions in the health sector, the bounds of professional practice, operating licenses for hospitals, nursing homes and other healthcare institutions, as well as health promotion and disease prevention. Varying from canton to canton, these also include requirements for homecare organizations and regulate certain aspects of their funding [131, 132].

Switzerland has three financing sources of homecare service: health insurance (HI), client copayments and residual financing (see Figure 1, below). While health insurance (HI) is mandatory for all residents in Switzerland, various plans are available. Premiums vary depending on the client's canton and community, their coverage, as well as their age and gender [131]. For the payment of homecare services, health insurers are required to pay a defined amount per hour, depending on the task performed. Hourly rates for specific tasks are set by the federal government. In 2019, the following fee schedule applied: 79.80 CHF/h for clarification and counseling; 65.40 CHF/h for treatment care; and 54.60 CHF/h for basic care [133].

In addition to their health insurance premiums, deductible payments (300 – 2500 CHF/year) and copayments (usually 10% of insurer expenditures to a maximum of 700 CHF/year) [131], the clients pay additional copayments for homecare services. Depending on the canton, these equal a maximum of 20% of the highest insurer contribution, to a maximum of CHF 15.35 per day [133]. As the federal government delegated the regulation of client copayments to the cantons, the exact types and amounts of client copayments differ between cantons.

The federal government has also delegated regulation of residual financing, i.e., expenses not covered by the first two sources, to the cantons. For homecare, then, two out of three funding sources—client copayments and residual financing—vary by canton. To complicate matters further, depending on cantonal health law, residual payments can be administered cantonally, by individual communities or both. Several cantons have delegated responsibility for residual financing to their municipalities. Therefore, questions regarding both the amounts of residual payments and of how those payments are structured can have very different answers between cantons, or even between municipalities in the same canton [132].

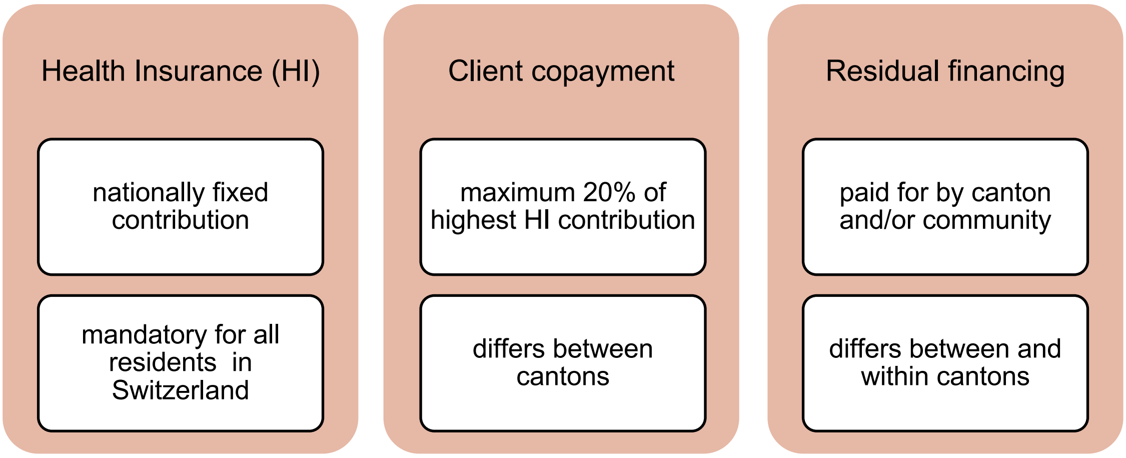

Figure 1. Three main sources of homecare service funding in Switzerland

Research gap and rationale

The above-mentioned evidence indicates that, across the homecare sector, numerous challenges and issues complicate not only care coordination and quality, but also researchers' understanding of these elements. As this sector has been neglected as a research area for many years, in favor first of acute hospital care, and later of institutional long-term (nursing home) care [106], many knowledge gaps have opened up. Although the literature shows that system-level factors certainly impact homecare organizations, little is known about how infrastructural elements such as regulations and funding structures influence those organizations' individual structures and processes.

Likewise, in terms of quality of care, knowledge of how homecare organizations perform regarding care quality is limited. This limitation is deepened by a lack of large-scale studies, especially those that would consider macro-, meso-, and micro-level influences and incorporate multiple perspectives and measurements to capture their target phenomena. Quantitative research on care quality in homecare typically uses routine data and is conducted predominantly in English-speaking regions. In addition, the current knowledge of macro- and meso-level factors' influences on homecare quality is limited. As noted in this dissertation's introduction, the homecare setting is highly dependent on and interconnected with other non-hospital healthcare providers. For patients who need to meet with multiple providers weekly, care coordination is crucial to ensure first, that they receive appropriate care, second, that the services they receive are not redundant, and third, that their healthcare professionals share any relevant information to prevent conflicting diagnoses, prescriptions or medical advice.

To date, most studies examining coordination in homecare settings have been qualitative, and no quantitative studies have examined homecare agencies' performance regarding care coordination, or identified factors associated with care coordination in this context. Moreover, no clear concept exists either of what exactly coordination is or of what it entails. This knowledge gap hinders not only homecare, but the entire healthcare system.

Study aims

This dissertation is part of the SPOT^{nat} study (**Sp**itex Ko**o**rdination und Qualitä**t** - eine **nat**ionale Studie – homecare coordination and quality - a national study). Its four objectives were: to clarify the concept of care coordination; to describe the Swiss homecare setting's main financial and regulatory mechanisms and explore how they relate to homecare agencies' structures, processes, and working environments; to explore how system and agency factors are related to care coordination; and to explore how care coordination is related to quality of care.

The aims of the dissertation’s five included articles were as follows:

"Clarifying the muddy concept of home healthcare coordination: A comprehensive theoretical framework" (Chapter 2) had two aims:

1. To build a conceptual framework to define the concept of care coordination in homecare; and
2. To define the coordination concept and its elements to enable the operationalization of the concept.

The SPOT^{nat} study protocol (Chapter 3) had a single aim:

1. To describe the rationale, objectives, sample and setting, variables and measurement as well as data collection of the SPOT^{nat} study

"How regulatory frameworks drive differences in homecare agencies: Results from a national multicenter cross-sectional study in Switzerland" (Chapter 4) had two aims:

1. To describe the different regulatory and financial mechanisms in the Swiss homecare setting
2. To explore how the regulatory frameworks drive differences in homecare agency structures, processes and the work environment

"How external and agency characteristics are related to coordination in homecare – Findings of the national multicenter, cross-sectional SPOT^{nat} study" (Chapter 5) had three aims:

1. To explore how external factors (financial and regulatory mechanism) are related to care coordination
2. To explore how homecare agency structures are related to care coordination
3. To explore how the homecare agency coordination process is related to care coordination

"Care coordination in homecare and its relationship with quality of care: a national multicenter cross-sectional study" (Chapter 6) had one aim:

1. To examine the relationship between care coordination and quality of care in homecare.

The SPOT^{nat} study

The SPOT^{nat} study is a national multi-center cross-sectional study in the Swiss homecare setting. With the main purpose of establishing baseline data and increasing the visibility of the homecare sector with data that had never before been collected on a national basis in Switzerland, it ran from 2019 until 2023. The SPOT^{nat} research team used on a randomly selected national sample of Swiss homecare organizations, including their employees, their clients, and relatives of those clients. Data were collected through questionnaires distributed to homecare managers, employees, clients and relatives. Where possible, the homecare organizations also provided electronic routine data (including RAI-HC data). Additionally, the researchers hoped to include anonymized health insurance data in their analyses. However, as only one insurer agreed to this request, the available data were not sufficient for analysis. Therefore, this dissertation presents only data from the homecare managers, employees, and clients and results of analyses based on those data.

For a deeper exploration of this topic, in **Chapter 3**, the SPOT^{nat} study protocol includes a detailed description of the study's background, its conceptual framework, its aims, its sample and setting, as well as its various measurements.

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CHAPTER 2

Clarifying the muddy concept of home healthcare coordination: A comprehensive theoretical framework

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Highlights

- Care coordination is essential to meet the needs of patients
- The lack of clear care coordination conceptualization hinders research
- To overcome this problem, we developed a theoretical care coordination (COORA) framework
- COORA distinguishes the different elements of the coordination process and the achieved level of coordination
- Distinguishing the coordination process, i.e., "coordinating" from coordination as an outcome of the process can guide future research

Abstract

Effective healthcare coordination is vital when such care is provided as a collaborative effort by many individuals and their task activities are interdependent. Coordination is necessary to ensure that care not only meets the needs of patients, but also avoids negative consequences for them due to omitted, inefficient, unnecessary, or even incorrect treatments. It also helps conserve resources. This has contributed to a rapid increase in articles on this subject.

Still, while care coordination topics are gaining the attention of researchers, there are a number of issues experienced, including the delineation of limitations, inconsistent definitions, and problems with measurement. Therefore, the aim of this article is to refine the concept of homecare coordination and provide a comprehensive theoretical framework, illustrated with examples from practice.

Focusing on this goal, we have reviewed the extant literature on the subject to develop a theoretical homecare coordination framework. The first intermediary goal was to integrate relevant concepts across multiple theories and frameworks into a unified synthesis. We do so in two parts: (1) analysis of extant coordination frameworks and theories; and (2) the presentation of our newly developed theoretical framework for homecare coordination.

The new framework differentiates clearly between coordination as a process—i.e., what people do to coordinate and coordination as an outcome—i.e., the state of coordination. Applying this distinction to both, measurement and interpretation of results helps avoid misleading conclusions. As a research outcome, our framework builds upon the extant coordination literature, considers the complex relationships among the various coordination-related factors and, while focusing on homecare, is applicable to various healthcare settings in general.

A nuanced differentiation and explanation of the elements involved enable a more consistent operationalization of the coordination concept. Additionally, as they explicitly address the healthcare system's micro, meso, and macro levels, they can be applied across diverse healthcare settings to investigate homecare coordination.

Keywords: Care Coordination, Coordination, Delivery of Health Care [Mesh], Theoretical Framework, Home Care Services [Mesh], Theory, Theoretical Models [Mesh]

Introduction

As the number of people with multiple chronic conditions and the options and specializations for medical treatment increase, the many fields of healthcare are becoming both more complex and increasingly interdependent [1-3]. As a result, there is a burgeoning need to align the different disciplines and professionals who provide patient care [4] and manage task dependencies among the various healthcare specialties involved, making care coordination, especially in homecare, particularly important.

Effective care coordination helps care providers deliver patient-centered care that meets patients’ needs, largely by avoiding scheduling conflicts and simplifying the management of task dependencies. By reducing omitted, inefficient, unnecessary, or even incorrect treatment—any of which can lead to negative patient outcomes—efficient care coordination avoids both unnecessary patient burden and resource waste [4]. Consequently, care coordination is a fast-evolving research field and is identified as a priority in various countries’ healthcare strategies (e.g., Switzerland, Canada, Norway) [5].

The conceptualization and measurement of care coordination in and across healthcare settings remains a challenge; and the blending of different concepts and models under the umbrella of "coordination" is pervasive in the literature. A recent example is a scoping review by Peterson et al. [6], which presents integrated care models (e.g., Wagner’s Chronic Care Model, Singer’s Integrated Patient Care Model), quality models (e.g., Quality Framework by Donabedian), and coordination models (e.g., Gittell’s approach to relational coordination, Weaver’s multilevel care coordination framework) all under the heading of "Healthcare Coordination Theoretical Frameworks. " These frameworks are very useful and a step in the right direction. However, this eclectic collection of models and concepts comingle multiple perspectives that are not necessarily related to coordination. This makes it difficult to delimit and apply the appropriate concepts from these various related and partly overlapping concepts (e.g., integrated care, quality of care, communication, collaboration). While all of these models include components of care coordination, they differ widely in focus and perspective (e.g., they may focus on quality of care or integrated care rather than care coordination per se). For a reader, such "muddiness" could be confusing or even frustrating. However, for a research team operationalizing the concept of care coordination for a study, a clear understanding and definition of the concept—one that distinguishes it from its nearest neighbors—is essential to avoid misinterpretation and research waste.

Research in coordination in healthcare faces a variety of issues. The first is that, depending on the context in which it is used, coordination may be interchangeable with terms such as teamwork, collaboration, or integration. Such lexical instability can complicate efforts to assess and compare studies and their results [7, 8]. In addition, coordination is often mixed with similar concepts such as cooperation, the care process, or case management [7, 9, 10]. As a result, studies may include "coordination" in their titles, but actually assess related concepts or elements such as leadership skills.

The second problem is a lack of agreement on the multiple definitions of coordination, some of which are so vague that they demand interpretation. In addition, where summaries and descriptions of coordination elements (e.g., coordination mechanisms) are overly broad, they make it difficult to operationalize coordination, which is essential to make it measurable in clinical settings [7, 9, 11]. One result is that, as one recent review reported, researchers hoping to examine care coordination often had difficulty finding enough published evidence to identify its key elements [8].

The third and biggest problem involves measurement. In this case, instruments developed to measure coordination rather measure care continuity or other related concepts [7]. In addition, they make no distinction between coordination as a process and coordination as an outcome [10, 12]. When measuring and analyzing coordination such a distinction is essential: confusing the two can lead to incorrect measurements and conclusions. Nevertheless, recent reviews show that studies commonly measure variables like re-hospitalization rates, patient satisfaction, or other care quality indicators as outcomes of the coordination process—without treating the coordination as an outcome itself—i.e., the level or state of coordination reached as a result of the intermediary coordination processes [8, 13]. Establishing a direct link between elements of coordination as a process (e.g., regular meetings) and quality of care outcomes poses problems. It cannot be assumed that simply having coordination processes in place is an assurance that higher levels of coordination (as outcome) will be reached. If they happen to be in place, they will not automatically lead to improved levels of coordination success. For example, there may be a mismatch in the type of coordination process employed and the characteristics of the task. In addition, high levels of coordination (as an outcome) do not necessarily lead to the desired quality outcomes [10, 12].

Given the problems outlined above, this article aims to refine the concept of coordination aiming to provide a comprehensive theoretical framework to capture homecare coordination. As we develop the framework, we illustrate its various aspects with practical examples, which will provide the basis for the operationalization and measurement of homecare coordination.

Methods

Our central component is the development of a comprehensive theoretical homecare coordination framework, aiming to integrate relevant concepts across multiple theories [14, 15]. As noted in the extant literature, "a theoretical framework is a structure that summarizes concepts and theories, which are developed from previously tested and published knowledge" (p. 46) [15]. To produce this framework, we conducted a literature search of coordination models, frameworks, and theories. Due to the fuzzy nature of the concept of coordination and given the various extant systematic reviews, we decided to build upon these reviews. More specifically, we used four comprehensive coordination literature reviews—by Van Houdt et al. [16], Schultz and McDonald [7], Weaver et al. [13], and Peterson et al. [6] as a starting point to better understand the concept of coordination and the current state of coordination-relevant knowledge in healthcare.

As a first step, we screened the studies referenced in these four literature reviews. We then identified additional studies and related article by searching Medline via Pubmed®. Next, we extended the literature search to include coordination in other research fields (e.g., psychology, sociology, software development) by iteratively searching studies referenced in identified articles using Google Scholar. We then searched new aspects described in relation to the various models and theories—i.e., different elements/underlying concepts of coordination (e.g., communication, mental models)—via Pubmed® and Google Scholar to gain a stronger understanding of underlying or related concepts as we elaborated our framework.

In parallel with the literature search, which was conducted from March 2020 until March 2021, we iteratively discussed and evaluated the models, frameworks, and concepts within the research group. In addition, to deepen our understanding and include a range of expertise in the development of our new theoretical framework, we held discussions with two authors of earlier coordination frameworks [9, 12].

Since the healthcare field is very broad and diverse, we focused in this paper more specifically on homecare in order to connect theoretical concepts with practical examples. We view homecare in this study as formal care provided to patients at their homes, including not only medical and therapeutic care but also basic care (e.g., personal hygiene or mobilization), domestic support (e.g., help with shopping, washing or cleaning) and social care (e.g., assistance with making appointments or going for a walk). To better understand the context in general and to gain familiarity about the context of the focal task, we held discussions with different homecare nurses, homecare nursing experts, and homecare patients and their relatives about their understanding of coordination and possible interrelationships with other elements and concepts. We purposely selected nursing experts because of their experience in this field and invited them for discussions and focus groups. Homecare patients, their relatives and nurses were also invited to focus groups by two homecare organizations in consultation with the first author.

Analysis of coordination frameworks and theories

Our literature review revealed that there are conditions that make coordination necessary and determine the extent to which it is needed. Therefore, we divided this section into two parts:

(1) preconditions for the need for coordination and (2) the coordination literature, with its definitions, frameworks, and theories.

Preconditions for coordination

Before elucidating the different elements of coordination, it is important to consider that not all work can benefit from coordination. We identified three key preconditions to coordination: **(1) Task activities have dependencies.** The most important consideration is that task activities included in the work must contain dependencies. Naturally, because task activities are carried out by individuals, task dependencies will inevitably lead to member dependencies. Without dependencies, there is really nothing to coordinate [17] and coordination could even be a distraction from the focal task or a cost-ineffective undertaking. Van de Ven et al. [18] described four bases of dependency between participants: 1. The task (workflow between participants); 2. Individual roles (participants position in joint action); 3. Social dependence (participants' reliance upon one another to fill mutual needs or achieve common goals); and 4. Knowledge dependence (participants' reliance on one another's various levels of expertise). Regarding task dependencies, three categories are relevant to coordination: pooled, sequential, and reciprocal [18, 19].

For *pooled dependencies,* each participant contributes his or her part somewhat independently or with little and no direct interaction, but depends on a pool of shared resources, such as shared budgets, technical resources, health insurance, etc. [20, 21].

Sequential dependencies occur when one participant depends on another to complete it (e.g., medication prescription must be provided before medication can be obtained and taken; and a budget must be approved before the funds can be spent), but the other participant does not depend on one [20-23].

Reciprocal dependencies or interdependencies arise when a task requires different participants to undertake different parts of it in a cyclic give-and-take. This interdependence implies some flexibility in the sequencing of tasks; and due to the cyclical nature of the work, adjustments are made iteratively between participants [20, 21, 23]. For example, adjustment of pain management requires iterative activities between the patient (feedback on whether pain medication is effective), nurse (preparation/administration of pain medication and monitoring of effectiveness), physician (adjustments to pain medication prescription). As dependencies increase in complexity, from pooled to sequential to reciprocal, the need for coordination increases [18]. In the homecare setting, we are mostly confronted with sequential dependence and/or reciprocal dependence [18, 21].

(2) There are multiple participants involved in the work. Even if task activities have dependencies, if there is only a single individual carrying out the task, there is no need for members to coordinate [18]. That is, the lower the proportion of one-person tasks and the higher the degree of task-related cooperation, the higher the dependence level [18]. The dependency grows exponentially to the number of persons [24]. For example, a group with n members collaborating have $n(n-1)$ possible dependency links between each other. In principle, this condition is always met in homecare, as at least two participants are always involved: the patient and a healthcare provider.

(3) There are uncertainties in the task. The level of uncertainty does not necessarily affect the need to coordinate. But task uncertainty determines the approach or mode to coordination [18]. Routine task with low levels of uncertainty can be effectively coordinated with impersonal coordination mechanisms like routines, plans, schedules, etc. Non-routine and uncertain tasks require more ad-hoc coordination through communication. Uncertainty can be understood as the number of potential choices in a given situation: the more choices or alternatives (or even possible outcomes), the higher the uncertainty [25, 26]. Several types of uncertainty are relevant to this context.

Task uncertainty refers to the difficulty (e.g. complexity, uncertain outcomes) and variability (e.g., same task sequences every day vs. daily changes in tasks) of the work that has to be achieved [18].

Input uncertainty refers to the unpredictability of the task quantity and the task itself, e.g., the unpredictability of the workload or the condition of a new patient [22]. Input uncertainty is high in homecare, as all patients differ regarding diagnoses or comorbidities and care needs, e.g., of those with cognitive impairment, can fluctuate depending on numerous factors [18, 22, 27].

Environmental uncertainty refers to organization-level physical and social factors that must be considered in decision-making. These factors can be classified according to how simple/complex and static/dynamic they are [26]. The simple/complex rating depends on two sub-factors: how similar the environmental factors are (e.g., all participants or teams belong to one organization); and the number of components involved (e.g., participants, teams, departments, organizations). The static/dynamic scale reflects the extent to which the environment tends to change: no change adds no uncertainty; constant change adds high uncertainty. Based on Duncan [26] description of environmental uncertainty, homecare workers' environment can be classified as complex-dynamic.

To summarize, the higher the number of dependency links between group members, the more participants are involved, and the higher the uncertainty of the work/environment, the more complex the coordination processes become.

Overview of the coordination literature

The definitions of coordination

Schultz and McDonald [7] found 57 different definitions of coordination in their literature review. They recognized five core elements that the majority of these definitions had in common: (1) involvement of multiple participants; (2) interdependence between the participants; (3) the presence of knowledge about roles and resources between the participants; (4) a foundation in information exchange; and (5) aims to ease the provision of proper healthcare [7]. Based on these core elements, the authors defined care coordination as "the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient’s care to facilitate the appropriate delivery of health care services […]." (p. 41).

In other research fields, reviews of coordination (i.e., organizational theory, coordination theory) also cite numerous definitions of the term "coordination" [9, 10, 17]. For example, Malone and Crowston [17] chose a simple and rather broad definition: "Coordination is managing dependencies between task activities" (p. 101). A decade later, working within the field of software development, Espinosa et al. [12] drew from coordination theory sources to arrive at "effective management of dependencies between subtasks, resources (e.g., equipment, tools, etc.) and people" (p. 6). Okhuysen and Bechky [9] also found commonalities among the definitions reviewed, namely (1) that people work collectively; (2) that the work is interdependent; and (3) that a goal or task is achieved or completed.

Based on the definitions above, coordination can be seen either as an outcome or a process. A process is a series of actions taken in order to achieve a result (definition of process by Cambridge dictionary 2021). Thus, coordination as a process are the things people need to do to coordinate. The result of these actions is a coordination state or outcome [12]. A good analogy is the difference between what you do to earn money (a process) and how much money you made (an outcome). Coordination as an outcome can be more easily understood when absent. Coordination failures or problems are obvious to anyone, whereas a successfully coordinated outcome may not be as noticeable [17].

Coordination theories and frameworks

In the following section, we briefly describe the terminology of the related frameworks and theories we referenced in our framework development, along with a discussion of their similarities and dissimilarities. We start with those from the extant organizational and coordination research literatures and continue with those that have been adapted or extended specifically for use in healthcare.

Van de Ven et al. [18] described coordination as the process of "integrating or linking different parts of an organization to perform a common set of tasks" (p. 322). They classified this into three types of work activities: impersonal, personal, and group. March and Simon [28], also differentiated between two *modes of achieving coordination* (i.e., as an outcome): through programming and through feedback. Programming is an *impersonal* coordination mode involving the proactive application of action plans, rules, standardized information, and systems. Feedback is a *personal* coordination mode involving formal and informal, one-to-one and group communication, in response to actions by individuals or groups and focuses more on the actors. Van de Ven et al. described feedback-based coordination as "mutual adjustments based on new information" (p. 323) through either one-to-one or group communication.

Malone [29] introduced *coordination theory* and stated that coordination is "the additional information processing performed when multiple, connected actors pursue goals that a single actor pursuing the same goals would not perform" (p. 5). He classified goal-relevant tasks as either *coordination tasks* or *production tasks*: "Coordination tasks are the information processing tasks that are performed because more than one actor is involved. Production tasks are all the other tasks that are performed in order to achieve the goals" (pp. 5-6). In other words, production tasks are needed to complete the task, whereas coordination tasks are needed to work with each other.

Espinosa et al. [12] defined a *coordination mechanism* as "a mechanism that helps teams manage dependencies" (p. 6). They differentiated explicit from implicit coordination mechanisms. Coordination processes are the implementation and use of such mechanisms. Explicit mechanisms are purposely and consciously used by participants to handle task dependencies. Implicit mechanisms are based on "shared knowledge [about the task and the team, which] enables them [participants] to explain and anticipate task states and actions of participants, thus helping them to manage task dependencies" (p. 10). They further differentiate two types of coordination outcomes: coordination as the "state of coordination," i.e., the extent to which dependencies are effectively managed; and performance or effectiveness, which occurs when key dependencies are successfully managed. These can be regarded as coordination processes and outcomes, respectively. And while Espinosa et al. acknowledge that the verb/gerund *coordinating* and the noun *coordination* are often used interchangeably, they distinguish between the two: "the process of 'coordinating' can be defined as the activities undertaken by the participants in managing dependencies" (p. 5)[12]; the state of coordination is the desired outcome of that process.

Faraj and Xiao [22] stated that each *coordination mechanism* contains a specific information processing capability, which needs to be adapted to the information processing requirements of the environment or to the needs from the interdependence of the work units—i.e., not every mechanism is equally suitable for every situation; and *coordinative action* is an unfolding process of linked skills and interconnected activities.

Okhuysen and Bechky [9] adopted the definition of Faraj and Xiao [22] and differentiate between *coordination mechanisms* as organizational arrangements, which enable individuals to perform collectively, and *integrating conditions for coordination*—the "how" behind the mechanism. These authors have not explicitly defined an outcome, their focus within the framework is partly on how coordination occurs and partly on which mechanisms enable it.

And finally, Zackrison et al. [10] distinguish between *coordination mechanisms* (existing structures, objects, processes or interactions to facilitate the coordination of a group or organization), *coordinating* (the organizational process of using coordination mechanisms to achieve a higher level of coordination), and *coordination* as "the extent to which the interactive *in situ* integration of the group(s)' work activities is logical and coherent when it comes to managing interdependencies towards a specific goal" (p. 210). They mention two outcomes: on the one hand, *organizational goals* regarding quality or quantity; on the other, the *reproduction of organizational mechanisms*, knowledge mechanisms, and routines.

Moving on to theories and frameworks in the healthcare setting, Gittell and Weiss [30] do not explicitly define *coordination mechanisms* but distinguish between (1) *coordination mechanisms*, i.e., routines, information systems, meetings or boundary spanners (they integrate work that crosses functional boundaries), (2) *coordination networks*, explained as relationship links—long-term patterns within relationships that serve as channels for resource transfer between actors, and (3) *coordination*, an activity that is essentially about making connections between interdependent actors who need to transfer information and other resources to achieve a goal. As outcomes, they name *quality* and *efficiency of performance*. We argue that with interdependent tasks like homecare, coordination outcomes are antecedents of quality, performance and other final outcomes.

McDonald et al. [31] specify *coordination activities* as actions that are assumed to support coordination. They specify ten such activities: assessing needs and goals, creating care plans, monitoring, adapting, communicating, establishing accountability and responsibility for care tasks, supporting self-management, aligning resources with patient needs, facilitating transitions, and linking the patient to community resources. As an outcome, they name *coordination effects*, which are perceived differently depending on the observer's perspective (system, healthcare professional, patient), for example, clinical outcomes, utilization-related outcomes or quality of life.

Van Houdt et al. [32] based their framework on 14 key concepts in care coordination. They derived these from a literature review of published theoretical frameworks from various research fields. In their framework they distinguish between *(inter)organizational mechanisms* (i.e., task characteristics, structure, knowledge and information technologies, administrative workflows, cultural factors, required coordination), and *relational coordination* (i.e., roles, quality of relationship, information exchange, goals). They also specify *outcomes* on the *patient level* (including continuity of care or improvements in patients' health status and psychological well-being), the *team level* (membership in a group of specialized health professionals) as well as *organizational level* (care process is performed in an acceptable order and follow each other quickly and smoothly).

And finally, Weaver et al. [13] integrated McDonald et al. [31] coordination activities into Okhuysen and Bechky [9] framework to produce a "Multilevel Framework for Examining Care Coordination." They mention *proximal outcomes* (i.e., health outcome, care costs, satisfaction, timeliness of care) and *distal outcomes* such as distal health outcomes for individual patients, public health outcomes, lifetime care costs and value. In addition, their framework differentiates between *context* and *setting*, which they classify as either a moderator or input; *coordinating mechanisms* (i.e., approaches, methods, or tools used to align and synchronize care), which they also classify as input; *emergent integrating conditions* (e.g., common understanding, trust) which they classify as mediators; and *coordinating actions* (e.g., communication) which they classify as proximal behavioral processes.

While the various frameworks and theories noted above present disparate views of coordination, all agree that it is a complex phenomenon. Our literature review also noticed a widely-shared conception that coordination includes structures and processes that enable or impede collaborative work, i.e., it ultimately promotes and results in collective performance. We agree with Zackrison et al. [10] and Okhuysen and Bechky [9], who point out that the multifaceted use of the term *coordination* makes it difficult not only to conceptualize but also to operationalize either as a process or as an outcome. Different researchers use different coordination labels and constructs, such as *coordination mechanism*, *coordinating actions* or *activities*, *coordinating*, *coordination*. At the same time, there are some similarities. Conversely, sometimes researchers use the same term to describe or define different concepts. Overall, all the frameworks and theories we reviewed are valuable for research in one way or another. However, none are entirely complete, they each miss some important aspects about coordination, or are too vague to be effectively incorporated into the framework. For coordination to function as a stable concept in healthcare, it is first necessary to understand and define its essential elements and how they are connected.

Building a theoretical framework for care coordination in home healthcare

In this section we develop our theoretical framework, depicted in Figure 6, step-by-step. First, we specify a multidimensional concept of coordination as a process, which requires a unified terminology and the various elements associated with coordination processes. We posit that coordination processes are antecedents to coordination outcomes. Next, we differentiate between two types of outcomes: (1) coordination as an outcome, resulting from the coordination process, which is the state of coordination of the group. The group is effectively coordinated if there are no or minimal coordination failures and problems; and (2) patient outcomes, which relate to the accomplishment of the related homecare task's goals. We posit that when the task contains interdependent activities carried out by multiple individuals, effective coordination outcomes are a precondition to patient outcomes. To finish, we discuss the various factors that influence the coordination process.

The multidimensional concept of coordination

Coordination has been described in many different ways in the extant literature. For example, it can refer to actions involving tools or barriers that promote, facilitate, or hinder successful coordination outcomes. These can range from physical artifacts (e.g., health records) to abstract or psychological constructs such as group dynamics or respect. It also can denote activities one undertakes (such as communicating) to promote, facilitate or hinder successful coordination; or it can mean the intended effects of such actions (coordination as an outcome). When Malone [29] introduced coordination theory, he explained that it "is in 'the eye of the beholder'….The components of coordination are analytic concepts imposed by an observer" (p. 5). However, any scientific discussion of coordination must include a precise shared terminology.

For this work, we adopted the definition of *coordination* used first by Espinosa et al. [12], then by Zackrison et al. [10], as an outcome measure of the extent to which work dependencies are effectively managed towards a specific goal. *Coordination mechanisms* are the "things" in place that promote or facilitate—but, if misused, can also hinder—coordination. The actual actions or activities undertaken to implement or use (consciously or unconsciously) these mechanisms are the actual coordination processes. In a nutshell, coordination mechanisms and processes are what enable participants to manage dependencies [12]. They can also be seen as approaches, methods, or tools available to align and synchronize work [13].

Explicit coordination mechanisms are behavioral in nature. They include conscious, purposeful actions people perform to coordinate tasks performed by two or more people (e.g., communicating). In contrast, *implicit coordination mechanisms* are cognitive in nature.

These are typically used unconsciously and evolve over time. They involve the knowledge the various participants have about the tasks they are working to fulfill and about each other. Implicit coordination mechanisms enable them to coordinate their efforts with minimal communication [12]. The most effective mix of explicit and implicit coordination mechanisms depends not only on their availability, but also on the structure of the organization (explained further below), the preconditions for coordination, i.e., the types of dependencies, the uncertainties, and the participants preferences [9, 12, 33]. Table 1 lists our terms and their meanings as we use them in our theoretical framework.

Table 1. Definitions of terms denoting coordination elements

Coordination (outcome)	The extent to which work dependencies are effectively managed towards a specific goal [10, 12].
Coordination mechanisms	Mechanisms that help participants to manage dependencies [12, 17]. They can be understood as approaches, methods, or tools available to align and synchronize work [13]. We differentiate between explicit and implicit coordination mechanisms.
Explicit coordination mechanisms	Mechanisms consciously used (behaviorally) by participants to help manage task dependencies [12]. Organizational arrangements that enable individuals to perform collectively [9].
Implicit coordination mechanisms	Cognitive mechanisms available to the participants from common knowledge that enables them to explain and anticipate task states and participants' actions and thus to help them manage task dependencies with minimal communication [12].
Coordination process	I.e., coordinating, is the entire process of implementing and applying the necessary coordination mechanisms to achieve positive coordination outcomes [10, 12, 34].

The dynamic coordination process

As stated in Table 1, the term *coordination process* is understood here as the entire process conducted within a system to achieve a certain degree of coordination. It has to be considered that coordination occurs in different systems. Within the context of healthcare, this includes nursing teams, a homecare organizations, or virtually any healthcare setting. Singer et al. [35] differentiate three types of coordination in healthcare: coordination between professionals (or within a care team); coordination across care teams (or facilities); and coordination between care teams and community resources (or support systems). Therefore, coordination can take place intra- or inter-organizationally. Nevertheless, in our view, the coordination process remains the same even if different mechanisms are used and to different degrees. This view is consistent with Gittell and Weiss [30], who observe that the same mechanisms are effective for intra- and inter-organizational coordination.

The relationships between the various coordination elements mentioned above are depicted in Figure 1 (Figures 1–5 pertain to the development of the model shown in Figure 6).

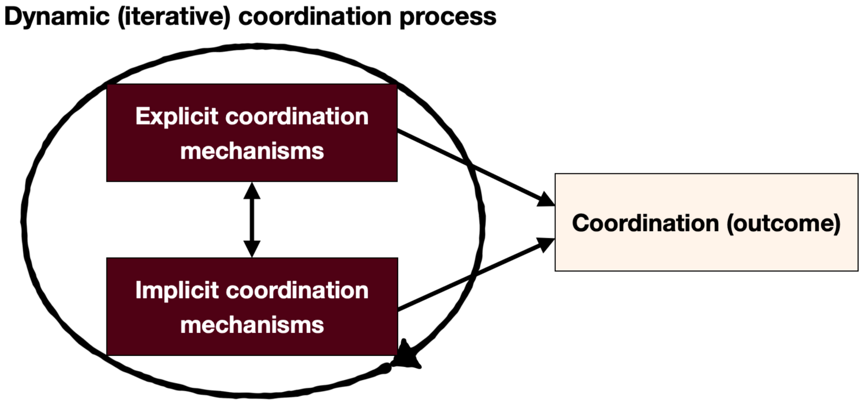

Figure 1. The connections between the coordination process, coordination mechanisms, and coordination

Explicit coordination mechanisms

Explicit coordination mechanisms can be understood as "mechanisms explicitly used by a team to help manage task dependencies" and are behavioral in nature [12]. More precisely, we see explicit coordination mechanisms as Okhuysen and Bechky [9] see them—as structural arrangements that are purposefully enacted to enable individuals to perform collectively.

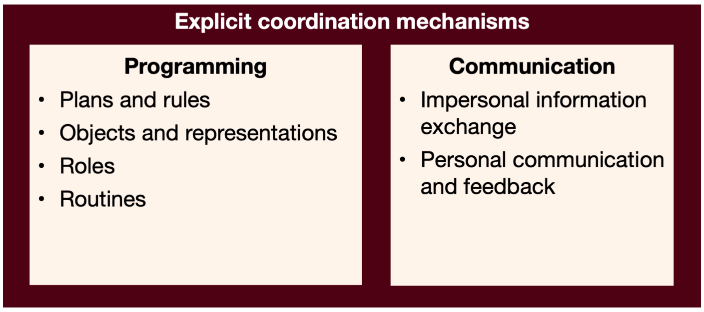

Fig. 2. Explicit coordination mechanisms

These explicit coordination mechanisms can be divided into two categories: *programming* and *communication*. Both have previously been described by March and Simon [28], Van de Ven et al. [18], and Mintzberg [33] and further elaborated in later publications by Espinosa et al. [12], Espinosa and Pickering [36], Rico et al. [37] and Rico et al. [38], among others. Figure 2 shows an overview of the explicit coordination mechanisms.

Programming

Programming is a type of explicit coordination mechanism characterized by blueprints, i.e., detailed sets of information that are impersonally formulated and usually pre-established [12, 18]. In essence, programming specifies the division of labor; therefore, it is used to "decouple" or reduce dependencies [33]. These may take time to conceptualize, develop, implement, and learn, but once in place can make coordination of more routine activities quite effective. We use Okhuysen and Bechky [9] categorization, which divides this into the following four groups:

Plans and rules include pre-defined plans, schedules, directions for resource allocation (e.g., time, manpower), formalized rules, policies, and procedures [9, 12, 18, 33]. Plans and rules explain the activities required to accomplish a task and provide guidance regarding the work that the various participants must perform [9, 13].

For example, a shift or route plan determines when individual people work and when and by whom the patients are to receive care. Plans and rules can also help to match resources to the tasks to be performed. One of their benefits is that they develop commitment between participants [9, 13]. To return to the example of shift planning (which is binding), based on guidelines or standards, it determines how much time is available for individual patients and what level of training (i.e., competencies) each nurse on the shift must have. Plans and rules can evolve at the team (micro) or organization (macro) level. In addition to presenting instructions on what needs to be done by whom (e.g., for each new patient admission in homecare), they make it easier for the different participants to relate to each other.

Objects and representations include programming items that rely on information technologies (e.g., letters, e-mail, telephone calls/texts, information boards, shared calendars) and patient files (e.g., care plans, electronic patient records, protocols) [9, 13, 22]. Each object or representation provides a common space for the exchange of information relevant to the participants’ task set [9]. For example, if a patient’s family doctor orders a change in therapy, that change can be communicated to the responsible nurse through a telephone call or an e-mail.

However, information technologies not only enable the sharing of information but also enhance *situation awareness* (discussed later): by making the various participants' activities visible, they also facilitate the coordination of future work [39]. Representations such as nursing plans or protocols help to operationalize the various tasks and provide a common point of reference that reminds the participants of what they have to do [9, 13].

Furthermore, shared protocols are an excellent example of how those involved in a patient’s treatment can develop "a common mental model of the patient's condition and the treatment options" [9, 22]. Another example is an entry in the patient's record about changes in their health status and any necessary adjustments to their care plan. This informs all subsequent nurses about which aspects of that patient’s care they should observe closely or what new interventions they need to carry out.

Roles are bundles of defined responsibilities held by individuals. Applying both to staff who work within an individual team, profession or organization and to *boundary spanners* (who work across those groupings), roles facilitate the division of labor. As roles are closely related to expectations associated with social positions, they can also facilitate continuity of behavior [9, 40]. Clear definition of both, roles and their associated hierarchies allow the various participants to monitor progress on tasks and to elicit commitment from one another regarding their activities [9, 22]. Roles also help to create a common understanding of responsibilities for routine tasks [9]. For example, if individuals understand which tasks are linked to the roles of which care team members, they can replace one another other in the execution of those tasks for which they have the necessary competencies.

For example, homecare nurses are often assigned overall responsibility for a certain number of patient cases. If a patient's situation changes, the responsible nurse must be informed. And as the role of each responsible nurse is clearly defined, other nurses can temporarily substitute for them in case of illness. One specific role to mention here is that of *boundary spanners*. Gittell [27] notes that, by providing information across groups within their organization, they contribute importantly to coordination by clarifying which tasks remain to be done by which teams [9]. One good example of a boundary spanner is a case manager, who must ensure that patients receive adequate care across professional groups or even organizations [27]. In homecare settings, *defined care coordinators* (e.g., nurses or general practitioners) can also take on boundary-spanning roles [41].

Routines are "repeated patterns of behavior that are bound by rules and customs and that do not change very much from one iteration to another" (p. 622)[42]. They include handovers, clinical pathways or algorithms, training, regularly scheduled sessions/meetings, or even standardized information and communication systems [9, 13, 27, 36, 43]. As the sequence of activities to be performed is well-established, dependent participants can gauge their progress through a routine, as well as knowing when it is complete [9]. Routines also define how and when tasks move from one participant to another (e.g., shift handovers). They may also provide guidance for moments when people work together on a task, e.g., handover reports.

The interpersonal connections included within routines facilitate interactions between participants [9, 27, 43]. By specifying in advance the tasks to be done and the order in which they are to be performed, they can also help create a common perspective on the pending work [9]. For example, in addition to promoting task agreements, *clinical pathways* can provide insights into the overall care process, the roles of participants, and the level of importance participants place on each of their allocated tasks [27]. Van Houdt et al. [44] found that care process standardization (through care pathways) across the primary and hospital care continuum led to clear definitions of required expertise, roles, and goals. In addition, by diminishing the need for interaction between participants, routines are a relatively inexpensive coordination mechanism [9]. However, the higher the level of uncertainty, the fewer routines are applicable, and the more communication and feedback are necessary [12, 18].

Communication

Communication can be understood as information exchange or feedback explicitly undertaken by participants when managing dependencies [12, 18]. It can be divided into personal and impersonal communication [12, 18, 37].

Impersonal communication refers to a set of impersonal practices and tools that participants use to manage the more stable and foreseeable aspects of work. As well as standardized information and communication, this includes board postings, general announcements, memos to all staff, manuals, written documents [18, 37]. As an example, if a nurse documents a pain medication administered to a patient in the health record system, subsequent nurses know what the patient received, even if no personal exchange occurred. Health record system documentation would be classed as impersonal communication.

Personal communication involves communication and feedback processes and encompasses the exchange of information between two or more participants to integrate their respective contributions; exchanges can be formal or informal, oral or written [18, 37]. Personal communication can be conducted one-to-one or in groups. ***For one-to-one communication****,* the individual participants use vertical (hierarchical) or horizontal (non-hierarchical) interpersonal communication channels (communication and feedback) to coordinate their tasks [18]. The larger the team, the more impersonal and vertical communication is required [18]. ***Group communication*** is used to conduct meetings (whether planned or unplanned) to coordinate tasks. A formal/impersonal tone is common for more routine, usually scheduled communications such as staff or committee meetings; for unplanned communications such as informal, spontaneous conferences between two or more participants about work-related issues, a personal/informal tone is more common. [18].

Implicit coordination mechanisms

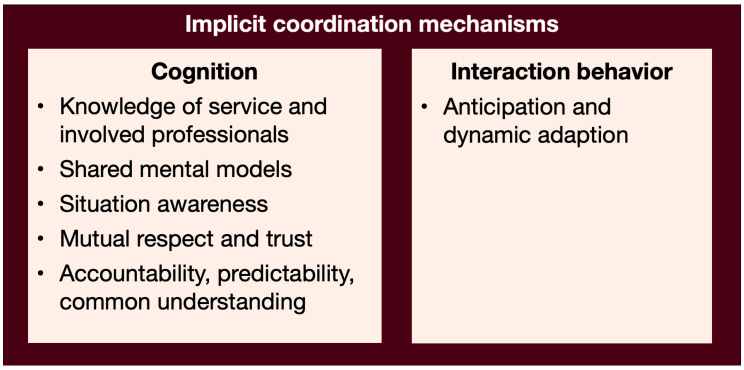

Fig. 3. Implicit coordination mechanisms

Implicit coordination mechanisms are those that are available to the participants through common or shared knowledge [12]. They help participants cope with task dependencies by being able to explain and anticipate the task states and activities of others, which can help them plan their own activities. These mechanisms are applied consciously or unconsciously and they develop over time through experience, interaction and training together. Thus, implicit and explicit coordination mechanisms influence each other [12].

For example, over time, the homecare nurses learn the physicians' procedural and interaction preferences (an implicit coordination mechanism). It is common knowledge, for example, that physician A is best reached by telephone (explicit coordination mechanism) to discuss patients' urgent concerns. Figure 3 provides an overview of implicit coordination mechanisms, distinguishing those that are cognitive from those that are interactive/behavioral.

Cognition

Knowledge of service and involved professionals. Successful coordination requires an in-depth knowledge of available services and which professionals will be involved in care [16, 30, 32, 45-47]. For example, a homecare nurse needs to be familiar with local services such as meal delivery or financial support options. Before arranging these services for the patient, though, it is also necessary to know which are covered by insurance. There are multiple implicit coordination mechanisms based on cognition, including:

Shared mental models. Mental models are "organized knowledge structures that enable individuals to interact with their environment" (p. 274): they help people to understand and predict events in their environment [48]. *Shared mental models* are based on similarities in knowledge content and structure between individuals, which enable participants to predict their colleagues' information and resource needs [48, 49]. The various common mental models can be split into task-based and team-based models [12, 48, 50].

Task-based models focus on functionality. They can be divided into technology/equipment models (knowledge of technologies and equipment and their limitations, such as electronic health records, prescription systems, and procedures, devices and materials) and task models (knowledge of task sequences, procedures or treatments and relationships between task components, emergency plans, and environmental constraints) [48, 49, 51].

Team-based models can be divided into team interaction models (knowledge of roles and responsibilities, information sources, interaction patterns, communication channels, role interdependencies, information flow) and team models (knowledge of team members' skills, attitudes, preferences, and tendencies) [48, 52]. In order to determine care plans, nurses need appropriate knowledge of their care team members' experiences, skills, plans, relationships, and preferences. Clinicians involved in the care of a patient may also have different opinions about the roles they and others should play in patient care. Such differences in role perceptions can lead to ineffective navigation back and forth across professions or organizations [46].

Espinosa et al. [12] argued that the importance of the different mental models for the management of interdependencies varies depending on the type of dependency. They also observed that when participants work asynchronously and are geographically dispersed, task-based models seem to play a greater role than team-based ones.

Situation awareness. Endsley [39] defines *situation awareness* as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future," i.e., "knowing what is going on." (p. 36). Situation awareness is situation-specific and more dynamic and fleeting than shared mental models, which are more durable knowledge and are not dependent on the situation [53]. For example, knowing a patients preferred walking aid is an example of a shared mental model, whereas knowing what the patient is doing at one particular point in time during mobilization is an example of situational awareness. *Team situation awareness* is up-to-the minute, relevant knowledge required for the participant's responsibilities in a specific situation and is no longer relevant when the situation no longer applies to that participant [39, 53]. If a high level of mental model sharing is present, each participant can achieve an equally high level of situational awareness without additional verbal communication [53].

Mutual respect and trust. When participants trust and respect each other because they know one another’s competencies and expertise, coordination is enhanced [9, 54]. Trust also provides assurance that the other participants will fulfill their duties consistently and reliably [9, 13, 18].

Accountability. While shared mental models provide a foundation for common knowledge, a shared sense of accountability clarifies participants’ understanding of their and their co-participants’ responsibilities. All participants must be accountable for their contributions [9]. Accountability is vital to ensure that everyone contributes as agreed to the intended "product" [9]. For example, when a colleague hands over a task, the person accepting it must be sure (unless otherwise informed) that all necessary actions have been completed so that subsequent actions can be carried out (e.g., administering the correct amount of insulin prior to meal intake in insulin-dependent patients); if this is not the case, the person handing over the work must take responsibility and inform their successor so that they can plan their activities as necessary.

Predictability not only enables participants to anticipate, plan and conduct their own tasks but also gives a picture of subsequent tasks, of any necessary interdependent tasks, and of the entire set of tasks to be accomplished. When predictability is high, participants can be secure in the knowledge that their teammates will successfully perform their work, allowing them to perform tasks that depend on that work as planned [9]. As an example, if the homecare team knows on which day the patient will be discharged from the hospital and what his/her further treatment will be, they can make the necessary preparations (e.g., organize wound dressing materials for home).

Common understanding or common ground, enables a shared perspective on the necessary tasks and integration of each individual's work into the whole. A common understanding of the broader context in which coordination occurs, such as the organization's or patient's goals, can keep everyone focused on common patient outcomes. Common understanding enables participants to develop both a common vision and common ground, enabling them to focus their efforts on a shared conception of the work or the processes necessary to complete it [9, 55]. Various studies have demonstrated the value of such common objectives [27, 30, 32].

Interaction behavior

Interaction behaviors, which Rico et al. call "team situation models," occur when participants anticipate both the needs of their co-participants and the demands of the task, and dynamically adapt their behavior without planning or communicating directly with one another [23, 37]. Rico et al. [37] identify two components within this phenomenon: (1) **anticipation,** which is reflected in participants' expectations and predictions of task demands and expressions of each other's actions and needs without being directly informed of those actions or needs; and (2) **dynamic adaptation**, which is reflected in the actions that participants continuously take to adapt their behavior to each other [37]. This implicit coordination mechanism can be characterized by the following conditions: (1) other participants are provided with task-related information, knowledge, or feedback without prior request; (2) the workload is proactively shared with colleagues or help is offered as necessary and accepted; (3) participants' progress in their activities is monitored; and (4) participants adjust their behavior to match the expected actions or needs of others [37]. Figure 4 shows the relationship between the various components of the coordination process.

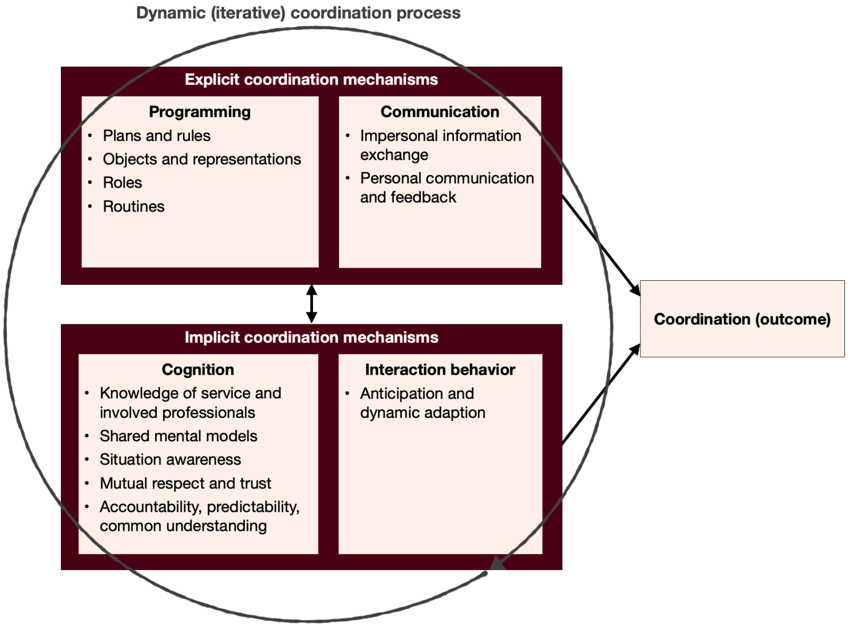

Figure 4. The coordination process with its components

The two different outcomes of the coordination process

Coordination (outcome) – the outcome of the coordination process

As noted above, the coordination as an outcome is understood as the extent to which work dependencies have been effectively managed toward the fulfillment of a specific goal [10, 12, 17]. Espinosa et al. [56] studied coordination in software development and differentiated three categories of coordination outcomes: *technical*, *temporal*, and *process*. While their study focused on software development, this differentiation is quite general and therefore applicable to other task contexts, including healthcare.

The importance of these outcomes is most obvious when their absence leads to coordination problems or failures. A **technical coordination** outcome is one in which the inherent technical dependencies of the task itself are effectively managed. In homecare, an example would be the successful integration or application of various services or treatments to a patient. Technical coordination failures would include prescribing or administering medication with negative interaction effects or applying a treatment to a patient that leads to severe effects in unrelated medical conditions (e.g., administering in-home tube feeding to a patient who should not receive it due to a diabetic condition). **Temporal coordination** denotes the timely management of sequential dependencies and the transmission of all relevant patient information from one care provider to the next and the timely delivery of the specified health service tasks to the patient when they are needed and in the correct order. An example of a temporal coordination failure would be when a patient receives a prescribed treatment too late for it to be effective, e.g., in a homecare patient with heart failure, increasing diuretic medication too late, leading to a medical emergency because of unchecked pulmonary edema. **Process coordination** focuses on following established procedures and processes, with each participant completing the tasks for which they are responsible in the recommended order and in compliance with established processes and procedures. An example of process coordination failure would be when a minor patient is treated without the parent's consent, or when a patient is released earlier than planned from hospital without involving the homecare organization according to usual procedure, leading to complications and hospital readmission.

However, the distinction between technical, temporal, and process coordination in evaluation or measurement (when failure is not being measured) is rather difficult. This brings us to the framework of Zackrison [34]. In that work, rather than emphasizing different types of coordination, Zackrison proposed assessing coordination based on two more observable phenomena: *in situ interaction* and *alignment of work*. **In situ interaction** can be assessed in terms of accurate and timely information sharing, prompt negotiation of differences, lack of disagreement, and problem-solving capabilities. **Alignment of work** can be assessed based on the degree to which the work is coherent, tasks are not duplicated, all group members perform the tasks they are supposed to do, participants can do their jobs without getting in each other's way, there are no delays in the process and subtasks are closely harmonized.

The outcome of coordination – the patient and economic outcomes

Higher levels of coordination lead to increased performance towards intended results/outcomes [12, 13, 57]. In healthcare, the target of a care team—whether within an organization or inter-organizational—is to deliver healthcare that meets patient needs effectively and appropriately. The logical consequence of this is that coordination pursues the goal of improving patient outcomes by delivering effective and appropriate care to patient while reducing costs by avoiding empty runs and resource waste [57]. Therefore, with successful coordination in place, both better patient outcomes such as reduced unplanned healthcare utilization, and better economic outcomes such as reduced cost can be expected [8, 13, 32, 57].

However, it is important to recognize that, while coordination can lead to more effective team performance, it is not always the main driver for delivering effective and appropriate healthcare. Many factors that impede or improve performance are not related to coordination. Members of a healthcare team may be extremely well-coordinated and still perform poorly. There are two possible reasons for this: First, they may be affected by other determinants of performance that have nothing to do with coordination (e.g., individual or equipment capabilities may not be adequate to perform the necessary tasks, or the patient's condition may be especially complex). Second, some dependencies may affect performance more than others; and while many dependencies may be properly managed, some of the most critical ones may not [12]. For example, even if a healthcare team provides excellent care to a homecare patient and successfully manages all dependencies, if the patient's diagnosis is incorrect, the treatment plan will also be incorrect. In such a case, even a highly coordinated team will perform poorly in terms of treatment outcomes (e.g., complications, worsening of the disease, or even life-threatening conditions).

An additional critical point mentioned by Malone and Crowston [17] is that "often,…good coordination is nearly invisible, and we sometimes notice coordination most clearly when it is lacking" (p. 90). This is likely one reason, apart from coordination's vague conceptualization, why many studies of it use outcomes at patient level without measuring – or even considering – measuring coordination as an outcome, i.e., the level of coordination. Figure 5 depicts the coordination process and its outcomes.

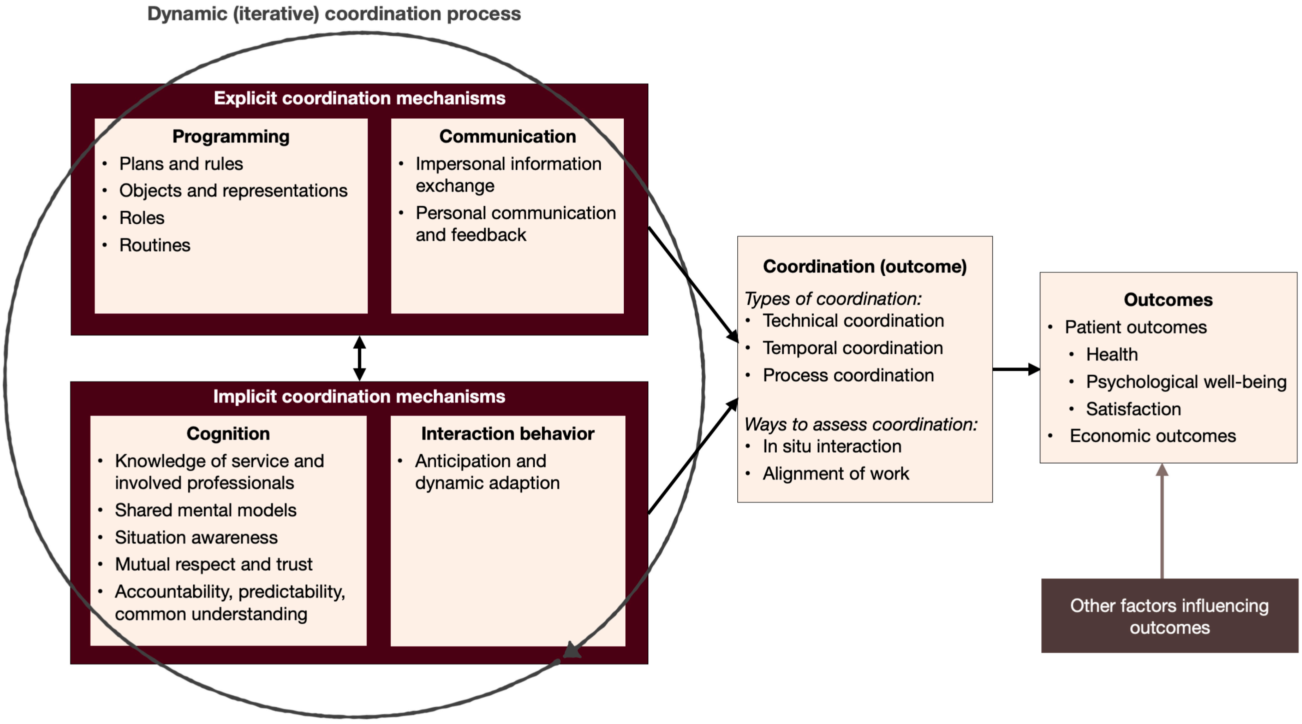

Figure 5. The coordination process, coordination, and outcomes

Factors influencing coordination processes

Coordination processes cannot be considered separately from the system within which it works. This is especially true in healthcare. It is essential to consider it in relation to its environment, i.e., characteristics of the meso (organizational) level and factors at the macro or system levels [12, 13, 32, 36, 58].

Organizational characteristics at the meso level

Several organizational characteristics affect the coordination process. One general point emphasized by Crowston [59] is that "organizations with similar goals will have to manage the same dependencies, but may choose different coordination mechanisms, thus resulting in different processes" (p. 159).

Factors such as **organizational culture and size** as well as the **number and variability of participants** influence the coordination process [12, 16, 59]. Organizational culture influences it by determining which coordination mechanisms are in place, for example, how technologies are used or how many tasks are standardized [12, 25, 33]. Regarding the team, the larger the number of members, the larger (exponentially) the number and complexity of the dependency links between members, resulting in more coordination challenges [12]. The team's composition also plays a role: the participants' experience, types and levels of specialization or expertise, prior experience working with the other members, or the linkages and boundaries between them all influence the coordination process [16, 36]. Espinosa and Pickering [36] observed that, based on personal experience and interaction styles, participants prefer certain coordination mechanisms.

Further, the **characteristics of the task(s)** also play a role as they determine what kind of dependency exists [12, 59]. The task characteristics of a car manufacturer differ from those of a hospital or homecare organization. Thus, while one organization may operate with a majority of sequential dependencies, another may have to deal with predominantly reciprocal dependencies. The tasks' complexity, their length and the way they are interrelated also affect the coordination process [16, 59, 60]. Some tasks are purely digital (e.g., software development) or knowledge-based (e.g., writing a book). Others are mostly physical (e.g., construction, nursing). Furthermore, the task coordination mechanisms and processes themselves may be digital (e.g., email, electronic documents) or physical (e.g., communicating in the operating room).

The coordination process is also influenced by whether the **tasks are synchronous or asynchronous** [9, 12]. In an operating room, for example, where tasks are mainly synchronous, members of the surgical team must maintain a high level of situation awareness to work simultaneously; throughout each procedure, all work must be tightly coordinated [39, 61]. Performing such synchronous tasks, the participants rely far less on mechanisms such as objects and representations than on their own roles, routines, and mutual trust to know exactly what they have to do and when. For example, situation awareness is critical during emergency surgery or in an airplane cockpit. In contrast, homecare work is largely asynchronous. For each patient, a homecare worker typically works alone, with no team on-site to provide immediate support if needed. The different participants contribute to the patient's care in a time-shifted, i.e., asynchronous manner.

For example, a patient recovering from a leg fracture receives homecare services in the morning and evening. In the afternoon the patient goes to the family doctor because the homecare nurse noticed an elevated temperature and an unusual urine smell in the morning. Later in the afternoon, a physiotherapist is scheduled to visit the patient for movement exercises. In the evening, a second nurse will visit. These five participants (the patient, the two nurses, the physician and the physiotherapist) need to be coordinated; but the applied coordination mechanisms and activities they apply differ widely from those of the surgical team. By scheduling the first nurse in the morning, the physiotherapist in the afternoon, and the second nurse in evening, the homecare agency has already used coordination mechanisms. When the nurse places a phone call to the family doctor to make an appointment, then helps the patient organize transportation to the doctor's practice, these represent two more coordination mechanisms. The physiotherapist must also be informed (by e-mail) that the patient will not be home at the scheduled time. Assuming that the physiotherapist can move the scheduled therapy session to later in the afternoon, he/she will need to adapt that day's therapy to the patient's condition. The homecare nurse who visits the patient in the evening must then check the patient's condition and, if necessary, organize, adjust or administer any necessary medications.

Another factor that influences the coordination process is **physical proximity**. By facilitating the possibility to see each other face-to-face, physical closeness enables easier exchanges, including informal conversations [9]. For example, when Espinosa et al. [56] examined how working in online environments affected team communication, they found that dispersion has a negative effect on coordination.

External factors at the healthcare system (macro) level

System-level factors such as **health policy, current legislation, economic factors, and existing resources** also influence care coordination [16, 62-65]. Health policy and current legislation influence coordination in numerous ways, e.g., through incentives or financial rewards, by providing definitions, e.g., of various actors' responsibilities, or eligibility criteria for homecare patients [62-64]. For example, O'Malley et al. [65] and Williams et al. [64] found that homecare agencies saw additional staffing costs to cover administrative and coordination efforts as a barrier to coordination, especially when reimbursement did not cover those costs. Other factors such as workforce adequacy and the sharing of electronic health records are coordination facilitators; workforce shortages and limitations to access to shared electronic health records are impediments [64, 65].

Patients have a special role in care coordination. As they are the "consumers" of healthcare services, their **characteristics** can actually be classified as system-level factors. However, this designation does not give them special privileges: depending on governmental regulations—when eligibility criteria are applied, for example—some can find themselves excluded from services [62]. Similarly, cultural differences (or other dissimilarities) between regions or countries can affect the patients' social networks or the availability of informal care [47].

Patients can also be placed at the organizational level—depending on the focus of their care-providing organization(s), patient characteristics can vary tremendously. A team (either inter- or intra-organizational) that cares for women after childbirth has a very different patient population one that cares for individuals with cancer or who are at the end of their lives. However, regardless of which organizational level they occupy, every patient is also the central member of their care team. As such, each also has a duty as an active participant in the coordination process—not simply a passive recipient of services [31, 47, 64]. Van Houdt et al. [32] and Williams et al. [64] found that, in addition to their individual characteristics—e.g., coping ability, participation in social networks and personality type—patients' expectations are linked not only to coordination needs but also to outcomes. Therefore, as noted briefly above, depending on the perspective chosen, patient characteristics also find a place in the "other factors influencing coordination" category. In our model, we added patients to the system level. Figure 6 (below) displays the final model.

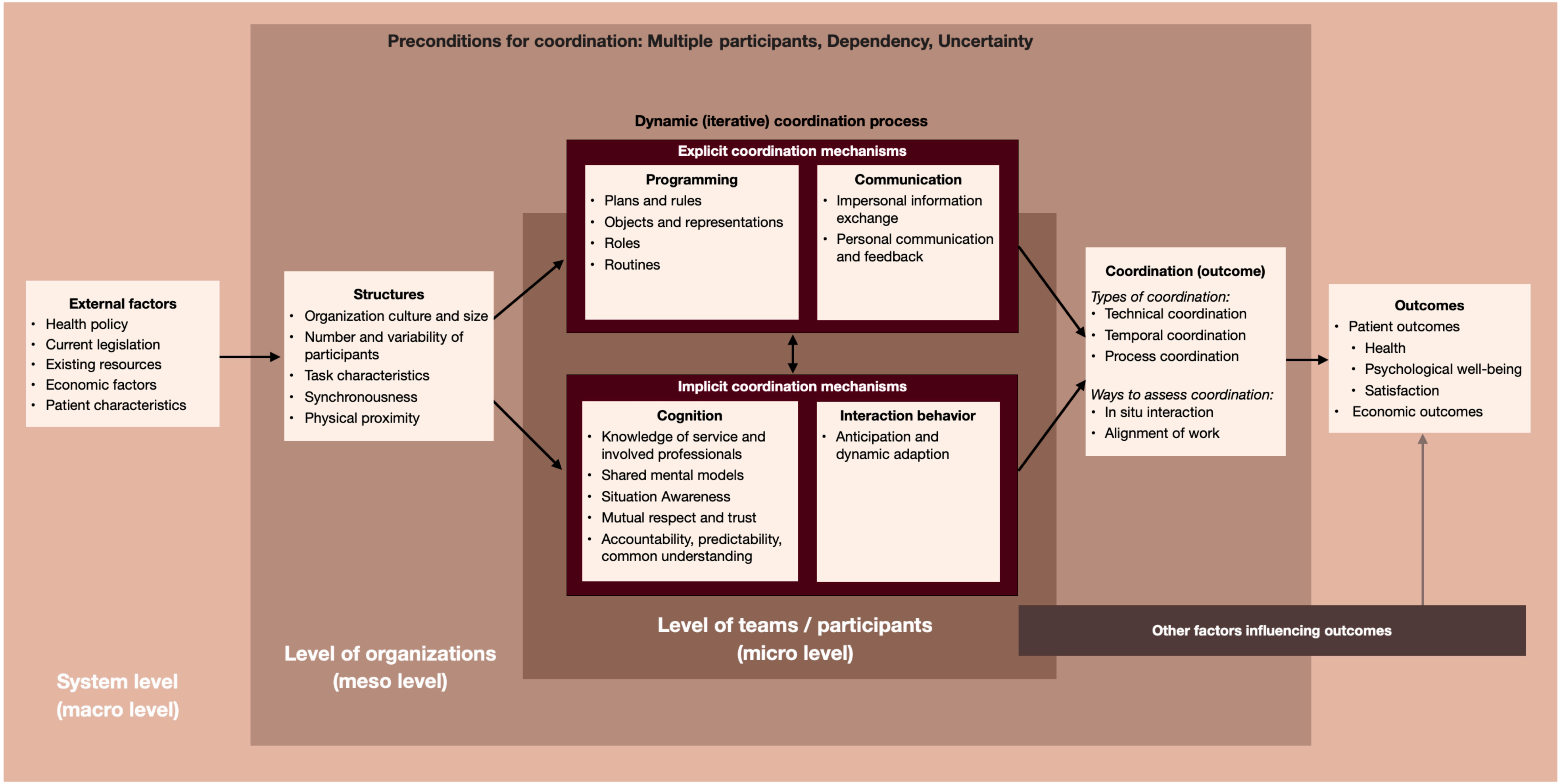

Figure 6. The theoretical homecare coordination framework (Care **COOR**din**A**tion (COORA) framework)

Discussion

This paper integrated a broad group of coordination theories and frameworks into a unified, comprehensive theoretical framework that captures care coordination in homecare. The availability of such a framework in the homecare setting will greatly improve the conceptualization and measurement of coordination. This theoretical coordination framework adds value in four main ways: First, based on a wide range of influential coordination literature, the research team has developed the framework iteratively in consultation with healthcare professionals, patients and their relatives, who provided descriptions and explanations to better understand the patient care context. Second, it is comprehensive, considering the complex relationships between the many factors influencing coordination, and applicable across all healthcare settings, not only in the homecare setting. In addition, to the best of our knowledge, it is the first theoretical coordination framework to explicitly address micro-, meso-, and macro-level system factors and their connections within an overarching framework for homecare coordination. Third, our specific explanation of coordination's foundational elements enables a more uniform operationalization of the overarching concept of coordination. And fourth, this framework emphasizes the importance of distinguishing between coordination as a process, coordination as an outcome, and patient outcomes. In measuring as well as in interpreting results this distinction is vital to avoid misleading conclusions.

Limitations

This theoretical framework is conceptual and requires further empirical testing. There are many ways to do this. One important first step would be to evaluate the framework with a qualitative study to better understand the variables that play a critical role and define these accordingly. The results of such a qualitative study could then be used to develop and assess more precise constructs to be tested with quantitative methods. Once we understand how to observe and measure these constructs, the actual framework could then be tested with statistical or ethnographic methods. Once the framework has been tested, we or other researchers could design studies to test individual aspects and components of the framework as a basis for measuring coordination's various elements and their effects. It is important to note that there is an abundance of empirical studies in coordination outside of the healthcare field, so there are many feasible constructs and variables we could employ. Naturally, these would have to be validated in the homecare context. As this framework is comprehensive, measuring all elements might not be feasible; therefore, we recommend identifying the elements on each level (in each box in the model) that are expected to play key roles in each selected setting and are measurable using an appropriate design and validated measurements. Finally, coordination issues vary widely in form and nature across different healthcare settings. Researchers interested in healthcare coordination research need to discern the more generally applicable aspects of our framework and those that may be unique to their focal healthcare context and tasks.

Conclusions

This framework is thorough and strongly relevant to coordination research in general. Once its application has been tested globally, it will be available to guide researchers to operationalize the concept of coordination in various healthcare contexts. With its potential to standardize our understanding and measurement of coordination, it could also contribute significantly to current practice. Finally, this framework clarifies the critical but formerly muddy distinction between coordination as a process and as an outcome. This distinction will prevent false conclusions or inferences about coordination processes based on product outcome assessments and vice versa.

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Declarations of competing interest

All of this paper's authors declare that they have no competing interests.

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CHAPTER 3

Factors associated with homecare coordination and quality of care: A research protocol for a national multi-center cross-sectional study

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Abstract

Introduction

The persistent fragmentation of home healthcare reflects inadequate coordination between care providers. Still, while factors at the system (e.g., regulations) and organizational (e.g., work environment) levels crucially influence homecare organization, coordination and ultimately quality, knowledge of these factors and their relationships in homecare settings remains limited.

Objectives

This study has three aims: (1) to explore how system-level regulations lead to disparities between homecare agencies' structures, processes and work environments; (2) to explore how system- and organization-level factors affect agency-level homecare coordination; and (3) to explore how agency-level care coordination is related to patient-level quality of care.

Design and Methods

This study focuses on a national multi-center cross-sectional survey in Swiss homecare settings. It will target 100 homecare agencies, their employees and clients for recruitment, with data collection period planned from January to June 2021. We will assess regulations and financing mechanisms (via public records), agency characteristics (via agency questionnaire data) and homecare employees' working environments and coordination activities, as well as staff- and patient-level perceptions of coordination and quality of care (via questionnaires for homecare employees, clients and informal caregivers). All collected data will be subjected to descriptive and multi-level analyses.

Discussion

The first results are expected by December 2021. Knowledge of factors linked to quality of care is essential to plan and implement quality improvement strategies. This study will help to identify modifiable factors at multiple health system levels that might serve as access points to improve coordination and quality of care.

Keywords: Care coordination, Delivery of Health Care, Health Services Research, Home Care Services, Nursing Administration Research, Quality of Care

Introduction

In 2018, for the first time in history, persons aged 65 years or older outnumbered children under five globally. Demographic aging will continue for some time: by 2050, in Northern North America and Europe, one person in four is expected to be 65 years or older [1]. By that time, current estimates indicate that the global population of older old persons (≥ 80 years) will have climbed from its 2019 level of 143 million to 426 million— nearly 300% the current figure [1].

As age rises, so do the prevalence of chronic conditions and multimorbidity (which affect more than 50% of those over 65), forcing many persons to become long-term care dependent [2-4]. Even when care-dependent, though, most prefer to live in their own homes as long as possible [4, 5]; and homecare is normally a cost-effective alternative to inpatient or residential care [6]. Therefore, care is shifting progressively from institutional to homecare settings [4, 7].

In Switzerland, homecare encompasses services delivered in the patient's own home for the purpose of promoting, maintaining, or restoring health or minimizing the effects of illness and disability [8]. In 2017, Swiss homecare agencies provided services to over 350’000 clients, almost all (99%) of whom received long-term care; 70% were over 65 years of age [9]. As the population of people in that age range is growing, homecare has recently become the fastest-growing segment of Switzerland's healthcare sector [6, 9]. Over the decade starting in 2021, keeping pace with projected care requirements will require a 57% increase in trained care providers [10].

Although health systems are being adapted to strengthen primary care and meet the complex long-term care needs of clients, the current focus on acute care hampers providers' ability to keep pace with these increases in demand [6, 11]. The main reason for this shortfall is the fragmentation of healthcare delivery, with inadequate information flow leading to inefficient coordination and collaboration [11, 12]. This lack of care coordination also poses a major challenge to the quality of homecare services, as it can lead to negative client outcomes (e.g., health deterioration), unnecessary or incorrect treatment and wasted resources (e.g., duplication of diagnostic tests) [6, 7, 13-15]. McDonald et al. [16] define care coordination as

> the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient’s care to facilitate the appropriate delivery of health care services. Organizing care involves the marshaling of personnel and other resources needed to carry out all required patient care activities,

> and is often managed by the exchange of information among participants responsible for different aspects of care (p.41).

Viewed as a process, care coordination is most necessary to manage all transitions between care providers, thereby bridging any gaps between the client and the healthcare system. These might involve changes between individual professionals, teams or settings, or any other points when changes in client care are necessary [17, 18].

Care coordination in homecare

Although homecare is interdependent with other care services, and homecare workers typically collaborate with various care providers (e.g., informal caregivers, general practitioners, social workers) [13, 19], homecare coordination is often provided on an unstructured and voluntary basis by homecare workers [13, 20]. In addition, care coordination in homecare is more challenging than in institutional settings (e.g., hospitals) [13, 21]. Homecare is non-continuous (e.g., with daily or weekly visits) and often augments the efforts of informal caregivers. Combined with relatively rare physician contact and a rather high administrative burden per hour of contact—especially for reimbursement—these characteristics limit homecare workers' ability to ensure necessary care [21-23].

Lack of care coordination in homecare also hampers healthcare delivery in other ways. Baker et al. [24] found that, in homecare, medication-related adverse events were mostly related to inconsistent care coordination. Clients also attributed issues such as conflicting care plans or medication mismanagement to a general lack of reliable care coordination [25]. And 33% of healthcare patients experience primary care coordination gaps, including conflicting information, lack of availability of tests or records, or uninformed healthcare providers [26].

On the other hand, compared to homecare clients receiving usual long-term care, those receiving specifically coordinated care report reduced pain, better cognitive functionality and increased participation in activities of daily living [27]. And in Spain, recent healthcare reforms both subsidized homecare and introduced care coordination programs, which significantly reduced homecare clients hospital admissions [28].

Factors associated with coordination in homecare

When elaborating factors associated with care coordination, the entire health system must be taken into consideration [13, 29, 30]. In developing our conceptual framework, as recommended by the WHO, one of our first steps was to divide the healthcare system into three distinct levels (the macro, meso, and micro levels) [29]. The macro level is where government and policy decisions are made; the meso level includes organizations such as homecare agencies; and the micro level is where client-care worker interactions occur [29].

Failure of care coordination can occur on each of these levels. The implementation of accurate strategies to enhance coordination first requires the identification of factors associated with coordination across all three system levels, as these are all interdependent [31].

As a second step, we incorporated Donabedian's model of quality, which specifies three categories of quality: *structure quality*, *process quality* and *outcome quality*. *Structure* deals with the characteristics of the care provision setting, *process* includes all relevant tasks performed by professionals or clients, and *outcome* refers to those tasks' effects or impacts on clients [32]. Finally, in order to establish the framework's content (cf. Figure 1), we searched the literature for factors associated with care coordination and/or outcome quality, including homecare expert opinions. The following sections present the results of that search.

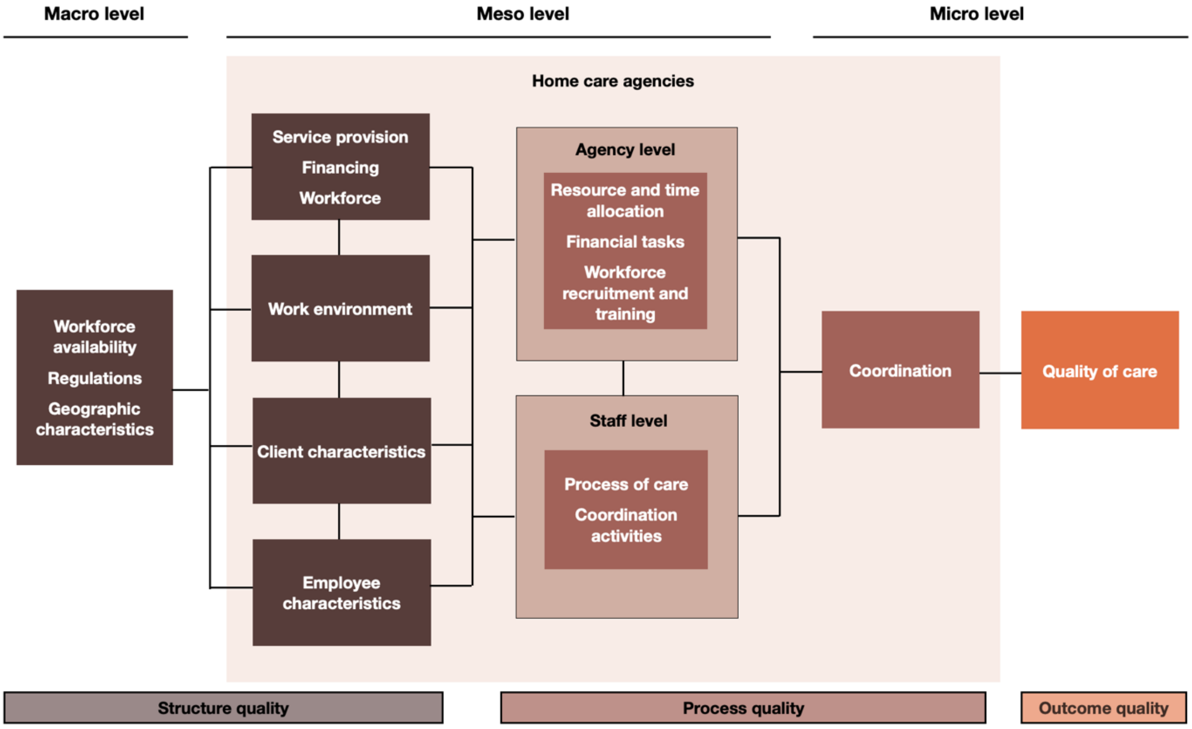

Figure 1. Conceptual framework

Macro level – Structure quality

At the macro level, we identified three structural aspects with impacts on coordination and quality of care: *workforce availability*, *regulations* and *geographic characteristics*.

Regarding ***workforce availability***, together with a general nursing shortage, a constant increase in demand for staff and a lack of interest among younger nurses regarding homecare can lead not only to a severe lack of qualified staff, but also to a range of corresponding issues, especially regarding quality of care [33-36].

Governance varies widely between and within countries [13]. Governments steer homecare by setting ***regulations*** such as quality standards, client copayments and eligibility criteria for homecare service use [13]. Poorly designed national (macro-level) legislation can unintentionally damage homecare workers' work environments, leading indirectly to cuts in quality of care and its coordination, or directly to care coordination deterioration [37, 38]. Macro-level policies also affect the meso level with respect to working hours, full versus part-time work, and employment conditions and opportunities [39].

As a macro-level tool to influence structural quality, regulation affects both structure and process quality at the meso and micro levels. One example of unsuccessful macro-level policy occurred in Canada, where healthcare restructuring has led to heavier homecare workloads and increasingly complex cases (i.e., unstable clients with unpredictable outcomes), causing many nurses to feel overworked and generally stressed [40]. Rudoler et al. [38] highlighted a number of these primary care reforms' unintended effects (e.g., ineffective incentives, failure to connect sectors/organizations) that hamper progress towards coordinated care. Additionally, Norman et al. [37] found that patients’ out-of-pocket costs and eligibility criteria were major barriers to coordination.

Regarding ***geographic characteristics,*** two systematic reviews found more problems in rural than in urban regions concerning meso-level factors such as trouble filling job vacancies, overloading of local professionals, longer travel times between clients and insufficient availability of resources, e.g., inadequate equipment and facilities. Consequences included reductions in the quality of care (particularly individuals not receiving the care they needed) [41, 42]. However, city dwellers did not necessarily fare better. Smith et al. [43] found that, compared to homecare agencies in rural locations, those in urban locations in the U.S. actually tended to score lower regarding clinical outcome measures and client experience.

From a macro-level perspective, failures of care coordination become apparent when fragmentation of health services (e.g., missing, redundant or simply wrong service provision) results in clients suffering adverse clinical incidents [17]. However, to date little information is available on how the macro-level factors influence either the meso-level operation of homecare agencies or the micro-level coordination of their services with those of other care providers.

Meso level – Structure quality

In our model, meso-level structure quality applies to service provision, financing and workforce, the work environment and the characteristics of homecare agencies’ clients and employees.

Considering ***service provision,*** Dalby and Hirdes [44] found that homecare agencies serving smaller populations achieved higher overall quality of care. Also, clients who received their first homecare visits during weekends were more likely to suffer adverse events, e.g., injuries from falls, wound infections and medication errors. However, regular weekend visits by homecare workers were associated with a decrease in such events [45].

As for ***financing***, how homecare agencies are financed appears to play an important role in relation to care coordination, as coordination requires time and personnel [46]. Studies in the U.S. indicate that financing models had an impact, with for-profit agencies scoring lower on overall quality measures [47, 48] and showing higher risks of client rehospitalization [47, 49] than non-profit agencies. In Canada, fixed multi-year service agreements resulted in understaffing and increased workload [40].

Regarding the ***workforce***, Smith et al. [43] found that agencies with higher numbers of homecare aides per 100 visits scored lower on clinical outcome measures and client experience. Furthermore, higher proportions of licensed practical nurses and nurse aides, as opposed to registered nurses, were associated with lower care quality and higher hospitalization rates [48].

As for the ***work environment****,* one study found that, in homecare workers' view, a reduced workload, frequent team meetings and increased management and supervision time were crucial elements for good care coordination [50]. Similarly, Swedish study in homecare assistant nurses found that work environment characteristics such as transformational leadership, peer support and job control correlated with higher quality of care [51]; a U.S. study among homecare nurses found associations between better organizational support and higher overall care quality, fewer medication errors and less uncontrolled pain [52]; and a scoping review identified several meso-level factors, such as peer support, role clarity, manageable workload and collaboration that influence optimal homecare nursing [40].

Other studies have shown that ***client characteristics*** such as age, co-morbidities, gender (inconclusive in which direction), depression, cognitive and functional impairment, low client compliance and living alone increase the risk for adverse events at home [15, 53] and were associated with higher rehospitalization rates [54].

Studies on ***employee characteristics*** are scarce. However, one found nonsignificant relationships between homecare employee characteristics such as age and job tenure with adverse events [45].

We were unable to identify any relevant studies focusing on the various meso-level elements of structural quality in relation to micro-level care coordination.

Meso level – Process quality

In constructing our conceptual framework, for meso-level processes we differentiated those at the agency level from those at the staff level. The agency level includes resource and time allocation, financial tasks, and workforce recruitment and training; the staff level includes care and coordination activities.

One US study named adequate ***resource and time allocation*** factors such as opportunities to interact and communicate intra- and inter-professionally, as instrumental to the improvement of homecare nursing [40], including reduction of hospital readmission rates [55]. Nevertheless, a qualitative US study found that homecare nurses often had difficulty accessing medical information, leading to the use of more time than allocated [56]. The same study reported that homecare nurses commonly had to make care decisions based on the observations of nursing assistants, who have less education and training, while more and more tasks are assigned to them [56]. In addition, agencies assigning smaller numbers of cases to each case manager performed better regarding overall quality of care [44]. While supporting evidence is currently scarce, this strongly suggests that time and other resources for effective information exchange and care planning are important factors for care coordination [46].

Regarding homecare agencies' ***financial tasks***, enabling and incentivizing them to cover care coordination expenses is fundamental. Where problems with payment occur, they have the opposite effect [27, 46]. To date, we have not found any studies exploring how care quality or care coordination is affected by homecare agencies' financial tasks, e.g., seeking reimbursement, determining or negotiating the amount of time billable to health insurers, or the planning or realization of cost saving measures.

Concerning ***workforce recruitment and training***, a qualitative study reported that a trained and available workforce is essential for sustainable care coordination; therefore hiring and retaining workers are also vital concerns [46]. Furthermore, qualitative studies have found that knowledge of the system and the necessary roles and responsibilities is an important element of effective care coordination [18, 57]. According to the scoping review of Masotti et al. [15], low team experience, training and knowledge, as well as inadequate patient monitoring/assessments, were frequently reported as factors contributing to adverse events in homecare. As a result, training opportunities were seen as crucial for care coordination by homecare workers [50]. However, to our knowledge, no studies have yet explored these various elements' associations with care coordination in the homecare setting.

A deeper understanding of the ***process of care*** is crucial to determine necessary care coordination activities. These include assessing needs, defining goals, proactively planning care, and monitoring and responding to change [17, 57]. To effectively coordinate care, a qualitative study found that care workers need both to understand their clients (e.g., details of their conditions, needs and preferences) and to empower them (e.g., how to use health services, manage their health) [18]. Each of these reflects a step in the process of care.

In our model, ***coordination activities*** can be understood as those undertaken by participating care providers in managing dependencies [58]. Identified activities include establishing accountability or negotiating responsibilities, communicating and facilitating transitions with the various care providers, linking community resources and aligning resources with client needs [17]. A recent US homecare study found that the most common coordination activities are follow-up with clients, assistance in completing applications and provision of service referrals [37]. Another is communication. A scoping review found communication issues the most commonly reported factors related to adverse events [15]. More specifically, the absence of standardized communication between team members has been strongly associated with medication-related events [24].

From a meso-level point of view, care coordination gaps become apparent when clients are directed to inappropriate health services or experience negative health outcomes due to inadequate handover or information exchange [17].

Micro level – Process quality

In our model, care ***coordination*** denotes "effective management of dependencies between subtasks, resources (e.g. equipment, tools, etc.) and people" (p. 5)[58]. To achieve overall care goals, care coordination focusses on facilitating high quality care provision across multiple providers to meet the client's needs and preferences [17]. Therefore, our framework presents coordination as a micro-level driver of process quality. On this level, care coordination failures often highlight additional efforts clients or informal caregivers have to make to ensure information flow or to meet care needs during transitions, i.e., shifts in responsibility [17]. If both macro- and meso-level factors facilitate (micro-level) care coordination, improvements can be expected not only in coordination but in care outcomes.

Micro level – Outcome quality

Campbell et al. [59] define ***quality of care*** as a measure of individuals' ability to "access the health structures and processes of care which they need and…[the extent to which] the care received is effective" (p.1614). With successful care coordination, higher quality of care can be achieved, e.g., in terms of reduced hospitalizations, improved clinical outcomes and higher levels of client satisfaction [60]. A study in the primary care setting showed that enhanced care coordination reduces the likelihood of hospitalizations or emergency room visits [26]. However, the specific association between care coordination and quality of care in the homecare setting remains unclear.

Considering the interplay between the micro, meso and macro health system levels, a system-wide overview is useful in evaluating or planning strategies to enhance coordination and improve quality of care. Detailed knowledge of how a system is performing makes it possible to select targets both for quality improvement and for investment [14]. Therefore, it is essential to explore how the three system levels interact. Although a number of qualitative studies have explored coordination-related factors, to our knowledge, very few quantitative studies have assessed macro- and meso-level factors' associations with care coordination. To develop and implement successful strategies to improve care coordination, knowledge of these relationships on every level is essential.

Methods

Aim

As little is known about the dynamic interplay between macro-, meso- and micro-level factors regarding care coordination and, in the end, quality of care in homecare, the following overall aims will be pursued:

(4) to explore how macro-level factors are associated with (meso level) homecare agency structures and processes;
(5) to explore macro- and meso-level factors' associations with (micro level) care coordination; and
(6) to explore care coordination's associations with (micro level) quality of care.

Study design and Setting

The proposed study is a national multi-center cross-sectional survey in the Swiss homecare setting.

Of Switzerland's 1020 homecare agencies, 577 are non-profit and 443 for-profit agencies [9]. Non-profit agencies care for roughly 80% of all homecare clients. They are larger on average than their for-profit counterparts, with an average of 31 full-time equivalent staff (FTEs), versus 9 for for-profit agencies [9]. Many homecare employees work part-time, with a mean employment rate of 45% in 2017 [9].

Homecare in Switzerland is funded by three sources: 1) the mandatory health insurance system; 2) client copayments; and 3) public funding of residual costs. Depending on the nursing tasks performed, insurers pay an hourly amount specified by the federal government [61]. The 26 Cantons of the Swiss Confederation, which have a relatively high degree of autonomy regarding healthcare decisions, are responsible for regulating client copayments and public funding. In some cantons, no copayments are required; in others clients pay up to 20% of the health insurance expenditures and up to a maximum of 15.95 CHF (approximately 15 Euro) per day of homecare services as defined by the federal government [61]. Requirements for and the extent of public funding also differ considerably between cantons [62].

Sample

Our sample will consist of homecare agencies, including their homecare workers, their clients, and the clients' informal caregivers. For this purpose, a three-stage sampling procedure will be carried out.

First, we will use a stratified random sample of ***homecare agencies***. Agencies will be pooled in the seven geographic regions used by the Swiss Federal Statistical Office [63] and stratified for each of those regions according to their profit status (non-profit/ for-profit). Only agencies with ten or more salaried employees will be included. Self-employed homecare nurses will be excluded. A formal power analysis is difficult in this context as many parameters, e.g., cluster effects of coordination outcomes, are unknown. For a multilevel analysis where the interest is mostly focused on fixed parameters, at least 30 groups of at least 30 individuals will be necessary for reliable results [64]. If there are strong interests in cross-level interaction, the number of groups should be larger—roughly 50 groups of 20 individuals per group. Our interest will be in cross-level interactions (aims 1 and 2) and fixed parameters (aim 3). The target sample size will be 107 homecare agencies, with 15% of the total sample size in each geographic region being non-profit and 15% for-profit agencies. Regarding homecare agency sizes in Switzerland, 50% of non-profit and 75% of for-profit ones represent fewer than ten FTE positions. Considering an average employment rate of 45%, excluding agencies with fewer than 30 employees would leave fewer than 50%. To overcome this problem, despite our knowledge that reducing the minimum number of FTEs would weaken the study's statistical power, we have chosen to include agencies with a minimum of ten employees.

Second, all ***homecare workers*** within each of the participating agencies who fulfill the following criteria will be invited to participate: 1) aged 18 years or older; 2) employed by the participating agency for at least three months; and 3) able to understand written German, French or Italian. With a mean of 44 homecare workers per agency and a response rate of 60%, we expect to achieve a sample size of approximately 3060 participants.

Third, within each of the participating agencies, 50 ***homecare clients*** (and their informal caregivers) will be randomly selected and invited to participate in our questionnaire survey. For agencies with fewer than 50 clients, all clients will be invited. Only clients aged ≥ 60 years and receiving nursing care will be included. We anticipate that roughly 30% of participating agencies will have fewer than 50 clients. Assuming a mean of 32 homecare clients per agency, a response rate of 30% would result in a final sample size of 1113 participants. For each participating client, a relative who accompanies him or her in everyday life is also invited to fill out the questionnaire for informal caregivers. If half of all invited clients pass on the questionnaire to their informal caregiver, with a 30% response rate, we expect a final sample size of roughly 550 participants.

Instruments and measurements

To answer our research questions, data will be gathered from various sources. Figure 2 gives an overview of the measurements planned for the different levels.

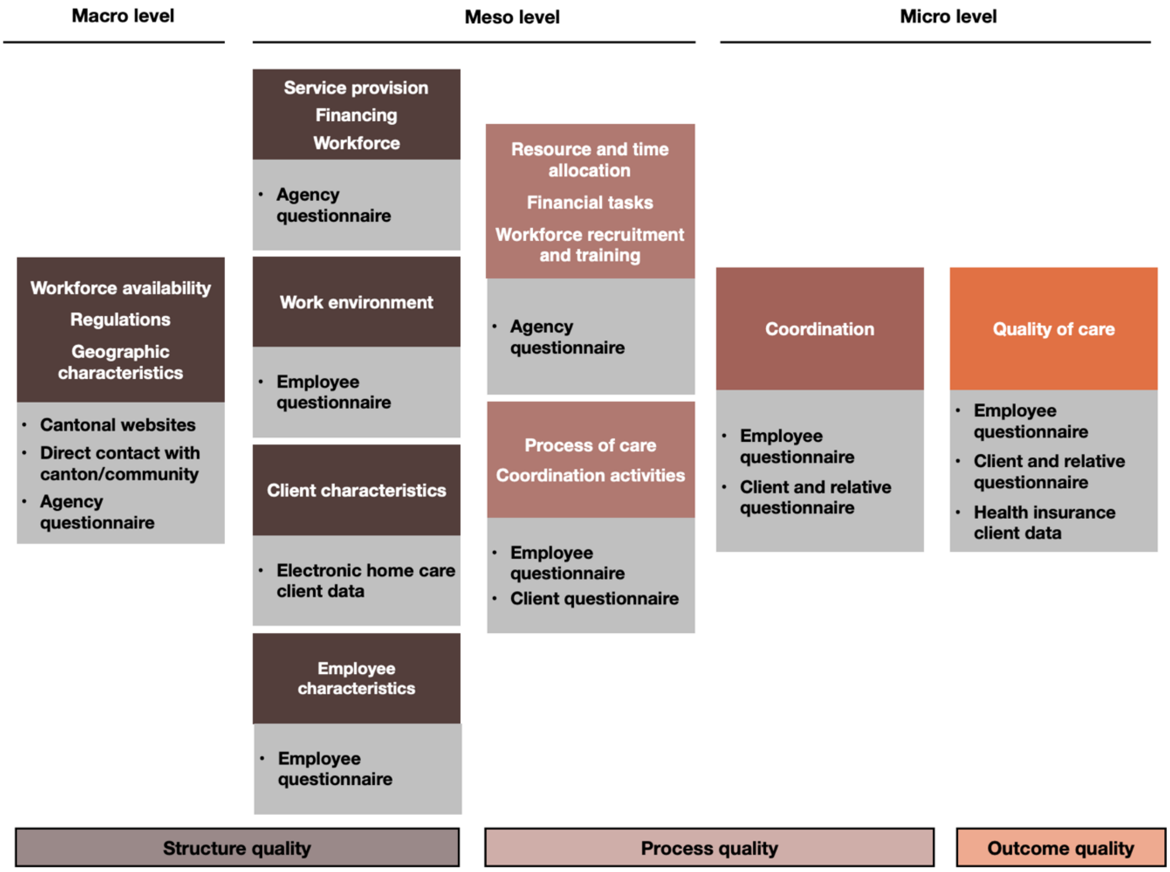

Figure 2. Measurements used for the three system levels

Questionnaires were iteratively developed in close collaboration with stakeholders (e.g., homecare nurse experts, managers, clients and their informal caregivers, homecare associations and political representatives). As a first step, an overview of existing scales measuring the different elements of interest was created. As well as focus group interviews with homecare workers, clients and informal caregivers, various group discussions and individual interviews were conducted with diverse stakeholders to discuss the questionnaires' key content and possible scales. Our decisions of which items to include and which scales to use were based on the research group's discussions of the interviews' results. The four questionnaires were developed first in German, then translated into French and Italian.

Validated translations were used when possible. The entire questionnaires were then back-translated into German and checked for inconsistencies, which were then discussed with bilingual local homecare workers (i.e., managers, nurses), clients and informal caregivers, then linguistically adjusted if necessary. After translation, using cognitive interviews, the questionnaires were pretested in each of Switzerland's three language regions.
For an overview of the variables measured at each level, see Table 1 (below).

Macro level – Structure quality

For structure quality on the macro level, three separate data sources will be used: 1) the websites of the cantons; 2) direct contact with cantons/municipalities; and 3) an agency questionnaire.
For each participating agency, data on public funding and reimbursement regulations will be collected, including those concerning client copayments [61] and residual financing, which must be provided either by cantons, by municipalities or by both. We will also collect data on the apportionment of residual financing, requirements for reimbursement (e.g., operating licenses, service agreements, cost calculation standards, required assessment tools) and methods of financing (e.g., shortfall warranty, paid hours of performance, standard vs. total costs). Geographic characteristics such as population size, numbers of physicians, pharmacies and hospitals will be recorded as appropriate. To assess workforce availability, we will ask agency managers about their perceptions regarding challenges to recruitment of qualified nursing personnel.

Meso level – Structure quality

For meso-level structure quality, three data sources will be used: 1) an agency questionnaire; 2) an employee questionnaire; and 3) electronic homecare client data.
For service provision, we will include agency size (number of FTEs, total hours of care provided in 2020), range of services and availability of services. Financing will be classified according to profit/non-profit status, percentage of financial contributions from all contributors and service agreements with cantons or municipalities. Regarding the workforce, we will assess the number of salaried employees at the time of data collection and the staff turnover rate. We will also measure staffing and skill mix, which are evaluated according to the percentage of the total number of care workers who are registered nurses, and the number of registered nurse visits per 50 home visits.
The work environment will be measured with validated instruments (e.g., the Safety Attitude Questionnaire [65, 66], Copenhagen Psychosocial Questionnaire [67]), and several self-developed scales and items. Table 1 (below) provides an overview of the variables; Appendix A provides detailed information on the employee questionnaire measurements and scales [see Additional file 1].

Client characteristics will be assessed using data extracted from the homecare agency database ADUA (*Administrative Daten und Anfrage* (translation: "administrative data and query")): year of birth (to calculate age), gender, living situation, place of care, minutes of professional care per visit, service intervals, types of services and whether services are covered by health insurance. Additional information, such as prior hospitalizations and the client's care needs (e.g., regular / palliative / psychiatric) will be assessed to deduce client profiles (% of clients receiving regular care, etc.).

Employee characteristics, including age, gender, employment rate and experience, will also be assessed.

Meso level – Process quality

Meso-level process quality will be gauged via three data sources: 1) an agency questionnaire; 2) an employee questionnaire; and 3) a client questionnaire.

Resource and time allocation data include variables such as the organization of the last three working days, regular intra- and/or interprofessional case discussions and/or team meetings, communication technologies currently in place, use of a planning system based on a reference person, and number of cases per nurse. For financing tasks, we will include criteria for reimbursement, settlement of conflicts with health insurance companies and municipalities regarding the financing of services, experienced cost pressure, the amount of time and costs not billable to health insurance, and planning and/or realization of cost-saving measures. Regarding workforce recruitment and training, we will assess the presence of nurses with case responsibilities / case managers / care managers (persons responsible and contact persons for individual clients regarding the care process or problems), as well as any provision by agencies of care worker training. We will also assess the presence of standards, checklists and guidelines for selected procedures and the availability of clear task/role descriptions.

On the staff level, evaluating the process of care includes questionnaire items asking whether interprofessional care goals and treatment plans are set, evaluated and adapted involving clients. Regarding coordination activities, from the employee perspective we will measure communication [68], accountability, predictability, common perspectives [69] and familiarity with the healthcare system. From the client perspective, we will assess communication between providers and clients [70] as well as coordination of homecare agencies [71] and the extent to which homecare nurses take up coordinator roles [72]. For detailed information regarding the measures in the client questionnaire, see Appendix B [see Additional file 1].

Micro level – Process quality

To measure process quality on the micro level, three different data sources will be necessary: 1) an employee questionnaire; 2) a client questionnaire; and 3) a questionnaire for informal caregivers.

To measure coordination from the employee perspective, we will assess the alignment of work within the care team, the alignment of client care with nominated providers (e.g., hospitals, general practitioners) and selected types of care coordination gap. Since we have been unable to locate any scales to measure care coordination as per our definition, all necessary scales have been developed by the authors; for details see Appendix A [see Additional file 1]. From the clients' and informal caregivers' perspectives, we will assess the perceived overall care coordination [71] and role clarity as well as care coordination between settings [72]. Detailed information about the measures in the informal caregiver questionnaire can be found in Appendix C [see Additional file 1].

Micro level – Outcome quality

As suggested by Hanefeld et al. [73], we will employ three separate approaches to our development of a comprehensive understanding of the quality of care delivered, i.e., not only clinical indicators but also client and care provider perceptions must be assessed and compared. Regarding provider perceptions, studies have indicated very strong correlations between nurse-sensitive quality measures (e.g., falls, pain) and nurse-reported quality in hospitals (overall rating of the quality of patient care) [74, 75]. Therefore, they will be included in the first of our micro-level outcome quality measures, i.e., our employee questionnaire. In all, four data sources will be used: 1) an employee questionnaire; 2) a client questionnaire; 3) a questionnaire for informal caregivers and 4) health insurer billing data.

One approach to measuring outcome quality is via employees' perceptions of quality of care, i.e., by asking them to rate their perception of the overall quality of client care (e.g., "On a scale of 1 to 10, with 1 representing "very low quality" and 10 representing "very high quality," how do you rate the quality of client care in your own homecare agency? " [75]). A second approach is to assess the quality of care perceived by clients and their informal caregivers, i.e., asking them to rate the overall quality of homecare they have received [70] as well as other healthcare service utilization by clients, such as their number of hospitalizations, emergency room visits and doctor visits (general practitioners and specialists) [76]. Our third approach is to obtain anonymized billing data from a sample of health insurance companies. These allow accurate calculation of the number of unplanned hospitalizations, visits to the emergency department and visits to the general practitioner over the last 12 months.

Table 1. Overview of the variables measured at each level

Topic	**Level**	**Domain**	**Variable**
Structure quality	Macro	Workforce availability	Recruitment situation for nursing and care staff
		Regulations	Reimbursement regulations (health insurance, client copayments, residual financing and methods of financing) Requirements for and content of an operating license Requirements for and content of a service agreement Requirements for reimbursement
		Geographic characteristic	Catchment area (rural, suburban, urban) Agency's service area (population size, numbers of physicians, pharmacies and hospitals)
	Meso	Service provision	Number of full-time equivalent posts Total number of clients and hours of care provided in 2020 Range of service (e.g., nursing care, domestic tasks, meal service, specialized care) Availability of services (e.g., only by day, day and night, on the weekend)
		Financing	Profit status (non-profit, for-profit) Percentage of financial contributions from different contributors (e.g., health insurance, client, canton/municipalities) Obligation to supply or service agreement with municipalities and cantons
		Workforce	Numbers of full-time equivalent positions differentiated according to educational background Turnover rate Staffing and skill mix (percentage of RNs and number of visits conducted by RNs within the last 50 visits)
		Work environment	Leadership Perceived staffing Teamwork Workload Overtime Predictability Role clarity Role conflicts Social support Sense of community
		Client characteristics	Age Gender Living situation (e.g., alone / with partner / with children) Type of services used (nursing care, domestic services or both) Service intervals (daily / weekly / monthly) Services covered by health insurance Place of care (e.g., apartment, house) Minutes of professional care per visit Prior hospitalizations Care needs (e.g., regular / palliative / psychiatric)
		Employee characteristics	Age Gender Employment percentage Experience in their profession Experience in their current homecare agency Job / position Country of education Educational background

Topic	Level	Domain	Variable
Process quality	Meso	Resources and time allocation	Organization of the last seven working days (e.g., number of nurses, number of visits, travel times, amount and type of services, time for coordinative and administrative work) Intra- and/ or interprofessional case discussions and/or team meetings Communication channels/technologies in place Planning according to a reference person system Number of cases for which each nurse is responsible
		Financial tasks	Requirements for reimbursement Conflicts with health insurance companies and municipalities pertaining to the financing of services Experienced cost pressure Time and costs not billable to health insurance Planning or realization of cost saving measures.
		Workforce recruitment and training	Presence of nurses with case responsibilities / case managers / care managers Provision of care worker training (e.g., regarding service availability, interprofessional care coordination) Presence of standards, checklists and guidelines for selected procedures (e.g., medication management, wound therapy, emergency situations) Clear task/role descriptions
		Process of care	Presence of interprofessional care goals Evaluation and adaption of care and treatment plans
		Coordination activities	Communication and information exchange Communication channels used Accountability, predictability, common perspective Familiarity with the healthcare system Communication between providers and clients (client perspective) Extent of coordinator role of homecare nurses (client perspective) Coordination through homecare agency (client perspective)
	Micro	Coordination	Alignment of work within the care team Alignment of client care with nominated providers Care coordination gaps (from employee and client perspective) Overall rating of coordination (from client and relative perspective) Role clarity and coordination between settings (from client perspective)
Outcome quality	Micro	Quality of care	Rating of care provided by the agency (from employee, client and relative perspective) Healthcare service use

Note. RN = registered nurse

Data collection

Data collection will take place from January 2021 until June 2021. Before data collection begins, each agency will choose a contact person who will be responsible for internal distribution of the questionnaires to the employees, clients and informal caregivers. At least two months in advance, that person will be informed in detail about the data collection procedure. Each agency will be given nine weeks to fill out the questionnaires.

The agency questionnaire will be delivered as an interactive pdf document and filled out by the management. Employees will receive paper-based questionnaires, each containing a return envelope addressed directly to the Institute of Nursing Science (INS). By preventing the collection of questionnaires by agencies, this will ensure confidential treatment of data. In line with data protection requirements, paper-based questionnaires will be distributed by homecare agencies to selected clients and their informal caregivers. The research team will support one person from the administration of each agency in randomly selecting clients without requiring access to client information. Every envelope will contain two questionnaires, one for the client and one for their relative/informal caregiver, and two prepaid return envelopes addressed to the Institute of Nursing Science (INS). Again, this is to avoid the collection of questionnaires by agencies. The clients are asked to give the relative questionnaire to the person who supports them in their daily life. To minimize response bias, homecare workers will be informed that they are not allowed to fill out the questionnaires with clients. Support by relatives is possible. We will send a request to each agency contact person for the participating homecare clients' relevant ADUA data. These will have to be exported and transmitted to the INS in anonymized and aggregated format. We will also request the relevant billing-related information from each participating insurer. Again, we will instruct them fully regarding the appropriate data handling procedures, including the use of an encrypted data transmission platform.

Patient and public involvement

To enhance the quality of this research, we will follow the INVOLVE standards as guidelines to work with public and patient involvement [77-79]. A stakeholder group, including representatives of various fields, e.g., research, practice, politics and professional associations, as well as a client, has been established to provide input and support throughout the study. In addition, clients, informal caregivers and homecare workers will be invited to discuss various aspects of the research process (e.g., questionnaire development and layout, design of information material, reporting and visualization of the result).

Data analysis

Statistical analyses will be conducted using the R version 3.X statistics programming environment [80]. First, data will be assessed for plausibility. Descriptive statistics will then be computed to summarize frequencies and percentages or means/medians with standard deviations/IQRs as appropriate. Data will be checked for missing values, floor and ceiling effects, normal distribution, and outliers. Items with more than 90% agreement or more than 5% missing answers will be checked for subgroup differences (e.g., professional background, professional experience, age). To assess the internal structure or inter-item consistency (e.g., Cronbach's α), psychometric analyses will be performed on all scales used. Depending on the data quality, appropriate strategies for handling missing data (e.g., multiple imputation) will be incorporated.

To explore relationships between the different levels, we will begin by assembling clusters of homecare agencies with similar policies / funding mechanisms. In a second step, we will use multiple regression analyses to investigate the associations between macro-level regulatory factors and meso-level homecare agency structures or processes (aim 1). To examine which regulatory factors on the macro and organizational factors on the meso level are linked with micro-level coordination (aim 2), and which connect coordination to quality of care (aim 3), we will use multilevel analyses.

After completion of this research project, the data will be stored for ten years in CSV format in the Information Technology Services (ITS) department of the University of Basel. For metadata, including the description of the document, the study, the variables and the files, the Data Documentation Initiative (DDI) standard, an international standard for describing observational data, will be applied [81]. Metadata will be stored in an xml file. Due to the sensitive and confidential nature of the agency, employee, client and relative data, non-disclosure agreements will be signed. None of our collected data will be openly accessible; however, with the consent and assistance of the principal investigator, re-use of the anonymous materials will be possible.

Discussion

As the proposed study will be the first national survey to explore macro-, meso- and micro-level factors influencing coordination and quality of care in the Swiss homecare setting, it will provide valuable insights into this increasingly important branch of healthcare. In addition to gaining the first insights at this level into homecare quality in Switzerland, we expect to identify factors related to coordination and quality in homecare on every level of the healthcare system. This knowledge will help to develop and implement targeted strategies to enhance coordination. This research project's first results are expected by the end of 2021. All study results will be published in peer reviewed journals.

One notable weakness of this research project is its cross-sectional design, which does not allow inference of causal relationships. However, as this is an explorative project with a representative sample, it is possible to make generalized statements about factors related to quality of care and coordination. Additionally, our study design removes any opportunity of us to control the environment while participants complete their questionnaires, and could increase recall bias. However, it is hoped that supplying a pre-stamped envelope for client and employee questionnaires will minimize the pressure towards social desirability bias.

The results of this project will support policy makers and homecare administrators in developing coordination interventions in homecare settings across Switzerland. In addition to improving need-oriented care provision, this study's findings regarding increased coordination of the various service providers' activities will very likely help reduce resource waste. Equally importantly, they provide a firm foundation upon which to develop a range of interventional, implementation science and quality improvement projects in homecare.

List of abbreviations

ADUA: Administrative Daten und Anfrage (translation: "administrative data and query")
CHF: Swiss Francs
FTE: Full-time equivalent
RN: Registered nurse

Declarations

Ethics approval and consent to participate

We obtained declarations of no objection [Req- 2020-00110] from the ethics committees of the cantons in which the participating homecare agencies are located, with the Ethics Committee of Northwestern and Central Switzerland (EKNZ) as the leading ethics committee. Moreover, informed written consent will be obtained from all participating homecare agencies; and we are currently concluding a data protection agreement with every participating health insurance company. As the client data are routinely collected and anonymized, no informed consent from clients is needed. The questionnaire's first page will inform clients, informal caregivers and homecare employees about the voluntary nature of participation and data confidentiality, and will explain that returning the completed questionnaires will be considered as informed consent. The Institute of Nursing Science ensures strictly confidential treatment of all agency, employee, client and relative data. As this is an observational study, the risk that this research project entails for clients, informal caregivers, homecare employees and homecare agencies can be considered minimal [82].

Consent for Publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Conflict of interest

The authors declare that they have no competing interests.

Authors' contributions

All authors have contributed to the conception and design of the study. NM conceptualised the study in consultation with FZ, MS, RF, CM, SP, MW and CS. NM designed the study and wrote the manuscript in collaboration with FZ and MS. RF, CM, SP and MW contributed to the design of the study and refined it. All authors contributed to refinement of the manuscript and have critically revised and approved the final version.

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Appendix and additional Files

Description of employee, client and relative questionnaire measurements

Appendix A. Employee questionnaire measurements

Variables	Instrument used (Reference)	Number of items (Anchor of answer options) Scale calculation / Cronbach's α	Meaning of score	Example of items
Work environment				
Leadership	PES-NWI [83]	5 (1 = strongly disagree, 4 = strongly agree) mean over all items / .88 in SPOT [84]	higher values indicating better performing leadership	"Supervisors use mistakes as learning opportunities, not criticism."
Staffing	PES-NWI [83]	3 (1 = strongly disagree, 4 = strongly agree) mean over all items / .74 (.70 in SPOT)	higher values indicating higher staffing adequacy	"There is enough staff to get the work done. "
Teamwork	SAQ [65, 66]	7 (1 = disagree strongly, 5 = agree strongly) with answer option "not applicable" mean over all items / .65 (.83 in SPOT[84])	higher values indicating better teamwork	"Input is well received in this team."
Workload	NASA TLX [85] with one additional self-developed item	6 (0 = low, 20 = high) mean over all items / .67 in SPOT (not published)	higher values indicating higher perceived workload	How much mental and perceptual activity was required (e.g., thinking, deciding, calculating, remembering, looking, searching)?
Overtime	from previous studies (SHURP, RN4Cast) [86, 87]	1 (1 = never, 5 = almost every shift) N/A	higher values indicating higher amount of overtime	How often do you have to work overtime more than 30 minutes?
Predictability	COPSOQ III [67]	2 (0 = to a very small extent 4 = to a very large extent) mean over all items / .73	higher values indicating higher predictability	Do you receive all the information you need in order to do your work well?
Role clarity	COPSOQ III [67]	2 (0 = to a very small extent 4 = to a very large extent) mean over all items / .82	higher values indicating higher role clarity	Do you know exactly which areas are your responsibility?
Role conflicts	COPSOQ III [67]	2 (0 = to a very small extent 4 = to a very large extent) mean over all items / .73	higher values indicating higher role conflicts	Are contradictory demands placed on you at work?

Variables	Instrument used (Reference)	Number of items (Anchor of answer options) Scale calculation / Cronbach's α	Meaning of score	Example of items
Social support from colleagues and supervisors	COPSOQ III [67]	4 (0 = never, 4 = always, with answer option "don't have a superior/ colleagues") mean over all items / .87 resp. .81	higher values indicating higher work-related social support	How often do you get help and support from your colleagues?
Sense of community	COPSOQ III [67]	1 (0 = never, 4 = always, with answer option "don't have a superior/ colleagues") N/A	higher values indicating higher sense of community	Is there a good atmosphere between you and your colleagues?
Staff-level processes				
Process of care				
Care process	Self-developed and adapted from AITCS II [88]	5 (0 = never, 4 = always) N/A	higher values indicating more pronounced interprofessional care process	Are interprofessional client care and treatment goals defined? Are clients and/or relatives involved in setting goals for their care?
Coordination activities				
Communication and Information Exchange	Adapted from CPAT [68]	6 (1 = disagree strongly, 5 = agree strongly) mean over all items / .84	higher values indicating better communication and information exchange	Client concerns are addressed effectively through regular team meetings and discussion.
Communication channels	Self-developed	2 (by phone, in written form with the client file, in written form via e-mail, personal, other) N/A	communication channels frequently used	How do you communicate important information about your clients, with people, involved in the care/treatment outside your homecare team, most often?
Accountability, predictability, common perspective	Adapted from the integrating condition scale of Thomas et al. [69]	4 (1 = disagree strongly, 5 = agree strongly)	higher values indicating higher accountability, predictability, common perspective	It is clear which professionals in our care team are responsible for fulfilling certain tasks.
Familiarity with the healthcare system	Self-developed	6 (1 = not at all, 5 = very well)	higher values indicating higher familiarity with the healthcare system	How well do you know the healthcare services in the catchment area of your homecare: Available health or social services? Requirements that clients must meet in order to benefit from the services?

Variables	Instrument used (Reference)	Number of items (Anchor of answer options) Scale calculation / Cronbach's α	Meaning of score	Example of items
Coordination				
Care coordination: Alignment of work	Self-developed and adapted from Zackrison [89]	7 (1 = never, 5 = very frequently)	higher value indicating better alignment of work	Are related processes and activities for client care well harmonized with other professionals?
Alignment of client care with nominated providers	Self-developed	7 (1 = never, 5 = very frequently) N/A	higher values indicating higher satisfaction with the alignment of client care	How often are you satisfied with the alignment of client care with the following professional groups? E.g., physicians, hospitals
Care coordination gaps	Self-developed	7 (1 = never, 5 = very frequently) / N/A	higher values indicating more frequently experienced coordination gaps	How often does it happen that... …you receive important information about the client too late? ...no or no current orders / prescriptions / medication lists are available?
Relational coordination with informal caregivers	RCS [90]	7 (1=Never, 5=Completely) / mean over all items / 0.86	Higher values indicating higher relational coordination	Do informal caregivers communicate with you in a timely way about your client's support/care?
Quality of care				
Quality and safety	from previous studies and self-developed [75, 87]	4 (0 = very low, 4 = very high) / N/A	higher values indicating higher quality resp. higher safety	How do you rate the quality of client care in your own homecare agency?”

Note. AITCS = Assessment of Interprofessional Team Collaboration Scale, COPSOQ = Copenhagen Psychosocial Questionnaire, CPAT = Collaborative Practice Assessment Tool, HPSI = Health Professions Stress Inventory, N/A = not applicable, NASA TLX = NASA task load index, PES-NWI = Nursing Work Index's Practice Environment Scale, RCS= Relational Coordination Scale, RN4Cast = Nurse Forecasting: Human Resources Planning in Nursing, SAQ = Safety Attitude Questionnaire, SHURP = Swiss Nursing Homes Human Resources Project, SPOT = SPitex work environment pilOT study, WLC = Work-Life Climate

Appendix B. Client questionnaire measurements

Variables	Instrument used (Reference)	Number of items (Anchor of answer options) Scale calculation / Cronbach's α	Meaning of score	Example of items
Coordination activities				
Communication between providers and clients	HHCAHPS [70]	6 (1 = Never, 4 = Always or 1= Yes, 2 = No or 1 = Same day, 4 = More than 14 days, with answer option "Do not remember" or "I did not contact this agency") Average proportion over all items of respondents who responded "Always" and "No" and "same day"/ .70 (on request)	higher values indicating better communication between providers and clients	In the last 2 months of care, how often did home health providers from this agency keep you informed about when they would arrive at your home?
Coordination through homecare agency	CPCQ [71]	4 (1=never, 5=always) mean over all items / .80	higher values indicating better coordination	How often did your homecare nurse seem to be communicating with your other providers?
Extend of coordinator role of homecare nurses	Patient perceived continuity of care from multiple clinicians [72]	5 (1=not at all, 5=totally) mean over all items / .87	higher values indicating a higher presence of coordinator role	How much does your homecare nurse seem up-to-date about healthcare given by others?
Coordination				
Overall rating of coordination	Adapted from CPCQ [71]	1 (1 = Never, 5 = Always) / N/A	higher value indicating better perceived coordination	In the past 2 months, how often did you feel the care you received was well coordinated?
Role clarity and coordination between settings	Patient perceived continuity of care from multiple clinicians [72]	3 (1=never to 5=very often)) mean over all items / .82	higher values indicating higher role clarity and coordination between clinics	Were there times when health professionals told you different things (that didn't make sense together) about your health?
Quality of care				
Rating of care provided by the agency	HHCAHPS [70]	1(0 = worst home health care possible, 10 = best home health care possible) / N/A	higher values indicating better care	Using any number from 0 to 10, where 0 is the worst home health care possible and 10 is the best home health care possible, what number would you use to rate your care from this homecare agency?
Use of healthcare services	Schweizerische Gesundheitsbefragung 2017 and self-developed [76]	10 (1= Yes, 0 = No and continuous answer options) / N/A	higher values indicating higher use of services	How many times have you been to a doctor in the last 12 months?

Note. CPCQ = Client Perceptions of Coordination Questionnaire, HHCAHPS = Home Health Care Survey of the Consumer Assessment of Healthcare Providers and Systems,

Appendix C. Informal caregiver questionnaire measurements

Variables	Instrument used (Reference)	Number of items (Anchor of answer options) Scale calculation / Cronbach's α	Meaning of score	Example of items
Coordination				
Overall rating of coordination	Adapted from CPCQ [71]	1(1 = Never, 5 = Always) / N/A	higher value indicating better perceived coordination	In the past 2 months, how often did you feel the care your relative received was well coordinated?
Perceived effort for coordination	Self-developed	1(0= Not at all effortful, 10= Very effortful) / N/A	higher values indicating higher effort for care coordination	Using a number from 0 to 10, please rate how effortful you feel it is to coordinate the care with all the health professionals involved?
Relational coordination with homecare workers	RCS [90]	7 (1=Never, 5=Completely) / mean over all items / 0.86	Higher values indicating higher relational coordination	Do homecare workers communicate with you in a timely way about your relatives' support/care?
Quality of care				
Rating of care provided by the agency	Adapted from HHCAHPS [70]	1(0 = worst home health care possible, 10 = best home health care possible) / N/A	higher values indicating better care	Using any number from 0 to 10, where 0 is the worst home health care possible and 10 is the best home health care possible, what number would you use to rate the care from this homecare agency?
Willingness to recommend homecare agency	Adapted from HHCAHPS [70]	1 (1= Definitely yes, 4 = Definitely no) / N/A	higher values indicating higher willingness to recommend agency	Would you recommend this homecare agency to other family members or friends if they needed home health care?

Note. CPCQ = Client Perceptions of Coordination Questionnaire, HHCAHPS = Home Health Care Survey of the Consumer Assessment of Healthcare Providers and Systems, RCS= Relational Coordination Scale

CHAPTER 4

How regulatory frameworks drive differences in homecare agencies: Results from a national multicenter cross-sectional study in Switzerland

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Abstract

Introduction

The sustainability and rising costs of the health-care system are of concern. Although health-care reforms impact various areas of care, there is only limited evidence on how regulations affect homecare agencies and health-care delivery.

Objectives

The primary aim was to explore different financial and regulatory mechanisms and how they drive differences in the organizational structures, processes, and work environment of homecare agencies.

Design and methods

We used data from a national multicenter cross-sectional study of Swiss homecare that included a random sample of 88 homecare agencies with a total of 3223 employees. Data was collected in 2021 through agency and personnel questionnaires including geographic characteristics, financial and regulatory mechanisms, service provision, financing, work environment, resources and time allocation, and personnel recruitment. We first conducted a cluster analysis to build agency groups with similar financial and regulatory mechanisms. We then performed Fisher's exact, ANOVA, and Kruskal–Wallis tests to determine group differences in organizational structures, processes, and work environments. Finally, we performed a lasso regression to determine which variables were predictive for the groups.

Results

We built four agency groups differing in view of financial and regulatory mechanisms and found differences in the range and amount of services provided, with regard to employment conditions and with cost structures.

Discussion

The most prominent differences were found between agency groups with vs. agency groups without a service obligation. Financial incentives must be well aligned with the goal of achieving and maintaining financially sustainable, accessible, and high-quality homecare.

Keywords: Delivery of Health Care [Mesh], Government Regulation [Mesh], Health Services Research [Mesh], Healthcare Financing [Mesh], Home Care Services [Mesh], Nursing Administration Research [Mesh], Working Conditions [Mesh]

Highlights

- Regulations impact the services provided by Swiss homecare agencies
- Agency groups with or without service obligations differ the most
- Regulations impact the work environment of homecare staff
- A one-sided focus in the care system risks damaging care structures

Introduction

The homecare sector has been growing steadily in recent years [1, 2]. Homecare service refers to formal healthcare provided to clients in their own homes. The number of homecare clients in Switzerland grew by 61% between 2010 and 2019 [3], and a similar increase can be seen in other countries, such as Japan, where the number of people needing care or support increased almost threefold between 2000 and 2017 to 6.41 million people, half of them receiving care at home [4]. In Switzerland, the size of the homecare workforce likewise increased by 58% between 2010 and 2019, and the total expenditures on home help and care services increased by 54% to 2.66 billion Swiss francs [3]. A growth trend is also visible in other countries such as the US, where the employment of home-health and personal-care aides is projected to grow by 25% from 2021 to 2031 [5]. Accordingly, increasing attention has been given to the impact of financial and regulatory mechanisms on the performance of homecare agencies.

The sustainability and rising costs of the health-care systems are of concern across the world [6]. Even though the homecare sector has only been a minor driver of the total expenditures on healthcare, due to the shift from acute to long-term and primary healthcare setting, this sector is also affected by rising costs and steadily increasing cost pressures [3, 7-9]. In order to secure financing, reduce costs, and optimize care in long-term care, different countries are undertaking reforms to the health-care system [10, 11]. In Switzerland, a 2011 federal act reorganized the financing for long-term care, so that mandatory health insurance has had to pay fixed contributions to care services, graded according to the time spent on care. In general, Swiss homecare receives revenue from three major sources: (1) mandatory health insurance, which pays a nationally regulated fixed contribution; (2) patients' copayments, which are regulated on the cantonal level but nationally capped and thus limited to a maximum of 20% of the insurance contribution or CHF 15.35 per day (≈ EUR 15.60), cantonal variations ranging from no copayment to a maximum copayment of 20% of the insurance contribution; and (3) residual financing by cantons and municipalities. Due to the confederation's delegation of residual financing to the cantons and the decentralized system in Switzerland, the regulation and amount of residual financing differ not only by canton but sometimes also by municipality [12, 13].

Studies all over the world show that regulations impact the provision of healthcare in terms of supply and client structures. For example, in Taiwan, Chen and Fu [14] showed that a reform to long-term care that only supplied payments for homecare services (and not institutional care) led to an increase in both homecare providers and homecare workers, while care institutions did not grow. And Chernichovsky et al. [15] reported that in Israel long-term care services have grown like a patchwork quilt, which has resulted in a fragmented system that provides limited coverage and inadequate benefits. For example, access depends on clients' ability and willingness to pay. In Canada, primary-care reforms have been shown to have had a number of unintended consequences such as patient selection and fragmentation [16]. A study from the Netherlands reported that the homecare patient population has changed as a result of health-care reform, where the use of care has decreased among people with high incomes and increased among single people [17]. Janssen et al. [18] conducted a study on how austerity-driven policy reforms impact the quality of long-term care in the Netherlands and Belgium and concluded that long-term care is mainly supply-driven rather than demand-driven and that care is not based on the care needs of individuals but on financial constraints.

In addition to structural changes, procedural and organizational changes in health-care delivery have also been observed. For example, a study on the consequences of market-oriented reforms for homecare workers in Germany, Japan, and Sweden found an increase in the number of employees and in part-time and temporary employment as well as high workloads, overtime work, and time pressure [19]. A health-care reform in the Netherlands decentralized social long-term care to municipalities, transferred the responsibility for contracting community care to health insurers, and introduced less comprehensive mandatory insurance for long-term care. This unintentionally created a number of major incentive problems regarding, for example, cost shifting, coordination, efficiency, and quality [11].

All of this evidence shows that health-care reforms can have an impact on various areas of homecare, such as on its organization and coordination, client populations, and the working environment and conditions. However, the evidence for how regulations affect homecare agencies is rather limited. One way to optimize the provision and delivery of homecare is to create the right incentives through regulations at the macro level. To do this, it is important to know which financial and regulatory mechanisms have a positive or negative impact on the meso or organizational level, that is, on homecare agencies. As far as we are aware, no other study has compared the different financial and regulatory mechanisms with structures and processes on the organizational level of homecare agencies. With its different financial and regulatory mechanisms, the Swiss federal system allows us to explore these relationships.

Aim

The primary aim of this study is to determine how financial and regulatory mechanisms are related to differences in the organizational structures, processes, and work environment of Swiss homecare agencies.

We sought to achieve this aim by:

(1) building and describing groups of Swiss homecare agencies according to their financial and regulatory mechanisms;
(2) determining if the agency groups differ regarding organizational structures, processes, and work environments; and
(3) analyzing the predictive value of variables in identifying group membership.

Methods

Study design

The data was drawn from a national multicenter cross-sectional study of Swiss homecare. Detailed information on the SPOT^{nat} study can be found in the published study protocol [20].

Setting and sample

We included a random sample of 88 homecare agencies in Switzerland that had a minimum of 10 salaried employees. Within each homecare agency, we included a full sample of homecare workers who worked directly or indirectly in nursing or caregiving, except in large agencies (>100 employees), where, upon request, a random sample of 100 employees was drawn to reduce the burden of conducting the study.

Data collection

Data was collected between January and September 2021 through personnel questionnaires that were filled out by the homecare employees and an agency questionnaire that was completed by management. Each agency had three months to complete the data collection and was free to choose the start date during this period to deliver the paper questionnaire to their employees. Each agency was informed about the response rates three, six, and nine weeks after the launch and about possible measures to increase the response rate (such as offering a reminder flyer). If the desired response rate of 60% was not achieved, the agency was contacted by telephone and data collection was extended by two weeks. Each questionnaire contained a stamped return envelope with the postal address of the research institute so that employees could return the completed questionnaire directly to the research team. The questionnaires were coded to allocate them to the respective agencies but not to the individual.

Instruments and measurements

In the conceptual framework of the SPOT^{nat} study—the overall aim of which was to explore coordination and quality in homecare—we divided the health-care system into macro, meso, and micro levels (see Figure 1). Characteristics included in this analysis are framed in red (dashed) in Figure 1. A detailed explanation of the assessed macro- and meso-level variables and calculations used for this analysis can be found in Appendix A.

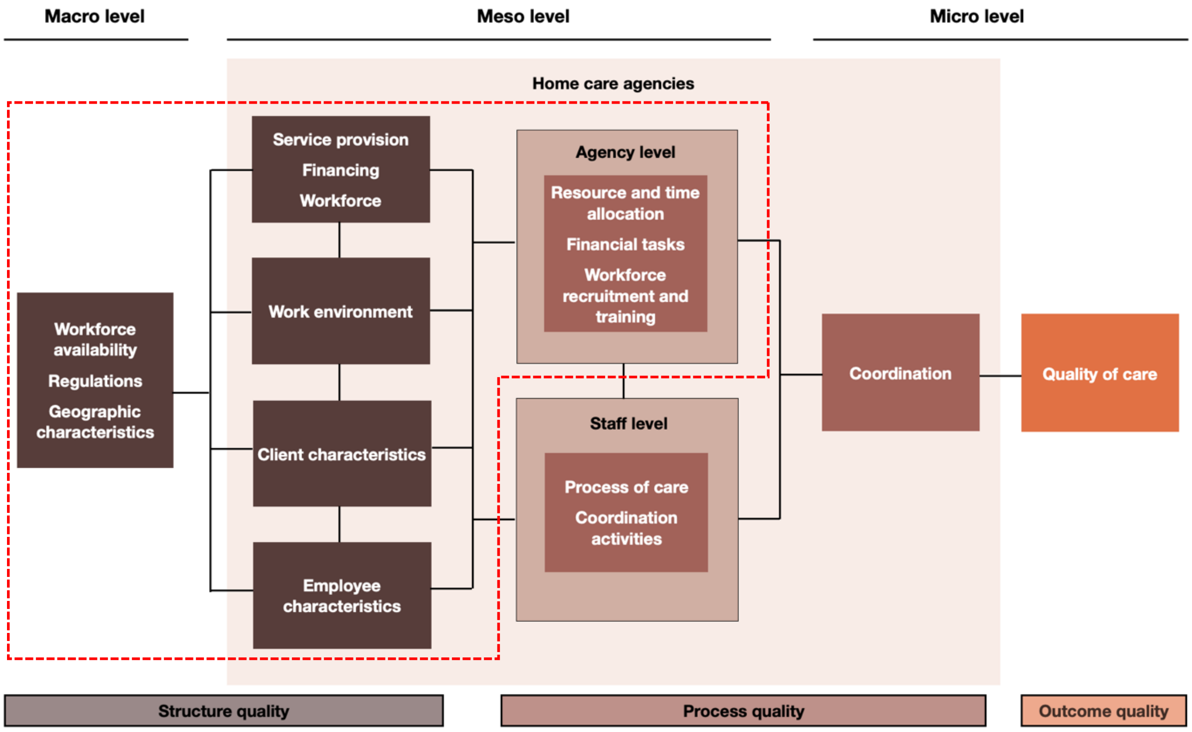

Figure 1. Conceptual framework

Macro-level characteristics

With regard to **geographic characteristics**, homecare agencies were asked to indicate their catchment area (rural, urban, suburban). In addition, they were assigned to one of Switzerland's different language regions based on postal codes.

To assess **financial and regulatory mechanisms**, we asked the homecare management about reimbursement regulations in four questions with nominal answer categories and the answer option "other" with a text field to specify. The questions concerned the basis of the residual financing of care costs as determined by a canton or municipality, whether there was a service agreement with a canton or municipalities and what its content was, and the regulations on client copayments.

For ***residual financing*** *(RF)*, the following four groups were built: (1) compensation of the effective full costs; (2) compensation of agency-specific and predefined costs; (3) use of standard costs, standard deficits, or maximum limits; and (4) other (e.g., compensation via a global budget).

If management affirmed that there was a ***service agreement*** with a canton or municipalities, then the conditions were asked for. The ***conditions for the service agreement*** fell into the following five categories: (1) service obligation; (2) time coverage (24-hour coverage and visits on weekends and at night if necessary); (3) assurance of service provision (maximum time between registration and first visit, admission of all clients in a defined catchment area, assurance of sufficient capacity); (4) range of services (offering specialized services (e.g., palliative care, psychiatric care) and defined compulsory services (requirements to provide certain services oneself and to ensure access to further services); (5) specifications regarding employees (predefined staffing ratio, requirements regarding the qualifications of nursing staff).

For ***client copayments*** *(CPs)*, the following four groups were formed: (1) No CP (no copayment by the client); (2) CPs of a maximum of CHF 7.65 per day, which means that copayments can be up to 10% of the health-insurance (HI) contribution or direct payment but is limited to CHF 7.65 per day; (3) up to 20% of the HI contribution with an upper limit of CHF 15.35 per day; and (4) direct payments up to the upper limit of a maximum of CHF 15.35 per day, which means that clients have to pay the difference between the full cost and the HI contribution up to the limit of CHF 15.35 per day when they receive services. The final group entails the highest financial participation by the client, so it is the most burdensome financing regime in this regard.

Since health-insurance companies pay nationally fixed contributions for the different service provisions (i.e., the three service categories: service A: clarification, consultation, coordination; service B: examination and treatment; and service C: basic care)—the Health Insurance Act by the ordinance on benefits for compulsory health-care insurance (Krankenpflege-Leistungsverordnung, KLV) stipulates that the same conditions and amounts apply to all homecare agencies—HI contributions were excluded from the analysis.

We did not assess **workforce availability** on the macro level; instead we assessed the situation of personnel recruitment on the agency level.

Meso-level characteristics

Meso-level characteristics were assessed via agency and employee questionnaire. For the detailed explanation of the variables and calculations, see Appendix A.

For **service provision**, we assessed the total number of clients and hours of care provided in 2020 in the three service categories: service A: clarification, consultation, coordination; service B: examination and treatment; service C: basic care; and in the additional category of domestic care (not covered by the KLV). We also assessed if agencies offered additional specific services: continuous 24-hour care, night care, and specialized services such as psychiatric care, palliative care, or oncological care.

With regard to the **financing** of homecare agencies, the questionnaire assessed profit status (nonprofit, for-profit) and what percentage of the total revenue came from each different source (i.e., health insurance, client, canton or municipalities).

For **workforce** we assessed staffing and skill mix (i.e., percentage of registered nurses, RNs, among all nursing and care staff, number of visits conducted by RNs in last 50 visits) as well as turnover rate (percentage of nursing and care staff who left the agency in 2020 from all its employees in the nursing and care sector).

The **work environment** was assessed by the employee questionnaire and included perceived staffing, workload, and overtime. We measured perceived staffing with the three items of the staffing- and resource-adequacy subscale of the Practice Environment Scale of the Nursing Work Index (PES-NWI) [21, 22]. The items were rated on a 4-point Likert scale (strongly disagree, slightly disagree, slightly agree, strongly agree), from which we formed a mean score per employee and then a mean score across each agency. We assessed workload with the NASA Task Load Index,[23-25] which consists of six items rated on a 20-point analogue scale. From them we also formed a mean score per employee and then a mean score across each agency. Overtime was measured with one item that asked employees how often they have to work more than 30 minutes of overtime. The item was adapted from the RN4CAST study and rated on a 5-point Likert scale (almost every shift, every 2–4 working days, every 5–7 working days, less frequently, never) [26, 27]. We calculated the percentage of employees working overtime at least once a week for each agency.

As **client characteristics**, we assessed, via the agency questionnaire, the average care duration per client in 2020 for each agency. This allowed us to obtain a rough estimate of the care duration, although the average does not provide information on the length of the treatment period or the intensity of treatment per client, nor does it make it possible to differentiate between a few long visits and frequent short visits.

We assessed **employee characteristics** via the employee questionnaire and included employment percentage and employment contract (hourly wage or monthly salary). We calculated the mean work percentage as well as the percentage of employees working for a monthly salary for each agency.

For **resources and time allocation**, we used the employee questionnaire to assess travel time and time spent on coordination and administrative work within the last three working days. We first calculated the average score per person for the three days and then the average score for all the employees at each agency. In addition, we assessed the nurses' caseloads via the agency questionnaire by asking for the number of cases that each nurse was responsible for.

Financial tasks included whether conflicts with municipalities pertaining to the financing of services were present (never, seldom, sometimes, often, very often), whether the agencies had uncovered costs in 2020 (yes, no), and the percentage of time and unbillable costs (e.g., travel time, building maintenance, further training costs, team meetings).

For workforce recruitment and training, we assessed the personnel-recruitment situation via the agency questionnaire with three questions asking about the recruitment situation of (1) registered nurses (and higher), (2) licensed practical nurses, and (3) assistant and support staff.

Data analysis

Descriptive statistics were performed to check the distribution of the data, for ceiling or floor effects, as well as outliers and missing values. We conducted a cluster analysis to check if our content-driven (theory-driven) grouping of the agencies matched the-data driven groupings (clusters). To do so, we created a k-means cluster with Euclidean distances based on three variables in our data that reflected financing and regulations: service obligation (yes, no), basis of residual financing (compensation of agency-specific and predefined costs; compensation of effective full costs; use of standard costs, standard deficits, or maximum limits; other), and client copayments (no copayments; a maximum of CHF 7.65 per day; up to 20% and limit of CHF 15.35 per day; direct copayments up to upper limit of CHF 15.35 per day). We evaluated the optimal number of clusters with different statistical testing (elbow, silhouette, and gap-statistic methods), inspected cluster results visually, and calculated overall cluster statistics and a confusion matrix to test how well the data-driven groups (clusters) matched our content-driven (theory-driven) groups (Appendix B) [28, 29]. We used the R package "factoextra" [30] to conduct the cluster analysis.

To investigate the differences between the agency groups, we performed groupwise descriptive statistics and calculated Fisher's exact test for the categorical variables and an ANOVA or Kruskal–Wallis rank-sum test for continuous data to detect any statistically significant differences between the groups [31]. Fisher's exact test was chosen because of the relatively small sample size, so we expected more than 20% of the cells to have <5 expected frequencies [32, 33]. For the ANOVA, if the homogeneity of variances and normal distribution were not fulfilled, a Kruskal–Wallis test was used [34]. To account for multiple testing, we calculated adjusted *p* values to control for the false discovery rate (FDR) [35], which is defined as the "the expected proportion of erroneous rejections among all rejections" (p. 1167)[36], at 5%. We followed the procedure of Benjamini and Yekutieli [36] as implemented in the "p.adjust" function in the "stats" R package [37].

To explore how financial and regulatory mechanisms are related to organizational structures, processes, and work environments, we applied sparse regression techniques (e.g., a lasso and elastic net)[38] with the four agency groups as dependent variables and the different agency characteristics (i.e., structures, processes, work environments) as independent variables. Sparse regression techniques are designed to deal with situations when the number of parameters, p, in a model is larger than the number of observations, n, and especially $p \gg n$ [39]. Regularized regressions aim to control overfitting by shrinking coefficients toward zero, to reduce the variance at the cost of adding a small bias, and to thereby achieve a better prediction. To do so, instead of finding coefficients that simply minimize the prediction term, regularized regressions add a penalty proportional to the magnitude of the coefficients. In the specific case of a lasso regression, the penalty term is proportional, through a parameter λ, to the sum of the absolute values of the coefficients, such that some regression coefficients shrink exactly to 0 and the corresponding predictors are excluded from the model [39]. Large values of λ imply a higher penalization of the nonzero coefficients, which leads to models with fewer predictors. Selecting an optimal value of the tuning parameter λ typically relies on cross-validation [40]. Because of the nominal dependent variable (agency groups), we applied a multinomial logistic lasso regression. The lasso-regression models directly predict the probability of a response falling within a particular group, with no explicit reference level. From the estimated model parameters, we can derive relative risk ratios between groups by taking a group (in our case group 4) as a reference. More details of the conducted lasso regression and the "raw" estimates can be found in Appendix C. As a last step, we conducted a sensitivity analysis by running the lasso regression without variables where ≥ 9 datapoints were missing as well as one model without the variable "language region," which can be found in Appendix D. We used the R package "glmnet" to run the lasso regression[41] and imputed missing data by mean substitution with the function "makeX. " All analyses were done with the software R 4.2.1 [37].

Ethical considerations

A declaration of no objection (Req- 2020-00110) was obtained from the Ethics Committee of Northwestern and Central Switzerland (EKNZ) as the leading ethics committee, and informed written consent was acquired from all participating homecare agencies. For the questionnaires, the first page of the written consent provided information about the voluntary nature of participation and data confidentiality; returning the completed questionnaire was considered as informed consent. The research institute ensured strictly confidential treatment of all the data.

Results

A total of 3223 homecare employees from the 88 participating agencies completed and returned the questionnaire (employee response rate: 73.6%). All 88 participating agencies returned the agency questionnaire.

Aim 1: Group building of homecare agencies with similar financial and regulatory mechanisms

Because the landscape of regulations and financing mechanisms was even more heterogenous than expected, the sample of homecare agencies was not large enough to reflect this heterogeneity, so it was necessary to build the groups of homecare agencies with similar requirements according to two indicators: service obligation and cantonal strategic orientation toward outpatient versus inpatient care, since we expected that the orientation of public authorities would have a major influence on regulation and financing. Generally, a service obligation—that is, the obligation to accept all clients in a given area without the possibility to deny service—only applies to organizations that have a service agreement with municipalities or a canton. Most of the time, these organizations are public or private nonprofit. For strategic orientation, we used the Swiss Health Observatory's (Obsan) classification of the cantons, which applies a cluster analysis to divide the 26 Swiss cantons into groups with a similar care landscape in old-age and long-term care [42]. To build these clusters, the utilization rate of nursing homes and homecare as well as the proportion of people in need of only minor care in nursing homes were used for the groupings. This reflects the strategic orientation of the cantons with regard to outpatient versus inpatient long-term care and produced four groups: inpatient-oriented cantons (eight cantons), increasingly outpatient-oriented cantons (four cantons), strongly outpatient-oriented cantons (five cantons), and cantons with an equal strength of inpatient and outpatient orientation (nine cantons) [42].

Based on these two indicators, we formed the following four groups of homecare agencies:

Group 1: agencies with a service obligation in inpatient-oriented cantons

Group 2: agencies with a service obligation in increasingly outpatient-oriented and strongly outpatient-oriented cantons

Group 3: agencies with a service obligation in cantons with an equal strength of inpatient and outpatient orientation

Group 4: agencies without a service obligation in all cantons

The cluster analysis, to test of how well the data-driven groups (clusters) matched our content-driven (theory-driven) groups showed an overall accuracy of 75% (95% CI, 0.64–0.84), an unweighted kappa of 0.67, and a balanced accuracy ranging from 0.76 to 0.96. Detailed results of the cluster analysis can be found in Appendix B.

Description of the financial and regulatory mechanisms and differences between agencies

The group building of homecare agencies with similar regulations yielded 12 agencies with a service obligation (SO) in inpatient-oriented cantons, 17 agencies with a service obligation in increasingly outpatient-oriented and strongly outpatient-oriented cantons, 29 agencies with a service obligation in cantons with an equal strength of inpatient and outpatient orientation, and 30 agencies without a service obligation in all cantons. Table 1 shows the different financial and regulatory mechanisms among the four homecare agency groups identified in the Swiss homecare setting. The basis of residual financing, client copayments, and the requirements specified in the service agreements differed significantly between the groups. For example, we saw the tendency that in cantons with an outpatient orientation, client copayments were lower, and the compensation of effective full costs was more often applied, though standard costs were more often applied for agencies without a service obligation.

Aim 2: Differences between agency groups

Differences between the agency groups were also observable for variables at the meso level, such as in average provided (billed) service hours of basic care per client, perceived staffing, workload, employees' overtime, and the range of services, including whether they offered psychiatric or around-the-clock (24-hour) care. The average number of cases for which each nurse is responsible became nonsignificant after correction for multiple testing; all other adjusted *p* values remained significant. For the complete results and test statistics, see Table 2.

Table 1. Different financial and regulatory mechanisms among the four homecare agency groups

Variable	**Total *n* (%)**	**missing *n***	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***p* value**	**Adjusted *p* value**[1]
			Group 1: inpatient with SO (*n* = 12)	Group 2: outpatient with SO (*n* = 17)	Group 3: equal in- and outpatient with SO (*n* = 29)	Group 4: without SO (*n* = 30)	Fisher's exact	
REGULATIONS								
Basis of residual financing		7					<0.001	<0.001
Compensation of agency-specific and predefined costs	27 (33.3)		8 (66.7)	2 (12.5)	15 (60.0)	2 (7.1)		
Compensation of effective full costs	22 (27.2)		4 (33.3)	10 (62.5)	6 (24.0)	2 (7.1)		
Use of standard costs, standard deficits, or maximum limits	29 (35.8)		0	4 (25.0)	3 (12.0)	22 (78.6)		
Other	3 (3.7)		0	0	1 (4.0)	2 (7.1)		
Service agreement with canton or municipalities		0					<0.001	<0.001
Yes	69 (78.4)		12 (100)	17 (100)	29 (100)	11 (36.7)		
If yes, requirements specified in the service agreement (multiple answers possible):							<0.001	<0.001
Time coverage: 24/7, visits on weekend and at night if necessary	30 (43.4)		4 (33.3)	10 (58.8)	10 (34.5)	6 (54.5)		
Assurance of service provision: maximum time between registration and first visit, acceptance of all clients in a given area, ensuring sufficient capacity	22 (31.9)		2 (16.7)	7 (41.2)	13 (44.8)	0		
Range of services: offer of special services, defined compulsory services	40 (58.0)		8 (66.7)	11 (64.7)	20 (70.0)	1 (9.1)		
Specifications regarding the employees: specified staffing ratio, requirements for the qualifications of nursing staff	18 (26.0)		1 (8.3)	7 (41.2)	4 (13.7)	6 (54.5)		
Number of requirements included in the service agreement							<0.001	<0.001
0 requirements specified	10 (14.5)		2 (16.7)	2 (11.8)	4 (13.8)	2 (18.2)		
1 requirement specified	23 (33.3)		7 (58.3)	1 (5.9)	10 (34.5)	5 (45.5)		
2 requirements specified	22 (31.9)		2 (16.7)	8 (47.1)	8 (27.6)	4 (36.4)		
3 requirements specified	13 (18.9)		0	6 (35.3)	7 (24.1)	0		
4 requirements specified	1(1.4)		1 (8.3)	0	0	0		

Variable	**Total *n* (%)**	**missing *n***	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***p* value**	**Adjusted *p* value[1]**
			Group 1: inpatient with SO (*n* = 12)	Group 2: outpatient with SO (*n* = 17)	Group 3: equal in- and outpatient with SO (*n* = 29)	Group 4: without SO (*n* = 30)	Fisher's exact	
Client copayments		0					<0.001	<0.001
No client copayments	18 (20.5)		0	11 (64.7)	0	7 (23.3)		
A maximum of CHF 7.65/day (no differentiation by increase)	34 (38.6)		2 (16.7)	2 (11.8)	20 (69.0)	10 (33.3)		
Up to 20% and limit of CHF 15.35/day	29 (32.9)		4 (33.3)	4 (23.5)	9 (31.0)	12 (40.0)		
Direct copayments up to upper limit of CHF 15.35/day	7 (8.0)		6 (50.0)	0	0	1 (3.3)		

Note. *n* = number, SO = service obligation
Group 1: agencies with a service obligation in inpatient-oriented cantons
Group 2: agencies with a service obligation in increasingly outpatient-oriented and strongly outpatient-oriented cantons
Group 3: agencies with a service obligation in cantons with equal strength of inpatient and outpatient orientation
Group 4: agencies without service obligation in all cantons

[1] Adjusted *p* values with Benjamini–Hochberg correction for multiple testing

Table 2. Differences between the four homecare agency groups at the macro and meso levels

Variable	**Total *n* (%)**	**missing *n***	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***p* value**	**Adjusted *p* value^1**
			Group 1: inpatient with SO	Group 2: outpatient with SO	Group 3: equal in- and outpatient with SO	Group 4: without SO	Fisher's exact ANOVA†† Kruskal–Wallis†	
Macro level								
GEOGRAPHIC CHARACTERISTICS								
Catchment area		0					0.028	0.046
rural	39 (44.3)		7 (58.3)	8 (47.2)	18 (62.1)	6 (20.0)		
suburban	32 (36.4)		2 (16.7)	6 (35.3)	8 (27.6)	16 (53.5)		
urban	17 (19.3)		3 (35.3)	3 (17.6)	3 (10.3)	8 (17.6)		
Language region		0					<0.001	<0.001
German speaking	67 (76.1)		12 (100)	5 (29.4)	28 (96.6)	22 (73.3)		
French speaking	14 (15.9)		0	11 (64.7)	0	3 (10.0)		
Italian speaking	7 (8.0)		0	1 (5.9)	1 (3.4)	5 (16.7)		
Meso level								
SERVICE PROVISION								
Average hours of service A (clarification, consultation, coordination) billed per client in 2020		4	4.1 [2.2]	6.2 [5.1]	4.7 [1.8]	5.2 [3.6]	0.674†	0.693
Average hours of service B (examination, treatment) billed per client in 2020		4	20.5 [5.6]	21.3 [9.1]	21.8 [6.5]	29.2 [22.9]	0.625†	0.661
Average hours of service C (basic care) billed per client in 2020		4	23.6 [6.8]	33.0 [17.4]	34.1 [19.9]	101.5 [76.3]	<0.001†	<0.001
Average hours of domestic care billed per client in 2020		5	12.1 [6.2]	13.7[6.4]	16.5 [13.8]	118.6 [190.2]	0.111†	0.152
Range of services								
Palliative care (yes)	64 (72.7)	0	11 (91.7)	13 (76.5)	21 (72.4)	19 (63.3)	0.325	0.393
Oncological care (yes)	18 (20.5)	0	3 (25.0)	5 (29.4)	3 (10.3)	7 (23.3)	0.365	0.421
Psychiatric care (yes)	59 (67.0)	0	8 (66.7)	16 (94.1)	25 (86.2)	10 (33.3)	<0.001	<0.001
24-hour care service (yes)	26 (29.5)	0	1 (8.3)	5 (29.4)	0	20 (66.7)	<0.001	<0.001
Continuous night care (yes)	28 (31.8)	0	1 (8.3)	4 (23.5)	2 (6.9)	21 (70.0)	<0.001	<0.001
FINANCING								
Profit status: nonprofit	62 (70.4)	0	12 (100)	17 (100)	29 (100)	4 (13.3)	<0.001	<0.001

Variable	**Total *n* (%)**	**missing *n***	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***p* value**	**Adjusted *p* value[1]**
			Group 1: inpatient with SO	Group 2: outpatient with SO	Group 3: equal in- and outpatient with SO	Group 4: without SO	Fisher's exact ANOVA†† Kruskal–Wallis†	
Percentage of total revenue from each different source: CP, HI, residual financing) (mean [*SD*])		2	88.3 [4.9]	87.4 [11.5]	88.7 [6.0]	74.5 [23.2]	0.501†	0.545
WORKFORCE								
Percentage of RNs (or higher educated) out of all employees in the nursing and care sector at the agency (mean [*SD*])		9	42.7 [11.5]	31.6 [6.6]	29.9 [8.9]	22.4 [17.2]	<0.001†	0.001
Percentage of employees with voluntary turnover out of all employees in the nursing and care sector at the agency (mean [*SD*])		6	11.8 [9.4]	11.8 [6.3]	8.8 [5.0]	19.3 [14.0]	0.008†	0.015
Number of visits conducted by RNs in last 50 visits (mean [*SD*])		10	23.2 [6.5]	15.4 [8.7]	18.5 [11.6]	15.9 [11.4]	0.129†	0.171
WORK ENVIRONMENT								
Perceived staffing[a] (1–4) (mean [*SD*])		0	2.8 [0.3]	3.1 [0.3]	3.0 [0.3]	3.1 [0.3]	0.019††	0.032
Perceived workload[a] (1–20) (mean [*SD*])		0	9.8 [1.1]	10.7 [0.7]	10.3 [0.7]	9.7 [1.0]	0.001††	0.002
Percentage of employees working overtime at least once a week or more[a] (mean [*SD*])		0	65.5 [23.4]	67.0 [14.6]	64.6 [11.5]	40.4 [20.8]	<0.001†	<0.001
CLIENT CHARACTERISTICS								
Average KLV care duration per client in 2020 (in minutes) (mean [*SD*])		5	3433 [759]	4491 [2259]	4220 [1639]	10020 [9408]	<0.001†	<0.001
EMPLOYEE CHARACTERISTICS								
Average employment percentage[a] (mean [*SD*])		0	55.4 [9.9]	69.0 [6.6]	61.5 [9.0]	62.2 [16.5]	0.012†	0.022
Percentage of employees on monthly salary[a] (vs. hourly wage) (mean [*SD*])		0	63.5 [25.5]	90.5 [11.7]	81.3 [16.7]	38.6 [30.1]	<0.001†	<0.001
RESOURCES AND TIME ALLOCATION								
Employees' average travel time per day during last 3 working days[a] (minutes) (mean [*SD*])		0	67.5 [17.2]	63.1 [15.4]	68.1 [19.8]	68.7 [37.1]	0.819†	0.819
Employees' average time for coordinative work per day during last 3 working days[a] (minutes) (mean [*SD*])		0	34.9 [11.6]	34.3 [10.1]	31.5 [13.4]	27.4 [19.4]	0.058†	0.083
Employees' average time for administrative work per day during last 3 working days[a] (minutes) (mean [*SD*])		0	76.4 [26.0]	68.2 [17.1]	76.5 [29.2]	53.3 [29.7]	0.008††	0.015

Variable	**Total *n* (%)**	**missing *n***	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***n* (%) mean [*SD*]**	***p* value**	**Adjusted *p* value**[1]
			Group 1: inpatient with SO	Group 2: outpatient with SO	Group 3: equal in- and outpatient with SO	Group 4: without SO	Fisher's exact ANOVA†† Kruskal–Wallis†	
Average number of cases each nurse is responsible for (caseload) (mean [*SD*])		14	16.6 [10.2]	30.1 [11.7]	23.7 [7.1]	23.0 [19.2]	0.045†	0.070
FINANCIAL TASKS								
Conflicts with municipalities pertaining to financing of services		5					0.279	0.357
Never	44 (53.0)		6 (50.0)	10 (62.5)	13 (48.1)	15 (53.6)		
Seldom/sometimes	27 (32.5)		2 (16.7)	3 (18.8)	12 (44.4)	10 (35.7)		
(very) often	12 (14.5)		4 (33.3)	3 (18.8)	2 (7.4)	3 (10.7)		
Experienced cost pressure: uncovered costs (yes)	34 (39.5)	2	4 (33.3)	7 (43.8)	8 (28.6)	15 (50.0)	0.373	0.421
Percentage of costs unbillable (mean [*SD*])		3	50.8 [7.3]	47.0 [9.6]	45.7 [12.9]	25.1 [22.3]	<0.001†	<0.001
WORKFORCE RECRUITMENT AND TRAINING								
Recruitment situation of registered nurses (and higher) rated as easy	6 (6.8)	0	0	4 (23.5)	1 (3.4)	1 (3.3)	0.050	0.073
Recruitment situation of licensed practical nurses (or equivalent) rated as easy	13 (14.8)	0	4 (33.3)	2 (11.8)	4 (13.8)	3 (10.0)	0.297	0.367
Recruitment situation of assistant and support staff rated as easy	61 (70.1)	1	10 (90.9)	12 (70.6)	24 (82.8)	15 (50.0)	0.019	0.032

Note. HI= health insurance, CP = client copayment, SO = service obligation, *SD* = standard deviation, *n* = number, RN = registered nurse

[1] Adjusted *p* values with Benjamini–Hochberg correction for multiple testing

[a] Variables measured on the employee level and aggregated on the level of the homecare agency. Missing at employee level: perceived staffing: 36 of 3223; perceived workload: 24 of 3223; overtime: 62 of 3223; employment percentage: 87 of 3223; monthly salary: 39 of 3223; travel time: 1032 of 3223 (only filled out by employees working in direct patient care); time for coordinative work: 777 of 3223 (only filled out by employees working in direct patient care); time for administrative work: 712 of 3223 (only filled out by employees working in direct patient care)

Group 1: agencies with a service obligation in inpatient-oriented cantons
Group 2: agencies with a service obligation in increasingly outpatient-oriented and strongly outpatient-oriented cantons
Group 3: agencies with a service obligation in cantons with equal strength of inpatient and outpatient orientation
Group 4: agencies without a service obligation in all cantons

Aim 3: Predictors of the group differences

The lasso regression highlights variables that are highly predictive of group membership. Of the initially 30 variables, seven remained in the model, while the other variable coefficients shrunk to 0 (see Table 3). The variables that remained showed differences in organizational structures and processes. The predictive variables were service provision with regard to whether 24-hour care, night care, and psychiatric services were offered to clients. Comparing the agencies with psychiatric care to those without, the relative risk of belonging to the groups with a service obligation (group 1 to 3) vs one without (group 4) is 7 and 13% higher. By contrast, comparing the agencies providing continuous 24-hour care or night-care services to those without, the relative risk of belonging to the groups with a service obligation vs the group without is predicted to be between 26% and 59% lower.

Also, the average hours of basic-care service and the percentage of unbillable costs remained in the final model as highly predictive variables. When comparing agencies that differed by 10% in unbillable costs and in basic-care service in units of 10 hours, the relative risk of belonging to the groups with a service obligation versus the one without was 4% higher for the agencies with a higher percentage of unbillable costs and 3% lower for the agencies with fewer hours of basic-care service.

For the work environment, the percentage of employees working for a monthly salary remained as predictive variable in the model. When comparing agencies that differed by 10% in the percentage of employees working for a monthly salary, the relative risk of belonging to the groups with service obligation versus the one without was 11–21% higher for agencies with a higher percentage of employees working for a monthly salary.

Finally, with regard to geographic characteristics, the language region was the most predictive variable. All else being equal, comparing agencies in the French-speaking region to those in the Italian-speaking region, the relative risk of belonging to the group of outpatient-oriented agencies with a service obligation versus the group without a service obligation was 2.6 times higher. In contrast, when comparing agencies in the German-speaking region to those in the Italian-speaking region, the relative risk of belonging to a group of outpatient-oriented agencies with a service obligation versus the group without a service obligation was 0.8 times lower, whereas the relative risk of belonging either to the group of inpatient-oriented agencies with a service obligation or to the group of equally inpatient- and outpatient-oriented agencies with a service obligation versus the group without service obligation, was 1.4 or 1.5 times higher, respectively. Details of the results of the lasso regression can be found in Table 3 and more detailed procedures and raw results in Appendix C.

The sensitivity analysis (see Appendix D), in which we removed the three variables with nine or more missing values (number of visits conducted by RNs in last 50 visits, percentage of RNs, average number of cases each nurse was responsible for [caseload]) did not change the final model. We additionally ran the model without the variable "language region," which resulted in some additional variables remaining in the model but none of the existing ones falling out of the model.

Table 3. Results of the multinomial lasso regression with group 4: without a service obligation (SO) as the reference category

Variables	**Group 1: inpatient with SO**	**Group 2: outpatient with SO**	**Group 3: equal in- and outpatient with SO**
	RRR	RRR	RRR
(Intercept)	0.148	0.128	0.159
Catchment area (one of rural / suburban / urban)	–	–	–
German-speaking language region1	1.354	0.815	1.499
French-speaking language region1	0.883	2.573	0.694
Average hours service A (clarification, consultation, coordination)	–	–	–
Average hours service B (examination, treatment)	–	–	–
Average hours service C (basic care) (in units of 10h)	0.970	0.970	0.970
Average hours domestic care	–	–	–
Oncological care (yes)	–	–	–
Palliative care (yes)	–	–	–
Psychiatric care (yes)	1.073	1.123	1.126
24-hour care (yes)	0.523	0.589	0.414
Continuous night care (yes)	0.678	0.739	0.635
Percentage of total revenue from each different source	–	–	–
Percentage of RNs (or higher educated)	–	–	–
Percentage of employees with voluntary turnover	–	–	–
Number of visits conducted by RNs in last 50 visits	–	–	–
Perceived staffing	–	–	–
Perceived workload	–	–	–
Overtime	–	–	–
Average KLV care duration per client	–	–	–
Average employment percentage	–	–	–
Percentage of employees on monthly salary (in units of 10%)	1.105	1.209	1.209
Employees’ average time for administrative work	–	–	–
Employees’ average time for coordinative work	–	–	–
Employees’ average travel time	–	–	–
Caseload	–	–	–
Conflicts with municipalities (one of often-very often / seldom-sometimes / never)	–	–	–
Experienced cost pressure: uncovered costs (yes)	–	–	–
Percentage of costs unbillable (in units of 10%)	1.041	1.041	1.041

Variables	Group 1: inpatient with SO	Group 2: outpatient with SO	Group 3: equal in- and outpatient with SO
	RRR	RRR	RRR
Recruitment situation of RNs (and higher) rated as easy	–	–	–
Recruitment situation of licensed practical nurses (or equivalent) rated as easy	–	–	–
Recruitment situation of assistant and support staff rated as easy	–	–	–

Note. Independent variable coefficients that shrunk to zero and therefore "fell out" of the regression are marked with a dash (–), [1]Italian-speaking language region as reference category, RN = registered nurse, RRR = relative risk ratio, KLV = Swiss ordinance on health-care insurance benefits, SO = service obligation

Discussion

The aim of this study was to explore how financial and regulatory mechanisms are related to differences in the organizational structures, processes, and work environment of homecare agencies.

In view of aim 1, we identified different financial and regulatory mechanisms in the Swiss homecare setting. The cluster analysis indicated that the strategic orientation of the cantons (emphasis on inpatient vs. outpatient care) and regulations were interconnected. This was also reflected by the group comparison, in which agency groups located in outpatient-oriented cantons exhibited a tendency toward lower client copayments and a higher prevalence of effective full-cost reimbursement, whereas agency groups located in inpatient-oriented cantons seemed to operate more frequently with higher client copayments and with agency-specific residual financing (which was often based on negotiations with municipalities or cost accounting from the previous year). The agency group without a service obligation clearly differed from the three groups with a service obligation—despite the fact that the group was dispersed over cantons with different strategic orientations—in that the agencies predominantly received standardized cost compensations (78.6%) as a residual financing method and had fewer requirements if they had a service agreement with municipalities. For instance, none of the agencies had to meet criteria such as staying within a maximum time between registration and the first visit, accepting all clients in a given area, or ensuring sufficient capacity, and only one agency needed to offer special services or had defined compulsory services.

With regard to aim 2, we were able to identify some differences between the groups of homecare agencies in organizational structures, processes, and work environments. Besides the differences in regulatory and financial mechanisms between the groups with a service obligation and the one without, these groups also exhibited the main differences in structures and processes. We observed differences with regard to service provision, and it seems that the group without a service obligation filled niches, such as continuous night or around-the-clock care, that are not covered by the groups with a service obligation. In the end, agencies with or without a service obligation might have a synergistic effect in their respective region, covering different needs of the population.

Additionally, the average number of hours billed for basic and domestic care was up to three times higher for basic care and up to seven times higher for domestic care for the agency group without a service obligation. This result is not surprising. If travel time and other activities that are not directly provided to the client cannot be charged, then longer visits per client with less travel time in between are more profitable for the agencies, and if there is no service agreement regarding the acceptance of all clients in a given area (and/or no service obligation), then agencies have the possibility to reject client requests, such as for only short visits to administer medication or change a dressing. Furthermore, most agencies (87%) without a service agreement were for-profit. To be able to operate cost-covering or even profitably as a business, this approach is reasonable and was also reflected in the percentage of unbillable costs (e.g., for travel time, team meetings, building maintenance), which was notably lower for the agency group without a service obligation (25% compared to 46–51%). As a downside of this distribution, agencies with a service obligation usually do not have the possibility to become more profitable by focusing on longer visits, since they have to cover all clients in a defined region, even if the visit lasts only 10 minutes.

The lower administrative time (office work) in the agency group without a service obligation seems reasonable. First, longer visits mean fewer visits per day, and each visit requires some administrative time for employees to record the visit. Second, a high amount of basic and domestic care services usually requires less administrative work such as writing progress reports, care plans, or handovers. In addition, we hypothesize that RNs usually spend more time on administrative work than lower-educated professionals, since they are the ones who take care of the nursing process, supervise students, or take on additional specialized functions and responsibilities. This might be another explanation why the agency group without a service obligation and a lower proportion of RNs had lower administrative time. This observation was also made in the study by Dick et al. [43]: for-profit agencies in the US had hired fewer RNs than nonprofit agencies. A recent study on the US also found that for-profit homecare agencies were less likely to discharge clients but were significantly more likely to have a longer length of stay (>99 days) than nonprofit agencies [44]. This could be an additional explanation for the reduced administrative time, as fewer admissions and dismissals usually also mean less administrative work. Due to the length of the average total care time (average duration of KLV care) per client in our sample, which was at least two times longer in the agency group without a service obligation, one could also assume that these clients used homecare longer.

Considering the work environment, employees in agencies without service obligation perceived themselves to have a slightly lower workload, and a lower percentage of them indicated that they work overtime. There are several possible explanations for these findings. One explanation for the differences in workload perception could be the fact that there are remarkably more persons employed on a monthly salary in the three agency groups with a service agreement. Working on an hourly basis could bring greater flexibility to the agencies to compensate for the variations in the volume of work and schedule visits, which could have a positive impact on the perceived workload of employees in the agency group without a service obligation [45]. Another explanation could be linked to the client population and the range of care and treatments. For example, a study by Aeschbacher and Addor [46] found that nurses perceived better working conditions, such as less stress and aggression, when they specialized on certain selected treatments. This also applied to our agency group without a service obligation, in which the agencies could select clients or also refuse a service. In addition, those who work on an hourly basis do not truly work overtime as they are paid on an hourly basis, and one day may be filled with one or two hours, while another day may be filled with the maximum hours allowed by the labor code, especially if employees are paid on an hourly basis [45]. For the agency group without a service obligation, patient selection and hourly nursing employment could allow steadier and more continuous scheduling of a reference nurse for each client, thereby resulting in more stable schedules for nurses, with less overtime and more balanced workloads. As Lanzarone and Matta [47] showed in their study, a robust assignment of a reference nurse to patients in homecare can minimize workload and overtime. As a final explanation, the agency group without a service obligation could also simply have a better working environment with regard to workload and overtime by having more freedom without contractual regulations they have to fulfill for a service contract and a service obligation. The study by Aeschbacher and Addor [46] found that working conditions varied according to the type of patient and treatment, institution size and organizational ownership.

With regard to personnel recruitment, the agency group without a service obligation seemed to have more difficulties in recruiting assistant and support staff (50% rated it as easy compared to 71–91% of agencies with a service obligation), whereas almost all agencies (93%) indicated that the recruitment of registered nursing staff was difficult. One reason that recruiting assistant and support staff could have been more difficult for them is that agencies without a service obligation generally hire more people from this occupational group, which is reflected in the percentage of RNs (which was lower) and also the hours of basic and domestic care provided (which was higher). Another reason may have been the differences in salaries paid to assistant and support staff, but the study did not provide any information in this regard.

The lasso regression, in which we modeled all the variables together to target our aim 3, showed that seven of the 30 independent variables were important for predicting group membership. However, only four variables—24-hour care, continuous night care, psychiatric care, and language region—showed noteworthy differences in the relative risk ratios, whereas the other variables were very close to 1. These results suggest that regulations had an impact on different areas of homecare agencies, especially on the range and amount of services provided. These differences were particularly evident between agencies with a service agreement (including a service obligation with municipalities or a canton) and agencies without such a service obligation. The explanations for this may vary, but according to the results, it can be assumed that the agency group without a service obligation performed services that could not be covered by the agency groups with a service obligation and that there were financial incentives for offering these services. A study by Kim and Norton [48] showed that agencies in the US adapted their practice patterns when given financial incentives to do so: agencies targeted a certain number of visits to receive maximum compensation, regardless of client needs, and they tended to shift resources away from home health aide and medical social service visits, where additional visits did not offer any additional compensation [48]. In our setting, the three KLV-service categories were checked and monitored by insurance companies, were renumerated at maximum based on set costs, and did not produce profitable revenue. For additional service offerings outside the KLV regulation, which were self-paid by clients, such as 24-hour care or continuous night care, the prices were set by the agencies, so these services were more profitable. In contrast, psychiatric care was more frequently provided by the agency groups with a service obligation; this service was regulated, requires additional specially trained nursing staff, and in some cantons was part of the service agreement. To cover higher costs per hour (e.g., costs for specialized staff), an additional reimbursement at a higher rate is needed. To maintain financially sustainable, accessible, and high-quality homecare, financial incentives have to be well aligned with the goals of the long-term care system [11, 14].

Limitations

There are some limitations and strengths of this study that are worth mentioning. The regulation and financing of homecare agencies is very specific to each country, so the transferability and generalizability of our results to other settings or countries is limited. With regard to the assessment of financial mechanisms, one challenging point is that residual financing is not always transparent, which made it difficult to assess whether our financial data for different agencies were comparable. The level of the standard costs also played a role: it may well be that an agency with standard costs can operate just as well or even better than an agency that receives effective full costs, if the standard costs are appropriate and reflect the actual expenses that cannot otherwise be billed to clients or insurers, such as travel time, certain administrative work, or further training. In addition, regional differences in wages and prices made it difficult to compare residual financing, since the same amount of residual financing does not provide the same conditions. It was also difficult for some agencies to evaluate residual financing, which resulted in missing data as they were not able to answer the question.

Data collection took place during the COVID-19 pandemic, which could have affected answers and in addition led some agencies to withdraw their consent, making it impossible to reach the target sample of 107 agencies. In Switzerland the homecare sector is highly volatile, with continual mergers, bankruptcies, closures, and new organizations, so the data must be viewed as a snapshot. It may also be that there are other unmeasured factors and unmeasured confounding factors that could have influenced the outcomes of agency groups. With regard to the employee level, we were only able to include the answers of the participating employees, and it could be that respondents and nonrespondents differ, so we do not know for certain if the values properly reflect the agency. However, the response rate was over 60% for the majority of agencies (80%).

As for our statistical analysis, due to the small sample size on the organizational level, the results of the sparse regression should be considered with caution. Another limitation is that the lasso regression is designed to optimize prediction, not necessarily interpretability, and it is possible that we therefore included only one of two or several highly correlated variables in the model. There may be other variables not included in the final model that are also highly predictive. Finally, there are no well-established methods for conducting reliable and robust inference for lasso regressions, and this presents a limitation of our study.

Conclusion

Based on our results, Swiss regulations seem to have had an impact on different aspects of homecare agencies but especially on the range and amount of services provided. The most prominent differences were found between agency groups with a service obligation and the agency group without a service obligation, and service obligations entailed the largest differences with regard to regulations and financial mechanisms. However, the differences between the three groups with service obligations would be critical to the future design of regulations. Financial incentives must be well aligned with the goal of achieving and maintaining financially sustainable, accessible, and high-quality homecare. Regulations seem to be an important driver not only in areas such as the range and type of services provided but also on the working environment of homecare staff. A one-sided focus in the system of long-term care—for example, only on cost reduction, as seems to be the case in many countries—can cause lasting damage to the supply structures of the care system.

Implications

For practice and policy, we recommend two considerations. First, in agencies with a service obligation, workload and overtime of employees need to be monitored and, if necessary, appropriate measures planned to reduce them. The current nursing shortage affects homecare and could cause more nurses to quit. To overcome this challenge, homecare management requires resources and support from the system (and policy makers) to balance cost-saving measures, high-quality care, and employees' health and retention, as already pointed out by Jarrin et al. [8]

Second, regional differences, not only in Switzerland but also in other countries, can be used to identify specific advantages and disadvantages of different strategic directions and, by extension, of the financial incentives created by regulatory and financial mechanisms. Such comparison can help plan reforms or adjustments to regulations with foresight and without creating the wrong incentives or jeopardizing the care of certain client populations. To do so requires a reliable and accurate national database that provides homecare statistics at the level of individual agencies and treatment cases and that includes both structural and outcome data.

With regard to future research, it would be useful to further investigate whether the agency groups with a service obligation and the one without a service obligation really have a synergetic effect and whether the care needs of the population are thereby covered. This is linked to the question how client copayments affect the use of homecare services: The homecare population in neighboring countries changed due to modified regulations,[17] and based on a 2016 survey, 22% of Swiss adults skipped needed care [49]. Accordingly, it needs to be clarified to what degree home healthcare is rather supply-driven than need-driven and the current regulatory system fails to reach the triple aim of improving patient experience of care, the health of the population and reducing per capita cost of healthcare [50].

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Conflict of interest statement

The authors declare that they have no competing interests.

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Appendix and additional Files

Appendix A. Macro-level and meso-level characteristics included in the analysis

Table A1. Macro-level and meso-level characteristics included in the analysis

Level	Domain	Variable	Source	Questions asked in the questionnaires Groups formed with response categories or calculation of variables
Macro	Regulations	Reimbursement regulations of residual financing	Agency questionnaire	On what basis is the residual financing of care costs determined by your canton or municipality? 4 groups: 1) Compensation of the effective full costs 2) Compensation of agency-specific and predefined costs 3) Use of standard costs, standard deficits, or maximum limits 4) Others (e.g., compensation via a global budget)
		Requirements for and content of a service agreement	Agency questionnaire	Does your homecare agency have a service agreement with a canton or municipalities? (yes/no) If yes, what are the conditions for the service agreement? 5 groups: (1) Obligation to provide service (used for building agency groups) (2) Time coverage (24h/7d coverage and visits on weekends and at night if needed) (3) Assurance of service provision (maximum time between registration and first assignment, admission of all clients in a defined catchment area, assurance of sufficient capacity) (4) Range of services (offering specialized services (e.g., palliative care, psychiatric care, wound care) and defined compulsory services (requirements to provide certain services and to ensure access to further services) (5) Specifications regarding employees (quality specifications, predefined staffing ratio, specification of the conditions of employment, requirements for the qualifications of the nursing staff, commitment to further training)
		Client copayments	Agency questionnaire	How are the amounts of patient copayments regulated? 4 groups: 1) No patient copayments (no payment from the client side) 2) Patient copayments of a maximum of CHF 7.65 per day, which means that the increase can be up to 10% of the health-insurance (HI) contribution, or direct payment limited to CHF 7.65 per day 3) Up to 20% of the HI contribution and upper limit of CHF 15.35 per day 4) Direct payment up to the upper limit of a maximum of CHF 15.35 per day
Macro	Workforce availability	-	-	Not assessed on the macro level
Macro	Geographic characteristic	Catchment area	Agency questionnaire	How would you describe the catchment area of your homecare agency? 3 groups: Urban, suburban, rural

Level	Domain	Variable	Source	Questions asked in the questionnaires Groups formed with response categories or calculation of variables
		Language region	Language regions allocated by the Swiss Federal Statistical Office (FSO)	Language region assigned via postal code of municipality where the agency is located, based on the allocation of the FSO 3 groups: German speaking, French speaking, Italian speaking
Meso	Service provision	Total number of clients and hours of care provided in 2020	Agency questionnaire	How many hours of the different services did your homecare agency bill in 2020? 4 groups: a) Average hours per client per year of KLV service A (clarification, consultation, coordination) b) Average hours per client per year of KLV service B (examination, treatment) c) Average hours per client per year of KLV service C (basic care) d) Average hours per client per year of domestic care
		Range of services (e.g., nursing care, domestic tasks, meal service, specialized care)	Agency questionnaire	Which of the following more specific service offers does your homecare organization provide? 5 groups: 24-hour care, continuous night care, oncological care, palliative care, psychiatric care
	Financing	Profit status (nonprofit, for-profit)	Agency questionnaire	Who is the funding body of your homecare organization? 2 groups: nonprofit, for-profit
		Percentage of total revenue from each source	Agency questionnaire	What percentage of the total revenue in 2020 came from each different source? Calculation: Percentage of total revenue that each of the three sources (health insurance, client copayments, canton/municipalities) accounted for
	Workforce	Number of employees according to educational background	Agency questionnaire	Total number of employees in the nursing and care sector at the end of the year 2020. Calculation: Percentage of RNs or higher education out of all employees in the nursing and care sector of the agency
		Turnover rate	Agency questionnaire	How many employees left your homecare organization in 2020? Calculation: Percentage of employees who voluntarily left out of all employees in the nursing and care sector of the agency
		Staffing and skill mix	Agency questionnaire	Of the last 50 assignments your organization performed for clients, how many were performed by a RN (or equivalent or higher)? For this answer, please consider only outreach to clients who have received nursing services. Calculation: Number of visits conducted by RNs (or equivalent or higher) in the last 50 visits
	Work environment	Perceived staffing	Employee questionnaire	3 items of the staffing- and resource-adequacy subscale of the Practice Environment Scale of the Nursing Work Index (PES-NWI) [1, 2] 3 items rated on a 4-point Likert scale (strongly disagree, slightly disagree, slightly agree, strongly agree) Calculation: Mean score per employee and mean score across each homecare agency
		Perceived workload	Employee questionnaire	NASA Task-Load Index [3-5] 6 items rated on a 20-point analogue scale (low to high) Calculation: mean score first per employee and then a mean score across each homecare agency

Level	Domain	Variable	Source	Questions asked in the questionnaires Groups formed with response categories or calculation of variables
		Overtime	Employee questionnaire	Question adapted from the RN4CAST study [6, 7] 1 item: How often do you have to work overtime more than 30 minutes? Item rated on a 5-point Likert scale (Almost every shift, once every 2–4 working days, once every 5–7 working days, less frequently, never) Calculation: Percentage of employees working overtime at least 1x per week for each homecare agency
	Client characteristics	Average care duration per client	Agency questionnaire	What was the average KLV care duration per client in your homecare organization in 2020? Calculation: Average KLV care duration per client in 2020 in minutes per homecare agency
	Employee characteristics	Employment percentage	Employee questionnaire	What is your employment percentage? Calculation: Mean employment percentage per homecare agency
		Employment contract	Employee questionnaire	Do you work on an hourly wage or a monthly salary? Calculation: Percentage of employees working on a monthly salary per homecare agency
Meso	Resources and time allocation	Travel time, coordinative and administrative time in the last 3 working days	Employee questionnaire	a. How many hours and minutes in total were you on the road when you walked or drove from client to client? (travel time/driving time) b. How much time did you spend on administrative tasks (office work)? c. How much time did you spend on coordinative tasks? (consultations, obtaining or conveying information, case discussions). Calculation: mean minutes of travel time, administrative time and coordination time over the last three days for each employee, aggregated to a mean score for each agency
		Caseload	Agency questionnaire	On average, how many clients is a case manager working 100% responsible for? Average number of clients, extrapolated to a 100% workload Calculation: Number of cases for which each nurse is responsible
	Financial tasks	Conflicts with municipalities pertaining to the financing of services	Agency questionnaire	Do you ever have disputes with municipalities/cantons regarding the payment of costs in the context of residual financing? Item rated on a 5-point Likert scale (very often, often, sometimes, seldom, never) 3 groups: (very) often, sometimes or rarely, never
		Experienced cost pressure	Agency questionnaire	Did your homecare organization report uncovered care costs in 2020? (This refers to the full costs of KVG care not covered by health-insurance contributions, patients' payments, and residual financing from a canton/municipalities (incl. deficit guarantee)). 2 groups: yes, no
		Time and unbillable costs	Agency questionnaire	What was the percentage of billable costs and unbillable costs in 2020? Calculation: Percentage of costs that are unbillable (e.g., travel times, building maintenance)
	Workforce recruitment and training	Workforce recruitment	Agency questionnaire	How do you currently rate the recruitment situation for nursing and care staff? a. Registered nurses (or equivalent) b. Licensed practical nurses (or equivalent) c. Assistant and support staff 3 items rated on a 4-point Likert scale (very difficult, rather difficult, rather easy, very easy) 2 groups: very/rather difficult, very/rather easy

Note. KLV = Swiss ordinance on health-care insurance benefits, KVG = Federal Health Insurance Act, RN = registered nurse

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Appendix B. Results of the Cluster Analysis

We conducted the cluster analysis based on three characteristics that reflected the financing and regulations:

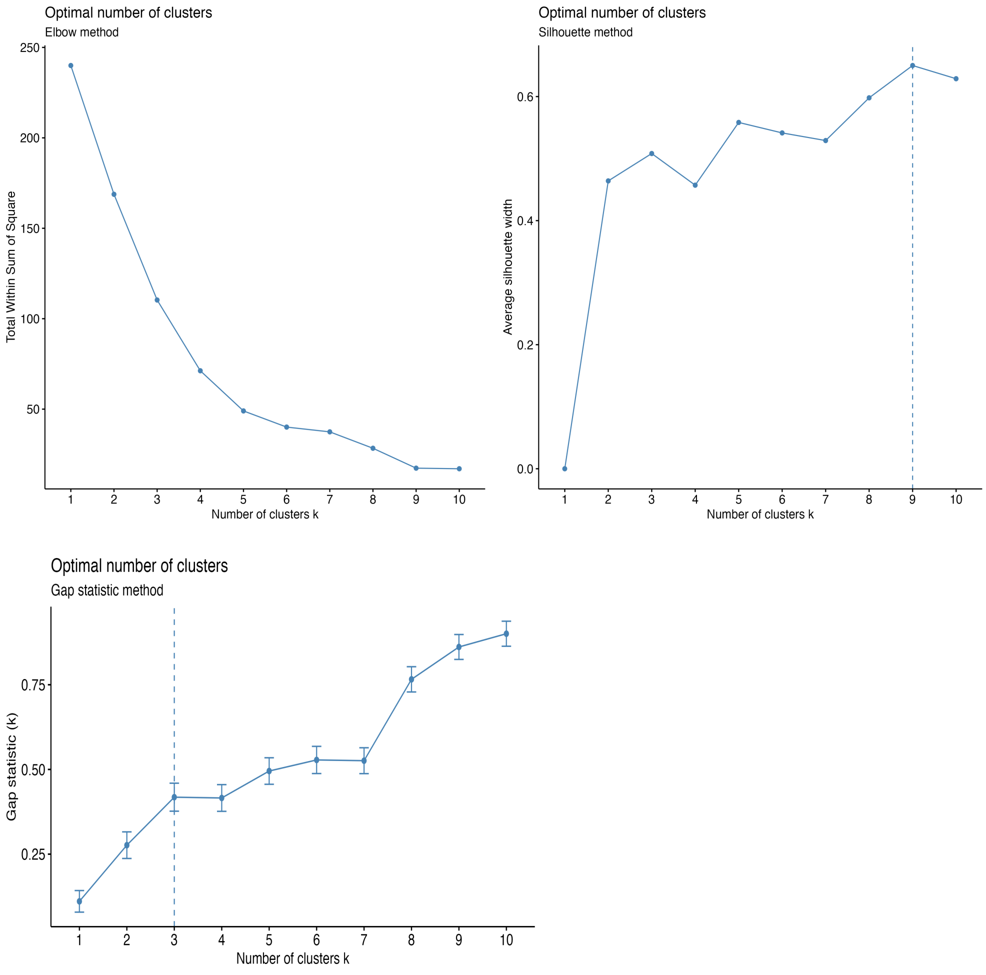
1) service obligation (yes/no)
2) basis of the residual financing (compensation of agency-specific and predefined costs / compensation of the effective full costs / use of standard costs, standard deficits, or maximum limits / other)
3) client copayments (no copayments / a maximum of CHF 7.65/day / up to 20% and limit of CHF 15.35/day / direct copayments up to upper limit of CHF 15.35/day)

The following steps were performed for the cluster analysis:
Found optimal number of clusters with different statistical tests (elbow, silhouette, and gap-statistic methods)
Displayed cluster results in graphics to inspect them visually
Conducted cluster statistics to test how well the data-driven groups (clusters) matched our content-driven (theory) groups

Results of the statistical testing to find optimal number of clusters

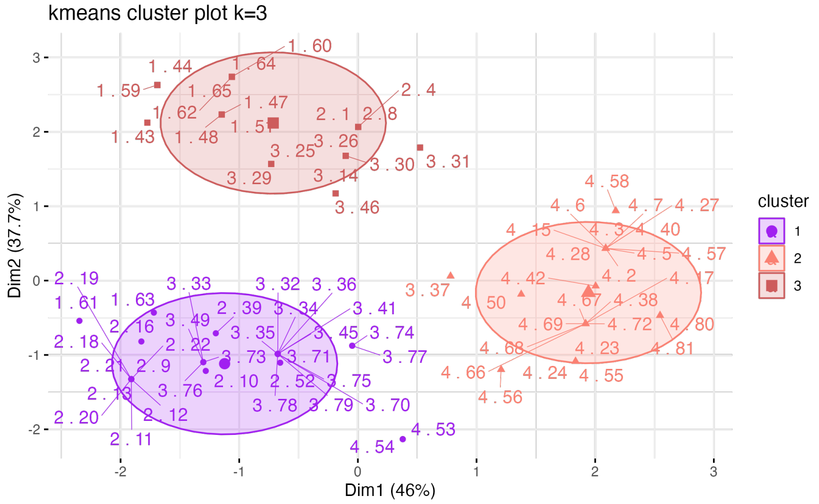
We used the elbow, silhouette, and gap-statistic methods to find the optimal number of clusters. The elbow and silhouette methods indicated a cluster number between 3 and 5, the gap-statistic method between 3 and 6, although not much information was added between 5 and 6.

Graphic B1. Results of the statistical testing methods

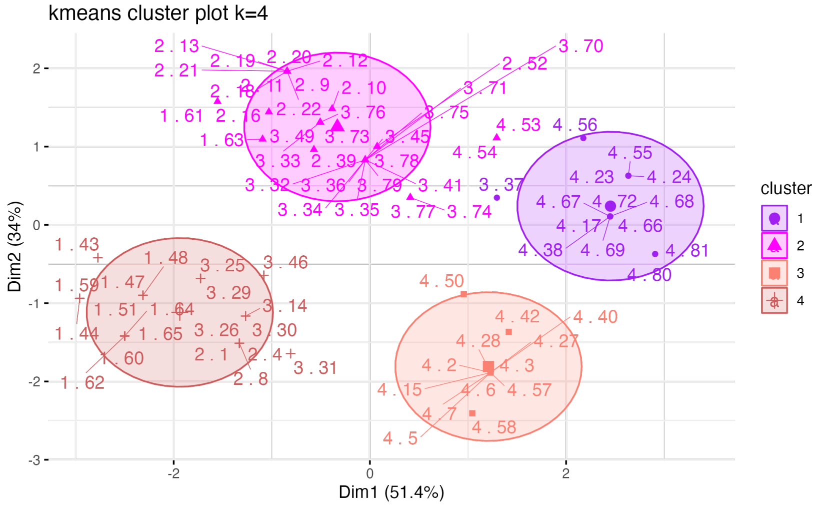


Visualization of cluster results

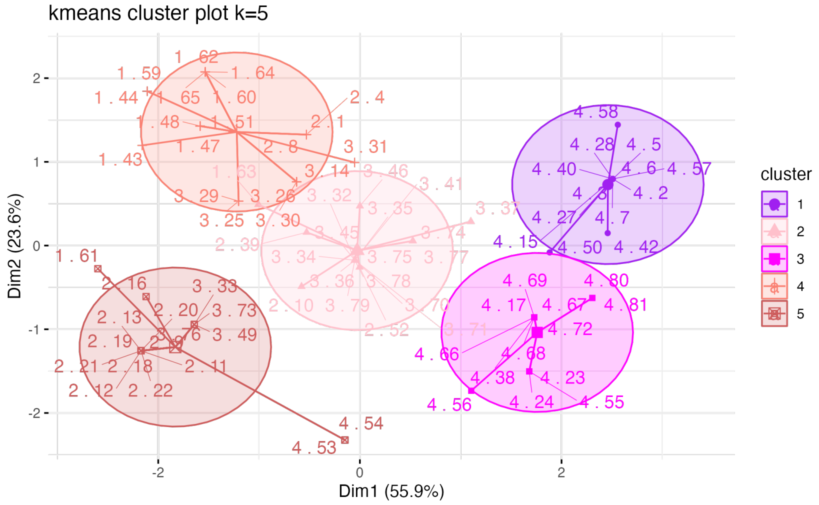
Graphic B2. k-means clustering with Euclidean distance (k=3)



Graphic B3. k-means clustering with Euclidean distance (k=4)



Graphic B4. k-means clustering with Euclidean distance (k=5)



Results of the cluster statistics

We conducted overall cluster statistics to test how well the data-driven groups (clusters) matched our content-driven (theory-driven) groups. To do so, we merged the two clusters that only contained group 4 agencies (see Graphic B4) into one group.

Table B1. Matrix of reference group (content driven) and predicted (cluster) group

	Group 1	Group 2	Group 3	Group 4
Cluster 4 ✚	10	1	1	0
Cluster 5 ☒	3	10	3	0
Cluster 2 ▲	6	4	15	0
Cluster 4 (1● & 3■)	0	2	0	26

Overall cluster statistics:

Accuracy: 0.7531
95% CI: (0.6447, 0.8422)
No Information Rate: 0.3457
P-Value [Acc > NIR]: 8.442e-14
Kappa: 0.6665

Table B2. Confusion matrix with content driven homecare agency groups as reference.

Statistics by cluster:	**Cluster 4 ✚**	**Cluster 5 ☒**	**Cluster 2 ▲**	**Cluster 1● & 3■**
Sensitivity	0.8333	0.6250	0.6000	0.9286
Specificity	0.8696	0.8923	0.9286	1.0000
Pos Pred Value	0.5263	0.5882	0.7895	1.0000
Neg Pred Value	0.9677	0.9062	0.8387	0.9636
Prevalence	0.1481	0.1975	0.3086	0.3457
Detection Rate	0.1235	0.1235	0.1852	0.3210
Detection Prevalence	0.2346	0.2099	0.2346	0.3210
Balanced Accuracy	0.8514	0.7587	0.7643	0.9643

Note. The reference groups were the following:
Group 1: Agencies with service obligation in inpatient-oriented cantons
Group 2: Agencies with service obligation in increasingly outpatient and strongly outpatient-oriented cantons
Group 3: Agencies with service obligation in cantons with equal strength of inpatient and outpatient-orientation
Group 4: Agencies without service obligation in all cantons

Appendix C. Results of the lasso regressions

We conducted the lasso regression through the following three steps:

1. We calculated the lambda (λ) value
2. We ran the lasso regression with the estimated λ parameter
3. We calculated relative risk ratios (table in result section)

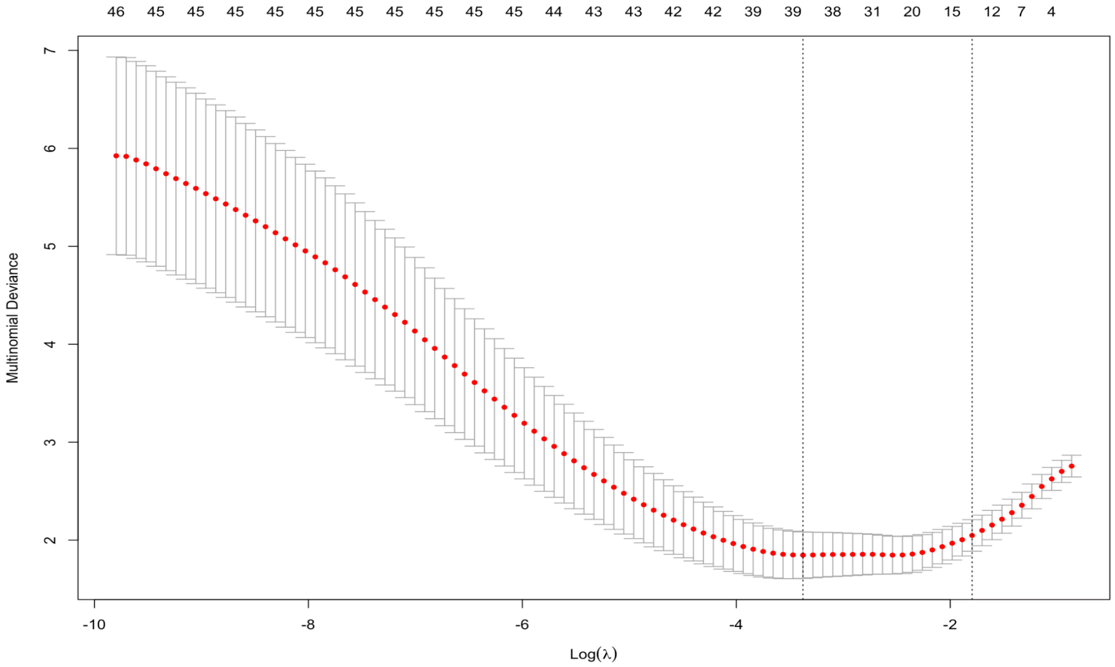
Calculation of λ

We calculated a leave-one-out (29n-fold) multinominal, grouped cross-validation to find the optimal λ value.
The cross validation resulted in a λ of 0.166, which was used as a penalty to run the lasso regression.

Table C1. Results of the cross validation to determine λ

Lambda	Index	Measure	SE	Nonzero
min 0.03415	28	1.847	0.2373	39
1se 0.16604	11	2.048	0.1612	12

Graphic C2. Cross validation λ values



Results of the lasso regression

We conducted the lasso regression with the following parameter: 1se Lambda, family = "multinomial," type.multinomial = "grouped"

Table C2. Raw results of the lasso regression

Variables	Group 1	Group 2	Group 3	Group 4
(Intercept)	-0.460	-0.604	-0.388	1.452
Catchment area: rural	–	–	–	–
Catchment area: suburban	–	–	–	–
Catchment area: urban	–	–	–	–
Language region: German speaking	0.177	-0.331	0.279	-0.126
Language region: French speaking	-0.238	0.831	-0.479	-0.114
Language region: Italian speaking	–	–	–	–
Average hours: service A (clarification, consultation, coordination)	–	–	–	–
Average hours: service B (examination, treatment)	–	–	–	–
Average hours: service C (basic care)	-0.001	-0.001	-0.001	0.002
Average hours: domestic care	–	–	–	–
Oncological care (yes)	–	–	–	–
Oncological care (no)	–	–	–	–
Palliative care (yes)	–	–	–	–
Palliative care (no)	–	–	–	–
Psychiatric care (yes)	-0.003	0.019	0.021	-0.037
Psychiatric care (no)	0.003	-0.021	-0.022	0.039
24-hour care (yes)	-0.066	-0.007	-0.182	0.255
24-hour care (no)	0.067	0.007	0.186	-0.26
Continuous night care (yes)	-0.051	-0.008	-0.085	0.144
Continuous night care (no)	0.051	0.008	0.083	-0.142
Percentage of revenue from each different source	–	–	–	–
Percentage of RNs (or higher educated) out of all posts	–	–	–	–
Percentage of employees with voluntary turnover	–	–	–	–
Number of RN (or equivalent or higher) visits within 50 visits	–	–	–	–
Perceived staffing	–	–	–	–
Perceived workload	–	–	–	–
Overtime	–	–	–	–
Average KLV-care duration per client	–	–	–	–
Average employment percentage	–	–	–	–
Percentage of employees on monthly salary	-0.002	0.007	0.007	-0.012
Employees’ average time for administrative work	–	–	–	–
Employees’ average time for coordinative work	–	–	–	–
Employees’ average travel time	–	–	–	–
Caseload	–	–	–	–
Conflicts with municipalities (often/very often)	–	–	–	–
Conflicts with municipalities (seldom/sometimes)	–	–	–	–
Conflicts with municipalities (never)	–	–	–	–
Experienced cost pressure: uncovered costs (yes)	–	–	–	–
Experienced cost pressure: uncovered costs (no)	–	–	–	–
Percentage of unbillable costs	0.001	0.001	0.001	-0.003
Recruitment situation of licensed practical nurses (or equivalent) rated as easy	–	–	–	–
Recruitment situation of licensed practical nurses (or equivalent) rated as difficult	–	–	–	–
Recruitment situation of assistant and support staff rated as easy	–	–	–	–
Recruitment situation of assistant and support staff rated as difficult	–	–	–	–
Recruitment situation of RNs (and higher) rated as easy	–	–	–	–
Recruitment situation of RNs (and higher) rated as difficult	–	–	–	–

Note. Independent variable coefficients that shrunk to zero and therefore "fell out" of the regression are marked with a dash (–)

Appendix D. Results of the sensitivity analysis

We conducted a sensitivity analysis by running two additional lasso regressions:

a) We removed the variables with which contained >= 9 missing values
b) We removed the language region

We performed the following two steps:

4. We calculated the lambda (λ) value
5. We run the lasso regression with the estimated λ parameter

Analysis 1: without variables that contained >= 9 missing values

We removed the following variables of the data set (c.f. Table 2 in paper):
Percentage of posts of RNs →9 missings
Number of RN visits within 50 visits → 10 missings
Average number of cases for which each nurse is responsible (caseload)) → 14 missings

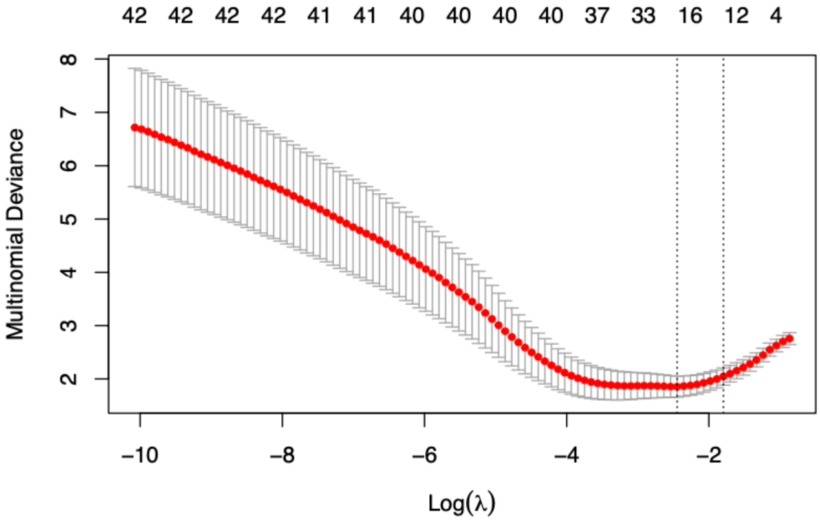
Calculation of λ

We calculated a leave-one-out (29n-fold) multinominal, grouped cross-validation find the optimal λ value.
The cross validation resulted in a λ of 0.166, which was used as penalty to run the lasso regression.

Table D1. Results of the cross validation to determine λ

Lambda	Index	Measure	SE	Nonzero
min 0.08657	18	1.856	0.1973	21
1se 0.16604	11	2.045	0.1608	12

Graphic D1. Cross validation λ values



Results of the lasso regression without variables that contained >= 9 missing values

We conducted the lasso regression with the following parameter: 1se Lambda, family = "multinomial", type.multinomial = 'grouped'

Table D2. Raw results of the lasso regression without variables that contained >= 9 missing values

Variables	Group 1	Group 2	Group 3	Group 4
(Intercept)	-0.460	-0.604	-0.388	1.452
Catchment area rural	-	-	-	-
Catchment area suburban	-	-	-	-
Catchment area urban	-	-	-	-
Language region German-speaking	0.177	-0.331	0.279	-0.126
Language region French-speaking	-0.238	0.831	-0.479	-0.114
Language region Italian-speaking	-	-	-	-
Average hours Service A (clarification, consultation, coordination)	-	-	-	-
Average hours Service B (examination and treatment)	-	-	-	-
Average hours Service C (basic care)	-0.001	-0.001	-0.001	0.002
Average hours domestic care	-	-	-	-
Oncological care (yes)	-	-	-	-
Oncological care (no)	-	-	-	-
Palliative Care (yes)	-	-	-	-
Palliative Care (no)	-	-	-	-
Psychiatric care (yes)	-0.003	0.019	0.021	-0.037
Psychiatric care (no)	0.003	-0.021	-0.022	0.039
24 hours care service (yes)	-0.066	-0.007	-0.182	0.255
24 hours care service (no)	0.067	0.007	0.186	-0.26
Continuous night care (yes)	-0.051	-0.008	-0.085	0.144
Continuous night care (no)	0.051	0.008	0.083	-0.142
Percentage of financial contributions from different contributors	-	-	-	-
Percentage of employees with voluntary turnover	-	-	-	-
Perceived staffing	-	-	-	-
Perceived workload	-	-	-	-
Overtime	-	-	-	-
Average KLV care duration per client	-	-	-	-
Average employment percentage	-	-	-	-
Percentage employees in monthly wage	-0.002	0.007	0.007	-0.012
Employees average time for administrative work	-	-	-	-
Employees average time for coordinative work	-	-	-	-
Employees average travel time	-	-	-	-
Conflicts with municipalities ((very) often)	-	-	-	-
Conflicts with municipalities (seldom/sometimes)	-	-	-	-
Conflicts with municipalities (never)	-	-	-	-
Experienced cost pressure: uncovered costs (yes)	-	-	-	-
Experienced cost pressure: uncovered costs (no)	-	-	-	-
Percentage of costs unbillable	0.001	0.001	0.001	-0.003
Recruitment situation of Licensed practical nurses (or equivalent) rated as easy	-	-	-	-
Recruitment situation of Licensed practical nurses (or equivalent) rated as difficult	-	-	-	-
Recruitment situation of assistant and support staff rated as easy	-	-	-	-
Recruitment situation of assistant and support staff rated as difficult	-	-	-	-
Recruitment situation of RNs (and higher) rated as easy	-	-	-	-
Recruitment situation of RNs (and higher) rated as difficult	-	-	-	-

Note. Independent variable coefficients that shrunk to zero and therefore "fell out" of the regression are marked with a line (-)

Analysis 2: without variable language region

We removed the variable language region of the data set.

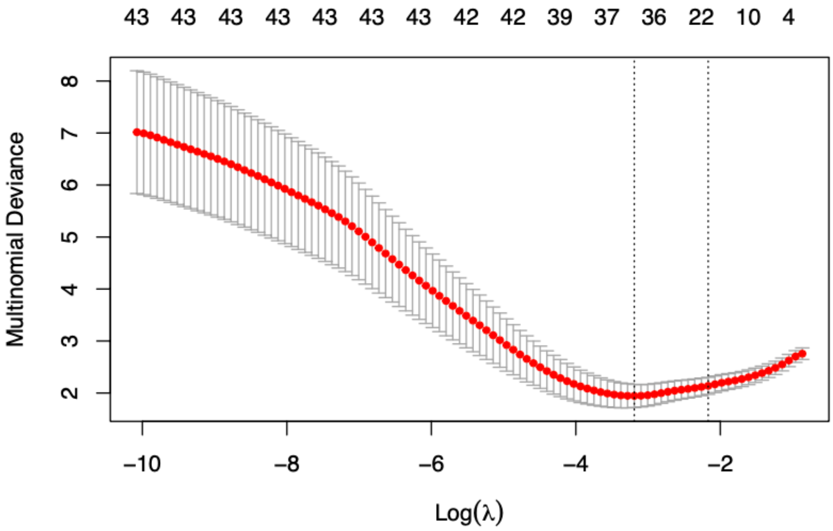
Calculation of λ

Also here, we calculated a leave-one-out (29n-fold) multinominal, grouped cross-validation find the optimal λ value.
The cross validation resulted in a λ of 0.114, which was used as penalty to run the lasso regression.

Table D3. Results of the cross validation to determine λ

Lambda	Index	Measure	SE	Nonzero
min 0.04113	26	1.944	0.2231	35
1se 0.11444	15	2.138	0.1639	18

Graphic D2. Cross validation λ values without variable language region



Results of the lasso regression without language region

We conducted the lasso regression with the following parameter: 1se Lambda, family = "multinomial", type.multinomial = 'grouped'

Table D4. Raw results of the lasso regression without variables that contained >= 9 missing values

Variables	Group 1	Group 2	Group 3	Group 4
(Intercept)	-0.675	0.087	0.092	0.497
Catchment area rural	0.016	0.005	0.053	-0.074
Catchment area suburban	-	-	-	-
Catchment area urban	-	-	-	-
Average hours Service A (clarification, consultation, coordination)	-	-	-	-
Average hours Service B (examination and treatment)	-	-	-	-
Average hours Service C (basic care)	-0.002	-0.001	-0.001	0.004
Average hours domestic care	-	-	-	-
Oncological care (yes)	-	-	-	-
Oncological care (no)	-	-	-	-
Palliative Care (yes)	-	-	-	-
Palliative Care (no)	-	-	-	-
Psychiatric care (yes)	-0.004	0.025	0.021	-0.041
Psychiatric care (no)	0.004	-0.027	-0.023	0.045
24 hours care service (yes)	-0.12	0.106	-0.385	0.399
24 hours care service (no)	0.12	-0.105	0.384	-0.398
Continuous night care (yes)	-0.034	-0.001	-0.057	0.092
Continuous night care (no)	0.035	0.001	0.059	-0.094
Percentage of financial contributions from different contributors	-	-	-	-
Percentage of posts of RNs (or higher educated)	0.011	-0.001	-0.006	-0.004
Percentage of employees with voluntary turnover	0	0.001	-0.005	0.005
Number of RN visits within 50 visits	-	-	-	-
Perceived staffing	0.079	-0.362	-0.056	0.34
Perceived workload	-	-	-	-
Overtime	0.001	0.001	0	-0.001
Average KLV care duration per client	-	-	-	-
Average employment percentage	-0.004	0.003	-0.002	0.003
Percentage of employees in monthly wage	-0.004	0.012	0.008	-0.016
Employees average time for administrative work	-	-	-	-
Employees average time for coordinative work	-	-	-	-
Employees average travel time	-	-	-	-
Caseload				
Conflicts with municipalities ((very) often)	-	-	-	-
Conflicts with municipalities (seldom/sometimes)	-	-	-	-
Conflicts with municipalities (never)	-	-	-	-
Experienced cost pressure: uncovered costs (yes)	-	-	-	-
Experienced cost pressure: uncovered costs (no)	-	-	-	-
Percentage of costs unbillable	0.003	0.001	0.001	-0.005
Recruitment situation of Licensed practical nurses (or equivalent) rated as easy	-0.059	0.189	-0.085	-0.046
Recruitment situation of Licensed practical nurses (or equivalent) rated as difficult	0.052	-0.168	0.076	0.041
Recruitment situation of assistant and support staff rated as easy	-	-	-	-
Recruitment situation of assistant and support staff rated as difficult	-	-	-	-
Recruitment situation of RNs (and higher) rated as easy	-	-	-	-
Recruitment situation of RNs (and higher) rated as difficult	-	-	-	-

Note. Independent variable coefficients that shrunk to zero and therefore "fell out" of the regression are marked with a line (-)

CHAPTER 5

How external and agency characteristics are related to coordination in homecare – Findings of the national multicenter, cross-sectional SPOT^{nat} study

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Abstract

Background

Homecare client services are often distributed across several interdependent healthcare providers, making proper care coordination essential. However, as studies exploring care coordination in the homecare setting are scarce, serious knowledge gaps exist regarding how various factors influence coordination in this care sector. To fill such gaps, this study's central aim was to explore how external factors (i.e., financial and regulatory mechanisms) and homecare agency characteristics (i.e., work environment, workforce, and client characteristics) are related to care coordination in homecare.

Methods

This analysis was part of a national multicenter, cross-sectional study in the Swiss homecare setting that included a stratified random sample of 88 Swiss homecare agencies. Data were collected between January and September 2021 through agency and employee questionnaires. Using our newly-developed care coordination (COORA) framework, we modeled our variables to assess the relevant components of care coordination on the structural, process, and outcome levels. We conducted both descriptive and multilevel regression analyses—with the latter adjusting for dependencies within agencies—to explore which key factors are associated with coordination.

Results

The final sample size consisted of 1450 employees of 71 homecare agencies. We found that one explicit coordination mechanism ("communication and information exchange" ($\beta = 0.10$, $p < .001$)) and four implicit coordination mechanisms—"knowledge of the health system" ($\beta = -0.07$, $p < .01$), "role clarity" ($\beta = 0.07$, $p < .001$), "mutual respect and trust" ($\beta = 0.07$, $p < .001$), and "accountability, predictability, common perspective" ($\beta = 0.19$, $p < .001$)—were significantly positively associated with employee-perceived coordination. We also found that the effects of agency characteristics and external factors were mediated through coordination processes.

Conclusion

Implicit coordination mechanisms, which enable and enhance team communication, require closer examination. In order to develop successful strategies to strengthen implicit mechanisms, the involvement of the whole care team is important in addition to create suitable structures (i.e., explicit mechanisms) that enable communication and information exchange. Appropriate processes seem to mitigate the association between staffing and coordination and can therefore be seen as a supporting factor to maintain better coordination, even if workload and overtime are higher.

Keywords: Delivery of Health Care[Mesh], Government Regulation[Mesh], Health Services Research[Mesh], Healthcare Financing[Mesh], Home Care Services[Mesh], Nursing Administration Research[Mesh], Quality of Health Care[Mesh], Coordination, Communication[Mesh]

Background

Care coordination improves the quality of care and reduces repeated, unnecessary, or omitted treatments. Reducing such errors benefits not only the clients, e.g., by preventing unnecessary hospitalizations, but also the health system by reducing unnecessary costs [1-3]. Therefore, given that care is increasingly shifting from inpatient to ambulatory care [4], effective care coordination is essential. At the same time, rather than moving into dedicated care facilities, many care-dependent elderly patients are opting to use homecare services [5]. For the purposes of this article, homecare is understood as professional care in the client's own home. It commonly includes combinations of personal, medical and domestic care. Homecare differs from institutional care not only in that the place of care is the client's home. Compared to carehome or hospital staff, homecare workers are quite isolated, with no "backup" team immediately available for urgent situations. Also, client services are often distributed across several healthcare providers [4]. At the same time, the client and their relatives and various professionals and institutions are involved in the care and must coordinate their work with each other, including homecare staff, general practitioners, specialists, social workers, pharmacists, hospitals, and nursing homes [6].

As no standard definition currently applies to care coordination, we broadly define it as "[…] the organization of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of healthcare services […]." (p. 41) [7]. To date, studies exploring care coordination in the homecare setting have focused on general practitioners or clinics [1]. In these settings, international studies show that clients commonly experience care coordination gaps. These include test results not being available (often requiring repetition of those tests), various professionals giving conflicting information, unnecessary testing, the specialists not receiving vital information from general practitioners [8], different physicians prescribing interacting medications, or medical records being unavailable for scheduled appointments [9, 10]. While such problems are well-documented, little is known about how external factors such as regulations or homecare agency characteristics are related to coordination in homecare.

The care coordination framework (COORA)

Problems that impede care coordination can originate at every healthcare system level. To capture these problems systematically, we developed and used the care coordination framework (COORA), which includes elements on the structural and process level relevant to coordination in homecare settings [11]. Specifically, these include external factors, agency characteristics and coordination processes. The COORA framework approaches coordination as "the extent to which work dependencies are effectively managed towards a specific goal" [12, 13].

To manage these work dependencies, different *coordination mechanisms* are used [13, 14], which can be understood as approaches, methods, or tools available to align and synchronize work [15] and can be distinguished in implicit and explicit mechanisms [13]. *Explicit coordination mechanisms* are of behavioral nature and can be for example pre-defined plans, schedules, letters, e-mails, telephone calls, group meetings, defined roles, while *implicit coordination mechanisms* include shared mental models or common goals and are cognitive in nature. The use of these mechanisms (i.e., the coordination process) is sometimes also referred to as “coordinating or coordination activities” in the literature [11].

Figure 1 displays the simplified care coordination (COORA) framework with the different coordination elements, which also served as a basis for this study.

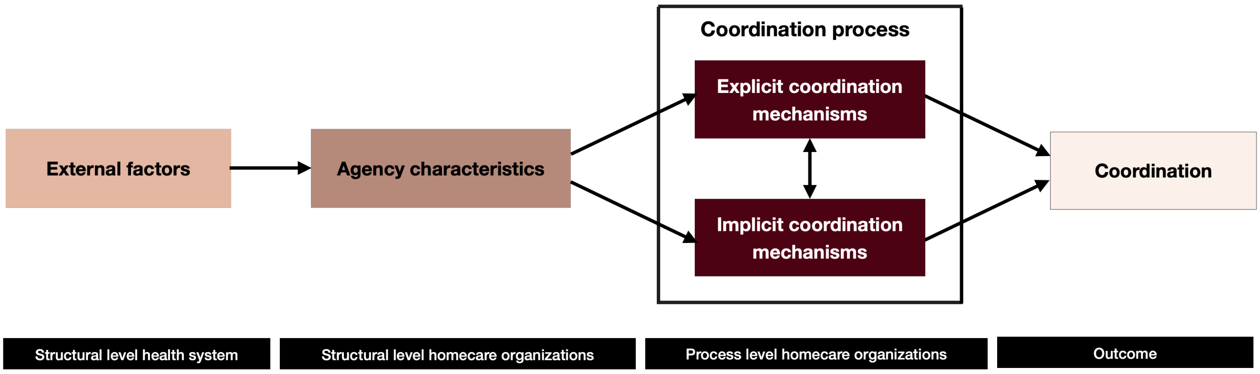

Figure 1. Simplified COORA framework used for this study

Factors that impede or enhance care coordination

Responding to a survey on how structural-level factors affect care coordination, home-based primary care workers in the U.S. reported that, when coordinating care, their most common barriers were of financial nature, including patient costs, eligibility requirements, and insurance coverage [16]. Primary care providers, administrators, and insurers agreed that current financial models in the U.S. were inadequate in regard to direct revenue, which impedes care coordination sustainability [17].

To search for ways to overcome such barriers Simpson et al. [18] examined institutional-level facilitators of patient-centered care and care coordination across multiple high-performing U.S. organizations. They found that these organizations shared four key foci: i.) the institutional promotion of patient-centered care and care coordination; ii.) the optimization of IT infrastructure to enhance performance and communication; iii.) the development of accountable reimbursement and incentivization structures; and iv.) the formation of organizing bodies dedicated to implementation support.

Barriers and facilitators of care coordination occur not only on the structural level, but also on that of processes. Williams et al. [17] found that fragmentation of systems and communication among healthcare providers severely hampered care coordination. In an international review seeking enhancing factors for care coordination, Morgan et al. [19] identified frequent opportunities for effective, informal joint communication as a key factor for successful interprofessional collaborative practice in primary care teams. They also found that multiple channels of repeated (often brief) informal joint communication were necessary to create shared knowledge, develop common goals, and make shared clinical decisions. They further noted that, combined with convenient physical space and "frequent short periods [working] together" were important factors. In another review, Albertson et al. [1] found that three coordination facilitators were present in the majority of the reviewed coordination programs: "in-person communication with patients to coordinate care; systematic assessment of patient needs to inform subsequent care plans and interventions; and the creation of standard protocols to guide care coordination processes" (p. 80). However, despite evidence that various structural- and process-level factors improve or hinder care coordination, we do not know how these factors are related, or which produce the most pronounced effects on coordination. In addition, no information at all is available on homecare coordination processes and structures. As effective care coordination can improve the quality of care as well as other outcomes, it is important to explore which factors influence successful care coordination.

Recognizing these gaps, this study aimed to explore how, in addition to homecare agency characteristics, external factors (i.e., financial and regulatory mechanisms) are related to coordination in homecare. From this aim, guided by the COORA (care coordination) framework [11], we formulated the following three hypotheses:

1) that external factors (financial and regulatory mechanisms) are related to coordination;
2) that homecare agency characteristics (i.e., work environment, workforce, and client characteristics) are related to coordination; and
3) that coordination processes (including both explicit and implicit coordination mechanisms) are related to coordination.

Methods

Study design

This analysis is part of the SPOT^{nat} (quality and coordination in homecare) study, a national multicenter, cross-sectional study in the Swiss homecare setting. Detailed information on the SPOT^{nat} study can be found in the study protocol [20].

Setting and sample

The SPOT^{nat} study included a random sample of Swiss homecare agencies. These were stratified by which of the country's seven major geographic regions they occupied, and by profit status. To be eligible for inclusion, each had to employ at least ten salaried employees. For small and mid-sized agencies (10 – 99 employees), full samples of homecare workers were included. To reduce the study burden regarding large agencies (>100 employees), we used random samples of 100 employees. Further details on the setting and sample, as well as the sample size calculations, can be found in the SPOT^{nat} study protocol [20]. For this sub-analysis, we included all homecare workers who (1) reported that their scope of practice included interprofessional exchanges, (2) had worked in the participating agency for at least three months, (3) worked in direct or indirect client care, (4) were at least 18 years of age and (5) were able to read and understand German, French or Italian.

Data sources

Data were collected between January and September 2021 through investigator-developed employee and agency questionnaires completed by homecare workers and management. Each agency had three months to complete the data collection and was free to choose the start date during this period to distribute the paper questionnaire to their employees. The employees were given six weeks to fill out the questionnaire, which was accompanied by a stamped return envelope addressed to the research institute. Questionnaires were code-numbered to match them to the participating agencies, but not to individual participants.

Variables and measurements

The adapted COORA framework served as a basis for the modeling of our variables and guided our assessments of the various care coordination components on the structural, process and outcome levels. An overview of the measured variables, i.e., external factors, agency characteristics, coordination processes and coordination outcome variables can be found in Table 1.

Dependent variable (Outcome)

We measured *coordination* from the homecare employee perspective using eight investigator-developed items (see Table 1 for details). Of these, two were expressed positively and six negatively. The negative items were reverse-coded. All items were rated on a fully-anchored 5-point Likert scale ranging from "never/almost never" to "very often" (respectively 0-4), with higher values indicating better coordination, i.e., reflecting fewer coordination problems. After checking the scale's unidimensionality with principle axis factoring [21], we calculated a total score as a mean across all items. The Cronbach's α value for our sample was 0.81 and principal axis factoring showed a shared variance of 38%

with item loadings between 0.32 and 0.83 [22]; however, the model fit was rather low (cf. Table 1).

Independent variables

Using two agency questionnaire items formulated to assess *external factors,* we measured two homecare financial and regulatory mechanisms: 1) The reimbursement regulations relevant to the residual financing (costs that are covered by the public authorities) and 2) the regulation of client copayments.

Homecare agency characteristics were assessed via agency and employee questionnaires. We assessed the presence of service obligations, the client characteristics, the range of services provided, the workforce structure, the employee characteristics and the work environment, as well as resources and time allocation.

For *homecare agency coordination processes,* we assessed both explicit and implicit coordination mechanisms in the domains of programming, communication and cognition.

Latent variable construction. We first created scores and indices for the latent variables to be evaluated on the framework's process level (i.e., explicit and implicit coordination mechanisms). Based on the content and the available items, we differentiated between formative and reflective indicators from a measurement perspective: indicators are either reflective, i.e., they are caused by the latent variable or formative, i.e., they cause the latent variable [23-25]. For the reflective latent variables, namely "communication and information exchange," "knowledge of the health system," "role clarity," "mutual respect and trust," "accountability, predictability and common understanding," as well as "coordination," we conducted confirmatory factor analyses using the R "lavaan" package [26]. We evaluated the model fit with a chi-square test, standardized root mean square residual (SRMR), Bentler Comparative Fit Index (CFI) and Normed Fit Index (NFI) (Table 1). As an indication of a good model fit, we expected non-significant chi-square test results with an α- level (for significance) set at .05, an SRMR value below .05, a CFI greater than 0.95 and NFI values greater than 0.90 [27]. In addition, we calculated the Cronbach's alpha for all scales used to check internal consistency [22]. If model fit was acceptable for the reflective latent variables, we applied a second step: we calculated the mean scores, which we then used as independent variable values for the regression analysis.

For the formative latent variables, we calculated a variable score (i.e., an index) as sums of their indicators. For the measurement model assessment of these indices, we calculated the variance inflation factor (VIF) using the R "car" package [28] to check for indicator collinearity. All showed acceptable results with values ≤ 3 [29] (Table 1). In our model, all formative latent variables, i.e., "presence of standards / guidelines for selected procedures,"

"possibility for continuous education," "electronic data sharing possibilities," "homecare team leaders/ case managers," and "exchange vessels," were measured on the agency level.
A detailed description of all the independent variables assessed can be found in Table 1.

Demographic characteristics

For homecare agencies, we assessed the size (number of full-time equivalent employees), number of clients and hours of care provided in 2020, profit status (non-profit, for-profit), catchment area (rural, suburban, urban) and the language region (German, French, Italian) in which each agency operates.
For the employees, we assessed age, gender (male, female, non-binary), employment percentage, years of experience in the current homecare agency, and educational background. We divided these data into two groups: 1) registered nurses (RNs), holding a Master's or Bachelor's degree or at least a 3-year education with a diploma; and 2) nursing and care staff with lower levels of nursing education, i.e., licensed practical nurses, certified nurse assistants or nurse aides. This group also included administrative staff, other care professionals, staff with client contact, and students/trainees.

Table 1. Description of the independent and dependent variables

Variable	Measurement level (source of variable)	Item(s) used	Answer options/categories	Variable type / Building of scale and interpretation
Dependent variable				
Coordination				
Employee-perceived coordination	Employee questionnaire (investigator-developed)	8 items assessing how often in general: 1) relevant information is reported in a timely manner by other professionals, 2) client care activities are well aligned with other professionals, 3) there are duplicate and overlapping activities with other professionals, 4) no or no current prescriptions/ medication/ medication lists are available, 5) not all or not the right medications are available at a client's home, 6) no one from the homecare team was involved at the discharge from an inpatient stay, 7) homecare employees do not feel sufficiently informed about a client's condition (e.g., information is not available, only partially documented) 8) homecare employees receive important information about the client too late.	5-point Likert scale: 0 = never/almost never, 1 = rarely, 2 = sometimes, 3 = often 4= very often for each item	Mean score over the 8 items: Cronbach's α: 0.81 p-value χ^2: 0.00 SRMR: 0.05 CFI: 0.86 NFI: 0.82 Higher values mean higher or better coordination, reflecting less coordination problems
Independent variables				
Explicit coordination mechanisms				
Presence of standards / guidelines for selected procedures	Agency questionnaire (investigator-developed)	5 items asking if guidelines and/or standard operating procedures (SOPs) are available for the following topics: Introduction of new employees Admission of a client to homecare Hospital admissions Emergency situations Medication management	Dichotomous answer option: Yes/No for each item	Sum score over the 5 items: ranging from 0 = no SOPs at all to 5= to all 5 topics an SOP Range VIF: 1.0 - 2.2 Higher values mean more standard operating procedures (SOP) are available

Variable	Measurement level (source of variable)	Item(s) used	Answer options/categories	Variable type / Building of scale and interpretation
Electronic data sharing possibilities	Agency questionnaire (investigator-developed)	1 item asking if electronic client documentation allows for electronic data exchange of health records with physicians	Dichotomous answer option: Yes/No	Used as dichotomous single item
Case responsible person/managers	Agency questionnaire (investigator-developed)	3 items asking about the allocation of specific case responsibilities and case managers: 1) If the agency works with defined reference nurses that perform all nursing activities from admission to discharge or with a defined reference nurse who is responsible for the entire nursing process for a specific client 2) If the agency works with assignment of case responsible nurses 3) If the agency has trained case managers or care managers	Dichotomous answer option: Yes/No for each item	Sum score over the 3 items: ranging from 0 = no case responsibilities at all to 3 = strong emphasis on case management/responsibilities Range VIF: 1.0 - 1.2 Higher values mean better established reference person system
Exchange vessels	Agency questionnaire (investigator-developed)	3 items assessing if the agency has established vessels for regular exchange: 1) If the agency conducts planned case discussions for complex clients within the homecare team 2) If the agency conducts planned interprofessional/interdisciplinary case discussions for complex clients 3) If handover reports for internal client information exchange are conducted by employees	Dichotomous answer option: Yes/No for each item	Sum score over the 3 items: ranging from 0 = no regularly exchange vessels at all to 3 = all three exchange vessels in place Range VIF: 1.0 - 1.2 Higher values mean higher number of regularly used exchange vessels in place
Communication	Employee questionnaire (adapted from the CPAT [30])	4 items of the CPAT scale assessing communication and information exchange: 1) Assessing if relevant information relating to changes in patient/client status or care plan is reported to the appropriate team member in a timely manner. Assessing if clients' concerns are addressed effectively through regular team meetings and discussion. Assessing if the team has developed effective communication strategies to share patient/client treatment goals and outcomes of care. Assessing if the patient/client health record is used effectively by all team members as a communication tool.	7-point Likert scale: 1= disagree, 2 = mostly disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = mostly agree, 7 = strongly agree for each item	Mean score over the 4 items Cronbach's α: 0.83 p-value χ^2: 0.00 SRMR: 0.01 CFI: 0.99 NFI: 0.98 The higher the values, the higher the agreement and the better the perceived communication and information exchange

Variable	Measurement level (source of variable)	Item(s) used	Answer options/categories	Variable type / Building of scale and interpretation
Implicit coordination mechanisms				
Knowledge of the health system	Employee questionnaire (investigator-developed and adapted from IBenC [31])	4 items addressing how well homecare employees know the healthcare services in their care catchment area: 1) Available health or social service options 2) Requirements that clients must meet in order to take advantage of the services offered 3) The area of responsibility of the other professionals/healthcare providers 4) Legal requirements regarding financing of healthcare services	Each item 5-point Likert scale answer options: 5 = Very good, 4 = good, 3 = moderate, 2 = little, 1 = not at all	Mean score over the 4 items Cronbach's α: 0.86 p-value χ^2: 0.976 SRMR: 0.001 CFI: 1.00 NFI: 1.00 The higher the values, the better employees rated their own knowledge of the health system
Possibility for continuous education	Agency questionnaire (investigator-developed)	3 items asking about which topics homecare agencies offer annual training for their employees (internal/external) 1) Interprofessionality and/or coordination 2) Health networks (local partners, offerings in catchment area) 3) Legal requirements and regulations in homecare	Each item Dichotomous answer option: Yes/No	Sum score over the 3 items: ranging from 0 = no annual training possibilities to 3= in all three domains annual training possibilities Range VIF: 1.0 - 1.1 The higher score meaning a higher number of training courses offered in relation to coordination
Role clarity	Employee questionnaire(COPSOQ [32, 33])	2 items of the COPSOQ asking about role clarity 1) are there clear objectives for your work? 2) do you know exactly which tasks fall within your area of responsibility?	5-point Likert scale: 4= to a very high degree, 3 = to a high degree, 2 = in part, 1 = to a low degree, 0 = to a very low degree for each item	Mean score over the 2 items Cronbach's α: 0.70 The higher the values, the better role clarity is rated
Mutual respect & trust	Employee questionnaire (adapted from the CPAT [30])	2 items from the CPAT assessing mutual respect and trust 1) If employees trust the accuracy of information reported among team members. 2) If team meetings provide an open, comfortable, safe place to discuss concerns.	7-point Likert scale: 1= disagree, 2 = mostly disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = mostly agree, 7 = strongly agree for each item	Mean score over the 2 items Cronbach's α: 0.56 The higher the values, the higher the mutual respect/trust and integrating conditions are rated

Variable	Measurement level (source of variable)	Item(s) used	Answer options/categories	Variable type / Building of scale and interpretation
Accountability, predictability, common perspective	Employee questionnaire (adapted from the three Integrating Conditions scale [34])	4 items from the integrating condition scale assessing accountability, predictability and common perspective 1) If it is clear which members in your care team are responsible for completion of specific tasks. (accountability) 2) If in general the care team knows the steps necessary to address complicated situations when they arise (predictability) 3) If each member of the care team understands the steps required to complete their tasks. (predictability) 4) If the care team has a shared perspective of how each person's work contributes to the overall goal (common perspective)	5-point Likert scale: 1 = strongly disagree, 2 = slightly disagree, 3 = neutral, 4 = slightly agree, 5 = strongly agree for each item	Mean score over the 4 items Cronbach's α: 0.85 p-value χ^2: 0.00 SRMR: 0.02 CFI: 0.98 NFI: 0.94 The higher the values, the higher the accountability, predictability and common perspective rated
Homecare agency characteristics				
Service obligation	Agency questionnaire (adapted from Trageser et al. [35])	1 item asking if the service agreement with the canton/municipalities includes a service obligation	Dichotomous answer option: Yes/No	Used as dichotomous single item
Client characteristics	Agency questionnaire (adapted from Trageser et al. [35])	1 item assessing the average care duration per client in 2020	Numeric answer option: average minutes per client	Used as numeric single item
Range of services provided	Agency questionnaire (adapted from SHURP [36])	5 items assessing if specific service offers are provided by the homecare agencies: 1) 24-hours care service, 2) Continuous night care, 3) Oncological care, 4) Palliative care, 5) Psychiatric care	Dichotomous answer options for items 1-5: Yes/No	Used as 5 dichotomous single items
Workforce	Agency questionnaire (adapted from SHURP [36])	1 item asking about the total employment percentage of the employees in the nursing and care sector at the end of the year 2020.	Numeric answer options: Working percentages of employees according to educational background Proportion of RN (or higher educated) employment percentage compared to all employees in the nursing and care sector of the agency	Used as numeric single item. A higher value represents a higher proportion of RN employment percentage over all employees

Variable	**Measurement level (source of variable)**	**Item(s) used**	**Answer options/categories**	**Variable type / Building of scale and interpretation**
Employee characteristics	Employee questionnaire (adapted from SHURP [36])	1 item asking homecare employees about the working percentages (percentage of full-time employment)	Numeric answer option: Employment percentage	Used as numeric single item Higher values meaning higher working percentage
	Employee questionnaire (adapted from SHURP [36])	1 item asking homecare employees about the years of experience in the homecare agency	Numeric answer option: years of experience	Used as numeric single item Higher values meaning more years of experience in the homecare agency
Perceived staffing	Employee questionnaire (PES-NWI [37, 38])	3 items of the staffing and resource adequacy subscale of PES-NWI	4-point Likert scale: 1= strongly disagree, 2 = slightly disagree, 3 = slightly agree, 4 = strongly agree for each item	Mean score over the 3 items Cronbach's alpha 0.65 Higher values indicating better staffing and resource adequacy
Perceived workload	Employee questionnaire (NASA task-load Index [39, 40])	6 items of the NASA task-load Index	Each item 20-point analog scale answer options: low to high	Mean score over the 6 items Cronbach's alpha 0.61 Higher values indicating higher perceived workload
Overtime	Employee questionnaire (adapted from RN4CAST [41] and SHURP [36])	1 item asking homecare employees how often they have to work overtime more than 30 minutes	5-point Likert scale answer option: 4= Almost every shift, 3= once every 2-4 working days, 2= once every 5-7 working days, 1= less frequently, 0 = never	Used as ordinal single item Higher values indicating more working days with overtime
External factors				
Reimbursement regulations of residual financing	Agency questionnaire (investigator-developed)	1 item asking on what basis the canton or municipality determined the residual financing of care costs for their agency.	Answers grouped in 4 categories: 1) Compensation of the effective full costs Compensation of agency-specific and predefined costs Use of standard costs, standard deficits, or maximum limits others (e.g., compensation via a global budget)	Used as categorical single item

Variable	**Measurement level (source of variable)**	**Item(s) used**	**Answer options/categories**	**Variable type / Building of scale and interpretation**
Client copayment	Agency questionnaire (investigator-developed)	1 item asking how the amount of the patient copayment is regulated in their canton	Answer grouped in 4 categories: 1) No patient copayment (no payment from the client side) 2) Patient copaymentof a maximum of CHF 7.65 a day, which means that the increase can be up to 20% of the health insurance (HI) contribution or direct payment but is limited to CHF 7.65/day 3) Up to 20% of the HI contribution and upper limit of CHF 15.35/day 4) Direct contribution up to the upper limit of a maximum of CHF 15.35/day	Used as categorical single item

Note. CFI = Bentler Comparative Fit Index, COPSOQ = Copenhagen Psychosocial Questionnaire, CPAT = Collaborative practice assessment tool, HI = health insurance, IBenC = Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care, NFI = Normed Fit Index, PES-NWI = Practice Environment Scale of the Nursing Work Index, RN = Registered Nurse, RN4CAST = Nurse forecasting in Europe study, SHURP = Swiss Nursing Homes Human Resources Project, SOP = standard operating procedure, SRMR = Standardized Root Mean Square Residual, VIF = Variance Inflation Factor

Data analysis

Descriptive statistics were performed to check data distribution, ceiling or floor effects, as well as outliers and missing values for all variables used within the analysis. Descriptive results include frequencies and percentages (%) for categorical variables, as well as means (m) and standard deviations (SDs) for continuous variables.

To explore the relationships between external factors, homecare agency characteristics (structures and processes) and the degree of coordination achieved, we conducted multilevel regression analyses with the R "lme4" package [42]. To run the models, we disaggregated the agency level data to the employee level, meaning each employee was assigned a corresponding agency value. Because the theoretical framework suggests that variables are positioned in a causal chain (with possible mediation effects), the analysis involved multiple steps. In each step, the agencies were included as random intercepts in a multilevel model. This was necessary to adjust for covariance structures within the nested design, since the intraclass correlation (ICC(1) = 0.10; CI: 0.06; 0.16) indicated inter-agency dependencies [43].

A sequential inclusion process to test several multilevel regression models was conducted. First, we modeled coordination (dependent variable) using the coordination process variables (independent) through a multilevel regression. Second, agency characteristics were added as additional independent variables to the model. Finally, we added the external factors.

If mediation of more distal variables through proximal variables occur, this should become visible by the fact that collinearity appears in later steps, meaning that (part of) the relationship of possible significant coordination process variables with coordination were explained [44]. Therefore, we compared the models to detect mediator effects of the agency characteristics and external factors on coordination and ran post-hoc regression analysis with the dependent agency characteristics and external factors variables as independent to explore possible collinearities and to make sure existing relationships were not masked by entering variables on a similar causal path to the outcome variable (c.f. Appendix A). We also calculated VIFs for all models.

Furthermore, we used the Nakagawa's R^2 with the R "performance" package to evaluate the explanatory power of the models [45]. While the marginal R^2 takes the variance of only the fixed effects into account, the conditional R^2 takes both fixed and random effects into account [46].

The results of the regression models are presented in the coefficient estimates (β) alongside their 95% confidence intervals (CIs). For this analysis we only included complete cases; therefore, missing data sets were deleted listwise. We conducted a sensitivity analysis by running a regression model with a complete data set with only process variables (implicit and explicit coordination mechanisms). This showed whether missing values changed the model's conclusion (Appendix B). Data analyses were conducted with the R 4.2.1 software [47].

Results

A total of 3223 employees (response rate: 73.6%) of the 88 participating homecare agencies completed the questionnaire. After applying the inclusion criteria for this analysis, only the 1784 employees who stated that exchanges with other professions fell within their scope of practice remained in the sample. A median of 13 employees per agency participated (interquartile range: 7 – 27 participants). After removing incomplete answer sets for the regression analyses, a final sample size of 1450 employees of 71 homecare agencies remained for the statistical analyses. The exclusion of 17 homecare agencies was due to missing values in "agency characteristics" and "external factors" (compare with Table 3). However, the sensitivity analysis, which included all 88 agencies, did not change the conclusion.

Descriptive sample characteristics

Participating homecare agencies were predominantly non-profit (70.5%) and based in the German-speaking part of Switzerland (76.1%). They employed a mean of 45.6 full time equivalents (FTEs) (range: 4.7 – 318.0 FTEs). The mean employment percentage of the participating homecare workers was 70% (range: 5 – 100%). Participating employees were mostly female (91.9%) and an average of 44.6 years old (range: 18 – 76 years). The majority (58.3%) were RNs with nursing diplomas or higher degrees (3.0%). Table 2 shows the sample characteristics.

Description of the dependent and independent variables

The participating employees rated their perceived coordination with a mean value of 2.5 on a scale from 0-4, i.e., above average. Just over two-thirds (67.6%) indicated that they are often or very often in possession of relevant information from other professionals at the right time. However, 14.5% reported that important information about clients was (very) often received too late. And while 66.9% stated that care activities are (very) often well-aligned between professionals and 12.3 % stated that duplicate or overlapping activities happen (almost) never, 8.1% reported duplicate or overlapping activities happening (very) often. Regarding client discharges from inpatient stays, 22.5% of respondents reported that (very) often no one from the homecare team was involved in the discharge process.

As for the independent variables, the participating employees allocated above-average values for their communication and information exchanges (m=4.8, SD=1.3; scale 1-7) and knowledge of the health system (m=3.7, SD=0.8; scale 1-5), the clarity of their roles (m=3.0, SD=0.7; scale 0-4), mutual respect and trust (m=5.3, SD=1.1; scale 1-7), and accountability/predictability/common perspective (m=3.8, SD=0.7; scale 1-5).

Of the 88 agencies represented, 79 worked with three or more SOPs and 29 had SOPs for all five assessed processes. Only six did not delegate case responsibilities, whereas fifteen allocated some case-administration responsibilities to nurses and trained other staff as case managers or care managers. Considering exchange vessels, over half of the agencies (49) worked with handover reports, with the majority (79) conducting case discussions for complex clients within the homecare team. On the other hand, 51 agencies did not offer annual training for their employees on the three assessed topics (interprofessional collaboration and/or coordination, health networks, and legal requirements & regulations in homecare). Further descriptive characteristics of the dependent and independent variables are shown in Table 2.

Table 2. Descriptive characteristics of the sample and the dependent and independent variables

Variables	**n (%)**	**Mean (SD)**	**missing n (%)**
Homecare agencies	**88**		
Status			0
non-profit	62 (70.5)		
for-profit	26 (29.5)		
Catchment area			0
rural	39 (44.3)		
suburban	32 (36.4)		
urban	17 (19.3)		
Language region			0
German	67 (76.1)		
French	14 (15.9)		
Italian	7 (8.0)		
Size			
Number of full-time equivalents (FTE)		45.6 (57.5)	0
Total number of clients in 2020		557.2 (734.7)	3 (3.4)
Hours of care provided in 2020		41404 (42582.3)	2 (2.3)
Independent variables measured on agency level			
Coordination Process			
Explicit coordination mechanism:			
Programming			
Presence of standards / guidelines (index 0-5)		3.8 (1.2)	0
Case responsible/managers (index 0-3)		1.9 (0.8)	
Exchange vessels (index 0-3)		2.5 ()	
Electronic data sharing possibilities with physicians (yes)	22 (25.0)		0
Implicit coordination mechanism:			
Cognition			

Variables	**n (%)**	**Mean (SD)**	**missing n (%)**
Possibility for continuous education (index 0-3)		0.7 (0.9)	
Agency characteristics			
Service obligation (yes)	58 (65.9)		0
Range of service			
Palliative Care (yes)	64 (72.7)		0
Oncology care (yes)	18 (20.5)		0
Psychiatric care (yes)	59 (67.0)		0
24 hours care service (yes)	26 (29.5)		0
Continuous night care (yes)	28 (31.8)		0
Average hours of care billed per client in 2020		83.0 (62.3)	4 (4.5)
Workforce			
Percentage of RNs or higher educational background		29.7 (13.8)	9 (10.2)
External factors			
Financial regulatory mechanisms			
Reimbursement regulations of residual financing			7 (8.0)
Effective full costs	22 (27.2)		
Agency-specific and predefined costs	27 (33.3)		
Standard costs, standard deficits, or maximum limits	29 (35.8)		
others (e.g., compensation via a global budget)	3 (3.4)		
Client copayment			0
No patient copayment		18 (20.5)	
Copayment of a maximum of CHF 7.65 a day		34 (38.6)	
Up to 20% of the HI contribution and upper limit of CHF 15.35/day		29 (33.0)	
Direct contribution up to the upper limit of a maximum of CHF 15.35/day		7 (8.0)	
Employees	**1784**		
Age		44.6 (12.1)	58 (3.3)
Gender			16 (0.9)
Female	1625 (91.9)		
Male	140 (7.9)		
Non-binary	3 (0.2)		
Educational background			13 (0.7)
RNs with a Master or Bachelor degree or at least a 3-year education with diploma	1085 (61.3)		
Nursing and care staff with lower education in the nursing field	686 (38.7)		
Language region			0
German	1148 (64.3)		
French	549 (30.8)		
Italian	87 (4.9)		
Independent variables measured on employee level			
Coordination Process			
Explicit coordination mechanism:			
Communication			

Variables	n (%)	Mean (SD)	missing n (%)
Communication and information exchange (scale 1-7)		4.8 (1.3)	6 (0.3)
Implicit coordination mechanism:			
Cognition			
Knowledge of the health system (scale 1-5)		3.7 (0.8)	14 (0.8)
Role clarity (scale 0-4)		3.0 (0.7)	8 (0.4)
Mutual respect and trust (scale 1-7)		5.3 (1.1)	6 (0.3)
Accountability, predictability, common perspective (scale 1-5)		3.8 (0.7)	4 (0.2)
Agency characteristics			
Employment percentage (%)		70.0 (21.3)	31 (1.7)
Experience in agency (in years)		6.5 (6.7)	89 (5.0)
Perceived staffing (scale 1-4)		2.9 (0.7)	21 (1.2)
Perceived workload (scale 1-20)		10.8 (2.7)	6 (0.3)
Overtime (single item 0-4)		0.74 (0.44)	25 (1.4)
At least once a week	1299 (73.8)		
Dependent variable measured on employee level			
Employee-perceived coordination (scale 0-4)		2.52 (0.61)	7 (<0.01)

Note. CHF = Swiss Francs, FTE = full-time equivalent posts, HI = health insurance, RN = Registered nurse, SD= Standard Deviation

Associations between external factors, agency characteristics, the coordination process and coordination

The results of the final analysis, which tested the full regression model (step 3 of the model), showed several significant positive associations. Five coordination mechanisms, one of which was explicit—"communication and information exchange" (β = 0.10, p < .001)—and the rest implicit—"knowledge of the health system" (β = -0.07, p < .01), "role clarity" (β = 0.07, p < .001), "mutual respect and trust" (β = 0.07, p < .001), and "accountability, predictability, common perspective" (β = 0.19, p < .001)—correlated with employee-perceived coordination. Regarding agency characteristics, only three variables—"perceived staffing" (β = -0.06, p < .05), "perceived workload" (β = -0.02, p < .01) and "overtime" (β = -0.05, p < .001)—reached statistical significance, while none of the external factors did. "Knowledge of the health system," "perceived workload," "perceived staffing" and "overtime" only showed very weak associations. The R^2 indicated that the final model explained around 37% of the variance in employee-perceived coordination data by the predictor variable(s). For details of the regression results, see Table 3.

Results in Appendix A suggested that agency characteristics and external factors may to a certain degree be mediated through coordination processes. Staffing, workload and overtime were significant in both models but lost half the strength of association when the process variables were added to the model. Two variables lost their significance after adding the process variables, namely the variable service obligation and the average hours of care per client. The R^2 values of both models, the ones with and without external factors, are nearly the same, hence the full model does not explain the data better than without including external factors as predictor. The sensitivity analysis did not change the conclusion of the model (Appendix B).

Table 3. Results of the different regression analysis with employee-perceived coordination (employees n= 1450; agencies n = 71)

	Coordination regressed only with coordination process variables	Coordination regressed with coordination process & agency characteristic variables	Coordination regressed with coordination process agency characteristic & external factors variables
	β [95% CI]	β [95% CI]	β [95% CI]
Coordination Process			
Explicit coordination mechanism (Programming & Communication)			
Presence of standards / guidelines	0.00 [-0.03; 0.03]	0.01 [-0.03; 0.04]	0.01 [-0.02; 0.04]
Case responsible/managers	-0.03 [-0.09; 0.02]	-0.01 [-0.07; 0.05]	0.00 [-0.06; 0.05]
Exchange vessels	-0.03 [-0.09; 0.02]	-0.03 [-0.08; 0.02]	-0.03 [-0.09; 0.02]
Electronic data sharing with physicians: yes	0.04 [-0.04; 0.12]	0.03 [-0.06; 0.11]	0.03 [-0.06; 0.10]
Communication and information exchange	0.11*** [0.07; 0.14]	0.10*** [0.06; 0.13]	0.10*** [0.06; 0.13]
Implicit coordination mechanism (Cognition)			
Knowledge of the health system	-0.09*** [-0.12; -0.05]	-0.07*** [-0.10; -0.03]	-0.07** [-0.10; -0.03]
Possibility for continuous education	-0.03 [-0.07; 0.01]	-0.02 [-0.05; 0.02]	-0.01 [-0.05; 0.03]
Role clarity	0.10*** [0.06; 0.14]	0.08*** [0.03; 0.11]	0.07*** [0.03; 0.11]
Mutual respect and trust	0.08*** [0.04; 0.12]	0.07*** [0.03; 0.11]	0.07*** [0.03; 0.11]
Accountability, predictability, common perspective	0.21*** [0.17; 0.26]	0.19*** [0.15; 0.24]	0.19*** [0.14; 0.24]
Agency characteristics			
Service obligation (yes)		-0.14* [-0.26; -0.02]	-0.14 [-0.31; -0.02]
Range of service			
Palliative Care (yes)		-0.02 [-0.15; 0.05]	-0.02 [-0.11; 0.09]
Oncological care (yes)		-0.01 [-0.09; 0.08]	0.00 [-0.07; 0.09]
Psychiatric care (yes)		0.03 [-0.10; 0.16]	0.04 [-0.09; 0.16]
24-hours care service (yes)		0.04 [-0.07; 0.15]	0.04 [-0.09; 0.13]
Continuous night care (yes)		-0.09 [-0.21; 0.03]	-0.05 [-0.16; 0.05]
Percentage of RNs		0.00 [0.01; 0.00]	0.00 [-0.01; 0.00]
Employment percentage		0.00 [0.00; 0.00]	0.00 [0.00; 0.00]
Experience in agency		0.00 [-0.01; 0.00]	0.00 [-0.00; 0.00]
Perceived staffing		0.05* [0.01; 0.10]	0.06* [0.01; 0.10]
Perceived workload		-0.01** [-0.03; 0.00]	-0.02** [-0.03; -0.01]
Overtime		-0.05*** [-0.08; -0.03]	-0.05*** [-0.07; -0.02]
External factors			
Reimbursement regulations of residual payments (reference: effective full costs)			
agency-specific and predefined costs			0.10 [-0.01; 0.18]
standard costs			-0.04 [-0.17; 0.07]
others			-0.00 [-0.22; 0.23]

	Coordination regressed only with coordination process variables	Coordination regressed with coordination process & agency characteristic variables	Coordination regressed with coordination process agency characteristic & external factors variables
	β [95% CI]	β [95% CI]	β [95% CI]
Client copayment (reference: No copayment)			
maximum of CHF 7.65 a day			-0.06 [-0.18; 0.03]
up to 20% of HI, with max CHF 15.35/d			-0.08 [-0.20; 0.03]
direct with max. of CHF 15.35/d			-0.05 [-0.17; 0.09]
Average hours of care per client			0.00 [0.00; 0.00]
Second level variable			
Homecare agencies			
Agency level (Variance [SD])	0.01 [0.11]	0.01 [0.11]	0.01 [0.10]
Residuals (Variance [SD])	0.24 [0.48]	0.22 [0.47]	0.23 [0.48]
Effect size			
AIC	2143.98	2183.22	2222.33
Marginal R^2	0.328	0.363	0.367
Conditional R^2	0.359	0.395	0.395

Note. AIC = Akaike Information Criterion, CHF = Swiss Francs, CI = Confidence Interval, HI = health insurance, RN = Registered nurse, SD= Standard Deviation,
α levels of significance = *p < .05, **p < .01, ***p < .001, β = coefficient estimate

Discussion

The aim of this study was to explore how, regarding homecare agencies, both external factors and internal structures and processes are related to care coordination. On the process level, in line with our third hypothesis, we found that communication, role clarity, mutual respect and trust, as well as accountability, predictability, and common perspective, correlate positively with employee-perceived care coordination. While the correlation was relatively weak, the employees' knowledge of the health system correlated negatively with employee-perceived care coordination. I.e., better healthcare system knowledge was associated with lower perceived care coordination ratings. One possible explanation is that respondents with more healthcare system knowledge recognized more coordination shortfalls, leading to more critical appraisals. Whatever the reason, the importance of knowing and working with the healthcare system to connect patients with the care they need has been reported by previous studies [48, 49]: this correlation cannot be ignored.

On the structural level, we found that overtime and higher perceived workload correlated negatively and higher perceived staffing correlated positively with employee-perceived care coordination. While these correlations supported our second hypothesis, they were marginal. We did not confirm our first hypothesis, i.e., the evidence does not indicate relationships between external factors and coordination.

One major finding of this study is that, while almost all implicit mechanisms were significantly associated with perceived care coordination, explicit mechanisms other than communication were not. Admittedly, this finding might be biased by the level at which the relevant assessments were made. Whereas all significant correlations were measured on the employee level, all insignificant mechanisms were measured on the agency level. Given that only 71 agencies were included in the analysis, the smaller sample's variability may have been inadequate to detect statistical differences. On the other hand, the finding might indicate that, alongside the explicit mechanism of communication, implicit mechanisms are the most influential ones in view of successful coordination.

As for explicit coordination mechanisms, the importance of communication and information exchange has been confirmed in previous studies. Qualitative research has identified it as a key factor for successful coordination [18, 50-53]. Mohr et al. [54] highlighted the value of inter-team communication in caring for complex clients. In our study group, considering that almost one-quarter of homecare workers reported that often no one from the homecare team was involved in the discharge process of a client from an inpatient stay, and over one-tenth reported often receiving important information too late, there is considerable room for improvement.

To the best of our knowledge, this is the first study to examine implicit coordination mechanisms in the homecare setting. Its results will support previous qualitative indications that implicit mechanisms, e.g., role clarity [52, 55], mutual respect and trust [17, 56] and accountability, as well as a common perspective [18, 52], contribute essentially to successful coordination. Gittell [57], who developed the concept of relational coordination, indicated that the explicit mechanism of communication (i.e., frequent, timely, accurate and problem-solving communication), and the implicit mechanisms tied to relationships (i.e., shared goals, shared knowledge, and mutual respect) are essential elements of coordination. Gittell's concept of relational coordination does not distinguish between coordination as a process and as an outcome; still, as it focuses on interpersonal relationships, we can support the conclusion that the above-named mechanisms of communication and relationships are positively associated with improved coordination not only in hospitals [58] but also in homecare. In addition, relational coordination has been linked to improved quality outcomes regarding, e.g., nursing care goals [59], better chronic care delivery [60], better patient perception of care [61] and higher patient satisfaction [62]. In addition, Cramm et al. [63] reported both that comprehensive care delivery demands strong connections between all involved health and social care professionals and that homecare nurses play an important role in strengthening those connections. Here, opportunities for face-to-face discussions in homecare—whether at conferences or workshops—can foster good relationships among colleagues [64].

At the agencies' structural level, we observed that key work environment factors—staffing, workload and overtime—were related to care coordination. This adds to the existing literature, where such variables have largely been explored in view of their relationships with quality outcomes in homecare [65-69], but have previously not been assessed in view of care coordination. As appropriate processes appear to mitigate associations between staffing and coordination problems, they likely supporting and maintain coordination even when workload and overtime are high.

None of the external factors we measured correlated with care coordination; however, our model only included two such factors: financial aspects and care hours per client. Building implicit coordination mechanisms is a long-term process [13]. Prerequisites to their formation include the presence of various external factors, e.g., a sufficiently trained workforce and methods of accounting for cross-cutting connections. As these factors are time- and resource-intensive, they may not be implemented voluntarily [6]. However, they certainly warrant further exploration.

This study also served as the first step in empirically testing the COORA framework. By transparently mapping coordination processes and outcomes, COORA illuminates the necessary mechanisms and their effects on coordination outcomes. With this study, we can substantiate the usefulness of the COORA framework, which differentiates clearly between implicit and explicit mechanisms, and, most importantly, between coordination as processes and coordination as an outcome.

Limitations

This study has several notable strengths and limitations. To begin with, its cross-sectional design does not allow causal inferences. Furthermore, homecare settings are very location-specific, i.e., they differ considerably between countries; therefore, our findings' transferability and generalizability are limited to Switzerland. However, the analysis is based on the COORA framework, which is firmly rooted in international literature across diverse research areas. Therefore, the framework and methodology used here are very likely applicable to international healthcare settings. In addition, our data collection took place during the COVID-19 pandemic, which could have influenced employees' perceptions of their work environment, particularly regarding workload and overtime. Further, due to pandemic-related challenges, the targeted homecare agency sample size could not be reached. This reduces the reliability of our results. However, the sample of homecare employees was sufficient for our needs.

In addition, some scales and indices were investigator-developed and had not yet been validated. These included the employee-perceived care coordination scale, which showed insufficient model fit in the CFA, and the "mutual respect and trust" variable, which showed a low Cronbach's alpha; therefore, we cannot be certain that we adequately measured the intended construct. However, our development of the scales used to measure aspects of care coordination was theoretically grounded and built upon previously-used content. In general, as proper measurements have not yet been developed and tested to measure explicit mechanisms of coordination, the items and indices used were based on peer-reviewed results and expert opinion, but had not been validated. This is a weakness.

Biases also present some concern. As the study design did not allow the researchers to control the environment during data collection, social desirability bias cannot be excluded. Similarly, because of the questionnaire design, some recall and common-method bias may have crept in.

Regarding our analyses, it is difficult to judge which increase in the regression coefficients used for the coordination scale are clinically meaningful. Finally, unconsidered factors and confounders may also have influenced our results.

Conclusion

This study's results indicate that, in addition to one explicit coordination mechanism (communication), four implicit coordination mechanisms play significant roles in the process of care coordination: role clarity, mutual respect/trust, accountability/predictability/common perspectives, knowledge of the health system. We recommend that homecare administrators reflect on which coordination mechanisms are strongest and weakest in their contexts. However, they should also be aware that, especially regarding communication and information exchange, achieving high-quality coordination (as an outcome) may require the addition of explicit mechanisms that facilitate these processes. In order to develop successful strategies on how implicit mechanisms and communication could be strengthened, the involvement of the entire care staff is demanded.

Additionally, while the COORA framework provided us with very useful guidance, it requires further testing. Tools to measure the various implicit and explicit mechanisms should also be developed. Furthermore, building a deeper understanding of the coordination process will require an examination of whether explicit mechanisms can be used to build implicit mechanisms.

List of Abbreviations

AIC = Akaike Information Criterion
CFA = Confirmatory Factor Analysis

CFI = Bentler Comparative Fit Index
CHF = Swiss Francs
CI = Confidence Interval
COORA = Care Coordination framework
COPSOQ = Copenhagen Psychosocial Questionnaire
CPAT = Collaborative practice assessment tool
EKNZ = Ethics Committee of Northwestern and Central Switzerland
FTE = Full-time equivalent posts
HI = Health Insurance
IBenC = Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care
ICC = Intraclass Correlation Coefficient
NFI = Normed Fit Index
PES-NWI = Practice Environment Scale of the Nursing Work Index
RN = Registered Nurse
RN4CAST = Nurse forecasting in Europe study
SD = Standard Deviation
SHURP = Swiss Nursing Homes Human Resources Project
SOP = Standard Operating Procedure
SPOT^{nat} = Spitex Koordination und Qualität – eine nationale Studie (homecare coordination and quality - a national study)
SRMR = Standardized Root Mean Square Residual
VIF = Variance Inflation Factor

Declarations

Ethics approval and consent to participate

A declaration of no objection [Req- 2020-00110] was obtained from the Ethics Committee of Northwestern and Central Switzerland (EKNZ), which is the leading ethics committee in the regions involved. Informed written consent was obtained from all participating homecare agencies. The first page of each questionnaire informed the respondent regarding the voluntary nature of participation, data confidentiality, and how to return the completed questionnaires. Returning the completed questionnaire was considered informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to the sensitivity of the data, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

NM conceived and designed the work, analyzed and interpretated data and drafted the manuscript, MS was involved in the conception and design of the work, analysis and interpretation of data, as well as substantial revision. KD and DT contributed substantially in the data analysis and interpretation and substantively revised the manuscript. TM and CM contributed in the conception and design of the work and revised the manuscript. FZ was involved in the conception and design of the work the work, analysis and interpretation of data, drafting of the work as well as substantial revisions.
All of the listed authors have approved the submitted version and agreed both to be personally accountable for their own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even those in which they were not personally involved, are appropriately investigated and resolved, with the resolution documented in the literature.

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Appendix and additional Files

Appendix A. Mediation effect testing

 # if there is a mediation effect, the AE (agency and external) variables will change when we add the mechanism.
 # I.e., we need to run first the model with the AE variables, then the full version, after which we can compare the results.

model_final_ALL_variables					**model_Only_Agency_ External_variables**					**model_Only_Process_variables**				
	beta	**se**	**z**	**p**		**beta**	**se**	**z**	**p**		**beta**	**se**	**z**	**p**
(Intercept)	1.36	0.21	6.32	0.00	(Intercept)	2.48	0.23	11.00	0.00	(Intercept)	0.95	0.15	6.54	0.00
SOPs	0.01	0.02	0.61	0.54						SOPs	0.00	0.02	0.02	0.98
Case responsible/managers	0.00	0.04	-0.03	0.98						Case responsible/managers	-0.03	0.03	-1.11	0.27
Exchange vessels	-0.03	0.03	-1.07	0.28						Exchange vessels	-0.03	0.03	-1.09	0.28
Electronic data sharing with physicians: yes	0.03	0.05	0.50	0.62						Electronic data sharing with physicians: yes	0.04	0.05	0.86	0.39
Communication and information exchange	0.10	0.02	5.72	0.00						Communication and information exchange	0.11	0.02	6.33	0.00
Knowledge of the health system	-0.07	0.02	-3.54	0.00						Knowledge of the health system	-0.09	0.02	-4.83	0.00
Possibility for continuous education	-0.01	0.02	-0.41	0.68						Possibility for continuous education	-0.03	0.02	-1.46	0.14
Role clarity	0.07	0.02	3.59	0.00						Role clarity	0.10	0.02	4.74	0.00
Mutual respect and trust	0.07	0.02	3.57	0.00						Mutual respect and trust	0.08	0.02	3.90	0.00
Accountability, predictability, common perspective	0.19	0.02	7.89	0.00						Accountability, predictability, common perspective	0.21	0.02	8.96	0.00
Service obligation (yes)	-0.14	0.09	-1.55	0.12	Service obligation (yes)	-0.22	0.10	-2.18	0.03					
24-hours care service (yes)	0.04	0.07	0.50	0.62	24-hours care service (yes)	0.05	0.09	0.55	0.58					
Continuous night care (yes)	-0.05	0.07	-0.73	0.46	Continuous night care (yes)	-0.11	0.09	-1.27	0.21					
Oncological care (yes)	0.00	0.06	0.02	0.98	Oncological care (yes)	0.00	0.07	0.03	0.98					
Palliative Care (yes)	-0.02	0.06	-0.41	0.69	Palliative Care (yes)	-0.01	0.07	-0.21	0.84					
Psychiatric care (yes)	0.04	0.07	0.54	0.59	Psychiatric care (yes)	0.09	0.09	1.10	0.27					
Percentage of RNs	0.00	0.00	-1.20	0.23	Percentage of RNs	0.00	0.00	-1.01	0.31					
Employment percentage	0.00	0.00	-1.66	0.10	Employment percentage	0.00	0.00	-1.29	0.20					
Experience in agency	0.00	0.00	-0.27	0.79	Experience in agency	0.00	0.00	0.73	0.47					
Perceived staffing	0.06	0.02	2.55	0.01	Perceived staffing	0.22	0.02	8.83	0.00					
Perceived workload	-0.02	0.01	-2.86	0.00	Perceived workload	-0.02	0.01	-3.60	0.00					
Overtime	-0.05	0.01	-3.85	0.00	Overtime	-0.08	0.01	-5.60	0.00					
Residual payments: agency-specific and predefined costs	0.08	0.06	1.28	0.20	Residual payments: agency-specific and predefined costs	0.11	0.07	1.54	0.12					
Residual payments: standard costs (reference: effective full costs)	-0.03	0.08	-0.43	0.67	Residual payments: standard costs (reference: effective full costs)	-0.01	0.09	-0.15	0.88					
Residual payments: others (reference: effective full costs)	-0.01	0.14	-0.06	0.95	Residual payments: others (reference: effective full costs)	-0.08	0.17	-0.45	0.65					
Client co-payment: maximum of CHF 7.65 a day (reference: No co-payment)	-0.06	0.07	-0.90	0.37	Client co-payment: maximum of CHF 7.65 a day (reference: No co-payment)	-0.07	0.08	-0.89	0.37					
Client co-payment: up to 20% of HI, with max CHF 15.35/d (reference: No co-payment)	-0.08	0.08	-1.09	0.28	Client co-payment: up to 20% of HI, with max CHF 15.35/d (reference: No co-payment)	-0.09	0.09	-1.05	0.29					
Client co-payment: direct with max. of CHF 15.35/d (reference: No co-payment)	-0.05	0.09	-0.59	0.55	Client co-payment: direct with max. of CHF 15.35/d (reference: No co-payment)	-0.05	0.10	-0.45	0.65					
Average hours of care per client	0.00	0.00	1.54	0.12	Average hours of care per client	0.00	0.00	2.40	0.02					

Appendix B. Sensitivity Analysis

We conducted a sensitivity analysis by running the regression model for coordination with coordination process variables on the dataset with complete cases only for these variables. For these variables, the complete data set consisted of n= 88 agencies and n= 1748 employee responses

	Coordination regressed only with coordination process variables (n=1748)
	***β* [95% CI]**
Coordination Process	
Explicit coordination mechanism (Programming & Communication)	
Presence of standards / guidelines	0.00 [-0.03; 0.03]
Case responsible/managers	-0.04 [-0.09; 0.01]
Exchange vessels	-0.02 [-0.07; 0.04]
Electronic data sharing with physicians: yes	0.02 [-0.07; 0.10]
Communication and information exchange	0.12*** [0.09; 0.15]
Implicit coordination mechanism (Cognition)	
Knowledge of the health system	-0.09*** [-0.12; -0.06]
Possibility for continuous education	-0.02 [-0.06; 0.01]
Role clarity	0.10*** [0.06; 0.13]
Mutual respect and trust	0.07*** [0.03; 0.10]
Accountability, predictability, common perspective	0.21*** [0.17; 0.25]
Second level variable	
Homecare agencies	
Agency level (Variance [SD])	0.02 [0.12]
Residuals (Variance [SD])	0.24 [0.49]
Effect size	
AIC	2585.04
Marginal R2	0.331
Conditional R2	0.371

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, SD= Standard Deviation, α levels of significance = *p < .05, **p < .01, ***p < .001, β = coefficient estimate

CHAPTER 6

Care coordination in homecare and its relationship with quality of care: a national multicenter cross-sectional study

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Abstract

Introduction

As healthcare complexity increases, skilled care coordination is becoming increasingly necessary. This is especially true in homecare settings, where services tend to be highly interprofessional. Poor coordination can result in services being provided twice, at the wrong time, unnecessarily or not at all. In addition to risking harm to the client, such confusion leads to unnecessary costs. From the patient's perspective, then, professional coordination should help both to remove barriers limiting quality of care and to minimize costs. To date, though, studies examining the relationship between care coordination and care quality have faced multiple challenges, leading to mixed results. And in homecare contexts, where the clients are highly vulnerable and diverse care interfaces make coordination especially challenging, such studies are rare.

Objectives

Therefore, the aim of this study was to explore the relationship, from the perspectives of clients and of homecare professionals, between coordination and quality of care. For both groups, we hypothesized that better coordination would correlate with higher ratings of quality of care. For the clients, we predicted that higher coordination ratings would lead to lower incidence of unplanned healthcare use, i.e., emergency department (ED) visits, unscheduled urgent medical visits and hospitalizations.

Design and Methods

This study is part of a national multi-center cross-sectional study in the Swiss homecare setting. We recruited 88 homecare agencies and collected data between January and September 2021 through written questionnaires for agencies' managers, employees (n=3223) and clients (n=1509). To test our hypotheses, we conducted multilevel analyses.

Results

Employee-perceived care coordination ratings correlated positively with employee-rated quality of care (OR=2.78, $p<0.001$); client-perceived care coordination problems correlated inversely with client-reported quality of care (β=-0.55, $p<0.001$).

Client-perceived coordination problems also correlated positively with hospitalizations (IRR=1.20, $p<0.05$) and unscheduled urgent medical visits (IRR=1.18, $p<0.05$), but not significantly with ED visits. No associations were discernible between employee-perceived coordination quality and either healthcare service use or client quality-of-care ratings.

Discussion

While results indicate relationships between coordination and diverse aspects of care quality, various coordination gaps (e.g., poor information flow) also became apparent. The measurement of both care coordination and quality of care remains a challenge. Further research should focus on developing and validating a coordination questionnaire that measures care coordination.

Keywords: Coordination, Delivery of Health Care, Health Services Research, Home Care Services, Nursing Administration Research, Patient Care Management, Quality of Health Care

This paper’s contribution

"What is already known"

- Poor care coordination can lead not only to client harm, but also to additional healthcare use and unnecessary costs.
- Care coordination can contribute significantly to quality of care; however, studies so far lack a clear conceptual model and are rare in the homecare setting.

"What this paper adds"

- In accordance with the conceptual model used in this study, results indicate positive correlations between care coordination and care quality.
- Various coordination gaps in homecare came to light. The most prevalent was inadequate information flow.

Introduction

Ongoing demographic change, the rise in (multiple) chronic conditions, and advances in the management of those conditions have led to growing numbers of homecare clients in many countries [1, 2]. In this context, homecare services include a wide range of formal nursing and other healthcare services provided in the client's home. These can include medical treatments and therapies, basic care (e.g., personal hygiene), or domestic services (e.g., household support). In addition to the growing number of homecare clients, the increasing complexity of clients' care demands is challenging health systems [1, 3]. This increase has two main contributors. First, in spite of multimorbidity and diminished physical and cognitive capacities, clients are living longer [1, 4]. Second, the range of available services has also increased. Not only are there more services in general, but also more specialized services and more therapy and treatment options [5, 6]. Given that clients with multiple chronic conditions need a broad range of providers and services to manage the relevant diseases and symptoms, those services' successful coordination is key to reach care goals [7, 8]. Based on Espinosa et al.'s (2004) definition, care coordination can be understood as the "effective management of dependencies between subtasks, resources (e.g., equipment, tools, etc.) and people" (p. 6). Without adequate coordination, services can be provided twice, at the wrong time, unnecessarily or not at all [6, 9]. Possible outcomes include not only harm to the client, but also unnecessary costs. Therefore, care coordination contributes meaningfully to the quality of care and is an increasingly important field of research [6]. In defining quality of care, Campbell et al. [10] focus on "whether individuals can access the health structures and processes of care which they need and whether the care received is effective" (p. 1614). A recent review by Joling et al. [11] listed over 500 indicators that reflect structure, process or outcome quality of community care for older people. Examples include budget resources, individualized care plans, advanced care planning, pain, pressure ulcers, falls, medication problems, hospitalizations, use of emergency services, or satisfaction with care services.

While many such indicators have been used in studies examining the relationship of successful coordination with quality of care, results are mixed. For example, some studies have found that specialized care coordination programs reduced emergency department (ED) visits and post-discharge re-hospitalization, enhanced health-related quality of life and patient satisfaction with care and reduced costs [12-15]. Other studies did not find any relationships between care coordination and quality indicators such as number of clinical visits, hospital stay length(s), incidence of ED visits, health-related quality of life or patient satisfaction with care [13-15].

The operationalization and measurement of care coordination present challenges that may explain such mixed results [11, 13, 16-18]. One of the most serious of these challenges is the assumption that an intervention that addresses the coordination process (e.g., the introduction of case discussions) will also automatically enhance care coordination as an outcome (cf. Figure 1). As a result, studies make direct connections between intervention components of the coordination process (e.g., case management, regular feedback, promotion of self-management to patients, provision of equipment) and patient or economic outcomes, but without considering the degree of coordination actually attained as an intermediate result [15, 18]. This logical leap, which confuses the process of coordination, i.e., "coordinating, " with its intended outcome, i.e., coordination, makes it difficult to find consistent results on either the process or the outcome. To overcome this problem, Möckli et al. [19] built the **C**are C**oor**din**a**tion (COORA) framework, which distinguishes between the process of coordination, the direct outcomes of that process (improved synchronization of tasks or services, i.e., coordination) and other relevant targets including patient outcomes (e.g., ED visits, satisfaction with services received, increased sense of well-being, cf. Figure 1), or economic outcomes (e.g., reduced expenditures) [19]. In the COORA model, coordination is specified as the (desired) result of a process, i.e., the extent to which work dependencies between the different involved professions are effectively managed towards a specific goal, e.g., the care goal agreed upon with the patient [20-22]. While successful coordination mostly goes unrecognized, the lack of it is usually quite noticeable [22], and can be measured via coordination problems including delays or conflicting information [19]. Still, it might be possible to measure successful coordination in terms of accurate and timely exchange of information, the avoidance of duplication of tasks, the ability of all members to complete their tasks, or the absence of delays [20]. For this study we will use just one part of the COORA framework and will focus only on coordination as an outcome and patient outcomes (dashed rectangle in Figure 1). Detailed information on the COORA framework can be found elsewhere [19].

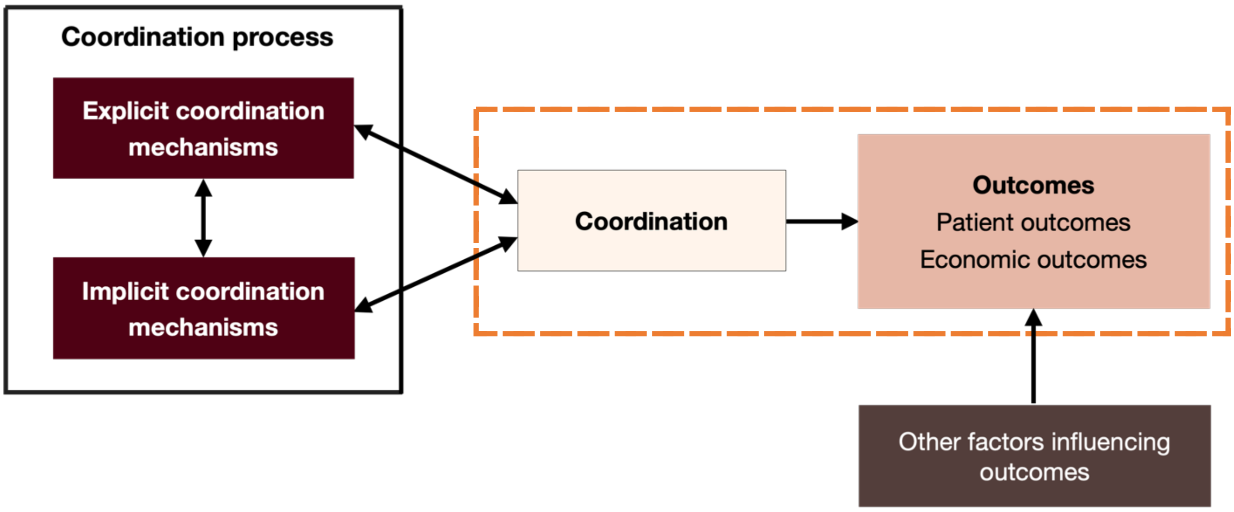

Figure 1. Adapted part of the Care Coordination (COORA) framework

In homecare, information on how coordination actually functions remains scarce. Moreover, to the best of our knowledge, no published studies have explored how coordination correlates with our main outcome of interest, i.e., improvements in quality of care in homecare settings. In addition, this study adds to the literature by using multiple perspectives to explore the relationship between coordination and quality of care, including a comprehensive view based on both clients' and homecare employees' perceptions. Accordingly, the aim of this study is to explore the relationships, i.e., regarding selected patient outcomes, between homecare coordination and quality of care from the perspectives of both clients and care workers. We have formulated the following hypotheses based on the COORA framework [19]:

1) Higher employee-reported coordination is associated with higher homecare employee-rated quality of care.
2) Higher homecare client- and employee-reported coordination is associated with higher client-rated quality of care.
3) Lower client- and employee-reported coordination is associated with higher unplanned healthcare use by the client (i.e., emergency department visits, unscheduled urgent medical visits, hospitalizations).

Methods

Study design

This descriptive correlational sub-analysis is part of the SPOT^{nat} study, a national multicenter, cross-sectional study in the Swiss homecare setting. Detailed information on the design can be found in the study protocol [23].

Setting and participants

The sample of homecare agencies was drawn from a random sample stratified by major geographic Swiss region and profit status. For small and mid-sized homecare agencies (≤100 employees), all homecare employees were included. For larger agencies (>100 employees), random samples of 100 employees were taken to reduce the study burden. At the employee level, homecare employees were included if they were at least 18 years old, worked in direct or indirect client care, had worked for the participating agency for at least three months, and understood written German, French, or Italian. For this sub-analysis, we only included employees who reported that exchanges with other professions were within their scope of practice.

We also included random samples of 50 homecare clients per agency who were at least 60 years of age and were receiving care from their homecare agency at the time of the data collection. For organizations with fewer than 60 homecare clients, we included all clients. No formal power analysis was conducted, as many parameters, including cluster effects of the different outcomes in the homecare setting, were unknown. For a multilevel analysis focusing on fixed effects, a sample of at least 30 groups of at least 30 individuals each is assumed to be sufficient [24]. For more details, see the SPOT^{nat} study protocol [23].

Variables

Independent variables

Employee-perceived coordination among healthcare providers. To measure coordination from the homecare employee perspective, we used self-developed items to assess *in situ* interaction and alignment of work within the care team [21, 25]. These were developed based on the COORA framework (c.f. Möckli et al. [19]). Therefore, we asked the homecare employees eight Likert-style questions on how often in general the following conditions applied: (1) Relevant information is reported in a timely manner by other professionals; (2) Client care activities are well-aligned between the involved professionals; (3) There are duplicated or mainly-overlapping activities between professionals; (4) No or no current prescriptions/ medication/ medication lists are available; (5) Not all or not the right medications are available at a client's home; (6) No one from the homecare team is involved in a client's discharge from an inpatient stay; (7) Homecare employees do not feel sufficiently informed about a client's condition (e.g., information is not available or only partially documented); and (8) Homecare employees receive important information about the client too late. As two items were positively and six items negatively formulated, the six negative ones were reverse-coded. All items were rated on a fully-anchored 5-point (0-4) Likert scale ranging from "never/almost never" to "very often." Therefore, higher values mean better synchronization, reflecting fewer coordination problems. After checking the scale's unidimensionality, we calculated a total score using the mean across all items. The Cronbach's α value was 0.81; principal axis factoring showed a shared variance of 38% with item loadings between 0.32 and 0.83 [26].

Client-perceived coordination problems. We assessed coordination problems from the clients' perspective by using the "Role Clarity & Coordination between Clinics" subscale from the "Patient-Perceived Continuity of Care from Multiple Clinicians" (CC-MC) [27]. The three items assessed (1) whether there were times when the healthcare team gave the clients conflicting health-relevant information or advice; (2) whether the healthcare team did not seem to work well together; and (3) whether the healthcare team did not seem to know who should be doing what. All three items were rated on a 5-point Likert-type scale ranging from "never" (=0) to "very often" (=4). The Cronbach's α of these items was 0.73; principal axis factoring revealed a shared variance of 49%, with factor loadings between 0.54 and 0.77. Before calculating a score for this scale, the author dichotomized each item's rating to indicate the presence or absence of a problem: "never" and "almost never" were recoded to 0 (="no problem"); and "sometimes," "often" or "very often" were recoded to 1 (="indication of a problem") [27]. After this step, the sum of the allocated values over the 3 items was calculated (possible range: 0-3), using listwise deletion. With higher values representing more pronounced coordination problems, the final scale showed a highly right-skewed distribution, with 78.5% of values located in the lowest answer category.

Outcome

To assess quality of care we used three distinct approaches:

1) Employees' rating of care. We assessed the ratings of care from the employee perspective using a single item. The homecare employees were asked to rate the quality of care offered to clients. Answer options ranged from "very bad" to "very good" on a 4-point Likert-type scale. As the lowest category was only chosen by one person, responses were transformed to 3 instead of 4 categories (0= (very) bad, 1=good, 2= very good).

2) Clients rating of care. Second, we assessed the overall rating of care from the client perspective by using one item of the "Home Health Care Consumer Assessment of Healthcare Providers and Systems Survey" (HHCAHPS) [28]. Clients were asked to rate the care from the agency from 0–10, where 0 was the worst home health care possible and 10 the best possible.

3) Clients' healthcare service use. To assess healthcare service use, we adapted items from the Swiss Health Survey 2017 questionnaire [29]. Clients were asked to indicate how many unscheduled urgent medical visits (needing urgently to see a doctor (including same-day appointments and urgent home visits), but not ED visits), ED visits, and hospitalizations (staying overnight in hospital or in a specialized clinic) they had had in the 2020 calendar year.

Demographic characteristics

We asked homecare agencies about their size (number of full-time equivalent posts, total number of clients and hours of care provided in 2020), profit status (non-profit, for-profit), catchment area (rural, suburban, urban), staffing (percentage of registered or higher-qualified nurses in relation to all other professions in nursing and care) and area of service (postal codes to allocate the language region German, French, Italian).

Regarding the selected homecare employees, we gathered information on age, gender (male, female, non-binary), employment percentage, years of experience in their current homecare agency, and educational background. The latter we divided into two groups for this sub-analysis: 1) nurses with a university/college degree and registered nurses (RNs) (BScN or at least a 3-year diploma program) and 2) nursing and care staff with lower levels of training in the nursing field (licensed practical nurses (LPNs), certified nurse assistants (CNAs), nurse aides (NAs), administrative staff, students/trainees and other professions working in client care. The language region (German, French, Italian) was assigned according to the postal code of their local agency office.

Clients were asked their age, gender (male, female, non-binary), living situation (alone, not alone), type of services used (nursing care and/or other services), health status (rating of own health from 1 (="poor") – 5 (="excellent") [28]) and perceived burden of healthcare expenses (how burdensome health-related expenses are for the monthly budget from 0 to 10, with 0 indicating "not at all burdensome" and 10 indicating "extremely burdensome"). As for the homecare employees, the language region (German, French, Italian) was assigned according to the postal code of the local agency office that served each.

Data sources/ measurement

We collected our data between January and September of 2021 through paper and pencil questionnaires for the homecare employees, clients and agencies. Each agency was given three months to complete the data collection and was responsible to deliver the questionnaires to their employees and clients. To ensure confidentiality and reduce social desirability bias, each questionnaire was accompanied by a stamped return envelope. Study participants were asked to mail the questionnaires directly back to the research institute. To enhance the response rate, each homecare agency was informed about its employees' response rate three and six weeks after the start of data collection and sent additional information material such as flyers, presentations, and argumentation lists. For employees who were non-native speakers of the language used for correspondence, a glossary was provided for important or potentially problematic terms. Clients' relatives were actively encouraged to help complete the questionnaires, while homecare workers were not allowed to do so. Questionnaires were coded to allocate them to their respective agencies but not to the individuals who answered them. After data entry, correctness of data was checked in a random sample of 5% and deemed accurate.

The Ethics Committee of Northwestern and Central Switzerland (EKNZ) issued a *Declaration of No Objection* [Req- 2020-00110]. We obtained informed written consent from all participating homecare agencies. For the employees and clients, the first page of each questionnaire informed them of the voluntary nature of participation, data confidentiality, and the consideration of informed consent when returning the completed questionnaire.

Data analysis

To assess how the data were distributed, descriptive statistics, e.g., frequencies, means, and standard deviations were used.

To explore the relationships between independent and outcome variables, we conducted separate multilevel regressions for each outcome. This allowed us to take into account the hierarchical structure of the data (employees within agencies, resp. clients within agencies). Complete data sets were constructed for each outcome by deleting missing values listwise. To build the regression models, we first performed intercept-only regressions, with each agency serving as a second-level (i.e., random intercept) variable. The result allowed the calculation of each outcome variable's intraclass correlation coefficient (ICC) (1), i.e., the amount of variance in individual-level responses explained by group-level properties [30]. Second, the independent variables were added to the multilevel model. Last, covariables were added to the model. For employee characteristics, covariables included gender, employment percentage, years of experience in current homecare agency, educational background and language region. For client characteristics we included gender, age, living situation, type(s) of services used, health status, burden of healthcare expenses (only for healthcare use outcomes), and language region.

For the *employee ratings of overall quality of care* variable, we ran ordinal logistic multilevel regressions using the R "ordinal" package [31]. For over-dispersed *healthcare service use* variables, we performed negative binomial multilevel regressions using the R statistical software "glmmTMB" package [32] and checked the regressions for zero-inflation, i.e., inflation resulting from frequent zero values; we found none in any of the three regression models [33]. For the *client-perceived quality of care* variable, we ran linear multilevel regressions with the R "lme4" package [34]. To produce regression models for the client outcome variables (i.e., healthcare service use and client-preceived quality of care), we aggregated the employee-perceived coordination scale data by calculating a mean score for every agency. Each agency's mean score was then assigned to each of its clients (disaggregated on the client level).

To test for multicollinearity among each model's independent variables, we determined the variance inflation factor (VIF), indicating that no multicollinearity was present [35]. We determined the model fit using both the Akaike information criterion (AIC) to reflect the conformity of the fitted model to the used data considering a penalty term [36], and Nakagawa's R^2 by using the R "performance" package [37]. The marginal R^2 indicates only the variance of the fixed effects, while the conditional R^2 takes both fixed and random effects into account [38]. To check whether the results would change the model's conclusions, we conducted several sensitivity analyses. For details see Appendix B. Data were analyzed with the R software, version 4.2.1 [39].

Results

From the 88 participating homecare agencies, 3223 employees (response rate 73.6%) and 1509 clients (response rate 35.3%) completed and returned the questionnaires. One agency did not participate in the client survey as they had only around 10 clients at the time of data collection; therefore, only 87 agencies were included in the final client data analysis. After removing employees who did not fulfill the inclusion criteria concerning exchanges with other professions as part of their scope of practice, a final sample size of 1784 employees remained for analysis, with a median of 12.5 (interquartile range (IQR) 7.0 – 27.3) employees per agency. According to the inclusion criteria for the client questionnaires, we removed all clients younger than 60 years of age, yielding a final sample size of 1466 client questionnaires, with a median of 16.0 (IQR 11.0 - 20.0) clients per agency.

Description of the sample and variables

Participating homecare employees were mostly female (91.9%); they had a mean age of 44.6 years and a mean employment percentage of 70% (corresponding to 3.5 working days (~29.5h) per week). Most participating homecare clients (76.5%) were between 75 and 94 years of age; most (62.9%) were female; and most (79.5%) were receiving nursing services. Details of the homecare agency, employee and client characteristics can be found in Table 1.

The mean score of the employee-perceived coordination scale was 2.5 (SD 0.6). Concerning their responses, slightly over two-thirds (67.6%) of employees reported that relevant information is often or very often reported in a timely manner, and that client care is often or very often well-aligned among professionals (66.9%). On the other hand, 20.9% of employees did not feel sufficiently informed about their clients' conditions. The client-perceived coordination problem scale showed a mean score of 0.3 (SD 0.7). Of the clients, 12% reported that sometimes, often or very often different healthcare professionals gave them conflicting information, while 21.1% reported at least one indication of a coordination problem. Detailed descriptions of the independent and outcome variables can also be found in Table 1. For full information on the coordination variables, see Appendix A.

The outcome variable's ICCs yielded values of 0.09 (95% confidence interval (CI): 0.05 – 0.13) for *employees' ratings of care quality*, 0.03 [CI: 0.00 – 0.06] for *client ratings of care quality*, 0.07 [CI: 0.04 – 0.10] for *unscheduled urgent medical visits*, 0.04 [CI: 0.02 – 0.06] for *ED visits*, and 0.12 [CI: 0.08 – 0.16] for *hospitalization*, all of which are low. However, to remain conservative in the calculation of confidence intervals, we still added random intercepts.

Table 1. Description of respondents' characteristics and independent and outcome variables

Variable	n (%)	Mean (SD)	missing n (%)
Homecare agencies	**88**		
Status			0
non-profit	62 (70.5)		
for-profit	26 (29.5)		
Catchment area			0
rural	39 (44.3)		
suburban	32 (36.4)		
urban	17 (19.3)		
Language region			0
German	67 (76.1)		
French	14 (15.9)		
Italian	7 (8.0)		
Size			
Number of full-time equivalent (FTE) posts		45.6 (57.5)	0
Total number of clients in 2020		557.2 (734.7)	3 (3.4)
Hours of care provided in 2020		41404 (42582.3)	2 (2.3)
Staffing			
Percentage of RNs or higher-educated staff over all personnel in the nursing and care sector		29.4 (13.7)	4 (4.5)
Number of visits conducted by RNs (or higher-educated staff) within the last 50 homecare visits		17.7 (10.6)	10 (11.4)
Employees	**1784**		
Age		44.6 (12.1)	58 (3.3)
Gender			16 (0.9)
Female	1625 (91.9)		
Male	140 (7.9)		
Non-binary	3 (0.2)		
Employment percentage (%)		70.0 (21.3)	31 (1.7)
Years of experience in current homecare agency		6.5 (6.7)	89 (5.0)
Educational background			13 (0.7)
Nurses with university/college degree and RNs	1085 (61.3)		

Variable	**n (%)**	**Mean (SD)**	**missing n (%)**
Nursing and care staff with a lower level of training in the nursing field	686 (38.7)		
Language region			0
German	1148 (64.3)		
French	549 (30.8)		
Italian	87 (4.9)		
Coordination variables, employees**			
Employees were asked: In general, how often (responses of "often" or "very often")			
1) … do you possess relevant information from other professionals at the right time to provide appropriate care/care to clients?	1193 (67.6)		19 (1.1)
(2) … are client care activities well aligned with other professionals?	1180 (66.9)		20 (1.1)
3) … are there duplicate and overlapping activities with other professionals?	142 (8.1)		27 (1.5)
4) … does it happen that clients do not have all or the right medications?	183 (10.9)		100* (5.6)
5) … does it happen that no or no current prescription/medication lists are available?	302 (17.9)		98* (5.5)
6) … does it happen that no one from the homecare team is involved at the discharge from an inpatient stay?	341 (22.5)		270* (15.1)
7) … does it happen that that you are not sufficiently informed about a client's condition? (e.g., information is not available, only partially documented)	362 (20.9)		50* (2.8)
8) … does it happen that you receive important information about the client too late?	253 (14.5)		41* (2.3)
Employee-perceived coordination (scale from 0-4)		2.5 (0.6)	7 (0.4)
Mean employee-perceived coordination aggregated at agency level (scale from 0-4)		2.6 (0.3)	-
Outcome variable employees			
Quality of care rating			7 (0.4
Very good	795 (44.7)		
Rather good	953 (53.6)		
Rather bad	28 (1.6)		
Very bad	1 (0.1)		
Clients	**1466**		
Age			34 (2.3)
60 - 64	62 (4.4)		
65 - 74	218 (15.2)		
75 - 84	497 (34.7)		
85 - 94	599 (41.8)		
≥ 95	56 (3.9)		
Gender			44 (3.0)
Female	895 (62.9)		
Male	527 (37.1)		
Non-binary	0		

Variable	n (%)	Mean (SD)	missing n (%)
Living situation			82 (5.6)
Alone	817 (59.0)		
Not alone	567 (41.0)		
Type of services used			
Only nursing care	730 (49.8)		
Nursing care & other services	433 (29.5)		
Other services (e.g., domestic services, meals on wheels)	303 (20.7)		
Health status (rating of own health)		2.3 (0.8)	31 (2.1)
excellent	8 (0.6)		
very good	55 (3.8)		
good	464 (32.3)		
fair	732 (51.0)		
poor	176 (12.3)		
Language region			0
German	1052 (71.8)		
French	298 (20.3)		
Italian	116 (7.9)		
Coordination variables, clients			
Clients were asked (responses of sometimes/often/very often)			
1) Were there times when the different healthcare professionals told you different things (that didn't make sense together) about your health?	171 (12.0)		41 (2.8)
2) Were there times when the different healthcare professionals did not seem to work well together?	167 (11.8)		51 (3.5)
3) Were there times when the different healthcare professionals did not seem to know who should be doing what?	142 (10.0)		48 (3.3)
Client-perceived coordination problems (scale from 0-3)		0.3 (0.7)	70 (4.8)
Outcome variables clients			
Overall rating of care (0-10)		8.9 (1.3)	41 (2.8)
Rating of 9 or 10	925 (64.9)		
Rating below 9	500 (35.1)		
Number of unscheduled urgent medical visits in 2020		0.7 (1.6)	196 (13.4)
no unscheduled urgent medical visit	792 (62.4)		
at least one unscheduled urgent medical visit	478 (37.6)		
Number of emergency department (ED) visits in 2020		1.7 (4.7)	137 (9.3)
no ED visit	766 (57.9)		
at least one ED visit	556 (42.1)		
Number of hospitalizations in 2020		0.7 (1.4)	144 (9.8)
no hospitalization	718 (54.0)		
at least one hospitalization	611 (46.0)		

Note. RN = Registered Nurse, SD= Standard Deviation,
* Answer option "not in my field of responsibility" treated as missing
** Items were translated into English for the purpose of this article, original language is German/French/Italian

Association between coordination and quality of care in homecare

Hypothesis 1: Higher employee-reported coordination is associated with higher employee-rated quality of care

Employee-perceived coordination ratings were significantly associated with their quality-of-care ratings. For every unit increase in the employee-perceived coordination, the odds of a higher rating for quality of care (i.e., bad/rather good vs. rather good/very good) increase by 2.78 times ($p < 0.001$) (holding constant all other variables). There were no substantial changes in the estimates after controlling for covariates. The coordination scale alone explains 8.8% of the variability in the quality-of-care rating. See Table 2 for details of the analysis.

Considering the strength of the relationship indicated, we conducted an additional analysis to examine which of the employee-perceived coordination scale's eight items show the strongest correlation with the quality-of-care rating. For details, see Appendix B. In descending order, the coordination variables "possess relevant information from other professionals," "care activities well aligned with other professionals," and "duplicate and overlapping activities with other professionals" showed the strongest associations with employees' quality of care ratings."

Table 2. Ordinal logistic multilevel regression output: Employees' quality-of-care ratings

	Quality-of-care rating from employees (independent variables only) (n= 1662)	Quality-of-care rating from employees incl. covariates (n= 1662)
	OR [95% CI]	OR [95% CI]
Independent variable		
Employee-perceived coordination	2.69*** [2.23; 3.24]	2.78*** [2.28; 3.38]
Intercept 0|1†	0.13*** [0.07; 0.23]	0.17*** [0.08; 0.37]
Intercept 1|2††	14.07*** [8.37; 23.64]	18.37*** [8.85; 38.13]
Covariables		
Employment percentage		1.00 [1.00; 1.01]
Years of experience in current homecare agency		0.99 [0.98; 1.01]
Nurses with university/college degrees and RNs[2]		1.19 [0.94; 1.49]
Language region French[1]		0.77 [0.49; 1.22]
Language region Italian[1]		2.08 [0.96; 4.49]
Second level variable		
Homecare agencies (Variance [SD])	0.46 [0.68]	0.40 [0.63]
Effect size		
AIC	2358.15	2358.71
Marginal R^2	0.088	0.105
Conditional R^2	0.200	0.203

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, OR = Odds Ratio, RN = Registered Nurse, SD = Standard Deviation, α levels of significance = *$p < .05$, **$p < .01$, ***$p < .001$

[1] = Language region German as the reference category

[2] = Nursing and care staff with a lower level of training in the nursing field as the reference category

† = OR for the intercept between answer category bad vs. rather good

†† = OR for the intercept between answer category rather good vs. very good

Hypothesis 2: Higher client- and employee-reported coordination is associated with higher client-rated quality of care

Client-perceived coordination problems were strongly associated with the clients' quality-of-care ratings. For every unit increase in coordination problems, clients' quality-of-care ratings decreased by 0.55 ($p < 0.001$) (holding constant all other variables). On the other hand, employee-perceived coordination showed no significant associations with clients' quality-of-care ratings. These estimates showed no substantial changes with or without covariates. The model not controlled for covariates explained roughly 11% of the clients' quality-of-care rating variability. For details of the analysis and model fit, see Table 3.

Table 3. General linear model output: Quality-of-care rating from clients

	Quality-of-care rating from clients (independent variables only) (n=1090)	Quality-of-care rating from clients incl. covariates (n=1090)
	Beta [95% CI]	*Beta* [95% CI]
Independent variables		
Client-perceived coordination problems	-0.56*** [-0.65; -0.46]	-0.55*** [-0.64; -0.45]
Mean employee-perceived coordination at agency-level	0.15 [-0.18; 0.49]	0.16 [-0.18; 0.50]
Covariables		
Types of services used: nursing care and other services[2]		-0.05 [-0.21; 0.11]
Type of services used: other services but not nursing care[2]		0.03 [-0.23; 0.16]
Living situation: alone[3]		-0.08 [-0.21; 0.07]
Overall health status (clients' ratings of their own general health)		0.11* [0.02; 0.21]
Language region French[1]		-0.16 [-0.38; -0.06]
Language region Italian[1]		-0.09 [-0.46; 0.27]
Gender male[4]		-0.05 [-0.19; 0.09]
Second-level variable		
Homecare agencies (n=87)		
Agency level (Variance [SD])	0.06 [0.25]	0.06 [0.25]
Residuals (Variance [SD])	1.29 [1.14]	1.29 [1.13]
Effect size		
AIC	3427.15	3453.54
Marginal R^2	0.109	0.118
Conditional R^2	0.151	0.160

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, SD= Standard Deviation,
α levels of significance = *p < .05, **p < .01, ***p < .001,
[1] = language region German as the reference category,
[2] = only nursing care as the reference category,
[3] = living situation "not alone" as the reference category
[4] = female as the reference category

Hypothesis 3: Lower client- and employee-reported coordination is associated with higher unplanned healthcare use by the client (i.e., ED visits, unscheduled urgent medical visits, hospitalization)

Client-perceived coordination was significantly associated with the number of unscheduled urgent medical visits and hospital visits but not with ED visits. Employee-perceived coordination, on the other hand, showed no significant associations with healthcare use (see Table 4). We found an 18% increase in the incidence rate (IR) of unscheduled urgent medical visits for every unit increase in client-perceived coordination problems ($p < .05$). Similar associations were noted with hospitalization, where (holding other variables constant) a one-unit increase in client-perceived coordination problems correlated with a 20% increase in the hospitalization rate ($p < .05$). The clients' rating of their own health was a significant covariable in all three models. The highest association was found with urgent medical visits: for every unit increase in self-rated health, the urgent medical visit rate fell by 37% (=100%-63%). As seen by the R^2 in Table 4, explained variabilities were generally lower than for the previous hypothesis.

Table 4. Negative binomial multilevel regression output: clients' healthcare use

	Urgent medical visits ind. variables only (n=994)	Urgent medical visits incl. covariates (n=994)	Hospitalization ind. variables only (n=1037)	Hospitalization incl. covariates (n=1037)	ED visits ind. variables only (n= 1034)	ED visits incl. covariates (n= 1034)
	IRR [95% CI]	IRR [95% CI]	IRR [95% CI]	IRR [95% CI	IRR [95% CI]	IRR [95% CI]
Independent variables						
Client-perceived coordination problems	1.20* [1.04; 1.39]	1.18* [1.02; 1.36]	1.29** [1.08; 1.52]	1.20* [1.01; 1.42]	1.10 [0.97; 1.25]	1.08 [0.95; 1.23]
Mean employee-perceived coordination at agency level	1.37 [0.84; 2.22]	1.29 [0.80; 2.08]	0.54 [0.29; 1.01]	0.63 [0.34; 1.17]	1.04 [0.66; 1.61]	0.94 [0.59; 1.52]
Covariables						
Type of services used: nursing care and other services [2]		1.04 [0.81; 1.34]		0.67** [0.50; 0.89]		0.90 [0.72; 1.13]
Type of services used: other services but not nursing care [2]		1.07 [0.78; 1.46]		0.99 [0.71; 1.38]		1.12 [0.86; 1.45]
Living situation: alone[3]		0.99 [0.78; 1.25]		0.68** [0.53; 0.88]		0.90 [0.74; 1.11]
Overall health status (clients rating of own general health)		0.63*** [0.54; 0.73]		0.83* [0.71; 0.97]		0.85* [0.75; 0.97]
Financial burden of health expenditures		1.05* [1.01; 1.09]		1.03 [0.99; 1.08]		1.03 [1.00; 1.07]

	Urgent medical visits ind. variables only (n=994)	Urgent medical visits incl. covariates (n=994)	Hospitalization ind. variables only (n=1037)	Hospitalization incl. covariates (n=1037)	ED visits ind. variables only (n= 1034)	ED visits incl. covariates (n= 1034)
	IRR [95% CI]	IRR [95% CI]	IRR [95% CI]	IRR [95% CI	IRR [95% CI]	IRR [95% CI]
Language region French[1]		0.78 [0.57; 1.06]		0.98 [0.68; 1.41]		0.89 [0.66; 1.20]
Language region Italian[1]		0.48** [0.28; 0.84]		0.68 [0.36; 1.28]		1.04 [0.64; 1.70]
Gender male[4]		1.17 [0.94; 1.47]		1.05 [0.81; 1.35]		1.45*** [1.19; 1.76]
Second level variable						
Homecare agencies (Variance [SD])	0.09 [0.29]	0.06 [0.24]	0.21 [0.45]	0.12 [0.35]	0.08 [0.28]	0.10 [0.32]
Effect size						
AIC	2336.8	2296.5	3358.2	3342.3	2390.5	2373.3
Marginal R^2	0.015	0.134	0.033	0.095	0.004	0.060
Conditional R^2	0.071	0.170	0.153	0.167	0.063	0.134

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, ED = Emergency Department, IRR = Incident Rate Ratio, SD = Standard Deviation, α levels of significance = *p < .05, **p < .01, ***p < .001,
[1] = language region German as the reference category,
[2] = only nursing care as the reference category,
[3] = living situation “not alone” as the reference category
[4] = female as the reference category

In almost all cases, sensitivity analyses for the different outcome variables did not change the models’ conclusions. One model—the one using the number of ED visits as its outcome variable—became statistically significant after that variable was dichotomized. However, for all others, the regression coefficients after dichotomization were comparable to those before. For details, see Appendix B.

Discussion

This study’s primary aim was to examine the relationship between care coordination and quality of care in homecare. Hypotheses 1 and 2—that higher care coordination is associated with higher quality-of-care ratings respectively from employees’ and clients’ perspectives—were supported. The third hypothesis, that higher coordination from the clients’ perspective is negatively associated with unplanned healthcare use (i.e., unscheduled urgent medical visits, ED visits, hospitalization), was partly supported. We found moderate positive associations between client-reported coordination problems and urgent medical visits and hospitalization, but not with ED visits. Nor did we find any noteworthy associations between employee-perceived coordination and clients’ healthcare service use or quality-of-care ratings.

To our knowledge, this is the first study to examine the relationship between the degree of coordination and quality of care. Moving away from measuring coordination processes as proxies for actual coordination, our findings confirm a relationship between coordination and quality-of-care outcomes based on both employee- and client-provided data. This supports our argument that coordination level should be considered an intermediate outcome between coordination processes and patient outcomes. However, based on the model fits for the three guiding questions, either 10%—for hypotheses 1 and 2—or only a negligible part of the outcome variables' variability—for hypothesis 3—could be explained by the independent variables of interest. This indicates that the outcomes measured are mostly determined by factors other than our independent variables. To name one other contributing factor, the intervention's appropriateness clearly has a greater effect than coordination: even the highest level of coordination cannot compensate for an intervention that does not fit the client's needs.

To the best of our knowledge, this is the first study to aim at measuring coordination in homecare. On a scale ranging from 0–4, the self-developed employee-perceived coordination scale recorded a mean rating of 2.5, indicating a rather good overall level of coordination. Nonetheless, it also shows potential for improvement, with several items exposing coordination gaps. For example, almost a third of employees (31.7%) reported that they only sometimes or rarely receive information from other professionals in a timely manner; and one in seven (14.5%) reported very often receiving important information about the client too late. For seamless coordination, a smooth flow of timely information is essential. As Jones et al. (2017) confirmed, access to information is crucial to the provision of optimal care. Unfortunately, other studies have shown that homecare workers commonly find themselves with scattered or conflicting information. This can be burdensome regarding referrals and lead to adverse medication events at home [40-42]. Our data also confirmed those of previous studies: over 10% of participating homecare employees reported that they are often or very often confronted with unavailable or outdated prescriptions, medication plans or medications; and 16.2% reported (almost) never being involved in their clients' hospital discharges.

Client-perceived coordination problems showed a mean value of 0.3 (on a scale from 0 to 3) indicating rather few coordination problems. One explanation for such a low score could be that coordination problems arising between healthcare providers or services are generally resolved before the clients can take notice. Another possibility is that a large proportion of our homecare clients sample dealt with small numbers of service providers and consequently few interfaces of care. As the complexity of coordination increases with the number of providers involved, such cases would entail correspondingly few conflicts [43, 44]. However, coordination problems did occur; i.e., 12.0% of clients experienced times when they received conflicting information from different healthcare professionals, 11.8% experienced times where their healthcare professionals did not seem to work well together and one-tenth experienced times where the different healthcare professionals did not know who should be doing what. Kern et al. [45] found similar numbers of client-perceived coordination problems in the U.S. In their study, almost 12% of respondents thought that their doctors did not communicate with each other about their care; 8.3% rated coordination of care among their health professionals as fair or poor. And a qualitative study by Chang et al. [46] found that patients who experienced coordination problems often attributed it to poor communication between healthcare providers. However, whether or not clients are aware of poor coordination, it is a problem: a single incident of failed coordination can lead to unnecessary healthcare use or adverse events.

Overall, employee-perceived coordination was significantly related to their quality-of-care ratings but not to any client outcomes. Considering the evidence that nurses' perceived quality aligns reasonably well with objectively measured quality indicators and nurse-sensitive indicators [47, 48], this positive association supports the premise that coordination is relevant to quality of care. The lack of finding a relationship with client outcomes might be a measurement issue: The employee-perceived coordination scale was aggregated at the agency level for client-level analysis, leading to only 87 individual scores for the analysis. The scale might also not be sensitive enough to capture more subtle levels of coordination regarding client outcomes. In addition, clients' and employees' perception of coordination might not match. If healthcare professionals are highly coordinated in virtually every aspect of client care, but fail to manage a key dependency properly (for example, a time-consuming process to gain access to client data or reports or additional efforts to obtain missing information), it can negatively impact the employee-perceived coordination rating, although clients might not notice it. Norlyk et al. [8] highlighted the ongoing behind-the-scenes activities of homecare nurses, which conceal the complexity of their work in the homecare setting (e.g., several health professionals involved but geographically dispersed, often working at the limits of available resources).

Client-perceived coordination showed significant associations with hospitalization and urgent medical visits as well as client-rated quality of care. In line with previous studies [49], our results accordingly indicate that coordination can impact diverse areas of care quality. However, client-perceived coordination and ED visits were not significantly associated. Other studies showed similar results, with no significant effects of care coordination on ED visits [15, 50]. Wells et al. [50] observed that most patients either reported that their ED visits were warranted or indicated that alternatives were unavailable. Indeed, in difficult care situations or where qualified personnel (e.g., general practitioners) are unavailable, ED visits are sometimes unavoidable or even included in contingency plans. However, even where a healthcare team is highly-coordinated, such transfers occasionally occur for reasons independent of coordination. In this sense, coordination is only one of a diverse range of factors that can impact ED visits. This issue raises the critical question of the contexts within which widely-cited quality indicators such as hospitalizations, ED visits or urgent medical visits, or even mortality or nursing home transfers are appropriate measures of care quality without also tracking and accounting for the underlying circumstances of admission or transfer. Therefore, as Haas and Swan [51] pointed out almost a decade ago, it is vital to choose quality of care outcomes that adequately reflect the success of interventions to improve coordination: choosing outcomes that are influenced only marginally by good coordination can lead to misleading conclusions. To help navigate the development of logic models [52] for interventions to improve care coordination, we recommend the COORA framework [19].

Strengths & limitations

This study has notable strengths and limitations. On the one hand, the application of the COORA framework creates consistency and transparency in the concept of coordination and its relationship to outcomes, which is a strength. In addition, the combination of perspectives on quality of care provides a more accurate image on how coordination is related to outcomes. On the other hand, due to the cross-sectional design and the country-specific functions of homecare services, our findings' generalizability is limited. Mainly due to the COVID pandemic, we did not enlist the targeted sample size of homecare agencies and the representativeness of the agency sample is questionable. Further, voluntary participation of agencies, employees and clients may have led to selection bias. The random selection of homecare agencies, as well as the sufficiently-large sample to increase power, and the good response rate may have reduced this problem. Clients who answered the questionnaire may have been in above-average health. To diminish this problem, clients' relatives were actively encouraged to assist in completing the questionnaires. Furthermore, it needs to be taken into account that data were collected during the COVID pandemic, which likely impacted overall healthcare use during 2020 (i.e., homecare services, doctor visits, ED visits, hospitalizations) [53]. Due to the nature of data collection, we may have introduced biases regarding recall and social desirability, and considering that both healthcare service use and care coordination are reported by the clients, self-reporting bias is likely involved. Further, validated instruments to capture coordination are not available, our self-developed questions are not validated, and unmeasured confounding factors may impact the outcomes.

Further research

Further research should focus on developing and validating a coordination questionnaire that reliably measures the process of coordination. In addition, in terms of research design, to collect data that reflects care coordination perceptions per case/interaction between healthcare providers and their clients would allow a deeper understanding of the different perspectives. The COORA framework provides guidance for just such a development. In addition, it would be useful to test the COORA framework in other healthcare settings, such as hospitals or nursing homes. For quality indicators, we strongly recommend further research to create a selection of indicators that reliably measure diverse aspects of care quality while relating accurately to coordination.

Conclusion

As this study indicates, interprofessional coordination contributes crucially to high-quality healthcare. Coordination problems including gaps in information flow and non-involvement of homecare workers in hospital discharge were identified, with communication (whether personal or impersonal) playing a particularly important role in ensuring the flow of information. At a time when the range of medical treatment options is greater than ever before, but must increasingly be weighed against budgetary constraints, the way healthcare is organized and coordinated is crucial and should be a key focus for all involved in healthcare delivery. However, from a research perspective, both measuring and operationalizing the process of coordination and quality of care remain challenging issues. The COORA framework can provide guidance in the development of research questions, the operationalization of coordination, and especially the development and evaluation of relevant interventions.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of interest: none

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Appendix and additional Files

Appendix A. Description of the coordination variables

Variable	n (%)	mean±SD	missing n (%)
Coordination variables, employees**	**1784**		
Employees were asked: In general, how often…			
1) … do you possess relevant information from other professionals at the right time to provide appropriate care/care to clients?			19 (1.1)
(Almost) never	13 (0.7)		
Rarely / sometimes	559 (31.7)		
Often / very often	1193 (67.6)		
(2) … are client care activities well aligned with other professionals?			20 (1.1)
(Almost) never	6 (0.3)		
Rarely / sometimes	578 (32.8)		
Often / very often	1180 (66.9)		
3) … are there duplicate and overlapping activities with other professionals?			27 (1.5)
(Almost) never	216 (12.3)		
Rarely / sometimes	1399 (79.6)		
Often / very often	142 (8.1)		
4) … does it happen that clients do not have all or the right medications?			100* (5.6)
(Almost) never	291 (17.3)		
Rarely / sometimes	1210 (71.8)		
Often / very often	183 (10.9)		
5) … does it happen that no or no current prescriptions/medication lists are available?			98* (5.5)
(Almost) never	255 (15.1)		
Rarely / sometimes	1129 (67.0)		
Often / very often	302 (17.9)		
6) … does it happen that no one from the homecare team was involved at the discharge from an inpatient stay?			270* (15.1)
(Almost) never	246 (16.2)		
Rarely / sometimes	927 (61.3)		
Often / very often	341 (22.5)		
7) … does it happen that that you are not sufficiently informed about a client's condition? (e.g., information is not available, only partially documented)			50* (2.8)
(Almost) never	164 (9.5)		
Rarely / sometimes	1208 (69.7)		
Often / very often	362 (20.9)		
8) … does it happen that you receive important information about the client too late?			41* (2.3)
(Almost) never	205 (11.8)		
Rarely / sometimes	1285 (73.7)		
Often / very often	253 (14.5)		
Employee-perceived coordination (scale from 0-4)		2.5 ± 0.6	7 (0.4)
Mean employee-perceived coordination aggregated at agency level (scale from 0-4)		2.6 ± 0.3	-

Variable	n (%)	mean±SD	missing n (%)
Coordination variables, clients	**1466**		
Clients were asked:			
1) Were there times when the different healthcare professionals told you different things (that didn't make sense together) about your health?			41 (2.8)
No problem (answers never/almost never)	1254 (88.0)		
Problem (answers sometimes/often/very often)	171 (12.0)		
2) Were there times when the different healthcare professionals did not seem to work well together?			51 (3.5)
No problem (answers never/almost never)	1248 (88.2)		
Problem (answers sometimes/often/very often)	167 (11.8)		
3) Were there times when the different healthcare professionals did not seem to know who should be doing what?			48 (3.3)
No problem (answers never/almost never)	1276 (90.0)		
Problem (answers sometimes/often/very often)	142 (10.0)		
Client-perceived coordination problems (scale from 0-3)		0.3 ± 0.7	70 (4.8)
0 problem	1102 (78.9)		
1 problem	175 (12.5)		
2 problems	71 (5.1)		
3 problems	48 (3.5)		

Note. SD= Standard Deviation,
* Answer option "not in my field of responsibility" treated as missing
** Items were translated into English for the purpose of this article, original language is German/French/Italian

Appendix B. Post-hoc Analysis and Sensitivity Analysis

Post-hoc Analysis

Table 1:

As a post-hoc analysis, we ran an additional ordinal regression analysis for the employee quality-of-care ratings, using the eight individual care coordination items instead of the employee-perceived coordination scale. The item description can be found in the article and Appendix A.

Sensitivity Analysis

We conducted several sensitivity analyses.

Table 2:

For the employee quality-of-care ratings, we ran one additional linear model and one model with the outcome dichotomized ([rather] good = 1, [rather] bad = 0).

Table 3:

For the client outcomes, we ran binomial multilevel regressions with dichotomized client-perceived quality of care (9,10 = 1; 1-8=0) and healthcare service use outcomes (0= no utilization at all, 1= at least one use).

For the regression models that used client outcomes, we additionally computed an unconditional random effect model with the employee-perceived coordination scale as outcome and the organization identifier as random effect. Organizations with significantly lower empirical Bayes estimates were coded as 1 and all others as 0. This provided an indicator for organizations rated substantially lower in terms of the coordination scale. The estimates of the regression models that used organizations with low-rated employee-perceived coordination (i.e., low employee-perceived coordination ratings) as predictors are shown at the bottom of the table.

Post-hoc Analysis

Table 1. Ordinal regression with the eight single employee-perceived coordination items

	Quality-of-care rating from employees' independent variables only (n= 1368)	Quality-of-care rating from employees incl. covariates (n= 1368)
	OR [95% CI]	OR [95% CI]
Independent variables		
Possess relevant information from other professionals	1.54*** [1.27; 1.88]	1.57*** [1.29; 1.91]
Care activities well aligned with other professionals	1.60*** [1.30; 1.96]	1.61*** [1.31; 1.98]
Duplicate and overlapping activities with other professionals (reversed coded)	1.23** [1.05; 1.44]	1.22** [1.05; 1.43]
Clients do not have all or the right medications (reversed coded)	1.15 [0.98; 1.35]	1.13 [0.96; 1.33]
No or no current prescriptions/prescriptions/medication lists available (reversed coded)	0.95 [0.81; 1.11]	0.97 [0.83; 1.13]
No one from homecare involved at the discharge from an inpatient stay (reversed coded)	0.94 [0.83; 1.07]	0.94 [0.83; 1.07]
Not sufficiently informed about a client's condition (reversed coded)	1.15 [0.96; 1.38]	1.14 [0.95; 1.36]
Important information about the client too late received (reversed coded)	1.08 [0.89; 1.31]	1.08 [0.89; 1.31]
Intercept 0|1†	0.38 [0.18; 0.79]	0.40 [0.16; 1.01]
Intercept 1|2††	42.55 [21.01; 86.15]	45.09 [18.31; 111.04]
Covariables		
Employment percentage		-
Years of experience in current homecare agency		-
Nurses with university/college degree and RNs[2]		-
Language region French[1]		-
Language region Italian[1]		2.87* [1.18; 6.98]
Second level variable		
Homecare agencies (Variance [SD])	0.56 (0.75)	0.49 (0.70)
Effect size		
AIC	1936.32	1938.49
Marginal R^2	0.121	0.138
Conditional R^2	0.248	0.250

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, OR = Odds Ratio, SD = Standard Deviation, α levels of significance = *p < .05, **p < .01, ***p < .001,

[1] = Language region German as the reference category

[2] = Nursing and care staff with a lower level of training in the nursing field as the reference category

† = OR for the intercept between answer category bad vs. rather good

†† = OR for the intercept between answer category rather good vs. very good

Sensitivity Analysis

Table 2. Regressions with binary ([rather] good = 1, [rather] bad = 0) and numeric (1-4) quality-of-care rating from employees. Only significant estimates are displayed

	Quality-of-care rating from employees ([rather] good = 1, [rather] bad = 0) (n= 1662)	Quality-of-care rating from employees (numeric 1-4) (n= 1662)
	OR [95% CI]	Beta [95% CI]
Predictors		
Employee-perceived coordination	2.32** [1.25; 4.33]	0.23*** [0.19; 0.27]
Covariables		
Employment percentage	0.98* [0.96;1.00]	-
Years of experience in current homecare agency	-	-
Nurses with university/college degree and RNs[2]	-	-
Language region French[1]	-	-
Language region Italian[1]	-	-
Second level variable		
Homecare agencies (Variance [SD])	0.77 (0.88)	0.24 (0.49)
Effect size		
AIC	277.92	2481.71
Marginal R^2	0.701	0.077
Conditional R^2	0.758	0.154

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, OR = Odds Ratio, RN= registered Nurse, SD = Standard Deviation,
α levels of significance = *p < .05, **p < .01, ***p < .001,
[1] = Language region German as the reference category,
[2] = Nursing and care staff with a lower level of training in the nursing field as the reference category

Table 3. Dichotomized outcome variables clients. Only significant estimates are displayed

	Quality-of-care rating from clients (9,10 = 1; 1-8=0) (n=1090)	Urgent medical visits (0= no utilization at all, 1= at least one use) (n=994)	Hospitalization (0= no utilization at all, 1= at least one use) (n= 1037)	ED visits (0= no utilization at all, 1= at least one use) (n= 1034)
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Predictors				
Client-perceived coordination problems	0.48*** [0.39;0.58]	1.22* [1.02; 1.46]	1.26** [1.06; 1.50]	1.22* [1.03; 1.46]
Mean employee-perceived coordination at agency level	-	-	-	-
Covariables				**-**
Type of services used: nursing care and other services [2]	-	-	-	-
Type of services used: other services but not nursing care [2]	-	-	-	-
Living situation: alone[3]	-	-	-	-
Overall health status (clients rating of own general health)	-	0.65*** [0.54; 0.78]	-	0.83* [0.70; 0.99]
Financial burden of health expenditures	-	1.06* [1.02; 1.12]	-	1.05* [1.00; 1.10]
Language region French[1]	-	0.70** [0.50; 0.99]	-	-
Language region Italian[1]	-	0.44** [0.24; 0.81]	-	-
Gender male[4]	-	-	1.38* [1.06; 1.79]	1.51** [1.16; 1.97]
Second level variable				
Homecare agencies (Variance [SD])	0.17 (0.41)	0.00 (0.07)	0.00 (0.00)	0.02 (0.15)
Effect size				
AIC	1333.90	1298.92	1428.80	1405.17
Marginal R^2	0.091	0.070	0.035	0.041
Conditional R^2	0.136	0.071	N/A	0.048
	Beta [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Predictor of unconditional random effect model				
Employee-perceived coordination rated low (using high ratings as reference category)	-0.35* [-0.61; -0.09]	1.14 [0.79; 1.66]	1.03 [0.66; 1.62]	1.08 [0.75; 1.54]

Note. AIC = Akaike Information Criterion, CI = Confidence Interval, OR = Odds Ratio, SD = Standard Deviation, α levels of significance = *p < .05, **p < .01, ***p < .001,

[1] = language region German as the reference category,

[2] = only nursing care as the reference category,

[3] = living situation "not alone" as the reference category

[4] = female as the reference category

CHAPTER 7

Synthesis and Discussion

Given the increasing need in Switzerland for homecare workers to coordinate their clients' complex therapy schedules, it is also increasingly necessary to ensure the quality of those workers' coordination efforts. However, no validated instruments are available to measure levels of homecare coordination. This is at least partly because, until the writing of this dissertation, no frameworks had been developed to guide their production in the Swiss healthcare sector. In fact, even now, in the entire field of healthcare, no standard clinical definition exists for coordination.

This final chapter summarizes this dissertation's research findings, discusses their highlights in greater detail, identifies this project's methodological strengths and limitations, and makes recommendations regarding further research, policy and practice.

Summary of key findings

As part of the SPOT^{nat} study [1], this dissertation's major aim was to explore quality of care and care coordination in the Swiss homecare setting. The research presented here focuses on care coordination and is the first to be based on both national data and a theoretical approach to operationalizing coordination.

By far the most notable product of this dissertation is the comprehensive care coordination (COORA) framework [2]. Based on diverse research findings, much of it in non-healthcare sectors, the COORA framework recognizes the complexity of care coordination as a topic, clarifies our understanding of how to measure it, and meaningfully organizes key concepts. Although developed with a focus on homecare, it can easily be modified to fit other healthcare settings as well.

Beginning by differentiating between coordination processes and their intended outcomes, i.e., a state of coordination, the COORA framework enables a systematic examination of care coordination. The results show that, regarding the coordination process, implicit coordination mechanisms including role clarity, mutual trust, respect, common understanding, predictability and accountability, as well as explicit mechanisms, especially communication, are crucial factors. They also confirm the importance of differentiating between coordination processes and coordination as the intended outcome of those processes. Without making this distinction, analyses will treat the two as a single variable, leading to unusable results. We also found that, as an outcome, improved care coordination is related to improved quality of care regarding two measures: self-reported quality (from the perspective either of homecare staff or of clients); and healthcare service use by clients. Results such as these emphasize the importance of choosing meaningful quality-of-care outcomes, i.e., quality-of-care outcomes that can truly be influenced by coordination.

Additionally, this dissertation brought to light several important results in terms not only of coordination, but also of regulations. We found that regulations have an impact on Swiss homecare agencies, especially regarding their range of services (e.g., whether they offer psychiatric or around-the-clock (24-hour) care), average service hours provided, perceived staffing, workload, and also employee overtime. These differences were particularly evident between homecare agencies whose service agreements included a service obligation with municipalities or cantons compared to those that did not have such an obligation. Perceived staffing, workload, and employees' overtime were also related to care coordination, while regulations, such as those concerning client copayments and residual financing of homecare agencies, were not. These associations, i.e., how external factors and agency characteristics such as workload/overtime and staffing are related to care coordination, will require further exploration.

Shedding light on care coordination

One major barrier to progress regarding care coordination has always been its conceptualization—or rather the lack of it. Kianfar et al. [3] stated that neither the definition, the description nor the associated activities of the coordination concept—especially in the context of healthcare—are clearly described in the literature. Also, Karam et al. [4] recognized that various methods exist to operationalize care coordination; and Thomas et al. [5] observed that "to better assess coordination in healthcare, much more work on coordination has to be done" (p. e15). The COORA framework, which we based on coordination literature from other research fields, bridges this gap with a comprehensive conceptual care coordination framework. This dissertation shows the value of a clear concept definition and framework as tools to understand and differentiate between the various elements of coordination that can be operationalized.

The first analyses assessing the relationships as presented in the framework are promising. We were able to confirm the associations between several elements, such as the different coordination mechanisms' links with coordination as outcome, and coordination's links (as outcome) with quality of care. Still, the COORA framework needs to be further validated.

The challenge of understanding and measuring care coordination

Until now, the concept of care coordination has lacked any coherent definition. While this lack has not stopped healthcare providers from maintaining confidently (albeit mutually inconsistently) that they understood what it entails, it has thwarted all efforts to measure or operationalize it. One tempting trap is the prevailing assumption that care coordination is bound to a role, e.g., a dedicated care coordinator. As people espousing this view tend not to be care coordinators, this pairing releases them from any obligation to share in coordination activities. As COORA illustrates, coordination is never bound to roles or competencies, but always involves a whole care team (including patients and relatives) equipped with different skills, responsibilities and competencies. The COORA framework has showed no tendency to associate coordination with roles or competencies. Instead, it offers guidance on how coordination can be understood.

Another of COORA's central features is that it highlights the importance of considering whether to approach coordination as a process or as an outcome. Distinguishing between the two is essential to draw consistent conclusions. Lacking that distinction, a researcher might falsely infer quality outcomes based on coordination processes, but without checking whether those processes actually improved coordination, i.e., led to successful management of the targeted work dependencies. This is just one example of how mixing the coordination process and outcome results can lead to problematic inaccuracies. If not noticed, such an error could confound the research results, leading to erroneous conclusions and incorrect recommendations for practice.

As described in COORA, the **coordination process** must be understood as the process of implementing and applying the necessary coordination mechanisms to achieve the target outcome, i.e., a state of coordination [6-8]. Coordination mechanisms can be classed as either explicit or implicit. Explicit mechanisms—those used consciously—can be further divided into programming and communication. Implicit mechanisms are used unconsciously. Stemming from common knowledge, they help explain and anticipate task states and actions by other participants. This class can be divided one step further, into cognition and interaction behaviors. When these are in place, both are used to help manage task dependencies and perform collectively [7, 9].

Our cross-sectional survey did not allow us to measure all *cognition* elements of the implicit mechanisms, e.g., situational awareness [10, 11], mental models [12], or interaction behaviors [13, 14], which have been shown to have an impact on team performance [12]. The measurement of these elements is quite complex, as they either show up momentarily in the midst of a situation, then pass by, need to match with the other participants, or become evident in the participants' behavior. Therefore we were not able to find suitable survey instruments to measure these sub-mechanisms. While such instruments should be developed, instrument development was outside the scope of this dissertation. Therefore, as these elements were not measured, it could not be determined whether or how they are related to coordination.

Coordination is the target outcome of the process, i.e., the extent to which work dependencies are effectively managed towards a specific goal [6, 7]. It is important to note that two aspects need to be considered when measuring coordination (as an outcome). The first is the perspective(s) from which it is measured, i.e., the client, provider or healthcare system [15]. In order to develop a comprehensive understanding, more than one perspective might be necessary. The second is the type of coordination to be studied. Three type(s) of coordination must be considered, i.e., technical, temporal, and process coordination [7]. Technical coordination relates to whether technical dependencies of the task itself are effectively managed. Temporal coordination denotes the timely management of dependencies, timely transmission of all relevant patient information, and timely delivery of the specified health service tasks in the correct order. Process coordination focuses on completing the tasks in the recommended order and in compliance with established processes and procedures [16].

Irrespective of which approach is taken, successful coordination is somewhat more difficult to measure than coordination failures, as it often goes unrecognized [17]. In this dissertation, we initially tried to develop a coordination scale from the homecare worker’s perspective. Unfortunately, due to time constraints and the complexity of developing an instrument that would both cover and differentiate between the three types of coordination, it was not feasible to develop one within the time available for this dissertation. This would need to be developed for future research. For future research it will be necessary to develop instruments that fulfill three goals: first of measuring both coordination successes and failures (or gaps), second, of including varied perspectives, and third, of differentiating between the three types of coordination (technical, temporal, and process coordination). The basis for identifying suitable items could be scales originally developed for other purposes, then identified via systematic reviews. One good starting point would be the McDonald et al. [15] Coordination Atlas. Although the Atlas needs an update and is largely a source of coordination processes and outcomes, it also presents many instruments from which individual items can be selected to compile coordination scales from the perspectives of healthcare providers, patients and relatives.

Even with access to ready-made items, though, measuring the concept of care coordination remains a challenge. Especially at the process level, measurement can entail an expansive range of aspects and very setting-specific mechanisms. So, while the COORA framework is not a silver bullet, it can narrow down those ranges to manageable sets. For research and interventions to improve care coordination, COORA offers guidance not only on choosing useful elements, but also on disentangling them from one another.

When planning coordination research, the first step is to ask which quality outcomes could be improved by a higher level of coordination. The second is to look at the coordination process in a setting-specific way to see what mechanisms are already in place and to what extent. The third is considering which mechanisms could help achieve each desired quality outcome. As might be expected, the fourth and crucial step involves implementing the process. However, rather than checking for improvement in the target outcome, it is vital first to check whether the intermediate outcome—coordination itself—actually improves. Then, in the fifth and final step, it is time to measure whether the quality outcome has changed as desired. The COORA framework can support these steps by highlighting the key elements that need to be considered and contextualized. This is especially valuable for distinguishing the coordination process from coordination as the intended outcome of that process.

Successful coordination: A matter of implicit or explicit coordination mechanism?

As mentioned above, with guidance from COORA, coordination mechanisms can systematically be divided into implicit (cognition and interaction behavior) and explicit (programming and communication) coordination mechanisms. The results of this dissertation's studies show that communication and information exchange—an explicit mechanism—is fundamental to successful coordination. This structure has been widely investigated elsewhere. In fact, the effective application of communication and information flow is one of the central aspects of care coordination [3, 18-22].

However, our findings indicate that implicit coordination mechanisms also play significant roles in homecare coordination. Studies on implicit mechanisms have predominantly focused on the synchronous work of high-performance teams, e.g., surgical teams or emergency units, to highlight the importance of shared mental models or situational awareness [11, 23-25]. However, as this dissertation's results show, in asynchronously-working homecare teams, implicit mechanisms also play influential roles and warrant consideration when developing or evaluating care coordination interventions. In our study group, implicit coordination mechanisms, i.e., role clarity, mutual respect & trust, accountability, predictability & common perspective, and knowledge of the health system were all significantly associated with employee-perceived coordination [26].

We only found weak associations regarding programming elements (which are explicit mechanisms). Other examples of programming elements include regularly planned team meetings or standard operating procedures (SOPs). The weakness of their associations may relate to the fact that they were measured on the agency level, while most of the implicit mechanisms were measured on the employee level. I.e., our agency-level programming variables simply may not have been sensitive enough regarding employee-level outcomes.

Another possible explanation is that regularly planned team meetings, SOPs and similar mechanisms actually play unseen roles in helping to strengthen and develop the implicit mechanisms, which then function as levers for successful coordination. Indeed, Espinosa et al. [27] recently found that explicit mechanisms, e.g., team meetings, communication goals fostered shared mental models as well as common understanding (both implicit mechanisms), which, in turn, enhanced communication. And to close the loop, a qualitative study in primary care found that implicit mechanisms—shared knowledge, situation/goal awareness and mutual respect—are essential elements of effective communication [28].

If implicit cognitive mechanisms and communication are drivers of successful coordination, the question arises of how they can be reinforced and strengthened. Regarding these goals, three points must be considered. First, if healthcare teams lack opportunities to interact, it becomes difficult to build implicit mechanisms such as mutual trust, common understanding or accountability, which normally develop over time [9]. Therefore, structures that favor or even necessitate interactions take on an important role [19, 20, 29, 30]. Second, it is not enough simply to promote interactions. All involved structures need to be transparent and follow clear rules. Well-defined areas of responsibility, regulations or requirements and procedures form a stable foundation upon which implicit mechanisms such as accountability, predictability, a common understanding and role clarity can stand [19, 29, 31]. Third, to provide clear rules and transparency, the various healthcare providers must be embedded in the healthcare system in such a way that interconnection is not only possible but also facilitated and encouraged [19, 22, 29]. Therefore, siloed thinking must be overcome, as they impede this interconnection. From a system-level perspective, a large step in this direction would be funding that crosses silo boundaries [22]. The alternative—segregated financing—promotes the shifting of patients and costs from one entity (or setting) to the next and is cost- or silo-centric rather than person-centered.

The need for systemic changes to advance care coordination

Our results show that siloed thinking is still common. We found that about every fifth homecare worker often did not feel sufficiently informed about their clients' conditions, or did not have current medication prescriptions or lists available, or that often no one from the homecare team was involved in a client's discharge from an inpatient stay.

Homecare clients also reported problems. At least one in ten remembered receiving conflicting information from their various healthcare providers, and times when providers either did not to know who should be doing what or seemed not to work well together [32].

It is well-established that no healthcare institutions—no hospital, nursing home or primary care practice—exists as a single, isolated entity [33-35]. Still, they continue to be treated as though they are. Given the affected population's rapidly-developing health needs, thinking in terms of isolated settings is completely inappropriate. A greater emphasis on linking the different settings is necessary [36]. Major changes are due at the system level. At the moment, especially in Switzerland but also in other countries, system-level structures leave coordination and cooperation to be done voluntarily by healthcare providers, with additional efforts and costs either not or not sufficiently covered [37]. Indeed, even if a homecare agency invests tremendous effort in care coordination, as long as medical practices, hospitals, pharmacies and other providers are not motivated or convinced that they share in the benefits of coordination, those efforts meet with little success [38].

Regarding care coordination processes, eliciting the necessary participation from all of the involved services can only be accomplished if the necessary fundamental structures, including incentives, regulations and data-sharing infrastructure, are first installed at the system level.

The necessary changes to the current system of multi-provider care amount to an update from the traditional model, which emphasizes the independence of healthcare-related service providers, to one geared towards optimizing patient trajectories. Before such changes can take place, though, a system-level change of perspective—towards patient-centered care—will be necessary [39]. This would involve, for example, an increased focus on helping patients navigate the care system, with an emphasis on providing them with clear, well-marked pathways. Such shifts would not only improve coordination but also facilitate smooth error-free transitions, which are particularly prone to coordination problems [36, 40]. By improving the involved care providers' ability to assess patient needs, a patient-centered model would also encourage them to engage fully in coordination processes [3].

These changes will require not only the alignment, as noted, of financing and regulations, but also the consolidation of all relevant information systems [36, 41, 42]. Efforts are being made to achieve the latter with electronic health records (EHR) [43-45]. Ultimately, these would need to be accessible nationwide by all healthcare providers, to be compatible across all software systems, and to contain all patients' current and historical health information. Considering Switzerland's current jumble of information systems from the provider level up through the municipal, cantonal and federal levels [46], meaningful changes will take time to achieve, but the benefits would be tremendous. By including the full range of settings (e.g., homecare agencies, hospitals, primary care practices) and making all important information available in one place to all necessary participants, a unified health information system would minimize coordination problems such as duplicate testing or prescribing, lack of up-to-date medication prescriptions, and lack of diagnosis and treatment histories.

The potential of effective care coordination

Our results show that homecare worker-perceived coordination as well as client-perceived coordination problems correlate significantly with their respective quality-of-care ratings. Receiving relevant information from other professionals, as well as well-aligned care activities without inter-provider activity duplication or overlap, showed the strongest associations with employee-perceived quality of care ratings. However, not only quality-of-care ratings but also healthcare service utilization, e.g., rates of unscheduled urgent medical visits and hospital visits, correlated with client-perceived coordination problems. Somewhat unexpectedly, though, rates of emergency department visits showed no significant correlations with client-perceived coordination problems. Nor did employee-perceived coordination correlate either with client-reported healthcare utilization or with clients' quality-of-care ratings. In addition, in our regression models, the coordination scales explained little of the related data variance. I.e., our coordination measures played only a small role in explaining the variability between the included outcomes' data [32].

Especially concerning the ongoing paradigmatic shift from volume- to value-based quality measures [47], the priority afforded to care coordination is increasing. And while the literature shows mixed results, the potential for good coordination to lead to improved care outcomes is considerable [48-51]. We have already argued that the broad variation between previous studies' results reflects the lack of a precise conceptualization for coordination. Without a clear conceptualization, consistent measurement is out of the question, as it is impossible to define the outcomes that can be changed by coordination.

Based on this dissertation's findings, unlocking the full potential of coordination will demand three fundamental changes.

First, system-wide coordination must be founded on system-wide health data that is accessible to the entire range of service providers. Only with reliable and complete data is it possible to scientifically support the development of both coordination and quality and thereby to introduce the evidence-based measures that are necessary for improvement. Current systems of data collection and administration suffer from too little consistency and too much fragmentation to allow long-term monitoring of patients' status, care coordination, or care- and coordination-related outcomes [52].

Second, for healthcare leaders to fulfill the Swiss population's rapidly growing needs, they must work together to enable and support the necessary system-wide changes. This will include developing a financing system that discourages silo thinking. In the current system, strongly-defined boundary-based responsibilities encourage a shift of costs to the next contributor not only at the healthcare providers (e.g., from hospital to the community) but also at the governmental level (e.g., from the health insurance companies to the municipalities, from the municipalities to the cantons or to the patients). What is needed is a comprehensive, patient-centered system view that provides integrated, coordinated care across patient pathways through information technologies that work smoothly across all relevant settings [52].

Concerning the current state of the Swiss healthcare system, numerous international studies have observed that inadequate coordination of inter-provider links is a major problem. This is particularly apparent regarding institutional transfers, e.g., patient moves from hospital to home entail severe risks for coordination failures [40, 53-57]. By facilitating a smooth transfer of information between all involved parties, a shared electronic information system would lead to much smoother patient transfers [58]. In a nutshell, without first fixing the current system, which disjoints and fragments care, trying to offer efficient, coherent care coordination is not only unsustainable but ineffective [59]. To optimize the balance between resource use and patient outcomes, the system must be rebuilt from the ground up with the patient at the center [60].

Third, recognizing that patient care is the health system’s first priority, many direct care workers treat patient-level organizational work as a non-core issue [61]—an attitude that almost certainly reduces both the time invested in proper coordination and the value of the final results. In addition, when implicit rationing takes place, it is particularly prevalent in organizational work [62]. However, for clients with high levels of healthcare service utilization, cutting back on organizational work only decreases the efficiency of those services’ delivery. In those cases, homecare workers need to be able to recommend critical services that go beyond healthcare, such as housing and legal support [59]. In homecare, many clients’ primary goal is to remain at home as long as possible. Fulfilling this goal means optimizing their quality of life and well-being while attaining and maintaining the best possible functional health status. Achieving a workable balance of the necessary elements demands first-rate coordination [63].

Different angles of care quality

In healthcare, the primary indicator of overall quality is not the volume of services provided, but the value of those services [47, 64]. Unfortunately, though, the concept of care quality has become so broad and is cited in so many contexts that it has virtually no specific meaning [47]. Especially in homecare, then, the questions first of what quality is and second, of how it can be measured are topics of much debate [65-68].

Further, as the homecare system depends many care and service providers, the success of the system as a whole depends on how well all of those providers fulfill their responsibilities. The complex interactions between the involved services makes it enormously difficult to define precisely and capture the quality of homecare services. Circumstances such as the client's geographical setting (e.g., canton, municipality, urban vs. rural), the availability of informal caregivers or helpful relatives, the home facility, the range of other health services available in the region, the available means of transportation, and also the extent to which the client wants to use certain services, if at all, and the intervals between homecare nursing or care services, all play roles [37, 69-71].

Therefore, in researching quality in homecare, our first hurdle was to identify whether the quality indicators currently in use actually measure the quality of the targeted services. I.e., before we could make accurate assertions about homecare quality, we first had to ensure that we were using appropriate indicators. Although the SPOT^{nat} study did not focus on developing quality indicators for the homecare setting, it did allow us to make observations applicable to future work—in this case, to measure and develop care quality indicators, e.g., by using different approaches to quality measurement.

The importance of approaching care quality from different angles

For this dissertation, we used two quality outcome indicators that have been associated with or measured in previous studies of coordination: "overall quality rating" and "healthcare use." As shown in the introduction, care quality applies not only to outcome quality, but also to the types of structures and processes described by Donabedian [72, 73]. Nevertheless, patient value is the central focus of healthcare, and is measured in relation to the patient, not the providers. Therefore, regarding quality measurement, much more emphasis should be given to patient outcomes [47, 74]. The quality of processes and structures are also vital to consider, including in relation to outcome quality; but those processes and structures are (or should be) means to reach outcome quality, not final goals in themselves [47]. To better categorize outcome quality in healthcare, the ECHO model is often very useful. This divides outcomes into three classes: Clinical, Economic and Humanistic [75]. "Clinical outcomes are medical events result from either treatment or disease. Economic outcomes include a service's direct, indirect, and intangible costs compared with those of alternative ways of influencing the same outcomes; and humanistic outcomes are the consequences of disease or treatment on patient functional status or quality of life (e.g., general health, well-being, satisfaction)" (p. 220)[75].

RAI-Data as homecare quality measurement?

As presented in this dissertation's introduction, data gathered using the RAI-HC (Resident Assessment Instrument – Home Care) can be used to assess and calculate selected quality indicators, such as daily pain, instrumental and basic activities of daily living, negative mood, falls, or social isolation [76, 77]. However, as we experienced problems with a number of this instrument's characteristics, we were unable to use RAI-HC data here.

The first of the RAI-HC's shortfalls is that it is quite restrictive regarding who it assesses. For example, it is only intended for long-term clients (who have been receiving or are expected to receive care for more than three months). In addition, unlike in nursing homes, homecare agencies often serve clients who only need temporary care, e.g., those recovering from arm or leg fractures. And unlike in nursing homes or hospitals, many homecare clients' primary care needs are domestic assistance or social support. While this type of care can impact indicators such as social isolation or strain on family members, this group's data are also excluded [67, 78, 79].

Second, missing data is an issue. According to Vanneste et al. [80], who examined incomplete RAI-HC data, it is likely that respondents simply do not know how to answer certain questions, i.e., the instrument requires both a competent person to fill out the form, and access to necessary tools for certain measurements. Any data gaps have clear negative influences on outcome generation [80].

Third, the RAI–HC's indicators tend to lack discriminatory power. Many present small numbers of cases and demonstrate issues with insufficient variation. Such deficiencies can make RAI–HC unusable to detect inter-agency differences [81].

Fourth, the RAI–HC's indicators lack proof of methodological quality [82]. In practice, in the absence of empirical evidence, the face validity of QIs is often based on expert opinion, thereby limiting their reliability [82, 83]. However, as Campbell et al. [84] stated, "the way in which indicators are applied is as important as the method of development" (p. 362).

Fifth and possibly most problematic is the matter of contextual appropriacy. As success in one care sector has little influence on indicators' applicability in others, The RAI–HC indicators fit the homecare setting rather loosely [85, 86]. These observations are congruent with those of Cleland et al. [87], who stated in their review that some of its clinical indicators are more applicable to frailer, less mobile nursing home residents than to homecare recipients.

In addition, while the RAI-HC indicators predominantly measure outcomes of care [82], it is questionable whether its measures fit the homecare context. Is it appropriate to measure outcome quality indicators like falls, dehydration or pressure ulcers when homecare workers only see the client for an hour a week? These quality indicators tend to be chosen based more on what can be easily measured than on what is actually relevant for clients or can be influenced by homecare workers. To evaluate outcome quality indicators, patient health outcomes achieved relative to care costs should be the central focus [47]. However up-to-date the RAI-HC quality indicators may be, they are more volume- than value-based. And even as this instrument incorporates a number of social indicators, it does not allow the assessment either of clients' experiences or of outcomes of care from their perspectives. Both topics should be central goals of aged care [88].

Besides these issues, one additional problem in Switzerland is that, even though the RAI-HC is the most widely-used standardized assessment tool in the homecare setting, its use is not mandatory. As a result, not all agencies use it (or not an electronic version of it). Consequently, its data do not provide a full nationwide image. Overall, then, to measure care quality for research purposes in the homecare setting, especially in Switzerland, the RAI-HC can offer only limited usefulness.

Client reported experience: the silver bullet to measure care quality?

The use of client perspectives is widely recognized as a crucial approach to care quality assessment [89-91]. Our use of client perspectives coincided with very high quality of care ratings: Clients gave their agencies top scores, with a mean value of 8.9 on a scale ranging from 0-10 and 10 indicates the best possible homecare agency [32]. Similar results were found by Smith et al. [92]. In their study, 83.7% of respondents rated their overall care as excellent (9 or 10 out of 10). However, while the home CAHPS® items cover a number of variables, their focus is more on process quality, e.g., the quality of communication, than on outcome quality, e.g., rates of healthcare system use. Therefore, this dissertation used only one item from it: the rating of care provided by the agency [93, 94].

Client-reported experience with the CAHPS® instrument shows several issues. Our results were similar to those of Smith et al., with items showing relatively high mean values and little variation, which makes it difficult to detect agency-level differences [92, 95]. However, this difficulty is not restricted to the CAHPS®. A WHO study conducted in inpatient and ambulatory settings in 41 countries on patient-reported experiences and outcome measures also reported issues with omitted responses in most negative answer categories, as well as ceiling effects [96]. In addition, a review by Bull et al. [97] indicated that more than 90 percent of PREMs were not responsive, i.e., not able to detect changes over time. Also most PREMs measure short-term care episodes, consequently, future PREM development should aim to capture continuity and coordination within and between different healthcare services [97]. Further, while PREMs and satisfaction measures are frequently used interchangeably, they are not exactly the same: PREMs report more concrete patient experiences; satisfaction is more subjective, often regarding whether or how well patients' expectations were met [96, 98]. Still, also regarding satisfaction measures, undifferentiated levels of satisfaction have been reported as a problem by different studies [99, 100]. One major shared weakness of satisfaction studies is the ambiguity of the term "satisfaction" itself. This affects the design and interpretation of the measurements [99, 100]. In addition, some measurements do not distinguish the construct of patient experience from that of satisfaction, instead including elements of both [101]. Here, clarification of the relationships between perceptions, experiences and expressions of satisfaction would be necessary to clarify the differences between them [100]. "Patient satisfaction" has multiple meanings with varying levels of relevance to value. Many patient surveys focus on satisfaction regarding processes, e.g., hospitality, amenities, friendliness, and other aspects of their service experience. Even in cases where service experiences can affect outcomes, though, those experiences themselves are not health outcomes and should not be treated as such [47]. At the same time, it was shown that the greater the patient satisfaction with nursing care, the greater the satisfaction with care in general (e.g., housekeeping tasks) [102].

Additionally, the CAHPS® and studies is showing its age. A recent review reported that many patient-reported experience measures, including the CAHPS®, were developed years ago and are not updated on a regular basis [101]. However, simply updating aging studies is not enough. To be relevant, measurement tools need to be valid and reliable and to measure value-based experiences and outcomes that are adapted to the context (including the time) in which they are administered [47, 102]. This creates a dilemma: on the one hand, it is recommended to use standardized instruments so that the results are comparable [101]; on the other, it has been shown that measurement instruments produce more meaningful results if they are adapted to the context, i.e., they should be situation-specific [100]. The deciding factor is the goal of the measurement. Is it to improve daily practice, to increase the value of research, or to facilitate national or even international comparisons? Whatever the specific details, in all cases, the measured data will be used to monitor and improve quality. According to Friedel et al. [101], no concrete examples have yet been found of exactly how the countries they studied are using national measures of patient experience and satisfaction, e.g., how or even whether their results are being implemented. This lack of information seems to indicate a missed opportunity. Putting their multi-national results to use, e.g., to promote healthcare reform, would be a step forward for value-based, patient-centered healthcare [47].

Nurse reported outcomes: Filling the gaps?

Quality of care ratings by homecare workers were also very high in our study. Almost all (98.3%) rated the quality of their homecare agency as rather good or very good. For this dissertation, we used only a global (overall) quality of care rating. As mentioned in the introduction, nurse perceptions of the overall care quality tend to reflect the actual quality of care provided in the hospital setting quite well [103]. However, as various researchers have also shown, the understanding and definition of quality of care differ from nurse to nurse [104, 105]. It is also quite possible that, even where the overall quality is rated as good, the quality of certain aspects of care can be perceived as poor.

However, in the homecare setting the question of appropriate quality measurement arises not only because the understanding of care quality varies between individuals, but also because the specific characteristics of this setting make it difficult to ensure that we are measuring the quality of homecare as opposed to that of general healthcare (including all other providers). A proper measurement—one that evaluates the quality of nursing care delivered in a way that informs practice—requires a common understanding of care quality [104, 106]. To clarify the distinction between quality regarding homecare versus general healthcare, nurses generally provide reliable data. Naturally, they approach quality of care specifically in terms of their organizations; so gathering useful data requires asking questions formulated with knowledge of their perspective.

There is also the question of the degree to which homecare agencies can ensure high-quality care. As Kane et al. [107] noted almost three decades ago, "before a provider agency can be held accountable for the outcomes of care, it must have some degree of control over what care is given" (p. 86). More recently, a study undertaken to evaluate nurse-sensitive outcomes in the homecare setting named five factors as most influenceable by nursing input and interventions: clients' autonomy, ability to make decisions regarding the provision of care, and satisfaction with delivered homecare services, as well as the quality of dying and death, and the clients' compliance with needed care [66]. Jeong et al. [86] added that, when the quality of homecare is evaluated, in addition to all clients' and family members' levels of satisfaction, all relevant homecare structures and processes, as well as medical outcomes should also be assessed. This approach is based on the premise that evaluating the quality of homecare requires more indicators than those used to assess the quality of traditional medical care, which focuses mainly on medical outcomes. To date, no staff-level measurement instrument is available to measure nurse-sensitive outcomes from the perspective of a homecare nurse. To develop the necessary indicators for such an instrument, the first step would be to work directly with homecare nurses to explore exactly which types of nursing input and interventions contribute to nurse-sensitive outcomes.

Which outcomes can be influenced by coordination?

Clearly, homecare requires different or at least additional quality indicators than those currently used in institutional settings. In the homecare sector, care coordination has repeatedly been linked to quality of care [51, 108-110]. However, one vital question remains: which quality outcomes are influenced by coordination, and how can they be measured in a meaningful way? In this dissertation we selected quality indicators based on care coordination interventions and reports from previous research [111], namely hospitalization, unplanned medical visits and ED visits.

One of our important findings is that client-perceived coordination is significantly associated with the number of unscheduled urgent medical visits and hospital visits, but not with ED visits. Also, we did not find any statistically significant associations between employee-perceived coordination and either clients' healthcare service use or their quality-of-care ratings. The percentage of explained variance was very low, meaning that the influence of other non-measured factors is important regarding the measured outcomes [32].

To apply Donabedian's quality model [73], coordination outcomes can be embedded in process quality and patient and economic outcomes as outcome quality. However, in relation to the COORA framework [2], it is essential to consider that several factors other than coordination also influence patient and economic outcomes, (i.e., outcome quality). If we shift our perspective to include the elements of coordination as suggested by Donabedian's framework, the coordination process can also be classified as *tasks done* (process quality), whereas coordination refers to the *outcome* of the process, i.e., another aspect of outcome quality. Within the homecare context, whichever angle coordination is assessed from, it cannot be exclusively related to quality of care. This is because coordination is always embedded in the overall care context. In addition, because more than one person is always involved, coordination can only influence outcomes that somehow relate to the organization of information-processing tasks [112]. Any other tasks performed to achieve specific goals, e.g., ensuring that examinations are performed correctly, are not dependent on coordination; nor are they enhanced by good coordination [112]. While hospitalizations, unplanned medical visits and ED visits (even "avoidable" ones) generally relate to the context and cause of the service use, they do not necessarily have any relationship with coordination. This realization echoes and supports Gorin et al. [48] observation that studies of care coordination tend not to focus enough on outcomes with meaningful relationships to care coordination. Especially in the homecare setting, any meaningful assessment of coordination outcomes demands on an approach that fulfills two conditions: first, measurements need to focus on homecare clients' satisfaction or experiences that relate to multidisciplinary cooperation, not to the work of individual service providers [86]. Second, those measurements must include, as fully as possible, all services and activities that jointly influence how well client needs are fulfilled [47, 113]. These two approaches are especially important regarding value, which is measured in terms of outputs that depend on actual client health outcomes. In this context, input variables, e.g., the volume of services delivered, are irrelevant [47, 114, 115]. And while individual clients' periods of involvement with homecare vary widely, client value is most clearly visible in relation to long-term dimensions such as full recovery or successful prevention of long-term consequences of a disease. This means that accurately measuring the value of care coordination would entail longitudinally monitoring all relevant trajectories over the entire period of care [47, 116].

To summarize, regardless of whether a measurement is intended to evaluate outcomes related specifically to care coordination or to other aspects of care quality, two points are key. First, there is a severe shortage of indicators that cross institutional boundaries. Second, for clients, healthcare providers or other stakeholders to make informed decisions, they need valid and transparent quality measures: flawed measures are not only meaningless but may actually cause more harm than good [87, 117].

Additionally, close attention must be paid to how the indicators are developed, especially as varied interests are represented in healthcare. I.e., healthcare policymakers' perspectives (i.e., population health) differ from those of healthcare organizations and agencies (which focus on optimizing the balance of client satisfaction and service costs). Meanwhile, insurers look for ways to reduce treatment expenses wherever possible, and industrial stakeholders are primarily oriented toward maintaining profits, often by maintaining or improving their products' reputations [107].

Impact of regulations and financing on homecare

Regarding financing and regulations, our most prominent finding is that homecare agencies differ considerably according to whether they have service obligations. This difference is particularly apparent regarding their range of services, including whether they offered psychiatric or around-the-clock (24-hour) care, the average number of hours of basic care they provided per client and employee-perceived staffing adequacy, workload and overtime [118].

As noted, Switzerland's cantons have considerable autonomy to regulate the financing of long-term care [119]. This results not only in a very heterogenous and non-transparent system but also in inter-cantonal disparities concerning client copayments and the funding of for-profit versus non-profit homecare agencies [120]. While a lack of data made it impossible for us to determine which funding strategies are most effective, previous studies have found that homecare regulations are far more effective at promoting inter-institutional competition than building meaningful collaboration [37, 121].

In general, with respect to the healthcare system, the overwhelming impression is that cost development is the primary concern [122, 123]. It is undisputed that all health system actors need to operate with limited resources. However, the question arises as to how much society is willing to pay for healthcare. A one-sided focus on cost reduction without considering the quality outcomes can lead to spurious savings and ineffective care, leading to poor outcomes [47, 74, 122, 123] Considering the cost and quality outcomes in homecare services, though, overall cost reductions do not necessarily mean that costs of all individual services also have to be minimized [47, 74].

In addition, compared to other sectors, healthcare is not a top cost-driver [124, 125]. Once again, then, it is not enough to treat healthcare sectors as independent entities. Client trajectories, which span not only their entire care periods but their uses of multiple care sectors, also have to be considered [47, 116].

A fragmented perspective on the allocation of financial resources increases problems with funding. Reimbursement should certainly not be a matter to be shuffled from one sector to another, and should be based not on the volume delivered but on the units of value achieved. Instead, funding strategies need to focus on providing an optimal mix of quality and cost [47, 123]. One consequence of the current fragmentation of care sectors is that it encourages each sector to shift patients—and the responsibility for those patients—to other sectors. If the Swiss health system was unified, when an individual patient left one institution (be it a hospital, rehab or nursing home) that institution would continue to share responsibility for that patient. I.e., throughout the entire care cycle, every involved care provider would remain linked to all of their patients' long-term outcomes [47, 116].

In Switzerland, though, optimizing both costs and quality would require a complete overhaul of the health system. The above-mentioned division of healthcare responsibilities across the cantons would likely make such a change very difficult [126, 127]. Some countries are currently attempting to formulate healthcare policies that focus on value instead of volume [128, 129]. Within such systems, Jani et al. [129] highlighted the need to engage with all stakeholders from the earliest stages of development—for example, to shift volume-based goals toward value- and patient-based healthcare. Countries including England, Scotland, Wales and Saudi Arabia are working toward these goals [129]. The results, which could take the remainder of this decade to produce, may determine whether other countries, possibly including Switzerland, will consider similar changes [128].

Concerning the impact of regulations and financing on homecare coordination, we did not find significant correlations between care coordination and regulations regarding client copayments or residual payments for homecare agencies [26]. However, not only regarding agency differences resulting from regulatory mechanisms but also in terms of coordination, although the correlations were weak, our results suggested that factors such as perceived staffing, workload and employee overtime influence coordination, whereas agency-level processes seem to mediate those influences. That is, as long as certain processes are in place, even where employees indicate high levels of workload or overtime, they tend to rate coordination highly [26]. These results suggest that work environment characteristics, especially workforce issues, play a central role regarding care coordination outcomes. Such characteristics have been linked both to the structure of the system and to the level of care coordination. While our results do not indicate how much specific regulations influence the workforce or how much their effects depend on workforce availability, it is well-known that homecare agencies have particular difficulty with recruitment, especially regarding RNs [118].

Various studies have emphasized the importance of considering workforce characteristics. For example, it is undisputed that ensuring high-quality work requires sufficiently-trained personnel [130-132]. Empirical evidence also clearly indicates that system-level regulations impact the working environment and working conditions: e.g., budget constraints clearly lead to higher workloads [133] and "market-oriented reforms" translate to unpaid overtime and time pressure, resulting in high stress levels [134]. However, to our knowledge, this is the first study to show that these workforce issues also correlate with care coordination. Therefore, budgetary policies should receive particular attention regarding how they influence the nursing shortage, recruitment problems, workload and overtime.

Methodological strengths and limitations

Guided by the total error framework, i.e., "the life cycle of a survey from a quality perspective," (p. 49) [135] we have identified several of this dissertation’s methodological strengths and limitations.

First of all, as cross-sectional data shows only a snapshot of conditions at the time of data collection, our results cannot show changes over time. Still, the inclusion of national data from Switzerland's three language regions is certainly a strength.

Representation

To optimize our representation of Swiss homecare agencies, homecare workers and clients (as well as their relatives), we chose a three-stage stratified random sampling approach. This produced representative samples of the studied groups. Our probability sampling approach reduced the risk of sampling bias, while the stratified sampling approach reduced the sample’s variance.

Regarding our eligibility criteria, we encountered an issue regarding possible coverage error. Fifty percent of Swiss non-profit and 75% of for-profit homecare agencies have fewer than ten FTE positions, while the average homecare worker’s employment percentage is 45% [136]. Considering these figures, setting our inclusion threshold, as originally planned, at 30 employees would have excluded over 50% of all agencies. Therefore, we had no choice but to include smaller agencies. Acknowledging that this would cut our statistical power, we reduced our minimum agency size to ten employees. However, with the onset of the COVID-19 pandemic, we were also unable to achieve our intended agency sample size of 107 agencies. Further, due to voluntary participation, the representativeness of the homecare agency sample is questionable.

Regarding the sample of homecare employees, we used a rather complex sampling method. As we needed to select random samples of 100 employees each from the large agencies, we requested them to send us anonymized employee information for all staff who met our inclusion criteria. The agencies supplied us with the necessary datasets, each of which included a coded identifier for the worker who matched the included characteristics. From each company’s list we drew a random sample of 100 identifiers, which we then returned along with one questionnaire pack for each respondent. Each pack was labelled with the coded identifier of one participating employee. After decoding the identifiers, agency personnel delivered the packs to the corresponding employees. The respondents returned their completed questionnaires directly to the research team using stamped, pre-addressed envelopes included in the questionnaire pack.

One clear risk was that the agencies supplying us with incomplete or incorrect information (e.g., regarding employee eligibility) or replacing selected individuals on the list (e.g., due to absences). While such cases would have introduced coverage or/and sampling errors, we could not control for that. To compensate for these possibilities, we informed every contact person about the importance of providing accurate information and adhering to the study instructions; therefore, if such errors occurred, we assume that their effects were very small. As for the distribution of the questionnaires, which were only available in paper-pencil form, especially with the random samples of employees, questionnaires could have been given to wrong employees, lost or simply not distributed. Moreover, employees who were absent from work during the data collection period (e.g., due to illness or holidays) probably never received their surveys, thereby increasing the risk for non-response error. However, with a response rate of over 60%, we assume that the sample is representative in this regard. Regarding homecare clients, due to the inaccessibility of contact information and data protection safeguards, we used the same procedure for drawing the client sample as for employees. This step, divergence from our instructions could have introduced coverage or/and sampling errors. In addition, this procedure of sample building entailed the risk that identifiers would be decoded incorrectly; thus clients (or employees) other than those selected may have been included in the sample.

As for the employees, client questionnaires were only available in paper-pencil form. We left the choice of distribution mode to the agencies. Again, however, they could have been given or sent to the wrong clients (even if the list was correctly decoded) or some clients on the list could have been omitted. If the intended client refused to participate, the involved homecare worker could have been tempted to give their questionnaire to another client. There was no way we could ensure that the questionnaires were delivered as instructed to selected clients only. Finally, as with homecare workers, questionnaires could have also been lost or forgotten to distribute either by the agency or homecare workers or also lost by homecare clients.

Of course, clients who did not receive care during the data collection period (e.g., due to hospitalization) probably did not receive the questionnaire. Others might not have been able to fill out the questionnaires due to either physical or cognitive impairment. Although we allowed proxy answers by relatives in the client questionnaire to reduce this bias, we did not know whether the clients had relatives and whether the relatives were willing to fill in the questionnaire on behalf of the client.

Measurement

One serious weakness is that validated instruments to capture care coordination (as we defined it) were not available. Lacking this, we used an unvalidated self-developed scale.

Therefore, the construct validity is questionable. However, we built the question items in accordance with the COORA framework and existing literature on the topics of interest. As that was developed within this dissertation, it has not been fully empirically tested; still, we assessed the coordination variables based on a theoretical framework.

To better ensure comprehensive measurement with the self-developed questions on coordination, we included questions covering both successful coordination and coordination gaps. We also conducted cognitive interviews with homecare clients and workers to better understand their criteria for good or bad coordination. We then checked for face validity in consultation with homecare nurse experts and homecare workers. While we did not conduct a validation study to substantiate the coordination scale, we did perform psychometric testing with explorative factor analysis. That indicated that the negatively formulated items were problematic. As a result, the factor loadings and thus also the model fit were too low. Regarding content, two of the problematic items were particularly important for the coordination measurement. To remedy the problem, we adapted the two originally-planned scales (one for coordination gaps, one for successful coordination) and used items from both to create a single scale. The result fulfilled our requirements, with acceptable model fit indexes and Cronbach’s alpha.

The second serious weakness concerned the measurement of care quality in homecare. We were hard-pressed to distinguish which of the numerous indicators available actually measured homecare quality, and which measured the quality of healthcare in general, i.e. the combined efforts of all healthcare providers involved. Similarly, the question of which indicators related to coordination remained open throughout our preparation of the questionnaires. Based on a literature review, followed by discussions with stakeholders and homecare experts we chose to use "rough" indicators, such as *general perceived care quality* and *the utilization of various services*.

In order to generate clean, detailed, reliable healthcare utilization data, we asked health insurers to allow us limited access to their files. After numerous discussions, the majority of insurers refused our requests (N.B., in Switzerland the health insurers are private/profit firms. While there are many different companies, the three largest cover about 60% of the Swiss population).

In addition to the insurers’ data, we asked the homecare agencies for access to their electronic data on client characteristics. This was problematic for two main reasons: First, as some agencies still work exclusively with paper documentation or have not sufficiently recorded the necessary information within their patient files, they were unable to fulfill our needs. Second, as the agencies worked with software from a wide range of providers, exporting and converting the raw data to usable files would have been too time-consuming and too expensive. In the end, it was impossible to use any of these data for the intended analyses. Nonetheless, in case we were unable to collect the necessary electronic data from our two intended sources, we had included several questions about healthcare service utilization in the client questionnaires. The resulting data were usable.

Regarding the quality of the data collected using the self-reported questionnaire, this might be prone of having some response bias. First, we were not able to control (or even observe) the environment while the clients and employees completed their questionnaires. This could have introduced a social desirability bias. This issue was also raised by Cleland et al. [87], who reported that many older people and their families were concerned about supplying low ratings due to the potential impact such ratings might have on their care. However, by supplying a pre-stamped envelope to send the questionnaires directly to the research institute, we tried to reduce the pressure towards social desirability. Second, the self-reported questionnaire could have introduced a recall bias, especially regarding clients' healthcare service use: its recall period was the entire previous year. Research has indicated that longer recall periods increase recall bias [137, 138]. A third potential source of bias in the responses could be that the clients who answered the questionnaire were in better than average health, or that employees who filled out the questionnaire were either more motivated or more dissatisfied than the average employee. It is also possible that respondents did not understand every question or did not read it carefully, either of which could lead them to respond inaccurately. We tried to reduce some bias by enhancing the response rates of employees and clients as much as possible and encouraging clients' relatives to help fill out the questionnaires. However, the client response rate remained rather low at 35%. For comparison, a recent review about response rates in surgical patients found an average response rate of 70% [56], while Fowler et al. [139] found response rates similar to ours: 20–40%, depending on the survey mode. In addition, for words that might be difficult to understand, we created and distributed a glossary with the employee questionnaires. The fourth and final point is that, as we cannot say whether missed items were (completely) at random, we cannot be certain whether non-response bias affected our data.

Regarding the assessment of agency-level variables, we were confronted with unexpected issues, especially regarding financing. One problematic characteristic was the lack of transparency concerning residual financing: several agencies did not know or did not want to disclose either how their residual financing was organized or how much money it involved. Likewise, some, for example, could not provide specific numbers of hours of service provided, or numbers of clients who received specific services. However, as most of the data we requested at the homecare agency level are required by the federal government for statistical purposes, answering them would simply have required querying their databases.

Statistical analyses

One major limitation affecting this study is its cross-sectional design, which does not allow inference of causal relationships. In addition, the wide range of homecare agencies, with sometimes fewer than 10 participants per agency. Such small samples allow few reliable observations. Also, certain values omitted from the agency questionnaire were problematic, as they reduced the sample size even further thereby also reducing the power and confidence/reliability of the results. We attempted to reduce the number of missing values by checking back with agencies three times about unanswered questions; however, some agencies simply could not answer them. However, the employee and client sample sizes remained large enough for analysis.

For the regression analyses, especially the lasso regression, we may have missed important predictors. In addition, calculations of confidence intervals or model fit were not possible for the lasso regression. For the other analyses, unmeasured confounding factors or other unconsidered variables may have impacted the studied outcomes.

As a last point, as some analyses involved measuring dependent and independent variables on the same level, we might have introduced a common method bias.

Generalizability

The details of how homecare services function, as well as their regulation and financing, are very country-specific. Alongside our findings' generalizability, this limits their transferability to other care settings or countries. However, both the COORA framework and this dissertation's general conclusion are transferable across both care settings and countries.

Still, one pervasive issue is that our data were collected during the COVID-19 pandemic, which strongly impacted homecare agencies, healthcare workers and homecare clients [140, 141]. In addition, it is very likely that the pandemic impacted overall healthcare use in our studied clients during 2020 (i.e., regarding homecare services, doctor visits, ED visits, hospitalizations) [142].

Finally, as coordination issues vary widely in form and nature across healthcare settings, the COORA framework is not a one-size-fits-all solution. While this weakness is certainly not unique to COORA, it must be borne in mind. Researchers interested in healthcare coordination research need to use their judgment to distinguish its more generally applicable aspects from those that only apply to specific healthcare contexts and tasks.

Implications

Implications for future research

The SPOT^{nat} study allowed us to dive deep into the topic of homecare coordination and quality. While this dissertation project is complete, further data analyses will be necessary to better understand the homecare setting, its work environment, employee outcomes and quality of care. This section briefly discusses our findings' implications for future research beyond those specific to the SPOT^{nat} study, which have already been partly touched upon in the previous chapters.

With respect to care coordination, the COORA framework needs further empirical testing and optimization. Reliable, i.e., validated, measurement instruments are needed to capture all relevant elements both of the coordination process (i.e., implicit and explicit coordination mechanisms) and of coordination as the intended outcome of those processes. Especially in the domain of implicit mechanisms, progress will depend on the availability of validated measurement instruments that capture, for example "shared mental models" or "situation awareness." Equally reliable instruments will be necessary to measure and evaluate the various types of coordination from diverse perspectives.

This dissertation provides a firm foundation for the measurement of coordination. The COORA framework will provide consistent, theoretically sound guidance in the operationalization and measurement of coordination.

Another area in which further research is desirable and necessary is in the development and definition of quality in the homecare sector. On the one hand, this will mean defining reliable homecare quality indicators, i.e., those that actually are influenced by and reflect relevant homecare outcomes. This will require the development of indicators that go beyond the range of those currently in use, such as RAI–HC quality indicators [106]. On the other hand, it will demand fundamental research to clarify which homecare goals quality measurements in the homecare sector need to reflect. Especially in the context of care coordination, except where quality measurements are necessary to clarify inter-setting differences, the value of measuring quality in individual settings is questionable: coordination focuses on understanding and managing the interplay of all involved parties, not on delineating boundaries between them. Moreover, as a topic of study, while quality applies to all care settings, attempts to define it in relation to individual settings suggest silo thinking. Therefore, in the study of care coordination, researchers need to focus more on which patient pathways lead to the highest quality-of-care outcomes [74]. This supports two further foci for research: one to develop quality indicators that reliably reflect the quality of care across settings, and the other on how inter-provider boundaries could be softened to allow better information flow and collaboration across healthcare fields.

Most importantly, this dissertation's findings indicate a clear need for further research first to identify and test processes that improve coordination, then to develop appropriate interventions to integrate them into practice.

Lastly, given the number of homecare agencies operating in Switzerland, it would be useful to study how fully those agencies cover their clients' care needs. For example, it would be useful to examine the various agencies' optional service offerings. While there appears to be an elevated need for these, especially regarding domestic and social care, their costs are not covered by Switzerland's basic health insurance. Therefore, as these additional offerings entail out-of-pocket payments, it would be worth studying them regarding the value they offer in relation to their quality and the fees charged. Similarly, the question of how client copayments affect homecare service use would be well worth examining.

Implications for policy and practice

Stakeholders including clinical practitioners, healthcare association delegates and policymakers were closely involved throughout the SPOT^{nat} study. With regular stakeholder meetings and six regional SPOT^{nat} meetings with participating homecare agencies, discussions were held concerning the study's implications regarding practical and regulatory concerns. Based on the SPOT^{nat} study, as a gesture of appreciation to the participating homecare agencies, we supplied them with a report (including a benchmark report) to use for quality improvement measures and organizational development. Additionally, we used SPOT^{nat} data to produce a publicly accessible national report on the Swiss homecare landscape [143].

The scale of the SPOT^{nat} study allows broad practical implications, including in homecare. Further, particularly in relation to care coordination, the knowledge generated by this dissertation has additional implications for homecare policy and practice.

Implications for policy

Internationally, interprofessional coordination contributes critically to high-quality healthcare. Therefore, it should be treated not as unpaid voluntary work by organizations or individual care providers, but as an integral part of countries' public service obligations [144]. However, there is no silver bullet solution. Each country and health system needs to tailor its approaches to the needs of its population [52]. Where necessary, structures must be created to promote and strengthen interdisciplinary and interprofessional care coordination. To do so, healthcare policy plays a major role to ensure that the necessary regulations, financial funding, and technical systems are in place [74, 145, 146].

Therefore, it is necessary to rethink how financing and regulation are designed and what goals they are intended to achieve. For example, while cost containment measures are essential, these should not be employed at the expense of quality and long-term value. And both regulations and funding should incentivize, not hinder, collaboration and coordination among service providers [147]. To this end, information pools such as EHRs should be nationally compatible and their use mandatory for all service providers.

Regarding quality, it is essential to align funding regulations (especially concerning residual financing) at the national level. In addition to increasing transparency, this would even out the current disparities in client copayments. Also, the quality requirements for homecare agencies (for example, the criteria for obtaining an operating license) should be defined nationally, not from canton to canton. Politicians also have a duty to collect and administer data regarding homecare services. As reliable data are essential to ensure that homecare clients are receiving quality care, these data must be both auditable and comparable [145, 148]. This will require other projects, including the development of suitable homecare quality indicators beyond the RAI-HC data. As the goal is a nation-wide database, it will be essential to include homecare agencies from all of Switzerland's language and geographical regions at every stage of the development process.

In addition to nursing care services, many elderly people living independently in their own homes require domestic or social support. For many, however, the costs for these services have to be paid out-of-pocket. Added to the already-high out-of-pocket costs of services in Switzerland [119, 125], the result is an additional financial burden. Policymakers need to consider whether adjusted funding would be reasonable in this area and whether a stronger focus should be placed on long-term cost-saving measures. Although neither of these aspects was a focus of this dissertation, they are particularly important in the homecare sector, both to prevent unnecessary future costs and at the same time to enable clients to remain at home for as long as possible.

Implications for practice

Throughout this dissertation, practical implications have arisen, particularly concerning coordination and quality. For example, our findings indicate that when homecare agencies identify coordination gaps with other care providers, they can bridge those gaps by identifying and employing coordination mechanisms. Based on our analyses, particular attention should be paid to implicit coordination mechanisms such as role clarity, mutual trust and common understanding. As coordination can be facilitated by defining clear roles, negotiating these with other service providers can prevent role conflicts. Further, interactions with other service providers should be encouraged. This not only improves communication but develops trust, respect, accountability and common understanding, all of which function as implicit coordination mechanisms. Likewise, further healthcare training, i.e., to help care staff understand their clients' service possibilities, offers and conditions, could help to improve care coordination. To reduce the burden on individual homecare agencies and facilitate inter-professional interactions, training could be organized across disciplines. Regarding care quality, homecare agencies should actively engage in continuous quality improvement. On the one hand, as the concept of quality is extremely broad (and rather vague), it is important to form a general understanding (a consensus) of what is understood as quality and how it can be achieved or improved within agencies.

To elaborate on this point, the involvement of the entire team is crucial, as the various members' perspectives may initially differ. In the best case, the clients' and relatives' viewpoints can also be included. On the other hand, it is imperative to make quality measurable: providing a baseline level of quality makes it possible to determine whether intended improvements actually result in benefits. Therefore, homecare agencies should also be required to collect, administer, and provide data for analytical purposes. As we have learned from this dissertation, it is only possible to conduct research and answer questions if both the quantity and the quality of the available data are sufficient for analysis.

Finally, agencies need to monitor their staff's work environment, especially regarding high workload and overtime. Particularly in times of nursing shortages, while this task can be challenging, it is a crucial tool for staff retention. Indeed, finding and keeping qualified staff requires innovative solutions and the support of the municipalities and cantons, which must mobilize the necessary resources to ensure that enough staff are trained and agencies can promote homecare nursing as an attractive and rewarding field of employment.

Conclusion

This dissertation includes the first national-level survey to explore macro-, meso- and micro-level factors that influence coordination and quality of care in the Swiss homecare setting. It provides valuable insights into this increasingly important setting.

Both policymakers and homecare management are called upon to develop a homecare working environment that fosters high-quality care. A one-sided focus in the system of long-term care on cost reduction alone can cause lasting damage to the care system's supply structures and should certainly be avoided. A more productive long-range strategy is to focus on durable quality as an investment to reduce long-term costs. As another investment example, well-aligned financial incentives are essential to achieve and maintain financially sustainable, accessible and high-quality homecare.

To prepare the way forward, research that covers the relevant multilevel health system factors to produce reliable results and support informed decisions demands reliable databases. Both to explore the interactions across all three health system levels and to identify which regulations and factors impact quality calls for reliable and transparent data structures.

As an initial step, the current focus must be broadened to include not only cost containment but also quality. High quality reduces costs, while well-aligned financial incentives help providers achieve and maintain sustainable, accessible, high-quality homecare. However, enabling reliable statements and supporting informed homecare decisions will require a database that spans all health system levels. This will allow researchers to explore multilevel interactions and identify which regulations and factors influence quality, cost and value.

While contributing further to the understanding of care coordination with the COORA framework. COORA has the potential to standardize our understanding and measurement of coordination. Beginning with the distinction between coordination as a process and as an outcome, this dissertation also raises key methodological issues. From both a research-oriented and a practical perspective, measuring and operationalizing both coordination and quality of care remain challenging issues. COORA can also guide researchers to develop research questions, to operationalize coordination, and especially to develop and evaluate theory-based interventions.

Coordination problems including gaps in information exchange and non-involvement of homecare workers in hospital discharge were identified. In these cases, gaps in inter-provider communication (whether personal or impersonal) precipitated coordination failures. While improved coordination shows potential to improve care quality, its success requires, on the one hand, the abandonment of silo-thinking, and on the other, access to adequate financial or technical resources. Homecare agencies in particular are called upon to create develop or adapt existing structures to promote coordination across settings.

And finally, homecare agencies need to reflect on which implicit coordination mechanisms, including role clarity, mutual respect and trust, accountability, predictability, common perspective, and employee knowledge of the health system, are present and which are lacking in their work environments. This will mean monitoring how their staff communicate both with one another and with other providers. Every step of the way, they need to remember that developing successful strategies to improve care coordination demands the involvement of the entire care team.

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