

A Nurse-led Model of Care's effectiveness (INTERCARE) in Reducing Unplanned Transfers from Swiss Nursing Homes

Inaugural dissertation

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To my Nana,
who passed away peacefully in her nursing home.

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List of abbreviations

ACP	Advance Care Planning
ACSC	Ambulatory Care Sensitive Conditions
ADL	Activities of Daily Living
APRN	Advanced Practice Registered Nurse
APN	Advanced Practice Nurse
CAS	Certificate of Advanced Studies
CFIR	Consolidated Framework for Implementation Research
CGA	Comprehensive Geriatric Assessment
CI	Confidence Interval
CPS	Cognitive Performance Scale
CRP	Cardio-Pulmonary-Resuscitation
CT	Computed Tomography
DRS	Depression Rating Scale
ECCP	Enhanced Care and Coordinator Provider
ED	Emergency Department
ERIC	Expert Recommendations for Implementing Change
GEE	Generalized Estimating Equations
GLMM	Generalized Linear Mixed Models
GP	General Practitioner
INTERACT	Interventions to Reduce Acute Care Transfers
INTERCARE	Improvement of Interprofessional Care for Better Resident Outcomes
IPR	Interpercentile range
IPRAS	IPR Adjusted for aSymmetry
ISBAR	Introduction, Situation, Background Assessment, Recommendation
IQR	Interquartile Range
LPN	Licensed Practical Nurse
LVN	Licensed Vocational Nurse
MOQI	Missouri Quality Initiative
MScN	Master of Nursing Science
NH	Nursing Home
NP	Nurse Practitioner
OR	Odds Ratio

OPTIMISTIC	A Program to Improve Nursing Home Care and Reduce Avoidable Hospitalizations
PAH	Potentially avoidable hospitalisation
PDSA	Plan-Do-Study-Act
PEACH	Proactive HEAlthcare of Older People in Care Homes
PPI	Patient and Public Involvement
RAI-NHs	Resident Assessment Instrument for NHs
RE-AIM	Reach, Effectiveness, Adoption, Implementation, Maintenance Framework
RN	Registered Nurse
SD	Standard Deviation
QI	Quality Improvement

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Summary

Nursing home (NH) residents are increasingly frail and suffer from multiple chronic illnesses, combined with functional and cognitive impairment. Due to their vulnerable health, residents are increasingly prone to sudden health deterioration due to an exacerbation of a condition or injury, resulting in an unplanned transfer such as an emergency department visit with or without an ensuing hospitalisation.

Hospitalisations put residents at risk for iatrogenic and nosocomial infections, complications, medication errors, and increased functional and cognitive impairment upon return to the NH. Additionally, transfers can create stress due to disorientation from isolation and changes in the environment, increase side effects from polypharmacy, delirium, and hinder mobility causing potential deleterious consequences. Some of these hospital transfers are avoidable or inappropriate. Increased geriatric expertise is needed in NHs to detect changes in residents' conditions at an earlier stage and to also address the overall growing lack of nurses and general practitioners in NHs.

Various nurse-led models of care have been developed and implemented in various countries building on different bundles of core components. Some of these models have shown effectiveness in decreasing unplanned or avoidable transfers, yet others have failed to show effectiveness. Few studies have investigated the reasons behind success or (partial) failure in reducing transfers. As well as highlighting the critical role of contextual analysis to adapt interventions to a specific context and setting, implementation science seeks to study methods and strategies to facilitate the uptake of an intervention in practice and to help interpret variations in implementation success.

The overall goal of this thesis was to evaluate the clinical and implementation effectiveness (degree of implementation fidelity) of a nurse-led model of care (INTERCARE) in reducing unplanned transfers from NHs; and gaining a better understanding of which resources could be introduced to mitigate one of the most common reasons for an unplanned transfer: fall-related transfers.

This thesis is embedded in the “Improving INTERprofessionalCARE for better resident outcomes (INTERCARE)” study which is a multi-centre non-randomized stepped-wedge design within a hybrid type-2 effectiveness-implementation study, implemented in 11 NHs in German-speaking Switzerland. This thesis explores and discusses how a reduction of unplanned transfers can be achieved with the example of the degree of implementation fidelity, as well as

further steps needed in NHs to reduce potentially avoidable transfers, with the example of fall-related transfers. This thesis contains 6 chapters.

Chapter 1 introduces the current issues faced by NHs and which contribute to unplanned transfers, the differences between avoidable hospitalisations and inappropriate emergency department visits and the different models of care which have been implemented in NHs to decrease unplanned and avoidable transfers. An overview of the INTERCARE project and its core components follows with a brief introduction to implementation science with a focus on the degree of implementation fidelity. **Chapter 2** outlines the overall goal and aims of this thesis.

Chapter 3 reports and discusses the clinical effectiveness of INTERCARE on the main outcome of unplanned transfers. A total of 942 residents with informed consent were included (females 69%) with a median age of 85.5 years, representing an overall consent rate of 68% across the 11 NHs which took part in the study. 303 unplanned (82.6%) and 64 planned transfers were collected during the study. The findings showed that during the baseline period, unplanned transfers increased over time after which the trend significantly changed resulting in a flattening of the average transfer rate throughout the post-intervention period. Furthermore, to confirm our results a larger anonymized dataset confirmed the trend discontinuation after intervention start, compared to the initial transfer rate trajectory. This chapter supports the effectiveness of INTERCARE and of nurses working in extended roles to enhance the geriatric expertise and provides an alternative for NHs which do not have access to advance practice registered nurses.

Chapter 4 applied a mixed-methods convergent/triangulation design to investigate the influence of implementation fidelity on unplanned transfers and explores the relationship which implementation fidelity to INTERCARE has on unplanned transfers. We combined findings from qualitative notes about implementation of the core components and fidelity scores over time to better understand which moderators (qualitative data) can explain the fidelity trajectory over time (quantitative data). Higher fidelity scores showed a decreasing rate of hospital transfers post-intervention, higher fidelity scores to advance care planning were associated with lower unplanned transfers and lower fidelity scores for communication tools (ISBAR and Stop&Watch) showed higher rates in unplanned transfers. NHs with in-house physicians, with a collaborative approach and with staff who perceived the need for support from nurses working in extended roles, were factors which helped achieve and sustain high fidelity to the INTERCARE model. This chapter presents a pragmatic way of measuring fidelity to a complex intervention and the application of a conceptual framework to help link implementation fidelity

to unplanned transfers. **Chapter 4** provides an overview of measurement issues linked with fidelity and the difficulty to accurately tackle the complexity of the outcome.

Chapter 5 focuses on fall-related transfers, one of the most common reasons for a transfer to hospital from NHs. This study uses a multi-method design to identify resources which are appropriate for the Swiss context to support NHs to better manage residents after a fall or fall-related injury. Potentially avoidable fall-related transfers were rated by an expert panel comprised of 5 experts from different fields of medicine and nursing with expertise in geriatrics. Furthermore, for every adjudicated transfer as potentially avoidable, resources needed to prevent the transfer were given. The resources were discussed in a panel of NH stakeholders and refined. An appropriateness questionnaire was sent to a larger group of NH stakeholders, to identify key appropriate resources for future implementation. Findings showed that 25% of fall-related transfers were rated as potentially avoidable and reasons included the possibility for an outpatient appointment, the transfer occurred before a medical assessment (i.e., by a NH GP) could be carried out, the resident was transferred because of an incorrect assessment and the necessary resources to handle and treat the resident were available in the NH. The findings from the appropriateness rating revealed that access to diagnostic resources such as mobile or outpatient X-ray/CT during office hours and access to timely geriatric consultation (GP, APRN, expert nurses with additional training) were deemed relevant for implementation. Further, resident care and treatment in the NH, such as wound dressing, suturing and following algorithms to assess a resident in the NH were also deemed relevant for implementation. Further research is needed to develop interventions geared to limit potentially avoidable fall-related transfers.

Chapter 6 synthesizes and discusses major findings of all studies in the context of the literature. Furthermore, strengths and weaknesses of this thesis are examined and implications for future research, policy and practice are presented.

Chapter 1

An ageing population, nursing home hospital transfers and the INTERCARE study

1.1 Introduction

In 2020, 20.6% of the European population was aged 65 years and above and this is estimated to increase to 24% by 2030¹. With a growing ageing society, increased burden will be placed on long-term care, in particular on nursing homes (NH) as many older adults will require institutional care and assistance with daily activities². Currently, NHs are challenged with restricted resources, difficulty to recruit and retain staff and ensuring good quality of care for residents; and this challenge will remain. Furthermore, the proportion of older adults entering NHs with complex needs has progressively increased and if they require hospital care, hospital stays are shorter, leaving NHs to care for sicker older people. Parallely to the growing demand on NHs to address complex care needs of residents living in NHs, NHs lack nurses and general practitioners (GPs) with geriatric expertise³. Care is mostly delivered by NH staff with little training in the management of chronic conditions and in the detection of early signs of deterioration². This can lead to an increase in unplanned transfers and emergency department visits (ED) with or without hospital stay, some of which could be potentially unnecessary⁴. This chapter will describe the current issues NHs face and possible solutions to reduce unnecessary NH transfers. This will lead to the introduction of a contextually developed nurse-led model of care - INTERCARE, as a solution to decrease unplanned transfers by increasing geriatric expertise in NHs.

1.2 Multimorbidity in nursing homes

Approximately 80% of people aged 65 years and above living in NHs have at least one chronic condition such as heart disease, diabetes, and cognitive impairment including Alzheimer's disease or dementia⁵. Chronic conditions do not only impact the quality of life of older adults, but are also associated with considerable costs for health systems, for instance, 75% of health care costs in the U.S. are due to chronic illnesses⁶. Multimorbidity is defined as living with two or more chronic conditions and can involve pain, functional limitations and the need for long-term management of symptoms^{7,8}. Multimorbidity is prominent in NH residents and this can complicate treatment and management within the NH setting as these residents are at higher risk of an exacerbation⁹⁻¹¹. Exacerbations of chronic conditions can occur due to failure in recognizing early warning signs and symptoms of deterioration (e.g., breathlessness leading to heart failure decompensation). To improve recognition and the management of signs and symptoms leading to a deterioration in condition, as well as addressing common risk factors which can prepone an exacerbation, geriatric expertise and skill are needed in NHs, which is a

challenge given the lack of adequately trained staff in NHs³. Inability or delay in recognition of resident deterioration can lead to a hospital transfer, some of these may be unnecessary with adequate chronic condition management¹².

1.3 Nursing home transfers

Unplanned transfers, defined as unexpected visits to an acute care setting, either resulting in an emergency department (ED) visit only or in a hospital admission, are more frequently observed in NH residents compared with community dwelling older adults¹³. Around 1.8 ED visits occur annually per resident and less than half of ED visits result in a hospitalisation¹⁴. Proportions of unplanned transfers from NHs range from 6.8% to 45.7%¹⁵. This wide range depends on the studies, definitions and varying time-periods measuring hospital transfers¹⁶ which makes comparisons between settings and countries difficult. Table 1 defines the different types of transfers described in this chapter.

Table 1: Types of hospital transfers and their definitions

Transfer type	Definition
Unplanned transfers	Unexpected visits to an acute care setting either ED visit or ED visit with ensuing hospitalisation.
Inappropriate ED visits^{17,18}	Clinical situations that could be managed by other means than a transfer to the ED without loss of opportunity for the resident. Examples include: “the absence of somatic and psychiatric emergency conditions” and/or “palliative care known before decision to transfer” and/or “the presence of advance directives of non-hospitalisation in the resident’s medical chart”.
Avoidable hospitalisations^{12,19}	Transfers which could have been avoided with adequate chronic disease management, prevention of exacerbations of chronic conditions or when treatment could have been delivered in the NH.

For both ED visits and hospitalisations from NHs, falls, injuries and infections are described as the main reasons motivating the transfer^{20,21}, although there are differences

between residents transferred to the ED and subsequently discharged, and the ones who are admitted to hospital. Visits followed by an ED discharge were more frequently characterized by treatment for injuries (44.8% in ED vs. 25.3% for hospitalisations) and hospitalised residents were more likely to be treated for an infection (22.9% for hospitalisations vs 11.1% for ED visits)¹⁴. Differences also include a higher proportion of residents presenting to the ED with normal vital signs compared to those hospitalised (62.8% for ED visits vs 41.8% for hospitalisations). In particular, residents subsequently admitted for an injury as in-patients had abnormal vital signs, compared to residents discharged from the ED and presenting for the same reason^{14,22}.

Common consequences of a hospital stay or ED visit include increased confusion and distress^{23,24} due to the sudden unfamiliar environment, the noise and waiting times. Functional decline has been frequently described in the literature post ED visit which entails the need for more support in their activities of daily living when discharged back to NHs²⁵. More serious consequences may include increased residents' risk of morbidity, adverse drug events, inadequate treatment, rehospitalisation and mortality²⁶. Furthermore, certain subgroups of residents such as older adults with cognitive impairment have a higher probability of receiving delayed pain assessment and treatment in hospital, compared with older adults without cognitive impairment²⁴. Additionally, around 30% of older adults received inappropriate initial treatment in the ED²⁴.

1.4 Avoidable nursing home transfers

1.1.1 Definition and rating of avoidability

Some hospital transfers are deemed either unnecessary or preventable and defined as transfers which could have been avoided with adequate chronic disease management, prevention of exacerbations of chronic conditions or when treatment could have been delivered in the NH. One way to identify avoidable transfers is using the ambulatory care sensitive conditions (ACSCs)^{19,27,28} which is a list of symptoms and common conditions, identified by ICD-10 codes²⁹ based on discharge data. The list of ACSCs was first developed for primary care and later refined for use in NHs^{19,29}. These include the most prevalent conditions for ED visits and hospitalisations which could be potentially managed in an outpatient facility or in the NH with adequate resources¹⁹. The list of conditions associated with potential avoidability for NH residents includes angina, asthma, bacterial pneumonia, chronic obstructive pulmonary disease, chronic heart failure, diabetes, dehydration, gastroenteritis, hypertension and urinary

tract infections, as well as falls and transfers due to fall-related injuries¹⁹. The most common ACSCs which are responsible for NH transfers include: falls and trauma (53.6%), pneumonia and bronchitis (15%) and chronic heart failure (12.1%)^{30a}. Although ACSCs are good proxies to identify avoidable transfers and help pinpoint areas for improvement, ACSCs are indicators but not direct measures of NH care. On one hand, context-specific variations (e.g., continuity of care) need to be carefully considered when using ACSCs and on the other, additional methods with a comprehensive rating of avoidability need to be developed to gain a better understanding of further factors which can contribute to an avoidable transfer^{30b}. For instance, factors include sociocultural norms and the standard of care in NHs which can help to better understanding what drives avoidable transfers³¹. Conjointly to ACSCs, different criteria has been used to target conditions or situations leading to an avoidable transfer based on a variety of components relating to the transfer situation. This included a balance between timeliness of assessment, results of ordered tests, availability of diagnostic and treatment resources (e.g., imaging, oxygen therapy, intravenous access) within NHs, availability of medical and nursing accessibility and expertise, advance directives and correct application of directives, resident and relative preferences, availability of background medical information, and comorbidities³².

A thin line exists between appropriate and inappropriate hospital transfers of NH residents and these can be challenging to measure and report due to the rater's subjectivity, the definition used and how these are classified³³. To adjudicate transfers as inappropriate or avoidable, resident documentation such as medical discharge reports containing the final diagnosis, root cause analysis^{34,35} which contains more information about the proceedings leading to the transfer, and nursing notes containing contextual information are usually the main sources used. Medical expert panels review transfer cases and based on the information present in the medical and nursing records conclude with regards to the inappropriateness of the ED visit or avoidability of the ED visit and ensuing hospitalisation, based on the final diagnosis and conditions leading to the hospital transfer. One identified issue regarding the use of expert panels is the lack of consensus of definitions used and having to relying on experts' judgements and opinions which are subjective and can change overtime based on the person's experience³⁶. A second issue is how the notion of avoidability can change over time based on a person's knowledge and on the learning effect itself. Although these points are raised in studies, expert panels are still considered as a much-valued approach to rate avoidability of hospital transfers and inappropriateness of ED transfers³⁶.

1.4.1 Inappropriate emergency department visits

Inappropriate ED transfers are clinical situations that could have been managed by other means than a transfer to the ED without loss of opportunity for the resident^{18,22,36,37}. These differ from avoidable hospitalisations as these are visits to the ED only and do not result in a hospitalisation. Inappropriate ED transfers are often associated with conditions for which better management could have occurred in the NH preventing an ED transfer. Studies report that the most common inappropriate ED visits were for injuries related to falling, fever, decreased food or fluid intake, functional decline, shortness of breath, new urinary incontinence, heart conditions and pneumonia³⁷⁻³⁹. A proportion of ED visits usually lead to a rapid discharge back to the NH, with 19% of ED visits receiving no diagnostic testing¹⁴. Furthermore, a scoping review evaluated interventions aimed at decreasing inappropriate ED visits and reported that successful ones can reach a decrease of 10% to 70% of visits. The interventions which are the most effective in reducing inappropriate ED visits are the ones based on interdisciplinary health care teams, especially close collaboration with GPs and resident assessments^{40,41}. While Kane et al. and Jensen et al. reported significant reductions using different interventions using outreach team, findings were varied across studies, suggesting that the interventions' design and implementation are critical to the achieved impact^{32,42}.

1.4.2 Factors associated with avoidable and inappropriate transfers

GP access

Despite differences in health care systems, levels of geriatric expertise, staffing models, and leadership practices between NHs, similar contributing factors to potentially avoidable hospital transfers including inappropriate ED visits, have been described. One main factor reported in the literature is the difficulty experienced by nurses to reach general practitioners (GPs) and ask for a timely resident assessment in the NH^{17,18}. If GPs are not available, nurses often do not feel equipped to manage the resident in the NH without medical support which prompts for an ambulance transfer¹⁷. Most GPs can be reached over the phone; however, phone conversations can also be challenging for both nurses and GPs. GPs can feel frustrated with the lack of precise information received and the inability to handle the situation over the phone leading to a transfer⁴³⁻⁴⁵, and nurses can find it difficult to communicate effectively with GPs¹⁷. In acute situations occurring during out-of-hours, emergency or "on call" GPs are often unfamiliar with both residents and NH staff. This can be challenging for GPs to safely treat residents in NHs and can motivate the decision to transfer, especially if the resident has complex

needs⁴⁶. Another factor, is the number of GPs responsible for residents in NHs and the difficult coordination associated with managing a large variety of GPs each with their own preferences, which contributes to communication difficulties as well as NH organizational deviations^{47,48}.

Geriatric expertise

The lack of geriatric expertise and knowledge of geriatric conditions in NHs is an additional issue contributing to avoidable transfers⁴⁹. Geriatric assessment is complex and recognition of subtle changes leading to rapid deterioration in older adults requires advanced skills, which NH staff can lack¹², in particular nurse aides or nurse assistants which are responsible for most of the residents' care⁵⁰. In addition to recognizing acute deterioration, adequate management of the resident during an acute event is needed to avoid a transfer. As NH residents have multiple comorbidities, clinical management is complex and challenging, thus fostering and supporting training opportunities for NH staff to develop their skills and competences as well as retain staff with experience in long-term care to coach less experienced staff can address this issue⁵¹. Additionally, allowing nurses with more ambition to develop their portfolio by undertaking additional training such as a certificate of advanced studies (CAS) or by following specialist courses can also provide opportunities for nurses to gain in leadership aptitudes⁵¹.

NH staff recruitment

NHs have been given the image of unattractive settings to work and develop in, mainly due to underinvestment in infrastructure (e.g., some NHs have double or tribble bedrooms making working conditions difficult) and in innovation compared with acute hospitals⁵². This in turn can lead to staff recruitment and retention challenges. Moreover, addressing the lack of geriatric expertise is needed but this can only be supported by an appropriate supply of both GPs and nurses with the right skill-grade mix, needed to tackle avoidable transfers⁵²⁻⁵⁴.

Diagnostic resources

Limited access to diagnostic resources (i.e., access to imaging, bladder scans) and clinical equipment (i.e., wound dressing, cast plastering area) within NHs, restrict the spectrum of procedures which can be performed in the NH to limit avoidable transfers. One example are fall-related injuries which are common in NHs and residents can be transferred for simple sutures, dressings or wound assessments, which could be conducted in NHs with the right equipment and training³⁵. Studies show that radiography is the most important diagnostic test in the elderly population, yet NHs rarely have the possibility of accessing such services without

a hospital referral⁵⁵. In Canada for instance, half of NHs have access to blood tests, and less than half have access to radiology, urine cultures and bacteriology and intravenous therapy (e.g., rehydration, antibiotics)⁵⁶. NHs with access to the above-mentioned diagnostics and treatment options, had fewer inappropriate ED transfers⁵⁶. In addition to having the appropriate resources in NHs it is as important to have NH staff accordingly trained and have diagnostic skills to be able to use the medical resources and initiate appropriate treatment¹⁹.

Advance care planning

Another contributing factor to avoidable transfers, is the lack of advance care planning (ACP) in NHs, despite its relevance^{34,57}. Currently, ACP uptake is considered rather low in NHs as few residents and their relatives are asked about wishes regarding their care, including preferences concerning end of life care (e.g., if a hospital transfer is wanted in case of sudden deterioration)⁵⁸. NH staff lack training in ACP and can be afraid of leading sensitive conversations and addressing complex questions and issues around end of life care (e.g., family disagreements)³⁴. Combining better GP access or access to geriatric expertise and support for NH staff with an uplift in attractiveness for NHs, with further work on ACP and diagnostic and treatment resources can enhance the quality of care in NHs and contribute to limiting avoidable transfers.

1.4.3 Fall-related transfers

Falls or fall-related injuries in NHs remain one of the main reasons for an ED visit or hospitalisation⁴⁹, despite a lot of research conducted in the area of fall prevention. Although multi-component interventions targeting NH staff knowledge and training, polypharmacy, NH organisation, and resources are important for the prevention of falls or for a falls-risk assessment, some falls are not preventable even if good fall prevention measures are applied^{18,59}. Gruneir et al., reported that 87% of all ED visits from NH residents were fall-related¹⁸, which is supported by other authors reporting that falls or falls related injuries are ranked as the predominant reasons for ED visits^{14,59}. Very little research has been conducted to investigate what is needed in NHs to mitigate potentially avoidable fall-related transfers, in other words the immediate post-fall period remains under-researched. Sluggett and colleagues investigated opportunities for fall prevention and transfer to hospital avoidance with a focus on strategies to avoid the fall rather than implementable resources to manage falls once they have occurred in NHs³⁵. Targeting specific causes of avoidable transfers and integrating measures in

broader initiatives could also help address this gap and further decrease avoidable transfers overall.

1.5 Nurse-led models of care

In order to reduce hospital transfers, strategies have been developed and include implementation of individual interventions targeting specific issues linked with hospital transfers such as NH staff palliative care training⁶⁰, introduction of ACP especially targeting older adults with cognitive impairment⁶¹, or algorithms focusing on specific common conditions (i.e., pneumonia)⁶². However, such individual strategies have yielded uncertain results depending on NHs' organization, stability and research methods used⁶³. One key strategy to reduce hospitalisations is the development and implementation of new models of care which allow to simultaneously address several factors by means of a multifaceted approach to increase geriatric expertise in NHs and to improve NH staff's clinical practice and target issues contributing to hospital transfers.

In order to tackle the reduction of avoidable hospitalisations, Ouslander et al., developed a comprehensive bundle of interventions as part of the "Interventions to Reduce Acute Care Transfers (INTERACT)" program⁶⁴. INTERACT included leadership and NH staff education, as well as collective telephone conference calls, and early warning communication tools, all targeted at improving the identification, assessment, and management of acute situations (often leading to a transfer), which could be dealt in the NH by care staff as opposed to transferring the resident. This program reduced transfers from NHs by 17%, across 25 NHs⁶⁴.

The OPTIMISTIC program built on the "INTERACT" program but also included nurse practitioners (NP) which cooperated with NHs and was successful in reducing potentially avoidable NH transfers⁶⁵. Ingber and colleagues implemented seven "Enhanced Care and Coordination Provider (ECCP)" models in 7 states in the USA, recruiting 67 000 residents⁶⁶. The ECCP models aimed at improving the overall health and health care of NH residents, with the primary goal of reducing potentially avoidable hospitalisations. Core elements of these models included either registered nurses (RN), nurse practitioners (NP) or advance practice registered nurses (APRN) which were responsible for delivering aspects of the models within NHs, such as education/training, clinical assessments or direct care to residents⁶⁶. They also supported the implementation of communication improvement tools, and in certain NHs, interventions for medication management and end-of-life care. Unlike other models such as OPTIMISTIC or INTERACT, the NHs implementing the ECCP models had the flexibility to

choose which interventions they wished to implement with the minimal requirements of hiring on-site staff and selecting interventions to improve interprofessional communication and coordination⁶⁶. This initiative resulted in a decrease of a probability for an acute care transfer of 8% and an avoidable transfer in 17% of cases⁶⁶.

The Missouri Quality initiative (MOQI) achieved a 30% reduction in all-cause hospitalisations and included APRNs hired for each participating NH to provide direct care to residents, coach NH staff and provide education and training about early detection of deterioration of acute symptoms and conditions⁹⁰. The MOQI model also implemented the INTERACT tools as core components⁹⁰.

The Aged Care Emergency program was implemented in 81 NHs and proved successful in reducing hospital admissions (21% less likelihood for a resident to be transferred). This program included interprofessional collaboration and strong partnerships with hospitals with an ED specialist nurse which could be contacted if a resident deteriorated in the NH⁶⁷.

Although these above-mentioned multi-component models reduced NH transfers, it is unclear to what extent each of the components was essential attributes resulting in a successful effect on the main outcome and how they interacted with each other. Other models built with similar components, such as services coordinated by APRNs and education programs for NH staff or implementation of multidisciplinary case discussions led by a geriatric nurse specialists as well as NH staff training in did not show an effect on reducing inappropriate ED visits⁶⁸ or avoidable hospitalisations^{69,70}. It is interesting to note that whilst most of these complex interventions have very similar core components and have included the combination of geriatric expertise, improved communication and guided reflection around NH transfers to foster a better understanding of how to reduce these transfers, it is not always clear why some achieve their pre-specified outcomes and others fail to do so⁷¹.

1.6 Implementation science

Implementation science is defined as the study of methods to support the systematic uptake of evidenced-based interventions into policy and practice⁷². Implementation Science seeks to close the gap between what we *know* and what we *do* (often referred to as “the know-do gap”) by identifying and addressing the barriers that slow or halt the uptake of proven health interventions and evidence-based practices. This enables a better understanding of why the intervention succeeded or, on the contrary, (partially) failed^{72,73}. By measuring a range of implementation outcomes as well as barriers and facilitators to an intervention’s

implementation, researchers can evaluate how effectively interventions are being implemented. Implementation outcomes are indicators of the implementation success and include outcomes such as adoption, degree of fidelity, acceptability and feasibility. Implementation outcomes provide information about implementation processes as well as the preconditions necessary to achieve clinical effectiveness and/or service outcomes⁷⁶. Moreover, collecting data about the implementation process can provide early insight into why intervention recipients do not adopt or struggle to implement an intervention or fail to sustain it⁷⁴. The next sub-chapter, will address the implementation outcome of implementation fidelity which is a critical indicator of the successful translation of evidence-based interventions into practice⁷⁵.

1.7 Implementation fidelity

Implementation fidelity is defined as “the degree to which programs are implemented as intended by the program developers”⁷⁶ and is considered to be an important moderator between the intervention and its intended outcome(s). As such, to identify why a model was successful or (partially) unsuccessful in decreasing unplanned or avoidable transfers it is important to consider the degree of implementation fidelity. Indeed, measuring the degree of fidelity allows to differentiate between intervention failure and implementation failure and it is an important outcome which can facilitate an intervention’s replication and generalizability. If implementation fidelity is low, then the likelihood of reaching the defined outcomes is weak⁷⁷. The INTERACT team reported the degree of implementation of the program’s components which demonstrated that NHs which reported an increased use of INTERACT achieved a significantly higher reduction in all NHs transfers compared to NHs with lower use⁷¹. Not many complex interventions conducted in NHs have reported on the degree of implementation fidelity and potential approaches to the measurement are lacking in the literature. As discussed by Ouslander and colleagues, this is highly needed to better understand which programs are successfully implemented⁷⁸.

A recent scoping review identified that only 3% of NH studies reporting the implementation of a quality improvement program measured and reported fidelity⁷⁹ which is congruent with other fields of study, where fidelity is not consistently reported. In the studies which do measure and report fidelity, it is not clear if a conceptual framework was used and if all components were assessed or if only certain aspects of an intervention were the basis for fidelity measurement⁸⁰. It is also clear that it is important to understand the causes of why an

intervention or component has lacked in fidelity, which is also not reported in NH studies and often listed as a limitation⁸¹.

Studies which have measured and reported on the degree of implementation fidelity commonly define fidelity as a combination of dose and reach and one of the methods used for the measurement consists of counting numbers of sessions (e.g., psychological sessions in a behavioural change intervention) or have an objective way of checking if a certain action was performed as it should have over a period of time (e.g., interventions delivering repeated teaching sessions to patients)⁷⁵. Measuring fidelity is challenging for complex interventions, as no measurement tools are available unlike for the measurement of acceptability or feasibility of an intervention (<https://implementationoutcomerepository.org/>). Further research is needed to operationalize the measurement of implementation fidelity and decipher which aspects of fidelity are important to focus on, and which approaches adequately measure fidelity in complex interventions. Data collection to support robust data analysis for fidelity can be resource-intensive and not always possible in multi-component interventions. Usually sample size limitations are discussed as limitations in studies as well as the struggle to collect observational qualitative data, which is recommended for fidelity assessment⁷⁹.

1.8 The Swiss context and the INTERCARE study

This dissertation is embedded in the INTERCARE study, taking place in Switzerland. The following sub-sections will give an overview of the Swiss NH setting as a basis to better understand what the INTERCARE project intended to achieve. An overview of the INTERCARE study is presented with focus on the implementation stage of the project.

1.8.1 The Swiss nursing home context

Switzerland comprises four language speaking regions (Swiss-German, French, Italian and Reto-romance) and counts 26 cantons (states). In the Swiss federalist system, cantons are responsible for the organisation of care delivery to their population. This federalist governance also allows for the implementation of local strategies and models of care, which are tailored and adapted to the needs of the local population and health system.

In 2019, the Federal Office of Statistics reported a total of 1565 NHs and 100'356 beds⁸². NHs employed 41% of the total care staff (45% are employed in hospitals). There are three main categories of care professionals in Switzerland, defined according to function and level of training. Registered nurses in Switzerland have at least 3 years of education and training, a "Fachperson Gesundheit" is comparable to a licensed practical nurse

(LPN) / licensed vocational nurse (LVN) in the US and has a 3-year education in healthcare but is not referred to as a nurse in Switzerland. Nurse aides have a 2-3 months course or on the job training and certified nurse aides have a 2-year education⁸². The majority of registered nurses work in hospitals (67% of the total), while LPNs or LVNs are more likely to be employed in NHs (58%), similarly to nurse aides (60%). In 2018, the grade-skill mix in NHs was about 30% registered nurses, 40% LPNs/LVNs and 30% nurse aides⁸². Since 2001, RNs have had the possibility of undertaking a Master of Nursing Science degree (MScN) and advance practice courses to take up Advance Practice Registered Nurse (APRN) positions. The number of registered nurses in Switzerland with a MScN was 828 in 2020 (<https://www.vfp-apsi.ch/portrait-pflegewissenschaft/bildung/>). Modules available in Swiss Universities focusing on competencies for primary care were only available from 2010 onwards. Currently, career options for APRNs offer larger prospects in university or cantonal hospitals rather than in NHs. This is due to the lack of “role” models in NHs and introducing APRNs can be daunting for NHs directors and some GPs resistance can be felt (i.e., apprehension toward task shifting). The NHs seem less attractive for APRNs compared with acute settings and the lower salaries in NHs add to the lack of incentives for APRNs to work in NHs⁸³. APRNs can share some of the GP tasks and support NH staff in NHs. APRNs have shown to provide a sustainable solution to increase geriatric expertise, provide support and take over defined tasks in NHs.

GPs have been the dominant responsible medical providers for primary care in Switzerland and there is a growing need to address the issue of insufficient numbers due to retirement and a lack of young GPs taking over⁸³. The majority of GPs (77%) responsible for residents in NHs are off-site. Additionally, NHs work with a variety of GP models. A closed model refers to having a NH based physician which is responsible for the majority of NH residents, an open model refers to working with several GPs which are not on site; and a mixed model refers to having a responsible physician assigned to the NH but most of the medical care provided by several different GPs. In order to provide a solution for NHs to overcome the shortage of GPs and the limited access to APRNs, a contextual nurse-led care model was developed for Switzerland, to enable NHs to use in-house resources by allowing RNs to conduct further training and become central components driving the INTERCARE model.

1.8.2 The INTERCARE study

Improving INTERprofessional CARE for better resident outcomes – INTERCARE –, is a hybrid type 2 implementation science study which simultaneously evaluates the intervention and implementation effectiveness^{73,84}. INTERCARE was implemented in 11 NHs in the German speaking part of Switzerland for a total duration of 21 months. A non-randomized stepped-wedge design was used to sequentially roll the intervention out. The stepped-wedge design is an attractive design for settings such as NHs as it enables all NHs to benefit from the intervention and for each NH to act as its own control⁸⁵. Each NH started with a baseline period of 3 months then had a one-month transition period to fully implement the INTERCARE model comprising six core components⁸⁴.

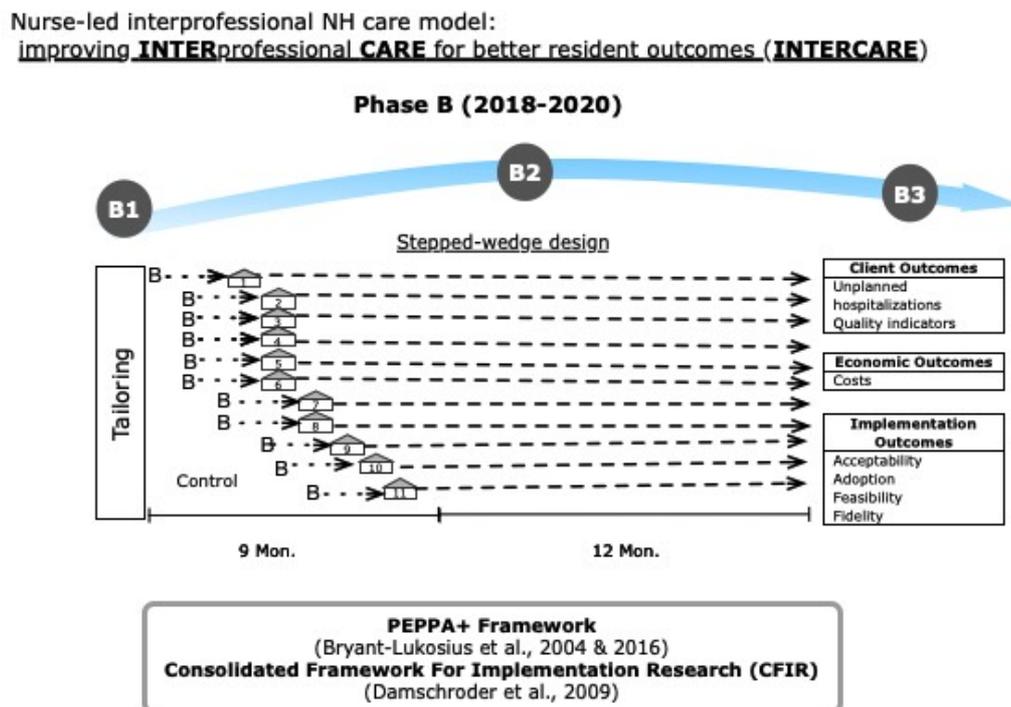


Figure 1: Design of INTERCARE phase B depicting the stepped-wedge implementation and measured outcomes.

The INTERCARE nurse-led model of care builds on intervention elements identified in the literature as effective in reducing unplanned hospitalisations. Based on a contextual analysis of existing nurse-led models in the Swiss nursing home setting and stakeholder input, including policy makers, health care providers, professional groups and residents, a group of six

intervention elements were defined⁸⁴. Additionally, national routine hospital transfer data was analysed to identify main reasons for avoidable transfers from Swiss NHs to acute care in order to target appropriate training and support for participating NHs³⁰. For the core intervention elements, we defined both minimal requirements mandatory for implementation and peripheral requirements that allowed for local tailoring. In brief, the core components included 1) interprofessional collaboration through the development of internal processes to facilitate communication between physicians and health care workers, including nurses; 2) an INTERCARE nurse with at least a registered nurse's diploma and three years professional experience in NHs, and followed a tailored curriculum to strengthen their geriatric expertise⁸⁶; 3) a comprehensive geriatric assessment of the residents initiated by INTERCARE nurses when needed; 4) evidenced-based tools to improve communication and recognize early warning signs and symptoms as used in the INTERACT-based studies⁶⁴; 5) advanced-care planning to help NHs initiate early discussions and document residents' wishes; and 6) data-driven quality improvement feedback to the NHs, to help them identify potential areas for improvement (e.g., advance care planning).

The contextual analysis with case studies of NHs already working with nurses in expanded roles helped to identify barriers and facilitators for the introduction of such models. Based on the results, implementation strategies (e.g., blended curriculum, two weekly telephone support for the INTERCARE nurse) were tailored to the local context to address implementation issues and discuss quality problems.

1.8.3 Theoretical frameworks

The Consolidated Framework for Implementation Research (CFIR) guided the development, implementation and evaluation of the INTERCARE study overall⁸⁷. CFIR has five domains which guide researchers to implement research into practice. These domains include: “*intervention characteristics*”, the “*outer setting*”, the “*inner setting*”, “*characteristics of the individuals*” involved and the “*process of implementation*”⁸⁷. During INTERCARE's contextual analysis, the CFIR framework was used to consider the available evidence and quality to develop INTERCARE's evidenced-based core components. In preparation for the implementation of INTERCARE, leadership meetings were conducted with the NHs to discuss important aspects of the “*outer setting*”, such as residents' needs and resources required, and to address structural characteristics of the participating NHs. Further, topics such as readiness for implementation, leadership engagement and implementation

climate were measured by means of staff and leadership questionnaires at various time points during the study including at baseline. Barriers and facilitators were identified through CFIR and implementation strategies were developed based on these to support the implementation and sustainment of INTERCARE.

The Care Transitions framework expands the CFIR framework with focus on transitions from one setting to another⁸⁸ which is the central theme of this thesis, with the additional domains of “*measures of implementation*” and “*outcomes*”. This framework guides the evaluation of interventions’ implementation to address how, why, and where interventions such as INTERCARE succeed or fail to achieve intended outcomes and how their components interplay⁸⁸. Figure 2 gives a simplified description of the framework and elements from this thesis.

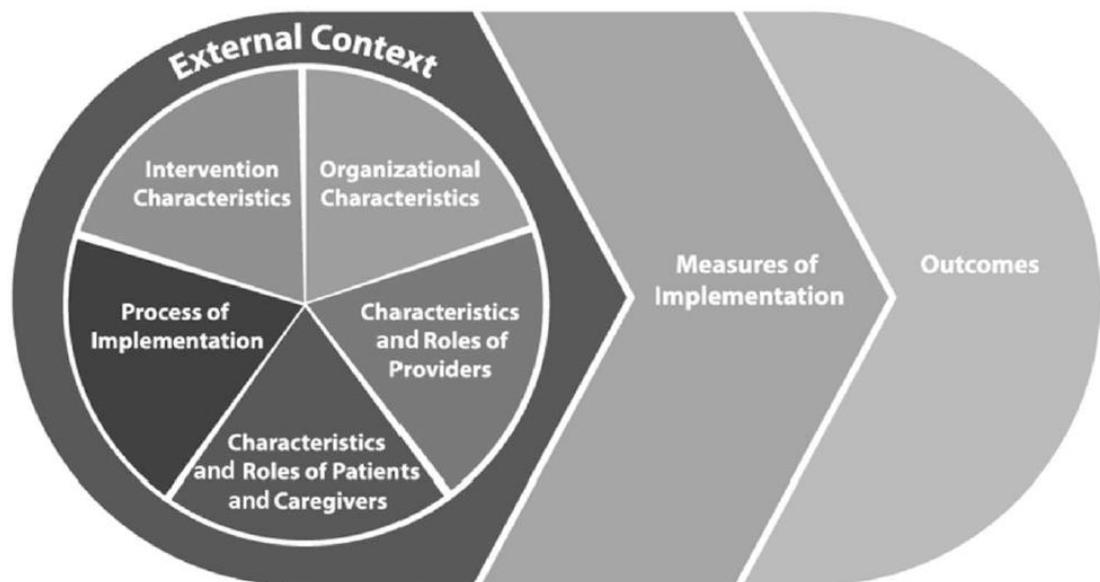


Figure 2.a: The Care Transitions framework according to Dy et al., 2015⁸⁸

The “*measures of implementation*” domain contains implementation outcomes which measures how the intervention’s components are implemented, (e.g., the degree of implementation fidelity). The “*outcomes*” domain refers to the results of the intervention, usually resident outcomes (i.e., number of unplanned hospitalisations, falls).

Although The Care Transition framework provides a sound theoretical background for the thesis's themes, the Conceptual Framework for Implementation Fidelity by Carroll et al., was applied with some adaptations to provide a more in-depth conceptualization of implementation fidelity (Figure. 2.b)⁷⁷

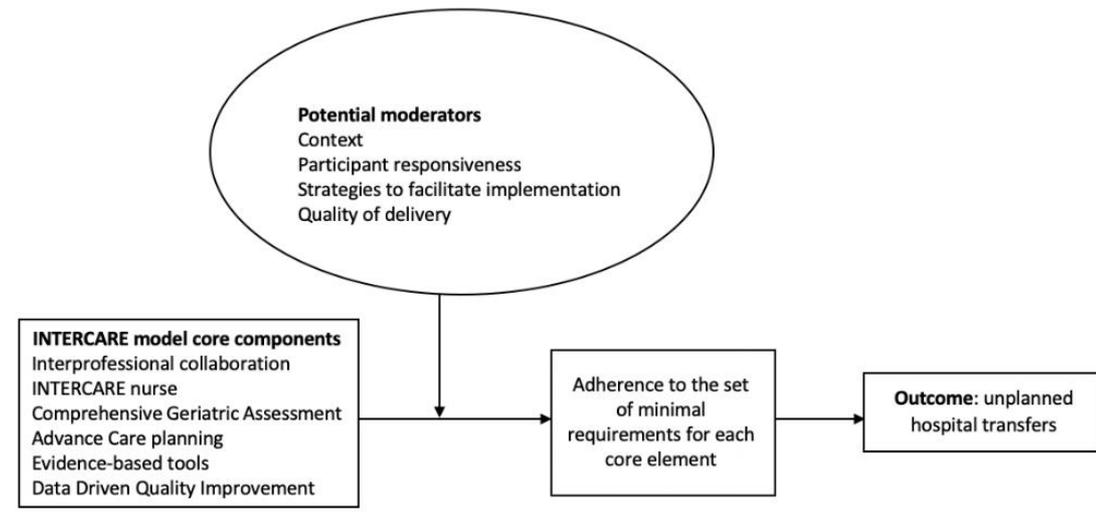


Figure 2.b: The conceptual framework for implementation fidelity adapted based on Carroll et al.⁷⁷

This conceptual framework was used as follows: the **“intervention”** box refers to the INTERCARE intervention with all 6 components, to define the components measured. For the INTERCARE study we defined fidelity according to the “adherence to the set of minimal requirements for each core component. The central element of **“intervention adherence”** is used to describe the minimal requirements of the INTERCARE study which are measured in relation to fidelity. For instance, each of the INTERCARE’s core components had a list of specific requirements which needed to be fulfilled by each NH, to consider the core components respectively to be considered adopted. All minimal requirements can be found in **Chapter 3**, table 2 provides an example for the INTERCARE nurse component.

Table 2: Example of minimal requirements pertaining to the core element INTERCARE nurse

Core component	Minimal requirements
INTERCARE nurse	<p>According to the INTERCARE nurse’s skills and expertise residents are assessed in acute situations, when called by a member of the care team.</p> <p>The INTERCARE nurse provides coaching to care staff on daily resident bedside needs.</p> <p>The INTERCARE nurse plans educational sessions with care staff regularly.</p> <p>The INTERCARE nurse drives team reflections for each reflection tool filled in.</p> <p>The INTERCARE nurse must have 3 years-experience in long-term-care.</p> <p>A position of 60% minimum per 80 beds for which the INTERCARE nurses are responsible for.</p>

The “**outcomes**” box refers to the primary outcome of INTERCARE: the number of unplanned transfers. Several factors may influence or moderate the degree of fidelity with which an intervention is implemented and these are referred to as “**potential moderators**”. Moderators listed in Figure 2b were used as overarching themes to gain an understanding of how fidelity to INTERCARE evolved over time and are presented in **chapter 4**.

1.9 Research gap and rational for this dissertation

Despite a number of nurse-led models of care which have been implemented internationally and in different NH contexts to reduce hospital transfers, all have a combination of different core components and few rely on implementation science methods.

INTERCARE contains six evidence-based core components with some adaptations from other models^{65,89,90}. A contextual analysis was conducted in a first stage to define additional components based on the context and needs of Swiss NHs. Implementation science methods were followed to measure the implementation process in order to better understand how unplanned transfers were reduced, by collecting implementation outcome data alongside clinical data.

Currently it is unknown whether a combination of six core components having previously shown efficacy but not necessarily as a bundle, including a nurse with an extended role, can successfully reduce unplanned transfers in Swiss NHs. Additionally, measurement

and reporting of implementation outcomes such as the degree of fidelity and linking it with the main outcome of unplanned transfers is presently lacking. A wealth of literature is available on the prevalence of potentially avoidable hospital transfers, yet one of the main causes of these transfers, are for fall-related injuries. To date, very little literature is available to explore potential solutions for NHs to better manage residents after a fall, despite there being many studies on the prevention of falls or the identification of risk factors. This thesis will address the above-mentioned gaps in three distinct chapters.

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Chapter 2

Research questions and Aims

2.1 PhD Research questions and Aims

The goal of this dissertation is to evaluate the effectiveness of the INTERCARE model on unplanned transfers and to understand to which degree the model's components were implemented during the study, as well as to investigate the most common reason for a hospital transfer.

It includes the following aims:

- (I) To assess the clinical effectiveness of a contextually adapted and implemented nurse-led model of care on the reduction of unplanned transfers of NH residents to hospital (**chapter 3**).
- (II) To describe the degree of implementation fidelity to all core components of the INTERCARE intervention by assessing which core components have an impact on reducing unplanned transfers and the possible moderators affecting fidelity (**chapter 4**).
- (III) To describe potentially avoidable fall-related transfers and identify infrastructure, training needs, and resources deemed appropriate for NHs to safely manage potentially avoidable fall-related transfers (**chapter 5**).

Chapter 3

Positive effect of the INTERCARE nurse-led model on reducing nursing home transfers: a non-randomized stepped-wedge design.

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Prior studies detailing roles and competencies of registered nurses working in extended roles (*K. Basinska, N. I. H. Wellens, M. Simon, A. Zeller, R. W. Kressig and F. Zuniga. Registered nurses in expanded roles improve care in nursing homes: Swiss perspective based on the modified Delphi method J Adv Nurs 2021 Vol. 77 Issue 2 Pages 742-754. Accession Number: 33222269 PMID: PMC7894469 DOI: 10.1111/jan.14644*) and the experiences of residents' and relatives' during acute situations (*K. Basinska, P. Kunzler-Heule, R. A. Guerbaai, F. Zuniga, M. Simon, N. I. H. Wellens, et al. Residents' and relatives' experiences of acute situations: a qualitative study to inform a care model. Gerontologist 2021. Accession Number: 33624766 DOI: 10.1093/geront/gnab027*) have been published elsewhere. The results from this study will be presented at the Gerontology Society of America's annual meeting, taking place in Phoenix Arizona, Nov 11-16. This study's protocol (*Zuniga F, De Geest S, Guerbaai RA, et al. Strengthening Geriatric Expertise in Swiss Nursing Homes: INTERCARE Implementation Study Protocol. J Am Geriatr Soc 2019;67(10):2145-50. doi: 10.1111/jgs.16074 [published Online First: 2019/07/19]*) was published in the Journal of the American Geriatrics Society in 2019.

Running head: Reducing hospitalisations from nursing homes

Key points:

- INTERCARE as a contextually tailored multi-component intervention could reduce nursing homes unplanned transfers.
- It supports nurses trained in geriatrics if advanced practice nurses are not available.
- Implementation with tailored implementation strategies is crucial for clinical effectiveness.

Why does this paper matter?

This paper supports the clinical effectiveness of in-house registered nurses working in extended roles to reduce unplanned transfers from NHs. It also provides nursing homes and stakeholders with a comprehensive example of a combination of six evidence-based core components addressing unplanned transfers, and which can be successfully implemented in daily practice.

3.1 Structured abstract

BACKGROUND: Unplanned nursing home (NH) transfers are burdensome for residents and costly for health systems. Innovative nurse-led models of care focusing on improving in-house geriatric expertise are needed to decrease unplanned transfers. The aim was to test the clinical effectiveness of a comprehensive, contextually adapted geriatric nurse-led model of care (INTERCARE) in reducing unplanned transfers from NHs to hospitals.

METHODS: A multi-centre non-randomized stepped-wedge design within a hybrid type-2 effectiveness-implementation study was implemented in 11 NHs in German-speaking Switzerland. The first NH enrolled in June 2018 and the last in November 2019. The study lasted 18 months, with a baseline period of 3 months for each NH. Inclusion criteria were 60 or more long-term care beds and 0.8 or more hospitalisations per 1'000 resident care days. 942 long-term NH residents were included between June 2018 and January 2020 with informed consent. Short-term residents were excluded. The primary outcome was unplanned hospitalisations. A fully anonymized dataset of overall transfers of all NH residents served as validation. Analysis was performed with segmented mixed regression modelling.

RESULTS: 303 unplanned and 64 planned hospitalisations occurred. During the baseline period, unplanned transfers increased over time ($\beta_1 = 0.52$), after which the trend significantly changed by a similar but opposite amount ($\beta_2 = -0.52$; $p=0.0001$), resulting in a flattening of the average transfer rate throughout the post-implementation period ($\beta_1 + \beta_2 \approx 0$). Controlling for age, gender and cognitive performance did not affect these trends. The validation set showed a similar flattening trend.

CONCLUSION: A complex intervention with six evidence-based components demonstrated effectiveness in significantly reducing unplanned transfers of NH residents to hospitals. INTERCARE's success was driven by registered nurses in expanded roles and the use of tools for clinical decision-making.

Keywords: Unplanned transfers, Implementation science, Nursing homes, Nurse-led models, Stepped-wedge design.

3.2 Introduction

Unplanned transfers from nursing homes (NH) are burdensome, associated with adverse outcomes for residents such as falls, delirium, or nosocomial infections; and are costly for the health system.¹ Various interventions have been tested in NHs to reduce unplanned transfers and address the growing lack of geriatric expertise and health care resources.²⁻⁶ Among these are new care models, implemented in NHs with multi-component interventions at both staff and organisational levels to improve the way health services are delivered.⁷ Care models that include improved access to medical providers such as geriatricians, specialist nurses, or registered nurses (RNs) with additional training – referred to as nurses in expanded roles – have shown effectiveness in reducing unplanned transfers from 6.1% to 11.7%.^{8,9} Other care models have shown successful reductions in unplanned transfers by integrating advanced practice nurses (APNs) into NHs.^{3,6,10,11} The Missouri Quality Initiative obtained a 30% reduction in all-cause hospital transfers⁶ and included the use of evidence-based tools from the Interventions to Reduce Acute Care Transfers (INTERACT) program, which has proven effective in reducing hospital transfers.^{12,13}

NHs face a shortage of trained nurses and general practitioners (GPs) and limited access to APNs to support staff and provide geriatric expertise. APN programs in Europe are recent and very few APN positions are available in NHs,¹⁴⁻¹⁶ driving a need for nurse-led care models based on RNs in expanded roles.

Implementation science methodology supports the successful implementation and uptake of evidence-based interventions such as nurse-led care models, by tailoring interventions to NHs' needs and resources.¹⁷ Methodological elements include a theory-driven contextual analysis and the use of implementation strategies. The former drives the development of contextually tailored interventions and implementation strategies, while the latter is key for the adoption, implementation, sustainment, and scale-up of a program.^{18,19} Improving INTERprofessionalCARE for better resident outcomes (INTERCARE), is a nurse-led care model for Swiss NHs working with registered nurses in expanded roles. INTERCARE is a theory-based implementation science study using contextual analysis, continuous stakeholder involvement, evidence-based interventions and development of implementation strategies to reduce unplanned transfers from NHs. INTERCARE measures unplanned transfers which has been recommended by Maslow and colleagues, due to the complexity of defining and measuring PAHs.^{20,21} INTERCARE used several adapted components from the Interventions

to Reduce Acute Care Transfers (INTERACT) quality improvement intervention:²² it adapted the “Stop and Watch Early Warning Tool”, “the SBAR Form” and “the Quality Improvement Tool for Review of Acute Care Transfers”. Furthermore, INTERCARE adapted the component of Advance Care Planning based on INTERACT and provided modified versions of the INTERACT “Care Paths” to interested INTERCARE NHs.²²

3.3 Objective

To assess the clinical effectiveness of the INTERCARE nurse-led care model on the reduction of unplanned transfers of long-term NH residents to hospitals.

3.4 Methods

3.4.1 Trial design and procedures

We applied a non-randomized stepped-wedge design (hybrid type 2, see [clinicaltrials.gov Protocol Record NCT03590470](https://clinicaltrials.gov/ProtocolRecord/NCT03590470)) over 18 months, from June 2018 until February 2020, in a convenience sample of 11 Swiss German NHs (Figure 1).²³

	2018							2019												2020	
Month of study	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	Continuous data collection of planned and unplanned hospital transfers Continuous data collection of routine resident data with the Nursing Home Resident Assessment Instrument																				
Step 1 – n= 1 Nursing home	Baseline			Intervention																	
Step 2 – n= 5 Nursing homes	Baseline		Intervention																		
Step 3 – n= 2 Nursing homes	Baseline			Intervention																	
Step 4 – n= 1 Nursing homes	Baseline				Intervention																
Step 5 – n= 1 Nursing homes	Baseline					Intervention															
Step 6 – n= 1 Nursing homes	Baseline						Intervention														

Figure 1: Non-randomized stepped-wedge design

The first nursing home (NH) implemented the nurse-led model in September 2018; followed stepwise by 5 NHs in October 2018, two NHs in November 2018, one NH in December 2018, one NH in January 2019, and the last NH, in February 2019. The longest and shortest intervention periods, including the transitional period of 1 month, were 18 months and 13 months, respectively.

Switzerland has around 1'550 NHs (45% are private, mean of 62 beds),²⁴ which provide dementia and palliative care, psychogeriatrics, intermediate care or assisted living. Medical care is often provided by GPs, 50% of NHs work with in-house physicians. In Switzerland, residents have free physician choice and NHs working with both in-house physician(s) and GPs is frequent.²⁵

The stepped-wedge design (Figure 1) included six steps, each step starting with a baseline observation period of 3 months after which INTERCARE was implemented. The roll-out period lasted six months with 1-2 NHs starting per step (September 2018 to February 2019), except for the second step with 5 NHs starting together. After the baseline period of 3 months, the NHs had a transitional period of 1-month to adjust to the requirements of INTERCARE and subsequently started with the INTERCARE model and continued until the end of the trial period, February 2020. Variability among NHs regarding the readiness for implementation at the NH management level and readiness of selected RNs to begin working in their new role as INTERCARE nurses precluded random assignment to the steps. Blinding of care staff, NH management or residents to the intervention was not possible, nor was the blinding of data collectors, since all NHs received the intervention. INTERCARE received ethical clearance for the 11 participating NHs (EKNZ 2018-00501).

3.4.2 Participants and setting

Seventeen NHs in the German-speaking part of Switzerland were purposefully approached by the research group based on previous collaborations and stakeholder recommendations (Supplementary Material Figure S1). The following criteria were applied for inclusion: (1) NHs had 60 or more long-term care beds, (2) had 0.8 or more hospitalisations per 1'000 resident care days over the year previous to recruitment based on their administrative data, (3) were in the German-speaking part of Switzerland with the willingness to introduce INTERCARE and recruit RNs to work in an expanded role. Within each NH, all residents providing written informed consent were included except for short-term residents. If residents were unable to consent, their legal representatives were asked on their behalf.

3.4.3 Sample size

The sample size for the primary outcome was estimated with a simulation of the proposed stepped-wedge design assuming an average of .8 unplanned transfers/1'000 resident days and a reduction of 25% in unplanned transfers in NHs after implementation of

INTERCARE.^{22,26} A sample size of 11 NHs allowed us to detect a 25% reduction of unplanned transfers with a power of 80% at a significance level of $\alpha = 5\%$.²³

3.4.4 The INTERCARE model

The INTERCARE model comprises six evidence-based core components with minimal requirements for each of these and adaptable elements for local tailoring (Supplementary Material Table S1). The core components were tailored to the Swiss context based on a contextual analysis of existing nurse-led care models in Swiss NHs and stakeholder involvement.²³ Stakeholders included NH leaders, NH associations, resident representatives, professional organizations, and health policy representatives.^{27 28} Their input guided the development of both the intervention and the implementation strategies. The needs and wishes of residents and relatives concerning unplanned transfers to refine the core elements were assessed.²⁹

In brief, the core components included 1) strengthening of interprofessional collaboration between physicians and NH staff through the development of internal structures; 2) an INTERCARE nurse specifically appointed in each NH;²⁸ 3) comprehensive geriatric assessment of residents initiated by INTERCARE nurses when a change in condition was observed; 4) the use of evidence-based tools from the Interventions to Reduce Acute Care Transfers (INTERACT) program, including STOP&WATCH, ISBAR, and a reflection tool to analyse reasons for unplanned transfers;²⁶ 5) advanced-care planning (ACP) to help NHs initiate sensitive discussions and document residents' wishes; and 6) data-driven quality improvement to identify areas for improvement (e.g., unplanned transfers).

3.4.5 Implementation strategies

Implementation strategies were developed based on a contextual analysis, where we identified barriers and facilitators impacting the implementation of a nurse-led care model. We used the Consolidated Framework of Implementation Research (CFIR) to synthesize the factors to be addressed by the implementation strategies³⁰ (e.g., clinical competencies for INTERCARE nurses) to facilitate the introduction, uptake and sustainment of INTERCARE (Supplementary Material Table S2). Implementation strategies were categorized according to The Expert Recommendations for Implementing Change compilation (ERIC).³¹ These strategies included the promotion for adaptability with peripheral components, ongoing training for INTERCARE nurses, providing NH continuous support, and audit and feedback to help NHs improve.

3.4.6 Outcomes

The primary effectiveness outcome of this study was unplanned transfers, defined as a transfer from the NH to a hospital (emergency department (ED), private clinic) without an appointment (e.g., transfer after a fall). Psychiatry referrals and visits to outpatient clinics were excluded because these are mostly planned transfers in Switzerland. Transfer rates were calculated as the number of transfers per 1'000 resident days over a given period. The INTERCARE nurses documented all unplanned transfers to a hospital within two weeks, collecting the date of transfer, type of transfer (planned/unplanned), and reason for transfer. The date of discharge from hospital and the hospital transfer outcome (back to NH, death, other) were documented within two weeks after discharge.

At the resident level, control variables were assessed for later adjustment for confounders, including age, gender, NH length of stay (day of NH admission until date of hospital admission), the Activities of Daily Living long form scale (ADL-long form, ranging from 0 to 28 where higher values mean more dependence),³² Cognitive Performance Scale (CPS, score ranging from 1 = intact to 6 = very severely impaired)³³ and Depression Rating Scale (DRS, score ranging from 0 = no mood symptoms to 14 = all mood symptoms almost daily in the last 7 days).³⁴

3.4.7 Validation dataset

To validate the primary data collection, we used anonymous administrative routine data, for which no informed consent from residents was needed. The 11 participating NHs extracted from their administrative software fully anonymized data of each hospital transfer between

January 2017 and December 2020, indicating the date of admission and the date of return to the NH. All planned and unplanned transfers of more than 1 day were included in this dataset (administrative software did not allow to assess stays outside of the NH of 1 day or less). NHs provided a summation of all care days for all long-term care residents for each month during the assessment period, used to calculate a monthly rate of transfers per 1'000 resident days.

3.4.8 Data collection

Local NH coordinators were responsible for resident recruitment. All long-term care residents present at baseline and all newly admitted residents throughout the study period fulfilling the inclusion criteria were asked to participate. Consenting residents were entered in

a customized electronic Case Report Form (CASTOR EDC),³⁵ developed and managed by the INTERCARE research group.

Data about residents and hospital transfers for residents with informed consent came from two sources. First, hospital transfer data were entered by the INTERCARE nurses via secure online access into CASTOR EDC. Given that the validation set also contained admission and discharge dates of all transfers during the study period but from a different data source, we used it to validate the data entered by the INTERCARE nurses. Second, resident data were extracted from routinely collected data using the Resident Assessment Instrument (RAI-NH)³³ every three months and transferred securely to the research team. For the validation dataset with the fully anonymized data, the responsible manager in each NH exported the overall transfer data quarterly from the administrative software, which included all residents in the participating NHs.

3.4.9 Statistical methods

Analyses were performed using SAS 9.4 (SAS Institute, Cary, NC) and R 3.5.2 (Eggshell Igloo)³⁶, with packages `dplyr`³⁷ and `tidyverse`.³⁸ Descriptive statistics were calculated for resident and transfer characteristics and reported as means, standard deviations (SDs), median, and interquartile range (IQR) for continuous, or frequencies and percentages for nominal variables. Mixed-effect logistic regression analysis was used to assess differences between groups of residents transferred for at least one unplanned transfer compared to those with none, and to compare hospital transfer characteristics between unplanned and planned transfers to give a clear overview of the sample of included residents.

Clinical effectiveness of the intervention was tested by a segmented mixed-effect logistic regression, predicting unplanned transfer status of individual residents assessed daily (yes/no).³⁹ NHs were entered as random intercepts and generalized estimating equations were additionally applied to correctly estimate serial correlations of individual observations nested within the NHs over time. The variables ‘time since baseline’ plus the ‘time since intervention start’ were entered as fixed variables to allow evaluating whether the intervention altered the trajectory of unplanned transfers over time i.e., if the existing trend of unplanned transfers (=time since baseline with estimated slope β_1) changed direction after deployment of the intervention (=time since intervention with estimated slope β_2). Thus, the parameter β_2 represented the relative slope alteration post-implementation relative to the pre-intervention trend β_1 . Hence, the slope of the regression line post-implementation could be obtained in this

second segment of the analysis as $\beta_1 + \beta_2$. We additionally checked if resident-level variables age, sex and cognitive status confounded the relationships of β_1 and β_2 to the outcome variable.

For the validation set, no daily resident-level unplanned transfer data were available. Instead, the number of monthly transfers per 1'000 resident days were retrieved, which could – as a logarithmically transformed outcome variable – be modelled by linear mixed regression analysis. As for the main analysis, clustering within NHs was taken into consideration by random intercepts and serial correlations determined empirically. The two covariates time since baseline (β_1) and time since intervention (β_2) served as predictor variables in the same segmented manner as explained above.

3.5 Results

Eleven NHs agreed to participate. Reasons for non-participation were ongoing projects or restructuring processes. Eight of the 11 NHs are situated in urban neighbourhoods and 9 out of 11 are privately funded, with a median size of 120 long-term care beds. Four NHs worked with external physicians responsible for more than 80% of residents, three with on-site physician(s) responsible for more than 80% of residents and the rest had mixed models. A median of one INTERCARE nurse worked per NH (Supplementary Material Table S3). A total of 942 residents with informed consent were included (females 69%) with a median age of 85.5 years (IQR 80-90) (Table 1), representing an overall consent rate of 68% across the 11 NHs (Supplementary Material Figure S1). Residents were exposed to the intervention for a mean duration of 1.1 years (SD 0.41). In the validation set, an observation period of 327 months across all NHs, resulted in 949 hospitalisations (planned or unplanned) and a summed length of stay of 7330 days.

Table 1: Consenting resident characteristics

INTERCARE consenting residents				
Characteristics	Overall participating residents with informed consent	Sub-group of residents never transferred for an unplanned reason during the study	Sub-group of residents transferred at least once for an unplanned reason during the study	P value ^b
Number of residents (%)	942 (100)	717 (76.1)	225 (23.9)	-
Age, median (IQR)	85.5 (80-90)	85.0 (80.0-90.0)	86.0 (79.0-91.0)	0.368
Gender, Female, n (%)	650 (69.0)	497 (69.3)	153 (68.0)	0.589
Length of stay in NH, years, median (IQR)	2.8 (1.7-4.7)	2.8 (1.4-4.8)	2.8 (1.7-4.5)	0.736
Intervention time, years, mean (SD)	1.1 (0.4)	-	-	-
Activities of daily living (0-28) (ADL)^a n (%)				0.109
Not/mildly impaired (0-4)	203 (22.1)	145 (20.7)	58 (26.9)	
Moderately impaired (5-23)	699 (76.1)	543 (77.3)	156 (72.2)	
Severely impaired (24-28)	16 (1.8)	14 (2.0)	2 (0.9)	
Cognitive performance scale (0-6) (CPS)^a, n (%)				0.004
Intact to mild impairment (0-2)	380 (41.4)	266 (37.9)	114 (52.8)	
Moderate to moderately severe (3-4)	388 (42.3)	306 (43.6)	82 (38.0)	
Severe to very severely (5-6)	150 (16.3)	130 (18.5)	20 (9.2)	
Depression rating scale (0-14)^a (DRS) (mean (SD))	1.1 (1.5)	1.1 (1.5)	1.2 (1.6)	0.330

^a For ADLS, CPS and DRS scores, data was unavailable for 24 residents

^b Group differences by random-intercepts logistic regression (t-value approximation)

NH= Nursing Home; IQR= Interquartile range; SD= Standard deviation

During the 3 month-baseline and 18 month-intervention study periods, 367 hospital transfers occurred, of which 303 transfers (82.6%) were unplanned (primary outcome) and 64 transfers (17.4%) planned (Table 2). The major reason for unplanned transfers was fall-related injuries (40.6%). At the resident level (Table 1), 225 residents (23.9%) were transferred to a hospital at least once for an unplanned reason. Residents with higher cognitive impairment were less often transferred for unplanned reasons (transferred: intact/mild cognitive impairment 52.8% vs. severe cognitive impairment 9.3%; not transferred: intact/mild cognitive impairment 37.9% vs. severe cognitive impairment 18.5%).

Table 2: Hospital transfer characteristics that occurred during the INTERCARE project from baseline until the end of the intervention.

Hospital transfer characteristics	All	Unplanned	Planned	P value^a
Number of transfers, n (%)	367(100)	303 (82.6)	64 (17.4)	
Length of stay in hospital in days, median (IQR)	4 (1-8)	4 (1-7)	4 (1-9)	0.235
Hospital transfer outcome, n (%)				0.235
Discharged back to NH	344 (95.0)	282 (94.0)	62 (100)	
Death in hospital	17 (4.7)	17 (5.7)	0 (0)	
Discharged elsewhere	1 (0.3)	1 (0.3)	0 (0)	
Missing	5	3	2	
Reason for hospital transfer n (%)				-
Injury	128 (34.9)	123 (40.6)	5 (7.8)	
Gastro-intestinal disorder	38 (10.4)	33 (10.9)	5 (7.8)	
Infection ^b	34 (9.3)	31(10.2)	3 (4.8)	
Cardiovascular disorder	43 (11.7)	32 (10.6)	11 (17.2)	
Respiratory disorder	31 (8.4)	30 (9.9)	1 (1.6)	
Urinary disorder	20 (5.4)	16 (5.3)	4 (6.3)	
Other ^c	34 (9.3)	16 (5.3)	18 (28.1)	
Dermatology disorder	20 (5.4)	12 (4.0)	8 (12.5)	
Ear Nose Throat disorder	7 (1.9)	7 (2.3)	0 (0)	
General deterioration	9 (2.5)	7 (2.3)	2 (3.1)	
Neurological disorder	8 (2.2)	7 (2.3)	1 (1.2)	
Problem with medical device	11 (3.0)	6 (2.0)	5 (7.8)	
Metabolic disorder	6 (1.6)	6 (2.0)	0 (0)	
Renal disorder	5 (1.4)	5 (1.7)	0 (0)	
Gynaecology disorder	4 (1.1)	2 (0.7)	2 (3.1)	
Psychiatry disorder	3 (0.8)	1 (0.3)	2 (3.1)	

Number residents with hospital transfers (n = 224 residents)				0.367
Number of residents with single hospital transfers, n (%)	166 (67.2)	146 (69.9)	20 (52.6)	
Number of residents with re-hospital transfers, n (%)	58 (23.5)	43 (20.6)	15 (39.5)	
Sub-group: Number of residents with 3 or more hospital transfers, n (%)	23 (9.3)	20 (9.6)	3 (7.9)	

^a Group differences by random-intercepts logistic regression (t-value approximation)

^b Infection can be concomitant to other conditions, for instance, a resident could be transferred for a respiratory disorder with infection.

^c Other includes a mix of signs and symptoms not attributable to a specific condition (ie., haemorrhage)
IQR= Interquartile range; SD= standard deviation

3.5.1 Effectiveness of INTERCARE model

Raw rates for unplanned transfers per 1'000 resident days were 0.41 for the 3 baseline months and subsequently 0.84 (intervention start = T1), 0.85 (3 months after T1), 0.64 (6 months after T1), 0.79 (9 months after T1), and 0.42 (12 months after T1) unplanned transfers/1'000 resident days per quarterly period after baseline.

During the baseline period, unplanned transfers increased over time ($\beta_1 = 0.52$, Table 3), after which the trend significantly changed by a similar but opposite amount ($\beta_2 = -0.52$; $p=0.0001$, Table 3), resulting in a flattening of the average unplanned transfer rate throughout the post-implementation period ($\beta_1 + \beta_2 \approx 0$). The trajectory post-implementation has a logodds of $0.524 + -0.521 = 0.004$, or an odds ratio of $\exp(0.004) = 1.004$, implying that the odds of unplanned transfer post-implementation only went up by 0.4% per month on average.

Table 3: Effect estimation of the INTERCARE nurse-led model on unplanned transfers using mixed-effect logistic regression model adjusted by NH as random effects.

Parameter	Estimate (logodds)	Standard Error	t-Value (df)	P-value	Odds ratio
Intercept (α)	-6.943 (-7.877 – -6.008)	0.4195	-16.55 (10)	<.0001	
Months pre-implementation (β_1)	0.524 (0.262 – 0.787)	0.1338	3.92 (41E4)	<.0001	1.69 (1.30 – 2.20)
Months post-implementation (β_2)	-0.521 (-0.783 – -0.258)	0.1339	-3.89 (41E4)	0.0001	0.59 (0.46 – 0.77)

Figure 2 shows these trends, as expressed in probabilities of unplanned transfer over the entire study follow-up. Controlling for depression and functional status did not have an effect on the model, therefore they were not retained in the final model. Nor did age, gender and cognitive performance affect these trends (Supplementary Material Table S4).

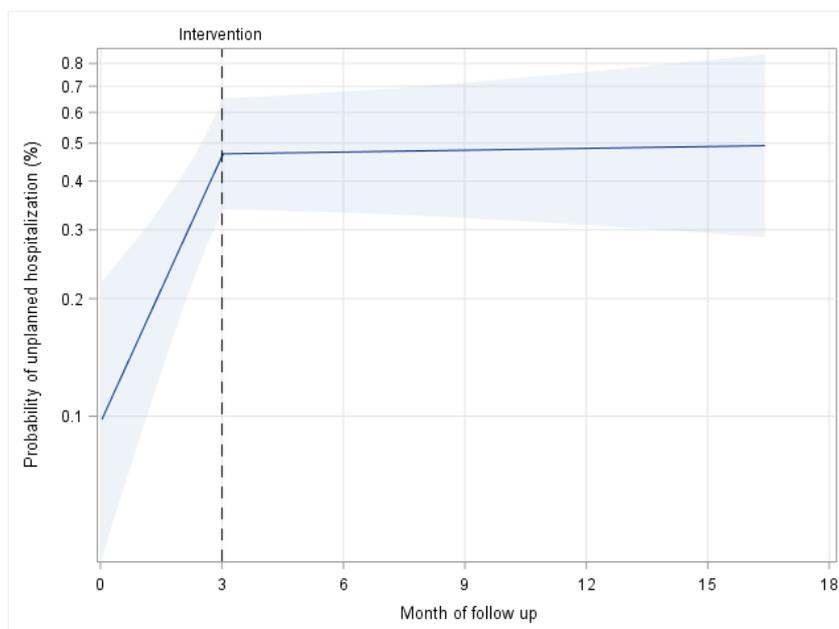


Figure 2: Predicted trajectory of unplanned transfers from baseline until end of intervention (+95% confidence intervals).

Probabilities are derived from the logodds shown in Table 4 and can be calculated as $\exp(\text{logodds}) / (1 + \exp(\text{logodds}))$. For example, solving the regression equation of Table 4 gives a logodds of referral at three months of $-6.943 + 3 * 0.524 + 0 * -0.521 = -5.37$, which can be algebraically transformed into a probability of 0.46% by substituting the formulae above $[\exp(-5.37) / (1 + \exp(-5.37))] = 0.0046$.

3.5.2 Validation dataset with overall hospitalisation data

An analysis of the validation dataset over an extended time window from 10 months before until 20 months after the study started, confirmed the trend discontinuation after intervention start, compared to the initial hospitalisation rate trajectory (Supplementary Material Figure S2).

A descriptive presentation of monthly total hospitalisation rates for both data sets (residents with informed consent and all residents) shows that routine data differed from study data, in that the number of registered unplanned transfers is slightly higher for the routine data, and that the baseline increasing trajectory is less steep (Supplementary Material Table S5 and Supplementary Material Figure S3).

3.6 Discussion

INTERCARE's implementation significantly changed the trend in unplanned transfers from NHs to EDs and hospitals. This change in trend was visible in both the dataset assessing unplanned transfers controlled for age, gender and cognitive performance and in the validation data set with overall hospitalisations. The primary outcome of unplanned transfers chosen in this study is distinct from the more commonly used outcome of potentially avoidable hospitalisations based on ICD-10 codes. Swiss NHs do not have access to ICD-10 codes that are used to identify Ambulatory Care Sensitive Conditions for which timely primary care can reduce the risk for an avoidable hospitalisation. The alternative approach using the unplanned transfer as the primary outcome was seen as a better fit for Swiss NHs.

INTERCARE is a pragmatic and contextually adapted multi-component intervention developed with NHs and stakeholders' input. Specifically developed implementation strategies to support the uptake of the intervention (e.g., a targeted curriculum for geriatric conditions to train the INTERCARE nurse) were used. INTERCARE's core elements build on the evidence of former successful care models to reduce unplanned hospitalisations. All 11 NHs adopted and implemented the core components but tailored the peripheral elements to their needs. Leadership engagement to both the study and the organizational change could be maintained and all NHs had an INTERCARE nurse in place throughout the study period, supporting an effective outcome.

INTERCARE used similar components to both The Missouri Quality Improvement (MOQI) study⁶ and the OPTIMISTIC program,¹² which respectively showed reductions in all-cause transfers or in the risk for these. Both models were supported by an operations team or by nurse practitioners.⁴⁰ INTERCARE did not integrate APNs in NHs but rather built a model with in-house workforce and chose to further educate NH RNs. Our results show that this is a viable solution for settings that do not have access to APNs or where NHs can't afford to integrate other professionals such as social workers.⁶ Both OPTIMISTIC and MOQI models report inter-facility variation depending on the use of the program, facility leadership stability, and engagement in and resource commitment to the project.^{40,41} All INTERCARE nurses' remained in their positions during the project. Turnover in APNs results in serious disruption of the intervention as reported elsewhere.⁴⁰ INTERCARE was developed as an implementation science study and we thoroughly assessed which implementation strategies could enhance and sustain implementation through the identification of barriers and facilitators. The additional

tailored training and education provided to the INTERCARE nurses as an implementation strategy helped enhance geriatric expertise in the NHs. The INTERCARE nurses were integrated into the NHs' teams and were involved in day-to-day care and clinical decisions, as opposed to external expertise brought into the NHs, e.g., in the form of Nurse Practitioners working with GPs. Extensive cost analysis of these different models is needed to be able to compare how cost-effective these models are with one another.

Neither the sampling of NHs nor the assigning of steps in the stepped-wedge design were random. Although non-randomization can lead to misleading estimates of effect, non-random sampling and step assignment allowed NH leadership to prepare for the implementation and fit it into their strategic goals and contexts, supporting successful implementation.¹⁹ The study results are not generalizable to Swiss NHs overall as NHs participating were highly motivated to implement a complex intervention requiring organizational and leadership engagement. The comparison of the baseline trend with the intervention period trend in unplanned transfers does not allow us to definitely attribute a direct effect to INTERCARE since we lack a true comparison group. We observed low transfer rates in the baseline period, which we cannot explain since recruitment of residents was finalized at the beginning of baseline and the INTERCARE nurses knew how to enter data correctly at the start of the study. We also saw fluctuating rates during the intervention phase, with a slight rise 9 months after the implementation start (0.79). Factors such as staff turnover could explain this. Temporal trends such as seasonal fluctuations were checked on both the study data and the larger validation data set and showed no differences. Interestingly, the validation data set showed a similar trend, adding weight to our findings and those of other pre-post studies.^{26,40,41} Also, we found that the proportion of days of planned transfers remained stable over the study period, whereas unplanned transfers showed a declining trend (Supplementary material Figure S4). Due to the sample size of 11 NHs, investigating physician coverage on the impact of unplanned transfers was not possible, although this would have been interesting to measure and could be addressed in future research.

3.7 Conclusion

This study supports the clinical effectiveness of in-house nurses working in extended roles to reduce unplanned transfers. Policymakers should consider expanding the scope of practice of RNs to help NHs acquire better geriatric expertise if APNs are not available. Clinicians can tailor the core elements to develop a similar model with in-house resources.

Further in-depth analysis of implementation outcomes (e.g., fidelity), strategies and barriers and facilitators, described elsewhere⁴² will examine the contribution of each intervention element to better understand what supports the successful implementation of nurse-led care models in NHs.

3.8 Acknowledgments

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Author Contributions: FZ, MSI conceived, designed, supervised, and obtained the funding for the study. FZ, RAG, MS, KD collected, analysed, and interpreted the data and are responsible for the overall content as guarantors. FZ and RAG drafted the manuscript. SDG, LLP, JB, KB, RWK, AZ, NIHW, CDP, MD, CS, DN critically revised the manuscript for important intellectual content. KD, DT, and RAG did the statistical analysis. The corresponding author attests that all listed authors meet authorship criteria and that others not meeting the criteria have been omitted. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit it for publication.

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Supplementary Material Table S1– Core and peripheral elements of the INTERCARE model

The following table provides the list of core components of the nurse-led model of care, which correspond to the minimal requirements and the peripheral components, which can be tailored to each nursing home (NH) (CFIR).

Core elements	Additional information for minimal requirements	Peripheral
Interprofessional collaboration		
A structure in place to facilitate interprofessional communication (e.g. meetings) between at least two different professions.	Each NH is free to decide how communication between different professions may occur, for instance regular team meetings or unit rounds.	Number of structures in place and who involved in the communication structures.
Noticing a resident issue and liaising with the relevant health care professional to establish the residents' care goal.		
Interpretation of assessment results and formulation of a resident care plan in collaboration with a member of the health care team.		
The INTERCARE nurse supports the communication process between physicians and health care staff.	This can occur by having a prior discussion (in person or phone call) with the care staff before they contact the physician. The INTERCARE nurse might guide the care staff to think through a situation and think about potential questions the physician may ask.	
INTERCARE nurse		
According to the INTERCARE nurse's skills and expertise residents are assessed in acute situations, when called by a member of the care team.		Range of educational backgrounds: RN, BSN, MSN, MAS, HöFa I and II Number of patients the INTERCARE nurse is responsible for in each NH. Number of units the INTERCARE nurse works on in the NH. The way and frequency in which the educational sessions are delivered
The INTERCARE nurse provides coaching to care staff on daily resident bedside needs.	The INTERCARE nurse supports care staff by assisting, guiding or advising them during bedside care, for instance helping staff to communicate with a resident showing aggression	
The INTERCARE nurse plans educational sessions with care staff regularly.	The INTERCARE nurse can choose a topic of interest to help care staff improve their competencies and knowledge. These educational sessions can be conducted as formal presentations or by the bedside depending on the topic chosen. The INTERCARE nurse can use their own experience to help care staff manage often occurring difficult situations.	

Core elements	Additional information for minimal requirements	Peripheral
The INTERCARE nurse drives team reflections for each reflection tool filled in.	The INTERCARE nurse plans informal team meetings to reflect and learn from each reflection tool, with the staff present at the time of the acute situation leading to the hospitalization.	
The INTERCARE nurse must have 3 years-experience in long-term-care.		
A position of 60% minimum per 80 beds for which the INTERCARE nurses are responsible for.		
Comprehensive geriatric assessment (CGA)		
The INTERCARE nurse collaborates with the leadership and/or interprofessional team to discuss and define which assessment instrument they work with, for each of the 5 CGA dimensions in their institution, within the first 6 months of the implementation of the model.	The CGA includes the following dimensions: <ul style="list-style-type: none"> • Physical dimension • Functional dimension • Social dimension • Economic dimension • Mental dimension 	Each INTERCARE nurse is free to define how involved they are and the degree of responsibility they have for each dimension. Any care staff can be involved in the 5 dimensions of the CGA, corresponding to their degree of training and experience
The INTERCARE nurse’s role is clearly defined with regards to their input in the 5 dimensions of CGA.		
The INTERCARE nurse is involved and supports the care team in integrating the 5 dimensions of CGA in daily practice.	Provides information and guidance to the care team about the 5 different dimensions and can suggest how each dimension can be assessed and evaluated.	
The INTERCARE nurse ensures that residents and relatives are involved in the decision-making process.		
Advance care planning (ACP)		
For every newly admitted resident, the following points must be documented in the residents’ records: <ul style="list-style-type: none"> ○ Do Not Resuscitate order ○ Do not hospitalize order ○ Use of antibiotics 		Presence of physician during initial conversation and subsequent conversations with residents/relatives. Degree of involvement of the NH staff in ACP discussions The INTERCARE nurse is in charge of ensuring that every question is clarified with residents and relatives.

Core elements	Additional information for minimal requirements	Peripheral
The leadership team decides who is responsible in the NH to guide the ACP process.		The INTERCARE nurse checks for each new resident admission if the resident has an advance care plan.
For residents in unstable condition before weekends: physician orders and care plans are clarified (Notfallplan), by the appointed responsible person(s) in each NH.		
Evidence-based tools		
STOP & WATCH		
The INTERCARE nurse is responsible for the implementation of the STOP&WATCH and supervises the usage of the Stop and Watch STOP&WATCH tool in daily practice.	None	Degree of penetration of the STOP&WATCH tool, e.g. used by housekeeping staff, therapists. Internal process of how the tools are handled and stored after completion. Implementation of other tools such as care pathways, to help guide assessment for chronic conditions. Using the tools to hand over information non-verbally, e.g. emails, fax.
Implementation of the STOP&WATCH tool on each participating unit, within the first 6 months of implementation of the model.		
Used by nurse assistants to inform the responsible person about changes in resident condition.		
It is clearly defined who will use the STOP&WATCH tool, if extended to other staff.		
All staff using the STOP&WATCH must be trained.		
The situation for which the STOP&WATCH tool is used, is recorded in the resident's documentation, if a change in resident situation has been recognized.		
The nurse responsible should perform the adequate assessment after being given the STOP&WATCH.		
The transmission of the STOP&WATCH tool is either indirect (e.g. storage in a designated compartment for the person in charge of the day) or it is handed over directly to the person in charge of the day / the responsible qualified nurse.		
The STOP&WATCH tool must be filled in and, if necessary, the appropriate letters should be marked as soon as a change in the residents' condition has been identified.		
General information about the resident and the person who filled in the instrument must be added.		
All unit staff are informed about implementation of the STOP&WATCH tool.		

Core elements	Additional information for minimal requirements	Peripheral
Distribution of the STOP&WATCH notepads to all employees who will use the tool.		
ISBAR The INTERCARE nurse is responsible for the implementation and monitoring of the use of ISBAR and in giving feedback. Implementation of the ISBAR tool on each participating unit within the first 6 months of implementation of the model. Used by registered nurses in communicating with physicians and with the INTERCARE nurse in acute situations. It is clearly defined who will use the ISBAR tool, if extended to the members of the care team. All staff using the ISBAR tool must be trained. Distribution of the ISBAR Pocket version to all registered nurses and all staff trained to use the ISBAR tool. All unit staff is informed about implementation of the ISBAR tool.	None	None
Data-driven quality improvement		
Continuous data collection for all hospitalisations and emergency department (ED) visits, with exports every 3 months for SPC charts and 6 months for benchmarking.		Each NH can decide who participates in the SPC/Benchmarking discussion. Each NH can decide who takes part in the discussion and completing one PDCA cycle
A member of the leadership team with or without/ INTERCARE nurse should discuss the SPC charts and benchmarking reports together and prepare discussion points for leadership meetings with the research group.		
A member of the leadership team and INTERCARE nurse should meet and discuss which steps are needed to improve quality improvement and complete one PDCA cycle for one identified quality indicator.	For an identified issue, a Plan-Do-Check-Act cycle is carried out. <u>Plan</u> Pre-defined persons should think about how they will analyze a situation, how information will be collected, what the goal of the planned change is. <u>Do</u> Pre-defined persons should think about how they plan to carry out the change, what is needed, from whom, and who is responsible for guiding the change. <u>Check</u>	

Core elements	Additional information for minimal requirements	Peripheral
	<p>Pre-defined persons should reflect on what was initially planned and what happened during the change.</p> <p><u>Act</u></p> <p>Pre-defined persons should discuss and describe which improvement measures were implemented and if change occurred.</p>	

Supplementary Material Table S2: Implementation strategies used to promote the up-take of INTERCARE

Implementation strategies: The “how to” component of changing healthcare practice or the means and methods of adopting and sustaining interventions, 8 strategies.

Summary of implementation strategies used to support and facilitate the implementation of the core elements of the intervention.

Implementation strategy	Implementation strategy and definition according to Powell et al ¹	Description for INTERCARE
International and national nursing home visits	<p><u>Visit other sites</u></p> <p>Capture local knowledge from implementation sites on how implementers and clinicians made something work in their setting and then share it with other sites.</p>	During a preliminary phase A of the INTERCARE project, 15 case studies were conducted in Swiss NHs to assess structures, processes, outcomes as well as barriers and facilitators to facilitate the implementation and planned strategies to reduce barriers and ensure the sustainability of the intervention. International models were also visited to help gain an insight into ANP roles and model differences.
Stakeholder meetings	<p><u>Conduct local consensus discussion</u></p> <p>Include local providers and other stakeholders in discussions that address whether the chosen problem is important and whether the clinical innovation to address it is appropriate.</p>	<p>A stakeholder group formed of nursing home leaders, physicians, Swiss policymakers and cantonal association representatives, are included in important decisions regarding the intervention, such as decision making regarding the appropriateness of the clinical tasks and responsibilities of the new nurse expert role, defining the core elements of the intervention and to help identify barriers and facilitators for the implementation of the intervention, as well as discussing the outcomes for the Swiss setting.</p> <p>Bi-annual meetings to exchange and discuss major points relating to the intervention.</p>
Binding contract between NHs and research site	<p><u>Obtain formal commitments</u></p> <p>Obtain written commitments from key partners that state what they will do to implement the innovation.</p>	A signed contract was established between the research site and the participating NHs.
Determining core and peripheral components of the nurse-led model of care	<p><u>Promote adaptability</u></p> <p>Identify the ways a clinical innovation can be tailored to meet local needs and clarify which elements of the innovation must be maintained to preserve fidelity.</p>	The model consists of 6 core elements and peripheral elements which allows the intervention to be tailored to meet the specific intervention site needs. Core elements are considered to be mandatory to be implemented and peripheral components can be adapted individually. Core elements were developed and described to reach the specific clinical outcomes of the study.

Implementation strategy	Implementation strategy and definition according to Powell et al ¹	Description for INTERCARE
Nursing home leadership training and support	<u>Assess for readiness and identify barriers and facilitators</u> Assess various aspects of an organization to determine its degree of readiness to implement; barriers that may impede implementation, and strengths that can be used in the implementation effort.	Specifically, tailored training sessions for NH leadership and additional staff such as NH accountants, physicians and nurses to ensure buy-in and tailoring of the nurse-led model to individual NHs through the identification of barriers and facilitators. 1 full day and 2 half-day follow-up training sessions were offered to all 11 NHs participating.
INTERCARE nurse blended learning curriculum	<u>Create new clinical teams</u> Change who serves on the clinical team, adding different disciplines and different skills to make it more likely that the clinical innovation is delivered (or is more successfully delivered)	Implementation of the INTERCARE nurses acquires new competencies and skills expanding the usual profile. Thus, position profile was developed and new competencies were described to ensure the ability to deliver the intervention.
	<u>Conduct ongoing training</u> Plan for and conduct training in clinical innovation in an ongoing way	Continuous education of INTERCARE nurses starting before the project and is further developed throughout the project.
	<u>Resource sharing agreements</u> Develop partnerships with organizations that have the resources needed to implement the innovation	Partnerships with nursing educational institutions who have geriatric expertise and/or experience in curriculum development.
	<u>Make training dynamic</u> Vary the information delivery methods to cater to different learning styles and <ol style="list-style-type: none"> 1. work contexts, and shape the training in the innovation to be interactive 	Blended learning curriculum including: e-learnings, readings, tests, reflections and case studies and face-to-face meeting accounts for variation in delivering the education. It maximizes the learning outcomes considering that adults have different learning styles and working environments.

Implementation strategy	Implementation strategy and definition according to Powell et al ¹	Description for INTERCARE
	<u>Develop and distribute educational materials</u> Distribute educational materials (including guidelines, manuals, and toolkits) in 1. person, by mail, and/or electronically	Various materials as e.g. guidelines on how to implement evidence-based tools, algorithms how and when to use Reflection tools, staff handouts to inform and powerpoint presentations to educate staff about the communication instruments, manuals on how to enter residents' data into data management system, will be developed and distributed. All materials should help facilitate the implementation and adherence to the intervention. All materials were posted on an online learning platform and/ or sent by email.
Data collection for benchmarking and internal quality control	<u>Audit and provide feedback</u> Collect and summarize clinical performance data over a specified period and give it to clinicians and administrators to monitor, evaluate, and modify provider behaviour.	Quarterly exports for quality indicators and on-going collection of data for hospitalisations to help NHs identify where better quality of care can be provided and which actions they may take. This will be discussed during the 2 monthly meetings in each NH.
Continuous support of NH	<u>Provide local technical assistance</u> 2. Develop and use a system to deliver technical assistance focused on implementation issues using local personnel	Project coordinator available to aid and ensure good communication between NHs and the research team. Face-to-face two monthly meetings with the leadership teams.
	<u>Provide ongoing consultation</u> Provide ongoing consultation with one or more experts in the strategies used to support implementing the innovation	A networking platform is available for NHs to share experiences and documentation, as well as 2 monthly in-person meetings and 2 weekly phone calls to support the INTERCARE nurse during the implementation process.

1. Powell BJ, Waltz TJ, Chinman MJ, et al. A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. *Implement Sci* 2015;10:21.

Supplementary Material Table S3. Nursing home characteristics

Nursing homes participating in the INTERCARE project (n= 11)		Missing
Location of nursing homes		0
Located in an urban area, n (%)	8 (72.7)	
Located in a rural area, n (%)	2 (18.2)	
Located in a suburban area, n (%)	1 (9.1)	
Legal status		0
Privately funded, n (%)	9 (81.8)	
Publicly funded, n (%)	2 (18.2)	
Bed count		
All long-term beds, median (IQR)	120 (114-161)	0
N of beds participating in INTERCARE, median (IQR)	88 (80-103)	1
Physician model		0
Physician(s) on-site responsible for $\geq 80\%$ of residents, n (%)	3 (27.2)	
External physician(s) responsible for $\geq 80\%$ of residents, n (%)	4 (36.4)	
Mixed model, n (%)	4 (36.4)	
INTERCARE nurses (n=19)		
Age, years, median (IQR)	39 (30.5-51)	0
INTERCARE nurses per NH, median (IQR)	1 (1-2)	0
Bed responsibility per INTERCARE nurse, median (IQR)	95 (80-121.5)	0

Supplementary Material Table S4: Effect estimation of the INTERCARE nurse-led model on unplanned transfers (controlled) using linear mixed regression model adjusted by NH as random effects.

Parameter	Estimate (logodds)	Standard Error	t-Value (df)	P-value	Odds ratio
Intercept	-4.171 (-6.525 – -1.818)	1.0563	-3.95 (10)	0.0027	
Months pre-intervention	0.510 (0.252 – 0.767)	0.1314	3.88 (403e3)	0.0001	1.665 (1.287 – 2.153)
Months post-intervention	-0.511 (-0.773 – -0.250)	0.1333	-3.84 (403e3)	0.0001	0.600 (0.462 – 0.779)
CPS	-0.231 (-0.447 – -0.014)	0.1105	-2.09 (403e3)	0.0369	0.794 (0.640 – 0.986)
Age	-0.035 (-0.048 – -0.022)	0.0067	-5.02 (403e3)	<.0001	0.966 (0.953 – 0.979)
Gender	0.420 (-0.200 – 1.040)	0.3165	1.33 (403e3)	0.1845	1.522 (0.819 – 2.830)

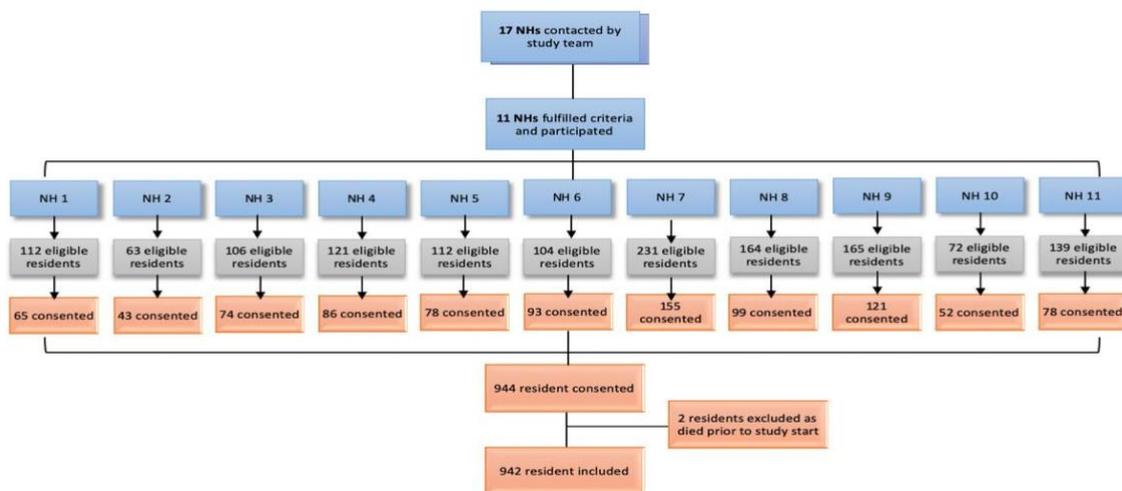
df = degrees of freedom; CPS = Cognitive Performance Scale

Supplementary Material Table S5: Effect of the INTERCARE nurse-led model on all transfers (10 months prior to intervention start until 20 months post-intervention start)

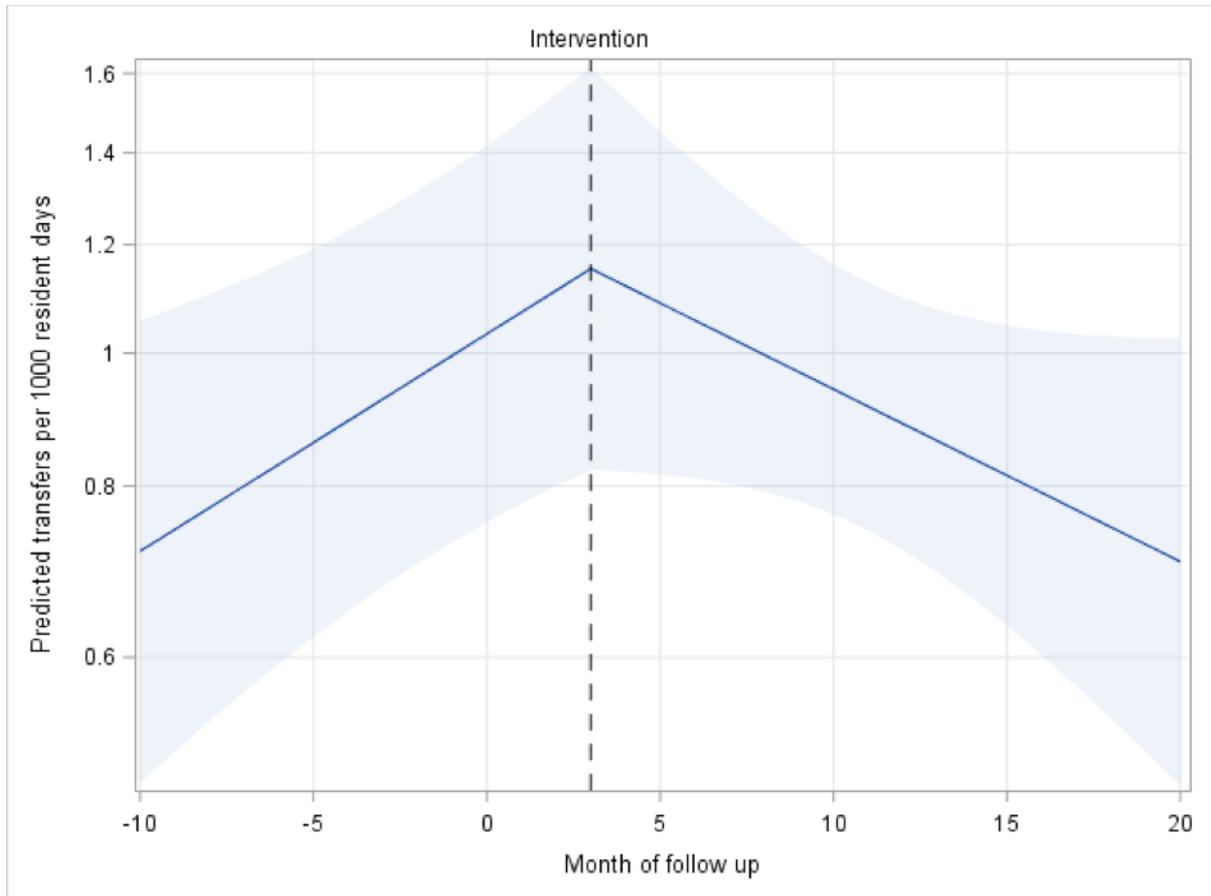
Parameter	Estimate (95% confidence interval)	Standard Error	t-Value (df)	Pr > t
Intercept (α)	0.032 (-0.325 – 0.390)	0.161	0.20 (10)	<.0001
Time since baseline (β_1)	0.037 (0.009 – 0.064)	0.014	2.61 (273)	0.0010
Time after intervention start (β_2)	-0.065 (-0.116 – -0.015)	0.026	-2.56 (273)	0.011

Logarithmically transformed outcome variables can be interpreted as percentage changes per 1-unit difference in the predictor variable. This means that before the intervention, an increase in all transfers of $100 \times \beta_1 = 100 \times 0.037$, or 3.7% per month was observed. After the intervention, a decrease in monthly unplanned referrals set in, at a rate of $(\beta_1 + \beta_2 = 0.037 - 0.065) \times 100 = -2.8\%$ per month.

df = degrees of freedom

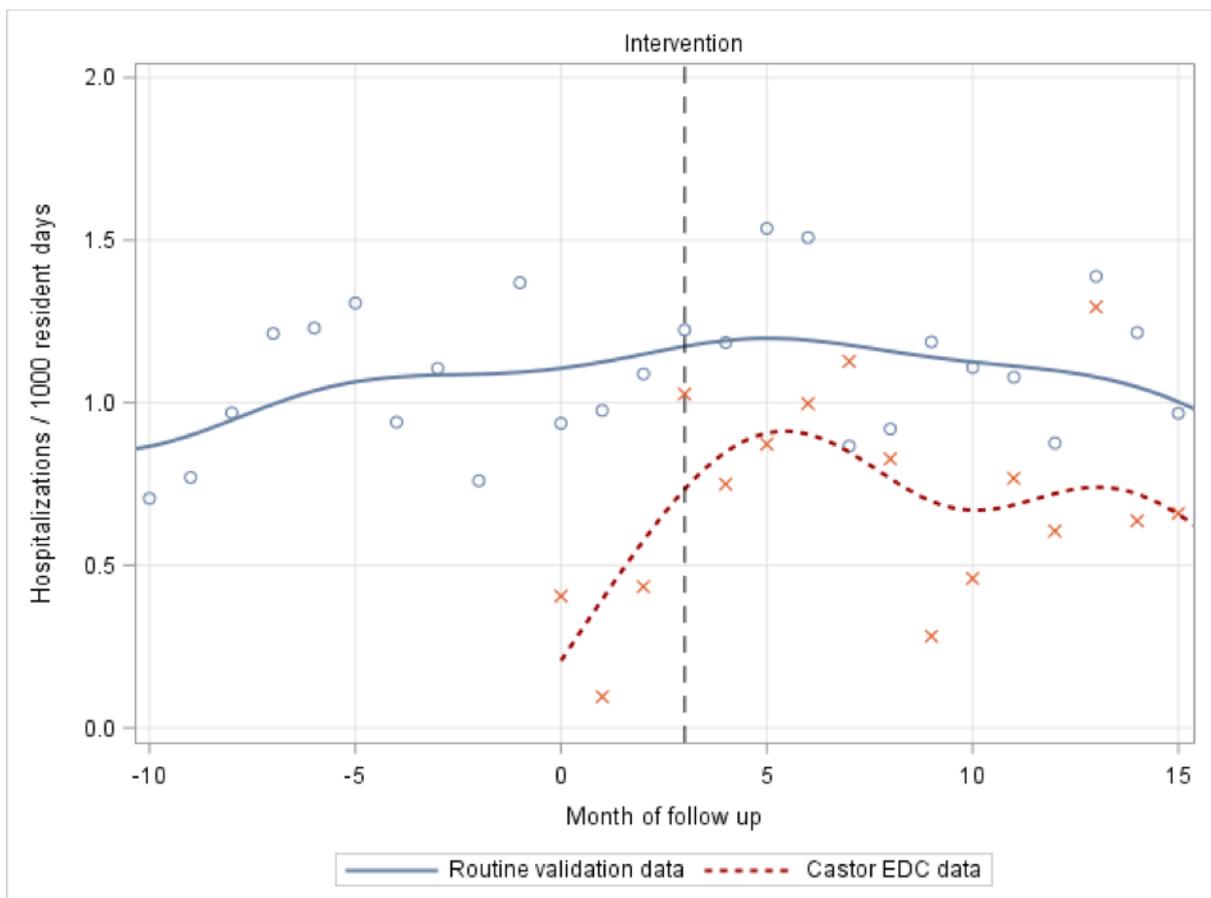
Supplementary Material Figure S1: Nursing home and resident recruitment flowchart

Supplementary Material Figure S2: Predicted total transfers per 1000 resident care days (+ 95% confidence intervals) calculated from validation routine data.

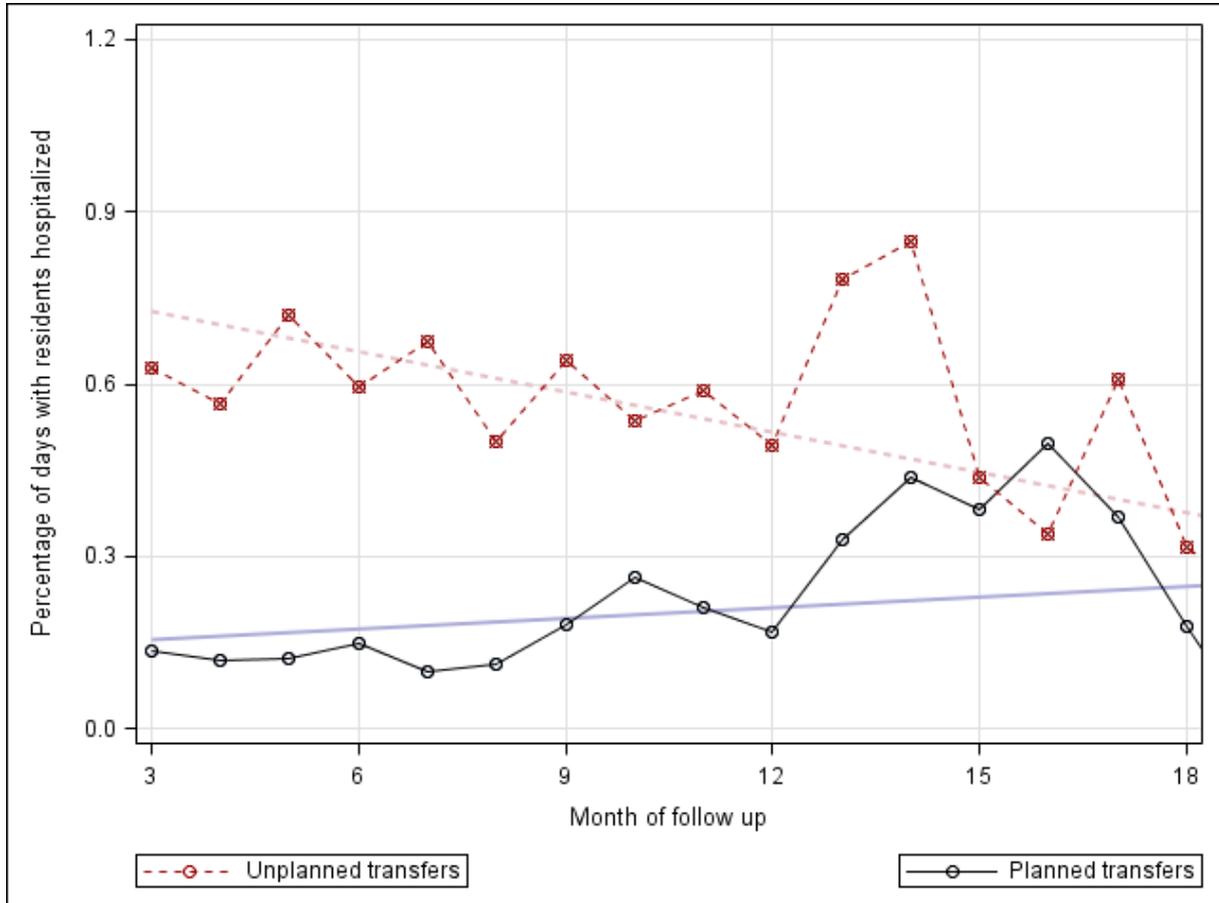


Supplementary Material Figure S3: Hospital transfer rates across the routine validation dataset compared to the CASTOR EDC dataset.

Note: Same-day hospitalisations from the CASTOR EDC data from residents with informed consent are omitted, to be comparable to the validation data; Lines fitted using penalized B-spline smoothing.



Supplementary Material Figure S4: Planned and unplanned transfer rates post implementation of INTERCARE.



Chapter 4

Evaluating Implementation Fidelity of a Nurse-led Model of Care “INTERCARE” Implemented in Swiss Nursing Homes: a Mixed-Methods Study

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4.1 Abstract

Background: Implementation fidelity assesses the degree to which an intervention is delivered as it should be. Fidelity helps to determine if the outcome(s) of an intervention are attributed to the intervention itself or to a (partial) failure of its implementation. The contextually adapted INTERCARE model successfully reduced unplanned transfers from nursing homes and followed implementation science methods. The aim of this study was to examine how fidelity to the INTERCARE model as a complex intervention evolved over time and the impact fidelity to its core components had on the successful reduction of unplanned transfers.

Methods: A mixed-methods convergent/triangulation design was used and the study was guided by a modified version of the Conceptual Framework for Implementation Fidelity. Fidelity to INTERCARE's core components was measured with 44 self-developed items at baseline, 6- and 12-months post intervention start, and 9 months after the intervention ended with yes/no questions; fidelity scores were calculated for each core component and for an overall score. Meeting notes from two-monthly meetings with the eleven participating NHs (September 2018-January 2020) were used to determine potential moderators affecting fidelity. Generalized linear mixed models were computed to analyze the quantitative data. Deductive thematic analysis was used for the qualitative analysis. The quantitative and qualitative findings were integrated using triangulation.

Results: The INTERCARE model was implemented across eleven NHs in Switzerland. A higher overall fidelity score showed a decreasing rate of hospital transfers post-intervention (OR: 0.65 (CI=0.43-0.99), $p=0.047$). A higher fidelity score to the core component advance care planning was associated with lower unplanned transfers (OR= 0.24 (CI 0.13-0.44), $p < 0.001$) and a lower fidelity score for communication tools (ISBAR and Stop&Watch) was related to higher rates in unplanned transfers (OR= 1.69 (CI 1.30-2.19), $p < 0.003$). Factors supporting the achievement of high fidelity to the INTERCARE model were NHs having in-house physicians with a collaborative approach and staff perceiving the need for support from nurses working in extended roles.

Conclusions: High implementation fidelity to several core component of a complex intervention was necessary to achieve a reduction in unplanned transfers from NHs. While advance care planning and evidence-based communication tools play a key role in decreasing

unplanned transfers, further research should seek to understand what supports the effective implementation of these components.

Trial registration

The INTERCARE study was registered at clinicaltrials.gov Protocol Record NCT03590470

Keywords: Nurse-led models of care, implementation science, fidelity, Advance-care planning, complex intervention

4.2 Background

Differentiating implementation effectiveness from clinical effectiveness is essential to distinguishing intervention failure (the intervention is unsuccessful) from implementation failure (flawed implementation)¹. To evaluate implementation effectiveness, implementation outcomes, defined as “effects of deliberate and purposive actions to implement new treatments, practices, and services”^{2,3} are measured and reported. One outcome is implementation fidelity, defined as the degree to which a program is delivered as it was intended to be by its developers¹. Guidelines such as the RE-AIM framework recommend to evaluate implementation fidelity to better understand which program components are correctly adhered to⁴. Implementation fidelity is considered as a mediator between intervention components and clinical outcome(s), and helps to unravel the reasons behind an intervention’s success or (partial) failure⁵. Additionally, implementation fidelity provides relevant information to help tailor interventions, informs scale-up and translation of interventions to different settings^{4,6}.

Little research has assessed the fidelity to activities implemented within nursing homes (NH) to reduce unplanned hospital transfers. As such, we will exemplify with a complex intervention: Improving INTERprofessional CARE for better resident outcomes – INTERCARE, a complex intervention with six evidence-based components with demonstrated effectiveness in reducing unplanned hospital transfers of NH residents. Implementation science methods were used to develop, implement and evaluate INTERCARE with the use of stakeholder input and theory-driven contextual adaptations⁷.

Decreasing NH hospital transfers

Decreasing unplanned hospital transfers (emergency department visits with or without ensuing hospitalisation) is a goal for many NHs⁸ since these transfers are associated with an increase in negative outcomes for residents and are costly for the health system^{9,10}. One strategy to reduce unplanned transfers is through implementation and utilization of communication tools. The Interventions to Reduce Acute Care Transfers (INTERACT) quality improvement (QI) program was the first initiative to develop a bundle of tools that can be implemented in NHs to drive staff clinical reasoning and communication with the goal of reducing avoidable hospitalisations¹¹. Another strategy is implementing nurse-led care models which comprise a combination of evidence-based interventions developed to help NH staff better respond to acute resident situations and to increase geriatric expertise within NHs¹²⁻¹⁵. The Missouri Quality Initiative (MOQI) implemented in the U.S.A, is a nurse-led model that also implemented

INTERACT tools and obtained a 30% reduction in all-cause transfers from NHs¹⁶. Innovative nurse-led models of care include advance practice registered nurses (APRN) or nurses with additional skills and competencies referred to as nurses in extended roles as central components of these models¹⁵⁻¹⁷. The development of these models of care and their positive findings have contributed to improving quality of care in NHs and serve as a basis from which researchers can tailor and adapt model components to other NH settings⁷, to successfully decrease hospital transfers [Zùniga & Guerbaai et al., accepted].

Complex interventions and implementation fidelity

Despite a growing number of nurse-led care models or multi-component QI interventions introduced in NHs, few studies examine the relationship between implementation fidelity and its influence on clinical outcomes (e.g., unplanned hospital transfers)¹⁸. Initiatives or programs implemented in NHs are frequently developed as QI studies (which seek to achieve measurable changes in processes of care and outcomes) rather than strictly following implementation science procedures (which studies the incorporation of evidence into practice)¹⁹. Although some principles of implementation science and QI overlap, implementation science frameworks specifically guide researchers to plan for the measurement of implementation science outcomes such as fidelity²⁰, whereas this is less the case for QI initiatives which can explain why few QI studies report the degree of fidelity²¹. Implementation fidelity of complex interventions conducted in NHs is rarely measured and reported, only 3% of NH QI studies measured fidelity²². The degree of implementation of the INTERACT quality improvement program was reported, and authors found that the increased usage – a way of measuring fidelity – of the INTERACT package was associated with a greater reduction of hospitalisations¹¹. Also, Ouslander et al., investigated the factors linked with successful implementation of INTERACT (e.g. facility and resident characteristics), but underlined the need to further assess implementation fidelity in such interventions, as factors that contribute to decreasing hospital transfers remain unclear¹⁸. There is uncertainty as to the variation in the size of the outcome of reducing hospital transfers between studies that used similar components, as some had a positive effect²³⁻²⁵, whilst others did not^{14,15,26}.

A number of barriers to the evaluation of implementation fidelity exist which can explain why few NH studies measure and report fidelity. First, complex interventions and their components have to be clearly defined by the study team to be able to accurately measure fidelity²⁷. Poorly defined core components lead to imprecise measurement of components and

a lack of clarity regarding which are being faithfully replicated^{4,6}. Second, no evidence-based psychometric tools to measure fidelity have been developed, adapted and tested in a variety of fields (add implementation science consortium) unlike other implementation outcomes (e.g., acceptability, feasibility)²⁸. Rather, studies develop their specific fidelity measurement tools and measurement processes depending on the specificities of their intervention, which limits their application to other studies²⁹. Approaches have been developed and reported to guide fidelity assessments, but rather limited to NH behavioral interventions^{30,31}. Last, some practical challenges to measuring fidelity have been described. Choosing the right unit of analysis for fidelity measurement is challenging in complex NH interventions as different components target different levels (ie, unit level and individual level). Also, internal validity threats can jeopardize data collection as focus groups aiming to collect information about fidelity can become part of the intervention and modify participant behavior²⁷. These challenges can complicate operationalization of fidelity especially when resources are limited.

4.3 Methods

To our knowledge, studies evaluating implementation fidelity of nurse-led care models implemented in NHs to reduce hospitalisations have not been conducted so far.

4.3.1 Aim

This study aims to:

1. Evaluate the degree of implementation fidelity to INTERCARE and of each core component over time, and the relationship fidelity has with reducing unplanned transfers (Quantitative aim)
2. Explore factors that might affect implementation fidelity (Qualitative aim)
3. Gain an understanding of which factors influenced the fidelity trajectory of core components over time (Mixed-method aim)

4.3.2 Design

This study is part of a larger hybrid type 2 implementation science study which applied a non-randomized stepped-wedge design to roll-out a nurse-led model of care “INTERCARE” in Swiss-German NHs. The overall objective of INTERCARE was to reduce unplanned transfers from NHs⁷. For the study described in this paper, a mixed-methods convergent/triangulation design was used to investigate the influence of implementation fidelity to the model of care on unplanned transfers³². This mixed methods approach was chosen as

thorough integration of findings from both quantitative and qualitative methods achieve a more comprehensive answer for the study aims. Figure 1 graphically illustrates the study design.

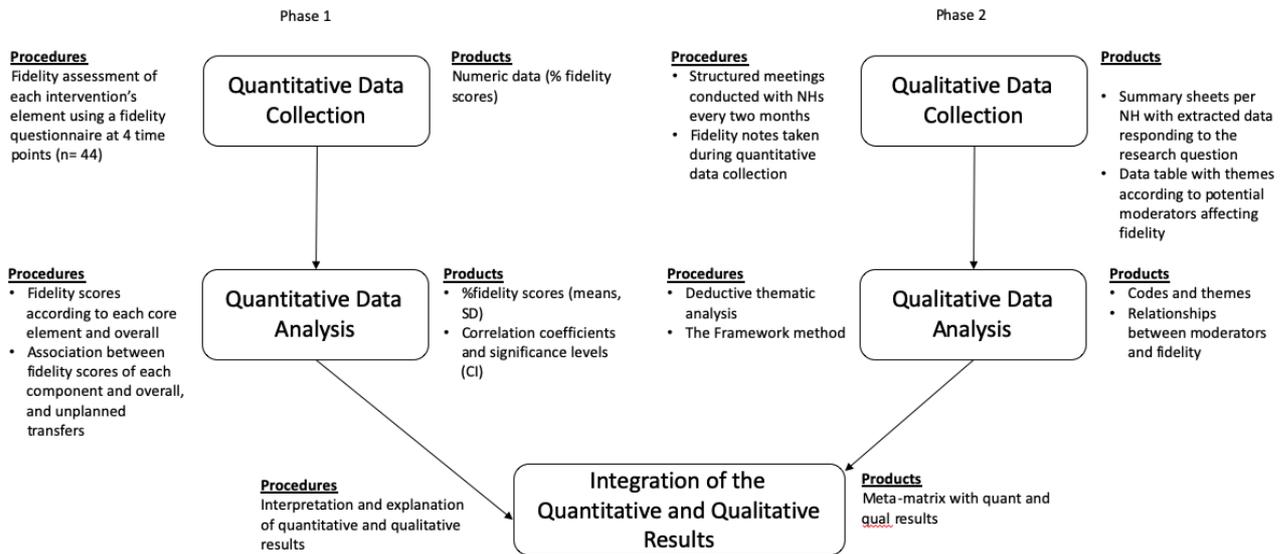


Figure 1: Representation of mixed methods convergent/triangulation design.

Conceptual Framework

The Conceptual Framework for Implementation Fidelity developed by Carroll et al.³³ was used to guide this study's development and to help depict the relationship between INTERCARE's core components, potential moderators which can influence fidelity and how the degree of fidelity can impact INTERCARE's main outcome, unplanned transfers (Figure 2). The degree of implementation fidelity for this study is defined as adherence to the set of minimal requirements defining each core element of the INTERCARE intervention.

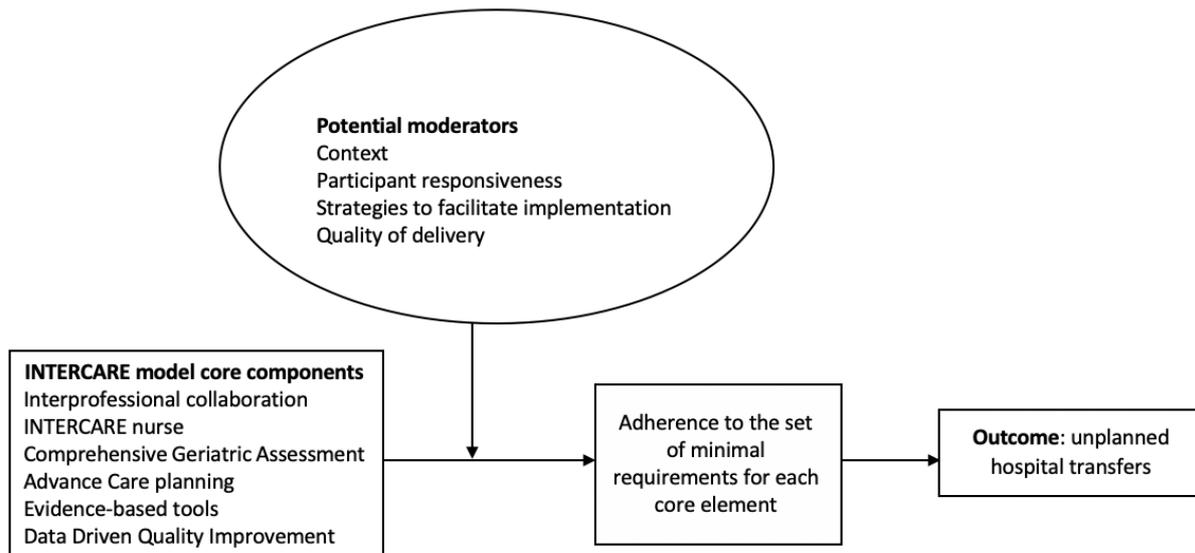


Figure 2: The Conceptual Framework for Implementation Fidelity adjusted for the INTERCARE study, adapted from Carroll et al.³³

Description of the intervention

A full description of the INTERCARE core components including their minimal requirements can be found in supplementary material Table S1. Each component was defined according to minimal requirements which needed to be fulfilled for the components to be considered implemented. A set of peripheral components were also defined for each core element, these could be adapted by each NH as local adaptations improve the fit of the intervention to different contexts, thus increasing successful implementation³⁴. INTERCARE's core components included six components. In brief, the core components included 1) strengthening of **interprofessional collaboration** through the development of internal structures and processes to facilitate communication between physicians and NH staff; 2) an **INTERCARE nurse** specifically appointed or hired in each NH with at least a registered nurse's diploma and three years professional experience in NHs³⁵; 3) conducting a **comprehensive geriatric assessment (CGA)** of the residents initiated by INTERCARE nurses when a change in condition was observed; 4) the use of **evidenced-based tools** from the INTERACT program, including STOP&WATCH to guide the detection and communication about changes in residents' condition at time of observance, ISBAR for structured communication between nurses and physicians, and an acute care transfer reflection tool

adapted from the INTERACT's Acute Care Transfer Tool¹¹ to analyse reasons for unplanned transfers;³ 5) **advance care planning (ACP)** to help NHs initiate early discussions about end of life care and document residents' wishes; and 6) **data-driven quality improvement** feedback to the NHs, to identify potential areas for improvement (e.g., unplanned transfers).

Ethical approval

INTERCARE received ethical clearance from all the ethics committees responsible for the 11 participating NHs (EKNZ 2018-00501).

4.3.3 Quantitative Phase

Data collection and procedures

The quantitative data for the present study was collected at four time points for each of the participating NHs during the INTERCARE study. A fidelity questionnaire was developed containing all core components and their minimal requirements, each minimal requirement was considered as a fidelity item in the questionnaire (Supplementary Material Table S2). All fidelity items remained the same for the four measurement points.

Measurement points included baseline (T0), six-months after intervention start (T1), twelve-months after intervention start (T2), and nine-months after the intervention ended (T3).

At measurement point T0, each NH fidelity questionnaire was filled out by the research team based on information the team had previously collected during leadership meetings with the 11 NHs concerning the intervention components which were already in place (i.e., advance care planning). For measurement points T1 and T2, the INTERCARE study coordinator completed the fidelity questionnaire during a one-hour telephone interview with the INTERCARE nurse in each NH. Any missing results were discussed during the next NH leadership meeting which occurred bi-monthly, to avoid any missing data and provide clarification if needed. For measurement T3, the questionnaires were completed by the NHs during an online post-study meeting, held nine months after the study ended. The final data was comprised of four fidelity questionnaires for each NH (total of 44 fidelity questionnaires), that were merged into one dataset and were coded with a randomly attributed NH number then securely stored on a secured server.

Variables and measurement

Fidelity

Each core component was defined prior to the intervention roll-out, there was a minimum number of requirements that had to be fulfilled for the intervention core element to be considered adhered to. To measure and evaluate fidelity for the component of “evidence-based tools”, the component was divided into separate components (STOP and WATCH tool and ISBAR tool), each with their own set of minimal requirements. The final set of minimal requirements were locked after the last NH started with INTERCARE, thus no modifications were made after the last NH implemented INTERCARE. The set of minimal requirements formed a questionnaire and were developed to address the delivery of each core component. Each minimal requirement was rated as either “yes” equating to a score of 1 or “no” equating to a score of 0 (supplementary material Table S2).

For the component of ACP, 2 minimal requirements were measured in the fidelity questionnaires and three minimal requirements were integrated into a case report form used to collect overall residents’ medical information. The three requirements added to the case report form questioned whether or not a “Do not Resuscitate Status”, a “Do Not Hospitalise Status” and preference for antibiotics in a palliative care situation, had been clarified with residents.

An *overall fidelity score* (ie., percentage of minimal requirements overall delivered as intended) per time point and NH was calculated. The *fidelity scores* for each core component of the INTERCARE model: Interprofessional collaboration, INTERCARE nurse, comprehensive geriatric assessment, ACP, evidenced-based tools (divided into two separate components, the STOP and WATCH tool¹³, and the ISBAR tool¹³) and data driven quality improvement. For each of the above-mentioned components, the *fidelity scores* were calculated as overall mean fidelity of content scores (ie., percentage of minimal requirements per core components delivered as intended). Levels of fidelity were interpreted as previously reported in the literature³⁶⁻³⁷, with 80%–100% adherence interpreted as ‘high’ fidelity, 51%–79% as ‘moderate’ and 0%–50% as ‘low’ fidelity. INTERCARE was considered successfully adhered to in each NH if the overall fidelity score was > 80%, and this threshold was also applied to individual core components (e.g., if >80% was achieved for the core element advance care planning, we considered it successfully adhered to).

Unplanned hospitalisations

Unplanned hospitalisations were measured as the main outcome of the INTERCARE study and described in a separate publication [Zúñiga & Guerbaai et al., accepted]. Residents with informed consent hospitalisation data (Transfer date, type of transfer (planned/unplanned), date of discharge and preliminary diagnosis) were collected throughout the study. *Unplanned hospitalisations* were defined as a transfer from the NH to a hospital (emergency department, private clinic) for an unplanned reason (e.g., fall), including ED admissions and excluding psychiatry referrals.

Analysis

Analyses were performed using SAS 9.4 (SAS Institute, Cary, NC) and R 3.5.2 (Eggshell Igloo)³⁸, with dplyr³⁹ and tidyverse⁴⁰. We predicted the probability of daily unplanned transfer status (yes or no) by 6-months fidelity, using generalized linear mixed models. Each NH received a random intercept and repeated observations were nested within residents. The same models were computed with the fidelity scores for each separate core component of INTERCARE (interprofessional collaboration, comprehensive geriatric assessment, INTERCARE nurse, communication tools, divided into two separate components: The STOP & WATCH tool and ISBAR tool), ACP and data driven quality improvement), to assess their individual relationship to unplanned transfers.

4.3.4 Qualitative Phase

Data collection and procedures

Qualitative data was collected during bi-monthly meetings organized with NHs, whereby leadership teams, INTERCARE nurses and other professions were invited to attend (e.g., NH's responsible physician). The INTERCARE study group led the meetings and was comprised of the INTERCARE study leader, the study coordinator and two research assistants. A structured spreadsheet was used for each NH to collect information during the meetings with pre-defined categories to address each core component. The meetings were held in Swiss German. The spreadsheets were translated via an online software system and checked for accuracy by two native speakers present at every meeting, including the research coordinator which was the responsible person for note-taking.

Data analysis

Deductive thematic analysis was supported by The Framework Method to extract meaningful data from the leadership meeting notes⁴¹. This procedure was chosen due to its flexibility to analyse qualitative notes and for its rigorous procedure which is easy to follow and apply to large datasets. It allows to summarize data while keeping general information about the context of each NH⁴². Prior to starting with the analysis, four NHs were selected by the first and last author based on their varying fidelity trajectories from the quantitative data as a basis to develop a code book of thematic codes to subsequently apply to the following seven NHs. First, the initial spreadsheet for each NH containing all the data from the leadership meetings was reduced to contain only the pertinent information relating to implementation fidelity to the core components. The potential moderators from the Conceptual Framework for Implementation Fidelity, namely: “Context”, “Participant responsiveness”, “Strategies to facilitate implementation” and “Quality of delivery” were used as the overarching themes to deductively select pertinent information. A definition for each for each potential moderator can be found in Table 1.

Table 1. Definition of the moderating factors identified for the INTERCARE study

Potential Moderator ¹	Definition
Participant responsiveness to the delivery of the core components of INTERCARE	Refers to how well the NH staff, leadership, physicians, respond to or are engaged by each core component. It can include judgment about relevance and outcomes of the components. Low participant responsiveness implies that the less enthusiastic participants (Leadership, NH staff, INTERCARE nurse, physicians) are about a component, the less likely the component is to be implemented properly and fully.
Quality of the core component’s delivery	Description of methods used to appropriately deliver of the core elements to achieve the intended goal or generate results.
Context	Surrounding systems, structures, cultures of NHs and concurrent events.
Strategies to facilitate implementation of the core component	Supporting strategies, which include standardized written procedures, training programs, guidelines and actions to enhance buy-in and optimize the implementation of the core components. Facilitation strategies are used to standardize implementation and heighten fidelity across NHs.

¹ Definitions were adapted from Carroll et al., and tailored to the INTERCARE study

Two researchers (RAG, first and FZU, last author) trained in qualitative methods screened each reduced NH's spreadsheet to extract data according to the potential moderators. Separate NH data tables were generated with information relating to each core component corresponding to the above moderators. RAG and FZU discussed and defined emerging codes based on three NH data tables, for each core components. The reliability of the codes was discussed with a third reviewer (project coordinator who was present at each meeting and took notes). The code book containing the moderators and associated codes can be found in Supplementary Material Table S3

Integration

Integration of quantitative and qualitative data occurred at an interpretation level using the triangulation methodology⁴³. A meta-matrix was developed comparing the quantitative results to the qualitative themes (Table 2).

Table 2: Triangulation of quantitative and qualitative results: convergence of findings based on the results from 4 nursing homes

Core component	Fidelity Trends from The Quantitative Findings	Moderating Factors for Fidelity From The Qualitative Findings	Triangulation
Interprofessional Collaboration	<ul style="list-style-type: none"> - Moderate fidelity at baseline - Maintained high fidelity during intervention/sustained post-intervention 	<p>Participant responsiveness NHs enrolled had a communication structure in place prior to the implementation of INTERCARE, which explains moderate fidelity at baseline. NHs made changes in communication structures (such as strengthened reports) at the start of the implementation of INTERCARE which helped develop and strengthen communication between nurses, physicians, and/or therapists and which led to improved collaborations. High fidelity was achieved and sustained six months after implementation of INTERCARE due to changes in practices which enhanced perception of professional roles, (i.e., nurses felt listened to by physicians and respected). In NHs working with a general practitioner model², some general practitioners showed resistance to change and collaboration with NH staff was not improved.</p> <p>Quality of delivery NHs described how they optimized the communication process to facilitate communication achieving desired results (ie., collaborative approach to treatment plans)</p> <p>Context The working practices embedded in NHs prior to the implementation of INTERCARE, such as physician preferences regarding communication and cantonal policies hindered or facilitated fidelity to this core component. As such, NHs working with responsible physicians had a better basis to develop the interprofessional collaboration.</p>	Convergence

² In Switzerland, nursing homes are required to abide to cantonal policies and some cantons regulate with which medical model nursing homes work with. A general practitioner model refers to nursing homes working with general practitioners as opposed to having a responsible physician for the nursing home.

INTERCARE Nurse

- Low to high fidelity achieved within the first six months post implementation of INTERCARE
- Maintained high fidelity during intervention/ sustained post-intervention

Participant responsiveness

The INTERCARE nurse's role developed rapidly in the NHs with INTERCARE nurses expressing growing self-efficacy and self-confidence, clear responsibilities and boundaries. Although it didn't hinder reaching high fidelity within the first six months of the study, clarifications as to when the INTERCARE nurse was needed and feeling overwhelmed due to uncertainty of this new role was acknowledged by the INTERCARE nurses. It was clear that the INTERCARE nurse's role was perceived as a relief for NH staff in challenging situations, and widely accepted by NH staff who responded well to being coached and empowered. Overall, it was acknowledged that there was a need for the INTERCARE nurse's role. Across the various NHs, the INTERCARE nurses fulfilled a number of outcomes depending on the NH needs, including interval trainings, improving their coaching skills helping NHs work independently and leading expert discussions.

Quality of delivery

Achieving high fidelity can be explained by high commitment to the INTERCARE role. INTERCARE nurses put effort into being present on units, engaging in unit rounds, combining the INTERCARE role with unit leader role for some of the INTERCARE nurses already working in that role. Physicians invested into training INTERCARE nurses, and having physicians in the background helped the role grow, even though this was not necessarily the case for all NHs and not a minimal requirement for the fidelity measurement. In NHs with an external GP model (i.e., working with external GPs), GPs could not engage in coaching, this didn't seem to affect reaching high fidelity for those NHs and the minimal requirements were independent to physician involvement.

Strategies to facilitate implementation

NHs introduced the INTERCARE study and INTERCARE nurse's role as possibilities to better prepare for future challenges.

NH's promoted the INTERCARE nurse's visibility and part taking in unit activities.

Context

Convergence

<p>Comprehensive Geriatric Assessment</p>	<ul style="list-style-type: none"> - Moderate fidelity reached at six months and maintained until twelve months. - Moderate fidelity decreased to low fidelity post-implementation of INTERCARE 	<p>INTERCARE nurses worked in different positions with different roles prior to endorsing the INTERCARE role such as working as nurse experts in some NHs.</p> <p>Participant responsiveness Comprehensive geriatric assessment (CGA) was perceived as important by INTERCARE nurses. Clinical assessment was an aspect of CGA and some INTERCARE nurses did perform it (i.e., lung auscultation), but they lacked supervision and the results were not always reviewed and followed-up accordingly.</p> <p>Strategies to facilitate implementation NHs purposely postponed the introduction of CGA and related tasks to invest in the implementation of other components in view of prioritizing resources and reducing burden. For the components of CGA which could be implemented, support given on a peer to peer basis helped foster putting knowledge into practice (i.e., interpretation of information gained from an assessment).</p> <p>Quality of delivery INTERCARE nurses which demonstrated willingness to implement aspects of CGA reported a lack of “fertile soil” although performing certain clinical tasks (ie., lung auscultation) prevented some unplanned transfers from occurring. Also, when assessment instruments were used, follow-up was missing which didn’t improve during the intervention period.</p>	<p>Convergence</p>
<p>Advance care planning</p>	<ul style="list-style-type: none"> - Moderate fidelity was reached progressively during the intervention period, and continued to increase in the post-intervention period reaching a high degree of fidelity nine months after INTERCARE ended. 	<p>Participant responsiveness Medical engagement for ACP varied across NHs, with ACP being challenging with external general practitioners as opposed to having a responsible physician participating in or overlooking the implementation of ACP in the NH. NHs were able to demonstrate that they had a system in place to anticipate issues occurring during out-of-hours to better address critical situations.</p> <p>Strategies to facilitate implementation NHs developed documents to help facilitate the implementation of ACP (i.e., emergency plan).</p> <p>Context</p>	<p>Convergence</p>

<p>Communication tool: STOP & WATCH</p>	<p>- High fidelity was achieved during the first six months of implementation but decreased continuously thereafter to moderate fidelity.</p>	<p>In most NHs the development and implementation of ACP was slow as time was needed to think and develop clear NH structures and processes needed for the implementation of ACP. Some NHs already had a basis or ACP in practice and INTERCARE helped NHs to strengthen prior practices and facilitate culture change or help NHs to further develop their needs (i.e., triggered by the SARS-COVID-19 pandemic). One NH acknowledged that ACP as a growing theme in the health sector helped support the introduction of ACP overall.</p> <p>Participant responsiveness The STOP&WATCH tool helped nursing aides to pass on information proudly and NHs reported high staff buy-in at the start. Effort was needed to help nursing aides to think for themselves and to not be afraid of using the tool (fear to commit a mistake). This tool was used in different ways, for handover to structure thoughts, but also extended to night teams and activity staff. For some NHs, S&W helped initiate a culture change and follow-up was requested. Although advantages were seen, some barriers were noted, such as difficulty in starting with this tool due to unclarity regarding its usage, misconceptions and how to handle feedback once a tool has been completed. Some INTERCARE nurses and physicians were uncertain as to how to use the STOP&WATCH tool within the nursing team, therefore the minimal requirements were not met.</p> <p>Strategies to facilitate implementation NHs trained champions to help introduce the S&W tool and progressively implemented tools on all units. Displaying the S&W tools enhanced their visibility and helped facilitate implementation.</p> <p>Context The first NH to start with the implementation reported lacking in information and materials regarding the tools which slowed down their implementation at the start.</p>	<p>Convergence</p>
<p>Communication tool: ISBAR</p>		<p>Participant responsiveness Implementation of the ISBAR tool support decision making and NH staff attitudes toward ISBAR were very positive. They felt valued and able to communicate on an</p>	<p>Convergence</p>

<p>Data driven improvement</p>	<p>- high fidelity was reached at six months after implementation of INTERCARE and sustained after INTERCARE ended</p>	<p>equal level with physicians with professionalism. ISBAR helped with changes in communication practices such as better prepared and structured phone calls between physicians and nurses. Vital signs and better documented and communicated which many physicians missed until the introduction of ISBAR. The utilization of ISBAR was extended to email and unit visits, so that any email correspondence was structured according to the ISBAR tool and contained information in a structured way and unit visits could be prepared in advance.</p> <p>Strategies to facilitate implementation NHs trained champions to help introduce the ISBAR tool and progressively implemented tools on all units.</p> <p>Participant responsiveness NHs discussed benchmarking reports and quality improvement charts to identify areas for improvement. some NHs identified specific procedures in place such as regular meetings to work on quality improvement. NHs identified some challenges such as high staff turnover which made it difficult to implement assessments or consistently work on a theme, however this did not seem to affect fidelity to this element. once main requirement was to use a plan-do-act-cycle to work on a theme in order to improve and some NHs were not able to use it or used it for other issues not quality related.</p> <p>Strategies to facilitate implementation the NHs were supported by the study leader to better understand how to tackle quality management and NHs demonstrated that different channels (i.e., variety of meetings between different professionals) were available to discuss topics.</p>	<p>Convergence</p>
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4.4 Results

4.4.1 Quantitative findings

Eleven NHs were included in the study. The NHs individual characteristics as well as the hospitalisations characteristics can be found in Supplementary Material Tables S4 and S5.

Implementation fidelity over time

Figure 3 illustrates the trend in implementation fidelity at four time points measured during the INTERCARE study (baseline until 9 months after the intervention ended) for each of the core components. Figure 4 depicts the fidelity trajectory separately for each of the core components in each of the 11 NHs included. The majority of NHs reached high fidelity within the first 6 months of the intervention for the following components: the INTERCARE nurse, STOP and WATCH, ISBAR and for data driven quality improvement. Only two NHs reached high fidelity for the components of ACP, comprehensive geriatric assessment and interprofessional collaboration within the first six months, however these components were already implemented as part of normal NH routine in these NHs. The other NHs worked to implement these components according to the INTERCARE protocol. Two components, comprehensive geriatric assessment and STOP and WATCH, decreased in fidelity over time. For comprehensive geriatric assessment, four NHs decreased in implementation fidelity overtime. For “STOP and WATCH”, eight NHs decreased in implementation fidelity overtime.

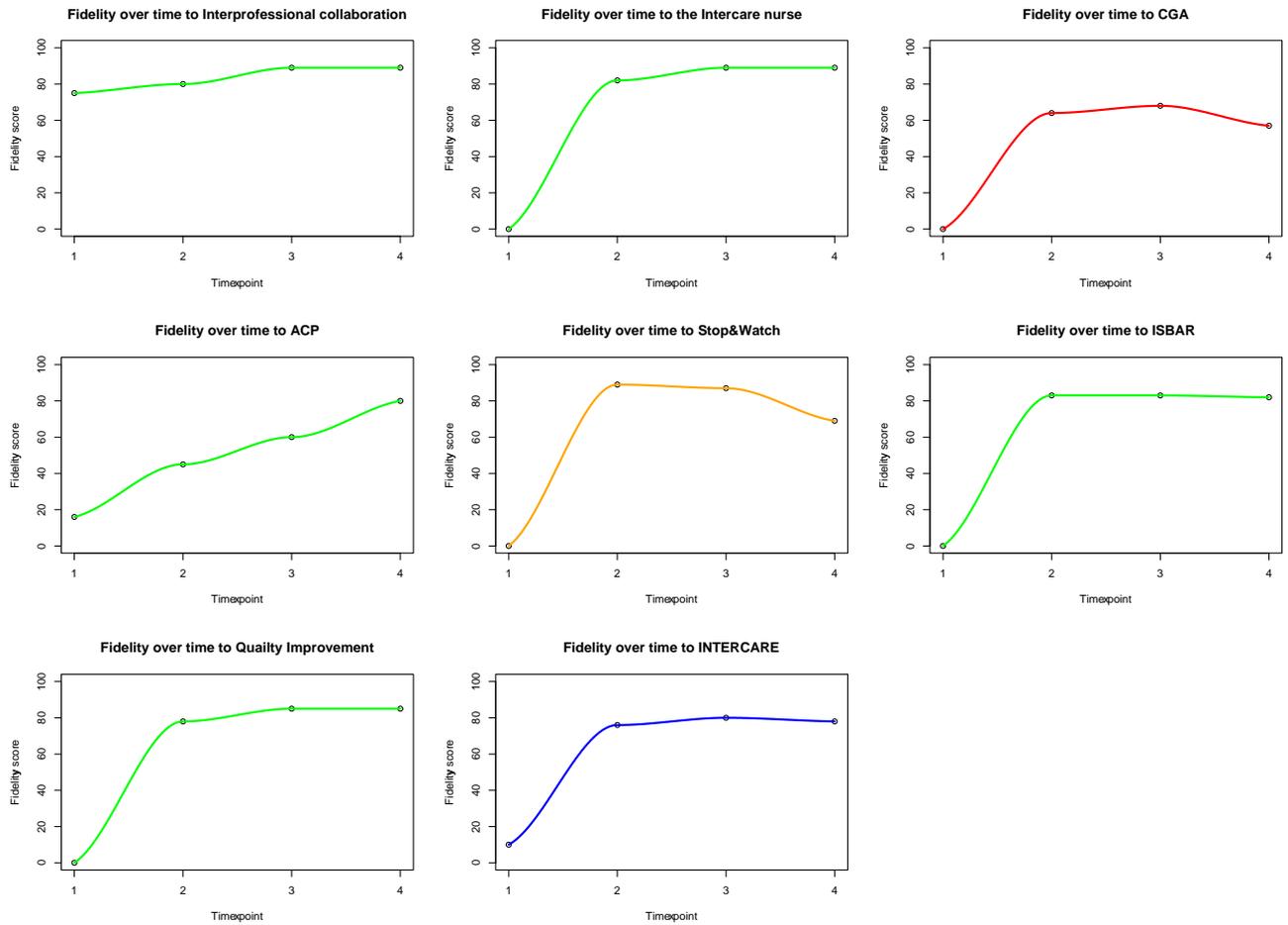


Figure 3. Description of implementation fidelity for the 11 INTERCARE NHs for each core element over time.

Legend: x axis: study time point, 1= T0; 2= T1; 3= T2, 4= T3 ; y axis: fidelity score with 0= 0% and 100= 100% Core components in green reached a high-fidelity score at T4, the one in Orange reached a high-fidelity score at 12 months but dropped and in red the one component which failed to achieve high fidelity.

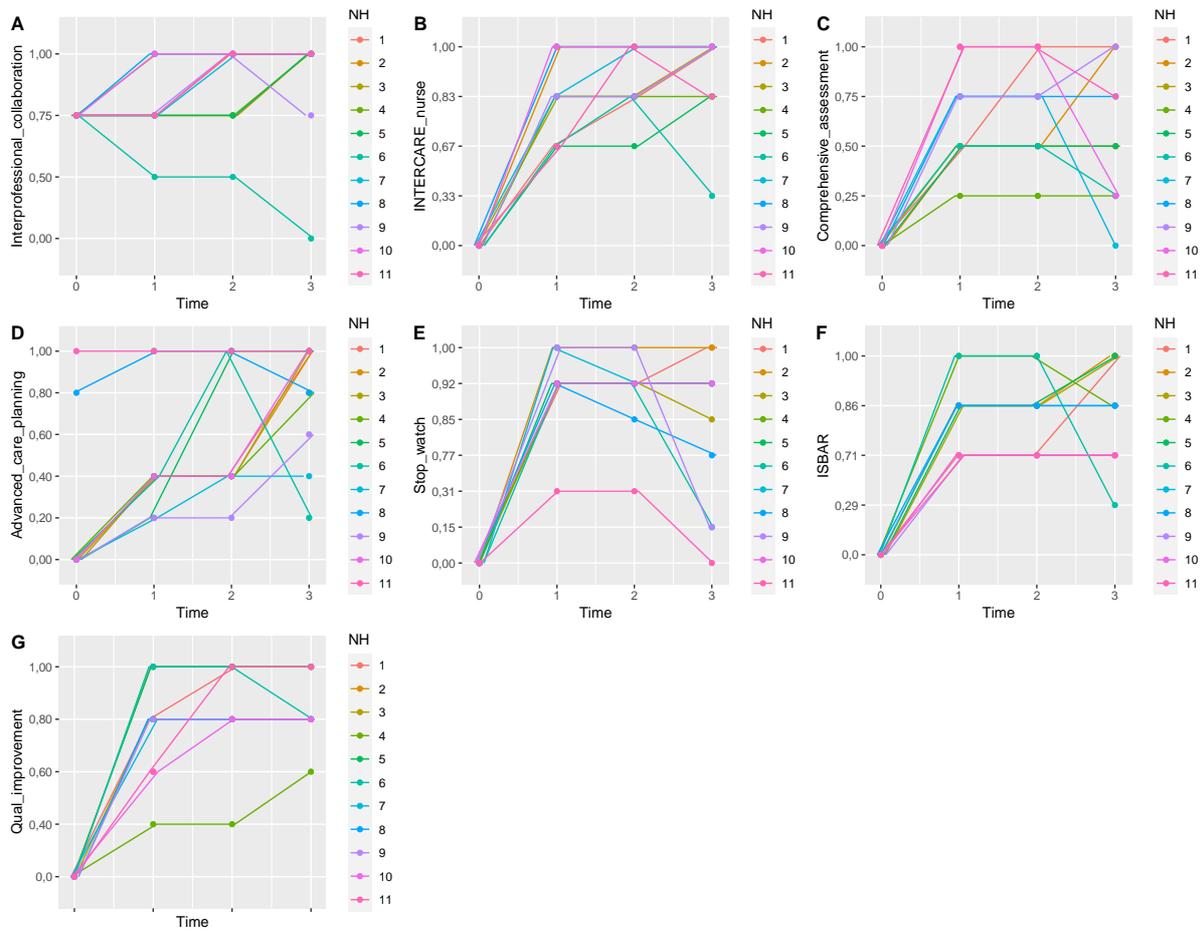


Figure 4 depicts the fidelity trajectory separately for each of the core components in each of the 11 NHs included over time. x axis: study time point, 1= T0; 2= T1; 3= T2, 4= T3 ; y axis: fidelity score with 0= 0% and 100= 100%

Impact on reducing unplanned transfers

Analysis of the relationship between fidelity score and unplanned hospitalizations showed a significant interaction effect between fidelity and time (OR: 0.65 (CI=0.43-0.99), $p=0.047$). As illustrated in Figure 5, higher fidelity scores showed a decreasing rate of hospitalizations post-intervention, while for the lower scores, the hospitalizations kept increasing.

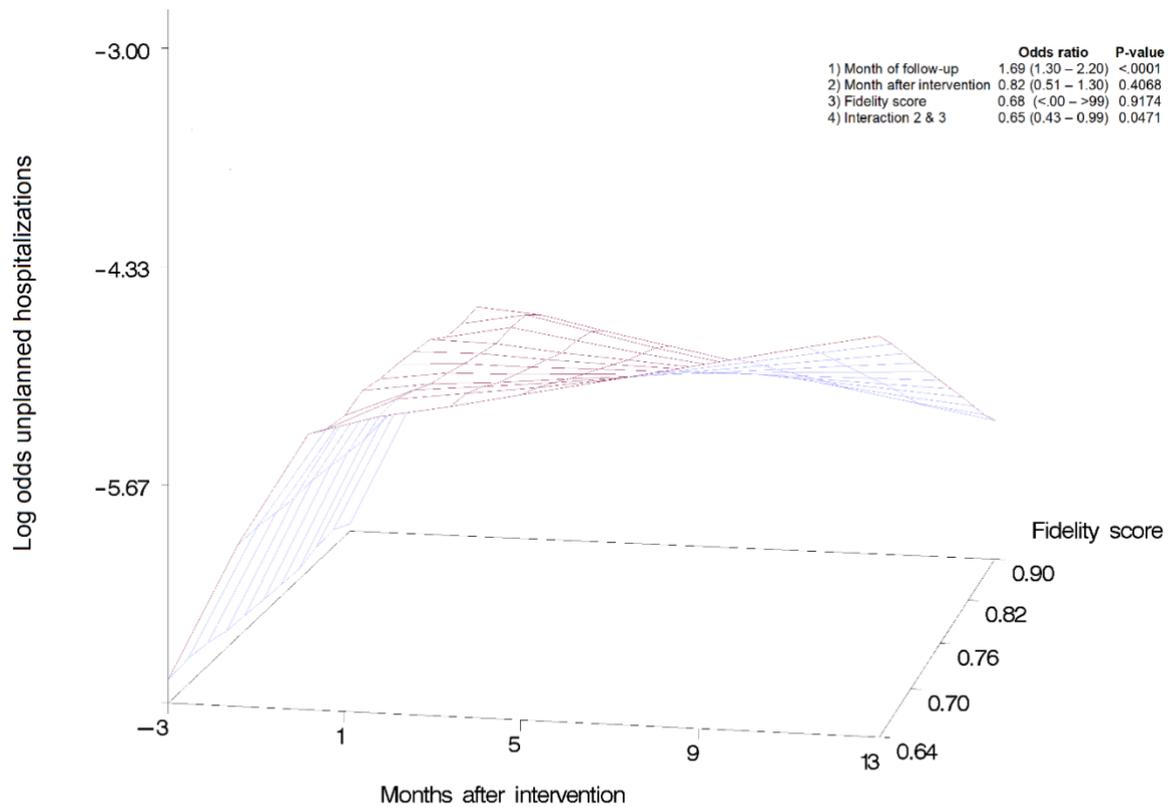


Figure 5: Three-dimensional representation of the fidelity score-dependent intervention effect

This grid surface representation of the regression equation predicting chances of unplanned hospitalizations on a log odds scale, allows to interpret any non-linearities in the association of time and fidelity score with hospitalizations. Observed can be 1) a discontinual trend in the rate of hospitalizations before versus after start of the intervention and 2) a changing association of the post-intervention hospitalisation rate with fidelity score (i.e. interaction of time and fidelity).

Advanced care plan scores did not show an interaction effect, however higher scores were associated with lower unplanned transfers (OR= 0.24 (CI 0.13-0.44), $p < 0.001$). Likewise, lower fidelity scores for the *STOP & WATCH* tool showed higher rates in unplanned transfers (OR= 1.69 (CI 1.30-2.19), $p < 0.003$).

The degree of fidelity to *The INTERCARE nurse, ISBAR, data driven quality improvement, interprofessional collaboration* and *comprehensive geriatric assessment* components did not have statistically significant relationships to unplanned transfers.

4.4.2 Qualitative findings

Context, participant responsiveness, strategies to facilitate implementation and quality of delivery were retained as the potential moderating factors to the fidelity trajectories observed in the participating NHs. The way each of these factors may have affected the fidelity trajectories of the various core components of INTERCARE are described below as well as how some of these factors contributed to the variability of implementation of fidelity in the NHs.

Context

NHs were not uniform in their capacity to implement INTERCARE. Contextual factors that prepared them to implement INTERCARE were crucial moderators as these impacted the fidelity trajectories due to structures and processes which were already in place prior to the implementation of INTERCARE (e.g., already using ACP). NHs working with a responsible physician had a stronger structure in place to work with. This helped NHs adhere to the minimal requirements of the different components, compared with NHs working with multiple general practitioners, where more effort was needed to get them accustomed to internal changes these brought after implementation. Contextual variability existed between NHs working with different physician models. NHs with responsible NH physicians described having their support (e.g., during medical ward rounds) whereas NHs working with different physicians had to accommodate to their preferences which made it more challenging to develop a strong internal communication process (e.g., some physicians preferred email over in-person meetings, difficulties to contact them).

NHs with a responsible physician had - to some extent - began working with aspects of core components (ie, ACP) prior to implementing INTERCARE which helped them further progress with the implementation of additional requirements of the INTERCARE model.

Similarly, NHs working with nurses in extended roles prior to implementing INTERCARE, facilitated adherence to the INTERCARE nurse component but also supported the adherence to the other core components, increasing the degree of implementation fidelity in those NHs. Furthermore, variability was seen between NHs working with responsible NH physicians and INTERCARE nurses with prior experience in an extended role, and NHs working with general practitioners and INTERCARE nurses without prior experience. NHs in the latter category, struggled to achieve high fidelity as this core component demanded a level of skill and knowledge as well as experience and support, which was provided by responsible physicians for the NHs managing to achieve high fidelity and sustain it.

In NH units with high staff turnover, difficulties to satisfy the minimal requirements and reach high fidelity for core components were raised, as consistent workflow was challenging to establish (ie, to sustain utilization of STOP and WATCH and to steadily work on quality improvement)

Participant responsiveness

Participant responsiveness had a direct impact on the degree of implementation fidelity over time. NH staff, NH leadership and physicians (some initial resistance was perceived from external general practitioners) saw the need for a role which could support NH staff and act as a resource person such as the INTERCARE nurse. There was a perceived need for improving and strengthening the quality of information handed over to various professionals, contributing to the attractiveness for STOP and WATCH and ISBAR tools which both received very positive attitudes mainly from nursing aides (STOP and WATCH) and from nurses and physicians (ISBAR), during the first six months after implementation. Unclear processes regarding the handling of STOP&WATCH impeded the usage affecting fidelity to this component. ACP is an example of a component which requires changes at several levels (policy level, NH level, individual level) and requires time for NHs to tackle the associated requirements. Better understanding of NH needs and feasibility regarding comprehensive geriatric assessment could help tailor the component to make sense for participants and improve fidelity.

Strategies to facilitate implementation

Prior to the implementation of INTERCARE, the research group developed implementation strategies based on a prior contextual analysis to help facilitate and sustain the

introduction of the INTERCARE model. As well as these strategies, NHs developed their own approaches to facilitate the implementation of the core components and to help achieve high fidelity. Contextual issues such as high staff turnover were challenging for the NHs and they purposely postponed implementation of certain core components and prioritized which components to implement first in order to reduce burden. NHs worked on positively promoting INTERCARE as a whole and increasing visibility, encouraging INTERCARE nurses to be accessible on the units and making the evidence-based tools (STOP and WATCH, ISBAR) visible and accessible to all NH staff. Units identified champions to help implement the tools and other aspects of some components (ACP, data driven quality improvement). Other strategies included peer to peer support to help putting knowledge into practice (for comprehensive geriatric assessment) or the development of channels to help discuss quality issues between different professionals.

Quality of delivery

NHs described a variety of ways to ensure the core components were appropriately implemented which contributed to the NHs reaching high fidelity for most components. A collaborative approach was used to discuss the processes needed to fully implement the core components and identify which steps were needed. NHs were highly committed to implement the core components of INTERCARE as intended. Some differences between NHs concerning the development of the INTERCARE nurse's role based on the NHs' vision and resources influenced the quality of how the intervention component of INTERCARE nurse was implemented. For instance, some INTERCARE nurses were able to conduct training sessions with NH staff, whereas others were not. This was mainly due to the nurses perceived knowledge limits and lack of time required to organize and prepare trainings/educational sessions. Unclear processes hindered the quality of how the STOP and WATCH tools were implemented as tools were filled out but NH staff did not know how to react once a tool had been filled out. This was very similar for comprehensive geriatric assessment, as lack of follow-up after an assessment was performed, weakened the quality of implementation and lead to it gradually being relinquished for most NHs.

4.5 Discussion

This study sought to better understand how the degree of implementation fidelity to a nurse-led model of care "INTERCARE" evolved over time and how it impacted the reduction

of unplanned transfers. INTERCARE was implemented in 11 NHs following implementation science methods. We found that most core components of INTERCARE reached and sustained high fidelity throughout the intervention period and even extended post -intervention. Across the time span of the project, higher fidelity scores to the INTERCARE model overall lowered the risk of an unplanned hospital transfer. When modeled separately, higher fidelity scores to *ACP* and to *ISBAR* and *STOP&WATCH* tools were associated with a decrease in unplanned hospital transfers. Moreover, the qualitative findings helped to understand how the moderating factors selected from the Consolidated Framework for Implementation Science affected the fidelity trajectory over time and varied between NHs. The physician model, prior knowledge and practice of core components (context), the perceived need of the intervention element (participant responsiveness), the use of key persons/champions (strategies to facilitate implementation) and commitment to the core components (quality of delivery), were key moderators for implementation fidelity of INTERCARE.

4.5.1 Advance care planning

ACP is considered as a key component of nurse-led models of care and has contributed to reducing hospitalisations in previous studies^{44,45}. For INTERCARE, the ACP element's main attributes were to record residents' wishes to three questions (they wished for a transfer in an acute situation, for CRP, and for antibiotics in palliative care). Most NHs included in the INTERCARE study struggled to reach high fidelity to ACP in the first year of the intervention (two NHs were working with ACP prior to the start of INTERCARE). Specifically, INTERCARE nurses found it challenging to find the time to initiate conversations with residents and their relatives and to involve the NH's physician in these conversations partly due to working with many different general practitioners. In other models working with ACP such as The Missouri Quality Initiative, which demonstrated a positive effect in reducing hospitalisations, used an interdisciplinary team that included licensed social workers to work with APRNs to facilitate end of life and goals of care discussions^{44,46}. According to other studies, ACP is highly relevant for NHs and contributed to reducing unplanned and avoidable transfers⁴⁷ but uptake remains low in NHs⁴⁸. Our findings suggest that, nurses working in extended roles such as INTERCARE nurses can drive the implementation of ACP and are well-equipped to conduct discussions, however implementing ACP in NHs requires detailed processes and time until fully adhered to. Therefore, considering implementing specifically

trained staff such as social workers in NHs could help obtain implementation fidelity sooner and support the implementation of ACP in NHs.

4.5.2 ISBAR and Stop& Watch tools

We found that higher fidelity to the ISBAR communication tool and STOP and Watch tool reduces unplanned transfers and this is consistent with Huckfledt et al's findings²⁰. The implementation of these tools was thoroughly discussed with all NHs which participated in INTERCARE and were adapted according to their needs. The INTERCARE study coordinator helped guide the implementation of these tools through bi-weekly phone calls and any barriers were identified and strategies to overcome the issues were discussed. Moreover, the implementation was supported through availability of the tools in different formats such as laminated pockets cards for both tools, to help staff become acquainted with the tools and facilitate higher fidelity. These tools were also found to be highly acceptable and feasible to implement; this is described in another paper [Basinska et al., under review]. Despite achieving high fidelity at the start of the INTERCARE project, the fidelity scores for "STOP&WATCH" decreased after a year. Indeed, in its current form, the "STOP and WATCH" tool was very attractive to NH staff, in particular nursing aides, as they could report resident changes in condition and were given more credibility. Nonetheless, in most NHs this tool stopped being used despite achieving high fidelity during the first six months. This was most likely due to the lack of clear processes describing nursing actions after receiving the filled-in tool. This proved to be too complex to manage and could not be implemented successfully during the entirety of INTERCARE. This is similar to findings from the pilot BIRCH program whereby the "Stop and Watch" tool was seldom used despite initial enthusiasm⁴⁹. NHs achieved high implementation fidelity for "ISBAR" and sustained it after the intervention ended. NHs reported adapting the usage of the "ISBAR tool" and extending it to an email template to improve not only oral communication between nurses and physicians but written communication as well.

Potential moderators

The potential moderators chosen from Carrol et al's framework, guided the deductive thematic extraction of data to explain the core component's fidelity trajectory. This approach was used in other studies examining fidelity in different contexts^{6,50}. Using these moderators as overarching themes is helpful to gain an overall understanding of some of the mechanisms

which impact fidelity. Further investigation as to how potential moderators impact one another deserves more attention. Furthermore, the list of potential moderators could still be extended⁶. To our knowledge, this framework has not yet been used in NH specific studies, therefore some moderators pertaining specifically to NHs could be added based on further research.

4.5.3 Measurement of fidelity

Very few studies conducted in NHs have measured or reported on the degree of fidelity of a complex intervention. Thus, efficient ways of measuring fidelity in the NH setting are lacking^{18,20}. We used a pragmatic method based on the resources we had, by defining minimal requirements for each core component of the INTERCARE model and asking the INTERCARE nurses if the minimal requirements were fulfilled or not by means of a questionnaire. This method may not be sensitive enough to thoroughly measure implementation fidelity. Fidelity can be defined and measured according to concepts of “content”, “coverage”, “frequency” and “duration”³³ or “adherence”, “dose” and “reach”, and sometimes a mixture of these^{1,51}. For instance, we convened to measure fidelity by evaluating whether a minimal requirement was performed as it should, thus assessing only “adherence” and not measuring any of the other above-mentioned concepts, which could oversimplify how we measured fidelity, which is a consistent struggle for other studies as well²⁷. Conducting direct observations in the NHs or asking the INTERCARE nurses to write a daily diary could have possibly contributed to strengthening the measurement of fidelity by gaining more information about how each minimal requirement was performed in addition to whether it was completed or not. Also, we did not measure fidelity in a way which captured specific adaptations made by the NHs, to each core element. Small adaptations could have occurred which could explain how implementation fidelity was enhanced (e.g., the PDSA cycles were considered too complex but were used for STOP and WATCH implementation). We found an effect with the component of ACP on unplanned transfers, but this component was measured slightly differently, as we counted the number of residents with ACP questions filled in and did not solely rely on the INTERCARE nurses’ fidelity questionnaire answers.

Although thresholds for fidelity to categorize high, moderate and low fidelity are consistent across studies, no « consensus » has been agreed upon to define what constitutes high, moderate or low fidelity and what these categories mean for complex interventions (e.g., what does high fidelity mean for a given component?)²⁷. For instance, in INTERCARE, some minimal requirements could have possibly been given higher weight compared to others and

thus deemed more important to fulfill to reach high fidelity. In this study, all core components were given the same importance, but did not have the same number of minimal requirements.

4.5.4 Limitations

Overall our sample size was rather small with 11 NHs participating, which can lead to little variability between NHs and is a challenge⁵². Due to time and resource constraints, only the INTERCARE nurses were asked to complete the fidelity questionnaires during a phone call which could have induced self-reporting bias and potentially recall bias⁵³. Fidelity results were nonetheless discussed with each NH's leadership team during bi-monthly meetings to avoid bias as much as possible. We used self-reported data to measure the "Stop and Watch and ISBAR" tool use as it was not feasible to measure their usage in detail at the facility level without the tools being in an electronic health record or onsite quantification of tool use.

4.6 Conclusion

Evaluation of implementation fidelity is needed to better understand how a complex intervention reaches clinical effectiveness. It helps practitioners, policymakers and other key stakeholders to understand if an intervention is being replicated as it should and to understand why comparable programs vary in their results. This study showed that high overall implementation fidelity to "INTERCARE" was necessary to reduce unplanned hospitalisations from NHs and it adds confidence that the decrease in unplanned transfers is attributed to INTERCARE. Furthermore, high implementation fidelity to ACP and communication tools directly contribute to decreasing unplanned transfers. Exploring moderating factors, can help understand how implementation fidelity can change over time and expose which aspects need further development or better strategies to increase implementation fidelity. Whilst more effort is needed to support comprehensive geriatric assessment in NHs, nurses working in extend roles were successful in achieving and sustaining implementation fidelity. Length of study is important to reflect fidelity changes overtime. Future research needs to focus on more robust methods to measure and analyze fidelity in complex interventions conducted in NHs.

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Supplementary Material Table S1– Core and peripheral elements of the INTERCARE model

The following table provides the list of core components of the nurse-led model of care, which correspond to the minimal requirements and the peripheral components, which can be tailored to each nursing home (NH) (CFIR).

Core elements	Additional information for minimal requirements	Peripheral
Interprofessional collaboration		
A structure in place to facilitate interprofessional communication (e.g. meetings) between at least two different professions.	Each NH is free to decide how communication between different professions may occur, for instance regular team meetings or unit rounds.	Number of structures in place and who involved in the communication structures.
Noticing a resident issue and liaising with the relevant health care professional to establish the residents' care goal.		
Interpretation of assessment results and formulation of a resident care plan in collaboration with a member of the health care team.		
The INTERCARE nurse supports the communication process between physicians and health care staff.	This can occur by having a prior discussion (in person or phone call) with the care staff before they contact the physician. The INTERCARE nurse might guide the care staff to think through a situation and think about potential questions the physician may ask.	
INTERCARE nurse		
According to the INTERCARE nurse's skills and expertise residents are assessed in acute situations, when called by a member of the care team.		Range of educational backgrounds: RN, BSN, MSN, MAS, HöFa I and II
The INTERCARE nurse provides coaching to care staff on daily resident bedside needs.	The INTERCARE nurse supports care staff by assisting, guiding or advising them during bedside care, for instance helping staff to communicate with a resident showing aggression	Number of patients the INTERCARE nurse is responsible for in each NH. Number of units the INTERCARE nurse works on in the NH.
The INTERCARE nurse plans educational sessions with care staff regularly.	The INTERCARE nurse can choose a topic of interest to help care staff improve their competencies and knowledge. These educational sessions can be conducted as formal presentations or by the bedside depending on the topic chosen. The INTERCARE nurse can use their own experience to help care staff manage often occurring difficult situations.	The way and frequency in which the educational sessions are delivered

Core elements	Additional information for minimal requirements	Peripheral
The INTERCARE nurse drives team reflections for each reflection tool filled in.	The INTERCARE nurse plans informal team meetings to reflect and learn from each reflection tool, with the staff present at the time of the acute situation leading to the hospitalization.	
The INTERCARE nurse must have 3 years-experience in long-term-care.		
A position of 60% minimum per 80 beds for which the INTERCARE nurses are responsible for.		
Comprehensive geriatric assessment (CGA)		
The INTERCARE nurse collaborates with the leadership and/or interprofessional team to discuss and define which assessment instrument they work with, for each of the 5 CGA dimensions in their institution, within the first 6 months of the implementation of the model.	The CGA includes the following dimensions: <ul style="list-style-type: none"> • Physical dimension • Functional dimension • Social dimension • Economic dimension • Mental dimension 	Each INTERCARE nurse is free to define how involved they are and the degree of responsibility they have for each dimension.
The INTERCARE nurse's role is clearly defined with regards to their input in the 5 dimensions of CGA.		Any care staff can be involved in the 5 dimensions of the CGA, corresponding to their degree of training and experience
The INTERCARE nurse is involved and supports the care team in integrating the 5 dimensions of CGA in daily practice.	Provides information and guidance to the care team about the 5 different dimensions and can suggest how each dimension can be assessed and evaluated.	
The INTERCARE nurse ensures that residents and relatives are involved in the decision-making process.		
Advance care planning (ACP)		
For every newly admitted resident, the following points must be documented in the residents' records: <ul style="list-style-type: none"> ○ Do Not Resuscitate order ○ Do not Hospitalise order ○ Use of antibiotics 		Presence of physician during initial conversation and subsequent conversations with residents/relatives.
		Degree of involvement of the NH staff in ACP discussions The INTERCARE nurse is in charge of ensuring that every question is clarified with residents and relatives.

Core elements	Additional information for minimal requirements	Peripheral
The leadership team decides who is responsible in the NH to guide the ACP process.		The INTERCARE nurse checks for each new resident admission if the resident has an advance care plan.
For residents in unstable condition before weekends: physician orders and care plans are clarified (Notfallplan), by the appointed responsible person(s) in each NH.		
Evidence-based tools		
STOP & WATCH		
The INTERCARE nurse is responsible for the implementation of the STOP&WATCH and supervises the usage of the Stop and Watch STOP&WATCH tool in daily practice.	None	Degree of penetration of the STOP&WATCH tool, e.g. used by housekeeping staff, therapists. Internal process of how the tools are handled and stored after completion. Implementation of other tools such as care pathways, to help guide assessment for chronic conditions. Using the tools to hand over information non-verbally, e.g. emails, fax.
Implementation of the STOP&WATCH tool on each participating unit, within the first 6 months of implementation of the model.		
Used by nurse assistants to inform the responsible person about changes in resident condition.		
It is clearly defined who will use the STOP&WATCH tool, if extended to other staff.		
All staff using the STOP&WATCH must be trained.		
The situation for which the STOP&WATCH tool is used, is recorded in the resident's documentation, if a change in resident situation has been recognized.		
The nurse responsible should perform the adequate assessment after being given the STOP&WATCH.		
The transmission of the STOP&WATCH tool is either indirect (e.g. storage in a designated compartment for the person in charge of the day) or it is handed over directly to the person in charge of the day / the responsible qualified nurse.		
The STOP&WATCH tool must be filled in and, if necessary, the appropriate letters should be marked as soon as a change in the residents' condition has been identified.		
General information about the resident and the person who filled in the instrument must be added.		
All unit staff are informed about implementation of the STOP&WATCH tool.		
Distribution of the STOP&WATCH notepads to all employees who will use the tool.		

Core elements	Additional information for minimal requirements	Peripheral
ISBAR		
<p>The INTERCARE nurse is responsible for the implementation and monitoring of the use of ISBAR and in giving feedback.</p> <p>Implementation of the ISBAR tool on each participating unit within the first 6 months of implementation of the model.</p> <p>Used by registered nurses in communicating with physicians and with the INTERCARE nurse in acute situations.</p> <p>It is clearly defined who will use the ISBAR tool, if extended to the members of the care team.</p> <p>All staff using the ISBAR tool must be trained.</p> <p>Distribution of the ISBAR Pocket version to all registered nurses and all staff trained to use the ISBAR tool.</p> <p>All unit staff is informed about implementation of the ISBAR tool.</p>	None	None
Data-driven quality improvement		
<p>Continuous data collection for all hospitalisations and emergency department (ED) visits, with exports every 3 months for SPC charts and 6 months for benchmarking.</p>		<p>Each NH can decide who participates in the SPC/Benchmarking discussion.</p> <p>Each NH can decide who takes part in the discussion and completing one PDCA cycle</p>
<p>A member of the leadership team with or without/ INTERCARE nurse should discuss the SPC charts and benchmarking reports together and prepare discussion points for leadership meetings with the research group.</p>		
<p>A member of the leadership team and INTERCARE nurse should meet and discuss which steps are needed to improve quality improvement and complete one PDCA cycle for one identified quality indicator.</p>	<p>For an identified issue, a Plan-Do-Check-Act cycle is carried out.</p> <p><u>Plan</u> Pre-defined persons should think about how they will analyze a situation, how information will be collected, what the goal of the planned change is.</p> <p><u>Do</u> Pre-defined persons should think about how they plan to carry out the change, what is needed, from whom, and who is responsible for guiding the change.</p> <p><u>Check</u> Pre-defined persons should reflect on what was initially planned and what happened during the change.</p>	

Core elements	Additional information for minimal requirements	Peripheral
	<u>Act</u> Pre-defined persons should discuss and describe which improvement measures were implemented and if change occurred.	

Supplementary material table S2: Fidelity measurement questionnaire

Core component	Yes (it is performed)	No (it is not performed)	Notes
Interprofessional collaboration			
A structure in place to facilitate interprofessional communication (e.g. meetings) between at least two different professions.	<input type="checkbox"/>	<input type="checkbox"/>	
Noticing a resident issue and liaising with the relevant health care professional to establish the residents' care goal.	<input type="checkbox"/>	<input type="checkbox"/>	
Interpretation of assessment results and formulation of a resident care plan in collaboration with a member of the health care team.	<input type="checkbox"/>	<input type="checkbox"/>	
The INTERCARE nurse supports the communication process between physicians and health care staff.	<input type="checkbox"/>	<input type="checkbox"/>	
INTERCARE nurse			
According to the INTERCARE nurse's skills and expertise residents are assessed in acute situations, when called by a member of the care team.	<input type="checkbox"/>	<input type="checkbox"/>	
The INTERCARE nurse provides coaching to care staff on daily resident bedside needs.	<input type="checkbox"/>	<input type="checkbox"/>	
The INTERCARE nurse plans educational sessions with care staff regularly.	<input type="checkbox"/>	<input type="checkbox"/>	
The INTERCARE nurse drives team reflections for each reflection tool filled in.	<input type="checkbox"/>	<input type="checkbox"/>	
The INTERCARE nurse must have 3 years-experience in long-term-care.	<input type="checkbox"/>	<input type="checkbox"/>	
A position of 60% minimum per 80 beds for which the INTERCARE nurses are responsible for.	<input type="checkbox"/>	<input type="checkbox"/>	
Comprehensive geriatric assessment (CGA)			

The INTERCARE nurse collaborates with the leadership and/or interprofessional team to discuss and define which assessment instrument they work with, for each of the 5 CGA dimensions in their institution, within the first 6 months of the implementation of the model.

The INTERCARE nurse’s role is clearly defined with regards to their input in the 5 dimensions of CGA.

The INTERCARE nurse is involved and supports the care team in integrating the 5 dimensions of CGA in daily practice.

The INTERCARE nurse ensures that residents and relatives are involved in the decision-making process.

<input type="checkbox"/>	<input type="checkbox"/>

Advance care planning (ACP)

For every newly admitted resident, the following points must be documented in the residents’ records:

- Do Not Resuscitate order
- Do not Hospitalise order
- Use of antibiotics

The leadership team decides who is responsible in the NH to guide the ACP process.

For residents in unstable condition before weekends: physician orders and care plans are clarified (Notfallplan), by the appointed responsible person(s) in each NH.

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

Evidence-based tools

STOP & WATCH

The INTERCARE nurse is responsible for the implementation of the STOP&WATCH and supervises the usage of the Stop and Watch STOP&WATCH tool in daily practice.

Implementation of the STOP&WATCH tool on each participating unit, within the first 6 months of implementation of the model.

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

Used by nurse assistants to inform the responsible person about changes in resident condition.	<input type="checkbox"/>	<input type="checkbox"/>	
It is clearly defined who will use the STOP&WATCH tool, if extended to other staff.	<input type="checkbox"/>	<input type="checkbox"/>	
All staff using the STOP&WATCH must be trained.	<input type="checkbox"/>	<input type="checkbox"/>	
The situation for which the STOP&WATCH tool is used, is recorded in the resident's documentation, if a change in resident situation has been recognized.	<input type="checkbox"/>	<input type="checkbox"/>	
The nurse responsible should perform the adequate assessment after being given the STOP&WATCH.	<input type="checkbox"/>	<input type="checkbox"/>	
The transmission of the STOP&WATCH tool is either indirect (e.g. storage in a designated compartment for the person in charge of the day) or it is handed over directly to the person in charge of the day / the responsible qualified nurse.	<input type="checkbox"/>	<input type="checkbox"/>	
The STOP&WATCH tool must be filled in and, if necessary, the appropriate letters should be marked as soon as a change in the residents' condition has been identified.	<input type="checkbox"/>	<input type="checkbox"/>	
General information about the resident and the person who filled in the instrument must be added.	<input type="checkbox"/>	<input type="checkbox"/>	
All unit staff are informed about implementation of the STOP&WATCH tool.	<input type="checkbox"/>	<input type="checkbox"/>	
Distribution of the STOP&WATCH notepads to all employees who will use the tool.	<input type="checkbox"/>	<input type="checkbox"/>	
ISBAR			
The INTERCARE nurse is responsible for the implementation and monitoring of the use of ISBAR and in giving feedback.	<input type="checkbox"/>	<input type="checkbox"/>	
Implementation of the ISBAR tool on each participating unit within the first 6 months of implementation of the model.	<input type="checkbox"/>	<input type="checkbox"/>	
Used by registered nurses in communicating with physicians and with the INTERCARE nurse in acute situations.	<input type="checkbox"/>	<input type="checkbox"/>	

It is clearly defined who will use the ISBAR tool, if extended to the members of the care team.

All staff using the ISBAR tool must be trained.

Distribution of the ISBAR Pocket version to all registered nurses and all staff trained to use the ISBAR tool.

All unit staff is informed about implementation of the ISBAR tool.

Data-driven quality improvement

Continuous data collection for all hospitalisations and emergency department (ED) visits, with exports every 3 months for SPC charts and 6 months for benchmarking.

A member of the leadership team with or without/ INTERCARE nurse should discuss the SPC charts and benchmarking reports together and prepare discussion points for leadership meetings with the research group.

A member of the leadership team and INTERCARE nurse should meet and discuss which steps are needed to improve quality improvement and complete one PDCA cycle for one identified quality indicator.

Supplementary Material Table S3: Codes and definition as applied in the qualitative notes

Core element	Themes: Modifiable factors	Codes	Definition of codes
ICP	Participant responsiveness to the intervention's delivery	Changes in communication structures	Instances of working together from two or more different disciplines
		Changes in practices	Impact / outcome in terms of changes to working practices
		Resistance to change	Demonstration of difficulties to obtain buy-in from NH collaborators
		Professional role	Perception of own or other's roles, including empowerment (or lack thereof), professional pride)
	Quality of delivery	Optimization in the communication process	Description of how the communication is facilitated in the NH
		Results produced	End products of successful collaborations
	Context	Working practices	Organization of day to day "business" in the NH
		Cantonal policies	Policies in place for medical care delivery
INTERCARE nurse	Participant responsiveness	Role development within NH	Reactions of NH collaborators towards the IN 's role in the NH including evolvement of duties, role awareness, embeddedness of role in the NH
		Reactions to the IN new role	Identified advantages, benefits, barriers, gaps of the IN role
		IN role outcome	Skills, abilities, training and competencies, carried out or developed by the IN as discussed/as intended
	Quality of delivery	Commitment to the role	Extent to which efforts are invested in the IN role in the NH
		Challenges to the delivery of IN role	Barriers which impede IN tasks and competencies
	Strategies to facilitate implementation	Avoiding negativity	Putting the emphasis on INTERCARE and IN scope to improve the future
		High reachability	Actions to promote visibility, take part in unit activities
	Context	Existing role	Embedding the IN role in a prior existing structure supporting advanced nursing
CGA	Context	Contextual barriers	Contextual obstacles believed to hinder CGA implementation

	Participant responsiveness	Attitudes towards CGA	Way of thinking, feeling or perceiving the implementation of CGA in NHs
	Strategies to facilitate implementation	Prioritizing to reduce burden	Actions taken to postpone the introduction of CGA and related tasks
		Individual coaching	Support given on a peer to peer basis
	Quality of delivery	Applying knowledge gained	Demonstration of conducting CGA or evidence of trying
Lack of follow-up		Description of a lack of follow-up after CGA is performed	
ACP	Participant responsiveness	Medical engagement	Involvement (or non-involvement) of medical profession in the ACP component, through support, praise, sharing discussions, paperwork
		Procedure to cover out-of-hours	System in place to anticipate issues occurring out of working hours or the will/ need to develop this
	Context	Expected progress	Development of ACP with regards to pre-implementation, processes, adaptations over time
		ACP public theme	Generating interest as a theme which receives attention at present
Strategies to facilitate implementation	Providing document support	Description of documentation to help introduce, support, inform the introduction of ACP in NHs	
S&W/ISBAR	Participant responsiveness	Modes of usage	How information in the tools is used shared, integration of tools as electronic support, adaptations to them
		Changes in communication practices	Perceived changes in communication within NHs and impact on practices
		Attitudes towards the communication tools	Expressed feelings, opinions, self-efficiency about the communication tools
		Perceived difficulties	Any challenges regarding the implementation, sustainment and usage of the communication tools
	Context	Timeliness with resources	Missing needed materials
	Strategies to facilitate implementation	Part of a routine	Integration in routine documentation delivered to new staff
		Champions	Dedicated person which helps introduce the tools, can be unit or NH level
		Pacing introduction	A progressive approach to implementation, statements of conscious non-implementation to secure implementation elsewhere
Enhancing visibility		Accounts of purposeful display on units	
DDQI	Context	Prior usage of QI	A pre-study initiative to work with QIs
		Responsibility level for QI	Description of how accountability for DDQI is organized in the NH
	Participant responsiveness	Collaborative vision	Teamwork to obtain a result

		Identified challenges for DDQI	Description of possible general barriers to conducting QI work
		PDCA application/responsiveness	Accounts given on the usage or adaptations to PDCA
	Facilitate implementation	Enhancing understanding of QI	A way of providing support, guidance, information for the NHs to better understand QI

Supplementary Material Table S4. Nursing home characteristics

Nursing homes participating in the INTERCARE project (n= 11)		Missing
Location of nursing homes		0
Located in an urban area, n (%)	8 (72.7)	
Located in a rural area, n (%)	2 (18.2)	
Located in a suburban area, n (%)	1 (9.1)	
Legal status		0
Privately funded, n (%)	9 (81.8)	
Publicly funded, n (%)	2 (18.2)	
Bed count		
All long-term beds, median (IQR)	120 (114-161)	0
N of beds participating in INTERCARE, median (IQR)	88 (80-103)	1
Physician model		0
Physician(s) on-site responsible for \geq 80% of residents, n (%)	3 (27.2)	
External physician(s) responsible for \geq 80% of residents, n (%)	4 (36.4)	
Mixed model, n (%)	4 (36.4)	
INTERCARE nurses (n=19)		
Age, years, median (IQR)	39 (30.5-51)	0
INTERCARE nurses per NH, median (IQR)	1 (1-2)	0
Bed responsibility per INTERCARE nurse, median (IQR)	95 (80-121.5)	0

Supplementary Material Table S5: Consenting resident characteristics

INTERCARE consenting residents				
Characteristics	Overall participating residents with informed consent	Sub-group of residents never transferred for an unplanned reason during the study	Sub-group of residents transferred at least once for an unplanned reason during the study	P value ^b
Number of residents (%)	942 (100)	717 (76.1)	225 (23.9)	-
Age, median (IQR)	85.5 (80-90)	85.0 (80.0-90.0)	86.0 (79.0-91.0)	0.368
Gender, Female, n (%)	650 (69.0)	497 (69.3)	153 (68.0)	0.589
Length of stay in NH, years, median (IQR)	2.8 (1.7-4.7)	2.8 (1.4-4.8)	2.8 (1.7-4.5)	0.736
Intervention time, years, mean (SD)	1.1 (0.4)	-	-	-
Activities of daily living (0-28) (ADL)^a n (%)				0.109
Not/mildly impaired (0-4)	203 (22.1)	145 (20.7)	58 (26.9)	
Moderately impaired (5-23)	699 (76.1)	543 (77.3)	156 (72.2)	
Severely impaired (24-28)	16 (1.8)	14 (2.0)	2 (0.9)	
Cognitive performance scale (0-6) (CPS)^a, n (%)				0.004
Intact to mild impairment (0-2)	380 (41.4)	266 (37.9)	114 (52.8)	
Moderate to moderately severe (3-4)	388 (42.3)	306 (43.6)	82 (38.0)	
Severe to very severely (5-6)	150 (16.3)	130 (18.5)	20 (9.2)	
Depression rating scale (0-14)^a (DRS) (mean (SD))	1.1 (1.5)	1.1 (1.5)	1.2 (1.6)	0.330

^a For ADLS, CPS and DRS scores, data was unavailable for 24 residents

^b Group differences by random-intercepts logistic regression (t-value approximation)

NH= Nursing Home; IQR= Interquartile range; SD= Standard deviation

Chapter 5

Identifying Appropriate Nursing Home Resources to Reduce Fall-Related Emergency Department Transfers

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Brief summary

Developing partnerships with outpatient clinics and strengthening geriatric expertise in nursing homes were two strategies nursing home staff believe could be implemented to prevent avoidable fall-related transfers to the ED.

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We would like to acknowledge and thank all the nursing homes which took part in the INTERCARE study and implemented the INTERCARE nurse-led model, as well as the INTERCARE research group and stakeholder group. The sponsor was not involved in the design, methods, subject recruitment, data collections, analysis, and preparation of the paper

5.1 Introduction

Falls are very common in nursing home (NH) residents with an average of 1.6 falls occurring per bed/year,^{1,2} and are associated with a decrease in quality of life due to impaired mobility and functional decline.³ Despite efforts invested in NHs to prevent falls with multi-component interventions,^{4,5} falls are responsible for 25% to 87% of emergency department (ED) transfers or hospitalisations with at least one night stay.^{6,7} Furthermore, up to 67% of ED transfers with or without hospitalisation are considered potentially avoidable.⁸⁻¹⁰ In Switzerland, falls in NHs were identified as the primary reason for potentially avoidable ED transfers (53.6%), costing 65 million Swiss francs per year (25% of the overall avoidable transfers cost).¹¹

Potentially avoidable ED transfers and hospitalisations are defined as transfers occurring for a problem or condition that could have been optimally managed in the NH with the availability of diagnostic and treatment resources (e.g., imaging, wound care), timely test results, and nursing and physician availability and expertise.^{8,12} Several factors have been associated with fall-related potentially avoidable transfers, including NH staffing, level of caregivers' training, degree of interprofessional collaboration with general practitioners (GPs), and availability of diagnostic resources.¹³⁻¹⁵

Swiss NHs are staffed with a majority of nursing aids (41%, 3 months training) covering shifts and performing bedside care, and licensed practical nurses (34%, 2-3 years training) and registered nurses (RNs) (24%) supervising or working as unit leaders.¹⁶ Even when shifts are staffed with qualified caregivers, NHs suffer from a lack of geriatric expertise contributing to fall-related avoidable transfers.^{15,17} Decision-making regarding a hospital transfer is left to NH caregivers who do not have the specific skills to help initiate a structured assessment immediately after a fall.¹⁸ As GP access can be challenging, fall-related situations are often assessed by phone,¹⁸ restricting interprofessional decision-making. Residents or relatives can pressure for a transfer for reassurance, which can be difficult to handle for caregivers, especially if it is not needed.^{19,20}

NH access to diagnostic resources (e.g., mobile imaging) is limited and partnerships between NHs and outpatient facilities are weak or non-existent.²¹ Sluggert et al., identified root causes contributing to better management of fall-related transfers such as GP's or advanced practice nurse's (APN) rapid availability for an assessment, as well as mobile imaging, but recommended to focused on medication review and fall's prevention.²²

Current research focuses on fall prevention strategies and only limited and general guidance about the post-fall period is available for NHs.^{23,24} For example, a reliable post-fall assessment tool with the aim of identifying opportunities to prevent falls focusing on underlying reasons causing falls has been developed for NHs.^{25,26} Additionally, studies in hospital and rehabilitation settings developed post-fall assessment algorithms and guidelines; however, they are rather focused on staff's expectations regarding patient care and the development of feasible algorithms to reduce injuries post-fall and prevent repeat falls from occurring.^{27,28} Studies describing appropriate infrastructure, training needs, and resources for NHs to prevent avoidable transfers after a fall are lacking and are needed to develop contextually adapted NH interventions. The aims of this study were: 1) to identify and describe potentially avoidable fall-related transfers, 2) to identify infrastructure, training needs, and resources deemed appropriate for NHs to safely manage potentially avoidable fall-related transfers after a fall.

5.2 Research design and methodology

5.2.1 Design and setting

This study uses data collected during the implementation science study INTERCARE to reduce unplanned hospital transfers (including ED visits). The study was conducted in 11 NHs situated in the German-speaking region of Switzerland, between June 2018 and February 2020.²⁹ This study used a combination of methods including (1) in-depth and structured case review of all falls by independent experts followed by (2) a structured discussion with NH stakeholders about resources needed for Swiss NHs to prevent avoidable fall-related transfers, and (3) a questionnaire survey rating the appropriateness of resources for implementation in Swiss NHs. This multi-method approach involved NH stakeholders throughout the study to promote active public involvement and support coproduction of research with those directly affected.³⁰ The findings generated set the basis for development of interventions which are contextually appropriate.

5.2.2 Sample

INTERCARE recruited 944 residents and recorded 367 hospital transfers. All residents present in the NHs at the time of the study were included except: 1) holiday residents, 2) short-stay residents and 3) day-care residents. Additional inclusion criteria can be found elsewhere.²⁹ Fall-related transfers were identified from the prospective reporting of every unplanned hospital transfer (either an ED visit only or at least one-night stay as an in-patient) collected with a

standardized root cause analysis tool and electronic health record data including medical discharge reports. Fall-related transfers were included in the final sample based on the following criteria: 1) root cause analysis indicated that a fall occurred before the transfer, 2) the medical discharge report indicated a fall as admission reason or fall-related injuries as the main diagnosis.

5.2.3 Data collection and procedures

An overview of the study design can be found in supplementary figure 1.

Step 1: Expert panel and adjudication of fall-related transfers

An expert panel independently rated each fall-related transfer with a self-developed rating questionnaire for potential avoidability, selected reasons attributable to avoidability, and possible resources which could mitigate these transfers. The root cause analysis tool and the medical discharge report were available for each fall's case. A potentially avoidable fall-related transfer was defined as a transfer occurring after a fall or for a fall-related injury with no urgent medical reason, which could have been managed in the NH.

The panel was comprised of five experts purposefully selected by the INTERCARE research group based on their experience and expertise in older people's care and complementary specialties. The panel included four NH medical doctors (Geriatrics (2), General practitioner (1), Emergency Medicine (1), and one NH experienced APN. The expert panel rating questionnaire (Table S1) was developed based on a literature review that identified common reasons attributed to avoidability of NH transfers. A first panel expert meeting occurred in October 2020, to enable the experts to familiarize themselves with the rating process and discuss rating issues. All falls' cases were independently rated by each expert. A second meeting occurred in December 2020, to resolve any disagreement between raters and obtain consensus. Cases with disagreement were re-rated and discussed. Finally, the expert panel discussed potential resources for NHs to safely manage the potentially avoidable rated cases.

Step 2: Nursing home stakeholder meeting

To contextually validate the resources discussed by the expert panel, a structured meeting was held with a group of NH stakeholders in January 2021. Fifteen stakeholders were invited via email to participate. These stakeholders were selected by the research group based on experience in the field of geriatrics and their implication in the INTERCARE project. The final group included two NH GPs, two NH directors, four nurses with expanded roles who took

part in the INTERCARE study and a NH physiotherapist.

Step 3: Rating of appropriateness

An appropriateness questionnaire was developed by the research group, comprising 21 items (e.g., mobile X-Ray brought to the NH) relating to resources needed in NHs (Table S2). Each item was rated on a scale from 1-9, 1 being not at all appropriate for implementation in Swiss NHs and 9 being appropriate. The appropriateness questionnaire was sent to the 9 stakeholders who participated in the NH stakeholder meeting (step 2) and to other stakeholders who participated in the INTERCARE study (n= 21). The response rate was 43.3%, with 13 questionnaires returned.

5.2.4 Variables and measurements

For step 1, the resident's characteristics (including age, activities of daily living³¹ and cognitive performance³¹) and fall-related characteristics were extracted from the standardized root cause analysis tool adapted for INTERCARE based on the INTERACT tool^{32,33} and from the electronic health record data (Table 1).

Table 1. Definition and source of resident characteristics

Variable	Definition/ measurement	Source
Age	Resident age at time of transfer (if resident was transferred more than once, age was taken at time of the first transfer)	Electronic health record
Gender	Resident gender (male or female)	Electronic health record
ADL*	The ADL score ranges from 0 to 28 based on the RAI-NH assessment, repeated every 6 months after NH entry or sooner if condition alternates. The seven items included in the MDS-ADL Long Form scale, ³⁴ include Bed mobility transfer, locomotion, dressing, eating, toilet use, personal hygiene (scores range from 0 (total independence) to 4 (total dependence). The total score was used to build 3 categories of dependence: Not/mildly impaired (0-4), Moderately impaired (5-23), Severely impaired (24-28)	Electronic health record
CPS†	The CPS score ranges from 0 (intact) to 6 (severe impairment) based on the RAI-NH assessment, repeated every 6 months after NH entry or sooner if condition alternates. These scores are derived from four MDS variables – two cognitive items (short-term memory and decision-making), one communication item (ability to make oneself understood) and one ADL item (eating) ³⁴	Electronic health record
NH‡ entry date	Date of entry in the NH	Root cause analysis tool
Date and time of transfer	For each transfer the date and time was retrieved	Root cause analysis tool
NH length of stay	Resident length of stay in the NH at time of transfer (if resident was transferred more than once, length of stay was calculated until the first transfer). Calculated based on the NH entry date and transfer date	Root cause analysis tool
Risk of falls	This variable was ticked if the resident was considered at risk of falls, based on the NH fall's risk assessment policy	Root cause analysis tool
Polypharmacy	This variable was ticked if the resident was prescribed 9 or more active substances daily	Root cause analysis tool
Identification of fall related transfers	Three variables were selected from the root cause analysis tool to capture all fall-related transfers. We used the <i>suspected diagnosis</i> at time of transfer, <i>a fall</i> was ticked as a new symptom warranting the transfer or an <i>X-ray</i> was ticked (to exclude or confirm a fracture)	Root cause analysis tool

* ADL: Activities of Daily Living

† CPS: Cognitive Performance Scale

‡ NH: Nursing Home

The items of the questionnaire for step 1 are in Table S1. Avoidability was dichotomized as avoidable or potentially avoidable vs. non-avoidable. The questionnaire for step 3 is shown in Table S2. Each item was rated on a scale from 1-9 with 1 indicating not appropriate and 9 appropriate for the Swiss NH context.

5.2.5 Ethical considerations

The INTERCARE study is registered at clinicaltrials.gov (Protocol Record NCT03590470) and received ethical clearance from all the ethics committees responsible for the 11 participating NHs (EKNZ 2018-00501). Written informed consent was obtained from all residents to participate in the INTERCARE study or from a resident's relative if otherwise.

5.2.6 Data analysis

Analyses were performed with R 3.5.2³⁵ on Mac with `dplyr`,³⁶ and `tidyverse`³⁷ packages. For step 1, descriptive statistics were used for residents' and fall-related transfer characteristics and reported as median (IQR) or frequencies and percentages as appropriate. χ^2 tests (including contingency tables) were used to assess whether a relationship existed between avoidability and the type of transfer (ED visit only vs hospitalisation) and the differences in proportion between potentially avoidable and nonavoidable transfers.

The RAND/UCLA method was used to calculate appropriateness and agreement for each questionnaire item for step 3. Per-item medians were computed and three relevance categories assigned: 1-3: not appropriate; 4-6: uncertain; and 7-9: appropriate.³⁸ Agreement was calculated based on the statistical measures of ratings' dispersion across the three categories. Disagreement was indicated when the unadjusted interpercentile range (IPR) was greater than the IPR adjusted for asymmetry (IPRAS), i.e., $IPR > IPRAS$. Agreement was indicated when IPR was less than the IPRAS, i.e., $IPR < IPRAS$. The final set of resources comprised the items which reached agreement and had a median rating of 7-9.

5.3 Results

A total of 73 residents and 81 fall-related transfers were collected in this 21-months study. Residents had a median age of 88 years (IQR: 85-92) at the time of transfer and 79.5% were female (Table 2).

Table 2. Resident characteristics at the time of the fall-related hospital transfer

Resident Characteristics (N[§]=73)	N (%) or median (IQR^{**})	Non-avoidable (N=55)	Potentially avoidable (N= 18)	Difference P value
Age, years	88 (85-92)	87.5 (83.5-91)	88 (86-92)	0.453
Gender				0.169
Female	58 (79.5)	41 (75.9)	17 (94.4)	
Male	15 (20.5)	14 (25.5)	1 (5.6)	
Length of stay in NH, years	2.5 (1.2-4.0)	6 (3-7)	0 (0-1.8)	<0.001
Residents with polypharmacy (9 or more active substances)	33 (45.2)	27 (49.1)	6 (33.3)	0.372
Residents deemed at high risk for falls	36 (49.3)	28 (50.9)	8 (44.4)	0.838
Activities of Daily Living score				0.237
Not/mildly impaired (0-4)	22 (30.6)	15 (27.8)	7 (38.9)	
Moderately to severely impaired (5-23)	50 (69.4)	39 (72.2)	11 (61.1)	
Cognitive Performance Scale				0.618
Intact to mild impairment (0-2)	29 (40.3)	23 (42.6)	6 (33.3)	
Moderate to moderate severe (3-4)	35 (48.6)	26 (48.1)	9 (50)	
Severe to very severe (5-6)	8 (11.1)	5 (9.3)	3 (16.7)	

§ N: Number

** IQR: Interquartile Range

Table notes: For Activity of Daily Living and Cognitive Performance Scale, we have missing information for one resident. Information is reported for 72 residents for the overall characteristics and for 54 residents in the non-avoidable group.

Potentially avoidable post-fall transfers

Around one of four fall-related transfers were rated as potentially avoidable by the expert panel and two out of three adjudicated transfers as potentially avoidable resulted in an ED visit without an overnight stay (Table 3). We found ED visits only were more likely to be rated as potentially avoidable by the expert panel, $\chi^2 (1, N = 81) = 18.0, p < .001$.

Table 3. Comparison of characteristic differences of fall-related transfers

ED* and hospital transfer characteristics	All	Potentially Avoidable	Non-avoidable	Difference P value
Number of transfers, N† (%)	81 (100)	21 (25.9)	60 (74.1)	
Length of hospital stay, days (median (IQR‡))	5 (1-7)	0 (0-2)	6 (3-7.3)	0.006
Type of transfer				<0.001
- ED visit only	23 (28.4)	14 (66.7)	9 (15.0)	
- Transfer resulting in a hospitalization	58 (71.6)	7 (33.3)	51 (85.0)	
Time of transfer				0.636
- Office hours, week days	63 (78.8)	17 (85.0)	46 (76.7)	
- Out of hours, weekends/evenings	17 (21.2)	3 (15.0)	14 (23.3)	
Treatment (Surgery)	34 (42.0)	0 (0.0)	34 (56.7)	<0.001
Diagnostic procedure, Imaging	75 (92.6)	17 (81.0)	58 (96.6)	0.005
Residents with polypharmacy	37 (45.7)	6 (28.6)	31 (51.7)	0.115
Residents with falls' risk	39 (48.1)	9 (42.9)	30 (50.0)	0.756

* ED: Emergency Department

† N: Number

‡ IQR: Inter Quartile Range

Table explanations: For time of transfer, we have missing information for one case meaning we have information for 80 transfers in the "All" category and for 20 transfers in the "Potentially avoidable category".

χ^2 tests (including contingency tables) were performed to compute the P values.

The four main reasons attributed to potential avoidability were (1) the possibility for an outpatient appointment (71.4%), (i.e., to a walk-in-clinic), (2) the transfer occurred before a medical assessment (i.e., by a NH GP) could be carried out (61.9%), (3) the resident was treated in hospital after an incorrect assessment of the situation (47.6%) and (4) the necessary resources to handle and treat the resident weren't available in the NH (33.3%) (Table 4).

Table 4. Characteristics of potentially avoidable fall-related transfers

Cases rated as potentially avoidable (N [§] = 21)	
Reasons attributed by the expert panel for potential avoidability**	N (%)
An outpatient appointment could have been possible before transfer	15 (71.4)
The transfer occurred before a medical assessment was obtained (i.e., GP consultation ^{††})	13 (61.9)
The resident was treated in hospital after an incorrect assessment of the situation	10 (47.6)
The necessary resources to handle and treat the resident weren't available in the NH ^{‡‡}	7 (33.3)
The status of the resident at the time of the fall was not an emergency	3 (14.3)
No further procedures were performed in hospital or ED ^{§§} to those received in NH	3 (14.3)
Relatives asked for the transfer	3 (14.3)
Palliative care status was known and not considered	2 (9.5)
The resident asked for the transfer	2 (9.5)
Presence of advanced care practice guidelines against transfer	1 (4.8)
Diagnostic procedures and treatment performed in the ED	N (%)
<i>Diagnostic procedures</i>	
Transfers requiring imaging (CT ^{***} or X-Ray)	17 (81.0)
- Evidence of a fracture only	7 (41.2)
- Evidence of head trauma only	7 (41.2)
- Evidence of a fracture and head trauma	1 (5.9)
- No evidence of fracture or head trauma	2 (11.8)
Laboratory work-up	6 (28.6)
<i>Treatment</i>	
Resident transfers requiring surgery	0 (0)
Resident transfers requiring pain relief	14 (66.7)
Resident transfers requiring a wound dressing	7 (33.3)

§ N: Number

** Multiple answers were possible for each answer option

†† GP: General Practitioner

‡‡ NH: Nursing Homes

§§ ED: Emergency Department

*** CT: Computed Tomography

Appropriateness of resources

Twenty-one different resources were rated in the appropriateness questionnaire, by 13 raters. Fourteen (66.7%) resources were considered appropriate for implementation in Swiss NHs including access to X-ray, in-house consultation by a variety of professionals and further training for APNs and RNs. Six (28.6%) resources were rated as uncertain (neither appropriate nor inappropriate) and would need further investigation. These resources included access to imaging during out-of-hours and consultation by external professionals. Disagreement between the raters only occurred for “suturing by a RN after training”. Table 5 provides a detailed overview.

Table 5. Appropriateness rating of 21 potentially implementable resources in Swiss nursing homes

Item rated	Median (IQR)*	SD†	IPR‡	IPRAS§	Disagreement between NH stakeholders	Decision for NH implementation
Diagnostic resources						
X-Ray brought to NH during office hours	9 (5.6-9)	2.54	3.4	5.8	No	Appropriate
X-Ray performed in an outpatient department	7 (6.6-8)	2.22	1.4	5.8	No	Appropriate
Build connections with local networks, such as outpatient departments	8 (7.6-9)	1.64	1.4	7.3	No	Appropriate
Computed tomography scanner brought to NH during office hours	8 (5.6-8.4)	3.18	2.8	5.35	No	Appropriate
Clinical assessment and diagnosis after a fall by advanced practice nurse	9 (9-9)	2.38	0	8.35	No	Appropriate
Clinical assessment and diagnosis after a fall by registered nurse after additional training	8 (6.6-9)	1.49	2.4	6.55	No	Appropriate
Consultation after a fall by an internal general practitioner	9 (8-9)	2.24	1	7.6	No	Appropriate
Consultation after a fall by an internal advanced practice nurse	9 (9-9)	1.33	0	8.35	No	Appropriate
Consultation after a fall by an internal physiotherapist	7 (6.2-8.4)	2.50	2.2	5.8	No	Appropriate
Neurological assessment by advanced practice nurse after additional training	9 (9-9)	0.58	0	8.35	No	Appropriate
Neurological assessment by registered nurse after additional training	7 (7-9)	1.44	2	6.85	No	Appropriate
X-Ray brought to NH during out of hours (evenings, bank holidays, weekends)	6 (5-9)	2.91	4	5.35	No	Uncertain
Computed tomography brought to NH during out of hours (evenings, bank holidays, weekends)	6 (5-7)	2.97	2	3.85	No	Uncertain
Computed tomography performed in an outpatient department	6 (5-7)	2.46	2	3.85	No	Uncertain
Consultation after a fall by an external general practitioner	6 (5-8)	2.72	3	4.6	No	Uncertain
Consultation after a fall by an external advanced practice nurse	5 (3.6-5.4)	2.15	1.8	3.1	No	Uncertain
Neurological monitoring by NH staff after initial assessment by advanced practice nurse or registered nurse	6 (6-9)	2.18	3	6.1	No	Uncertain
Treatment and care resources						
Wound suturing by APN	8 (5.6-9)	2.90	3.4	5.8	No	Appropriate
Availability of an algorithm for immediate post-fall management to guide NH staff	9 (8.2-9)	1.83	0.8	7.8	No	Appropriate
Availability of an algorithm to help NH staff reflect on the management after a fall	9 (9-9)	0.60	0	8.35	No	Appropriate
Wound suturing by RN after training	5 (3-8)	3.00	5	3.1	Yes	Uncertain

† SD: Standard deviation

‡ IPR: Unadjusted interpercentile range

§ IPRAS: IPR adjusted for asymmetry

§ IPRAS: IPR adjusted for asymmetry

** NH: Nursing home

Table explanations: This table displays the items rated by nursing home stakeholders via a questionnaire. Each item was rated on a 1-9 agreement scale. Per-item medians were computed and three relevance categories assigned: 1-3: not appropriate for implementation in NHs; 4-6: uncertain; and 7-9: appropriate for implementation in NHs. Disagreement was indicated when the unadjusted interpercentile range (IPR) was greater than the IPR adjusted for asymmetry (IPRAS), i.e., $IPR > IPRAS$. Agreement was indicated when IPR was less than the IPRAS, i.e., $IPR < IPRAS$. The final set of resources comprised the items which reached agreement and had a median rating of 7-9 (highlighted in grey)

5.4 Discussion

To our knowledge, this is the first study to focus exclusively on the avoidability of post-fall ED transfers and exploring appropriate resources for NHs. This study found that 1/4 of transfers are avoidable, of which 2/3 are ED visits only.

Our findings are comparable to other studies, whereby most fall-related transfers are necessary and the majority of residents benefit from hospitalisation after a fall (i.e., hip fractures).¹ Almost half of the residents needed surgery post-fall (42%, table 3). However, some situations seem safe to handle in NHs with close monitoring or with an organized outpatient appointment for further medical evaluation.¹ Most transfers rated as potentially avoidable occurred during working hours, which allows for a range of different interventions to be feasibly implemented. An outpatient visit to a GP's practice or outpatient clinic was the most commonly reported reason for a rating of potential avoidability. One of five fall-related transfers did not receive any diagnostic imaging or medical treatment in the ED beyond a simple assessment which underpins the importance of proposing solutions to prevent these unnecessary transfers and the detrimental consequences on residents. Fourteen resources including access to imaging services (particularly mobile X-ray) during office hours, timely access to GPs, and in-house presence of nurses with additional clinical skills or specialist training (i.e., APNs, expert nurses, or specialist nurses) were deemed appropriate by NH stakeholders for NH implementation to reduce potentially avoidable fall-related transfers (Table 5).

Access to on-site infrastructure

Burke et al. reported that 20% of NH residents were transferred to the ED and rapidly discharged without further treatment.² According to Wang et al. approximately 72% of NH transferred residents needed diagnostic imaging; of these, approximately 85% needed X-ray examinations, and 35% needed CT scans.³ This is very similar to our findings, whereby an X-ray and/or CT was performed in 97% of fall-related transfers rated as non-avoidable and in 81% of those considered potentially avoidable. This corroborates the need for NHs to be able to safely assess and diagnose residents within NHs to only transfer the residents when there is evidence that it is needed.

NHs which are geographically close to outpatient imaging facilities use these more easily and frequently compared to NHs which are distant or isolated,⁴ indicating that partnerships between facilities and NHs should be developed or strengthened. For NHs which

do not have logistical or financial possibilities to access mobile/outpatient services, a “half, half” solution is possible. Residents are transferred to the ED for diagnostic imaging and sent back to the NH for clinical management, as opposed to being formally admitted.⁵ This requires strong partnerships between NHs, EDs, or outpatient services, and access to an onsite GP or APN to interpret the diagnostics and develop the treatment plan. The feasibility for NHs who wish to improve their access to imaging services and take over the resident’s medical management might depend on the NH GPs’ level of geriatric expertise, willingness to interpret imaging results, availability of APNs.

Access to clinical training

In Switzerland, geriatric expertise is lacking in NHs and caregivers, residents and relatives need timely geriatric support and advice after a fall or fall-related injury.⁶ The presence of APNs in NHs or support from RNs working in extended roles are considered key solutions to re-engineer resources already present in Swiss NHs.⁶⁻⁸ NH stakeholders are in favor of APNs and RNs with additional training providing that these roles are fully embedded in teams, as opposed to “consulting” APNs or RNs, which visit NHs based on needs.^{9,10} A viable solution for NHs is to offer RNs within NHs the possibility of additional clinical training such as wound assessment, dressing and monitoring, and simple suturing techniques, after final sign-off as competent (ie., timely review by a GP). These are services that are often delivered in the ED and performed by APNs and nurses working in extended roles such as nurse practitioners, in acute care.^{11,12} These services could be offered in NHs, if RNs could benefit from additional clinical skills training such as neurological assessments, monitoring, and initiating a care plan (ie., pain management), and would greatly benefit residents who do not need an ED transfer.

Access to NH decision-making algorithms

Algorithms for immediate post-fall management to guide NH caregivers to establish whether an immediate transfer is necessary are not available in Swiss NHs or internationally, despite there being many regularly updated recommendations available for the prevention of falls.¹³ The Registered Nurses’ Association of Ontario provides a list of interventions to follow after a fall has occurred, however, these are non-NH specific and rather general.¹⁴ According to our results (Table 5), an algorithm with recommendations is deemed appropriate and validated by stakeholders.

Implementation of the above-mentioned resources

Evaluation of contextual readiness to implement and sustainably use the above-

mentioned services/resources is crucial before implementation. This study gives an insight into possible resources which could be implemented in NHs, providing that NH leadership and medical teams are committed and willing to support change in practice, according to the principles of implementation science.¹⁵ Further research is needed to determine how these resources can be implemented. Additionally, it would be interesting to collect data about falls which were managed in NHs and resources which were used to enable this.

5.4.1 Recommendations for practice

Addressing the lack of geriatric expertise in Swiss NHs and supporting the implementation of nurses working in extended roles is necessary, as APNs are not routinely implemented in Swiss NHs despite pilot projects since 2016¹⁶. Enhancing geriatric training and diagnostics (e.g., wound care, basic physical and neurological examinations) of both RNs and nurses working in extended roles can increase attractiveness for nurses and allied health professionals to work in NHs and develop their careers. Swiss NHs have a variety of nurses' working in extended roles¹⁷ but their daily tasks and responsibilities are heterogeneous. Implementing post-fall management guidelines and standardizing training would move the field ahead.

Strengthening partnerships between GP practices, outpatient departments, EDs and NHs, driven by nursing and medical associations to develop collaboration between these settings are needed to leverage resources and ensure better coordination between NHs and hospitals, to ensure minimal time spent in the ED.

As most NHs in Switzerland work with multiple GPs, involving them in discussions regarding clinical practice in NHs and considering what they perceive as important skills are prerequisites for better practice in NHs.

5.4.2 Strengths and limitations

The generalizability of findings may be limited as the study took into consideration the legal framework in which Swiss NHs operate, but provides insights into possible solutions to improve the management of residents after a fall. We worked with a small, purposefully selected expert panel, which was blinded to the residents, NHs, and care settings. The panel has extensive experience and represents the different settings to which NH residents are usually exposed to when transferred from a NH. This enabled in-depth and rich discussions between panel members. The appropriateness questionnaire was simple to use and internally developed but was not piloted and is not exhaustive.

5.4.3 Conclusion and implications

To reduce avoidable transfers after a fall, NHs should consider possible organizational changes, invest in geriatric-focused clinical skills training for nurses, and better integration of APNs in NHs. Most of the resources discussed here could also benefit other common conditions associated with an avoidable transfer, such as the use of diagnostic imaging for better management of respiratory or cardiac conditions within NHs.

Conflicts of interest

The authors have no conflicts of interest to disclose.

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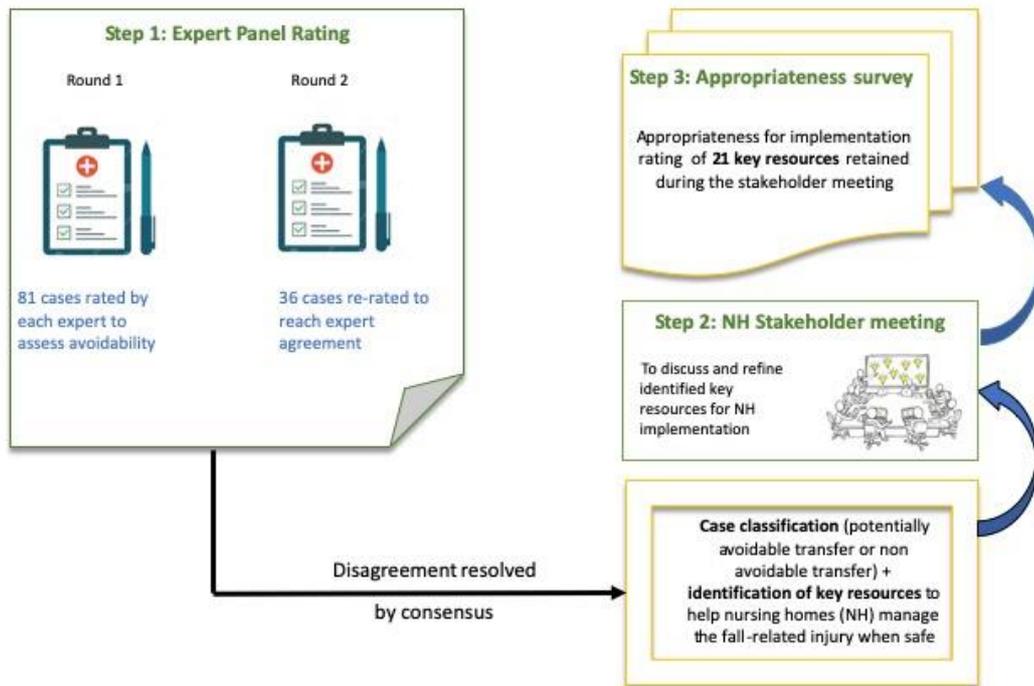


Fig.S1. Study design depicting the various steps to classify each falls' case and identify key resources implementable in Swiss nursing homes.

Step 1 shows the number of cases rated during each panel expert round and the information generated. This information was used for step 2 during the nursing home stakeholder meeting to discuss and refine resources needed to reduce potentially avoidable fall-related admissions. Finally, based on the stakeholder's input 21 resources were rated for implementation appropriateness by a larger group of nursing home stakeholders.

Table S1. Rating questionnaire for hospital transfers occurring after a fall in Swiss nursing homes.

Question 1a: Could this situation have been handled in the nursing home?					
Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	Maybe	<input type="checkbox"/>

Question 1b (If yes was answered in question 1a, please answer the following question): What are the reasons for the transfer being rated as avoidable? Multiple answers possible, please tick the appropriate answer(s)		
1	Incorrect assessment of the situation	<input type="checkbox"/>
2	Resources needed to assess the resident were available in the nursing home	<input type="checkbox"/>
3	Absence of somatic emergency	<input type="checkbox"/>
4	Palliative care status known before transfer	<input type="checkbox"/>
5	Presence of advance directives for non-hospitalisation in the reflection tool	<input type="checkbox"/>
6	The resident was transferred before a medical assessment could be carried out in the nursing home to determine if transfer was necessary	<input type="checkbox"/>
7	An outpatient's appointment could have been arranged	<input type="checkbox"/>
8	No treatment/further examinations were performed in the hospital	<input type="checkbox"/>
9	Relatives insisted for the resident's transfer	<input type="checkbox"/>
10	Other reason(s), please state:	

Table S2: Appropriateness questionnaire rating 21 key resources (translated from German)

	Item rated by nursing home stakeholders	Scale
1	Mobile X-ray brought to the nursing home during office hours	1-9
2	Mobile X-ray taken to the nursing home outside office hours (evenings, nights, weekends/holidays)	1-9
3	Resident goes for an X-ray at an outpatient radiology service or GP* practice (if these can be reached in a reasonable time)	1-9
4	Establishment of local networks between nursing home, nearby hospital and/or outpatient radiology service to provide outpatient radiology (X-ray/ CT†)	1-9
5	Mobile CT is brought to the nursing home during office hours	1-9
6	Mobile CT is brought to the nursing home outside office hours (evenings, nights and weekends/holidays)	1-9
7	Resident goes for a CT at an outpatient radiology service (if this can be reached in a reasonable time)	1-9
8	Extended assessment and diagnostics by a nursing expert APN‡ who has additional training for these situations. They are supervised by a doctor via telemedicine or otherwise.	1-9
9	Extended assessment and diagnostics by a qualified nurse (HF/FH)§ who has additional training for these situations. She is supervised by a doctor via telemedicine or otherwise	1-9
10	1st consultation by home doctor after a fall	1-9
11	Consultation by external family doctor after a fall	1-9
12	Consultation by external nursing expert APN after a fall	1-9
13	Consultation by internal nursing expert APN after a fall	1-9
14	Supplementary consultation with internal physiotherapist after a fall	1-9
15	After fall on head: in-depth neurological assessment by a nursing expert APN with additional training	1-9
16	After a fall on the head: in-depth neurological assessment by a qualified nurse (HF/FH) with additional training.	1-9
17	Suturing of simple wounds by nursing experts APN, after appropriate training under the supervision of a doctor	1-9
18	Suturing of simple wounds by qualified nurse (HF/FH), after appropriate training under the supervision of a doctor	1-9
19	Implement an algorithm to assist in decision-making at the time of the fall (use during post-fall management).	1-9
20	An algorithm to help reflect on what happened after a fall	1-9
21	Continuous training and update of nursing home staff (all levels) on the use of a falls' guideline or algorithm.	1-9

* GP: General Practitioner

† CT: Computed Tomography

‡ APN: Advanced Practice Nurse

§ HF/FH: The Swiss German equivalent to license practical nurses

Scale: 1: Not at all appropriate for implementation in Swiss NHs, 5: neither appropriate or inappropriate; 9: extremely appropriate for implementation in Swiss NHs.

Chapter 6

Synthesis and Discussion

In this final chapter, the results of the three studies presented in this thesis (**Chapter 3 to 5**) are synthesized and key findings are summarized. Further insights into INTERCARE's core components and how their mechanisms intertwined and played a part in decreasing unplanned transfers are discussed. Two further sub-chapters tackle the necessities for NHs to enhance diagnostic possibilities and medical treatment within NHs to enable better management of residents and possibilities for further tailoring of INTERCARE. The last part of this chapter will address methodological strengths and limitations of this thesis and key implications for research and practice.

6.1 Key findings

INTERCARE was implemented in eleven Swiss-German NHs by means of a non-randomized stepped-wedge design. The evaluation of INTERCARE on the reduction of unplanned transfers showed that it proved effective in significantly changing the rising trend observed in the number of unplanned transfers during the three-months baseline period, to a flattening of this trend post-intervention start. This means that the INTERCARE model can be considered as a successful program or strategy for NHs to reduce unplanned transfers. Furthermore, to validate the results found on the cohort of consenting participants, the analysis was conducted on a larger anonymized dataset showing similar findings (**Chapter 3**).

Chapter 4 explored the degree of implementation fidelity, defined as the degree to which INTERCARE was delivered as it was intended to be¹. The aim was to gain a better understanding of how NH fidelity to the core components of INTERCARE evolved over time and whether NH fidelity could be linked to a decrease in unplanned transfers. Measuring the degree of fidelity is crucial to understand which program components are correctly adhered to and distinguishing intervention failure (the intervention is unsuccessful) from implementation failure (flawed implementation)¹. Moreover, evaluating fidelity helps to unravel the reasons behind an intervention's success or (partial) failure². **Chapter 4** established that a higher degree of implementation fidelity to INTERCARE overall, reduced the probability for an unplanned transfer. Also, higher fidelity to the components of ACP, STOP and WATCH and ISBAR communication tools³ had a direct effect on lowering the probability of an unplanned transfer. A modified version of Carroll et al's framework⁴ was used to conceptualize the link between intervention components, fidelity and unplanned transfers. The framework depicts potential factors which can modify the fidelity trajectory (e.g., context and participant responsiveness) and these were used as a basis to explain the trajectory over time for each of INTERCARE's

core components. We found that participant responsiveness and context were key moderators and usually explained why fidelity to core components increased or decreased over time. Furthermore, additional moderators were suggested to expand the framework.

The unplanned transfer data collected as part of the INTERCARE study, served as a basis to investigate the main reasons for a NH transfer to hospital. Indeed, fall-related transfers were the main reason for an unplanned transfer (40.6%) (**Chapter 3**) and 25% of these fall-related transfers were deemed potentially avoidable (**Chapter 5**). Furthermore, a positive association was found between an ED visit and potential avoidability, underpinning the importance of investigating fall-related ED visits with regards to the reasons and factors attributed to avoidability. The majority of potentially avoidable transfers were ED visits (67%). In this study, the four main reasons attributed to avoidability included: the possibility for an outpatient appointment such as in a community medical facility, occurrence of the transfer before a medical assessment could be carried out, due to an incorrect assessment, and the lack of availability of necessary resources to handle and treat the resident in the NH (**Chapter 5**). A list of twenty-one resources (i.e., access to X-ray) was developed based on the above-mentioned findings and rated by stakeholders to identify appropriate resources which could be considered for future implementation in NHs. Fourteen resources were deemed appropriate and covered the themes of “diagnostic resources” (imagery brought in to the NH during office hours, consultation in the NH by a GP, APRN, possibility for a neurological assessment by a trained RN), and “treatment and care resources” (possibility for suturing to be done by APRN in NHs), availability of an algorithm to guide NH staff in the management post-fall). Additionally, very little disagreement occurred between the raters, suggesting that different NH providers, have corresponding opinions about the resources needed in NHs to mitigate fall-related transfers (**Chapter 5**).

6.2 INTERCARE’s components

As described in **Chapter 1**, the detrimental effects of unplanned transfers on NH residents as well as the need to tackle the lack of geriatric expertise and the growing shortage of trained nurses and GPs, warrant implementable and sustainable solutions^{5,6}. Some of INTERCARE’s evidence-based core components were derived from nurse-led models and programs implemented internationally, mainly in the U.S.A, but tailored to the Swiss context prior to implementation⁷. The contextual analysis, guided by the CFIR framework⁸, identified the needs of Swiss NHs in relation to unplanned transfers as well as the identification of barriers

and facilitators with regards to implementing models of care in NHs. More specifically, the contextual analysis coupled with stakeholder involvement enabled the tailoring of components and helped select implementation strategies necessary to support and sustain the implementation of INTERCARE in the NHs. Despite similarities across previously implemented models in other settings, such as access to an APRN or nurse working in an extended role, some models are successful in decreasing transfers and some failed to show an impact. In this thesis the The Care Transitions Framework provided the theoretical structure to consider the “how” when evaluating interventions⁹. The ARCHUS model was similar to INTERCARE in terms of components and content, but did not show any effect on the reduction of transfers¹⁰, yet the MOQI¹¹ and EVERCARE¹² models worked with visiting APRNs and the programs were effective in reducing transfers. INTERCARE was developed based on nurses in expanded roles embedded in NHs to foster in-house expertise and support interprofessional collaboration. Based on these differences, it is interesting to take a deeper look into INTERCARE’s components. The following paragraphs will discuss the possible mechanisms through which INTERCARE’s components achieved a successful reduction in unplanned transfers.

6.2.1 In-house expertise: the INTERCARE nurse

The INTERCARE nurses were at the heart of the INTERCARE model and were recruited by the NHs as fixed employees and completely embedded in the NHs. This is distinctive to most nurse-led models implemented and evaluated so far^{5,11,13}. **Chapter 4** shows that a high degree of implementation fidelity was reached within the first six months for this component and high fidelity was sustained throughout the study and maintained after the study ended (82% fidelity at 6 months after intervention start and remained around 90% at 12 months into the study and 9 months after the study ended). In order to reach high fidelity, moderators included positive NH responsiveness to the INTERCARE nurses’ role, the way the role was tailored to the needs NH’s needs, efforts to develop strategies to facilitate implementation within NHs (e.g., promoting the INTERCARE nurse’s role as a possible solution to prepare for future challenges) and the INTERCARE nurse’s ability to adjust their previous role to the demands of the INTERCARE role. This suggests that this role can fit different NHs and is attainable to nurses with different backgrounds and levels of training, providing they have some long-term care experience (e.g., three years’ experience). These findings were congruent with high acceptability (84% of care staff), feasibility (83% of care staff) and uptake (83%/ 77% nurse

aids/RNs & LPNs) for the role of the INTERCARE nurse which are described in another publication (Basinska et al., under review).

In order to support the INTERCARE nurse's role, a dynamic curriculum was developed by the research team to align clinical knowledge and build a common basis for all INTERCARE nurses. The curriculum was specifically tailored to steadily increase efficacy in the management of geriatric syndromes and address early warning signs and symptoms of exacerbations of common chronic conditions, with the overall aim of reducing unplanned transfers. This curriculum also contained information about the other core components and could serve as a guide to help INTERCARE nurses with their new role. Two-monthly meetings were scheduled with each participating NH as well as two-weekly phone calls with the INTERCARE nurses, to discuss implementation challenges.

In **Chapter 5**, one of the key resources identified and discussed to move the NH field along was the access to nurses with enhanced geriatric skills or when possible to APRNs. NHs stakeholders recognize the need for nurses working in expanded roles and to facilitate access to geriatric expertise within NHs, yet studies also report that the field of geriatrics can generate some anxiety and apprehension for nursing students and early career nurses, especially topics related to end of life care and complexity of chronic conditions¹². Targeting training needs of young nurses and providing access to programs such as INTERCARE can enhance attractiveness for expanded roles and encourage nurses to consider expanding their career in long-term care.

6.2.2 Interprofessional collaboration

The component of interprofessional collaboration sought to improve collaboration and communication between NH staff and GPs in the participating NHs. Interprofessional collaboration is complex and is shaped by the variety of different professionals involved and constellations such as experience, training, staff turnover and communication systems. A number of barriers exist and have been reported with regards to interprofessional collaboration such as issues reaching GPs, the feeling of not being listened to by GPs, a lack of trust between nurses and GPs or logistic problems (e.g., failure to update medical records, technology illiteracy)¹⁴. This component was defined as having a system in place to improve communication between different professionals in the INTERCARE NHs. NHs could choose between which professional groups they wanted to focus their efforts, for instance some NHs wanted to improve collaboration between care staff and physiotherapy or between nurses and

GPs. All NHs were working with the component of interprofessional collaboration to some extent prior to INTERCARE's implementation (**Chapter 4**). Overall, this component was deemed highly important and was very highly adhered to as shown in **chapter 4**, with high fidelity scores sustained overtime. NHs discussed collaborative approaches to improving resident treatment plans and developing stronger relationships with GPs in particular. These positive outcomes were mainly due to changes in attitudes which enhanced perception of professional roles, (i.e., nurses felt listened to by physicians and respected). As discussed in other successful models, supporting collaboration at the clinical level enables better decision making and fosters identification of future areas for improvement^{15,16}.

Most models or interventional studies have RNs, APRNs or nurses working in extended roles embedded in interprofessional teams and are key actors in the implementation of the interprofessional collaboration component¹⁷. However, models can include a wider range of professionals such as social workers, dieticians or pharmacists as leaders, which can also foster better collaboration, but depends on NH regulations and the availability of categories of staff in NHs. Interprofessional collaboration did not show a direct impact on the reduction of unplanned transfers as discussed in **chapter 4**, which was expected as interprofessional collaboration usually has an impact on resident-reported measures of health, such as quality of life or satisfaction with care provided, rather than directly on hospital transfers¹⁸.

1.1.2 Comprehensive geriatric assessment

Comprehensive geriatric assessment is commonly described as an interprofessional systematic evaluation of the resident, involving various health professionals in order to develop and implement a complete treatment plan to address the resident's needs¹⁹. Comprehensive geriatric assessment usually relies on a core team consisting of a physician (usually a geriatrician), a nurse, and a social worker²⁰. Comprehensive geriatric assessment is performed at varying levels of intensity in different settings, and its content may vary depending on the setting (ie, hospital, NH, or community). A systematic review of RCTs involving older patients from a variety of settings found that many of the components of comprehensive geriatric assessment were parts of interventions that were effective in reducing ED visits and rehospitalisations²¹. In the INTERCARE model, the comprehensive geriatric assessment component was part of the INTERCARE nurse's role to enhance their ability to assess residents holistically whilst teaching them to recognize symptoms leading to acute deteriorations and performing the basic clinical examinations (e.g., respiratory/cardiac auscultation). The aim of

an adapted version of comprehensive geriatric assessment in INTERCARE was to help INTERCARE nurses develop their clinical skills and critical reflection alongside the routine resident assessment instruments used in Swiss NHs, (RAI-NHs)²². In Switzerland, NHs evaluate residents for pain (observed and self-reported), polypharmacy or urinary incontinence, amongst others. The RAI-NH assessments are performed when residents first enter the NHs, and regularly thereafter (at least every 6 months if no change in condition is observed). Comprehensive geriatric assessment in INTERCARE extended and strengthened the routine RAI assessments with a more clinical focus. Although INTERCARE nurses recognized the importance of comprehensive geriatric assessment to help avoid some hospital transfers through basic auscultation and examination, **chapter 4** demonstrated that it was challenging to achieve high implementation fidelity this component despite high participant responsiveness (e.g., willingness of the INTERCARE nurses to develop this component).

One of the challenges encountered was that the INTERCARE nurses had to develop this component and often requires the involvement of different health professionals such as social workers, which Swiss NHs do not have²³. An interesting question for the swiss context would be to identify how comprehensive geriatric assessment should be better tailored to address Swiss NH's needs with the resources at hand. For instance, many NHs work with GPs who are not familiar or trained in comprehensive geriatric assessment, thus cannot support nurses with the different aspects it requires. Another factor which needs to be considered is the time NH staff need to discuss, develop and review residents' care plans. The PEACH initiative, used data driven quality improvement as a strategy to improve the implementation of comprehensive geriatric assessment in NHs, by focusing on first identifying specific issues and common reasons for transfers and then using a Plan-Do-Study-Act approach to work on different interventions²³. A similar approach could be a possible way to improve the embedding of comprehensive geriatric assessment in NHs and to gradually expand comprehensive geriatric assessment overtime to not overburden nurses. Identifying residents at high risk of transfers or re-hospitalisations and performing comprehensive geriatric assessment for these residents has been described as strategies in other studies to help further develop this component without overburdening care teams^{24,25}.

6.2.3 Advance care planning

Advance care planning (ACP) plays a major role in the decrease of unplanned transfers, with previous research showing a 9 to 26% decrease in hospitalisation rates²⁶⁻²⁸. **Chapter 4**

demonstrates how we assessed whether high fidelity to ACP, as defined for the INTERCARE model, had an impact on the reduction of unplanned transfers, which provided an indication that documenting resident's wishes was sufficient to show a reduction in unplanned transfers (**Chapter 4**). The approach to ACP taken in INTERCARE was a minimal one and an introduction for NHs, as the majority of NHs had not yet integrated ACP in the resident care plans prior to INTERCARE. Furthermore, we learned from INTERCARE that the implementation of ACP requires time and investment from NHs. High fidelity to ACP was reached after the INTERCARE study ended, meaning that for the NHs participating, it took on average two years to fully implement this component (**chapter 4**), which is congruent with another study²⁶. The INTERCARE study could not include social workers or trained champions to facilitate ACP conversations, unlike other models²⁹ which could have further facilitated the implementation of ACP by reducing the burden on INTERCARE nurses. Training champions could be considered in a follow-up study to help with ACP implementation and to extend this component to include further training, documentation and to nurture a culture for sensitive conversations concerning residents' preferences and wishes, which are important preconditions for ACP to develop successfully in NHs³⁰.

To reach high fidelity to ACP and to show an effect on the reduction of unplanned transfers, context was an important moderator for the NHs (**chapter 4**). Depending on whether NHs had a responsible physician or worked with a range of GPs, impacted on the implementation of ACP, as it was easier for NHs working with in-house physicians to discuss ACP and lead conversations with residents. Overall, NHs reported that ACP helped them to better plan for acute situations and to discuss residents who were at risk of a transfer prior to weekends or bank holidays. NH staff's lack of knowledge about ACP and their self-efficacy in conducting ACP, are identified in the literature as important factors preventing them from engaging in ACP^{30,31}. Improving this should be a first priority, which is the approach we used with INTERCARE as intermediate steps to reach ACP specific outcomes.

1.1.3 Communication tools

Both the ISBAR and STOP and WATCH tools were new to all 11 NHs and high fidelity was achieved for both within the first six months after implementation. The NHs put effort into making the tools visible on units and requested these to be available in different formats (such as laminated pocket cards) to help staff remember how to use them but also as their own strategies to facilitate implementation (**chapter 4**). Both tools are important for the reduction

of unplanned transfers (**chapter 4**) and add to the literature concerning the usage of the tools to strengthen communication in NHs³². Previous research identified that the STOP and WATCH tool showed an effect on reducing 30-day readmissions³³, yet further studies are necessary as limited literature investigates the effect the communication tools have on resident outcomes³². Although ISBAR maintained high fidelity throughout INTERCARE, fidelity to the STOP and WATCH tool declined significantly at the end of INTERCARE. Some NHs did not see the advantage of using it, whilst other adapted the usage of the tool (used as a structured handover tool) which no longer fitted the minimal requirements of INTERCARE. Moreover, NHs reported that it was difficult to know how to follow-up certain situations which were reported via STOP and WATCH and ultimately who was responsible for this. Nonetheless, STOP and WATCH was used by nursing aides during the first year of INTERCARE and this tool helped them to identify and report early changes in condition which has a direct impact on transfers. A possible explanation could be that after a year staff were naturally detecting early changes in condition without needing to go through the STOP and WATCH items, although this would not be the case on units with high staff turnover as the learning effect would not be sustained. ISBAR strengthened interprofessional communication as it helped nurses report important information in a structured way, which eased decision-making from the physicians' point of view. ISBAR was also adapted and used as an email template in some NHs, which helped with the flow of information, as email exchange was better structured and information easily found which contributed to efficient decision-making.

1.1.4 Data-driven quality improvement

Quality improvement is necessary in NH and routinely collected data can help identify areas for improvement, such as using reliable quality indicators³⁴. Every NH which participated already worked with data to improve quality of care, to various degrees prior to the start of INTERCARE, which can explain how NHs achieved and maintained high fidelity to this component. The participating NHs received benchmarking reports and individual charts with their transfer rates on a regular basis and were very enthusiastic to discuss these during team meetings and identify priorities to improve (most often polypharmacy). NHs brought up the theme of staff turnover when quality improvement initiatives were discussed as this can have an impact on how interventions are developed and implemented in NH. NHs described their own strategies to improve uptake of quality improvement initiatives such as allowing more time for units with high staff turnover and providing more support to these units. More insight into

this topic would be interesting for future development of this component as little research has been conducted about how to further develop NHs' ability to collect, analyze and work with their own data. During INTERCARE, NHs were supported by the research team as data were analyzed and results presented in the form of reports developed by the research team, which isn't a sustainable solution for NHs to learn how to work with their data, on the long-term. As part of the quality improvement component, identifying an issue and using the PDSA to address it was also a minimal requirement for INTERCARE. When evaluating the fidelity to the core components, the PDSA approach was not necessarily applied (one NH used it to help implement and address issues with the utilizations of the communication tools) (**chapter 4**). In discussions with the INTERCARE NHs, we realized that NHs did not understand how to use the PDSA approach which might have needed more emphasis and training.

6.3 Key implementation strategies supporting INTERCARE

Based on the Expert Recommendations for Implementing Change (ERIC) taxonomy for implementation strategies, seven strategies were defined and used to support the implementation of INTERCARE. Moreover, these strategies especially targeted and supported the NH leadership teams and the INTERCARE nurses during the implementation of INTERCARE.

As discussed in **Chapter 3 and Chapter 5**, high NH leadership engagement to the study and for the organizational change was necessary to achieve successful implementation. The implementation strategy "*assessing the readiness for change*" helped NH leadership teams to prepare for the implementation of INTERCARE and collegially discuss the vision they had for the model, yet also to think about how the NH staff could be adequately prepared, supported and motivated. For instance, the communication tools which were implemented, were delivered to the NHs in different formats such as laminated pocket cards. Furthermore, "*promoting adaptability*" helped NHs tailor the core components to their own NH needs as each core components had peripheral elements which allowed for local tailoring. As discussed in **Chapter 4**, providing NHs with flexibility regarding adaptable elements of each core element ensures uptake and implementation effectiveness and increase success of any intervention, which was also underlined as important by Hasson et al.³⁵ As stated above, prior to the implementation of INTERCARE the "identification of barriers and facilitators" (i.e., little support from GPs toward the INTERCARE nurses, committed leadership) helped with INTERCARE's uptake and achieving high fidelity to the INTERCARE model (**Chapter 4**). Continuous support of

NHs was provided through “*local technical assistance*” and “*ongoing consultation with the NHs*”. NHs were assisted through data collection and any issues could be directly discussed with the project coordinator.

The INTERCARE study was implemented using implementation science methods, which on one hand guided the development of the INTERCARE model (this part is not covered in this thesis) and on the other, the implementation and evaluation of INTERCARE. The selection and careful tailoring of implementation strategies was key in achieving successful implementation of the model. For instance, Kane and colleagues reported that the training and implementation support may have been insufficient to reach a significant decrease in hospitalisations and that online training and telephone support were not adhered to as much as hoped for³⁶. Their NHs were expected to complete all training modules but only attended 67% of online webinars and completed 52% of online course modules³⁶. INTERCARE applied a more local approach with in-person training and support rather than distance learning and remote implementation support. Additionally, the INTERCARE group worked with a rather small group of NHs which simplified the communication process and getting to know the NHs on an individual basis. The research group was able to be frequently physically present in the NHs, which also possibly enhanced INTERCARE’s success. Tena-Nelson and colleagues underlined some key lessons which could have improved their implementation process, namely better staff and stakeholder involvement, planning, preferring a gradual approach to implementation, training and sustainability³⁷, which could have been further developed in their study. Their results showed a non-significant decrease in potentially preventable hospital transfers, and although it is not certain that using a defined and explicit set of implementation strategies would have helped achieve a greater decrease, tailored implementation strategies are deemed necessary to enhance the implementation of models of care³⁸.

6.4 Enhancing diagnostic and treatment possibilities in NHs

Literature indicates that NHs are ill-equipped to assess, diagnose and treat acute situations in NHs³⁹⁻⁴¹. Reasons for this include lack of diagnostic equipment, resources and treatment possibilities in NHs such as access to X-ray, computed tomography, urinalysis, 12-lead electrocardiograms, or to treatment options such as intravenous antibiotics, blood transfusions, oxygen, intravenous antibiotics, parenteral (tube) feeding, bladder irrigation and wound dressings.^{42,43} Although a need for better access to diagnostic and treatment resources has been recognized, some barriers exist and have been described in the literature. First, it may

not be possible for NHs to access infrastructure such as mobile radiology due to lack of government funding or simply due to logistic difficulties (e.g., lack of staff, NH location, lack of comprehensive program for training to use infrastructure)^{44,45}. However, a systematic review does support the clear advantages of having access to mobile radiology as this is the most commonly prescribed examination for nursing home residents⁴⁶ which is congruent with the findings of **chapter 5** (92.6% of transferred residents). Also, access to radiology does significantly decrease NH transfers⁴⁴ which decreases burden of the hospitals and hospital staff. Also, some services such as access to radiology could be feasible during working hours but other solutions would be needed for out of hours. Furthermore, enhancing diagnostic capabilities is one aspect but another is having the on-site personnel to provide the care needed. A number of factors need to be considered such as GP and nursing availability and expertise (a sick resident which needs close monitoring or regular IVs set up can often require a dedicated person which may be unfeasible), NH policies and culture of practice⁴⁷. The threshold of what is feasible in NHs to safely care for residents during acute situations varies greatly depending on the country and practices, which has to be considered if diagnostic or treatment possibilities are discussed for NHs⁴⁷.

Promoting the development of “diagnostics” in NHs is delicate due to the resources and re-organization it requires, as well as the promotion of organizing NH care in such a way as to ensure the resident feels at home and focusing on their desires and well-being. Promoting patient-centered care is being increasingly advocated for in NHs in Switzerland and abroad, which move away from typical NH set up with an imposed routine for residents (such as bedtimes or meal-times) to resident-centered care and avoid overmedicalization. Interestingly, novel NHs support access to diagnostic equipment and clinical services such as on-site X-ray, catheter and drain care, wound care and parenteral feeding, whilst also providing a home like environment with as little medicalization as possible (ie, no medicine carts, nurse’s uniforms). Unfortunately, no studies have been conducted or published to evaluate these models in terms of clinical outcomes such as hospitalisations. Nonetheless, these NHs can be considered as inspirational models to show that increasing access to medical resources within NHs as well as providing an environment as close to home as possible by supporting resident’s rhythms, preferences and choices regarding their care, is possible⁴⁸.

6.5 Going beyond INTERCARE

As discussed in **chapter 3** and **4**, INTERCARE reduced unplanned transfers and the degree of fidelity was overall high throughout the intervention and sustained afterwards. When thinking about how to further adapt INTERCARE based on the findings of this thesis, it would be interesting to investigate some of the most common reasons for transfers, such as fall-related transfers illustrated in **chapter 5**. This would enable to discuss interventions targeted at individual conditions or specific reasons for transfers and to also further tailor INTERCARE components to incorporate these findings (e.g., including a post-fall guideline in the INTERCARE nurse curriculum as a peripheral add-on). Researchers underline the need to work on specific conditions to develop tailored interventions in NHs, however it is important to have an overall strategy such as INTERCARE to initiate culture change and support other interventions in NHs^{39,49}. For instance, developing nursing leadership as well as comprehensive geriatric assessment could help strengthen nurses as key members of the diagnostic team to actively participate in the decision-making process, as well as strengthening clinical reasoning⁵⁰. During the contextual analysis which led to the development of the INTERCARE model, residents and relatives reported feeling alone when a decision to transfer a resident was required, with very little input from nurses and GPs⁵¹. This supports the need for further investigation into how nurses can be better supported to guide-decision making based on their clinical expertise and to be able to measure this in studies such as INTERCARE. Anecdotal evidence from INTERCARE, supports that there was an increase in geriatric expertise in NHs, however we did not measure this upfront. Furthermore, **chapter 4** underpins the need to further investigate how comprehensive geriatric assessment can be further adapted to best suit the needs of NHs and capabilities of nurses. Studies report the need for further development of comprehensive geriatric assessment or revising nursing curriculums to align with the needs of NHs, the ageing population and shortage of nurses and physicians⁵⁰ and integrating interprofessional frameworks for education and training to define new appropriate competences for nurses^{52,53}.

Advance care planning is an area of care which, as shown in **chapter 4**, is necessary to help reduce unplanned transfers, but more importantly encourages NHs and staff to start thinking about how to organize advance care planning in NHs and initiate conversations with residents and their relatives. As we discussed in **chapter 4**, it took time for NHs to reach a high degree of fidelity to advance care planning, due to a number of factors including working with

different GPs (contextual factor) and also who takes charge and leads conversations (participant responsiveness). Indeed, in NHs who appointed the INTERCARE nurse as responsible person, advance care planning developed quickly, whereas if it was a GP responsibility it took more time and effort. Overall, NH leadership, GPs and care staff need to be better prepared for advance care planning implementation and positive examples of the importance of care planning and residents' and relatives' wishes have to be displayed especially during challenging times such as the SARS-COVID-19 pandemic, where advance care planning became extremely important in NHs.

In **chapter 4** we discussed some of the key moderators of fidelity, however we did not comprehensively analyze other possible factors influencing fidelity. The constructs we included were rather on processes, yet constructs such as characteristics of the implementer (e.g., the INTERCARE nurse), the intervention in itself, the setting in which the intervention takes place and the population, could be interesting aspects to consider for future studies⁷⁰.

6.6 Strengths and limitations of methodologies

This sub chapter will discuss strengths and limitations of methods used in **chapters 3, 4 and 5** of this thesis, as well as methodological features which could be helpful to consider in the future.

INTERCARE is the first nurse-led model of care to be implemented in Swiss NHs following the principles of implementation science and targeting a reduction of unplanned transfers. A stepped-wedge design was used to implement the INTERCARE model, allowing for sequential crossover of every NH from control to intervention⁵⁴. The strength of this design allows to conduct research under real circumstances as opposed to the standard randomized controlled trials. This design enables all NHs to benefit from INTERCARE which had the overall goal of increasing geriatric expertise and improving resident quality of care. Moreover, considering the burden of data collection for the NHs it would have been ethically challenging to withhold participation in NHs and to not offer any advantages or any gain in exchange for their participation. The sequential implementation allowed for individual NH preparation prior to enrollment and timely support during the one-monthly transition period from the baseline phase until implementation. This has been underlined as a strength in other studies¹⁶, and NHs participating in INTERCARE confirmed the importance of having time for preparation. From the research team's perspective, the resources needed for implementation could be spread out as not all NHs received the intervention at the same time, which also alleviated the research

team's burden and enabled to support the next NH starting with the intervention. From an analytic perspective, we applied generalized linear mixed models (GGLM) which enable evaluation of intervention effects on continuous outcomes, such as hospitalisations^{55,56}. Furthermore, Generalized Estimating Equations (GEE) were used to estimate the intervention's effect given that we had longitudinal data with repeated observations⁵⁷ (some residents had repeated unplanned transfers) which are also described in similar studies^{58,59}. Other studies analyzed aggregated data which would result in a loss of power or did not consider repeated hospitalisations³⁶.

Chapter 4 used a mixed-methods approach to investigate an implementation outcome: the degree of implementation fidelity to INTERCARE and to link fidelity to the clinical effectiveness of INTERCARE. The mixed-methods approach enabled the combination of qualitative and quantitative data to gain a thorough understanding of the evolution of NH fidelity to INTERCARE overtime. The quantitative data enabled the measurement of fidelity in relation to unplanned transfers which was a focal point of **chapter 4**, as this helped us better understand which core elements could be linked with a decrease of unplanned transfers. The qualitative data offered rich details and explanations as to why some minimal requirements could not be fulfilled. **Chapter 4** provides an explanation as to possible factors contributing to fidelity changes overtime. This is the first NH implementation science study that proposes a pragmatic way of measuring fidelity and links the degree of implementation fidelity to unplanned transfers, the main outcome of INTERCARE.

A further strength of this thesis is the use of multi-methods applied in **chapter 5** to investigate appropriate resources to mitigate fall-related transfers. A group of experts in all fields related to NHs and the care of older persons and NH stakeholders were included throughout the different steps depicted in **chapter 5** to gain an accurate understanding of NHs' needs to better handle falls in NHs once they have occurred. Collaboration with stakeholders is increasingly advocated in implementation science as it enables an accurate understanding of the context and the facilitation of implementation of interventions afterwards⁸.

Alongside the above-mentioned strengths, there are some limitations to take note of. Firstly, the NHs were not randomized to receiving the INTERCARE model which could have introduced bias⁶⁰. Randomization was unfeasible for the NHs which needed time for pre-implementation preparation. Non-randomization is often criticized as it doesn't allow for results found to be solely attributed to the intervention and thus are considered less robust and

applicable, yet it offers the possibility for settings such as NHs to consider other ongoing priorities (e.g., infrastructure maintenance, other research projects) and to choose the preferred time for implementation^{61,62}

The INTERCARE study design had a short baseline period (3 months for each NH) and the number of transfers collected during baseline was low which could have led to an overestimation of the effect we found which is described in **chapter 3**. This was discussed with the participating NHs and we have no explanation to account for this from the NH's perspective however underreporting may have been possible. For a future study, hiring research nurses to support data collection in NHs would enhance the quality of collected data (e.g., avoid missing data, recall bias) and ensure consistency in the way data is collected throughout the study period.

Further, a pilot study is recommended by The Medical Research Council prior to the real-scale trial to assess whether an intervention can be delivered as expected and whether some aspects or measurements need tailoring to increase acceptability and feasibility⁶³. Although the development and implementation of INTERCARE followed evidenced-based guidelines and the best available evidence was used, a pilot study was not conducted due to time and financial constraints. Piloting of INTERCARE in a small sample of NHs could have perhaps exposed some difficulties encountered toward the collection of hospitalisation data in the NHs and enabled the research group to better understand how to best support the NHs to optimize data collection. Regarding implementation fidelity, a pilot study could have informed how comprehensive geriatric assessment could have been better suited for NHs and might have helped address issues regarding follow-up after a STOP and WATCH tool (**chapter 4**) was completed and increased its acceptability (Basinska et al., under review).

Data collected during the one-month transition period of INTERCARE (between baseline and intervention periods) was included in the final dataset and analysis, however INTERCARE nurses were still getting used to their role and to the data collection procedures (e.g., entering each transfer in the electronic case report form). Other studies tended to exclude data collected during this period to avoid possible errors¹⁶.

Generalizability of findings of **chapters 3 and 5** can be considered limited. First, INTERCARE was implemented in 11 NHs in the Swiss- German region and these NHs were considered as NHs with strong leadership and with low hospitalisation rates compared with nationwide NHs, which have an average hospitalisation rate of 1.34 per 1000 resident care

days⁶⁴. To increase our confidence in the generalizability of the results presented in **chapter 3**, INTERCARE would have to be implemented with the same core elements (but adapting the peripheral requirements) in different and varying NH settings (different regions of Switzerland or countries) and yield the same results. The expert panel and stakeholder group participating in **chapter 5** was comprised of 5 and 13 participants respectively. Although this enabled interesting discussions and the ability for all participants to join in and give their opinion, the listed resources to mitigate fall-related transfers only reflects the Swiss German NH context. It is most probable that the resources rated as appropriate in **chapter 5** would be different in other contexts and these would need to be discussed and redefined based on NH needs and policies. To increase generalizability, a larger expert panel with international experts and NH stakeholders from different settings could be more representative of different NHs and their functioning. Moreover, the inclusion of more resources and a larger group of NH stakeholder representing varying settings (e.g., smaller NHs, larger NHs, high and low performing NHs) would have allowed for more variability with regards to the appropriateness of resources and wider applicability.

In **chapter 4**, we struggled to perceive differences in variability regarding fidelity scores between NHs. As INTERCARE included 11 NHs, which as stated above, were eager and motivated to implement INTERCARE, most NHs had very similar fidelity scores. This could be due to the way fidelity was quantitatively measured, as the fidelity self-developed items may not have been sensitive enough to capture differences between NHs. As eleven NHs were included, fidelity data was collected on the NH level so we obtained eleven data points per time point, which is a small sample. One alternative would have been to develop and test a fidelity measurement tool with a Likert scale, and to pilot test it before using it in **chapter 4** such as those developed and tested to measure treatment fidelity in other studies⁶⁵. Nonetheless, this would have necessitated considerable further logistical, budgetary and time resources which was not feasible given the timeframe of the INTERCARE project.

6.7 Implications for research

The INTERCARE model was developed based on a thorough contextual analysis and contributes to existing knowledge about models of care to reduce unplanned transfers. It is among the first studies in this field to follow the principles of implementation science with a strong theoretical background⁶. Although we obtained successful implementation and clinical effectiveness, further in-depth analysis of the implementation process of INTERCARE is

needed to better understand the reasons behind INTERCARE's success and possible improvements to consider for the scaling up of INTERCARE and for future models of care. Further research is necessary to better understand which implementation strategies are crucial to best support INTERCARE's implementation, and which strategies may need refinement or tailoring. As such, developing a Hybrid type 3 study design and randomizing a larger sample of NHs to various packages of implementation strategies, as well as measuring resident outcomes, will provide important insights into which bundles of implementation strategies are the most effective to support the implementation and sustainment of INTERCARE. By looking at different implementation strategies and how to adapt them to different NHs, this will contribute to facilitating the translation of research into practice⁶⁶. Including NHs with – for instance – differences in management and leadership styles, staff turnover, hospitalisation rates, GP implication, could further help determine if additional implementation strategies are needed that might help weaker NHs implement and sustain INTERCARE.

Robust methods to evaluate implementation fidelity in complex interventions require further research. First, little guidance exists to help researchers develop measurement tools to accurately measure fidelity throughout the implementation period of an intervention. Utilization of fidelity frameworks are limited and need further development and testing to extend their use to different settings and to gain in applicability⁶⁷⁻⁶⁹. For instance, there aren't any NH studies that conceptualize fidelity with a strong theoretical underpinning and further evaluate implementation fidelity within a conceptual framework. Further work is needed for researchers to better understand how adaptability of core elements and degree of fidelity are related. An interesting question is how to best capture and measure adaptability of core elements and how to determine how adaptability affects the degree of fidelity. Although conceptual frameworks exist to depict mechanisms which influence fidelity, these are often modified by research teams to suit the study and thus provide examples of how these are applied but cannot be used to compare studies between themselves and validate their utility. This makes it challenging to build upon other fidelity studies and to accurately measure this outcome. As an example, Carroll et al's framework⁴ is rather anchored on general fidelity modifiers such as context, quality of intervention delivery, strategies for implementation and participant responsiveness; whereas other frameworks propose a top-down approach starting from the implementer characteristics (e.g., knowledge about the intervention) down to the population characteristics (e.g., access to health) which suggests studying barriers and facilitators⁷⁰.

In order for NH research to improve the use of implementation science methods and as an example, better measure key implementation outcomes such as the degree of implementation fidelity, funding agencies must allocate more importance to the cost this entails and better support researchers in this area. INTERCARE was a cost-intensive study and to move forwards and address knowledge gaps such as the study of implementation fidelity and process evaluations, accurate funding is a pre-requisite for both further research and further training of researchers in the field of implementation science. Most often funding agencies focus on funding clinical studies or the clinical period of a trial and there is less emphasis on funding implementation research⁷¹.

An important consideration for future research would be to investigate how to better integrate public involvement in health care studies. Patient and Public involvement (PPI) is certainly gaining more attention and importance as guidelines (<https://www.invo.org.uk/posttypecycle/disseminating/>) and funders recommend to involve the public in research and certain medical journals impose researchers to use PPI and report it⁷². Nonetheless, it is still difficult to achieve especially in NH settings, as most residents are frail, assistance may be needed which can overburden NH staff, as well as lack of time and financial resources which can be difficult for researchers to overcome. Based on the experience gained with INTERCARE, it is extremely relevant and possible to organize workshops with residents and their relatives⁵¹, although drop-out was frequent as well as last minute impracticalities, which can hinder PPI.

Investigating how NHs problematize detection of deterioration and hospital transfers is needed so to better understand the processes of care for residents and further improve these. Connolly et al., suggest that a next step forward targeting a reduction of targeted hospital transfers would be beneficial by implementing individual interventions tailored to specific transfers as well as aiming for a reduction of transfers overall. For this, the use of automated algorithms which have been developed to help assess hospital admissions from NHs could help to strengthen the quality of collected data⁷³. Including NHs in studies with differences in low and high admission rates could also help identify different care processes and how models can be tailored for different NHs. Further work might also consider the value of nationally standardized record formats to improve early detection and assessment of residents in NHs, reducing variation of what is recorded in daily practice in NHs, which could facilitate access to complete homogeneous data for researchers across settings.

Further research into the development of statistical methods applied for the analysis of stepped-wedge designs, could be beneficial for researchers, especially those with little experience in conducting complex designs. INTERCARE demonstrated that it was challenging to analyze the clinical data in a way which made the interpretation of the results clinically meaningful. For instance, using orthogonalized least squares frameworks have been described as a suitable analytic strategy for non-randomized stepped wedge designs⁶¹, but no studies were found to illustrate how this method was applied and how results were clinically interpreted.

6.8 Implications for policy and practice

INTERCARE is a solution for policymakers, stakeholders and NHs who wish to strengthen geriatric expertise and reduce unplanned transfers but have limited or no access to APRNs or specialized nurses. Furthermore, INTERCARE can be implemented alongside the introduction of APRNs, as the model is complementary to models of care including APRNs. This is important to consider as APRNs may become more readily available in Swiss NHs in the future and a model like INTERCARE can serve as a stepping stone and facilitate implementation of APRNs alongside nurses working in expanded roles.

In addition to implementing models of care like INTERCARE, policymakers and stakeholders need to think about better ways to help attract and retain nurses with additional training to work in NHs⁷⁴. Research shows that not enough geriatric training appears in nursing curriculums and the NH setting isn't represented as a desirable setting to evolve in. Undergraduate nurses would benefit from more opportunities to discover the NH setting, and NHs with innovative models could be attractive and provide solid learning environment for student nurses. Additionally, investing into making NHs more attractive includes better salaries, working conditions and as we have experienced with INTERCARE, a visionary way of working which show-cases NHs in positive ways, such as offering a learning environment and support for RNs through nurses working in extended roles. NHs reported that with INTERCARE, nurses were asking to work in the NHs participating as it increased desirability to work in such NHs. RNs and specialist nurses working in extending roles need to be publicly recognized for their additional skills, supported and encouraged to further develop their competencies. Opportunities for training and coaching in NHs need to be provided to help them develop the expertise required for roles to continue to evolve within NHs depending on the demands and NH population.

The overall INTERCARE project underpinned the need to strengthen partnerships between NHs and hospitals, ED departments, outpatient departments, and GP practices to gain a better understanding of what could be further addressed in both settings to tackle readmissions, improve communication and information exchange, and develop hospital discharge care plans which are in adequacy with the NH environment. Working more closely with GPs and further involving them in both the development of models of care such as INTERCARE and in the practical daily work such models require is crucial to enable nurses working in extended roles to work within a scope of practice and boundaries that medical professionals agree with and understand.

Last, the INTERCARE nurse was a central point of the INTERCARE model and some recommendations for NHs who wish to implement a model like INTERCARE are described thereafter. With the example of INTERCARE, leadership support and implication throughout the project was necessary for the project to succeed and without this support, it is likely that implementation of new nursing roles, like the one of the INTERCARE nurse may fail or fail to be sustained^{75,76}. NH unit managers are essential figures for such projects as they organize everything from communication to health care on units and are also directly connected to the NH staff and nurses working in extended roles. They are important stakeholders to consider as they directly influence model buy-in on units, provide support and resolve conflicts with upper management⁷⁵. Local stakeholders are also important in how the model and new role are communicated and boost acceptance for and facilitate integration of the role. High stakeholder involvement also prevents false expectations to be communicated and are able to address upcoming issues on a macro level.

6.9 Conclusion

This thesis presented the results of three studies embedded in the INTERCARE project concerned with decreasing unplanned and avoidable hospital transfers from NHs. Older people in NHs are in demand of care around the clock and nurse-led models of care which can be tailored to different settings are needed, especially in countries and areas where nurses working in extended roles are not available. To meet the increasing demands for more complex medical treatment in nursing homes, to provide high-quality palliative care, and provide advanced medical diagnostics and treatment possibilities, unremitting effort is needed to continuously revise and further develop nurse-led models of care. INTERCARE offers a solution for NHs and policymakers to strengthen care delivery by improving geriatric expertise, which can be

adapted to different settings - as one size does not fit all. The goal for the future should be to better fund and support nursing homes with well-educated and trained NH staff.

6.10 References

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