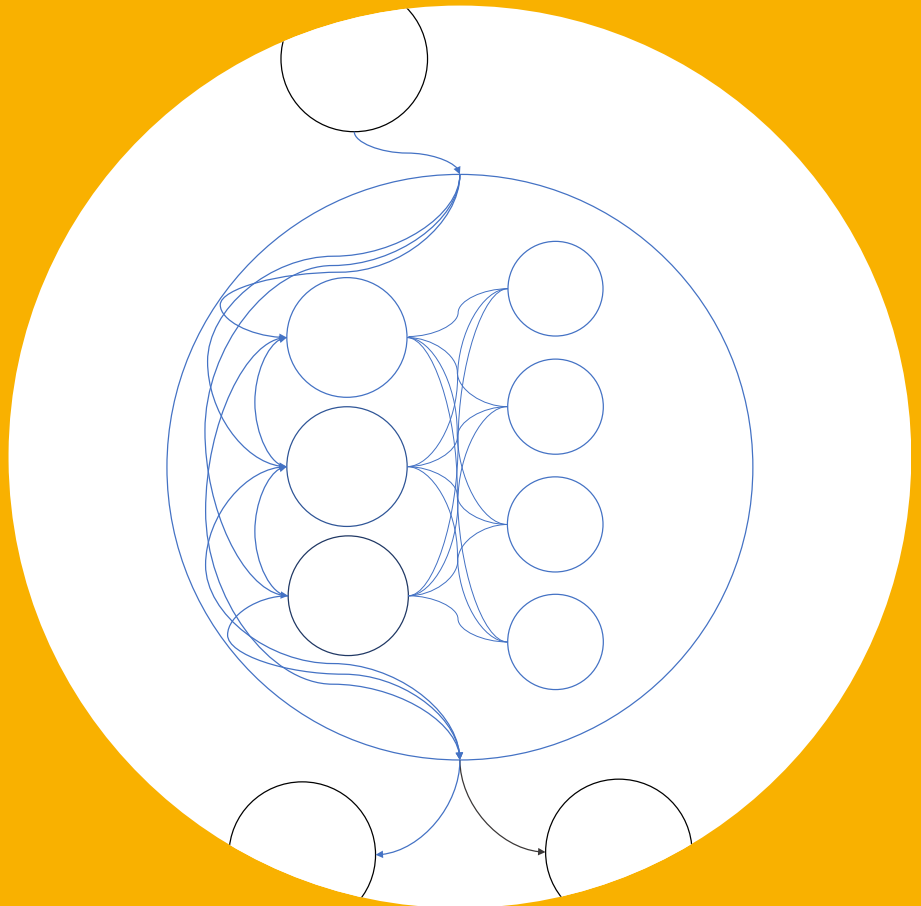


Analysing the Performance of Meso-level Care Systems Including Long and Short Term Services

Olli Halminen



Analysing the Performance of Meso-level Care Systems Including Long and Short Term Services

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A doctoral thesis completed for the degree of Doctor of Science (Technology) to be defended, with the permission of the Aalto University School of Science, at a public examination held at the lecture hall TU1 of the school on 20 January 2023 at 12 noon.

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Different managerial logics are relevant when managing individual care organisations, networks of interrelated care organisations, or national health systems. Individual care organisations and national health systems are often referred to as the micro and macro levels of management, whereas the networks of different organisations as the meso-level. The regional social and health care reform currently taking place in Finland will further accentuate the role of the meso-level of management. Meso-level social and health care systems have, however, received less attention in registry-based studies than micro and macro level systems. Also, the literature on social and health care management has not focused at length on meso-level managerial issues.

This thesis applies a systems approach on social and health care management to shed light on the managerially relevant mechanisms on the meso-level. The goal of this thesis is to create an analytical framework of meso-level social and health care system and test its applicability when analysing these systems with national routinely collected registry data.

As an empirical context, this thesis studies the Finnish meso-level care system for older people. A nationally collected data set includes social and health care use of over 300,000 individuals aged over 74 years, in 65 Finnish municipalities, and is complemented with sociodemographic background information, including marital status and income level. The sub-studies included in this thesis analyse diverse meso-level system mechanisms that take place in the meso-level care system. The synthesis part of the thesis gathers findings from the sub-studies to create, via inductive analysis, meso-level logics of management.

The results imply that the meso-level system's manager must find a balance between the costs of individual long-term states and the use of short-term services. Coordination between organisations and homogenous criteria for care can reduce the need for urgent care and the over- and under-care that stem from discrepancy between long-term need for care and services provided. A meso-level framework enables comprehensive analysis of both the patient and system level service use distribution. This analysis is especially relevant for the care system of older people, which concerns diverse actors and time scales for care processes. The detailed definition, establishment, and management of the analytical framework must, however, be established in collaboration with all the actors within the system. Additionally, similar meso-level mechanisms might be transferable from the care management context of older people to mental health services and child welfare services, and the generalisability of the results and frameworks to these contexts of care should be considered.

Keywords health economics, systems approach, registry study, social and health care, meso-level, elderly care

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Tekijä

Olli Halminen

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Lyhyt- ja pitkäaikaispalveluita sisältävien mesotason hoito- ja hoivajärjestelmien suorituskyvyn analyysi

Julkaisija Perustieteiden korkeakoulu**Yksikkö** Tuotantotalouden laitos**Sarja** Aalto University publication series DOCTORAL THESES 1/2023**Tutkimusala** Tuotantotalous**Käsikirjoituksen pvm** 14.09.2022**Väitöspäivä** 20.01.2023**Väittelyluvan myöntämispäivä** 12.12.2022**Kieli** Englanti **Monografia** **Artikkeliväitöskirja** **Esseeväitöskirja****Tiivistelmä**

Sosiaali- ja terveydenhuollon johtamisessa tarvitaan erilaisia logiikoita riippuen siitä, johdetaanko yksittäistä hoito- tai hoivaorganisaatiota, useiden organisaatioiden verkostoa tai kansallista järjestelmää. Yksittäisen organisaation tasoon ja kansalliseen tasoon viitataan usein mikro- ja makrotasoina, ja näiden välissä olevaan useiden organisaatioiden verkoston tasoa kutsutaan mesotasoksi. Suomessa käsillä oleva alueellinen sosiaali- ja terveydenhuoltouudistus tulee entisestään korostamaan mesotason järjestelmän johtamisen tärkeyttä. Mesotason sosiaali- ja terveydenhuoltojärjestelmien johtamista on kuitenkin tutkittu kansallisten rekisteriaineistojen avulla vähemmän kuin mikro- ja makrotason järjestelmiä. Myöskään sosiaali- ja terveydenhuoltojärjestelmien johtamisen tutkimus ei ole kovinkaan perehtynyt mesotason johtamiseen.

Tässä väitöskirjassa tarkastellaan sosiaali- ja terveydenhuollon johtamista systeemiteoreettisesta näkökulmasta, ja pyritään valottamaan johtamisen kannalta relevantteja mekanismeja mesotason hoivajärjestelmissä. Väitöskirjan tavoitteena on luoda mesotason sosiaali- ja terveydenhuoltojärjestelmän analyttinen viitekehys, ja testata sen soveltuvuutta järjestelmän analysointiin kansallisesti kerättyjen rekisteriaineistojen avulla.

Väitöstyön empiirisenä kontekstina on Suomen mesotason ikääntyneiden hoivajärjestelmä.

Kansallisesti kerätty rekisteriaineisto sisältää tiedot 65:stä Suomen kunnasta ja yhteensä yli 300 000:sta yli 74-vuotiaasta ikääntyneestä, ja sitä on täydennetty sosiodemografisella taustatiedolla potilaiden avioliittohistoriasta ja tulotasosta. Väitöstyön osatutkimukset tarkastelevat erilaisia mesotason järjestelmän suorituskyvyn vaikuttavia mekanismeja. Työn synteesisosassa yksittäiset löydökset koostetaan induktiivisen analyysin avulla mesotason johtamisen logiikoiksi.

Työn löydöksenä mesotason järjestelmän johtajan on löydettävä tasapaino järjestelmän yksittäisen pitkäaikaistilan kustannusten ja lyhytaikaisen palvelunkäytön välillä. Organisaatioiden välisellä koordinaatiolla ja hoidon kriteerien yhtenäistämällä voidaan vähentää pitkäaikaisen palvelutarpeen ja -tarjonnan eroista johtuvaa yli- ja alihoitoa sekä palvelutarpeen kriisiytymistä. Mesotason viitekehys mahdollistaa kokonaisvaltaisen palvelujen käytön jakauman analyysin sekä potilas- että järjestelmätasolla, mikä on erityisen tärkeää ikääntyneiden palveluiden kaltaisessa monia toimijoita ja erilaisia aikajänteitä sisältävässä kontekstissa. Analyttisen viitekehysten tarkka määrittely, luonti ja johtaminen on kuitenkin toteutettava yhteistyössä järjestelmän kaikkien toimijoiden kanssa. Ikääntyneiden palvelujärjestelmän lisäksi vastaavat mesotason mekanismit vaikuttavat relevanteilta myös mielenterveyspalveluiden sekä lastensuojelun johtamisen konteksteissa ja tulosten yleistämistä näihin hoiva- ja hoitokonteksteihin tulisi harkita.

Avainsanat terveystaloustiede, systeemiteoria, rekisteritutkimus, sosiaali- ja terveydenhuolto, mesotaso, ikääntyneiden hoiva ja hoito

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Otaniemessä joulukuussa 2022,

Ilolla,

-Olli

A. A. A. Cercasi (*cerca, sì*)
storie dal gran finale;
sperasi, (*spera, sì*)
comunque vada, panta rhei
e *Singin' in the Rain*.

(Francesco Gabbani - *Occidentali's Karma*)

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Abbreviations

AD – Alzheimer’s Disease

Hilmo – *Hoitoilmoitusjärjestelmä*, Finnish national hospital patient registry

ICD-10 – International Classification of Diseases, tenth revision

ICER – Incremental Cost-Effectiveness ratio

LTC – Long-Term Care

NICE – National Institute for Care Excellence

NUTS - *Nomenclature des Unités Territoriales Statistiques*, Nomenclature of Territorial Units for Statistics

PERFECT - PERFORMANCE, Effectiveness and Cost of Treatment episodes research project

WHO – World Health Organization

Glossary of key terms

Micro-level of care – Care system level including individual service-providing organisations, such as health centres and hospitals.

Meso-level of care – Operationally comprehensive care system level between micro and macro, such as networks of organisations offering all services from the viewpoint of a specified context of care, regional care systems, or cross-organisational care pathways.

Macro-level of care – National care system level including services such as national health system or primary care system.

Long-term states – Categorisation of services into discrete care service bundles regularly offered to patients in the care system. Patients are assumed to reside in one long-term state for an extended time period.

Short-term care services – Other care services used by the patient, in addition to the regular service included in the long-term states’ service bundle. Assumed to be less regular and more stochastic than long-term services.

List of sub-studies

This doctoral dissertation consists of a summary and of the following sub-studies, which are referred to in the text by their numerals.

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3. Halminen, O., Vesikansa, A., Mehtälä, J., Hörhammer, I., Mikkola, T., Virta, L. J., Ylisaukko-oja, T., & Linna, M. 2021. Early Start of Anti-Dementia Medication Delays Transition to 24-Hour Care in Alzheimer's Disease Patients: A Finnish Nationwide Cohort Study. *Journal of Alzheimer's Disease*, 81(3), 1103-1115.
4. Halminen, O., Keppo, J., & Linna, M. Reshaping Care: System-level analysis of the Finnish Act on Care Services for Older Persons. Unpublished, submitted. A previous version of this manuscript was presented in the *Manufacturing and Service Operations Management* conference in Singapore, Singapore, June 30 – July 2, 2019.

Author's contribution

1. **OH** was the main author and came up with the main idea for the paper, performed the data analyses, and wrote the initial version of the paper. **OH** and ML carried out the data gathering process. ML and IH took part in writing the final version of the article. TM provided comments and suggestions for writing of the article.
2. ML was the main author and came up with the main idea for the paper, performed the data analyses, and wrote the initial version of the paper. **OH** and ML carried out the data gathering process, and planned the analytical framework for the study. ML, IH, KS, and **OH** took part in writing the final version of the article with input from all co-authors.
3. **OH** was the main author and came up with the main idea for the paper, performed the data analyses, and wrote the initial version of the analysis results. **OH** and ML carried out the data gathering process. **OH**, AV, ML, and JM wrote the manuscript with input from all co-authors.
4. **OH** was the main author and came up with the main idea for the paper, performed the data analyses, and wrote the initial version of the paper. **OH** and ML carried out the data gathering process. **OH** and JK planned the analytical framework for the study. **OH** wrote the final version of the paper in participation of both co-authors.

1 INTRODUCTION

1.1 Background: future well-being regions require comprehensive analysis strategies

Finland, a Nordic country of 5.5 million people, endeavours to tackle the challenge of future care cost development by undertaking a massive social and health care reform, entering into force between July 2021 and January 2023 (*Government proposal for health and social services reform and related legislation adopted by Parliament - Ministry of Social Affairs and Health, 2021*). The main goals of this reform, as listed in the current Government Programme (Finnish Prime Minister's Office, 2019), are "to reduce inequalities in health and well-being, safeguard equal and quality health and social services for all, improve the availability and accessibility of services, ensure the availability of skilled labour, respond to the challenges of changes in society, and curb the growth of costs." The reform merges the social care services and primary health services, organised by 300+ municipalities, and secondary care services, organised by 20 hospital districts, under 22 well-being service organising bodies (*Government proposal for health and social services reform and related legislation proceeds to Parliament - Ministry of Social Affairs and Health, 2020*). The reform will shift the responsibility of management of social care and primary and secondary healthcare services to a regional level. Previously, the horizontal equity between citizens in different municipalities had not been optimal, as the fragmented provision of services had depended on the budget and resource allocation decisions on the municipal level (Keskimäki *et al.*, 2018). The reform and concurrent standardisation of service provision are expected to increase horizontal equity and possibly the system cost-efficiency via strategic decision-making (Tupala *et al.*, 2020).

In future, one organising body will coordinate, and can simultaneously analyse, most of the public social and health care service provision within the regional, or *meso-level*, system. As the micro system-level concerns the processes within one organisation, and macro-level pertains to the whole national health system, meso-level falls between these two, and concerns the interactions between organisations or within some subpopulations of the system. Data-based analysis of meso-level systems will be especially relevant in the care planning of individuals with varying needs of diverse social and health care services, such as patients with severe, enduring mental illness, severe physical disability, dementia, or socially excluded groups (Vuik, Mayer and Darzi, 2016).

Already, several hospital and care-process level innovations to improve the efficiency of care operations have been presented (Vissers and Beech, 2004). Also macro-level strategic initiatives, such as value-based models of care, have been proposed for cost containment (Porter and Wennberg, 2009; Porter and Guth, 2012). However, meso-level frameworks enable the analysis of complex dynamic interactions between parts of the system, which may be ignored by micro-level process models or overlooked by reductionist macro-level analyses. Meso-level allocative decisions on resource distribution affect where people are treated, and whether their care process is performed in a cost-efficient manner.

In future, meso-level analytical frameworks for care services will be needed. Finland has good premises for meso-level analysis, as comprehensive national level data registries already collect detailed information on the use of public social and health care services. This data can be combined with background information, such as sociodemographic information of individuals, for research purposes. However, what is missing is a holistic analytical understanding on how to perform this analysis on a regional level. Only recently, a growing amount of literature in service operations management has focused on the meso-level system dynamics of social and health care delivery systems (Dai and Tayur, 2019; Keskinocak and Savva, 2019), and to the author's knowledge, methods and applications of operations management principles remain underdeveloped for this rising field of analysis. In particular, analysis frameworks that could specifically suit the needs of Finnish tax-based, universal social and health care systems, and utilise comprehensive registry data, are lacking.

This thesis aims to create an analytical framework that would shed light on the analysis of public meso-level systems of care with national registry data.

1.2 Aim of the thesis

The explicit aim of this thesis is twofold:

1. To create a meso-level analytical framework for studying social and health care system dynamics, and
2. test its practical applicability in creating managerial implications from registry data.

Firstly, the analytical framework will be created based on a literature review of the characteristics of meso-level systems. The framework is shaped around long-term states, which are a viable way of segmenting patients within a population-based meso-level system. The framework should ideally help in designing (*ex ante*) and identifying (*ex post*) cost-effective improvement initiatives that rise from the interaction between different entities in the care system. The framework should be able to accommodate registry-based comparison and contextualisation of different cost-effectiveness claims created from the standardised set of data. The framework should be flexible concerning the quality and granularity of source data, so that it can be used also with incomplete data sets. The framework should keep in consideration some relevant characteristics of a Nordic, tax-based universal care delivery system, such as low out-of-pocket payments for services, and inevitable gatekeeping role of public health providers.

After creating the analytical framework, as an empirical part, this thesis tests whether the framework enables registry-based system-level analysis of cost-effectiveness on the **meso-level care system for older people**. Ideally, the analysis could provide new insight on the management of care services for older people, a field of services that is focal in the national rise of care service demand with the global population ageing development (Dzau *et al.*, 2019). Services for older people are rarely offered by one, but several different long and short term care service providers. Efficiency measurement is therefore especially challenging for long-term care services. Long-term care processes have, by definition, a large time span, and the causal relationship between caregiving and outcomes is non-linear. For these kinds of services, ordinary means of efficiency measurement, such as resource efficiency, do not necessarily carry far. In addition to long-term care services, which are largely social care services, older people also use a wide range of short-term healthcare services, which are substitutive with long-term services. This additional substitution factor further increases the importance of meso-level analysis.

The empirical part of this thesis is formed around four separate sub-studies, each of which analyses a different phenomenon in the meso-level care system

for older people. Each study employs routinely collected Finnish national registry data on individual patients and their social and health care service use, yet the data sets and analysis methods differ slightly for each of the studies. The studies, which focus on cost of dying, efficiency of pharmaceutical dementia treatments, and policy impact of legislation for older people, all consider a different aspect within the same delivery system model. The separate sub-studies aim to demonstrate the applicability of routinely collected administrative data in creating data-based policy implications in the context of public care provision system. The sub-studies aim to demonstrate that the framework is general enough to accommodate such diverse phenomena, but also that consideration of a more generic contextual framework gives a more comprehensive view on the studied phenomena than, e.g., the analysis of a single service provider would deliver.

In addition to the sub-studies in a meso-level care system for older people, the model is created with high generalisability in mind, and the transferability of the framework into other parts of public social and health care systems will be analysed in the synthesis section.

1.2.1 ELSE project and related non-peer-reviewed publications

The sub-studies of this thesis were initially planned as a part of the ELSE project (Elderly people's services: use, costs, effectiveness, and financing), a collaboration project between Aalto University and the Association of Finnish Local and Regional Authorities. The project, which also saw collaboration from the Finnish Social Insurance Institution, Finnish Ministry of Social Affairs and Health, and Finnish Association of Private Care providers, aimed at analysing the effectiveness of the current service system for older people, and find ways to support older peoples' well-being and living at home (*Ikääntyneen väestön palvelut: käyttö, kustannukset, vaikuttavuus ja rahoitus*, no date). The ELSE project had also its own (non-peer-reviewed) publication series, in which two additional publications closely related to this thesis have been published (Halminen, Koivuranta and Mikkola, 2018; Halminen *et al.*, 2019).

Additionally, the Ikäpiha project, funded and ordered by the Finnish Prime Minister's Office, analysed the potential effects and cost savings that would stem from harmonising the municipal service structures for older people (Tupala *et al.*, 2020). The project, although unrelated to the sub-studies in here, employed a similar analytical framework as this thesis. I performed the quantitative scenario analyses for the project.

1.2.2 Positioning

The study at hand is of multidisciplinary nature and applies methodology from several fields of study. For quantitative analysis, the methodology of all the sub-studies included in the thesis stems from the field of health economics. However, for the creation of the meso-level model of a care system, I applied some concepts and ideas from systems theory for creating a well-specified system. Furthermore, in positioning the sub-studies and framing their research problems, I employed some epistemological stances more traditionally applied in the fields of management sciences and design sciences. For example, I start off by designing the specific care delivery system before deciding on a group of more specific research phenomena of interest.¹

1.2.3 Novelty

To my knowledge, the methodological practices of analysis of meso-level care systems is, to some extent, underdeveloped. System-level complex phenomena within a regional healthcare system, such as coordination of care systems, has been proposed as a relevant research question (Peltokorpi *et al.*, 2016). Particularly, there seems to be a lack of generic yet applicable framework via which the meso-level cost and service structures and the dynamic changes in the system could be estimated. Developing this analytical framework is especially important for those care systems in which the substitutive nature of diverse services is accentuated, further increasing the relevance for system-level analysis of service cost-efficiency.

¹Due to the multidisciplinary nature of the study, there are several concepts which have a different definition depending on the field of study (for example, *risk* of care transition is a neutral concept from statistical perspective, whereas in the medical field it might have a negative connotation). In the footnotes I mostly aim to clarify explanations of terminological and methodological choices, and definitions of concepts.

1.3 Research questions

As stated in the previous section, the overall aim of this thesis is **to create a framework of the meso-level social and health care system and test its applicability when analysing these systems with national routinely collected registry data**. This aim is formulated into a more specific research problem, which is further divided into explicit research questions. The research problems and questions structure the synthesis part of this thesis: based on the synthesis of empirical findings, the thesis strives to answer each research question. The research problem strives to summarise the concerns with managerial relevance, prerequisites, and applicability of the meso-level analytical framework.

Research Problem: *Can our understanding of the regional care system be improved and turned into actionable knowledge by developing a meso-level analytical framework? Can the framework be built and used by employing routinely collected registry data sets? What value would a meso-level system model employing national routinely collected registry data sets bring to studying cost-effectiveness?*

The research problem is answered in multiple ways. Firstly, model building is considered with two research questions.

RQ1.1: *What prerequisites have to be considered when employing national-level data in studying cost-effectiveness on the meso-level?*

RQ1.2 *How should a corresponding meso-level model be formulated?*

Secondly, the added value of applying registry data on the analysis of a meso-level system is considered with the set of supporting research questions.

RQ2.1: *What value does registry data bring to current status analysis involving, e.g., the cost structures, distribution of service use and relative costs of services between different systems?*

RQ2.2: *What is the value brought by registry data to the evaluation of intervention cost-effectiveness?*

RQ2.3: *What is the value brought by registry data to the evaluation of policy cost-effectiveness?*

Based on the analytical insights brought by the model, actionable knowledge, or managerial implications, are extracted.

RQ3.1 *How should the system dynamics or operating logic of the meso-level care system be described?*

RQ3.2. *What are the managerial implications brought by the increased understanding of the meso-level system?*

Finally, the generalisability of the findings in the thesis to other regimes of care has to be considered.

RQ4: *Would such a model be applicable in other meso-level contexts or services?*

1.4 Structure of the thesis

The thesis, after the introductory first chapter, is structured as follows.

This thesis combines ideas from streams of literature in systems sciences, care operations management, and health economic registry research. Chapter two introduces the key concepts from these, including the themes of complex social and health care systems, system levels of social and health care, operating logic of care services, and previous registry research on care systems.

The third chapter introduces the empirical context, or the meso-level care system for older people, by defining its key static and dynamic characteristics. The chapter presents both a conceptual model for a meso-level care system, and its context-specific version for the care system of older people.

In the fourth chapter, the employed data set and data gathering process is detailed. Additionally, the formal definition of a meso-level care system is presented, after which the specific applications used in the sub-studies are described.

The fifth chapter describes the context, study setting, main results, and conclusions of different sub-studies.

The sixth synthesis chapter analyses the main findings of each sub-study in relation to the model of meso-level care systems and synthesises their implications as several answers to the research questions of this thesis.

The seventh discussion chapter discusses the synthesis of results and methodological, theoretical, and practical contributions of this thesis and the analysis of the strengths and weaknesses of the thesis, and recommendations for possible avenues for future research.

The final chapter concludes.

2 SYSTEMS APPROACH, CARE SERVICES, AND REGISTRY RESEARCH

As mentioned in the introduction, this thesis lies in the intersection of three main themes: Systems approach to healthcare, characteristics and management of care services, and registry research of social and health care systems. This literature review chapter is structured following these themes: Firstly, the history of systems approaches and prevalent system-level models in fields of management science and healthcare management are introduced; Secondly, the characteristics of care as a mode of service provision is discussed; and finally, nature of registry analysis as a research methodology is briefly considered, including an overview of previous research employing registry data. Based on the review of literature, key relevant concepts, and the potential research gap of underlying fields of literature is synthesised.

2.1 Systems approach in healthcare management

Consider a patient, who, a week after seeing a doctor at the local primary care centre, is suddenly rushed into hospital emergency department in an ambulance. What could have gone wrong? Intuitively, we can come up with several reasons for this urgent hospital admittance. Firstly, the patient's health status might have been poor to start with, and the patient might have encountered a severe health problem from natural causes – for example, kidney disease has been found to predict 7-day hospital readmission (Eastwood *et al.*, 2014). Also the patient might have taken a wrong medicine, or not have followed a drug prescription given by doctor (Col, Fanale and Kronholm, 1990). Secondly, the “fault” may lie at the doctor: they might have misdiagnosed the patient's health problem (Chang *et al.*, 2021; Horberg *et al.*, 2021), or overlooked some comorbidity, and issued a drug prescription which is not fit for the patient, resulting in the sudden admittance to hospital (Lau *et al.*, 2005). All these are realistic and prevalent risk factors for hospital admittance.

However, if we expand our root cause analysis from the actions of individual people to the processes beyond, we find more potential reasons for the hospitalisation. The hospitalisation might stem from an error in the care process: patient records might miss some key information (Gleason *et al.*, 2004), or the doctor might not have routinely checked for possible medical allergies (Bates *et al.*, 1995). The doctor might not have had access to complete medical history of the patient, if the patient has visited some other healthcare organisation in the past (Boockvar *et al.*, 2010). It is possible the patient might have needed constant monitoring at home or should have been admitted to an institutional care centre, but, due to resource shortages, has stayed home without proper care. It is also possible, that the patient's health problem could have been treated in a primary care setting, but the care system has erroneously directed the patient to the emergency care department.

Although the first set of possible reasons – patient and doctor-related – are relevant, they might not cover all the possible causes of the acute hospitalisation. Expanding the scope of analysis to the administrative level of processes, interfaces between organisations, capacity issues, and care pathway coordination, might give us additional actionable information on how to prevent negative health outcomes. The individual actions of patient and doctor might not be the only factors affecting the outcome, but also the organisational structures and processes of care – system-level factors – must be considered. Analysis of the effect of these system-level factors on care outcomes and effectiveness is called a **systems approach on healthcare**.

Systems approach in management sciences, or holistic thinking, pertains to the use of “holism” rather than reductionism in solving complex, real-world problems set in social systems (Jackson, 2007). The field of systems thinking approaches is vast, as there have been schools of thought of more applied and pragmatic approaches, and of more general and idealistic. For example, operations research approach, analysing emergency department gatekeeping systems and aiming to minimise the wrongful discharges of patient (Freeman, Robinson and Scholtes, 2021), would deal with solving a clear, applied problem; whereas general systems theory ideas (Boulding, 1956; Bertalanffy, 1969), applied in, e.g., understanding the multi-level dynamics of regional mental healthcare system (Katrakazas *et al.*, 2020), represents a much more abstract and general level of approach.

In the field of management, system is a quite common metaphor for an organisation. It has rivalled two prior, quite usual metaphors: the organisation as a machine, stemming from the 1930 and approaching organisations as a complicated deterministically working whole, where each part has a well-specified function which it fulfils; and the organisation as a collection of human relations, where the focus is highly on interactions between individuals, and focusing on matters such as motivation (Jackson, 2007). The systems thinking approach in management highlights the effects of external as well as other internal parts of organisation on a problem at hand. For example, the dynamic phenomena within the whole business ecosystem might affect an individual company.

Systems approach to health has been described by Kaplan *et al.* (2013) as applying “scientific insights to understand the elements that influence health outcomes”, modelling “the relationships between those elements”; and altering “design, processes, or policies based on the resultant knowledge in order to produce better health at lower cost”. They argue that systems approaches in healthcare have been found to increase care quality, value, patient safety, patient experience, and overall health outcomes (Kaplan *et al.*, 2013).

2.1.1 Socio-techno-economic systems

Several system-theoretical concepts are present in management science, one of the being Socio-technical systems. Socio-technical systems, a concept coined by Trist and Bamforth in their study of coal mines (1951), pertains to a work context where the social and technological aspects of the work affect each other to a great length, and the whole cannot be understood without the analysis of the both. Social, in here, refers to the psychological and behavioural aspects of the work, whereas technological does not only refer to the material

equipment, but also the processes and the work structures designed to enable efficient production². For example, one cannot optimise the conveyor speed without considering the skills and capabilities of the employers (Emery, 2016). To expand, also the economic dimension has to be included, and the socio-techno-economic organisation has to be managed via the joint optimisation of social, technical and economic subsystems (Jackson, 2007, pp. 117-125).

Healthcare can also be seen as a socio-techno-economic system (Lillrank, 2018). For example, a clinical process, such as a heart surgery, requires specific skills and capabilities and an appropriate cognitive state of mind from all the care personnel, who also have a clearly defined roles, hierarchy of communication, and explicit processes for performing a surgery. The design of such process needs a thoughtful consideration of the technological performance of the surgery, but also the required skillset of the people, and the costs of medical equipment, education, and labour.

2.1.2 *Complex adaptive systems*

Plsek and Greenhalgh (2001) define complex adaptive systems as a “collection of individual agents with freedom to act in ways that are not always totally predictable, and whose actions are interconnected so that one agent’s actions changes the context for other agents”. This definition might call for some clarification. Complexity pertains to a system having a high level of interdependencies between actors that also change highly dynamically (by time), “oscillating between periods of stability and chaos” (Khan *et al.*, 2018). In comparison to complicated system, which includes a high number of

²The definition of technology varies across scientific fields and contexts of use. In medical field, the term *medical technology* usually covers both the medical devices and pharmaceutical innovations applied in the care process, but might not explicitly include, e.g., the innovations in healthcare process design (for example, WHO defines medical technologies as “the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives”). Schatzberg (2018), in his critical history of the term technology, criticises the idea of technology as a mere subordinate and instrumental application of science, and sees it as a historically developed concept which is also essentially intertwined with arts and crafts. In this thesis, I use *technology* in a broad sense, stemming from Greek word *techné*, including a range of social practices which have been developed and applied by some group of professionals, or, to quote Arthur (2009, p. 51), “a phenomenon captured and put to use”. This broad understanding of technology is further described by Michel Foucault as covering not only production technologies, such as medical devices, but also semiotic, power-related, and self-related technologies, such as language protocols, organisational structures, and social competence of individuals (see e.g. Rooney, 1997).

individual actors, a complex system is also characterised by this interdependency between actors. Interdependency in complicated systems is typically stable and predictable, whereas complex interactions refer to dynamic, non-linear, and emergent phenomena. Adaptiveness refers to the system's ability to react and self-organise themselves in the face of change. This leads to a system which easily evades stable states and simplistic models of description. Long et al. (2018) note that "key features of complex adaptive systems generally include embeddedness, nested systems, fuzzy boundaries, distributed control, self-organisation, emergence, unpredictability, non-linearity, phase changes, historicism, sensitivity to initial conditions, non-equilibrium, adaptation, and co-evolution".

Several fields within the social and health care sector can be regarded as complex. Ansah et al. (2018) view chronic care as a multidimensionally complex system. They mark that firstly, the case mix of chronic patients, who usually have multiple co-occurring medical conditions, is easily complex. Secondly, the care processes are complex – the patients usually need a well-coordinated multitude of partly substitutive services, and it is difficult to manage patients through the whole healthcare delivery process. Thirdly, quality assessment is complex, as the patients' reactions to care might be nonlinear and there is a lack of generally accepted criteria for high-quality care. Fourthly, health system for chronic care is complex, as the approaches to divide a chronic care system to silos and perform changes in one part of the system is likely to have unintended consequences on others. The non-linear nature of the causal relations in the system and high level of interaction result in a complex care system with low level of predictability and plannability.

2.2 Meso-level social and health care system theory

In healthcare, the word system usually carries a more administrative than a purely functional meaning. For example, national health systems may be treated as the collection of all the public social and health care services provided within some nation, without implying any goal-seeking or strategic behaviour. Consequently, the functioning of national systems is usually measured only through aggregate numbers, such as the average life expectancy of citizens, or yearly incidence of influenza. From the point of view of complex adaptive systems, national systems are dynamic wholes comprising of several systems, which are embedded or nested inside each other. These embedded systems, include regional health systems, hospital systems, local health centres, and other ecosystems and organisations, all of which have their own goals and managerial issues. Long et al. (2018) state that “There are two pervasive issues with defining a social system, nesting and fuzzy boundaries, both of which are implicated in, and complicate, complexity research”. To characterise the meso-level, these fuzzy boundaries have to be defined to some extent. This section aims first to articulate the boundaries of public health systems, secondly to clarify the social and health care service system in micro, meso, and macro levels, and thirdly, characterise operational mechanisms and managerial issues that concern meso-level.

2.2.1 *Boundaries of public health systems*

The definition of a national health system varies. National health system can be defined to broadly consist “of all the people and actions whose primary purpose is to improve health” (*The world health report 2000: health systems: improving performance, 2000*), or more narrowly to focus on “performance of the healthcare system, as opposed to public health activities and other wider issues” (Hurst and Jee-Hughes, 2001). These broader or narrower boundaries for what constitutes a health system (only medical care or all determinants of health) have their own advantages and disadvantages, discussed in Figure 1 (adapted from Papanicolas and Smith, 2013). In general, focusing only on healthcare-related actions might leave out major factors influencing health, whereas too broad a scope creates difficulties in management of the system. I agree with the idea that focusing only on strictly healthcare-related organisations and actors would draft out a sharper picture. However, the core idea in system approaches in social sciences is to understand the effects of interactions on system level, and not measuring clearly and separately all the independent parts (Jackson, 2007, p. 1). As the empirical part of this study focuses on a care system for older people, in which a large part of services is provided outside a hospital setting, a broader boundary for what constitutes a

health system is in order. Therefore, I would advocate for understanding a health system to consist of at least all the nationally governed actors that offer social and health care services.

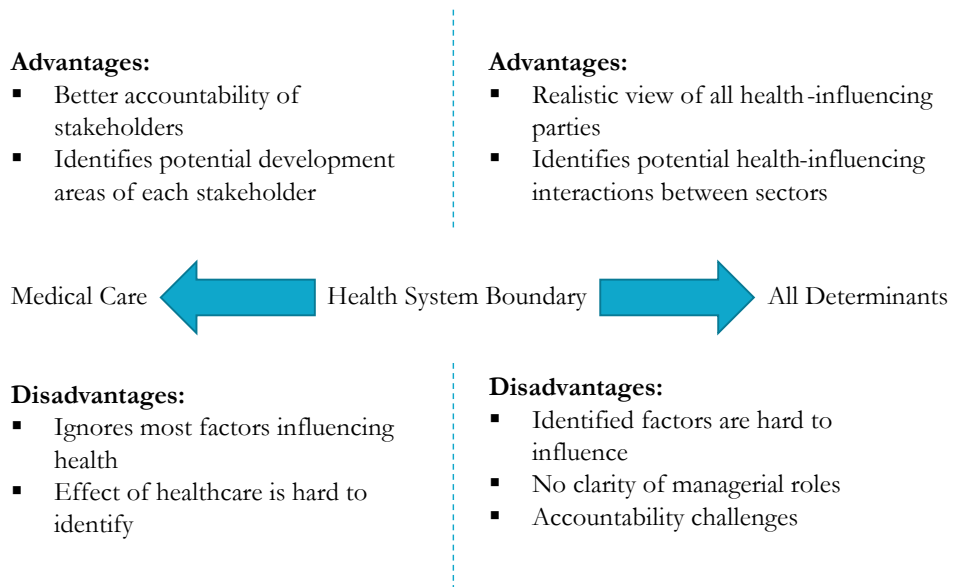


Figure 1: Advantages and disadvantages of broader (all determinants of health) and narrower (only medical care) definitions of health system (adapted from Papanicolas & Smith 2013).

2.2.2 Health system goals

Socio-techno-economic systems do not have one-dimensional goals but have to consider multidimensional aspects of performance. For health systems, governmental bodies have a high mandate to improve the well-being of their citizens (see, e.g., *Alma Ata Declaration*, 1978). However, aside of improving the health, public governance also is accountable of reasonable use of public money. Thus, the goals of the health system are not only in improving health. Institute for Healthcare Improvement (IHI) from Cambridge, Massachusetts, has developed a framework of three dimensions which have to be considered when managing healthcare systems (Berwick, Nolan and Whittington, 2017). The dimensions of IHI Triple Aim are **improving the experience of care, improving the health of populations, and reducing per capita costs of healthcare**. All three goals have their own fortes and problems and create tension to others.

World Health Organization (WHO) has already in 1946 proposed an all-encompassing definition for health: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (World Health Organization, 2020). This definition carries several

major philosophical implications. Most importantly, the definition is an ideal: an individual is hardly ever likely to reach the state of *complete* well-being. This means that also our efforts should focus on *improving* health, rather than striving for a perfect state of health. However, from this also follows that no matter how high the level of health we have achieved for a population, there is always room to improve. More practical definitions have also been defined: Huber et al. (2011) criticise the requirement of complete state of health, as patients with chronic diseases and minor health problems are usually well capable of performing their activities of daily living, and propose the definition of health as the “ability to adapt and to self manage” with life. Nevertheless, the pragmatically acceptable level of population health cannot be derived from definitions but has to be defined via strategic decision-making processes.

Improving health also creates costs. Even if we spent all our money on increasing our health, we still would not reach perfection. Instead, our efforts should focus on how to reach an acceptable level of well-being with an acceptable amount of money – an equilibrium, that is. Several models for finding a balance between the demand of health and the cost to produce these services have been proposed. Most usual one is to define a cost threshold for one Quality Adjusted Life Year (QALY). For example, National Institute for Care Excellence (NICE) in the United Kingdom has established an acceptable cost range of GB£20,000 to GB£30,000 per QALY. A recent systematic review by Cameron et al. (2018) found that 13 countries who have implemented formal cost-effectiveness thresholds roughly fall within the 1 to 3 times cost per capita range established by WHO. Some open problems with these definitions exist: currently, NICE threshold, set in 2004, has not been corrected for inflation (Low and Macaulay, 2021), and the limit is not hard-coded, but more dire services can cost more. Additionally, the limit does not consider emergent and existing, costly services. Even nowadays there exist some treatments which are known to be more expensive than the limits. For example, stroke patients can cost more than a 100 thousand euros per patient episode, as do dire burn patients. How should one justify those costs? How should one account for the horizontal equity, or the stance that persons with same level of need for services should be given the same level of treatment? Again, the aspired and acceptable levels of costs are strategic decisions, and not derivable from theory.

Thirdly, the most difficult to operationalise, is improving patient experience. Most widely used tool for measuring care experience is patient-reported experience measures (Chen *et al.*, 2021). However, absolute measures such as mortality or costs of care estimates are not found for care experience, but all the measures must be context-dependently defined. Giving absolute measures for care experience in all situations would be reductive at best. However, at

least some minimum level of patient experience can and should be set for specific care contexts – again, a decision to be made.

While all three aims are, when individually considered, good goals, they can hardly be improved individually, and improvement of one might result in a reduction in other. Management of a health system has to consider all three at the same time and find an acceptable balance between the three. A recent systematic review on applications in primary care has also found the aims to be difficult to operationalise (Obucina *et al.*, 2018). However, I try to summarise the three goals for the public health system:

- 1) Answering the population’s care needs in a manner that maximises the system-level quality of life, while
- 2) containing the costs of the services provision on an acceptable level, while
- 3) keeping the patient satisfaction in consideration.

2.2.3 Micro, macro, and meso system levels

Most laypersons are familiar with the terms **micro**, pertaining to small, and **macro**, pertaining to large. Microscopic phenomena are not visible to eye, whereas macroscopical are. Microeconomic issues deal with individuals, companies, and specific industries, whereas macroeconomics focuses on national and global level phenomena. There is no general and exact definition on what micro and macro levels are, but the concepts vary by field of science (Li, 2012, p. 26). Fewer people are familiar with the term **meso**, pertaining to something in between (e.g., Mesopotamia, literally “between rivers”). Concept of meso level – something between micro and macro levels – has been employed in several fields of science to address issues that fit best somewhere between these two layers.

Due to the different conceptions of micro and macro in different fields of science, also the concept of meso varies (Li, 2012, p. 32-33). In social and health care field, depending on the researcher and study setting, micro-level has been defined as the level of individual people (Richter and Dragano, no date; Ellen and Perlman, 2022), patients and families (Epping-Jordan *et al.*, 2004), or clinical programs (Kapiriri, Norheim and Martin, 2007). Meso-level can be defined as within-organisation (Niskanen, Louhelainen and Hirvonen, 2016), institutional (Ellen and Perlman, 2022) regional or institutional (Kapiriri, Norheim and Martin, 2007), and healthcare organisation or community level (Epping-Jordan *et al.*, 2004). Macro-level has been defined as national (Hipgrave *et al.*, 2014), national or provincial (Kapiriri, Norheim and Martin, 2007), health system (Ellen and Perlman, 2022), legislative/policy-level

(Epping-Jordan *et al.*, 2004; Niskanen, Louhelainen and Hirvonen, 2016; Sawatzky *et al.*, 2021), and “system, organization, structure or strategy” level (Sheard *et al.*, 2019). Large variance in use of concepts means that, depending on the study, hospital level may be classified either as micro, meso, or macro level. As this study concerns with system dynamics and social and health care management, level of individual patients is not focused on. Instead, I apply the similar framework as Li (2012, p. 32), which defines, for engineering purposes, the micro, meso and macro levels in a similar way as the concepts are used in the field of economics, or “micro as individuals and firms, meso as regional economy or industrial economy, and macro as a state economy”. Figure 2 illustrates the division and gives examples of analysable systems in each level.

Firstly, the macro level concerns the national and global levels. National level is tasked with, e.g., setting health policies, organising funding, and setting the regulations including staff credentials and drug and device approval processes for each country. Systems in macro level are typically analysed via aggregated data sets, which might offer information on yearly level. In Finland, the National Institute for Health and Welfare performs the system-level performance measurement. Examples of systems in this level include national health systems, and possibly some specific subdivision of all the social and health care services, such as national primary care system. Macro-level system performance analysis enables international comparison. For example, WHO periodically compares countries’ health system performance, with dimensions such as population health, health service outcomes, equity, fairness in financing and responsiveness (Papanicolas and Smith, 2013). Also the structural factors, such as the organisation of social and health care provision, financing, governance, and the social, economic, environmental or behavioural risk factors may be considered and compared (Papanicolas and Smith, 2013). National-level analysis enables understanding the macro-level trends that are happening over time, and are proper for, e.g., measuring the impact of national policy changes. However, aggregate measures are not sufficient for managing what is happening within the system. Aggregate measures fail to see the differences between different areas, and do not allow for the analysis of what is causing the changes in the system.

On the other end, micro-level systems concern organisations, and individuals within them, and interactions between individuals. Management tasks on organisational level are practical: organisation of production, analysis of process performance, monitoring of patient and personnel satisfaction etc. This is a relevant level of analysis for most activities of daily management: most applied management problems deal with a specific context, for which solutions are presented. Micro-level analyses usually deal with data that has a high level

of detail, and the level of abstraction can be quite low. Examples of operations management studies on micro level include case study improving the economic efficiency of operating rooms (Peltokorpi *et al.*, 2009), or a case study developing the urgent surgery processes in a trauma centre (Torkki *et al.*, 2006).

Thirdly, between the macro and micro levels lies the meso level. Meso level concerns organisational units that stretch beyond one location and one purpose. These include umbrella organisations that coordinate several sub-organisations, such as groups of hospitals or health centres; local and regional administrative systems that offer services for a specific region; and disease specific care networks that span across several organisations. Meso-level is tasked with allocating and organising resources within a region, or setting up networks that determine cross-organisational care processes, specialisation and division of labour, establishing local and regional policy objectives and priorities within and between patient segments, between prevention and treatment, etc. In meso-level systems of care, the performance measurement is not about production efficiency of a specific actor: instead, the questions of performance are more concerned with proper allocation of resources, and, for example, the balanced adjustment of proactive vs. reactive care.

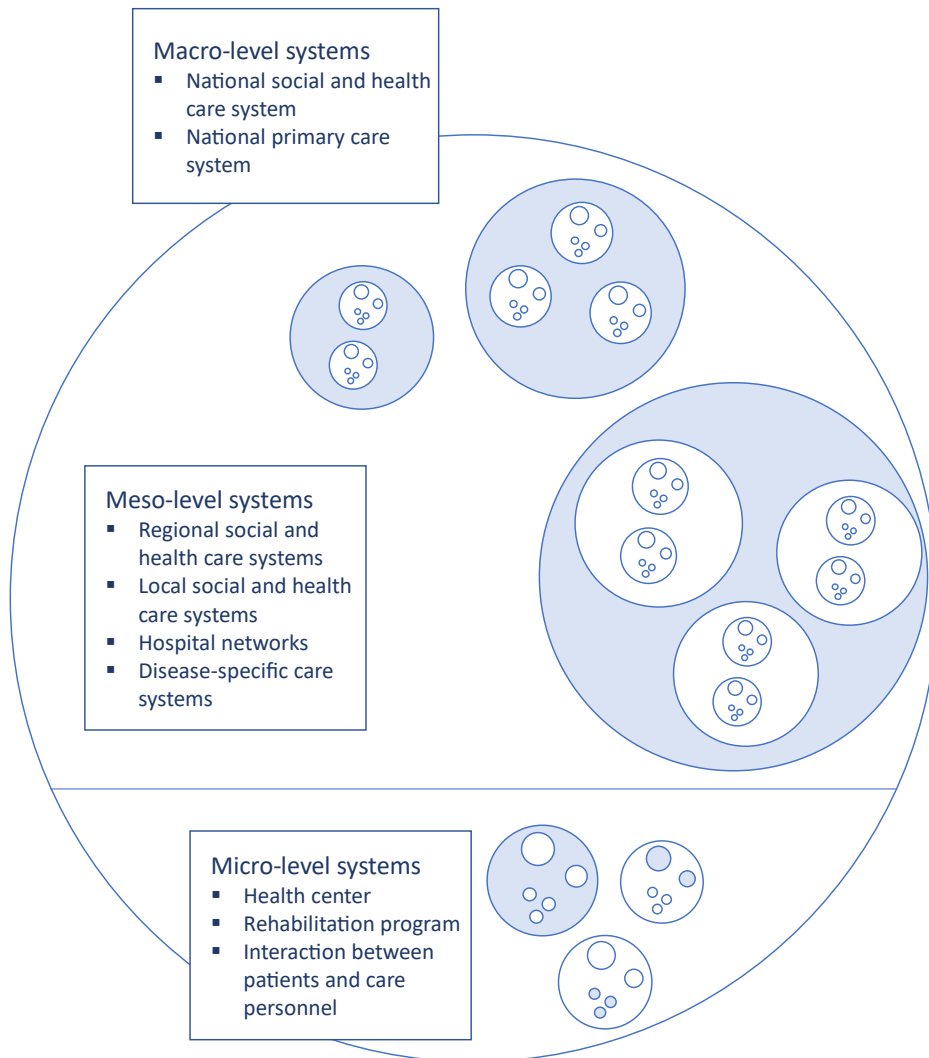


Figure 2: Examples of systems in micro, meso and macro levels of social and health care.

2.2.4 Examples of meso-level care systems

Different meso-level systems of care are discussed in the following.

Dependent on how the national health system is organised, the actual provision of services is usually delegated from national level to regional or local administrative bodies tasked with maintaining the health and well-being of their citizens. This shift in accountability also shifts the unit of analysis from a

national to regional or local level.³ These providing organisations can be viewed through the lens of **regional and local care service systems** (Lillrank *et al.*, 2011). In contrast to the national level, the managerial role of regional and local organisations is more prevalent: they are, in practice, responsible for designing the coordination and provision of services in their area. Goals of regional and local care service systems can be framed in a more pragmatic way than goals on the national level. Lillrank *et al.* (2011) suggest two trilemmas that have to be considered in the management of these systems: trilemmas of equity and efficiency. Equity considers the balance between specialisation level of services, geographical access to services, and the variety of services provided. To achieve efficiency, economies of scale, high-capacity utilisation, and economies of scope should be considered. Specialisation of services required high-capacity utilisation and economies of scale to be effective, but these factors are in contradiction to dispersed and geographically accessible services.

In general, any **population-specific care delivery system** which seeks to deliver services of a specific nature to a specific population segment, could be defined as a meso-level system. For example, some patient populations, such as patients in need of challenging liver surgery, are offered tertiary care services in one university hospital in Finland, whereas the primary and secondary care services for same patients are offered in the geographical vicinity of their homes. This mode of organising care services, regardless of whether all services are provided by the same organisation, can still be analysed, and managed as a one performing system. The empirical part of this thesis considers the care service delivery system for older people and aims to illustrate the operational logic of the aforementioned system on a general level. There are also other systems that focus on a specific clinical speciality. For example, a quick web search also finds papers discussing mental health systems (Petrea and Muijen, 2008; Kigozi *et al.*, 2010; Whiteford, Harris and Diminic, 2013; Nicaise, Dubois and Lorant, 2014), child welfare service systems (Kramer *et al.*, 2013), and also children's mental health system (Green *et al.*, 2014).

Operations-related care systems are formed around a group of social and health care operations. For example, organ transplantation networks are a highly specific operating network within a health system, which aim to

³ Terms *regional* and *local* refer to existing geographical areas, region pertaining to the Finnish regions (maakunta), and local pertaining to the municipalities (kunta), or levels NUTS 3 (provinces) and Local Administrative Unit 2 (municipalities and cities) in the Nomenclature des Unités Territoriales Statistiques (NUTS) of European Union, respectively.

coordinate the intense interaction between different facilities, while considering the logistical constraints related to the perishability of organs (Zahiri *et al.*, 2014). Other service systems can also be found in literature, especially those that have been formed around a specific production logic. Most prominently, integrated care systems are a care system type where the workflows or resources of one or more bodies are combined in care delivery. The performance measurement of such systems might vary depending on the context: A recent systematic review by Bautista *et al.* (2016) found 206 instruments measuring the integration of care.

Aforementioned categorisations of meso-level systems are not perfectly exclusive. For example, the care system for older people studied is in part, a regional system, in the sense that it covers all patients of certain age within one geographic area. It is also a population-specific system, due to this age limit as an inclusion criterion to the system. It also is, in some sense, an operation-related system, as it includes the long-term care services given to an elderly person in their homes or in a care facility, and primary and secondary healthcare services, but excludes, for example, the day activities for the older people.

2.2.5 Characteristics and managerial issues of meso-level systems

Public meso-level care system studied in this thesis has some specific characteristics. Some of them are characteristics of Finnish decentralised, tax-funded universal care system, some are universal. These characteristics are described in Figure 3, which follows the industry model of Porter (1990), and in the following.

Firstly, demand conditions of a public meso-level care service system include:

- Price of services is mitigable to the customer. This is to say, the price is not reflective of the actual allocative cost of resources used in providing the service. Although there are some administrative costs which even might make the service more costly than its production, the demand of services cannot be assumed to reflect their production costs.
- Patients have limited agency within the system: the definition of admission to care is more strongly regulated by the gatekeeping bodies who must consider the prioritisation of patients by their needs, and the scarcity of resources, when compared to the private sector within a same system with a different funding logic and a smaller amount of emergency medicine cases.

- The causality of care services is non-linear. Especially in the case of long-term services, similar care services might not result in a similar outcome, as the outcomes, such as hospitalisations, may happen stochastically.
- Services are, to some extent, substitutable. Long-term care services may be provided in home, or in institutional setting, and short-term services may be given either in primary care or secondary care setting.

Secondly, factor conditions must be considered:

- Much of social and health care provision system consists of different specialised silos, every one of which has their own education pathways and work practices. General practice medicine professionals, dentists, and surgeons perform different tasks and are specialised in their own field. Nowadays, there is an abundance of specialisations: e.g., in Finland, there are 50 fields of specialisation for doctors (Kaila, Mäkelä and Heikkilä, 2021; Lääkäriliitto, 2021).
- The healthcare industry is also highly regulated (Walshe, 2003). For example, medical professionals are required to complete certificate education programs to work in the industry, and the public care organisations are subject to third party monitoring. This is partly due to high demand of quality and accountability in the industry (Walshe, 2002, 2003).

These factor conditions are likely universal for all social and health care systems, and create a specific industry, where workforce changes happen slowly, and distribution of specialised workforce cannot be modified dynamically.

Thirdly, interaction between organisations includes some characteristics that may create tension to the industry. Organisations may have asymmetric goals and information, and there might exist budget rivalry between organisations (at least between regional care systems). Unless care pathways are created explicitly, information may not transfer effectively between organisations, reducing care quality, and patient safety and satisfaction (Raeisi, Rarani and Soltani, 2019).

Finally, the related and supporting industry of private care services creates substitutive services, and the unmet demand will likely channel to private market. Secondly, as the social and health care industry is highly labour-intensive, the educational service system that trains workforce has to be taken into account.

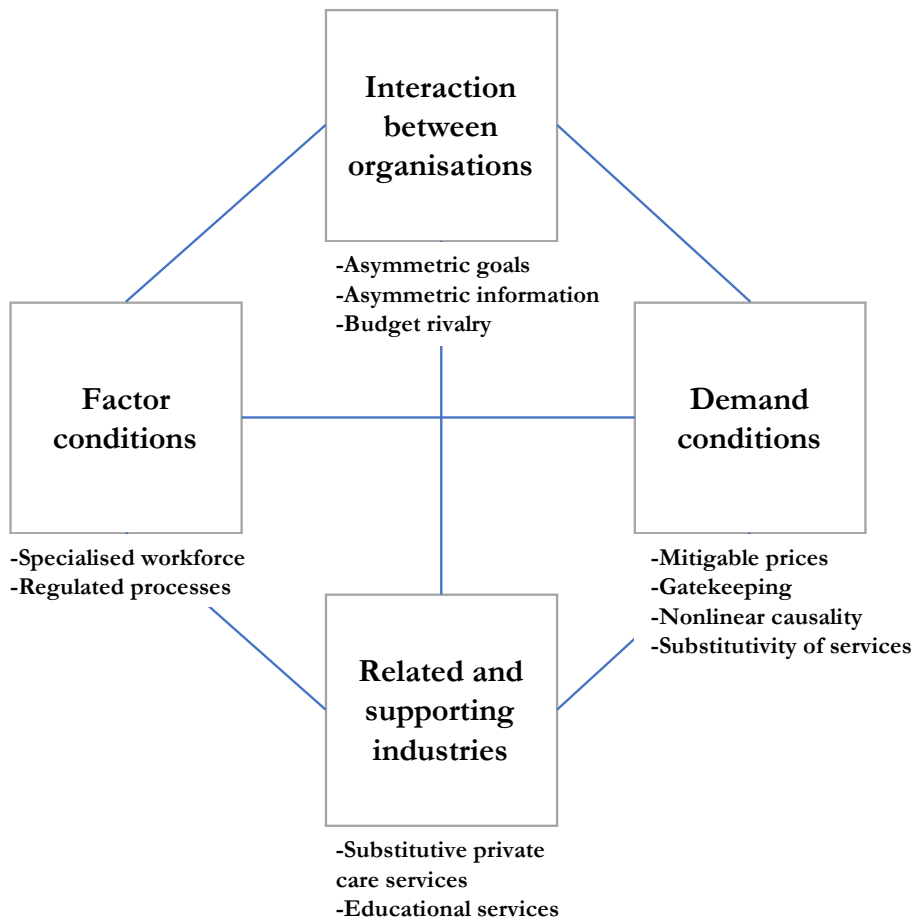


Figure 3: Cluster model of meso-level social and health care system, adapted from Porter (1990).

2.3 Managerial logic of long and short term care services

The empirical part of this thesis concerns with the social and health care services for older people. These services will be divided to long and short term services. Long-term services mostly consist of care services, which are characterised by their long timespan, and their non-curing (often non-teleological overall) rationale. This makes them distinguishable from shorter-term modes of services, such as emergency services.

This part of literature review shortly discusses the segmentation of healthcare services and strives to elucidate the managerial differences in long and short term service organisation.

2.3.1 *Segmentation of services*

Specialisation of healthcare professionals should affect the organisational structures in healthcare. Managerial view of structural contingency theory (Hage and Aiken, 1969) states that the technology applied by the organisation should heavily influence the processes and structures of the organisation. Being more an orienting strategy, metatheory, or a set of interrelated proposition than a theory in a classical sense (Schoonhoven, 1981), the structural contingency theory proposes that (1) there is not one best way of organising operations; (2) the effectiveness of organisation structure is condition-dependent; and (3) “in order to be most effective, organizational structures should be appropriate to the work performed and/or to the environmental conditions facing the organization” (Schoonhoven, 1981).

The diversity of health services and system division into specialities has led to the view that, for managerial purposes, the services need to be segmented into categories with similar logics of management. Classic models of segmentation, used in almost all health systems, include segmentation by organ groups (e.g., fields of specialisation for medical professionals), and level of urgency (e.g., primary, secondary, and tertiary care services). Other segmentation logics, such as segmentation by population needs, also exist. Among others, Lynn et al. (2007) have proposed a population segmentation model, which would categorise patients into groups with similar needs, such as “healthy”, “maternal and infant health”, “acutely ill”, or “frailty with or without dementia”, and suggest planning services for these groups. Similar population segmentation tools all follow quite comparable segmentation logics (Chong, Lim and Matchar, 2019). These population segmentation approaches have been criticised, however, for failing to inform how to design efficient service delivery for these segments (Brommels, 2020). Instead of categorising patients

with similar needs together, it has been suggested that people be grouped by the type of care service they would need.

Possibly the most relevant segmentation strategy for this thesis is the demand-supply operating logic (DSO) approach (Lillrank, Groop and Malmström, 2010; Lillrank, 2018), which categorises the social and health care sector by the operating logic of services. The operating modes are “the different states in which a production system can operate with a given set of resources”. These states are formed to answer to specific kinds of demand and cannot be changed instantly due to the established specialisation of resources and capabilities. The states are depicted in the Figure 4. Basically, the categorisation aims to balance between offering appropriate care for the patients whilst considering the operational efficiency. If the health risk has not realised yet, the mode of production should be prevention; for severe and urgent issues, emergency; for health problems that can be treated via a well-defined continuous process after arrival, a visit; if there is no any pre-designed process, a project; for well-defined procedures which require scheduling of multiple resources together, elective process; for a treatable health problem with none of the following characteristics, a curing process; and finally, for health problems with no end point, a care process.

The DSO categorisation helps in analysing the complexity of social and health care processes. Any one of the categories, in itself, is not complex (except possibly for a project, where designed processes do not exist). However, some clinical contexts include services from several DSO categories. For example, an elderly person in a care home (care), suffers an accident, breaks a hipbone and is taken to the ED (emergency). After receiving immediate help, the patient returns to the care home to await restorative surgery scheduled for the next month (elective).

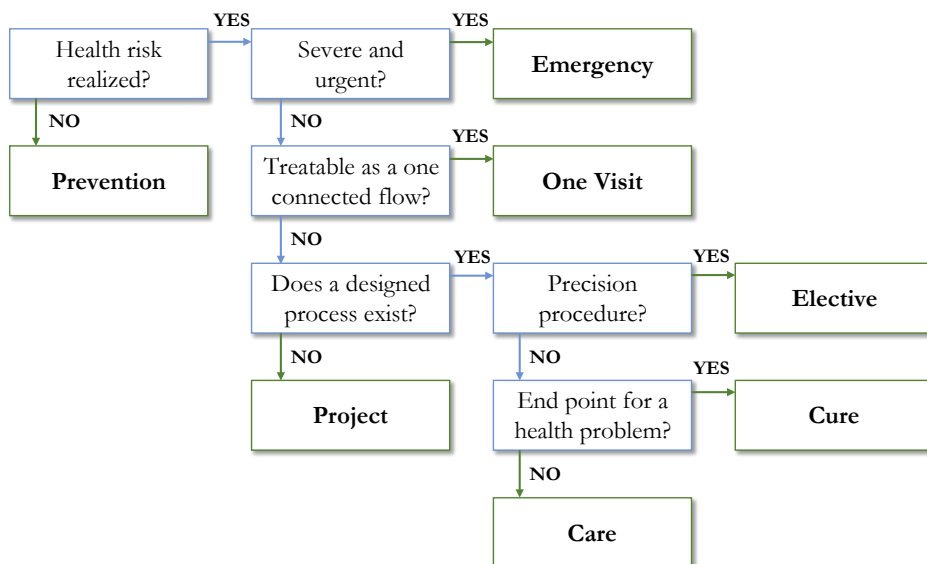


Figure 4: Demand Supply Operating Modes approach, adapted from Lillrank et al. (2010) and Lillrank (2018).

2.3.2 Production system of long-term care

The DSO-categorisation defines care services as a regime that tends for health problems that are not urgent, and not severe, but also not curable. As will be discussed in the following section 3, social and health care services for older people consist of two forms of services: long-term care services, divided into separate long-term modes of care, which are offered in different locations and facilities of care; and short-term care services, that answer to health problems that long-term care cannot clear. Long-term care services, are, by definition, not episodic, but long-term, and in a punctuated equilibrium: The long-term states typically are associated with steadiness or slow decline of health status, which are punctuated by episodic medical issues. Hence, the production logic of long-term care should aim for two goals: to minimise the slow decline in patient's condition, and to prevent the episodic medical issues, such as hospitalisations and emergency department admissions.

As defined above, care services are services that answer to a non-curable health condition by offering constant support on activities of daily living and tending to the health problem. This leads to some characteristics of care services which makes them different from other services. Firstly, the patients are involved in the production of care services in a **much more interactive and participatory manner** than is usual for more diagnostics-oriented services. This reduces the information asymmetry between patient and the care provider, although the services might require a high level of personalisation. The patients

requiring assistance in their daily living need a multitude of different types of services: for example, they might need assistance in eating, or hygiene activities, or help with medical treatment such as home dialysis. Secondly, care services are **repetitive**, in the sense that the activities of daily living stay relatively similar from day to day. Thirdly, they are **time- and space-dependent**, in the sense that the patient is in constant need for support in their activities of daily living.

Due to this overall nature of service care services have their own managerial challenges. Long-term care services are typically not acute, in the sense that the contextual timeframe for caring the patients would be minutes, but the patient needs specific services, such as medicine dispensation, within a timeslot of some hours. For the most frail patients, there might also be a need for constant monitoring of health status. Constant upkeep of even a minor service level is resource-intensive, incurring costs that add up fast. Additionally, highly interactive services are not very scalable, but need a person to interact with the patient, regardless of the level of customisation for the services. Some innovations to answer for the space-dependency and need of monitoring have been developed, such as sensors and communications devices (Azimi *et al.*, 2017) and fall and heart attack monitoring wristbands (Elakkiya, 2017). Despite the technological developments, care for elderly remains resource-intensive.

The business logic for long-term care services is challenging to create. As the services are resource-intensive and hardly scalable, the most logical option is to pay a monthly fee for services. However, monthly payment based financing model does not incentivise the producer of services to slow the decline in a person's health status: nor does it incentivise treatment of minor acute conditions in a care facility, but the transition of patients with acute care into other facilities of care.

The meso-level system for older persons is characterised by a relatively clear-cut staging into long-term states. In these states, varying level of services is offered. Also, the nature of ageing causes that the long-term states are to a large extent non-curable, or the people will rarely return from a more dire state of care into a more "lighter" state of care. State transitions come with a cost: change in a long-term state might cause a rise of care costs size of tens of thousands of euros per year. Also, the capacity of long-term states is limited: the patients cannot be transferred into a long-term care institution if there are no places.

The long-term states within the care system could be described as a form of service bundling. Bundling is a concept originally stemming from the idea of bundle pricing strategy (Wilson, 1993). A group of products is offered as a

group and sold in a lower price than the separate products. In care context, the bundling means a pre-set collection of services, that are organised to answer for some level of services. These collections of services are then offered for the patient with an appropriate need for care services. These services are then complemented with a set of on-demand services, such as acute primary and secondary care services (Figure 5).

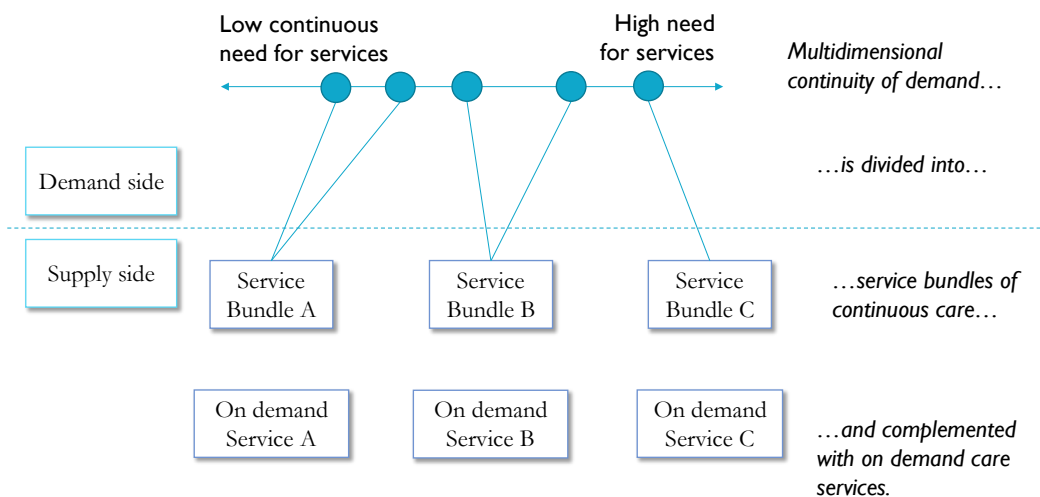


Figure 5: Service bundling.

2.4 Registry research

Registry research pertains to acquiring information through scientific methods while employing routinely collected registry information as data. National health registries have been developed in past decades, and, for example in the Nordic countries, are systematically used in epidemiological research (Ludvigsson *et al.*, 2015). Probably the greatest forte of researching national, routinely collected data registries is their comprehensiveness. Currently, all inpatient and outpatient care episodes offered by public healthcare providers can be found from the registries. The registries are also designed with epidemiological research in mind, which means that they are planned to stay consistent over years. There are also some challenges when using registry data. Firstly, no additional, more detailed data outside the database specifications is stored: if there are some additional information that doctor has added in the hospital registry with the diagnosis codes, it is possible that only the diagnosis codes can be transferred to national registries.

As discussed in chapter 2.2.3, performance analysis of macro-level health system usually deals with aggregated data and presents the results as singular numbers to describe a nation or an area. On the other end, micro-level performance analysis might have extremely detailed data, which is used in the evaluation of an individual or an organisation. Meso-level analysis, which falls in between the two, requires data which includes all services given in the system, and they must be allocatable per each individual to estimate the allocative efficiency of the system. The data cannot be too aggregated, or meso-level phenomena cannot be analysed. However, the data must be coded in some manner: as there might be tens of thousands of individuals within the meso-level system, the patient records cannot be on paper, or without any method of codification.

2.4.1 Previous registry-based research

As a previous research project that has in great scale implemented Finnish national registry data is the PERFECT (PERformance, Effectiveness and Cost of Treatment episodes) research project (Häkkinen, 2011; Häkkinen, Malmivaara and Sund, 2011). This registry projects aimed at monitoring the effectiveness and cost-effectiveness of care pathways in secondary care. The specific care pathways include ones studying stroke (Meretoja, Roine, Kaste, Linna, Juntunen, *et al.*, 2010; Meretoja, Roine, Kaste, Linna, Roine, *et al.*, 2010; Meretoja *et al.*, 2011b, 2011a), very preterm infants (Korvenranta, 2010; Korvenranta *et al.*, 2010; Rautava *et al.*, 2010), hip fracture (Sund, 2007, 2008; Riihimäki, Sund and Vehtari, 2010; Häkkinen and Sund, 2021), myocardial

infarction (Häkkinen *et al.*, 2011), and hip prostheses (Mäkelä *et al.*, 2011; Peltola, Malmivaara and Paavola, 2013b, 2013a; Jämsen *et al.*, 2015; Mononen *et al.*, 2020). The PERFECT studies have focused on secondary care services, or data that can be found from Finnish hospital discharge registry (Hilmo, *hoitoilmoitusjärjestelmä*). They have not, for the most part, included information on the use of primary care services or social care services.

In Sweden, registry studies have mostly been formed around Swedish quality registries of care. These studies have focused on, for example, on rheumatoid arthritis (Lekander *et al.*, 2010; Lekander, Borgström, *et al.*, 2013; Lekander, Kobelt, *et al.*, 2013), palliative care (Martinsson *et al.*, 2012), quality-of-life indicators for older people (Teni *et al.*, 2020), and transient ischemic attacks and ischemic strokes (Buchwald, Norrving and Petersson, 2016, 2017, 2018). Swedish quality registers differ somewhat from comprehensive hospital registries, as they typically include all information that is relevant for the care of a specific cohort. However, social and health care services are to a large extent substitutive, and cohort-specific information might leave out some of the services these patients are using, hindering the estimation of total costs per patient.

2.4.2 *Ontology and the epistemology of registry data*

Ontology and epistemology of this thesis are, to a great extent, dictated by the data set I am employing and the phenomena under study. This study concerns national registry data, which is pre-coded and where the researcher is not involved in the actual creation of the data. Instead, the data is coded by medical professionals and reflective of patients' health status. Because of this matter, several aspects have to be recognised. Firstly, the ontological position of this research is *realist* in the sense that it assumes the registry information to present information of the real world. Also, the ontology must be *critical* of some aspects of reality in the data. The information is pre-coded and standardised, so it might lose some level of detail. In this sense, the study could also be deemed to have characteristics of *critical realism*, which assumes us to be studying information from real world, but which is filtered by our method of data acquisition. Figure 6 explains the coding and data acquisition process in question.

Validity and reliability of data is to some extent limited in registry studies. As for validity, the registered diagnoses of the patient pertain to real health problem, in the sense that they are independent of our perception and interpretation. This also stands for psychosomatic and psychiatric symptoms, such as depression, the ontology of which has historically been challenging to define (Helén, 2011). However, even the diagnoses are interpretations of

doctors on what social constructs (i.e., diagnoses) would best describe the conditions of patients. This somewhat distorts the information that we get from what is actually happening. Considering reliability, a lot of missing information might also affect the effects we may study – for example, obesity is not coded in Finnish health information, even though it could well predict some of the phenomena of interest. There might also be some level of errors in the reporting and coding processes.

In the same way as the coding of individual diagnoses and operations, the system phenomena I’m studying in this thesis (the estimated costs of care and the care transitions within the system) are presumed to be system-theoretical descriptions of real-world phenomena. This also posits this research into a more interpretive stance than plain positivism would imply. The information used in the study is not perfect, and a level of critical understanding must be applied when extracting policy implications based on registry data.

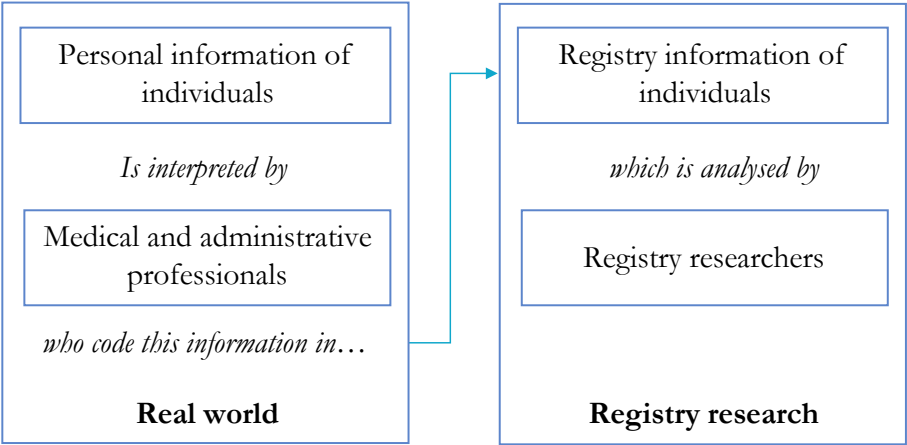


Figure 6: Process of data acquisition in a registry data study.

2.5 Synthesis of literature review

Meso-level health and social care systems lie between the national macro-level and the organisational micro-level. Meso-level care systems for older people, as presented in the following chapter, include characteristics of regional, patient population based, and care operations based meso-level systems. The care system is a complex socio-techno-economic system, as it strives to answer to the care needs of individual patients in a cost-efficient and satisfactory manner, while at the same time, the capacity restraints, mitigated price of services, and ambiguous incentivisation nature of long-term care services are assumed to create emergent phenomena which cannot be controlled for at the system level. Proper performance analysis of meso-level care systems requires linking all care services given in the system on an individual level, which can be performed via registry data. Previous registry studies have focused on specific care pathways, and for the most part, included only hospital registries. This thesis expands this information by also including information from primary and social care registries, to include all the services given for a specific population segment, the older people.

In the following chapter, the Finnish meso-level care system for older people is discussed in more detail.

3 EMPIRICAL CONTEXT: MESO-LEVEL CARE SYSTEM FOR OLDER PEOPLE

In this chapter, I will, in more specific detail, describe the characteristics of the ageing process and the health needs that arise from ageing, including the process of dying. After this characterisation of health need and changes in health status by age, I will also briefly discuss the recent political questions concerning the cost-effectiveness and quality of care for older people. After this, I will go through the typical social and health care services offered for the older demographic segments and present a meso-level system model for a care system of older people.

3.1 Characteristics of care systems for older people

3.1.1 Ageing and health need

As we get old, our bodies' regenerative functions start to slow down, the process which can be described as a growing amount of failures in our DNA-environmental system (Lakatta, 2015). This, in turn, increases the amount of impaired cell renewal and molecular disorder in the body, and eventually results in failing of adaptive compensation systems and a growing disequilibrium of decline within the body (Lakatta, 2018). This process of biological ageing is also called senescence. Although ageing in itself could be considered a progressive, subclinical disease (Lakatta, 2018), the diagnostics are typically formed around the specific diseases and conditions caused by the slow deterioration of the body. Even though our lifestyle, health behaviour and socio-demographic background might in large scale affect the speed of ageing, and even though the process of deterioration could be extremely stochastic, eventually we all do age. After all, no panacea for mortality has yet been created.

Ageing is related with a large set of comorbidities which might manifest at different times of life. A cluster analysis study of patients aged 65 years or older from 50 primary care centres in Barcelona (Guisado-Clavero *et al.*, 2018) formed 6 disease clusters based on the most prevalent comorbidities and their covariances. These groups include firstly, the *non-specific* cluster, and the remaining five being *Musculoskeletal*, *Endocrine-metabolic*, *Digestive/Digestive-respiratory*, *Neurological*, and *Cardiovascular* patterns. *Non-specific* cluster, for females, included hypertension, lipid disorder and osteoporosis (for older females, also osteoarthritis and cataract were included for the older population); for males, this cluster included hypertension, lipid disorder and benign prostatic hypertrophy (for older men, diabetes and cataract were added to this group). *Musculoskeletal* cluster was characterised by the prevalence of, e.g., osteoarthritis of knee, *Endocrine-metabolic* by diabetes, *Digestive/Digestive-respiratory* by chronic obstructive pulmonary disease, cholecystitis and urinary tract infections, *Neurological* by depression and dementia, and *Cardiovascular* by atrial fibrillation and heart failure. The study was based on ICPC-2 primary care classification codes and primary care data, thus possibly mitigating the role of cancer (which was not prevalent in the study).

The final point of life is characterised by the oncoming death. Lunney *et al.* (2002) have characterised four trajectories of death. These include *Sudden Death*, *Terminal Illness*, *Organ Failure*, and *Frailty* (Figure 7). Sometimes death takes place suddenly, and with little interaction with the health system. Some

diseases are associated with a relatively stable chronic phase, which then turns into a terminal phase with a sharp deterioration of condition and an increased use of health services. Organ failures are characterised by slow deterioration of health status, and temporary lapses in health status that result in, e.g., non-fatal hospitalisations. Finally, frailty is associated with an extremely slow deterioration of condition over decades, which finally results in death – usually in care homes or at least the patient receiving some long-term care services.

In addition to older people needing a vast amount of healthcare services, they also might need diverse social care services. Most intuitively, perhaps, older people need support in their daily activities of living. This might include any care services from helping to shower to receiving meal services or nursing services, offered either at home or in a specialised facility. In addition to this, however, older people are in relatively high risk of depression and loneliness. Other social services might help in living a healthy and active life.

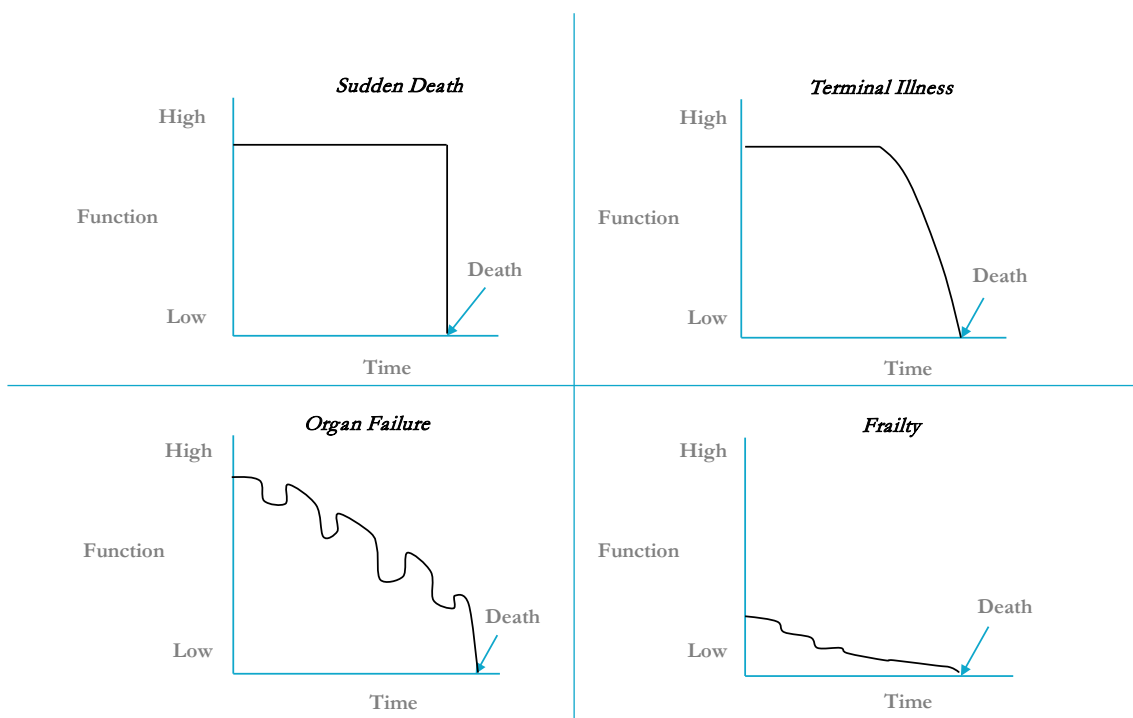


Figure 7: Trajectories in the end of life. Adapted from Lunney et al. (2002)

Sometimes ageing is, for practical purposes, defined through demographic factors such as age groups. In 1985, the concept “oldest old” was used to refer to patients over 85 years of age (Suzman and Riley, 1985), and since then, one quite standard way of demographic reporting has been to divide aged people to youngest old (65 to 74 years), middle old (75 to 84 years) and the oldest old

(85 years and older) (Hudson, 2010). However, it should be noted that the age-group-based definitions are relatively arbitrary and time-dependent, as the increasing life expectancy might result in older people being more healthy than before. In Finland there is no strict policy limit for what constitutes an aged person. For example, Finnish “Elderly Care Act”, or the Act on Supporting the Functional Capacity of the Older Population and on Social and Health Services for Older People, refrains from giving a strict age limit for what constitutes an older person. However, the formative recommendation document, “Quality recommendation to guarantee a good quality of life and improved services for older persons 2020–2023: The Aim is an Age-friendly Finland”, by Finnish Ministry of Social Affairs and Health and Association of Finnish Local and Regional Authorities, mostly reports statistics for “most aged” people over 75 years old and for over 85 years old, whereas the age group 65 to 79 years is referred to as “young retirees” (Finnish Ministry of Social Affairs and Health, 2020).

3.1.2 Challenges in the care of older people

Globally, populations are ageing. The world population globally will be ageing continuously throughout the 21st century (Lutz, Sanderson and Scherbov, 2008), changing and increasing the need for health services, and requiring public decisionmakers to adjust medical resource allocation and public health policies accordingly (J. Li *et al.*, 2019). This development is also visible in Finland, currently one of the fastest ageing countries in Europe (Eurostat, 2019; Pirhonen *et al.*, 2020). Ageing populations and rising costs of public social and health care industry create pressure for public decision-makers to improve the cost-effectiveness of care services while maintaining the balance between effectiveness of care, costs of care, and patient experience (Berwick, Nolan and Whittington, 2017).

Seeing the ageing of global populations as a challenge is arguably paradoxical. On the one hand, increase in life expectancy globally is a result from decades of thoughtful work on improving the quality of life and health of people. Increases in life expectancy come from increased public health, and, in current years especially from decreased tobacco use for men and improved cardiovascular health for men and women (Mathers *et al.*, 2015). However, several challenges are associated with the ageing of the population (Binstock, Cluff and Von Mering, 1996).

First challenge of ageing is related directly to the **increasing need of services** for the population (Dzau *et al.*, 2019). This, consequently, increases the need for trained personnel, facilities of care, capacity for long-term care, and medical technologies. In future, we need to produce more health and social

care services. To alleviate this challenge, more cost-efficient and cost-effective ways for caring need to be innovated and implemented into action.

The second challenge is the **shift in need for services** due to population ageing, or what services will be needed. As the age expectancy of populations is increasing, the distribution of comorbidities will also shift. Most markedly, the amount of older people with Alzheimer's disease and other dementias will increase, further increasing the need for long-term care services specifically designed for patients with memory disorders. Some practices of geriatric care, such as care services for centenarians, might develop into a new level. Additionally, as the life expectancy is partly driven by improvements in cardiovascular health, the usage of cardiovascular health services might decrease. However, this trade-off is not inevitable, as there are two competing hypotheses for population cost development. The *expansion of morbidity* hypothesis postulates that the healthcare costs will, in the future, be spread more evenly across our olden years; whereas *compression of morbidity* hypothesis suggests that our old age will be healthier, and only the last few years will remain associated with high need for services.

Third challenge, stemming from the increase and shifts in need for care, concerns the **societal changes we will meet as the societies age**, or how we see older people as a society. As the amount of oldest old will grow, so will their possibilities for social impact. Some topics that might have been seen as taboo previously, such as dementia, might become more easily approachable with their rising prevalence. Additionally, we might have to address some issues in our care system, which have not been discussed before, such as "quality of death", or the state of palliative care. The challenge of population ageing has also been framed as the challenge of healthy ageing, or good ageing – as people are getting older, we should envision what good older age might be.

Ageing populations has been declared as one of the grand challenges of the European Union (The Swedish Presidency of the European Union, 2009). The idea of grand challenge pertains to a strategically relevant and complex phenomenon, for which no specific solutions have yet been presented, and the solving of which will likely require a multidisciplinary co-operation of experts from different fields, or other "less conventional approaches" (Colquitt and George, 2011). Globally, population ageing has been framed as a grand challenge, requiring input from multidisciplinary teams acting together to "identify priorities and directions for improving health, productivity, and quality of life during a period of extended longevity" (Dzau *et al.*, 2019). In general, pragmatist approaches have been proposed as a fruitful philosophical

school of thinking in addressing grand challenges (Ferraro, Etzion and Gehman, 2015).

3.1.3 Finnish care system characteristics

Saarivirta (2009) gives a brief account of historical development of Finnish medical care system. The system started, historically, developing in during the 18th and 19th centuries, with building of first hospitals. The municipal-driven expansion of hospital network started in 1950s, and Finland was divided into 20 hospital districts in 1950s and 1960s. 1960s marked the establishment of universal health insurance, and the building of municipal primary care centres was started in 1970s. Before the organisational social and health care reform (as of mid-2021), Finnish national social and health care system was a decentralised three-level system consisting of 311 municipalities responsible for health and social care provision for their citizens. Responsibility of organising primary care services laid within municipalities. Secondary and tertiary care services were also paid by municipalities but organised by 18 hospital districts and 5 university hospital districts. The system was funded through several channels, mainly government, municipalities, and patients themselves. In 2018, healthcare expenditure accounted for 9% of GDP (National Institute for Health and Welfare, 2021). Healthcare costs in Finland (excluding day-care) amounted to €21.1 billion in 2018 (ibid.).

In addition to the organisation and funding system, some formative documents have been developed especially for the management of Finnish care system for older people, in collaboration between ministry and non-governmental bodies. The most relevant formative documents are the legislation, “Act on Supporting the Functional Capacity of the Older Population and on Social and Health Services for Older Persons” (980/2012 Elderly Care Act), and collaboratively written quality recommendation for older people. The legislation, or “elderly care act” (*vanhuspalvelulaki*), was passed on 2013, and it required, e.g., a specific level of services that municipalities have to offer for persons that are over 75 years old. The quality recommendation is a guiding document created by Ministry of Health and Social Affairs and Finnish Association of Local Authorities (*Kuntaliitto*). The quality recommendation has been updated regularly, in 2001, 2008, 2013, 2017 and 2020, and gives a more specific goals for municipalities in their work with older people (Finnish Ministry of Social Affairs and Health, 2020).

3.2 Modeling a Finnish meso-level care system for older people

This thesis aims to improve the methodology in analysing the performance of meso-level care provision systems. Thus, I present a conceptual discrete-state model for a meso-level care provision system. The most important characteristic for this conceptual model is to (a) enable the analysis of interventions that cause the long-term status of patients to change, (b) allow the analysis of all related service use at the same time, and (c) allow us to aggregate the use of diverse services under the relevant actor – on individual, care service provider, or at the system-level.

I assume the meso-level care systems to consist of several interactive, possibly overlapping open subsystems, each of which have defined rules for input and output, and which offer a predefined set of care services for its target population.

I divide the definition of the meso-level care system into separate conceptual categories. These concepts, applied together, are used constitute a system:

- 1) Population of individuals with defined demographic status, place of residence, and medical history.
- 2) Input and output conditions of the system.
- 3) Set of mutually exclusive long-term states to which a person belongs within the system at a given time, and transitions between these states.
- 4) A vector of short-term services, which a person uses during a specific time state.
- 5) An auxiliary coordinating agent which assigns a state for each person at any given time and acts as a gatekeeper for short-term services.
- 6) Cost vector of service use.
- 7) Health status effects of services.
- 8) Information on interventions performed to the part or the whole of the system.

Figure 8 gives a visual presentation of the model, or its basic concepts and main interactions. The model has five relevant parts:

- A: The input condition, by which the individuals are considered to be included in the system: for example, turning 75 years old, living in the city of Oulu, or being diagnosed with MS disease.
- B1-BN: Long-term states in the system, varying by their threshold value of need of care: for example, home care or intensive sheltered housing for older people.
- C1-CN: Short-term service providers, varying by the services they offer to the individual: for example, primary care visits, emergency department visits, or brief episodes in hospital ward care.
- D: Preferred output conditions, which are those output conditions we would expect to get from a system with well-performed standard treatment: for example, performing routine activities of daily living normally after a cardiac surgery.
- E: Non-preferred output conditions, which are unwanted for any reason: for example, death.

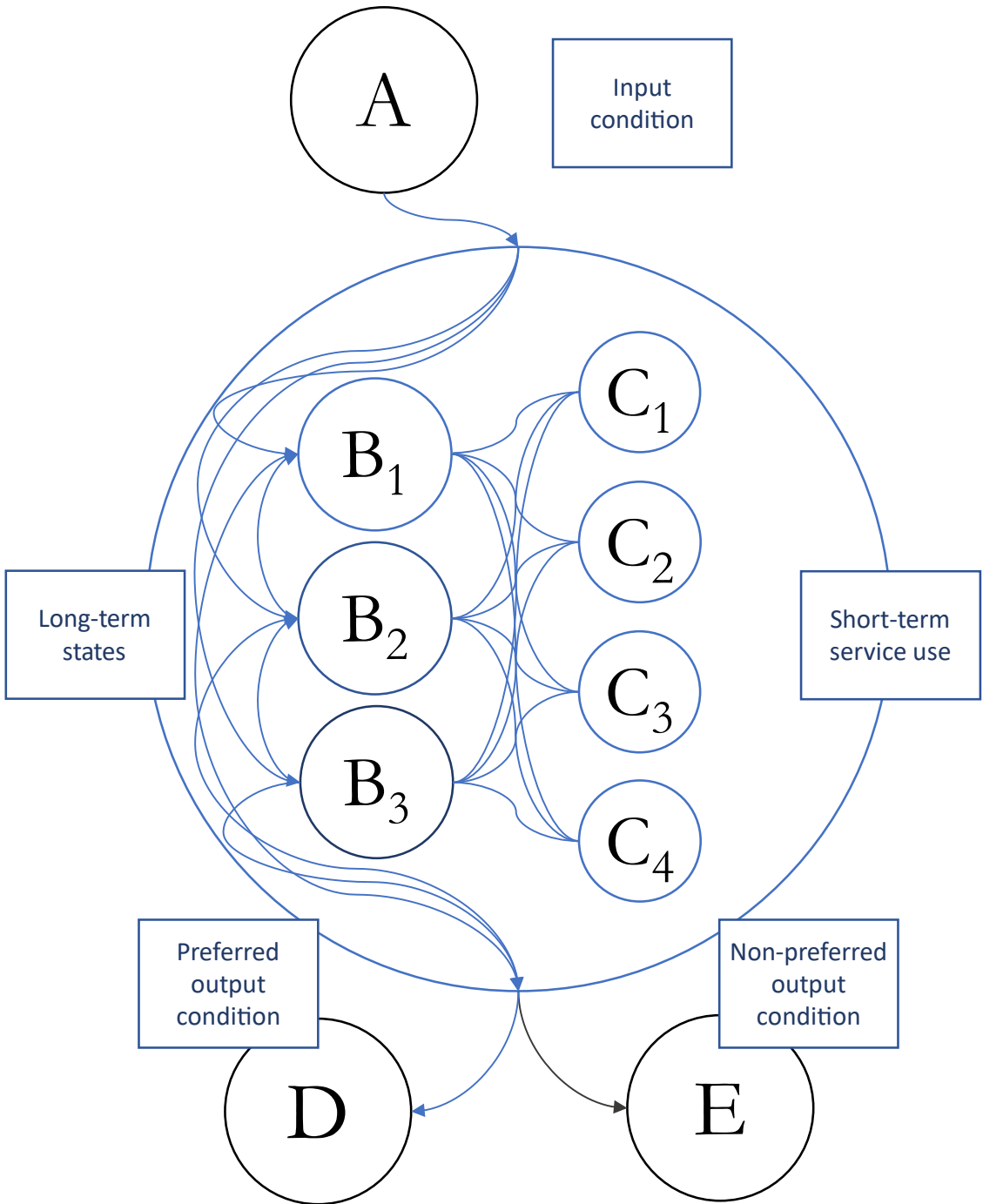


Figure 8: Graphic presentation of the model for meso-level care provision system with long and short term services.

3.2.1 Input and output rules

3.2.1.1 Inclusion to the system - patient population

Firstly, we must define the target population that is to be included in the care system at hand. A specific patient population which are to be included in the system may be formed around several specific criteria, such as geographic, demographic, disease-specific or operation specific criteria.

As the care system of older people in Finland is indirectly centred around the care of over 75-year-olds, we take this as the inclusion criterion for our system. The person is introduced into the system on the date they turn 75 years old.

3.2.1.2 Exit from the system – outputs

Also output criteria from the system have to be specified. For all systems, the natural and inevitable exit from the system is death. Especially for those systems the input for which is associated with unending demographic characteristic, such as turning over 75 years old, or a non-curable chronic condition, death is typically the only output condition. Similarly for adolescent care, a final output would be transfer to adult care system. For other systems where the care process in itself is likely to end after time, such as rehabilitation pathway after a fractured ankle, typically the output is defined as a cured health problem.

Output conditions can, to continue, be defined as preferred and non-preferred output conditions. Preferred output conditions should be related with the positive solution to the health problem, whereas non-preferred output conditions should refer to the output criteria where the person cannot be treated within the current system, but the health problem has not been solved, has worsened, or has been deemed as non-treatable. Again, the decision of what output conditions are non-preferred and which are preferred is highly context-dependent. For example, in a screening and diagnostic care system the patient having been successfully diagnosed with a specific diagnosis may be deemed as a preferred output, as the system has performed its goal of diagnosing patients.

For the care system of older people in Finland, no preferred output condition exists: as the inclusion criterion is age-specific and concerns all the people that have turned 75 years old, the only relevant output condition is death.

3.2.2 Long-term care states

In many medical fields, especially when the timeframe of analysis is months to years or when individual's condition is of a chronic nature, the treatment of the disease is formed around progressive categories. These categories may be

closely related to the health status and the need of specific healthcare services, such as in case of diagnostic, treatment and follow-up phases for cancer treatment (Paredes, Canavarró and Simões, 2011), or around the living facilities the patient is allocated into, such as in case of community-dwelling vs. institutionalised older people (Tison *et al.*, 1995; Prieto-Flores *et al.*, 2011; León-Salas *et al.*, 2013; Gonzalez-Colaço Harmand *et al.*, 2014).

For each long-term care state of the individual in the system, there may or may not be one or several specific, routinely offered service associated with it. The categories may include any level of service provision, from none to multiple care services provided daily. These long-term services are deemed to be associated with this specific long-term state.

It should be noted that, as was the case with general patient segmentation, also the segmentation between long-term states within the system is context-dependent and may shape the provision logic of services. Not only can the entry to the system be defined through different criteria, but also the long-term states: in case of care system for older people, the states are defined by the living conditions an elderly person is allocated into. However, the long-term states could also be defined via changes in long-term health status itself (not the administrator-allocated residence of living) – such as the rehabilitative stage of the patient after a hip surgery, or in case of addiction treatment, person having a minimum adequate level of visits to social care per time period. In some cases, the long-term status of the person is not clearly associated with any treatment procedure but is more of an administrative definition of the current condition of the patient.

To answer for chronic care needs of older people, the relevant long-term care states include:

- Services received at person's home. These services include supporting the person's activities of daily living, and, if needed, also providing medical care for patients in their home (ranging up to dialysis care in person's home, or home hospice care).
- Long-term care services received in a specific chronic care facility. The most usual type of care offered in a specialised facility are the living services offered for older people. Other examples of specific chronic care facilities are mental rehabilitation centres for people recovering from mental disorders. In this type of care in live-in facility, the person maintains a relatively high level of independency.

- Institutional long-term care services. These services are usually offered for the persons whose support for daily living cannot be organised in other than institutional setting. Institutional care services include long-term institutional care for older people, institutional care for children, and institutional care services for the intellectually disabled.
- Other social care services. Social care services are wide-ranging type of services offered to people with needs of care or support in their life. These services include financial aid, support in children’s well-being, and support in activities of daily living. Some of the services have a more care-oriented nature, whereas some (such as financial aid) can be deemed as more administrative services.

3.2.3 *Short-term care services*

In addition to the routine services associated with the long-term state of the person, there are also additional care services the individuals use. These might include, for example, emergency care services only partly related with the long-term state (such as emergency dental care services within the dental care system), or any additional service use the costs of which can be allocated on top of the costs from long-term state-related care.

For older people, specific services include:

- Emergency care services are life-saving services offered for the people requiring immediate medical attention. Provision of emergency care services may take place in pre-hospital settings, or care facilities, such as hospital emergency departments and intensive care units.⁴
- Primary care services offer the lowest level of care for patients with mild health problems. These service providers typically work as the primary contact point of the patients when entering the public health system with a new acute care need. The initial need-of-care assessment is performed on the primary care level and, if needed, a patient may be referred to contact more specialised secondary and tertiary care service providers. Primary care is typically provided in

⁴ I have kept the emergency care category separate from other types of care services. It is true that the emergency care can also be divided into primary, secondary, and tertiary categories. However, the service type is kept separate due to its distinctive nature, and as it is a strong indicator of the populations’ incidence of life-threatening health conditions, further indicative of population health status.

either local primary care health centres or as a field service, at the patient's place of residence.

- Secondary care services are more specialised care services offered for the patients with a previously assessed and established need for services. These care services are offered by specialised medical professionals or teams, and typically their provision takes place in a hospital setting. However, there are also specialised facilities for some clinical conditions, such as physical rehabilitation centres.
- Finally, tertiary care services are provided in tertiary care hospitals. These facilities are typically better resourced than the ordinary specialised care units and are further specialised in more complex or uncommon clinical cases. Sometimes the clinical treatments are even more focused within tertiary care facilities due to their low volume: In Finland, for example, provision of demanding liver surgery has to be concentrated in less than 5 university hospitals.
- Primary, secondary, and tertiary care services are sometimes needed also for chronic care. However, these services are typically needed for the routine check-ups, to ascertain the proper balance of care and e.g., keep track of patient's health status. However, these services are sometimes easiest provided within the facilities ordinarily targeted for acute care.

3.2.4 *Transitions within the system*

Any time a person changes their long-term status, a *state transition* happens. Whereas patient transitions in general may pertain to any physical relocation of patient (Aaltonen *et al.*, 2014), the state transition is only thought to occur when the long-term state changes.

As mentioned before, as states are, at least to some extent, administrative entities, there must be some administrative body that assigns the new state. Also some real-life restrictions require this – most importantly, the capacity of care providers is limited, and some entity has to decide who will be admitted to a new long-term state (even though this state transition would be independent of the patient's want, and based on the *need* for care). This is why we must additionally assume an abstract *allocator* to the system. This allocator assesses, on each discrete time step, the current health status of each person in the system and decides whose long-term state will change. Additionally, for each point in time, the allocator also acts as a proxy for gatekeeping in short-

term services, and also coordinates the administration of these services. A more technical term for this administrator would be an auxiliary function in the system (Mesarovic and Takahara, 1975).

Care services offered by private providers cannot be controlled for – and, as they have differing goals from public service providers, will most likely distort the functioning of this system to some point. However, this thesis only focuses on the public or publicly paid and bought provision of services. This will also exclude the provision of informal care, which might, in some care settings, form a major part of the service provision costs and differ from patient to patient (Zhu *et al.*, 2006).

Most relevant care provision decision that is assumed to follow an allocator logic is the older person's transition from home to some other long-term state of care, such as nursing home admissions.

3.2.5 Meso-level care system for older people

To summarise, meso-level care system for older people can be understood as a discrete-state system, consisting of discrete long-term states of care, and short-term usages of various types of healthcare services (Figure 9). On the bottom side of the model, we can see the long-term states or 'housing types' while the upper side of the model includes the short-term services. In general, each individual can be in one of the long-term states of care but use any additional short-term care services. The precise long-term states and short-term services included in this model were iterated in collaboration with the ELSE project organisation, which also included medical and administrative professionals specialised also in care organisation for older people.

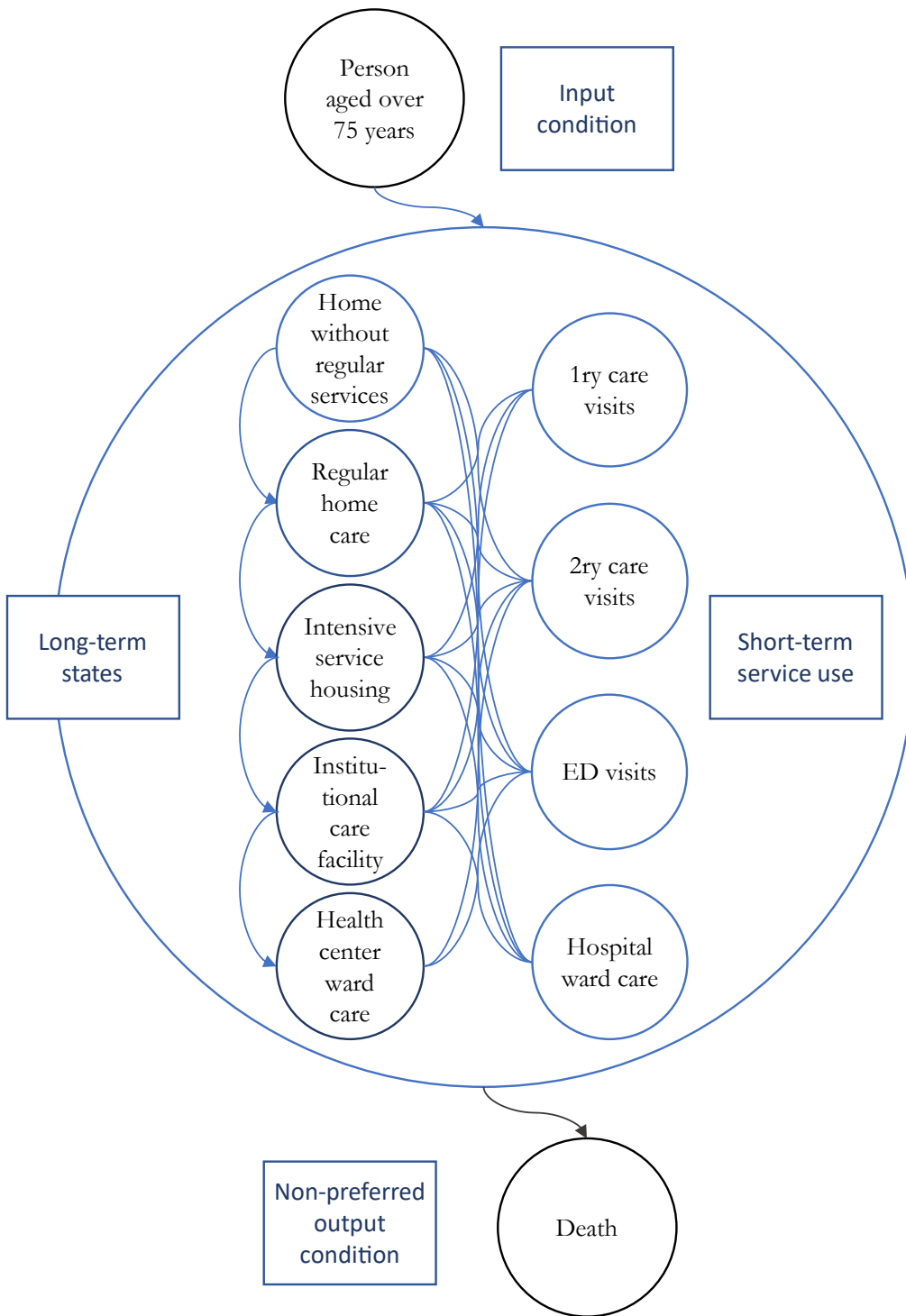


Figure 9: A conceptual model of meso-level care system for older people.

4 DATA AND METHODS

This section presents the data set employed in the ELSE study, the source data sets, and methodological choices. Additionally, a formalisation of the system model and statistical methods is presented.

4.1 Empirical data in sub-studies

The data was gathered from several Finnish registry holders, which are listed in more detail in Table 1.

Table 1: Data registries employed in the study. Abbreviations include ICD-10: International Classification of Diseases; DDD: Defined daily dose.

Register	Description
Care Register for Health and Social Care	Registry holder: National Institute for Health and Welfare. Key data content: Diagnoses (ICD-10), operations, healthcare utilisation (both inpatient and outpatient), and housing status. Both primary (Avohilmo), and secondary (Hilmo) healthcare data, as well as social care data (Sosiaalihilmo) is available.
Prescription register	Registry holder: Social Insurance Institution. Key data content: Information on all prescription purchases of all reimbursed drugs; data on drug, dispensing date, number of packages, strength, package size, dispensed amount in DDD and costs.
Special Reimbursement Register	Registry holder: Social Insurance Institution. Key data content: Detailed information of benefits by Social Insurance Institution.
Cause of Death Registry	Registry holder: Statistics Finland. Key data content: Time, cause, and place of death.
Tax Registry	Registry holder: Tax Administration. Key data content: Taxable income.
Housing Information	Registry holder: Population Register Centre. Key data content: Information about single housing
Costing information	Registry holder: The Association of Finnish Local and Regional Authorities. Key data content: Algorithms employed in estimating the health and social care costs.

The data population consisted of all individuals that were 75 years old or senior during the study period (2010-2014), in 65 Finnish municipalities (list in Appendix A), that could be identified from national care registries. Municipalities included 12 largest Finnish cities, a collection of mid-range cities, and a sample of smaller municipalities. The total amount of patients in the data was 316,470.

The data included all information on the social and health care service use from the registries of Finnish National Institute for Health and Welfare. The data included hospital registry data from the hospital discharge registry Hilmo, and primary care data from primary care registry Avohilmo. Additionally, Social care registry Sosiaalihilmo included data on the use of other long-term care services for older people, and the use of home care services was calculated based on the home care registry. Additionally, history data from time period 2008-2009 was collected from Hilmo hospital registry in order to identify previous comorbidities of patients. Comorbidities were defined by diagnosis codes, data for which used International Classification of Diseases version 10 (ICD-10).

Data from prescription registries was collected from the Finnish Social Insurance Institute. The data included all prescription drugs (most importantly Alzheimer's disease medication) purchased by individuals during the study period. Additionally, Special Reimbursement information on whether a patient had an ongoing special reimbursement for a specific pharmaceutical product was collected from the Social Insurance Institutes Medical Reimbursement Registry.

Information on the causes of death, dates of death, and place of death was collected from Cause of Death Registry of Statistics Finland. The main categorisation for cause of death employed in this project was the 54-group time series classification for cause of death, which is especially designed to enable comparison between the causes of death on different years.

Information on taxable income was retrieved from Finnish Tax Administration. Taxable income from year 2011 was used as a static proxy for the socio-economic income status of the individual, as the yearly fluctuations in the income of an older person was assumed to be relatively low.

Whether the individual was living alone or not was approximated based on their marriage history, retrieved from the Population Register Centre. The marriage status could, e.g., be either be unmarried, married, divorced or widowed. It should be noted that also the marriage status of the individuals remained relatively stable during the study period, except for the deaths of a

spouse, and divorces were rare in this age group, and were ignored for most of the analyses.

Cost information, based on the algorithmic information and cost information acquired from The Association of Finnish Local and Regional Authorities, was added on each episode. For secondary and primary care costs, each individual diagnostic and treatment procedure was assigned a cost based on the Finnish national version of the Nordic Diagnosis-Related Groups classification system. The treatment procedures were based on Nordic Classification of Surgical Procedures codes. For primary care episodes, we employed a similar grouping system, the Ambulatory and Primary Care Related Patient Groups (APR), to group the individual level data on diagnoses and procedures. For Long-term care services, per diem cost estimates were based on the unit cost report of Finnish National Institute of Health and Welfare (Kapiainen, Väisänen and Haula, 2014).

4.2 Formalisation of the system

In their seminal work *General Systems Theory: Mathematical Foundations* (1975), Mesarovic and Takahara state the following:

“The important point to note when using general systems theory for concept definition is that when a concept has been introduced in a precise manner, what is crucial is not whether the definition is ‘correct’ in any given interpretation, but rather, whether the concept is defined with sufficient precision so that it can be clearly and unambiguously understood and as such can be further examined and used in other disciplines”.

Their idea here is that giving a formal definition for a system helps transferring it to other disciplines. I would also argue precise definition also helps enabling conversation between care providers, most importantly providers of social and health care services.

In here I give a formal definition for the meso-level care provision system. The definition as such is a brief mathematical outline of the system. This outline can be expanded depending on the requirements of a specific context.

4.2.1 Population in the system

Let us assume a population that consists of N individual persons $i=1,2,\dots,N$.

Firstly, we define an input condition for a person to be in the system sys in the point-of-time t :

$$\text{input}_{i,t,sys}(pr_{i,t}, sd_{i,t}, mh_{i,t}) = \begin{cases} 1, & \text{if criteria}(sys) \text{ fulfilled,} \\ 0, & \text{if not fulfilled} \end{cases} \quad (1)$$

where pr denotes the persons place of residence history, sd sociodemographical background of the person, and mh the medical history of the patient (ideally from the beginning of their life, but in practice, including all the available medical history data up to the time point t). $\text{Criteria}(sys)$ is a system’s input criteria (such as, person has lived in Helsinki in the beginning of January 2020 or has a type II diabetes diagnosis). In this formalisation, the criteria are assumed to be uniform for all points of time.

We also assume an exclusion condition (after being initially admitted to the system) similarly:

$$\text{output}_{i,t,sys}(pr_{i,t}, sd_{i,t}, mh_{i,t}) = \begin{cases} 1, & \text{if outcriteria}(sys) \text{ fulfilled,} \\ 0, & \text{if not fulfilled} \end{cases} \quad (2)$$

The input and output criteria give us the inclusion condition:

$$\text{inclusion}_{i,t,\text{sys}}(pr_{i,t}, sd_{i,t}, mh_{i,t}) = \begin{cases} 1, & \text{if input}_{i,t,\text{sys}} = 1 \text{ and output}_{i,t,\text{sys}} = 0, \\ 0, & \text{otherwise} \end{cases} \quad (3)$$

And, continuing, the amount of people in the system (or the system population) in the point-of-time t :

$$\text{pop}(\text{sys}, t) = \sum_i^N \text{inclusion}_{i,t,\text{sys}}(pr_{i,t}, sd_{i,t}, mh_{i,t}) \quad (4)$$

4.2.2 Need-of-care

We also assume that the need-of-care level is known for each individual for each discrete point of time t (to be perfectly accurate, this would assume quite an efficient public healthcare operator, but we can expect this information to be available with a reasonable accuracy). The need-of-care level is evaluated based on the persons previous need-of-care level from the point of birth, and medical history before the current point of time:

$$\text{careneed}_{i,t,\text{sys}} = \text{evaluation}(\text{careneed}_{i,t-1,\text{sys}}, mh_{t-1}) \quad (5)$$

$$\text{careneed}_{i,t=\text{birthdate},\text{sys}} = \text{birthneed}_{i,\text{sys}} \quad (6)$$

For practicality, we define the careneed to range from 0 to 1, of which 0 would be the case of perfect physical, mental and social well-being in the system context, and 1 the case of context-dependent maximum dependency on and need of care:

$$0 < \text{careneed}_{i,t,\text{sys}} < 1 \quad (7)$$

It should be noted that the *careneed* as we define it is system-specific: this follows from the fact that many fields of social and health care are exclusive. A person can be in dire need of dental care and at the same time have no need for mental health services.

4.2.3 Long-term state of the individual

Also, a set of long-term service providers that offer services with n provision levels $l_0...l_k...l_n$ is assumed, l_0 pertaining to the service level *not receiving services*. For all service provision levels there are three characteristics: free capacity $c_{\text{free},k}$ of all service providers in that care provision level l_k , maximum capacity $c_{\text{max},k}$ of service providers in that level, and threshold level of care value threshold_k , which is the minimum level need-of-care expected for the patient to be eligible for the transfer to this provision level of care. For these applies:

$$n \geq 1 \quad (8)$$

$$c_{\max,k} \geq 1 \quad (9)$$

$$0 \leq c_{\text{free},t,k} \leq c_{\max,k} \quad (10)$$

$$c_{\text{free},k_0,t} = \text{pop}_{\text{sys},t} \quad (11)$$

$$0 < \text{threshold}_{l_k} < 1 \quad (12)$$

As the equation 11 implies, the capacity of service provision levels is always higher than the population. This follows from the idea that if no other long-term services can be offered to a person, the person is expected to be in the *no services* provision level, which has the capacity to include all persons in the system.

In the case of meso-level care system for older people, treshold for care entry grows with k . Other contexts of care either can define services levels with growing level of direness with k , or, for example, they can consider employing a multidimensional vector of care need.

After this, for each time t , we allocate a long-term state. Unless otherwise defined, as the person enters the system, their individual service provision level or long-term state lts is *no services*, or $lts_{i,t_0,\text{sys}}=l_0$. As we discussed before, in Finnish social and health care system the out-pocket-payments for services are relatively low, and we thus assume the system to act based on the allocators decision, which is again based on the assessed *need* level of the services, not the possible *demand* for services. The long-term state lts of the individual at any given time is defined here as the minimum state for which the level of care need, i.e., applies the following:

$$lts_{i,t,\text{sys}} = \begin{cases} \min(l_k \mid (\text{threshold}_{l_k} < \text{careneed}_{i,t,\text{sys}}) \& (c_{\text{free},t,k} > 0)), & \text{if } l_k > lts_{i,t-1,\text{sys}} \\ l_{i,t-1,\text{sys}} \end{cases} \quad (12)$$

A transition $\text{transitioned}_{i,t,\text{sys}}$ takes the value of 1 if the long-term state changes between t and $t-1$, and 0 otherwise.

At the start of time period t , the allocator is expected to prioritise all the elderly people into new states with a prioritisation algorithm, which goes through the elderly people starting with the one with the highest previous need-of-care level, and allocates the new possible long-term state based on the freed capacity and the individual's assessed need-of-care. Situations with equal need-of-care levels are resolved by the allocator⁵.

⁵ In practice the care allocator will be several allocators, deciding on the allocation of each patient. If there is no commonly decided explicit prioritisation algorithm, the

The free capacity for a service provision l_k on time t follows from the free capacity in the past turn, persons exiting the system, and persons moving to the other long-term state:

$$c_{\text{free},l_k,t} = c_{\text{free},l_k,t-1} + \text{output}_{i,t,\text{sys},l_k} + \text{transitioned}_{i,t,\text{sys},l_k} \quad (13)$$

No hierarchy of increasing need-of-care between levels of care provision is assumed, as the system could be defined as, e.g., patients in the process of rehabilitation after a surgery, which would imply that their need of care would *decrease* after a period of time.

4.2.4 Short-term use of services

We assume that the individuals in the system will meet a certain amount of short-term service need. For each possible reason of visit to a short-term service provider v , is a probability of visit p_v , which is dependent on the individual's past medical history, current long-term state and the socio-demographic background of the person⁶. The probability for a person to visit healthcare for each reason is:

$$p_{v,i,t,\text{sys}} = \Pr(v_{i,t,\text{sys}} \mid mh_{i,t}, ts_{i,t,\text{sys}}, sd_{i,t}) \quad (14)$$

From equations 5 and 14 we can see that both the previous long and short term service use affect the current use of both.

It should be noted that the short-term service use not assumed to be affected by the price of the services. As mentioned in chapter 2.2.5, as the price of services within a public service system is assumed mitigable, the patients will use services based on their care need, not the price of services⁷.

implicit algorithm the allocators use will be ambiguous, and probably non-efficient, independent of the efficient measure.

⁶For simplicity, the place of residence of the person is not assumed to affect the short-term service use as such: the effect of place of residence is included in the system's capacity for long-term service provision. Also, the nature of several short-term care services is usually acute, meaning that these services *have to* be offered for the individual, independent of the geographical location of the person. However, this assumption can easily be changed by including the information of place of residence to the equation, if relevant.

⁷ In reality, also the capacity of short-term services will affect the use of services but is ignored here due to simplicity and the acute nature of these services.

4.2.5 Cost of service use

For each individual cared for per each long-term service provision level, we can assign a long-term service cost lc_{lk} per time period t^8 . The long-term service cost lc of an individual is thus:

$$lc_{i,t,sys} = lc_{lts_{i,t,sys}} \quad (15)$$

Similarly, an individual's short-term cost can be defined as the sum of costs w of all visits to be:

$$w_{i,t,sys} = \sum_v w_{v,i,t,sys} \quad (16)$$

By identifying the long-term state of each individual, we can also allocate the cost of short-term service use for each long-term service provision level. The total long and short term service costs of all individuals per one service provision level is

$$\text{cost}_{l_k,t,sys} = \sum_i \text{islevel}_{i,t} * lc_{i,t,sys} + \text{islevel} * w_{i,t,sys} \quad (17)$$

where islevel is a dummy variable taking the value of 1 if $lts_{i,t,sys}$ equals l_k , and 0 otherwise.

4.2.6 Cost of non-preferred exits

Additionally, a proxy for cost of each non-preferred exit (such as death) should be added into the system. Mere allocation of the QALY standard price per remaining life years is likely not acceptable, as the absolute value of human life should be taken into consideration. In case of non-preferred exits to other care systems, the cost estimation could be estimated as the average cost of care in the other system per some defined time period, but for deaths, the estimation is less clear. This is an acknowledged developmental challenge to the model for the future.

⁸The real value of which is assumed to be constant, as the care organiser is assumed to be the single payer who can control the price level of the services.

4.3 Examples of applications

In the following, I shall give three examples of how this formalisation can be expanded to analyse different phenomena in the regional social and health care system. These examples represent the four studies in the related thesis.

It should be noted that for any of these sub-studies we do not need to consider or evaluate the *careneed* of individuals, but it is implied in the background. For these applications, we can use the information of the individuals' current long-term state to approximate the need of care.

4.3.1 Average system-level cost of a disease group

We can include, similar to the first sub-study of the thesis, additional information on our data set for all individuals to allocate the costs in more detail. For example, if we know the cause of death $cod = \{s, \dots, u\}$ of an individual, we can allocate the cost per cause of death to get cause-specific average cost of death $csacod$:

$$csacod_{cod,t,sys} = \frac{\sum_i cod_{i,t} * (lc_{i,t,sys} + w_{i,t,sys})}{\sum_i cod_{i,t}} \quad (18)$$

Where cod is a dummy variable for a specific cause of death. This information can, for example, be used in evaluating the cost differences between cause-of-death and service provider groups (Halminen, Koivuranta and Mikkola, 2018; Halminen, Hörhammer, *et al.*, 2021).

4.3.2 Risk of a care transition

Secondly, we can also calculate the risk of care transition by employing a logistic regression framework, which will give us the estimation of odds ratio for care transition. Consider the probability p_{tr} of an individual being transitioned into a long-term state A between time periods $t-1$ and t :

$$p_{tr,A,t} = \Pr(lts_{i,t,sys} = A \mid lts_{i,t-1,sys} \neg A) \quad (19)$$

We can now employ a logistic regression model to explain $\log\left(\frac{p_{tr,A,t}}{1-p_{tr,A,t}}\right)$, or the log-odds of the probability p_{tr} , with the patient's sociodemographic information, medical history, and the current long-term state:

$$\log\left(\frac{p_{tr,A,t}}{1-p_{tr,A,t}}\right) = \beta_0 + \beta_{sd_{t-1}} + \beta_{mh_{t-1}} + \beta_{lts_{t-1,sys}} \quad (20)$$

We can also employ a proportional hazards model, to explain the *survival time* t_{surv} in the system in a similar manner:

$$\lambda(t_{surv}|X_i) = \lambda_0(t_{surv}) \exp\left(\beta_{sd_{t_0-1}}X_1 + \beta_{mh_{t_0-1}}X_2 + \beta_{lts_{t_0-1,sys}}X_3\right) \quad (21)$$

This modelling approach will give us an estimation of the effect of various individual characteristics on care transition. In particular, we can estimate the effect of separate pharmacological therapies on care transition by including one dummy variable $\beta_{med_{t-1}}$ per therapy to the equation (Linna, Vuoti, *et al.*, 2019). Continuing, we can also model the effect of pharmaceutical therapies on risk of dying by considering death as one (absorbing) long-term state (Halminen, Vesikansa, *et al.*, 2021).

4.3.3 Estimating the effect of policy change

Thirdly, gathered data and system model together enable the application of different quasi-experimental study settings (e.g., difference-in-differences and regression discontinuity designs) in the evaluation of cost-effectiveness. Next, an application of difference-in-difference design (see, e.g., Angrist and Pischke, 2009) is presented. We can estimate the effect of a policy change on the set of units of analysis by finding those units that were most affected by the legislation (called the *treatment group*) and performing a before-after-policy analysis on the system. For example, should we have a health improvement program that is targeted for men, we could estimate the interaction effect of (*isman*afterpolicy*) on weight with:

$$\text{weight} = \alpha + \beta * (\text{isman}_i * \text{afterpolicy}_t) + \gamma_i + \delta_t + X_{i,t} + \varepsilon_{i,t} \quad (22)$$

in which γ indicates individual fixed effects, δ time fixed effects, and X the set of control variables.

Additionally, we can perform a crude cost-effectiveness analysis by calculating the incremental cost-effectiveness ratio (ICER) for the policy change by studying the transitions in the system, and estimating the cost-effect related to the transition:

$$\text{ICER}_{\text{policy change}} = \frac{\text{AIC}_{\text{after}} - \text{AIC}_{\text{before}}}{\text{Average QALY}_{\text{after}} - \text{Average QALY}_{\text{before}}} \quad (23)$$

Both these approaches have already been also applied in practice (Halminen, Keppo and Linna, 2021).

5 EMPIRICAL SUB-STUDIES

Four sub-studies are associated with this thesis. This section briefly presents each of the sub-studies and their contribution to the system-level thinking in meso-level care provision system.

As an overview, Table 2 lists the characteristics of each study.

Table 2: Characteristics of the four sub-studies

	Sub-study 1	Sub-study 2	Sub-study 3	Sub-study 4
Phenomenon of interest	Cost differences between cause-of-death groups	Mortality differences between medication groups	Service housing admission differences between medication groups	Changes in system-level care provision after a legislation
System population	≥75-year-olds deceased in 2014	≥75-year-olds living at home with a new Alzheimer's disease diagnosis in 2012	≥75-year-olds living at home with a new Alzheimer's disease diagnosis in 2012	≥75-year-olds in each quarter
Unit of analysis	Cause-of-death group	Individual	Individual	Municipality
Main methods	Descriptive analysis	Survival analysis	Survival analysis	Quasi-experimental design (Difference-in-differences analysis)
Long-term services of interest	Intensive sheltered housing Institutional care facility	Home care Intensive sheltered housing Institutional care facility Long-term care in health center ward	Home care Intensive sheltered housing Institutional care facility Long-term care in health center ward	Intensive sheltered housing Institutional care facility Long-term care in health center ward
Short-term services of interest	Health center visits Health center ward care Secondary care visits Secondary care ward care	-	-	Health center visits (short-term) health center ward care Secondary care visits Secondary care ward care
Other medical information of interest	Cause-of-death category	First date of Alzheimer's disease diagnosis Comorbidities	First date of Alzheimer's disease diagnosis Comorbidities	Comorbidities
Other socio-demographic information of interest	Income group Marital status	Income group Marital status	Income group Marital status	Income group Marital status
Cost information	Per diem costs of each service provider of interest 365 prior to death	-	-	Quarterly costs of each service provider of interest for each municipalities between 2011Q1-2014Q3

5.1 Paper 1: Health and long-term care cost of dying among elderly people - differences by age and cause of death in Finland.

Context and aims: The goal of the first sub-study was to analyse the costs of care associated with the care in the last year of life for older aged citizens. The last months of life are among the most expensive in persons' life (Hogan *et al.*, 2001; Polder, Barendregt and Van Oers, 2006; Hanratty *et al.*, 2007; Riley and Lubitz, 2010; Blakely *et al.*, 2014; Tanuseputro *et al.*, 2015; Hamblin *et al.*, 2018). However, the results have been seemingly incongruous on whether the older age of dying is related with higher or lower social and health care costs. For example, studies from the United States and the Netherlands (Levinsky *et al.*, 2001; Lunney, Lynn and Hogan, 2002; Polder, Barendregt and Van Oers, 2006) have found decreases in individual last-year costs of care by age, whereas ones from Canada, the United Kingdom and New Zealand (Seshamani and Gray, 2004; Payne *et al.*, 2009; Blakely *et al.*, 2014) have reported increased costs with higher age of death. Studies have differed in their populations of interest and data sources, with some of the studies focusing solely on cancer patients (Zhang *et al.*, 2009; Langton *et al.*, 2014; Z. Li *et al.*, 2019), and some only on hospital costs (Angus *et al.*, 2004; Kardamanidis *et al.*, 2007; Barnato *et al.*, 2015; Howdon and Rice, 2018; Z. Li *et al.*, 2019).

The aim of this study was to employ routinely collected registry data to study how the costs in the last year of life are distributed between different age and cause-of-death groups, and between different care providers (namely primary care, secondary care, and long-term care service providers). To the best of our knowledge, this was the first large-scale registry study to analyse all three aspects – age, cause of death, and service provider type – in the same study.

Data and Methods: We employed a sample of 15,730 older citizens of over 75 years from 65 Finnish municipalities, deceased in 2014. As with other studies in the ELSE project, the data set included the primary, secondary and social care episodes, from the years 2013 and 2014. Costs of care for the last 365 days before the date of death were used for the analysis. The costs were analysed descriptively, with a table describing all costs per care provider and cause-of-death group, and individual graphs depicting costs per age and cause-of-death group, and age and service provider group. Additionally, we performed a cost comparison with a similar sized control (non-decedent) group, with a similar gender, age, and income distribution as our patients.

Results: For an elderly decedent, the average cost in the last year of life was €34,622. Total costs for all the 15,730 elderly decedents together were €545M. Total individual costs of care increased by age, mainly due to the increase in

costs of long-term care services. The hospital costs were highest for the youngest age group, with secondary care hospital visits attributing 10 times more costs than for the oldest age group (€2,610 vs. €262). Most expensive cause-of-death groups were Alzheimer’s disease, ischemic heart diseases, and neoplasms, with long-term care forming 68%, 38%, and 17%, and secondary care 5%, 27%, and 46% of the costs, respectively. Cancer decedents had a comparatively low age of dying, Alzheimer’s disease the highest. Five most expensive causes of death by total costs, also including cerebrovascular diseases and other diseases of circulatory system, accounted in total for approx. €405M, 75% of all costs, and 73% of all decedents. In comparison with the control group, decedents had approx. €25,000 higher costs, which were in most part formed by healthcare costs for younger decedents, and by long-term care costs for older decedents (Figure 10).

Contribution to this thesis: The results provided a comprehensive view to the costs of decedents. This was largely due to the wide data set, which included a population sample from 65 municipalities, and relevant social and health care costs. When reflected upon the findings from previous studies, it becomes clear that studying only the costs of one service provider or cause-of-death group might produce a myopic view of the system, with over-pronounced costs in some areas, and further lead into sub-optimisation or non-effective resource allocation.

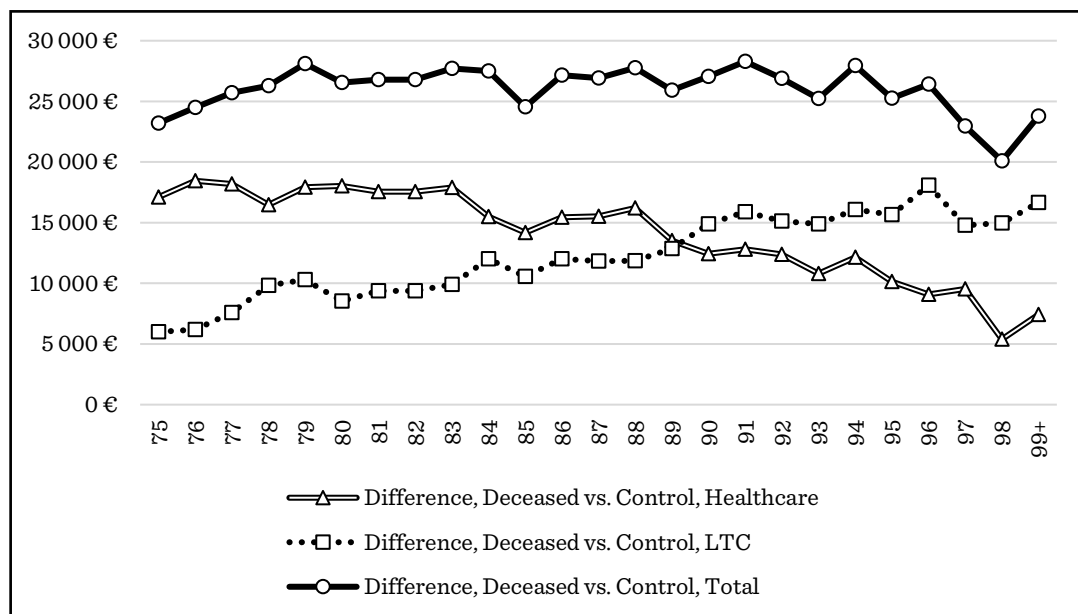


Figure 10: Comparison between decedents and matched non-decedents (N=15730, respectively) - differences in average healthcare, long-term care (LTC), and total care costs per individual by age group in year 2014.

5.2 Paper 2: Studying the effectiveness of early-started Alzheimer's disease medication in reducing mortality

Context and aims: Alzheimer's disease (AD) is the most common form of dementia, and accounts for up to 50 to 70% of dementia cases (Winblad *et al.*, 2016). Additionally, AD is one of the most common cause of death with the elderly (Larson *et al.*, 2004; Lönnroos *et al.*, 2013; Alzheimer's Association Report, 2021). Acetylcholinesterase inhibitors donepezil, rivastigmine, and galantamine, and N-methyl-D-aspartate receptor blocker memantine are common treatments in the European Union to slow down the deterioration of the mental cognition of patient and prevent dying (Cummings, Tong and Ballard, 2019). In this study, we studied the differences in mortality risk between early start of AD treatment after diagnosis vs. late start (within less than 3 months from diagnosis vs. after 3 or more months).

Methods: We formed an incident cohort of 9,204 AD patients in our ELSE project data set who had the first AD diagnosis in 2012. We performed a survival analysis in order to estimate the risk for mortality. The main outcome measure was overall 2-year risk of death. Statistical modelling was used to assess mortality (Kaplan-Meier) and adjusted hazard ratios (HR) (Cox proportional hazard model).

Results: Early started AD medication reduced the risk for all-cause mortality when compared to late users (27.0% versus 47.0%; $p > 0.001$). Dementia was the most common recorded cause of death for both early and late medication users, followed by cardiovascular disease.

Contribution to the thesis: This study was the first of two AD-related studies associated with the thesis. This study had a relatively absolute measure of impact, i.e., all-cause mortality. The results of the study imply that system-models and registry data may be used in studying this kind of "hard" endpoints, such as mortality.

5.3 Paper 3: Studying the cost-effectiveness of Alzheimer's disease medication in delaying the transition to 24-hour care

Context and Aims: Similar to study 2, this second study also analysed the impact of early AD medication start on endpoint. In this study, the phenomenon of interest was admission to a 24-hour care facility. AD is one of the main predictors of being transferred from home to a 24-hour care facility (Nihtilä *et al.*, 2008). 25% of patients with dementia become institutionalised within three years of diagnosis and 70–90% before death (Smith, Kokmen and O'Brien, 2000; Eska *et al.*, 2013; Brodaty *et al.*, 2014; Korhonen *et al.*, 2018). The institutionalisation also comes with a cost: mean yearly societal cost of AD in Finland and in Europe has been estimated to be between €30,000 and €40,000 (Prince *et al.*, 2015; Reed *et al.*, 2017; Linna *et al.*, 2019; Hiltunen *et al.*, 2020).

Methods: The study incidence cohort of 7,454 AD patients included those patients who had not been in 24-hour care before, comprising of two subgroups: those living unassisted at home (n=5,002), and those receiving professional home care (n=2,452). The primary outcome was admission to a 24-hour care facility. Exploratory variables were early vs. late anti-dementia medication start, sociodemographic variables, care intensity level, and comorbidities. The Fine-Gray (Fine and Gray, 1999) proportional hazards model was used to estimate sub-distribution hazard ratios and 95% confidence intervals for 2-year risk of transition to 24-hour care. Death was considered as a competing event.

Results: Early AD medication start was associated with lower transition risk in the total cohort. The effect was stronger with patients living unassisted at home. All anticholinesterase inhibitors significantly decreased the risk of transition to 24-hour care in both patients living unassisted at home and patients receiving home care, whereas the reduced risk for memantine was observed only in total population. This was likely due to memantine being usually administered to more severe typed of AD, in comparison with the other medications studied.

Contribution to the thesis: The study enabled us to study a less, although still quite, absolute phenomenon of interest than the other AD study, a transition to 24-hour care facility. Transition to a 24-hour care facility may, after all, also be due to other contributing factors in the system than the individuals' health status, risking the analysis to become incoherent. The models gave congruent results even with still more detailed study subgroups, as the analyses were performed separately for both those living at home unassisted and those

receiving home care. This implies the system model and registry study design enable the study of more complicated phenomena than the most basic ones.

5.4 Paper 4: A framework for studying the system-level effects of policy change

Context and Aims: Finnish Act on Care Services for Older Persons took action in 2013. The legislation, planned to be a holistic set of rules concerning all the care services for the older people, states that long-term care in health centre wards should only be given to older people unless there are medical grounds for it. In other words, if there were persons with lower level of health needs in ward care, these persons were likely to be either moved to institutional care or intensive sheltered housing facilities.

Our goal of the paper was to analyse, whether the municipalities that still had a higher level of people in health centre ward care, reduced their ward care levels after the legislation took place. We also explored various determinants of the transition patterns (e.g., multimorbidity and socio-demographic factors) within the regional elderly care system. We also studied the effect of legislation on the short-term health effects, in case of acute unintended spillover effects. Based on the short-term effects on service use, a brief cost-effectiveness analysis was performed.

Data and Methods: The study was based on an individual-level retrospective registry linkage study of 316,470 Finnish individuals aged 75 years or more. Dataset containing socio-demographic information of patients and a wide range of social and health care service episodes and their unit costs from 2011-2014 was combined from several Finnish national registries. All older patients from 65 Finnish municipalities were studied.

We employed a difference-in-differences study design to study this phenomenon. In addition to several regression models studying the effects of legislation on costs and service use, we performed several robustness tests to ensure robustness of our model.

Results: The results indicate that the level of long-term care given in health centre wards decreased significantly after the legislation. The legislation specifically affected patients with fewer comorbidities and offered them more appropriate services. There were no significant negative health outcomes, and the legislation was cost-effective assuming even a relatively slight quality of life impact for the system-level reorganisation of care.

Contribution to the thesis: In this study, we were able to set out a quite complex regression model to study a relatively non-trivial legislative change. The model performance implies that similar models may be used in the future to study the impact and cost-effectiveness of similar policy changes

6 SYNTHESIS OF FINDINGS

This synthesis chapter combines findings of the sub-studies in order to answer the research questions of this thesis. The separate sub-studies of this thesis each focussed on a different aspect within the meso-level care system for older people. The sub-studies employed methods from the field of health economics, and brought new knowledge on a specific, atomistic phenomena within the system. The practical implications of these separate sub-studies can quite easily be extracted and explicated. This chapter of the thesis aims to synthesise these findings into a more holistic view on the workings of the meso-level care system and give methodological perspectives on how this constellation of registry data and system model of care can be used to create management-relevant system-level insights. This synthetisation is done by applying an inductive process of reasoning, which is started with an observation, combined with a plausible explanation, and a rule is inferred, “thus, mov[ing] from the particular to the general” (Mantere and Ketokivi, 2013). Inductive reasoning has been proposed to be “especially helpful” for solving grand challenges (Eisenhardt, Graebner and Sonenshein, 2016). I agree with this view, and think that grand challenges, such as good ageing or building sustainable social and health care systems, cannot be solved without open thinking towards novel solutions. Induction is, however, an incomplete method of reasoning (Mantere and Ketokivi, 2013). Therefore, presenting normative claims based on the research synthesis would be ill-considered. Instead, I present descriptive ideas, especially on the managerial logic of meso-level systems. When presenting descriptive ideas based on inductive reasoning, the focus should be on the transparency of reasoning practices that link data into empirical generalisations (Mantere and Ketokivi, 2013).

6.1 Prerequisites to be considered

The first set of research questions of this thesis considered whether we can build a meso-level model, and what is needed in the process. The specific meso-level model of care services for older people was created in collaboration with the Finnish Association of Regional Authorities. In the creation process of the conceptual model, several prerequisites became apparent, and are presented in the following.

6.1.1 Prerequisites

Firstly, in order to analyse the meso-level system of care with registry data, one should have a **clear understanding of the system**. It should be clear what the system-relevant patient group is, and what services belong to the system scope. In other words, the system's input and output criteria, and the long-term states and short-term services should be defined. The long-term states do not necessarily have to be linked to any use of services, as was the case with older people's long-term state "no regular services". However, the boundaries between the long-term states should be clearly defined, especially on an administrative level. This might be challenging, as the systems are sometimes in the cross-section of several legislative frameworks, which include service definitions for different long-term care services. For example, the care system for older people included services defined, in, e.g., 1) the Social Welfare Act, 2) the Primary Health Care Act, 3) the Act on Specialised Medical Care, and 4) the Act on Supporting the Functional Capacity of the Older Population and on Social and Health Services for Older Persons (Finnish Ministry of Social Affairs and Health, 2022). To prevent excessive conflict between legislations, the input and output criteria, long-term states, and short-term services of interest should be defined in collaboration with the professionals from that specific administrative field.

Secondly, **comprehensive data should be available**. The analysis requires, at minimum, information of long-term states of people in the system. Another main source of information would be the short-term services given to a person, including, at minimum, hospital episodes. After this, auxiliary information which enables specific types of analyses include background information of individuals, cost estimates of care episodes, and quality-of-life data. Secondary information is useful, but the total distribution of services, and distribution of services per individual, can be analysed without these. If the data cannot be accessed for all the people within a system, its total service provision distribution becomes difficult to analyse, yet could be counteracted with, e.g., well-administrated random sampling strategies. The data acquisition requires

collaboration with national or regional registry holders, existing pipelines, and legislative frameworks to enable the use of registry data for research purposes.

Thirdly, **a strategic view of the system and system-level goals have to be defined**. As discussed previously, a perfect level of health with zero costs cannot be achieved, but the level of services and desirable level of population health have to be strategic decisions. The decision on an acceptable level of services does not have to be performed all-inclusively, but without any performance indicators the system will likely be managed in a way that does not strive for cost-efficient performance. The performance indicators and strategic views will likely need expert panels to be created.

Finally, **policy actions to meet these strategic goals have to be innovated and designed**. Although this innovation process can happen outside of the public care system, following market logic, sometimes public decision-makers should employ intra-organisational research and development activities to create new potential modes of care and organisation.

In essence, acquiring the relevant data is not the only prerequisite for the registry-based performance analysis. The analysis also requires strategic and context-specific insight, which is only achieved via collaboration with field specialists and managerial experts in healthcare. Collaboration and co-design, consequently, will require a shared model of a system to be used as a collaborative tool by system theorists, clinical experts, and managers. The conceptual model presented in this thesis is likely to work as this kind of a shared model.

6.1.2 Roadmap for analysis

Having developed the general model and possible strategies to increase cost-efficiency, we can formulate a roadmap which can be used to design specific sub-studies inside a system.

When creating more specific underlying studies, the research design process consists of two main parts. First, the conceptual model for the system has to be specified. Only after this can we design the relevant sub-studies based on the data we have acquired and the phenomena we aim to analyse.

The roadmap is as follows.

1. Define the meso-level care system
 - a. Who belongs to the system population?
 - i. What is the “input rule”? Define the geographic, demographic, and clinical factors
 - ii. What are the “output rules”?
 - b. Define the long-term states of interest
 - c. Define the relevant short-term services of interest (if all services not offered to the population)
2. Acquire the relevant data
 - a. Information of long-term status
 - b. Information of short-term service use
 - c. Information of previous medical history (e.g., comorbidities, medications, past changes in long-term service use status)
 - d. Relevant sociodemographic information (e.g., date of birth, gender, income information, marital status)
3. Approximate the costs and quality of life values
 - a. Select costing methods to allocate the costs for each long-term service (e.g., per diem costs)
 - b. Select costing methods to allocate the costs for each short-term service (e.g., diagnosis-related groups costing)
 - c. Approximate the possible quality of life measures for each long-term service use status
 - d. Approximate the possible quality of life impacts for each “output” event from the system (e.g., death reduces quality of life to zero)
4. Refine the model for each sub-analysis
 - a. Operationalise the phenomena of interest
 - b. Analyse the long and short term service costs and amount of people associated with each relevant long-term state for the groups of analysis
5. Create design propositions based on the analysis

6.2 Value brought by registry data and meso-level system model

The second set of research questions in our study explored whether the system-level model would bring additional value to the analysis of meso-level systems of care. This research question is answered in multiple ways in the following. One to two key findings (F1.1-F4) from each sub-study, concerning the system-level logic of social and health care management, is identified, and listed in Table 3. The table also lists the practical implications conveyed by each finding, which are consequently translated into methodological implications.

***RQ2.1:** What value does registry data bring to current status analysis involving, e.g., the cost structures, distribution of service use and relative costs of services between different systems?*

The first two findings (F1.1-F1.2) concern the first sub-study, which analysed the social and health care costs of the last year of life. The analysis showed a clear relationship between the cause of death and the type of services used (F1.1). Additionally, age was found to correlate with the cause of death (F1.2). In practice, younger decedents in the study population more often died of cancer, and the use of hospital resources was accentuated in this patient group. The oldest decedents, in comparison, had an accentuated use of long-term care services. As a practical implication it can be stated that the system-level use of services is likely to shift from acute hospital services towards other forms of services, namely primary care services and long-term care services. From this, the first methodological finding can be derived. When we applied data concerning several parts of the care system, we were able to better understand the total cost structure of individuals and see this phenomenon of shifting costs from hospitals to social care. If the analysis had focused only on hospital costs, the costs of dementia patients would have been highly underestimated and conversely, a study focusing only on social care would have neglected the sizable costs of cancer patients in hospital care. **Comprehensive registry data, paired with a meso-level system model, enables the analysis of cost distribution between patient groups and analysis of total system costs and cost distribution.**

Especially when comparing two patient groups, all services relevant to the care system at hand should be analysed as comprehensively as possible. The organisation of social and care service provision typically has a form-follows-the-function logic and includes varying care pathways and steering mechanisms for different patient groups. Thus, the service use of patients with similar needs may be directed to different parts of the system. Same services use might, e.g., be answered in primary or secondary care, depending on the

care pathway. The services are substitutive in another sense too: if the long-term care service level does not answer person's care needs, the use might convert to a stochastic use of acute care services.

***RQ2.2:** What is the value brought by registry data to the evaluation of intervention cost-effectiveness?*

Our next findings (F2-F3) concern the two papers that studied the Alzheimer disease medication's effects on mortality and care institution transition. The findings in themselves are clear: early start of Alzheimer's disease medication lowers both the mortality risk and the risk for transition to a care institution. The practical implications are also in line with the papers' conclusions: medical treatments can be an effective way of improving the system-level performance. Although seemingly trivial as such, the implication carried by the second paper should especially be highlighted: the cost-effectiveness of changes in care transitions within the system should be analysed as a key part of the performance measurement framework. All in all, these two studies as a whole demonstrate that, on a methodological level, the **use of registry data for meso-level system analysis also enables the effectiveness evaluation of atomistic interventions**, such as the effectiveness of medication administration, **especially in relation to transitions of care**.

***RQ2.3:** What is the value brought by registry data to the evaluation of policy cost-effectiveness?*

Finally, the key finding of this thesis' fourth sub-study (F4) is that the new legislation changed the case-mix of the patients receiving treatment in health centre long-term ward care. The change in case-mix was due to patients with less comorbidities being transferred to other long-term care facilities, which consequently led to an increase of multimorbid patients in health centre wards, as the freed capacity was utilised more appropriately. As a practical implication, it can be stated that the systems do react to legislative changes, and that there likely are sub-optimal capacity decisions in place. The goal of this sub-study was to work as a proof-of-concept and analyse the system-level effects of a legislative change. As a methodological implication, **comprehensive registry data enables evaluation of meso-level system-dynamic effects of legislation to some extent**.

One should note that although our difference-in-difference design strived to control for endogeneity, the social and health care systems are complex in nature, and there could still have been external factors which affected our results. Our analysis also found some unintended consequences of policy changes, and it might be that some complex mechanisms within our system of study caused the observed effects instead of our hypothesised mechanisms.

Therefore, similar policy analyses should be performed in the future to analyse the extent of causal claims that can be extracted from meso-level system-dynamic analysis.

Table 3: Key findings of sub-studies and their practical and methodological implications.

Finding	Source	Practical implication	Methodological implication	RQ
F1.1: Cause of death correlates with the type of services used	P1	Changing demographical structure will change the demand of services	System-level data analysis helps understanding the total cost structure of individuals with varying medical needs and drafting policy implications based on these	RQ2.1
F1.2: Age correlates with the cause of death and the types of services used	P1			
F2: Early administration of Alzheimer's medication lowers mortality risk	P2	Medical interventions are an effective way of improving system-level performance	Registry data enables system-level effectiveness analysis of atomistic interventions, such as medication therapies	RQ2.2
F3: Early administration of Alzheimer's medication lowers institutionalisation risk	P3	Medication cost-effectiveness analysis should consider the cost-effect of changes in care transitions		
F4: Legislative change altered the patients receiving long-term care in health centre wards. The policy change can be deemed cost-effective or cost-neutral with quite realistic values for a quality-adjusted life year	P4	The systems react to legislative changes, and there likely are sub-optimal capacity decisions in place	Registry data enables system-level policy effectiveness analysis to some extent; however, spillover effects and complexity might hinder the viability of this analysis approach	RQ2.3

6.3 Meso-level logics of management

Our third set of research questions considers the operating logic of meso-level systems. Next, the analytical findings of this thesis are synthesised into chunks of operating logic that have to be considered in the management of meso-level systems.

The optimisation of meso-level care system performance is not straightforward, but a compromise between several tensions. The trends in population need for services cannot be effectively changed in the short run, and the need for services is likely to rise. Sub-study 1 found that age correlates with a high cost of dementia care services, and the Finnish population is inevitably ageing.

6.3.1 *Logic of long-term flow*

In sub-study 4, there was a sizable variation in the care structures of different municipalities, indicative of a system-level structure affecting the long-term states of individuals. The effective system restructuring brought by the legislation change also implies there was ineffectiveness in the allocation between long-term states and patients.

The transition of older people between long-term states does not follow a rational-consumer logic traditionally employed in health economics but is pronouncedly controlled by the gatekeeping nature of administrative personnel, who assess the person's need for changes in long-term care, and who also have to consider the capacity limitations of long-term care facilities in their decisions. The administrators should, from cost perspective, have all the incentives to prevent the unwanted state transitions to more dire states of care. However, from health perspective, administrators should perhaps aim to offer as many people as possible the best long-term care possible.

Unsuitable long-term states of care will likely lead to ineffectiveness or spillovers. If people are receiving more services than would be required considering their health status and ability of daily living, this can be considered to be over-care. On the other hand, if people receive less services than they require for daily living, their health status will likely deteriorate at an unnecessary speed, and result in hospitalisations and use of acute on-demand care services.

The administrator of a meso-level care system should understand the **logic of long-term flow** in order to coordinate long-term care allocation, design suitable service bundles that cover the system population, and reduce the

unnecessary use of short-term services. For example, creating common criteria for long-term care institution access within a region has been found an effective way to reduce variation in care service system structures (Tupala *et al.*, 2020).

6.3.2 *Logic of short-term services*

Similarly to long-term care services, the non-suitable allocation of short-term services to a patient will also lead to either ineffectiveness or spillovers if the patient's need of care is not met. Typical issue of unsuitable care allocation is when the patient is given emergency care for a non-acute health problem, or specialised care services to mundane health problems.

The **logic of short-term services** differs slightly from long-term services. For short-term care services, a much more diverse set of services from different specialities of care is offered than in long-term care. This also reduces the possibility to proactively coordinate the collection of services received by the patient. Consequently, there are much more numerous places of contact for patients to seek for care, even on primary care level, and care contacts that make decisions of care. Therefore, demand management becomes increasingly relevant. Patients should have easy access to, e.g., coordinating services that tell the patient which is the most suitable point of contact considering their health problem (Tenhunen *et al.*, 2018). For patients that require an increasing number of services, the bundling of short-term services in the form of integrated care can also be considered.

6.3.3 *Logic of slowing-down efficiency*

Short-term care services, or any services given in addition to the patients' service bundle, are not only a result of unmet health needs for a long-term care patient but can also be an effective means of improving health. This may, in turn, prevent the patient from having to transfer to a more dire long-term state. Talk of "slowing down the progress of ageing" would be excessive on an individual level, but if, on average, the patients receiving an intervention spend more time in less dire long-term states, this **logic of slowing-down efficiency** should be considered when measuring the cost-effectiveness of the intervention.

The decelerating function also concerns interventions made on the long-term service bundles, and should, perhaps, be considered in the financing models of long-term care. Instead of a monthly fee based on a certain service level, financing bodies of long-term care services should consider a change into a pay-per-value financing model of long-term care, which would consider the

average aggregate preventive effect to state transitions that is reached by the care provider. In this kind of consideration, it should be remembered that the long-term care transitions are also dependent on the free capacity in a facility providing services of a more dire long-term state: if there is no free capacity, no transition can happen. The estimation methods of transition prevention effectiveness should merit to be researched in the future.

6.3.4 Logic of input and output

Finally, system's interfaces to other systems, or **logic of input and output**, have to be considered. Sub-studies 1 and 2 considered dying patients. Dying can be considered as a long-term state transition, but, at the same time, an exit from the system. The logic of system exits differs from other transitions: the patient is no longer creating costs for the system, nor is the patient part of the performance measurement. However, non-preferred exit, in this case, death, is generally considered as a more non-wanted outcome than healthcare operations that cost much more than the conventional tens of thousands of euros per quality adjusted life year. Giving monetary value for death is likely unconstructive and might lead to challenges in measuring system performance. This input/exit logic is also partly the reason why optimisation of the system as a whole is challenging, and instead, the system exit effect should be studied separately from other functions in the system.

In the conceptual model for a meso-level care system, there are both non-preferred and preferred exits from the system. As the service system for older people is age-defined, input from the system cannot be prevented, and there is no preferred exit from the system. However, for general purposes, there might be preferred exits and preventable input rules, or more or less preferred health conditions on input moment. Non-preferred input may be reduced via primary prevention and health promotion activities, whereas preferred output is likely the result of well-performed care and should be the strategic aim of the system.

Figure 11 outlines the presented logics of increasing the cost-effectiveness of the system.

1. Reduce the system input by stretching prevention measures into the wider population outside the system.
2. Reduce the amount of non-cost-effective long-term state transitions by better coordination of services. This includes both optimising of the number of short-term services given for the patient in a less dire long-term state, and also improving the gatekeeper efficiency of the more dire long-term state. This means, for example, that the decisions to transfer the patient into the more dire long-term state are based on the well-performed needs assessment.
3. Reduce the amount of non-cost-effective care by better coordination between different levels of short-term services.
4. Reduce the system-costs by increasing the preferred output from the system. In short, cure people faster.
5. Reduce the non-preferred output from the system, meaning the transitions to more costly health systems, such as acquiring a new, more fatal disease from e.g., hospital bacteria, or deaths.
6. Increase the cost-effectiveness of all individual healthcare units (assuming no externalities).

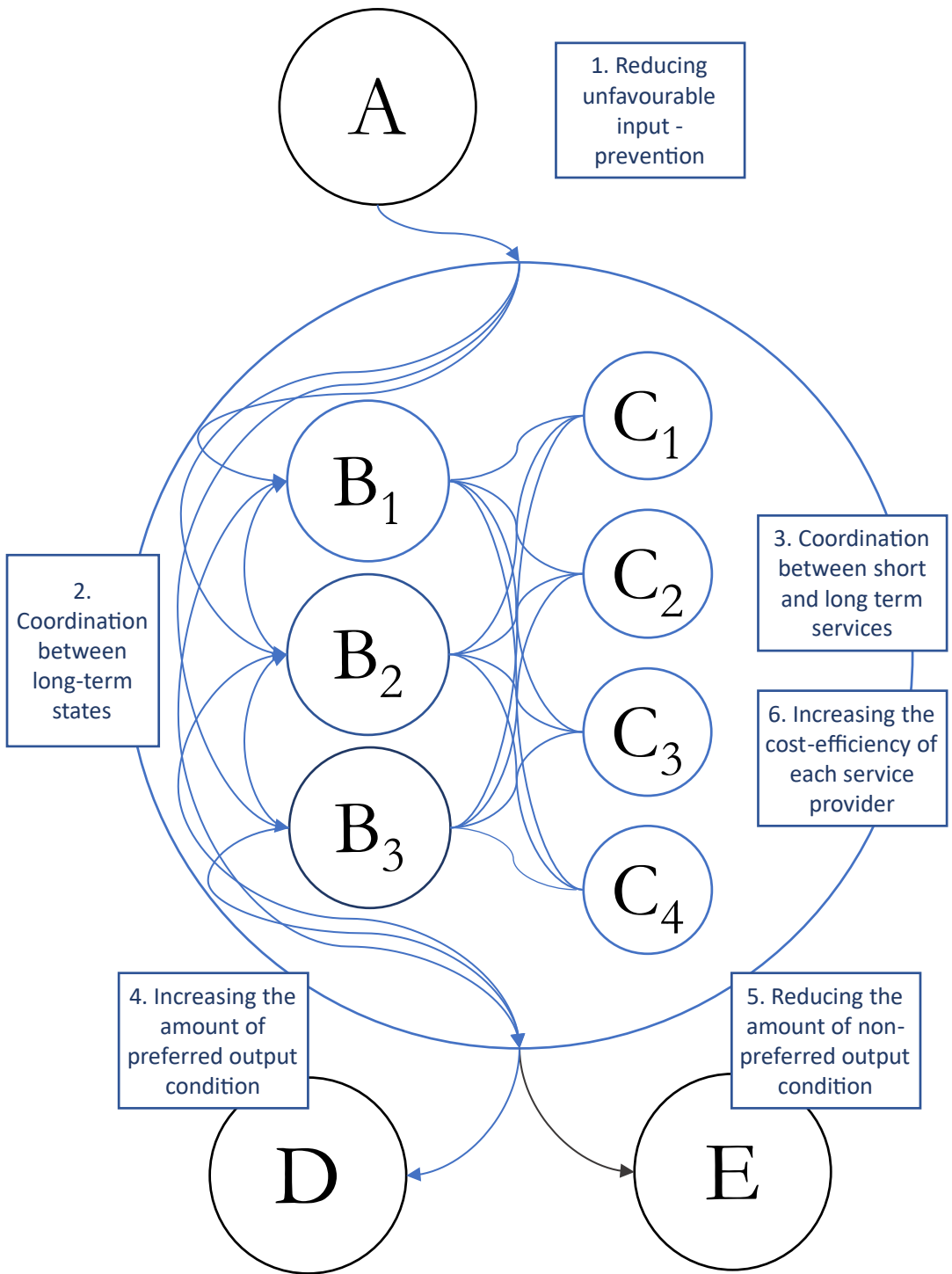


Figure 11: Cost-effectiveness improvement strategies for meso-level social and health care systems.

6.4 Generalisability of the system model

The generalisability of the model has to be discussed. I approach the generalisability via two related concepts: the transferability of the model to other regimes of care, and the issues that may rise from the expansion of the system model to a meso-level system of systems, which might face contradictory goals or service bloat.

This thesis concerned the meso-level care system for older people. Similar to this system, two other possible cases arise quite naturally: the meso-level system for mental health services, and the meso-level system for child welfare services. These two systems share some characteristics with the care system for older people: they both include social and health care services, the agency of a patient is limited by administrative bodies, and the causal relations between care and outcome are limited. However, they do as well have some special characteristics. In the following, I will discuss the potential transferability of the system model for these two regimes of care and will present a similar conceptual model as with the care system for older people.

It should be noted that the characteristics of other systems of care are also highly detailed, and the definitions of system objects should be developed with the collaboration of topic-specific experts, which would be outside the scope of this thesis. This sub-chapter should be considered mostly as an illustration of generalisability potential.

6.4.1 *Transferability to child welfare system*

Like the care system for older people, the system of child welfare services could also benefit from a meso-level approach. The three most important analytical benefits of a meso-level system approach are also present in the analysis of child welfare system: the analysis of total cost distribution within the system, analysis of cost distribution per individual, and the cost-effectiveness of transition management.

There is also a relevant case for management of the child welfare system. In 2020, 5.2 percent of all children aged 0 to 17 years old, in six largest cities of Finland, were within child welfare services (Lastensuojelun Kuusikko-työryhmä, 2021). The costs of child welfare services in these cities were 422.1 million euros, and the share of costs from children being placed outside of home ranged from 72.5 to 85.5 of costs – and the share of institutional care ranged from 23.7 percent to 57.6 percent by city. Similarly to the care system for older people, some explicit research questions come to mind. Can we calculate the cost-effectiveness of interventions that reduce the transitions to more dire and costly long-term states? Are there some health services that are

used in disproportionately large amounts by some child groups? The meso-level system model raises similar questions and modes of analysis for this care regime as well.

In the care system for older people, the inclusion criteria for the system were age-based. In contrast, the exclusion criteria for child welfare services are partly age-based, and the inclusion criteria were that there has been an assessed need for child welfare services. Similarly to the care system of older people, there are also some long-term states of varying level of services in children's welfare. Firstly, when a child is assessed to have a need for services, they are offered at home. As a crude simplification, the other following long-term states would be placement into another family, placement into an institution, and after-care following an institutional placement (see Figure 12). Placement outside of home might be done as an emergency placement, and the child may be taken into custody in the process. Long-term states may be associated with costs, such as institutional care, or be without costs, like when a child lives at home. Additionally, a child uses a vector of short-term services – especially when living at home, basically all service use is short-term in the model. Finally, the output of the system happens when a child is no longer in need of child welfare services, turns 18, or is deceased.

Characteristics of child welfare service industry make the meso-level logics relevant. As with the care system for older people, the agency of children is limited in the system. The child and the family must be heard when making decisions of placement outside home and potential short-term services offered, but the final decisions are done by local and regional officials. The services are also substitutive. Especially short-term services may be parallelly substitutive: a child may be helped by school nurses, or social workers, or psychiatric personnel in health centres and hospitals. Long-term transitions can also be really costly: if the child placed in an institution, additional yearly costs when compared to living in home can well range from a hundred two hundred thousand euros per year (Heinonen, Väisänen and Hipp, 2012). Prevention becomes exceedingly relevant. Meso-level administrators need to design a system structure and service bundles that balance the need for services and costs for child welfare services, thus slowing down the transition rate to more dire long-term states of child welfare. Also, the exits from the child welfare system should be preferred is possible: part of the system performance is that the child welfare services prevent, e.g., future non-employment and lack of education.

6.4.2 *Transferability to mental health services system*

A meso-level system analysis would likely be a viable approach for mental health services too. For example, a recent registry study on mental health services (Karolaakso *et al.*, 2021) found significant regional variation in mental disorder disability pensioning, which might stem from differences in regional mental health service systems. The author of the publication later published a public opinion piece on how the oncoming regional decision-makers should acquire a basic understanding of system-level factors related to mental care (Karolaakso, 2022).

The conceptual model for a care system of mental health services would bear similarities to two previously discussed systems. The model is presented in Figure 13. It should be noted, that the etiological and diagnostic nature of mental illnesses is much more complex than in more somatic fields of medicine (Helén, 2011). However, the long-term states could be categorised by the levels of service need and range from low but regular service use to ward care. I would posit that same managerial logics as in care for older people could be, to some extent, applied in this field. The service bundle in less dire long-term states should be balanced and answer to the service need, to reduce transitions to more dire long-term states.

For both child welfare and mental health systems, the complexity arises from gatekeeping, which turns the individuals quite dependent on the systems' decision on where they are placed. In child welfare services, the gatekeeping of long-term states is, to some extent, performed regardless of the child's own preferences, but to secure the safety of the child. In mental health services, the gatekeeping is more realised through the granted access to either services, or public reimbursements for, e.g., therapy. However, also some acute care processes may be performed regardless of the mental health patient's preferences, mostly the gatekeeping is about whether the person is accepted to enter a certain care pathway.

In mental health, the question of gatekeeping also turns into question of access to care. Especially the demand for mental health care visits is growing in Finland, which is an identified challenge in the system (Kolonen, Riski and Vuorinen, 2021). The input to a system should be defined as the assessed need for care services, not, e.g., by whether patient has managed to receive mental care services.

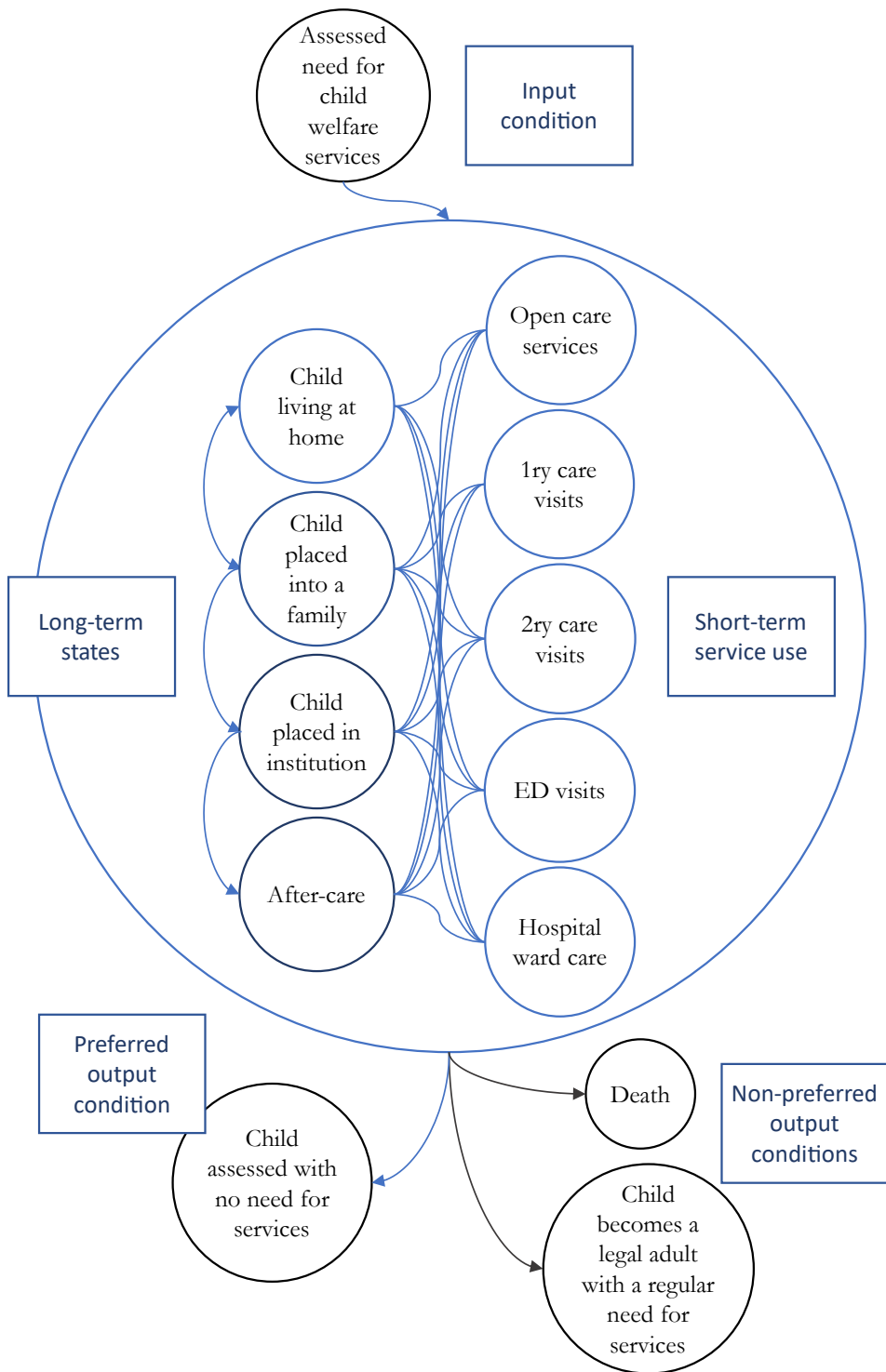


Figure 12: Conceptual model of the meso-level child welfare system.

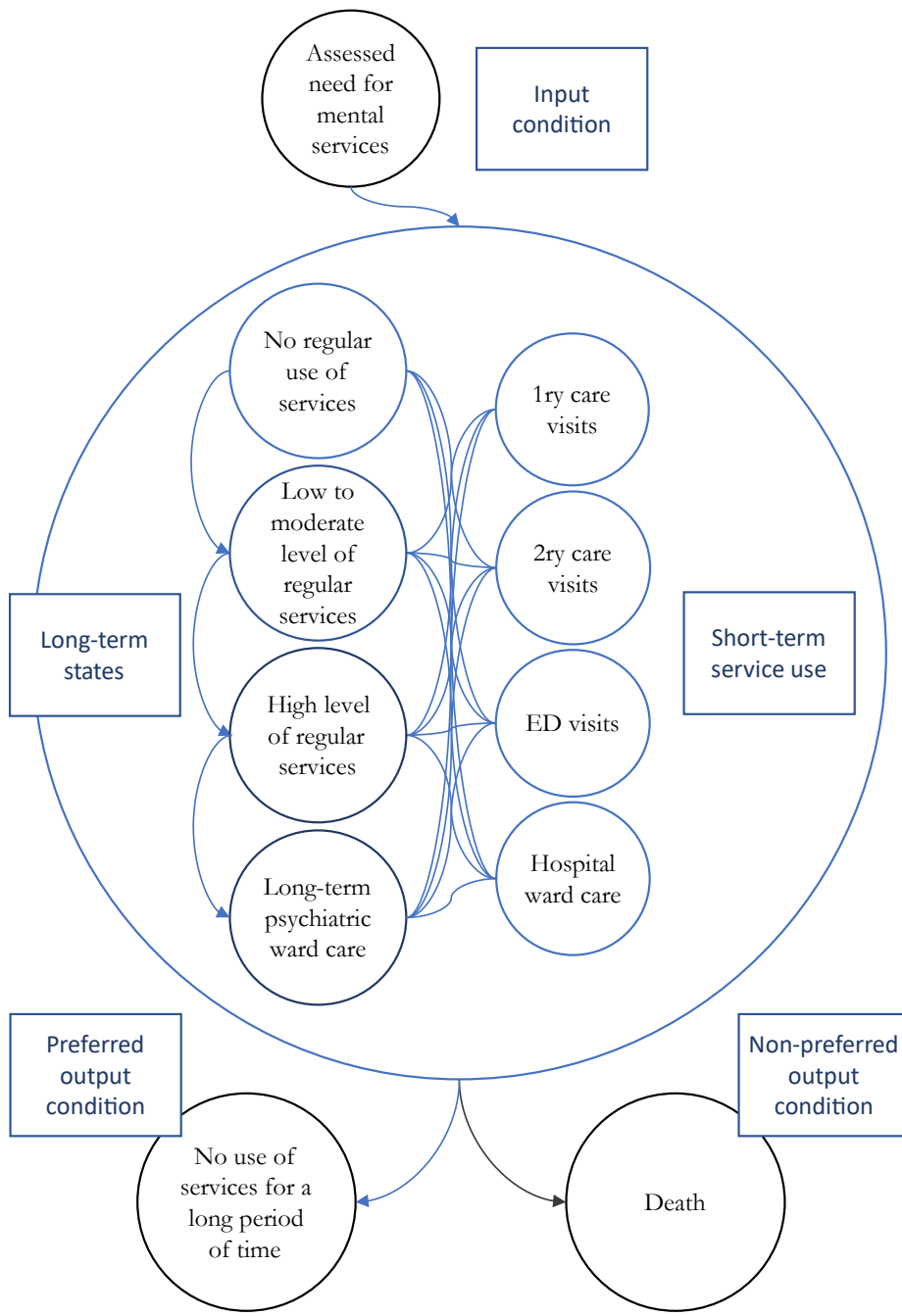


Figure 13: Conceptual model for the meso-level mental health service system.

6.4.3 Challenges in the system of systems

In this thesis, I have presented a model for one meso-level system of care and discussed its practical applicability for the analysis of the system performance and cost-effectiveness. However, the care system for older people is only one system among many. Should this kind of performance analysis model be employed in practice, other meso-level systems of care also have to be considered. A regional care delivery system is a *system of systems*, in which sub-systems of clinical specialties act. Even for older people, there could exist other systems that also have specific goals for the patient. An older person could also be receiving services that cannot be fully understood as age-specific but might be related to some other clinical speciality or care organisation. For example, an older person might also be rehabilitating from a fractured femur and receiving care services that are strictly related to the healing of the leg, and not related to the activities of daily living. To continue, the same older person may be receiving services for diabetes care, or various mental health services. It soon becomes an issue to manage the care complexity of all the overlapping care processes.

As the model presented in the thesis is, by definition, an idealisation of the real world, there are several challenges that may rise from the conflicts between separate care systems and care pathways that have to be considered. These are briefly discussed here, as they are only partially within the scope of this thesis. In the end, the dirty details of a chaotic real-life environment have to be managed by the practitioners.

Several imminent problems arise from the systems approach:

- How to avoid the overlap between different systems?
- Should overlapping use of health services be considered when estimating the cost-effectiveness of specific service type?
- How to measure the spillover effects?
- How to avoid “service bloat” for one patient, or can the amount of services supplied for one patient become overwhelming?

One realistic problem would be conflicting results of cost-effectiveness between two sub-systems. If the patient is both demented and rehabilitating from an organ transplant surgery, the most cost-effective care pathways or service bundles could differ. However, in these cases, the medical history should be included in the model as a covariate anyway, and the service bundles should be integrated to accommodate the most usual needs of patients.

Some of these problems can be solved with considering on-demand services as external to the system and including in these all other costs that the patient accrues. However, if the costs are truly external to the system, they are exogenic factors which should not disturb the measurement of cost-effectiveness of specific policy interventions with robust quasi-experimental settings. Conversely, if the use of external services varies between comparison groups, then the service use is not independent of the system but can be considered as an endogenic factor. Adding all the costs that can be considered as endogenic to the models should not be a problem with robust analysis methods; it is the exemption of endogenous factors that might bring bias to the model.

Even though the use of other services could be treated as a covariate or as an endogenic factor, the causal relations of service use within a service system which consists of somewhat substitutive services are difficult to predict or understand. The care systems might have non-linear spillover effects to other sub-systems of care. For example, improvements in regional mental health or child welfare services might decrease the need for dental health services. Some externalities might also be related in the care context at hand, and it is likely that the boundaries between the sub-systems might not be perfectly definable. In other words, the idea that models of subsystems within one system should be mutually exclusive and comprehensively exhaustive might not be pragmatic in managing the system level cost-effectiveness. The system boundaries should work as tools for understanding the performance-related factors in the system and acquire strategic status views in support of the decision-making processes, not, e.g., for siloing patients into specific care-related processes and not directing the patients into different care service systems when needed.

In my opinion, the most important challenge is the “service bloat” that rises from the patient belonging to several different sub-systems within a system. It is likely that after the patient has accumulated a specific level of care need, it would become more cost-effective to offer customised services for one patient, instead of offering a multitude of short visits to separate service providers. The system-model where all sub-systems would be perfectly separated would likely not serve well with these patients with exceptionally high care needs, but instead result in unnecessarily high levels of use of different services.

Other concerns, such as accounting-related, e.g., what costs should be considered when reporting the costs of cardiovascular diseases, or managerial-roles related, e.g., how to avoid conflicting strategies between sectors, are also valid. However, these concerns are likely to exist in any organisation with

different sectors, regardless of the conceptual model of performance analysis employed.

7 DISCUSSION

The goal of this thesis was to create a framework for analysing the system-level effects in the regional social and health care systems and apply a systems approach on nationally collected registry data-based analysis. Based on the four sub-studies presented in the thesis, we have shown that the systems approach can bring new information into social and health care management. Next, I will shortly frame the findings of this thesis as theoretical, methodological, and practical implications. I will also discuss the strengths and limitations of the thesis, and present potential future research problems to be inspected.

7.1 Methodological and theoretical implications

The main contributions of this thesis can be summarised as follows:

- 1) Conceptualisation of meso-level system model of long-term states and short-term services use;
- 2) definition on the prerequisites of registry data based meso-level performance analysis;
- 3) definition of value brought by the registry data based meso-level performance analysis;
- 4) conceptualisation of managerial issues relevant for the meso-level system including long and short term services; and
- 5) description of generalisation-related possibilities and challenges.

Firstly, the most important contribution from a methodological viewpoint is the explication of general conceptual model for meso-level systems. I presented an empirically applicable conceptual model of a meso-level system, which, to my knowledge, has not been done previously in social and health care management literature. Modelling the care system for older people as a discrete-state system enabled the explication of the dynamic effects taking place in the system. The system with mitigable prices and non-linear causal relations between care provision and outcomes cannot fully be characterised as a traditional market system. Market inefficiencies furthermore lead to substitutivity of services, gatekeeping characteristics of social and health care administrators, and capacity constraints, which all contribute to the complexity of the care system. Complex discrete-state system approach might be a more suitable for understanding long-term care than, for example, behavioural modelling or classical consumerist economics approaches. More specifically, I have demonstrated how this general conceptual model can be employed for registry-based performance analysis in the context of each sub-study. Although these sub-studies could be deemed only as components for the inductive analysis, they all were also relevant and justified studies in themselves.

Secondly, I went through some of the imminent prerequisites that have to be met for practical implementation of meso-level model-based performance measurement systems and drafted out clear roadmap for building a meso-level analytical system using nationally collected registry data. The prerequisites for creating a system-analytical model do not only consider the collecting and processing of data but stress the importance of activating both policy makers and healthcare professionals in order to create meaningful analytical strategies. This is in line with extant literature of evidence-based policymaking, which stresses the gap between science and practice, and that currently scientific findings are hardly localisable or relevant for the purposes of

managerial decision-making (Black and Donald, 2001; Head, 2010; Orr, 2018). I offer this model as an understandable and practical tool for bridging the gap between science and practice. The findings of this thesis can, in future, be used when designing analytical strategies for meso-level systems, such as the new well-being regions forming in Finland.

Thirdly, I explicated the analytical value that can be found from meso-level performance analysis, especially in the context of the Finnish care system for older people. Focusing only on a singular part of the care delivery system might carry problems. Limiting the level of analysis on one care provider might lead to sub-optimisation, or negligence of other parts of the health sector. Social and health care services are also largely substitutive and studying only a specific part of the system might neglect the spillover cost effects to other part of system. Analysing the whole meso-level is especially useful when (1) one wants to calculate the total system costs; (2) one wants to allocate the costs of all service use in system to each individual; or (3) one wants to analyse the effects of specific interventions or policy actions on the service use distribution. Considering the intervention and policy evaluation, creation of the system model helps explicating the individuals who are supposedly affected by an intervention, and help understanding the relevant services the use of which has to be considered in the effectiveness analysis.

Fourthly, I conceptualised several “chunks of operational logic”, or meso-level operational system phenomena, that must be considered in the managerial analysis of the system. One of the key phenomena to be considered when analysing meso-level systems is the transition between long-term states, and the prevention of unnecessary transitions. This is especially relevant in the care system for older people due to the sizable long-term cost effect of transition to 24/7 care. However, at the same time, managers also have to consider the use of short-term services, which might act as a substitute if the long-term state fails to fill the care need of an individual. State-transition and combined service use analysis should be employed in future managerial decision-making processes as an important measure of meso-level policy effectiveness. State-transition analysis should also consider the reductions in non-preferred inputs to and outputs from the system, which might entail even more drastic changes in the quality of life than state-transitions within the system.

Logic of state transitions is not new in itself. Singular transition phenomena between care providers have been studied before, such as transitions to and from institutional care (Martikainen *et al.*, 2009), transitions from hospitals to permanent residence (Hiltunen *et al.*, 2020), and reductions in rehospitalisations after hip fracture (Viberg *et al.*, 2022). However, to my

knowledge, conceptual model presented in the thesis brings a novel level of abstraction in understanding these system phenomena.

Finally, I argued that similar measurement and analysis systems can also be set up in other contexts of care. Both meso-level systems for child welfare and mental care services seem to include similar division to long-term states and short-term service use. Furthermore, presented managerial logics of balance between long and short term services, slowing-down efficiency, and the logic of input and output, seem relevant also in these two systems of care. Implementation of similar conceptual models and performance measurement systems should also be considered for these contexts of care. Again, to my knowledge, system-level phenomena have been much less studied in these contexts of care than in care context of older people. As the demand for these services is also growing in Finland, cost-effective policy actions and thorough performance measurement is required in these contexts in future.

7.1.1 Contribution to the management of care services

Lillrank (2018) defined care services as a type of services that deal with incurable conditions. As was discussed in the literature review, care services are difficult to manage, as they are personnel-intensive, need a high level of interaction with the patient, and the causal relation between high quality of care and health outcomes may be unpredictable. These problems, however, mostly exist when care processes are analysed from the micro perspective. The meso-level approach employed in this thesis brought forward system phenomena that might affect the cost-effectiveness of care services, without considering the efficiency of the care process in itself. Instead, the meso-level system mechanisms, such as spillover use of services resulting from improper balance of long-term care, are phenomena that can be analysed and managed to some extent. Lillrank (2018) states that in managing care services, one should find an optimal rhythm for care service provision. I agree with this view, as from the micro-level perspective the management of care services does not offer too much potential for radical improvement. However, meso-level perspective offers additional promise in finding balance and cost-savings via reducing system-level effects.

Through the lens of DSO logic, long-term services for an individual older patient do not fit into only one DSO category. The DSO Care category is usually complemented by the vector of short-term services such as emergency care and secondary care services, which are intertwined with the ongoing care mode of delivery. These could be categorised as DSO categories Emergency and Elective process. For these intertwined processes, there is a risk of

complexity to arise, when all the parallel care processes affect each other. If one studies an individual older patient's service use as a whole, they start to resemble DSO category Project, which implies that there does not exist a pre-designed process to solve health problems, and that several caregivers need to coordinate their activities. On the other hand, patient's demand for health services might also resemble a punctuated equilibrium with alternating modes of Care and Cure. All in all, the role of handovers between modes of deliveries grows relevant when all services are considered. For smooth handovers between modes of care, a structured format of information to be delivered between care providers could be designed.

7.2 Practical implications

As mentioned in the introduction, this thesis is especially relevant in the light of the oncoming Finnish regional reform, which will merge the existing municipal primary healthcare organisations with regional organisations offering specialised care services. Considering the meso-level of management is especially relevant for those contexts of care, in which causal relations between care provision and effectiveness are difficult to verify, structure and gatekeeping actions affect care service use, and services are substitutive to a great extent. Several relevant insights regarding the findings and the reform are presented.

The synthesis of findings did not produce explicit design principles or straightforward solutions for the meso-level management of care for older people. Instead, a collection of managerial logics was presented. The meso-level care system has almost imminent discord that results from the tension between long and short term care services: reducing the service level of one kind will likely increase the demand of other services, and unmet demand might hasten the deterioration of patient's health status. Instead of solutions, the managerial logics help explicating this problem. Regional managers should aim at analysing this discord and evaluate the performance of their own solutions.

With the constant demographic shift in virtually all societies throughout the world, the estimates for the demand and balance between different services should be updated with time. Our study concerning the end-of-life costs of elderly people noted the shift in the service use from health care to social care services, quite well following the demographical pattern that can be seen in the last 50 years. The shift in demand should result in a shift in financing and provision of care services. This shift has to be considered in the future, either proactively or reactively.

In order to create meaningful and cost-effective policy actions, the future well-being regions have to create a quite clear data-based view of their population. Regions need to understand which kind of sub-systems of service offering the population would need, and how to create different cost-effectiveness analyses from within these sub-systems. In practice, the regions should build routinely collected data bases, from which cost-effectiveness analyses are systematically created. If all new development projects would have to start from scratch and go through the data specification and collection processes before the analysis phase, the resources will ineffectively focus on data management instead of creation of meaningful insights. Establishment of well-being areas will enable the combined management of primary and secondary

care services and make the distribution of costs between primary and secondary care more transparent. This is needed, as the primary and secondary care services are largely intertwined and complex, and substitutively interacting to some extent.

System view is required for several managerial problems faced by well-being regions. We have to understand, what is the holistic resource use distribution between long and short term states, and how it is predicted to change in the future. We have to understand how the costs accumulate for each individual, and for which individuals it is meaningful to offer and which services. System-level view is needed to assess policies' effects on transitions to more expensive modes of care. The cost-effectiveness of the current long-term-state related allocation (or gatekeeping) strategy cannot be analysed in any other analytical level than meso-level analysis.

The current system accentuates the health problems that develop within a restricted scale. Some health problems and effects might have a low incidence rate and take decades to develop, and for these clinical contexts, accurate information of development require a much longer study period that would be typical for one-off research project. Long time series to study the effects of care reform should be started to gather already, to study the long-term health effects of reform.

The presented model might also be beneficial in terms of policy design and adoption. In particular, the meso-level social and health care system is characterised by two distinct groups of actors, social-care-related and health-care-related, that have not traditionally interacted with each other. I personally believe that a generic system-level model can help in bringing these two groups together and enable their interaction with creating a shared ontology and understanding. A conceptual model of meso-level care system might also help integrating the care services between these two groups of actors.

7.3 Strengths and limitations

Some strengths of the registry-data-based systems approach in analysing diverse phenomena within one system can be addressed. The main strength of the study is its comprehensiveness. From each municipality we acquired comprehensive population data. This enabled us to analyse the true system-level cost distribution between services, and as the data covered all the relevant services, also to analyse the total costs per individual. The study was also relatively repeatable and scalable. Quasi-experimental retrospective registry studies are, in general, highly repeatable. The conditions under which the individuals were selected for this study (list of municipalities and age groups) are explicit. The registries are kept by national officials, and the study data sets are available for anyone wishing to perform a similar study, given they have the financial and time resources for data gathering and acquisition. The study was also scalable in the sense that all of the sub-studies in this thesis are based on the same data set. After the data gathering phase, a generic data set may be used to study different sub-phenomena with ease. Another aspect of generalisability is that although each of the sub-studies in this thesis answers to a highly specific question, they are all tied to a larger context of the system model. I see that the system model makes it easier for a policymaker to put the results of each study into a larger context and improves the applicability of single studies.

Registry studies are always limited by the general nature of their data. Some of the most apparent limitations include that although the data of individual visits is quite detailed, in the sense of it including all the diagnoses and procedures performed to a patient in a certain visit, it is still on somewhat general level. No hour-level timestamps of individual procedures are included, and there are no open text fields to give additional details of caregiving decisions. Additionally, some relevant measures such as height and weight of the individual are not recorded in the current care registries. This limits the application of registry data on problems that would require specific clinical knowledge. Also underreporting of specific diseases has been found to affect care registries: A study in Denmark (Frost *et al.*, 2012) found underreporting of chronic diseases in elderly men; and a study with Finnish hospital registry, although not directly related to our studies, found underreporting of hypertension and obesity in ICD-10 codes (Laatikainen *et al.*, 2020).

It should also be noted that the methodology described in this thesis attends to the challenges that are prevalent in meso-level analysis of social and health care provision. Even though this analysis aims to prevent too myopic analysis of only specific parts of the regional social and health care system, micro-level

mechanisms and contextual factors that might also affect the system structures are inevitably overlooked on some level due to this methodological choice. I have also only focused on the service provision system, and ignored other activities performed by the municipal actors. For example, infrastructure decisions by the municipality might affect the health and well-being of citizens. We also have allocated the equipment and other medical technology costs to the costs of different care services.

Only standardised unit costs were used in this thesis, and unit-level productivity differences of services were not considered. The standardised costs used in the study were gross costs of the service providers and did not take into account the service payments of the individual patients, or the differences between the financial structures of the service providers.

We only had one year of income tax data. This is not a perfect proxy for the available assets of an elderly, as the elderly person typically has a certain set of accumulated wealth available. It is also not rare for the relatives to cover some of the costs of care for elderly people with low wealth. However, cost information was used as a control variable among other variables, and the income level of one year can be understood as a relatively good proxy of person's long-term income level.

Although this thesis answers its specific research problems, it is still a partial answer to the complex societal challenge of growing care costs and ageing society. Systems approach is always, inevitably, reductionist in some sense: patients are considered through their medical history, not through all of their needs and wants. The frameworks developed in this thesis should be considered as a practical tool for strategic planning, but not as an all-defining tool to solve all problems.

7.4 Avenues for future research

Results of the thesis implied some specific areas of further research. Moreover, several methodological choices were made in creating the study constellation for this thesis. Therefore, expansions to the potential analysis can easily be thought out via these.

Most importantly, also other regional social and health care systems could be analysed using the performance measurement framework and the evaluation methodology employed in the thesis. For example, applications in child welfare and mental care service systems might prove viable in analysing the cost-effectiveness of interventions aiming to prevent acute institutionalisation or the need of foster care services.

Estimation methods for the prevention of long-term state transitions can be further developed. In particular, as this study focused on the elderly people, the population which is defined by being over 75 years of age, there was no inspection of the prevention of patients getting sick in the first place. In the future, this efficiency should also be inspected – as it already has been, through different population screening policy inspections.

With the development of national standards for data gathering, these analyses could also be complemented with information on patient experience. In Finland, registry officials are setting up a national-level database on the life quality of elderly institutional care patients. The same information will also be gathered from home care patients, improving the possibilities to also gather comparable data from all the patients in different discrete long-term states.

Our study had only standardised costs, meaning we did not employ specific data on employee numbers, nor did it have information on specific personnel costs in each institution. If deemed relevant for benchmarking and funding allocation purposes, this information could be included in future studies to achieve more granular information.

The timescale of the registry studies is inevitably long. Therefore these studies cannot easily answer to questions which require a relatively quick answer, such as pilot studies in application of new digital health technologies (Halminen, Chen, *et al.*, 2021). The timeline of service use was not considered in this model. Some health problems only develop after a long timeframe, and some of them can be prevented in a long term. There have already been some studies employing registry data with longer time-frames, such as Mustonen *et al.* (2020) in their eight year follow-up study of tele-based coaching.

The cost of patients' time and inconvenience was not included in the cost estimates. In future, research focusing on the travel times of the individuals by employing geospatial data might show to be an interesting research avenue.

The model described in this study is individual-based. However, for some services, such as child welfare services, the unit of analysis could also be the family. However, as the information of family structure is not included in the routinely collected national registries, the unit of analysis cannot readily be expanded.

This study focused on cost-effectiveness analysis. Currently, our system-level model only includes a static definition for the cost and state function. In the future, dynamic models which predict the changes in long-term care states should be developed. For more detailed system modelling exercises (such as applications of control theory on care systems), registry data might not be applicable. However, this applicability would also be an interesting avenue for future research.

8 CONCLUDING REMARKS

In this thesis, I have conceptualised the meso-level model of public care delivery system and given a formal definition of the analysis that can be applied in the social and health care system. I have also described several possible strategies to achieve cost-efficiency and improve performance and formed a design process for formulating design propositions for sub-studies to be performed within the system.

Through the synthesis of results, I have answered the initial research questions given for this thesis. As a result, I have defined an analytical performance measurement system, which, under certain conditions, can be applied in practice to analyse the performance of meso-level systems of care.

The presented general model, which can flexibly be modified for more detailed analyses of the system, shows two-fold promise: firstly, the model enables more consistent and coherent analysis of quite different phenomena within the same system. Secondly, this kind of general model might work to provide a shared precise vocabulary of the phenomena to the abundant actors working with the same system, and also to bridge the gap between research and practice. For example, the upcoming regional social and health care organisers might benefit of such a shared view of their system.

The studies showed that routinely collected Finnish national-level registry data may be used in evaluating the performance of regional social and health care systems. Creating a general model which is adjusted for each sub-study enables an explorative approach to understanding different aspects of the system after an initial definition of its key aspects.

Winslow's (1920) basic tenet of public health as "the science and art of preventing disease, prolonging life and promoting health through the organised efforts and informed choices of society, organisations, public and private, communities and individuals" still rings true. So does the Mushkin's (1958) definition of health economics as a "field of inquiry whose subject matter is the optimum use of resources for the care of the sick and the promotion of health", the task of which is to "appraise the efficiency of the

organisation of health services, and to suggest ways of improving this organisation.” As the needs for care services grow in the forthcoming years, so does our need for thoughtful organisation and high quality of information to make well-argued policy decisions. I hope the frameworks in this thesis will offer some tools of thought in this major endeavour.

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Appendix A - Sample municipalities

The base collection of municipalities in the research was gathered from those municipalities and cities that have partaken either in the ongoing cost comparison activities for middle-sized municipalities, or cost comparison activities for large-scale cities offered by the Finnish Association of Regional Authorities. In addition, the sample includes municipalities that have merged into these municipalities between 2011 and 2014. This sample focuses on large and middle-sized municipalities, and has been expanded with a comparable data group from 24 smaller municipalities.

Municipality	Municipality number	
Espoo	049	
Helsinki	091	
Hyvinkää	106	
Imatra	153	
Joensuu	167	
Jyväskylä	179	
Järvenpää	186	
Kaarina	202	
Kemi	240	
Kerava	245	
Kirkkonummi	257	
Kotka	285	
Kouvola	286	
Kuopio**	297	
Lahti	398	
Lohja**	444	
Loviisa**	434	
Mikkeli**	491	
Oulu**	564	
Pori**	609	
Porvoo	638	
Rauma*	684	
Rovaniemi	698	
Salo	734	
Sipoo	753	
Tampere	837	
Tornio	851	
Turku	853	
Tuusula	858	
Vantaa	092	
Varkaus*	915	
* Municipal cost info only from 2013		
** Municipality has undergone municipal merger, see below		
Co-management areas		
Mustijoki joint municipal basic social security authority		
Mäntsälä	505	
Pornainen	611	
Kainuu region's joint municipal authority		
Hyrnsalmi	105	

Kajaani	205	
Kuhmo	290	
Paltamo	578	
Puolanka	620	
Ristijärvi	697	
Sotkamo	765	
Suomussalmi	777	
Vaala	785	
Municipal mergers after 2010 in sample municipalities		
	Municipality number	New municipality
2010: Pori ja Noormarkku	609	Pori
Noormarkku	537	Pori
2010: Loviisa, Pernaja, Liljendal, Ruotsinpyhtää	434	Loviisa
Pernaja	585	Loviisa
Liljendal	424	Loviisa
Ruotsinpyhtää	701	Loviisa
2011: Kuopio ja Karttula	297	Kuopio
Karttula	227	Kuopio
2013: Oulu-Haukipudas-Kiiminki-Oulunsalo-Yli-li	564	Oulu
Haukipudas	084	Oulu
Kiiminki	255	Oulu
Oulunsalo	567	Oulu
Yli-li	972	Oulu
2013: Mikkeli-Ristiina	491	Mikkeli
Ristiina	696	Mikkeli
2013: Lohja-Nummi-Pusula-Karjalohja	444	Lohja
Karjalohja	223	Lohja
Nummi-Pusula	540	Lohja
2013: Kuopio-Nilsjä	297	Kuopio
Nilsjä	534	Kuopio

Comparative group of small municipalities

Municipality	Municipality number
Taivassalo	833
Tarvasjoki	838
Marttila	480
Hämeenkoski	283
Luumäki	441
Pyhtää	624
Myrskylä	504
Pukkila	616
Lapinjärvi	407
Askola	018
Inkoo	149
Siuntio	755
Kyyjärvi	312
Karjajoki	218
Kannonkoski	216
Siikainen	747
Urjala	887
Hankasalmi	077
Enonkoski	046
Pyhäntä	630
Tervo	844
Rautavaara	687
Pielavesi	595
Juankoski	174

The regional social and health care reform currently taking place in Finland will further accentuate the role of the regional meso-level of management, which is positioned between micro (hospital) and macro (national) levels. This thesis applies a systems approach on social and health care management to shed light on the managerially relevant mechanisms on the meso-level. As an empirical context, the thesis studies the Finnish meso-level care system for older people. A nationally collected data set includes social and health care use of over 300,000 individuals aged over 74 years, in 65 Finnish municipalities. The sub-studies analyse diverse meso-level system mechanisms that take place in the meso-level care system, and the synthesis part of the thesis gathers these findings to create meso-level logics of management. Additionally, the transferability of these management logics from the context of older people to mental health services and child welfare services is considered.



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