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Constructing a framework to manage high utilizers in social and health care

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Abstract

Objectives of the Study

The study analyzes to what extent social and health care expenditures are generated by a small percentage of people, generically referred to as "high utilizers". The research is focused on understanding the types of social and health services that experience high cost utilization and suggest how this high utilization could be managed and curbed. Understanding the main drivers and nature of high utilization would help the municipalities to deliver better overall quality of services, enhance the wellbeing of individuals and to reduce the high burden of illness of high utilizers, while also reducing the overall cost of social and health care.

Academic background and methodology

The paper is a retrospective registry study and is based on anonymous register data. The longitudinal data covers service usage from the years 2011 and 2012. The data pertained to 28 255 individuals for year 2011, and 28 929 for year 2012. Data analysis is performed by descriptive statistics methods. Service usage is analyzed in a joint municipality of Peruspalvelukuntayhtymä KALLIO, located in central Finland.

Findings and conclusions

This study defines "high utilizers" (HU) as the top 5% individuals incurring the highest cost per capita in social and health care associated expenditures. This top 5% group of HU accounted for 64% percent of KALLIO's social and healthcare costs in year 2011, and 65% percent in year 2012, confirming the findings of previous research made. Persistence over a 2-year period among HU is remarkably high. Approximately 53.7% of high utilizers remain high utilizers the following year, confirming that a large share of social and health care resources are associated with a limited number of individuals who are facing recurring needs. Observed HU were generally older, as approximately 50% of HU being aged 65 years or above, compared to other users where only 13.7% were aged 65 years or above in year 2011.

Since a relatively small percentage of people account for the largest share of social and health care related costs, there is an opportunity window for new innovative services that could curb the high use. Targeting care and timing efforts systematically would require supportive information systems and accurate patient selection processes, as the high utilization is varied among different services. Further research is needed to understand what could be prevented and how to build feasible management models and proactive efforts.

Keywords High utilization, high cost, social and health care, expenditure, cost distribution, persistence

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1. INTRODUCTION

1.1. Background of the study

Municipalities in Finland are responsible for organizing social and health care services for their residents. In 2012, the municipalities of Finland spent EUR 24.1 billion on social and health care expenditures, accounting for 55.3% of the total expenditures of all municipalities (Tilastokeskus 2012). However, previous studies have shown that distribution of social and health care expenditures per individual is highly skewed. A small minority of people tend to account for a major share of total expenditures. Berk and Monheit (2001) have analyzed the healthcare expenditures in the United States, where five percent of the population accounted for 55% of total payments in healthcare expenditures in 1996. One percent accounted for 27% of total expenditures and the top 10 percent consumed 69% of total expenses. This skewed distribution of expenses is also present in Finland. A recent study made in Oulu, Finland found that 10% of the population in that region consumed 81% of the total social and health care costs in 2011 (Leskelä et al. 2013). Similar findings of highly skewed consumption of expenditures have been observed all over the world, e.g. in Ontario, Canada, the costliest five percentage of hospital and home care service users accounted for 61% of the total annual hospital and home care costs in 2009 – 2010 (Rais et al. 2013).

This manner of social and health care concentration is expected, as a person that has a high burden of illness or complex social needs will have a high utilization and incur higher expenses than the rest of the population. A higher need of services was observed in the Oulu study as the costliest 10% of customers used at least four different services per year, while the rest utilized an average of 1.1 services (Leskelä et al. 2013). Social and health needs are driven by different factors, and by understanding more profoundly what drives high utilization, it could be possible to plan services that would prevent an unnecessary high utilization of services. Many times high utilization occurs over several years, and some of it could be prevented with proactive and preventive services. What kinds of services are offered and financed for the population is a matter of social and health policy. In Finland, the municipalities are in charge of organizing the social and health care services for

their residents, and thus they have an interest in researching the field and developing innovative new service solutions. Municipalities want to utilize their scarce resources in an efficient manner that would generate a higher overall quality of service, provide better social and health outcomes, and most importantly enhance the quality of life for their people. Taking the social and health needs of residents into account and providing appropriate services offers a platform for service innovation, as private or third-sector service providers can provide these options for municipalities. This study tries to explore possible areas for this kind of service improvement and innovation in the case of high utilizers.

1.2. Research objectives and research questions

Earlier research (Leskelä et al. 2013) has shown the skewed consumption of health care services in Finland. The social and health care sector faces pressure to enhance operations as costs increase. One reason for this is the aging population and the rise of chronic conditions. In Finland, the publicly funded social and health care sector is facing pressure to renew and innovate better services that can respond to the health and social needs of population more extensively. An aim of this research is to understand the high utilization of social and health services more profoundly as high cost accounts for a major share of the social and health care spending. The utilization of social care is a less studied research field and this study tries to build understanding in social care usage. This study is interesting for Finnish municipalities as it explores the use of their services which account for a large share of their annual total expenditures.

This study attempts to explore the basic demographic characteristics and service usage of high utilizers in social and health care at a municipality level. The research aims to explore the characteristics of users and to understand the basic service categories that account for high utilization. This study tries to understand the expenditure distribution and how it reflects previous research efforts. One objective is to understand what should be taken into account when planning and offering services for high utilizers.

The research questions are stated as follow:

1. By which criteria can high utilization be defined?

2. What are the characteristics of service use and possible groups of high utilizers?

3. What should be taken into account when planning services for high utilizers?

This study tries to answer these questions in the following manners: For question number one, a literature review is used to understand in what ways and by what criteria high utilization can be defined in the context of social and health care. Previous research is explored to see what kind of criteria has been used in earlier studies for high utilization: is it defined by cost, frequent utilization, or combination of these two? Quantitative data and a literature review is used to answer the second question. Literature helps to build understanding on the basis of previous research and quantitative data is utilized to explore high utilizers in a municipality. The following aspects of high utilizations at the municipality level are explored in the empirical part: the annual distribution of expenditures, the persistence of high utilization over a short-term 2-year period, and the basic characteristics of high utilization in a municipality setting. Question number three is approached in the literature review, and to summarize the findings, this thesis constructs a framework that would aid the planning and development of services and reflect research findings for question number three.

1.3. Research environment

This research is conducted in the Institute of Healthcare Engineering, Management and Architecture (HEMA) at the Department of Industrial Engineering and Management (DIEM), Aalto University School of Science. The HEMA institute is a research group which focuses on research about services and operations in the context of health. The research is part of the JYVÄ project (Public Private Co-Operation - Effective Models in Social- and Healthcare Service Value Networks), which tries to build understanding about service innovations in social and health care. JYVÄ tries to understand how these innovations affect productivity, effectiveness and business models. The project wants to explore how innovations spread and what barriers prevent their adoption. A central point of the research is the role of public and private providers in the service delivery process.

JYVÄ project is a multi-disciplinary research effort by three research centers:

- Aalto University's HEMA research group and the department of design, specializing in Service Design
- Oulu University School of Economics' research group for micro-entrepreneurship
- Oulu University of Applied Science's School of Health and Social Care

JYVÄ project has four private and three public service provider partners:

- Doctagon, specializes in medical services for the elderly
- Megaklinikka, specializes in dental care
- Omasairaala, specializes in orthopedics and hand surgery
- Laastari, specializes in treating common acute diseases
- Joint municipalities of Kallio, offering public social and health care services
- City of Tampere, offering public social and health care services
- City of Espoo, offering public social and health care services

JYVÄ project runs from year 2014 to year 2015 and receives funding from Tekes, the Finnish Funding Agency for Innovation.

JYVÄ wants to promote the enhanced co-operation of public and private partnerships, and provide more cost-effective services that are customer-orientated and which target individuals who use large amount of services. The aim is to improve how people use healthcare services and to develop enhanced models of operation. This research is one part of the JYVÄ project and carried out by the HEMA institute.

1.4. Scope and limitations

This study focuses on high utilizers in a social and health care setting. Earlier research has focused mostly on studying users and the utilization of services in health care; limited studies have focused on social care or the combination of these both. A limited amount of research might be available for studies which account for social care usage.

This research analyzes quantitative data from a joint municipality Kallio located in Finland, and might not be generalizable to other municipalities or countries if the demographic characteristics of the populations are not similar. This data is able to capture the characteristic of users and state of service use in the time period studied. As the social and health needs of population change over time, this study might not reflect the real future needs of the population.

In this study the term social care is a synonym for social welfare services. The term high utilization/utilizer refers to a small proportion of people that incur a disproportionally large share of annual expenditures, the term is used as a synonym for high cost, high user and high cost user. High utilization/utilizer term is preferred, except in the literature review where terms are used according to the cited research.

This thesis explores the basic characteristic of high utilizers and is not able to capture what might lead to high use. Diseases related to high use are not a focus of this research.

The aim of this study is not to provide cost-benefit or cost -effectiveness analysis; this is left for future research.

1.5.   Structure of the thesis

This research is divided into six chapters. The first chapter introduces a brief background and motivation for this research. In addition, it gives us guidelines in the form of research questions to guide this study forward. The second chapter reviews the literature and builds understanding of the problem, and reviews what previous literature has to offer. The third chapter introduces the research methods and materials used to analyze the social and health care services in specific municipalities. The fourth chapter reveals the results of the data analysis. The fifth chapter constructs a framework of what is needed to manage high utilizers, using the literature analyzed earlier and using the empirical research parts. The sixth chapter evaluates findings on the theoretical and empirical content, evaluates this study's contribution to the literature, and suggests future research areas of interest.

2. LITERATURE REVIEW

2.1. Structure and methods of literature review

This conceptual literature review tries to build understanding on scientific knowledge related to high utilization of social and health care services. The aim is to understand the nature of high utilization and what kind of efforts have been made earlier to curb the preventable high utilization of social and health services. This understanding helps to conduct the empirical part of this research (chapter 3).

Structure of the literature review is displayed in figure 1, the key themes try to answer the research questions. The literature review starts from examining how high utilization has been defined in earlier scientific research. The aspects and nature of high utilization are explored in order to understand what to take into account when analyzing high utilization and planning services. In conjunction, study explores what kinds of efforts have been made to manage high utilization. The findings of the literature review are used in chapter five, where an effort is made to construct a framework for the management of high utilization.

Key themes	
What is high utilization?	High utilization is defined as disproportional use of social and health resources
What kind of high utilization occurs and how it behaves?	Utilization rate of services varies due different individual needs and by lifetime variation. Sometimes utilization of services is unavoidable, but sometimes preventable by proactive measures
What should be taken into account?	High utilization has tendency to move towards the average mean, fulfilling the needs of individuals at the right time could curb some of the high use
What is needed to curb preventable high utilization?	Right infrastructure and measures to make it possible to identify risk individuals early and to provide proactive measures

Framework for management of high utilizers

Figure 1. Structure of the literature review

How the literature review was conducted

In order to form a broad understanding of high utilization, a conceptual style was used in conducting the literature review. The literature review was started from a few key articles: (Leskelä et al. 2013; Reid et al. 2003; Calver et al. 2006; Garfinkel, Riley & Iannacchione 1988). A divergence search of the Web of Science and ProQuest databases was used in conjunction. The keywords used in the divergent search were: *healthcare cost, health care cost, high medical expenditure, high-risk patient, healthcare expenditure, readmission, high utilizers, social care high cost* and *social welfare.*

2.2. High utilizers in social and health care

This section reviews the previous literature on high utilization in order to build an understanding of how and by what criteria high utilization could be defined. The nature of high costs is explored

by different viewpoints such as the annual concentration of expenditures, the persistence of high utilization, the variation of individual lifetime costs and the end of life costs. Different viewpoints shed light on how to analyze and what to take into account when high utilization is the focus of research.

2.2.1. Criteria for high utilization

In literature, there have been multiple ways to define high utilization in social and health care. The most obvious distinction is what is used as a measure for the definition. When the focus is on cost, high utilization is defined as a minority group of people who account for a disproportionally large share of total expenditures. Cost-related research usually uses three ways to define high cost, by utilizing expenditures incurred by an individual:

1. Absolute amount
2. Relative percent value
3. Normative middle group

There is no standard definition of which level use or cost could be defined as high. Another measure would be to use the number of visits or contacts, or a combination of expenditures incurred and number of visits. The definitions are first looked individually and a brief comparison how they have been used in the previous literature is made.

By expenditure

For absolute amount, a certain monetary threshold value is defined, e.g. individuals with annual expenses over USD 10 000. For relative percent value, a certain most expensive percentage of total expenditures is defined, e.g. most expensive 1%, 5% or 10% of all individuals by annual expenditures. Researchers tend to use relative value or absolute amount without any reasoning behind why these variables were selected (Yip et al. 2007) – see table 1. A third way to define high cost is through the empirical distribution of expenditures, which was developed by Garfinkel, Riley & Iannacchione (1988). In this model, skewed consumption is assumed and high cost is analyzed via a normative middle group. This normative middle group accounts for a same proportionate share of cost and population, e.g. 15% of population accounting for 15% of total cost. High and

low cost are defined relatively above and below this normative middle group, which can be calculated. (Garfinkel, Riley & Iannacchione 1988.)

By frequency of use

Another way to find criteria for high utilization is via number of visits or contacts. Admission rate is usually analyzed and this is usually referred to as frequent use. Frequent use appears mostly in studies about emergency departments (ED) and ambulatory care. (Locker et al. 2007.) Frequent use is not necessarily equivalent to high cost. It is a valid research interest, as frequent use increases the workload of those services, especially when the re-admission is unnecessary. Recent research by Ondler, Hegde & Carlson (2014) found no statistical difference in the visits charges, when comparing frequent users to non-frequent users. Billings, Raven (2013), on the other hand, found a difference in total health care cost incurred, though they note that this relates to the high burden of illness that frequent ED users have. They assert that cost is driven up mostly by hospitalizations, and high rate of usage in primary and specialized care. *Frequent use can be seen as part of high utilization*, as some of the frequent users might incur disproportionally large annual cost.

Use in previous research

There is no uniform way to define high utilization, see table 1 for summary on what has been used in previous studies. High utilization is usually defined as individuals that incur disproportionally large annual costs. Calver, Bramweld et al. (2006) analyzed the inpatient hospital users in the Western Australia population where high cost was defined as the costliest five percent who had have at least one hospitalization per annum. Defining two criteria is not common. Others have used varied measures ranging from the costliest 1% to 25% of the population. It is worthwhile to note that sometimes the population studied affects how much of the total expenditure the costliest percentage incurs, e.g. is the focus all population or institutional patients. Table 1 is not a comprehensive analysis; it summarizes the previous research that is used in this literature review.

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Table 1: Criteria for costliest percentage and incurred percentage of total cost.

Criteria: High Cost Definition(s)	Incurred % of total cost, %	Reason to select	Study focus	Authors
Top 10% age under 65 / Top 15% age over 65	73.3 / 78.7	Normative, accounts for a large share of cost	Noninstitutionalized population	(Garfinkel, Riley & Iannacchione 1988)
Top 5% cost	29.3	Previous research	Fee-reimbursed physician services	(Reid et al. 2003)
3% most cost incurring patients	20.0	Visual means, cut-off point 6% and 20% seen as cut-off point	Hospital data	(Heslop et al. 2005)
Top 1% cost consuming	18.0	n/a	Uninsured patients	(Radcliff, Côté & Duncan 2005)
Top 5% cost-consuming users and at least one hospitalization per annum	38.0	Previous research	Hospital separations, in Western Australia	(Calver et al. 2006)
Top 19%	71.0%	Normative model	Institutional and community care	(Yip et al. 2007)
Top 25%	69.0%	n/a	Medicare beneficiaries	(Reschovsky et al. 2011)
Top 5% cost-consuming users	61.0	n/a	Hospital and home care services	(Rais et al. 2013)

2.2.2. Historical concentration of health care spending

While trying to define criteria for high utilization, the historical concentration of health spending was briefly discussed. Historical concentration refers to analysis of how the historical concentration of annual spending changes over a longer time period. Berk and Monheit (2001) analyzed the noninstitutionalized U.S. populations annual spending where they observed a steady concentration over multiple decades. In their study, they observed that the costliest five percent accounted for approximately half of the total cost, all the way from 1928 to 1996. There was a slight change, but the annual expenditures for the costliest five percent was roughly 50% of the total annual expenditure. Riley (2007) examined Medicare spending covering a thirty-year period in the US, and he noted a small decline in the distribution of spending concentration. As the top 5% accounted for 54.2% of total expenses in 1975, the concentration gradually decreased to 43.0% of total expenditure in 2004.

It is important to notice this change; if the concentration of spending weakens over time, then focusing efforts on high utilization are less beneficial (Riley 2007). Zuvekas and Cohen (2007) observed a small decline in the concentration of medical spending from 1996 to 2003, after they examined U.S. Medical Expenditure Panel Survey (MEPS) data. The observed driver for this decline was the increased usage of prescription drugs among all population, which weakened the concentration because for the costliest percentages of the population, prescription drug expenditures were not a major driver for cost. For the costliest 1% and 5% of spenders, inpatient and ambulatory treatment accounted for the most of their expenses and prescription drugs accounted for only a small proportion of their total expenditures. Prescription drugs accounted for 11% of total expenditures for the costliest 1% and 5% of population in 2003, whereas for the rest prescription drugs accounted for 20% of their total expenditures.

Increased overall social and healthcare costs might be a factor of increased supply and demand, but might also reflect consumption that is driven by real needs. Especially in health services, there is endless need for better individual health – even if you are healthy, and especially if you possess real medical needs.

2.2.3. Short-term persistence of high cost

Spending concentration has been stable over longer periods of time, but how persistent is the concentration in individual levels? For example, are the high utilizers the same individuals in consecutive years? Studies have observed some persistence of high cost individuals on a short term, year-to-year basis. Riley (2007) notes that top 5% of high cost beneficiaries in 2001 had a 23.7% of chance of being high cost in the subsequent year, a 15.5% chance in the second subsequent year, and a 12.1% chance in the third. Monheit (2003) analyzed the two-year persistence of top users in US population, using Medical Expenditure Panel Survey (MEPS) data. Using data from 1996 and 1997 he discovered that from the top 5% high-cost users, 30.6% remained in the same expenditure rank group of the top 5%. Not all top users persist in the costliest category and it was observed that the top users have tendency to move towards the average mean of expenditure. Average expenditures of the top 5% declined from USD 23 117 in 1996 to USD 9 798 in 1997. (Monheit 2003.)

This kind of transitory movement (to incur high costs for a certain time and then to move towards the average mean) can be seen as a basic characteristic of high cost use. Zhao, Ash et al. (2003) confirm this argument, observing that high cost patients were not the same individuals from year to year. They observed that the least expensive 80% accounted for 18% of all dollars spent in year 1998, and in the following year this least expensive group consumed 44% of all dollars spent. The expenditures used by the most expensive 0.5% of population in 1998 was 20% of the total cost and this same group only accounted for 7% of the total cost in 1999. (Zhao et al. 2003.) This fact of transitory movement is important to note, especially when planning efforts to curb the high utilization of services.

2.2.4. Variations in individuals lifetime healthcare expenditure

The previous chapters analyzed the concentration and persistence of high utilization. It is evident that there is certain amount of annual variation per person in the lifetime cost of social and health care expenditures. These variations of lifetime healthcare costs, ranked as high cost years, were researched by Forget, Roos et al. (2008). They modelled the lifetime healthcare cost of the population of the Manitoba province in Canada using a simulation technique. Their model utilized

past healthcare data and generated simulated expenditures from birth to death. The results were as follows: research suggested that on average females will incur 81.0% costs over 11 high cost years and males 80.5% of their high costs over 7.8 years. The standard deviations were 5.33 years for females and 4.9 years for males. The average female had 47.0 low cost years and males 52.6 years, life expectancies being 78.0 years for women and 72.4 years for men. High cost was defined as the highest spending 10% of the population, low cost as the lowest spending 70%, and moderate as the next 20% before the high cost group. See figure 2 for probabilities of incurring different cost categories for males. (Forget et al. 2008.)
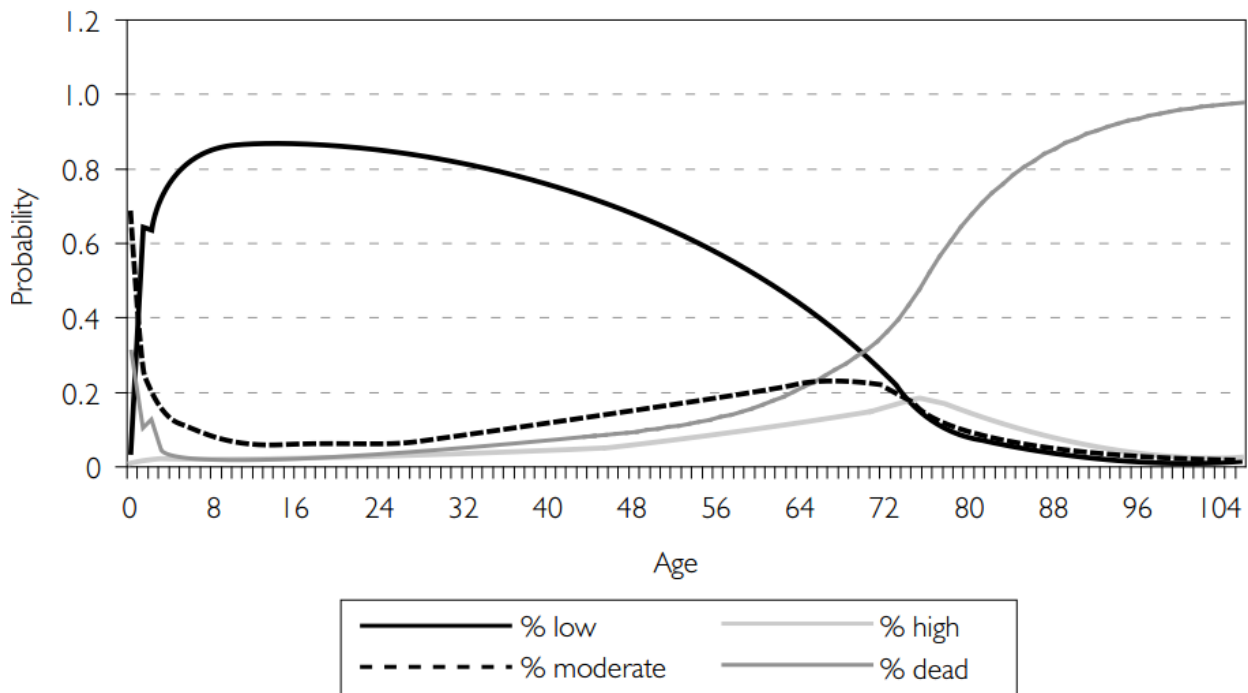
Figure 2. Probability of incurring following healthcare costs over lifetime: low, moderate, high costs and dead by age (males, 2002–2003). Source (Forget et al. 2008).

Forget, Roose et al. (2008) observed that females incurred 40% higher lifetime per capita expenditures than men. A similar finding was made by Alemayehu and Warner (2004). They observed one-third larger lifetime expenditures for females, though the higher cost for females is

partially explained by their longer life expectancy. Neither study was able to determine how much is explained by pregnancy and childbirth for the higher female lifetime cost. Carreras, Ibern et al. (2013) simulated how morbidity patterns change over a lifetime, utilizing data from 2004–2007 for the population of the county of Baix Empordà in Catalonia. They simulated lifetime cost. Females were more likely to suffer from a chronic illness, and had 28.4 years of life suffering from something chronic versus 21.9 years for men. This explains partially the variation between males and females, as females tend to live longer and have a higher burden of chronic illness.

The variation of lifetime cost is an important factor and it should be taken into account while planning policies for care. The transition of individual health situations are important drivers for cost. Carreras, Ibern et al. (2013) *suggest that focus should be on efforts that would promote healthier lifestyles* and *prevent health deterioration* for healthy individuals and people with complex healthcare needs and chronic conditions. According to Forget, Roos et al. (2008) most people will incur relatively low cost during their lifetime.

2.2.5.   End of life cost

Early childhood and end of life are events that increase the chances of incurring substantial costs. In particular, the end of life cost is usually relatively high in comparison to the other stages of life. *This is important to note when analyzing service use.* Menec, Lix et al. (2004) analyzed the patterns of health care use and the cost at the end of life. They found out that the 1.1% of population who died had accounted for 21% of annual health care costs, all during the last six months of their lives. Hospitalization was being observed to be one of the main cost drivers, as nearly half of the deceased passed away in hospitals. Others have observed similar pattern for the end of life costs. Georghiou et al. (2012) found a steep rise in health care expenditures at the last months before death. Social care cost was observed to rise more modestly at the end of life. It was observed to have a steady rise all year long before death, instead of a steep rise at the end of life (see figure 3). (Georghiou et al. 2012.)
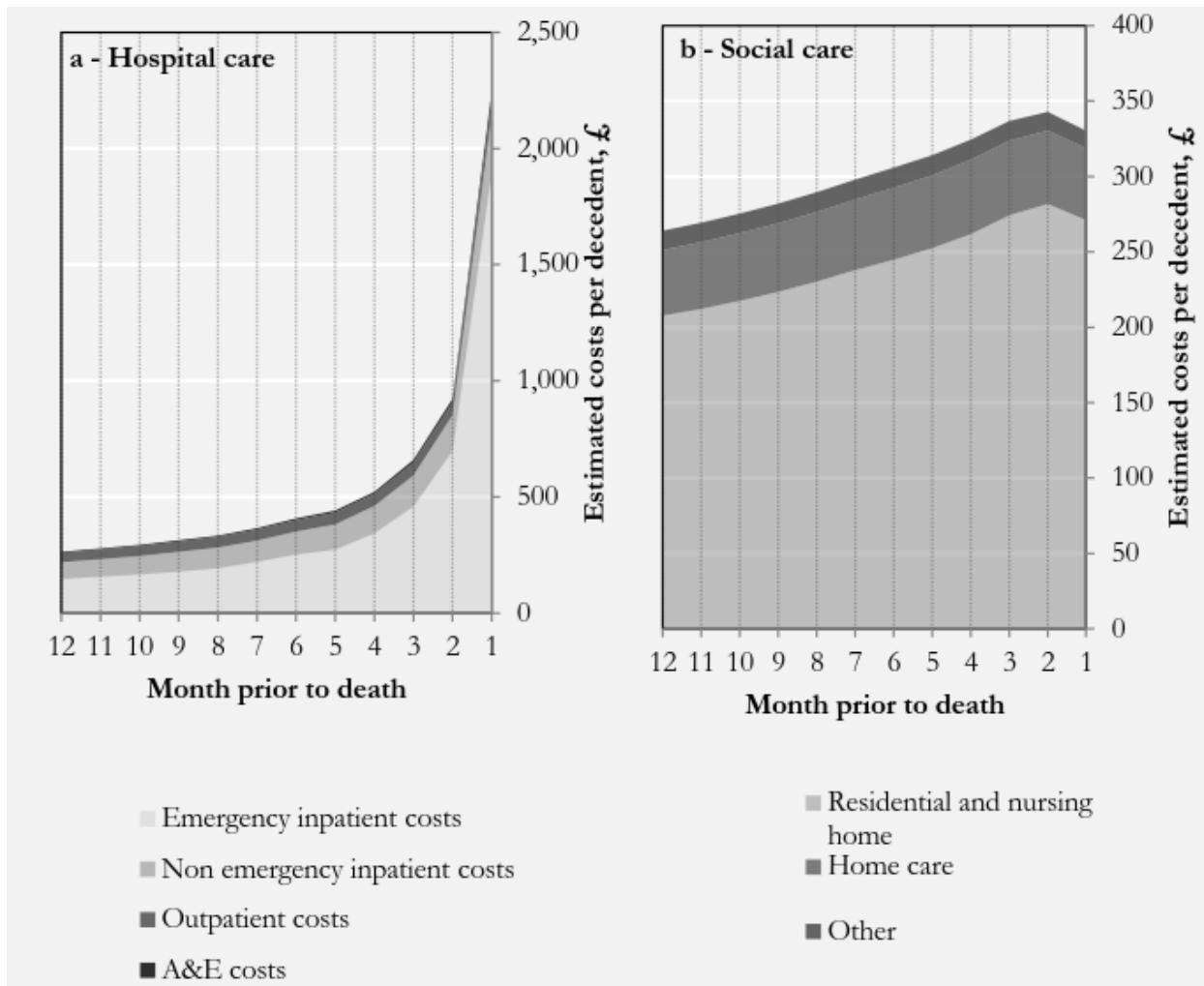
Figure 3. Estimated average costs of care services in each of last twelve months of life split by type of service, hospital care (a) and social care (b). N = 73 243. Source (Georghiou et al. 2012)

Enhanced care at end of life is usually due to severe illness and because of functional impairments. Hogan, Lunney et al. (2001) used a model to classify high cost users as deceased and survivors. They note that the deceased usually had four or more significant diseases in the last year of life, compared to survivors who had only one. They argue that if the burden of disease is the same, survivors vs. the deceased do not really differ in cost. (Hogan et al. 2001.) A high utilization of services is often needed at the end of life. This is one distinct occurrence of high utilization where need of service use is high, but this stage only explains a small part of high use (Reid et al. 2003).

Summary

There are no standard definition criteria for high utilization. The usual way is to define a certain percentage of individuals who account for a disproportionate share of expenditures. High utilization or cost is difficult to control, as personal situations change over a lifetime. Individual persistence of high cost is often temporary, as high cost tends to regress towards average mean cost over time. This can be observed in the variations of lifetime cost, where certain events like birth, childbirth and the end of life cost have likelihood to account for high utilization.

Other events that require a high need of specialized treatment also account for high cost in the short term, such as the treatment of acute illness. This can be seen in the persistence analysis of individual level high costs, as it seem to be a transitory movement. All these factors are important to think about when planning efforts to target high utilizers for enhanced care. An observed high cost individual one year might incur relatively low costs the following year, as the high costs have the tendency to regress towards the average mean.

2.3. Characteristics of high utilization

What drives and contributes towards high utilization in social and health care context is discussed next via the previous literature. Need usually drives the disproportionally high use of different kind of services, due to the complex conditions that high utilizers often possess. This often leads to a fragmented use of different providers, and may lead to an inadequate understanding of one's one conditions or the inability of service providers to provide adequate coordination for their customers. The factors affecting costs are reviewed in next subchapters.

2.3.1. Contributing factors associated in high utilization

The simultaneous occurrence of multiple diseases, called comorbidities, are seen as one of the key drivers for high utilization. Rais, Nazerian et al. (2013) studied high cost users and found that 83% of them had received care for multiple conditions. A study conducted by Reid et al. (2003) in British Columbia, Canada examined the usage of physicians' services; high users had five times the chance to have six or more comorbidities compared to other users. Psychosocial illness was

also common as one-third of high users had at least one diagnosis. Hospitalization was 12 times more likely in the high users group, as compared to other users. This high burden of illness is typical of high users and drives high service needs. Stable and unstable chronic conditions are a major characteristic among high utilizers. (Reid et al. 2003.) Similar discovery was made by Calver et al. (2006), when studying hospital users in Australian population, the prevalence of chronic conditions among high cost users was high. It was particularly evident that diseases which required frequent contact with hospital staff and diseases related to circulatory health accounted for high costs in hospital separations (Calver et al. 2006). It is worthwhile to note that these characteristics may differ by the populations studied. The focus of the study also affects the characteristics and the occurrence of conditions.

Sex

Previous research had made efforts to analyze how high utilizers differ from low utilizers in demographic characteristics. Sex is often found to be a distinctive feature. Females represent a larger share among high users – around 60% (Reid et al. 2003). Rais et al. (2013) discover a slightly smaller percentage of females in their high cost group, but females still dominated their results. An interesting observation was that high cost males are more expensive on average than females.

Age and health status

Poor health status is related to high cost and it has been observed that older people aged 65 and up account for half of high cost groups. Calver et al. (2006) found that 55.9% of high cost people are 65 or older, Rais et al. (2013) found that 60% of high cost people are 65 or older, and Reid et al. (2003) found that half of their high users are aged 60 or higher. Interestingly average cost among high users was not any different among distinct age categories (Reid et al. 2003). Rais (2013) even observed a small average cost decrease in relation to aging among high cost users.

It is evident that burden of illness is higher among high utilizers. Reid et al. (2003) observed that chronical medical conditions, occurring together with major psychiatric conditions, represented approximately one-third of the high user population. This was drastically different compared to other users, where the occurrence of similar conditions together was only 6.6% (Reid et al. 2003).

Mental and behavioral disorders were identified as a character for high utilization by Calver et al. (2006). It is often thought that somatization represents a major share of high utilization, but it actually represents a small percentage among high costs users. Somatization is estimated to be 5% to 10% of high users (Reid et al. 2003). Reid et al. (2003) suggest that high users are much sicker than others when high utilization occurs and that the major share of high costs are not explained by death or somatization.

Cost increasing factors

Some have tried to understand what contributes to increased medical costs. Brilleman, Purdy et al. (2013) analyzed which factors are associated for increased costs when patients have multiple chronic conditions. They found out that the most cost increasing was depression, in combination with a range of other conditions. Managing multiple disease conditions in an appropriate way was suggested as a way to tackle the burden of illness among patients with multiple disease conditions. (Brilleman et al. 2013.)

As mentioned earlier, individuals reported that the poor health status of a person was associated with high costs, which was also discovered by Garfinkel, Riley & Iannacchione (1988). They suggested that marriage tended to decrease high cost. This suggestion is in line with the more recent study, which suggests that *social isolation* acts as a contributing risk factor for high utilization (Billings et al. 2013).

Other things found out to be associated with increased healthcare costs over a lifetime is abuse in childhood. This is found to significantly increase the number of long-term physical and mental health conditions. Child abuse may also contribute to higher costs all the way to adulthood, but may later dissipate. (Reeve, Gool 2013.)

2.3.2. Fragmented health care use

Many factors contribute to the increase in social and healthcare costs at the individual level. The high burden of multiple illnesses spreads the service use of high utilizers into various services and for multiple service providers. As many different conditions characterize high utilization, it leads to a fragmented use of services.

Hempstead, Delia et al. (2014) analyzed fragmented hospital use among people with multiple chronic conditions. Fragmentation was defined as having multiple hospital episodes in different facilities and high utilization was defined as having at least two inpatient admissions in a two-year period. The primary data source used was New Jersey's Uniform Billing hospital discharge data from 2007–2010. Multiple chronic conditions were common in this high utilizer group, as nearly 80% were identified to have two or more chronic conditions. Hypertension was the most common comorbidity in this cohort, as 48.3% had it. Diabetes without chronic complications was listed for approximately 17.1% of cases, and chronic pulmonary disease appeared in 15.1% of cases. Fluid and electrolyte disorder appeared in 15.1% of cases. Multiple chronic conditions increased the chance to use multiple hospitals, but fragmentation was less likely in the elderly population. (Hempstead et al. 2014.)

Reid, Evans et al. (2003) observed that high utilizers were three times more likely to see different physicians as their health needs were more complex in the high cost group. They did not define if the use happened in different facilities, but merely observed the trend of using different physicians as they observed the service use of the costliest 5% of healthcare users. Fragmentation of service use is not necessary a problem, but should be noted while planning care coordination among high utilizer groups. It might also indicate something about the quality of care and it makes the follow-up care difficult to manage, as well as acting as an instrument of inefficient service delivery. Also, the cause of fragmentation may come from doctor referral or through patient choice. Most social and health care services operate in parallel, and are highly specialized. Opposite of parallel operation, which often leads to fragmented use, would be integration. Integration could be seen as a way to plan and manage care better when needs are complex.

2.3.3. Use of social welfare services

Social care or social welfare systems are distinct in different countries. They are defined as governmental provision and economic assistance for individuals in need. Studies that take into account the use of social services are limited. Existing studies have focused on the relationship between social and health care utilization. However, some studies capture some form of social services under health care, as the definition of social services is not universally defined.

Bardsley, Georghiou et al. (2010) studied how health and social care usage relate to each other. They found out that the number of long-term conditions usually relate to increased health care costs. As the number of long-term conditions increased, the incurred costs tended to rise as well. However, the social care cost does not follow this pattern. Social care cost remains quite stable when the number of conditions increase. Social care costs tend to increase near the end of life if you are over 60 years or older, while health care costs decreases at the same time. The highest social care use at the end of life was observed among patients with mental care diagnosis, and the lowest among cancer diagnosis and no diagnosis groups. (Bardsley, Georghiou & Dixon 2010.) Georghiou, Davies et al. (2012) analyzed the patterns of health and social care near the end of life among people in the United Kingdom. The study found that the usage of social care increased with age, especially when nearing the end of life. One-third of people used social care services in the last year of their lives. (Georghiou et al. 2012.)

Georghiou, Davies et al. (2012) analyzed the relationship between social and health care usage, looking if the usage of social care related to the usage of health care. They found an inverse relation, where social care usage decreased with the usage of health care services. Kehusmaa, Autti-Ramo et al. (2012) analyzed the patterns and individual characteristics of health and social care usage, among the frail elderly in Finland. They also found that informal social care (i.e. caring for close relatives) and support can reduce the need for health services among the elderly. A lower level of overall service usage was observed when informal care was used. The ability to live independently and have ability to function lowered the usage of health care services. (Kehusmaa et al. 2012.) The availability of informal social care seems to have an effect in the usage of health services.

Summary

In summary, high health care utilization relates to multiple chronic conditions and translates to poor health status. How services operate and are managed also affects the costs incurred, as the fragmented use of services may not allow providers to give adequate information for patients to self-manage their situations. In particular, if providers are unaware of what other kind of conditions and services patients are using, fragmentation can lead to the overlapping use of services or even conflicting advice being given. (Peikes et al. 2009.)

What kinds of management efforts have been made toward high utilization are discussed in more detail in section 2.5, but before that possible methods for identifying high utilization are analyzed.

2.4. Identifying high utilization

Targeting any kind of management program for high utilization needs a way to identify people in need first. Identifying and selecting the right people in any care program is a key element in order for the efforts to be effective. Finding high-risk people early enough for preventive interventions is seen as a way to prevent risk to occur, especially in cases where this risk would be preventable. Screening for diseases is not seen as an identifying measure in this research, as it is related to advancements made in the medical field. Selecting from people who would most likely benefit from management of his or her situation can be achieved in multiple ways. It is vital to target individuals likely to benefit, as some individuals can be seen as too ill to benefit from care efforts i.e. terminal illness and some individuals might not gain benefits as they might not need improved care. Selecting the people affects the outcomes of care efforts and identifying these people can be made with many risk-stratification methods. These methods can be divided in three categories (Lewis, Curry & Bardsley 2011):

- Threshold modelling
- Clinical assessment
- Predictive risk modelling (PRM)

Knowing the intended use and for what the model was built plays an important role when selecting a risk model. Methods are developed for different use and are distinct in the following ways (Panattoni et al. 2011):

- What risk event they are predicting, e.g. hospital re-admission, upcoming high utilization, likelihood of future medical episode or even likelihood of mortality
- Purpose of the why the risk is being measured, e.g. budget allocation, identifying risk of readmission. Intended use of risk model results should match what for the model is developed for
- Timeframe being predicted, e.g. next year/month, past events, real-time events
- Scope of prediction, what level of detail is identified, e.g. patient level risk-stratification, which can be used for direct patient care or is the focus in population risk profiling which can be used for non-clinical planning and service redesign

Understanding what the data requirements are for using a specific model and what data is available plays a vital role in model selection, as selected data variables have an effect on the predictive ability.

2.4.1. Threshold modelling

Threshold modelling is a rules-based assessment, where the selection is made if a certain criteria set is met. For example, a certain age and number of visits might act as a criteria. Yet this approach poses certain problems. The accuracy of identifying the right patients is very low, and the model is prone to suffer from the regression to the mean. Rules that take into account the number of visits suffer from the fact that high use might be lower the following year. This phenomenon is called regression to the mean, which often occurs with high utilization. Thus threshold modelling is not able to predict future high risk patients correctly and care efforts might not accomplish the desired results. (Panattoni et al. 2011; Lewis, Curry & Bardsley 2011.)

2.4.2. Clinical assessment

Clinical assessments have been used to enroll patients for care management programs. Clinical assessment is based on the judgment of social and health care staff, who based on their beliefs and

judgment choose people likely to benefit from managed care efforts. This approach poses multiple problems. First, the scope is limited as it targets only those who already are in contact with services. People likely to become high utilizers might not be in contact with services at all. The second problem is the objectivity and accuracy of the judgment. (Lewis, Curry & Bardsley 2011; Panattoni et al. 2011.) Predicting readmission by clinical assessment has been studied and it is not seen as a reliable way to assess risk in planned care efforts. The accuracy of clinical assessment is comparable to chance when predicting future events. (Allaudeen et al. 2011.) Considering all these limitations, *clinical assessment alone* is not seen as a good way to find or predict the future use of social and health services (Freund et al. 2011). Clinically screening large populations would not be a feasible option, as it is a resource heavy method and a costly endeavor.

2.4.3.   Predictive risk modelling

Predictive risk modelling is a third way to identify people who might become high risk and it is considered the best method to identify people for interventions (Murphy, Castro & Sylvia 2011). It is a data driven approach, which uses statistical analysis to predict whom might be or not be in the predicted risk group. Factors that influence the predictive power are statistical methods used and the quality of data. Most of the research and commercial models are based on different forms of regression analysis. Data mining techniques such as decision trees, neural networks and Bayesian networks have been in a focus of research in recent years (Izad Shenas et al. 2014).

The most obvious benefit of using predictive modelling is that it can be easily applied to entire populations. Predictive models differ in the ways they are intended to be used (Lewis, Curry & Bardsley 2011) and the target levels they are intended to predict (Elissen et al. 2014). Models can be used for risk adjustment to predict future costs across entire populations or as a case-finding tool to find potential patients for preventive care management. Predictive models were used often for budget allocation or adjusting payment plans according to risk in insurance-based health systems. From there, models evolved for the use of case-finding tools, e.g. to predict hospital readmissions and future medical episodes for specific diseases. A multitude of use cases exist and they vary according the needs of the organization. Different uses of risk adjustment include (Panattoni et al. 2011; Kansagara et al. 2011; Georghiou et al. 2011):

- Resource allocation, e.g. budget allocation according to the future prediction of risk
- Case finding, e.g. finding patients that would benefit from preventive care efforts
- Population profiling, e.g. finding a community's health needs and planning services accordingly
- Evaluation and performance management, e.g. to analyze effectiveness of different care efforts, were they targeted accordingly, and how the services perform

Predictive models are intended for specific use needs and are thus distinct in the ways they are designed and built, and how they operate. This makes the choosing and comparing models a difficult task. (Elissen et al. 2014.) In this study, the focus is purely in the literature of case finding.

Factors that affect accuracy: Information

Accuracy is one of the most wanted features in case finding, and the variable that has the most effect in accuracy is the information used. What kind of data and information is available is usually a deciding factor on model design and selection as data collection is a costly endeavor in large populations. Automatically gathered information is rarely perfect and it is common to have flaws, errors or missing information in the data. These data inconsistencies have an impact on the data quality and affect the predictive power of the model used. As data quality may vary, it is important to understand if the model can handle data inconsistencies in its specific dataset. (Elissen et al. 2014.) The time scope of historical data can vary, and what range of historical data is used might vary as well. Data sources used in predictive modelling are primarily routinely gathered information among populations or demographic details recorded. Models can use, for example, the following datasets and variables (Kansagara et al. 2011):

- Retrospective administrative data e.g. prior utilization/cost, medical conditions, functional status, demographic details, social determinant variables
- Real time administrative data e.g. medical records, social factors, socioeconomic status, marital status
- Data collection e.g. survey data, questionnaires (e.g. inquiry about polypharmacy)

The data sources listed above could be divided into trivial and non-trivial data attributes. Data such as disease condition or visit counts can be seen as trivial as they usually correlate with high risk only after the high risk occurs. *Trivial attributes do not necessary reflect much about what is happening before the high risk event*. To overcome this shortcoming, Izad Shenas, Raahemi et al. (2014) have suggested using *non-trivial variables, which they claim are more proactive measures*. In their study to predict future high costs for individuals they found five non trivial attributes that predict this risk: 1. Individual's overall health perception, 2. Age, 3. History of blood cholesterol check, 4. History of physical/ sensory/ mental limitations, and 5. History of colonic prevention measures. They argue that using these variables would further increase the predictive power of the model. (Izad Shenas et al. 2014.)

Increased predictive power by understanding pathways to high utilization or just adding to the complexity

Traditional predictive models that utilize non-trivial data attributes are becoming more accurate and are approaching a level of reasonable use (Haas et al. 2013). To gain more accuracy, some have suggested that a more holistic approach is needed in order to understand the pathways to high utilization (Cucciare, O'Donohue 2006). Izad Shenas, Raahemi et al. (2014) suggested the utilization of trivial attributes to gain more details of high risk patients. Similar suggestions have been made earlier; for example Haas, Takahashi et al. (2013) suggested research towards adding variables such as: *living situation, high-risk medication and individual's lifestyle choices*. They argue that these variables would yield better predictive power and help on the efforts of planning and targeting interventions. Many have proposed variables that measure the social environment and living situation, but the availability of this information is one limiting factor of adding these variables to predictive models. Data might be collected, but is not available or allowed to be used due to limitations of information governance. Data sharing between social and health care institutions is often prohibited due to privacy concerns or legislation.

To understand pathways to high utilization more variables might reveal things in a more detailed level. As lifestyle choices play an important role in an individual's wellbeing, it has been proposed as a variable by Orueta, Nuño-Solinis et al. (2013) and Elissen, Struijs et al. (2014). How to

measure and add this as a variable in a systematic way is a difficult question. A limited amount of studies have actually interviewed high utilizers to gain insight on the underlying issues. Raven, Billings et al. (2009) conducted an interview-based study among identified high utilizers, which revealed factors such as social isolation. Similar suggestions about variables that tell more about social networks (Elissen et al. 2014), social environments and socio economic situations have been made (Orueta et al. 2013; Hebert et al. 2014). Why a person is using so many services, and are there any patterns in service use are questions that might help find the underlying factors of utilization. Limited studies have focused on the reasons for service use, and how to incorporate this underlying information into predictive models (Cucciare, O'Donohue 2006).

Predictive models tend to get very complex if more variables are used, and some have suggested using less information and measures that are easier. For example, a simple count of chronic conditions has been suggested to offer a simpler way to predict high cost use (Fleishman, Cohen 2010). Wallace, Stuart et al. (2014) compared predictive risk models in a systematic review and found out that models that utilize traditional variables such as prior utilization, comorbidity or polypharmacy and the diagnosis or prescribed medicines possess the most predicative power. But in the end, they note that adding nonmedical factors might improve predictive power even further. Fleishman and Cohen (2010) also note that certain variables beyond the simple count of chronic conditions increase the accuracy even further. Adding more variables seems to offer improvements in predictive power, but certain limitations remain. Factors limiting adding more variables are as follow: the cost of collecting data, the cost of improving data quality, privacy restrictions and legislation in how data is shared and how it can be used.

Viability of predictive models and participant selection

The predictive power of predictive models is increasing and it is becoming a reasonable way to find high risk cases. If used in the right way, selecting multimorbid patients via predictive models is a reasonable way, argues Cohen et al. (2014). Models that combine different predictive models seem to perform best (Rosen et al. 2005). Some have found the results discouraging, as the degree of prediction is limited and thus applications hard to employ on an individual patient (Radcliff, Côté et al. 2005). Identifying high utilization is an important element in targeting interventions, as

targeting care to wrong individual might not result in the desired outcomes. Identifying high utilization is not an easy endeavor and the cost of prediction should be considered beforehand. Also, the cost of not predicting should be considered, while keeping in mind that some events are not foreseeable and can't be predicted at an individual level (Bernstein 2007), e.g. the amount of accidents can be predicted per annum at the population level but not on an individual level. Overall risk screening is a promising and developing field (Haas et al. 2013), but evidence of the actual successful use of predictive models at the individual level is mixed and certain limitations remain.

2.4.4. Targeting efforts meaningfully

Getting clinically meaningful outputs from predictions is not necessary easy. The importance of careful participant identification and selection for care management and intervention requires skilled clinical staff and supportive information structures. It can be argued that selecting individuals that are "care-sensitive", who react to targeted management efforts, requires both good clinical judgment and the infrastructure to target efforts to individuals likely to benefit.

Care-sensitivity is as important factor for selection as it affects the outcomes. Care sensitivity refers to two dimensions: 1. The patient has to be approachable, meaning willing and able to participate in the care effort; 2. the patient needs have to have actionable situation and needs, meaning the care must be needs driven and should make an impact. (Freund et al. 2011.) To accomplish this, Freund, Mahler et al. (2011) suggest using a combined model where the initial selection is made by a predictive model, which is then refined using clinical assessment. This way, patients who might respond better to care management are targeted for interventions. Bernstein (2007) suggests a similar approach to the two-step selection in order to find participants for care management. Cohen, Flaks-Manov et al. (2014) criticized the two-step selection because it is subjective to clinical bias. They refined the method to a more systematic approach, ruling out clinical bias, and eliminating criteria that excludes or includes patients on set of clinically predetermined criteria inside the predictive model. A similar suggestion to use an evidence-based cut off point was made by Murphy, Castro et al. (2011) in order to optimize the selection process.

Finding the right patients is not easy and realizing cost-saving from preventive care efforts has been difficult. This might be due the fact that predictive models identify high risk patients, but

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they do not consider the individual response for care. Lewis (2010) suggests developing "impactibility models" into predictive models that would help to identify individuals who would be amenable for preventive care and how this care should be provided based on their characteristics. This strategy would help to identify patients likely to benefit from proactive care and to deliver care with impact. Strategies for different risk scores could be utilized, as different risks might benefit from different methods of intervention. Interventions could differ according to the service channel, care intensity and what kind of support is provided and needed. The timing of an intervention should also be considered and assessed, according to how the individual might respond in his or her current life situation.

Of course, any patient selection is faced with the issues of equity, which should be considered while planning care efforts through predictive analysis. Ethical issues in using predictive models are evident, but face different issues on the basis of how social and health systems are organized by country. Patient identification and selection for interventions is the just the first step towards the management of high utilizers, what happens after makes the effect.

2.5. Management of high utilizers

Efforts made to curb high utilization have been around some time. Simple measures alone, such as increasing access to primary care, do not seem to lower health care spending among high-cost groups (Joynt et al. 2013). Various management models have been proposed and analyzed in the literature. Some models focus on one specific condition and some focus on the individual needs of a person.

Management models might build upon the old ways of doing things, but some innovate a bit further in order to change the way we, for example, deliver care and services. The way people are enrolled in care programs varies. At the lowest level, people are enrolled if they have certain chronic conditions, and more advanced models seek to identify people early in order to take preventive measures before their health declines and to prevent high utilization. The problem of how to correctly identify people early was discussed in previous chapter. What kinds of efforts have been made earlier and how to manage high utilization is discussed as a continuum in this chapter.

2.5.1.   Chronic care model (CCM)

The chronic care model (CCM) is designed to enhance the outcomes of ambulatory care with lower costs. This is achieved by reorganizing the framework for care. This model aims for the long-term treatment of disease, not just for acute illness or treating symptoms as they emerge. It is designed around the patient to empower and to activate them to take responsibility for their personal health outcomes. The key is to help patients learn how to better self-manage the conditions they have, which is seen as a vital element for long-term health benefits to occur. It has been argued that managing chronic disease in adequate way could provide savings in the cost also. (Wagner et al. 2001.)

The chronic care model is based on work done in mid-1990s, which was organized into a framework by Wagner et al. (2001). The idea was to change the care system completely, transforming passive patients into more active roles. The patient is seen as the main contributor for care outcomes. The care system has to provide the patient the needed skills and confidence to manage one's disease, as well ensure good communication with the care provider. This ensures that conditions are well managed in the best way possible. Managing chronic conditions can be difficult and involve substantial changes in the patient's lifestyle. The care paths are evidence-based and strive for the best quality outcomes in the treatment guidelines. (Wagner et al. 2001.)

CCM is a new way to think about how to provide care and it challenges the old methodologies. Some studies have showed that this new framework for care really can give better health outcomes and quality improvements in care (Coleman et al. 2009a; Bodenheimer, Wagner & Grumbach 2002). On the other side, the cost-effectiveness of this model has mixed results. As the method requires an initial investment in the care redesign, any savings may take time to materialize.

2.5.2.   Disease management

Disease management also drives quality improvements for the chronically ill. Quality improvements to reduce complications and to prevent declining health were thought to reduce overall cost. Disease management is targeted for conditions that require self-management, and it aims to act as an intervention and to improve communication between care provider and patient. Coleman, Mattke et al. (2009b) differentiate disease management and chronic care model by the

way they are organized. Disease management is usually an effort of an outside vendor and usually disease management does not involve practice redesign. Coleman, Mattke et al. (2009b) reviewed studies that ranged from pure disease management to CCM with practice redesign and concluded that practice redesign combined with efforts to change patient behavioral yield better results than efforts that focus solely on the patient alone.

Others have questioned the viability of the disease management model as well. It can yield quality improvements, as found out by Fireman, Bartlett et al. (2004), but usually the cost does not decrease. Mattke, Seid et al. (2007) evaluated disease management through a literature review and found that disease management did not actually decrease the utilization of health care. No direct impact on cost or long-term health benefits were observed, despite the fact that the care process was improved. The findings of scientifically conducted studies do not support the promises of disease management (Mattke, Seid & Ma 2007). Charlson, Charlson et al. (2007) analyzed how the effect of multiple chronic conditions affect cost, and found that the costs increase sharply as the number of chronic conditions rise. Thus they suggest to target complex comorbid patients that incur the highest overall cost, but note that single protocol-orientated disease management might not be the right model for this task. In conclusion, single disease specific management might not yield the best result when patients have multiple chronic conditions. (Charlson et al. 2007.)

2.5.3. Care management

The term 'care management' could be used in conjunction with case management. Some make a small distinction between the two, saying that the timeframe in case management is shorter and that care management is more of a long-term solution. Care management can be defined as a model that drives for quality improvements and cost savings, by coordinating better care in order to minimize unnecessary medical treatments and to improve the health of clients. The focus is broader than any single disease - care management tries to focus on the needs of an individual with streamlined care efforts. Care management targets patients with multiple chronic conditions. (Bodenheimer, Berry-Millett 2009.)

Care management can operate in different settings. Bodenheimer and Berry-Millett (2009) list four possible scenarios for care management: primary care, vendor supported, integrated

multidisciplinary group, and hospital-to-home/home-based. Patients that need care management are usually at risk to induce high costs and one key element is the need to identify patients early. The selection of patients is one of the most important steps, as the focus should be on patients that have a need and are likely to benefit from the effort. (Bodenheimer, Berry-Millett 2009.)

Bodenheimer and Berry-Millett (2009) analyzed if care management efforts can enhance quality with less cost in practice. In some of the settings the evidence is supportive; especially in hospital-to-home settings, both quality increased and costs were reduced. Similar evidence was found in primary care settings, where quality improved and in some cases hospital use was reduced. In primary care, the positive outcomes take time to materialize. They also list common characteristics for successful care management: good physician-patient communication, support from a multidisciplinary team and the right setting. (Bodenheimer, Berry-Millett 2009.) But in some other settings, the results have not been so encouraging. While analyzing recent studies about unplanned hospital readmissions, Huntley et al. (2013) found that most studies in case management showed no reduction in admission rates. It was proposed that maybe the patient selection process in the reviewed studies did not target patients at a high risk of hospital readmission.

2.5.4. Person-centered care and patient centered care

Person-centered care is a move from disease management toward fulfilling the needs of patients, taking into account difficulties and allocating resources by demand (Eissens van der Laan et al. 2014). Starfield (2011) analyzed the differences between person- and patient-focused care. Patient-focused care can be seen more like a visit-based approach. Person-focused care offers a wider scope for patient problems and tries to manage and prevent these problems over time. The focus is on the person, not the disease, patients viewpoint is taken into account and care is not one sided treatment of disease. (Starfield 2011.)

In person-centered care, the patient is also seen as an active partner of the care process (Ekman et al. 2011) and the focus is on fulfilling the needs of patients (Eissens van der Laan et al. 2014). Making the patient an active part of the care path is seen as a vital component for the success of care efforts to work in this model. Limited studies have been made about how person-centered

care performs, but results are promising, though also mixed as an insufficient number of studies have been carried out. (Olsson et al. 2013.)

2.5.5. Managerial models to address the needs of high utilizers

The above models tend to focus on handling diseases or chronic conditions, and do not necessarily address the managerial problems – "how to offer services according to the different needs of high utilizers". To address this problem, a brief review is made on two models that might be suitable for tackling this shortcoming. As a limitation, the following models are general frameworks that offer a perspective to divide the operations or population needs homogenously, and are not designed to address especially high utilization.

Bridges to health model

As individual needs among populations differ substantially, it is hard to provide the services people need in an efficient and effective manner. The Bridges to health model tries to close this gap by offering a framework that helps to plan, manage and deliver services according to population's needs. Heterogeneous populations are divided into homogeneous segments by their needs in order to provide better overall health outcomes by services and care that match individual needs. Populations are divided into eight groups according their current health care needs, so it is an ongoing process and one individual's group might change over a lifetime. (Lynn et al. 2007.) The bridges to health model is a proposed concept on how health care could be organized in more meaningful way in order to provide better overall health for population.

Demand and supply- based operating modes

Demand and supply based operating modes (DSO) offer a conceptual lens on how to meet the needs of populations in relation to what can be supplied. In order to meet this goal, DSO helps managers to divide populations into homogeneous groups and offer seven modes of operation to aid service design. Three of those elements can be identified as viable to manage the problems faced in preventable high utilization: preventive mode, project mode, and managing care process. Preventive care is one of the most important elements in high cost management. And the project mode is helpful when trying to manage complex conditions and comorbidities. Managing care

mode focuses especially on patients with comorbidities and tries to optimize the quality of life by managing the conditions via frequent visits. (Lillrank, Groop & Malmstrom 2010.) The remainder of the operational modes might touch upon high utilizers, but they lack the focus of preventability and thus are not discussed further.

2.6. Summary of the literature review and connection to empirical research part

Tackling high utilization is a complex endeavor, which requires an understanding of the nature of the phenomenon. The biggest challenge is with transitory movement, which makes it hard to target efforts to those most likely to benefit. The changing social and health needs of a population over time, and the unavoidable variation among different populations makes it difficult to develop universal solutions. Luckily, most people live relatively healthy lives, but some incur a high cost period (or periods) that usually lasts through multiple years of their lives. Some part of high utilization is unavoidable, like childbirth; but some of it could be avoided or at least curbed if people at risk could be identified early enough.

Identifying those individuals likely to benefit from proactive measures requires a necessary supportive infrastructure to make efforts reasonable. Selecting people for enhanced care efforts calls also for unbiased assessments by skilled staff. Lifestyle-related choices play a major role in preventing high costs, and it is necessary to promote healthier lifestyles and behavioral change in order to tackle the problem. Also, preventing further health deterioration is key to attaining positive outcomes for those individuals where preventative measures come too late. The elevated individual wellbeing through service quality improvement and innovation can be seen as a worthwhile investment, even though prolonged lives limit the savings made at the end.

However substantial benefits, both economic and situational, are hard to realize (Bernstein 2007). Solutions to managing high utilizers have had mixed results, as *a limited amount of studies have been made on what accounts as preventable* among high utilization (Joynt et al. 2013) and how to further use this knowledge in managerial models. The problem with preventable care is that it takes time to realize the benefits, and it might take years to see clear benefits, as mentioned by Joynt et

al. (2013). There is uncertainty about where to focus these efforts to benefit both the individual and the economic perspectives. It is difficult to justify improvement that might break even at best.

The purpose of this literature review was to build understanding of the problem domain and to aid in conducting the empirical study part. This literature review helped to understand what should be analyzed and studied in the empirical part of this research. Chapter 3 presents the research methods and data used; the results are displayed in chapter four. How those results relate to previous literature is reviewed in chapter six.

3. RESEARCH METHODS

The objective for the empirical part of this research is to explore the service usage and possible characteristics of high utilization in social and health care services in one Finnish municipality. The empirical part consists of a quantitative study on the usage of social and health care services in the joint municipality of KALLIO, and the use of these services in $2011 - 2012$ is analyzed. For this study, high utilization was defined as a group of people that account for a disproportionally large share of total expenditure. The percentage of the population labeled as high utilizers were defined as the costliest five percentage of the studied population, ranked by their total annual expenditure incurred.

This study uses research data repositories maintained by The National Institute for Health and Welfare (THL), which tracks a range of person-specific usage data over publicly funded social and health care services. The data makes it possible to analyze the usage of services at an individual level and to observe demographic characteristics of users. The data captures all publicly funded healthcare at an individual level, as well most social welfare usage. The level of data detail and accuracy varies, but it is possible to analyze annual usage per person. Expenditure data was available for some of the records provided, missing expenditures were allocated by service and with the help of a unit cost report for 2011 published by THL.

This study tries to summarize which kinds of demographic details and service usage occurs among high utilizers in social and health care. Service utilization was examined on an individual level by forming 17 service categories. Descriptive statistics were used to analyze the data.

3.1. Study setting and population

The study population includes inhabitants of four Finnish municipalities: Alavieska, Nivala, Sievi and Ylivieska. Together, they form the joint municipality of Kallio (KALLIO), and co-operation is responsible for organizing and funding social and health services for the residents in the region. In Finland, municipalities are responsible by law for organizing social welfare and health services for their residents. Municipalities can provide these services by themselves or by forming a co-operation; KALLIO is one example of such co-operation. A municipality can also purchase services from other municipalities, organizations or private service providers (Suomen Kuntaliito 2015).

KALLIO is participating in this research in order to understand their service use better and to help to design new ways to deliver these services. The focus of this research is social and health care services; other services provided by KALLIO co-operation are not included in this research. Excluded services are:

- Environmental health
- Early childhood education and early childhood care

The municipalities forming KALLIO are located in the Northern Ostrobothnia region of Finland at the southern province of Oulu. According to the SOTKAnet (THL 2015) statistics and indicator bank, the total population of KALLIO was 33 352 at the end of 2011 and 33 520 at the end of 2012. This population structure is changing, and as a service provider, KALLIO wants to understand the challenges it will face in order to operate under the changing landscape. The main driver for change is the aging population, and it reflects in the demographic dependency ratio. This addresses the number of people under 15 and over 64, per hundred working-age people aged 15–64 years. In KALLIO this ratio is higher than the average ratio in Finland (see table 2), due to

the fact the population structure is old. The projected dependency ratio for upcoming years is showing an in the near future-

Table 2: Demographic dependency ratio for the municipalities in KALLIO, compared to mainland Finland, years 2011 and 2012 and estimations for 2015, 2020, 2030 and 2040. Number of people under 15 years and over 64 years per hundred working-age people aged 15–64 years. (THL 2015)

Area/Year	2011	2012	2015(est.)	2020(est.)	2030(est.)	2040(est.)
Alavieska	66,3	67,1	74,4	85,9	100,6	98,1
Nivala	69	70,8	77	84,7	87,3	85,8
Sievi	73,5	74,8	77,8	87,6	97,4	97,4
Ylivieska	56,3	57,9	62,9	70	76,6	74,3
Mainland Finland	52,9	54,3	58,6	64,4	71,2	71,2

This demographic change will eventually be reflected in the demand structures of social and health care services. This is evident especially in rural locations such as KALLIO, where young people tend to migrate to metropolitan regions and where the elderly tend to settle. This aging population is driving the change, and the upcoming decades introduce a major pressure to reform services according to the needs of the population. This research is driven by this need to structure better services for residents, and to deliver them in a more efficient way. The management of KALLIO wants to understand high service use better and to develop new models of operation for high utilizers. This study tries to analyze possible areas for service improvement and innovation in case of high utilization.

3.2. Social and health care register data

3.2.1. Data source

Research permission to use anonymous register data was granted by the National Institute for Health and Welfare (THL) for this research. THL receives data from municipality regions offering services on an annual basis and has guidelines how to report social welfare and health service

usage. THL provided unidentified register data to study the social and health care service usage in KALLIO. The longitudinal register data provided covers data from 2011 and 2012. In Finland, no ethical approval is required for register studies that use anonymous register data.

The data covers all inhabitants of KALLIO visiting the publicly funded social and health care services that are offered and the services purchased for its inhabitants at the hospital district level. The usage of private sector services, third sector services and prescription drugs is not covered in this study, nor are the deaths occurring due to unavailability of records holding this information. The absence is worthwhile to note, and should be kept in mind while comparing results to other studies.

3.2.2.   Data description

The acquired longitudinal data was delivered in six different datasets, each both years studied. Social security numbers were encrypted using the same encryption key by THL, which forms a study number that can be used to identify individuals across different datasets. This design allows one to combine records and to study cumulative annual service use at the individual level. Even though no identification information was available, ethical consideration was taken when reporting results that contain small group of people, in this case under 40 individuals.

Table 3 provides a short description of each dataset and what information each individual dataset contains. Register data comes from different information systems and is not uniform - guides provided by THL were used to understand the structure of data.

Table 3: Dataset descriptions:

Register dataset:	Register contained	Records total	Distinctive users total (n)	Notes
Dataset 1: Specialized health care	Including both inpatient care and outpatient care. Visit to specialized outpatient care. Covering specialized somatic care, specialized psychiatric care and long-	72 339	12 958	

	term inpatient care at hospitals and community health centers. Including service used in hospital districts.			
Dataset 2: Primary health care	Contains data on service providers, population's service use, access to services, population's health problems, epidemic development, client's/patient's municipality of residence and gender, visits by age group, outpatient visits by service type, reasons for visit, procedures and follow-up care, medication and vaccinations as well as check-ups to promote the health of children, young people and pregnant women. Regarding patients on health centre wards, the statistics also contain data on the number of care days and periods of care as well as on the appropriate care place of patients.	765 458	31 234	AvoHilmo
Dataset 3: Child welfare	Annual data on children and young people placed outside home with support in community care. Data available on placement setting and duration.	444	83	No municipality information recorded
Dataset 4: Social assistance	Contains information on the number and composition of households receiving social assistance, the duration of assistance and the amounts paid to recipients.	2198	1473	No municipality information recorded
Dataset 5: Institutional care and housing services in social care	Institutional care and housing services with 24-hour/part-time assistance for older people, people with physical or intellectual disabilities and people with mental health problems. Including detoxification and rehabilitation centers operated as part of services for substance abusers.	3 217	831	

Dataset 6: Count of regular home-care clients on 30 November	Data regular home care, covering: clients receiving regular home care, clients receiving support services and clients receiving support for informal care	1 244	788	November visits of each year only

Data quality

There have been some studies about the information quality of these datasets. The data quality of dataset 1, generally known as Finnish hospital records, ranges from satisfactory to very good. Levels of accuracy and completeness may vary by hospital region as each have distinct information systems and practices of information collection. Poor recording practices affect the data quality, e.g. usually only primary diagnoses are recorded. (Sund 2012.) The data transformation process from primary source to THL may affect the quality and level of detail in the data. Which THL tries to avert by requiring a specific reporting style and elements.

The data quality of the datasets 3, 4, 5 & 6 related to social services are considered as good, as they have been collected for some time (Räisänen et al. 2013). The data quality of dataset 2 is less studied, as THL started to collect it in its current form in 2011. Quality may vary or be poor due the fact that it is new, and variation in coding might still occur. The accuracy and completeness depends primarily on how data recording is carried out in the primary data source.

3.2.3. Data processing and assembly of research record

Microsoft Office's Excel 2013 tool was used to process and analyze the data, as it was readily available and allowed the necessary level of analysis. Data was first cleaned and incomplete records were excluded from the analysis. In total, 356 records had incomplete or missing information and were discarded, as they did not record which services were used at any level. Each dataset had the study number as a common identifier, which made it possible to combine datasets and to identify services utilized at an individual level.

The received data contained all visits and service use that KALLIO has to offer, but only people living in the municipality area are included in the analysis. This is required as some datasets reported also people visiting the municipality region and using its services. Inclusion was done by using the recorded municipality code. Unfortunately, this information was missing from two datasets. The problem was resolved by fetching the study number and municipality information from the other datasets containing this information. This was done by following a rule: including all study numbers whom were marked as resident in observed municipalities at least once per annum. In total, 82 entries were discarded as they did not follow this rule. This is of course a factor for error, e.g. if person used only one service that did not record municipality information, they were discarded from the study population.

Data was analyzed on an annual basis. This annual timeframe method was chosen as it has been used in previous research and makes it easier to interpret how results correlate with previous research efforts. Ongoing hospital episodes occurring at the turn of the year were split, as they were recorded as events. In the end, the combined dataset included a total of 28 225 individual study numbers for 2011 and 28 929 individual study numbers for 2012.

3.2.4.   Allocating costs to service events

Data received from THL did not contain expenditures incurred, except for the social assistance dataset which contained this information. Service usage was transformed into cost by utilizing the national Finnish unit cost report for 2011, published by THL (Kapiainen, Väisänen & Haula 2014). This report identified social and health care costs, but the level and depth of detail reported varied by service type.

Monetary value was used for calculation and reporting in the monetary value of the euro currency in 2011, in order to make it possible to compare changes in service use. To account for inflation costs, it can be converted to a specific year by using the price index for public expenditure for social   and   health   expenditure   provided   by   Statistics   Finland (http://www.stat.fi/til/jmhi/index_en.html).

Costs were calculated as detailed as possible, using an analogy that goes from as detailed as possible to less detail when needed. For example, if a cost was not available for a certain level of detail, the level was decreased step by step, until it became possible to allocate cost. The following logic - in this order- was utilized:

1. Cost from data, if available
2. NORD DRG point information, if available
3. Cost as defined by service type, service channel and profession, if available
4. When above was not available, cost was allocated by: service type, service channel and mean cost per service OR only the mean cost per service type OR the length of stay in specialized care
5. When THL report did not have the needed information, KALLIO's annual report for 2012 was used to calculate average cost per visit.

The data quality affected the process. For example, in dental care, the THL report identified cost per treatment code, but the dataset was inconsistent in the coding of treatments done. Thus the average cost per visit in oral health was used. Specialized care incidents that lasted less than one day were treated as a one day care visit, e.g. cost by outpatient care visits.

Datasets 2 and 6 had overlapping information, but dataset 2 was more comprehensive and was therefore used. Data for informal care in dataset 6 was available only for one month per annum. To form annual informal care cost, the available informal care usage for each November was annualized. This leaves room for error, as actual use might differ substantially.

3.2.5. Service categorization

In order to assess service usage and cost drivers, 17 service categories were formulated. To derive these 17 categories, services with similar etiology or resource type were combined. Categorization of services was done in a manner that would group services across the social and health services in a logical and homogenous way. The register data guides provided by THL and the annual report of KALLIO were used to understand the structure of data and to guide the effort to organize

services into categories. The 17 formulated service categories can be seen in the list below, and specific services included in each category can be found in appendix 1.

- Specialized somatic care
- Specialized psychiatric care
- Guidance service clinics
- School and student health services
- Occupational health services
- Medical rehabilitation and physical therapy
- Services for older people
- Disability services
- Services for substance abusers
- Rehabilitation center care
- Oral health
- Support for informal care
- Child welfare
- Social assistance
- Mental health services
- Primary care: Ambulatory & outpatient
- Primary care: Inpatient

3.2.6. Grouping of individuals by the most expensive service category

In order to see what services drive costs among high utilizers, each individual was ranked by their most expensive service category per annum. These specific groups of high utilizers were further analyzed; to see specific characteristics, how each costliest group accumulates cost and what other services they tend use in conjunction.

4. RESULTS AND ANALYSIS

This chapter introduces the results of the analysis made in the empirical part of this study. The analysis started by ranking individuals according their annual cost. Individuals were ranked by per capita cost for both 2011 and 2012, from the lowest to highest incurred annual cost and arranged into different percentiles. The percentiles differentiate a bit according to what is studied, and most suitable percentile grouping per case is used. The percentiles used were the following:

- For distribution of social and health care costs, the following percentiles were used: Most expensive 1%, 5% and 10% of population as (top 1, top 5, and top10) and least expensive 90% of population (bottom 90)

- To analyze high and low utilizers in KALLIO, high utilizers (HU) were defined as the costliest 5% of population and low utilizers (LU) were defined as the least expensive 95% of population

- For persistence in social and health care expenditure between consecutive years, the following percentiles were used: Most expensive 1%, 5%, 10%, 20%, 30% and 50% of population as (top 1, top 5, top 10, top 20, top 30 and top50) and least expensive 50% and 90% of population as (bottom 50, bottom 90)

First the distribution of expenditure and persistence is analyzed in general level and then at little more detail in chapters 4.1 and 4.2. High utilizers are analyzed in detail at chapter 4.3.

4.1. Distribution of expenditures

KALLIO incurred a total cost of EUR 76 million in 2011 and EUR 81 million in 2012 for social and health care services. This distribution of expenditures is highly skewed for both years, as the most expensive 1% of population accounted for approximately 30% of the total cost in both years studied. The most expensive 5% of the population accounted for 64% of the total cost in 2011 and 65% of total cost in 2012. The proportional amount of the top 5% spenders is observed to be fairly stable between 2011 and 2012. Tables 4 and 5 summarize the results of cumulative cost and cost distribution per percentile. The cost structure is highly skewed, as small percentage of population

accounts for the majority of social and health care expenditures. In both years, the costliest five percentage incurs nearly 13 times higher average cost compared to the average cost of the total population. The annual average cost per patient for the most expensive 5% is approximately EUR 30 000. Approximately three quarters of annual social and health care expenditures is incurred by the most expensive 10% of the population.

Table 4: Distribution of social and health care cost per percentile: Calendar year 2011

Percentile of costs	N	Total costs, €1000	Average cost per individual, €	% of the costs
Top 1	334	23 615	70 702	31,2
Top 5	1668	48 640	29 160	64,4
Top 10	3335	57 887	17 357	76,6
Bottom 90	30017*	17 682	589	23,4
Total		75 569	2 266	100,0

*Note: In year 2011 KALLIO's total population was 33352, which was used for calculation. There were 5097 individuals, who did not use any service.

Table 5: Distribution of social and health care cost per percentile: Calendar year 2012

Percentile of costs	N	Total costs, €1000	Average cost per individual, €	% of the costs
Top 1	335	23 859	71 222	29,6
Top 5	1667	52 142	31 279	64,7
Top 10	3354	62 318	18 580	77,3
Bottom 90	30189*	18 275	605	22,7
Total		80 593	2 409	100,0

*Note: In year 2012 KALLIO's total population was 33453, which was used for calculation. There were 4614 individuals, who did not use any service.

The same monetary value for both years was used, and it can be observed that the total social and health care expenditure has a small annual rise. Both total cost and average cost per patient rise in all percentile categories from 2011 to 2012. It should be noted that there was a percentile of the population which incurred no cost for social and health services. The amount of people that did

not use any service was different between 2011 and 2012: in 2011 15.3% incurred no cost and in 2012 the figure was 13.8%. The amount of no cost users was calculated by using the annual end of the year population reported by KALLIO and by subtracting the amount of individuals found in the data (see footnotes in table 4 and table 5 for results). A greater percentage of the population was observed to use services in year 2012.

4.1.1. High utilizers and low utilizers, demographic details and average expenditure

High utilizers (HU) were defined as the costliest 5% of population and low utilizers (LU) were defined as the least expensive 95%. The demographic details were gender and age group. The following six age categories were defined: –1, 1–17, 18–34, 35–49, 50–64, 65–79, 80–. The average cost per individual between high and low utilization groups was t-tested and all differences were statistically significant, $p < 0.001$. There was a small gender difference between high utilizer and low utilizers groups (see tables 6 and 7). Women accounted for a slightly higher percentile in the high utilizer group, as 54.8% were women, in comparison to the low utilizer group where both genders have a nearly equal share. Women are observed to have a higher average expense in both low utilizer and high utilizers groups than men.

High utilizers are considerably older than low utilizers. In the high utilizer group the proportion of elderly people aged 65 years or older was 51.6% for 2011 and 58.5% for 2012. In the low utilizers, the age category of people aged 65 or older is only 13.7% for 2011 and 14.1% for 2012. In both groups, the average cost is observed to rise with age after 35. Among the high utilizers, the age group of people 80 or older is observed to be 4.6% larger in 2012 compared to in 2011. People aged 50 or over present a 71.9% share in the high utilizer category of 2011 and 77.2% in 2012.

Table 6: Social and health care distribution in 2011 among high utilizers and low utilizers by gender and age groups.

Gender and age	High utilizers (HU)				Low utilizers (LU)			
	N	% of (HU)	Average cost per individual, €	Total costs, €1000	N	% of (LU)	Average cost per individual, €	Total costs, €1000
Women	914	54,8	29 499	26 962	13506	50,9	1 124	15 186
Men	754	45,2	28 750	21 678	13051	49,1	900	11 743
−1	28	1,7	29 736	833	463	1,7	981	454
1–17	124	7,4	33 427	4 145	7889	29,7	683	5 390
18–34	156	9,4	29 659	4 627	4903	18,5	1 155	5 663
35–49	161	9,7	21 727	3 498	4219	15,9	1 008	4 253
50–64	339	20,3	25 477	8 637	5433	20,5	1 079	5 864
65–79	430	25,8	29 394	12 640	2872	10,8	1 303	3 743
80–	430	25,8	33 165	14 261	778	2,9	2 007	1 562

Table 7: Social and health care distribution in 2012 among high utilizers and low utilizers by gender and age groups.

Gender and age	High utilizers (HU)				Low utilizers (LU)			
	N	% of (HU)	Average cost per individual, €	Total costs, €1000	N	% of (LU)	Average cost per individual, €	Total costs, €1000
Women	918	54,7	31 378	28 805	13907	51,0	1 162	16 162
Men	759	45,3	30 746	23 336	13345	49,0	921	12 289
−1	25	1,5	22 602	565	491	1,8	916	450
1–17	108	6,4	39 582	4 275	8105	29,7	685	5 554
18–34	135	8,1	31 268	4 221	5143	18,9	1 152	5 926
35–49	114	6,8	26 490	3 020	4221	15,5	991	4 184
50–64	314	18,7	26 850	8 431	5434	19,9	1 107	6 015
65–79	471	28,1	31 069	14 633	2983	10,9	1 455	4 341
80–	510	30,4	33 327	16 997	875	3,2	2 265	1 982

Gender differences in average age and used service categories

Gender specific differences among high utilizers were analyzed to see if there is variation among genders. The examined characteristics were age, average cost and service categories used. Additionally, the rest of user – low utilizer were analyzed for comparison. The average age did not differ in the analyzed two years among low utilizers, but there was a rise of age among high utilizers from year 2011 to year 2012 (see table 8). High Females use 0.2 more service categories and incur slightly higher average cost compared to males. A similar trend can be observed among low utilizers.

Table 8: Gender differences: average age, average cost and average of services used by service categories for high and low utilizers annual.

Year	Expenditure rank	Gender	n	Average age	Average of used service categories	Average cost, €
2011	High utilizers	Males	754	56	4,0	28 750
		Females	914	63	4,2	29 499
		Both	1668	60	4,1	29 160
2011	Low utilizers	Males	13051	34	2,2	900
		Females	13506	37	2,6	1 124
		Both	26557	36	2,4	1 014
2012	High utilizers	Males	759	60	4,0	30 746
		Females	918	66	4,2	31 378
		Both	1677	63	4,1	31 092
2012	Low utilizers	Males	13342	34	2,2	921
		Females	13907	37	2,5	1 162
		Both	27249	36	2,4	1 044

4.1.2. Persistence of high cost

In order to see if high utilization occurs among the same individuals from year to year the short-term persistence of high cost utilization was explored in KALLIO. The total population of KALLIO was used for this analysis, in order to account also for the people that incur no cost. The results of the analysis about the short-term persistence in different percentiles of high cost

utilization in KALLIO from year 2011 to 2012 is presented in table 9. The analysis revealed a remarkable high persistence in the top 1% to the top 30%, as persistence was around 50%.

Table 9: Persistence in social and health care expenditure in KALLIO: 2011 observed customers of KALLIO, according to their 2012 expenditure status.

Percent of KALLIO population in 2011 ranked by expenditures	Sample Size Data, 2011	Not eligible for 2012 Died, moved, did not use services (total of 1738)*	Rank in 2012 expenditure distribution							
			Top 1	Top 5	Top 10	Top 20	Top 30	Top 50	Bottom 50	Bottom 90
Top 1	(n = 334)	0,3	**49,8**	83,1	90,0	95,4	97,8	98,3	1,5	9,9
Top 5	(n = 1668)	1,1	15,7	**53,7**	68,4	82,3	89,7	94,6	4,3	30,6
Top 10	(n = 3335)	1,9	8,5	33,2	**50,6**	68,7	78,6	87,8	10,4	47,5
Top 20	(n = 6670)	2,3	4,5	19,2	33,7	**56,3**	70,7	84,3	13,4	64,0
Top 30	(n = 10006)	2,1	3,1	14,0	25,6	46,4	**63,0**	81,5	16,4	72,3
Top 50	(n = 16675)	2,9	1,9	9,0	17,2	33,2	48,2	**71,5**	25,6	79,8
Bottom 50	(n = 11550)	10,8	0,1	1,1	3,1	7,7	13,5	33,5	**55,7**	86,1
Bottom 90	(n = 24890)	6,8	0,2	2,1	6,2	16,7	28,0	51,7	41,6	**87,1**

* Died, moved, did not use services, top 50% and bottom 50% account for 100% of observations.

One possible explanation for this high persistence is that the data cannot capture deaths occurring, which may have an effect on the results. Including death data would allow one to add a "category" deceased, which might increase the percentage in the category "not eligible". The end of life cost is usually very high, as high utilizers that pass away early or midyear might cumulate high costs and contribute to this persistence. Also, people going for high cost specialized treatment at the change of year might incur high costs for both years, even if their cost dramatically drops after treatment is over (thus contributing to persistence). Analyzing persistence over a three or four-year time period could offer further insight into how persistent high utilization is, as it would allow for ruling out deaths and other disturbances in short term analysis.

Gender differences in persistence

How about the gender differences in persistence of high and low utilization? As observed in table 10, females seem to keep their short-term high utilizer status more often than males. This could be explained by the fact that women tend to live longer, and perhaps that males seek supportive

services too late and decline at a faster rate before death. Regardless of the reasons, this difference reflects a fragile stage in life where the need of services and support is high and gender differences occur for some reason.

Table 10: Persistence of high and low utilization by gender.

Year to year peristance by gender, from 2011 to 2012		
	Persistance by gender, %	
	Males	Females
High utilizers	43,6	56,4
Low utilizers	47,9	52,1

4.2. Expenditure distribution in service categories

Among the 17 defined service categories in chapter 3.2.5, three service categories were observed to account for approximately 60% of the total expenditures. These three categories are following: (i) specialized somatic care, (ii) services for older people and (iii) primary care: inpatient. Annual expenditure distribution for the 17 defined service categories is displayed in table 11.

The amount of individual service users is high in basic healthcare services such as "Primary care: Ambulatory and outpatient care" and "Oral health" services. Both of these categories have a high number of individual service visitors per year, and approximately over half of KALLIO's population use both of these services annually. The highest average cost per person was observed in child welfare and the second highest in disability services. As the use of service categories might be skewed among low and high utilizers, the service use among low and high utilizer groups is analyzed next.

Table 11: Cost distribution among service categories, years 2011 and 2012. Amount of individual service users (N), average cost per individual, total cost incurred and percentage of annual total costs. Arranged from largest to smallest by total cost in service category for year 2011.

	2011				2012			
	N	Average cost per individual, €	Total cost, €1000	% of total costs	N	Average cost per individual, €	Total cost, €1000	% of total costs
Specialized somatic care	8058	2 825	22 767	30,1	8229	2 782	22 895	28,4
Services for older people	1452	8 089	11 745	15,5	1610	9 215	14 837	18,4
Primary care: Inpatient	1228	7 934	9 743	12,9	1329	8 258	10 975	13,6
Primary care: Ambulatory and outpatient	20217	332	6 702	8,9	20317	319	6 480	8,0
Mental health services	1259	3 061	3 854	5,1	1313	3 234	4 247	5,3
Disability services	141	24 436	3 445	4,6	81	30 050	2 434	3,0
Oral health	16983	191	3 243	4,3	16632	191	3 169	3,9
Specialized psychiatric care	290	10 277	2 980	3,9	312	10 678	3 332	4,1
Child welfare	62	39 832	2 470	3,3	71	45 685	3 244	4,0
Medical rehabilitation and physical therapy	3269	742	2 426	3,2	3490	703	2 455	3,0
Social assistance	975	2 090	2 037	2,7	997	2 237	2 230	2,8
Guidance service clinics	6096	228	1 388	1,8	6353	246	1 566	1,9
Occupational health services	5070	167	849	1,1	5109	168	859	1,1
Support for informal care	151	4 494	679	0,9	165	4 494	742	0,9
School and student health services	4891	124	605	0,8	5013	124	621	0,8
Services for substance abusers	354	1 432	507	0,7	404	1 119	452	0,6
Rehabilitation center care	57	2 232	127	0,2	51	1 158	59	0,1
			75 569	100,0			80 593	100,0

4.2.1. Expenditure distribution: high utilizers and low utilizers

To gain more insight into the use of the service categories, usage of services was analyzed among high and low utilizers. In this analysis each person could be ranked multiple times in different service categories. Three service categories among high utilizers accounted for 43.6 % of their total expenditures in 2011 and 45.1% in 2012. These service categories are as follows: specialized somatic care, primary care inpatient and services for older people (tables 12 and 13). This can be compared to low users who account only for 15.2% of the total expenditure in these same categories in 2011 and 15.3% in 2012. Among the top 5% of high utilizers, the *distribution of expenditures between social welfare and health care was fairly even*: 47% were social costs and 53% cost came from health care services.

The average cost for certain service categories greatly differed between high and low utilizers, as high utilizers incurred over six times higher average annual costs over both years, spread across seven service categories. These service categories are as follows: child welfare, disability services, specialized psychiatric care, services for older people, mental health services, primary care inpatient and specialized somatic care.

The distribution of users between high and low usage varies by category, especially groups that have very distinctive and/or special needs that require practically round-the-clock attention. Child welfare and disability services rank high for this ratio, as the average cost of high utilizers is observed to be the highest for both of the years in these two categories. This ratio indicates which amount of the annual customers are high utilizers, but does not necessarily tell how the service encounters are divided between these two groups. The lowest ratios for high and low utilizers were observed in: oral health, occupational health services and school and student health services. They seem to perform well and are optimized for cost per patient. It should be noted that the cost for the service "support for informal care" is not accurate enough to make a distinction in average cost, as the dataset reported usage from each November only.

To provide more detail, how utilizers were further ranked into distinct categories is observed next in section 4.3.

Table 12: Use of service categories among high and low utilizers, 2011: Amount of individual service users (N), % of (HU)/(LU), average cost per individual, total cost incurred and percentage of annual total costs. Displaying ratio of high and low utilizers per service category. Arranged from largest to smallest on average cost of high utilizers.

| | High utilizers (HU) | | | | | Low utilizers (LU) | | | | | |
| | | | Average cost per individual, € | Total cost, €1000 | % of total costs | | | Average cost per individual, € | Total cost, €1000 | % of total costs | Ratio |
Year 2011 (total cost €76 million)	N	% of (HU)				N	% of (LU)				(HU/LU)
Child welfare	56	3,4	43 826	2 454	3,2	6	0,0	2 552	15	0,0	9,333
Disability services	85	5,1	39 472	3 355	4,4	56	0,2	1 614	90	0,1	1,518
Specialized psychiatric care	136	8,2	20 096	2 733	3,6	154	0,6	1 605	247	0,3	0,883
Services for older people	692	41,5	16 246	11 243	14,9	760	2,9	661	502	0,7	0,911
Mental health services	246	14,7	13 182	3 243	4,3	1013	3,8	603	611	0,8	0,243
Primary care: Inpatient	694	41,6	12 674	8 796	11,6	534	2,0	1 774	948	1,3	1,300
Specialized somatic care	1159	69,5	11 134	12 904	17,1	6899	26,0	1 430	9 863	13,1	0,168
Support for informal care*	90	5,4	4 494	404	0,5	61	0,2	4 494	274	0,4	1,475
Rehabilitation center care	20	1,2	3 910	78	0,1	37	0,1	1 324	49	0,1	0,541
Social assistance	165	9,9	3 578	590	0,8	810	3,1	1 787	1 447	1,9	0,204
Services for substance abusers	97	5,8	3 205	311	0,4	257	1,0	763	196	0,3	0,377
Medical rehabilitation and physical therapy	800	48,0	1 440	1 152	1,5	2469	9,3	516	1 275	1,7	0,324
Primary care: Ambulatory and outpatient	1535	92,0	731	1 122	1,5	18682	70,3	299	5 580	7,4	0,082
Guidance service clinics	164	9,8	367	60	0,1	5932	22,3	224	1 328	1,8	0,028
Oral health	717	43,0	219	157	0,2	16266	61,2	190	3 086	4,1	0,044
Occupational health services	100	6,0	191	19	0,0	4970	18,7	167	830	1,1	0,020
School and student health services	116	7,0	155	18	0,0	4775	18,0	123	587	0,8	0,024
				48 640	64,4				26 929	35,6	

*Dataset for service "Support for informal care" reported service usage for each november only and was annualized. This leaves room for error, as actual use might differ substantially.

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Table 13: Use of service categories among high and low utilizers, 2012: Amount of individual service users (N), average cost per individual, total cost incurred and percentage of annual total costs. Displaying ratio of high and low utilizers per service category. Arranged from largest to smallest on average cost of high utilizers.

| | High utilizers (HU) | | | | | Low utilizers (LU) | | | | | Ratio |
| | | | Average cost | | | | | Average cost | | | |
Year 2012 (total cost €81 million)	N	% of (HU)	per individual, €	Total cost, €1000	% of total costs	N	% of (LU)	per individual, €	Total cost, €1000	% of total costs	(HU/LU)
Child welfare	60	3,6	53 441	3 206	4,0	11	0,0	3 381	37	0,0	5,455
Disability services	57	3,4	41 651	2 374	2,9	24	0,1	2 499	60	0,1	2,375
Specialized psychiatric care	151	9,0	20 520	3 099	3,8	161	0,6	1 448	233	0,3	0,938
Services for older people	796	47,5	17 890	14 240	17,7	814	3,0	732	596	0,7	0,978
Mental health services	235	14,0	15 174	3 566	4,4	1078	4,0	631	681	0,8	0,218
Primary care: Inpatient	743	44,3	13 113	9 743	12,1	586	2,2	2 102	1 232	1,5	1,268
Specialized somatic care	1145	68,3	10 759	12 319	15,3	7084	26,0	1 493	10 576	13,1	0,162
Support for informal care	84	5,0	4 494	378	0,5	81	0,3	4 494	364	0,5	1,037
Social assistance	159	9,5	4 131	657	0,8	838	3,1	1 877	1 573	2,0	0,190
Services for substance abusers	97	5,8	2 337	227	0,3	307	1,1	734	225	0,3	0,316
Rehabilitation center care	27	1,6	1 300	35	0,0	24	0,1	999	24	0,0	1,125
Medical rehabilitation and physical therapy	838	50,0	1 275	1 069	1,3	2652	9,7	523	1 386	1,7	0,316
Primary care: Ambulatory and outpatient	1537	91,7	654	1 005	1,2	18780	68,9	292	5 474	6,8	0,082
Guidance service clinics	123	7,3	414	51	0,1	6230	22,9	243	1 515	1,9	0,020
Occupational health services	101	6,0	216	22	0,0	5008	18,4	167	837	1,0	0,020
Oral health	639	38,1	203	130	0,2	15993	58,7	190	3 039	3,8	0,040
School and student health services	107	6,4	196	21	0,0	4906	18,0	122	600	0,7	0,022
				52 142	64,7				28 452	35,3	

*Dataset for service "Support for informal care" reported service usage for each november only and was annualized. This leaves room for error, as actual use might differ substantially.

4.3. High utilizers ranked by the most expensive service category

High utilizers were classified for one service category by their most expensive service, which is explained in more detail in chapter 3.2.6. Each individual was ranked for only one category and the distribution of expenditures across service categories was observed. Categories containing less than 40 people were combined into one category labeled "others". To ensure confidentially, detailed demographic details for this group were not disclosed. For the combined categories, a rough categorization by average age is disclosed underneath:

- Older people:
    - Support for informal care
- Middle age:
    - Services for substance abusers
    - Medical rehabilitation and physical therapy
    - Primary care: Ambulatory & outpatient

Life stages as divider

The most distinctive feature across categories is the difference in average age. The time before adulthood and older age are clearly distinct life stages. Two more categories – adulthood and middle age – were used to divide the expensive service categories by their average age; not including the aforementioned "others". Life stages by average age were as follow:

- Children and adolescent (0–18): Child welfare was naturally a distinct group that consisted of very young people
- Adulthood (18–40): Social assistance was a category where the average age was slightly over 30 years
- Middle age (40–60): An average age between 40 and 60 was observed in specialized somatic care, specialized psychiatric care, disability services and mental health services
- Older people (60–): Categories that relate to old age were: Primary care: inpatient and service for older people

Accumulation of service use in the categories

High utilizers on average were observed to use approximately 4.1 service categories in the section 4.1.1., by ranking high utilizers into costly categories with a clear variation in the amount that used service categories appeared. The average of used service categories was more than three in all these categories, with the variation in 2011 being from 3.3 – to 5.1 (table 14). It is also possible to look with more detail at how each costly group accumulates its expenditure and what service categories are used.

It was assumed that variation among categories would appear. Costs might accumulate only for the ranked expensive category or spread wider into other services as well. Accumulation of cost for the ranked high category varied from 63.8%–94.6% , (see table 14 and 15). Variation of spread was described as either minimal, high and moderate. The minimal use of other services (91%–) appeared in these expensive categories:

- Child welfare and disability services are groups that have very distinct needs and utilize little other services.

A high spread of other service use (–70%) appeared in these expensive categories:

- Primary care inpatient and social assistance were observed to have the highest usage of other service categories as well.

A moderate use of other services (70%–91%) appeared in the rest of the categories. It should be noted that variation at the individual level might be substantial.

Table 14: 2011 High utilizers classified by their most expensive service category. Displaying number of HU per category, average cost, total cost, average age and average of used service categories. Use of different service categories is displayed as %, rounded to first decimal – smaller values are omitted.

		2011 High utilizers ranked in costliest service category								
		Specialized somatic care	Services for older people	Primary care: Inpatient	Disability services	Mental health services	Specialized psychiatric care	Child welfare	Social assistance	Others
Descriptive information per costliest category	n	693	347	264	73	75	66	54	45	51
	Average cost per individual, €	20 076	34 344	35 242	47 208	43 246	45 987	47 659	11 731	13 327
	Total cost,€1000	13 912	11 918	9 304	3 446	3 243	3 035	2 574	528	680
	Average age	53	81	75	44	52	42	13	34	n/a
	Average of used service categories	4,0	3,6	5,1	3,3	3,7	5,1	4,2	4,3	n/a
Service categories used, %	Specialized somatic care	79,6	2,5	**13,1**	1,1	2,5	2,3	0,6	8,8	9,6
	Services for older people	**0,8**	83,3	**12,0**	**0,2**	**0,0**	1,5	**0,0**		4,6
	Primary care: Inpatient	**8,9**	**10,3**	64,8	**1,6**	**1,6**	3,9	**0,1**	**4,3**	8,7
	Disability services	0,1		0,1	94,5	**0,8**		2,2		
	Mental health services	0,6		0,4	**0,0**	90,0	**6,0**		1,0	1,4
	Specialized psychiatric care	0,3	0,2	0,2	0,1	2,7	82,9	**0,8**	2,8	0,5
	Child welfare				0,5			94,6		
	Social assistance	0,5		0,6		0,5	0,9	0,3	69,9	6,1
	Services for substance abusers	0,1		0,4		0,2	0,5		**5,3**	29,2
	Medical rehabilitation and physical therapy	3,2	1,1	4,7	0,3	0,2	0,3	0,2	0,2	14,9
	Support for informal care	1,1	**0,7**	**1,1**			0,4		0,9	7,9
	Primary care: Ambulatory and outpatient	**3,7**	**1,6**	2,2	1,4	1,1	0,9	0,3	5,2	9,0
	Rehabilitation center care		0,1	0,1					0,2	7,0
	School and student health services						0,1	0,3		0,1
	Occupational health services	0,1							0,1	
	Oral health	0,6	0,1	0,2	0,2	0,2	0,3	0,3	0,6	1,0
	Guidance service clinics	0,4					0,1	0,1	0,6	0,1
Total		100	100	100	100	100	100	100	100	100

Table 15: 2012 High utilizers classified by their most expensive service category. Displaying number of HU per category, average cost, total cost, average age and average of used service categories. Use of different service categories is displayed as %, rounded to first decimal – smaller values are omitted.

		2012 High utilizers ranked in costliest service category								
		Services for older people	Specialized somatic care	Primary care: Inpatient	Mental health services	Specialized psychiatric care	Child welfare	Disability services	Social assistance	Others
Descriptive information per costliest category	n	418	626	300	84	64	59	52	48	26
	Average cost per individual, €	35 917	20 054	35 891	41 441	53 417	57 737	48 356	12 962	14 016
	Total cost,€1000	15 013	12 554	10 767	3 481	3 419	3 406	2 514	622	364
	Average age	82	57	76	54	42	14	43	33	n/a
	Average of used service categories	3,5	4,0	5,0	3,4	5,0	4,4	3,6	4,5	n/a
Service categories used, %	Services for older people	84,7	0,9	**12,6**	0,3	0,7		0,3	0,1	5,2
	Specialized somatic care	**2,6**	79,7	**14,4**	**2,2**	**3,7**	0,4	**1,7**	9,8	12,2
	Primary care: Inpatient	**9,4**	**9,1**	63,8	2,6	**3,1**	0,3	**1,5**	6,8	9,5
	Mental health services	0,1	0,3	0,2	88,7	**9,3**	**2,0**		1,8	1,3
	Specialized psychiatric care	0,2	0,3	0,4	**4,1**	79,9	**2,4**	0,5	2,0	2,8
	Child welfare						92,8	**1,8**		
	Disability services				0,2		**1,0**	92,7		
	Social assistance		0,6	0,7	0,3	1,2			69,3	4,5
	Services for substance abusers		0,2	0,4	0,1	0,9			**3,7**	28,7
	Support for informal care	0,7	1,0	1,1					0,7	9,9
	Medical rehabilitation and physical therapy	0,9	**3,2**	**4,2**	0,3	0,1	0,1	0,3	0,4	16,6
	Primary care: Ambulatory and outpatient	**1,2**	**3,6**	2,0	1,1	0,8	0,4	0,9	3,3	8,3
	School and student health services						0,1	0,3		0,1
	Rehabilitation center care	0,1		0,1						
	Oral health	0,1	0,5	0,1	0,2	0,2	0,3	0,2	1,0	0,8
	Occupational health services		0,1						0,1	0,1
	Guidance service clinics		0,3			0,1			0,9	
Total		100	100	100	100	100	100	100	100	100

4.3.1. Persistence of high cost in categories and short-term movement

The persistence of high utilization in each category and what kind of movement can be observed among expensive/costly category is analyzed in two parts. First part examines how persistent high utilizers rank per each expensive/costly service category and what number remained as high utilizers the following year. Both years the person had to be a high utilizer and was grouped according the most expensive service category in year 2011. Part two explores if the ranked category changed and in which way.

Table 16 shows the variation of persistence in the expensive service categories, which ranged from very stable to highly transitory. *Highly transitory* was specialized somatic care where only 25.3% of high utilizers remained the following year. Services for the elderly were the most *stable* as 97.4% of 2011 high utilizers remained so the following year. A similar observation of fairly stable persistence can be made in child welfare and mental health services.

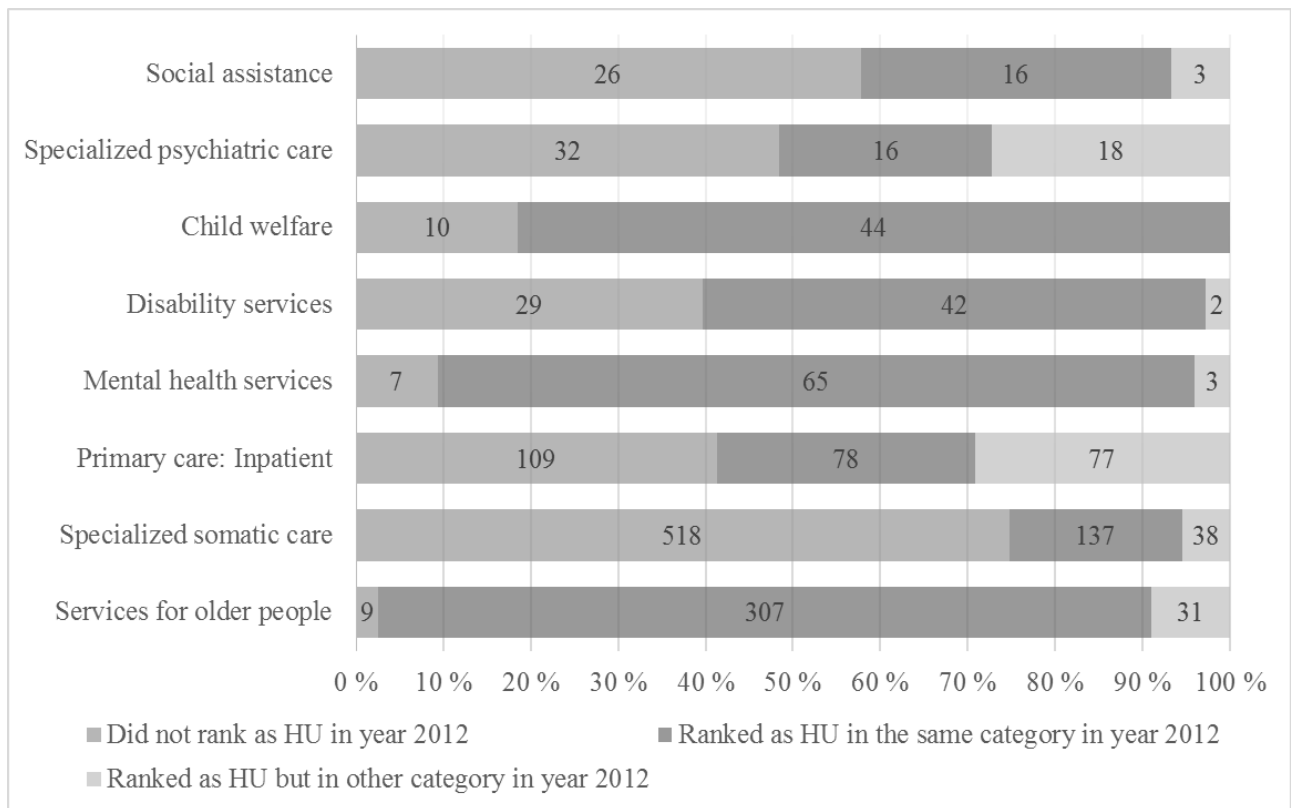**Table 16: Persistence among high utilizer per expensive service category**

	High utilizers(HU) of KALLIO in 2011, ranked by their expensive service category								
	Services for older people	Specialized somatic care	Primary care: Inpatient	Mental health services	Disability services	Child welfare	Specialized psychiatric care	Social assistance	Others
Number of HU per costliest service category in year 2011, n=1668	347	693	264	75	73	54	66	45	51
Number of 2011 HU that remained HU also in year 2012, n=896 (%)	338 (97,4%)	175 (25,3%)	155 (58,7%)	68 (90,7%)	44 (60,3%)	44 (81,5%)	34 (51,5%)	19 (42,2%)	19 (37,3%)

The rest of the expensive service categories are observed to have persistence ranging from 37% to 60%. Remarkably, variation in persistence is an interesting observation as it may reflect something about the types of social and health needs that are either fairly stable or unpredictable. This leads us to the second part, where movement among service categories is explored.

Short-term movement

Short-term movement describes in which of the expensive categories the "persistent" high utilizers rank in the following year, i.e. do they rank in the same category or move across the expensive

categories? Varying levels of movement were observed among the service categories. Figure 4 shows amount of movement and the amount of persistence observed.

Figure 4. Persistence among high utilizer per expensive service category, divided into rank types.

This movement was divided into three levels of movement: low, moderate and high. Table 17 provides more detail on how the persistent high utilizers ranked the following year, i.e. movement into different service categories. This change in the expensive categories is discussed below, by the three levels of observed movement:

1. **Low or no movement**

Child welfare is very distinct as *no movement* among service categories was present. Mental health services and disability services were observed to have similar stable pattern as approximately 95% of high utilizers ranked in the same category the following year.

2. **Moderate movement**

Specialized somatic care was observed to be least persistent, but those who stayed remained mostly in this category as 78.3% ranked the same category following year and 15.4% "moved" to "Primary care: Inpatient care". Similar patterns of substantial movement towards the "Primary care: Inpatient care" were present for "Social assistance" and "Services for older people".

3. High movement

Two observed categories had a high level of movement, as approximately only half ranked in the same category following year. This was observed in "Primary care: Inpatient care" where a movement of 34.8% was toward "Services for older people" and a smaller percentage of 8.4 moved toward "Specialized somatic care". High movement was also present in specialized psychiatric care, but the transition was spread across multiple categories.

Summary

Dividing high utilizers into expensive service categories revealed a high variation in year-to-year persistence. Transitory movement is present in certain categories, but in contrast, others are stable. Movement among categories is distinct in every group and it may reflect the changing needs of high utilizers or a planned change toward more appropriate service.

Table 17: Short-term movement of 2011 high utilizers.

		Rank of high utilizers (HU) among expensive service categories, in year 2011								
		Services for older people	Specialized somatic care	Primary care: Inpatient	Mental health services	Disability services	Child welfare	Specialized psychiatric care	Social assistance	Others
	Amount of HU that ranked as HU both years, amount per service category	(338)	(175)	(155)	(68)	(44)	(44)	(34)	(19)	(19)
Rank of high utilizers in following year 2012, displayed as % of those who remained	Services for older people	90,8	1,1	34,8				11,8		15,8
	Specialized somatic care	0,6	78,3	8,4				8,8		15,8
	Primary care: Inpatient	6,8	15,4	50,3	1,5			11,8	15,8	10,5
	Mental health services	1,5	1,7	1,3	95,6	2,3		14,7		
	Disability services	0,3		1,3		95,5				
	Child welfare			0,0		2,3	100,0	5,9		
	Specialized psychiatric care		1,1	0,6	2,9			47,1		15,8
	Social assistance		0,6	1,3					84,2	5,3
	Services for substance abusers		0,6							21,1
	Medical rehabilitation and physical therapy		0,6	1,3						5,3
	Support for informal care		0,6	0,6						10,5
		100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

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4.3.2. Prior placement

Prior placement shows how the 2012 high utilizers accumulate from the previous years' expenditure categories, i.e. looking at the 2012 high utilizers and their placements in the previous year, by taking into account both low and high utilizers as well people with no previous service use. To account for people with no service use previous year, a category was added.

Information about previous placement may reflect *planned* changes in the "care" or from *unpredictable* need or needs, which lead to high utilization. This placement information could be further used when planning and targeting proactive service efforts.

Previous placement was divided into varied and stable placement categories, as there was a clear division for both. Stable placement was defined when ¾ had the same prior placement and the rest was defined as varied placement.

Varied previous placements

Specialized somatic care was a category that had the highest amount of people with no previous service use (see table 18); in this case, the need/s could be described as *unpredictable, urgent or planned one time procedure*. Prior placement was high also in the ambulatory and outpatient care, which might be related, for example, to urgent need. Interestingly, "oral health" was the next highest placement in the previous year among the specialized somatic care.

Primary care inpatient and specialized psychiatric care both had previous placements that could be described as *planned or unplanned.* For example, in specialized psychiatric care a placement change from the mental health services might be planned, but placement change from the ambulatory and outpatient might be seen as an unplanned event.

Stable placement

Stable placement towards the same category was present in the rest of the expensive categories, but each one had variation with distinctive features. The following was observed:

- Services for older people saw little prior placement outside its own category; the most common prior placement outside the category was in the inpatient primary care
- In child welfare, significant prior placements were observed in specialized psychiatric care and in school and student health services
- In social assistance, previous placement was divided into multiple categories. The three highest were no service use, service for substance abuser and inpatient primary care
- Mental health services was fairly stable. Major prior placement was in services for older people and specialized psychiatric care, small percentage came also from specialized somatic care

Previous placement might indicate, for example, of unplanned events, planned care or high burden of illness that causes needs that are difficult to fulfill. These observations are useful when planning which events could be potentially prevented and where to target proactive efforts.

Table 18: 2012 high utilizer placement in the previous year.

		High utilizers (HU) of KALLIO in 2012, ranked by the costliest service category per individual								
		Specialized somatic care	Services for older people	Primary care: Inpatient	Mental health services	Specialized psychiatric care	Child welfare	Disability services	Social assistance	Others
	n(1677)	626	418	300	84	64	59	52	48	26
	Specialized somatic care	47,6	1,2	18,0	3,6	10,9	1,7		2,1	23,1
	Services for older people	0,6	80,6	13,7	6,0	4,7		1,9		
	Primary care: Inpatient	4,3	13,4	34,7	2,4	3,1		5,8	4,2	11,5
	Mental health services	0,3		1,3	79,8	14,1			2,1	3,8
Costliest	Specialized psychiatric care	0,8	1,0	2,0	6,0	34,4	6,8		2,1	3,8
service	Child welfare						79,7			
category	Disability services				1,2		1,7	84,6		
rank in	Social assistance	2,4		3,0		3,1			77,1	
previous	Services for substance abusers	0,3		1,0		4,7			4,2	23,1
year 2011.	Support for informal care	0,6	1,4	3,7						19,2
% per	Medical rehabilitation and physical therapy	2,4	0,2	3,0		1,6				7,7
costliest	Primary care: Ambulatory and outpatient	25,4	1,2	16,7		10,9	1,7	5,8	2,1	7,7
service	Oral health	5,4		2,0		6,3	1,7		2,1	
category	Occupational health services	2,2				1,6				
	Guidance service clinics	0,3								
	School and student health services	0,6				1,6	6,8			
	Rehabilitation center care	0,2	0,7							
	No service use in 2011	6,4	0,2	1,0	1,2	3,1		1,9	4,2	
	Total	100	100	100	100	100	100	100	100	100

5. CONSTRUCTING A FRAMEWORK TO MANAGE HIGH UTILIZERS

A relatively small percentile of the population utilizes a major share of the total social and health care resources in this studied Finnish joint municipality (see chapter 4). This chapter tries to draw a framework of what elements and factors are needed when efforts to curb high utilization are made. This framework is constructed by the findings from the literature review in chapters 2, as well the findings made in the empirical part.

Managing and preventing high utilization requires two elements: 1. supportive infrastructure and 2. proven service solutions that make an impact. Building and providing these elements offers a field for innovation, as municipalities have limited resources to develop these capabilities. Procurement of these capabilities is possible from the private service providers or by the 3rd sector (see chapter 3.1).

In the empirical part this study explored the service use in KALLIO and chapter 5.2 suggests how to better manage this found high utilizer population.

5.1. Elements to manage high utilizers

Some high use is not preventable and targeting proactive measures toward future high utilizers whom possess preventable events is necessary in order to obtain the desired results. This upfront investment could enhance the life quality of the population, and even make savings on the overall cost. The prolonged longevity of lives might reduce the overall savings made, but the increased well being of people can be seen as a worthwhile investment.

Better management of current high utilizers might be beneficial, especially when uncoordinated application leads to unnecessary service use that does not fulfill the needs of an individual. High utilization might stem also from poor service quality that does not recognize needs early enough

and allows preventable problems to emerge. No matter what leads to high utilization, it can be argued that some part of it could be prevented and services could be improved to better match the needs of high utilizers.

Figuring out what part of high utilization is preventable requires an analysis of the current high use and the driving factors behind it. A careful assessment of which driving factors could be classified as preventable by existent service/care solutions indicates where to target management efforts. Assessing the possible impact and feasibility requires identifying individuals likely to benefit from proactive care or enhanced care efforts. As stated, earlier efforts require two elements to be viable: supportive infrastructure and service solutions that can make an impact.

5.1.1. Supportive infrastructure

As discussed in chapter 2.3, identifying and targeting prospective high utilizers likely to benefit is not an easy task, but it is necessary in order to gain positive outcomes. Targeting enhanced services for people that are not in the target group would cause unnecessary service use and increase the overall cost. Identification must happen early to make it possible to provide proactive efforts in time, and this requires timely use of available information.

The supportive infrastructure should be able to provide the following aspects:

- Possibility to share and use data across different services, in a confidential way
- Use of real time data and predictive risk modeling, in order to allow early interventions
- Combining automatic or manual "clinical assessment" for targeting and selecting efforts
- Feedback system to track the success of efforts and to aid in redesign and realignment
- Possibility to coordinate efforts across the field of social and health care

Finnish municipalities collect information about service users, but using this collected information has certain limitations. The biggest obstacle is how to share and use the data, as it requires assessment of the legislation and related ethical and privacy issues.

5.1.2.   Service solutions

As reviewed in chapter 2.4, the management of high utilizers has faced mixed results, and there is no clear evidence if managing efforts offers cost savings or prevents social and health problems from emerging. The most promising results come when a supportive infrastructure is in place and it is possible to target the real future high utilizers. Thus two pathways are needed; better management of current high utilizers, and management of future high utilizers by proactive measures.

High utilization is varied and the solutions to their problems differ by their demographic characteristics and individual needs. However, the following aspects should be in place in all service solutions:

- In the case of *highly persistent,* use managing is towards the *current high utilizers.* These solutions should enhance the care coordination process, take a person-centered focus and facilitate management of complex conditions, problems and the felt needs
- *Proactive measures* are acceptable especially when targeting the future high utilizers. These solutions should be cost effective and have to be proven to make an impact on the wellbeing of individuals
- Sometimes the problems and conditions are lifestyle-related. Therefore, solutions should facilitate behavioral change and allow substantial interpersonal contact when necessary
- Incorporated follow-up and feedback system are required to track the success rate of proactive and managing efforts, i.e. are the felt needs met

Solutions should migrate from the uncoordinated use of services and allow individuals to better manage their personal situations when viable. Working together across sectors might curb uncoordinated use and centralizing the management of similar high utilizer groups might be beneficial.

5.2. Possible intervention pathways for KALLIO

In this chapter, suggestions on how to manage and curb the high utilization in KALLIO could be done. These efforts are described as intervention pathways. The service use and high utilizers of KALLIO were analyzed in chapter 4. Different kinds of intervention pathways are considered, as the profiles and the needs of high utilizers are considered to be different. Analysis is needs-driven and uses the idea found in the bridges to health model (see chapter 2.5.5.) High utilizers are stratified into four intervention pathways by their most expensive service category, formed earlier in chapter 4.3. The following factors shape the formulation of these pathways:

- The first thing considered is the type of needs associated
- Second, the demographic details must form a limited number of homogeneous groups into the pathway
- Homogeneous groups should aid the planning efforts in social and healthcare services
- In each pathway information about the persistence, movement and prior placement helps to analyze if there is a need for varied approaches inside the pathway

The two least expensive categories are left out as they are not a major driver of high use in KALLIO. These two categories were "social assistance" and the "others". Keeping in mind that high utilization was transitory and high use tends to regress over time, people are not tied into one pathway during their lifetime.

Intervention pathways

Four needs-driven intervention pathways try to capture elements of the service use, taking into account their basic demographic details and most importantly considering the *needs* that might drive utilization.

1. **High utilization driven by old age and declining health**

   Two expensive service categories included mostly people with a high average age, which might be associated with *declining health and increased need of daily support*. These two categories were "Services for older people" and "Inpatient care in primary care". In both

cases preventing the health from declining and providing adequate social support in older age could be seen as a priority. Providing adequate informal care that helps to maintain a functional status has been proven to lower the use of health services among the frail elderly (see 2.3.3).

These ranked categories have some variation which should be considered in planning efforts. The average number of used services was different. High utilizers in *inpatient care primary care* tended to use more services, which might tell about more *complex* or obscure needs that require attention or personal care/service planning. This category also had higher transitory movement towards other categories and varied prior placement. The prior placement is important to note as it was described as planned or unplanned in chapter 4.3.2. The primary care's inpatient care might benefit from predictive risk modeling as the high utilization is not stable.

Services for older people, on the other hand, was very stable and persistent in nature. It requires an approach that focuses on the current high utilizers. The burden of illness might be high and complex, thus providing enough support to maintain the daily functions and to manage multiple chronic conditions simultaneously, which can be seen as important elements.

2. **High utilization driven by special needs**
The categories that had people with very distinctive needs were child welfare and disability services. Both of these categories require substantial daily assistance, and the expenditure is driven mostly by different kind of placements or by institutionalizations.

Child welfare was a category with *very high persistence and little movement*, as child welfare accrues a very high cost when the child placement is outside of the home. Focusing efforts towards proactive social care for children and their families could be seen as a priority, as it might make an impact on the number of placements outside home. It was observed that the prior placement of child welfare was in school health services or in

specialized somatic care. Offering enough support in these prior steps might be beneficial to make early interventions possible. Risk modelling or predictive models might offer support on targeting the preventive efforts.

Individuals in disability services might not benefit from the preventive measures that much, but better coordination of care might be beneficial as they have very distinctive needs. Helping people to get the needed services may prevent problems and facilitate the wellbeing of the individuals. Assistance could be offered for example in how to navigate the system and how to fulfill the personal social and health needs.

3. **High utilization driven by urgent need**

   Specialized somatic care was the most transitory category and among the biggest for total cost among the expensive service categories. This research argues that highly transitory subjects relate to very unpredictable and urgent needs, which trigger high service use. This category would likely benefit from predictive risk modelling and a better use of information, in order to make it possible to offer targeted interventions.

   Somatic care is disease heavy and some part of this disease burden might be related to lifestyle choices that increase the likelihood to develop these "lifestyle" diseases. Offering proactive care for people at high risk could be seen as beneficial strategy. Viable models could include: offering support for improving the individual health literacy, self-management capabilities, and to aid lifestyle changes. The management of chronic conditions might be beneficial if preventable complications lead to the high use of the somatic care services.

4. **High utilization driven by mental health problems**

   Two expensive high utilizer categories could be considered to relate to mental health problems. Those were "mental health services" and "specialized psychiatric care".

Specialized psychiatric care was very transitory, with relatively low persistence, high movement, and a varied previous placement and use of multiple service categories. This might tell about urgent unpredictable need or the lack of management of personal conditions. It could benefit from same methods as specialized somatic care.

Mental health, on the other hand, was fairly persistent and stable with little movement. A smaller number of used services were observed compared to specialized psychiatric care. Focus that would provide support for the existing high utilizers may be more viable. This could, for example, involve in-person focus that would take into account the treatment of mental illness.

Summary

This pathway analysis is limited in multiple ways. It captures only a limited depth of the problems and needs faced by high utilizers. Adding more information through further analysis might offer increased insight into what to take into account and where to focus. Information such as disease burden, pharmaceutical use and proximity of death could be used to segment populations into more detailed groups. This suggestion acts as an early concept and could be improved further.

Compared to the rest of population, high utilizers do not follow the normal use patterns and might benefit from enhanced managerial efforts. Planning how social and health care could better fulfill the needs this population requires the building of more understanding on what could be seen as preventable and feasible to manage. The current methods for producing and delivering services do not necessarily respond to the needs of the high utilizers in efficient and effect manners. Many needs may go unnoticed, as the services do not communicate or act in an integrated way. A supportive infrastructure is necessary when developing and targeting services for high utilizers, especially when adding the proactive elements.

6. DISCUSSION AND CONCLUSIONS

This research aimed to understand how high utilization can be defined, to determine the characteristics of service use, and to explore the basic groups of high utilizers. One goal was to understand the nature of high use; this gained knowledge especially on the differences among high utilization groups that can be used further in managing and planning efforts. In this discussion, findings are evaluated against previous knowledge and some explanations are offered.

6.1. Contribution to the literature

Defining high utilization did not reveal anything new from the literature. Most of the research did not justify this selection. High utilization is described as presenting a small minority of a population that consumes a disproportionally large share of the total expenditure. In this study, the used definition for high utilization as the costliest 5% of population yielded a relatively high proportion of total expenditure and made it possible to compare results with previous studies.

A limited amount of studies have explored high utilization in both social and health care services. Studies may have a specific focus areas such as institutional care (Yip et al. 2007), medical care (Reid et al. 2003; Garfinkel, Riley & Iannacchione 1988), and sometimes a combination of medical care and home care services (Rais et al. 2013). *This might be due the different methods for organizing and funding social and health care services*. This study was able to capture a wide amount of social and health care services, comparable to the focus found in a previous Finnish study by Leskelä et al. (2013) in the region of Oulu. They studied service usage in the social and health care services, and the only difference was that this study included the social assistance as a service.

Compared to the study made by Leskelä et al. (2013) , the distribution of expenditure among high utilizers is line with their findings. In their study, they observed that the most expensive five percentage accounted for 68% of the total cost, and the costliest ten percentage accounted for 81% of the total cost in 2011. In KALLIO the costliest five and ten percentages incurred a slightly smaller percentage of the total cost, with approximately 65% for the costliest five percentage and

77% for the costliest ten percentage. This might explained by the fact that Oulu is a big city and people that have high burden of illness tend to be near places which can provide service to them.

The expenditure distribution observed by Garfinkel, Riley & Iannacchione (1988) in the U.S. population is fairly similar to what was found in this study: they observed that one percentage accounts for 29% of total expenditure and the costliest 10% accounts for 75% of all expenditure. Rais et al. (2013) observed a slightly smaller skew in their study about high cost users in Ontario's healthcare services. High cost users defined as the costliest five percentage accounted for 61% of the total expenditure in Ontario. The observed skew in Finland is higher than in some of the international studies, which might explain more about how social and health care is organized and what has been the focus of the studies.

Comparing the average cost incurred by the high utilizers is inline with the previous research, as Rais et al. (2013) found out that the average cost of the high cost user was 12 times higher compared to all users among Ontario's high cost users. In KALLIO the costliest five percentage of the population accumulated nearly 13 times more expenses on average compared to all users.

Demographic details

Females were observed to account for a slightly bigger percentage among high cost users in the earlier research (Reid et al. 2003; Rais et al. 2013) and this study confirms this finding about the gender difference. High utilization was observed to occur in all the age categories, but especially in the age group above 65 years who represented approximately half of all high utilizers. Earlier studies – with the same definition for high utilization – have made similar observations related to old age (Calver et al. 2006; Rais et al. 2013).

Persistence

When analyzing the costliest 5% of the population, previous studies had found a short-term year to year persistence ranging from 23.7% (Riley 2007) to 30.6% (Monheit 2003). In KALLIO the observed persistence was fairly high (53.7%) compared to the previous studies, which might be slightly explained by the fact that this study could not account for the deaths occurring. Monheit

(2003) categorized deaths separately and did not include them in the persistence, but ranked the deceased as not eligible. Riley (2007) did include deaths in his analysis. Another possible explanation is that the focus of the studies was different as these previous studies explored the persistence in health and medical care expenditure in the U.S. population. This study captures elements of social care, where long-term placements might increase persistence.

When the costliest 5% of KALLIO population was grouped by their most expensive service category, it revealed a persistence ranging from 25.3% – 97.4% in the different categories (see chapter 4.3.1). This remarkably high variance might be explained by the fact that the different services are very distinct in their nature and how urgently they may or may not respond to peoples' needs. Urgent and unplanned needs might reflect a low persistence, as observed in the specialized somatic care. On the other hand, special and stable needs translate to highly persistent use as observed in the services for older people and in child welfare.

Varied demographic details and variations in the persistence suggest that efforts to curb high utilization should be diverse and specific towards the condition they want to prevent. Finding feasible solutions for high use is a multidisciplinary task that requires a timely use of information in a service delivery system that promotes proactivity.

6.2. Strengths and limitations

A strength of this study is that it is able to capture nearly the entire social and health care expenditure incurred by the population of KALLIO. The allocation of cost might contain some errors, especially when monthly cost had to be annualized or when the average cost had to be used. This study did miss the use of pharmaceuticals and the data containing death records.

The pharmaceutical cost has been observed to be fairly skewed as the costliest 5 % of pharmaceutical users account for over half of the drug costs in Finland (Saastamoinen, Verho 2013). This unnecessary polypharmacy can increase costs and cause complications, which increases the likelihood of heavy service use. Not being able to capture the end of life is limiting as it affects the results in the persistence analysis.

6.3. Suggestion for future research

High utilizers or high cost users are a current issue in scientific research and especially in the political field. Future research suggestions are made towards how information could be used better and how to understand high utilization more profoundly.

In social and health care, lots of information is collected, but little or none of this recorded information is used in a proactive way. An interesting question to ask is if this recorded information could be used and shared in a manner that would allow the organizing of service solutions for high utilizers.

Social and health research should aid in defining which parts of high utilization are feasible to prevent. Researching the pharmaceutical use and the diagnosis associated with the high utilizer Finnish population might be beneficial, but it may not necessarily capture the social dimensions associated with high use. Thus, understanding also the felt needs of high utilizers might offer further knowledge on what risk factors are present before high use, and how this risk could be handled better.

Researching high utilization is a complex endeavor and a multidisciplinary approach is needed in order to build a holistic scientific base of knowledge for the management and service innovation efforts.

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APPENDICES

APPENDIX A. SERVICE CATEGORIES. DATASET SOURCE AND SERVICE IDENTIFIER
IN A SPECIFIC DATASET.

Category	Service	Dataset	Identifier in Dataset
Specialized somatic care			
	Anesthesiology and intensive care	Dataset 1: Specialized health care	11
	Neurosurgery	Dataset 1: Specialized health care	25
	Phoniatrics	Dataset 1: Specialized health care	57
	Oncology and radiotherapy	Dataset 1: Specialized health care	65
	Neurology	Dataset 1: Specialized health care	77
	Pediatric neurology	Dataset 1: Specialized health care	78
	Heredity / Medical genetics	Dataset 1: Specialized health care	94
	Occupational medicine and occupational health	Dataset 1: Specialized health care	95
	Physical medicine	Dataset 1: Specialized health care	96
	Geriatrics	Dataset 1: Specialized health care	97
	Internal medicine	Dataset 1: Specialized health care	10(E-G-H-I-K-M-R)
	Surgery	Dataset 1: Specialized health care	20(E-J-L-O-P-R-U-V-Y)
	Gynecology and parturition	Dataset 1: Specialized health care	30(E-Q)
	Pediatrics	Dataset 1: Specialized health care	40(A-D-E-G-H-I-K-M)
	Eye diseases	Dataset 1: Specialized health care	50 (N)
	Otorhinolaryngologic diseases	Dataset 1: Specialized health care	55(A-B)
	Stomatognathic diseases	Dataset 1: Specialized health care	58(V-X-Y)
	Skin diseases and sexually Transmitted diseases	Dataset 1: Specialized health care	60(A-C)
	Lung diseases	Dataset 1: Specialized health care	80(A)
	Uncategorized special care	Dataset 1: Specialized health care	99K
Specialized psychiatric care			
	Psychiatry	Dataset 1: Specialized health care	70(Z)
	Adolescent psychiatry	Dataset 1: Specialized health care	74
	Child psychiatry	Dataset 1: Specialized health care	75
Guidance service clinics			
	Maternal health clinic	Dataset 2: Primary health care	T21
	Child health clinic	Dataset 2: Primary health care	T22

	Family planning and preconception care	Dataset 2: Primary health care	T23
	Aged individual guidance clinic	Dataset 2: Primary health care	T24
School and student health services			
	School health services	Dataset 2: Primary health care	T26
	Student health services	Dataset 2: Primary health care	T27
Occupational health services			
	Statutory occupational health services	Dataset 2: Primary health care	T30
	Non-statutory occupational health services	Dataset 2: Primary health care	T31
Medical rehabilitation and physical therapy			
	Physical therapy	Dataset 2: Primary health care	T51
	Assistive devices	Dataset 2: Primary health care	T52
	Speech therapy	Dataset 2: Primary health care	T53
	Occupational therapy	Dataset 2: Primary health care	T54
	Podiatry	Dataset 2: Primary health care	T55
	Nutritional therapy	Dataset 2: Primary health care	T56
	Other rehabilitation and special therapy	Dataset 2: Primary health care	T59
Services for older people			
	Assisted living facilities	Dataset 5: Institutional care and housing services in social care	81
	Geriatric long-term care facilities	Dataset 5: Institutional care and housing services in social care	31
	24-hour assisted living for older people	Dataset 5: Institutional care and housing services in social care	32
	24-hour assisted living for demented	Dataset 5: Institutional care and housing services in social care	34
	Home care	Dataset 2: Primary health care	T40
	Home care services	Dataset 2: Primary health care	T41
	Homemaker services	Dataset 2: Primary health care	T42
Disability services			
	Services and support for people with disabilities	Dataset 5: Institutional care and housing services in social care	41
	Assisted living for people with disabilities	Dataset 5: Institutional care and housing services in social care	42
	Guided living for people with disabilities	Dataset 5: Institutional care and housing services in social care	43

	Supported living for people with disabilities	Dataset 5: Institutional care and housing services in social care	44
Services for substance abusers			
	Welfare for intoxicant / Drug abusers	Dataset 5: Institutional care and housing services in social care	5
	Substance abuse services	Dataset 2: Primary health care	T73
Rehabilitation center care			
	Rehabilitation center care	Dataset 5: Institutional care and housing services in social care	6
Oral health			
	Oral health	Dataset 2: Primary health care	T60
Support for informal care			
	Support for informal care	Dataset 6: Count of regular home-care clients on 30 November	N/A
Child welfare			
	Child welfare	Dataset 3: Child welfare	1,2,3,4,5,6,9,10,11
Social assistance			
	Social assistance	Dataset 4: Social assistance	
Mental health services			
	Mental hygiene	Dataset 2: Primary health hare	T71
	Supported housing	Dataset 5: Institutional care and housing services in social care	82
	24-hour Sheltered housing/ Accommodation (under age 65)	Dataset 5: Institutional care and housing services in social care	84
	24-hour care in a sheltered housing	Dataset 5: Institutional care and housing services in social care	85
Primary care: Ambulatory & outpatient			
	Ambulatory care	Dataset 2: Primary health care	T11
	Day hospital	Dataset 2: Primary health care	T81
	Other services	Dataset 2: Primary health care	T90
	Screenings and other mass Screenings	Dataset 2: Primary health care	T28
	Other health care	Dataset 2: Primary health care	T29
	Medical social work	Dataset 2: Primary health care	T58
Primary care: Inpatient care			
	Long term inpatient care	Dataset 1: Specialized health care	98