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ESSAYS ON CARE INTEGRATION AND FRAILTY: CHALLENGES AND PERSPECTIVES

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A dissertation submitted to the

Faculty of Economics

Università della Svizzera italiana

For the degree of Ph.D. in Economics

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Lugano – June , 2013

To my mother and my sister

Acknowledgments

It goes without saying that the completion of this thesis would not have been possible without the guidance and support of numerous people. I would like to assure them all of my gratitude and appreciation, although only some are acknowledged below.

I am thankful to my supervisor, Prof. Stefano Calciolari, for having offered me the opportunity to work with him, for his patience and for his guidance. What I have learned from him goes far beyond the work presented here. I am also grateful to the members of the committee, Prof. Marco Meneguzzo and Prof. Giovanni Fattore, both for taking the time to read this document and for their constructive criticism and helpful suggestions.

I owe a debt of gratitude to Prof. Mario Jametti, for helping me find within myself the force to complete this project. His guidance and insight have truly been invaluable. I am humbled by his trust and appreciation and I can only hope to live up to his expectations. A heart-felt thank you goes to Prof. Susan Hamer, who is an inspiration and a true role-model.

I also want to thank my colleagues, who I am proud to call my friends. During the past four years, they have taught me Italian, to cook, to bike, to hike and most everything I know about friendship. I am a better researcher and a better person for having known them. They have shared with me the difficult and trying times and I am honored to share with them all merit.

Finally, my most important acknowledgments are towards my family. Their love and support give meaning to everything I do and have been the single biggest motivating force in my life. To my mother, my sister and my baby I dedicate this work, as I do all my efforts and achievements. They are my balance and my home.

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INTRODUCTION

As the population of developed countries is ageing, health care systems are faced with the challenge of rapidly responding to emerging needs by rearranging service delivery. The elderly represent a large and growing proportion of the total population and tend to use significantly higher amounts of health services as compared to younger age groups, leading to the concern that resource consumption in health systems will increase exponentially. In addition, population ageing is associated with a high prevalence of chronic diseases and poly-morbidities, which posits the issue of how to better manage emerging clusters of patients characterized by fragilities that require involving providers across care settings.

Care integration has often been cited as an effective strategy to deal with both cost containment and demographic change issues. Integrated care models represent innovative attempts to redesign the deployment of available resources along the care continuum, in such a way as to limit the amount of waste, ensure a seamless care path for patients, and foster service quality. Integrated models are most relevant for clusters of patient with complex needs who are likely to require concomitant attention from multiple providers across care settings: the frail elderly form one such cluster. However, while a growing body of research assesses the challenging complexity associated with aging and frailty through service integration, substantial knowledge about the conditions leading to positive outcomes is still lacking and numerous questions remain. The three essays we present are an attempt to shed some light on some of the most salient. They build around the concepts of care integration and frailty, and aim to unveil the challenges and opportunities associated with each concept in the perspective of innovating health service delivery.

The first essay comprises an exploratory investigation of models of care integration for the frail elderly in Europe and North America, through an extensive literature review and a comparative case study analysis. Four relevant cases of integrated service provisioning (in Canada, United States, Italy, and Switzerland) were selected on the basis of the maximum environmental differences criterion and compared along four main dimensions: (1) contextual factors – including funding schemes, insurance coverage and level of decentralization; (2) cultural factors – including governance models, division of responsibilities between providers and system conduciveness to collaboration; (3) organizational level factors – referring mainly to networking

and collaborative arrangements between organizations; and (4) operating means – grouping the tools and practices adopted in order to enact the objectives shared across organizations and care settings.

On the basis of the comparative analysis we built a conceptual framework which links the success of integrated care initiatives with adequate funding and governance structures, the implementation of a result-based accountability system, the organizational attitude toward strategic partnerships and the collaborative culture of professionals. We labeled these general dimensions: Institutional Adequacy and Focus on Results, Organizational Arrangements and Transition Management Culture; and argue that they strongly influence the success of care integration initiatives. Finally, we posit that the intensity of integration (defined as the number of implemented operating means) does not directly influence the success of care integration.

In the second essay, we present an empirical test of the propositions derived from our conceptual framework. Namely, that successful integration is influenced by contextual, cultural and organizational factors and that it has a positive impact on care quality. We use the Italian national health system as our empirical setting, capitalizing on the fairly wide variation in regional and local settings. The dataset was built by administering an ad hoc questionnaire to the top managers of all Italian local health units. We used confirmatory factor analysis to validate the measurement models and structural equation modeling to test the hypothesized relationships between the latent constructs of our conceptual framework.

Notably, we validated a composite measure of care integration that could be useful for both policy makers and health managers willing to design and assess successful initiatives. There is also evidence that providers' collaborative attitude and goal sharing are highly relevant enablers for integration efforts; also important are a system-wide focus on results and organizational models mainly based on partnerships. However, not all factors considered in the literature exert a significant influence. In particular, the introduction of results-based accountability systems (e.g., evaluation of effectiveness or satisfaction) is more effective than imposing system-level constraints or shaping the service delivery (e.g., budget constraints, number of providers). Finally, our sample suggests that the gap between priority setting on the policy agenda and appropriate resource allocation for implementation is likely to be a major hindering factor of care integration. In addition, we found evidence that: (a) the attained level of integration positively

influences care quality as reported by respondents; and (b) it fully mediates the effect of the technical intensity of integration on care quality.

The third essay contributes to the literature on the dynamics of the frailty process and its implications for health care utilization. Frailty is highly associated with multi-morbidity and is a precursor to disability, both significant contributors to the burden of disease and the sustained upsurge in health care expenditure across Europe. However, little is known about the burden the frail elderly place on the health system before their physical decline into disability and dependency. To answer this question, we used data from the three currently available panel waves of The Survey of Health, Ageing and Retirement in Europe (SHARE), exploiting the longitudinal structure of the dataset to account for unobserved heterogeneity at the country and individual level. We measure the effect of frailty and the presence of multimorbidity on the number of doctor visits, which can be further decomposed into number of GP visits and the probability of seeing a specialist within the past 12 months, and on the probability of being admitted to the hospital.

We confirm that worse frailty states are associated with significant increases in the number of doctor visits. However, this association is entirely driven by an increased level of primary care utilization among the frail; we find no effect of frailty on the probability of seeing a specialist, after controlling for chronicity and multi-morbidity. We also find a strong effect of frailty on the probability of being hospitalized, confirming a susceptibility to adverse outcomes in this cluster of patients and a need for targeted preventive interventions.

CHAPTER 1
CARE INTEGRATION FOR THE FRAIL ELDERLY: FOUR INTERNATIONAL EXPERIENCES

INTRODUCTION

The world population is ageing. This trend, first apparent in Western developed countries but more and more diffuse, is projected to enlarge and deepen (Anderson & Sotir Hussey, 2000), underpinning the urgency for all societies to direct their attention and their efforts toward the momentous consequences of ageing. The implications for health care systems are profound: utilization will increase considerably and new, complex clusters of patients, requiring attention from multiple providers across care settings, will account for a much larger proportion of health care users. Consequently, the exigency to coordinate a wide array of social services (care) with multifaceted health services (cure) leads to interdependency of results between care sectors.

Care integration is a potential solution to such issues (Hofmarcher et al., 2007), as it addresses salient problems of misconnect and fragmentation. Nonetheless, it remains a highly non-specific objective both at the policy and at the managerial level and a general lack of knowledge about success drivers considerably hinders progress. We attempt to contribute to the literature by proposing a conceptual framework of the dynamics of care integration, as it emerges from a comparative case study analysis focused on programs for the frail elderly.

The essay follows the ensuing structure. We start by presenting a general overview of recent demographic trends and their relevance for health policy. We also discuss in some detail the characteristics of the frailty syndrome, its assessment in clinical practice and its prevalence around the world. We then move to a review of the most recent research literature on care integration, including an overview of the attempts at a comprehensive definition. Four comparative case studies of care integration in Europe and North America are described, with an investigation into the strategies adopted and combined in these relevant initiatives. Finally, we describe and discuss a comprehensive framework structuring the information for each case study in four main integration dimensions. The analytical comparison allows us to suggest key factors that seem to be associated with success – summarized in the final discussion – and directions for further research.

DEMOGRAPHIC TRENDS AND WELFARE

As there is no generally agreed upon definition of old age, in the present study we opt for the most common: demographic aging is to be understood as the proportion of the population 65 years of age or over. The 'World Population Ageing 1950-2050' report, intended as a foundation for the debates and follow-up activities of the Second World Assembly on Ageing, presents four major findings: (a) population ageing is unprecedented in the history of humanity; (b) it is pervasive – affecting every person, on a global scale; (c) it is enduring – continuously on the rise in a stable trend; (d) it is profound, having extensive implications for the economic, social and political spheres and being most likely irreversible (United Nations, 2001).

Though different countries may currently find themselves at different points in the aging cycle and thus more or less pressured to consider its implications, demographic trajectories invariably point to a significant shift in the age distribution of the population. The median age of the total population of the EU27 is expected to increase from 40.4 years to 47.9 years between 2008 and 2060 (Giannakouris, 2008), while by 2050 the world median age is projected to increase by almost 40%, to 36 years (United Nations, 2001). In the next 50 years the population aged 65 years or over is expected to almost double in absolute terms (from 84.6 to 151.5 million) in EU countries. The age group 80 years and over displays a similar tendency (from 21.8 million to 61.4 million). The relative size of the old age group is expected to increase rapidly, reaching 30.00% of the total population by 2060.

Population ageing posits challenges covering a multitude of economic, social and political aspects. The old age dependency ratio[1] will increase from 25.4% in 2008 to 53.50% in 2060, practically doubling the burden on the active population in the EU area (Giannakouris, 2008), in a trend that is consistent at a global scale[2]. As a result, governments are making consistent efforts to adapt policies in order to allow older individuals to lead independent lives and to actively participate in the work force (Zaidi, 2008). Such policies are expected to mitigate the disruptive impact in the economic arena: labor markets, pension systems and intergenerational transfers are likely to be most affected (Lloyd-Sherlock, 2002), though scholars have also raised questions about the impact of demographic change on economic growth, savings, investment and taxation.

[1] The old age dependency ratio is an indicator of the level of support of the old by the working population expressed in relative size of the old age group to the working population.

[2] The old age dependency ratio will almost double in North America (from 19.00% to 35.00%), Africa and Oceania, and more than triple in Asia and Latin America, from 9.00% to 26.00% (United Nations, 2001).

Health care is another relevant component of the welfare state that directly faces the challenge of population ageing. Old age is associated with high prevalence of chronic disease and high risks of multiple morbidities and adverse outcomes (Anderson & Sotir Hussey, 2000), which in turn drive health care costs and considerably increase the use of long-term care facilities (WHO, 2005). The elderly use significantly higher amounts of health services, compared to the younger aged groups (OECD, 1996). In a study on eight OECD countries, Anderson & Sotir Hussey (2000) found that between 34% and 47% of total health expenditure is accounted for by the costs of treatment for the elderly. Interestingly, Jencks and colleagues (2009) showed that almost one fifth of about 12 million Medicare beneficiaries discharged from hospitals from October 2003 and September 2004 were re-hospitalized within 30 days. Their average stay was 13.2 % longer than that of patients in the same DRG who had not been hospitalized during the previous 6 months ($p<0.001$), and in half the cases there was no bill for a visit to a physician's office between the time of discharge and re-hospitalization. The risk of re-hospitalization persists over time with estimated costs of over $17 billion for unplanned re-hospitalizations in 2004, and the low involvement of physicians after discharge suggests a lack of community care perhaps resulting from neglecting the complexity of frail patients' needs. Therefore, the authors suggest that hospitals may need to collaborate with other actors within the health system to improve the promptness and reliability of care by integrating a variety of services. In addition, they emphasized that the average length of stay for re-hospitalized patients is 0.6 day more than for patients in the same DRG whose most recent hospitalization had been at least 6 months previously; while their DRG-based payments would be largely the same. When improper re-hospitalizations reach such rates the impact is felt both by provider organizations (hospitals carefully manage their capacity and would see their profits reduce) and by the health system as a whole (accumulation of inefficiencies).

EMERGING CLUSTERS OF PATIENTS

The depicted situation calls for new strategies in order to effectively deal with emerging clusters of patients. European countries have been at the forefront of policy innovation providing services for the elderly within the framework of the welfare state (Zaidi, 2008). Several countries (e.g., Germany, Japan, Israel, Canada) have introduced specific insurance schemes to face the financial burden of what can be considered a particular risk blurring the line between health care and other sectors (e.g., the social one). However, responses at the managerial and clinical level have

been less decisive. It is of paramount importance to rearrange the service delivery system according to identified and properly combined strategies in order to deal with the complexity associated with ageing. For instance, disease management programs are specifically designed to respond to the care needs of chronic patients with a focus on particular pathologies (Wagner et al., 1999; Pilnick et al., 2001). But complex patients – such as disabled, mentally ill and multimorbid individuals - require concomitant attention from multiple providers across care settings. They need constant care from GPs, specialists and other care givers who should share the understanding that standard treatments might be intolerable for such types of patients and that the treatment for one specific condition can have adverse effects on their overall health status by complicating concurrent conditions (Fried et al., 2001). The frail elderly also form a cluster of complex patients. Frail individuals need simultaneous treatment for any potential pathological causes of their functional decline, rehabilitation services after adverse events in order to restore their health without complicating concurrent conditions and targeted interventions which can help them improve or maintain functional status (Fried et al., 2004). The best results are likely to be achieved if the care process is continuous and inter-disciplinary and follows tailored individual care plans (Espinoza & Waltson, 2007).

In summary, increasing numbers of patients require a wide array of both social assistance and health services, whether simultaneously or sequentially. The policy implications that ensue must be carefully considered, as the system should be equipped to respond satisfactorily to the constant changes on the demand side (Anderson & Sotir Hussey, 2000). Evidence suggests that hospitals collaborating with other actors of the health system improve the promptness and reliability of care by properly integrating a variety of services (Rollow et al., 2006; Bondestam et al., 1995). Hospitals should better coordinate processes according to the patient-centric principle of care intensity (rather than mere medical specialty) redefining their offer according to clinical pathways articulating a range of multidisciplinary services – vertical dimension (Jencks et al., 2009). In addition, they should establish or join strategic networks of care aiming to integrate those services needed to cover the whole range of needs (occurring before and after hospitalization) of their patients and eventually capitalize on the opportunities for economies of scale – horizontal dimension (Lega & Calciolari, 2012).

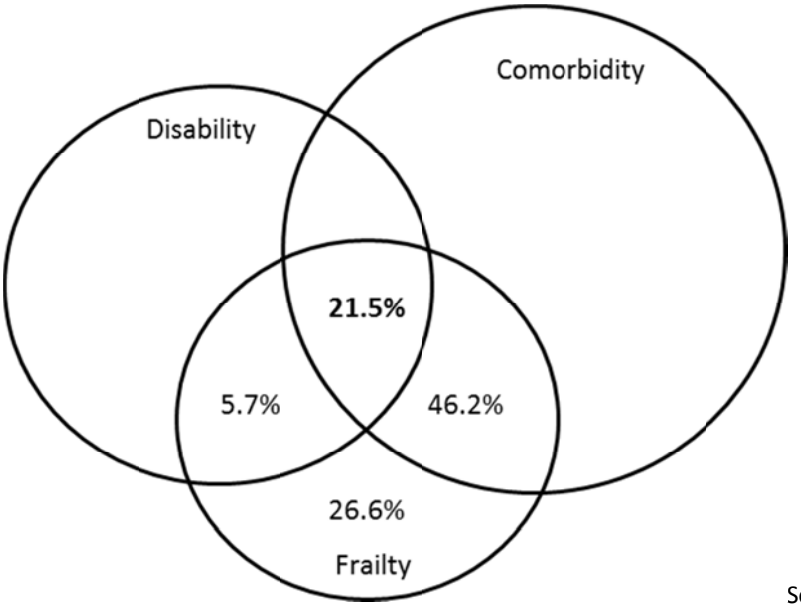
In response to these pressures, reactions in the health care sector were oriented to improve efficiency and effectiveness by reducing fragmentation along both the aforementioned dimensions. Integration efforts have been extended over the whole value chain of the health sector: health insurance (i.e., the creation of long term-care schemes), long-term outpatient/inpatient care, information systems supporting administration and clinical care, financing mechanisms (Wan et al., 2001). Health care providers' goals are starting to change from a focus on independent care episodes to the provision of efficient care across the continuum - through not only treatment, but also prevention and caring (Wan et al., 2002).

THE FRAILTY SYNDROME

Frailty is a geriatric syndrome whose rising prevalence makes it progressively more relevant for public policy. It denotes a condition whereby the patient's reserve capacity is diminished and her health risks increase considerably. The lack of a generally agreed upon operational definition has led to the term being used interchangeably with those of co-morbidity or disability, to describe vulnerable adults (usually elderly) in need of enhanced care services. However, consensus is building between geriatric professionals that, despite being causally interrelated, the three terms define different clinical entities and that the lack of clarity in defining and distinguishing between them may lead to a loss of diagnostic accuracy and effectiveness of treatment (Fried et al. 2004).

From the literature on frailty, we emphasize two attempts to provide a comprehensive definition. Bortz (2002: 284) describes frailty as "a state of muscular weakness and other secondary, widely distributed losses in function and structure that are usually initiated by decreased levels of physical activity". Fried et al. (2004: 256) consider frailty to be "an aggregate expression of risk resulting from age- or disease-associated physiologic accumulation of sub-threshold decrements affecting multiple physiologic systems. Although the early stages of this process may be clinically silent, when the losses of reserve reach an aggregate threshold that leads to serious vulnerability, the syndrome may become detectable by looking at clinical, functional, behavioral, and biological markers." It is quite apparent from the above that, while being distinct from both co-morbidity and disability, frailty still overlaps the two, to some extent (Figure 1.1).

FIGURE 1.1 THE OVERLAP OF FRAILTY, COMORBIDITY AND DISABILITY IN THE CARDIOVASCULAR HEALTH STUDY



Source: Fried et al., 2004

Old age is also commonly associated with frailty but the overlap is only partial. In fact, while frailty is a fairly good predictor of adverse health outcomes, it is so independently of disability or old age, which, in comparison, are weak predictors of adverse outcomes (Walston et al. 2002). Four main etiologies have been identified and confirmed in the literature; we list them here in ascending order of their contribution to the state of frailty: genetic disorders, ageing, disease and injuries, and lifestyle (Bortz, 2002). More recently, research results have contributed to enriching the set of potential risk factors (Espinoza & Fried, 2007). Certain physiological changes are known to contribute to the decline in frailty state; most notably: anemia, inflammatory processes and immune system dysfunctions. Cardiovascular diseases, diabetes, arthritis and cognitive impairments also associate highly with frailty. Finally, low socio-economic status (Blaum et al., 2005) and being female (Woods et al., 2005) predispose individuals to frailty in older age.

The clinical criteria used to identify frailty under the phenotypic definition include weight loss and/or undernourishment, muscle weakness, fatigue, declines in activity, unsteady gait and poor endurance (Fried et al. 2004, Bortz, 2002). Frailty is clinically identified on the basis of this assemblage of symptoms, with the central focus falling on multisystem involvement (as frailty cannot be defined as the alteration of any single system). When none of these deficits are present the individual is defined robust, whereas if three or more of the criteria are met the individual is

categorized as frail. The in-between situation, when only one or two criteria are present, is classified as a state of pre-frailty and identifies a subset of the population who, despite maintaining most of their functional abilities, are at high risk of progressing to frailty.

Alternatively, the "Frailty index -FI" (Rockwood et al., 2007) is a risk index counting deficit accumulation over time. In a comprehensive geriatric assessment, individuals are evaluated for the potential accumulation of any of 70 identified deficits, covering the presence and severity of disease and physical symptoms apparent in the physical or neurological examination and the individual's level of disability. Measures of an individual's social and psychological functioning are also included, rendering the assessment a comprehensive overview of all the domains of human functioning. We note in passing two similar instruments: the Edmonton frail scale (Rolfson et al., 2006) and the Tilburg frailty indicator (Gobbens et al., 2010). Such measures are more sensitive predictors of adverse health outcomes, though less practical in most settings than the simpler, phenotypic operationalizations (Xue, 2011).

The frailty syndrome is highly prevalent in the elderly population. While this is a well-established fact, prevalence estimates vary markedly between different populations, geographical regions and, most noticeably, depending on the assessment instruments used. Even if we restrict the scope to studies using the phenotypic assessment criteria, as described in the above, frailty prevalence around the world is generally high but very heterogeneous. In the United States, between 7% and 12% of community dwelling adults aged above 65 who took part in the Cardiovascular Health Study were diagnosed as frail (Fried et al., 2001). The prevalence for the 65 to 79 years women enrolled in the Women's Health Initiative Observational Study (Woods et al., 2005) reached 16.3% whereas prevalence in a comparable population of 65 and older males was estimated at only 4% (Cawthon et al., 2007). The average prevalence across Europe is estimated at over 17% in a cross-national study including 10 European countries: the authors note the very large variations between countries, ranging from 5.8% in Switzerland to 27% in Spain (Santos-Eggimann et al., 2009). Even higher prevalence levels resulted from a study by Alvarado et al. (2008), using data on residents of 5 large Latin American and Caribbean cities. They classified as frail 30% to 48% of women in the local samples and 21% to 35% of the men.

It is apparent from these results that the frailty syndrome is a large-scale issue of global relevance. As the population grows older, the urgency of addressing the care needs of the frail

will weight ever more heavily on health policy agendas around the world. The frail require the attention of multiple care providers, usually spanning traditional care settings, to be offered in a coordinated and continuous manner. Their care plans must be geared towards the achievement of long-term, comprehensive health goals and prevention of decline, and revolve around the patient herself rather than any distinct pathology she might be suffering from (Anderson, 2011; Fried et al., 2004). In order to offer such care, health systems must manage the shift from traditional, disease-based or episode-based care to a patient centric model of care integration.

FOSTERING CARE INTEGRATION

Over the past decades, the concept of integrated care has become a part of health policy in most European states. Both the WHO and the European Commission endorse national efforts to implement integrated care initiatives, declaring it vital for the sustainability and improvement of the health and social care systems. Nonetheless, there is no general consensus over a standard definition, nor consistency in employing the specific terminology (Bell et al., 2008). The literature is replete with a variety of characterizations; we summarize some of the most comprehensive and widely accepted in the following.

The World Health Organization defines integrated care as "a concept bringing together inputs, delivery, management and organization of services related to diagnosis, treatment, care, rehabilitation and health promotion. Integration is a means to improve the services in relation to access, quality, user satisfaction and efficiency" (Grone & Garcia-Barbero, 2001). This definition, taking the provider's perspective to integration, encompasses all elements generally associated to health care. However, it fails to explicitly account for the deep divide between social and health care and for the heterogeneity of integration models, as determined by the national contexts and cultures.

From a policy perspective, the OECD employs the concept of coordination of care to illustrate "system-wide efforts and/or specific policies to ensure that patients – particularly those with chronic conditions – receive services that are appropriate to their needs and coherent across care settings and over time" (Hofmarcher et al., 2007). Though the terms integration and coordination are often used interchangeably, some authors differentiate between the two: they represent rising levels of integration intensity. The scale can consist of two – coordination and integration

(Grone & Garcia-Barbero, 2002), three – linkage, coordination, full integration (Leutz, 1999) or five different levels – information sharing, cooperation and coordination, collaboration, consolidation and full integration (Konrad, 1996). Generally, each level represents a point on the same integration continuum ranging from loosely coupled and informal to highly unified and formal relations. At the extremes of the spectrum linkage represents informal relationships, while full integration is associated with a single leading authority, pooled funding, and unified activities (Konrad, 1996).

Taking a patient-centered perspective to care integration, Kodner and Spreeuwenberg (2002) suggest the following definition: "Integration is a coherent set of methods and models on the funding, administrative, organizational, service delivery and clinical levels designed to create connectivity, alignment, and collaboration within and between the cure and care sectors. The goal […] is to enhance quality of care and quality of life, consumer satisfaction and system efficiency for patients with complex, long-term problems cutting across multiple services, providers and settings." Here the emphasis falls on the different levels at which integration might occur: at the *macro* level – the health system structure and its general policies – at the *meso* level – the organizations and professions – and at the *micro* level – the techniques and processes (Delnoij et al., 2002). Of course, outcomes of interventions at any level are interdependent and should be designed with consideration to the general characteristics of the system.

The literature is replete with descriptions and evaluations of specific techniques and/or tools (i.e., means) aimed at fostering integrations. Among them, we note some of the most commonly employed: case/care management, discharge arrangements, intermediate care and informal care support.

Case/care management entails a phased and structured guidance of the care process, in which care is individually tailored, planned and implemented in an interdisciplinary team, coordinated by a case manager (Steeman et al 2006). It is a client-based method aimed at building up a network spanning time and different services and allowing the patient to use it independently (Leichsenring, 2004). It builds on the strengths of multidisciplinary teams: medical, socio-medical and social professionals who, by using their joint expertise and knowledge, can select the most appropriate services to be provided; while the case manager ensure service provision coherence and follow-up.

Intermediate care strategies are focused on filling organizational gaps. They are designed to facilitate the smooth transition of patients from one level of care to another. Such strategies target patients who are more likely to require a multitude of care and cure services from different providers (Leichsenring, 2004). In this spirit, discharge arrangements across the hospital-community interface have been employed in an attempt to reduce readmission rates, length of stay and mortality, and to improve health status and patient satisfaction.

Finally, informal (family) care support strategies are aimed at smoothing the transition of patients from institutional care settings to the home and provide the necessary help for carers. Among the mechanisms used are the provision of discharge/information packs, ward-based discharge coordinators, training for staff and/or carers, schemes to support carers at home immediately after discharge, pre-discharge home-visits and early discharge schemes. This strategy can easily blur the line of home care schemes, designed with different mixes and intensity levels of medical (cure) and non-medical (care) assistance and intended to cover longer periods of time.

FOUR CASE STUDIES ON CARE INTEGRATION

Our analysis focuses on four cases of complex integration initiatives, providing care for frail elderly patients. The case selection was based on the maximum environmental differences criterion (Rihoux & Ragin, 2009). Selected cases are similar for target population, success in terms of outcomes, and continuation to the present; while they are different with respect to the context in which they are embedded: the United States, Canada, Italy, and Switzerland. The first case study is an example of a successful nationwide extension of a local initiative, while the second was originally designed for a province of Canada and is being adopted in other provinces; the Italian case is a local pilot project with strong political support in one Region (Lombardia) of the national health system; the last case focuses on the experience of a Swiss canton in regulating and organizing home care assistance according to a legislation enacted in 2000.

The first two cases were selected because they are considered best practices of care integration in the literature. The information presented in the case profiles comes from secondary data, collected in a comprehensive review of the English literature published in the period 1985-2010 and accessed through the following databases: Science Direct, Business Source Complete, Cilea

Digital Library, Jstor, ABI/Inform, PubMed. The main keywords used (aside from the program names) were: integrated care/health, elderly care, population ageing, frail patient, frailty, coordination of (health)care. We have also searched the bibliographies of the articles retrieved for interesting references to acquire. Overall we have read over 250 peer-reviewed articles and official documents. The Italian case was selected on the basis of similarities in target population and availability of data, which were mainly retrieved from institutional documents and reports published on the official Website of the local health unit (LHU). Finally, the Swiss case study was selected because of its geographical proximity, facilitating the collection of primary data through interviews and from institutional sources. The case presentations are structured in three core sections: (1) a short description of the contextual setting in which the initiative is rooted, its origins, driving principles and progress to the present, (2) an analysis of the integrated care model used with a special focus on the main integration strategies implemented, and (3) available evaluation results and overview of care outcomes.

PROGRAM OF RESEARCH TO INTEGRATE THE SERVICES FOR THE MAINTENANCE OF AUTONOMY (PRISMA)

Canada has a universal, predominantly tax-funded health system, articulated in ten provinces and three territories, which offers health care coverage to all the residents on its territory (including immigrants, but excluding foreign visitors). While funding and regulatory infrastructure are federal responsibilities, provinces and territories finance, administrate and organize service delivery in a highly decentralized manner. In the late 1980s a regionalization process started, combined with devolution of funding based on global budgets. The reform intended to rationalize resource allocation and foster continuity of care through service integration. Each Regional Health Authority (RHA) is now in charge of the public health of its population, but the range of services offered varies considerably between provinces (EOHCS, 2005). All the 13 provinces and territories offer universal hospital and physician care to their citizens, but they exhibit marked differences in funding, administrative and organizational models employed. Both public and private actors are involved in the direct provision of care: the RHAs act as both purchasers (e.g. the provision of some specialized ambulatory services is contracted out to private providers) and providers (e.g. most acute care facilities are managed directly by the RHA). Funding is largely public (70%), supplemented by private expenditure in the form of out-of-pocket payments

(15%) and private insurance (12%) for dental care, long term and community care, and others (WHO, 2005; OECD Health, 2012). Most private insurance is sponsored by employers and can be classified as complementary, as its coverage does not overlap the public one.

In 1999 the PRISMA project was launched with the support of a consistent grant from the Canadian Health Services Research Foundation in partnership with the "Fonds de la Recherche en Santé du Québec" (Quebec Health Research Fund), the Quebec Ministry of Health and Social Services, the Sherbrooke Geriatric University Institute, and five Regional Health and Social Service Boards. Its designers had in mind an extremely relevant question: "Can the implementation of mechanisms and tools to deliver integrated, continuous services enhance the relevance, quality, effectiveness and efficiency of care and services for people with diminished independence?" (Hébert & Tourigny, 2007). In other words, they were elaborating a strategy to address the issue of frail patients. Enrollment in the program is based on four main eligibility criteria: patients must be older than 65 years, suffer from moderate-to-severe disabilities (Hébert et al., 2004), have a good potential for treatment at home, and require the provision of two or more health care or social services (Hébert et al., 2003a).

PRISMA was designed as a strategic partnership between researchers and health care administrators representing the Government and the Regional Health Boards, who share decisional power in both the strategic and scientific decisional processes, with a resulting participatory governance model. It employs an integration model based on coordination that does not strive to change the existing context in the Quebec province, but rather aims to work within it and to draw on pre-existing resources and structures. The program has been specifically designed to appropriately function within a publicly funded system. Participation in the PRISMA system does not require joining health care organizations to alter their structure, but rather to align their operations and resources to fit the agreed upon requirements and processes. This particular aspect qualifies PRISMA as a program "embedded" in the health care system (Hébert et al., 2003b), and differentiates it from "nested" models like – for instance – the PACE program (see next sub-section for further information).

Six main strategies aimed at fostering continuity of care are emphasized in PRISMA: decision makers' coordination, single entry point, case management, individualized service plans, standard assessment instrument, and integrated information systems (Hébert et al., 2003a),

briefly discussed below. These strategies identify six fundamental principles or critical success factors and, when the program was extended into three new regions, the rate of implementation was measured along these dimensions (Hébert & Veil, 2004).

Coordination at the strategic level is essential as it is here that decisions on common policies, standards and resource allocation are made. This is achieved by ensuring that all partners are represented in the PRISMA executive board. The initiative fosters partners' stability over time and representatives' regular attendance to executive board meetings. In this way all partners can actively contribute to the joint planning, be fully informed about changes of service delivery, and participate in their appraisal (Hébert et al., 2004).

The single entry point acts as a gate facilitating the access of patients and professionals to the appropriate resources and services of all health care organizations in the area. It is a unique gate that patients can access by telephone or referral and which can grant access to all the organizations that provide services for the frail seniors in the area. This gate-keeping mechanism relies on the use of a standardized screening procedure based on a seven-item questionnaire (PRISMA-7). The single entry point is essential to an embedded integrated care model as the PRISMA program, since without it service provision could not be coordinated effectively from the beginning.

Patients who are identified as eligible for the program are immediately assigned to a case manager. In the PRISMA project, existing teams in service carry out case management. The case manager is responsible for the evaluation of the clients' needs and their appropriate matching with services: including planning, arranging admittance, coordinating support, monitoring and constantly reevaluating patients' needs. Case managers work closely with family doctors, as they are the main medical care providers, while relieving them of part of their burden by coordinating the remnant social and health care interventions (Hébert et al., 2003a). A case manager leads each team, who is responsible for the development of individualized service plans, which include all necessary interventions and are reviewed periodically. The assessment of needs is carried out with the help of a standard instrument called Système de mesure de l'autonomie fonctionnelle – Functional Autonomy Measurement System (SMAF). On this basis, a case-mix classification system has been developed, consisting of 14 iso-SMAF profiles (grouping similar patients according to disability level). The profiles inform decisions on admission to various institutions

and services as well as financial implications, as they are also used to estimate the costs incurred by providers involved in the treatment of each case.

Finally, as PRISMA relies heavily on coordination of services between organizations, the success of this integration model depends on computerized tools that allow for easy communication and, as a consequence, continuity of care. A computerized clinical record system, called SIGG (Systeme d'Information Geronto-Geriatique) has been implemented in order to satisfy providers' information exchange needs. SIGG is constantly updated and continuously accessible to any provider participating in the assistance of a case. Together with the case manager – whose facilitating role among providers is of paramount importance – the SIGG represents the connecting tissue among autonomous organizations, which have an intense need of information exchange to coordinate their actions on their common patients over time.

An impact assessment of PRISMA program conducted in the Estrie region of Quebec four years after its launch (when implementation had reached roughly 80%) concluded there was no significant effect in the experimental group for death, institutionalization and level of disability indicators. However, the experimental group showed significantly lower handicap levels, lower functional decline, higher satisfaction levels and higher empowerment levels (Hébert et al., 2007). Therefore, five years after the launch of PRISMA, the question that initially motivated its creators was given a first positive answer: the program's integration model led to better outcomes without increasing the burden on the health system.

The Program of All-inclusive Care for the Elderly (PACE)

The United States have a multi-payer health care system, characterized by the high level of reliance on the private sector for both health care insurance and provision, as compared to most other developed countries. Medicare, Medicaid and the Veteran Health Administration are the public health insurance programs covering the elderly and the disabled, the poor, and respectively, the veterans. Health financing is based mostly on private funds (53.5%) and health care expenditure absorbs about 16% of GDP (OECD, 2010). As a result, cost containment has become an increasingly important concern throughout the system and the focus of reforms. About 15% of the population is currently uninsured with an estimated larger percentage being underinsured (in fact, a very large percentage of the American population is at risk of being

uninsured for some period of time during their lifetime). The US system is also recognized as one of the most innovative and responsive health care systems, providing its insured citizens with the best access to state of the art medical technologies (Docteur et al. , 2003).

PACE is a permanent program currently functioning in 75 sites located in 29 States (National PACE Association, 2011). Its roots can be traced back to San Francisco, where the On Lok demonstration was launched in 1973, with grant funds provided by the Administration on Ageing and the State of California. It initially consisted solely of community day health centers (Eng et al., 1997). The model stemmed from the belief that frail older adults could delay or even avoid institutionalization if appropriate daily health and social services were made available to them: all at an equivalent or smaller cost than more traditional long-term care arrangements. The On Lok program progressively extended its service basis, adding medical services, in-home services, housing and skilled nursing support. In 1983, On Lok offered a good opportunity to test a new financing method: prepaid capitation. The program received Medicare and Medicaid waivers, being paid a constant monthly amount for each enrolled patient in exchange for the delivery of the full range of services, including acute care when necessary. Under this arrangement, the On Lok program retained all the risk for exceeding costs. The model was extended nationwide and currently, PACE receives fixed payments per enrollee from Medicare and Medicaid, while enrollees themselves are not responsible for any added costs, co-payments or deductibles. Medicare reimbursement is computed on the basis of the average area per capita cost (AAPCC) methodology multiplied by a frailty adjustment factor. While the adjustment factor is unique across sites, the AAPCC varies between PACE sites (Eng et al., 1997). Medicaid capitation results from a negotiation between PACE sites in each State and the specific Medicaid authorities. It is based on two main factors: (a) the cost of long-term care for a comparable population not served by the program, and (b) the eligible rate recognized by each state – ranging for 74% to 96% in 1994 (Eng et al., 1997). Under this financing mechanism providers have the opportunity to integrate Medicaid and Medicare funds and to flexibly use this pool of resources for services which are not routinely covered by any of the two plans: for instance, social services interventions, respite care, and case management (Lee et al., 1998). In addition, the financial risks are shifted to the providers, which are committed to their enrollees for the entire duration of their lives and have no possibility to cap service utilization. This mechanism is intended to incentivize for providers to timely offer the entire range of needed services, as postponing care

may result in higher costs in the future. This is the very belief of the program: the costs of the extensive care offered to the patients – preventive and rehabilitation efforts included – are compensated by the associated avoided costs of very expensive services in hospitals or long-term care institutions (Kane et al., 1992). This mechanism allows for two of the seven underlying principles of the On Lok philosophy to be put in practice: provider assumption of risk – shifting it away from the patient – and integrated funding – as a pre-requisite for integrated service delivery.

The focus on the frail elderly, the third principle, is safeguarded through the eligibility criteria. PACE offers comprehensive services to adults aged 55 or over who live in the defined catchment areas and who are certified by the state Medicaid agency as eligible for nursing home care. These eligibility criteria ensure that the enrollees fit the target population: high-risk, high-cost elderly patients, who would otherwise have a very high likelihood of hospitalization and institutionalization. The average PACE enrollee is 80 years old, suffers from 7.8 medical conditions and is dependent in 2.7 activities of daily living (Lee et al., 1998). The remaining four principles of the On Lok philosophy – continuum of services, integration through consolidation, control of service delivery by a team and community involvement – are very apparent in the features of service delivery under the PACE model (Kane et al., 1992), as described in the following.

The most important characteristic of the PACE program is the fact that in each site, one organization, the PACE center, provides comprehensive services, including acute and long-term care, covering a wide range of benefits. The PACE center, comprising a day health center and a full service medical clinic, remains the primary service location and generally, the core around which everything else gravitates. Services are also delivered at the patient's home, in the hospital and at the nursing home when deemed necessary. Each PACE center serves, on average, 120 patients with a staff of 60 to 80 professionals (Eng et al., 1997). This heavy reliance on the PACE center for service provision is an important determinant of financial viability. Furthermore, the centrality of the PACE center fosters integration, through the logistic consolidation of services. Unfortunately, the extent to which different PACE sites have managed to replicate this very aspect varies considerably, as sometimes, activities co-located in the PACE center are run quite independently (Kane et al., 1992).

At the very heart of the program stands the multidisciplinary team, responsible for both the treatment and case management of each enrollee. It consists of physicians, nurse practitioners, clinic nurses, social workers, occupational therapists, dietitians, health workers and recreational therapists, and together it serves as care manager (Eng et al., 1997). The team's wide range of responsibilities includes individual needs assessment and the formulation of an individualized treatment plan for each enrollee, resource planning, service delivery and/or making arrangements for the delivery of appropriate services (when they have to be contracted out), constant monitoring of treatment, health conditions and costs of care and making the necessary adjustments according to the results of monitoring. What is most remarkable about this model is not the range of services offered but their consolidation. The concentration of control over the entire service continuum in the PACE center and the multidisciplinary approach foster coordination among the professionals involved in each case and facilitate communication between providers in different service locations. Of course, formal and informal communication between team members is time consuming: each case is re-evaluated by every team member independently every three months and the entire team formulates a new treatment plan at an assessment conference. However, the exchange of ideas and the active participation of multiple professionals lead to a more effective process of care and, on average, more than offset the cost of time (Eng et al., 1997).

Another important instrument for the integration of services is DataPACE, a web-based benchmarking data collection system designed specifically for the program and used across all PACE organizations. Though its main purposes are data collection for benchmarking between sites, report generation and program progress monitoring, DataPace incorporates a comprehensive set of assessment tools. Doctors, nurses and social worker can autonomously use instruments that are specific to their discipline and pool all the information into one complex profile, updated periodically, which is then used for the planning of the patient's care needs and for estimating internal and external resource allocation needs (Kodner & Kyriacou, 2000).

Ten years after its launch the On Lok program had proved that an integrated, comprehensive delivery system is efficient in the treatment of frail old patients, with cost savings as high as 15% when compared to the more common fee-for-service scheme (Eng et al., 1997). More recent studies found that patient outcomes in the PACE program have been satisfactory: decreased

hospital admissions, inpatient hospital days and nursing home days, increased attendance at social activities, improvements in quality of life, patient satisfaction and functional status. PACE enrollees have also been shown to have lived longer than comparable groups and to have spent more days living in the community (Chatterji et al. , 1998). Whether the improvements in health status and patient satisfaction are paralleled by cost savings in the PACE program is less clear. A 1997 study of the National PACE Association claimed 12% cost savings for Medicare and Medicaid by comparing the PACE program with another fee-for-service system serving a comparable population (Lee et al., 1998); while a 2001 evaluation report stated that capitated payments in favor of PACE are 8-10% higher – only 4-6% when excluding two low-performing sites – than fee-for-service reimbursements for comparable group members (White et al., 2000).

THE DEPARTMENT OF FRAILTY IN THE LHU OF LECCO

Italy has a universal national health care system providing comprehensive coverage to all its citizens and legal residents on its territory. It is organized in three tiers: the national government (defining the basic benefit package and transferring funds to the Regions), the 21 Regions (responsible for the organization and governance of service delivery), and local organizations (managing service delivery). Funding for public health care draws on two main sources: taxation at the central and regional level – that account for over 95% of all funds – and out-of-pocket payments, generally limited to co-payments for pharmaceuticals and ambulatory specialist services (France et al., 2005). Over the entire health expenditure, public expenditure accounts for 77% (OECD, 2010). Service delivery is managed by local health units (LHUs): each one promotes public health in a defined catchment area - with an average population of about 300.000 inhabitants – and is responsible for numerous hospital and community care services. The regions fund LHUs through a capitation-based scheme; and the LHUs contract covered services with public or private accredited providers (Cantù, 2009).

The LHU of Lecco is one of the 197 LHUs currently operating within the Italian National Health System (Cantù, 2009). It is articulated in three Districts (Bellano, Lecco, and Merate) on its geographic area and responsible for the health of 330,000 inhabitants. In coherence with the service delivery model set by Region Lombardia, the LHU of Lecco provides direct primary and secondary care, while it contracts tertiary care to public and private accredited hospitals. At the

beginning of the 1990s, on the wave of the reform of the national health system, the LHU of Lecco underwent a reorganization initiative. The idea behind this reorganization was that for some patients there is a primary need of ensuring "quality of life" rather than curing or reducing problems due to acute illnesses. This re-focusing could be interpreted as a cultural shift from the focus on provision to patient centeredness.

In 1992, the LHU of Lecco established a department dedicated to the assistance of frail patients: the Department of Frailty (DF). This department is the pivotal node of a network intended to provide integrated care to selected profiles of patients. The other main actors are: the hospice "il Nespolo" (ran by the Association "Fabio Sassi"), the specialized home care equips of the three Districts, the Department of Oncology of the public hospital of Lecco, and the general practitioners (GPs) who play the role of gatekeepers (unless the access occurs through a discharge arrangement set after an acute episode). When necessary, the network requests social assistance from the local governments (financially and operationally responsible for this aspect) where patients live and/or local associations of volunteers (e.g., "Fabio Sassi di Merate", "ACMT di Lecco", "Cancro Primo Aiuto di Monza", and "Fondazione Floriani di Milano"). The system has a single entry point: an operations center, within the DF, articulated in nine equips serving the three districts. There are five phases of the care process: (i) signaling, (ii) assessment, (iii) access with the definition of an individualized care plan, (iv) monitoring, and (v) conclusion.

The first phase also represents the first contact of the patient and, eventually, her family with the network. The person who signals a patient as frail (e.g., permanent/temporary functional or mental disability, specific medical conditions) and – consequently – eligible for assistance is usually the GP or, in case of a protected discharge, the hospital defines the discharge arrangements, which also involve the GP. The signaling reaches the closest articulation of the operations center. The second phase consists of the evaluation of the patient's needs resulting in a clinical and functional assessment, involving a multidisciplinary team of professionals (including representatives of the ward where the patient might have been hospitalized). The assessment is based on multiple measurement scales well supported in the literature – for instance, the Activities of Daily Living (ADL), the Functional Independence Measure (FIM), the Global Evaluation Functional Index (GEFI), the Cumulative Illness Rating Scale (CIRS), the Geriatric Depression Scale (GDS), and the Karnofsky index.

In the third phase, the team defines an individualized care plan (PAI), where the patient's and her family's problems are identified, together with the consequential care objectives and the means to fulfill them (services, professionals, times and methods of work), the necessary medical aids and devices, the institutional case manager, the informal caregiver (a family member or a delegate) that should be supported to qualify her assistance as appropriate, the monitoring methods and the necessary periodic follow-up. In the fourth phase (monitoring) the team meets to share information, discuss about each case and contact personnel dedicated to coordinating activities. This phase aims to plan the assistance as much in advance as possible, but with the flexibility of revising periodically the planned care (i.e., PAI), and ensure the matching between provided services and the patient's needs on the basis of periodic monitoring. Finally, the fifth phase marks the conclusion of the process: after the final evaluation of the objectives, the patient is "discharged" from the plan (as problems are solved or because of death) or, if necessary, she is assigned to a different level of assistance. Therefore, multidisciplinary assessment, nursing care, social assistance, rehabilitation and palliative cures are major components of the therapeutic strategy adopted. Homecare, whenever feasible, is the fundamental operating channel through which the LHU fosters a sound partnership with the families of their patients.

The key elements of the network are: (1) the single entry point, where initial planning and coordination of all necessary services for each care process take place; (2) the development of an information system geographically distributed in the different locations of the network ; (3) the implementation of pneumologic tele-assistance and cardiologic tele-assistance, which allow the operation center to remotely monitor a number of patient parameters – e.g., oxygen saturation, cardiac frequency, ECG record, respiratory frequency; (4) periodic monitoring of process, financial, and outcome indicators by patient profile; (5) a budget process substantiating a constructive negotiation of resources between, firstly, the DF and the General Direction of the LHU, and secondly with all the partners of the network; (6) a strong political support of the regional health authority, who trusts the project to be a valid pilot experience.

The current network is the result of a pilot project aimed to provide proper health and social care to frail patients and explore innovative reimbursement systems. To this end, the LHU of Lecco conducted several quantitative analyses based on data gathered during the period 2001-2005. The philosophy of the project is: resource allocation should be a function of needs – i.e.

Resources=f(needs). The identification of care needs results from the output of the multidisciplinary assessment (e.g., age, pathologies, functional status). The left side of the equation is managed through the PAI, which is characterized by three variables: (1) period of coverage (Giornate di Copertura - GDC), or the overall number of days the process lasts; (2) complexity (GEA Value), represented by the ratio between the overall costs associated with the case and number of days in which at least one professional actually provided homecare (Giornate Effettive di Assistenza - GEA), and (3) intensity, which can significantly vary according to clinical conditions, functional or mental disabilities or family problems (Coefficiente di Intensità Assistenziale - CIA). Thus patients are classified according to groups – or profiles – characterized by similar monthly costs (i.e., iso-costs groups) and appropriate care according to each patient's needs: each group is identified by different ranges of CIA with GEA values fairly constant and GDC depending on clinical conditions, level of autonomy, and family support. In other words, for profiles with the same GDC, the variability of costs depends strictly on CIA.

If, the process is the same for each patient, the actual assistance is planned and provided according to four levels: (a) extemporaneous level, including occasional services that do not require the definition of a PAI – e.g., blood samples, diet counseling; (b) low intensity home care level (i.e., CIA ≤ 0.2), identifying low intensity health services and require the definition of a PAI including the support of informal social assistance (e.g., the patient's family) at home – e.g., hydration and nutrition cycles, post-acute rehabilitation; (c) integrated home care level, targeting patients with multiple social problems and affected by chronic diseases that require the definition of a PAI differentiated in three profiles, according to the assessed degree of intensity (0.2 ≤ CIA ≤ 0.4); and (d) high intensity level, targeted to fragile patients, who need high intensity, post-acute or palliative care that can only partially provided by informal carers– e.g., fractures, stroke, multiple trauma, terminal patients or cases with CIA higher than 0.4. Therefore, PAIs and case profiles are fundamental means, on one hand, to match assessed needs with the appropriate care approach, and, on the other, to implement the selected care approach with the proper organization support.

In 2003 the DF assisted 5.434 patients: 2.690 fell exclusively in the first level of assistance, 70 in the low intensity homecare, 2.162 in the integrated home care level, and 582 in the high intensity level. Among the patients in the last three intensity levels, 83% were over-65 (and 50% of them

were over-75). The overall GDC (Giornate di Copertura – Number of care days) provided were 286,481 in 2003 – 37,293 of which were palliative care (Scaccabarozzi et al., 2004). In 2007 the GDC raised to 320,000 (LHU di Lecco, 2008). The DF's budget for the same year was €5.4 million: €4.9 million for direct provisioning of care, while the remaining part was dedicated to ancillary services - operation center running costs, management functions of PAIs, governing activities of the DF, and coordination with social services (Scaccabarozzi et al., 2004).

The analysis conducted on 2004-2005 data shows that family support and the patient's functional autonomy play an important role in limiting service consumption and suggested an enhanced classification of patients in six groups characterized by monthly costs with a significantly different variation between and a minimal variation within each group. Therefore, the results of such analyses suggest new reimbursement schemes oriented towards effectiveness and fostering more efficiency, as compared to the classic fee-for-service arrangement (LHU Lecco, 2006). The proposed system basically reimburses standard processes of care for each patient, whose medical status, and social conditions are objectively defined (i.e., patient profile). The process of care is agreed with the patient's informal caregiver(s), her GP, health and social specialists. The comprehensive reimbursement does not incentivize providers to multiply services, as it encourages planning in advance the resources necessary for the whole process of care.

Customer satisfaction surveys conducted with patients and their families, during and at the end of the period of care, provide evidence about the effectiveness of the assistance offered. In 2003 a survey conducted on a sample of 180 patients showed that 68% were very satisfied and 26% were fairly satisfied (a more recent survey, conducted in 2007, confirms these results); interestingly, more than 50% of the interviewed think they wouldn't have been able to continue living at home without the services provided by the DF, and almost 50% think they would have needed hospitalization. In addition, the absence of recurrent access to hospitalization and emergency services, the fact that 59% of terminally ill patients died at home or in the hospice, and the decreased hospitalization rate of the elderly in the 1999-2003 period (-8.6% for over-65, averaged over age categories: -8.5% for patients 65-74 year-old, -11.7% for over-75) are positive indicators of effectiveness (LHU di Lecco, 2007; Scaccabarozzi et al., 2004).

THE HOME CARE SERVICES OF CANTON TICINO (SACD)

The Swiss health care system is organized in 26 Cantons responsible for planning and providing health care. It offers virtually universal coverage (estimated at 99.5% by the Association of Swiss Health Insurance Companies) to its citizens and is characterized by a mix of public and private providers operating in a framework of managed competition. Private insurers compete in a highly regulated market where no profits can be derived from basic insurance coverage (defined at the federal level). As compared to all other countries who have universal health care coverage, Switzerland has the most market-oriented system, with the government financing less than one third of total health expenditure (OECD & WHO, 2006). Citizens are free to choose their providers (EOHCS, 2000), a right that is safeguarded by legally imposing to insurers a mandatory contracting clause: sickness funds must contract with all health care providers in the market and thus ensure that, regardless of the sickness fund to which they subscribe, patients have unrestricted access to the providers of their choice. A noteworthy exception are managed care plans, which are based on selective contracting and limiting access to certain services, but enrollment in such insurance schemes is voluntary and their diffusion is limited.

Following a debate that started in the 80s, the Swiss law on home care assistance, passed in 2000, formalized a system with three pillars: (1) the Spitex organizations – in Ticino called Services of home care and assistance (SACDs) – providing medical care, personal care and domestic services; (2) support services (e.g. transport, day centers for Alzheimer patients, social services); (3) and direct aids, in the form of vouchers, for household maintenance. Before the adoption of the law currently in force, the same type of services were offered in a quite similar manner in Ticino, with two notable differences: (a) only four regional entities existed and (b) they were organized as consortiums of municipalities in the catchment area (a stronger connection to the municipal authorities than presently observed). The Cantons are responsible for regulating and planning home care and financially support Spitex, which are non-profit providers. Other private providers offer similar services but they do not receive public financial support and are not constrained by all the regulation public providers face (e.g. principle of subsidiarity and inability to turn down eligible patients on any considerations of profitability).

Ticino Canton has six SACDs that offered services to about 11,200 people in 2009. The density of cases varies considerably from one SACD to another, mainly reflecting the population density of the served area; the SACDs operating in the main urban centers average over 2,500 cases per

year, while those operating in predominantly rural and remote areas only just exceed 1,000 cases per year. Eligibility conditions are quite lax: in order to qualify for SACD services a patient must have good potential for being assisted at home, reside in one of the six defined geographic regions and suffer from disability, illness, maternity related issues, or be elderly. In practice, more than 60% of all customers in 2009 were elderly. Due to the legal monopoly in their areas and the marked differences from one area to another, there is no competition and virtually no operative collaboration between the SACDs. As of 2005, a mix of sources is employed in order to finance SACD operations. Supporting services are financed exclusively through user fees, calculated on the basis of the cantonal progressive tariffs and absorb about 10% of the budget (in 2009, CHF 4,643,674). Insurance plans finance medical and home care services (as part of the mandatory basic coverage package) accounting for 35% of the budget (in 2009, CHF 15,134,554). The remaining 55% of the budget is covered through public financing on the basis of a global budget system and a list of standard costs. All administrative and overhead costs are also covered by the canton. Public funds are provided by the Canton (20%) and the municipalities of the six geographic regions (80%).

Each SACD has a role of coordination between GPs, hospitals and support service providers (formally recognized by Cantonal authorities) according to each patient's needs. This however, rarely involves formal agreements. Collaboration is based on participatory governance, common goals and mutual trust between all involved actors. Competition between public providers is discouraged by the way in which the objectives of each actor are defined in their service contract with the Canton. The objectives of individual organizations never overlap but are meant to complement each other, thus encouraging sustained cooperation. As far as the relationships between public and private for profit providers are concerned, competition has always been a reality: private for profit providers has served about 50% of the market in the past 10 years. Nevertheless, voluntary collaborations between the majority of private and public providers have become commonplace: for instance, the SACD Lugano requests regularly personnel support from Internursing, a private for-profit provider operating in the same area.

A complex governance model insures that all stakeholders are proportionally represented in the decision-making bodies and an effective equilibrium is achieved between conflicting or competing interests. The strategic management of each SACD resides with a steering committee

composed of four representatives of municipalities in the area, one representative of voluntary associations, one representative for support service organizations, and one representative for the Canton. The composition of the steering committee, more precisely the heavy representation of municipal interests as compared to federal interests (embodied by the Cantonal representative) is roughly proportional to the financial contribution of the two levels of government. What is more, in order to ensure that all municipalities, regardless of size, are democratically represented in the decision-making process a bi-annual General Assembly is held, where municipal representation is proportional to the population (one representative for every 3,500 inhabitants). Monthly meeting are organized between the directors of the six SACDs, with the participation of Cantonal representatives, where discussions focus on strategic and administrative issues. As a result, a coherent policy is applied Canton-wide and collaboration is not restricted to the predefined service areas. Aside from these formal meetings, numerous informal contacts between managerial and operating staff in different SACD, joint training sessions, innovation sharing efforts and best-practice diffusion guarantee that coordination is facilitated.

The eligibility of a patient for SACD services can be signaled by any actor in the system (e.g., hospital, GP, informal carers) or by the patient herself. Signaling is followed by a nurse's visit to the patient's home where eligibility is confirmed and the comprehensive assessment of the case begins. A standardized instrument (RAI-HC Swiss) supports all assessments: it is an adapted version of the international resident assessment instrument homecare (RAI-HC), redesigned to account for the specificities of the Swiss context and home care assistance. The Swiss Association of Home Care Services adopted the instrument after being tested in 2001, with a pilot study involving 15 sites in 15 Cantons. The study concluded that the new instrument fulfills all the requirement of the system and that professionals in the field found it useful and conducive to interdisciplinarity. RAI-HC is composed of 4 separate modules, and covers a wide range of administrative data, household conditions, patient's needs, and specific services planned for the patient (Müller & Staudenmaier, 2002).

The information collected with the RAI instrument bases the case assessment, performed by a specialized nurse, who can contact specialized experts in case of necessity. This is due to the fact that the small size of the SACDs and low number of patients generally imposes limits on the

investment in highly specialized personnel. However, in Lugano, an urban, more densely populated area, the SACD employs multidisciplinary teams (composed of a geriatric nurse, a pediatric nurse, a generalist nurse, a psychiatric nurse, an oncologic nurse and a social worker) for the comprehensive assessment of all cases and the resource planning associated with patient care. The needs assessment leads to the creation of an individualized care plan associated with a case manager, generally a nurse, who closely follows the progress of the patient and coordinates the provision of services. The care plan is revised periodically by the multidisciplinary team, who decides on necessary adjustments in the type or intensity of care. Whenever an individual care plan includes medical care, SACDs must refer back to the patient's GP. Decisions on necessary medical services and decreases or increases in the intensity of care are made by SACD personnel, however the GPs are legal gatekeepers and their authorization is mandatory by law and required by health insurers for cost reimbursement. Although very rare, problems related to differences of opinion between SACD personnel and GPs do arise. Despite this, SACDs do not employ directly family doctors, as patient's freedom of choice is considered paramount.

The general principle that inspires the law regulating home care in Switzerland is that of "subsidiarity": providing only those services that the community alone cannot provide. The first visit in the patient's home and the initial assessment aim to define the strictly necessary services. Here the community is involved mainly through a negotiation with potential informal carers and monetary disincentives on those services not judged necessary or in contrast with the principle of subsidiarity (e.g., pricing the delivery of the prescribed pharmaceuticals when family members can buy them in pharmacies). SACDs support this shared responsibility by maintaining constant contact with family members and coaching their patients towards self-care within the limits of their psychological condition (in fact, dementia is often a barrier).

Electronic patient records exist in most SACDs. Unfortunately, their use is limited to internal purposes. In the SACD of Lugano all assessments and service data are electronically stored. This allows for a distributed billing system, for presenting sickness funds with information on services provided according to the patient profile (thus reducing their administrative burden) and for projecting volumes of services according to up-to-date patient care plans. Privacy concerns and technical limitations on hospitals' information systems negatively affect information sharing: hospitals' medical records can only be shared with GPs. However, SACDs are partners of a

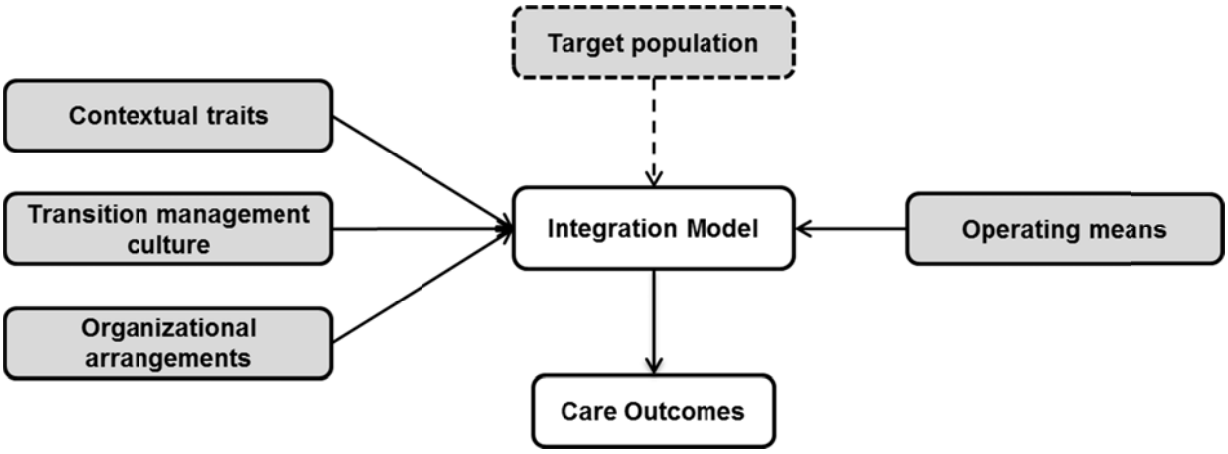
Cantonal e-health project ("Rete Sanitaria") that is expected to improve information sharing by means of flexible, secure technologies available to all the actors. Currently, as information transfer between hospitals and SACDs is still problematic, the latter are planning to have one of their nurses accessing hospitals in their area weekly and preparing the discharge of complex cases.

Cantonal authorities evaluate regularly the activities of the SACDs. Authorizations to function are released by the Canton annually after having established compliance with regulations in force. In addition, mandatory annual self-evaluations of the SACDs, including data on operations, closed cases and motives for their closure, and indirect inputs (e.g. number of cases, age groups, structural information) are used by the Canton in order to assess whether the service performance standards are respected. This information is used for benchmarking purposes with regularity. However, such benchmarking analyses include only the six SACD operating in Ticino and their consequentiality is limited. A comprehensive evaluation of SACDs one year after the implementation of the law found positive results in terms of efficiency, but less so on effectiveness indicators and accessibility of services (Crivelli & Lisi, 2002). In 2003 a customer satisfaction evaluation found that 88% of users and their caregivers were satisfied with the received services: 74% claimed their autonomy has improved and 69% judged as positive the impact of services on their families (Mariolini & Wernli, 2003, 2004).

CATEGORIES OF INFLUENTIAL FACTORS

Based on the analysis of the four case studies, we propose four main dimensions along which integration models can be interpreted: contextual traits, transition management culture, organizational arrangements and operating means (Figure 1.2). We intend these as broad categories, further subsuming arrays of factors that can influence the integration process. The contextual traits dimension can be paralleled to the macro level of the health systems while the organizational arrangements correspond to the meso level. The operating means can influence both the meso and micro level; and finally, the transition management culture can be an element of either the macro or meso level. The framework below is intended to be flexible enough to both retain enough precision to identify the main influential factors and to accommodate highly heterogeneous initiatives.

FIGURE 1.2 DIMENSIONS INFLUENCING CARE INTEGRATION



CONTEXTUAL TRAITS

The contextual traits define the structure of incentives and obstacles that influence the dynamics occurring at the meso and micro levels. It deals with the statutory framework, the target population – or what Kodner (2009) called "*foci* of integration" – and the object of integration. The statutory framework refers to funding mechanisms (e.g., fee-for-service, case budget, prepaid capitation), decision-making *loci* involved in planning the different services candidate for being integrated (e.g., national, state/regional, local governments), formal rules and regulations (e.g., administrative flexibilities such as allowing organizations to pool budgets according to shared risks). The object of integration derives from the needs of the target population. The specific situation may require integration of support activities (e.g., finance, information systems) or may call for services provided by different health care organizations according to their professional specialization (e.g., acute care, rehabilitation) or by organizations operating in different sectors and institutional arenas (e.g., acute care, social home care).

In our cases, Canada and Italy have single-payer systems, whereas the American and Swiss systems allow for multiple payers. While services offered by PRISMA are financed within the general payment framework in the Canadian health system, special reimbursement schemes are in place for PACE (capitation and full financial responsibility), the LHU of Lecco (capitation and pooled budgets) and SACD Ticino (partial pooled budgets). The level of institutional fragmentation also varies between the different settings. Numerous public and private providers

offering services for the target population co-exist and compete to a certain extent in the U.S. and Switzerland. In Italy, the local health unit is the only provider responsible for public health in its defined catchment area while in Canada numerous public providers are in charge of and held accountable for the provision of different types of health or social care services.

TRANSITION MANAGEMENT CULTURE

The transition management culture refers to the "soft" aspects that influence the dynamics of care integration. It captures the actors' general attitude towards the transitions of frail patients from one care setting to another and their consequential orientation toward collaboration rather than self-promotion. It goes beyond the formal structures created and impacts on final results through less tangible mechanisms. In actuality, whether local practices tend to compensate for potential organizational gaps, rather than becoming resistant to change and over-promoting themselves, can make the difference between the success and failure of integration initiatives (Etheridge et al., 2009; Hardy et al. , 1999). In the Swiss case, and to a lesser extent in the case of PRISMA, the willingness of involved providers to collaborate throughout the care process has been instrumental for the success of the initiatives. SACD representatives maintain constant communication, be they formal or informal, which allow them to sustain a high level of coordination despite the lack of a rigid formal structure. In contrast, in Italy and in the US, the lack of a sustained cooperative approach of different health care providers is part of the issue that integration programs are intended to address. In settings where provider collaboration is irregular and superficial care integration initiatives should be designed with a view on providing a formal scaffolding on which cooperative agreements can be built.

ORGANIZATIONAL ARRANGEMENTS

The organizational arrangements represent the structure supporting care integration. In this respect, solutions range from simple contractual relationships of service brokerage to the creation of new organizations or the merger between existing organizations, covering strategic partnerships among few providers, networks of complimentary actors, and others. PRISMA and the LHU of Lecco operate as networks of independent providers aiming to align their operations and resources. However, while in the case of PRISMA all actors play equal power roles, in Lecco

their activities revolve around a pivotal node - the Department of Frailty, which links together all other members and consolidates activities. In the PACE program a single organization assumes responsibility for the patient and provides comprehensive care services and coordinating contracted care, should it be necessary. The Swiss SACDs also collocate a complex range of services under the umbrella of one organization but they do not operate medical centers and do not offer advanced medical care.

OPERATING MEANS

The operating means are tools and practices adopted, at the meso and micro level, to enact the objectives shared across care settings. Following Wagner's chronic care model (Wagner et al., 2001; Wagner et al., 1996), we classified the operating means according to the their particular organizational and clinical function: organization and leadership development, decision support and information management, delivery system design, and community resources involvement (Table 1.1). The first class of means aims at building organizational capacity and giving visible support to the continuity of care and patients' transitions. Decision support and information systems are intended to trigger behavioral change through guidelines and mechanisms that foster cooperation in operations. The means labeled "delivery system design" are intended to constantly arrange and align services according to each patient's needs. Finally, the means listed under the label "community and self-management" aim at taking advantage of available social resources and foster active cooperation between patients, thus making care personalized and filling potential capacity gaps in service provision.

Finally, we do not further discuss the target population (dashed line in Fig. 1.2) as an influential variable because, in the interest of comparability we have selected initiatives highly similar in this respect; same reasoning applies to the object of integration which, as previously mentioned, is strictly related to the target population.

TABLE 1.1 IMPLEMENTED OPERATING MEANS BY CATEGORY

		PRISMA	PACE	LHU Lecco	SACD
ORGANIZATION & LEADERSHIP	Steering Committee	√	-	√	√
	Networking meetings	√	-	-	√
	Multidisciplinary team	√	√	√	√
	Single entry point	√	-	√	-
	Co-location of services / HMO staff	-	√	-	√
	Intermediate structures	-	-	-	-
	Teaching programs for personnel	√	√	√	√
	Jointly managed programs or services	√	-	√	√
DECISION SUPPORT & INFO. SYSTEM	Centralized/shared information systems	√	-	√	(developing)
	Service standards & protocols	√	√	√	√
	Population registry	-	-	√	-
	Joint need assessment	√	-	√	√
	Joint care planning	√	√	√	√
	Common assessment instrument(s)	√	-	√	√
	Standard performance measures	√	√	√	-
DELIVERY SYST. DESIGN	Case management	√	√	√	√
	Frequent patient's stability monitoring	√	√	√	√
	Telemedicine	-	-	√	-
	Logistic accessibility of services	√	-	-	-
	Around the clock coverage	-	-	-	-
COMMUNITY & SELF-MGMT	Partnership with carers & community	-	√	√	√
	Self-management support (patient education)	√	√	√	√
	Encouraging patients to enroll in community programs	-	√	-	-
	Support advocates of community policies	-	-	-	-

By looking at the clustering of operating means by sub-category and by case, it is quite apparent that the concentration of Organization & Leadership means is negatively correlated with the strength of the structure in the organizational model: it is lowest in PACE, characterized by a single formal hierarchy, and highest in PRISMA and Ticino's SACD. Where the necessity of avoiding duplications and fostering coherence between the roles of the different autonomous actors involved in the care processes is the most important consideration, means like the single entry point and participatory planning processes prove effective. Investments in Organization & Leadership support means can also address issues of high fragmentation and heterogeneity of

providers, as exemplified by the Swiss case. However, in the presence of a pivotal organization purchasing or providing comprehensive services (LHU Lecco and PACE, respectively) a representative governance system is not required.

Decision support and information system instruments aim to facilitate coordination between providers. The larger the number of involved providers, the higher is the importance of implementing these means. This is the case for PRISMA and the LHU Lecco, both models highly reliant on protocols and standardized clinical tools. On the contrary, in the case of PACE decision coherence is ensured by the co-location of the involved professionals and their full participation in decision making processes; while in Ticino the emphasis falls on finding the right balance between the need of standardizing clinical practices and the imperative of accommodating for ample regional differences through a process of participatory governance. Furthermore, publicly funded, universal systems seem to have a higher need to re-design the delivery system: this is apparent in the higher concentration of Delivery system design instruments in Canada and Italy as compared to Switzerland or the US.

Finally, Community and self-management instruments benefit all programs alike, irrespective of specific characteristics. They are designed to reduce demand pressures by mobilizing and better deploying existing resources, which can complement the official efforts of the health and social systems. Of course, the ability of health professionals and managers to activate community driven initiatives is a function of the context, especially of the cultural and social underpinnings.

Synthesizing and reorganizing the information from our case studies according to the proposed dimensions we obtained four case profiles, presented in tabular form below. For each dimension, we tried to emphasize the main characteristics, which define to a large extent the chosen integration model, and brush over the particular details.

SUMMARY TABLES FOR THE FOUR CASE STUDIES

Table 1.2 PRISMA		KEY OPERATING MEANS	CARE OUTCOMES
CONTEXT	Universal coverage Tax-based funding – Single payer Service delivery decentralized to Provinces Total health expenditure 10% GDP, out of which 70% is public	**Organization & Leadership** Steering Committee Single entry point	Better outcomes without increasing the burden on the health care system
TARGET POPULATION	Aged over 65 Moderate to severe disability Good potential for staying at home Need two or more health care and social services	**Delivery system design** Case management Constant patient monitoring	Significantly lower handicap levels, lower functional decline, higher satisfaction and higher empowerment levels for the experimental group
TRANSITION MANAGEMENT CULTURE	Paternalistic approach fostered by RHA responsibility on public health Leadership on caring for frail patients (numerous)	**Decision support & information** Individualized service plans Service standards and protocols Standard assessment instrument Integrated information systems	
ORG. MODEL	Network of providers aligning their operations and resources		

Table 1.3 PACE		KEY OPERATING MEANS	CARE OUTCOMES
CONTEXT	Multi-payer system (significant proportion of population uninsured or underinsured) Total health expenditure 16% GDP, 46.5%of which is public	**Organization & Leadership** Collocation of services Multidisciplinary team	Cost efficient in the treatment of frail patients, with cost savings up to 15%
TARGET POPULATION	Adults aged 55 or over who live in the defined catchment area Certified by the State Medicaid agency as eligible for nursing home care	**Delivery system design** Case management Patient stability monitoring	Patients had less hospital admissions, inpatient stays and nursing home days, but increased attendance at social activities, better quality of life and higher functional status
TRANSITION MANAGEMENT CULTURE	Patient freedom of choice, but mandatory stay once in the program HMO staff collaborative approach	**Decision support & information** Individualized service plans Comprehensive patient profile Integrated information systems	
ORG. MODEL	One organization provides comprehensive services and assumes full financial responsibility for cases		

Table 1.4 LHU Lecco		KEY OPERATING MEANS	CARE OUTCOMES
CONTEXT	Universal coverage Tax-based funding - Single payer Service delivery decentralized to Regions Service delivery managed by local organizations Total health expenditure 9.5% GDP, 77.3% of which public	**Organization & Leadership** Single entry point Multidisciplinary team **Delivery system design** Case management Frequent patient monitoring **Decision support & information** Individualized service plans Service standards and protocols Standard assessment instrument Needs assessment	Improved effectiveness: absence of recurrent access to hospitalization and emergency services; decreased hospitalization rate High patient satisfaction: 68% were very satisfied 26% were fairly satisfied 50% thought they couldn't have continued living at home without the program
TARGET POPULATION	Frail elderly and terminally ill patients		
TRANSITION MANAGEMENT CULTURE	Patient freedom of choice Institutional subject (LHU) responsible for public health in a defined catchment area		
ORG. MODEL	Single purchaser with a network of partners aligning their operations		

Table 1.5 SACD Ticino		KEY OPERATING MEANS	CARE OUTCOMES
CONTEXT	Virtually universal coverage Multi payer system - highly regulated private insurance market Managed competition between private and public providers Significant regional disparities Total health expenditure 11% GDP, out of which 60% is public	**Organization & Leadership** Steering committee & working groups Multidisciplinary team (Lugano) Joint training **Delivery system design** Case management Frequent patient monitoring **Decision support & information** Individualized care plans Standard assessment instrument Standard service protocols **Community & patient empowerment** Self-management support Partnerships with informal carers	Considerable improvements in efficiency, but less so on effectiveness indicators and accessibility of services High customer satisfaction: - 88% of users and their caregivers were satisfied with the received services - 74% claimed their autonomy has improved - 69% judged as positive the impact of services on their families
ELIGIBILITY CRITERIA	Are elderly, suffer from disability, illness, maternity related issues & reside in one of the defined regions Good potential for being assisted at home		
TRANSITION MANAGEMENT CULTURE	Patient freedom of choice Complex governance models balancing multiple interests and responsibilities Providers cooperative (informal) approach		
ORG. MODEL	One organization providing medical and personal services and coordinating complimentary providers		

DISCUSSION & LIMITATIONS

We focus our discussion on three interesting findings: (a) integrated care initiatives are highly heterogeneous; (b) there are some patterns of association between macro level factors and meso/micro level factors; (c) at the micro level there is a relatively higher level of uniformity across cases.

First, the results of our analysis provide a picture of heterogeneous integrated care initiatives around the world. In the four cases analyzed some factors prove relevant for the attainment of successful outcomes: integration of funding (e.g., PACE, LHU Lecco), joint care planning (PRISMA), co-location of services (PACE), representative governance (SACD Ticino, PRISMA), strategic partnerships between providers and community involvement (SACD Ticino), and the standardization of select elements in the delivery system as to encourage care integration (e.g., common assessment tools). Any of these strategies per se are neither necessary nor sufficient for success, but reinforce the idea that context-dependencies can call for very specific strategies.

Secondly, by looking at the first three analytical dimensions, defining the macro and meso levels, the most striking characteristic is their wide diversity. However, different features at this level can lead to success in integration efforts if appropriately combined with factors at lower levels. The PACE and SACD initiatives operate in multi-payer health systems; so they have designed new financial mechanisms, better aligned with the complexity of frail patient's needs. On the other side, PRISMA and Lecco, were designed for single-payer universal health systems; here the emphasis falls on restructuring providers' interaction and resource allocation mechanisms, in view of better matching existing services with patients' needs. In other words, different contexts, translate into different intermediate goals and, thus, different models of care integration represent solutions to quite diverse issues.

At the micro level the range of operating means implemented overlaps significantly in the four cases analyzed. Case management, frequent patient monitoring, individualized care plans and standard assessment instruments (in PACE the state home-care eligibility certification ensure homogeneity of the enrolled patients) are common across all cases. Numerous other overlays can be identified across pairs and triads of cases. This, in no way, stands to say either that micro-level integration is sufficient for positive outcomes or that implementing a wide range of operating

means does lead to success. Most probably it is a necessary condition, as no formal structure can compensate for lack of technical coordination in service provision tasks and between providers. Overall we observe the highest concentration of implemented operating means (across sub-categories) where the formal structure is weak: highest concentration in the cases of PRISMA and LHU Lecco. The case of the SACDs is somewhat of an in-between case, as the strong cooperative orientation of involved providers might compensate for the lack of formal structure.

The main limitation of our study arises from the fact that it infers form a small, purposive sample of cases. Our findings are not directly generalizable and our conclusions refer only to the cases compared here. But while context dependent knowledge suffers from lack of generalizability it affords a more in-depth understanding of the involved processes. The four case studies described have a lot to teach about the opportunities and pit-falls of care integration. Case study analysis is a hypothesis-generating research methodology: all the relationships we identified between care integration and contextual and organizational categories of influential factors can be reformulated into hypotheses to be tested, in a more extensive (and, consequently, less intensive) study.

CONCLUSIONS

The results from the four cases suggest that the probability of reaching positive outcomes in integration is influenced by numerous factors and their grouping does matter. Mere technical intensity of integration, by which we mean the implementation of numerous operating tools in order to encourage integration, is not a guarantee of success. Rather, positive outcomes are likely to depend to a very large extent on the correct matching between such operating means and the contextual, cultural and organizational factors present in each setting. In essence, this complexity allows for tackling the specific issues arising from different situations. While goals are rather uniform, each initiative faces context-specific problems: that is why the four cases represent four different paths to success.

The heterogeneity of the cases chosen allows for a fairly wide overview of care integration models but it comes at the cost of limiting inference from these findings. In order to determine which factors and to what extent contribute to success in integration initiatives a more homogeneous sample is necessary. The variability of approaches is mainly driven by differences

in the targeted population, and consequentially their different care needs, and the marked dissimilarities between the health care systems they are embedded in. As such, we propose that the causal links between the four dimensions we identified, care integration and care outcomes can be investigated in a setting where the main system characteristics and the target population are homogeneous.

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CHAPTER 2
CARE INTEGRATION IN A SINGLE-PAYER HEALTH SYSTEM: EVIDENCE ON ITS DETERMINANTS AND INFLUENCE ON QUALITY

INTRODUCTION

Health systems are facing the challenge of maintaining quality and financial viability, while increasing their responsiveness to emerging priorities and changing population needs. Technological advances, epidemiologic and demographic trends lead decision-makers to rethink the organization and the mix of services provided to meet the needs of new, relevant clusters of patients (Lega & Calciolari, 2012). For instance, health systems have reacted to the growing burden of chronic diseases by shifting services and resources towards primary care (Fantini et al., 2012). But while some conditions are best managed by concentrating care in specialized settings, others are so complex in nature that they require the concerted action of multiple providers across care settings. The need then arises to coordinate the care process, across providers, across care settings and through time, centering it on the patient rather than on any specific pathology. In other words, care processes should be integrated.

Care integration identifies a complex endeavor, attempting to rearrange resource usage, shuffle institutional building blocks and redesign organizational processes in view of enhancing efficiency and better aligning health care provision with evolving patient needs. It can be considered an innovation that spans the boundaries between organizations and aims to emphasize coordination between distinct parts of the health system (Maula et al., 2006).

The present study focuses on a specific cluster of patients (or target population): the frail elderly. We propose a measurement instrument, which capitalizes on the decomposition of the care integration construct into its more basic dimensions, and a conceptual framework aimed at identifying the factors that influence care integration. We propose that the contextual traits, organizational arrangements, the transition management culture and the operating means implemented act as antecedents of care integration. From the conceptual framework, we derived five hypotheses, which we test in the empirical setting of the Italian NHS.

In the next sections we present: our proposed measurement instrument for care integration, the conceptual framework and its operationalization. We then formulate five hypotheses on the dynamics of care integration, and describe the empirical setting for our analysis and the methods employed. The last sections are dedicated to the results of the empirical analysis, the limitations of our study, directions for further research and our conclusions.

MEASURING CARE INTEGRATION

Care integration has been part of health policies in developed countries and a relevant research topic for over a decade. However, there is neither consensus over a common definition, nor consistency in the terminology employed (Bell et al., 2008). Kodner and Spreeuwenberg's (2002) proposed the following, widely cited definition: "Integration is a coherent set of methods and models on the funding, administrative, organizational, service delivery and clinical levels designed to create connectivity, alignment, and collaboration within and between the cure and care sectors. The goal […] is to enhance quality of care and quality of life, consumer satisfaction and system efficiency for patients with complex, long-term problems cutting across multiple services, providers and settings." Their conceptualization captures the three main characteristics of care integration: wide range of interventions, patient-centeredness, and complexity. By the former, we mean the different interdependent levels at which interventions aimed at fostering integration might occur (Delnoij et al., 2002): the macro, meso, and micro level of a health system.

Reinterpreting Kodner's definition, care integration is the result of two elements: (a) the implementation of carefully articulated methods and instruments at the micro, meso and macro level; (b) the correct matching of interventions along all the three aforementioned dimensions. The objective of integration initiatives is to improve care quality, efficiency and patient satisfaction, which are the final outcomes of the process. We can distinguish, then, between two perspectives: care integration as an intermediate goal per se, and care integration as an instrument for improving final care outcomes. The former calls for unveiling the antecedents (e.g., methods, means) of care integration; the latter perspective focuses on identifying the impact of integration on care quality (intended here as a multidimensional concept). In the course of our

analysis we emphasize the first perspective, as we are mainly concerned with measuring the attained level of care integration and identifying its antecedents. However, we also present a test of the relationship between care integration and care quality, which draws on the second perspective.

Definitions of care integration, like Kodner's above, paint the picture of a "balancing act" aimed at aligning care processes with complex and evolving patients' needs, and fine tuning them along several dimensions. But while such definitions capture the spirit of care integration and recognize the complexity and range of integration models, they don't provide clear insight into an operationalization. In order to do that, we propose deconstructing the concept of care integration into more basic dimensions. We adopt the perspective of integration as an attribute of care processes and define integration dimensions as those characteristics of care processes that would allow one to describe care as seamless and patient-centered. The academic literature is rich in discussions about such characteristics; we selected those most commonly cited with respect to our target population. Table 2.1 summarizes our final selection.

Care integration is frequently associated with continuity of care and longitudinal coherence. In its general acceptation, continuity goes beyond the sustained relationship between patients and their providers over time – relational continuity (Freeman & Hughes, 2010); it also implies a certain coherence of care services, linking together past, present and future care episodes in a sequential continuum (Freeman et.al, 2007; Haggerty et. al, 2003).

TABLE 2.1 DIMENSIONS OF CARE INTEGRATION

Conceptual dimensions	**References**
Continuity in time	Freeman et.al (2007); Haggerty et. al (2003); Longo (2009); Kodner & Speewenberg (2002); Ouwens et.al (2005)
Flexibility	Haggerty et. al (2003); Freeman et.al (2007);Kodner & Speewenberg (2002)
Information availability	Haggerty et. al (2003); Freeman et.al (2007); Wei et al. (2008)
Complementarity (of roles)	Kodner & Speewenberg (2002); Wagner et.al (1996)
Responsiveness	Haggerty et. al (2003); WHO (2000)

Flexibility refers to the ability to adapt care processes to changes in a patient's condition and needs. Certain authors present flexibility as a facet of continuity (Haggerty et. al, 2003). However, we consider it a separate dimension of care integration, because integrated care models target mainly complex patients (in our case frail elderly) whose needs and circumstances are likely to vary (large fluctuations in health status are, in fact, a characteristic feature of frailty). Responsiveness is closely related to the concept of flexibility, but premised by a sense of urgency. It captures to extent to which care process can quickly adapt to drastic, unforeseen changes.

Information availability, also described in the literature as informational continuity, is paramount if coordination between providers is to be achieved. The flow of comprehensive clinical information, both longitudinally – i.e. between care episodes – and transversally – i.e. between care settings - helps bind care processes together and ensure appropriateness of care.

Finally, care integration is often defined in antithesis to over-specialization and fragmentation in health care. The complexity of the tasks requires that different providers join efforts in a coordinated fashion, each complementing the other contributions. Too much overlap would translate into inefficiency, too many gaps into fragmentation. When separate parts come together in an orchestrated manner in order to achieve joint goals, integration is "the glue that bonds the entity together" (Kodner & Speewenberg, 2002: 2). Such orchestration of efforts calls for awareness and complementarity of roles between the different professionals involved in the care process.

Putting all the pieces back together, we propose that the construct of care integration refers to care processes which are continuous in time (continuity) and malleable enough to adapt to various, potentially changing care needs (flexibility). In addition, care is integrated when providers appreciate their matching expertise and roles (complementarity), facilitate information exchanges between them (information availability), and can rapidly respond to changing needs and emergencies (responsiveness).

A CONCEPTUAL FRAMEWORK FOR CARE INTEGRATION

Measuring care integration is a necessary first step in the analysis of its dynamics, followed by the need to define a model of its antecedents. We argue that two main forces shape care integration: (a) external pressures which emanate from the institutional context; and (b) internal pressures to innovate and achieve higher service standards, generated either within the strategic apex of each organization or within the professional groups involved.

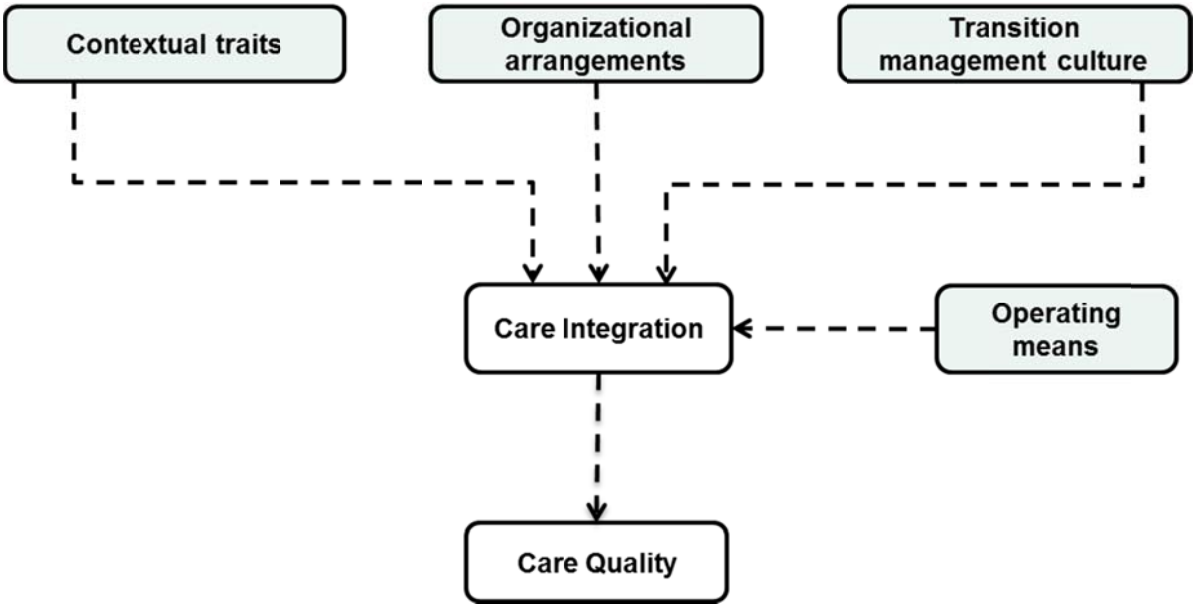
In the health care arena, external pressures refer mainly to the regulatory structures in place. The success and design of any integration initiative will depend to a large extent on the context in which it is embedded (Scott, 1995). In addition, the presence of formal and stable ties between organizations can help counterbalance fragmentation in health care. Professional cultures also play an important role. Professional networks act as a medium for the dissemination of values, beliefs and innovation beyond the boundaries of each organization; in this respect, they can generate pressures counterbalancing the influence of managers and policy makers. In particular, the stronger the professional identities become, the higher the barriers to collaboration between professional groups (Ferlie et al., 2005). Consequently, the dynamics of innovation involving multiple professional links – such as care integration – might also significantly depend on the permeability of professional group boundaries and the level of trust and social interaction between such groups.

Internal pressures describe the strategic behavior of organizational actors. Managers can redesign organizational processes and structures (Anessi Pessina & Cantu, 2006), which may lead to the acquisition of new organizational competences. They have at their disposal a set of instruments whose implementation can help compensate for contextual rigidities and organizational gaps toward integration.

A variety of international experiences support the understanding that the combination of internal and external pressures (or factors) determine, to a large extent, care integration (Calciolari & Ilinca, 2011; Curry & Ham, 2010; Van der Linden et al., 2001; Kodner & Kyriacou, 2000; MacAdam, 2008). On the basis of this literature, we propose a conceptual framework identifying the influential factors specific to the field, grouped in four general dimensions: contextual traits, transition management culture, organizational arrangements and operating means (Figure 2.1).

In order to emphasize the distinction between external and internal factors they are presented on different levels in the diagram below: the higher level corresponds to external pressures, while the middle level can be paralleled to the organizational one (i.e., factors within each organization). Finally, in the lower part of the diagram, we switch to the integration as instrument perspective and link the level of integration attained to improvements in final care outcomes – here defined as care quality.

FIGURE 2.1 CONCEPTUAL FRAMEWORK FOR CARE INTEGRATION



The strategy employed to describe these factors is to break each down to the smaller, more manageable constituent parts. Of course, our choice of indicators for each category is neither exhaustive nor universally applicable. We tried to maintain a strong focus on the target population and on the setting under study, balancing the loss of generalizability against the loss of precision.

Contextual traits

The contextual traits represent manifestations of the regulative structures imposed onto organizations: they do not lie within the influence of managers and cannot be altered in the design phase of an integration initiative. We limited our analysis to the structure of incentives and impediments that are most likely to influence the dynamics occurring at the organizational

level. In particular, we considered the number of providers involved in the care processes and their level of specialization, the availability of resources for care integration and the flexibility of financing sources, and the frequency and accuracy of performance evaluations.

The high number of health care providers and their level of specialization have arisen in an attempt to manage knowledge complexity (Plochg et al., 2009). However, this trend has also led to fragmentation, rendering inter-professional and inter-sectoral work difficult. Integration initiatives address this issue by involving providers from various disciplines in the care process of each patient, often organizing them in multidisciplinary units.

Another relevant aspect is funding. The availability of necessary resources is essential for any integration initiative, as initial investments can be large and pay-offs deferred. In addition, the financing mechanisms and streams in place affect the incentives to integrate (Kodner, 2009): they should be harmonized across care sectors in order to align the interests of the various actors involved in the care process (Suter et al., 2009; Weatherly et al., 2010). We consider flexibility in their use to be an important element for integration, as several initiatives introduced pooled budgets in order to accommodate appropriate risk sharing.

We group all the aforementioned indicators under the label 'Institutional Adequacy' and distinguished it from another dimension that can incentivize providers to engage in integration efforts: the performance accountability system, or what we named 'Focus on Results'. In general, as the need for steering mechanisms grows with the expected level of integration (Leichsenring, 2004), the focus on results introduces strong motivations for rising care standards. If accountability systems include an appropriate range of performance measures, capable of capturing care outcomes (e.g., effectiveness, patient satisfaction), they will help instill a system of rewards conducive to coordination between providers (Suter et al., 2009).

Two final important and intertwined dimensions are: (a) the target population - also called 'the focus of integration'– and (b) the object of integration (Kodner, 2009). The former results from assessing the mismatch between the needs of a cluster of patients and the services the system provides to them (Leutz, 1999). The object of integration derives from the specific needs of the target population: the specific conditions of a patient could necessitate a particular mix or sequence of services, which in turn may require the integration of support activities or may call

for involving different health providers (Kodner, 2009). Our study focuses on a specific target population. Therefore, our framework does not explicitly account for this aspect.

Transition management culture

Transition management culture is a category of 'soft' factors that influence the dynamics of integration. It represents the manifestation of normative structures and captures the attitude toward care integration (rather than self-promotion) of actors involved in the care processes across professional specializations, organizations and/or sectors.

The level of trust, goal sharing and interaction between professionals influence the success and spread of organizational change. These aspects are related to the willingness to enter collaborative arrangements, which can clash with existing differences of organizational and professional cultures (Horvitz-Lennon et al., 2006; Mann, 2005). Studies in the sociology of professions confirm the importance of this divide: in highly professional environments – like health care – the influence of third-party actors tends to be weak and normative structures shape change pathways and innovation diffusion (Adler & Kwon, 2009). Strong professional groups tend to block external sources of change and learning, which creates an environment where uni-professional innovations spread faster than multi-professional initiatives (Ferlie et al., 2005). Consequently, the difficulty of integrating services across the social and health care sectors is notorious (Jones et al., 2004; Mur-Veeman et al., 2003). However, the presence of local leaders encourages communication and mitigates the conflict by bridging professional gaps and promoting a vision shared by all actors (Shortell et al., 2000, Barnsley et al., 1998). If the involved actors do not feel their status and claim to power undermined by the new arrangements they are facilitated in finding communication channels and in adapting their practices as to enable collaboration. This situation can lead providers to compensate for potential organizational gaps, thus pushing integration forward (Etheridge et al., 2009; Hardy et al., 1999; Helleso & Fagermoen, 2010).

Considering all these strands of research, we grouped under the "transition management culture" construct the indicators of: level of goal sharing, existence of local leadership, providers' propensity to collaborate and adaptability to patient needs.

Organizational arrangements

An organizational arrangement is a set of voluntarily established rules aimed to support cooperation within and among organizations (Kodner, 2009). Organizational arrangements range from informal collaborations between providers, to the consolidation of all functions and responsibilities in a new formal entity (Leutz, 1999). While the latter is quite rare in practice (Weatherly et al., 2010), formal arrangements foster cooperation and align providers' goals. High degrees of formalization are most effective when the involved actors are separated by structural or professional boundaries (Booth, 1981) and when no single actor can autonomously deal with the complexity of the task (Alter & Hage, 1993). Care integration initiatives targeting frail patients are a case in point.

Historically, health care organizations have operated as loosely coupled structures with a high level of autonomy and specialization, despite the natural interdependencies arising between them out of the need to offer complex services (Luke et al., 1989). Such links have traditionally been managed by contracting services, leasing and entering service agreements. However, when facing an uncertain environment the need to achieve strategic coordination calls for stronger and more stable ties between partners.

Stability of ties is just as important at the strategic level as it is at the operational one, as unintended variation in work processes is likely to cause inefficiencies (Berwick, 1991). The adoption of common medical guidelines and standardized care pathways reduces such variation by improving quality of care and communication between providers (Atwal & Caldwell, 2002; Harvey, 2000).

All in all, under the "organizational arrangements" construct we grouped three indicators: the formalization of interactions (aimed to address complexity), strategic partnerships (aimed to address uncertainty), and defined care pathways (intended to reduce process variability).

Operating means

The operating means are tools and practices adopted by each organization in order to foster care integration. Myriad instruments are mentioned in the literature but in this study we consider a more parsimonious set. The selection was based on the relevance of each instrument to integration efforts, as it emerges from the academic and professional debates, and their applicability to the Italian context. We started with a comprehensive literature review and chose the integration instruments most commonly cited and evaluated. We then reviewed LHU websites and official documentation, which resulted in the integration of further instruments and in the fine-tuning with the terminology adopted by Italian practitioners and in LHU documentation (as the wording in the academic literature is not always aligned with that used by professionals in the field). Finally, in the test phase of the questionnaire we received feedback from professionals and experts in the Italian NHS on the understandability and completeness of the list. The final list is composed of 24 instruments and is presented in Table 2.2.

When an initiative implements a large number of operating means, we define it as having achieved a high technical intensity of integration. The studies evaluating specific means generally showed limited effects associated with their implementation, perhaps because success depends on combinations of means (Compagni et al., 2010) and because several other factors, at different levels in the health system, interact and influence positive outcomes. Therefore, the mere technical intensity should not be equated with successful integration.

TABLE 2.2 LIST OF SELECTED OPERATING MEANS AND LEVEL OF ADOPTION

Operating means	Description	%
Steering committee	A group of high-level stakeholders representing all involved actors, who are responsible for providing guidance on overall strategic direction	34.3
Networking meetings	Opportunities for information and opinion exchange between professionals in different organizations, co-involved in the care process	71.7
Multidisciplinary team	A group different professionals concerned with the treatment and care of patients, who meet regularly to discuss patient treatment and care	97.0
Co-location of services	Logistic concentration of all services in one center	31.3
Teaching programs for personnel	Periodic trainings for personnel aimed at improving coordination	91.9
Jointly managed programs	(e.g., condition-specific clinics)	68.7
Shared information systems	(e.g., electronic patient record, intake, population registry)	63.6
Service standards & protocols	(e.g., discharge planning, EBM guidelines)	90.9
Joint needs assessment	A formal process undertaken to assess the health and social care needs of a given population	82.8
Joint care planning	Configuration of mixed groups, who, by using their joint expertise and knowledge can choose the most appropriate services to be provided	77.8
Common assessment instruments	(e.g. standard assessment scales)	35.4
Standard performance measures	Standard evaluation measures of care outcomes	30.3
High risk population registry	Identification of categories of subjects characterized by high health and/or social risk	46.5
Single entry point	Unique access point for all needed services	75.8
Case management	A phased and structured guidance of the care process, in which care is planned and implemented by an interdisciplinary team, coordinated by a case manager	64.6
Frequent patient monitoring	Regular monitoring of the patient's health status and progress	47.5
Telemedicine	The remote delivery of health care services by means of advanced telecommunication technology	37.4
Telephonic triage	Telephonic support service for potential patients, available 24 hours/day and managed by nurses	9.1
Post-acute structures	Intra-hospital structures aimed to assist and monitor patients	75.8
Rehabilitation structures		83.8
Logistic accessibility of services	(e.g. availability of transportation means, extended access time)	51.5
Partnership with carers& community	Involving and promoting initiatives of the community aimed at supporting the care process	57.6
Self-management support	Patient and care givers' education	53.5
Home-care programs	Home care services adapted to patient need and with various care intensity levels	97.0

FIVE HYPOTHESES ON CARE INTEGRATION

The complexity of our conceptual framework, inherent to the very nature of the topic, makes it hard to simultaneously test all conjectured relations without a very large dataset. We addressed the computational challenge in two ways. First, as previously mentioned, we narrowed the scope of our study to a specific target population (the frail elderly). Secondly, we derived five hypotheses on partial dynamics of integration, the confirmation of which would support the structure of our framework. While confirming these hypotheses cannot be equated with the confirmation of the complete model, it would represent an important step towards the substantiation of the theorized relations. The first three hypotheses build on the perspective of integration as an intermediate goal, while in the last two hypotheses integration is conceptualized as an instrument for improving care quality.

Care quality is measured as improvements with respect to a reference time period. We asked our survey participants, what, if any, changes in care quality they have observed during the last 3 to 5 years. While we acknowledge our measure of care quality is subjective, we opted for this measurement strategy because no standard indicators were available at the regional or national level. While several LHUs calculate and sometimes publish indicators on patient satisfaction, process measures (e.g., waiting lists), and health outcomes they are neither comparable nor complete at the national level. In contrast, our measure of care quality is comparable across the sample; though it does not attempt to capture an absolute level of quality but rather variations, which might be traced back to the perceived level of integration. We recognize that there can be an upward bias in reporting such perception; however, we have no reason to believe that it is not consistent for all respondents.

HYPOTHESIS 1: INSTITUTIONAL ADEQUACY AND A FOCUS ON RESULTS POSITIVELY AFFECT THE ACHIEVED LEVEL OF CARE INTEGRATION. The traits of the context in which the integration initiative develops are expected to significantly impact the attained level of integration. We grouped contextual traits in two constructs: institutional adequacy and focus on results. The former regroups indicators for the availability of resources earmarked to integration, the flexibility in their use, the numerosity of providers involved in care processes, and their levels of specialization. The latter identifies the implementation of performance measurement systems including an appropriate range of

measures, capable of capturing outcomes on the most relevant dimensions: efficiency, effectiveness and patient satisfaction.

HYPOTHESIS 2: THE TRANSITION MANAGEMENT CULTURE SIGNIFICANTLY INFLUENCES THE LEVEL OF INTEGRATION. We expect a higher level of integration where the actors involved in the care process share goals, are keen to adapt their practices to the needs of patients and involve other professionals if necessary, and local leadership is active.

HYPOTHESIS 3: THE STABILITY OF ORGANIZATIONAL ARRANGEMENTS IN PLACE SIGNIFICANTLY INFLUENCE THE LEVEL OF INTEGRATION. We expect that integration is facilitated where relations among providers are formalized, partnership formation is eased, and care pathways are predefined.

HYPOTHESIS 4: CARE INTEGRATION LEADS TO IMPROVED CARE QUALITY. We expect a strong positive relationship between the level of integration in care processes and care quality; for instance, the higher the level of attained care integration the better is the perceived quality of care as reported by professionals.

HYPOTHESIS 5A: THE TECHNICAL INTENSITY OF INTEGRATION, PER SE, DOES NOT HAVE A RELEVANT INFLUENCE ON CARE QUALITY. We expect technical intensity of integration (in our study a count measure of the implemented operating means) not to be significantly associated with care quality.

HYPOTHESIS 5B: ITS EFFECT ON CARE QUALITY IS INDIRECT AND FILTERED THROUGH THE IMPACT OF THE OVERALL LEVEL OF INTEGRATION. Technical intensity of integration is expected to be positively associated with the level of integration: it is through this indirect path that managerial efforts fostering integration enhance care quality.

EMPIRICAL SETTING: THE ITALIAN NATIONAL HEALTH SYSTEM

Italy has a universal national health system (France et al., 2005) organized in three tiers: the national government (defining the basic benefit package and transferring funds to the Regions), the 21 Regions (responsible for the organization and governance of service delivery), and local organizations (responsible for service provision). Local health units (LHUs) numbered 146 in July 2011 (Ferré & Ricci, 2011), but as two merging processes were ongoing only 144 are

included in the present analysis. LHUs manage service delivery, each one promoting public health for the population resident in a defined geographic area (or "catchment area": 415,000 inhabitants on average in 2011). They take responsibility for numerous hospital and community care services, with a natural orientation toward their coordination (Palmieri & Mascia, 2008). Regions fund LHUs through a capitation-based scheme; then LHUs contract individual services with a number of public and private accredited providers (Ferré & Ricci, 2011). Social services are mainly under the financial responsibility of local governments.

In the last decade, a number of legislative interventions have aimed to foster coordination of health and social services. In particular, the national health plan 1998-2000 identified the "districts" as LHU geographical divisions where social and health services integration should take place. The DPCM 14/2/2001 indicated the "individual care plan" based on multidimensional evaluation as the standard for successful care integration; the DPCM 21/4/2008 codified the home care services included in the national essential levels of care and defined the appropriate role of primary care in their delivery. In parallel with the national legislation, a number of organizational pilots and service delivery models developed in different regions with the twofold aim of implementing the national legislation and the autonomous regional strategies to integrate primary, secondary and social care. In particular, the Tuscany region embraced the model of the "Societies for Health" (Società della Salute): it is located at the sub-district level (serving a population of 5-10,000 people) and is based on the single-entry-point concept; it involves administrative and nursing staff members of the district, ambulatory care specialists (e.g., rehabilitation, community hospital), general practitioners (GPs), social workers, emergency services, and local providers of community services. The Emilia-Romagna region developed the model of the Primary Care Department (Dipartimento Cure Primarie): it is a LHU organizational unit dedicated to coordinate GPs, ambulatory care, home care, residential long-term care and social care. In addition, the region established, in each LHU, the organizational position of the Social Director: a top-management role with the explicit goal of recomposing the service delivery fragmentation and ensuring the coverage of health and social needs, especially by managing the relations with local governments and other institutional subjects involved in the decision-making processes. Also Veneto, Emilia-Romagna and Lombardy introduced the position of the Social Director, though with different organizational powers (Longo et al., 2010). Our analysis

capitalizes on the diversity of regional contexts and the consequential variation of solutions across the national health system.

DATA AND METHODS

Instrument and sample

The dataset we use in our analysis was collected with the help of an ad-hoc instrument (see Appendix A1). The questionnaire aims to capture the complexity of the care integration models implemented in Italy. Whenever possible the items were derived from validated instruments, but most of them were custom-built to account for the specificities of the empirical setting. The instrument was tested for understandability and face validity with some Italian scholars and professionals.

We focused the analysis on a specific target population. The questionnaire instructed the respondents to refer exclusively to 'frail elderly patients', defined as: (a) geriatric complex cases, suffering from poly-morbidity and presenting a high risk of adverse outcomes; (b) who require comprehensive care, often being discharged from hospital or a long-term care institute into a protected regime.

The items are grouped in seven sections: (1) general information about the organization; (2) contextual traits; (3) transition management culture; (4) organizational arrangements; (5) care quality; (6) level of care integration; and (7) implemented operating means. The majority of items were measured on a 7-point Likert scale anchored at the end points, with the notable exception of items concerning the presence/absence of operating means.

The questionnaire was administered to all Italian LHUs. The data collection procedure involved: (a) contacting by phone the general and/or social direction to present the study; (b1) sending, via mail, a standard survey package containing the questionnaire, a customized cover letter, and a prepaid, self-addressed envelope for participants requesting the paper-based copy; (b2) sending a customized e-mail indicating the link to our web-based questionnaire – graphically reproducing the paper-based one – and including attached the electronic copy of the questionnaire to be sent back via e-mail or via fax. Participants were free to choose between the paper-based and the web-based questionnaire, to be filled in by any or a combination of four suggested organizational figures: the Director of Social Services, the Director of a Social Care

District, the Director of the Geriatrics Operative Unit and the Director of the Department of Geriatrics. The dataset was built between July 1st, 2011 and March 6th, 2012. It consists of 102 useful responses from 87 different LHUs, with a response rate of 60.4% and 19 regions represented. Most participating LHUs contributed a single response, officially declared as representative of the organization. Multiple responses were collected from 12 LHUs. Response rates vary between macro areas, defined here in accordance with the NUTS1 classification (Eurostat)[3]. The Northern areas are overrepresented in our sample: 57.6% response rate for Northwestern and 85% for Northeastern Italy. The rate reached 48% in Central Italy and 47.1% in Southern Italy.

Methods

We conducted confirmatory factor analyses (CFA) to assess the validity and reliability of our latent constructs. CFA is a statistical procedure used for identifying relations between observed variables (called items or indicators) and an underlying construct common to them (called latent variable or factor) by analyzing the covariance patterns between the manifest indicators (Blunch, 2008). That is, CFA is concerned with validating a proposed measurement model, by which we mean the extent to which the items are determined by the underlying construct. It can be applied in situations where the researcher has *a priori* knowledge on the structure of the factor and attempts to test hypothesized relations (Brown, 2006). We ran a two-factor model for the 'Contextual traits' construct and a single factor model for each of the remaining constructs.

In order to further test the relations between two or more latent variables we adopted a structural equation modeling (SEM) approach. SEM builds on the measurement models validated by CFA and allows for the specification of structural paths between factors (i.e. regression structure with specified causal directionality). As with CFA, structural models are a statistical test of the tenability of a previously specified set of relations on a dataset (Byrne, 2001). In our case, the relations hypothesized via our conceptual framework are applied to the sample data and a measure of the plausibility of seeing the data at hand generated by the specified mechanism is calculated (i.e. the model fit). All models are presented diagrammatically and all factor loadings

[3] Based on the regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003, the NUTS (Nomenclature of territorial units for statistics) classification is a hierarchical system for dividing up the economic territory of the EU. The NUTS 1 level represents major socio-economic regions.

reported represent the standardized estimates, which allow for the comparison of loadings between factors.

The missing values issue[4] was addressed by using the Maximum Likelihood Robust estimator (Yuan & Bentler, 2000), which produces robust standard errors and chi-square estimates under conditions of non-normality and non-independence (Muthen, 2010). For the assessment of model fit we used the indexes most commonly cited in the literature, and followed the value thresholds suggested in Brown (2006) and Hu & Bentler (1999). All statistical analyses were performed using the Mplus (version 6.11) and IBM SPSS Statistics 19 packages.

Inter-rater agreement

Most of our dataset consists of single responses for each LHU. The 12 aforementioned exceptions are LHUs for which two or three questionnaires were collected, independently filled in by different organizational representatives. They offer an opportunity to check the level of reliability of our raters. Inter-rater reliability refers to the level of agreement between two or more judges, in their assessment of identical items – in our specific case, independent judgments on the profile and situation of a single LHU by different managers at different levels in the organizational hierarchy. Low concordance between ratings can be the result of either scale inappropriateness with respect to the measured variable – which would lead to a reconsideration of the item- or inappropriate judgments on the part of the raters – which can be addressed through re-training.

We used the intra-class correlation coefficient (ICC) in order to assess the consistency of ratings in our sample (Field, 2005). The ICC evaluates rating reliability by comparing the variability of different ratings of the same item to the total variation across all ratings and all items. It can theoretically vary between 1 and 0, with larger values being indicative of little variation within the groups as compared to variation among group means, and thus higher rating consistency. Different versions of the ICC exist and can yield quite disparate results; following Shrout & Fleiss (1979) we use the so-called ICC (3,1) which implies a statistical model based on a two-way ANOVA design with mixed effects. In this case, the raters are considered fixed effects in the model and the ICC acts as a measure of consistency between their ratings. By ignoring the variability of the rater effect we lose the power to infer to a wider population of raters, as we treat the raters in

[4] Item non-responses ranges from 0 to 19% with a sample average of 1.43%

our study not as a random sample for a larger population but as the only judges of interest. This assumption relies on the specific instruction we used in the surveying process that the organizational figure(s) working closest to and being most informed with respect to care integration for the elderly is the correct referent for participating in our study. As such, the selection of respondents was not a random process and inference on the population of raters they belong to is neither possible nor of importance to our study. We calculated the ICC for each of the 12 pairs of ratings for the same subject LHU by the two (three) managers. We found their ratings to be highly consistent (see Appendix A2) with most values ranging between 0.9 and 1.

RESULTS

Table 2.2 shows the frequency distribution of the implemented operating means in our sample. Our results confirm an overall high adoption rate across Italy, with none of the instruments listed being completely absent and with most instruments having been implemented in more than a third of the LHUs in our sample. Interestingly, while some instruments are practically fully adopted, others remain unpopular. The presence of multidisciplinary teams, the organization of joint teaching programs for personnel, the existence of standard and protocols and the implementation of home-care programs overcome the threshold of 90%; at the other end of the spectrum, telephonic triage, standard performance measures and co-location of services show low and fairly low adoption rates.

All the measurement models for our latent constructs show a satisfactory overall fit and all the selected indicators load significantly on their respective factors. We report the average variance extracted (AVE), the Standardized Root Mean Square Residual (SRMR), the Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI) for each measurement model. We use Cronbach's coefficient α in order to assess the composite reliability of the proposed constructs; however, as coefficient α commonly underestimates true reliability we also calculate Raykov's ρ an alternative measure of reliability with more desirable properties for congeneric measures (Raykov, 1997). In the following, we limit our discussion to the measurement model for the integration construct, but detailed descriptive statistics and estimation results for all other constructs can be found in Table 2.3.

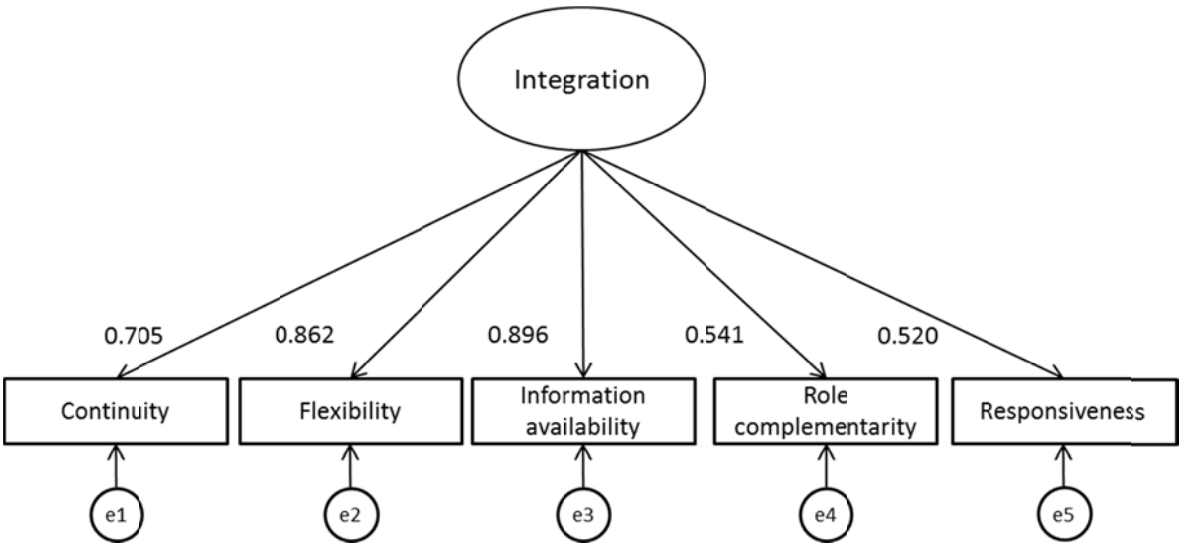
TABLE 2.3 MEASUREMENT MODELS FOR THE LATENT CONSTRUCTS

Indicators (by latent factors)	Factor loadings	p-value	N	Mean (Std.Dev.)
Care quality				
Improved quality	0.837	0.000	102	5.85 (0.825)
Improved needs assessment	0.800	0.000	102	5.62 (0.902)
Improved alignment of care	0.729	0.000	101	5.29 (1.061)
Cost efficiency of care	0.508	0.000	100	4.41 (1.583)
Cronbach's α = 0.761 Raykov's Rho= 0.757	AVE= 0.72			
Chi-square = 4.694 (0.096)	SRMR = 0.031		CFI = 0.980 / TLI = 0.940	
Integration				
Continuity	0.705	0.000	101	5.17 (1.011)
Flexibility	0.896	0.000	101	5.22 (1.137)
Information availability	0.862	0.000	101	5.08 (1.189)
Role complementarity	0.541	0.000	101	5.36 (1.117)
Responsiveness	0.520	0.000	101	5.43 (1.152)
Cronbach's α = 0.823 Raykov's Rho=0 .840	AVE= 0.52			
Chi-square = 6.899 (0.228)	SRMR= 0.041		CFI = 0.988 / TLI= 0.977	
Transition Management Culture				
Providers' adaptability	0.797	0.003	102	5.11 (1.218)
Goal sharing	0.324	0.000	101	5.65 (1.117)
Providers' co-involvement in care	0.849	0.000	102	5.10 (1.165)
Leadership	0.584	0.000	101	5.20 (1.349)
Cronbach's α = 0.722 Raykov's Rho= 0.736	AVE= 0.65			
Chi-square= 0.453 (0.797)	SRMR= 0.011		CFI=1.000 / TLI=1.063	
Contextual traits				
Institutional adequacy			100	4.54 (1.473)
Resource availability	0.659	0.000		
Financial flexibility	0.411	0.000	96	3.99 (1.395)
No. of involved providers	0.742	0.000	101	4.76 (1.201)
Specialization	0.565	0.000	101	4.77 (1.406)
Cronbach's α = 0.547 Raykov's Rho= 0.684	AVE= 0.59			
Focus on Result				
Effectiveness evaluations	0.887	0.000	102	4.35 (1.487)
Patient satisfaction	0.806	0.000	102	4.54 (1.500)
Efficiency evaluations	0.754	0.000	102	4.66 (1.411)
Appropriate measures	0.860	0.000	99	4.21 (1.540)
Cronbach's α = 0.884 Raykov's Rho= 0.899	AVE= 0.81			
Chi-square= 23.802 (0.204)	SRMR= 0.037		CFI=0.982 / TLI=0.974	
Factor correlation: r=0.420 (0.000)				
Organizational Arrangements				
Formality	0.719	0.000	99	5.07 (1.231)
Partnership	0.645	0.000	98	4.80 (1.251)
Care flexibility	0.448	0.003	100	5.24 (1.199)
Cronbach's α = 0.632 Raykov's Rho= 0.637	AVE= 0.60			
Operating Means			101	14.70 (4.23)

MEASUREMENT MODEL FOR INTEGRATION

We confirm that a measurement model for integration can be constructed with the five aforementioned indicators: continuity, flexibility, information availability, role complementarity, and responsiveness (Figure 2.2). Not surprisingly, the indicators with the higher factor loadings are continuity of care, care flexibility and information exchange. Our measure of integration has high composite reliability as indicated by Cronbach's coefficient $\alpha = 0.823$ and Raykov's $\rho = 0.840$. The Integration construct explains more than half of the covariation of the five indicators (AVE=0.520), confirming its convergent validity.

FIGURE 2.2 MEASUREMENT MODEL FOR THE INTEGRATION CONSTRUCT

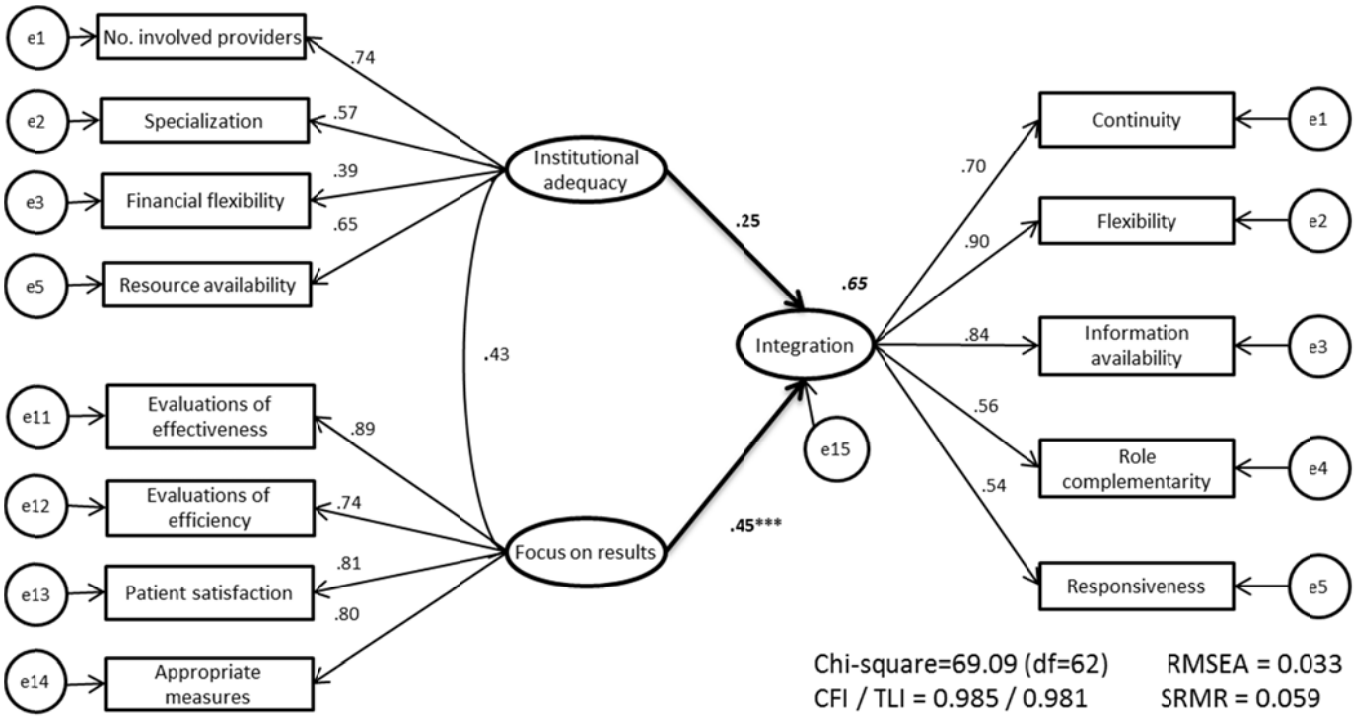


We conclude that a good proxy for care integration can be constructed on the basis of the five selected indicators, which strike a good balance between parsimony and explicative power.

THE INFLUENCE OF CONTEXTUAL TRAITS ON THE LEVEL OF INTEGRATION

We tested the relationship between the contextual traits and the level of integration by specifying a three-factor structural equation model, where the construct of 'Integration' is influenced by two factors: 'Institutional Adequacy' and 'Focus on Results', which represent the break-down of the contextual pressures considered in our conceptual model (Figure 2.3). The model has an overall satisfactory goodness-of-fit and a good comparative fit. The 'Institutional Adequacy' factor has a low and not significant loading on 'Integration'. As such, we cannot confirm the hypothesized association between the institutional structure (macro level) and the level of attained integration. Conversely, the 'Focus on Results' construct shows a strong positive relation with 'Integration' confirming that integration is fostered by results-driven environments, where performance evaluations are frequent, comprehensive in their scope, and measure actual results.

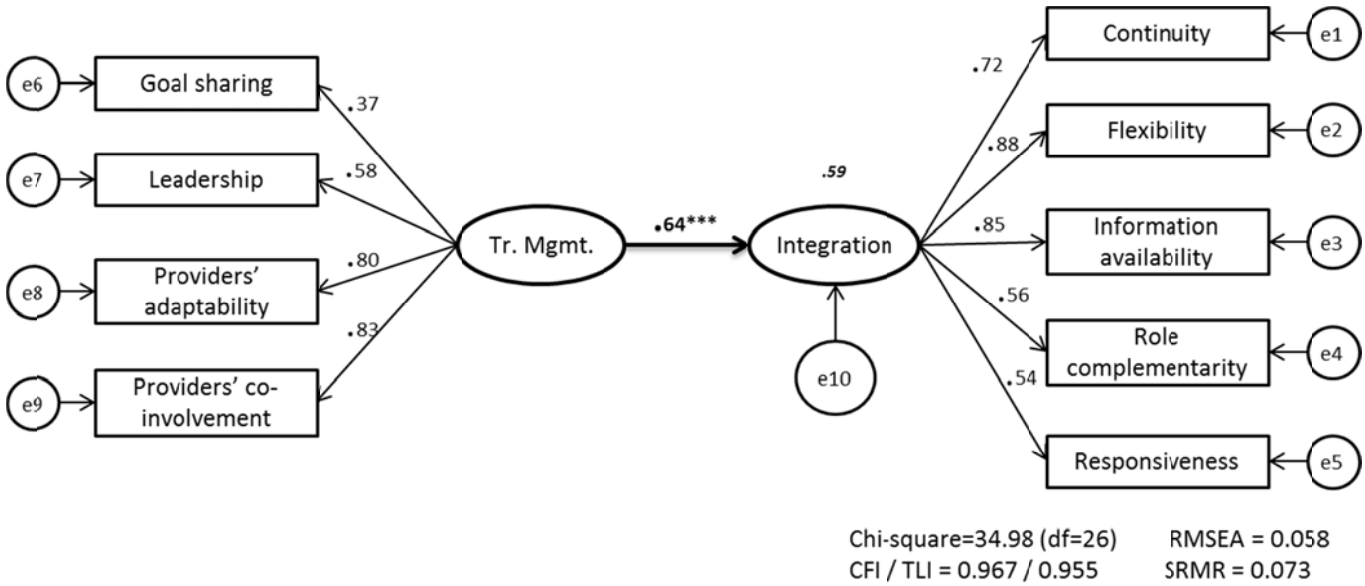
FIGURE 2.3 THE EFFECT OF CONTEXTUAL TRAITS ON THE LEVEL OF INTEGRATION



THE INFLUENCE OF TRANSITION MANAGEMENT CULTURE ON THE LEVEL OF INTEGRATION

In order to test the second hypothesis we specified a two-factor model, with a direct causal link between 'Transition Management Culture', measured by indicators of goal sharing, leadership, providers' adaptability and providers' co-involvement in the care process - and 'Integration' (Figure 2.4). Fit measures of the model have very good values and the regression weight (0.64) confirms a strong relationship between cultural factors associated with change management and the attained level of integration. Therefore, professionals are confirmed as a cornerstone of care integration, which can only be attained through bridging the cultural and communication gaps between different professions and care sectors.

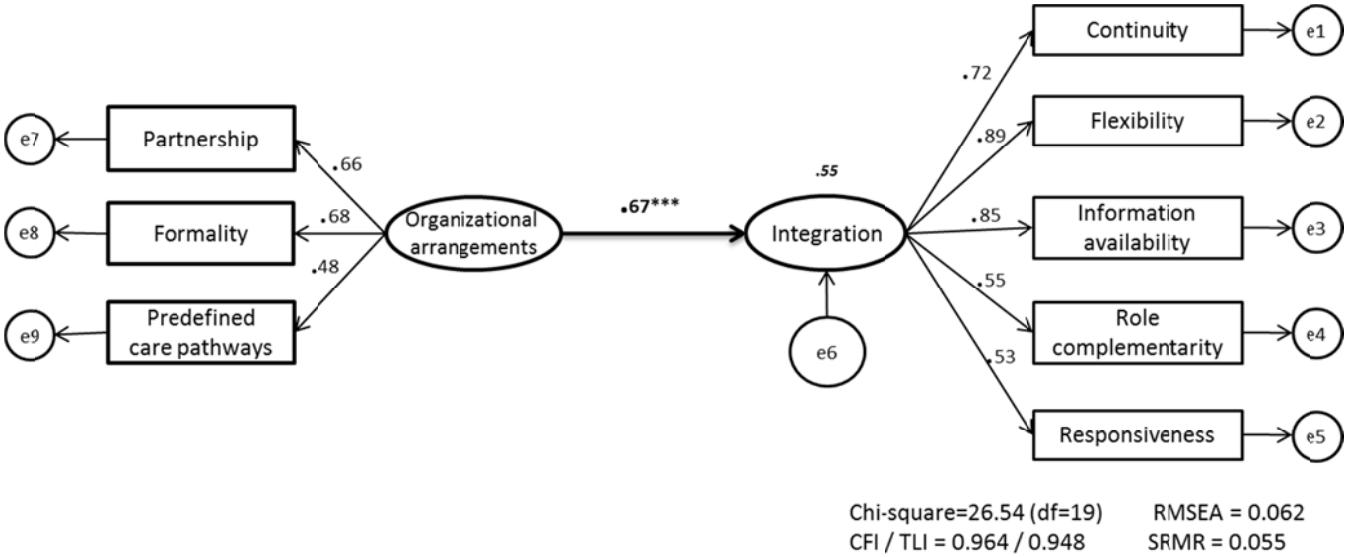
FIGURE 2.4 THE EFFECT OF TRANSITION MANAGEMENT CULTURE ON THE LEVEL OF INTEGRATION



THE INFLUENCE OF THE ORGANIZATIONAL ARRANGEMENTS IN PLACE ON THE LEVEL OF INTEGRATION

For our third hypothesis we specified a model with two latent constructs: 'Integration' regressed on 'Organizational arrangements' (Figure 2.5). The good global and comparative fit of the model and the strong positive relationship between the two constructs provide evidence supporting the positive influential role of organizational arrangements oriented toward strategic partnership and intended to generate clear expectations by formalizing interactions and standardizing care processes.

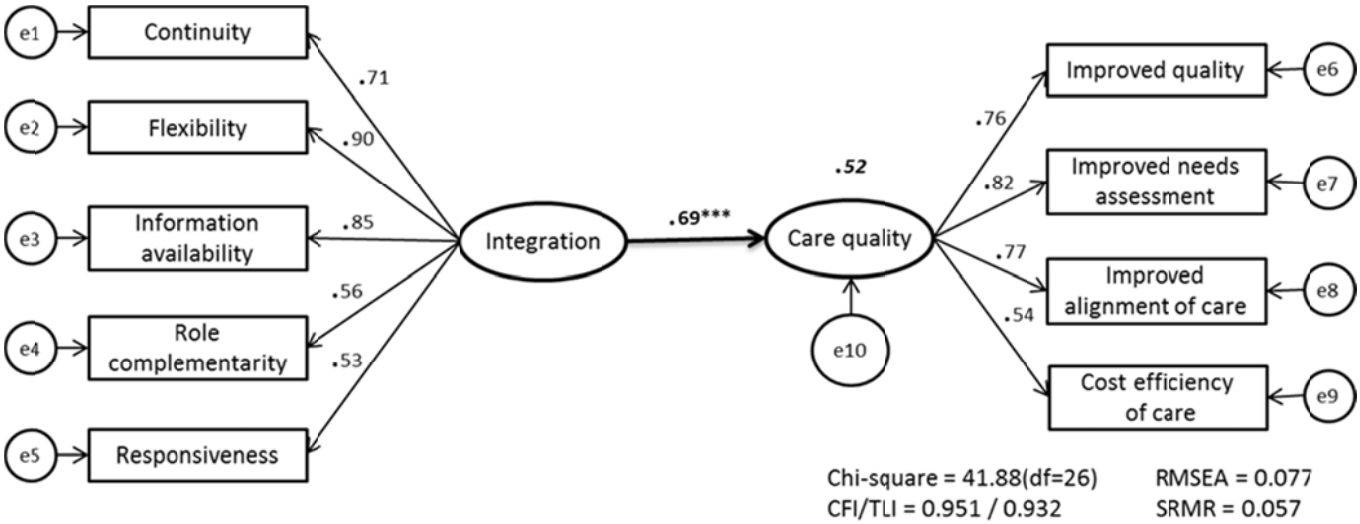
FIGURE 2.5 THE EFFECT OF ORGANIZATIONAL ARRANGEMENTS ON INTEGRATION



THE EFFECT OF THE LEVEL OF CARE INTEGRATION ON CARE QUALITY

In order to test our fourth hypothesis, we specified a two-factor model, where 'Care Quality' is regressed on the 'Integration' construct (Figure 2.6). The model showed a very good overall fit supporting the idea that the level of care integration attained significantly and positively influences care quality. Higher levels of integration can be expected to lead to considerable increases in the perceived quality of care, as indicated by the 0.69 regression coefficient.

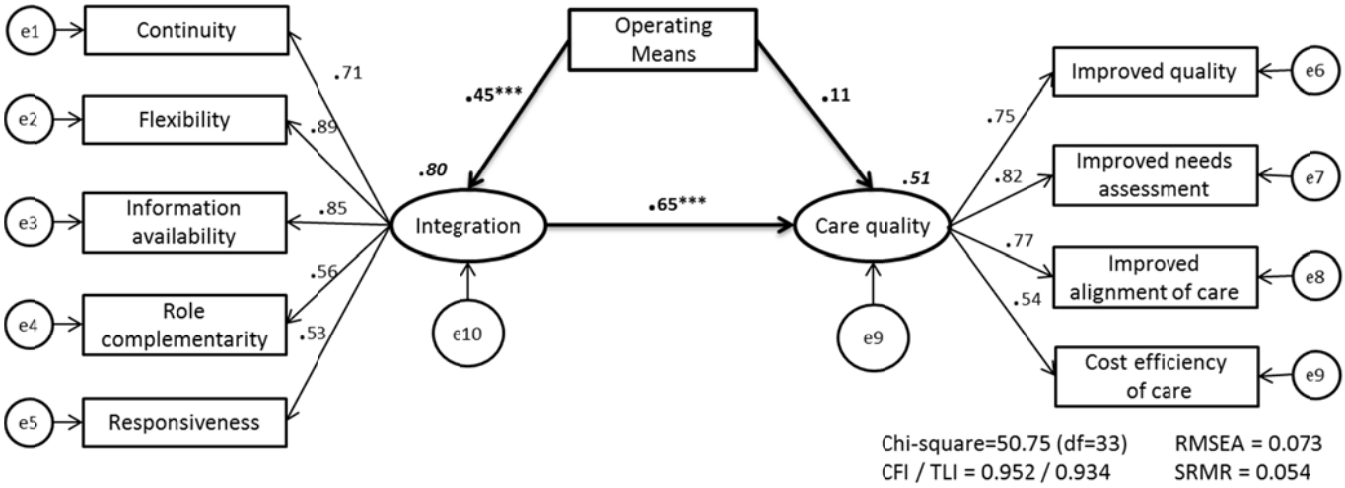
FIGURE 2.6 THE EFFECT OF INTEGRATION ON CARE QUALITY



CARE QUALITY AND THE TECHNICAL INTENSITY OF INTEGRATION

For our last hypothesis we started by specifying a model regressing 'Care Quality' on a count variable of the number of implemented operating means. The global and comparative fit of the model was satisfactory. While the regression coefficient for 'Care Quality' on 'Operating means' was significant at a 95% confidence level the strength of the association was low (0.06). We then specified a model in which 'Care Quality' is simultaneously regressed on both 'Operating means' and 'Integration' (Figure 2.7). We found a strong association between 'Operating Means' and 'Integration' and between 'Integration' and 'Care Quality', while the regression weight between 'Operating means' and 'Care Quality' was not significant. This suggests that the effect of operating means on care quality is fully mediated by the attained level of integration. In other words, the technical intensity of integration influences care quality only in as much as it can favor the attainment of higher levels of care integration.

FIGURE 2.7 THE EFFECT OF IMPLEMENTED OPERATING MEANS ON CARE QUALITY



LIMITATIONS

We acknowledge three main limitations of the present study. First, computational challenges (mainly related to the limited sample size) arise when attempting to simultaneously test the relationships between all relevant factors identified in our conceptual framework. We are constrained to estimating individual models for each hypothesized relationship, which does not amount to confirming the proposed framework as a whole. However, we argue that the partial

tests conducted convincingly confirm the explanatory power of the proposed framework and its usefulness in synthesizing the dynamics of integration processes. Secondly, we use a subjective measure of care quality. All the information used in the present study were collected by surveying health care managers in Italian LHUs. By virtue of the data collection strategy, reporting bias is to be expected. However, we argue that our choice is justified by the current absence of an alternative measure of care quality, both comparable across LHUs and objective. Finally, our operationalization is context dependent. This limits the generalizability of our results to similar settings and similar target population. Nonetheless, we argue the main structure of our framework can be extended straightforwardly to even starkly different contexts. The instrument we propose can be easily adapted to a specific survey context (i.e. language, prevalent terminology, common operating means, etc.) and can base further research efforts.

CONCLUSIONS

We started from the assumption, largely supported in the literature, that care integration is a complex endeavor, whose success depends on contextual, cultural and organizational factors, rather than the mere implementation of technical tools. As we could not test the full model (as proposed in the conceptual framework) our results pertain only to the individual relations between care integration and its main antecedents.

Drawing from the literature, we validated a composite measure of care integration that could be useful for both policy makers and health managers willing to design and implement successful initiatives. Our analysis of the antecedents of care integration suggested that the context influences integration, though not all the contextual traits considered in the literature exert a significant influence. In particular, the introduction of results-based accountability systems (e.g., evaluation of effectiveness, satisfaction) is more effective than interventions introducing system-level flexibilities or shaping the service delivery (e.g., budget pooling, number of providers). Integration is fostered in environments measuring and monitoring care results which depend more on collaboration and learning rather than competition.

In addition, a strong transition management culture is an invaluable enabler. For instance, providers' collaborative attitude and goal sharing are important elements. This strong association emphasizes the importance of long-term interventions in health care education

systems, as to foster communication between professionals and envision the complementarities between disciplines and care technologies, whenever the complexity or the novelty of cases blurs the line between institutional responsibilities. In addition, the presence of strong local leaders can act as an important trigger for promoting integration. This emphasizes the need to consider, when appointing social and health professionals (especially in managerial roles), also personal attitudes and professional styles apt to facilitate interdisciplinary and inter-organizational collaboration.

We also found that the organizational arrangements in place influence care integration. In particular, the definition of strategic partnership among providers and the formalization of providers' interactions have a positive influence on care integration. The former highlights the importance of clear expectations among involved actors in order to reduce uncertainty.

Finally, we found evidence that the attained level of integration positively influences care quality as reported by respondents. This supports the idea that care integration plays an important role in the way frail elderly patients experience the care process. If we pair this insight with the forecast of rapid growth for this cluster of patients in developed countries, we can conclude that care integration should continue to rank high on the health policy agenda and remain a topic of deep interest for health care managers and policy makers alike. In addition, our composite measure of care integration allows for breaking down the concept to its constituent elements, thus providing direction for policy interventions and evaluation.

All in all, our results suggest that multiple, diverse factors come into play and directly influence outcomes in care integration efforts. Although the partial tests conducted do not allow for assessing the relative importance of each factor and all their interactions, the intuition behind the available evidence is that the outcomes of integration initiatives depend on several factors at different levels in the health system. Therefore, mangers and policy makers should acknowledge the complexity of integration in health care and design interventions accordingly.

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APPENDIX A

APPENDIX A1. QUESTIONNAIRE EXCERPTS (ADAPTED TRANSLATION FROM THE ORIGINAL ITALIAN VERSION)

	Indicator	**Item**	**Response scale anchors (1 / 7)**
INTEGRATION	Continuity	The care process is continuous over time (i.e., past, current and future care are linked and coherent)	Strongly disagree / Strongly agree
	Flexibility	The care process is constantly adapted coherently with the monitoring results	Strongly disagree / Strongly agree
	Information Availability	The relevant information are always available to the providers involved in the care process	Strongly disagree / Strongly agree
	Role complementarity	The different professionals involved in the care process appreciate the complementarity of their roles	Strongly disagree / Strongly agree
	Responsiveness	Eventual emergencies are met in a timely manner	Strongly disagree / Strongly agree
CARE QUALITY	Improved quality	*Over the last 3 to 5 years your Local health unit …* … has achieved actual improvements in terms of quality of care	Strongly disagree / Strongly agree
	Improved needs assessment	… did a good job of assessing the actual needs of frail elderly patients	Strongly disagree / Strongly agree
	Improved alignment of care	… has managed to align service provision to the actual needs of frail elderly patients	Strongly disagree / Strongly agree
	Cost efficiency of care	… has managed to maintain the level of quality of care despite having to deal with cost containment pressures	Strongly disagree / Strongly agree
INSTITUTIONAL ADEQUACY	Number of involved providers	The average number of providers involved in the care process of each patients is:	Very low / Very high
	Specialization	The level of specialization of the providers involved in the care process is:	Very low / Very high
	Financial flexibility	The level of flexibility in the use of different financing sources is:	Very low / Very high
	Resource availability	The resources available for the care integration process are adequate	Strongly disagree / Strongly agree
FOCUS ON RESULTS	Effectiveness	*On the services provided to frail elderly patients are carried out …* … measurements of effectiveness	Never / Always
	Efficiency	… measurements of efficiency	Never / Always
	Patient satisfaction	… measurements of patient satisfaction	Never / Always
	Appropriate measures	The resulting measures are representative of actual outcomes (in terms of effectiveness, etc.)	Never / Always

TRANSITION MGMT. CULTURE	Goal sharing	The goal of integrating care is shared among social care, primary care and acute care professionals	Strongly disagree / Strongly agree
	Leadership	There are local leaders foster care integration	Strongly disagree / Strongly agree
	Providers' adaptability	Providers are willing to adjust their practices according to the specific needs of patients	Strongly disagree / Strongly agree
	Providers' co-involvement	Social, primary and acute care professionals involve one each other in all the phases of the care process	Strongly disagree / Strongly agree
ORG. ARRANGEMENTS	Partnership	Providers aiming to integrate services manage their relations more frequently with:	Market contracts / Strategic alliances
	Formality	The relations between providers aiming to integrate services are more frequently:	Informal / Formal
	Predefined care-pathways	The definition of the care processes for frail elderly patients is more frequently:	Entrusted to the involved providers / Standardized in advance

APPENDIX A2. INTER-RATER AGREEMENT

Paired-Responses Groups	N of items	Intra-class Correlation	Confidence Interval	
			Lower bound	Upper bound
Group 1	3	.977 ***	.964	.986
Group 2	2	.910 ***	.846	.948
Group 3	2	.971 ***	.949	.983
Group 4	3	.969 ***	.950	.981
Group 5	2	.951 ***	.913	.972
Group 6	2	.952 ***	.917	.973
Group 7	2	.990 ***	.982	.994
Group 8	3	.946 ***	.914	.967
Group 9	2	.923 ***	.867	.956
Group 10	3	.911 ***	.862	.946
Group 11	2	.848 ***	.744	.912
Group 12	2	.956 ***	.923	.975

CHAPTER 3
THE PATTERNS OF HEALTH CARE UTILIZATION OF ELDERLY EUROPEANS: FRAILTY AND INCREASED CARE UTILIZATION

INTRODUCTION

Increased longevity and the changing population structure are calling in question the long-term sustainability of health systems in developed countries. Consensus is growing on the urgency to redesign care processes as to better respond to the specific care needs of the elderly but there is still much debate on the most appropriate strategies. Beyond the general principle that the largest volume of care should be shifted upstream - when there is scope for prevention and for the identification of populations at risk- rather than toward the end of the disease cycle - when symptoms are manifest – complex clusters of patients require targeted care.

The frail elderly form one such cluster. Frailty is known to be a precursor to disability and to overlap with multimorbidity; frail individuals are prone to adverse health outcomes and acute episodes and have an increased risk of mortality and morbidity (Fried et al., 2004). However, if they are successfully targeted for prevention and maintenance of functional and health status such adverse outcomes can be delayed or avoided. Unfortunately not much is known to date about the patterns of care utilization of the frail. We attempt to fill this gap and offer much needed insight into their level of care utilization, how it changes with functional decline and which care settings are most burdened by it. We use cross-national survey data on primary, secondary and tertiary care utilization and estimate the level of association with frailty, after having controlled for care needs, socio-economic status and differences in regional settings.

The study is structured as follows. The first section discusses the demographic trend of population ageing and its implications for health care systems. We then provide an overview of the frailty syndrome, its measurement, prevalence, correlates and dynamics. The next two sections present the dataset and the econometric strategy. We conclude with the study results, limitations and a short discussion.

POPULATION AGEING AND IMPACT ON HEALTH CARE SYSTEMS

According to the latest projections released by the World Bank by mid-century the world population will reach 9.15 billion. Within this time horizon, regions and countries are likely to follow different paths at different rates, but they will invariably experience significant changes in population structure: fertility will slowly but constantly decline while life expectancy will rise throughout the world (World Bank – HNP Stats, 2011). A population which to present standards can be characterized as aged will become the predominant demographic feature in all geographic regions. High income countries are already facing the significant challenge of adapting to the new population structure while middle and low income countries will shortly follow on the same path. In 2010, 15% of the population in developed countries was 65 years or older, a proportion which will steadily increase to over 21% by 2030 and approach 24% by 2050. The world average is considerably lower, standing at under 8% elderly in 2010, but projected to increase at a much faster rate and double by 2050 to 16% (World Bank – HNP Stats, 2011). These shifts translate into a soaring dependency ratio: from a current 49% to almost 70% by 2050 in high income countries. In the EU27 the population is expected to increase by 3% to a total of 516.5 million by 2060, mainly as a result of increases in life expectancy (European Commission, 2012). The age group with the fastest growth during the next 50 years will be the very old (80 and above). This is expected to lead to massive changes in the European population structure and to an increase in the total dependency ratio from 50% in 2010 to 78% in 2060. The world population is ageing and it presents important challenges for public policy.

The phenomenon of population ageing has led to ever growing concerns for the sustainability of long-term and health care systems, which together account for a substantial part of age-related expenditure in European countries. Between 2010 and 2060 average health expenditure in the EU27 is projected to increase from an average of 7.1% to 8.3% of GDP. Such concerns are equally rooted in the swift demographic shifts and the inability of health care systems to respond rapidly and reliably to the associated challenges. As individuals age their health status tends to decline and they require increasingly more health care services. The very old are highly prone to frailties, disability and dependency. While the rate of severe disability is declining in developed countries, the gains in health are not likely to translate into lower expenditure for long-term and health care (Jacobzone et al., 2000). According to the World Health Survey report, an estimated 12% of the

population in high-income countries are experiencing significant difficulties in their everyday lives due to disability (WHO, 2011). The prevalence is higher in rural areas, among females, in lower income quintiles and in older age groups (almost 30% of individuals aged 60 and above report a moderate or higher level of disability).

Ageing is also closely linked to the increasing prevalence of chronic conditions, which presently account for an overwhelming share of the total burden of disease (WHO, 2008). World-wide, 59% of all deaths are attributable to non-communicable diseases which dominate the list of the 10 leading causes of mortality both in the developed world (9 out of 10) and in middle income countries (7 out of 10). In the future the proportion of deaths due to non-communicable diseases is expected to constantly increase and reach 75% of all-cause mortality by 2030 (WHO, 2008). Ischemic heart disease, cerebrovascular disease and cancers, the three leading causes of death in the world today, are projected to account for an even higher proportion of total deaths by selected causes in the future. Such increases in mortality as a result of non-communicable diseases, strongly driven by population growth in the developing world, are triggered by the ageing of the population in the developed world and only marginally offset by gains due to epidemiological changes (WHO, 2008).

What further complicates the challenge of dealing with chronic conditions, for individuals and for health systems alike, is the possibility of their co-occurrence. Individuals who suffer from two or more chronic conditions contemporaneously are diagnosed as multimorbid and represent a large and growing part of the population in developed countries (Vogeli et al., 2007). Experts have yet to reach consensus on how to best measure multimorbidity (Diederichs et al., 2010) and, as a result, estimates of its prevalence vary markedly between studies. Despite these discrepancies it is well established that the number of chronic conditions increases with age and that multimorbidity is extremely prevalent in the older age groups: one in two individuals aged 65 and above are likely to suffer from multiple chronic conditions, a proportion that increases rapidly to 75% for the 75 years or older groups (Guthrie et al., 2011). The presence of multimorbidity is associated with increased mortality, lower quality of life, decreased functional status and increased health care utilization, so as the world population ages its becomes ever

more relevant to find solutions for effectively dealing with this challenge. Unfortunately, such solutions are neither evident nor easy to implement.

Health systems in developed countries have mainly evolved to respond to the treatment and containment needs posed by infectious diseases. As their prevalence slowly declined with time, health systems shifted focus to the treatment of acute illnesses in highly specialized, technology-intensive settings (Anderson, 2011). The resulting delivery systems are adapted for treating separate and distinct illness episodes, with little overlap with future care needs, where the emphasis falls on the correct identification of the condition and the provision of the treatment. Unfortunately, for chronic conditions no such general cures are known and available to patients. Individuals diagnosed with chronic conditions and multimorbidity face the prognosis of a lifetime of treatments for symptom alleviation and for slowing down, what usually is, an inevitable decline. The most health care providers can do is "manage" the disease and its progression and offer patients a higher quality of life despite their illness. Unfortunately, the organizational structures currently in place are often ill adapted to offer such care. Patients who suffer from multimorbidity use a wider array and a higher amount of care services than other age matched individuals, a difference which is explained only in part by greater health care needs. Inappropriate care and complications from treatment explain the remainder: multi-morbid patients are more likely to be admitted to the hospital for adverse drug reactions (Zhang, 2009), suffer adverse events from drug-drug interactions (Gurwitz et al., 2003) and be hospitalized for preventable complications (Wolff et al., 2002).

Good chronic care models, especially when targeting multimorbid and elderly patients, are built around the coordination of care across settings, team work and community involvement (WHO, 2002; Wagner, 1998). They emphasize a patient-centered approach and a focus on prevention. Lifestyle choices and health behaviors throughout the life cycle will play a large role in the probability of suffering from chronic diseases later in life. Four preventable risk factors are associated with the most prevalent chronic conditions: smoking, physical inactivity, poor nutrition and alcohol abuse (WHO, 2011). Health resources should then be concentrated where the highest beneficial impact can be expected: prevention and the identification and management of populations at risk should be emphasized over the intensive treatment of symptoms, once

manifest. The frail are another group which could benefit greatly from models of care built around prevention and maintenance of functional and health status, albeit one which has received little attention from health policy makers. In the following we provide a general introduction to frailty and a short description of the burden it places both on individuals and on care processes.

THE FRAILTY SYNDROME AND ITS DYNAMICS

FRAILTY: THE PHENOTYPE AND MEASUREMENT

Frailty as a distinct geriatric syndrome has emerged in the specialized literature only in the past two decades. Prior attempts at definitions were often vague and failed to conceptually distinguish frailty from disability, comorbidity and advanced old age (Rockwood et al., 1999; Winograd, 1991; Campbell, 1997). As ever more convincing evidence was building up from the clinical experience of geriatricians, experts converged on the understanding of frailty as a biological syndrome, most relevant for geriatric practice but not limited to the elderly population. It describes a state of increased vulnerability, as a direct result of progressive and cumulative physiologic declines in reserve capacity and fitness across multiple body systems (Fried et al., 2001). Frail individuals have a severely reduced ability to deal with common acute stressors (i.e. disease, hospitalization, immobility) and are highly susceptible to poor health outcomes, incident disability and death (Xue, 2011; Espinoza & Walston, 2005). In clinical practice, different operational definitions coexist, but virtually all include low levels of strength, energy and physical activity, insufficient nutrition and unintentional weight loss, slow performance and decreased mobility (Espinoza & Fried, 2007)[5].

Because its understanding promised new insights into the ageing process, the frailty syndrome has commanded increasingly more attention among practitioners (Fulop, 2010). In recent years, as it became apparent that the prevalence of frailty in the elderly population is high and on the rise and that frailty associates strongly with an increased risk of adverse health outcomes and mortality, interest has also increased among policy makers. Currently, frailty is gaining

[5] While we will focus on frailty as defined by physical factors, it is worth noting here that several authors have argued that psychological and social factors are very likely to play an important role and should be included in the definition and assessment of frailty (Gobbens et al., 2010; Fulop, 2010).

recognition as a public health problems (Ferrucci et al., 2004; Rockwood et al., 2004), rendering further investigation into its dynamics and effects opportune.

Assessing frailty: the Fried criteria

Probably the most used operational definition of frailty, and the one adopted in the present study, was developed by Fried and colleagues as part of the Cardiovascular Health Study (Fried et al., 2001). It typifies frailty as a sum of compromised energetics along five main dimensions: low grip strength, low energy – generally measured as self-reported exhaustion-, slowed walking speed, low physical activity and unintentional weight loss – alternatively loss of appetite. The individual is categorized as frail if three or more of the above criteria are met and robust when none of these deficits are present. The in-between situation, when only one or two criteria are present, is defined as a state of pre-frailty and identifies a subset of the population who, despite the maintenance of most functional abilities, is at high risk of progressing to frailty. Different operational definitions coexist in the literature, although, the differences between them are mainly driven by practical considerations (as data availability) rather than by conceptual dissimilarities (Xue, 2011). To give but one example, frailty has also be operationalized as a risk index counting deficit accumulation over time: "Frailty index - FI" [6] (Rockwood et al., 2007).

Main correlates of frailty

While recent research results have contributed significantly to a better understanding of the frailty syndrome and its complexities, it is still difficult to completely separate it from the natural process of ageing. This overlap translates in a very strong association between the two, making chronological age a very strong predictor for the incidence and progression of frailty. But while natural ageing explains the progressive decline of physiological systems as individuals advance in their life cycle, chronological age is a weak predictor of vulnerability to adverse outcomes. Frailty, however, is very helpful in understanding the high variability of functional decline in individuals of the same age and a much better proxy for physiological decline (Bergman et al., 2007). Other important physiologic correlates are nutritional inadequacy, lifestyle characteristics (smoking, alcohol use, mental and social stimulation, regular physical activity) and genetic factors (Hueberger, 2011).

[6] Usually, such assessments include over 40 different deficits as well as disability, disease, physical and cognitive impairments and psychosocial risk factors. The resulting measure is a more sensitive predictor of adverse health outcomes but is less practical in most settings (Xue, 2011)

Sarcopenia[7] is a key component in the diagnosis of frailty, as exemplified by the centrality of weight loss and exhaustion in all operational definitions. It is likely to be triggered and accelerated by changes in the endocrine system, the immune system and in inflammatory processes, which also contribute to anemia and negative hematologic effects. While it is likely that changes in a single system will not result in frailty, simultaneous deficits in all these system are not necessary for frailty symptoms to occur. Rather, deficits associated with interactions of several systems, which have global anatomical impact, are the most probable precursors of frailty (Espinoza & Walston, 2005).

PREVALENCE OF FRAILTY AND ASSOCIATED RISK FACTORS

Estimates for the prevalence of frailty range substantially, depending on the selected population, the geographical location and most considerably, the clinical criteria used to determine it. Studies using the phenotype classification, based on the 5 aforementioned criteria, found the prevalence rates of frailty around the world to be generally high but quite heterogeneous. In the US, the Cardiovascular Health Study team estimated the prevalence of frailty in community dwelling older adults between 7% and 12% (Fried et al., 2001). A study of 10 European countries found a higher average prevalence across Europe (over 17%), and large variations between countries, ranging from 5.8% in Switzerland to 27% in Spain (Santos-Eggimann et al., 2009). Alvarado et al. (2008) estimated even higher prevalence levels; they used data on residents of 5 large Latin American and Caribbean cities. In their study, the estimated prevalence rates by sub-populations range from 20% to 48%.

All the above mentioned studies find important differences between age groups and genders. The aging process is characterized by declines in physiological functions and loss of reserve capacity in normal feedback mechanisms; as a result it contributes to physiological decline and frailty in myriad ways (Espinoza & Fried, 2007). Older age groups are more affected by frailty to the extent that among the very old the presence of at least one functional impairment is practically ubiquitous. Equally marked is the influence of gender, on both the prevalence and development

[7] "Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life and death" (Cruz-Jentoft et al, 2010)

of frailty. Women are considerably more affected by frailty and frailty symptoms, irrespective of context and age. The prevalence of frailty for the 65 to 79 years old women enrolled in the Women's Health Initiative Observational Study (Woods et al., 2005) reached 16% whereas prevalence in a comparable population of 65 and older males was estimated at only 4% (Cawthon et al., 2007). Alvarado et al (2008) estimated that 30% to 48% of women but only 21% to 35% of men could be classified as frail. This might be the case because men are generally more able than women to maintain levels of fitness, throughout the life course (Hueberger, 2011). An alternative proposition builds on the link between frailty and sarcopenia: as women have less muscle mass than men of comparable ages, they are naturally more at risk for frailty (Fried, 2001).

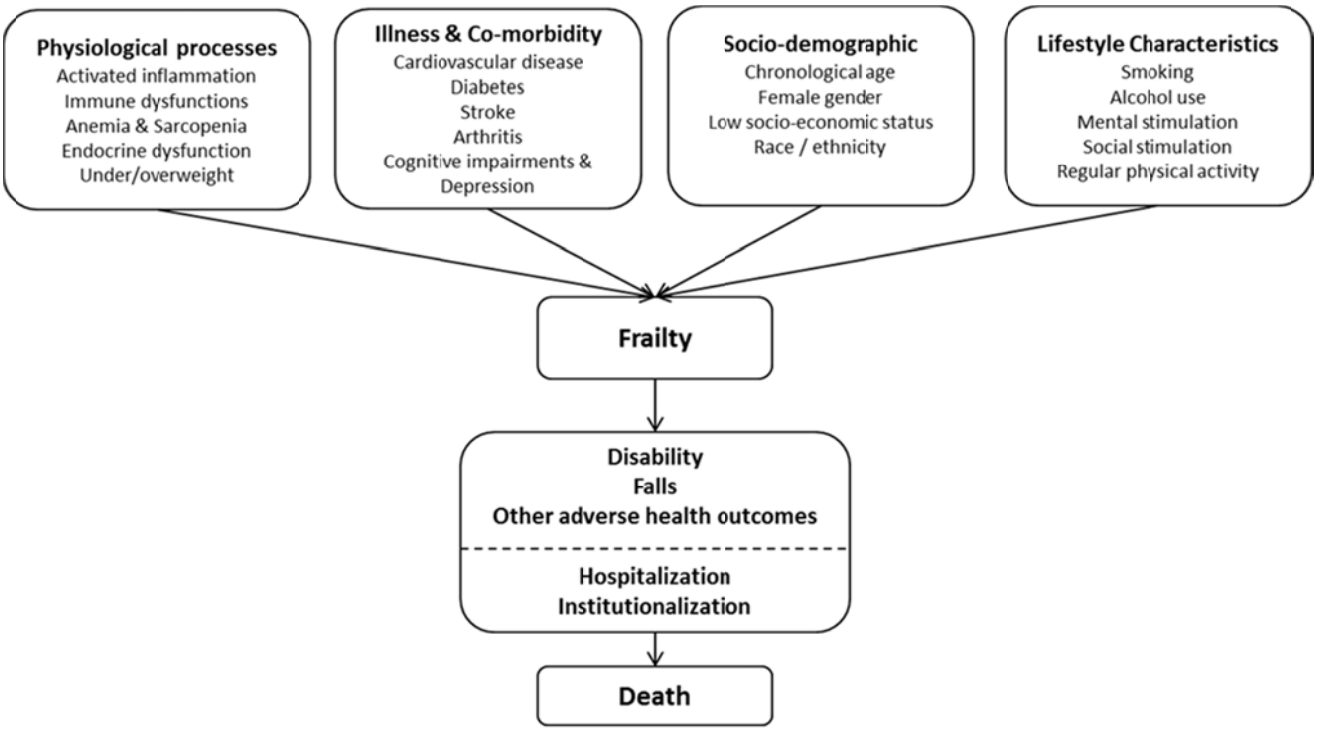
FRAILTY, MULTIMORBIDITY AND DISABILITY

Frailty has been shown to be highly associated with a number of chronic diseases. Most commonly the frail are diagnosed with anemia, hypertension (Heuberger, 2011), cardiovascular conditions (Woods et al., 2005; Chaves et al., 2005), cognitive and central nervous system impairments (Studenski et al., 2004), and diabetes (Willey & Fiatarone Singh, 2003). To these physiological factors we can add the contribution of psychological ones: depression can accelerate the onset and progression of frailty, as individuals who suffer from depressive symptoms are likely to be less active and, as a result, lose strength and body weight faster, becoming more prone to acute illness (Espinoza& Fried, 2007). Socio-economic status has also been proposed as a correlate and low income and low education have been found to be associated with higher frailty levels. However, most authors argue that this association is likely confounded by the high correlation between lifestyle factors and low socio-economic status (Espinoza & Fried, 2007). Woods and colleagues (2005) found that after controlling for ethnicity, smoking and alcohol use, health status and comorbid conditions the strength of association between frailty and socio-economic status is significantly reduced.

Multimorbidity also displays striking increases with age and has also been linked to higher rates of hospitalization, many of which should be preventable, and adverse health outcomes. It carries a huge burden of disease and strains health system resources: individuals with four or more

chronic conditions use on average, 70 times more Medicare resources and are 99 times more likely to need admission for an ambulatory care sensitive condition, than those without chronicity (Wolff et al., 2002). In 1999, 66% of all Medicare spending was accounted for by individuals with 5 or more chronic conditions, who represent only 20% of the population of beneficiaries, while the 15% of beneficiaries who do not suffer from multimorbidity represented only 3.5% of total Medicare spending (Anderson, 2002).

FIGURE 3.1 RISK FACTORS AND PROGRESSION OF FRAILTY IN OLDER ADULTS



Adapted from Espinoza & Fried, 2007; Heuberger, 2011; Espinoza &Walston,2005

Multimorbidity is closely linked to frailty, leading to a significant overlap between the two clusters of patients: in the Cardiovascular Health Study, 68% of frail individuals also suffered from multimorbidity (Fried et al., 2004). The exact causal mechanism which leads to this close correspondence is yet imperfectly understood but it is likely that the two conditions contribute to reinforcing and aggravating each other.

Unlike the relationship with multimorbidity, the link between disability and frailty is explained to a larger extent by clinical results. Physical disability, to which we restrict our reference in the following, describes a condition which substantially limits one or more of an individual's major life activities[8]. These include, but are not restricted to, communication and mobility, activities of daily living and self-help, vocational or avocational activities. A commonly used instrument for disability screening among the elderly, in a variety of settings, is the Katz Index of Independence in Activities of Daily Living, generally referred to as ADL (Katz, 1970). The functional status of the individual is determined by assessing adequacy of performance in six basic daily functions: eating, bathing, dressing, toileting, transferring and continence. Each function is evaluated with a binary indicators (yes/no) of impairment. Individuals with no impairments are classified as retaining full function, those with up to two impairments are considered moderately impaired while four or more limitations indicate severe functional impairment.

Physical disability is very common among older adults and its frequency rises with age. For individuals aged 60 and above the prevalence of moderate and severe disability in developed countries is estimated at 35%, while the world average reaches 46% (WHO, 2011). Many of these individuals progress into disability from chronic conditions, multimorbidity and frailty. As a result, they are at higher risk of hospitalization, mortality, need for long-term care and higher health care expenditure (Fried et al., 2004). In the Cardiovascular Health Study, frailty was found to be an independent cause of disability and a strong predictor of the incidence and progression of disability in both ADL and mobility. These results were reinforced in a longitudinal study of 832 elderly Americans (based in Chicago, Illinois) followed for 8 years (Buchman et al., 2009). The authors conclude that participants categorized as frail at the baseline measurement have a 40% higher risk of developing IADL disability (Instrumental Activities Of Daily Living) and a 70% higher risk of ADL disability during follow-up, with respect to a non-frail individual.

[8] In the International Classification of Functioning, Disability and Health (ICF) the WHO conceptualizes disability as a multidimensional experience, encompassing difficulties in any or all functioning areas: accumulation of impairments in body structure and function, activity limitations and participation restrictions (WHO, 2011).

TRANSITIONS BETWEEN FRAILTY STATES AND PREVENTION STRATEGIES

While it was once believed to be a progressive, irreversible condition, frailty has been shown recently to be a dynamic process, with transitions between frailty states occurring frequently over time. Such studies of the dynamics of frailty have been pioneered by Gill et al (2006), who found that 58% of the nearly 800 participants in a longitudinal study of adults over 70 years of age, experienced at least one transition between frailty states within the 4.5 years follow up. One third of the registered transitions were associated with improvements in frailty status (from higher to lesser frailty), although direct transitions from frail to robust status was exceedingly rare. These results are supported by data from the Women's Health and Aging Studies, where 72% of participants registered at least one transition between frailty states in the 7.5 years follow-up, only a third of which represented improvements in frailty state. The study also confirmed that the majority of transitions take place between adjacent frailty states. Etman et al. (2012) find that on average 22.1% of older Europeans experienced a worsening of their frailty state over the two year follow-up, 61.8% remained in the same frailty state while 16.1% improved. Among individuals who experienced improvements in frailty state a vast majority transitioned from pre-frail to non-frail and only 3.3% transitioned from frail directly to non-frail. Fallah and colleagues (2011) also document an average tendency towards decline but, interestingly, find that individuals with good mobility tend to remain stable in their frailty state or improve much more frequently than those with reduced mobility. They propose that frailty and the loss of mobility tend to reinforce each other, progressing in a vicious circle: frail individuals move less and individual who move less experience more rapid functional decline.

If frailty can be delayed or prevented and if once manifest it can be managed and reversed there is scope for measured optimism: interventions targeted to the maintenance and rehabilitation of functional status and mobility could greatly improve the prognosis for even the most frail patients. More research is needed in this direction, but available results suggest there are clear opportunities for intervention: on the one hand for frailty prevention and on the other, for remediation among the frail elderly, which in turn would help offset a probable decline into more serious health states and even death (Lang et al., 2009).

STUDY OBJECTIVES

While the evidence for the increased risk of acute complications, hospitalization and adverse health outcomes among the frail elderly has been steadily growing (Fried et al. 2001, 2004; Morley et al., 2006; Bortz, 2010), the literature on the specific patterns of health care utilization for this cluster of patients is still scarce. Much more is known on the specific care needs of the disabled or those suffering from chronic conditions and, in recent years, efforts have been made to develop care programs which directly address their treatment and prevention. Frailty has received less attention, maybe as a result of the imperfectly understood distinctions between these overlapping conditions. Unfortunately, programs which target disability and specific chronic conditions do not appropriately respond to the needs of the frail, which go beyond the necessity to treat coincident impairments and comorbidities.

At the same time, little is known on the burden of care utilization carried by frailty, independently from disability and multimorbidity. In a cross-sectional study of the frail elderly in Belgium Hoeck and colleagues (2011) found that the frail are significantly more likely to use both health and home care services than robust individuals, after adjusting for the presence of chronic diseases, socio-economic status, age and gender.

The present study tackles a similar research question: "What are the specific care needs of the frail elderly and what care utilization patterns do they translate into?". We are interested in decomposing total health care utilization and independently estimate the impact of functional decline on primary, secondary and tertiary care utilization. We expand on previous results by including in our analysis 10 European countries representing quite different health care settings which serve highly heterogeneous populations. This allows us to draw more generalizable conclusions and infer to a much larger population. We also include a wider sets of controls, in order to eliminate potential confounders, and finally, we explore the longitudinal dimension of our dataset which allows us to control for individual effects.

DATA

We avail of data from the three panel waves of the Survey of Health, Ageing and Retirement in Europe (SHARE), a multidisciplinary dataset aiming to capture the dynamics and implications of ageing for individuals and households in Europe. SHARE is a rich source of information on the health, socio-economic status, social participation and family support of community dwelling Europeans aged 50 and above (Börsch-Supan, 2005). The data collection for the first wave started in 2004 and included 11 Western and Central European countries and Israel (which participated only in the first wave)[9]. Presently, the dataset comprises over 85,000 individuals in 18 European countries (in all the geographic regions of the continent) collected in three regular panel waves (2004-2005, 2006-2008 and 2011) and a retrospective life survey (SHARELIFE - 2008). The sampling was carried out at the country level using the most adequate sampling technique on a case by case basis, after having considered local idiosyncrasies and data availability (Klevmarken et al., 2005). As probability samples are used throughout the survey, inferences can be drawn to the entire population of 50+ Europeans or to sub-groups of this population. In this analysis, we use data from release 2.5.0 for the first two waves and release 1.1.1 for the fourth wave.

THE SAMPLE

Because our study hinges on exploring the longitudinal dimension in the dataset we retain for the analysis only those countries which have participated in all three regular panel waves. This reduces coverage to the northern (Denmark, Sweden, the Netherlands), central (Germany, France, Belgium, Switzerland, Austria) and Mediterranean (Spain, Italy) regions, but affords a more in-depths look at the dynamics of health care utilization. By choosing to exclude those countries surveyed in only one or two waves we avoid the problem of introducing considerable bias in the estimates, as a result of systematically missing values which cannot be considered missing at random.

[9] Data collection in SHARE is based on a common Computer Assisted Personal Interviewing questionnaire in the official languages of each country included in the sample. It comprises a cover screen and 20 individual modules presented to the household respondent, the financial respondent, or the family respondent (Das et al., 2005).

The retained sample consists of 83,019 observations, corresponding to 50,967 individuals. A breakdown of the sample features by country and age category is presented in Appendix B1. As sample attrition has been a significant problem in SHARE - although quite marked differences are observed between countries and waves- and as mortality affects the baseline sample, refresher subsamples were drawn in both the second and fourth waves. The resulting panel is unbalanced, with the majority of individuals - more precisely 29,074 - being observed just once and only 10,159 individuals being observed in each of the three waves (Appendix B2 provides the country level decomposition). While individuals who are observed only once do not provide any information on the dynamic aspects of health care utilization we kept these observation in the sample as they contribute to the accuracy of cross sectional estimates. It is also likely that systematic differences exist between individuals retained in the longitudinal sample and those who are not. As such, had we deleted these observations we would have risked biasing inference for the larger target population (Buhi et al., 2008).

As is usually the case with large household surveys, the SHARE dataset suffers considerably from the problem of item non-response. The high prevalence of missing values is generally driven by non-responding partners in sampled households and varies considerably between countries and waves. The problem of missing values affects economics variables much more than it does demographic ones and is especially severe for items regarding income and assets. As deleting all observations which are incomplete would result in a massive reduction in sample size and introduce bias, SHARE provides researchers with a set of imputed values. Multiple imputations techniques[10] are employed in order to generate five independently calculated implicates for each missing value, for a selected subset of variables(Christelis, 2011). All the results and statistics presented in this analysis are based on samples that include imputed values, whenever such values were provided. T

[10] The imputation technique relies on a multivariate iterative procedure which attempts to exploit information from all available waves and to preserve the correlation structure of the imputed data (Christelis, 2011).

THE FRAILTY INDEX

We adopt the definition of frailty proposed by Fried and colleagues in their seminal paper on the frailty phenotype (Fried et al., 2001). They suggest five assessment criteria: unintentional weight loss, exhaustion, weakness, slowness and low physical activity. The accumulation of a critical mass of three or more of these characteristics, irrespective of order, renders an individual frail. If only one or two features are present the individual is categorized as pre-frail. Finally, if none of the assessment criteria are present the individual is classified as robust or non-frail.

Due to differences in information availability, it is not possible to perfectly replicate Fried's operationalization of the frailty phenotype with data from the SHARE survey. However, a close parallel can be constructed. Appendix B3 details on the comparison of the survey items used in order to construct the indicators. The most significant departure from Fried's operationalization refers to the construction of the slowness criterion which is not directly measured in SHARE. The information is reconstructed from responses relative to difficulties in performing low intensity physical activities (i.e. walking 100 meters and climbing one flight of stairs). The operationalization we employ here has been applied to the SHARE dataset by Santos-Eggimman et al. (2009) and validated by Romero-Ortuno et al. (2010).

PREVALENCE OF FRAILTY IN EUROPEAN COUNTRIES

In our sample, the average prevalence of frailty over the six years covered was 10.3%, showing a slight but constant increase between waves: from 9.6% in the first wave to 11.0% in wave 4. Roughly half of the sample is robust and approximately 40.0% of the observed individuals are classified as pre-frail (see Table 3.1). However, such averages brush over very different settings and population characteristics and as a result, they conceal wide differences between countries, genders and age groups.

Studies using data from the first SHARE wave, found important variations in the prevalence of frailty between the southern and northern regions of Europe – in Spain and Italy significantly higher rates of frailty and pre-frailty were registered, whereas Sweden and Switzerland had a very low prevalence compared to the other countries in the sample (Santos-Eggimman et al., 2009).

TABLE 3.1 DISTRIBUTION OF THE FRAILTY INDEX BY WAVE AND GENDER (PERCENTAGES UNDER HEADCOUNTS)

	Wave1			Wave 2			Wave 4			Total		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Robust	5,975 *45.53*	6,339 *57.13*	12,314 *50.84*	5,739 *44.20*	5,985 *54.66*	11,724 *48.99*	8,085 *42.24*	8,255 *52.49*	16,340 *46.86*	19,799 *43.76*	20,579 *54.48*	40,378 *48.64*
Pre-frail	5,597 *42.65*	3,990 *35.96*	9,587 *39.58*	5,698 *43.88*	4,141 *37.82*	9,839 *41.11*	8,522 *44.53*	6,155 *39.13*	14,677 *42.09*	19,817 *43.80*	14,286 *37.82*	34,103 *41.08*
Frail	1,552 *11.83*	766 *6.90*	2,318 *9.57*	1,547 *11.91*	823 *7.52*	2,370 *9.90*	2,532 *13.23*	1,318 *8.38*	3,850 *11.04*	5,631 *12.45*	2,907 *7.70*	8,538 *10.28*
Total	11,095	13,124	24,129	12,984	10,949	23,933	19,139	15,728	34,867	45,247	37,772	83,019

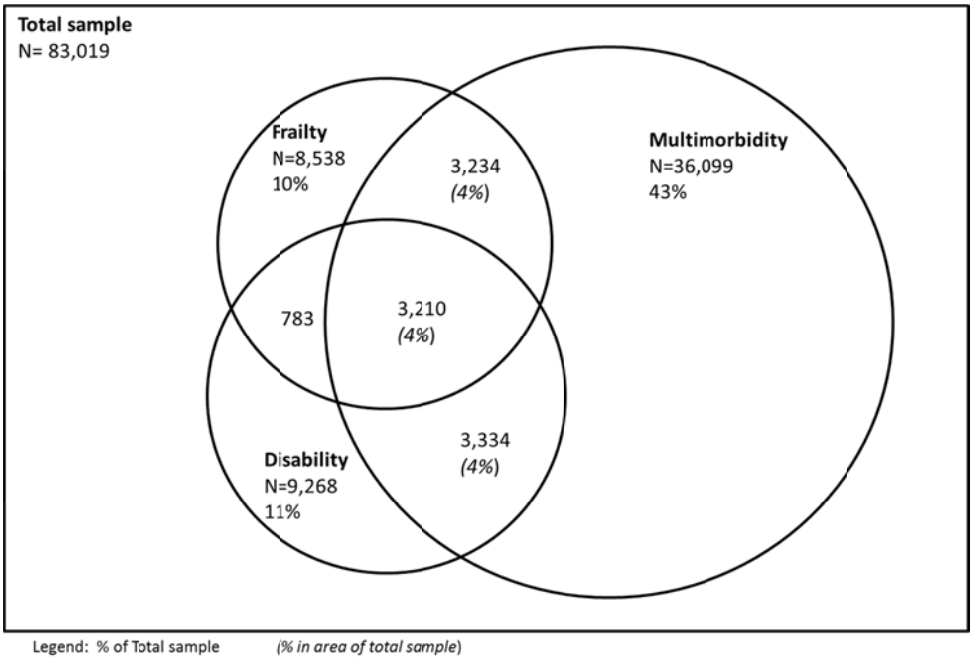
This health risk gradient remained unexplained even after controlling for population structure and sample characteristics, leading the authors to speculate that cultural differences might influence the perception of health and lead to different interpretations of the questionnaire items used to construct the frailty indicator. We confirm their results, as differences remain quite marked in the two subsequent waves (see Appendix B4). Spain, Italy and France have the highest prevalence of frailty in each wave: Spain nears 20% prevalence in the first and fourth wave and over 15% in the second, while in Italy the prevalence of frailty has been growing steadily between waves from just under 14% in 2004 to over 17% in 2011. France and Belgium also experienced steady increases in the surveyed time period, as have Germany and Sweden, two countries previously below the sample average. Finally, Switzerland displays significantly lower rates compared to all other countries in the sample, which despite a slight increase with time remain under 5 %.

We also find pronounced differences between age groups, confirming a previously documented positive correlation between frailty and age: we observe slight increases between the 50-59 and 60-69 age groups followed by more significant jumps in prevalence in higher age groups. On average, one in three very old (80+ years of age) Europeans is frail, with peaks in Spain and Italy where almost half of the very old population is affected by frailty (see Appendix B4). Pronounced differences can also be observed between genders, in all countries in our sample. Both frailty and pre-frailty are on average more prevalent among females (12.5%) than among males (7.7%) in

all the surveyed countries, but more so in Belgium and Spain. While this holds true in all age categories, the gap is especially noticeable in the older age groups (see Appendix B5).

As expected, there is considerable overlap between frailty, multimorbidity and disability in our sample (Figure 3.2). Over 3,000 individuals, representing 4% of the population under study, suffer from all three conditions simultaneously and almost 6,500, representing 75% of the frail group are also affected by multimorbidity.

FIGURE 3.2 FRAILTY, MULTIMORBIDITY AND DISABILITY IN OUR SAMPLE (PROPORTIONAL VENN DIAGRAM)



INDICATORS OF HEALTH CARE UTILIZATION

The SHARE data allow for the analysis of health care utilization both at the primary level and the acute care level. The two main variables of interest for this analysis are the number of doctor visits in the last 12 months (coded as a count variable ranging from 0 to 98) and an indicator of whether or not the individual has been admitted to a hospital in the past 12 months (binary coded). We can further decompose the number of doctor visits between the number of GP visits during the past 12 months and a binary variable indicating contact with a specialist during the same time horizon. Unfortunately, the information on the number of specialist visits is severely

limited by a high number of missing values, as are to a lesser extent the other variables on health care utilization. As a result, whenever possible we use imputed values to enhance the size of the usable sample, which varies between estimations. Table 3.2 offers a detailed account of the number of observations, and patterns of repeated observations for our dependent variables (for a further breakdown and descriptive statistics refer to Appendix B6).

TABLE 3.2 DESCRIPTIVE STATISTICS AND REPEATED OBSERVATION PATTERNS FOR HEALTH CARE UTILIZATION INDICATORS

	Dr. visits	GP visits	Specialist visits	Hospital admission
Mean	6.72	5.27	0.94	0.15
Median	4	3	1	0
Range	0-98	0-98	0-1	0-1
Std. deviation	9.75	7.58	0.22	0.35
No. of observations	82,033	72,364	38,637	82,409

	Health care utilization indicator	Wave 1	Wave 2	Wave 4
Robust	Doctor visits	12,262	11,681	16,279
	GP visits	10,175	9,741	14,016
	Specialist visits	4,863	4,886	7,186
	Hospital stays	12,283	11,710	16,303
Pre-frail	Doctor visits	9,369	9,679	14,366
	GP visits	8,431	8,766	13,175
	Specialist visits	4,383	4,907	7,496
	Hospital stays	9,418	9,734	14,445
Frail	Doctor visits	2,286	2,331	3,780
	GP visits	2,182	2,239	3,639
	Specialist visits	1,289	1,417	2,210
	Hospital stays	2,312	2,368	3,836
Total	Doctor visits	23,917	23,691	34,425
	GP visits	20,788	20,746	30,830
	Specialist visits	10,535	11,210	16,892
	Hospital stays	24,013	23,812	34,584
		Once	**Twice**	**Three times**
Repeated observations	Doctor visits	28,792	11,658	9,975
	GP visits	27,718	10,932	7,594
	Specialist visits	20,566	5,857	2,119
	Hospital stays	28,822	11,681	10,075

METHODS

Two main characteristics of the dataset led to the selection of the econometric approach to be employed: (1) the dataset is longitudinal, thus we need to account for the fact that observations are not independently distributed in time, and (2) all the response variables we consider are limited dependent variables – counts in the case of doctor and GP visits and binary in the case of hospital admissions and specialist visits. In the following, we shortly present the econometric options and estimation strategy for each of the two categories.

PANEL MODELS FOR COUNT DATA

Count variables are responses which can take any non-negative, integer values including zero but generally their range includes relatively few values. In our sample, both doctor and GP visits can take values in the range 0 to 98, but the variation in the sample is much limited: 50% of the observations register values under 4, respectively 3 visits.

The nominal distribution for counts is the Poisson distribution and the natural starting point in modeling is the Poisson regression model. We start by defining y as the number of doctor / GP visits and $\boldsymbol{x}$ as a vector of covariates, both indexed by individual (subscript i) and time (subscript t), where $i = 1, 2, \dots, N$ and $t = 1,2, \dots, T$. $\boldsymbol{\beta}$ is a vector of regression coefficients to be estimated. The expected value of y conditional on $\boldsymbol{x}$ can be modeled as an exponential function:

$$E(y_{it} \mid \boldsymbol{x}_{it}) = \exp(\boldsymbol{x}'_{it}\boldsymbol{\beta}) \tag{1}$$

The regression model to be estimated is:

$$\ln y_{it} = \alpha + \boldsymbol{x}_{it}\boldsymbol{\beta}$$

The equation describes a pooled Poisson model which can be consistently estimated under the sole assumption that the parametric model for $E(y_{it} \mid \boldsymbol{x}_{it})$ is correctly specified, independently of whether or not the data are Poisson distributed. However, it has the shortcoming of placing no restriction on the time dependence between the observations, treating the data as if it were a long cross-section of size NT (Wooldridge, 2002). This dependence can be specified directly in a marginal expectations model by allowing for correlations between y_{it} :

$$\rho_{ts} = Cor[\{y_{it} - \exp(\boldsymbol{x}'_{it}\,\boldsymbol{\beta})\}\{y_{is} - \exp(\boldsymbol{x}'_{is}\,\boldsymbol{\beta})\}]$$

Different correlation structures can be defined in marginal models. We use an unstructured correlation matrix, whereby ρ_{ts} can vary over t and s, that is each values is freely estimated over time points but assumed to be constant across individuals (Rabe-Hesketh & Skrondal, 2008). We chose not to impose any constraints on the estimation as we had no *a priori* expectations of a simpler correlation pattern: the individuals in our sample are observed at unequal time intervals.

The models can be further enriched by the inclusion of unobserved effects at the individual level, denoted α_i (note the addition of the subscript), which allows us to account for unobserved heterogeneity between individuals. In the special case of count variables, unlike in the linear case, it is convenient to specify a multiplicative unobserved effect (Wooldridge, 2002):

$$E(y_{it} \mid \boldsymbol{x}_{it},\ \alpha_i) = \alpha_i \exp(\boldsymbol{x}'_{it}\,\boldsymbol{\beta}) \tag{3}$$

Cameron and Trivedi (1998) point out that the multiplicative effect can still be interpreted as an intercept shift in this case, albeit not in all count models. Two alternatives for estimation are possible: the random effects estimator and the fixed effects estimator. The former treats α_i as a random variable, independently and identically distributed (iid), while in the latter α_i is considered an unknown parameter, to be estimated. We discuss each in turn.

The Poisson random effects estimator is efficient under standard regularity conditions, if four main assumptions are not violated. The first is the strict exogeneity assumption, which implies that the regressors are strictly exogenous conditional on the unobserved effect. Formally:

$$E(y_{it} \mid \boldsymbol{x}_{i1}, \dots, \boldsymbol{x}_{iT}, \alpha_i) = \alpha_i \exp(\boldsymbol{x}'_{it}\,\boldsymbol{\beta}) \tag{4}$$

The second is the mean independence of the unobserved effects from the regressors. It derives from the assumption that α is iid, thus it cannot be correlated with the regressors.

$$E(\alpha_i \mid \boldsymbol{x}_{i1}, \dots, \boldsymbol{x}_{iT}) = E(\alpha_i) \tag{5}$$

A violation of this assumption, i.e. a case where the unobserved individual effects are correlated with the regressors, leads to inconsistent estimates. The last two assumptions, are necessary in

order to ensure efficiency. We note, however, they can both be relaxed in quasi-MLE random effects analyses (Wooldridge, 2002):

$$y_{it} \mid \boldsymbol{x}_i, \alpha_i \sim Poisson[\alpha_i \, exp(\, \boldsymbol{x}'_{it} \, \boldsymbol{\beta})] \tag{6}$$

$$y_{it}, y_{is} \text{ are independent conditional on } \boldsymbol{x}_i, \alpha_i \tag{7}$$

In comparison, the fixed effects Poisson estimator allows for causal inference under weaker assumptions. Initially proposed by Palmgren (1981) and Hausman, Hall & Griliches (1984) it generally maintains assumptions (4), (6) and (7), but remains consistent as long as the strict exogeneity assumption (4) is satisfied (Wooldridge, 2002). Whereas the random effects estimator is inconsistent if (5) is violated, the fixed effects estimator, a conditional ML estimator, remains consistent if α is correlated with $\boldsymbol{x}$, as long as $\boldsymbol{y}$ varies with t (Cameron and Trivedi, 2005). The case of Poisson fixed effects regression is a fortunate exception: it is one of the few cases where the maximum likelihood fixed effects estimator remains consistent in situations where the length of the panel is fixed (Greene, 2004). It is worth noting that using the fixed effects estimator might entail a loss of efficiency, as the number of parameters to be estimated increases greatly.

In fixed effects estimation the coefficients of time invariant covariates cannot be identified (their effect is absorbed by the individual-specific term), which can be an important drawback in certain applications. Additionally, the use of the fixed effects estimator can lead to an important reduction in sample size, as only individuals who are observed in at least two time points contribute to the estimation and among them only those for whom the response variable is not equal to zero for every t in the panel (Cameron & Trivedi, 2005). This derives from the fact that, while the random effects estimator uses the variation between individuals in the cross section in order to estimate the βs, the fixed effects estimator used the individual-specific variation over time (more precisely, deviations of the regressors and the dependent variables from their time-averages). While this effectively controls out the influence of higher level covariates and any contextual determination, estimates may be imprecise if within variation is low (small cluster size). What is more, fixed effects models cannot predict the conditional mean of the response variable, but only variations in the conditional mean due to changes in time-varying regressors (Cameron & Trivedi, 2005).

If the dataset under consideration does not directly restrict the choice of estimation strategies, it would ideally be made on the basis of the type of inference the researcher is interested in. Fixed effects estimation, being conditional on the individual effect, allows only for inference to the particular sample under consideration. Conversely, in random effects analysis inference can be made to the population from which the sample has been drawn - a situation which arises more often in applied research. This observation, however, is only valid when the true model is a random effects model, as otherwise the estimator is inconsistent and the results become meaningless. The random effects estimator has generally been preferred in situations where the causal mechanism is clear, which is not necessarily our case. Fixed effects estimation is more popular in economic applications as the assumptions it relies on are more tenable in most situations. However, more often than not, the decision between the two estimators is based on whether or not the assumption of mean independence of the unobserved effects is credible. In applications, the Durbin-Wu-Hausman test (Hausman, 1978) can be used to compare the two estimators. If the true model is a random effects model, the fixed effects estimator is consistent while the random effects estimator is both consistent and efficient. However, if certain random effects assumptions are violated the fixed effects estimator remains consistent, while the random effects one becomes inconsistent. The test performed is for the presence of systematic differences between the coefficients resulting from both estimations. If the Hausman test is significant it is interpreted as evidence for the presence of fixed effects.

In situations in which the random effects assumptions are not tenable, more complex random effects specifications, as those developed by Mundlak (1978) and Chamberlain (1980) can be used. They have the desirable property of preserving the advantages of the random effects estimator while approaching the "spirit" of fixed effects analysis (Cameron & Trivedi, 2005). Mundlak proposed to directly addresses the problem of correlation between $\boldsymbol{x}$ and α in a more parsimonious manner than the fixed effects estimator, by introducing among the covariates time averages of the time-varying regressors ($\overline{\boldsymbol{x}}_i$). As a result, the individual unobserved effects can be rewritten as (Greene, 2012):

$$\alpha_i = \overline{\boldsymbol{x}}_{i.}\boldsymbol{\gamma} + u_i, \qquad where\ u_i\ is\ iid$$

The random effects model then becomes:

$$\ln y_{it} = \boldsymbol{x}_{it}\,\boldsymbol{\beta} + (\overline{\boldsymbol{x}}_{i.}\boldsymbol{\gamma} + u_i)$$

Similar to the fixed effects model, by including time-averages among the regressors, random effects models with the Mundlak correction allow for the estimation of within-cluster effects of covariates. The $\overline{\boldsymbol{x}}'_{i.}\boldsymbol{\gamma}$ term is the only difference between the standard random effects specification and Mundlak's model; as a result, a joint Wald test for $\boldsymbol{\gamma} = \mathbf{0}$ offers a means to test for fixed versus random effects (Greene, 2012).

PANEL MODELS FOR BINARY DEPENDENT VARIABLES

Much of the discussion in the previous section extends naturally to the analysis of our two binary dependent variables (e.g. estimation approaches, random versus fixed effects). We proceed in a similar fashion as above, but in order to avoid redundancies, we limit ourselves to referencing results previously treated in detail.

Binary variables take only two values, usually coded 0 and 1 and corresponding to a no/yes response to a question of interest. In our case, we code as 1 a positive response to the questions "Have you been admitted to a hospital during the last 12 months?" respectively "Have you seen a specialist during the last 12 months?", and 0 in the case of a negative answer. We are then interested in modeling the probability of a positive response as a function of the covariates. Maintaining the notation used before, we can formally write:

$$\Pr(y_{it} = 1 \mid \boldsymbol{x}_{it}) = \Lambda(\boldsymbol{x}'_{it}\,\boldsymbol{\beta}) = \exp(\boldsymbol{x}'_{it}\,\boldsymbol{\beta}) \Big/ 1 + \exp(\boldsymbol{x}'_{it}\,\boldsymbol{\beta}) \quad (8)$$

The function $\Lambda(\,.\,)$ is the logistic cumulative distribution function and it results in the logit model [11]. The structural model is:

$$y^*_{it} = \boldsymbol{x}_{it}\,\boldsymbol{\beta} + \varepsilon_{it}$$

where y^*_{it} is an underlying latent variable, such that:

[11] We note that other distributions could have also been used, most commonly, the normal CDF, leading to the probit model.

$$y_{it} = \begin{cases} 1 \; if \; y_{it}^* > 0 \\ 0 \; if \; y_{it}^* = 0 \end{cases}$$

Equation (8) defines the pooled logit estimator, which, similarly with the Poisson homologous estimator can be further developed by specifying a correlation structure within groups of observations, i.e. for individuals at different time points.

$$\rho_{ts} = Cor[\{y_{it} - \Lambda(\boldsymbol{x}_{it}' \boldsymbol{\beta})\}\{y_{is} - \Lambda(\boldsymbol{x}_{is}' \boldsymbol{\beta})\}]$$

In order to account for unobserved heterogeneity at the individual level, we can specify an unobserved effects model, which can be written as:

$$Pr(y_{it} = 1 \mid \boldsymbol{x}_{it}, \boldsymbol{\beta}, \alpha_i) = \Lambda(\boldsymbol{x}_{it}' \boldsymbol{\beta} + \alpha_i)$$

Maximum likelihood random effects estimation specifies that individual effects are normally distributed, with $\alpha_i \sim \mathcal{N}(0, \sigma_\alpha^2)$ and, as before, uncorrelated with the regressors (Greene, 2012). The log-likelihood to be maximized has no closed form solution and is computed by numerical methods, using Gauss-Hermite adaptive quadrature (Cameron & Trivedi, 2005). The resulting parameter values are not comparable with those obtained with the pooled estimator. An important drawback of random effects estimation in logit models is that predictions for individuals cannot be calculated. This is a side-effect of the characteristics of the logistic distribution leading to a situation where the probability to be estimated depends on the unobserved effect. In consequence, marginal effects can only be computed for $\alpha_i = 0$ which constitute an excessive limitation for most analyses (Cameron & Trivedi, 2010).

Fixed effects estimation, as mentioned in the above, remains consistent when relaxing the assumption of independence between α_i and $\boldsymbol{x}_{it}$, but it entails its own complications for binary dependent variables. As the number of parameters to be estimated can explode in datasets with large N the individual effects can be biased and estimated imprecisely. The unconditional maximum likelihood estimators in this framework can be shown to be asymptotically unbiased and consistent only when both N and T tend to infinity (Neyman & Scott, 1948; Lancaster, 2000). This is known as the incidental parameters problem and affects numerous applications in economics, as the most common type of panel data used in this field is characterized by fixed T

and $N \rightarrow \infty$. However, due to functional form particularities, fixed effects can be consistently estimated within the logit framework with a conditional maximum likelihood estimator (Chamberlain, 1980), which has been shown to carry a negligible amount of bias for fixed $T < 20$ (Katz, 2001). The resulting model is known as the conditional logit[12].

It requires limited assumptions on the unobserved effects but maintains that y_{it}, y_{is} are independent conditional on $\boldsymbol{x}_i, \alpha_i$. The likelihood is conditional on sufficient statistics $\sum_t y_{it}$ for the unobserved effects: i.e. it is not possible to condition on $\sum_t y_{it} = 0$ or $\sum_t y_{it} = T$ and all individuals who do not change responses in the panel are effectively excluded from the sample (Maddala, 1987). In our specific case, only individuals who have been admitted to the hospital or have seen a specialist in at least one wave, but not in all three waves, are considered in the analysis. As a result, estimation is carried out only for a sub-sample, which can be considerably reduced with respect to the original dataset. It is also important to note that the individual unobserved effects are never actually estimated in the conditional logit model, so in this respect, it cannot be paralleled with other fixed effects estimators which do estimate α_i along with the β coefficients (Greene, 2012). It follows that, similarly to the case of the random effects logit model, neither probabilities nor marginal effects can be computed, which severely limits inference.

ROBUSTNESS CHECKS

The main strength of the fixed effects estimators we use in the analysis is the fact that they produce consistent estimates while requiring weaker assumption. However, if the true model of the data is the random effects model than our estimates would be inefficient. In order to discriminate between the two and choose the most appropriate model for our data we use the Durbin-Wu-Hausman test, Mundlak random effects specifications and the joint Wald tests of significance on the coefficients of time-averages regressors. All these tests converge on the conclusion that the fixed effects model is the most appropriate in our data for doctor visits, GP visits and the probability of being admitted to a hospital. The model for the probability of seeing a specialist is an exception: in this case, random individual effects seem to be the better

[12] No appropriate transformations are known for the probit model which cannot be adapted for consistent fixed effects estimation.

specification. However, we present results for all the estimation options listed in the above. This stems mainly from a concern that fixed effects estimation might be imprecise, as the within individual variation in our data is low when compared to the much higher between individual variation (representing the bulk of the variance in our sample). In order to avoid potential overestimation of the significance of identified effects, we use robust standard errors for the pooled estimates and bootstrap estimation for the random and fixed effects models. We also re-ran the estimation on sub-samples excluding extreme utilization cases: i.e. maintaining in the sample only individuals who report having seen the doctor or the GP a maximum of 40, respectively 30 times during the past year. We confirm that our results are not driven by outliers in the sample.

Finally, in the next sub-sections, we address the issues of over-dispersion, missing values (by using imputations) and the use of numerical methods and confirmed the stability of our results.

OVER-DISPERSION

The Poisson distribution is completely described by one parameter, the mean, which determines all the higher moments. In particular, the conditional variance equals the conditional expectation, a feature known as equi-dispersion:

$$Var(y \mid \boldsymbol{x}) = E(y \mid \boldsymbol{x})$$

However, this is a highly limiting assumption and is often violated in practice, as numerous counts are over-dispersed (i.e., the conditional variance is larger than the mean). In order to account for potential over-dispersion problems we use cluster robust standard errors in the estimated marginal models (Cameron & Trivedi, 2010). The random and fixed effects models don't suffer from this problem, if it is not severe, since, at least to some extent, it is captured by the unobserved effects term (Wooldridge, 2002). Nonetheless, we checked the robustness of the results by verifying that coefficient values and statistical significance do not change considerably when specifying a negative binomial model, designed to account for over-dispersion (Long, 1997).

IMPUTATIONS

As already mentioned in the above, The SHARE dataset suffers from considerable item non-response. In order to minimize the potential bias we use imputed values whenever provided in the dataset. We confirm that coefficient estimates are robust (virtually stable to the third decimal digit) to changes in implicate number used, for all the described models. The results we present and discuss in the following are based on average values over all 5 implicate sets, while detailed results by implicate number are presented in Appendix C.

QUADRATURE ESTIMATION

In order to estimate the random effects Poisson with normal distribution of the individual effects and the random effects logit model the statistical software (Stata, version 12) uses numerical methods for the maximization of the log likelihood. By default, a Gauss-Hermite adaptive quadrature with 12 integration points is used for estimation. We checked the quality of the approximation by running the estimation with different numbers of integration points (i.e. 8 and 16). The estimation is considered highly reliable if coefficients do not change by more than 0.01%, but with relative changes lower than 1% we can conclude that the choice of quadrature points doesn't significantly affect the outcome (Stata Corp, 2009). In our study, none of the estimated coefficients vary by more than a relative difference of 10^{-6} , confirming that results are not sensitive to the choice of integration points in the quadrature method and the estimation is carried out with a high level of precision.

MODEL SPECIFICATION

In the models we estimate $\boldsymbol{x}$ is a vector of covariates subsuming three main sets of regressors which are likely to be associated with the health care utilization of the frail elderly (refer to Table 3.3 for descriptive statistics). Aside from our main variables of interest - frailty, multimorbidity and disability- they include indicators of health status, socio-economic status, behavioral risks and social participation. We can then write:

$$\boldsymbol{lny}_{it} = Frail\beta_1 + MMorb\beta_2 + Frail * MMorb\beta_3 + ADL\beta_4 + \boldsymbol{Health}_{it} + \boldsymbol{BRisk}_{it}\,\boldsymbol{\theta} + \boldsymbol{SocEc}_{it}\,\boldsymbol{\eta} + \boldsymbol{Country}\,\boldsymbol{\tau} + \boldsymbol{Wave}\,\boldsymbol{\varphi} + \boldsymbol{Country} * \boldsymbol{Wave}\,\boldsymbol{\zeta} + \alpha_i$$

Based on the accumulation of the five criteria as described above we have created a categorical variable (*Frail*) taking three different values: robust, pre-frail and frail. In the statistical analysis, we have decided to use indicator variables for each frailty state, i.e. frail, pre-frail and robust (reference category) as this treatment of the variable does not rely on the assumption that the change in the magnitude of the effect is equal between all the variable levels. In other words, the impact of transitioning from a robust to a pre-frail state is not necessarily equal to the impact of transitioning from a pre-frail to a frail state.

We also include indicators of multimorbidity (MMorb) and ADL disability (ADL); frailty is associated with both these conditions and their overlap in our sample is considerable, thus it becomes essential to be able to control for their effects. Disability is measured as a count of ADL limitations accumulated in any of the 6 dimensions included in the Katz's ADL Index, such that higher values represent more severe disability. Multimorbidity is measured as an indicator of the presence of two or more diagnosed chronic conditions, reconstructed from questions on whether or not any of the following conditions were diagnosed by a physician: heart attack, hypertension, high blood cholesterol, stroke, diabetes, chronic lung disease, asthma, arthritis, osteoporosis, ulcer, cancer, Parkinson disease, cataracts, hip or femoral fracture or other conditions. While only 10% of individuals in our sample report ADL limitations, over 43% suffer from multimorbidity (Appendix B6). As we expect the relation between frailty and multimorbidity to be complex we also include an interaction term (Frail*MMorb) which would capture the variation in the effect of frailty on health care utilization at different levels of multimorbidity.

From the rich set of physical health variables included in the SHARE survey we have selected a parsimonious set (***Health***) which should allow for a comprehensive overview of an individual's health status, as a proxy for health care need. We include an indicator of self-perceived general health ranging from excellent to poor, which despite being a subjective measure has been shown in previous research to be highly predictive of mortality (Idler & Benyamini, 1997) and health care utilization (Miilunpalo et al, 1997), and indicators for the presence of long term illness and of two or more symptoms which might require medical attention. Finally, we include a control for the mental health status of the individual as measured by the EURO-D instrument, a validated, 12-item depression symptoms scale created for the purpose of between center comparisons (Prince et al., 1999).

Whenever possible, we also condition on a set of behavioral risks (***BRisk***) which associate with health and health care utilization: smoking behavior, drinking and exercise. We use an indicator of past and present smoking behavior derived from yes/no answers to the question "Have you ever smoked cigarettes, cigars, cigarillos or a pipe daily for a period of at least one year?" and a dummy variable for frequent drinking, which we derived from answers of three or more times a week to the question "During the last six months, how often have you drunk any alcoholic beverage …?". Individuals who reported participation in sports or other vigorous physical activities at least as often as once a week were coded as physically active, whereas those who participate hardly ever or at most once to three times a month were coded as inactive.

Following the research literature on the topic we control for a standard set of socio-economic indicators which are likely to be correlated with health care utilization (***SocEc***). We use household wealth quartiles and an indicator of whether or not the household has been subject to financial distress ("The household makes ends meet … with great difficulty/ with some difficulty/ fairly easily/ easily") in order to account for the impact of financial constraints on the use of care services. The highest attained level of education was calculated on the basis of provided ISCED codes (harmonized between countries) and collapsed to three values corresponding to: none or primary education, secondary education and tertiary education or higher. Age is measured as a four level categorical variable, covering ten year age brackets: 50-59, 60-69, 70-79 and 80+. As our interest lies with the patterns of health care utilization among the elderly, we excluded from

the study sample all individuals younger than 50 years of age at the time of the interview. Finally, we include dummy variables for being male, living with a partner and having children.

Whenever possible, we control for country and time fixed effects by including a full set of dummy variables for the countries in our sample, the survey waves and their interactions.

TABLE 3.3 DESCRIPTIVE STATISTICS FOR THE COVARIATES INCLUDED IN THE ANALYSIS

	Mean	Median	Standard deviation	Number of obs.	Range	Variable type
Frailty category	0.616	1	0.665	83’019	0-2	categorical
Multimorbidity	0.434	0	0.495	83’019	0/1	binary
ADL limitations (Disability)	0.223	0	0.829	82’556	0-6	count
Health Status						
Self-perceived health	3.020	3	1.074	82’558	1-5	categorical
Long-term illness	0.487	0	0.499	82’601	0/1	binary
Two or more symptoms	0.417	0	0.493	82’566	0/1	binary
Depression symptoms	2.322	2	2.220	80’675	0-12	count
Socio-economic status						
Age	2.15	2	0.994	83’000	1-4	categorical
Male	0.455	0	0.497	83’019	0/1	binary
Living with partner	0.736	1	0.440	83’002	0/1	binary
Children	0.891	1	0.311	83’019	0/1	binary
Education	1.908	2	0.674	82’610	1-3	categorical
Household wealth quartile	2.499	2	1.118	83’019	1-4	categorical
Financial distress	2.956	3	0.929	83’019	1-4	categorical
Behavioral risks						
Socially active	0.446	0	0.493	81’286	0/1	binary
Physically active	0.477	0	0.499	82’019	0/1	binary
Ever smoked	0.610	1	0.487	66’273	0/1	binary
Frequent drinking	0.268	0	0.443	83’019	0/1	binary

RESULTS

We find a strong and robust association between frailty and health care utilization, both at the primary and acute care level. In the following, we discuss in detail only the results of the fixed effects models, which we hold to be the most appropriate for the data at hand. However, different models allow for different interpretations of results: marginal and random effects estimates can be used for inference to the population from which the sample was drawn, whereas inference from fixed effects models is limited to the sample used in the estimation. For the interested reader, we offer the possibility of comparison by also including in the attached tables the estimation results for the pooled and random effects models. We limit ourselves to noting the robustness of the results across all the different specifications used.

All the reported results are based on bootstrapped standard errors. We ran 300 bootstrap replications for each model and confirmed the robustness of the results with different random seeds. Country dummies, by virtue of time invariance are excluded form fixed effects estimation, but we maintain country-time interaction dummies in all estimated models.

FRAILTY AND HEALTH CARE UTILIZATION

Table 3.4 summarizes the results of our analysis of the determinants of health care utilization. We confirm that multimorbidity and, to a lesser extent, disability lead to a rise in the number of doctor visits. Holding all other things equal, a multi-morbid patient will see a doctor 22% (incidence rate ratio (IRR) = exp(0.205) = 1.227) more than one who does not suffer from the condition and every added ADL limitation will lead to a 3.7% higher annual expected number of visits.

We find frailty also has a strong, positive impact on the number of doctor visits, which increases noticeably with functional decline: individuals who are pre-frail are expected to see a doctor 16% (IRR = 1.167) more times than robust individuals while the frail increase their primary care utilization by over 45% (IRR=1.454), when compared to the same reference category. This is a sizeable effect, fully comparable with that of multimorbidity, especially if we consider that frailty and pre-frailty are jointly more prevalent (51.3%) in our sample that multimorbidity (42.4%).

Interestingly, we also find evidence of the interplay between the two conditions: the interaction term between multimorbidity and frailty is statistically significant, indicating that the effect of

frailty on the expected number of doctor visits is moderated by the presence of multimorbidity. The coefficient is negative which means the impact of frailty decreases in the presence of multimorbidity. More precisely, for multi-morbid patients the difference between the expected number of doctor visits for a robust individual and a frail one is 26% lower than for patients who are not multi-morbid ($\text{IRR} = \exp(-0.318) = 0.727$). This is not a surprising finding as multimorbidity and frailty are known to overlap significantly and their co-occurrence is common among the elderly (65% of the multi-morbid also frail or pre-frail). We propose the following interpretation: the attention received by multi-morbid patients from their primary care providers addresses to some extent their functional decline, partially offsetting their need to increase the number of doctor visits as they experience aggravation in their frailty state.

At the same time, for the over 55% of the elderly population who is not diagnosed with multimorbidity, the transitions to pre-frailty and frailty can be expected to lead to a large, unmitigated, increase in care utilization. The presence of long-term illness, is also positively associated with the number of doctor visits, although to a lesser extent than multi-morbidity or frailty (IRR =1.173). We expect this is the case because such illnesses are generally dealt with in specialized care settings, and are thus more likely to have a higher impact on the level of home and long-term care utilization which we do not measure here.

After controlling for individual unobserved heterogeneity, none of our socio-economic and behavioral risks variables seem to explain the number of doctor visits during the past year, although in alternative model specifications the impact of age, gender and physical activity is statistically significant, albeit small. If these characteristics do have an effect, it is most likely filtrated to a large extent through the general health of the individual, which is captured by our health status variables. Self-assessed general health and the presence of two or more symptoms – be they physical or depression related – are positively and highly significantly correlated with the total number of doctor visits.

TABLE 3.4 ESTIMATES FOR THE NUMBER OF DOCTOR VISITS

	Pooled	Fixed effects	Random effects		
			~ Gamma	~ Normal	Mundlak
	(1)	(2)	(3)	(4)	(5)
Frailty (Ref. Robust)					
Pre-frail	0.186***	0.155***	0.177***	0.167***	0.156***
Frail	0.397***	0.373***	0.411***	0.400***	0.365***
Multimorbidity	0.325***	0.205***	0.300***	0.323***	0.206***
Pre-frail*M-Morbidity	-0.066**	-0.054	-0.076**	-0.074**	-0.062*
Frail * M-Morbidity	-0.237***	-0.318***	-0.328***	-0.321***	-0.292***
ADL limitations	0.034***	0.035*	0.038***	0.032**	0.040**
Self-perceived health	0.224***	0.170***	0.207***	0.204***	0.172***
Long-term illness	0.281***	0.159***	0.252***	0.259***	0.167***
Two or more symptoms	0.151***	0.112***	0.148***	0.156***	0.131***
Depression symptoms	0.027***	0.017**	0.026***	0.024***	0.017**
Age category (Ref. 50-59)					
60 -69	0.034*	-0.028	0.0703***	0.085***	0.040
70 -79	0.049**	-0.067	0.101***	0.128***	0.045
80+	-0.010	-0.092	0.104***	0.135***	0.029
Male	-0.007		-0.042***	-0.058***	-0.037**
Living with partner	0.011	0.032	0.008	0.029	0.009
Children	0.022	0.158	0.024	0.028	0.170
Education	0.003	-0.038	-0.007	-0.009	-0.030
Hh wealth (Ref. 1st quartile)					
2nd quartile	-0.036*	0.007	-0.016	0.002	-0.001
3rd quartile	-0.051***	-0.017	-0.036	-0.019	-0.013
4th quartile	-0.055**	0.012	-0.026	-0.009	0.006
Financial distress	-0.004	-0.015	-0.012	-0.010	-0.010
Socially active	0.016	-0.029	-0.004	0.013	-0.024
Physically active	-0.065***	-0.029	-0.048***	-0.044***	-0.032
Ever smoked	-0.005		-0.014	-0.012	-0.010
Frequent drinking	-0.072***	-0.059	-0.062***	-0.060***	-0.066*
Country Dummies	Yes	No	Yes	Yes	Yes
Wave Dummies	Yes	Yes	Yes	Yes	Yes
Country*Wave Dummies	Yes	Yes	Yes	Yes	Yes
Time-averages of regressors	No	No	No	No	Yes
Durbin-Wu-Hausman test					
Chi2 (42)		1178.11			
p-value		0.000			
Wald joint test (Ho: $\gamma = 0$)					
Chi2 (15)					214.66
p-value					0.000
LR test (H0: $\sigma(\alpha_i) = 0$)					
$\overline{Chi}2(01)$			$1.8*10^5$	$1.8*10^5$	$1.8*10^5$
p-value			0.000	0.000	0.000
Observations	64012	29071	64012	64012	64012
No. of individuals	48878	14461	48878	48878	48878

Legend: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

All results are based on bootstrapped standard errors. Coefficients for country, and wave dummies and their interactions can be provided upon request

Primary and specialist care utilization

We can add a layer of detail to our results, by attempting to unravel the total number of doctor visits, an umbrella indicator of the amount of contacts with the non-acute health care system. Our dataset allows us to discriminate between the number of contacts with a primary care provider (number of GP visits) and an indicator of whether or not the patient has also seen a specialist during the previous year. This is of course an imperfect decomposition, but nonetheless, it affords a finer-grained analysis. The estimation output is summarized in Tables 3.5 and 3.6.

The study of the number of GP visits during the last 12 months produces strikingly similar results to those of the general analysis, presented above. This likely stems from the centrality of the primary care provider and his role in the coordination of the care process in European health systems; even in countries where GPs do not act as gate-keepers, they are likely to treat and follow up with patients for longer spells than any other health care provider. As before, multimorbidity, disability and all the proxies for the general health status of individuals are significant predictors of the number of GP visits. Patients suffering from 2 or more chronic conditions are expected to have 14% more contacts with their primary care providers than those who don't, the presence of two or more physical symptoms leads to an increase of over 5.5% in expected levels of primary care utilization and every added ADL limitation will lead to a 3% increase in the expected number of GP visits. The presence of a long-term illnesses is associated with an increase of over 10% in contacts with the GP while the manifestation of depression symptoms lead to low, but significant increases. The effect of frailty on driving GP visits, as indicated by the highly significant positive coefficient, is sizeable. A frail patient is expected to see his GP 37% more than a robust one (IRR= 1.368) whereas a pre-frail patient will increase his utilization by under 10%. We again find this effect is moderated by the presence of multimorbidity, the difference in primary care utilization between a robust and a frail patient is 26% lower if the same individual also suffers from multimorbidity than if he does not. This is a very strong impact, practically compensating for the expected increase in GP visits by a worsening in functional status: with respect to our reference category (i.e. robust individuals who do not suffer from multimorbidity) frail, multi-morbid individuals are expected to increase their primary care use at roughly the same rate as pre-frail, non-morbid patients.

TABLE 3.5 ESTIMATES FOR THE NUMBER OF GP VISITS

	Pooled	Fixed effects	Random effects		
			~ Gamma	~ Normal	Mundlak
	(1)	(2)	(3)	(4)	(5)
Frailty (Ref. Robust)					
Pre-frail	0.143***	0.087**	0.132***	0.114***	0.085***
Frail	0.349***	0.313***	0.373***	0.339***	0.277***
Multimorbidity	0.223***	0.134***	0.212***	0.214***	0.121***
Pre-frail*M-Morbid	-0.030	-0.032	-0.039	-0.035	-0.025
Frail * M-Morbid	-0.157***	-0.312***	-0.252***	-0.238***	-0.223***
ADL limitations	0.049***	0.028	0.046***	0.037***	0.038*
Self-perceived health	0.167***	0.104***	0.154***	0.143***	0.106***
Long-term illness	0.182***	0.108***	0.177***	0.173***	0.117***
Two or more symptoms	0.114***	0.053*	0.101***	0.100***	0.068***
Depression symptoms	0.019***	0.019**	0.021***	0.020***	0.018**
Age category (Ref. 50-59)					
60 -69	0.057***	-0.059	0.077***	0.079***	0.016
70 -79	0.106***	-0.139*	0.129***	0.137***	0.007
80+	0.101***	-0.175*	0.165***	0.179***	-0.007
Male	0.030*		0.008	0.008	0.017
Living with partner	-0.025	0.013	-0.027	-0.010	-0.000
Children	0.023	0.191	0.022	0.023	0.170
Education	-0.075***	-0.026	-0.062***	-0.063***	-0.016
Hh wealth (Ref. 1st quartile)					
2nd quartile	-0.074***	0.007	-0.053**	-0.030	-0.014
3rd quartile	-0.106***	-0.038	-0.094***	-0.079***	-0.027
4th quartile	-0.170***	-0.033	-0.143***	-0.129***	-0.042
Financial distress	-0.029***	-0.021	-0.031**	-0.032***	-0.015
Socially active	-0.037***	-0.036	-0.039**	-0.031**	-0.026
Physically active	-0.064***	-0.052*	-0.059***	-0.055***	-0.054**
Ever smoked	-0.031**		-0.028*	-0.028*	-0.019
Frequent drinking	-0.052***	0.005	-0.036**	-0.036**	-0.003
Country Dummies	Yes	No	Yes	Yes	Yes
Wave Dummies	Yes	Yes	Yes	Yes	Yes
Country*Wave Dummies	Yes	Yes	Yes	Yes	Yes
Time-averages of regressors	No	No	No	No	Yes
Durbin-Wu-Hausman test					
Chi2 (42)		940.49			
p-value		0.000			
Wald joint test (Ho: $\gamma = 0$)					
Chi2 (15)					156.88
p-value					0.000
LR test (H0: $\sigma(\alpha_i) = 0$)					
$\overline{Chi}2(01)$			$9.9*10^4$	$1.0*10^5$	$9.9*10^4$
p-value			0.000	0.000	0.000
Observations	56441	24101	56441	56441	56441
No. of individuals	44177	11991	44177	44177	44177

*Legend: * p < 0.05, ** p < 0.01, *** p < 0.001*

All results are based on bootstrapped standard errors. Coefficients for country, and wave dummies and their interactions can be provided upon request

TABLE 3.6 ESTIMATES FOR THE PROBABILITY OF SEEING A SPECIALIST

	Pooled	Conditional logit	Random effects	
			~ Normal	Mundlak
	(1)	(2)	(3)	(4)
Frailty (Ref. Robust)				
Pre-frail	-0.006	0.220	-0.014	-0.013
Frail	0.045	0.112	0.042	0.136
Multimorbidity	0.513***	0.595*	0.576***	0.486**
Pre-frail*M-Morbid	-0.005	-0.230	-0.001	0.013
Frail * M-Morbid	-0.179	-0.276	-0.187	-0.187
ADL limitations	-0.052	0.038	-0.062	-0.137
Self-perceived health	0.119***	0.177	0.136***	0.146*
Long-term illness	0.372***	0.414*	0.425***	0.280*
Two or more symptoms	0.321***	0.715***	0.373***	0.378***
Depression symptoms	0.014	0.028	0.019	0.068
Age category (Ref. 50-59)				
60 -69	0.033	0.175	0.036	0.199
70 -79	-0.018	0.072	-0.024	0.327
80+	0.049	0.408	0.055	0.653
Male	-0.034		-0.047	-0.029
Living with partner	0.110	-0.240	0.135	-0.083
Children	0.065	16.04	0.086	0.321
Education	0.184***	0.120	0.212***	0.020
Hh wealth (Ref. 1st quartile)				
2nd quartile	0.040	0.012	0.043	-0.078
3rd quartile	0.093	-0.053	0.114	-0.046
4th quartile	0.215**	-0.186	0.243**	0.041
Financial distress	0.050	-0.090	0.059	-0.093
Socially active	0.186***	0.033	0.208***	0.007
Physically active	-0.009	0.160	-0.002	0.048
Frequent drinking	-0.004	0.065	-0.007	0.276
Country Dummies	Yes	No	Yes	Yes
Wave Dummies	Yes	Yes	Yes	Yes
Country*Wave Dummies	Yes	Yes	Yes	Yes
Time-averages of regressors	No	No	No	Yes
Durbin-Wu-Hausman test				
Chi2 (42)		35.90		
p-value		0.221		
Wald joint test (Ho: $\gamma = 0$)				
Chi2 (15)				25.10
p-value				0.048
LR test (H0: $\rho = 0$)				
$\overline{Chi}2(01)$			49.73	38.13
p-value			0.000	0.000
Observations	37319	1509	37319	29785
No. of individuals	27711	670	27711	25514

*Legend: * p < 0.05, ** p < 0.01, *** p < 0.001*

All results are based on bootstrapped standard errors. Coefficients for country, and wave dummies and their interactions can be provided upon request

We note the coefficient for physical activity is negative and statistically significant. Those individuals who participate in sports or intense physical activities are expected to have 5% less GP visits than those who don't, all other things being equal.

The similarity of the results in Tables 3.4 and 3.5 is an indicator of the fact that health care utilization among the frail elderly is mainly driven by contacts with primary care providers. We reinforce this finding by confirming that frailty does not associate with the probability to seek specialist care (see Table 3.6). Neither frailty nor disability have a significant impact on the probability of seeing a specialist. Somewhat surprisingly, the coefficient for depression symptoms is also not significant. Our results suggest the two main drivers of specialist care utilization are the presence of multimorbidity and the occurrence of two or more physical symptoms. The presence of multimorbidity leads to a 1.62 factor change in the odds of going to a specialist in a given year (OR = 1.626 = exp(0.486)) while for individuals who suffer from two or more symptoms the odds are 1.45 times higher.

The other significant predictors in our covariate set are the presence of long term illness and self-assessed health. All other things equal, individuals suffering from long-term illnesses have 50% higher odds of seeing a specialist with respect to those who do not, while a worsening in health status, as perceived by the individuals themselves, would lead to a 15% increase in the odds of seeing a specialist.

Please note we are interpreting the coefficients of the random effects model, with the Mundlak correction and not the results of the fixed effects estimation, as before. Two main reasons stand behind our choice. First, the conditional logit model is performed on a severely reduced sample: only 1509 observations, corresponding to 670 individuals, are considered for estimation. This subsample represents less than 2% of our initial sample and only 5% of the sample on which the random effects model is estimated. Secondly, as reported in Table 3.6, the Durbin-Wu-Hausman test fails to reject the null hypothesis of no systematic difference between the coefficient obtained with the fixed and respectively the random effects estimators. This result is further reinforced by a failure to reject the hypothesis that all γ coefficients are simultaneously equal to zero in a joint Wald test. We conclude that the random effects model is likely the true model for the specialist visit data.

Tertiary care utilization

The results of our analysis of the effects of frailty and multimorbidity on the probability of being hospitalized are summarized in Table 3.7. We find both are significant predictors, but that the effect of frailty is stronger. Individuals who suffer from two or more chronic conditions have 1.43 times higher odds of being admitted to a hospital in a given year (OR=1.428). At the same time, pre-frailty increases the odds of hospital admission by a factor of 1.24 with respect to the robust reference category, while the presence of frailty leads to a near doubling in the same odds (OR = exp(0.638) = 1.892) holding all other things equal. The sheer strength of the effect is impressive: the 89% increase in the odds due to the presence of frailty represents more than double the strength of association between the probability of being hospitalized and self-assessed health status (OR= 1.394) and four time the increase in odds expected from the presence of two or more symptoms (OR=1.221).

A worsening disability status also leads to higher probabilities of being hospitalized: for every increase in the number of ADL limitations the odds ratios go up by a factor of 1.09, a slightly stronger effects than that of the presence of depression symptoms (OR=1.059). We also find that, after controlling for heterogeneity at the individual level, none of the socio-economic control variables seem to have a statistically significant impact on the probability of being hospitalized. We note however than in the alternative model specifications older age and the male gender (coefficient not identified in fixed effects estimation) are strongly associated with hospitalization.

We find an interesting association between behavioral risks and hospitalization. Individuals who report having smoked at any point in their lives have 1.12 times higher odds of being hospitalized (OR=exp(0.118)=1.125 - coefficient from the Mundlak specification, random effects model), presumably by impacting on the general health status of individuals. However, the opposite is true for individuals who drink alcoholic beverages frequently: in this case we find an inverse association with the probability of being hospitalized (OR=0.848). As this is unlikely to be a true health effect we propose it can act as a proxy for health attitudes: frequent alcohol consumption might indicate a general lack of concern with one's long-term health, and consequently, such individuals may not always seek the care they require and avoid or postpone more expensive, acute treatment.

TABLE 3.7 ESTIMATES FOR THE PROBABILITY OF BEING ADMITTED TO A HOSPITAL

	Pooled	Conditional logit	Random effects	
			~ Normal	Mundlak
	(1)	(2)	(3)	(4)
Frailty (Ref. Robust)				
Pre-frail	0.316***	0.210**	0.326***	0.259***
Frail	0.674***	0.638***	0.707***	0.574***
Multimorbidity	0.412***	0.356***	0.428***	0.331***
Pre-frail*M-Morbid	-0.051	0.025	-0.044	-0.043
Frail * M-Morbid	-0.174*	-0.308*	-0.176*	-0.173*
ADL limitations	0.059***	0.082**	0.065***	0.108**
Self-perceived health	0.359***	0.332***	0.376***	0.346***
Long-term illness	0.359***	0.332***	0.376***	0.346***
Two or more symptoms	0.184***	0.199***	0.196***	0.188***
Depression symptoms	0.039***	0.057***	0.042***	0.053***
Age category (Ref. 50-59)				
60 -69	0.124***	0.057	0.129***	0.146*
70 -79	0.265***	0.200	0.279***	0.317**
80+	0.205***	0.262	0.216***	0.273
Male	0.248***		0.263***	0.262***
Living with partner	-0.012	0.214	-0.013	0.223
Children	0.140***	-0.147	0.146***	0.013
Education	0.015	-0.004	0.010	-0.062
Hh wealth (Ref. 1st quartile)				
2nd quartile	-0.006	0.053	-0.007	-0.008
3rd quartile	-0.069	-0.026	-0.073	-0.073
4th quartile	0.115**	0.143	0.122**	0.119
Financial distress	0.022	-0.001	0.023	-0.007
Socially active	0.038	-0.127**	0.040	-0.095
Physically active	-0.051	-0.090	-0.051	-0.086
Ever smoked	0.105***		0.108***	0.118***
Frequent drinking	-0.059*	-0.165*	-0.060	-0.100
Country Dummies	Yes	No	Yes	Yes
Wave Dummies	Yes	Yes	Yes	Yes
Country*Wave Dummies	Yes	Yes	Yes	Yes
Durbin-Wu-Hausman test				
Chi2 (42)		70.01		
p-value		0.000		
Wald joint test (Ho: $\gamma = 0$)				
Chi2 (15)				28.79
p-value				0.017
LR test (H0: $\rho = 0$)				
$\overline{Chi}2(01)$			29.40	29.93
p-value			0.000	0.000
Observations	64207	14121	64207	64207
No. of individuals	49004	5522	49004	49004

*Legend: * p < 0.05, ** p < 0.01, *** p < 0.001*

All results are based on bootstrapped standard errors. Coefficients for country, and wave dummies and their interactions can be provided upon request

Finally, we note a negative association between the probability of being hospitalized and the level of social participation (OR=0.881) but this effect might also be filtered through the association with the general health status, as individuals who are in better health are more likely to be socially active than those who are not.

LIMITATIONS

While we feel the present study has reached its aims, three main limitations need to be acknowledged. First, by virtue of the estimation strategies chosen, it is impossible to make individual predictions. Secondly, as information on long-term care and home care utilization are not available in all three survey waves of the SHARE dataset we were unable to estimate the impact of frailty on demand for services in these care settings. This is unfortunate, as home and long term care are likely to account for a sizeable part of total health care utilization among the elderly. Finally, the dataset includes no information on context level variables, whose effect on health care utilization is of utmost interest for public policy. Although we effectively controlled for contextual difference by introducing individual effects, the policy recommendations which can be derived from our results are limited.

CONCLUSION

Population ageing in developed countries has been generally approached as a complex problem for pension, health and social care systems, calling in question their long-term sustainability. While such issues remain pertinent for policy makers and researchers alike, attitudes are slowly starting to shift towards a reinterpretation of the ageing process as a challenge for public systems to adapt to new realities and not as an unequivocal burden. Longevity in itself does not place a strain on health care resources; growing rates of morbidity and disability do. If people live longer, but healthier and more active lives, they can become valuable resources for society and not necessarily an added encumbrance (Taylor, 2011).

As a consequence, health systems should respond to population ageing by investing in public health promotion, prevention and the maintenance of good health into older ages. Our analysis of

the patterns of health care utilization of the elderly population in European countries supports this conclusion. We found that care utilization (in all care settings) increases as individuals grow older. However, this effect is explained much more consistently by the higher prevalence of chronic conditions, disability and functional decline in older age groups. Therefore, these are the conditions that need to be addressed in order to ensure health system sustainability and hopefully allow elderly to be a valuable resource for society.

We found a significant and strong association of frailty with health care utilization. The frail were already recognized as a cluster of patients at risk for adverse health outcomes, acute episodes and even death. Even after controlling for health status, socio-economic factors and behavioral risks, the frail are likely to have significantly more contacts with the health care system in general. While we don't directly measure costs in our analysis, it is safe to assume that increased care utilization would translate into a considerable burden for the health system, especially as the prevalence of frailty is very high and rising in most Europeans countries. This is convincing evidence that the pressure on health system resources from functional decline in the older age groups begins further upstream than generally thought. Well before they progress to moderate and severe disability, the frail and pre-frail become frequent users of health services. Such findings will hopefully draw attention on frailty both as a prevention target and a tool for prevention: functional decline among the elderly comes with an important increase in health care utilization, in addition to predisposing affected individuals to further deterioration and increased care needs.

The increase in service utilization that comes with worsening frailty is intertwined with the presence of multimorbidity. Our data suggest that patients who suffer from two or more chronic conditions and who are likely to receive treatment for these illnesses will increase their number of doctor visits at a lower rate if they also experience functional decline. This leads us to conclude that the care they receive from their providers addresses to some extent the care needs which arise with frailty. Considering that individuals who are affected by frailty often suffer from chronic conditions as well, they could be successfully targeted by initiatives that would blend interventions for the maintenance of functional fitness into disease management programs. Such

programs are well established in most European countries and the existing infrastructure could be enhanced for the prevention and management of frailty and functional decline.

Interestingly, we found the strong effect of frailty on general health care utilization to be mainly driven by contacts with primary care providers: all other things equal, the frail are likely to see their GPs more often than robust patients. Conversely, secondary care utilization does not significantly associate with functional decline. It is mainly the presence of physical symptoms, chronic conditions and multimorbidity, which increase the probability of an elderly person seeing a specialist. Frailty is also a strong predictor of hospital utilization, a result which was to be expected seen how functional decline predisposes individual to adverse health outcomes. Unfortunately our data does not allow us to analyze the patterns of home-care and long-term care utilization, but we feel confident to infer from our results that interventions targeting the frail elderly should be centered on primary care and should integrate in the care pathways stable links with other providers. Managing functional decline in the primary care setting is likely to help offset to some extent the costs that the elderly tend to accrue in secondary and tertiary care settings. Comprehensive screening processes for frailty in a primary care setting have the potential to identifying the population at risk for intense care utilization and adverse care outcomes and could target their care needs more efficiently, helping them avoid unnecessary spells of treatment in more intensive and more expensive care settings.

All in all, the knowledge we currently have on frailty as a dynamic process, which can be delayed and even reversed, is opening new avenues for prevention strategies. Frailty offers a target for prevention and concerted intervention before disability and adverse outcomes set in. It affords the opportunity to promote healthier, more active ageing, and to shorten or avoid periods of ill health at the end of the life cycle. These goals can be reached if we recognize the complex care needs of frail patients, much like multimorbid or disabled ones, and design care services accordingly. In this respect, we argue that care integration – with specific attention to providers' coordination, community involvement, and patient centeredness – is critical in the care of complex clusters of patients and should be at the heart of health system reforms throughout Europe.

Acknowledgments

This paper uses data from SHARE wave 4 release 1.1.1, as of March 28th 2013 and SHARE wave 1 and 2 release 2.5.0, as of May 24th 2011. The SHARE data collection has been primarily funded by the European Commission through the 5th Framework Programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th Framework Programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5- CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th Framework Programme (SHARE-PREP, N° 211909, SHARE-LEAP, N° 227822 and SHARE M4, N° 261982). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11 and OGHA 04-064) and the German Ministry of Education and Research as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).

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APPENDIX B

APPENDIX B1. SAMPLE CHARACTERISTICS - NUMBER OF OBSERVATIONS BY COUNTRY, WAVE AND AGE GROUPS

Country	Wave1						Wave 2						Wave 4					
	50-59	60-69	70-79	80+	.	Total	50-59	60-69	70-79	80+	.	Total	50-59	60-69	70-79	80+	.	Total
Austria	514	716	398	176	0	1,804	317	517	335	148	0	1,317	1,492	1,769	1,287	543	5	5,096
Germany	951	1,131	605	207	1	2,895	805	906	571	227	0	2,509	276	593	505	187	0	1,561
Sweden	987	990	633	313	0	2,923	720	1,034	580	358	0	2,692	230	808	587	318	0	1,943
Netherlands	1,108	892	549	232	7	2,788	929	924	520	231	0	2,604	725	1,099	588	304	0	2,716
Spain	665	700	652	298	0	2,288	617	639	594	319	0	2,169	915	1,026	950	595	0	3,486
Italy	781	946	552	179	0	2,458	813	1,082	751	259	0	2,905	858	1,265	992	395	0	3,510
France	1,121	806	689	350	0	2,966	987	822	624	325	0	2,758	1,761	1,798	1,218	835	3	5,615
Denmark	572	458	335	177	0	1,542	910	820	503	275	0	2,508	802	708	418	275	0	2,203
Switzerland	306	288	216	104	1	915	478	472	309	155	0	1,414	1,200	1,225	791	400	0	3,616
Belgium	1,355	1,057	846	382	0	3,640	1,065	926	698	368	0	3,057	1,835	1,588	1,013	683	2	5,121
Total	8,360	7,984	5,475	2,418	9	**24,219**	7,641	8,142	5,485	2,665	0	**23,933**	10,094	11,879	8,349	4,535	10	**34,867**

APPENDIX B2. UNBALANCED PANEL FEATURES – NUMBER OF INDIVIDUALS OBSERVED REPEATEDLY IN THE PANEL WAVES

	Once	Twice	Three times	Total
Austria	4,985	716	600	6,301
Germany	1,874	1,230	877	3,981
Sweden	1,245	1,433	1,149	3,827
Netherlands	2,173	1,346	1,081	4,600
Spain	3,047	1,107	894	5,048
Italy	2,679	1,255	1,228	5,162
France	4,829	1,383	1,248	7,460
Denmark	1,319	1,330	758	3,407
Switzerland	3,041	762	460	4,263
Belgium	3,882	1,172	1,864	6,918
Total	**29,074**	**11,734**	**10,159**	**50,967**

APPENDIX B3. THE FRAILTY PHENOTYPE - OPERATIONALIZATION IN SHARE AND THE CARDIOVASCULAR HEALTH STUDY

	Item in SHARE	**Item in the Cardiovascular Health Study**
Exhaustion	In the last month, have you had too little energy to do the things you wanted to do? Response: Yes	Felt that everything I did was an effort in the last week OR Could not get going in the last week Response: Yes
Weight loss / Shrinking	What has your appetite been like? Response: Diminution in the desire for food OR So, have you been eating more or less than usual? Response: Less	Baseline: Lost > 10 pounds unintentionally last year Follow-up: $\frac{weight\ in\ previous\ year - current\ weight}{weight\ in\ previous\ year} \geq 0.05$ and the loss was unintentional
Slowness	Because of a health problem, do you have difficulty [expected to last more than 3 months] …walking 100 meters OR …climbing one flight of stairs without resting Response: Yes	Time needed to walk 15 feet (≈ 5 m) at usual pace Women: time ≥ 7s for height ≤ 159cm time ≥ 6s for height >159cm Men: time ≥ 7s for height ≤ 173cm time ≥ 6s for height >173cm
Weakness	Grip strength measurements (highest of four) Women: ≤ 17 kg for BMI ≤ 23 ≤ 17.3 kg for BMI 23.1 – 26 ≤ 18 kg for BMI 26.1 - 29 ≤ 21 kg for BMI > 29 Men: ≤ 29 kg for BMI ≤ 24 ≤ 30 kg for BMI 24.1 – 26 ≤ 30 kg for BMI 26.1 - 28 ≤ 32 kg for BMI > 28	Grip strength measurements Women: ≤ 17 kg for BMI ≤ 23 ≤ 17.3 kg for BMI 23.1 – 26 ≤ 18 kg for BMI 26.1 - 29 ≤ 21 kg for BMI > 29 Men: ≤ 29 kg for BMI ≤ 24 ≤ 30 kg for BMI 24.1 – 26 ≤ 30 kg for BMI 26.1 - 28 ≤ 32 kg for BMI > 28
Low-activity	How often do you engage in activities that require a low or moderate level of energy such as gardening, cleaning the car, or doing a walk? Response: One to three times a month Hardly ever, or never	Women: Kcal < 270 on activity scale (based on the short version of the Minnesota Leisure Time Activity Questionnaire – 18 items) Men: Kcal < 383 on activity scale
	Based on Santos-Eggimann et al. 2009 & Romero-Ortuno et al. 2010	Based on Fried et al. 2001

APPENDIX B4. DYNAMICS OF FRAILTY PREVALENCE* OVER THE THREE WAVES BY COUNTRY AND AGE BRACKET

Country	Wave1					Wave2					Wave4				
	50-59	60-69	70-79	80+	Total	50-59	60-69	70-79	80+	Total	50-59	60-69	70-79	80+	Total
Austria	4.67	5.31	12.31	28.41	8.92	5.99	8.90	14.63	42.57	13.44	4.02	4.86	11.19	31.68	9.07
Germany	1.79	3.89	10.58	29.47	6.43	1.24	3.09	10.33	27.31	6.34	2.54	5.06	7.72	29.41	8.39
Sweden	1.93	2.63	7.42	22.68	5.58	2.08	2.13	7.41	20.67	5.72	3.91	3.34	8.35	22.96	8.13
Netherlands	3.52	4.04	11.11	24.14	6.90	3.55	4.65	9.23	29.87	7.41	3.72	3.91	10.37	29.28	8.10
Spain	8.12	13.86	26.24	47.99	20.02	5.51	10.49	21.55	34.17	15.58	6.56	11.40	25.79	43.53	19.54
Italy	6.15	10.57	19.93	44.69	13.75	4.55	10.26	24.90	40.54	15.15	5.83	11.38	22.18	46.58	17.04
France	3.21	5.83	14.80	33.43	10.18	3.04	6.33	16.35	36.92	11.02	5.22	5.39	13.30	37.25	11.80
Denmark	3.67	4.80	10.15	31.64	8.63	2.64	4.15	12.72	30.91	8.25	2.87	2.82	9.33	26.18	6.99
Switzerland	0.98	3.13	5.09	11.54	3.83	1.26	1.91	6.47	16.77	4.31	1.17	2.53	5.94	19.25	4.67
Belgium	4.21	5.96	12.53	32.46	9.62	4.51	7.24	14.04	33.70	11.02	5.12	6.93	15.00	37.92	12.01
Total	**3.80**	**6.04**	**13.73**	**31.84**	**9.57**	**3.35**	**5.88**	**14.55**	**31.41**	**9.90**	**4.32**	**5.93**	**13.87**	**34.20**	**11.05**

** Frailty is defined here as the presence of three or more phenotypic criteria*

APPENDIX B5. PREVALENCE OF FRAILTY* BY COUNTRY, GENDER, AND AGE BRACKET

Country	Male					Female					Total				
	50-59	60-69	70-79	80+	Total	50-59	60-69	70-79	80+	Total	50-59	60-69	70-79	80+	Total
Austria	4.88	4.52	9.05	28.57	7.81	4.08	6.54	14.16	35.16	11.17	4.43	5.66	11.98	32.87	9.74
Germany	1.47	3.77	8.00	23.45	5.63	1.83	3.98	11.36	31.65	7.91	1.67	3.88	9.64	28.66	6.84
Sweden	1.18	2.82	6.06	18.98	5.40	3.03	2.50	9.41	24.81	7.06	2.22	2.65	7.72	22.04	6.28
Netherlands	1.67	2.95	7.59	22.61	5.34	5.05	5.31	12.70	32.23	9.28	3.58	4.19	10.26	27.90	7.47
Spain	3.67	7.73	16.73	33.47	12.71	9.09	15.48	32.07	47.82	23.39	6.74	11.88	24.76	42.16	18.59
Italy	3.00	7.73	15.94	37.40	11.66	7.33	13.30	29.05	50.22	18.74	5.51	10.78	22.53	44.30	15.51
France	3.21	3.84	11.95	31.28	8.35	4.85	7.30	16.45	39.05	13.45	4.08	5.72	14.46	36.29	11.19
Denmark	2.31	2.90	10.52	24.54	6.25	3.57	4.70	11.24	32.16	9.33	2.98	3.83	10.91	29.30	7.90
Switzerland	1.24	2.20	4.45	15.75	3.76	1.09	2.71	7.28	18.65	5.05	1.16	2.47	5.93	17.45	4.46
Belgium	3.48	4.38	10.24	28.21	7.89	5.73	8.88	17.04	40.43	13.71	4.68	6.72	13.92	35.38	11.02
Total	**2.75**	**4.36**	**10.55**	**27.20**	**7.70**	**4.78**	**7.35**	**17.13**	**36.64**	**12.45**	**3.87**	**5.95**	**14.02**	**32.83**	**10.29**

** Frailty is defined here as the presence of three or more phenotypic criteria*

APPENDIX B6. PREVALENCE OF MULTIMORBIDITY AND DISABILITY IN ACTIVITIES OF DAILY LIVING BY FRAILTY STATE

(HEADCOUNTS AND PERCENTAGES IN PARENTHESES)

	No. of chronic conditions		**No. of limitations in activities of daily living**		
	None or 1	**2 or more**	**0 no dependence**	**1-3 low to moderate dependence**	**4-6 moderate to high dependence**
Robust	27,688 *59.01*	12.690 *35.15*	39,435 *53.47*	924 *12.74*	8 *0.51*
Pre-frail	17,138 *36.53*	16,965 *47.00*	29,771 *40.37*	3,371 *46.49*	522 *33.38*
Frail	2,094 *4.46*	6,444 *17.85*	4,545 *6.16*	2,956 *40.77*	1,034 *66.11*
Total	46,920	36,099	73,751	7,251	1,564

APPENDIX C

APPENDIX C1. FIXED EFFECTS ESTIMATES FOR NUMBER OF DOCTOR VISITS BY IMPLICATE NUMBER

	Implicate 1	Implicate 2	Implicate 3	Implicate 4	Implicate 5
Pre-frail	1.167***	1.167***	1.167***	1.167***	1.168***
	(0.0141)	(0.0141)	(0.0141)	(0.0141)	(0.0141)
Frail	1.455***	1.455***	1.453***	1.453***	1.453***
	(0.0345)	(0.0345)	(0.0345)	(0.0345)	(0.0345)
Multimorbidity	1.229***	1.231***	1.230***	1.229***	1.230***
	(0.0154)	(0.0154)	(0.0154)	(0.0154)	(0.0154)
Pre-Frail*MMorb	0.947***	0.947***	0.946***	0.947***	0.946***
	(0.0144)	(0.0144)	(0.0144)	(0.0144)	(0.0144)
Frail*MMorb	0.728***	0.727***	0.727***	0.728***	0.727***
	(0.0178)	(0.0178)	(0.0178)	(0.0178)	(0.0178)
Disability	1.036***	1.036***	1.037***	1.037***	1.037***
	(0.00498)	(0.00499)	(0.00499)	(0.00499)	(0.00500)
Self-perceived health	1.184***	1.186***	1.185***	1.185***	1.185***
	(0.00604)	(0.00605)	(0.00604)	(0.00604)	(0.00604)
Long-term illness	1.172***	1.171***	1.171***	1.170***	1.173***
	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0105)
Depression symptoms	1.018***	1.018***	1.018***	1.018***	1.018***
	(0.00221)	(0.00221)	(0.00221)	(0.00221)	(0.00221)
2 or more symptoms	1.119***	1.120***	1.118***	1.119***	1.120***
	(0.00991)	(0.00992)	(0.00990)	(0.00991)	(0.00992)
Age 60-69	0.973*	0.972*	0.974*	0.973*	0.976*
	(0.0122)	(0.0121)	(0.0121)	(0.0121)	(0.0122)
Age 70-79	0.934**	0.933***	0.936**	0.935**	0.938**
	(0.0195)	(0.0195)	(0.0195)	(0.0195)	(0.0196)
Age 80+	0.912**	0.910**	0.914**	0.911**	0.914**
	(0.0272)	(0.0272)	(0.0273)	(0.0272)	(0.0273)
Living with partner	1.049**	1.046**	1.048**	1.049**	1.053**
	(0.0174)	(0.0174)	(0.0174)	(0.0174)	(0.0175)
Children	1.161***	1.139***	1.162***	1.155***	1.179***
	(0.0422)	(0.0409)	(0.0424)	(0.0414)	(0.0428)
Financial distress	0.980***	0.981***	0.979***	0.978***	0.980***
	(0.00505)	(0.00505)	(0.00504)	(0.00505)	(0.00507)
Education	0.952***	0.969***	0.971***	0.967***	0.966***
	(0.00761)	(0.00775)	(0.00784)	(0.00779)	(0.00777)
Hh wealth quartile 2	0.998	1.014	1.016	1.021	0.995
	(0.0108)	(0.0110)	(0.0110)	(0.0113)	(0.0110)
Hh wealth quartile 3	0.982	1.014	0.989	1.013	0.960**
	(0.0125)	(0.0128)	(0.0125)	(0.0130)	(0.0123)
Hh wealth quartile 4	0.986	1.025	1.020	1.024	0.963*
	(0.0146)	(0.0149)	(0.0150)	(0.0151)	(0.0143)
Social participation	0.973**	0.972**	0.973**	0.973**	0.972**
	(0.00879)	(0.00878)	(0.00878)	(0.00879)	(0.00878)
Physical activity	0.969***	0.970***	0.969***	0.969***	0.969***
	(0.00817)	(0.00817)	(0.00817)	(0.00817)	(0.00817)
Frequent drinking	0.946***	0.945***	0.944***	0.945***	0.944***
	(0.0103)	(0.0103)	(0.0103)	(0.0103)	(0.0103)
Observations	29233	29237	29249	29233	29227

Exponentiated coefficients; Standard errors in parentheses * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

APPENDIX C2. FIXED EFFECTS ESTIMATES FOR NUMBER OF GP VISITS BY IMPLICATE NUMBER

	Implicate 1	Implicate 2	Implicate 3	Implicate 4	Implicate 5
Pre-frail	1.094***	1.095***	1.094***	1.093***	1.094***
	(0.0167)	(0.0168)	(0.0167)	(0.0167)	(0.0167)
Frail	1.373***	1.373***	1.373***	1.373***	1.372***
	(0.0393)	(0.0393)	(0.0392)	(0.0392)	(0.0392)
Multimorbidity	1.147***	1.147***	1.149***	1.148***	1.148***
	(0.0179)	(0.0179)	(0.0179)	(0.0179)	(0.0179)
Pre-Frail*MMorb	0.965	0.966	0.964	0.966	0.965
	(0.0183)	(0.0183)	(0.0183)	(0.0183)	(0.0183)
Frail*MMorb	0.733***	0.732***	0.731***	0.731***	0.731***
	(0.0215)	(0.0215)	(0.0214)	(0.0214)	(0.0214)
Disability	1.029***	1.029***	1.030***	1.029***	1.030***
	(0.00596)	(0.00597)	(0.00598)	(0.00597)	(0.00598)
Self-perceived health	1.111***	1.111***	1.111***	1.111***	1.111***
	(0.00705)	(0.00706)	(0.00705)	(0.00705)	(0.00705)
Long-term illness	1.115***	1.113***	1.114***	1.113***	1.115***
	(0.0121)	(0.0121)	(0.0121)	(0.0121)	(0.0121)
Depression symptoms	1.020***	1.020***	1.020***	1.021***	1.020***
	(0.00269)	(0.00269)	(0.00269)	(0.00270)	(0.00270)
2 or more symptoms	1.055***	1.056***	1.056***	1.057***	1.056***
	(0.0115)	(0.0115)	(0.0115)	(0.0115)	(0.0115)
Age 60-69	0.944***	0.944***	0.944***	0.945***	0.946***
	(0.0148)	(0.0148)	(0.0148)	(0.0148)	(0.0148)
Age 70-79	0.871***	0.871***	0.871***	0.873***	0.874***
	(0.0225)	(0.0225)	(0.0225)	(0.0226)	(0.0226)
Age 80+	0.840***	0.840***	0.840***	0.840***	0.842***
	(0.0305)	(0.0305)	(0.0305)	(0.0305)	(0.0306)
Living with partner	1.037	1.036	1.037	1.038	1.041*
	(0.0207)	(0.0206)	(0.0207)	(0.0207)	(0.0208)
Children	1.183***	1.202***	1.205***	1.178***	1.221***
	(0.0528)	(0.0531)	(0.0542)	(0.0517)	(0.0545)
Financial distress	0.973***	0.973***	0.973***	0.972***	0.974***
	(0.00609)	(0.00609)	(0.00609)	(0.00609)	(0.00611)
Education	0.967***	0.979*	0.979*	0.981	0.983
	(0.00955)	(0.00966)	(0.00974)	(0.00978)	(0.00986)
Hh wealth quartile 2	1.012	1.015	1.027*	1.013	1.003
	(0.0133)	(0.0132)	(0.0134)	(0.0136)	(0.0134)
Hh wealth quartile 3	0.980	0.995	0.977	0.998	0.954**
	(0.0150)	(0.0152)	(0.0150)	(0.0157)	(0.0148)
Hh wealth quartile 4	0.970	0.968	0.979	0.970	0.934***
	(0.0175)	(0.0172)	(0.0176)	(0.0176)	(0.0169)
Social participation	0.965**	0.964**	0.964***	0.964**	0.964***
	(0.0107)	(0.0107)	(0.0107)	(0.0107)	(0.0107)
Physical activity	0.945***	0.945***	0.945***	0.945***	0.946***
	(0.00992)	(0.00992)	(0.00992)	(0.00992)	(0.00993)
Frequent drinking	1.007	1.006	1.007	1.007	1.006
	(0.0134)	(0.0134)	(0.0134)	(0.0135)	(0.0134)
Observations	24239	24245	24255	24237	24237

Exponentiated coefficients; Standard errors in parentheses $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

APPENDIX C3. CONDITIONAL LOGIT ESTIMATES FOR PROBABILITY OF BEING ADMITTED TO THE HOSPITAL BY IMPLICATE NUMBER

	Implicate 1	Implicate 2	Implicate 3	Implicate 4	Implicate 5
Pre-frail	1.228**	1.231**	1.231**	1.228**	1.227**
	(0.0820)	(0.0822)	(0.0822)	(0.0820)	(0.0819)
Frail	1.863***	1.874***	1.875***	1.868***	1.866***
	(0.239)	(0.240)	(0.240)	(0.239)	(0.239)
Multimorbidity	1.431***	1.432***	1.429***	1.429***	1.430***
	(0.0999)	(0.100)	(0.0998)	(0.0999)	(0.0998)
Pre-Frail*MMorb	1.030	1.029	1.029	1.030	1.031
	(0.0873)	(0.0872)	(0.0872)	(0.0873)	(0.0874)
Frail*MMorb	0.740*	0.737*	0.736*	0.737*	0.738*
	(0.101)	(0.101)	(0.101)	(0.101)	(0.101)
Disability	1.086**	1.085**	1.084**	1.085**	1.084**
	(0.0321)	(0.0320)	(0.0320)	(0.0320)	(0.0320)
Self-perceived health	1.394***	1.393***	1.393***	1.393***	1.392***
	(0.0401)	(0.0401)	(0.0401)	(0.0401)	(0.0400)
Long-term illness	1.169**	1.170**	1.171**	1.171**	1.171**
	(0.0577)	(0.0578)	(0.0578)	(0.0578)	(0.0578)
Depression symptoms	1.059***	1.059***	1.060***	1.059***	1.059***
	(0.0134)	(0.0134)	(0.0134)	(0.0134)	(0.0134)
2 or more symptoms	1.224***	1.221***	1.225***	1.224***	1.226***
	(0.0595)	(0.0594)	(0.0596)	(0.0595)	(0.0596)
Age 60-69	1.051	1.049	1.053	1.050	1.051
	(0.0820)	(0.0818)	(0.0821)	(0.0819)	(0.0820)
Age 70-79	1.213	1.212	1.216	1.214	1.215
	(0.150)	(0.150)	(0.150)	(0.150)	(0.150)
Age 80+	1.297	1.294	1.298	1.296	1.297
	(0.222)	(0.222)	(0.222)	(0.222)	(0.222)
Living with partner	1.237*	1.237*	1.245*	1.240*	1.240*
	(0.134)	(0.134)	(0.135)	(0.134)	(0.134)
Children	0.861	0.785	0.838	0.873	0.894
	(0.182)	(0.166)	(0.178)	(0.182)	(0.189)
Financial distress	1.001	0.994	1.003	0.995	0.994
	(0.0301)	(0.0298)	(0.0300)	(0.0297)	(0.0299)
Education	0.998	1.009	0.984	0.990	0.979
	(0.0544)	(0.0549)	(0.0539)	(0.0544)	(0.0537)
Hh wealth quartile 2	1.067	1.078	1.055	1.053	1.011
	(0.0692)	(0.0703)	(0.0680)	(0.0685)	(0.0663)
Hh wealth quartile 3	1.024	1.072	1.033	1.030	1.022
	(0.0765)	(0.0802)	(0.0769)	(0.0772)	(0.0766)
Hh wealth quartile 4	1.211*	1.252**	1.110	1.187*	1.148
	(0.104)	(0.108)	(0.0954)	(0.102)	(0.0983)
Social participation	0.881*	0.883*	0.882*	0.882*	0.883*
	(0.0443)	(0.0443)	(0.0443)	(0.0443)	(0.0444)
Physical activity	0.913	0.914	0.913	0.914	0.913
	(0.0430)	(0.0430)	(0.0430)	(0.0430)	(0.0430)
Frequent drinking	0.847**	0.849**	0.847**	0.847**	0.847**
	(0.0535)	(0.0536)	(0.0535)	(0.0535)	(0.0535)
Observations	14145	14145	14145	14145	14145

Exponentiated coefficients; Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX C4. RANDOM EFFECTS LOGIT ESTIMATES FOR PROBABILITY OF SEEING A SPECIALIST BY IMPLICATE NUMBER

	Implicate 1	Implicate 2	Implicate 3	Implicate 4	Implicate 5
Pre-frail	0.988	0.988	0.989	0.986	0.987
	(0.0769)	(0.0770)	(0.0771)	(0.0769)	(0.0769)
Frail	1.039	1.044	1.046	1.042	1.041
	(0.192)	(0.193)	(0.194)	(0.193)	(0.193)
Multimorbidity	1.780***	1.782***	1.780***	1.778***	1.778***
	(0.157)	(0.157)	(0.157)	(0.157)	(0.157)
Pre-Frail*MMorb	0.994	0.993	0.995	0.995	0.996
	(0.117)	(0.117)	(0.117)	(0.117)	(0.117)
Frail*MMorb	0.832	0.829	0.830	0.830	0.832
	(0.172)	(0.171)	(0.172)	(0.172)	(0.172)
Disability	0.939	0.939	0.939	0.939	0.939
	(0.0392)	(0.0392)	(0.0393)	(0.0393)	(0.0393)
Self-perceived health	1.147***	1.147***	1.148***	1.146***	1.147***
	(0.0389)	(0.0389)	(0.0390)	(0.0389)	(0.0389)
Long-term illness	1.529***	1.527***	1.528***	1.529***	1.529***
	(0.0967)	(0.0966)	(0.0968)	(0.0968)	(0.0968)
Depression symptoms	1.020	1.020	1.020	1.020	1.020
	(0.0160)	(0.0160)	(0.0161)	(0.0161)	(0.0161)
2 or more symptoms	1.448***	1.449***	1.450***	1.451***	1.451***
	(0.0950)	(0.0951)	(0.0954)	(0.0954)	(0.0954)
Age 60-69	1.030	1.031	1.031	1.033	1.031
	(0.0690)	(0.0690)	(0.0691)	(0.0693)	(0.0691)
Age 70-79	0.973	0.971	0.970	0.975	0.971
	(0.0758)	(0.0757)	(0.0757)	(0.0761)	(0.0758)
Age 80+	1.053	1.047	1.046	1.052	1.048
	(0.115)	(0.115)	(0.115)	(0.115)	(0.115)
Male	0.958	0.958	0.958	0.958	0.958
	(0.0555)	(0.0555)	(0.0556)	(0.0556)	(0.0556)
Living with partner	1.140	1.141	1.136	1.147	1.135
	(0.0799)	(0.0800)	(0.0798)	(0.0805)	(0.0798)
Children	1.083	1.086	1.090	1.085	1.087
	(0.0969)	(0.0972)	(0.0977)	(0.0973)	(0.0974)
Financial distress	1.048	1.059	1.072*	1.057	1.062
	(0.0356)	(0.0359)	(0.0363)	(0.0359)	(0.0361)
Education	1.215***	1.213***	1.220***	1.228***	1.214***
	(0.0562)	(0.0561)	(0.0566)	(0.0570)	(0.0563)
Hh wealth quartile 2	1.020	1.056	1.092	1.031	1.091
	(0.0791)	(0.0820)	(0.0847)	(0.0800)	(0.0849)
Hh wealth quartile 3	1.085	1.091	1.124	1.144	1.144
	(0.0872)	(0.0880)	(0.0906)	(0.0929)	(0.0928)
Hh wealth quartile 4	1.387***	1.334***	1.315**	1.261**	1.323**
	(0.123)	(0.116)	(0.115)	(0.110)	(0.116)
Social participation	1.227***	1.229***	1.229***	1.230***	1.230***
	(0.0722)	(0.0724)	(0.0724)	(0.0726)	(0.0725)
Physical activity	0.994	0.995	0.996	0.997	0.996
	(0.0585)	(0.0585)	(0.0586)	(0.0587)	(0.0586)
Frequent drinking	0.988	0.991	0.988	0.989	0.990
	(0.0627)	(0.0629)	(0.0628)	(0.0629)	(0.0629)
Observations	37381	37382	37382	37382	37382

Exponentiated coefficients; Standard errors in parentheses * *p < 0.05,* ** *p < 0.01,* *** *p < 0.001*

APPENDIX C 5. NEGATIVE BINOMIAL AND POISSON ESTIMATES FOR NUMBER OF DOCTOR VISITS

	Random effects		Fixed effects	
	Poisson	Negative binomial	Poisson	Negative binomial
Pre-frail	0.167***	0.116***	0.155***	0.091***
Frail	0.400***	0.308***	0.373***	0.210***
Multimorbidity	0.323***	0.340***	0.205***	0.193***
Pre-Frail*MMorb	-0.074***	-0.051***	-0.054***	-0.052*
Frail*MMorb	-0.321***	-0.222***	-0.318***	-0.233***
Disability	0.032***	0.012**	0.035***	-0.002
Self-perceived health	0.204***	0.187***	0.170***	0.132***
Long-term illness	0.259***	0.271***	0.159***	0.146***
Depression symptoms	0.024***	0.024***	0.017***	0.014***
2 or more symptoms	0.156***	0.152***	0.112***	0.101***
Age 60-69	0.085***	0.083***	-0.028*	0.003
Age 70-79	0.128***	0.139***	-0.067**	0.041
Age 80+	0.135***	0.113***	-0.092**	0.037
Male	-0.058***	-0.050***		-0.073
Living with partner	0.029**	0.038***	0.032	0.040
Children	0.028*	0.012	0.158***	0.084
Financial distress	-0.010**	-0.001	-0.015**	0.007
Education	-0.009	0.012*	-0.038***	0.014
Hh wealth quartile 2	0.002	0.018	0.007	0.053**
Hh wealth quartile 3	-0.019*	0.004	-0.017	0.059**
Hh wealth quartile 4	-0.009	0.003	0.012	0.088***
Social participation	0.013*	0.052***	-0.029**	0.015
Physical activity	-0.044***	-0.046***	-0.029***	-0.030*
Ever smoked	-0.012	-0.013	-0.061***	-0.064***
Frequent drinking	-0.060***	-0.058***	-0.059***	-0.043*
Constant	0.367***	-0.023		-0.313**
lnsig2u Constant	-0.555***			
ln_r Constant		1.689***		
ln_s Constant		2.137***		
Observations	**64012**	**64012**	**29071**	**29071**

APPENDIX C6. NEGATIVE BINOMIAL AND POISSON ESTIMATES FOR NUMBER OF GP VISITS

	Random effects		Fixed effects	
	Poisson	Negative binomial	Poisson	Negative binomial
Pre-frail	0.114***	0.081***	0.087***	0.048*
Frail	0.339***	0.260***	0.313***	0.164***
Multimorbidity	0.214***	0.195***	0.134***	0.093***
Pre-Frail*MMorb	-0.035**	-0.009	-0.032	-0.023
Frail*MMorb	-0.238***	-0.136***	-0.312***	-0.186***
Disability	0.037***	0.028***	0.029***	-0.038
Self-perceived health	0.143***	0.132***	0.104***	0.068***
Long-term illness	0.173***	0.153***	0.108***	0.054***
Depression symptoms	0.020***	0.018***	0.013***	0.016***
2 or more symptoms	0.100***	0.100***	0.053***	0.042**
Age 60-69	0.079***	0.073***	-0.059***	-0.039
Age 70-79	0.137***	0.142***	-0.139***	-0.060
Age 80+	0.179***	0.170***	-0.175***	-0.071
Male	0.008	0.016		0.071
Living with partner	-0.010	-0.006	0.013	-0.006
Children	0.023	0.011	0.191***	0.107*
Financial distress	-0.032***	-0.031***	-0.021***	-0.004
Education	-0.063***	-0.059***	-0.027**	0.004
Hh wealth quartile 2	-0.030***	-0.019*	0.007	0.041*
Hh wealth quartile 3	-0.079***	-0.063***	-0.038*	0.025
Hh wealth quartile 4	-0.129***	-0.115***	-0.033	0.052
Social participation	-0.031***	-0.014	-0.036**	-0.004
Physical activity	-0.055***	-0.041***	-0.052***	-0.015
Ever smoked	-0.028***	-0.032***	-0.070***	-0.061***
Frequent drinking	-0.036***	-0.048***	0.005	-0.002
Constant	0.837***	1.198***		0.427***
lnsig2u Constant	-0.826***			
ln_r Constant		2.028***		
ln_s Constant		1.806***		
Observations	**56441**	**56441**	**24101**	**24101**