Chapter 10
Roadmap to Expanding Alternatives to Hospitalization

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10.1 Aging Society

Elderly population is growing faster than all younger age groups. The most recent data on global aging report that the number of persons aged 60 years or older is expected to more than double by 2050 and to more than triple by 2100, rising from 962 million globally in 2017 to 2.1 billion in 2050 and 3.1 billion in 2100 [1]. According to United Nations, it is estimated that virtually every country in the world is experiencing growth in the number and proportion of older persons in their population. As a consequence of this, population aging is becoming one of the most significant social phenomena of the twenty-first century, leading to repercussions for several sectors of society, mainly the demand for goods and services and implications for labor and financial markets. When particularly looking at European Union, on January 2016, the whole population was estimated at 510.3 million; while people up to 14 years were 15.6%, elderly (65 years old or over) were 19.2%. Notably, such an increase is of 0.3% compared with the previous year and even of 2.4% when compared with 10 years earlier. According to recent statistics [2], across the EU member states, the lowest share of young people is recorded in

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Germany (13.2%) and about the share of persons aged 65 or older, the highest shares were in Italy (22%), Greece (21.3%), and Germany (21.1%).

Although it is widely recognized that new generations of elderly are relatively active and healthy when compared with past generations of older people, however, it is undeniable that aging process naturally leads to an increase of frailty and vulnerability. Indeed, compared to younger populations, older adults are more vulnerable to multimorbidity and chronic illnesses, and thus it is estimated that 50% of hospitalized adults are 65 years or older and this proportion is only expected to increase [3, 4].

10.2   Elderly Services

As a consequence of the abovementioned demographic and societal developments, health and social care systems are asked to face a growing demand for services and goods for elderly population. For example, demand for long-term care (LTC) services is expected to increase in the next decades. Particularly, projections of LTC expenditures showed that home care is in high demand. Although it is a matter of common knowledge that European citizens prefer to live and, if possible, spend their final days at home, however, public policy has been slow, and still is, to support a shift from institutions and hospitals to home-based care settings [5]. Nevertheless, all over Europe, a major share of the older population in need of care is receiving care from informal carers (e.g., spouses, children, and other family members), even in those countries having large publicly supported elderly care services [6]. Moreover, it is reported that most public funding for LTC services goes to institutional services [5], even over 70% in Belgium, Iceland, and Switzerland. Impressively, such funding accounts for 0.3–3.9% of gross domestic product. At the same time, LTC institutions often require, on top of public funding, high fees to the users and their relatives, and these in some cases exceed the net monthly salary of an average production worker.

Accurate forecast analyses are performed by decision-makers who expect homes to be a cheaper alternative to hospital-based services and nursing home care [7]. Nevertheless, at present in most European countries, demand for home care cannot yet be met by the available formal home care schemes, and therefore it is needed that policy-makers will look for inspiration beyond the usual models and good practices to find solutions in response to these challenges.

10.3   Long-Term Care Services for Elderly in Europe

World Health Organization defines LTC as "the system of activities undertaken by informal caregivers (family, friends, and/or neighbours) and/or professionals (health and social services) to ensure that a person who is not fully capable of self-care can

maintain the highest possible quality of life, according to his or her individual preferences, with the greatest possible degree of independence, autonomy, participation, personal fulfilment and human dignity" [8]. When talking about elderly population, by informal caregivers, it is meant family, in-home nurses, friends, and neighbors; by professionals, it is meant health and social services provided by public health, primary care, home care and rehabilitation services, palliative care, and institutional care in nursing homes and hospices.

The way health systems respond to the need of LTC of elderly is strictly related to the local health service organization. In each European country, national health systems provide care coverage mainly on the basis of their respective past tradition [9, 10]. Indeed, national health systems of European countries are based on elements from the Beveridgean and Bismarckian model systems together with conservative and family traditions. Particularly, the Bismarckian model views LTC protection (as well as any social insurance) as depending on labor and social contributions. Therefore, insurance helps contributors with proportionality of benefits to contributions. This model is mainly adopted in Germany, Denmark, and the Netherlands. On the contrary, in countries adopting the Beveridgean model (also called "social democratic model") such as Sweden and Spain, social protection is supported by the national government that decentralizes implementation to municipalities. This system is financed by taxes and is unrelated to employment, thus striving for egalitarianism through uniform benefits. A special case is the Anglo-Saxon model, adopted in the United Kingdom and Ireland where healthcare is provided through a national tax-supported system, although most recently supplementary services, partially covered by private health insurance, have been gaining in importance. This model is also known as "liberal", due to its liberal attitude to markets. Indeed, most of the funds are used for the working-age population, and less for pensioners. Moreover, it is previous employment that defines the access to benefits, thus resulting in that those who have not been employed would not be admitted to such benefits and this might constitute a problem for those family members who have to stay at home to take care of their disabled and/or elderly relatives.

Overall, the use of LTC services by elderly varies widely across European countries. The share of elderly receiving services in institutions ranges from less than 1% in Poland and Russian Federation to 9% in Iceland. As for those receiving publicly funded services at home, the share ranges from very small in many countries in Eastern Europe to 25% in Denmark [5]. Finally, about Southern Europe countries, according to Bocquaire [9], the traditional model tends to leave LTC responsibilities on families, although this is progressively challenged with rising rates of female employment.

Below is reported, regardless of the models specifically adopted in the individual countries, the main LTC solutions adopted across European countries.

Home Care is a service carried out in the home of the elderly. Usually, it is targeted to older people recently released by the hospital or in need of regular treatments, with the aim of supporting them in daily living, thus allowing them to continue to live in their own homes for longer and avoiding inappropriate hospital

admissions. Home care services are provided by three different kinds of persons/ entities: (i) Integrated home care services. Integrated and coordinated health and social activities have been accredited for this function. Health services are medical care (geriatricians, psychiatrists, etc.), nursing, rehabilitation, medicines, and prosthesis supply services; social services are personal care, meals, housework, laundry, and administrative services. Such services may also be provided by public sector but the law on eligibility for accessing them often covers only persons without adequate family support, who are dependent on the help of another person, and poor. Moreover, funding remains a long-term problem and its consequences are non-permanent work contracts for staff, non-payment of salaries, and long-term insecurity; (ii) In-home nurses. These are mainly migrant women and it is estimated that many (especially those providing a 24 h/service) are without work permits, without social insurance, without residence permits, and, at least initially, they are usually paid around the lowest basic salary; (iii) Family and friends networks. When it comes to the need for care for loved ones, the family and friends' networks choose to be involved in this. Although this is often due to the limited welfare state provision, however, this is also related to traditional ways. Indeed, it is expected that older people, who have contributed throughout their lives to the practical and financial support of children and grandchildren, can draw on the same network when they need help. On the other side, often there are no services for the carers (e.g., psychosocial support) and no financial support is provided for those who are sometimes forced to quit their jobs in order to assist their relatives. Differently, in some other cases, a reimbursement is offered for those persons needing such services. For example, an LTC insurance was established by the German welfare state in 1996 to either provide elderly the care services they need or cash benefits to pay for a private caregiver, such as a family member.

Day Centers are (mainly local) semi-residential structures hosting elderly people. They are usually open during the day (less frequently, some semi-institutional care services are open during the night). They provide healthcare (e.g., prevention, therapy, and rehabilitation) and social care services (e.g., personal care and promotion of personal autonomy, entertainment, job therapy, and social activities). Furtherly, possible additional formal care services are provided through the accommodation of elderly in residential apartments, in sheltered housing, and under foster care.

Residential structures are nursing homes which provide health and social care, and functional rehabilitation for elderly people presenting disabilities. The staff is made of physicians, nurses, social workers, and psychologists. Such structures can offer two kinds of care, extensive or intensive: the first comprising long-term rehabilitation and accommodation through hospitalization; the latter includes rehabilitation with high medical importance but it might also provide hospice and palliative care for terminal patients. Residential structures can also offer institutional care, an LTC service adapted to the type and degree of dependency, and the intensity of care required by the user (i.e., on a permanent basis, when the residential center becomes the user's usual residence, or temporarily, when the person requires a stay for the purpose of convalescence, during holiday periods, or at

weekends). Residential structures, when publicly financed, have a limited access, often with long waiting lists, and are mainly addressed to the poor. Otherwise, private organizations and licensed individuals offer a variety of health- and care-related services for a negotiable fee through private hospitals, clinics, and residential structures. These are usually monitored by a public body, e.g., the corresponding prefecture.

Private not-for-profit sector. This sector deserves a particular mention as, by means of non-governmental organizations, charity and philanthropic organizations, churches and privately funded foundations, many services and programs are offered. They are monitored and regulated by public bodies to assure both the legality and quality of services they provide and staff is composed of paid employees in cooperation with volunteers. In many countries, these services cover the inadequacies of the welfare system and they are partners of the state in the provision of some social services.

10.4   New Frontiers in LTC for Elderly: ICT Services

With the elderly population growing faster than any other, an appropriate social and financial plan for LTC targeted to elderly is needed and it should aim at balancing between informal care and public support and services. A sustainable LTC system might be based on a proper combination of public health and social services, supported informal care, and technical aids.

With regard to technical aids, the demand for ICT products and services supporting elderly population in their daily living is enormously growing, yet is still characterized by

– *high fragmentation*: the available products and services are still characterized by high heterogeneity and poor standardization at the European level. As a consequence, there is a lack of a wide and systematized diffusion of such products and services;
– *inelasticity*: the lack of close substitutes for ICT products and services causes a weak price elasticity;
– *scarcity*: in spite the growing demand, not all elderly actually can access assistive ICT devices and services; and
– *need of adaptation*: several products need to be adapted to the specific characteristics and needs of users.

Overall, although a growing number of products aiming at supporting and enhancing daily living of elderly people are currently available in the market, however, often they can address a limited target of users and only provide partial and/or superficial solutions.

The current scenario in European countries seems to show a co-existence of services different in terms of "delivery", thus resulting in a sharp separation

between healthcare and social care and their corresponding ICT services, often named *telecare* (i.e., social alarms) and *telehealth*. The differentiation between what is funded under LTC insurance furtherly confirms this traditional separation, for example, social alarms (i.e., telecare) are basically covered, while home telehealth often is not and is just beginning to be covered in some countries (e.g., Germany). Therefore, the first urgent need is developing integrated models of social and health cares, and thus only later properly integrated ICT services can be implemented. With the increasing average age of European population, a growing number of people will develop chronic diseases, thus potentially needing both telecare and home healthcare services.

10.5   Vision and Objectives

The demographic and epidemiological transition has taken us to the crossroads of aging and chronic diseases, forcing a diversification in the provision of care. Healthcare policies constantly try to adapt to the demographic and epidemiological needs of our society, and nowadays must be submitted under the prism of "the triple aim": better health system, better health, and lower cost [11].

Healthcare policies force to rethink models that cover the increasingly complex needs of elderly groups, considering integrated social and health models instead of fragmented care [12]. Obviously, it is about implementing the most effective and efficient models, based on scientific evidence; unfortunately, this is scarce in our field [13].

Despite the moment of rapid technological development in which we live, there are still many questions left unanswered, many referents to the field of aging. We must not only deal with the impact on the level of independence achieved with the intervention but also if the needs of the elderly have been considered in their design. Still today, we have challenges ahead in the design and evaluation of intervention studies with new technologies. The focus has mainly been on studies of satisfaction and feasibility rather than in studies of effectiveness and cost-effectiveness. An extra challenge in gerontechnology research is that of implementation and adherence to interventions, showing low rates of achievement [14–16]. These circumstances show the relevance of our research, which pretends to easy access to relevant technologies.

The plan of the consortium from a clinical point of view is focused on improving access to RADIO in order to improve quality of home and community care for seniors. From a medical perspective, the system could help in two ways: to primary users (prevention and wellness services, for education and lifestyle changes, and for family caregivers) or to the healthcare setting (home care, nursing home, and rehabilitation) with a large amount of benefits for different end users.

By using RADIO system, clinicians can easily monitor "risk situations" and early detect clinical problems both improving patient's quality of life and reducing caregiver's burden. Healthcare facilities providing services to elderly can improve

the quality of provided assistance as well. Next, we list most relevant areas of interest in which the system may be used and integrated into the future management of the elderly patient from the medical perspective.

10.6   Prevention and Wellness Services

Prevention activities seek to avoid the onset of disease, detect the onset of disease early through screening, and stop disease from progressing or worsening. Prevention in elderly people includes and has to be focused on prevention of frailty and disability. Screening and early detection refer to a broad range of instruments—including exams, tests, and clinical guidelines—used to identify a disease in individuals who do not have symptoms. While not all screenings have proven effective, employing evidence-based detection techniques has the potential to improve health outcomes and lower the cost of treatment by detecting and mitigating the progression of numerous diseases associated with aging, including multiple forms of cancer, cardiovascular disease, chronic kidney disease, diabetes, hepatitis, as well as Alzheimer's, dementia, depression, and alcohol abuse.

Screening and early detection are especially crucial in a frail elderly. Frailty is one of the most relevant geriatric conditions, which has shown to be extremely suitable to serve as target for preventive and therapeutic interventions. However, other geriatric conditions such as functional impairment and dementia are frequently unrecognized or inadequately addressed in older adults. For many elderly individuals, the loss of everyday competence may stem from a variety of sources; notable among these is the presence of disease. Often these problems arise gradually and may not even be considered a problem for some time.

The RADIO system can help caregiver in the management of their relatives. The system can detect any possible change from the iADL standard pattern and alert caregivers and physicians. In other terms, an alert can be sent if, in the daily routine, something is not happening as usual (e.g., user has not taken his pills, user has reduced his weekly physical activity, etc.).

10.7   Home Care Solutions

Together, ICT and domotics may deeply influence the rise of new models of care through the connections among professionals, the changing roles of formal and informal actors and of the patients, the reduction of the functional limitations and the frailness, and the reduction of the burden for informal carers. Overall, the increasing synergy between the ICT and the home-based advanced equipment—which can be expected to grow further in the next years—may reach the effect of enabling effective and innovative care models, thus facilitating the management of

deep changes in the care organization and in the respective roles of all the formal and informal actors (including the beneficiary) [17].

10.8 Residential Care Solutions

Ambient-assisted living (AAL) technologies aim to assist elderly people and their caregivers using a set of technologies (such as sensors, actuators, interaction devices, and, more recently, robots) in order to respond specific patient's needs. Nursing home providers can also improve efficacy and efficiency [18] using these technologies.

One of the goals of the technology is to ensure greater safety. In this sense, the most rewarding areas according to the elderly are fall detection [19]. However, activity monitoring, iADL as well as ADL, could have an important role as detection method for early diagnosis [20]. Similarly, one of the major potential utilities of the technology is having an accurate way of performing human activity patterns such ADL-iADL assessments, somehow "equivalent to healthcare professional's assessment". Functional assessment is a very time-consuming exercise in everyday practice and any robust and ergonomic improvement will be very much appreciated.

10.9 Rehabilitative Solutions

For the older patient, the discharge from a hospital is a critical issue, when decisions are made that may influence the rest of that person's life. Discharge planning is a challenging task under the best of circumstances, and changes in the healthcare environment have made it almost impossible to do such planning well. Even under the best of circumstances, the discharge planning process in hospitals is inherently complex. Information from many sources must be gathered, including patient-specific information regarding functional status and patient and family preferences, as well as information about available community resources. With shortened lengths of hospital stay, it is difficult to assess a patient's medical prognosis and pre-hospital level of functioning, much less predict post-hospital potential. Effective discharge planning can decrease the chances that a patient is readmitted to a hospital, help in recovery, ensure medications are prescribed and given correctly, and adequately prepare caregivers to take care of their relatives. Key elements of a well-managed post-hospital discharge geriatric assessment include targeting criteria to identify vulnerable patients, a program of multidimensional assessment, comprehensive discharge planning, and home follow-up.

Efforts to re-engineer the discharge process to assure a safe transition involve such issues as improved clinician communication, patient education, information technology systems, involvement of community-based providers, and arrangements for prompt follow-up [21]. Such interventions have the potential to substantially improve patient care and reduce healthcare expenditures. The patient's assessment

before discharge and the follow-up program are identified as the two characteristics necessary in a formally structured discharge planning program for effective care of older patients [22]. RADIO system can provide a comprehensive assessment before and after the discharge to home or to nursing home.

10.10 Conclusions

It seems possible to affirm that in the healthcare sector there are many possibilities to integrate RADIO system with a large amount of benefits for different end users. In fact, RADIO system can improve elderly and/or patients quality of life. Caregivers may obtain many benefits as well, as their care burden would result significantly reduced. By using RADIO system, clinicians can easily monitor "risk situations" and early detect clinical problems. Finally, healthcare facilities providing services to elderly can improve quality of provided assistance.

The plan of the consortium from the clinical point of view is focused on improving access to RADIO system in order to improve quality of home and community care for seniors. It will help seniors to live independently in their own homes and communities, avoiding social isolation and loneliness. It will reduce pressure on family members—many of whom are already balancing full-time employment and parenting their own children—to act as care providers. It is also the most cost-effective way to increase access to hospital services for people of all ages.

Assessment of function and targeting interventions during hospitalization are critically important to acute care of older adults. The impact of functional decline on resource utilization and healthcare costs may further reinforce the need to assess and intervene to prevent functional decline. In literature, among health providers and within governments, there is growing recognition that a comprehensive and well-coordinated home and community care system can significantly alleviate pressure in the most expensive part of the health system—hospitals—by reducing wait times for both emergency and surgical services.

On the other hand, the real strength of ICT lies in the opportunity to combine and analyze data from various sources. ICT is also strong in collecting and storing data over long periods of time: significant but not obvious changes in one's health status can be detected and signaled by continuous analysis of such data as done by RADIO system.

References

1. United Nations, Department of Economic and Social Affairs, Population Division. (2017). *World population prospects*: *The 2017 revision, key findings and advance tables*. Working Paper No. ESA/P/WP/248.
2. Eurostat Statistics Explained. (2017). *Population structure and ageing*. http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing. Accessed March 15, 2018.

3. Bell, S. P., & Saraf, A. A. (2016). Epidemiology of multimorbidity in older adults with cardiovascular disease. *Clinics in Geriatric Medicine, 32*(2), 215–226.

4. Bergvalle, D., Charbit, C., Kraan, D., & Merk, O. (2006). Intergovernmental transfers and decentralised public spending. *OECD Journal on Budgeting, 5*(4), 111–158.

5. World Health Organization—Regional Office for Europe. *Health and social care systems*. http://www.euro.who.int/en/health-topics/Life-stages/healthy-ageing/data-and-statistics/health-and-social-care-systems. Accessed March 15, 2018.

6. Riedel, M., & Kraus, M. (2011). *Informal care provision in Europe*: *Regulation and profile of providers*. ENEPRI Research Report No. 96, November 2011.

7. Western Sydney University—Centre for Health Research. (2016). *Taking healthcare home*. Ideas Lab Issues Paper.

8. World Health Organization. (2002). Active aging. A policy framework.

9. Bocquaire, E. (2016). *Long-term care coverage in Europe*. https://www.soa.org/Files/Pubs/pub-2016-05-ltc-coverage-europe.pdf. Accessed March 15, 2018.

10. European Association of Service Providers for Persons with Disabilities (EASPD). *Social welfare systems across Europe*. http://www.easpd.eu/sites/default/files/sites/default/files/SensAge/d4_social_welfare_systems_across_europe.pdf. Accessed March 15, 2018.

11. David, S., Sheikh, F., Mahajan, D., Greenough, W., & Bellantoni, M. (2016). Whom do we serve? Describing the target population for post-acute and long-term care, Focusing on nursing facility settings, in the era of population health in the United States. *Journal of the American Medical Directors Association, 17*(7), 574–580.

12. Vrijhoef, H., & Thorlby, R. (2016). *Developing care for a changing population: Supporting patients with costly complex needs*. London: Nuffield Trust.

13. Pla de Salut de Catalunya 2016–2020. (2016). Un sistema centrat en la persona: públic, universal i just. In Catalunya. DdSGd, editor.: Direcció General de Planificació en Salut.

14. Petermans, J., & Piau, A. (2017). Gerontechnology: Don't miss the train, but which is the right carriage? *European Geriatric Medicine, 8*(4), 281–283.

15. Dupuy, L., Froger, C., Consel, C., & Sauzeon, H. (2017). Everyday functioning benefits from an assisted living platform amongst frail older adults and their caregivers. *Frontiers in Aging Neuroscience, 9,* 302.

16. Yusif, S., Soar, J., & Hafeez-Baig, A. (2016). Older people, assistive technologies, and the barriers to adoption: A systematic review. *International Journal of Medical Informatics, 94,* 112–116.

17. Mori, A., Dandi, R., Mazeo, M., Verbicaro, R., & Mercurio, G. (2012). Technological solutions potentially influencing the Future of Long Term Care.

18. Aloulou, H., Mokhtari, M., Tiberghien, T., Biswas, J., Phua, C., Kenneth Lin, J. H., et al. (2013). Deployment of assistive living technology in a nursing home environment: Methods and lessons learned. *BMC Medical Informatics and Decision Making, 13,* 42.

19. Broadbent, E., Tamagawa, R., Patience, A., Knock, B., Kerse, N., Day, K., et al. (2012). Attitudes towards health-care robots in a retirement village. *Australasian Journal on Ageing., 31*(2), 115–120.

20. Gokalp, H., & Clarke, M. (2013). Monitoring activities of daily living of the elderly and the potential for its use in telecare and telehealth: A review. *Telemedicine and e-Health, 19*(12), 910–923.

21. Hansen, L. O., Young, R. S., Hinami, K., Leung, A., & Williams, M. V. (2011). Interventions to reduce 30-day rehospitalization: A systematic review. *Annals of Internal Medicine, 155*(8), 520–528.

22. Haddock, K. S. (1991). Characteristics of effective discharge planning programs for the frail elderly. *Journal of Gerontological Nursing, 17*(7), 10–14.