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Implementing Best Evidence-Based Practice into Ambient Assisted Living Solutions: From User Outcome Research to Best Social Practices

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ABSTRACT The evidence-based approach derived from the health care and medicine disciplines is the explicit and rational use of current best evidence in making decisions about the care of individuals and the population. At present, new technology may enter directly into the people care service without evaluation and without the evidence-based approach. Knowledge and evaluation bypasses will delay the time to market for a rapid and systematic routine use of innovations. Decision making about the purchase of equipment is more problematic when there is less evidence available or when this evidence is of poor quality, because there is no demonstration of efficacy and cost-effectiveness before the introduction of new technology. Information and communication technology (ICT) solutions aim to improve health care providers, professional and informal carers, decision makers, and all stakeholders in the field of elderly care. Implementing knowledge and experiences from the medical research and health care fields, we propose some

recommendations for an evidence-based approach in *gerontotechnology* and ICT solutions. The final outcomes of any intervention in the elderly population would ensure well-being and good health and the improvement of quality of life by respecting the autonomy of a potentially frail and vulnerable population. Besides the technology development of ICT solutions, an evidence-based approach including a clinical research-like program would be necessary. Translational research using models from the health care and medicine disciplines will provide added value and also help to spread the use of cost-effective ICT solutions in the elderly. A call to action implementing evidence-based practice into ambient assisted living (AAL) organization and call procedures may be challenging.

Let us hope that our desire to use it for the good of the person is stronger than the temptation to use it for our own convenience.

Richard Fleming

KEY WORDS: *evidence-based practice, evidence-based health care, evidence-based medicine, gerontology outcomes, elderly ecosystem, cost-effectiveness, guidelines, best-practice recommendations.*

Introduction

Population ageing will have major implications for Organization for Economic Co-operation and Development (OECD) economies and societies over the next few decades, and many of these implications have been analyzed in depth (Jacobzone et al. 1999). The area in which the implications are obviously important is long-term care for the frail elderly. The results from research on the impact of age-specific disability trends have important implications in several areas but are specially relevant for the health and ageing dimensions of social policies, particularly with regard to long-term care policies. In pure financial terms, such trends suggest that caution is needed in inferring links between improvements in health and health care spending. It seems that better health can be acquired through better lifestyles and through appropriate access to new technologies like ICT.

We should always refer back to the double objective of the ambient assisted living (AAL) program to enhance the quality of life of older people and to strengthen the industry and the use of ICT in Europe (Cullen and Kubitshk 2008). The concept of AAL has to be understood as follows:

- To extend the time people can live in their preferred environment by increasing their autonomy, self-confidence, and mobility
- To support maintaining the health and functional capability of elderly individuals
- To promote a better and healthier lifestyle for individuals at risk
- To enhance security, to prevent social isolation, and to support maintaining the multifunctional network around the individual
- To support carers, families, and care organizations
- To increase the efficiency and productivity of used resources in ageing societies

Thus, one may implement into practice the ambition of the AAL program in two opposite directions: to focus on the development of ICT for the elderly considering that the field is naive or to have a person-centered approach to the elderly and ICT development as part of the ecosystem. We will discuss the following key challenges of ICT for the elderly by considering

- The person-centered approach
- The evidenced-based practice methodology
- The application of evidence-based practice to AAL
- The strategies to implement best practices

Implementing knowledge and experiences from the medical research and health care fields, we will propose some recommendations for an evidence-based approach in *gerontechnology* and ICT solutions. The final outcomes of any intervention in the elderly population will ensure well-being and good health and the improvement of quality of life by respecting the autonomy of a potentially frail and vulnerable population.

Rationale for an Elderly-Centered ICT Evidence-Based Practice

The Concept of Ageing

The classical vision of ageing via the decline status, overestimated the burden of ageing and limited ICT development to compensation for deficiencies. Healthy ageing is likely to be of importance for the global cost of ageing.

The concept of ageing must be viewed from three dimensions: decline, change, and development.

- The term *ageing* can connote decline, and decline is not successful. After age 20, our senses slowly fail us. By age 70, we can identify only 50% of the smells that we could recognize at 40. Our vision in dim light declines steadily, until, by age 80, few of us can drive safely at night; by age 90, 50% of us can no longer use public transportation.
- The term *ageing* also conveys development and maturation. Analogous to a grand cru wine evolving from bitterness to perfection, at 70, we are often more patient, more tolerant, and more accepting of affect (ours and that of others). We are more likely to tolerate paradox, to appreciate relativity, and to understand that every present has both a past and a future. Finally, like age itself, experience can only increase with time.

The Berlin Aging Study (Baltes and Mayer 2001) recently concluded, “Old age is not foremost a negative and problem-ridden phase of life.” The MacArthur study of ageing (Seeman et al. 2001) also provided excellent support for the finding that our greater longevity is resulting in fewer, not more, years of disability. On one hand, after age 70, almost all of the subjects suffered at least one serious (chronic but treatable) illness, and many suffered up to five. Fifty percent had painful arthritis; after age 95, 50% experienced significant dementia. On the other hand, before age 95, less than 10% manifested dementia; 9 out of 10 still retained life goals.

When we look at mental functioning, first, the bad news is that the Berlin Aging Study's old-old subjects (aged 85–100 years) resembled humans coping with severe stress. They experienced fewer positive emotions, more emotional loneliness, and a feeling that others controlled their lives. After age 90, only 50% felt they had a confidante.

The good news was that with the exception of dementia, there was not more mental illness among the elderly, even among the old-old. Like arthritis and hip fractures, even dementia should be viewed as a common, but not inevitable, consequence of longevity.

With increasing age, spirituality and serenity increase. By *serenity*, we mean faith, acceptance, and allowing someone else to take over (Berlin study). The strategies of *giving up* or of information seeking were more common among the young-old, whereas the more *Buddhist* strategy of perceiving life as *being without meaning* was preferred by the old-old. Coping strategies that did not change between ages 70 and 90 were humor and comparing oneself with others more severely afflicted. The two most important psychosocial predictors of successful ageing were high level of education and having an extended family network. In a hierarchical regression model, the important correlates of poor ageing (defined as dependence, dissatisfaction with living, and being bedridden) were trouble walking (mobility), poor vision, age per se, depression, and dementia.

Integration of these three ageing dimension concepts into ICT solutions would be the cornerstone of a development framework with a person-centered approach and also of an evidence-based approach. Implementing the third dimension, development, one could expect to have a positive health approach, described by Martin Seligman (2008), contrasting with the classical assistive ICT solutions focusing on deficiencies of the older person.

Concept of the Person-Centered Approach

The person-centered approach was developed by Carl Rogers (1902–1987), who proposed new humanistic psychotherapy. Rogers trusted in people and believed that if a safe psychological environment existed, then all people would naturally move toward greater awareness and better fulfillment of their potentials.

The following potentials are within all of our actions in the field of ICT development for the elderly:

1. Sociability: the need to be with other human beings and a desire to know and be known by other people
2. Being trusting and trustworthy
3. Being curious about the world and open to experience
4. Being creative and compassionate

Today, there are many applications of Carl Rogers's approach in child care, patient care, elderly care, and relationship development that use his three guiding principles or *core conditions*, empathy, unconditional positive regard, and congruence. Patient- and family-centered care is an approach to the planning, delivery, and evaluation of health care that is grounded in mutually beneficial partnerships among patients, families, and health care practitioners. It is founded on the understanding that the family plays a vital role in ensuring the health and well-being of patients of all ages. The ultimate goal of patient- and family-centered care is to create partnerships among health care practitioners, patients, and families that will lead to the best outcomes and enhance the quality and safety of health care (Mead and Bower 2000).

The person-centered approach applied to the elderly is defined as services, solutions, treatment, care, and ICT applications provided by caregiver services that place the person at the center of their own care and consider the needs of the older person's carers.

Person-centered care is about a collaborative and respectful partnership between the service provider and the service user:

1. Getting to know the service user as a person
2. Sharing of power and responsibility between the service user and service provider
3. Accessibility and flexibility of both the service provider as a person and of the services provided
4. Coordination and integration of care for the service user
5. Having an environment that is conducive to person-centered care for both service providers and service users

Bridging the ambition of AAL program objectives and the elderly-centered approach should be the framework of our ICT assistive technology development, aiming to maintain the autonomy and empowerment of the elderly and to leave the old paternalistic model of care. ICT development would not create a *new numeric control* of dependence.

Elderly Ecosystem

There are some common approaches to ecological interdependence. Any change in one component of a natural ecosystem influences the other components.

Human development is the result of continual and reciprocal interactions between the organism and its environment. The body and its environment influence each other, and constantly, each adapts in response to changes in the other. The adaptation is the balance between the strengths and weaknesses of the individual, and the risks and opportunities encountered in the environment. Urie Bronfenbrenner (1979) described the human environment as a set of five systemic levels, which are concentric structures that are included into each other and that hold each other within their functional relationships to varying degrees (Figure 5.1):

- The ontosystem is the body itself, with its innate or acquired characteristics, the physical, emotional, intellectual, and behavioral.
- The exosystem is the social environment, the place or context in which the individual is not directly involved but which nevertheless influences their lives. It refers to physical locations but also to people and objects they contain, activities and roles that take place, and very often, the decisions made there.
- The microsystem is the place or immediate context in which the individual has an active and direct participation (family, clubs, social groups, etc.). It refers to physical locations but also to people and objects they contain, activities and role of tension there (the environment).
- The mesosystem is a set of links, relationships, and processes that take place between two or more microsystems.
- The macrosystem is a set of beliefs, ideologies, values, and way of life of a culture or subculture. This is the background that encompasses and influences all other systemic levels.

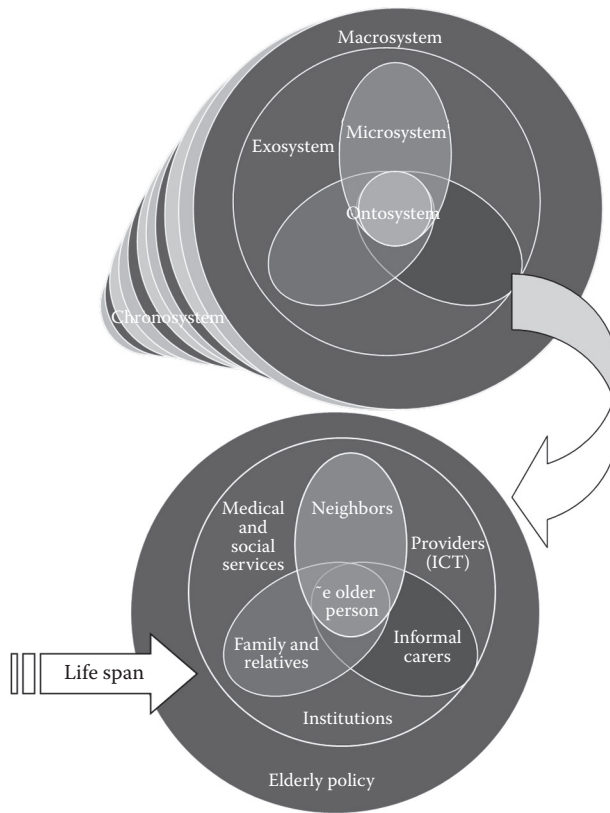


FIGURE 5.1
The elderly ecosystem.

Bronfenbrenner introduced also the concept of the chronosystem (Figure 5.2) to refer to models that examine the developmental change and the cumulative influence of environments over time (years).

The chronosystem applied to the elderly ecosystem is the life span and represents functional and physiological evolution with age.

The model proposes a perspective on the life cycle that allows taking into account the history, development, and interplay of environments. It refers to the influences arising from the

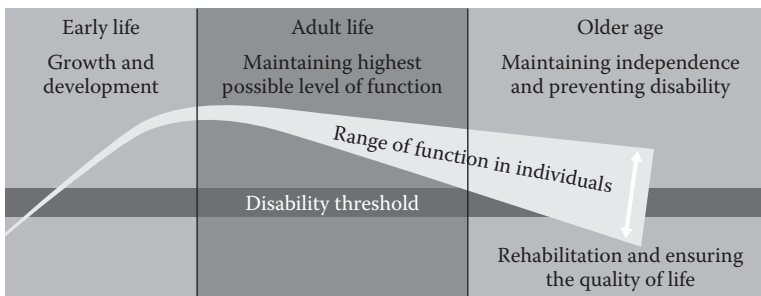


FIGURE 5.2
The chronosystem (or the life span): physiological and functional evolution with age.

passage of time. The individual is presented in a context through which different parts of evolution interact with various socioeconomic and cultural organisations and institutions.

This reading ecosystem with the vision of implementing ICT has the advantage of cross-matching the interaction of biogenetic factors, psychological resources, and lifestyle habits developed by the individual, the various organizations and social institutions, social and cultural values and economic conditions, and the social communities in web social media with on-demand add-on extensions. With the elderly-centered approach putting the elderly in the center of the human ecology concept as the ontosystem, one will see the necessity of a *social network* development of elderly care. The microsystem population represents *natural carers or helpers*.

Many innovative services and technical solutions, including assistive living environments, are brought to the market highly fragmented and do not adapt to the person's needs. This is due to an isolated business perspective without a thorough methodological framework to investigate the person's environment as an ecosystem.

One of the important impacts of an assistive living ecosystem approach is the systematic integration of a user interface requirement protocol according to impairments (Table 5.1).

The assistive living ecosystem is considered a paradigm that stimulates ICT innovation in favor of the elderly. An assistive living ecosystem ICT platform will aim to satisfy some of the primary needs of elderly people, such as alerts and control of basic vital parameters, and to satisfy some of the secondary needs, such as social interactions (Newell et al. 2006). The lack of web accessibility (easy to use, properly designed) will create an overexclusion (Fleming and Sum 2010).

An assistive living ecosystem ICT development designed for all should also be easy to use for operators and carers. Robotic products designed for an elder ecology must be conceived as part of a larger system of existing products and environments that serve elders and others in the ecology. When designing, first-order effects (such as fit) and second-order effects (such as social and cultural implications) must be considered (Forlizzi et al. 2004). Familiar

TABLE 5.1
Ambient Assisted Living User Interface Requirements

Impairments	Interface Standards
Visual	Use of colors
	Large text size
	Background color of text
	Background designs
	Audio description of visual part
Hearing	Volume control
	Signing videos or animations
	Subtitles/captioning of videos
Cognitive	Headings and subheadings
	Scroll bars
	Image/icons/graphs to illustrate textual content
Dexterity	Use of icons associated with buttons and pages
	Big-size buttons/menu items
	Allowing users to control size and formatting of elements
Low literacy	Keyboard shortcuts
	Labels familiar to users
	Explanation of descriptions

product forms with augmented product functionality will fit the system and maximize early product adoption.

The ecology of ageing in the design and the development of assistive technologies for the elderly has to be considered a framework toward best evidence practice.

Evidence-Based Practice

Appraisal of Evidence-Based Practice

During the last decades, the concepts of evidence-based practice have stimulated wide-ranging interest among health professionals as one of the central foundations underpinning the organization and provision of care services (Grol and Grimshaw 2003). The core of the evidence-based approach is decision making (between a patient and a doctor or a caregiver). This first concept concerning decision making for individual patients is named evidence-based medicine (EBM). EBM is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of EBM means integrating individual clinical expertise with the best available external clinical evidence from systematic research. By *individual clinical expertise*, we mean the proficiency and judgment that individual clinicians acquire through clinical experience and clinical practice. Increased expertise is reflected in many ways but especially in more effective and efficient diagnosis and in the more thoughtful identification and compassionate use of individual patients' predicaments, rights, and preferences in making clinical decisions about their care.

By *available evidence* we mean clinically relevant research, often from the basic sciences of medicine but especially from patient-centered clinical research, into the accuracy and precision of diagnostic tests (including the clinical examination), the power of prognostic markers, and the efficacy and safety of interventions (therapeutic, rehabilitative, preventive, and assistive regimens).

In contrast, a wider approach called evidence-based health care (EBHC) incorporates approaches to understanding the target population's and practitioners' beliefs, values, and attitudes. This approach also takes account of evidence at a population level, such as the burden of disease and implications for resource utilization including delivery of care.

Considering that ICT solutions for the elderly population have somewhere a link to and an impact on health status from a population and individual perspective, evidence-based practice will include EBM and EBHC.

Evidence-Based Approach

Decisions about groups or populations are a combination of three factors: evidence, values, and resources. Most of the time, many decisions (i.e., health care decisions) are driven by values and resources, as opinion-based decision making. Little attention has been given or is paid to applying any evidence from research. Even in cases for which the evidence is low or lacking, the decision made in the context of increasing pressure on resources has to follow the transition from opinion-based to evidence-based decision making (Corring and Cook 1999).

ICT solutions developed in the elderly may be considered as decision-making systems or processes. Besides the technology framework, every ICT solution development in the elderly must be based on a systematic appraisal of the best evidence available. A critical

TABLE 5.2
Skills for Evidence-Based Decision-Making Management

Skills
To ask the <i>right</i> questions (research, use, population, outcomes, etc.)
To define a priori criteria such as effectiveness, safety, and acceptability
To track down the evidence (to find articles and validated information, to have expert opinions, etc.)
To assess the quality of evidence (what is the available level of evidence?)
To assess whether the results of existing research are generalizable or applicable to the target population (to define the experimental population [study sample] among the final users)
To define an experimental plan including a cost-effectiveness approach
To publish the results in peer-reviewed journals
To define an implementation plan for the population
To test the use and to measure best use and misuse
To define a risk management plan
To define a reevaluation of evidence

pathway of questions may help every project leader find and apply the best evidence available (Green and Kreuter 2005). This requires the development of evidence management skills (Table 5.2).

Tracking Down the Evidence: The Value of Information

The evidence-based approach consists of three key stages: producing evidence, making evidence available, and using evidence (Figure 5.3).

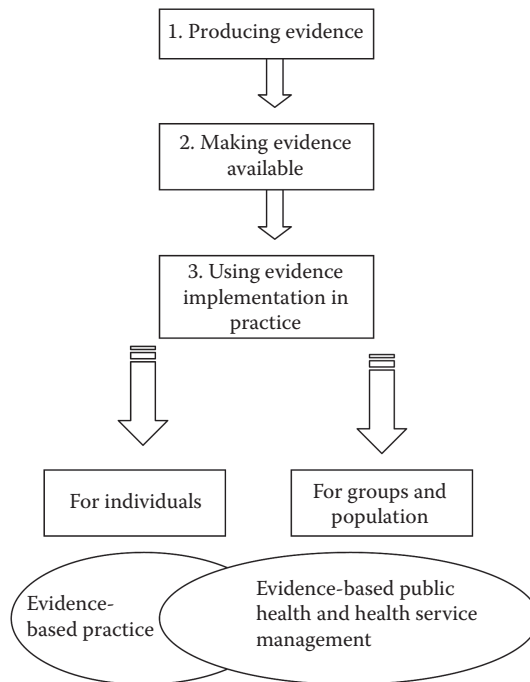


FIGURE 5.3
The three stages of the evidence-based approach.

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Evidence comes from research. There are over 2 million research articles in the world’s health care literature each year. One could add hundreds of thousands of scientific publications on ICT. The challenge is to be able to access effectively the information required to address the specific decision-making needs and to be able to use the information appropriately. Making the evidence available is valuable. In the era of Web 2.0, access to information has changed the scene and the scenario. In the era of Web 2.0, patients and final users have access to similar professional information, which forms the basis of discussion and negotiation. They also produce information via social media, blogs, tweets, etc. Access to information also increases the patient’s and user’s sense of autonomy and ability to take responsibility for their health.

However, not all sources provide information of equal quality or relevance.

ICT solutions should nowadays include options on information analysis, knowledge organization, and management. Portals must define the information production sources, the links with relevant libraries and scientific databases (such as MEDLINE, Embase, PASCAL, Cochrane Collaboration, etc.), and undergo some certifications. Health on the net (HON) certification has to be a prerequisite, and a conflict-of-interest policy has to be transparent. Quality of information, specifically information in the field of gerontology and gerontotechnology, will be the key challenge of the AAL evaluation policy.

Levels of Evidence

It is possible to conceptualize a hierarchy of evidence (Muir Gray 2001). This particular hierarchy is used to prepare guidelines of good practice in medicine in order to give some idea of the *grade of evidence* (Table 5.3).

Example of Low Evidence: Do We Answer to Carers’ Unmet Needs?

Caring for others is a human value. Caring is everybody’s task during the life cycle as life expectancy has been extended. It generates financial, health, and social activities and

TABLE 5.3

Grades of Evidence: Grading of Recommendations Assessment, Development, and Evaluation (GRADE)

Code	Quality of Evidence	Definition
A	High	Further research is very unlikely to change our confidence in the estimate of effect. <ul style="list-style-type: none"> • Several high-quality studies with consistent results • In special cases: one large, high-quality multicenter trial
B	Moderate	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate. <ul style="list-style-type: none"> • One high-quality study • Several studies with some limitations
C	Low	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate. <ul style="list-style-type: none"> • One or more studies with severe limitations
D	Very low	Any estimate of effect is very uncertain. <ul style="list-style-type: none"> • Expert opinion • No direct research evidence • One or more studies with very severe limitations

Source: Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group 2007.

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penalties. Care of older persons by family and friends, defined as *informal carers*, has provided the nutshell of home care and will continue to do so in the future everywhere across Europe.

In the European Union of 27 members (EU 27), it was estimated that there were more than 19 million carers and that the numbers would increase by 13% by 2030 to 21.5 million providing at least 20 hours of care a week and 10.9 million providing at least 35 hours of care a week (source, European Quality of Life Survey [EQLS] described by Anderson et al. 2009). Recalculation to include only those who report they are involved in caring on a daily basis leads to an estimate that 32 million people care on a daily basis.

The gendered nature of informal care is clearly evident, with more women than men. According to EUROFAMCARE, 76% of those caring for an older person were found to be women. Women were also predominately found to be the main older person cared for (68%). Carers of older people were children of the older persons. There may be a care gap in the years ahead with the demand of informal carers outweighing the needs. There is a growing concern that the reliance on family carers in Europe in the future will not be sustainable. The concentration of carers in the age group of 50–64 reflects the prevalence of older people as the recipients of care.

The Eurofamcare study reported by Triantafyllou et al. (2006) on older peoples' needs for care and help reported by family carers across Europe:

- Domestic needs, household: 92%
- Emotional/psychological/social needs, companionship, reassurance: 89%
- Mobility needs, inside or outside; transport: 82%
- Financial management, paying bills from the older person's money: 80%
- Organizing and managing care support, contacting services: 79%
- Health care needs, assistance with medication, medical treatment, rehabilitation: 79%
- Physical/personal care needs, washing, dressing, eating, going to the toilet: 66%
- Financial support: 36%

Caring for others is an enriching and rewarding experience when the expectations placed on carers are reasonable and adequate support is provided. Caring can also be a source of burden and stress, with costs to many aspects of the carers' life—emotionally, physically, socially, and financially.

User-friendly ICT has a vital part in facilitating care by family members and in supporting care providers to enable them to do so. Therefore, ICT should respond to the service provisions made by carers and also should aim to relieve the burden of caring. The highest quality of life reported may reflect the availability of support services and the policies for carers.

Example of High Evidence: Preventing Falls

Falls in the elderly are a public health problem. Falls occur in 30–60% of older adults each year, and 10–20% of these result in injury, hospitalization, and/or death. Most falls are associated with identifiable risk factors. Fall prevention has been an area of active research over the past 20 years. There is evidence that multifactorial interventions reduce falls and the risk of falling in hospitals and may do so in nursing care facilities. Vitamin D

supplementation is effective in reducing the rate of falls in nursing care facilities. Exercise in hospital settings appears effective, but its effectiveness in nursing care facilities remains uncertain.

Recent research shows that detection and amelioration of risk factors can significantly reduce the rate of future falls. Other evidence-based fall reduction methods include systematic exercise programs and environmental inspection and improvement programs. Those combining all these approaches seem to have the strongest effects on the consequences of falls (hip fracture, hospitalization, loss of autonomy, etc.).

Recent international groups have developed useful clinical guidelines for reducing the risk of falls.

Contrary to this evidence, ICT solutions or assistive technology has been developed over time mainly for the detection of falls and not for fall prevention.

Evidence-Based Practice for AAL Solutions

ICT or assistive technologies could be considered as interventions aiming somehow to increase the autonomy and the quality of life of elderly people. Keep in mind that these interventions are for a frail population with a high prevalence of *gerontology diseases*. Implementation of an evidence-based approach in the development of ICT solutions is the best value for money.

Few data existed to build research (external) evidence in the field of ICT for the elderly. A number of generalizations can be made on the basis of the literature:

1. The technology studied to date is often unreliable.
2. There is marked resistance to the acceptance of most of the technologies available.
3. The available technologies are no substitute for supportive human contact.
4. The technology should be tailored to the needs of the person.
5. The simpler the technology, the more likely it is to have a beneficial effect.
6. There is a great need for better-designed studies with larger samples.

Within the context of low external evidence, with the lack of convincing research published studies, a review of all sources of information, experts' opinions in both fields of ICT and gerontology, and users' qualitative and quantitative evaluation of unmet needs is mandatory.

TABLE 5.4
The PRECEDE–PROCEED Model

PRECEDE Phases	PROCEED Phases
Phase 1—Social diagnosis	Phase 5—Implementation
Phase 2—Epidemiological, behavioral, and environmental diagnosis	Phase 6—Process evaluation
Phase 3—Educational and ecological diagnosis	Phase 7—Impact evaluation
Phase 4—Administrative and policy diagnosis	Phase 8—Outcome evaluation

Users' evaluations and opinions on a web-based platform or social media or by interviews are possible approaches to increase the level of evidence and to certify or validate ICT solutions. In the field of health care the predisposing, reinforcing and enabling constructs in educational diagnosis and evaluation-policy, regulatory and organizational constructs in educational environmental development (PRECEDE-PROCEED) (Table 5.4) model of health planning and evaluation could be adapted in the assessment phase of high-health-care-impact ICT solutions.

Implementing Best Evidence Practices in AAL Solutions: Guidelines Needed

Designing guidelines of evidence-based practice in the field of AAL solutions is challenging. One may remember the conclusion of Richard Grol and Jeremy Grimshaw (2003): "If you would like to start tomorrow to change practice and implement evidence, prepare well: involve the relevant people; develop a proposal for change that is evidence-based, feasible, and attractive; study the main difficulties in achieving the change, and select a set of strategies and measures at different levels linked to that problem; of course, within your budget and possibilities. Define indicators for measurement of success and monitor progress continuously or at regular intervals. And, finally, enjoy working on making patients' care more effective, efficient, safe, and friendly."

Guidelines could be developed on different aspects:

1. The development of ICT solutions in the elderly would be done on the model of LivingLab based on coconception with users supported by the European Network of Living Labs (EnoLL).
2. AAL projects will include
 - a. The review of existing data and information on unmet needs
 - b. The description of the ecosystem of the final users
 - c. The description of the target population with at least the *autonomy* status with the use of validated scales (activities of daily living [ADL], instrumental activities of daily living [IADL], etc.)
 - d. The territory or the perimeter of action
 - e. The definition and the metrology of the primary global public health indicators or use benefits indicators
 - i. Quality-of-life scales
 - ii. Autonomy grids
 - iii. Acceptability
 - iv. Medicoeconomics
 - f. The comparative study versus nonintervention
3. AAL projects will have a risk management plan including the follow-up of the elderly abuse (weakness abuse) risks.

TABLE 5.5

Design Guidelines and Example of Design Recommendations

Design Guideline	Recommendations
Robotic products must fit the ecology as part of a system.	<p>Consider scale and footprint.</p> <p>Consider placement in the home environment.</p> <p>Make the product portable and usable beyond a home context.</p> <p>Use familiar product forms to inspire early adoption.</p>
Robotic products must support the migrating values of the elderly and others within the ecology.	<p>Provide a natural, "walk-up-and-use" interface.</p> <p>Allow the user to initiate product interactions.</p> <p>Provide more than one choice to complete any given task.</p> <p>Provide options for aesthetic appearance.</p>
Robotic products must be functionally adaptive.	<p>Provide multimodal input and consistent lightweight output.</p> <p>Support universal access and use by the largest number of people in the ecology.</p> <p>Provide mutable functionality for different users and contexts.</p>

4. AAL projects will comply regarding the respect of autonomy of the subject, which means that an informed consent form has to be signed.
5. Web accessibility and interfaces responding to impairments are the minimum required. A design guideline is part of development (Table 5.5).
6. Web-based platform services should have a description of the data warehouse, data management, and data analysis.
7. A quality process has to be defined and followed.
8. Audits have to be performed.

Elderly ICT Ecosystem: An Evidence-Based Approach Proposal for the Future

Coming back to the two most important unanswered questions of the AAL program, we are convinced that ICT solutions to elderly care are innovative interventions

- To support maintaining the health and functional capability of elderly individuals
- To increase the efficiency and productivity of used resources in ageing societies

These two objectives are the background of a framework focused on an evidence-based practice. We will propose an evidence-based stepwise approach and an evidence-based organization within the elderly ecosystem. ICT solutions and assistive technology should integrate some evidence from the gerontology and geriatric disciplines to become innovative gerontotechnology as interventions to address the two remaining AAL objectives (Figure 5.4).

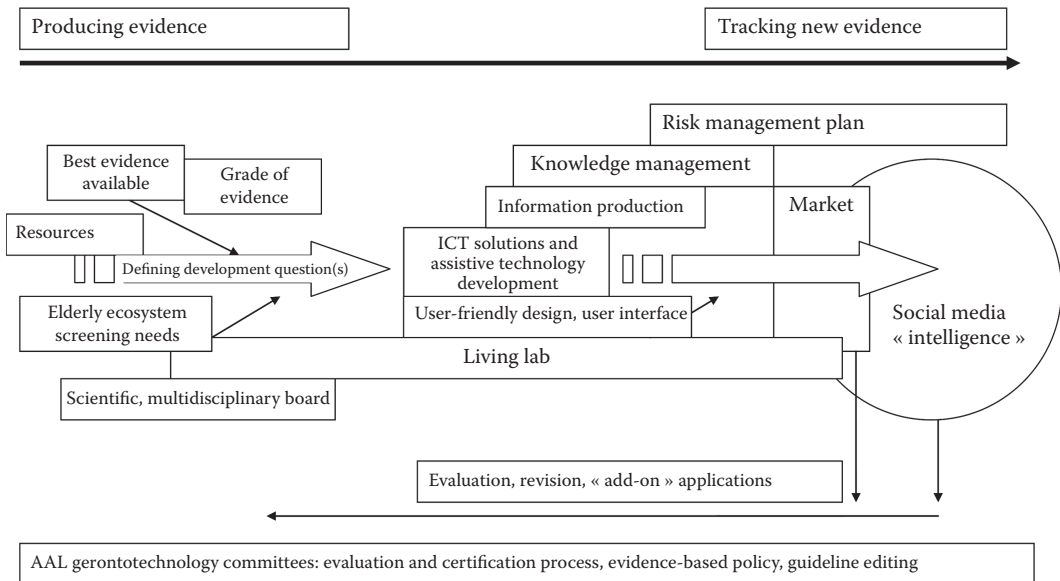


FIGURE 5.4
Elderly ICT ecosystem and evidence-based approach: a certification pathway.

Conclusion

The realities of health care complexity, the frail status of our final user population together with masked or visible impairments adding to the *invasive* intervention nature of any ICT solutions or assistive technologies in daily life, led us to rethink our practice. A minimum set of best-practice guidelines may be welcome. The ambition of all ICT in the elderly is, besides the economical development of ICT solutions, services, tools, or equipment, an improvement of some global health indicators and the quality of life of the elderly. A minimum level of evidence is needed. A culture of research and evaluation complying with scientific research methodology should be boosted. The line between ICT solutions or assistive technologies and medical devices is blurred and, in some cases, is nonexistent. Many ICT solutions are models of web-based services; added value created by the data analysis via data mining and new approaches of data analysis in the era of Web 2.0 has to become a standard. The challenge in the near future will be to transform patient-related information into patient-related outcomes with appropriate tools and methodology.

ICT could be the key to progress, or it could be harmful to a frail population. An evidence-based approach, which is good value for money, will help ICT solution providers to reach the market with a sustainable business by responding to unmet needs and also to the cost-effectiveness vision of decision-making stakeholders and public buyers of innovative equipment.

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