Asia-Pacific
Economic Cooperation

Economy Reports for APEC Economies on demographics, policies & ICT applications for people with Special Needs (Seniors and People with Disabilities)

APEC Telecommunications and Information Working Group

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On demographics, policies & ICT applications for people with Special Needs (Seniors and People with Disabilities)

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Australia

1. Demographic

1.1.Disability Statistics

Four million people in Australia (18.5 percent) reported having a disability in 2009, according to the results of the Survey of Disability, Ageing and Careers (SDAC) (Australian Bureau of Statistics, 2009). The disability rate increases steadily with age, with younger people less likely to report a disability than older people. For example, in 2003 while about 21 percent of the Australian population aged 65 and over had a profound or severe disability, the proportion increased to 65 percent for persons aged 85 or above. In 2009, almost nine in ten people aged 90 and over (88%) had a disability, compared with 3.4 percent of those aged four years and under (Figure 1).

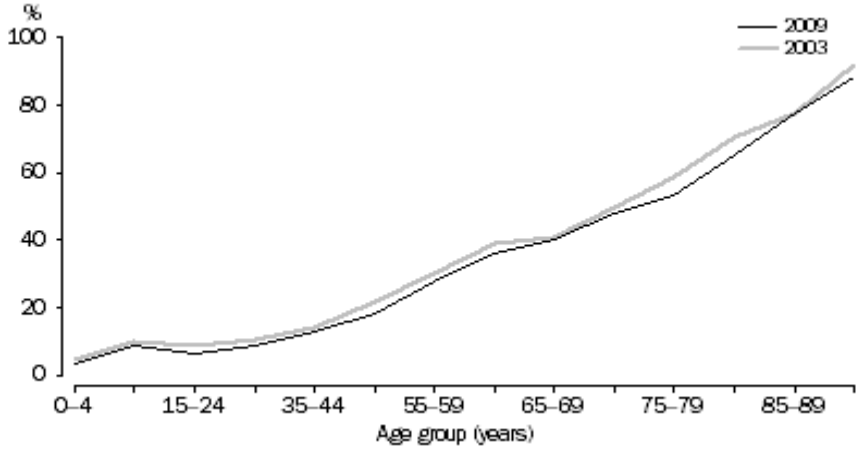

Figure 1: Disability prevalence by age - 2003 and 2009[1]

1.2. The aging of Australian population

The population of Australia is projected to grow to 36 million by 2050, of which 25 percent will be aged over 65 (around 7.8 million), with 5 percent over 85 (around 1.8 million) as in Figure 2 (Treasury Intergenerational Report, 2010). Therefore services provided to people with special needs (i.e. elderly people and disability) will grow in demand over the coming years. As there will be difficulty in obtaining financial support of these services from the people with special needs themselves, government assistance, grants, and industry assistance are needed to make up for the shortfall.

[1] *Source: Australian Bureau of Statistics, 2009*

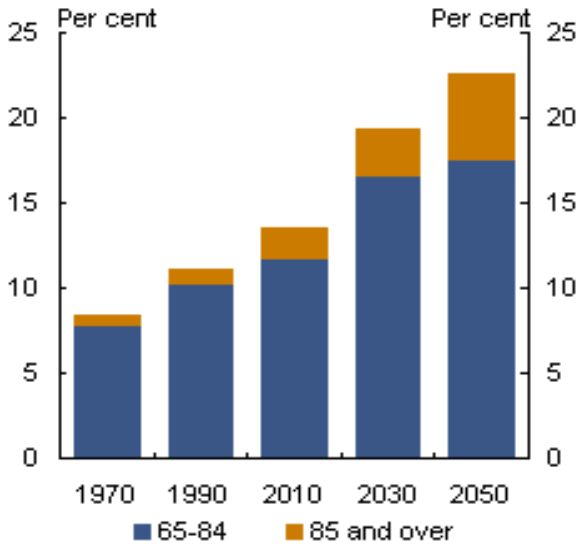

Figure 2: Proportion of the Australian population aged 65 and over[2]

2. Policies

The following discusses some major policies which have been implemented by Australian Government in order to promote ICT applications for people with special needs

2.1. E-Health

In early 2008, Australian Health Ministers, through the Australian Health Ministers' Advisory Council, commissioned Deloitte to develop the National E-Health Strategy to provide a useful guide to the further development of E-Health in Australia. The ultimate benefit achieved from the National E-Health Strategy is a safer, higher quality, more equitable and sustainable health system for all Australians by transforming the way information is used to plan, manage and deliver health care services. This health system is equipped to respond to emerging health sector cost and demand pressures of the future aging population.

The strategy aims to increase co-operation in E-Health between the central government and the local governments, and sets priorities for further development. It does so by outlining a common framework that allows public and private stakeholders to adopt an approach suitable for E-Health implementation (National E-Health Strategy, 2008). Furthermore, domestic consultation and international research identified the set of high priority E-Health solutions in three categories - electronic information sharing, service delivery tools and health information sources that will provide the greatest tangible benefits to Australian consumers, care providers and health care managers.

[2] *Source: see* *http://archive.treasury.gov.au/igr/igr2010/report/html/01_Executive_Summary.asp*

Table 1: High priority e-Health solutions[3]

E-Health Solution Category	Priority Solutions	Description
Electronic Information Sharing	• Referrals • Event summaries including discharge summaries, specialist reports and notifications • Prescriptions • Test orders and test results • Care plans	Improving the capability of patient, clinical and practice management systems to support key electronic information flows between care providers. These key information flows provide a basis for improved care planning, coordination and decision making at the point of care.
	• Consumer demographics • Current health profile • Current medications list	The key datasets that provide the summary of a consumer's key health data and their current state of health, treatments and medications. These datasets will improve the quality of service delivery and will ensure that consumers do not have to remember or repeat this information as they navigate the health system.
Service Delivery Tools	• Decision support for medication management • Decision support for test ordering	Encouraging the development of specific tools that improve the quality of clinical decision making and can reduce adverse events and duplicated treatment activities.
	• Chronic disease management solutions. • Telehealth and electronic consultation support	Encouraging development of specific tools that improve the management of chronic disease and the accessibility of care delivery. Chronic disease management solutions enable timely identification and monitoring of individuals and support management of their condition by providing automated reminders and follow-ups. Telehealth and electronic consultation tools enable improved rural, remote and disadvantaged community access to health care services.
Information Sources	• Health care reporting and research datasets • Health information knowledge bases	Implementing improved datasets for health care management that provide access to longitudinal and aggregated information for analysis, reporting, research and decision making. Providing access to a set of domestically coordinated and validated health knowledge sources for consumers and care providers.
	• Individual electronic health records (IEHRs)	Implementing IEHRs that provide consumers with access to their own consolidated health information and provide care providers with a means to improve the coordination of care between multi-disciplinary teams. IEHRs can also support the collection and reporting of aggregated health information.

The strategy describes foundations, solutions, change and adoption and governance as the key building blocks for delivering e-Health. Most of the foundations have been delivered, including a domestic Healthcare Identifier Service established in 2010. Solutions are building on these foundations with the most significant solution being the personally controlled electronic health record (PCEHR) system, which commenced on 1 July 2012. Figure 3 summarizes the E-Health program over the three, six and ten year planning horizons.

[3] *Source: National E-Health Strategy, 2008*

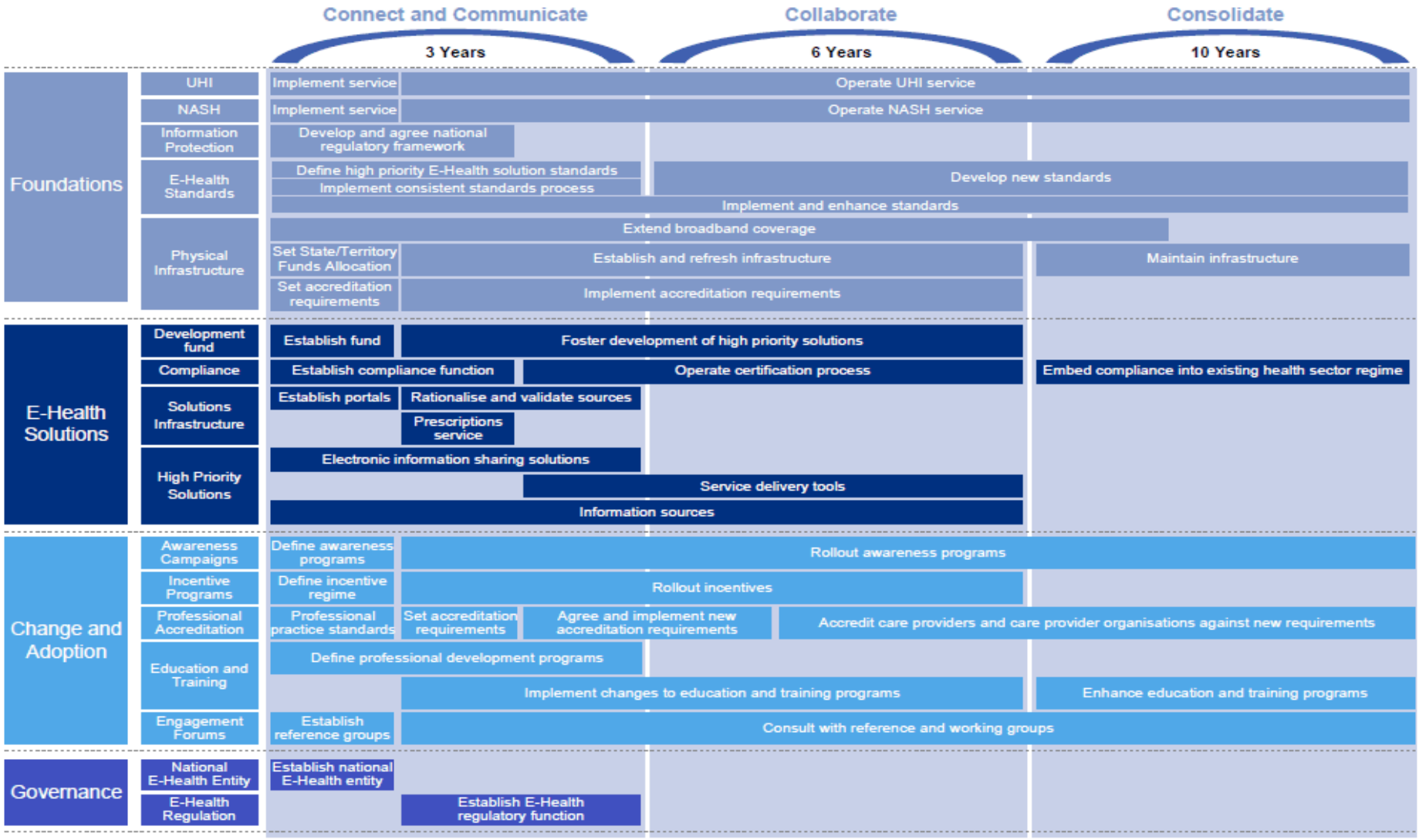

Figure 3: E-Health Implementation Roadmap[4]

[4] *Source: National E-Health Strategy, 2008*

2.2. Accessibility

In recent years Australia has introduced a range of progressive public policies to address the participation barriers faced by its citizens who live with disability. In 2008 the Government ratified the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) that obliges the Government to progressively dismantle the barriers that Australian citizens with disability encounter every day in all areas of economic, social and cultural participation. Particularly Australia has reinforced its commitment to the UNCRPD by ratifying the Optional Protocol which enables disability discrimination complaints to be taken to the United Nations if they have failed to be resolved using all domestic remedies within the States Parties. Australian government has also adopted a Social Inclusion agenda, aiming at all Australians to have the opportunity to participate in society. The agenda implies that people with disability should be provided the means to access all services that other, non-disabled citizens are able to access.

The Commonwealth Disability Discrimination Act (1992) requires all public sector agencies and government departments to ensure that online information and services are accessible by people with disabilities. Similarly, in 2010 the Australian Government Information Management Office (AGIMO) has issued the policy which commits all government websites will adopt the World Wide Web Consortium's (W3C) Web Content Accessibility Guidelines version 2.0 (WCAG 2.0) to be level "A" by end of year 2012 and level "AA" compliant by end of year 2014. This policy will make access to online government information and services that are delivered via the web accessible and easier to use for many people living with disability, thus improving e-Access and e-Inclusion.

Despite the ratification of the UNCRPD in 2008, adoption of the National Disability Strategy in 2010, and implementation of its whole-of-government Social Inclusion Agenda, Hawkins, 2011 argued that Australia lacked of a comprehensive ICT procurement policy that will only continue to exclude the people with special needs from gaining the benefits of a new digital society. The Australian Communications Consumer Action Network (ACCAN) has also emphasized the inclusion of accessibility to the domestic ICT strategy, including the ICT procurement policy. Ultimately, ACCAN attempts to drive the adoption of accessibility technology throughout government organs to allow all citizens equal possibilities to use public services. The organization sees the threat being that Australia would become a "dumping ground" for technologies that are not suited for accessibility criteria set in larger economies such as the United States and European Union. Therefore, they see it as important

to lobby the Australian government to adopt accessibility principles and thus encourage awareness, availability, and innovation in Australia regarding these technologies.

3. ICT services and applications for people with special needs

Technologies for people with special needs, such as telehealth, fall detection and prevention, control of wandering, smart homes, are being developed in Australia in several universities, research centers and companies. Based on the survey of the literature and the workshop discussions with many researchers and practitioners in Australia and Europe, Australian Academy of Technological Sciences and Engineering (ATSE) in 2010 assessed the opportunity areas for large scale application of technologies for the ageing in Australia and summarized in Table 2 below.

Table 2: Possible technology areas with large-scale impacts on elderly Australians in the next 15 to 20 years[5]

Area	2008–13	2013–18	2018–23
Security and safety	- Tracking systems - Improved house design - Smart homes - Improved networking/ - communication - Safer transport vehicles	- Implants for monitoring vital symptoms - Smarter homes - Falls alleviation - Smart clothing sensors	- Personal sensory devices to provide data about social and physical environments - Sensors to detect composition of drugs, foods and biohazards - Sociable technology to enhance relationships with one another and with machines
Diagnosis and treatment	- Telemedicine for remote - health monitoring - Devices for medication - compliance - Wider use of biosensors for diagnosis	- Rehabilitation robotics - Tele-rehabilitation, low cost haptic systems - Nanodelivery systems for medication - Biometric devices for identification	- Diagnosis and control of neurodegenerative diseases
Assistive technologies	- Audio GPS for visually impaired - Aids for driving Ultralightweight wheel chairs - Improved prostheses - Handling devices	- Brain/neuro computer - interaction - Improved vision and hearing devices - Exoskeletons for lifting objects - Enhanced mobility systems	- Service robotics - Artificial molecular muscles

Selected technologies, of particular concern to the conditions of people with special needs, will now be discussed in more detail.

[5] *Source: Adopted from Smart Technology for healthy longevity, the Australian Academy of Technological Sciences and Engineering, 2010*

3.1.E-Health

The National Digital Economy Strategy sets out a vision for Australia to realize the benefits of The National Broadband Network (NBN) and position Australia as a leading digital economy by 2020. As part of the government's digital economy goal for improved health, aged care and quality of life, the government will aim to promote the use of individual electronic health records (through the PCEHR system) and will promote the use of telehealth consultations, particularly for people in rural, regional or remote areas.

3.1.1. Telematics[6] (Telehealth, Telecare and Telemedicine)

The NBN-Enabled Telehealth Pilots Program administered by the Department of Health and Ageing (DoHA), supports innovative proposals to deliver high-quality telehealth services that take advantage of the high-speed broadband connectivity available through the NBN. The program will fund telehealth pilots in those areas that will first receive the NBN, with a focus on aged care, palliative care and cancer care.

The program, developed collaboratively between DoHA and the Department of Broadband, Communications and the Digital Economy, aims to generate a better understanding of and address barriers to the adoption of telehealth services in the home. This is a major opportunity to improve the way healthcare is delivered in Australia, particularly for consumers outside major urban areas and those with mobility issues.

Figure 4: The TeleMedCare Health Monitor's relationship with patients and doctors [7]

[6] *See* *http://www.who.int/trade/glossary/story021/en/index.html*

Many services utilize the Broadband for Seniors Initiative and support communication and mobility for the elderly and disabled. For instance, a telehealth system developed in Australia by TeleMedCare Pty Ltd **(**www.telemedcare.com.au**)** is shown in Figure 4. The TeleMedCare Health Monitor is designed for the care of those with single or multiple chronic disease conditions. It enables video conferencing, messaging, questionnaires, a daily health diary, and transfers the data via a dedicated website to doctors and care-givers to avoid costly hospitalizations. The product was received an Australian International Design Award in the Medical and Scientific category in 2010.

In addition, there are communication systems by which the health of elderly people can be monitored. One particular concern is elderly people diagnosed with dementia, who can forget taking medicine or important appointments. A project by ARC Special Research Initiative on Thinking Systems (see www.arc.gov.au) is developing a "Memory, Appointment and Navigation Assistant" (MANA) that can remind the patients about these activities and even provide memory training exercises. There is a strong commitment from the academy such as the College of Health and Science at the University of Western Sydney, to develop and use tele-health technologies and services to better manage and serve patients in the home and the community (icsid, 2010).

3.1.2. Personally Controlled Electronic Health Record (PCEHR)

The introduction of the PCEHR is an important step to enhance the Australian healthcare system. Australians will be able to check their medical information online and share it with their healthcare providers through the introduction of the PCEHR system (more information can be found at the website of Australian Government, Department of Health and Aging), which will boost patient safety, improve health care delivery, and cut waste and duplication. <www.eHealth.gov.au> is the gateway to Australia's PCEHR system.

3.2.Smart Homes

The concept of smart homes is being actively pursued in a number of developments throughout Australia (Table 3). For example, the Queensland Smart Home Initiative was one of the first organizations bringing together major companies such as Intel and Tunstall, universities, health care providers and housing providers in the collaboration projects. The projects have implemented demonstrator units for the public. So far, all technology providers in Australia are foreign companies.

[7] *Source: see http://www.telemedcare.com.au/*

Table 3: Development in smart homes in Australia[8]

State	Location	Details
Queensland	Brisbane, Kenmore	Blue Care Retirement Village-retrofit house 2007-08, sensors and assistive technologies
	Brisbane, Newmarket	Life Tec-New demonstration house, opened 2009, to be followed by large project of "101 Smart Homes" linked to overseas projects
New South Wales	Sydney, Marsfield	Baptist Community Services – retrofit house 2008, renovations, sensors, Tele Care
	Sydney, Bondi	The Benevolent Society – development application lodged 2008, amended 2009, 133 apartments, 7 townhouses
Western Australia	Perth, Bentley Park	SwanCare Group – approx. 800 dwellings ranging from free-standing villas to apartments

The Smart Home projects demonstrate equipment that has the capability to monitor residents' activities, send out a warning with a ringing alarm when accidents such as falls occur. Security and safety technology which are incorporated in smart homes cover a wide range of aspects including central locking, controlled access via smart cards or biometrics such as fingerprint scanning, smoke detectors, and automatic preset timed switching for appliances. It is also possible to install motion sensors to alert both in the case of unexpected movement such as falls, and in the case of unusual inactivity such as an occupant losing consciousness. These sensors may be worn by the occupant on their wrists or hang from their neck like a pendant (ATSE, 2010; IBES, 2012).

This kind of smart housing and research is increasingly needed in Australia. To support future developments, policies and strategies that encourage designing of friendly environments and assistive technologies for the elderly should be adopted. For example, better accessibility with wheelchairs, safe and easy-to-use kitchens and bathrooms would need to be designed. This might require lawmakers to consider the improvements in land-use for new construction, transportation networks, new building regulations and design of public spaces (ATSE, 2010).

3.3. Robotics

Robotics for the elderly and disabled is not widely researched and developed in Australia.

[8] *Source: Adopted from Smart Technology for healthy longevity, the Australian Academy of Technological Sciences and Engineering (ATSE), 2010*

The main projects have been at the University of Technology Sydney (UTS), where the ARC Centre of Excellence for Autonomous Systems has developed mobility systems to improve gait stability and to assist navigation with a wheelchair. A literature review conducted by IBES, 2012 found that the majority of studies were focused on lower limb "exoskeleton" technologies that could help older and disabled people around the home. Similarly, exoskeletons have been developed for carers to facilitate lifting patients and to the disabled whose upper bodies are weak in UTS. UTS has also been active in developing robot agents that help patients in various other daily tasks (ATSE, 2010).

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Canada

1. Demographic

1.1.Disability Statistics

About 4.4 million Canadians (14.3 percent) reported having a disability in 2006. The percentage of Canadians with disabilities increased with age, ranging from 3.7 percent for children 14 years and under to 56.3 percent for those 75 years and over (Figure 1).

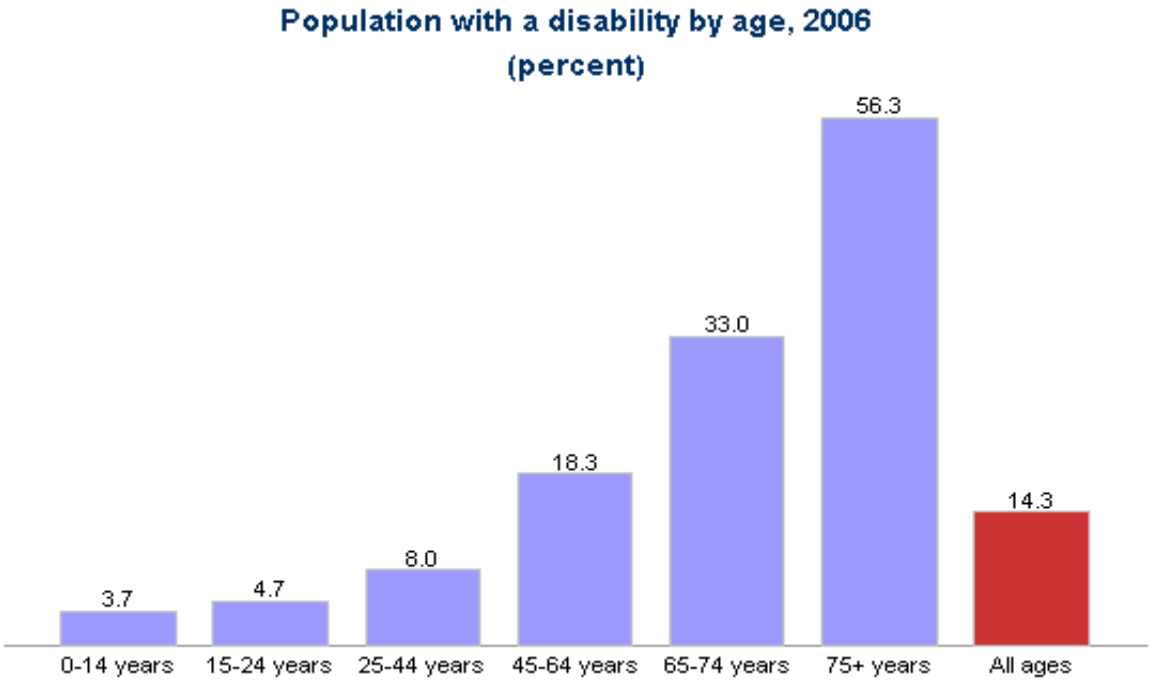

Figure 1: Population with a disability by age[9]

1.2. The aging of Canada populations

In 2011, an estimated 5.0 million Canadians were 65 years of age or older, a number that is expected to double in the next 25 years to reach 10.4 million seniors by 2036. By 2051, approximately 25 percent of Canada's population will be over the age of 65, almost doubling the current proportion of 13 percent.

[9] *Source: Adopted from Human Resource and Skill Development Canada (HRSDC), Canadians in Context – People with Disabilities*

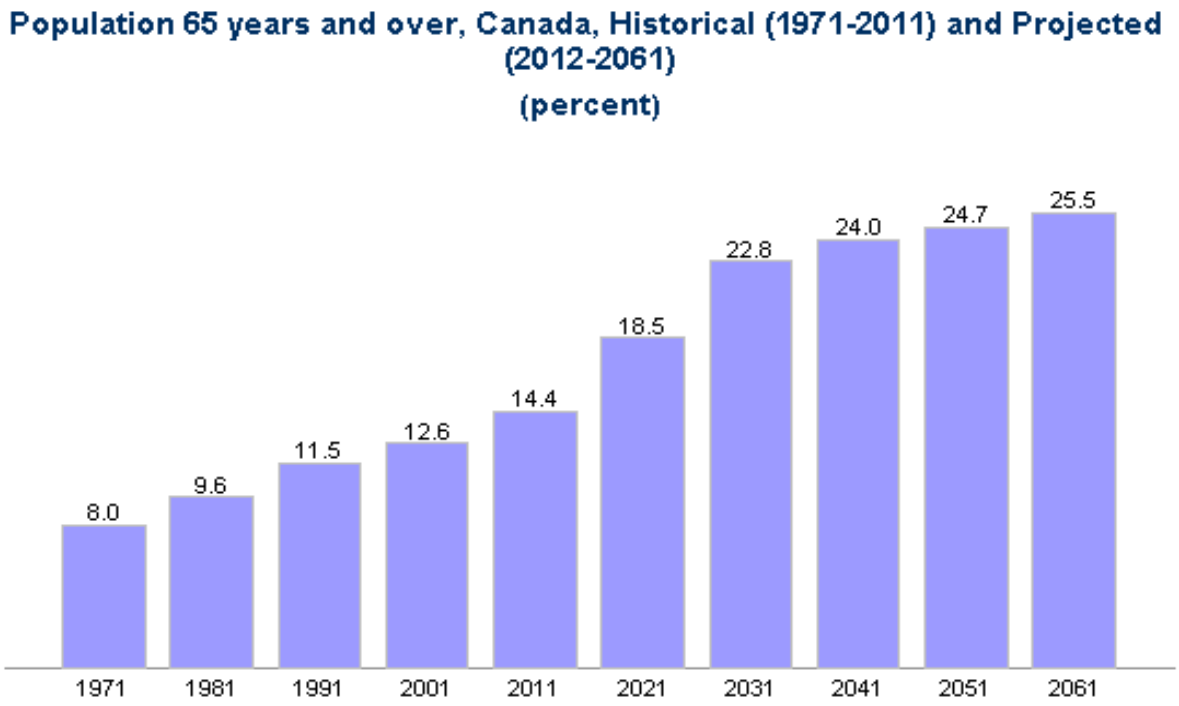

Figure 2: Population 65+, Historical (1971-2011) and Projected (2012-2061)[10]

2. Policies

2.1. E-Health

The federal government established Canada Health Infoway, which is an independent, federally-funded, non-profit organization, to accelerate the e-Health agenda and to create a domestic system of interoperable electronic health records. This government-funded organization developed a new approach for interprovincial/ territorial collaboration to establish core aspects of a domestic framework.

In 2001, Canada Health Infoway unveiled a plan to implement a domestic system of interoperable electronic health records. To carry out this plan, a domestic strategy and infrastructure was implemented whereby the exchange of health information is made possible throughout the economy. A change model was developed by Canada Health Infoway to guide the implementation of these e-Health initiatives at a domestic level (Box 1).

Investments to healthcare ICT in Canada are made in the province, but with joint involvement from the Canada Health Infoway. These investments may follow federal guidelines but adherence to the guidelines is voluntary. Thus, each province tends to develop their systems. The province and territory also establish their own e-Health strategic

[10] *Source: Adopted from Human Resource and Skill Development Canada (HRSDC) Canadians in Context – Aging Population*

frameworks. In such strategies, the government plays the role of stewards while provinces have responsibility for their own e-Health strategy. This approach aims to avoid duplication, fragmentation and proliferation of e-Health efforts within the province.

Box 1[11]: Components and highlights of Canada Health Infoway's change model used to guide the implementation of a domestic system of interoperable electronic health records

Leadership

- Adopted a shared governance model with the provinces and territories to ensure continued collaboration and accountability.
- Implemented a co-investment model with the jurisdictions to leverage $1.6 billion in federal funding.

Approach

- Created a single architecture for the economy, based on a data-sharing approach aimed at linking local clinical systems with regional and provincial registries to create a longitudinal electronic health record that would be accessible to the clinician at the point of care. The architecture was used as a reference model for investment decisions.
- Used gated funding (the release of funds in accordance with performance benchmarks) to reduce financial risk and increase motivation for the jurisdictions to deliver projects on time and on budget.
- Linked project funding to the use of standards to support interoperability.
- Consolidated the efforts to establish domestic e-health standards into a single organization that involved all key stakeholders to accelerate adoption.

Implementation

- Established preferred pricing agreements with vendors; encouraged the use of commercial solutions and the replication of the same solutions across jurisdictions to help reduce risk and cost.
- Engaged professional associations as part of change management to accelerate adoption and use of e-health solutions by individual clinicians.

Benefits

- Developed a structured approach to measure the return on investment; benefits would be measured against the savings of $6 to $7.6 billion expected from improvements in patient safety and quality and effectiveness of health care delivery.

For example, British Columbia (B.C.) is participating in a ten year plan led by the Federal Government's Canada Health Infoway to create a safer and more efficient healthcare system by creating Electronic Health Records (EHRs). The progress underway in British Columbia will contribute to Infoway's goal of ensuring that 50% of the Canadian population benefits from an Electronic Health Record by the end of 2009 (British Columbia Ministry of Health, 2005). This progress is exemplified by the e-health strategy (Figure 3) that attempts to cover

[11] *Source: Adopted from Rozenblum et al., 2011*

many of the success factors of technology adoption and implementation.

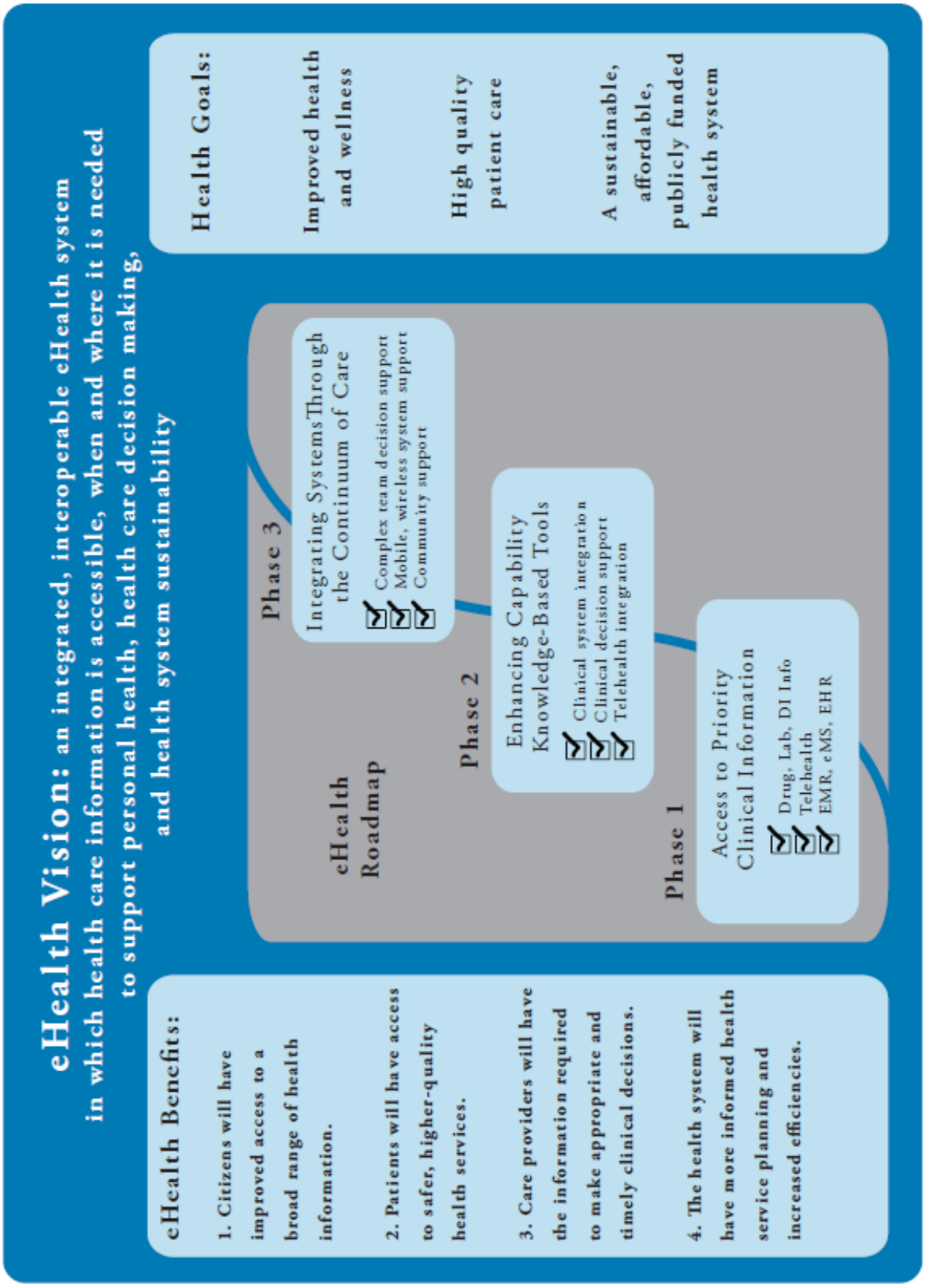

Figure 3: Strategic Phases of the implementation of e-Health in British Columbia[12]

2.2. Accessibility

The Canadian government invests annually in programs such as the Enabling Accessibility Fund and in the financial security including the Disability Tax Credit and the Working Income Tax Benefit disability supplement in order to support people with disabilities (HRSDC, 2010). On March 11, 2010, Canada reaffirmed its ongoing commitment to supporting people with disabilities by signing the United Nations Convention on the Rights of Persons with Disabilities.

Furthermore, the Department of Justice in Canada has mandated organizations to make ICT available to disabled people, including the Government of Canada to make its websites accessible to persons with impaired vision (AODA Alliance 2010). In addition, the Accessible Procurement Toolkit was developed by the Assistive Devices Industry Office as a web-based application and launched in 2000 at http://www.apt.gc.ca/. The toolkit includes information such as the US Section 508 Electronic and Information Technology Accessibility Standards, the Canada Common Look and Feel Standards for the Internet, and other best practices that are used for procurement of ICT. However, there is no federal legislation that mandates procurement of accessibility ICT, e.g. Ontario has its own regional legislation in force (Waddell, 2007).

Recently the Canadian Radio-television and Telecommunications Commission (CRTC) has approved a proposal from BCE (Bell Canada Enterprise) to establish an independent Broadcasting Accessibility Fund which will support innovation solutions to improve access to the Canadian broadcasting system by persons with disabilities (Canadian Radio-television and Telecommunications Commission, 2012). Besides, the Minister of Industry's Advisory Committee on Assistive Devices for Persons with Disabilities (ACAD), which was created in May of 1990 as part of the Federal government-wide National Strategy on the Integration of Persons with Disabilities, has played an instrumental role by supporting Industry Canada in ensuring on-going accessibility for people with disabilities.

[12] *Source: British Columbia Ministry of Health, British Columbia e-Health Steering Committee, e-Health Strategic Framework, November 2005*

3. ICT services and applications for people with special needs

3.1. E-Health

In Canada, the ICT services and applications range from the small scale implementation of Electronic Health Record in physician offices, to large initiatives that are bringing tele-health services to thousands of patients. Some projects are carried out in isolation while some involve multiple government organizations, hospitals and other partners. The Office of Health and the Information Highway, Health Canada has gathered the success stories about the implementation of ICTs in health and published at the website of Canada Health Infoway[13]. These stories explain how the projects improve health care services, and to share lessons to be learned within the ICT sector, health care community and other interested parties.

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

The April 2002 report of the Standing Senate Committee on Social Affairs, Science and Technology as well as the November 2002 report of the Commission on the Future of Health Care in Canada both identified telemedicine as a strategy for strengthening the delivery of health services (Special Senate Committee on Aging, 2009). Telehealth is also important for provision of healthcare services to rural areas where few local services are available. This allows a more balanced and fair healthcare access to citizens in all parts of the economy. The technology can also be utilized to provide services for minority language groups such as the French minority in Ontario (Special Senate Committee on Aging, 2009).

The Canadian e-Health Initiatives Database, which is a collaboration between the Office of Health and the Information Highway (OHIH), Health Canada and the Canadian Society of Tele-health, provides profiles on Canadian initiatives in categories such as telehealth, electronic health records, education and training, health information, health infrastructure, and standards. Table 1 below clearly demonstrates the wide diversity of telehealth applications and programs across Canada and all health care sectors (e-Health solutions unit, 2004). However, in order for the communities in rural areas to use many telemedicine applications they must have a high-quality internet connection, which is still not a reality in many communities (Special Senate Committee on Aging, 2009).

[13] *Office of Health and the Information Highway, Health Canada, How Canadian e-Health Initiatives are Changing the Face of Healthcare: Success Stories, August 2002,* last accessed 15 August 2012 at *http://www.hc-sc.gc.ca/hcs-sss/pubs/ehealth-esante/2002-succes/index-eng.php*

Table 1: Summary of Canadian Telehealth Related Initiatives[14]

BY FOCUS/INTERESTS		BY DISCIPLINE	
PROGRAM/PROJECT	**NUMBER**	**PROGRAM/PROJECT**	**NUMBER**
Applied Research	41	Addictions (Substance-Related Disorders)	6
Continuing Medical Education	12	Allergy and Immunology	2
Electronic Prescribing	5	Anesthesiology	2
Health Informatics	21	Cardiology	29
Health Information for Providers	122	Community Medicine	10
Health Information for Public/Patients	55	Dentistry	3
Health Information Management	41	Dermatology	10
Health Technology	34	Diabetes Services	13
Standards	26	Ear, Nose, Throat	2
Tele-Administration	2	Emergency Medicine	11
Telecare / Teletriage	24	Endocrinology	3
Teleconsultation / Telemedicine	59	Epidemiology	8
Telehomecare / Telemonitoring	18	Family Medicine	14
Telelearning / Teletraining / Telementoring	54	Gastroenterology	7
Telenursing	3	Genetics, Medical	2
		Geriatrics	9
		Health Education	2

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record (EMR)

In Canada, development of the EHR has been led by Canada Health Infoway since 2001, which oversees the development of Canadian standards whilst working with provinces and territories which implement and operate their systems. For example, the partnership of Canada Health Infoway and British Columbia on the Fraser Health Authority shared diagnostic imaging project has brought together 12 hospitals to share their patients' X-Rays, MRIs and CT-scans. Such collaboration can result in productivity increases and cost savings due to e.g. reduced need to rescan patients when they visit another hospital of the group (British Columbia e-Health Steering Committee, e-Health Strategic Framework, November 2005).

Another example is ClinicalConnect which is the secure, clinical provider portal. This online portal presents information which is integrated from the hospital information systems of 28 hospitals plus the Community Care Access Centres (CCACs) and Cancer Centre that are within the regions of Hamilton Niagara Haldimand Brant (HNHB) and the Waterloo Wellington (WW) LHINs (see at http://info.clinicalconnect.ca/). The portal can now be accessed using mobile devices. The benefits of such a portal include not only cost-savings

[14] *Source: adopted from Backgrounder on Telehealth activities in First Nations and INUIT Communities: Telehealth strategic planning overview e-Health solutions unit, 2004*

from sharing of data, but also ease of access from the mobile terminal. Thus, decision-making related to medical data could be conducted wherever it is most expedient for the doctor and patient (Canada Health Info, 2012).

The total cost of EHR implementation has been estimated at $10 billion to $12 billion, but when fully implemented, the savings are pegged at $6 billion to $7 billion annually. More importantly, the value of lives saved is immeasurable (Special Senate Committee on Aging, 2009).

3.2. Smart Homes

Senior-friendly housing is in high demand in Canada and as the Baby Boomer generation ages the need is rising. The aim is utilizing ICT and construction techniques to build houses where senior citizens can live safely and comfortably. For instance, in collaboration with industrial partners the JG Group of Companies and Intelligent Senior Independent Living Spaces (iSILS) Inc, researchers at the National Research Council (NRC) Institute have been developing and testing smart home technologies to support independent living. A sophisticated test facility called Lab for Independent Living Technologies (LILT) (Figure 5) has been implemented and deployed in two sites (at the NRC facility in London and at iSILS facility in Waterloo) to further develop, test, and demonstrate the technologies. Various monitoring options are available, such as the interior temperature and humidity, water consumption, usage of household electronics, and the occupant's vital signs and location. These data are available to the family of the occupants via a password-protected online system, which can also send alerts if there are unusual patterns in the occupant's behavior.

Another example is a smart-home research project launched by Carleton University in conjunction with e-Radio Inc., to determine the homeowner benefits of using these technologies. A part of funding is coming from the Natural Sciences and Engineering Research Council. In the long term, e-Radio – which uses FM to connect users to "smart" thermostats and appliances – will partner with Carleton to create a simulation model including utilities and networking alternatives.

3.3. Robotics

One direction that is being explored in Canada is the development of robots to include in smart home technologies that have previously been installed as immobile packages. The University of Toronto Intelligent Assistive Technology and Systems Lab (IATSL) is commencing a pilot in this field. The project attempts to construct an assistive robot and

evaluate the responses of dementia patients and caregivers when interacting with the robot. The hope is that the mobility characteristic of the robot can encourage dementia patients to more independent activities compared to static technologies.

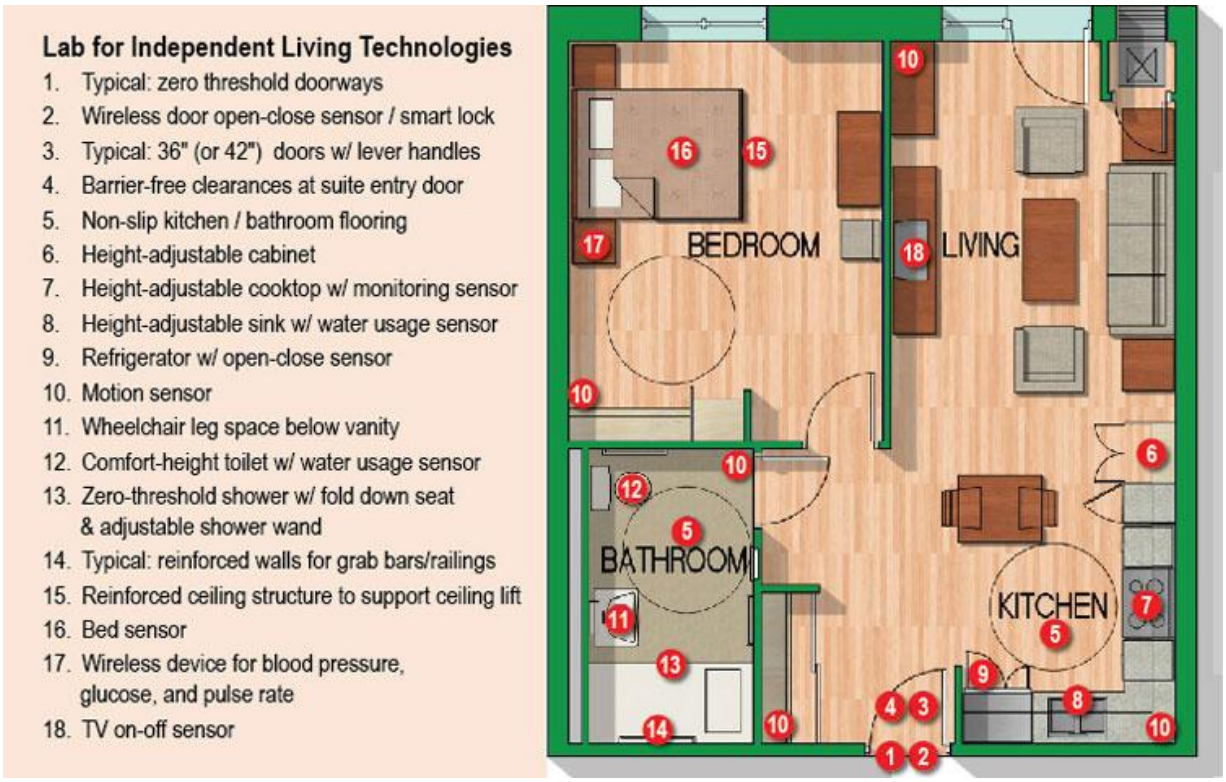

Figure 5: Illustration of the proposed Smart Home Lab[15]

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[15] *Source: National Research Council Canada, Smart home technologies to support independent living, 2011 (see* http://www.nrc-cnrc.gc.ca/eng/ci/v16n4/1.html*)*

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China

1. Demographics

1.1. Disability Statistics

According to the 2nd National Sampling Survey on Disabled Persons, the population of people with disabilities climbed to 82.96 million (6.34% of population) in 2007 from over 51.64 million (4.9% of population) in the 1st Survey in 1987. The disability rate tends to be high among elderly people, because of the high morbidity rate caused by cerebrovascular diseases, arthropathy, dementia and other senile diseases. It is found in the survey that 44.16 million disabled people are over 60 years old, 23.65 million more than the figure in 1987, accounting for 75.5 percent of the newly increased disabled population all over the economy (China Disabled Persons' Federation, 2006).

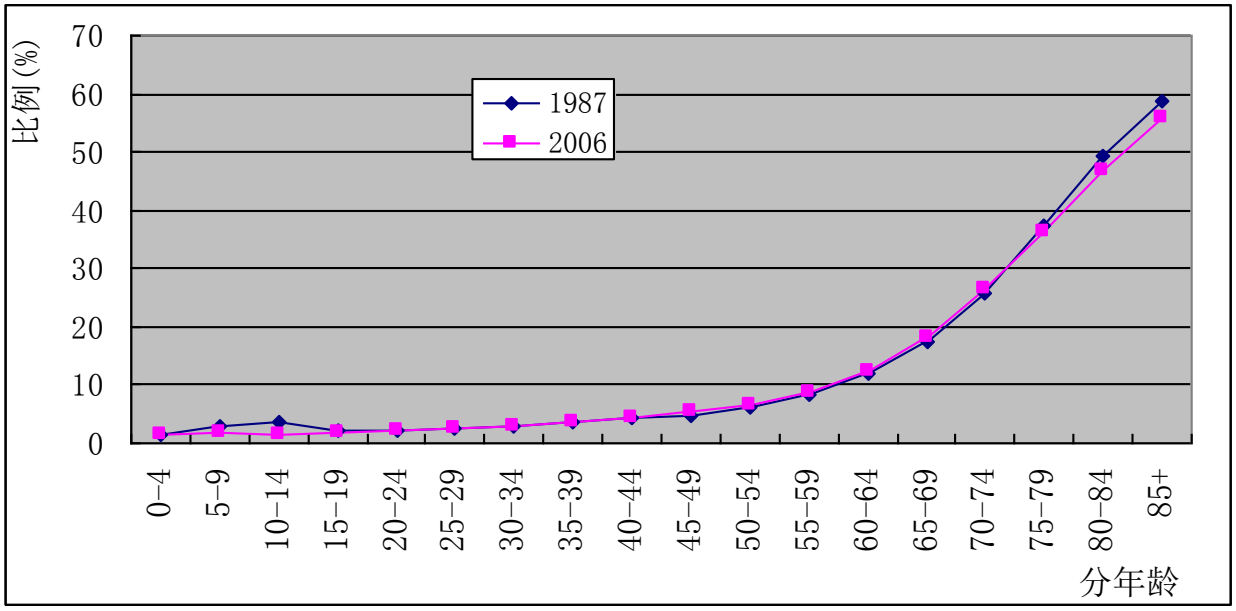

Figure 1: Comparison of the disability proportion[16]

1.2. The ageing of the Chinese population

According to China's census in 2011, people over the age 60 accounted for 13.7 percent (or 185 million) of the total Chinese population, up nearly 3.37 percent since 2000 and will continues to increasing by 2.5 times by 2050 as shown in the figure below.

[16] *Source: Zheng, 2007*

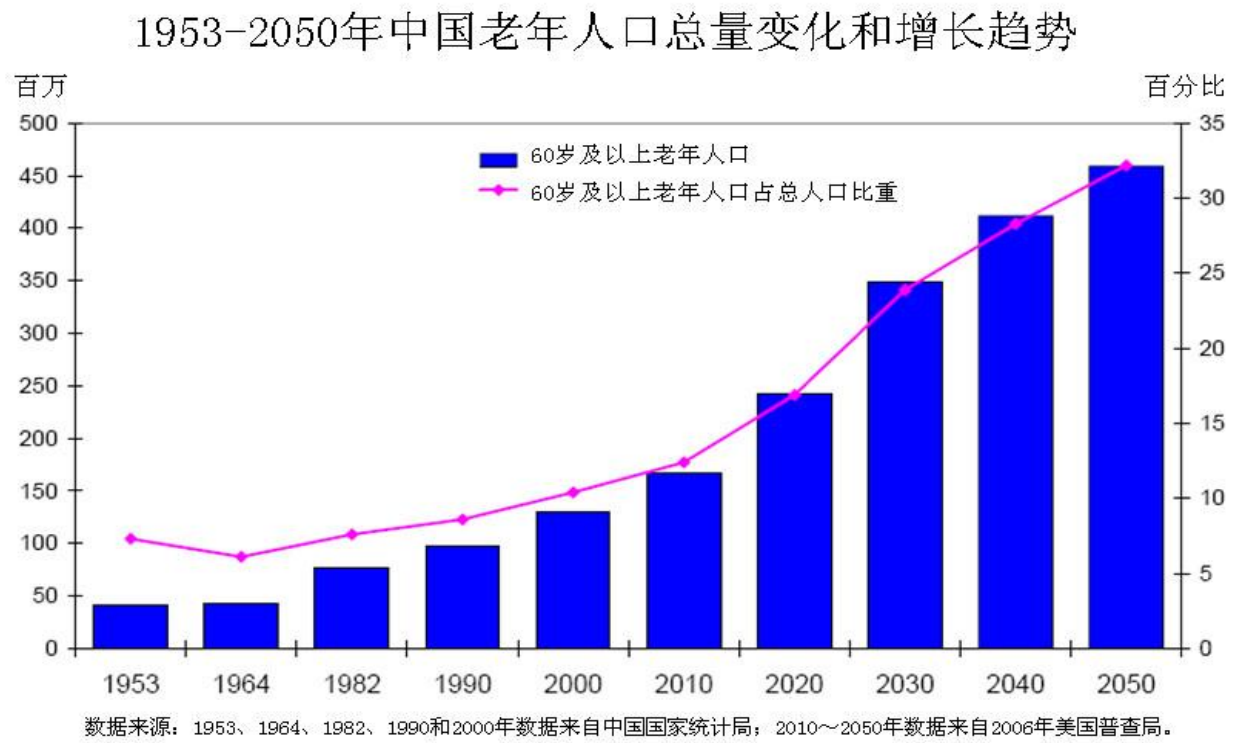

Figure 2: Changes and Increase Trend of Chinese Elderly Population 1953 – 2050[17]

By 2010 the population of partially and completely disabled elderly[18] was about 33 million, accounting for 19.0 percent of the total elderly population in China, and by 2015 the partially and completely disabled elderly population will increase to 40 million, or 19.5 percent of the total elderly population in China. Of which the completely disabled elderly people will reach 12.40 million, standing for 6.05 percent of the total Chinese elderly population (Zhang Kaiti, 2012).

According to the China National Committee on Ageing about 25 percent or 30 million older people need long-term care due to disability and disease. The number of the elderly who need care is increasing significantly in China while China has an underdeveloped aging services system. Therefore, the aging issues are addressed for the first time in the current five-year

[17] *Source: Adopted from Zhang Kaiti, Elderly Services: Supply and Demand, May, 2012, Data for 1953, 1964, 1982, 1990 and 2000 come from National Bureau of Statistics of China; and data for years between 2010 and 2050 come from US Census Bureau 2006.*

[18] Indicator measuring the ability to look after oneself – ADLs consists of eating, dressing, going to the toilet, getting onto and off the bed, bathing, and walking in the room.
If an elderly person selects "I can't" in one of these items, he or she would be defined as "completely disabled".
If an elderly person can do all these items but selects "It's difficult and I need help", he or she would be defined as "partially disabled".

plan.

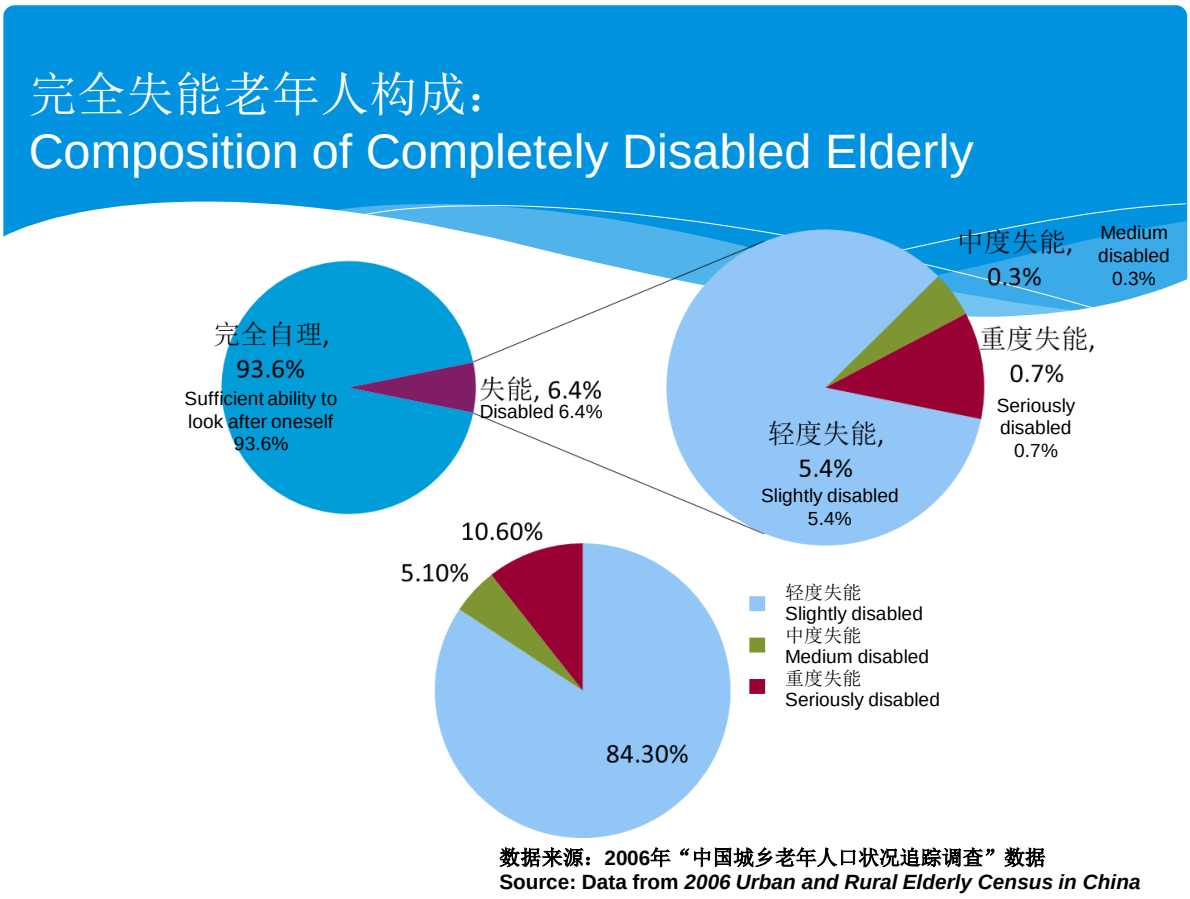

Figure 3: Composition of Completely Disabled Elderly[19]

Similar to some APEC economies, the family unit has traditionally provided eldercare, but in recent times supporting functions of traditional families are weakening. The industrialization and urbanization, migration of workforce, small family size, and in particular, the one child family planning policy brings great challenges to traditional family-based elderly care. In addition, the workforce of caregivers for elderly care is small, and there are few vacancies for the elderly in care institutes. Per 1000 elderly people, there are only about 10 long-term care beds in the care facilities compared to 50-70 beds in other industrialized economies. Community centers for senior citizens are in their inception phase and the current number of 30.000 caregivers has been said to seriously fall short of the estimated 10 million workers needed (Coughlin, 2010).

Some qualitative development needs for caregivers are the formalization of professional

[19] *Source: Adopted from Zhang Kaiti, Elderly Services: Supply and Demand, May, 2012*

programs and certifications, as well as training in new technologies (e.g., HelpAge International, Home Instead, and Golden Living). The awareness of citizens is also quite low with regard to the services available, and thus the construction of national information systems could increase the options that elderly people themselves and their families can choose f*rom*. The ICT applications will not only assist the healthcare organizations but also provide an aging in place for elderly in China as analyzing in following parts (Coughlin, 2010).

2. Policies

2.1. E-Health

In 2005, the Chinese Ministry of Health included e-Health in the national long-term scientific and technological development plans, and is the main objective of the "The Eleventh Five-Year Plan" of China's Health Information. In April 2009, the Chinese government devised a national medical reform plan with emphasis on Regional Collaborative Medical Service (RCMS). The Ministry of Health of China also issued the "Health Profile of Basic Architecture and Data Standards (for trial implementation)". The purpose of the implementation is to make personal health records more uniform and standardized (Yun et al., 2010).

Furthermore, the guide on the construction of medical case history-based regional medical information sharing platform was issued to establish a national unified public medical case history. The guide includes the standardization and security systems that run through the four tiers of the platform, namely hardware infrastructure, data center, data exchange and business service. The guide also encourages the establishment of services such as long distance diagnosis, joint diagnosis by two or more experts, online examination of patients and online communication in rural and remote areas. The Administrative Measures for Internet Medical and Health Information was also issued to stipulate basic principles for medical organizations setting up websites to provide medical healthcare information for online users. The period from now to 2020 will be the key period of development for the e-Health industry in China (UKTI Beijing ICT & Life Sciences Team, 2010)

2.2. Accessibility

China supported the UN Standard Rules on Equalization of Opportunities for Persons with Disabilities and was one of the first economies signing the international convention on the rights of people with disabilities. China also ratified ILO Convention 159 Concerning

Vocational Training and Employment (Disabled Persons).

The Constitution (enacted in 1982 and amended in 1988, 1993, 1999 and 2004) provides a general principle on protection of people with disabilities. In addition, more than 30 national laws, such as the Law on Higher Education, the Law on the Protection on Rights of Elderly People, contain specific provisions concerning people with disabilities and the protection of their rights. Particularly, the Law on Protection of Disabled Persons and Articles 37, 38 and 45 in particular guarantee access to information and communication for people with disabilities. The government has included objectives in the national development program to promote these aspects (Zhang, 2007).

Furthermore, the Government (e.g. the Ministry of Information Industry, the Ministry of Sciences and Technology), corporations (e.g. Microsoft, IBM, Nokia, Motorola, Siemens and SONY), civil society, and disabled peoples' organizations (e.g. the China Disabled Persons' Federation, the China Blind Association) hold workshops (e.g. an Information Accessibility Seminar in October, 2004) to discuss how to create an accessible information environment for people with special needs (Zhang, 2007).

3. ICT services and applications for people with special needs

Due to the advocacy and promotional activities of disabled peoples' organizations, efforts have been made, in recent years, to develop high-tech devices that accommodate the needs of people with disabilities.

3.1. E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

Although China started implementing telemedicine programs later than advanced economies, telemedicine has developed rapidly (Zhao, 2010) and it may be one of the best investments of an aging China. The Ministry of Health has established telehealth regulations in 1999 and since then, many different telehealth programs have been conducted in China. The telehealth programs have been sponsored by different entities including the government, medical universities, hospitals and even some private companies, have employed different telecommunication means such as fixed telephone lines, ISDN and satellite, and have operated at different scales from national to local levels (Chen and Xia, 2009).

For example, the Ministry of Health supported the establishment of the Jin-Wei (Golden Health) Telemedicine Network, which started in July 1997. Remote consultation and

education services were offered via the network for over 1.000 patients, and remote education services were offered for over 50,000 doctors and nurses. Many hospitals from over 20 provinces took part in the network activities, but the high cost of satellite communications restricted the number of hospitals participating. The ISDN technology was adopted to increase the number of participants. Also in 1997, the International Medical Network Association, a non-profit making organization, established the China Medical Foundation (CMF) Telemedicine Network by employing several different methods of telecommunication from telephone lines for basic level hospitals network, then ISDN and the Internet for higher-level hospitals network, and eventually satellite communication for national-level hospitals network. The CMF Telemedicine Network mainly provided telehealth services for basic-level hospitals that was different from the Jin-Wei network. Following these two large telemedicine programmes, several other telehealth programmes were set up in China, such as the Shuang-wei network (Satellite Health Education Network of the Ministry of Health) which provided remote medical education services for doctors and nurses all over the economy (Chen and Xia, 2009).

Besides, many telehealth programs have been initiated in other areas and supported by local government. For instance, the Fujian Province Telemedicine Network was set up in late 2003 and the Gansu Province Telemedicine Network in late 2007 (Chen and Xia, 2009). Recently, more than 100,000 patients across the Shandong Province in China took part in the largest remote health monitoring initiative in the world, a partnership between Canada-based Ideal Life and China's Shandong NovaTech Biological Pharmaceutical. Patients used interactive kiosks and remote health monitoring devices in villages and community hospitals across Shandong to record their health information and have it instantly transmitted to their healthcare provider (E-Health Insider, 2010).

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record (EMR)

While "informatization" was adopted by the Chinese government in the 1990s, the policy started in 1995 with the "Golden Health Project". The objectives of this project were to make it possible to link health administration, hospitals, universities and research institutes. More activity was started in recent years, as evident from the Health Guidelines 2003-2010 which encouraged development of EHR and regional health information networks (Yu, 2008).

In January 2009 China announced a fundamental change to the domestic healthcare sector by a RMB 850 billion ($124 billion) stimulus package over three years of which a key element is to modernize healthcare services with digital hospitalization, electronic medical records, and next-

generation information networks. Healthcare IT spending has grown by about 20% per year since 2004. The government is taking steps to achieve shareable health data throughout the economy. Future spending is forecasted to focus on establishing Regional Healthcare Information Networks (RHIN) – sometimes referred to in China as Regional Collaborative Medical Services (RCMS) (Zita, 2009).

Figure 4: The three demonstration cities, Beijing, Dalian, and Xiamen are leading the Regional Collaborative Medical Service (RCMS) in China[20].

In fact, most healthcare organizations have invested mainly in information systems and hardware rather than software and applications and chiefly for administrative management purposes. Only a few of the largest, wealthiest and sophisticated hospitals could integrate their information systems in clinical diagnosis, decision support, and electronic patient records. One of obstacles which prevent China from widespread adoption of healthcare information technology is standardization for the EMR and EHR/RHIN. Hence the MoH created the Electronic Records Standards Technical Steering Committee in 2006 and in April 2009 published a 170-page "EHR Guidebook" (Zita, 2009).

At the city level, Xiamen is an example of successful EHR implementation. Citizens could make appointments with doctors by using their social security card, and check their health data on the Internet with various devices such as TV and cell phones. The benefits of medical records can also ultimately result in possibilities to screen high-risk groups to identify

[20] *Source: adopted from Zhao, 2010*

patients needing preventive treatment. This screening would be made more useful when the health information of citizens is recorded since birth in a central data repository. The Minhang District in Shanghai is also working on a similar system and is receiving increasing investments. (People's daily Online, 2010).

3.2. Robotics

In the future, China will face the same demographic problem as other industrialized economies. The numbers of elderly people continue to increase, while the number of young people to support them is decreasing – in particular because of the "one-child policy". Robotic agents may offer help to these problems. However, robot research in China has not a long history. The main applications so far have been in cleaning and manufacturing, although there have been applications in e.g. surgical procedures. Robots for elderly care are currently in development. These include, for example, robots that do housework and help the elderly and disabled at home. The latter can monitor the person, provide counseling and fetch items for the person. An example is UNISROBO, a new robot by the Chinese company UNIS, loosely based on the Japanese PaPeRo robot developed by NEC.

Figure 5: UNISROBO and PaPeRo[21]

The Robotics and Automation Laboratory, Tsinghua University, is one of the earliest founded laboratories that focus on robotics theory and technology in China. Under China's 11th Five-Year Plan, Tsinghua's robotics program is moving toward solutions for the aging Chinese population. Its discoveries will possibly be productized into items like robotic wheelchairs

[21] *Source:* http://www.plasticpals.com/?attachment_id=28603 and http://www.nec.co.jp/products/robot/en/index.html

and hospital beds (Southern Innovation).

The robots for use in nursing homes have been tested at Evergreen, a state-owned old people's home in north Beijing. The solutions tested by the Beijing Aeronautics and Astronautics University include a bed that turns into a wheelchair, and a robot "dog", which can chat with older people, play music and opera, and dance for them (Branigan, 2012).

3.3. Other applications

Various news reports have revealed that ICTs are used by China's disabled persons to do a lot of things such as creating job opportunities and supporting one another. There are also websites and online groups especially serving disabled persons (Jin, 2010). For instant, Chinese Deaf Online has become popular among deaf youth. Furthermore, user-friendly pagers, mobiles phones and internet-based communication technologies and services have been developed for people who are blind or deaf (Zhang, 2007). For example, IBM has worked with South China University of Technology to develop an accessibility technology to make it easier for elderly and disabled people to surf the Internet.

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Indonesia

1. Demographics

1.1. Disability Statistics

According to National Economic Census on 2006, the population of persons with disabilities in Indonesia is 3,063,559 persons or 1.38% of national population[22]. However, the number of disabled people nationwide, according to Social Affairs Ministry records, was around 1.5 million in 2008 and 2009 increased to 2.1 million in 2010 (Figure 1). The highest prevalence of persons with disabilities is those of 31- 59 years of age and more than 50 per cent of persons with disabilities are above 50 (Markus, 2002)

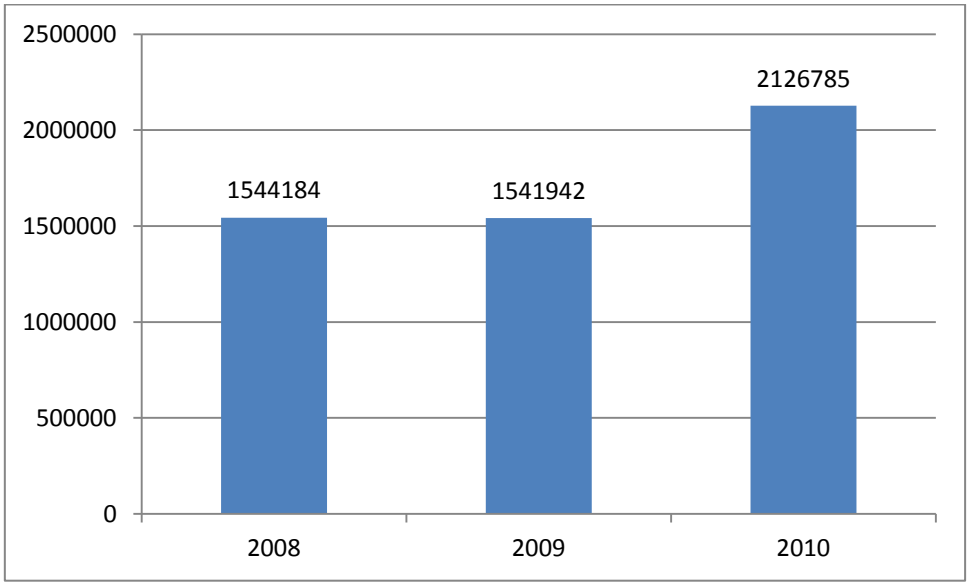

Figure 1: Total people with disabilities[23]

1.2. The Aging of Indonesia population

Indonesia is the world's 4th most populated nation, accounting for 3.51 percent of the world´s total population. The total population in Indonesia increased 160 percent during the last 50 years from 93.1 million in 1960 to 242.3 million people in 2011. It is predicted to reach the

[22] *Source: Government achievement and challenges regarding the enhancement of ICT accessibility for PWD's Indonesia last accessed 20 November 2012 at* http://unpan1.un.org/intradoc/groups/public/documents/ungc/unpan040430.pdf

[23] *Source: the author composed based on the data from Ministry of Social Affair of Republic of Indonesia, 2008, 2009 and 2010*
http://database.depsos.go.id/modules.php?name=Pmks2008&opsi=pmks2008-1
http://database.depsos.go.id/modules.php?name=Pmks2009&opsi=pmks2009-5
http://database.depsos.go.id/modules.php?name=Siks

peak of around 300 million in 2050 (Figure 2).

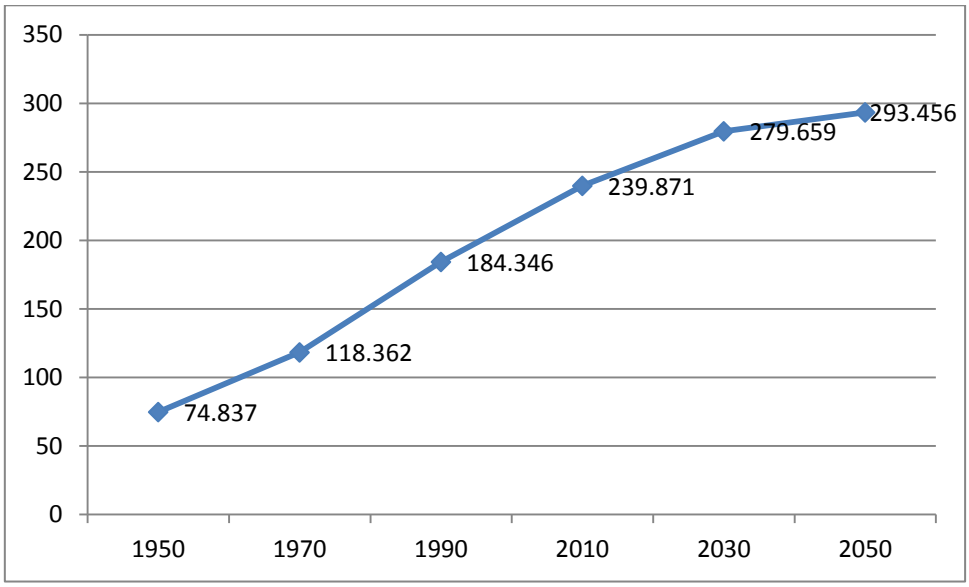

Figure 2: The Population of Indonesia (unit: millions)[24]

Although the aging population in Indonesia is relatively small, its absolute number is significant, for example 11.5 million in 2007. In the future, because of its big population the absolute number of the aging population in Indonesia will be close to the absolute number of the aging population in some advanced economies such as Japan. The situation is starting to resemble that of the developed world, such as demographic conditions and aging of the population. However, the elderly people in Indonesia are divided by significant geographical differences in education. Those living in the countryside are poorly educated in comparison with their urban-dwelling compatriots. Most elderly people were working in farming and industry as self-employed or in unpaid jobs.

[24] *Source: The author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

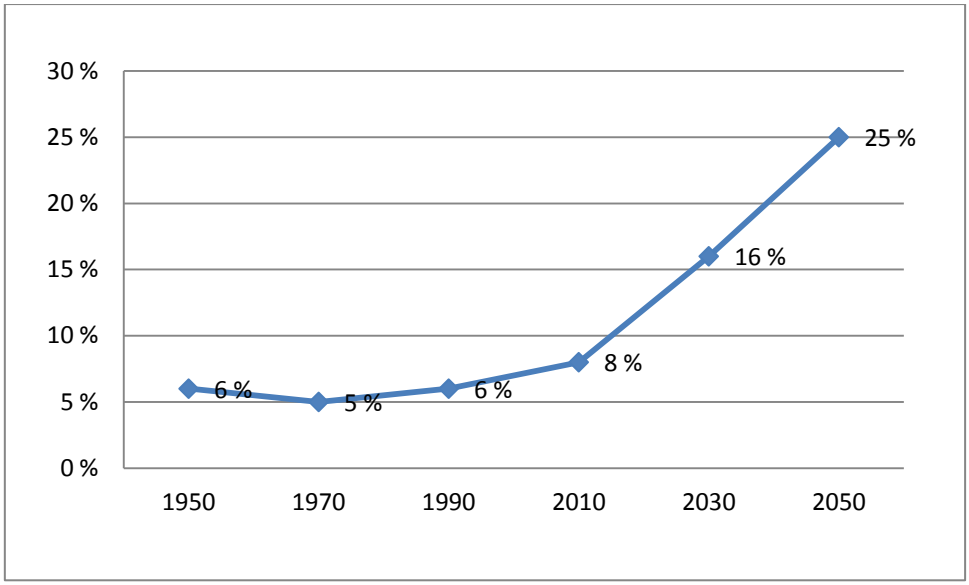

Figure 3: The Indonesia Population aged 60+[25].

2. Policies

2.1. E-Health

Varghese and Scott (2004) analyzed the telehealth environment in Indonesia and concluded that Indonesia's telehealth policies are integrated into other development objectives. In other words, Indonesia aims for telehealth to support its objectives to emerge as a developed economy. In addition, Indonesia published a roadmap to strengthen the health information system in Indonesia from 2011 to 2014 (Figure 4). The strategic goal is for all Provinces and 60% Districts/Cities to have implemented integrated Health Information System by 2014. Besides, strategic policies for health information and e-Health are in place in 2014. The implementation is coordinated by Director of Center for Health Data and Information in Indonesia Ministry of Health (Figure 5).

[25] *Source: The author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

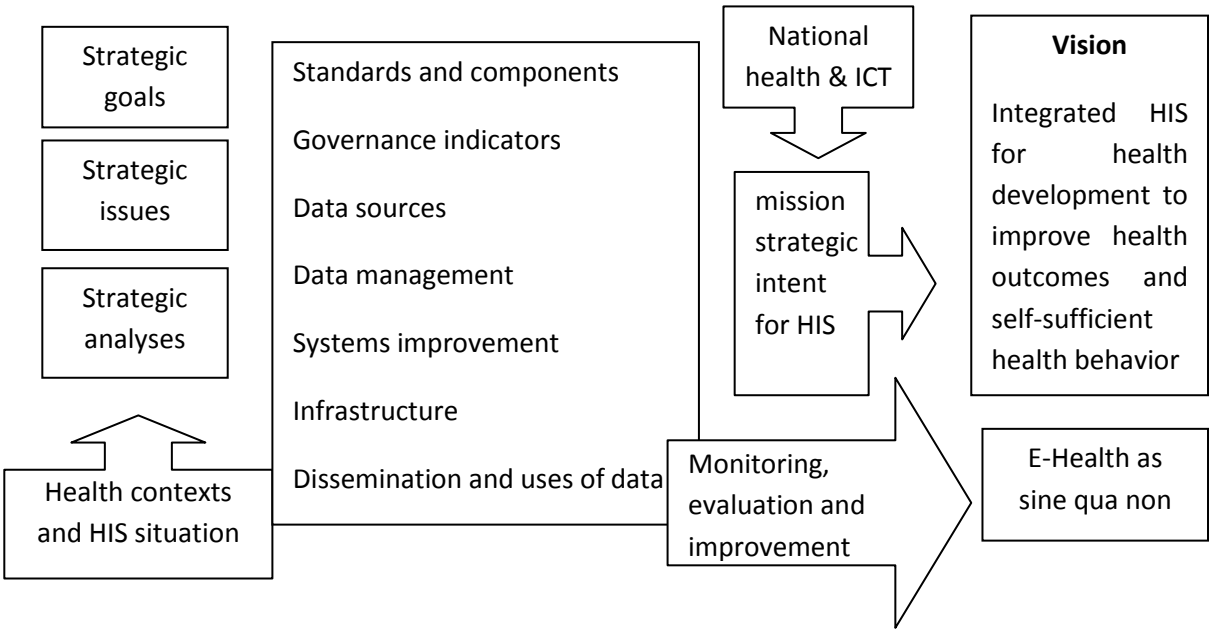

Figure 4: Roadmap to strengthen the health information system in Indonesia 2011-2014[26]

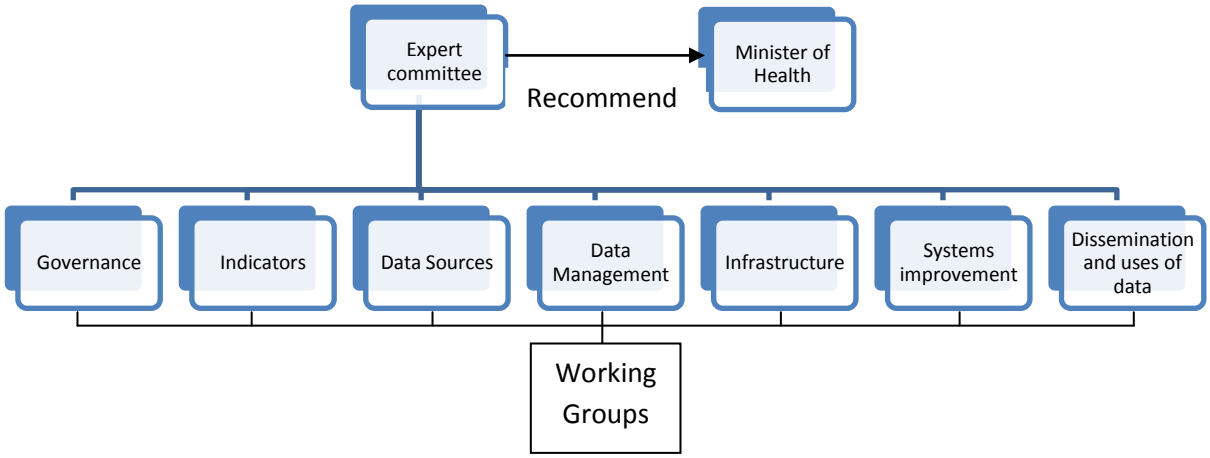

Figure 5: The implementing organization[27]

2.2. Accessibility

The Indonesian Government issues different regulations concerning the disabilities[28], such as Law of Republic of Indonesia No. 4/1997 which is considered as the main legal instrument for the social welfare of persons with disabilities and Government Regulation No 43/1998 concerning Effort of Social Welfare Enhancement of Disabled People. Laws from 1997 establish equal rights and opportunities for disabled people in every aspect, and outline that

[26] *Source: Kusnanto, 2012*
[27] *Source: Kusnanto, 2012*
[28] *Source: Government achievement and challenges regarding the enhancement of ICT accessibility for PWD's Indonesia last accessed 20 November 2012 at* http://unpan1.un.org/intradoc/groups/public/documents/ungc/unpan040430.pdf

the government must guarantee these rights and opportunities for disabled people. This responsibility lies with every government agency and institution. In addition, to realize participation in global society, Indonesia's government formulated the Indonesia National Plan of Action (INPOA) of Disabled People 2004-2013 which has a forward action of Biwako Millennium Framework (BMF), and signed the International Convention on Rights of Persons with Disabilities on May, 30th, 2007.

Regarding accessibility of ICT for people with special needs, government issued policies which improve the facilities and infrastructure of ICT accessibilities and enhance coordination, cooperation, as well as extended the network among sectors to provide better ICT services for people with special needs. In order to realize these policies some main strategies are implemented by government and other stakeholders. For example, regular meetings are held for different stakeholders to participate and create similar perception about ICT accessibility programs. In addition, working groups within National Coordinating members are established to formulate the national program of ICT accessibility. The ICT training programs are also provided for people with special needs. Furthermore, information is disseminated to increase awareness of communities on the ICT accessibility right of people with special needs.

Mitra Netra Foundation, a Social organization has program stress on the development of ICT for Persons with Visual Disability, has conducted several efforts such as developing resources such as Mitra Netra Electronic Dictionary (Meldict), that enables persons with visual disabilities to access is by speaking; Talking books; Digital Accessible Information System (DAISY). They have also cooperated with colleges and universities to establish ICT Service Centers for Persons with visual disabilities with purpose to help students with visual disabilities by providing technology assistive devices. Cooperating with Ministry of National Education in providing computer catalog help library consumer to read books through computer software and scanner

3. ICT services and application for people with special needs

3.1. E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

INTELSAT sponsored the Satellite for Health and Rural Education (SHARE) project as part of the first computer and satellite based telemedicine experiment in Indonesia in 1985-1987 in. Following that, PARTNERS (Pan Asia-Pacific Region Telecommunication Network for

Experiments and Research by Satellite), a regional cooperation which was sponsored by the Ministry of Posts and Telecommunications (MPT) of Japan, conducted experiments on ETS-V L-Band transmission and its application for slow scan video lectures among PARTNERS members including Indonesia from 1992 to1997. Another telemedicine experiment implemented by PARTNERS was the wireless based telemedicine system (Figure 6) connecting two schools of medicine in Bandung, Hasan Sadikin Hospital (RSHS) and UNJANI, with Ohkura National Hospital in Hibiya, Tokyo through satellite link and ISDN (Suksmono et al., 2004).

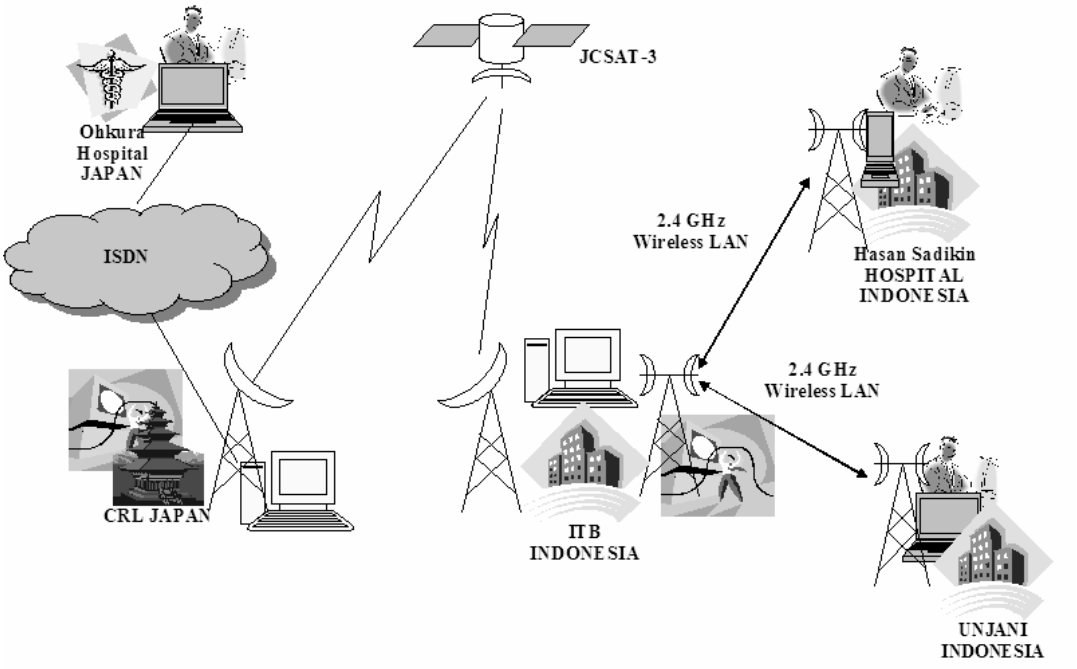

Figure 6: Early 2.4 GHz Wireless LAN-based Telemedicine connecting ITB, UNJANI, Hasan Sadikin Hospital (Indonesia) and CRL, Ohkura Hospital (Tokyo)[29].

Another telemedicine initiative is the development of an internet-based telemedicine system for Primary Community Health Center (Puskesmas) which consisted of six medical stations in community health centres, and a station for the referral hospital, health office and a test laboratory. Supported by a grant from the Pan Asia Networking (PAN) Department of Electrical Engineering, Institute Teknologi Bandung (ITB) developed internet-based telemedicine applications (Figure 7) included tele-consultation, simple tele-diagnosis, medical information display software, a blood pressure and fetal heart rate interface (Elder and Clarke, 2009).

[29] *Source: Suksmono et al., 2004*

Furthermore, since 2005 special efforts have been dedicated to the development of "mobile telemedicine system with multi communication links". Different types of medical information (e.g. ECG signals, blood pressure, temperature, SpO2) can be measured and transferred from the mobile (movable) unit (installed in an ambulance or in a movable vehicle) to the base unit (installed in a hospital or healthcare unit) (Soegijoko, 2009).

Figure 7: Indonesian mobile telemedicine application[30]

In addition, Indonesians are more familiar with using SMS to communicate than the Internet because it is also less costly than Internet use and less training is needed for SMS use compared to Internet use (Maharani et al., 2012). Therefore, some m-Health application have been developed and/or under development. For example, SMS Info Obat Murah (Figure 8) originated from the Drugs Information Assistant Database built by Lembaga Anti-Fraud Asuransi Indonesia (LAFAI), an independent institution working on anti-fraud within the insurance industry. SMS Info Obat Murah provides information on affordable pharmaceutical drug options to anyone who subscribes to the service.

[30] *Source: Elder and Clarke, 2009*

Figure 8: *SMS Info Obat Murah* Mechanism[31]

The advantage of the application is that Indonesians, particularly uneducated patients, have a channel to access drug information which can give them more options regardless of their purchasing power. If the doctor describes patented drugs, which are more expensive, the patient can ask pharmacists for the equivalent generic option based on the information they receive from the service of SMS Info Obat Murah (Maharani et al., 2012). Other examples of applying mobile in healthcare services are Healthcare Promotion using SMS (Short Messaging Service) and SMS-based Reminder e-Health System for Tuberculosis Management.

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record (EMR)

By 2007, more than 100 out of approximately 1,600 hospitals in Indonesia had adopted Health Information System (HIS). However, most systems, even the Electronic Medical Record (EMR) and Computerized Physicians Order Entry (CPOE) programs, mainly aimed at cost-savings strategies. The situation has been changed recently when Clinical Information System (CIS) is designed to also reduce diagnostic errors. For example, one version of CIS includes a physical medical encyclopedia which records medicine and diseases knowledge. In addition, the government has shown support by creating new regulations related to health informatics and this will promote confidence in the adoption process (Maharani et al., 2011).

Specific ICT-based e-health systems for outbreak management which aims to provide

[31] *Source: Maharani et al., 2012*

supports for both reporting stations (CHCs, *puskesmas*) and monitoring station (Health Office, *Dinas Kesehatan Kota*) have also been developed since 2005. In addition, the "e-health system with paperless prescription function/capability" has been designed to be used in a community health centre (CHC). It has the following main functions: patient record, e-prescriptions with drug test alert, and sending the appropriate reports to the District Health Office (Soegijoko, 2009).

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Japan

1. Demographics

1.1.Disability Statistics

The number of disabled people in Japan is reported by the government to be 2.9 percent (3.66 million), of which more than 70 percent are over 60 years of age. However, Obi et al. (2012) argues that the numbers of disabled would be even greater because the criteria used by the Japanese government causes an underestimation of the number of mentally disabled.

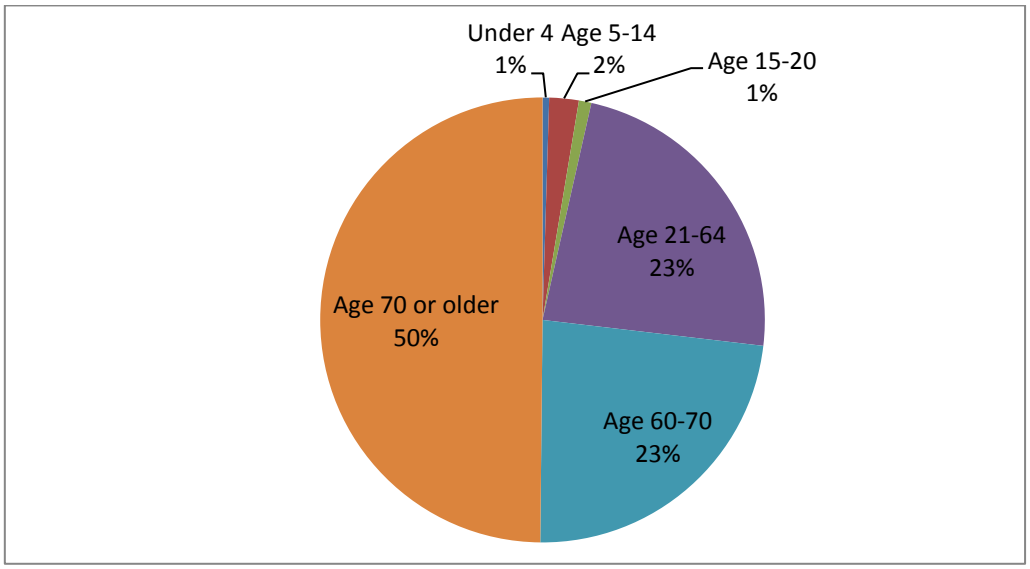

Figure 1: Disability prevalence by age – as of 1st July 2006[32]

1.2.The aging of Japanese population

Recently the number of people aged from 65 to 74 was over 15 million in addition to 13.7 million over the age of 75. The percent of people aged 65 and over increased from 4.9 % of population in 1959 to 23.1% in 2010 and projected to reach almost 40% of total population in 2050 as shown in the diagram below.

[32] *Source: The author compiled from Table 3-28 Estimated number of disabled persons (aged 18 or older) throughout Japan by type of disability, age group/sex/degree of disability/cause of disability, and Table 3-29 Estimated number of disabled children (aged less than 18) throughout Japan by type of disability, age group/degree of disability/cause of disability of "Statistical Handbook of Health and Welfare Statistics 2011" by Ministry of Health, Labor and Welfare, Japan*

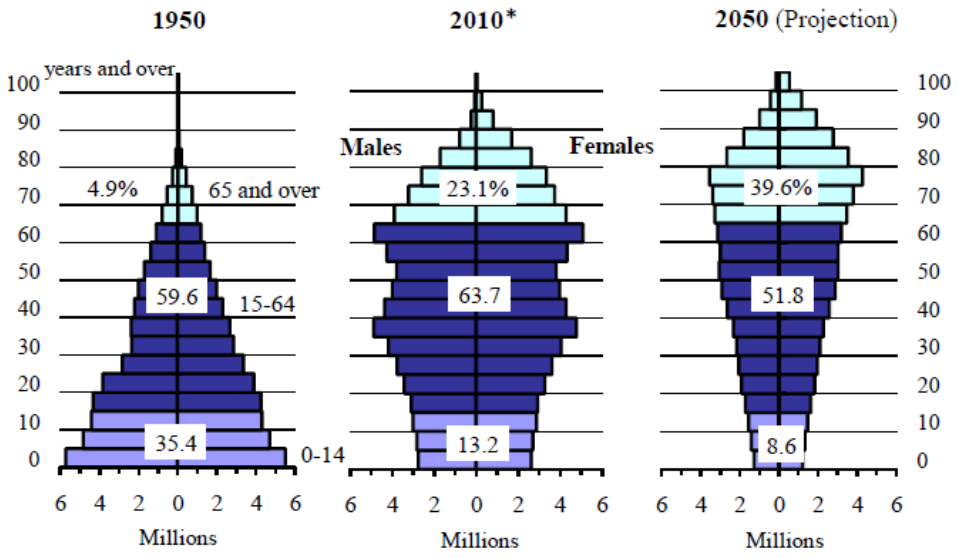

Figure 2: Changes in the Population Pyramid[33]

2. Policies

Both state and local governments in Japan are making efforts to increase ICT innovation for the older and disabled people to be capable of living independently.

2.1.E-Health

Policies on e-Health were implemented beginning from 1993 by the creation of the Health Care Information Systems Advisory Committee and the Health Care Information System Strategy. In 2001, digitization of healthcare sector was decided in the e-Japan Priority Policy Program and followed by a grand design which provided practical strategies and an action plan for the public and private sectors. In 2006 the New IT Reform Strategy provided further policy measures and initiatives with attention to the online processing of all medical insurance claims and self healthcare management. In 2007, the Ministry of Health and Welfare (present Ministry of Health, Labour and Welfare, MHLW) issued other grand design, the Informatisation of Healthcare, Nursing Care and Welfare Domains on standardization of clinical nomenclature, formats for clinical documents, interoperability between medical systems, and creation of a secure network for medical data (Kimura, 2006; Obi et al., 2012). MHLW also issued a grand design to conduct medical facilities surveys. In 2009, the government introduced the i-Japan Strategy for 2015 whose one priority was healthcare.

[33] *Source: Adopted from Statistics Bureau, MIC; Ministry of Health, Labour and Welfare.*

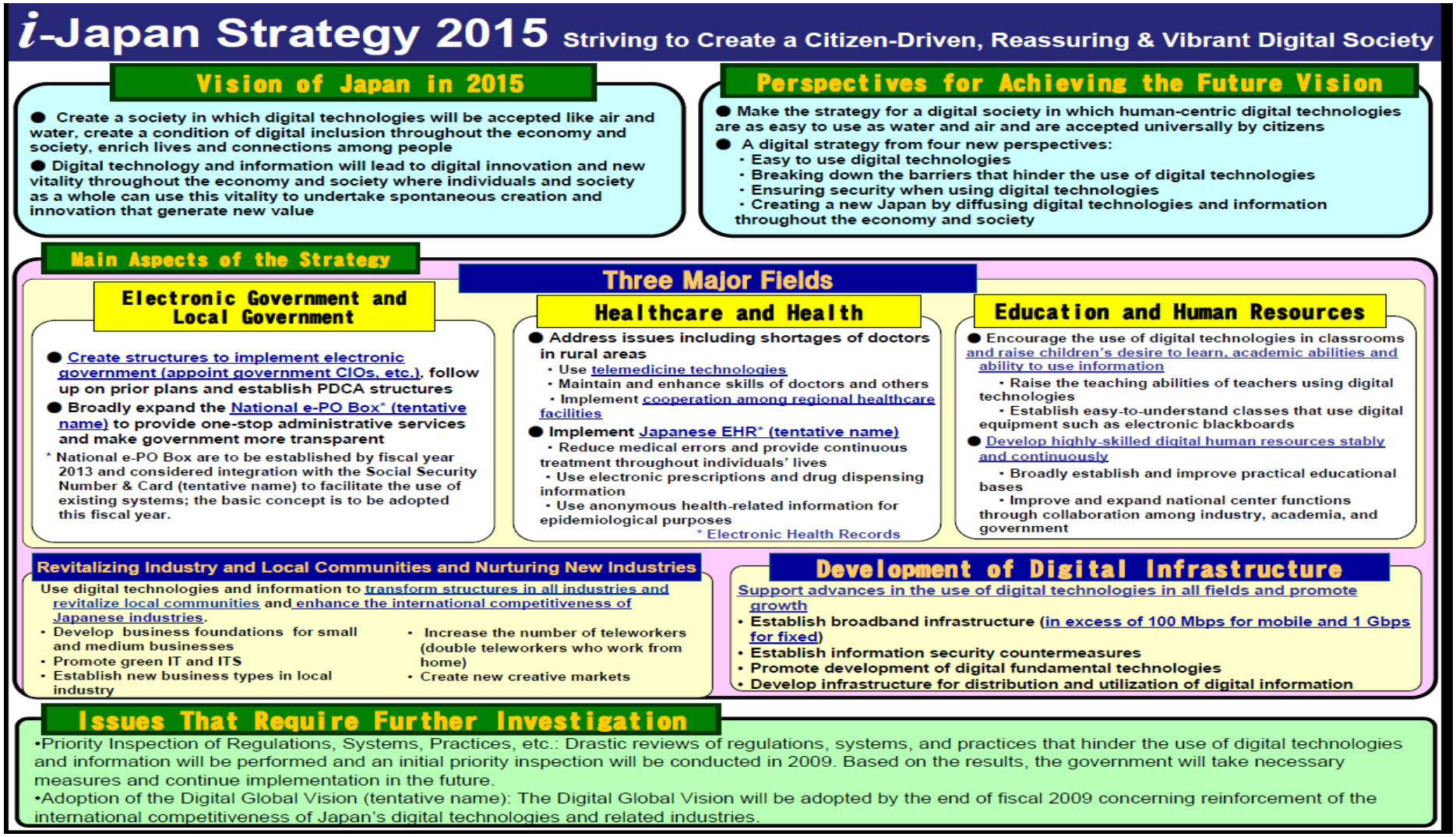

Figure 3: i-Japan Strategy 2015[34]

[34] *Source:* http://www.kantei.go.jp/foreign/policy/it/i-JapanStrategy2015_summary.pdf

2.2.Accessibility

Inclusion of elderly and disabled people is one crucial policy issue in the Japanese government, and is being addressed by both specific and generic legislation such as the Basic Law on the Formation of an Advanced Information and Telecommunications Network Society, enacted in 2000, and the Persons with Disabilities Fundamental Law, amended in 2004. In addition, the e-Japan Priority Policy Program promotes the establishment of a universal concept for an accessible environment for ICT. Each government agency should ensure the accessibility of their electronic government services. The Ministry of Internal Affairs and Communications (MIC) will provide support to these agencies to make them capable of reaching this goal (Obi et al., 2012).

Prompted by the Basic Program for Persons with Disabilities, the Japanese Standards Agency issued a series of guidelines that help manufacturers develop accessible ICT for elderly and disabled persons. The main topic of specific policy areas has been web accessibility. This has been advanced by the Web Accessibility Infrastructure Committee (WAIC), which provides guidelines and information to promote accessibility of web content. The committee has founded a Consortium to further promote the dissemination of these accessibility guidelines and information (Obi et al., 2012).

The universal design model of ICT for elderly people includes the creation of guidelines for standardization of methods of operation for devices and terminals, and the promotion of user-friendly websites and set up special study groups (such as the Strategic Council on Bridging the Digital Divide, the Study Group on Broadcasting for People with Visual and Hearing Disabilities in the Age of Digital Broadcasting, etc.). The other long-term policy road map is "Innovation 25" launched in 2006, which calls for greater working opportunities for elderly; and progress in healthcare to enable children, the elderly, and the handicapped to live safe, secure and comfortable lives (Obi et al., 2012).

3. ICT services and applications for people with special needs

3.1.E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

Telemedicine is at the forefront of Japanese ICT-enabled health provisions and is a prioritized direction of health-care service delivery for seniors. While the first telemedicine application was conducted in 1971 by the Medical Association of Wakayama, telemedicine services are becoming increasingly popular not only among domestic customers but also

international customers. With over 1.000 telemedicine projects implemented such as in Asahikawa Medical University Hospital in Hokkaido, Chiba Prefecture Togane Hospital and the Kagawa Medical Association, services are primarily divided into teleradiology (37 percent), telepathology and home telecare (33 percent). In Tsuruga City, which is located 170 km away from Osaka and has 30.35% of 68.9 thousand population are aged 60 and above, the elderly people who do not require direct care can connect their homes to a professional caregiver or rehabilitation centre to have preventive healthcare support such as instruction on exercises to maintain sense of balance and avoid injurious slips and falls (Park, 2011; Obi et al., 2012).

Regarding m-Health, Raku-Raku phones are one innovation in communication for elderly and disabled people. These phones were introduced in 1999 by NTT DOCOMO and one of the latest models of Raku-Raku phones provides the preventive healthcare services such as a built-in pedometer, heart rate meter, and the data analysis to give and health advice to the user (NTT DOCOMO Newsletter, 2008). NTT has also developed location-based services to assist elderly people and their families keep track of their whereabouts. KDDI is also operating its Helpnet, an emergency service that signals the location of the caller and can facilitate caregivers and family members locate the recipient in an emergency. There are also attempts to provide communication services that are not reliant on the cellular network. The Hometown Cell Phone Project in Koto town tests a service where elderly people can connect to a center on a 24/7-basis through a special device installed in the home of the elderly person. When activated, emergency services can be dispatched to check the health of the elderly person (Obi et al., 2012).

In Japan, many telemedicine projects receive support from the government but are run by local governments, medical institutions, private companies and universities. The service fees for communication services are typically subsidized by local governments. This is however dependent on the decisions of each municipality. For example, Iga City in Mie prefecture subsidizes the contract deposit and set-up fee. The Isahaya City in Nagasaki prefecture subsidizes the terminal equipment, and Shinjuku city in Tokyo metropolis subsidizes the usage fees of terminal equipment (Park, 2011; Obi et al., 2012). The government is also consulting these other groups to help avoid problematic legislation in telematics.

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record

In Japan Electronic Medical Record was authorized as a formal document in 1999. In

September 2001, the Ministry of Health, Labor and Welfare (MHLW) issued a 'grand design' for promotion of IT in the healthcare sector which set targets to achieve by 2006 including use of an EMR system in at least 60 percent of hospitals with more than 400 beds and 60 percent of clinics, and use of e-Claim systems by 70 percent of hospitals. To reach these targets the government implemented the Program for the Development of Facilities through the introduction of EMR. In 2002 and 2003, MHLW and the Ministry of Economy, Trade and Industry (METI) distributed around 45 billion Japanese yen to assist hospitals with the introduction of EMR. Almost all recipients of these subsidies were large hospitals. In 2004, these subsidies were discontinued.

In 2002 only 1.2 percent of hospitals had introduced an EMR system but in 2004 increased to 12 percent of the hospital with more than 400 beds and 3 percent of clinic; in 2009 about 25 percent of large hospitals had an EMR system and more than 80 percent of large hospitals had a computerized physician order entry (CPOE) system. Most of large hospitals (e.g. public or university hospitals) which were not burdened by cost-effectiveness implementation received government subsidies for the introduction of EMR whereas the smaller hospitals which account for 90 percent of Japan's hospitals, or 9.000 hospitals with 1.800.000 beds were excluded from the grand design (Kimura, 2006; Obi et al., 2012; Nishihara, 2012).

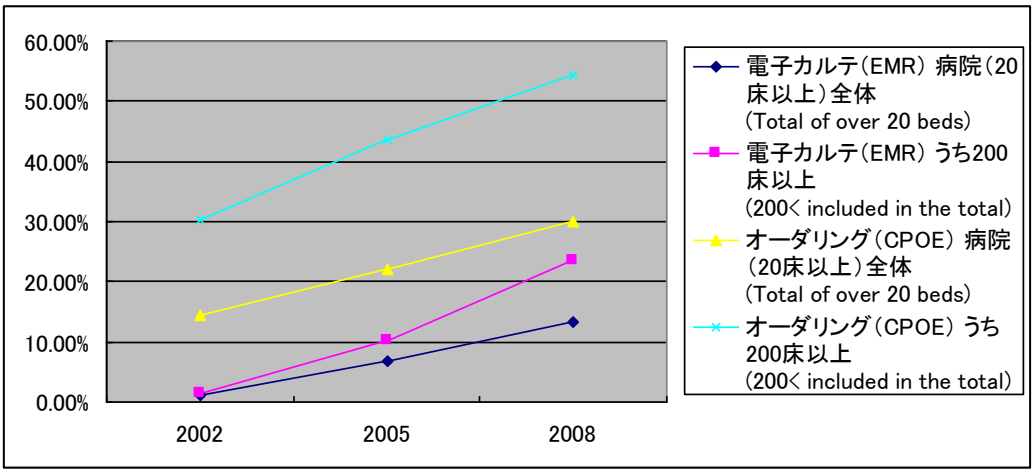

Figure 4: Penetration rate of the EMR and CPOE in the hospital[35]

3.2. Smart Homes

In Japan, several projects aim to maximize the use of assistive technology, enabling the elderly to live autonomously at home by creating a smart and comfortable environment. For example, since 1995, the Japanese Ministry of International Trade and Industry

[35] *Source: Adopted from Nishihara, 2012*

has constructed 'Welfare Techno-Houses' (WTH) (Figure 5) which collects data on residents' activity and vital signs by equipping the rooms with IR sensors, the doors with magnetic switches, and the bathroom with fully automated biomedical devices (Chan et al., 2009, Yamazaki, 2007). A smart house developed by Matsuoka in Osaka has 167 installed sensors that can detect unusual events that may be connected to an accident or disease of the occupant. Every sensor is connected with a certain household activity and some are installed in electrical appliances such as the rice cooker, air conditioner, refrigerator and the TV set.

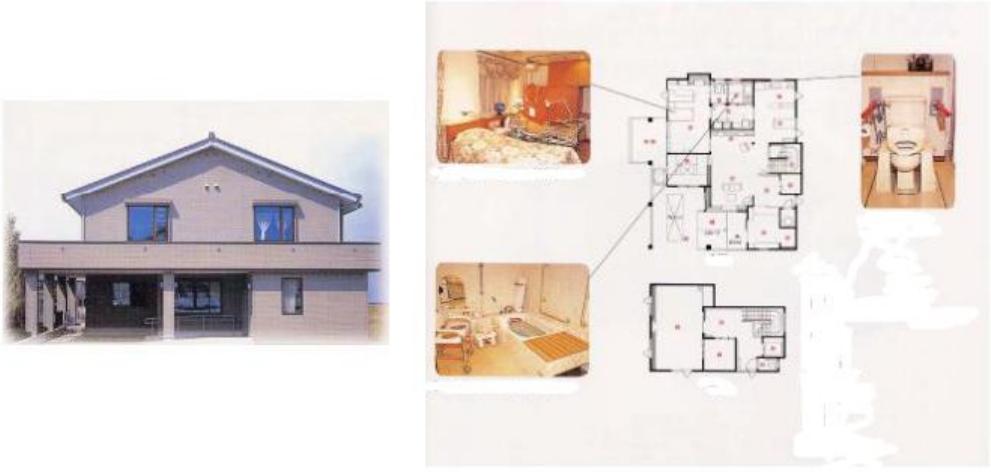

Figure 5: Overview of Takaoka Welfare Techno House[36]

Another project is the "Ubiquitous Home" of the National Institute of Information and Communications Technology. The facility is a test bed for various applications using smart home technologies. The house has an installed base of cameras and microphones to fully observe the occupants, and pressure sensors to detect their movements inside the house. In addition, RFID sensors are used to identify the occupants. The aim of the Ubiquitous Home is to help the residents to take advantage of user-adaptation technologies (Chan et al., 2009). Recently, Japanese electronics manufacturer Panasonic has launched an app for cloud-based services that will let consumers control home appliances using their Android smart phones (Adhikari, 2012).

3.3.Robotics

Robotics is another domain where Japan has progressed further than any other economy. There is the intensity of technology development and marketing in the activities of different

[36] *Source: Tamura et al., 2007*

organizations and associations (Long, 2012). In the Ubiquitous Home above, a robot plays a role of interface for the residents (Yamazaki, 2007). A visible robot serves as an intermediary between the residents and the unconscious robot (i.e., the house). It may help with activities such as getting out of bed (Chan et al., 2009)

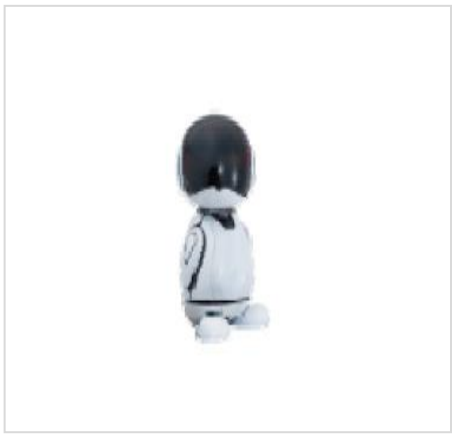

Figure 6: The robot in the Ubiquitous Home[37]

Technologies have also been developed to integrate various disability aids. For example, the Intelligent Systems Research Institute of the National Institute of Advanced Industrial Science and Technology (AIST) uses "Robot Technology Middleware" to connect various input and output devices through a common network platform. The benefits include joint information sharing a signaling between the devices and easy connection and disconnection of the devices. It also includes a common interface of operation for gestures and speech recognition, both of which are customized to accommodate people with difficulties in communication.

Figure 7: Coordinated operation among a life-supporting robot system (RT space), a refrigerator and a mobile robot[38]

[37] *Source: Yamazaki, 2007*
[38] *Source:* http://www.aist.go.jp/aist_e/latest_research/2005/20050311/20050311.html

Tokyo University has been developing robots to act as memory aides for people suffering from dementia. For example, a robot has been designed to monitor the user and warn the user if he or she repeats an action. Another robot is monitoring the room, remembers the position of objects, advises the user where each item is located, and takes the user to the location of the item when necessary. Twendy-One (Figure 8) from Waseda University is a sophisticated human-symbiotic-robot which has the functions of human friendly communication, human safety assistance and dexterous manipulation to provide hands-on elder care.

Figure 8: Twendy-One[39]

Recent research has shown that robotic agents can be used as substitutes for animals in the treatment of Alzheimer's disease patients. These robots would be designed to look like animals and they would function by stimulating cognitive and emotional interactivity on the part of the patients. One research facility where this type of research is carried out is the National Institute of Advanced Industrial Science and Technology. For example, the PARO-robot is one widely used application of robot therapy technology for elderly and disabled people (Figure 9). It became commercially available in Japan in 2005 and in Europe and the USA in 2009. The robot is currently in use in thirty economies, and has been extensively used in disaster areas in Japan as well (Šabanović et al., 2011).

[39] *Source: http://www.twendyone.com/concept_e.html*

Figure 9: A **seal-like robot PARO**[40]

Another application of robots in elderly care is the walking assistance robots. They can support the physical capabilities of the disabled user in allowing normal gait. For example, the HAL (Hybrid Assistive Limb) robot suit (Figure 10) can receive signals going from the brain to the muscles and help the muscles execute the desired action by producing a concurrent effort from the robot suit. About 130 healthcare institutions in Japan are using the suit, and it is only available on a rental or lease contract. Similar robot suits are being developed by various research centres (Obi et al., 2012).

Figure 10: Various applications of the Robot Suit HAL[41]

Transportation means have also been developed for people who have trouble walking for long distances. Automobile makers have pioneered these innovations, one of which is the U3-X by Honda. It allows movement to various directions by the user leaning in the desired direction. Toyota has also developed its own model which similarly is guided by the body weight of the user.

[40] *Source:* http://www.inhabitots.com/paro-therapeutic-baby-seal-robot/ *and* http://news.cnet.com/8301-17938_105-20081012-1/robot-seal-paro-comforts-japan-tsunami-victims/
[41] *Source: Adopted from Obi et al., 2012*

Figure 11: U3-X by Honda and Winglet by Toyota[42]

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[42] *Source:* http://www.honda.co.jp/robotics/u3x/ *and* http://www.toyota.co.jp/jpn/tech/partner_robot/

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Korea

1. Demographic

1.1. Disability statistics

According to the sample survey conducted by the Korea Institute for Health and Social Affairs (KIHASA) in 2000, the total number of persons with disabilities in Korea was estimated at 1.5 million with an appearance rate of 3.09 percent of population. As shown in Figure 1, older people over 60 accounted for more than 60 percent of people with disability in both 1995 and 2000.

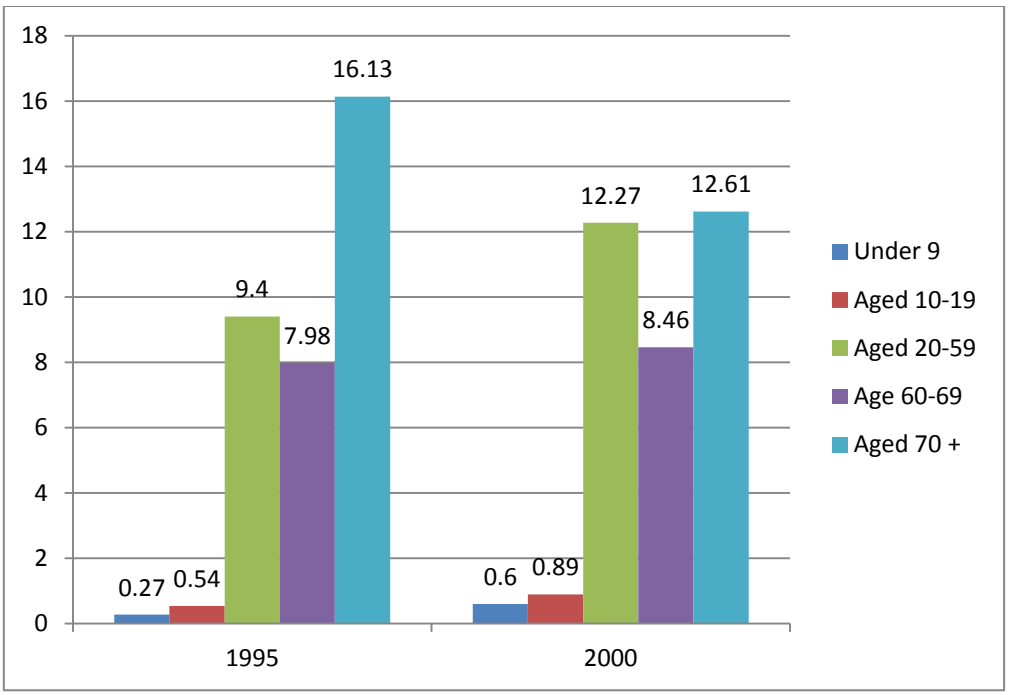

Figure 1: Disability prevalence by age - 1995 and 2000[43]

In correlation with the aging population, the number of people with disabilities has increased annually. According to Ministry of Health and Welfare (2010), in 2009 the number of people with disabilities increased to 2.429.547 and the elderly groups remain accounting for the main proportion as described in Figure 2.

[43] *Source: The author composed based on the data from Byun, Yong-Chan, Trends of Disability Prevalence Rates of Korea, Korea Institute for Health and Social Affairs,* http://isi.cbs.nl/iamamember/CD2/pdf/883.PDF

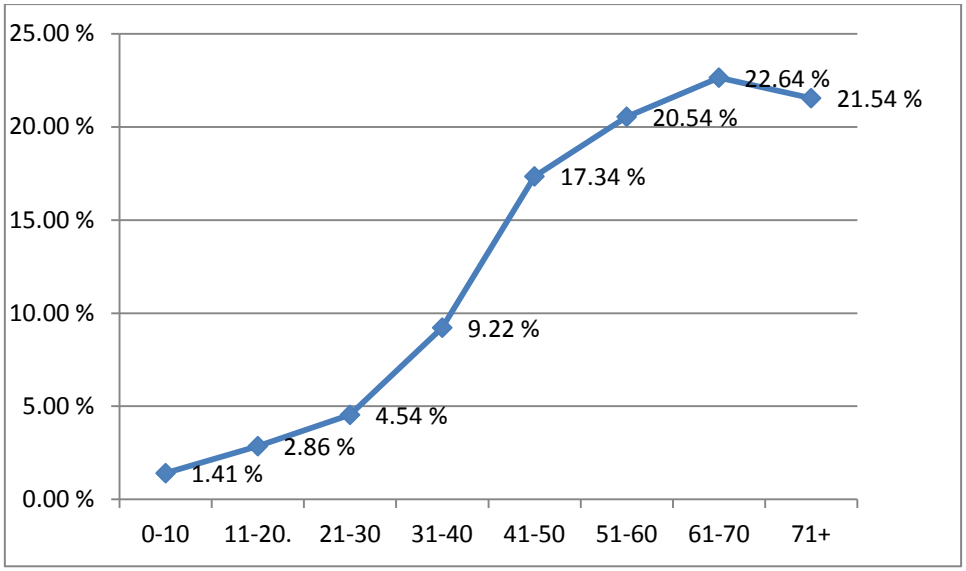

Figure 2: Disability prevalence by age – 2009[44]

1.2. The aging of Korean population

According to the medium-growth scenario, the total population for Korea is projected to increase from 49.4 million people in 2010 to 52.2 million people in 2060. It is said that Korea is aging faster than any economy in history (Howe et al., 2007).

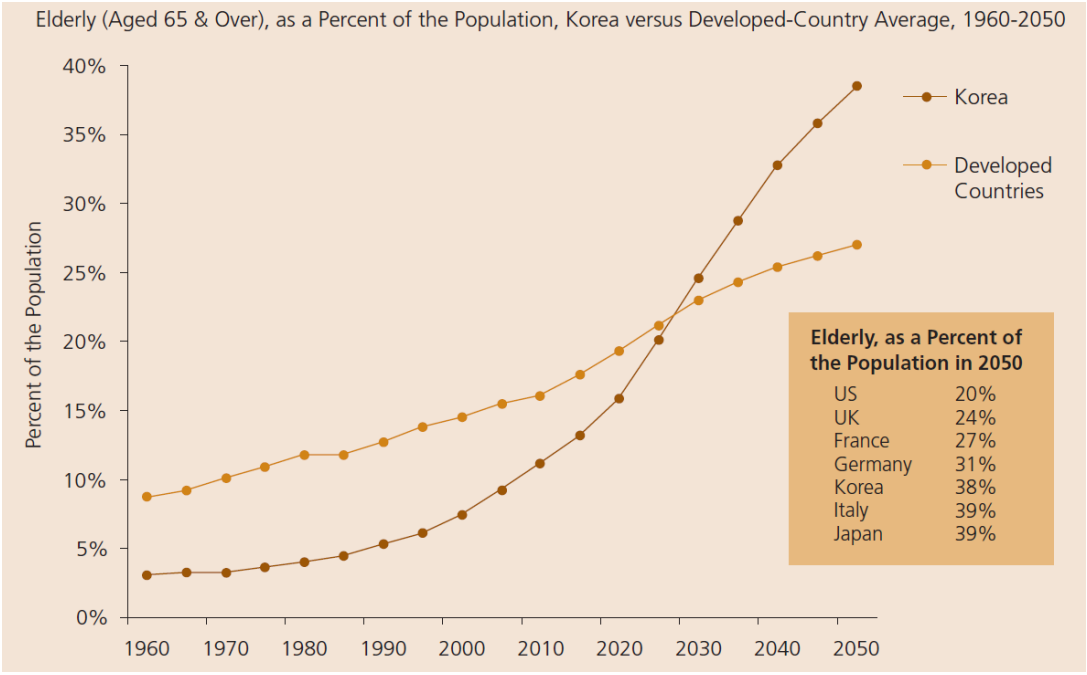

Figure 3: Elderly (Aged 65 & Over), as a Percent of the Population, Korea versus

[44] *Source: The author composed based on Table 14: Registration Status of Disabled Persons by Gender, Age, and, Rating (2009) in the "Initial Report under the Convention on the Rights of Persons with Disabilities", the Republic of Korea, June 22, 2011*

Developed-Economy Average, 1960-2050[45]

Median age would increase to 48.5 years in 2030 and 57.9 years in 2060, compared to 37.9 years in 2010. The population aged 60 and over was 15.5 percent of the total population in 2010, and that is set to increase to 47.4 percent by 2060 (Statistics Korea, 2011).

2. Policies

2.1. E-Health

Progress in Korean health information systems initiative has occurred after the year 1990, when the first Information Strategy Plan (ISP) for National Health Information Systems (NHIS) was developed. The ISP has been revised and developed twice, in 2001 and 2004. The ISP came to consist of three phases between 2004 and 2009, whereby standards are first developed and then progress occurs on the development of public health information systems based on these standards. Finally, the standards will be redeveloped to meet the needs of private operators.

The establishment of the Korea e-health Association (KeHA) was one important landmark for the development of e-health in Korea. KeHA has focused on the development of policy research, regulation, standardization, research and development, and e-Health best practices and encouraged four departments in various ministries to develop their own strategies for e-Health.

In the vision of the Korean government's e-Health policy, Korea will become the leading e-Health industry economy by 2012, with the goal of becoming a developed nation and a welfare society. There are four important goals in this vision (Figure 4):

- Nurturing e-Health industry as a next generation growth industry,
- Development of world-class e-Health products including health mobile phones,
- Provision for substantive framework for people's healthy life, and
- Providing efficient and equitable medical services using e-Health.

[45] *Source: Adopted from Howe et al., 2007*

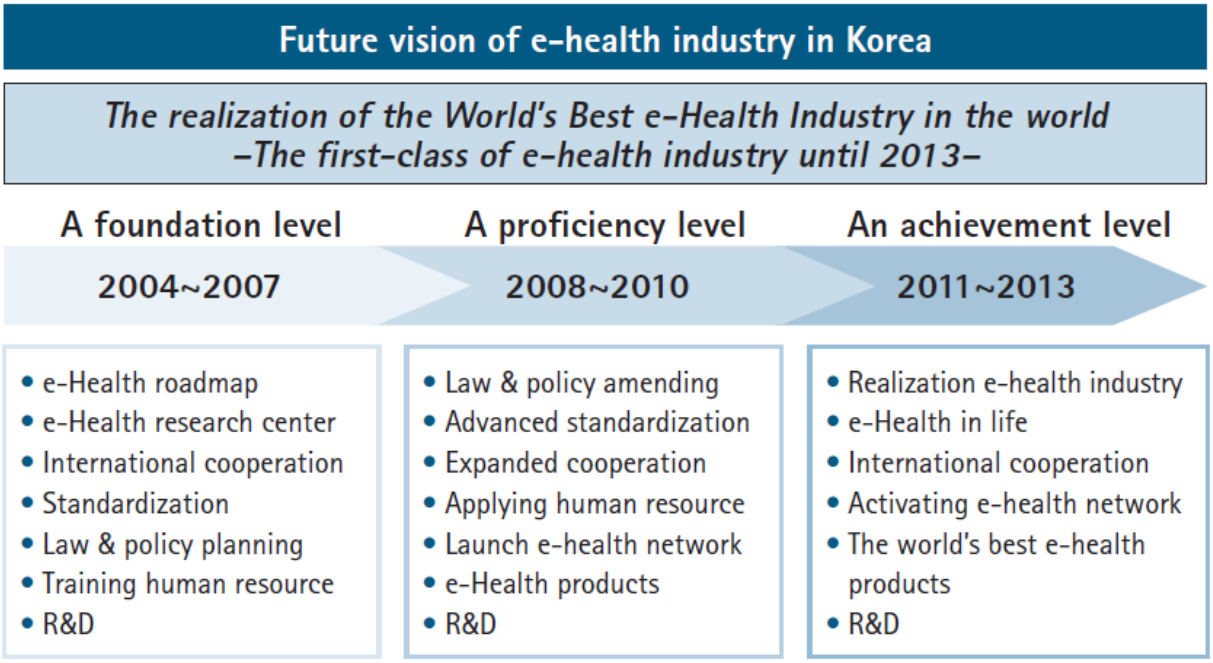

Figure 4: Future Vision of e-Health Industry in Korea[46]

The Korean government identified standardization, legal and policy planning, human resources development, research and development, and international collaboration as the five core pillars for the achievement of these goals (Figure 5). [47]

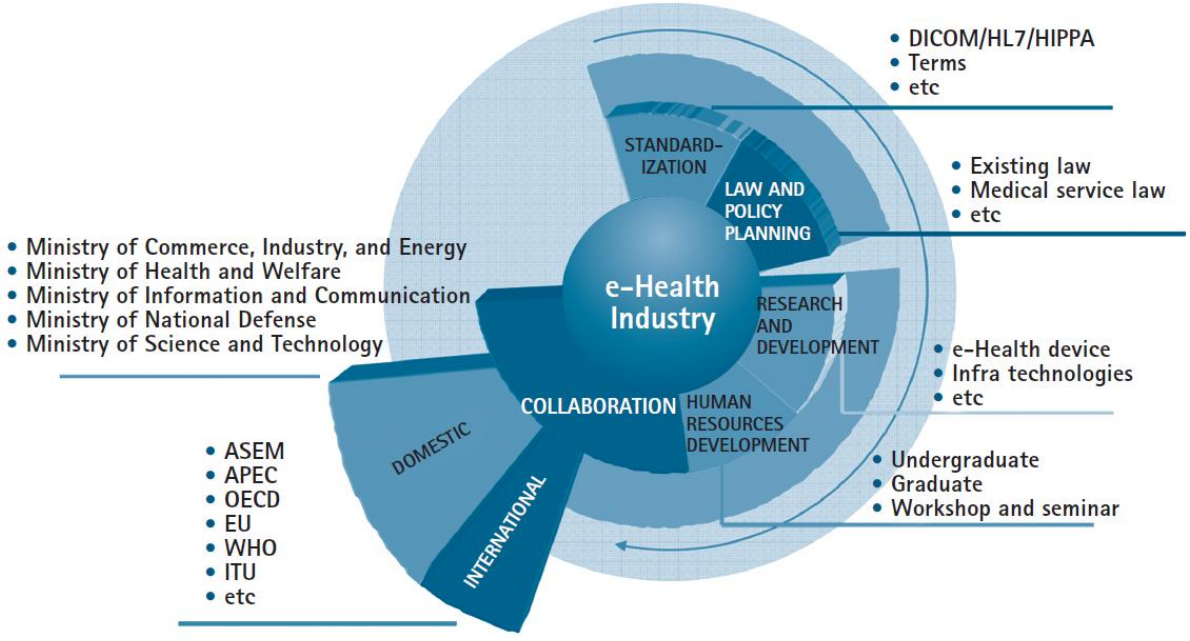

Figure 5: Major issues of e-Health industry in Korea[48]

[46] *Source: Lee et al., 2009*
[47] Ministry of Commerce, Industry and Energy became Ministry of Knowledge Economy from 2008 Ministry of Science and Technology also became Ministry of Education, Science and Technology.
[48] *Source: Lee et al., 2009*

2.2. Accessibility

Policies have been adopted by the government between 2001-2010 (e.g. the Digital Divide Act, The First and Second Master Plan for Closing the Digital Divide) to improve the conditions for people with disabilities to use ICT. The objectives of these initiatives were to establish the basic conditions for disabled people to use ICT, including the construction of high-speed internet networks, provision of computer terminals in local administration offices, provision of ICT training, and provision of valuable content on the internet that is accessible by disabled people.

The discrimination of disabled people has also been outlawed from 2008. While the law has implications for employment, education, etc**.**, it also applies to IT services and products. For example, government websites are scrutinized for compliance with the law. The law is enforced by the Ministry of Public Administration and Security and the National Information Society Agency.

In addition Korean government has supported the development of Assistive Technology (AT) such as screen magnification, screen reader and Braille display since 2004. Also, there is a program which is supported to participate in foreign AT related exhibitions such as CSUN (March, U.S), RESNA (June, U.S). As most assistive devices are expensive, people with disabilities receive subsidies to buy AT since 2003 (the government subsidy could be around 80 percent of AT price).

Another initiative by the government is the facilitation of sharing of information among developers of telecommunication devices and services regarding accessibility. The Telecommunication Accessibility Promotion Standard Forum (http://www.iabf.or.kr) has been active from 2002 and has the following objectives:

- Development of technical standards for improving accessibility to telecommunication devices and information services
- Information sharing on the trends of accessibility policies, laws and regulations and relevant technologies such as voice recognition and synthesis, digital talking books, and other new technologies related to accessibility issues
- Development of methods and tools needed to implement accessibility evaluation on telecommunication devices and information services
- Cooperation with international organizations which deal with accessibility issues

- Promotion of public awareness on accessibility items through holding seminars and workshops, developing brochures and operating homepages

Moreover, the government policy is supported to develop ICT accessibility standards. There are two national standards: Korean Web Content Accessibility Guideline 1.0 (KWCAG 1.0) enacted in late 2004 and Automatic Teller Machine (ATM) accessibility guidelines enacted on Oct. 2007. Also, there are nine ICT accessibility standards such as DAISY (Digital Audio Books), Mobile phone, DTV captions, etc.

KWCAG was derived from the Web Content Accessibility Guidelines (WCAG) working draft as of June 2003. KWCAG therefore has many similarities with WCAG. However, KWCAG does not include specific guidelines to Section 508. This is because web accessibility groups in the economy believe that these checkpoints and guidelines are not applicable to Korean circumstances. These groups believe that fancy images and animation elements are very rarely used to design web pages in Korea; hence the aforesaid checkpoints and guidelines are not included in KWCAG. As of March 2010, KWCAG 1.0 will be implemented in stages over the next three years. During this time frame, all organizations within Korea will be required to follow KWCAG's design principles for creating accessible Web content.

Figure 6: Web accessibility on governmental website from 2005 to 2008[49]

Finally, government has hold ICT universal design Contests and annual ICT accessibility Seminars by Korea Web Accessibility Group (KWAG) since 2005. Also, there are educational programs which deal with web accessibility issues. NIA has operated web accessibility certification programs since 2007. In 2008, Cheong Wa Dae (Office of presidency) received web accessibility certification. Korean government also developed online education programs, brochures and video clips, and ran campaigns in order to increase

[49] *Source: Adopted from Hyun et al., 2008; Hyun, 2009*

ICT accessibility. As a result, the rate of compliance of web accessibility standards has increased since 2005 (Figure 6).

3. ICT services and application for people with special needs

3.1. E-Health

3.1.1. Telehealth and Telecare

The first pilot project on telemedicine was carried out from 1995 to 1998 between the Wooljin Health center and the Kyungbook University hospital using a high speed telecommunication network. Since then, several pilot telemedicine projects have been carried out mainly at community health centers (Chea, 2006). According to Briggs et al., 2011 the Korean telemedicine has focused on videoconferencing between doctors and patients to alleviate the need for patients to physically visit doctors, and the exchange of medical records between institutions so that unnecessary repeated examinations could be reduced. In addition, one project had been implemented to support nurse home visits with a notebook computer to provide a data and video link to a doctor in an institution. According to Zamanian and Whitmore, 2011 Korea has enormous potential for telehealth, because 95% of households possess broadband internet access.

Recently, the "Self Quality Care" project has been implemented by a private and public collaboration (the Gyeonggi provincial government, Qualcomm, Korea Centers for Disease Control and Prevention and Korea Telecom). The initiative uses 3G-enabled applications and services, and devices such as smart phones, tablet PCs and IPTV devices are linked with medical treatment systems to enable patients and health workers to better manage diabetes. The Electronics and Telecommunications Research Institute, a non-profit, government funded organization, will oversee the implementation and evaluation of the project (Rufino, 2011).

On the other side, Kwon et al., 2012 emphasizes that the introduction of telemedicine in Korea has been lagging behind because of outdated legislation. For example, medical consultations have had to take place in a face-to-face setting with the doctor and patient, and tele-consultations have only been possible between healthcare providers, not between the provider and patients. Three revisions in the medical law enacted in 2003 greatly upgraded healthcare information systems in Korea: legalizing telemedicine, legalizing electronic medical record, and legalizing e-prescription system for outside pharmacies. However, revising the law and relaxation of the legislation is still needed in order to increase the usage

of ICT in healthcare services.

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record (EMR)

The Korean government developed its first 10-year national Information Strategy Plan (ISP) for in 1990, followed by the second version in 2001. The scope of the ISP was broad, covering almost all activities of the Ministry of Health and Welfare (MOHW). In 2004, MOHW revised the ISP into three phases: Phase 1 (2004-2005) mainly focused on standards and e-Health laws, Phase 2 (2006-2007) concentrated on developing EHR and public health information systems based on the new standards, and in Phase 3 (2008-2009), standards and EHR for health centers was redeveloped to meet the needs for the private health institutions (Chae, 2006).

In order to effectively carry out ISP, the MOHW created several advisory committees to provide policy directions and expert opinions. Two centers (Center for National Health Information System Development and R&D Center for EHR) were also created to carry out system development and the related researches.

According to the recent research of Yoona et al., 2012, the rate at which EHR for medications systems have been adopted by Korean tertiary teaching and general hospitals was higher than the rate of adoption by US hospitals. Financial aspects are reported to be the most important facilitators of and barriers to EHR adoption in Korea. Thus, government financial support, especially to small hospitals, seems to be essential to promoting the adoption of EHRs by Korean hospitals.

3.2. Smart Home

Different smart home projects have been implemented in Korea. For example, Korean electronics company LG is collaborating with builders to create developments of smart homes which use the HomeNet standard (see http://www.lge.com/products/homenetwork/homenetwork.jsp), developed by LG, to communicate with devices and appliances by sending signals and data over power lines (Simmons, 2006). Besides, Korea Association of Smart Home (see http://www.hna.or.kr/eng/m1/m1_s1.asp) was founded to construct a Digital Home Network system that can provide convenient and extensive home digital services anywhere at any time based on a well-connected infrastructure and connect stakeholders, such as telecommunication providers, NI/SI providers, and device manufacturers, for the development of Smart Home, Broadband Convergence Network and Ubiquitous Network.

Regarding smart homes for seniors, U-Health Smart home, which is being developed at Pohang University of Science and Technology (POSTECH) in Korea, is a typical example. It integrates advances in ICT, nanotechnology, and biotechnology to support the elderly and/or people with chronic diseases in their own home (Figure 7). This U-Health smart home initiative as other smart home projects aims to create a friendly-environment where the elderly can continue to live independently as long as possible in their own home while being monitored and assisted (as much as possible) in an unobtrusive manner.

Figure 7: Overview of the U-Health System[50]

Moreover, the U-Health smart home takes advantage of advances in low power electronics and sensor technologies and provides the inhabitants with a large range of health and safety services that can be upgraded from time to time. The solution also introduces a U-Health autonomic decision making system (ADMS) which can make autonomic decisions for many situations and therefore reduce the cost of human intervention (Agoulmine et al., 2011).

The functional architecture of the U-Health smart home is composed of four layers (Figure 8). A silicon nanowire (Si-NW)-based bio-FET which has the ability to detect charges from biological molecules was selected as the sensor platform in this POSTECH's project

[50] *Source: Agoulmine et al., 2011*

Figure 8: Autonomic u-Health smart home Framework[51]

3.3. Robotics

One of the main actors in robotics development for elderly care has been the Korea Institute of Science and Technology (KIST). The organization supervises the Center of Intelligent Robotics (CIR) (see http://www.irobotics.re.kr/eng_index) that is sponsored by the Ministry of Knowledge Economy.

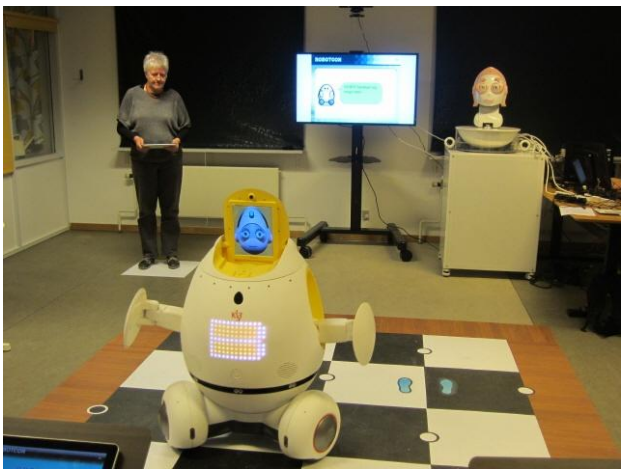

Figure 9: SILBEOT (meaning Senior Citizens' Friend) and MERO[52]

Within this institute, the Frontier Artificial Intelligence Robot Project Team is developing a

[51] *Source: Agoulmine et al., 2011*
[52] *Source:* http://irobotics.re.kr/eng_sub3_3/articles/view/tableid/press_e/id/1107

robot called “Silbeot”, which can help elderly people in dishwashing, conduct brain training exercises to prevent dementia, and offer them English language training. These robots are being used as part of a pilot project in senior welfare centers (Kim, 2011).

Also developed by CIR is an elder care robot, Mero, which has cognition training game and portal info (health, horoscope, weather, traffic, etc.) service (Figure 8). Mero made it on to Time magazine’s “50 best inventions of 2010" list along with a lifeguard robot and sarcasm-detecting software.

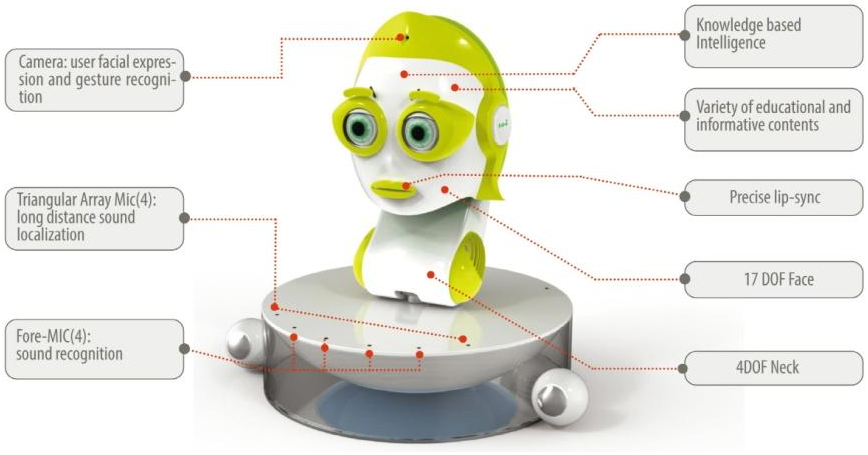

Figure 10: Mero Robot main functions[53]

Figure 11: Mero in the test project at a senior welfare center and an assistive robot for self-feeding[54]

Another example is the introduction of a newly designed self-feeding robot which allows people who have difficulty moving their upper limbs to feed themselves. A research team from National Rehabilitation Center, Seoul, Korea has developed this novel assistive robot for self-feeding which strongly depends on the culture of users (Song et al., 2011).

[53] *Source: http://kistrobot.blogspot.fi/p/mero.html*
[54] *Source: http://www.koreabrand.net/en/know/know_view.do?CATE_CD=0011&SEQ=1860 and Song, et al., 2011*

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Peru

1. Demographic

1.1. Disability Statistics

In the population census in 1993, 1.3 percent of the population admitted to having some type of disability. However, in the same year, by a similar study, the INR (National Rehabilitation Institute) found that 31.28 percent of the total population suffered from some type of disability (IDRM Economy Report, 2004). In 2005, the National Institute Information and Statistics (INEI) conducted the Continuous National Census (ENCO) and found that 8.4 percent of the total population (around 2 million persons) suffered from a disability. According to the latest census performed in 2007, the number of people with disabilities increased to approximately 3 millions, accounting for 11.86 percent of the total population (CONFENADIP, 2008). The number of persons with disabilities has increased due to the lingering effects of the conflict, occupational and traffic accidents, the lack of an effective prevention policy, and other causes (IDRM Economy Report, 2004).

It is noteworthy that in March this year, the PCM (Presidency of the Council of Ministers) created the Multisectoral Commission responsible for support and assistance in the preparation, formulation and implementation of the National Survey on Disability Specialized, which is being executed by the INEI (National Institute of Statistics and Information) and will end later this year and is expected to be ready by mid 2013. The Multisectoral Commission will be chaired by a representative of the Ministry of Women and Vulnerable Populations and will include representatives of the Ministries of Finance, Health, Education, Labor and Employment Promotion, Development and Social Inclusion, Transport and Communications, Housing, construction and Sanitation, Foreign Affairs and representatives of the Social Health Insurance (EsSalud), National Rehabilitation Institute and the National Institute of Mental Health. The INEI is responsible for the Technical Secretariat of the Commission. This representation functions include agreeing on the objectives of the National Survey on Disability Specialist, in order to meet the information needs of the sectors involved in the care of people with disabilities.

1.2. The aging of Peru population and disability

The total population in Peru was reported at 30.1 million people in 2012, increasing from 9.9 million in 1960 and changing 203 percent during the last 53 years. It continues the growing

trend and reaches the peak of around 40 millions in 2050 (DGRAIC-MTC based on the data from INEI, Total Population and Average Annual Growth Rate: the 2009 Revision).

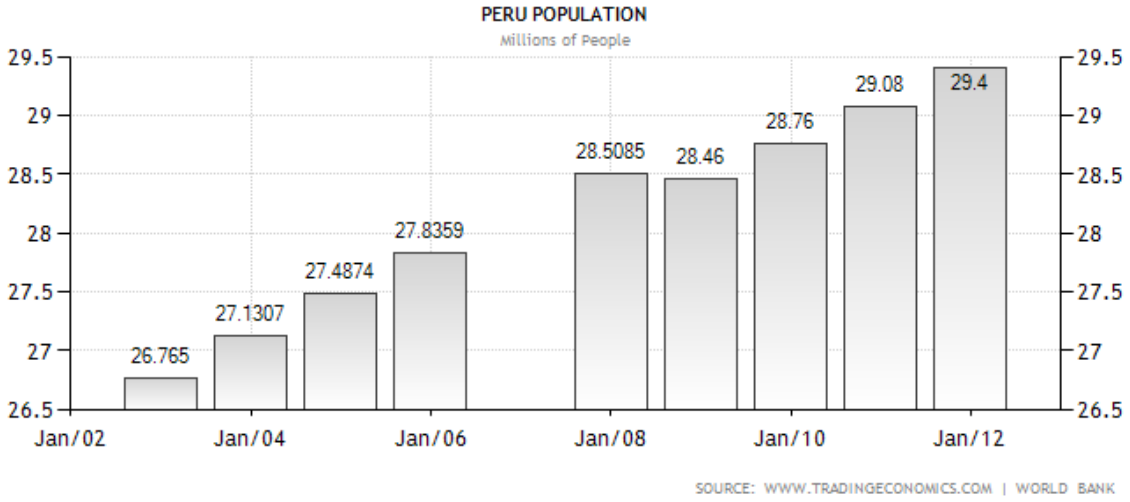

Figure 1: Peru Population (unit: millions)[55]

Before 1990, people more than sixty years of age hovered around 5.3 percent of the total population. After 1990, the number of 60+ elderly people increases gradually and surpasses over 10 percent of the population to become aging society in 2015 and it is estimated to account for more than 20 percent of the total population in 2050.

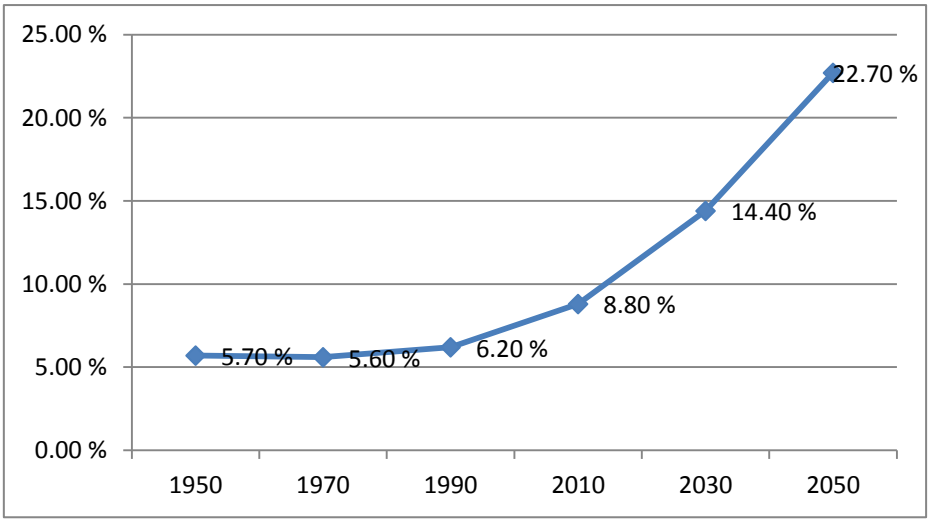

Figure 2: The projected Peru population aged 60+[56].

[55] *Source: see* http://www.tradingeconomics.com/peru/population
[56] *Source: the author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

2. Policies

2.1. E-Health

In April 2003, the Ministry of Transport and Communications (MTC) established the National Telehealth Committee which the representatives came from the MTC, National Institute for Research and Training in Telecommunications (INICTEL), the telecommunications regulator (OSIPTEL), National Institute of Statistics and Informatics (INEI), social security (EsSALUD) and Ministry of Health (MINSA). This committee had responsibility to design a National Plan for Telehealth which aimed to increase the provision of health care services in underserved and remote areas.

The Ministry of Health also played an important role in promoting e-Health in Peru by preparing a set of standardized identifiers for health data in 2005. Further, in 2008, the Ministry of Health led a committee to assess the information systems in healthcare and concluded that there were not enough information systems and those that existed were obsolete and not integrated. Solutions were recommended including hiring consultants and experts on health informatics, creating the Informatics Center of the National Health System (NHS) and coordinating with the National E-Government and Informatics Office (ONGEI) from the Presidency of the Council of Ministers (PCM).

The above policies were considered as milestones policies for the development of e-Health in Peru. In fact, most of the policies are for general information technology purposes and very few policies specifically address e-Health issues. Besides, there is very low compliance to these policies and they have not been fully enforced. One of first solutions is enhancing the leadership of the health sector on developing socio-technical policies to foster the development of e-Health (Castagnetto, 2008).

2.2. Accessibility

Peru was the 15th economy to ratify the "International Convention on the Rights of Persons with Disabilities (CRPD)" (Disabled World News). In addition, a review of the national legislation in Peru reveals a variety of laws, decree-laws, legislative decrees, executive orders, and municipal orders have been passed to mandate priority treatment, care, and benefits, and provisions for the social inclusion for persons with disabilities.

Particularly, the current Constitution, adopted in 1993, provides broad coverage and specifically addresses the areas of social security, health, education, and employment. Moreover, the People with Disabilities Act stated that people with disabilities have the same

basic rights as all others in the society and also declared 16 October as the "National Day of the Disabled Person". However, in Peru, enforcement is still needed. Many of these laws are primarily statements of rights, as they are not mandatory in nature (IDRM Economy Report, 2004).

Regarding information accessibility, despite “Law 28530” for Internet access for people with disabilities and adequacy of physical space in public internet cabins enacted five years ago, the government has not properly incorporated the accessibility criteria; therefore, more than 80 percent of the information is not available in an accessible format (Gould, 2012). Meruvia, 2012 even argued that Information Units, which has responsibilities in providing modern information technology systems and equipment for Peruvian persons with disabilities, should be established due to serious limitations of access and availability of information services.

In 2006, the National Institute for Research and Training in Telecommunications (INICTEL) developed a project called CETIC-PCD which aimed to facilitate access to ICT for people with special needs. The project created an administrative and logistical system regarding ICT for people with disabilities in four regions in Peru; organized the training of trainers and ICT training programs for people with disabilities (e.g. web master specialist and graphic designer); and developing platforms for people living with disabilities (e.g. Internet portal).

3. ICT services and applications for people with special needs

3.1. E-Health

3.1.1. Telemedicine (Telehealth and Telecare)

There are different ways in which Peru has benefitted from telemedicine. For example, physicians who care for people with HIV/AIDS can receive the training on how to administer antiretroviral therapy electronically.

Figure 3: Example of Educational Material for People Living with HIV[57]

[57] *Source: Herold, 2011*

NETLAB, a web-based laboratory information system, is used by over 10% of people living with HIV in Peru (Herold, 2011). Figure 3 is an example of what NETLAB offers.

Other application recently implemented this year, is the Observatory of Pharmaceuticals and the "National System Price Information" are a platform that provides information on sales prices of drugs with current Health Record and are sold in pharmacies and private and public pharmacies nationwide.

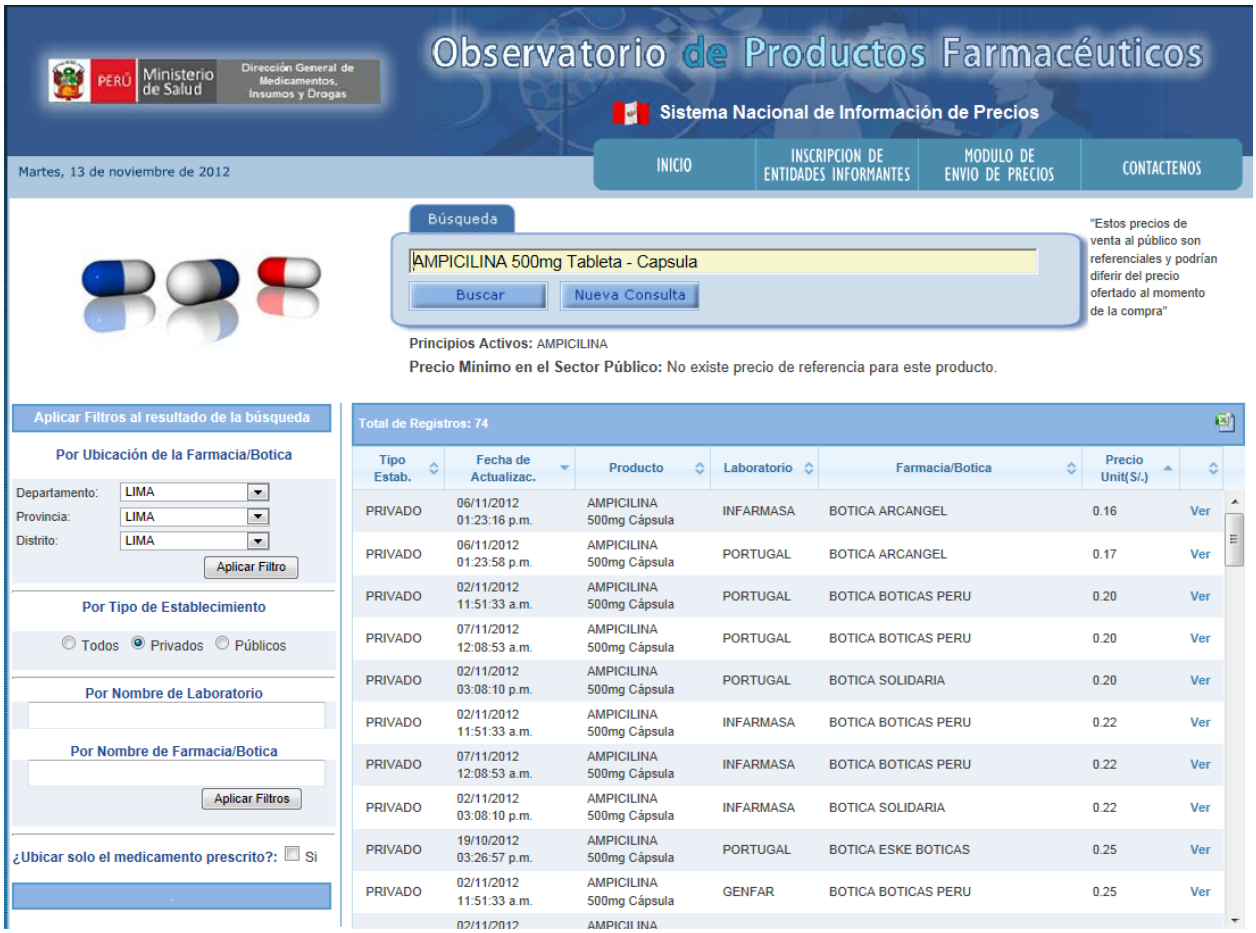

Figure 4: Example of a price consultation Ampicillin 500 mg[58]

The method used to promote telemedicine in the rural parts of Peru such as Amazon region was a radio system (VHF, HF and WiFi) which is developed by EHAS (Hispanic American Health Link) to exchange information through email. The government was involved in this project and aided the researchers by installing telephone lines in every health center (Herold, 2011). Recently another telemedicine project under the Humanitarian Technology Challenge (HTC), a partnership between IEEE and the United Nations Foundation, was implemented to assist three health facilities in the remote Amazon jungle to communicate with each other and

[58] *Source: Ministry of Health website, 2012*

exchange information with a regional hospital (Kowalenko, 2012).

Regarding m-Health, CareNet, a project funded by the Fund for Innovation Science and Technology (FINCyT), allows patients to use cell phones to report on compliance and to send reminders, alerts, and useful information to them and to health care workers. However, up to now, the use of mobile health applications in Peru has been mainly restricted to pilot projects and the delivery of SMS alerts (Castagnetto et al., 2008).

3.1.2. Electronic Health Record (EHR)

As in some other developing economies, most of the existing EMR in Peru are still in the initial stage. Some middle-sized organizations have been using their own budget to develop IT infrastructure for EMRs because there are not specific grants to support EMR infrastructure. Recently, e-Chasqui and NETLab are two systems which create the improvements in the accessibility of patient data. The e-Chasqui system contains the information on the treatment of patients with tuberculosis, considered as a limited EMR component, and a messaging system that email the results to the patient and physician, and provides a web-based interface to access to the data. NETLab, which was used nationwide, proved its usefulness in reducing the average time it took to process lab samples, and speeding up the delivery of information (Castagnetto et al., 2008).

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Philippines

1. Demographics

1.1. Disability Statistics

The number of people with disabilities (PWDs) in the Philippines was estimated to be 1.2 percent of the population in 2000, but organizations representing the disabled people have criticized this number to be too low (Mori et al., 2009).

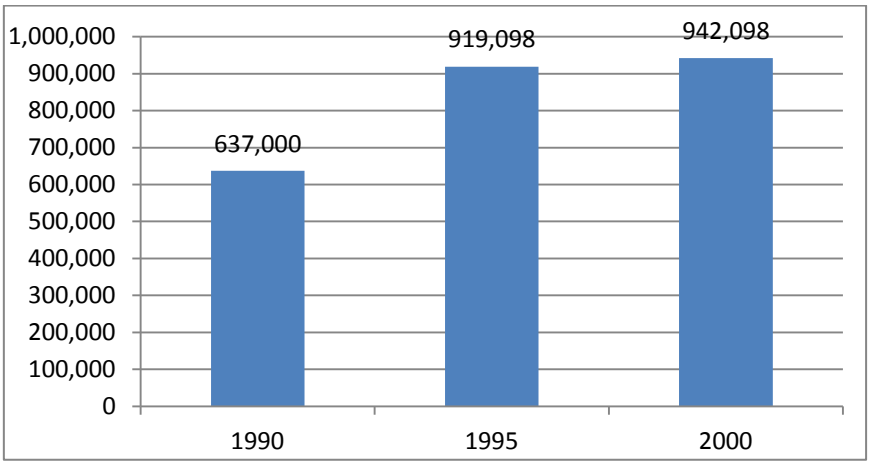

Figure 1: Total people with disabilities[59]

1995 NSO Census has reported number of persons with disabilities in each disability category by age, and it can be seen that around over 50 percent of the total disabled people are elderly (JICA, 2002)

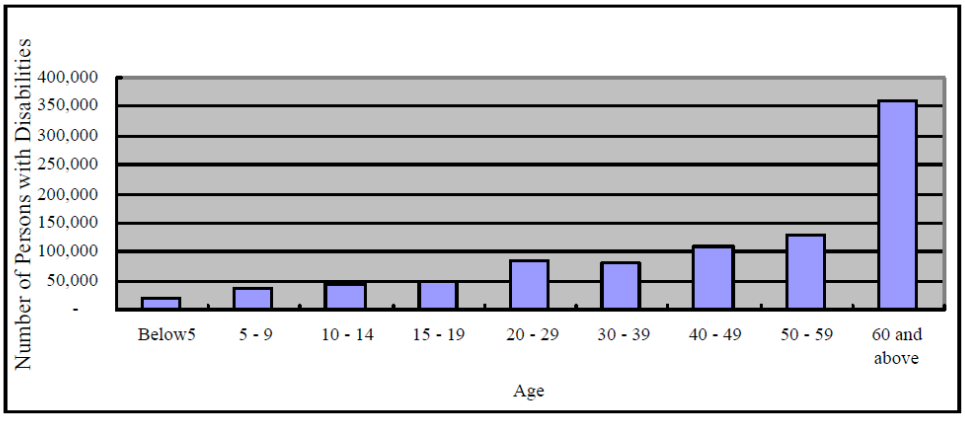

Figure 2: Number of Persons with Disabilities in Each Age Category in 1995[60]

[59] *Source: the author composed based on the data from Mori et al., 2009*
[60] *Source: JICA report, Planning and Evaluation Department, Economy Profile on Disability: The republic of the Philippines, 2002*

1.2. The aging of Philippine population and disability

Based on the 2010 Census of Population and Housing the total population of the Philippines in 2010 is over 92 million which increased by 30 million from 60.70 million in 1990[61]. It is forecasted to reach approximately 150 million in 2050

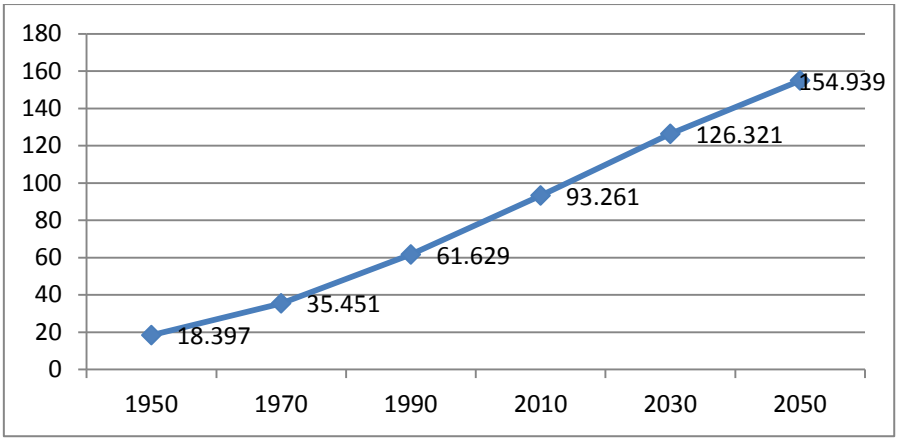

Figure 3: The Population of Philippine (unit: millions)[62]

Even though Philippine population is young, the number of senior citizens in the Philippines rose from 3.19 million in 1990 to 4.59 million in 2000 and 7 million in 2010 (6.8 percent of the population 92.1 million, higher than the 6.0 percent recorded in 2000) and 5.4 percent of them lives alone. The median population projection indicates that by 2030, the older population will be 10 percent of the total population.

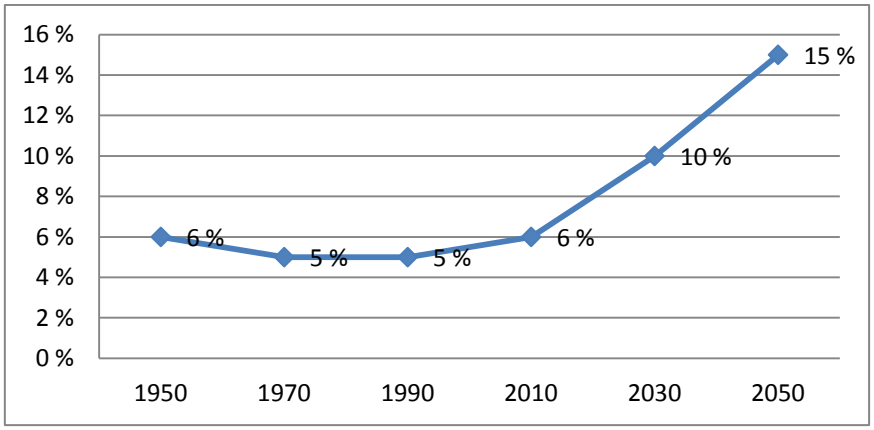

Figure 4: The projected Philippine population aged 60+[63].

[61] *Source: National Statistics Office* http://www.census.gov.ph/content/2010-census-population-and-housing-reveals-philippine-population-9234-million

[62] *Source: the author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

[63] *Source: the author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

The public interest in tackling the challenging of supporting old people may be low when the numbers of elderly people in economies such as the Philippines is small while younger people also need assistance. However, if the supporting programs for elderly people are prepared early, the problem of aging society can be mitigated before it becomes difficult to control.

2. Policies

2.1. E-Health

The Philippines government has developed the e-Health Strategy via five main steps (Figure 5). The key players in e-Health Strategy are the Department of Health (DOH), National Statistics Office, National Statistical Coordination Board, University of Philippines, Local Government Units, Department of Science and Technology, other government agencies, NGOs, and the private sector.

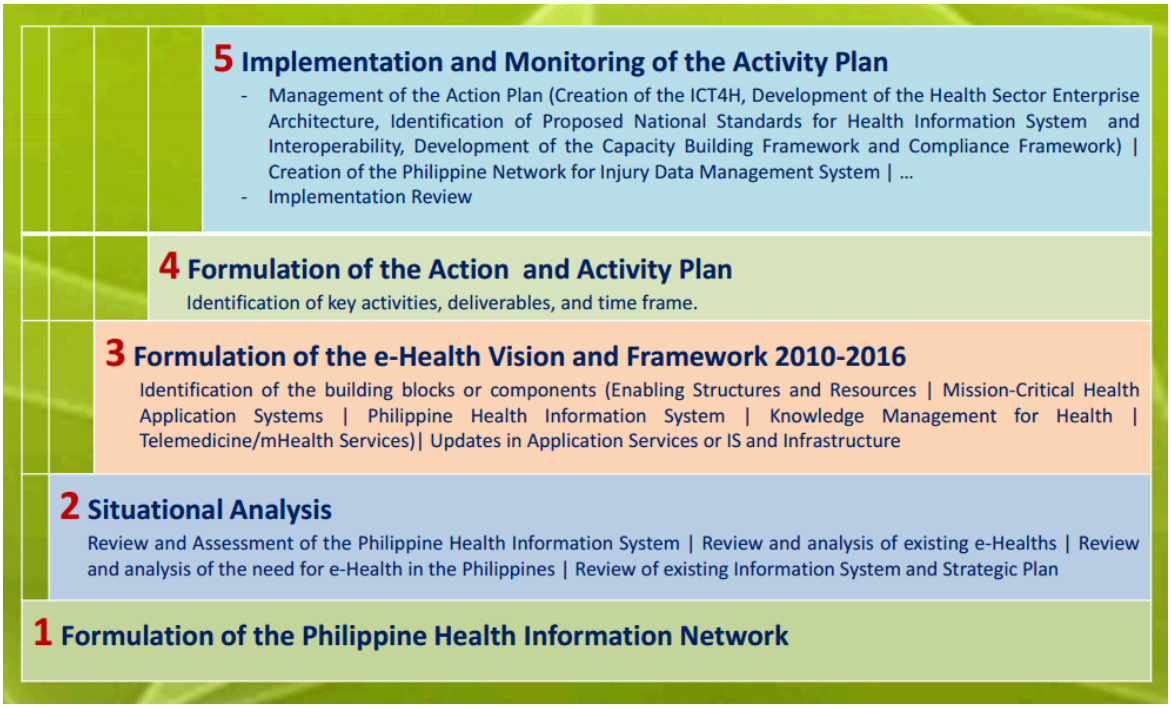

Figure 5: Strategy Development Process[64]

The implementation of Universal Health Care is to ensure that all Filipinos, especially the disadvantaged group, have equitable access to health care. In the Second Philippine Health Outlook Forum 2010, Health Secretary Dr. Enrique Ona underscored the important role that Information and Communications Technology (ICT) would play in achieving universal health care in the country (Zuellig Family Foundation, 2010).

[64] *Source: Aragone, 2012; Consulta, 2012*

In the vision of the national e-Health Strategic framework 2010-2016 (Figure 6), ICT will be applied to support Universal Health Care to improve access, quality, efficiency, patient safety and satisfaction, reduce cost, and enable policy makers, providers, communities, and individuals to make the best possible health decisions. The strategic goals include enabling structure and resources, creating critical health application systems, establishing health information system, institutionalizing knowledge management systems, and providing telemedicine/m-health services.

University of Philippines, National Telehealth Center (NTHC) (see http://one.telehealth.ph/beta/) which was established in 1998 to investigate the use of ICT to improve health care delivery for all Filipinos, participates and leads in e-Health policy research in Philippine. In addition, ICT4H technical working group, which includes participants from Department of Health (DOH), academe, NGO, Government Science and Technology, telecommunications company, IT professionals association, private sector health IT was established to support DOH. The working group held the consultation meetings (open to public), hired International consultant to review the ICT4H output and local consultant to craft action plan to move forward.

2.2. Accessibility

The main legislations concerning persons with disabilities in the Philippines are the Republic Act (RA) 7277 and its amended version the RA 9442, or the Philippine Magna Carta for disabled people. The elderly and persons with disabilities were two of 14 sectors defined by the Philippine Government as underserved and marginalized areas. The information needs of these marginalized areas usually concern social services and livelihood like health information (e.g. family planning, nutrition, and sanitation), livelihood and productivity information, employment and trade opportunities, education and training and those that relate to government services.

Some organizations such as the Department of Social Welfare and Development (DSWD), the National Council on Disability Affairs (NCDA) and the Department of National Defense along with local government units have augmented funds to provide limited subsidy for purchasing of assistant devices for people with disabilities who cannot afford the cost of such devices. In addition, some government organizations and NGOs have programs to train people with disabilities on how to use assistive devices.

VISION: ICT supporting UHC to improve healthcare access, quality, efficiency, and patient safety & satisfaction, to reduce cost and enable policy makers providers, individuals and communities to make the best possible health decisions.				
MISSION: To effectively use ICT to improve health care delivery, administration and management, and in communicating health				
STRATEGIC GOALS				
Strategic Goal 1: Provide a rational and accountable eHealth agenda, and legal and normative framework and structures to implement eHealth (Enabling Structures & Resources)	**Strategic Goal 2:** Increase efficiency of processes and systems in health care delivery and administration and create new processes and forms of doing things (Mission-Critical Health Application Systems)	**Strategic Goal 3:** Establish a unified and coherent health & management Information systems (Philippine Health Information System)	**Strategic Goal 4:** Institutionalize knowledge management systems to promote knowledge exchange and utilization especially at sub-national levels (Knowledge Management for Health)	**Strategic Goal 5:** Capitalize on ICT to reach and provide better health services to GIDA, support MDGs attainment and dissemination of information to citizens and providers (Telemedicine/mhealth Services)
STRATEGIC TARGETS				
• Establishment of legal, policy & normative frame ○ Definite Road Map ○ Standardization(technical infrastructure , health informatics, statistics, interoperability, etc.) • Increased & sustained financing including those from LGUs for local health facilities • HHR e-maturity/ capacity building • Multi-agency/sectoral collaboration & networks • Support LGUs to finance, and sustain • ICT Infrastructure development • R & D • M & E	• Promoting more efficient health systems with the following priorities: ○ Social Health Insurance ○ Disease Surveillance ○ Essential Drugs Management & Price Monitoring ○ Health Emergency Preparedness & Response ○ Health facilities Management including Blood Supply ○ Other Ancillary services ○ Referrals ○ Health Regulation of facilities, services, goods (drugs, food, cosmetics, hazardous household chemicals, etc.) ○ Health records ○ Health promotion & learning ○ Financial, procurement, & material management	• Harmonization/integration of data sources and Information systems • Adoption of a data management standards and protocols • Enhancing health services statistics reporting and from both public especially from LGUs & private sector • Improve and scaling up implementation of ISs for health centers, hospitals, PHIC, HHR, and other critical information system under UHC • Expand data access and utilization for evidenced-based decisions and ISs sustainability • Information governance	• Increase capacities for K production, use & application ○ Health Research ○ Knowledge translation • Improve access, exchange and sharing ○ K portal & dashboard, Intranets, EIS, call center ○ Data warehouse ○ E-library ○ National & international databases, publications ○ Best practices ○ CoPs or K networks ○ GIS • Improve K tools, K hubs or learning & resource centers • Promote standard, repeatable processes & procedures	• Policy & Strategic framework • Implement systems to reach GIDA, and to support MDGs attainment (patient monitoring/tracking (WOMB-Watching Over Mothers and Babies , referrals, health providers networks, connecting health providers and patients , diagnostic services, etc)
GUIDING PRINCIPLES	Client-focus, Collaboration/Partnerships/User Involvement, Judicious & Efficient Use of Resources, Better Performance, Transparency, Public Accountability, Safeguarding privacy & Ensuring confidentiality, Keeping technology simple & relevant, Shared Learning			

Figure 6: National e-Health strategic framework 2010-2016[65]

[65] *Source: Aragone, 2012; Consulta, 2012*

The Philippine government is providing more support to accessibility and accessibility has nonetheless garnered more recognition now than in the past few years.

3. Services and application for people with special needs

3.1. E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

The Philippines' Congressional Commission on Science Technology and Engineering (Comste), has identified telehealth as a top national priority for 2011. The National Telehealth Project, which was initiated by the University of the Philippines, Manila, National Telehealth Center (NTHC), allows specialists based at the Philippine General Hospital in Manila to help rural doctors or health workers to diagnose patients in rural and far-flung communities remotely. Remote consultations include the use of SMS and MMS services, video conferencing, and email referrals. The Internet-based system has been accepting referrals through text messages. Its computer system receives the message and forwards them to the cell phone of the appropriate expert. The expert's response is also usually sent back by SMS.

The current telemedicine services in the Philippines are simple enhancements to existing trust structures. In addition, in implementing e-Health and telemedicine, NTHC chose an approach based on community involvement as well as technology. NTHC is already running the tele-health pilot in ten sites complete with workstations and training centers in four areas (Cagayan Valley, Tacloban, Capiz and University of Philippine Manila) as in Figure 7. In a 34 month period (from 15 October 2007 to 10 August 2010) there were 1,389 tele-health referrals from remote doctors.

The mobility and polarization of healthcare personnel are very high in the Philippines. On the one hand, there is movement of personnel from the Philippines abroad, and on the other, there is movement from rural to urban areas. Telemedicine services hold promise to mitigate the effects of this polarization, and the establishment of a trust-based referral system is crucial.

As most doctors own mobile phones, they are able to communicate more effectively. By using SMS, the National Telemedicine Center is able to increase the area of coverage of the Center by providing access to experts for patients who would not otherwise have been able to consult them

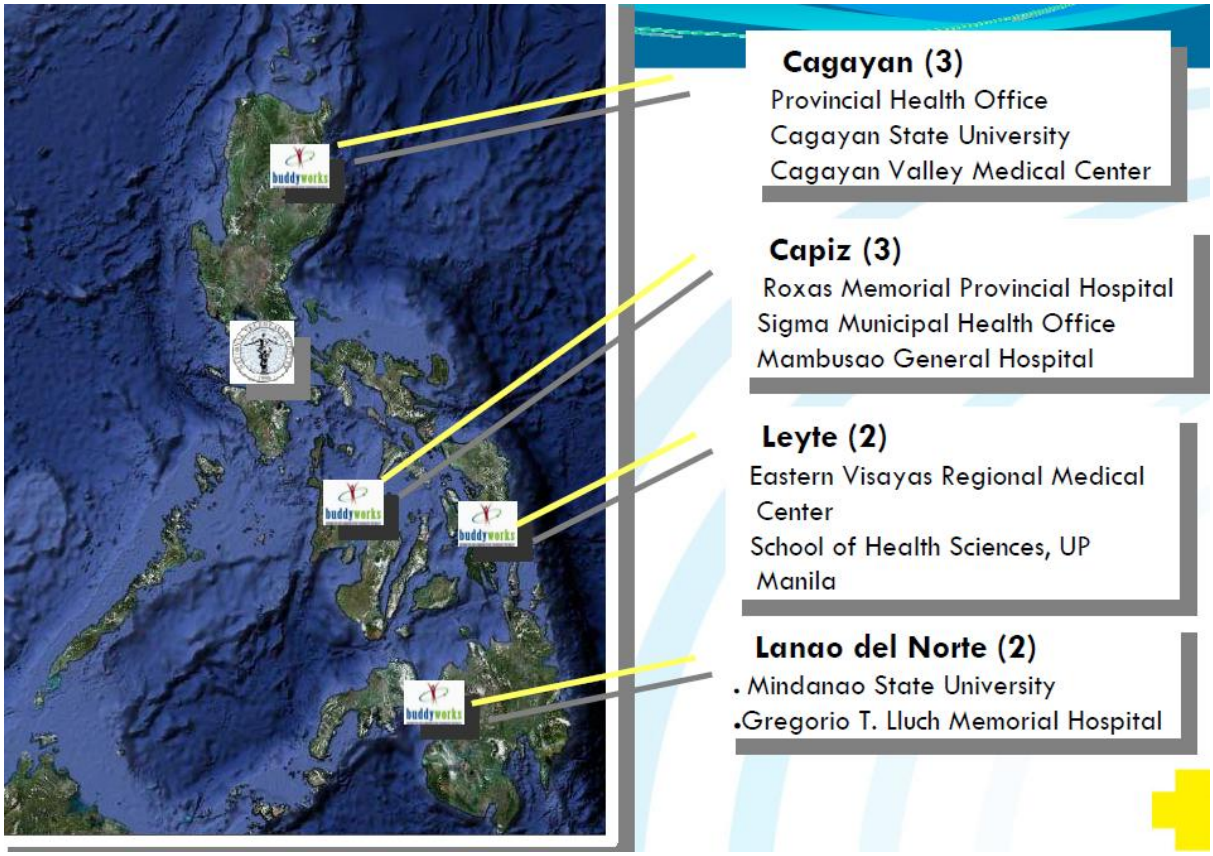

Figure 7: Telemedicine in four areas[66]

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record (EMR)

The "Community Health Information Tracking System" (CHITS) is an open-source web-based EHR system designed for government health centers. CHITS-EMR can be accessed via the LAN network and computers installed in the health centers and it has main functions such as patient consultations and reporting features for decision making. Thus, it can help doctors and other staff to minimize time for administrative work and maximize time for patient care. CHITS was pilot-tested in 10 centers of Pasay City in 2004 and since has been expanded up to 50 rural health units nationwide. In November 2011, Navotas City also agreed to use Smartphones in CHITS (Fernandez-Marc et al., 2012; Marcelo, 2010).

Moreover, in order to develop and upgrade the existing CHITS Wireless the "Access for Health (WAH) project" was implemented to use 3G wireless technology to streamline the reporting process and facilitate a locally developed EHR system. The WAH project recently completed the pilot phase recording over 12,000 patient consultations. The WAH was managed though Public Private Partnership (Ramos et al., 2012).

[66] *Source: Wee, 2010; Marcelo, 2010*

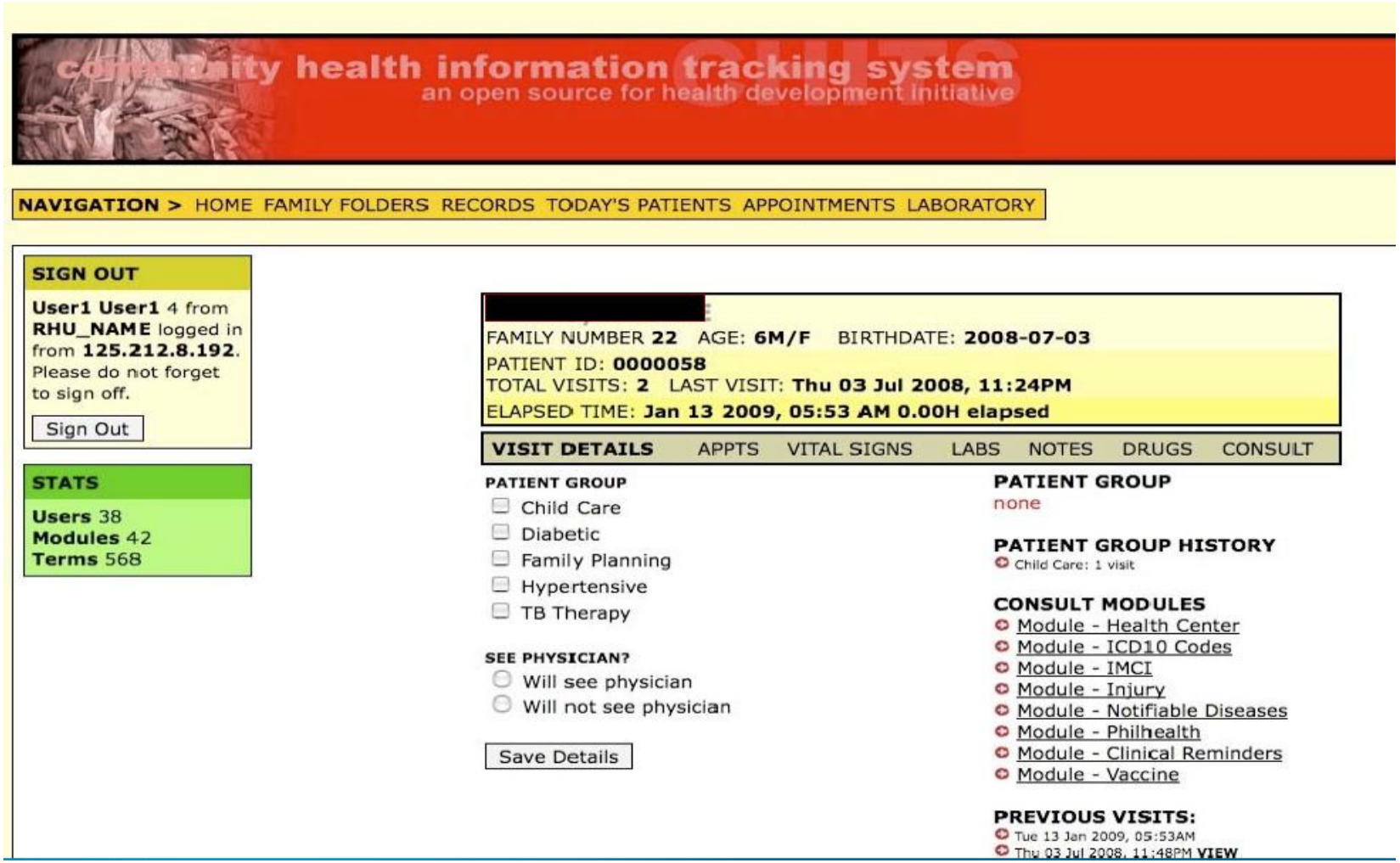

Figure 6: Community Health Information Tracking System[67]

[67] *Source: Wee, 2010; Marcelo, 2010*

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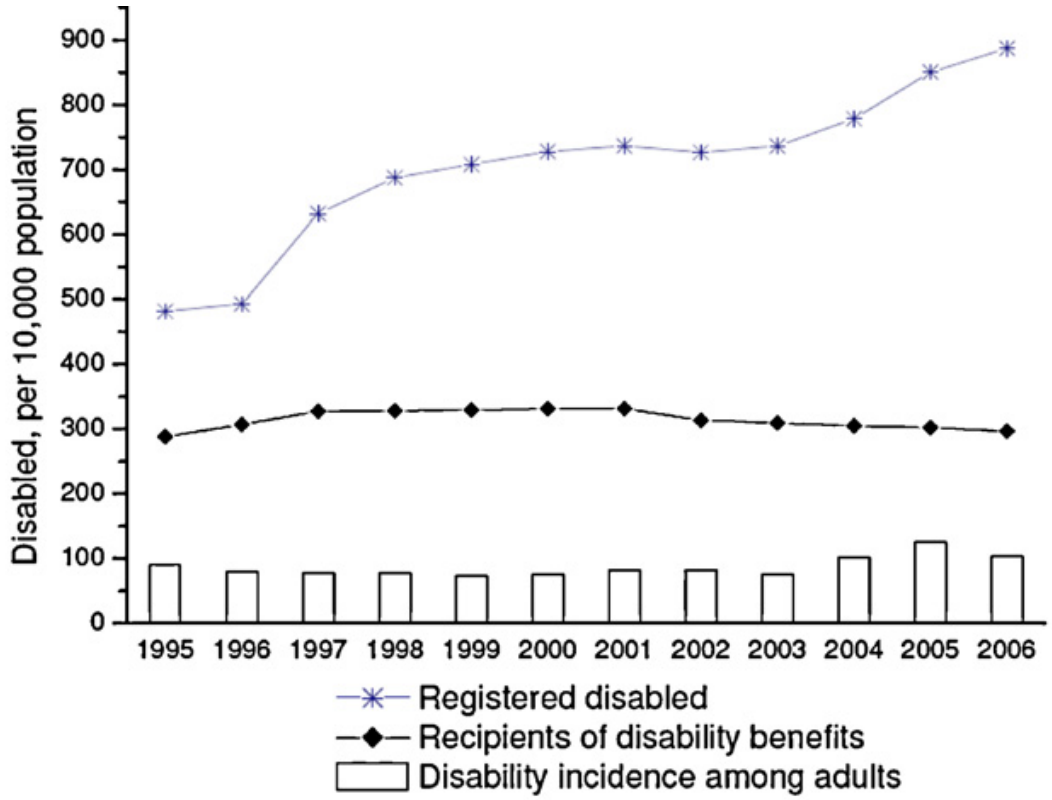
Russia

1. Demographic

1.1.Disability Statistics

According to the Federal Service of State Statistics, in January 2007, there were 13,014,000 people with disabilities officially registered in Russia. Presently, the number of disabled persons in Russia is around seven percent of the entire population and has a tendency to grow (Figure 1).



Source: *Public Health in Russia* (Rosstat 2001, 2005, 2007); *Statistical Yearbook of Russia* (Rosstat 2000, 2007)

Figure 1: Disabled population in Russia, 1995–2006[68].

According to the research of Becker and Merkuryeva 2003 and 2012, disability risk in Russia rises sharply when the age increases, and declines with income and self-reported good health (Becker and Merkuryeva, 2003 and 2012).

1.2.The aging of Russia population and disability

The total population in Russia was last reported at 142.9 million people in 2011 (Federal Service of State Statistics, 2012) increased from 119.9 million in 1960, changing 18 percent

[68] *Source: Adopted from Becker and Merkuryeva, 2012*

during the last 50 years. Russia's population peaked in the early 1990s (at the time of the end of the Soviet Union) with about 148 million people in the economy. The United Nations estimates that Russia's population will decline from the current 143 million to a mere 111 million by 2050, a loss of more than 30 million people and a decrease of more than 20%. The primary causes of Russia's population decrease are a high death rate, low birth rate, high rate of abortions, and a low level of immigration. Figure 2 describes the historical and projected data for Russia's total population.

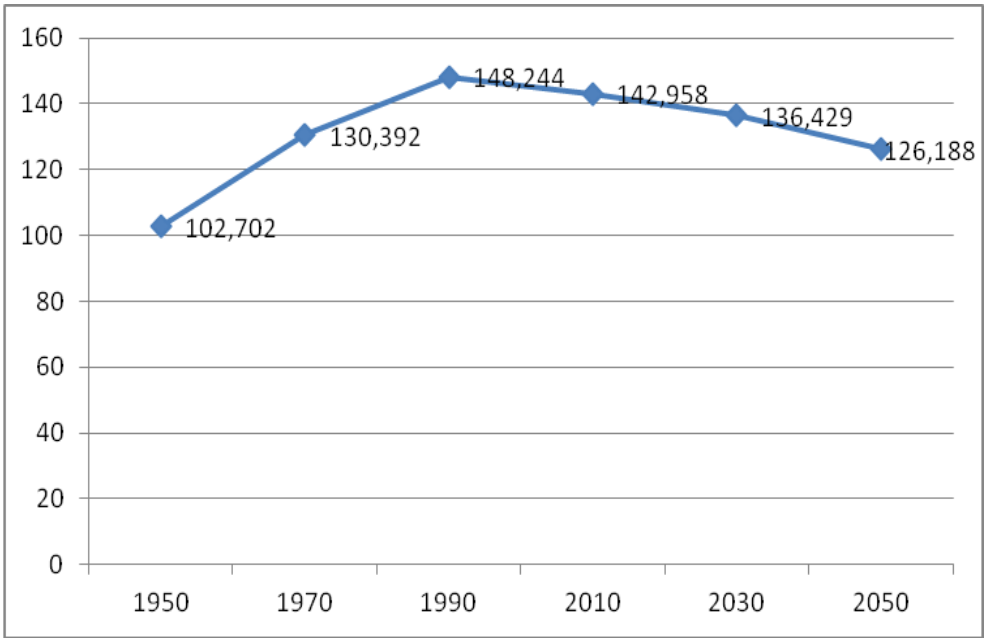


Figure 2: The historical and projected population of Russia (unit: millions)[69]

Despite the decrease in the total population, the proportion of seniors (aged 60+) continues increasing at rapidly accelerating speed as from only around 9 percent in 1950 to approximately 18 percent 50 years later and to more than 31 percent in 2050 as in the figure below.

[69] *Source: the author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

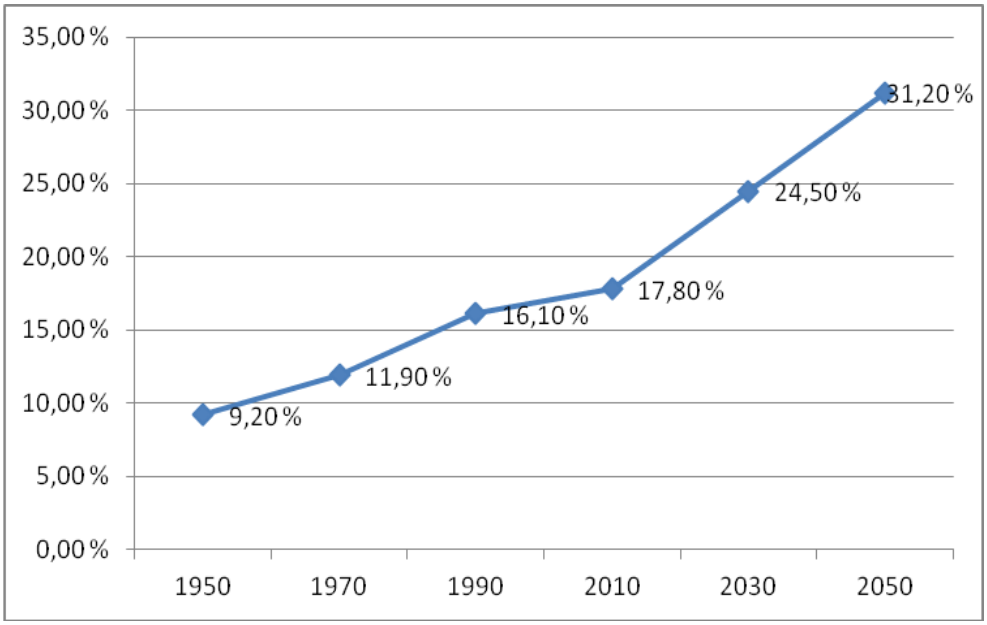


Figure 3: The projected Russian population aged 60+[70].

2. Policies

2.1.E-Health

Despite the currently relatively low level of Information and Communication Technology (ICT) deployment in the Russian healthcare sector, ICT is considered as a priority investment and development target in healthcare sector (Frost & Sullivan, 2012). Several major initiatives are currently being implemented at state and regional levels, such as the consolidation of the work of chief scientists in the area of health computerization, and the establishment of medical informatics associations. Other important initiatives are the establishment of a committee for standardization within the area of ICT in health, and the creation of a testing centre for software used in health care (WHO European region, 2006). Strong support also comes in form of the lobbying and promotional activities of the Russian Association of Healthcare IT vendors (ARMIT), a group of 284 developers operating in the healthcare sector. Especially, the Russian government recently has launched the comprehensive Healthcare Development Concept 2020 which aims to improve the health of the citizens by various solutions with the support of high technology such as installing new equipment at oncology centers to ensure greater detection of early-stage cancers and increasing access of the population to high technology medical services (The Stockholm Region office in St. Petersburg, 2010).

[70] *Source: the author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

The Russian Federation describes centralizing the compulsory medical insurance (OMC) system as the most effective action in building ICT infrastructure for the health sector. Standardization issues within the ICT field pose significant challenges (WHO European region, 2006). In addition, absence of legislation regulating electronic medical records is one of the main obstacles to the progress of deployment of ICT solutions in the Russian healthcare.

2.2.Accessibility

Russian Web-accessibility standard (RWAS) was developed in 2007 and the Federal Agency on Technical Regulating and Metrology is an official organization to issue Certificates of Compliance with Russian Web-accessibility standard (RWAS). On the 1st of January, 2009 a national standard: "GOST R 52872-2007: The Internet-Resources. Requirements of Accessibility for -Visually Impaired Persons" which serves as a technical foundation for implementation of international and Russian socially oriented laws on free information access for blind and visually impaired people was issued (Popko and Kamynin, 2010). However, according to Minister of Labour and Social Security, people with disabilities have problems with the accessibility of information and communication services (the Russian Government, a government meeting, 13 September 2012). Popko and Kamynin, 2010 also stated that only few federal government agencies (such as Federal Ministry of Health and Social Development and Central Election Commission) strive to provide some accessibility of their official web resources and the same situation in the private sector where few large international organizations (e.g. Russian UN office) attempt to conduct professional accessibility-testing to redesign web-interface based on the principles of WCAG (Popko and Kamynin, 2010).

Therefore, the Accessible Environment program was drafted in 2008, after the Government signed the UN Convention on the Rights of Persons with Disabilities, in order to create a barrier-free environment for people with disabilities. Regarding information accessibilities, in 2011, federal agencies, including the Ministry of Communications and several other ministries, have created guidelines on the Living Together website. Maps and a list of social sector, transport and communications facilities can be accessed online by disabled people. The Ministry of Communications is also installing subtitling equipment at the main TV channels. Further, specialized websites for disabled people and subtitles for the deaf on TV channels are set up (the Russian Government, a government meeting, 13 September 2012).

Russia ratified the Convention on the Rights of Persons with Disabilities on May 3, 2012. The implementing of the convention has been aided by different programs and policies, of which is the establishment of the Russian version of the e-Accessibility Policy Toolkit. This toolkit supports the various stakeholders to realize the tenets of the convention (United Nations Information Centers, 2011). Furthermore, there are social programs and initiatives to support ICT literacy of elder citizens such as online computer literacy classes (see http://www.webgramota.ru/).

3. ICT services and applications for people with special needs

3.1.E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

Telemedicine has become part of the long range plans of Russian national health policy. The geography of Russia and the complex structure of the Russian health-care system make telemedicine systems especially appropriate (Orlov et al., 2003; Khasanshina and Stachura, 2006). In Russia, telemedicine has its roots in the space program (i.e. the first telemedicine started as space flight telemetry in 1960) and evolved during the course of 40 years of space exploration. The Russian Telemedicine Foundation (RTF) was established in 1997 and regional telemedicine centers are operating in more than 20 cities as in figure below (Doarn et al., 2003).

An example is the telemedicine project between Nizhny Novgorod and the Privolzhsky District which was one of the first in Russia to introduce telemedicine technologies in clinical practice. The project established a high-speed telemedicine center and provided training courses and tele-consultations with specialists from the most advanced medical institutions in Moscow. The regional telemedicine network linked nearly 78 medical sites and provided approximately 500 tele-consultations and 100 educational sessions within the past 3 years (Orlov et al., 2003). The Russian Ministry of Railways, which has its own healthcare institutions, also implemented its own fiber-optic backbone which is used among other things for tele-consultations and distance medical education to the railways workers (Khasanshina and Stachura, 2006).

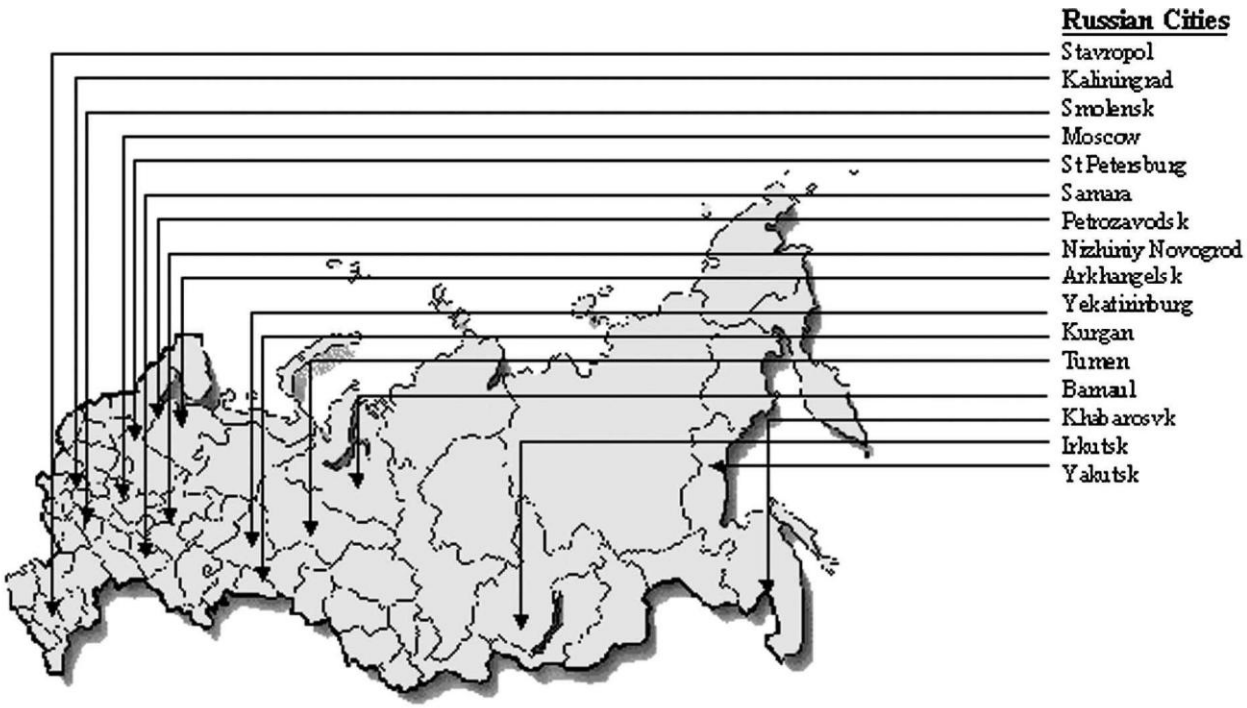


Figure 4: Active telemedicine programs in Russia[71]

Regarding mobile applications in healthcare, an example is Knopka Zhizni ("Life Button"), a mobile medical alert system for the elderly and the disabled. In addition, the electronic emergency bracelets and a one-button push emergency service also provides a way to connect senior people and help centres operating 24 hours a day and providing health-related information support for elderly (Figure 5). In early 2012, another online service ("Family Ribbon") which provides elderly friendly usage of Skype, Facebook and online photo services, was launched. The software is targeted at the seniors among other groups in connecting family members. The program also has reminders to help seniors take their medicines as in the schedule or remember their grand children's birthdays (Gorelova, 2012).

[71] *Source: adopted from Doarn et al., 2003*

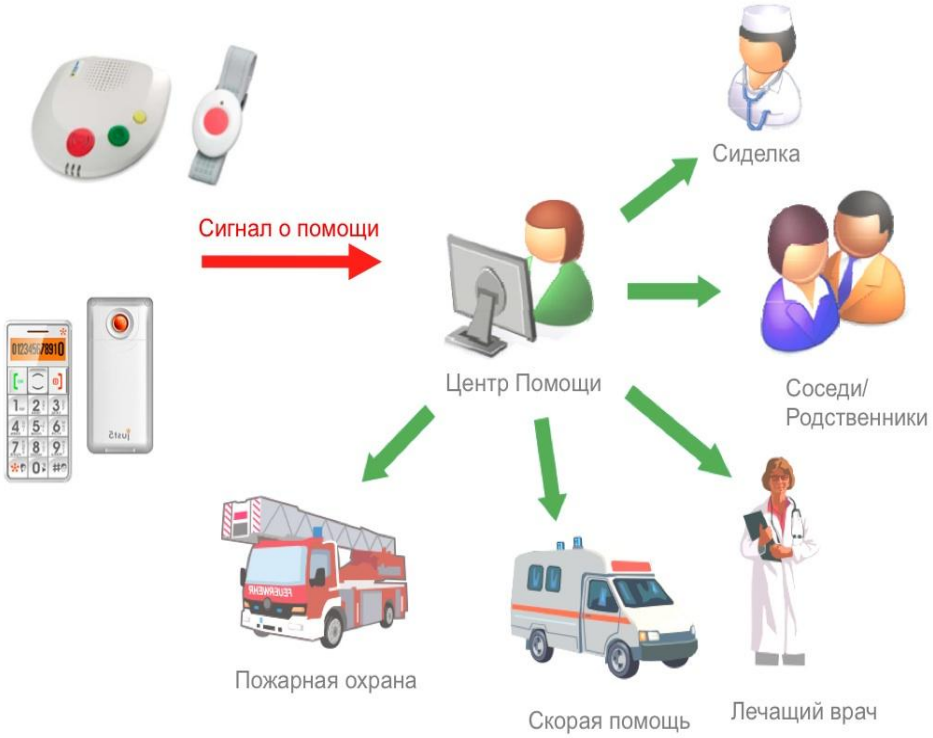


Figure 5: Emergency–services for senior people[72]

3.1.2. Electronic Health Record (EHR)

According to the analyst company Frost and Sullivan (2009), the percentage of Russian hospitals with modern IT systems in use was only 20 percent. Each hospital was equipped with 37 computers on average, approximately one device for every five staff members. However, investments in healthcare IT is expected to increase from 310 million dollars in 2010 to 882.0 million dollars in 2017 (Frost & Sullivan, 2012).

The National Standard of Russia "the Electronic Health Record" that has been developed based on experience acquired by design and implementation of EHR system of the National Center for Hematology (NCH) in Moscow since 2008. NCH has applied Internet technologies in clinical trials and expected that the patients are active participants of treatment and reporting outcomes. As a result, in 2009, it started the Personal Health Records service (PHR service) that allows patients to manage their own medical records and have internet-based communication with on www.medarhiv.ru (Shklovskiy-Kordi et al., 2011).

Recently, several other hospitals throughout the economy, including in Moscow, St. Petersburg, Pskov, Kirov, and Vladimir have switched from paper-based medical systems to

[72] *Source: http://knopka24.ru/*

a new solution (i.e. Health Integration Framework) from IBM which was first used by Municipal S.Z. Fisher Hospital No. 1 in Volzhsky in the Volgograd region of Russia. Furthermore, IBM stated that the system is the first health care solutions which comply with all standards (HL7, HIPAA, and IHE) and can serve as a roadmap for other hospitals throughout Russia (IBM News room, 2011).

However, there is still a lack of standardizing information exchange between the hospitals and the various medical information systems and applications. This means that the current systems cannot be used with maximum efficiency. Another area of development is the localization of health-related web sites by translation and cultural adaptation. It is considered important that Russian speakers have access to foreign-language medical information and are able to access electronic libraries in their mother tongue (WHO European region, 2006).

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Singapore

1. Demographic

1.1. People with disabilities

Since 1989, the Central Registry of Disabled Persons was disbanded at the advice of the Advisory Council on the Disabled. Currently there is still no official central registry of persons with disabilities. Existing data from government agencies such as Ministry of Culture, Community and Youth (MCCY), Ministry of Education (MOE) and Ministry of Health (MOH) are estimates based on incidence rates and service utilization. Approximately 3 percent of the resident population has some form of disability. There are approximately 7,000 preschool children with developmental difficulties, 13,000 school-going children with special needs and more than 80% is the adults as the table below.

Table 1: Prevalence rates of disability in Singapore[73]

	Incidence Rate	Estimated No. Of PWDs (Based on 2010 population)
Preschool (0-6 years)^	3.2%	7,000
School (7-18 years)+	2.5%	13, 000 (7,600 mainstream, 5,400 SPED)
Adulthood & Aged# (>18 years)[3]	2.5%	77, 200

1.2. The aging of Singapore population

Reflecting the ageing population, the median age of the resident population rose from 37.4 years in 2010 to 38 years in 2011. Consequently, the proportion of Singapore residents aged 65 years and over increased from 7.2% of the population in 2000 to 9.30% in 2011 (Figure 1). According to UN forecast, in two decades, an estimated 20 percent of the Singapore population will be 65 years or older, compared to 9.3 percent at present (Figure 2).

The severity of handicap has directly correlation with age as found in the study of Yadav, 2001. In a sample survey of 1209 elderly Singaporeans living in parliamentary constituencies which have high proportions of the aged population more than one third of the elderly had a handicap and more than half of the aged had a disability (Yadav, 2001).

[73] *Source: MOH's Child Development Unit statistics 2006 – 2011; MOE data on school-going cohort 2005 – 2010; and MOH's National Health Surveillance Survey 2001*

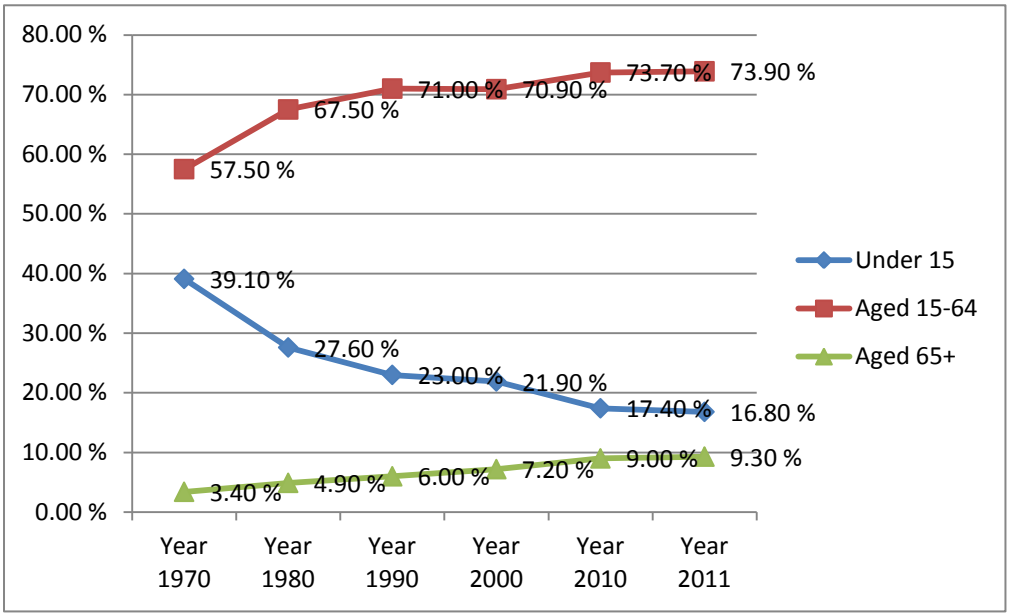

Figure 1: Proportion of the Singapore population under 15, aged 15 – 64, and aged 65+[74]

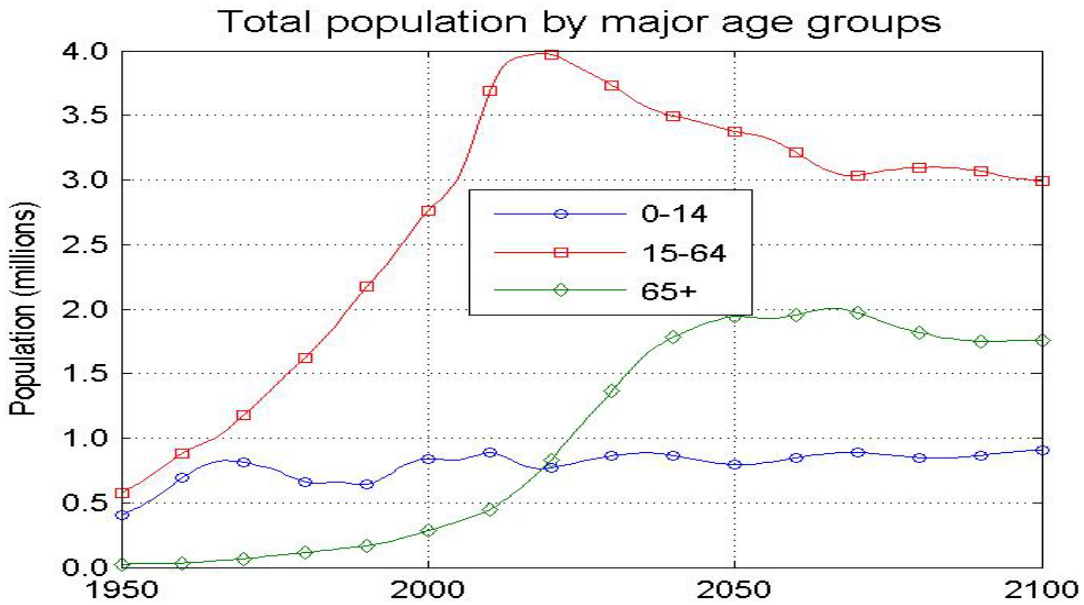

Figure 2: Total population by major age groups[75]

2. Policies

2.1. E-Health

The goal of the iN2015 programmes (*Infocomm Development Authority, iN2015 Masterplan),*

[74] *Source: the author composed based on the data from Key Demographic Indicators 1970 – 2011, Statistics Singapore at http://www.singstat.gov.sg/stats/themes/people/popnindicators2012.pdf*
[75] *Source: World Population Prospects, the 2010 Revision, UN*

a 10-year plan is to utilize infocomm technologies to establish a well connected society. The healthcare sector accelerates its transformation through an infocomm-enabled personalized healthcare delivery system to achieve high quality clinical care, service excellence, cost-effectiveness and strong clinical research. The various programs initiated to reach the goal of providing each citizen a single health record are listed below.

National Electronic Health Record (NEHR)

To improve healthcare quality for all residents, increase patient safety, lower healthcare costs and develop more effective health policies, Singapore's Ministry of Health (MOH) created the National Electronic Health Record (NEHR) vision - "One Singaporean, One Health Record" - which enables patient health records to be shared across the nation's healthcare ecosystem.

Integrated Clinical Management System (CMS)

Launched in 2006, the Integrated Clinic Management Systems (CMS) program aims to encourage GP clinics to adopt and leverage on infocomm technologies to facilitate operations and clinical improvements in their patient care. The integrated CMS facilitates scalability of the GP infrastructure by enabling consistent and standards based interface with different healthcare provider systems. Secured and seamless information flow will allow GPs to plan the patient's treatment in an integrated and coordinated manner with other hospitals and step-down care providers. Through this program, GPs will have the capability to easily plug into the national healthcare network and achieve MOH's "One Singaporean, One Electronic Medical Record" vision.

GP-IT Enablement Programme

Building on the momentum of the CMS Program which has resulted in most GPs having some form of IT system in place, the GP-IT Enablement Program was conceptualized in 2010 as the next phase of GP IT adoption. It aims to support more sophisticated IT usage for GPs through introduction of an IT-enabled clinical foundation that contains linkages to the National Electronic Health Record (NEHR) and care services such as laboratory and diagnostic radiology results. GPs currently participating in the CMS Program will be transited to the IT-enabled clinical foundation when the system is implemented.

Intermediate and Long-Term Care (ITLC) IT Enablement Program

The ILTC sector comprises residential and community-based services and is currently

managed mostly (approximately 70%) by voluntary welfare organisations (VWOs), where resources are usually stretched, clinical documentation capability or management is limited, IT usage is minimal and IT expertise a scarce occurrence. To address these issues, the ILTC Programme consists of an IT strategic framework that aims to establish the core foundation for the use of technology across ILTC settings, for operational efficiency, and subsequent electronic exchange of information between care settings within the ILTC sector and nationally to the National Electronic Health Record (NEHR). In addition, an ILTC IT Adoption Model will be developed to categorise the IT adoption of different care facilities, to allow policy planning to better develop specific programmes to meet the needs of care facilities with similar maturity levels, and to increase industry interest in the ILTC sector to explore more innovative & sustainable solutions and develop more targeted products and services for the care providers and care givers.

2.2.Accessibility

2.2.1. Social Service Sector ICT Masterplan (2012-2016)(SS2016)

The Social Service Sector comprises five sub-sectors namely:

- Family services - families in need of support;
- Eldercare services - seniors in need of support;
- Children disability services - children with special needs aged 0-18 years;
- Adult disability services - persons with disabilities aged 16-55 years; and
- Children and youth services - children and youth in need of support.

In order to create an inclusive society, SS2016, which was designed by then Ministry of Community Development, Youth and Sports (MCYS) (now Ministry of Culture, Community and Youth; and Ministry of Social and Family Development), together with the National Council of Social Service (NCSS), and the Infocomm Development Authority of Singapore (IDA), aims to enable the delivery of coordinated and integrated social services through VWOs and Help Agencies by the adoption of ICT, to some 400 Voluntary Welfare Organizations (VWOs), and about 8,000 social service personnel.

The three key strategies of SS2016 are:

- Strategy 1 - Innovative use and adoption of ICT to build VWO capability to maximize productivity and improve service delivery.

- Strategy 2 - Create a conducive client-centric environment to enable the social service workers to deliver connected, seamless and accessible social services to the clients.
- Strategy 3 - Streamline and simplify information management to enhance the collection, sharing and use of information within the sector so as to facilitate strategic and operational planning of social services.

2.2.2. Enabling Masterplan 2012-2016

MCYS has developed the Enabling Masterplan 2012-2016 which the vision is for an inclusive Singapore where every person with disability can maximize his potential and is embraced as an integral member of the society. MCYS has also announced enhancements to the Assistive Technology Fund (ATF); a part of Enabling Masterplan helps disabled students and employees purchase assistive technology devices for education and work purposes. To date, about 780 ATF applications have been approved. A further 900 individuals is expected to benefit from the enhanced ATF.

2.2.3. Web accessibility

The Singapore Government recognizes the importance of ensuring universal access. Therefore since 2004, the Government (IDA) has introduced a set of Web Interface Standards (WIS) for government websites to comply. Under the WIS, government agencies are required to adopt a set of mandatory standards and recommended guidelines for designing their websites and online services. The guidelines include catering to the needs of the disabled by adopting World Wide Web Consortium (W3C) and Web Content Accessibility Guidelines. However, government-wide web accessibility can only be achieved if it's mandatory. It is hoped that the next review of the WIS will make accessibility a requirement.

Besides, IDA has also updated both the www.gov.sg and eCitizen portals. As part of the update, IDA has incorporated more Web accessibility features in these portals. This is positive development to have more accessibility on government websites.

3. ICT Applications and Services for people with special needs

3.1. E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

As Singapore prepares itself for the rapidly ageing population, Telehealth will be a key enabler behind strategies that are being adopted to enable "ageing-in-place". In line with this, IDA, in collaboration with Ministry of Health (MOH), is inviting the industry to participate in

the Telehealth Call-for-Collaboration (CFC). This CFC aims to develop new models of distance care for the elderly - at home, within the community or at institutions such as nursing homes - assisted by ICT.

3.1.2. Electronic Health Record (EHR) or Electronic Medical Record (EMR)

In 2009, MOH Holdings (MOHH), the holding company of Singapore's public health assets, initiated the project to develop the NEHR system. The first phase of the NEHR system went live in April 2011 and included putting in place the entire technical solution, all physical system components, and data centre equipment in fully tested and approved state. This was followed by the synchronization and integration of the NEHR system with existing legacy systems. The long-term goal of the NEHR is to allow primary-, acute- and community-care clinicians access to shared clinical data that help to enhance medical treatment and improve safety and in the future help analyze health trends and better manage disease. The first phase of release offers the following capabilities:

- A National Health Identification Service (NHIS) or patient master index to match patient records across the health domain.
- Summary care records, which provide a concise overview of individuals' most recent clinical activities.
- Access to discharge and event summaries, which provide high-level overviews of specific clinical episodes (such as hospital admissions).
- Access to health data in national registries; Singapore's NEHR also serves as a doorway to access health data residing in existing national registries for immunization, medical alerts and allergies.
- Privacy and security, including role-based access, data sensitivity classification and "break-the-glass" functionality for use during emergencies.
- Audit and logging capabilities, which capture who has accessed information, when, where and how.

EMRs are essentially electronic versions of paper-based medical records which can be easily shared online across IT-enabled healthcare institutions. The **Electronic Medical Record Exchange (EMRX)** allows all public hospitals and polyclinics in Singapore to share patient records online was launched from April 2004.

3.2. Smart Home

The Connected Homes program was completed in 2008. It provided a test-bed environment for the industry to develop and pilot innovative and integrated end-to-end solutions for the homes and community. It included two Calls-for-collaboration and trials in homes and communities.

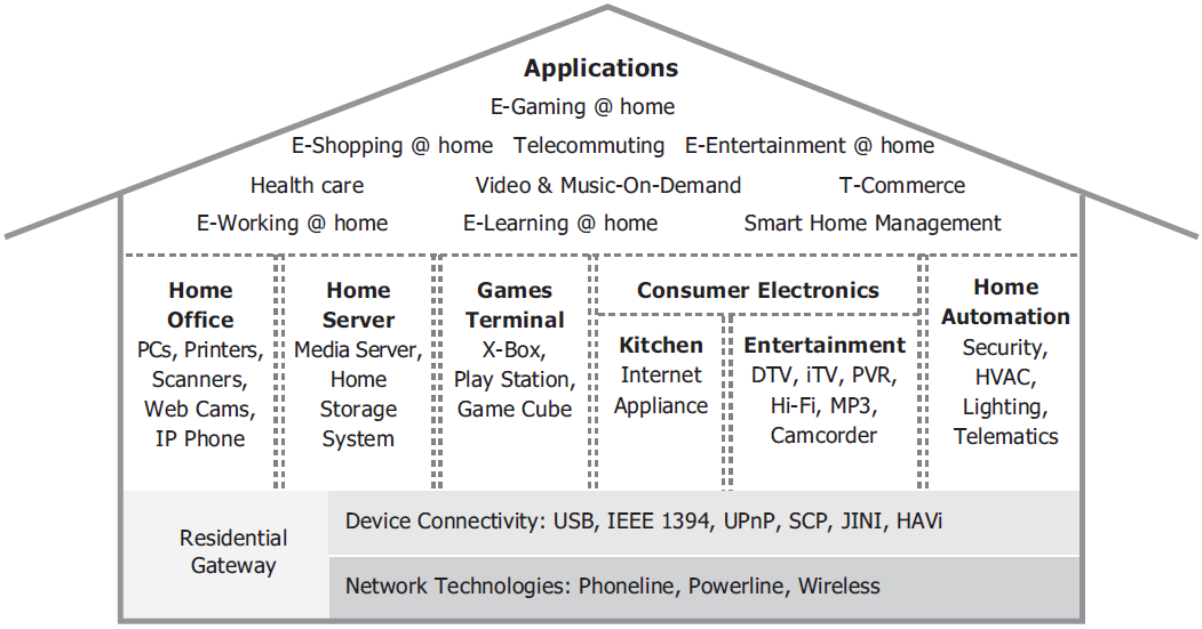

Figure 3: Overview of "The Connected Home"[76]

3.3. Robotics

A*STAR (see http://www.asoro.a-star.edu.sg) is Singapore's lead government agency dedicated to fostering world-class scientific research and talent for a vibrant knowledge-based economy. They have a department that looks at robotics for social use. Lucas the robot for example, can be used for home based tele-health while Mica can work as home robot helper.

[76] *Source: IDA, "The Connected Home", 4th Infocomm Technology Roadmap Report 2002 – 2007*

Figure 4: Lucas-Tele-present Robot and Mika Robot[77]

Another example is the latest generation of service robots called Snowie and Walkabot (Figure 5) which were developed in the Advance Robotics and Intelligent Control Centre (ARICC) at the Singapore Polytechnic to help people with daily activities.

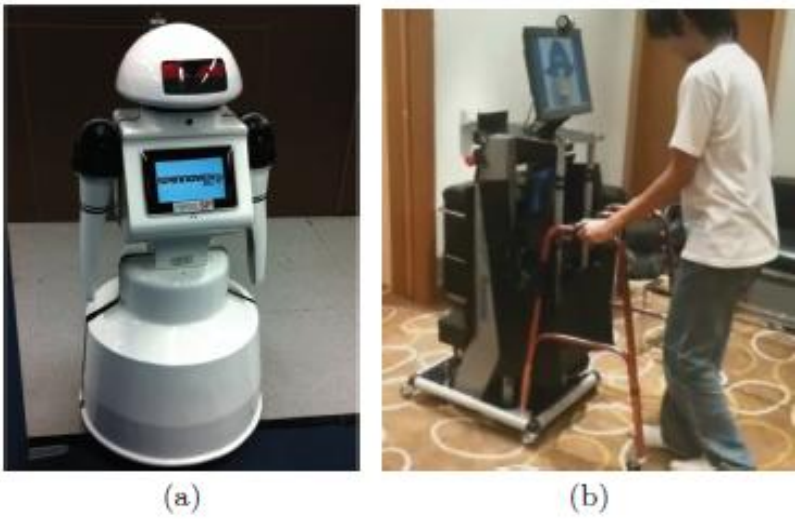

Figure 5 (a) the Snowie robot and (b) the Walkabot robot[78]

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[77] *Source:* http://www.asoro.a-star.edu.sg
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Chinese Taipei

1. Demographic

1.1. Disability statistic

According to the statistics of Directorate-General of Budget, Accounting and Statistics, Executive Yuan, in 2011 there were around 1,100,000 people who have physical or mental disabilities registered with the department, which represents 4.7 percent of the Chinese Taipei's population. According to the analysis of the disabled population of the Department of Statistics, Ministry of the Interior at the end of 2000 and 2011, the biggest age group of the physically and mentally disabled citizens was those over 65 increasing from 34.86 percent to 37 percent, in 2000 followed by those between 30–44 (21.90 percent) and 45–59 (27.24 percent), but in 2011 followed by those between 45-49 (21.90 percent) and 30-44 (14.7 percent). The number of people with disabilities is rising due to aging. Thus, the 2010 survey of Department of Health (DOH) estimated that the disabled population would reach 1.04 million by 2026.

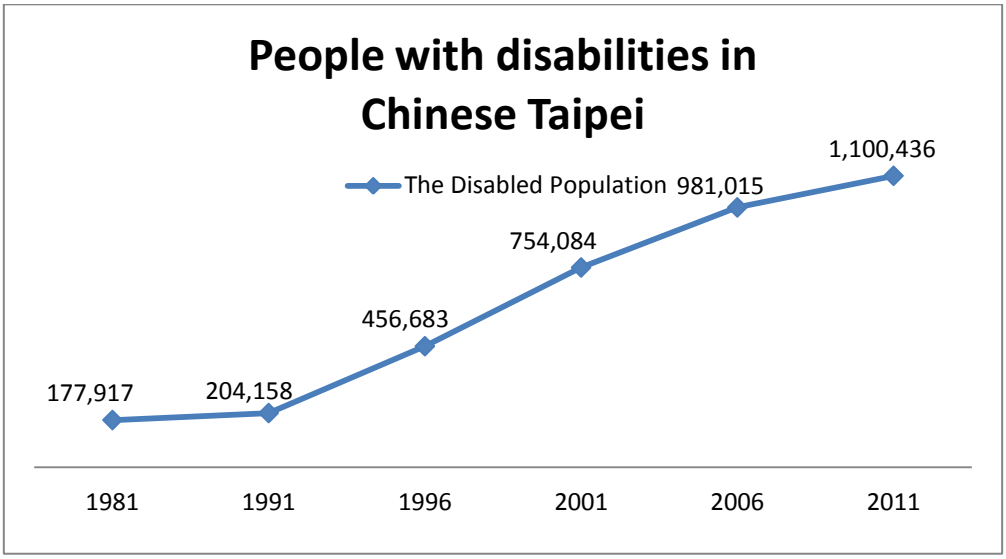

Figure 1: The statistics of disability in Chinese Taipei 1981-2011 (unit: persons)[79]

1.2. The aging of Chinese Taipei population

The Chinese Taipei's population increases gradually during the last decades, i.e. from around 18 million in 1990 to about 23 million in 2011. The Chinese Taipei's population is also aging. Already in 1993 the proportion of those aged 65 and older population reached around

[79] *Source: The author composed based on the data from Tais and Ho, 2010; The Department of Statistics, Ministry of the Interior at* http://www.moi.gov.tw/stat/english/index.asp

7 percent of population.

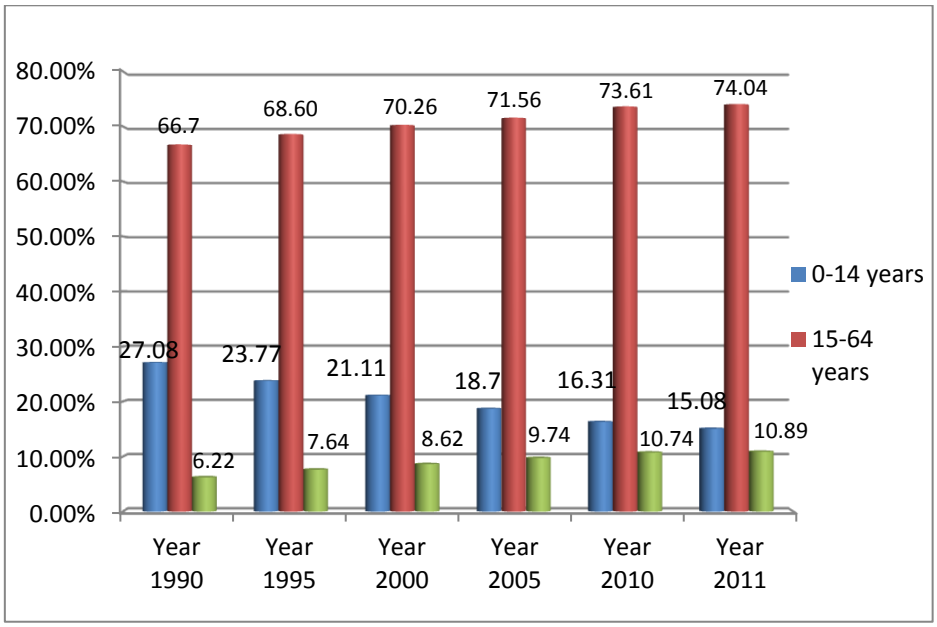

Figure 2: Percentage of age distribution 1990-2011 (unit: %)[80]

The population will turn to a steep decline from year 2060 (due to the low birthrate and other reasons). Concurrently with the decrease in population is the quick aging as projected in Figure 3. The proportion of those aged 65 and older is forecasted to be almost doubled from 7 percent in 1993 to 12.5 percent in 2015.

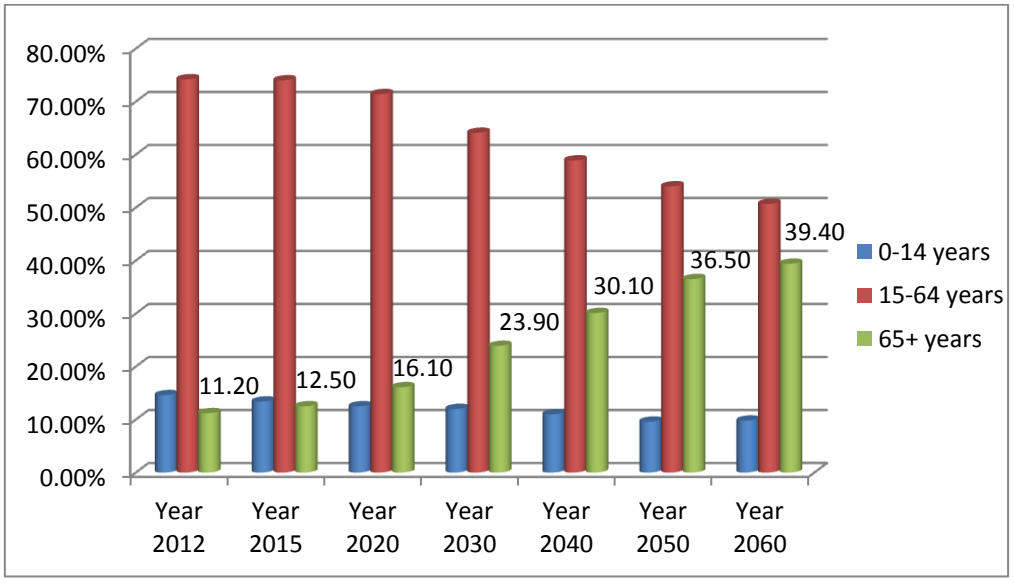

Figure 3: Projected percentage of age distribution 2012-2060 (unit: %)[81]

[80] *Source: The author composed based on the data from Department of Statistics, Ministry of the Interior at* http://www.moi.gov.tw/stat/english/index.asp

[81] *Source: The author composed based on the data from Council for Economic Planning and*

2. Policies

2.1. E-Health

Chinese Taipei uses several E-Health technologies, among them electronic patient records, smart card medical health interface, medical kiosks, and telehealth for remote areas. The smart cards have been in operation from 2004, and carry patient medical information such as data on the last six medical visits, data on prescriptions and medication for allergic reactions, organ donation willingness and vaccinations. The privacy of this information is guaranteed by having only specialized readers decode the data on the cards. The medical kiosks are installed in most hospitals in Chinese Taipei, and facilitate self-service registration, payments, and in some cases access to medical records.

Chinese Taipei is known as an IT manufacturing hub and many medical equipment makers are based there. The Minister of the Department of Health, Chiu Wen-Ta, argues that Chinese Taipei aims to provide "ubiquitous healthcare" using IT to its citizens. He claims Chinese Taipei is well placed to become a forerunner in applying IT to medical pursuits (Hou, 2011).

2.2. Accessibility

From year 1980, people with disabilities received the constitutional right for medical rehabilitation, preferential education, promotion of employment, and welfare services. Until then, disabled people were expected to rely on their family and relatives, as well as non-profit organizations for support (Chang 2007), but now, the Law on the Protection of Physically and Mentally Handicapped places responsibilities for their care on the government. In addition, the state is obliged to provide insurance, medical care, barrier-free environments, education, vocational guidance, and other assistance for disabled people (IDRM Compendium Report 2003).

Accessibility guidelines have been on the agenda for some time already. The Research, Development and Evaluation Commission (RDEC) of the Executive Yuan is the governmental department in charge of making the regulations and supervising the websites of all governmental agencies to stratify Web accessibility in Chinese Taipei. In 2002, the RDEC of The Executive Yuan of Chinese Taipei adopted the Web Content Accessibility Guideline (WCAG 1.0) of WAI (Website Accessibility Initiates) from W3C (World Wide Web Consortium) and all kinds of policy and strategy economies around the world to establish

Development of Population Projections for R.O.C. (Taiwan): 2012~2060 at http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0001457

"The Guidelines of Accessible Websites." From 2003, a service has been offered on-line by which webmasters can validate their websites and receive the "claim of conformances" if they satisfy the requirements. According to Chen et al. (2005), additional tools have been offered, including a stand-alone validation tool "Freego".

3. ICT services and application for people with special needs

Three nationwide plans for ICT development in Chinese Taipei have been adopted: the e-Chinese Taipei in 2002, and the m-Chinese Taipei and u-Chinese Taipei in 2008. The latest, u-Chinese Taipei, embraces the idea that Chinese Taipei should be developed to become a Ubiquitous Network Society. The problems to be addressed by this development include energy shortages, the aging population, low birth rates, and security.

3.1. E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

The development of telemedicine in Chinese Taipei can be divided into three stages. The first began in 1994 and consisted of initiation research, i.e. testing and developing different network platforms and promotion research under the National Information Infrastructure Project. In 1997, the telemedicine systems were applied in various medical subspecialties, and in 2000, the implementation was commenced with mature and ready to market applications (Chen et al. 2001). Figure 4 outlines the major telemedicine systems in Chinese Taipei.

Acute tertiary care centers and teaching hospitals played the leading role in telemedicine implementation and evaluation. For example, National Chinese Taipei University Hospital (NTUH) joined the NII telemedicine scheme at its launching in 1995. Then, in 1997, NTUH expanded its telemedicine program by directly connecting with National Cheng-Kung University Hospital, the most important telemedicine center in southern Chinese Taipei. The link was created to serve as a backbone network for the national telemedicine service, and it has been used to conduct numerous consultations and teaching cases between the hospitals (Hu et al., 2002).

The early telecare/telehealth projects in Chinese Taipei (i.e. "Pilot Telecare Project" and "Telecare Services Modification and Quality Promotion Project") were commenced in 2007 and 2008, by the Department of Health (DoH) and the Department of Industrial Technology (DoIT). This latter project is depicted in Figure 5. Its objective was to verify the integration, accessibility, scalability and business model options of telecare in Chinese Taipei, and combines home care, institution care,

community healthcare and living support (Huang et al., 2008).

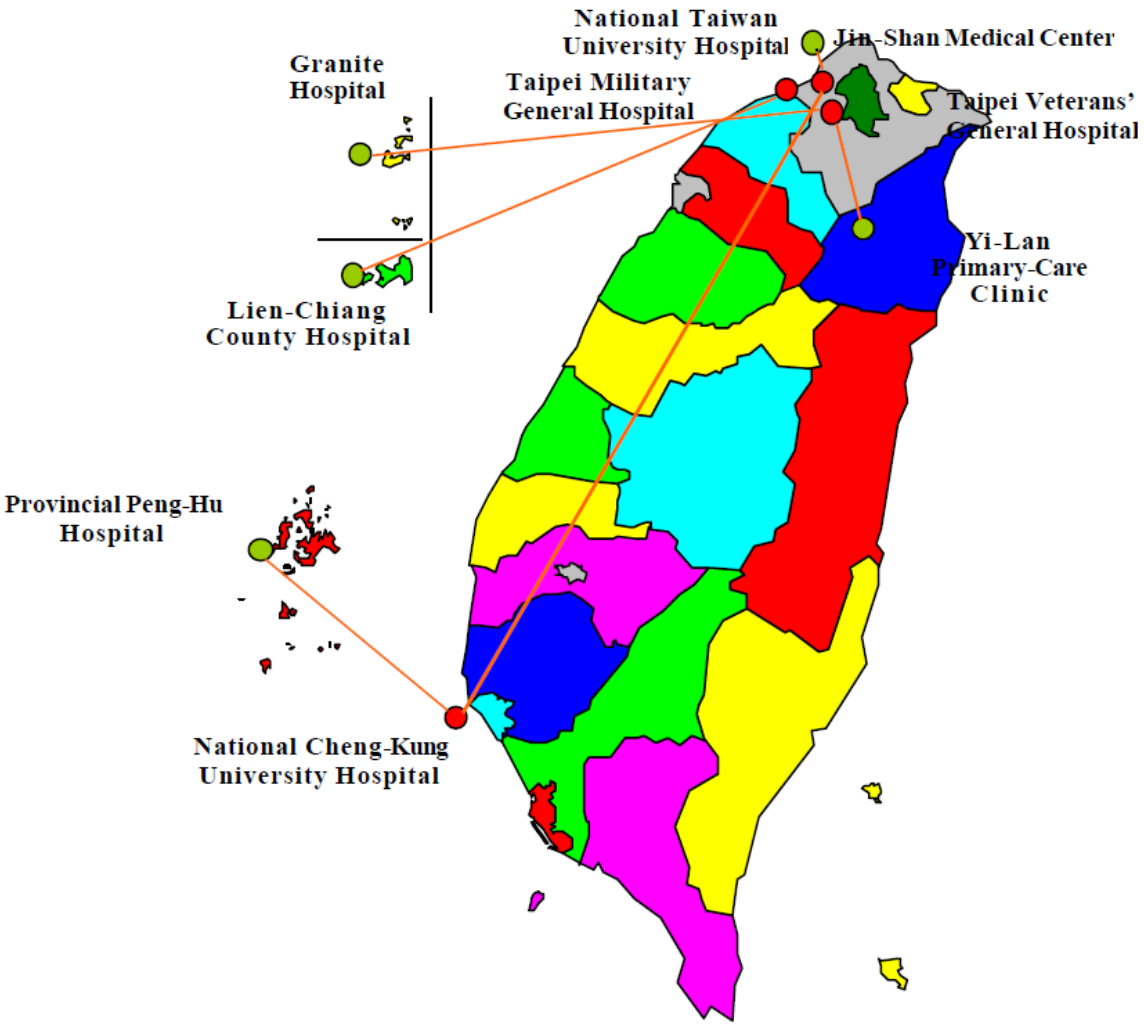

Figure 4: Major Telemedicine programs in Chinese Taipei[82]

Both pilot projects have successfully established the foundation of technology utilization for long term care services and been targeting the promotion of health care accessibility in order to support health care continuum. Based on the results of previous pilot projects, the DOH plans to carry out the "Telecare Service Development Project" from 2010 to 2014[83]. In order to replicate and spread Tele-healthcare services throughout Chinese Taipei, the DOH commissioned teams in the northern, central, southern, and eastern regions to integrate 62 healthcare institutions into a Tele-healthcare network. As of the end of June 2011, the network has provided 745,061 services for 3,717 people. In order to achieve the main goal of service sustainability, the network establishes regional service centers to integrate care

[82] *Source: Hu et al., 2002*

[83] *Source: http://doh.telecare.com.tw/eng_Index.htm*

resources and provide the public with real-time consultation and health management services.

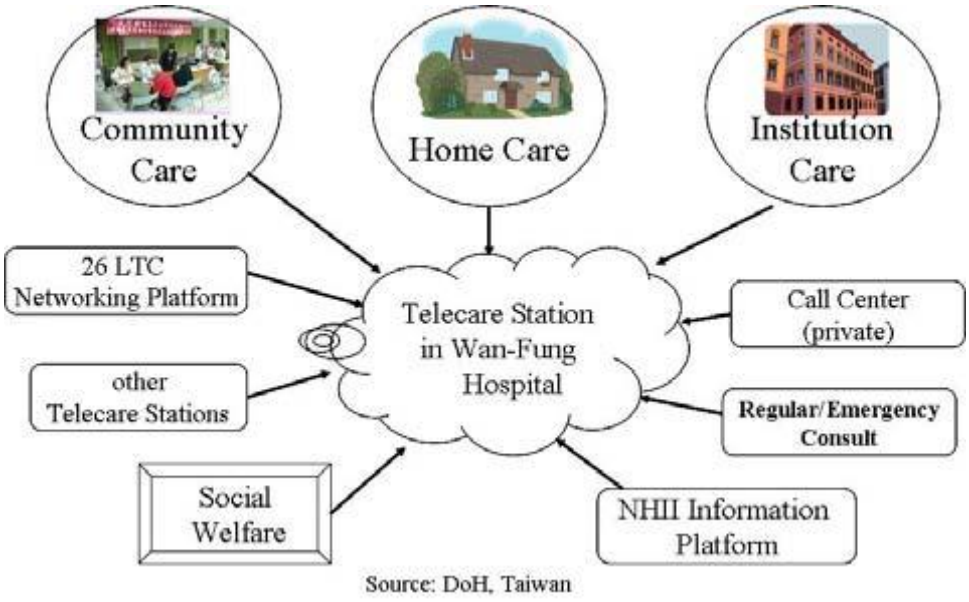

Figure 5: The architecture of DoH Telecare pilot project[84]

Regarding the application of mobile services in Telecare, an example is the Minibond phone (Figure 6) developed in 2006 by Chung-Hwa Telecommunication Company and Chung-Shing Security Company to provide location-based services for children, women and older people. An older person with dementia can press the SOS button to request for help if s/he gets lost. In addition, his/her family members can call the Call Center or access a website to find his/her position by way of Assisted Global Positioning System (AGPS) (Lin, 2010).

Figure 6: The Minibond phone[85]

[84] *Source: Huang et al., 2008*

The success factors of Chinese Taipei's telemedicine service may be said to be fourfold. First, the DOH has had a critical role in the program assessment and coordination. It has functioned as a centralized program planner, integrating individual services into the nationwide network. Second, the role of the government has been important also in the costs support area. Telemedicine has been reimbursable within the National Health Insurance Scheme and the National Infrastructure Initiative. Third, each initiative was allowed to remain independent, giving them more flexibility in terms of services and specialties provided. Fourth, the technology base of each program was fairly strong, and telemedicine services were built on top of this foundation (Hu et al., 2002; Chen et al.; 2001, Lin, 2010).

Furthermore, in response to future healthcare plans in government cloud computing, the DOH will integrate the healthcare cloud with regional healthcare services, link regional service systems and life resources, and establish a cloud healthcare record database. The Department also will use various cloud computing terminal equipment to provide new types of smart, mobile, and personalized healthcare services.

3.1.2. Electronic Health Record (EHR)/Electronic Medical Record (EMR)

The Department of Health (DOH) introduced the Nationwide Electronic Medical Record plan in November, 2010. The plan allows doctors from different hospitals to access a patient's EMR with the patient's consent. The plan was launched at 126 hospitals in Chinese Taipei such as Taichung Veterans General Hospital, Taipei Medical University Hospital and Wan Fang Hospital. The plan also aims to extend the use of EMR to the 500 hospitals nationwide. The subsidies are provided based on the size of each hospital: the smaller the hospital, the larger the subsidy is.

According to Rau et al. (2010), the development of Chinese Taipei Electronic Medical Record standards was begun with an initiative from the government in 2004. This development was based on the Chinese Taipei Electronic Medical Record Template (TMT) designed by the Chinese Taipei Association for Medical Informatics. The first version of the basic outpatient, emergency and hospitalization EMR formats were completed in 2005, and in 2006, the templates for specialized departments were designed. After assessment and evaluations in three medical institutions, the updated TMT was developed into an international standard in 2007-2008. The development continued in 2009 with the addition of new formats, and a new project was expected to begin in 2010.

[85] *Source: Adopted from Lin, 2010*

3.1.3. Picture archiving and Communication System (PACS) and Health Information Systems (HIS)

The Department of Health (DOH) improves medical information available in remote indigenous communities by forming shared information platforms, set up Picture archiving and Communication system; and Health Information Systems are integrated. 31 health centers in Nanao Township, Yilan County were connected to the DOH-Hospital to improve the medical care quality in remote tribes, and also set up 268 mobile medical stations at 39 health centers in 13 counties to provide more convenient medical care services to the local residents, reducing the medical resource gap between cities and rural areas.

3.2. Smart Home

In 2007, Chinese Taipei's National Science Council launched a Smart Living Technology program by combining technology, humanity and culture. The program integrates together many other National Science Council programs and establishes three Smart Living Interactive Innovation Centers including the INSIGHT Center at National Chinese Taipei University (NTU) in northern Chinese Taipei, the Eco-City Center at National Chiao Tung University (NCTU) in central Chinese Taipei and the Touch Center at National Cheng Kung University (NCKU) in southern Chinese Taipei (Figure 7).

These centers have developed many applications on smart living with an extensive network of collaborative research and cooperation with various stakeholders such as the industry, government, scientific institutions, and research organizations. An example of a technology so developed is the TOUCH doctor (Figure 8), which had contributions from technology, communication and medicine (Lin et al. 2012).

Figure 7: The NCKU Aspiring Home for Quality Life (優質生活體驗屋)[86]

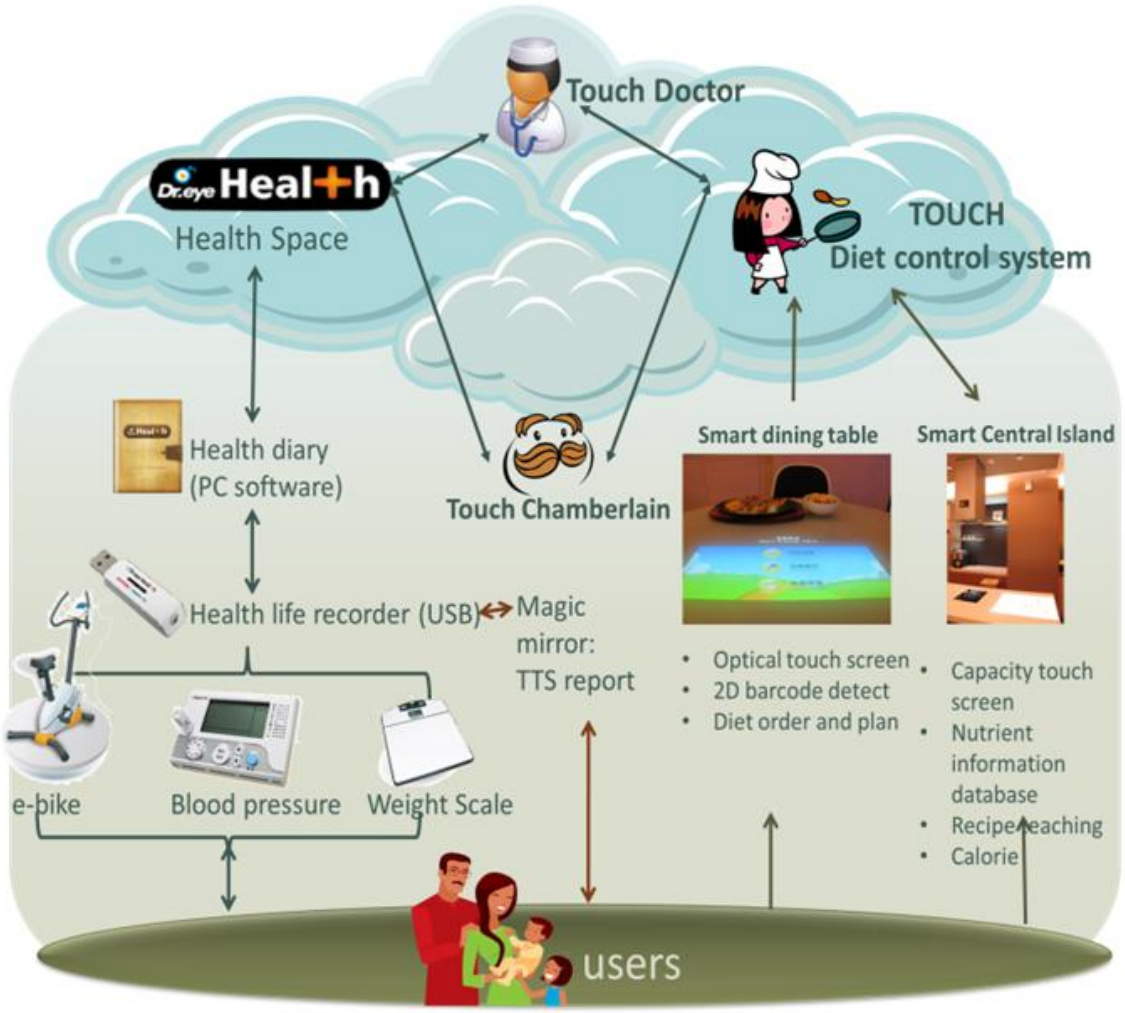

Figure 8: Complete design concept of TOUCH doctor, combining Dr. Eye Health, TOUCH diet control system, and TOUCH Chamberlain[87]

In order to let Living Lab approaches be well-adopted in i-Chinese Taipei's Intelligent Living projects, the Ministry of Economic Affairs/Chinese Taipei therefore launched an i236 project in 2009. The objective of the project is to create a Smart Town and Intelligent Park for applications including safety and disaster prevention, healthcare, energy sustainability, intelligent traffic management, comfort and convenience, and farming/leisure (Lin et al. 2012).

3.3. Robotics

Chinese Taipei has an existing industrial robotics sector that is supported by a strong

[86] *Source:* http://news-en.secr.ncku.edu.tw/files/16-1083-32415.php
[87] *Source: Lin et al., 2012*

competence in the ICT industry and precision machinery value chain. The economy's strengths lie in product commercialization and low-cost production. There is domestic demand to develop robotics for elderly and disabled people because the birth rates are low, and the elderly population increasing.

An example of a system developed to assist the mobility and stimulate the social activity of elderly people is the NTU-PAL1 and NTU-PAL2 robots, developed by National Chinese Taipei University. The former robot (Figure 9) is designed as a wheelchair and installed with cameras, laser scanners and sonar to increase the perception of the elderly person and allow free movement in both indoor and outdoor environments (Wang et al. 2009).

Figure 9: The NTU-PAL1 robot[88]

[88] *Source:* http://www.csie.ntu.edu.tw/~bobwang/Papers/wang_automation09.pdf

Figure 10: The NTU-PAL2 robot[89]

The latter robot (Figure 10), NTU-PAL2, is designed to keep company with elderly people who are living alone. The robot can work as a schedule reminder, train the memory of the elderly person, and conduct entertainment activities. It has an expressive face and arms, and is designed to be animal-like to present more natural and interesting social companionship (Wang et al. 2009).

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[89] *Source: See* http://www.csie.ntu.edu.tw/~bobwang/Papers/wang_automation09.pdf

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Thailand

1. Demographic

1.1. Disability Statistics

According to the 2007 National Statistics Office data, Thailand has 1.9 million persons with disabilities, consisting of about 2.9 percent of the entire population (63 million persons). A majority of people with disabilities in Thailand are 60 and over (accounting for 57 percent of the people with disability).

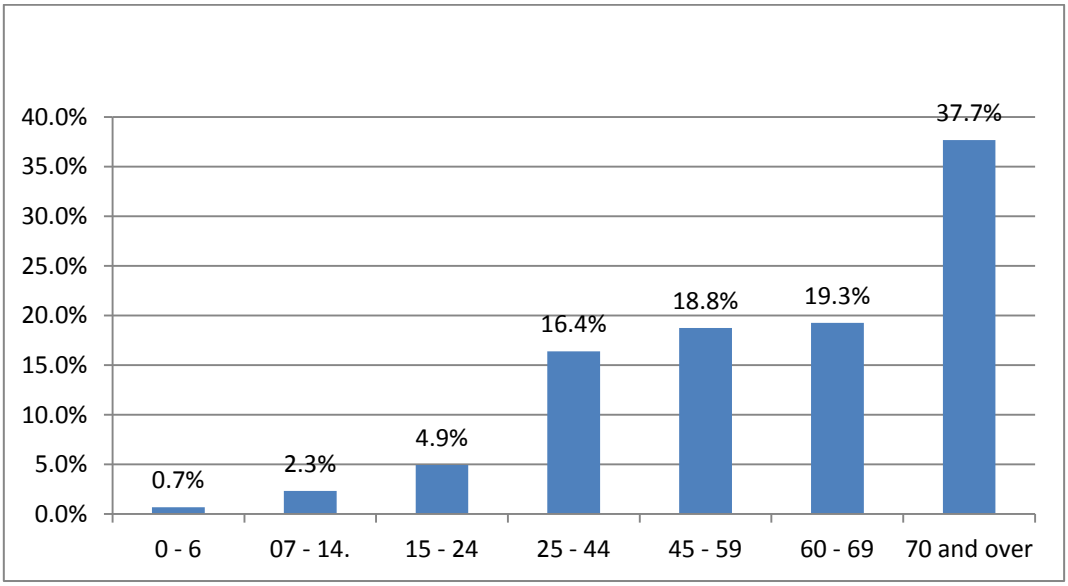

Figure 1: Disability prevalence by age – 2007[90]

1.2. The aging of Thailand population

Thailand's elderly population (aged 60+) has rapidly increased from 5 percent of the total population in 1950 to 9.5 percent of the total population in 2000. At the same time, the ranking of Thailand among its Southeast Asian neighbor economies has increased from the sixth to second in the relative number of elderly people, just after Singapore (UNFPA Thailand, 2006). Figure 2 describes the population ageing and growth of the older population in Thailand from 1950-2005

[90] *Source: The author compiled from Table 1: Number of population, number and percentage of persons with disabilities by age group, sex and area, Whole Kingdom, 2007, the 2007 Disability Survey, National Statistics Office, Thailand, 2008.*

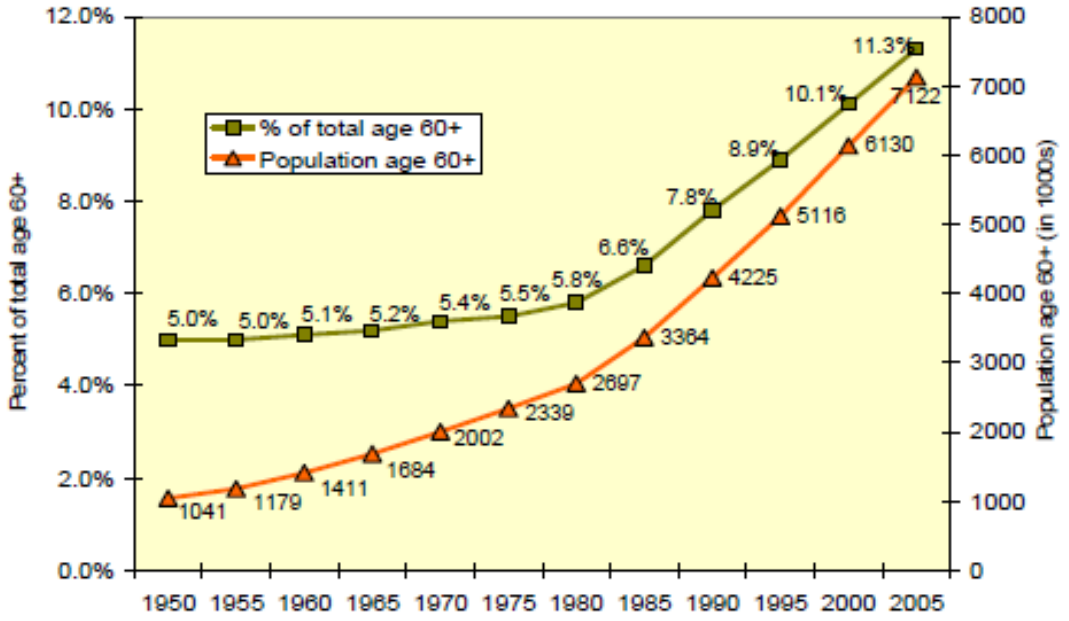

Figure 2: The Thailand population aged 60+[91]

The proportion of elderly people is set to increase even further. The percentage of elderly people is expected to stand at 14 percent in 2015, 19.8 percent in 2025, and 30 percent in 2050. According to estimates, the Thai senior population would number over 20 million by the year 2050.

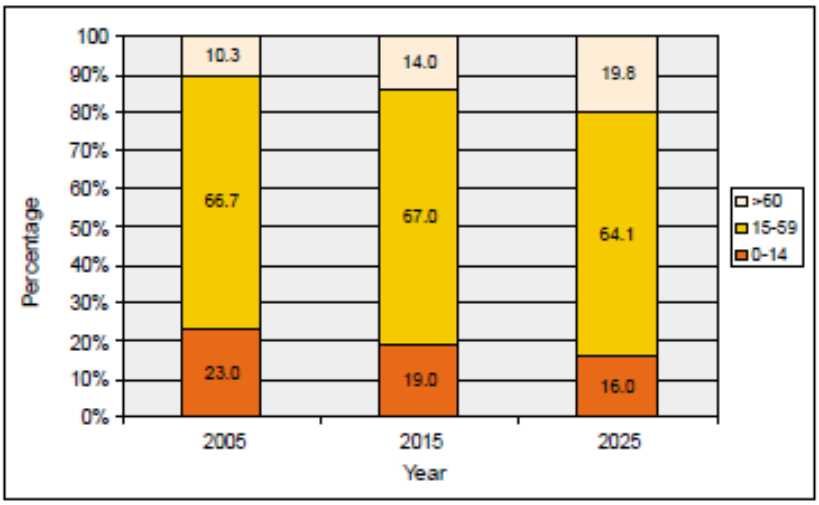

Figure 3: Proportion of the Thailand population in 3 groups [92]

[91] *Source: Adopted from Knodel & Chayovan, 2008*
[92] *Source: Adopted from Population Aging in Thailand: Prognosis and Policy Respond, UNFPA Thailand, 2006*

2. Policies

2.1. E-Health

Thailand has adopted a national ICT policy strategic framework in 2000 with e-Government, e-Education, e-Commerce, e-Society and e-Industry, and implemented it in 2002. Although the framework lacks an e-Health plan and thus no e-Health governing body has been set up, a number of e-Health applications and services have nevertheless been implemented. Funding for these projects is usually from the government, although some projects have received funding from public-private partnerships and NGOs (Kijsanayotin et al., 2010).

Table 1: Summary of e-Health uptake in Thailand [93]

eHealth Development	Uptake
I. Foundation Policies & Strategies	
1. National eGovernment policy & strategy	√ ICT2010
2. National eHealth policy & strategy	X
3. National eHealth governance body	X
3. Funding	+ Public, No Private
4. Public & Private partnership	+
5.Infrastructure	++
II. Enabling Policies & Strategies	
1. Health information security & privacy laws	X
2. Actions on Multilingualism & Multiculturalism	X
3. Capacity building	++
3.1. IT courses for health science students	+++
3.2. IT courses for health professional	+
4. National health IT standards (Interoperability)	+
4.1.Core data set standards	12 & 18 files standards
4.2.Semantic standards	ICD 10 TM, ICD 9 CM
4.3.Syntactic standards	X
4.4.Security and privacy standards	X
III. eHealth Applications	
1. mHealth	++, mostly pilot
2. Telemedicine	+, pilot
3. eLearning in health sciences	+
4. EHR/EMR (Health Information Exchange)	++
4.1 For administration, claims	+++
4.2 For clinical care	+
Note: √ = Adopted, X = No uptake, + =0-25% uptake, ++ = 26-50% uptake, +++ = 51-75% uptake, ++++ = 76-100% uptake, ICT 2010 = Thailand ICT development frame work 2000-2010, ICD 10 TM = International Classification of Disease version 10 Thai Modification, ICD 9 CM = ICD9 Clinical Modification procedure codes.	

The economy's e-Health experts recommend that the economy should put the development of e-Health foundations (i.e. governance, policy, funding, and infrastructure) as the priority.

[93] *Source: Adopted from eHealth in Thailand: The current status, Kijsanayotin et al., 2010*

2.2. Accessibility

The Thai government adopted the Convention on the Rights of Persons with Disabilities (CRPD) in 2008. The Government of Thailand has adopted and implemented various laws and policies in compliance with the CRPD pertaining to people with disabilities.

For example, the Thai Constitution, adopted in 1997 and amended in 2007, contains anti-discrimination provisions based on physical or health conditions and guarantees accessibility to social welfare and services for persons with disabilities. Moreover, the Persons with Disabilities' Quality of Life Promotion Act B.E. 2550 (2007), an amendment to the Rehabilitation of Persons with Disabilities Act B.E 2543 (2000), the first law on disability in Thailand, is a comprehensive rights-based law for persons with disabilities and also contains a strong anti-discrimination section. Another example is the Persons with Disabilities Education Act B.E. 2551 (2008) which promotes fairness of access to education and vocational training for all disadvantaged groups and to enhance their quality of life and independent living through empowerment.

The CRPD has been extended with the Persons with Disabilities' Quality of Life Promotion Act B.E. 2550 (2007), which states the rights of disabled people to access ICT. To realize this, applications have been developed in the Thailand National Electronics and Computer Technology Center (NECTEC), under the National Science and Technology Development Agency (NSTDA), Ministry of Science and Technology, to e.g. enable blind people to travel independently, facilitate the deaf people to communicate, and to help disabled people to live independently. These tools have been distributed to certain disabled people throughout the economy (Ministry of Foreign Affairs, 2010; ILO, 2009).

In 2011, "Telecommunication Services and Devices Showcase for Persons with Disabilities and the Elderly Project" was commissioned to NECTEC, by The Office of the National Broadcasting and Telecommunications Commission (NBTC) to provide knowledge and training on accessible telecommunication equipment and services. NBTC also funds the project "Thai Telecommunication Relay Service" implemented in 2011, enhancing deaf and people with speech impairment's rights to communicate via 6 types of services; sms/mms, text on the Internet, video on the Internet, video on mobile, video on public kiosk and emergency service.

3. ICT services and applications for people with special needs

3.1. E-Health

The market for health information technology in Thailand is strong and fast growing. Adoption of basic information technology like internet and mobile phones has been considerably high in the healthcare sector in Thailand. The penetration of health information technology in Thailand's healthcare sector is high compared to other regional economies such as Malaysia, Viet Nam, and China (New Zealand Trade & Export, 2011).

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

In the past decade there were many telemedicine projects and activities, mainly short-term pilot projects between international agencies and Thai's universities or big private hospitals (Kijsanayotin et al., 2010). Only one national telemedicine project was implemented by the Ministry of Public Health (MOPH) during 1998-2003, called MOPH's telemedicine network that linked the Information Technology Office of the MOPH and 19 hospitals with health facilities all over the economy via satellite and computer networks (Kasitipradith, 2001).

The project had ambitions to provide healthcare services to rural areas with few doctors and hospitals, but it was abandoned in 2003 due to the deteriorating economic situation, change in technology used and the rapidly changing socio-political environment in Thailand. Moreover, IT skills were lacking and there was no national regulator for telemedicine policy and strategy (Kijsanayotin et al., 2010). The existing services are in teleradiology (collaboration with RamSoft and InforMed Co. Ltd.), providing services for large hospitals in the cities, and certain telemedicine pilot projects such as in teledermatology (operated by the Institute of Dermatology) (Kijsanayotin et al., 2010).

Besides, several m-Health initiatives are being piloted and implemented in Thailand. The cross-border Mekong Basin Disease Surveillance System is an example of a piloted m-Health project which uses mobile devices for diseases surveillance and management of emergency and disaster situations. The project uses GeoChat SMS group communication software developed by InSTEDD to report communicable diseases and emergency occurred in community in Mukdahan province (Thailand) and Suvanakhet (Laos). The public health personnel working in the sub-district level use SMS format to report cases in order to improve timeliness of report and warning for potential disease outbreak and disaster (Kijsanayotin et al., 2010)

3.1.2. Electronic Health Record (EHR)/Electronic Medical Record (EMR)

The MOPH is the key driving body for the public Healthcare IT industry. In 2005, the Thai government launched the Thailand Center of Excellence for Life Sciences Pharmacogenomics Project (see http://www.tcels.or.th/en/Home.aspx), in collaboration with Oracle, to set up a National Electronic Health Record system that will gather and unify health records electronically for clinical and research purposes. However, at this stage, a fully integrated National Electronic Health Record system has not been implemented (New Zealand Trade & Export, 2011).

The national standard is the citizen identification number which is used to identify patient data in addition to the use of certain other formats in a few large hospitals. However, although the legislation to protect personally identifiable data is in place, there is so far no legal protection of health-related data (Kijsanayotin et al., 2010).

The mix of paper and computerized patient information (individual data and aggregated data) are being used in healthcare services. The public healthcare providers are required to provide specific datasets to the MOPH for analysis. However, the datasets contain only demographic and financial information. As Table 1 shows, patient administrative information that is used for e.g. reimbursement and reports is typically computerized and may be electronically transmitted between health organizations. In the public health sector, almost all of hospitals (1,001 hospitals) and health centers/primary care units (10,068 PCUs) have implemented various degrees of capabilities of EMR/HER (Kijsanayotin et al., 2010). However, the use of electronic medical data is still mainly for auditing purposes and the capability to transmit electronically is usually not present (Kijsanayotin et al., 2010).

The majority of uptake with Hospital Information Systems (HIS) has been in private hospitals. This has been driven by medical tourism, increasing demand for quality health care, improved patient safety as well as increasing competition. Some Thai private hospitals follow the Information Technology Infrastructure Library (ITIL) and ISO 20000 framework to manage information technology in the hospital (New Zealand Trade & Export, 2011).

3.2. Robotics

There is activity and interest in Thailand regarding robotics development, which is shown by a number of prizes in robotics-related competitions such as the A.N.T.Z. Robotics Competition World Challenge, RoboCup Rescue and Robocon. Especially Thai Robotics Society (TRS) (see www.trs.or.th) was established in 2000 by groups of roboticists,

researchers, and industrial people, involving in robotic education and application. Since 2002 TRS in collaborations with other organizations has established several activities (e.g. selecting the best national team for World RoboCup, organizing Thailand Rescue Robot Championship and the Humanoid Robot Competition) to promote Robotics in Thai.

Several universities and institutes are initiating the development of rehabilitation robotic systems such as Mahidol University, Chiang Mai University, Institute of Field Robotics at King Mongkut's University of Technology Thonburi, and Rehabilitation Engineering and Assistive Technology (REAT) of NECTEC. The current impediment to bring robotics rehabilitation systems to Thais is the standardization. Despite the lack of standards, researchers believe that distributing the prototypes for clinical trials might be another solution to encourage the use of technology in Thailand. Several rehabilitation centers have been involved, e.g. The Royal College of Physiatrists of Thailand, Sirindhorn National Medical Rehabilitation Center, and The Thai Red Cross Rehabilitation Center. The collaboration and involvement of physiatrists and patients from the earlier stages is viewed as a critical success factors. (NECTEC-ACE 2012, 2012)

In the private sector, CT Asia Robotics (see http://www.ctasia-robotics.com/home/) is the first and currently the only company to research, develop and manufacture robots commercially in Thailand. The company aims to deliver Thai-made robots into service areas such as housekeeping service, restaurant service and elder care service worldwide. Recently it has developed a high-tech nursing robot, called Dinsow2, to assist the disabled and the elderly, (Figure 4).

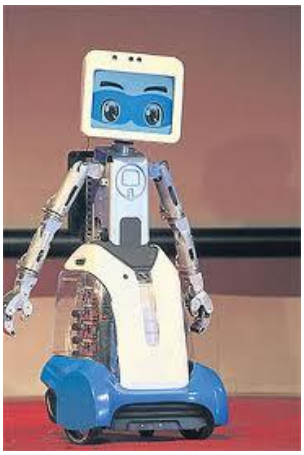

Figure 4: The Dinsow 2, the personal healthcare assistant [94]

[94] *Source:* http://www.bangkokpost.com/tech/gadget/274606/is-there-a-robot-in-the-house

This robot has several capabilities such as movement, picking up and carrying items with its hands, serving food, administering medicine, and making phone calls. This latter capability is called DinsowPond. It allows the user to make phone calls by touching the screen on the robot and selecting the person to be called. Should the intended recipient of the call not respond, the robot will automatically make a phone call to the nurse or doctor. In addition, the Dinsow 2 robot also features a camera and the ability to monitor the heart rate and blood pressure of the user, and can call the hospital for aid should an emergency such as heart attack ensue.

According to the CEO of CT Asia Robotics, the company will cooperate with local hospitals and medical centres to provide robotic services, leasing the robots on a monthly revenue-sharing basis. CT Asia Robotics through its Japanese subsidiary CT Asia KK will introduce the Dinsow2 in Japan for use in nursing homes and hospitals.

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United States

1. Demographic

1.1. Disability Statistics

In 2010, the overall percentage (prevalence rate) of people with a disability of all ages in the United States was 11.9 percent. Particularly, more than 50 percent of persons ages 75 and above are disabled. The figure 1 shows that the percentage of disability increases significantly along with the age

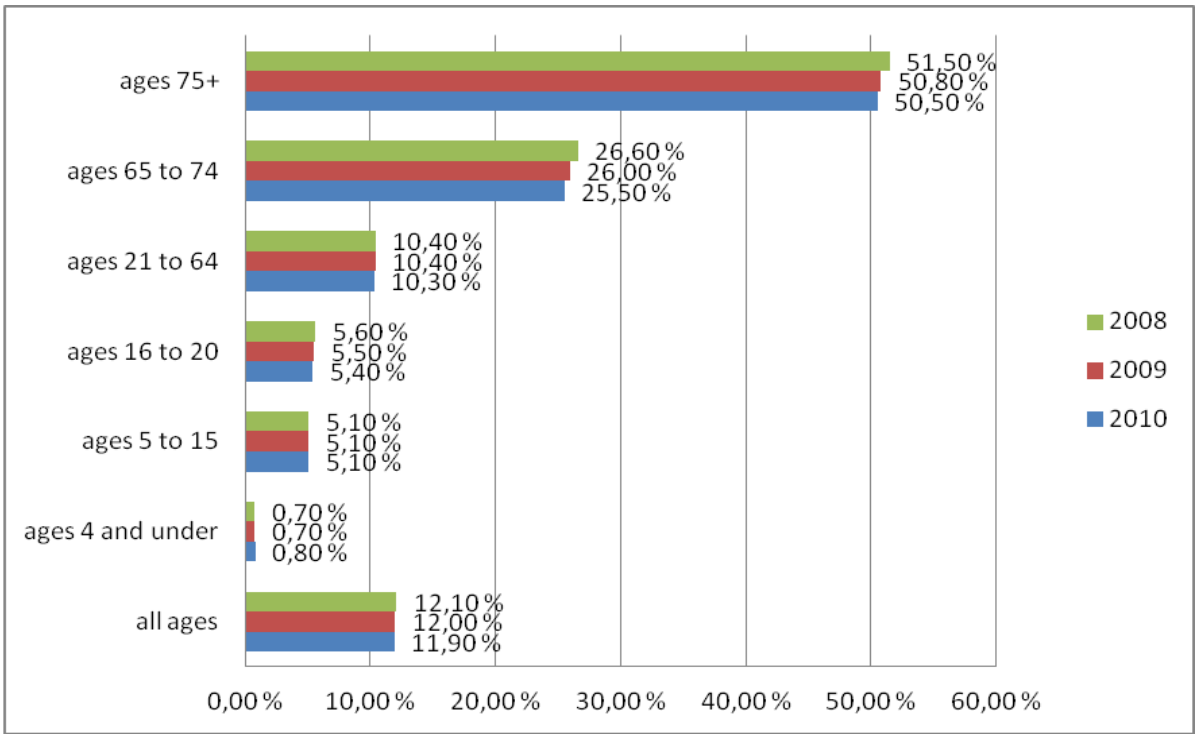


Figure 1: The prevalence of disability in the US 2008, 2009 and 2010[95]

1.2. The aging of the United States population

The percent of the population 60 and over increased from 6 percent in 1900 to 16 percent in 2000 and projected to be 25 percent and 26 percent in 2030 and 2050 respectively. The number of people aged 65 and over increased from 4 percent of the population in the beginning of 1900's to 12.4 percent by the end of the century. By 2030, there will be about 72.1 million older persons, more than twice their number in 2000 and forecast to increase further to 20 percent of the population by 2050 (Administration on Aging, 2011).

[95] *Source: This chart was compiled by the author based on the data from the Disability Status Report: United States, 2008, 2009 and 2010, Erickson and Schrader, 2010, 2011 and 2012*

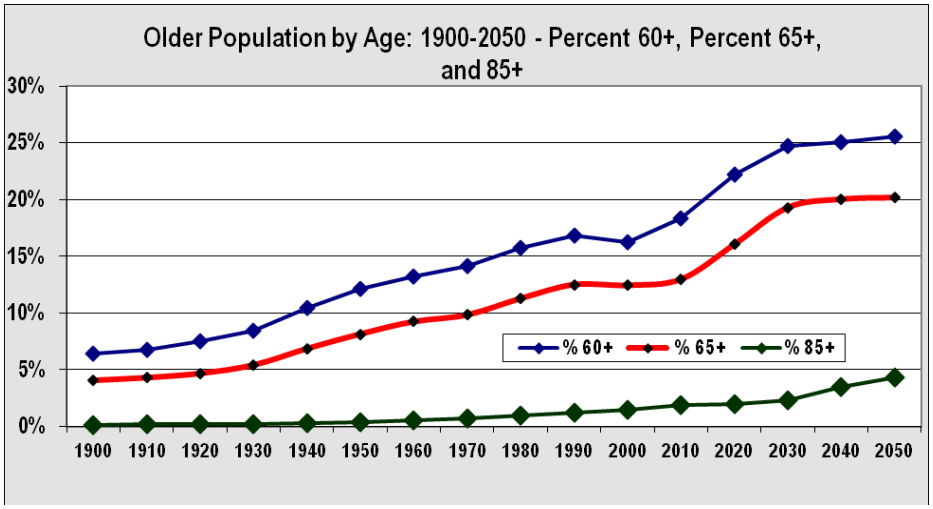


Figure 2: Projected Future Growth of the Older Population[96]

2. Policies

2.1. E-Health

In the United States Health Information Technology (HIT) has become central to health care reform due to its potential to improve efficiency and increase the quality of health care. Adoption of these technologies has remained a priority of the federal government as evidenced by incentive programs enacted through legislation, including the American Recovery and Reinvestment Act (ARRA) of 2009, an economic stimulus bill which contains significant financial incentives for clinicians to implement these systems, and the Patient Protection and Affordable Care Act (PPACA) of 2010, which further reinforces their importance with its long-term reliance on electronically generated data for improvements in health care quality, efficiency, and overall population health.

Particularly, the Health Information Technology for Economic and Clinical Health Act (HITECH Act) legislation as part of ARRA was created to stimulate the adoption of electronic health record (EHR) and supporting technology in the United States. One crucial step in this adoption is the efficient use of HIT for clinical purposes (Blumenthal and Tavenner, 2010). Indeed, HITECH asks clinicians to be able to prove that such meaningful use has been attained. HITECH states that during the period of 2011-2015, incentives shall be in place to demonstrate this efficient use. Conversely, after this period has ended, penalties shall ensue for failure to demonstrate efficient use. The Act also provides grants for the training centers.

[96] *Source: Aging Statistics, Administration on Aging, 2011*

Regarding organization, the Health Information Technology (HIT) Policy Committee is a Federal Advisory Committee to make recommendations to the National Coordinator for HIT on a policy framework for the development and adoption of a nationwide health information infrastructure, including standards for the exchange of patient medical information, implementation specifications, and certifications criteria. The Office of the National Coordinator for Health Information Technology has designed many initiatives to increase EHR adoption.

Health Information Exchange (HIE) has emerged as a core capability for hospitals and physicians to achieve "meaningful use". Stimulus funding (from the State HIE Cooperative Agreement Program) is available to states in order to boost this capacity, and to promote the health information exchange planning and implementation. Conditions for the funding are that states adopt three development goals: (1) e-Prescribing, (2) receipt of structured lab results, and (3) sharing patient care summaries across unaffiliated organizations.

2.2. Accessibility

In the United States there are at least three levels of legislation: the Americans with Disabilities Act (US Department of Justice, 1990), Section 508 of the Rehab Act (US Department of Justice, 1998), Section 255 of the Telecommunications Act and State Legislation (US Federal Communications Commission, 1996).

Section 508 was introduced to eliminate barriers in information technology, to make available new opportunities for people with disabilities and to encourage development of technologies that will help achieve these goals. Particularly, Section 508 requires all Federal Agencies and Departments to ensure that development, procurement, maintenance, or use of information and communications technology is accessible for Federal employees with disability, and to make their electronic and information technology accessible to people with disabilities. The Rehabilitation Act Amendments also require businesses to address accessibility issues in their products when selling to the U.S. government.

An employee with the responsibility to coordinate Section 508 issues has been named in each government Chief Information Technology Office. There is a federal office charged with providing assistance and advice regarding the procurement of accessible ICT, in addition to a publicly available web tool, the Buy Accessible Wizard, that is designed to help producers of ICT to determine whether their product meets federal guidelines.

In 2010, the US Congress enacted the “Twenty-first Century Communications and Video

Accessibility Act". This new regulation updates the Communications Act and establishes new safeguards for disability access to ensure that that new Internet-enabled telephone and television products and services are accessible to and usable by people with disability.

3. ICT services and applications for people with special needs

3.1. E-Health

3.1.1. Telematics (Telehealth, Telecare and Telemedicine)

In the US Department of Health and Human Services there is a Health Resources and Services Administration (HRSA) which mission is to assure the quality of healthcare for people with special needs. The Office for the Advancement of Telehealth (OAT) was established within HRSA to promote the use of telehealth technologies for health care delivery, education, and health information services to meet the needs of underserved, vulnerable, and special needs populations (see http://www.hrsa.gov/ruralhealth/about/telehealth/).

According to a survey of U.S. telehealth activity published by the Telemedicine Research Center (TRC) in 2003 there were a total of 145 telehealth programs in 45 states and the District (Miller, 2007). Especially the Care Coordination Home Telehealth (CCHT) program of the Veterans Administration (VA) is probably the most developed example of mainstreaming of home telehealth in the United States and indeed the largest implementation of telehealth in the world (Cruickshank, 2012). Other relevant examples are the Jewish Home and Hospital Lifecare System with a series of pilot programs on telehealth for congestive heart failure and diabetes management, the "well@home" system by Patient Care Technologies Inc, the "Health Guide" by Intel, the "Health Buddy" by Bosch, and the "RemoteNurse Telehealth Solution" by WebVMC (European Union, 2010).

According to the survey of TRC, major clinical applications were ongoing patient management (58%), diagnostic exam interpretation (49%). Networks were also used for several non-clinical activities such as education administrative applications and other activities related to research (Miller, 2007). Particularly, in CCHT program**, t**he messaging and monitoring devices (85% of widely used applications) keep track on the vital signs of the user and present questions to the user to assess their state of health. They also feed data to the health experts who can continuously stay informed about the state of the patient and take action as necessary. Video telemonitors (11%) and videophones (4%) allow users to consult

health experts with videolink, giving more information to the experts than a mere telephone link would (European Union, 2010).

Organizations are testing systems which are taken up by several homecare agencies for individuals with chronic diseases. However, VA is introducing a newly telehealth module on issues such as smoking cessation and the management of obesity aims to promote better lifestyle choices and intervene early in order to prevent progression of the disease. The telehealth data from individual patients is also integrated into the EHR which allows all validated telehealth data to be accessed through the patient record (Cruickshank, 2012).

These technologies are typically covered from Medicare and Medicaid programs and private insurance companies, but coverage is sporadic. The American Telemedicine Association has released recommendations for reimbursement of telehealth and remote monitoring. These reimbursements are frequently connected with savings resulting from transportation of patients. An increasing number of private insurance companies, certain foundations, community health providers and other organizations also provide reimbursements for telehealth based on their own decision or mandated by the state. The focus of such reimbursements, however, has been on teleconsultations and not systematic care (European Union, 2010).

3.1.2. Electronic Health Record (EHR)/ Electronic Medical Record

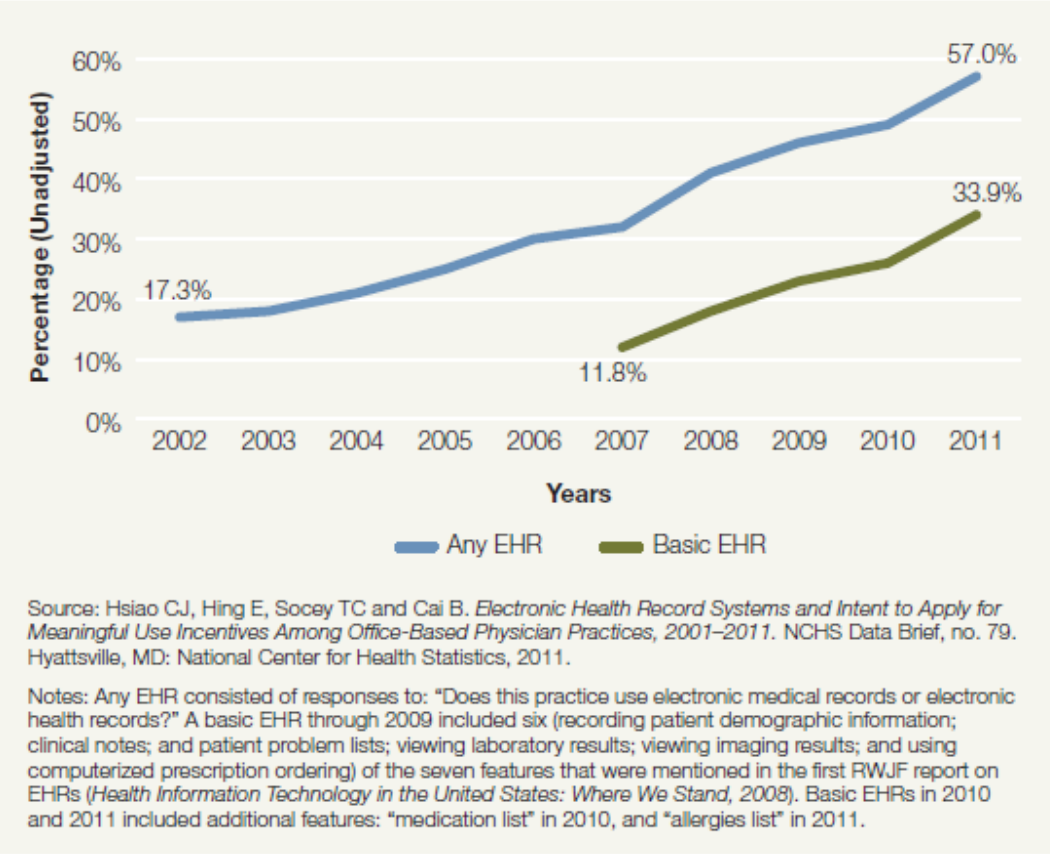
The federal government began using EHR in the 1970s with the implementation of Veterans Health Information Systems and Technology Architecture (VistA) which is consistently well reviewed for reducing medical errors and improving health-record component integration. State governments and private providers have also undertaken local scope EHR initiatives. Examples are Massachusetts' ongoing statewide electronics records system project and a major electronic records project started by Kaiser Permanente, a large nonprofit health management organization (Atherton, 2011).

For EHR to be widely implemented in the United States, a national infrastructure for data transfer and data standardization and compatibility are needed. At the moment, the latter objective is being pursued and formats are being designed for facilitating data interchange between organizations (Gunter et al, 2005). For example, the CONNECT initiative (see http://www.connectopensource.org/about/what-is-connect) is a Federal Health Architecture project that was conceived in 2007 and initially built by 20 various federal agencies and now seven federal agencies have demonstrated the feasibility of sharing data with each other and

with private sector organizations using CONNECT. The VA and Kaiser Permanente has a pilot program, which uses the CONNECT, an open source software solution that supports electronic health information exchange, to share health records between their systems VistA and HealthConnect, respectively (Mearian, 2010). There is also collaboration between the VA and US Department of Defense to develop programs to exchange patient records, medical images and laboratory tests. Clinical Data Repository/Health Data Repository (CDHR) is one example operating on patient records. The Laboratory Data Sharing and Interoperability (LDSI) application is another program that allows sharing of chemistry and hematology laboratory tests.

The Institute of Medicine (IOM) has been critical of the rate of technology adoption by US hospitals (Gunter et al, 2005). The report funded by the Robert Wood Johnson Foundation, *Health Information Technology in the United States: Moving Toward Meaningful Use, 2010* found that wide-spread adoption of HIT by hospitals and doctors was slower than expected. However, with the government policies (e.g. meaningful use incentives) the proportion of physicians reporting the use of any EHR[97] increased from 17.3 percent in 2002 to 57.0 percent in 2011, while the proportion of physicians with at least a "basic" system rose from around 12.0 percent in 2007 to nearly 34.0 percent in 2011 as shown in Figure 3.

[97] Defined here as either "all electronic" or "part paper/part electronic"



Source: Hsiao CJ, Hing E, Socey TC and Cai B. *Electronic Health Record Systems and Intent to Apply for Meaningful Use Incentives Among Office-Based Physician Practices, 2001–2011.* NCHS Data Brief, no. 79. Hyattsville, MD: National Center for Health Statistics, 2011.

Notes: Any EHR consisted of responses to: "Does this practice use electronic medical records or electronic health records?" A basic EHR through 2009 included six (recording patient demographic information; clinical notes; and patient problem lists; viewing laboratory results; viewing imaging results; and using computerized prescription ordering) of the seven features that were mentioned in the first RWJF report on EHRs (*Health Information Technology in the United States: Where We Stand, 2008*). Basic EHRs in 2010 and 2011 included additional features: "medication list" in 2010, and "allergies list" in 2011.

Figure 3: Percentage of Office-Based Physicians with EMR/EHR Systems: United States 2002–2011[98]

3.2. Smart homes

Some smart home healthcare solutions have been developed in the United States. Examples of developments in "Social Robotics" to support people with special needs are listed below. The researchers at MIT's AgeLab are developing Intelligent Adaptive Devices for Independent Living with the goal to deliver personal information, basic health care, support and critical assistance for elderly people and those with severely debilitating conditions. PlaceLab monitors the activity and vital sign of the residents, controls energy expenditure, and provides entertainment, learning and communication by using ubiquitous sensors and wearable systems

The Georgia Institute of Technology has developed a smart home which addresses some of

[98] *Source: Adopted from Harvard School of Public Health, the Robert Wood Johnson Foundation, Mathematica Policy Research, Health Information Technology in the United States: Driving Toward Delivery System Change, 2012*

the challenges posed by future domestic technologies. There is an automatic function to open and lock doors, close blinds, turn of lights, and allow the relatives and family members of the occupants monitor the state of health of the occupants. Commands are relayed by using pendants that can recognize hand gestures. A smart home is based on ubiquitous computing that senses and recognizes potential crises, to assist declining elderly memory, and to behavioral trends.

The University of Florida has developed Gator Tech Smart House, based on environmental sensors, for the elderly and the disabled. The house can manage energy efficiency, safety and security, monitor activity/mobility, detect fall. It is equipped with smart devices and appliances (smart phone, smart mailbox, etc.), and biometric technologies for physiological monitoring (weight, temperature) (Chan at al., 2009). Similar technology has also been researched at the University of Texas, University of Massachusetts, Massachusetts Institute of Technology and University of Missouri, as well as the Pratt School of Engineering.

3.3. Robotics

The United States lags behind other economies in recognizing the importance of robotics technology. While the European Union, Japan, Korea, and others have made significant R&D investments in robotics technology, the US investment, outside unmanned systems for defense purposes, remains practically non-existent (CCC Report, 2009). Examples of developments in "Social Robotics" to support people with special needs are listed below.

The *Nursebot project* was conceived formed by a multi-disciplinary team of investigators from the fields of health care, HCI/psychology, and AI/robotics. The overall goal of the project is to develop mobile robotic assistants that can assist nurses and elderly people in their daily activities (Pineau et al., 2003). More information about the project can be found at http://www.cs.cmu.edu/~nursebot/

Figure 4: The Nursebot Robot and the Berkeley Lower Extremity Exoskeleton (BLEEX)[99]

University of California (UC) Berkeley was funded in 2000 by the Defense Advanced Research Projects Agency (DARPA) to develop The Berkeley Lower Extremity Exoskeleton (BLEEX). The purpose of this tool is to help people with reduced strength to walk and carry loads. The electric motors adjust to the users' own motor functions and acts as an external prosthesis (see).

Another relevant example is an assistive robot, called Nepturne, and being developed at the MultiScale Robotics and Systems Laboratory (μRSeL) at The University of Texas at Arlington. This robot system (Figure 6) is devised to assist children with Cerebral Palsy to rehabilitate by using the control device (which can be an iPad, WiiMote or Neural headset). The system also facilitates the process of administering the rehabilitation for caregivers, and even permits independent rehabilitation at home environments (Popa et al., 2011).

[99] *Source: see* http://www.cs.cmu.edu/~nursebot/web/press/cmu_99_12/nursebot.html and http://berkeley.edu/news/media/releases/2004/03/03_exo.shtml

Figure 6: Neptune with iPad and Flexi Force sensors mounted on the Ipad Tablet[100]

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[100] *Source: Popa et al., 2011*

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Viet Nam

1. Demographic

1.1.Disability Statistics

A survey in 2009 has shown that the number of people with disabilities since childhood (5 years old) was 7.8 percent that is 6.7 million people. A slight majority (53.8 percent) of these disabled people is female and most (75 percent) live in rural areas (adopted from The Viet Nam National Coordinating Council on Disability - NCCD, 2010). Other statistics from international organizations shows that the ratio of people with disabilities in total population can be more than 10 percent. As in the table 1 below, the older people account for more than 50 percent of people with disabilities.

Table 1: Disability prevalence by age in 2006[101]

Characteristic	DISLOW	DISHIGH	DISLOW	DISHIGH	Blind people	People with low vision
Age						
5–18	1.63	1.09	1.51	1.01	0.03	1.83
	(0.13)	(0.11)	(0.13)	(0.11)	(0.02)	(0.14)
19–40	2.02	1.54	1.69	1.35	0.10	1.94
	(0.14)	(0.12)	(0.13)	(0.12)	(0.03)	(0.16)
41–62	8.49	3.26	4.81	2.49	0.12	19.62
	(0.37)	(0.20)	(0.27)	(0.18)	(0.04)	(0.59)
Older than 62	45.20	20.59	33.02	16.83	1.59	52.57
	(1.05)	(0.79)	(0.98)	(0.72)	(0.24)	(1.10)

It is predicted that the reasons of disability are likely to change in the future due to societal change. For example, the number of people with war diseases and inborn disabilities are likely to decrease, and the people disabled as a result of traffic and labor accidents and environmental pollution are likely to increase.

1.2.The aging of Viet Namese population

The numbers of elderly people are likely to increase as well. A survey in 2004 showed that 9.9 percent of the population (equivalent to 7.8 million people) was 60 years of age or above. It seems that the population is ageing more rapidly than predicted by previous estimates (Nguyen and Nguyen, 2009).

[101] *Source: Adopted from Mont and Nguyen, 2011*

Table 2: Viet Nam' elderly people by number and percentage[102]

Year	Population (Million)	Elderly People (Million)	Elderly people in total population (in %)
1979	53.74	3.71	6.9
1989	64.41	4.64	7.2
1999	76.32	6.19	8.2
2002	79.73	7.37	9.24
2004	82.03	8.12	9.9
2006	84.14	8.75	10.4
2008	86.21	9.47	11.0

Figure 1 presents a projection of aged population (over 60) in coming decades using the median variant scenario which increases sharply after 2010. In 2050, the number of people over 60 years old in Viet Nam will reach about 30.80 percent of the population.

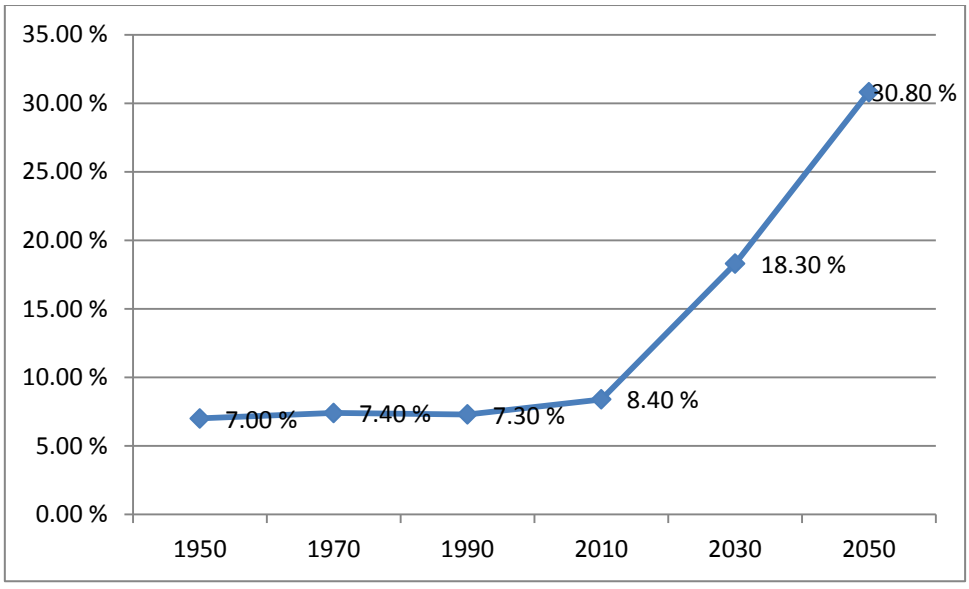

Figure 1: The projected population aged 60 + in Viet Nam [103]

[102] *Source: Adopted from Nguyen, 2012*
[103] *Source: the author composed base on the data from United Nations, World Population Prospects: the 2010 Revision*

As the Law on the Elderly has recently passed the Viet Namese Parliament and came into effect in 2010, new policies, public health systems, and aged care infrastructures and services will be upgraded and developed in near future.

2. Policies

2.1.E-Health

Recognized the importance of IT application in health sector, Ministry of Health (MoH) created early the IT Application Steering Committee and established a Centre for Health Information Technology which aims to provide technical support to other health institutions. Besides, a number of policies regarding IT application for health sector are made as follows

1. Ordinance No 58/CT-TW dated 17/10/2000 by the Ministry of Politics on promoting the application of IT in the health sector.
2. Decision No 81/2001/QD-TTG dated 24/05/2001 by the Prime Minister approving action agenda on applying IT in the career of industrialization and modernization over the span of 2001-2005.
3. Decision No 531/QD-TTG dated 08/08/1996 by the Prime Minister regarding management of national target programs using IT.
4. Decision No 112/QD-TTG by the Prime Minister approving a computerization project for public administrative management over the period of 2001-2005 (Project 112) that aims to develop infrastructure for information management and towards an e-government.
5. Direction of the health sector, Party and Government on applying IT for health sector management
6. Strategic orientations of the Ministry of Health leaders on public administrative and professional management using IT, as well as developing a unanimous database bank for the whole health system or health sector.

In 2006, national conference on IT applications in hospital management had identified objectives for developing hospital management IT to 2020 as 100% of hospital economy-wide applying hospital manage statistics software and integrated network connections between hospitals economy-wide and MoH progressive implementation of telemedicine. The Ministry of Health has adopted policies to develop e-Health. For instance, targets have been set for internet access in hospitals, development of web sites, construction of public health

databases, and adoption of hospital management systems (e-Health connection organization, 2008).

2.2.Accessibility

Viet Nam actively participates in international agreements regarding people with disabilities. For example, Viet Nam signed the International Treaty on the Rights of People with disabilities in October 2007 and simultaneously committed to fulfill the Biwako Millennium Framework for Action "on promoting an inclusive, barrier-free and rights-based society for people with disabilities" in Asia-Pacific the second Decade of People with disabilities (2003-2012). In order to fulfill its international and regional commitments such as United Nations' Conventions and Resolutions, as well as the responsibility of the Party, the state and the society for People with disabilities, Viet Nam has gradually perfected its legal framework and policies on people with disabilities and implemented programs and projects that support people with disabilities.

Legislation is in force regarding the rights of people with disabilities since 1992 and has been supplemented in 2001 and 2011. The Viet Nam National Coordinating Council on Disability (NCCD) has also been established in 2001. Its task is to monitor and promote the enforcement of legislation concerning people with disabilities.

Access to information and communication plays an important role in supporting people with disabilities to integrate into the community and to find jobs. Government encourages the development and use of ICT for persons with disabilities by issuing policies on tax exemption, tax reduction, to loan with low interest and supporting research activities. Particularly in the Law on Information Technology 2006, Paragraph 6 of Article 5 provided that "make preferential policies to…people with disabilities or persons with difficult conditions".

In addition, the Ministry of Information and Communication (MIC) has developed standards to ensure the accessibility of ICT services to people with disabilities, including the following:

- TCVN 8701:2011: Public Internet Access Points – technical requirements for aiding older people and PWDs to access and use;
- TCVN 9247:2012: Telecommunication products and services assisting PWDs and older people– basic requirements;
- TCVN 9248:2012: Telecommunication products and services assisting persons with

disabilities and older persons– Design guidelines for interactive services using DTMF input;

- TCVN 9249:2012: Information and communication products and services assisting persons with disabilities and older persons - Design guidelines.
- Draft of standard on Service quality of sign language and lip-reading real-time conversation using low bit rate video communication;
- Draft of standard on Telephone transmission quality – Coupling Hearing Aids to Telephone sets;
- Draft of standard on website assisting people with disabilities access to information

Other measures also have developed such as Circular No. 26/2009/TT-BTTTT issued by Minister of MIC dated 31st July 2009 on rules for information supply and accessibilities guarantee for websites of state agencies. Particularly, Article 10 of the Circular provides the support for people with disabilities to access information. Furthermore, Circular No. 28/2009/TT-BTTTT issued by Minister of MIC dated 14th September 2009 provisions on application of standards and technologies supporting people with disabilities to access to and use information and communication technologies. Accordingly, national television broadcasters which are licensed nationwide coverage shall apply technology such as Viet Namese subtitle to support people with hearing problems, and sign language to assist people with visual disabilities to access daily political news.

3. ICT services and applications for people with special needs

3.1.E-Health

3.1.1. Telemedicine (Telehealth and Telecare)

Telemedicine has great potential in Viet Nam where four-fifths of health care needs are from rural areas, while provincial and communal health centers lack trained medical personal. For example, the National Hospital of Pediatrics has utilized video conferences to arrange teleconsultations and telesurgery for patients in severe condition. Teletraining and tele-imaging assistance with other hospitals have also been conducted. Similar telemedicine activities have taken place with hospitals in other economies, notably Japan, Australia, France and Singapore. In addition, since 2007 in Ha Noi, FPT Telemedicine, which belongs to FPT Group, declared the remote health care service by applying information technology and telecommunication. There are also health-consulting services through telephone at Ha

Noi Post Offices and HCM City Post Offices noticeably. One currently ongoing telemedicine project is a joint undertaking by ELINCO – a Viet Namese IT and telecommunications organization and AMD. This project aims at developing a telemedicine system for military hospitals using ELINCO's telemedicine portal and AMD's exam cameras[104].

3.1.2. Electronic Health Record (EHR)

In Viet Nam, EHR system was introduced in the mid-1990s when the national information policy, e-Policy and e-Health policy were made. Some of the EMR systems developed and used locally are Medisoft2003 and HTMedsoft. The former is an epidemiological information repository used and devised by the Ministry of Health and in use in certain hospitals in Viet Nam. The latter is a comprehensive hospital information management system designed by Medsoft Viet Nam Co. Ltd. and in use in many clinics in Viet Nam (Nguyen et al., 2011).

Standardization in the economy's healthcare organizations is strong. Most hospitals and clinics are managed directly by the Ministry of Health or its subordinate bureaus. All clinical documentation and communication forms between organizations are standardized, and decisions have been taken to build electronic systems that support the interoperability of individual IT applications. Computerization of the healthcare is being likewise supported from the ministerial level, where standardized electronic reporting is already being used to receive public health data of the population. However, the practical implementation of e-Health standards to facilitate interoperability in individual hospitals is still in the beginning stages which, among others, could limit the EHR adoption.

According to the report of the Therapy Department of Ministry of Health, until 2005, there were only 5% among nearly 1000 hospitals in the whole economy able to apply EHR system. Such hospitals would all be located in the big cities such as Ha Noi or Ho Chi Minh City, because the costs of implementing EHR are too high for small, rural hospitals. The initial costs for EHR systems are 600 million Viet Nam dong (as reported from Thanh Cong Clinic in HCM city), and in addition, training, data abstraction, productivity loss and telecommunications costs will be incurred separately[105].

3.2.Other applications

The adoption of the Internet in Viet Nam in families has created an environment where ICT is easier to integrate into elderly care. Many elderly people in Viet Nam live with their

[104] See http://ehealth-connection.org/files/resources/Vietnam%20Case%20Study.pdf
[105] See http://ehealth-connection.org/files/resources/Vietnam%20Case%20Study.pdf

children's families, and these children are often avid users of the Internet and the mobile Internet. Thus, elderly people can search health-related information by tapping into the knowledge of their Internet-savvy offspring (Nguyen et al., 2008).

There are also many websites for people with disabilities such as http://nccd.molisa.gov.vn of Viet Nam's National Coordinating Council for Disabilities (NCCD), http://www.nghilucsong.net ,http://www.nguoikhuyettat.com, http://asvho.org.vn particularly, the http://pwd.vn and http://tamhonViet Nam.net websites have applied the technologies supporting people with disabilities based on the WCAG2.0 Guidelines. These website post news, events, and policies relating to disabled people as well information on priority issues such as vocational training, employment, allowances, education and health care.

There are ICT applications in some devices such as smart wheelchairs controlled by Viet Namese voice and equipment support visually impaired pedestrians. Certain software such as screen-reading applications that help visually impaired people and communication support tools for hearing-impaired people is also available in Viet Nam. However, as the cost of the equipment is often prohibitive, exploration of applications for individual use over the internet that is low-cost or free should be considered. More research, however, is needed into the applicability and development of such applications.

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