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Value Co-creation in eHealth Service Model for Elderly Care  
: A Case of Emergency Medical Service System in Thailand

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Japan Advanced Institute of Science and Technology

Doctoral Dissertation

Value Co-creation in eHealth Service Model for Elderly Care  
: A Case of Emergency Medical Service System in Thailand

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# Abstract

The trend of aging population in Asian countries is expected to increase at an average of 30% by 2050. An essential mechanism for the well-being of the elderly is healthcare service from physical, mental and social well-being. Healthcare service for elderly people are various ranging from personal care, nursing, life-threatening illness, health consulting, and contingency help. Technologies and innovations have been involved to support the well-being of aging population in an aspect of simplicity with universal design, for example products and equipment used in smart homes, smart cities, or mobile applications. Lack of workforce in healthcare sectors and limited of funding are the main problems in developing countries. To tackle with the problems, technologies and applications need to be properly designed. Besides, right decision making is crucial in order to support diverse requirements of the aging population that are different from country to country in terms of policy, infrastructure, and culture.

Electronic healthcare (eHealth) is an application of information technology in healthcare services that communicates health information in medical team or in healthcare service system. Implications of eHealth and mobile technology for elderly are challenges in technological management and healthcare market for developing countries. Although applications of eHealth have been applied in developed countries for over 10 years; from basic information management to online health service, the applications have not been broadly adopted in health system of Asian developing countries. Emergency medical service (EMS) is a critical healthcare service as it is a part of healthcare giving process ranges from simple cases like physical activity to severe cases relating to life-threatening illness on a 24-hour basis. These services need to provide a flexible application that enables the elderly to communicate their desires with others within a reasonable time. Accordingly, there is a need to identify and develop an eHealth model to support EMS for the elderly in developing countries.

The research objectives are separated into three parts. The first part aims to identify the alternative technological challenges for EMS system to support elderly patients' demands. The second part focuses on healthcare knowledge sharing on the basis of technology acceptance of people. The last part aims to develop a conceptual eHealth service model and infrastructure framework based on value co-creation concept and knowledge sharing in elderly care service system. In terms of research methodology, statistical analysis is used based on secondary data from the World Health Organization (WHO). Systematic reviews are applied to identify the needs of healthcare technology related to aging people. Questionnaire surveys are conducted to identify technology acceptance and perspective of stakeholders and patient in Asian developing countries. Conceptual modeling and framework approaches are adopted to develop eHealth service model and infrastructure framework by enabling healthcare knowledge in service system.

This research identifies the alternative technological challenges for EMS system to support elderly patients' demands and develops a conceptual eHealth service model and infrastructure framework based on value co-creation concept and knowledge sharing in healthcare service system. The findings reveal that knowledge sharing and value co-creation concept involve positively significant factors that influence innovations in healthcare service. The results support service system design that offers e-service in emerging market of mobile technology by integrated resource and value-added in service through co-operation of different levels of technology and consumer groups.

**Key words:** eHealth, Emergency medical service, Value co-creation concept, Knowledge sharing, Technology acceptance

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# **Chapter 1**

## **Introduction**

### **1.1 Research Background**

The trend of the aging population in Asian countries is expected to increase at an average of 30% in 2050. Healthcare service management is an essential mechanism to support and increase the well-being of the elderly. In the service system, factors need to be prepared in order to support aging population are mobility, physical condition, and daily life (Peterson & Gray, 1999). These main factors are related to health policy, promotion, and service infrastructure (Stockdale, 2013; Wright, 2000; Richards, 2012). Asian countries are different in health system, health policy and quality of provided services. Accordingly, each country needs to arrange the factors to support an increase in aging population. Principle healthcare services for elderly involve, for example, health monitoring, Emergency Medical Service (EMS), health management plan, nursing at home. An essential mechanism for the well-being of the elderly is healthcare service that covers physical, mental and social well-being aspects (Niehaves, 2011; Stockdale, 2013). Trends in aging population have had an effect on Asian societies, especially on the issues of healthcare service and the well-being of people.

Primary healthcare service is a basic factor for societal well-being. The effectiveness of the service differently depends on health policies and standards of each country, which requires co-operation of providers in healthcare services and community. EMS is a primary health service that supports life-threatening illness of people in remote area on a 24-hour basis. Lack of workforce in healthcare sector and limited funding are the main constraints that obstruct the effective service provision in developing countries. Technologies for healthcare services need to be well designed and carefully selected to satisfy the requirements of the aging population on the basis of respective countries (Patrick, 2008; Moor, 2013; Mercado, 2010; Peckham, 1999). Healthcare service developments for elderly in Asia are challenged by healthcare technology investment and service management to support increasing healthcare demands.

In the 21st century, technology and service innovation drives the economic and society through a variety of applications involving education, communication, entertainment, and healthcare. Many technologies and innovations aim at supporting the well-being of the aging population for simple use with universal design, examples of which can be found in smart homes, smart cities and mobile applications (Obi, 2013; Wu, 2007; Davis, 2012; Wiredu, 2007). One research project has focused on technology and aging population by using a new concept called an “innosumer” such as, an innovative consumer for the aging market (Peine, 2013). Complementary perspectives on the relationship between technology and aging population have focused on the elderly as active consumers and co-creators of transformations in technological changes and consumption. Healthcare service innovations are significant for elderly, family, and caregiver by providing services based on their needs.

Implications of information and communications technology (ICT) to support healthcare service in developing countries are important issues for policy makers and governments, especially in mobile technology and applications through internet (Junhua et al, 2013). Mobile technology effects quality and cost of service in healthcare market by supporting basic health monitoring and connecting to caregiver. The advancement of mobile technology is a key factor of healthcare service management in many developed countries. As an alternative for implication in developing countries, mobile technology allows self-service provision on health monitoring by patients and enables online medical service provision by physician. Trends in healthcare market are expanded by the adoption of ICT applications to embrace consumer behaviors and health demands, which overcome the concerns of limited healthcare resource. Therefore, it is essential to apply mobile technology to support healthcare service in the interaction among healthcare providers, communities, families, and the elderly.

Technology acceptance and readiness are factors that support ICT implication for healthcare service. ICT and its applications of mobile technology are available to allow communication between people and social network. The applications can be used for communication and sharing healthcare knowledge among the elderly, caregivers, families, and communities. Knowledge sharing through innovative healthcare management is an essential factor that increases service quality based on the use of appropriate technology. Knowledge sharing can be applied to solve health problems in the daily lives of elderly people through mobile technology and the internet that will guide them on how to respond to emergency cases based on integrated technological services systems. Due to the importance of appropriate actions dealing with emergency cases, it is important to increase the quality of EMS through mobile technology and knowledge sharing based on the ability of people to use EMS related technologies.



Electronic healthcare (eHealth) is an application of information technology in healthcare services. It communicates health information throughout a medical team or a healthcare service system. It has become an interesting topic for policy makers in developing countries to overcome the lack of resource problem in health system (Petrovic, 2013; Kishimoto et al, 2013). eHealth expands from general healthcare practice to integrated healthcare communication between service providers and patients. It relates to many applications from health records, radiography, picture archiving communication system (PACS) to tele-Health. eHealth requires incorporation of ICT, skill workforces, and technical support in health service systems; it is usually to gain applied effectiveness and efficiency of healthcare systems. Although applications of eHealth have been applied to healthcare system in developed countries for over 10 years; from basic information management to complex online health service, there has not been broadly adopted in healthcare systems in Asian developing countries. It is different when comparing with e-commerce and internet banking (Plaza et al, 2011; Mendonca et al, 2004; Liu et al, 2011). Thus, there are challenges in preparation and implementation of eHealth in Asian countries with a crucial limitation that is a lack of resource and technology.

From the viewpoint of service-dominant logic (S-D Logic), the co-creation concept is intended to capture the essential nature of value creation between participators; it involves the participation of beneficiaries through use and integration of resources among partners (Vargo&Lusch, 2004 and 2008). The concept supports service exchange through the interaction of service providers co-operating together with consumers, who are active participants in the service system. The increasing aging population reflects the need of effective healthcare services and the well-being of the elderly, which is to receive flexible applications that enable the elderly to communicate their desires with others when they encounter with emergency cases. There is a need to improve the quality of EMS by being more service oriented and developing new technologies. Alternative of EMS applications for elderly should be provided with reasonable price to satisfy the needs of patient and caregivers.

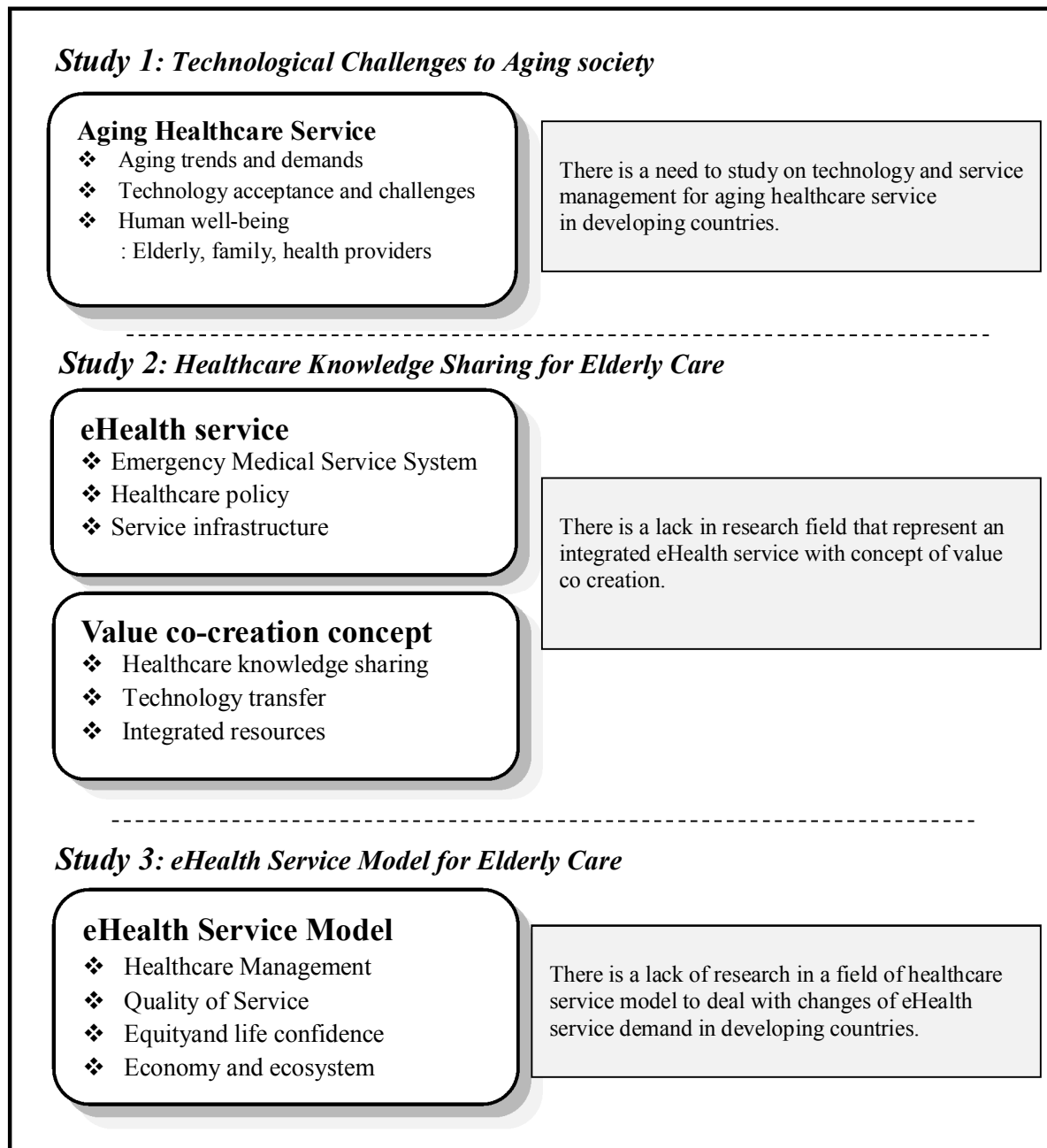
From the research background, it is important to improve EMS and eHealth for the elderly in developing countries. Healthcare providers and related co-operators have to prepare eHealth systems that provide worthy services and conform to the guidelines issued by WHO. Based on the problems of lack of workforce and technology in developing countries to support healthcare knowledge management both for the elderly and health providers, there is a need to identify and develop eHealth service model to support EMS for the elderly through providing a flexible application. Moreover, it needs to focus on attitudes and behaviors of the elderly in the part of healthcare management through mobile technology. eHealth service is an necessitate service concept that needs a thorough study in order to overcome the lack of resource and to enhance the quality of provided healthcare service towards well-being of people in developing country.

## 1.2 Research Objectives and Research Questions

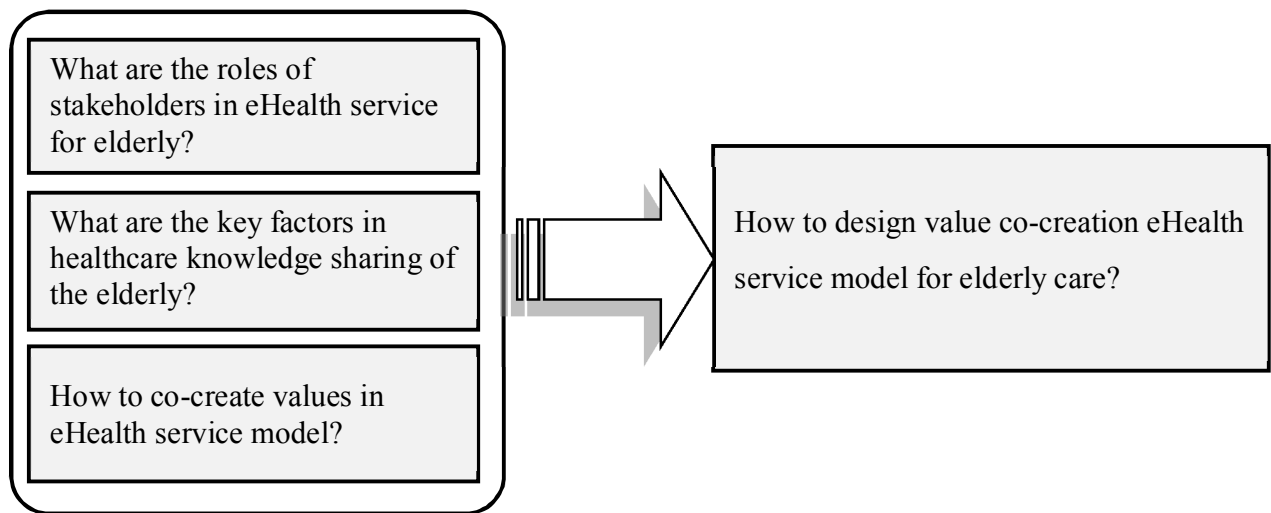
Based on the limitations on a lack of workforce and deficiency of appropriate technology to support healthcare knowledge management both for the elderly and health providers, there is a need to identify and develop an eHealth service model to support EMS for the elderly in developing countries through providing a flexible application. Research objectives of this study is separated into three part based on research problems represented in Figure 1.1.

The first objective aims at identifying the technological challenges that face healthcare services in terms of the EMSS to support elderly patients' demands. It adopts a conceptual modeling approach to represents a framework of EMSS for elderly people on the basis of the value co-creation concept. The second objective is to find key factors that affect healthcare knowledge sharing through mobile technology of people in developing countries. Theory of Reasoning Action (TRA) and technology acceptance are applied to support eHealth development in last study (Study 3). The last objective aims to develop a conceptual eHealth service model for the elderly people. Developing eHealth service model in this study is based on the integration of value co-creation and knowledge sharing concepts into EMSS for the elderly.

Research questions in this research can be divided into two parts, as represented in Figure 1.2. As presented in the figure, it is necessary to understand the relationships of essential factors that are the core elements in constructing an eHealth service model for the elderly. This study focuses on how the eHealth service model can overcome the resource limitation in Asian developing countries. According to that, we verify the constructed model by exemplifying a case study based on healthcare system of Thailand. In the first stage of study, we need to find the answers for these following questions "What are the roles of stakeholders in eHealth service for elderly?", "What are the key factors in healthcare knowledge sharing of the elderly?", and "How to co-create values in eHealth service model?". After that, all findings from the first stage are incorporated to complete the process of the study, as represented on the right side of Figure 1.2.



**Figure 1.1.** Research problems and related studies



**Figure 1.2.** Overview of research questions for eHealth service model

**Major Research Question (MRQ):**

How to design value co-creation eHealth service model for elderly care?

**Subsidiary Research Questions (SRQ):**

- (i) What are the roles of stakeholders in eHealth service for elderly?
- (ii) What are the key factors in healthcare knowledge sharing of the elderly through mobile technology?
- (iii) How to co-create values and integrate resources of stakeholders in the eHealth service model?

The incorporated answers are served to answer the question of “How to design value co-creation eHealth service model for elderly care?”. In other words, this study intends to deal with the lack of implication and readiness in developing an eHealth service system to support social change that is required alternative solutions for enhancing quality of service through technology and service management.

## 1.3 Structure of the Study

Structure of this study is separated into eight chapters, as demonstrated in Figure 1.3, namely Introduction, Literature Reviews, Research Methodology, Hypotheses, Study 1-3, and Conclusion. Details of Chapters 2 to 8 are briefly explained as follows;

‘Chapter 2: Literature Reviews’ consists of details of overview of related research and concepts, including healthcare technology in aging society eHealth, healthcare knowledge sharing, emergency medical service system (EMSS), and service dominant logic (S-D Logic). Related work and concepts discussed in this chapter are essential in supporting the design of the technology based eHealth service model and service management.

‘Chapter 3 Research Methodology’ is related research methods used in each study based on structured and research objectives.

‘Chapter 4: Study 1 – Technological Challenge to Aging Healthcare Service’ is the first phase that identifies related healthcare service applications and technologies based on needs and ability to participate of consumers. This chapter sheds light on many important topics, including health system situation, aging society, healthcare technology for elderly, technological challenges to EMSS Thailand, and EMSS model based on value co-creation concept.

‘Chapter 5 Hypotheses in Knowledge Sharing Behavior’ includes hypotheses based on the value co-creation EMSS model presented in Study 1 (Chapter 4: Technological Challenge to Aging Society: EMSS) to use in Study 2 (Chapter 6: Healthcare Knowledge Sharing for Elderly Care).

‘Chapter 6: Study 2 – Healthcare Knowledge Sharing Model for the Elderly Care’ aims to study people’s attitudes on mobile healthcare technology, healthcare knowledge sharing model, and factors in effective knowledge sharing.

‘Chapter 7: Study 3 – Value Co-creation in eHealth service model for Elderly Care’ focuses on developing the model by integrating details obtained from the previous two studies (Study 1 and Study 2). This chapter includes topics of eHealth service model for EMSS and eHealth policy for developing countries.

‘Chapter 8: Conclusion’ includes answers for research questions, academic implications, and practical implications. The chapter explains findings and solutions of this study.

# **Chapter 2**

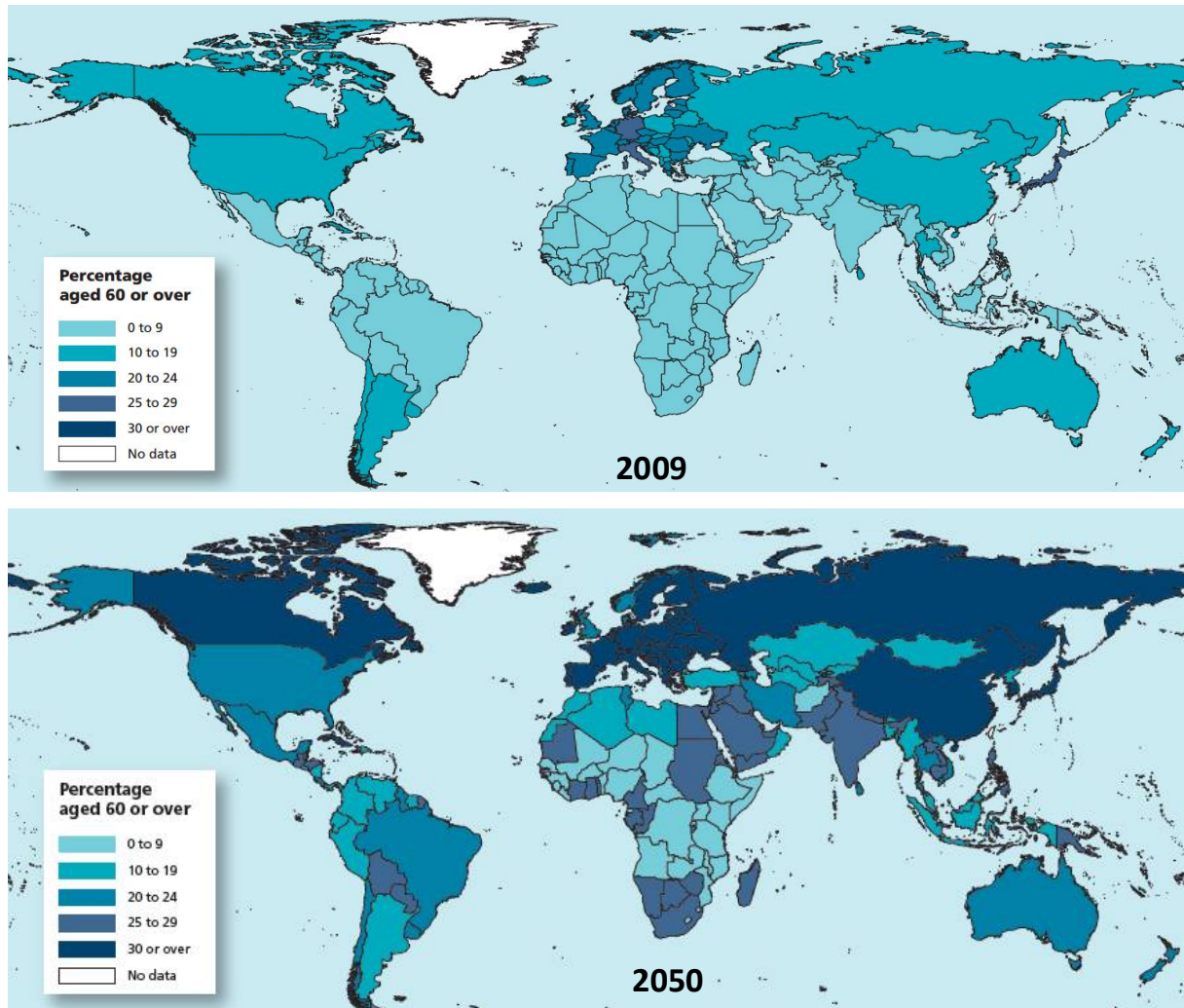
## **Literature Reviews**

### **2.1 Healthcare Technology in Aging society**

#### **2.1.1 Overview of Aging Society**

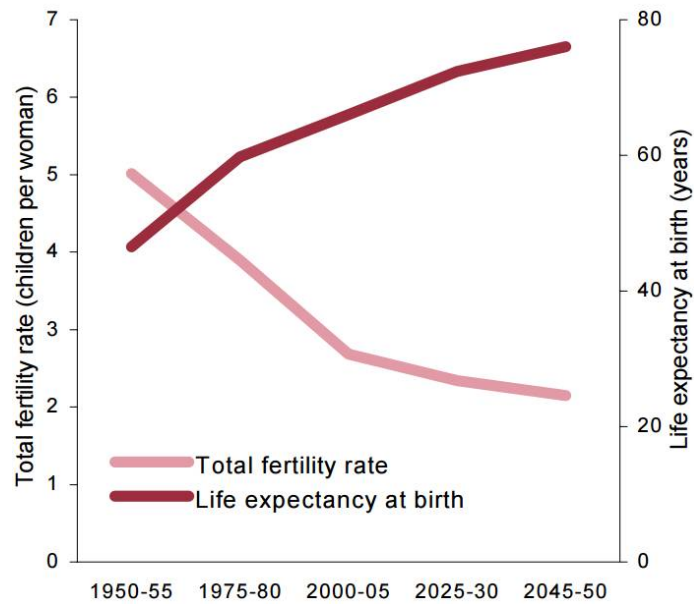
An aging society is defined as a population of elderly people in society who are 60 years old and older. The increase in the number of elderly is caused by changes in lifestyles, a shrinking birthrate, and increasing quality of health over the last 20 years. The trends of aging societies impose economic and social costs through changing services and market demand. These trends have occurred in developed countries since 2000 and are expected to expand to developing and undeveloped countries. Governments and societies should prepare for and plan to support growth of these trends with public infrastructures and service systems (Niehaves, 2011; Stockdale & MacLeod, 2000; Wright & Lund, 2000).





**Figure 2.1:** Percentage of the total population in 2009 and 2050(United Nations, 2009)

Population aging is a phenomenon that occurs when the median age of a country or region rises due to rising life expectancy and/or declining fertility rates. There has been, initially in the developed countries but also more recently in less developed countries, an increase in life expectancy which causes the aging of populations. As presented in Figure 2.1, the rate of population aging in the 21st century will exceed that of the previous century. For the reason that life expectancy is rising, the number of people aged 60 years and above had tripled from its number in 1950 to 600 million in 2000, in 2006 it had surpassed to 700 million, and is projected that to reach around 2 billion by 2050(United Nations, 2009). For the entirety of recorded human history, the world has never seen as aged a population as currently exists globally.



**Figure 2.2:** Trends of declining fertility rate and increasing life expectancy (UN, 2002).

Population aging is a process known as the “demographic transition” in which mortality and fertility decline from higher to lower levels. Decreasing fertility along with lengthening life expectancy shown in Figure 2.2 has reshaped the age structure of the populations in most regions of the planet by shifting relative weight of populations from younger to older groups. Fertility decline has been the primary determinant of population aging. Over the last half century, the total fertility rate decreased globally by almost half, from 5.0 to 2.7 children per woman. Moreover in the next half century, it is expected to drop to the replacement level of 2.1 children per women.

Studies about aging society in social science mainly focus on well-being, service system, impact of aging society, and technology adoption. Today, ICT offers several solutions for elderly people for their independent living by managing their preferred environment through maintaining their independence and autonomy in order to enhance their mobility and quality of life (Li, Y.B., Perkins, 2007). ICT helps elderly people improve their quality of life, promote them to stay healthier, and live independently for longer. In addition, ICT possibly allows counter action capabilities that are more prevalent with aging people to remain active at work and/or in their society (Sitti & Nuntachompoo, 2013). All in all, ICT provides opportunities to the elderly to be accessible to integrated social and health care services.

An elderly individual's background and level of technological knowledge directly influence his or her willingness to learn. Through ICT, technological knowledge helps the elderly people increase their interest in social engagement and consequently become more socially interactive and less isolated (Li, Y.B., Perkins, 2007). Marketing approaches are needed to develop a framework in which a specific organization is embedded. Providers necessitate to classify suitable marketing approaches that are relevant for healthcare organizations to provide services in public health systems (Lega, 2006). Through proper commissioning of providers and consumer education, matching elderly needs and expectations with services will enhance the level of appropriateness, cost-effectiveness, and quality of services.

Sixsmith and team (2014) present a number of ways in which very old people perceive healthy aging in the context of living alone at home within urban settings. The elderly perceive healthy aging as an active achievement, which is created through personal effort and supports of social ties, despite the fact of declining health, financial and social concerns associated with elderly. The availability of supports to assist the elderly to age-in-place is likely to vary according to national context (Cutchin, 2003, Cutchin, 2005). However, if high standards of domiciliary care can be maintained, 'aging-in-place' in one's own home is seen to fundamentally and positively enhance well-being, autonomy, social participation and healthy aging amongst older people (Rosel, 2003). While the home may play a crucial role, the health benefits of aging-in-place at home have yet to be fully explored. The term 'healthy aging' signals an increasingly positive perspective on health and well-being in old age.

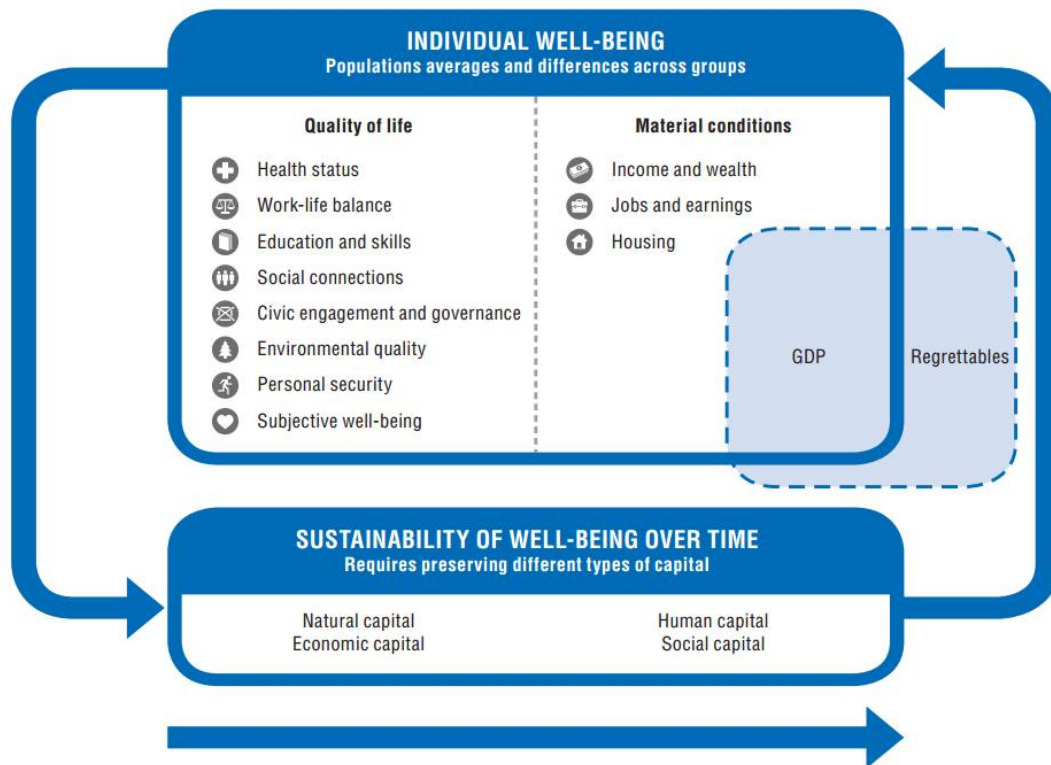
### **2.1.2 Healthcare Technology for the Elderly care**

Technologies and communication systems in many countries have developed to support the daily lives of people to achieve faster and easier living. Developments in technologies are driven by many industries and have changed the lifestyles of people into those of technology consumers (Harry et al., 2006; Selwyn, 2004; Li et al., 2005). A new concept called “innosumer” focuses on technology and consumer for the aging market (Peine et.al, 2014). In modern society, elderly people are innovative consumers who exchange value of service in technology market and use technology to support themselves in daily life.

Healthcare technology developments support the daily life of people for faster and easier living by changing the lifestyle of people in technology consumers (Harry et.al, 2006; Selwyn, 2004; Li et.al, 2008). A complementary perspective on the relationship between healthcare technology and aging market focuses on elderly as co-creator of the transformation for technological change and consumption. Many pieces of research aim at trying to develop and focus on possible technologies that can be applied to healthcare services, from basic needs in daily life to special help (Taboada M, 2010; Lee, 2009; Pantelopoulos, 2010; Jung, 2013; Djellal, 2005; Lu, 2005).

Healthcare technology for elderly is significant to aging market especially in developing countries, which are emerging markets of e-service and smartphone.

Healthcare is an industry that has put efforts to involve mobile technology and communication systems for elderly people to support the well-being and quality of life through security and confidence(Richards et al, 2012; Obi et al, 2013; Wu et al, 2007; Davis et al, 2012; Wiredu, 2007). Mobile phones are promising tools to improve the quality of life for the elderly as their functions and applications can satisfy the people requirements (Plaza et al., 2011; Mendonca et al. 2004; Liu et al., 2013; Ngai &Gunasekaran, 2007; Junglas et al., 2009; Chatterjee et al., 2009; Standing & Standing, 2008). Therefore, these components should be taken into account when defining the current and future roles of mobile applications in an aging society.



**Figure 2.3** The OECD well-being conceptual framework (OECD, 2011)

The well-being conceptual framework presented in Figure 2.3 defines well-being in the context of the OECD as ‘Better Life Initiative’ (OECD, 2011). This framework distinguishes between current and future well-being perspectives. The current well-being is subjected in terms of outcomes achieved in the two broad domains: material living conditions (income and wealth, jobs and earnings, housing conditions) and quality of life (health status, work-life balance, education and skills, social connections, civic engagement and governance, environmental quality, personal security and subjective well-being). Future well-being is a topic that involves key resources that drive well-being overtime. It is persistently affected by current’s actions which can be measured through different types of “capital” (Natural, Economic, Human, and Social). The well-being conceptual framework evaluates the sustainability of well-being over time that is essential to measure the average well-being of people in different countries.

The approach of well-being framework is based on a multidimensional definition of well-being consisting in what people do such as having a good job, expressing their political voice, or having freedom to choose. As presented in the figure, quality of life and material living conditions are broken down into 11 dimensions namely: health status; work-life balance; education and skills; social connections; civic engagement and governance; environmental quality; personal security; subjective well-being; income and wealth; jobs and earnings; and housing. The rationale for selecting these dimensions is explained as follows:

- **Physical and mental health** is important in itself for people's well-being but also because it allows the people to perform a range of personal and social activities that contribute to their well-being.
- **Education and skills** can be seen as both a basic need and an aspiration of all humans, as well as being instrumental to achieve many other economic and non-economic well-being outcomes.
- **Work-life balance** is important for people's well-being in terms of family life; more generally, the amount of time that people can devote to leisure, personal care and to other non-work activities that help individuals remain healthy and productive.
- **Social connections** are valuable in themselves as many people report that the most pleasurable activities are performed with others; but they are also instrumental in achieving a number of other important goals such as finding a job, or support in case of need.
- **Civic engagement and governance** matters, as having political voice in the society where people live allows them to have a say in political decisions that affect their lives and to contribute to deliberations that shape the well-being of communities; similarly, good governance is needed to translate people's voice into policies that support their aspirations for a good life.

- **The quality of the natural environment** where people live and work is important in its own right but it also matters for people's health and their ability to undertake a number of activities (e.g. raising children, social life, etc.).
- **Personal security** is living in a secure environment, for example, where the risks of being robbed or assaulted are low, is important to generate well-being.
- **Subjective well-being** is besides objective aspects of living conditions and quality of life, it is crucial to consider how people feel about their life and experience.
- **Income and wealth** measure the economic resources that people can use today or in the future to satisfy various human needs and wants and that protect against vulnerabilities and risks of various types.
- **Availability and quality of jobs** are relevant to people's well-being, not only because quality jobs increase people's command over resources but also because these jobs offer the opportunity to fulfill one's own ambitions, to develop skills and abilities, to feel useful to society and to build self-esteem.
- **Housing** is quality satisfy people's basic needs. Beyond their intrinsic importance, they are also important determinants of health and subjective well-being, as well as of social connections and access to jobs and public services.

**Table 2.1**

Expectation on technology of the elderly (Plaza, et.al, 2011)

Needs and expectations	Notes
Feeling safe and secure	To be connected to the usability of the technology
Memory and daily life activity aids	To have appointment reminder, alarm, address book, diary, medication reminder, and caller ID complement
Communication device	To enable contacts with friends and family
Freedom of movement	To involve both self-determination and empowerment
Enjoyment, self-actualization, healthier independent life	To get services that promote people's physical and mental well-being (Intrinsic motivations)

Aging people require various supports from individuals to social preferences. The individual preferences of elderly people differ depending on their ability to live at home through appropriate technology base on lifestyle and environment (Hoof, 2013; Li, 2007). Moreover, technologies are also possible to improve the physical health and independence of the elderly. One piece of research that has focused on the needs and expectations of elderly people in using technology has been classified by using the criteria represented in Table 2.1. The criteria are, for example, to maintain contact with families, to help elderly adults stick to medication, to provide reminders and exercise plans, and even to identify and alert professionals to potential health problems. For instance, mobile devices are possible to connect medical professionals with the elderly to monitor and review their chronic conditions.



In modern societies, elderly people have access to technology and applications that support their health and social care. The perspectives of human factors in the context of an elderly monitoring system are necessary to have a design that can continuously monitor the elderly and support them with various services (Hossain, 2014). Technological applications are necessary in order to learn and share experience on services among providers, elderly people, and families. Aging healthcare services that provide through e-services are essential to quality of life of patients and increase availability of service on time in any place (Sintonen&Immonen, 2013; Petrovic, 2013; Kishimoto et al., 2013). Thus, this approach can improve the effectiveness of health system by building up technologies that meet the general and specific needs of aging people.

## 2.2. eHealth

eHealth is a broad application of information technology or health informatics in healthcare service, focusing on communication in a medical team or a healthcare service system. It widely employs applications of the internet, digital process, and recognition for supporting medical practices or healthcare management by electronic based devices. eHealth practices are implicated in many healthcare processes, including electronic medical record (EMR), PACS, online monitoring, tele-health, and online healthcare through the internet. The range of applications expands from processes in hospital, self-monitoring at home, to personal health management by interaction through the internet on mobile phones and computer support systems. Healthcare applications on mobile phones are an alternative medical device in healthcare service; it is possible to be supported by roles of eHealth in clinical data, healthcare service management, and co-operate in medical team (Etsenbach&Diepgen, 2001). Actors in healthcare service have to set health policies and strategies to develop health information infrastructures based on the successful best practices from developed countries.

The applications of ICT in healthcare have exponentially developed over the last 15-20 years as the applications overcome concerns of a lack of communication and, instead, provide potential to improve effectiveness and efficiency of the healthcare service. eHealth applications used in many developed countries are different in terms of infrastructure and health policy. The World Health Organization (WHO) suggests that telemedicine and primary healthcare are required to propose for community health provider in rural areas. The applications are possible to be supported by main medical centers to improve quality of service through the use of ICT and EMR (Junhua et.al., 2013). eHealth increases quality and efficiency of service to participants by enabling online access to EMR and clinical practices, and to service management via mobile applications(Sintonen&Immonen, 2013; Petrovic, 2013; Kishimoto et.al., 2013). Internet based devices and mobile phones have become prospective pervasive technologies that change healthcare market in aspects of service cost, process, time, and place.

**Table 2.2.**  
Categorization of studies in eHealth service modeling

Authors	Journal	Main Results	eHealth Challenges
Junhua, Li. et al., (2013)	Interactive Journal Of Medical Research	<ul style="list-style-type: none"> <li>- Health Care Provider Adoption of eHealth</li> </ul>	<ul style="list-style-type: none"> <li>- eHealth acceptance factors and clusters of healthcare provider</li> <li>- Healthcare decision makers proactively encourage acceptance of eHealth and also assist health policy makers to promote the eHealth innovation.</li> </ul>
Etsenbach, G. &Diepgen, T.L. (2001)	Clinics in Dermatology	<ul style="list-style-type: none"> <li>- Fundamental problems of telemedicine</li> <li>- The use of the internet for health education</li> <li>- Those who have preventable health problems and lack health insurance coverage are the least likely to have access to technologies</li> </ul>	<ul style="list-style-type: none"> <li>- The role of e-Health and consumer health informatics</li> <li>- On the internet, information can be pushed (broadcast) or pulled (on demand).</li> <li>- Consumers may automatically get tailored “pushed” health messages “just in time”</li> </ul>
Davis, S. et al., (2012)	Journal of Rural Studies	<ul style="list-style-type: none"> <li>- The elderly people develop and maintain strong community connections and well-functioning social capital and that participation in social activities was associated with feelings of being connected with community.</li> </ul>	<ul style="list-style-type: none"> <li>- Lack of options as the main constraints on participation and communication</li> <li>- Older people play an important role in the sustainability of rural communities</li> <li>- Implication and adoption technology</li> </ul>
Halteren, A.V, et al., (2004)	The Journal of Information Technology in Healthcare	<ul style="list-style-type: none"> <li>- The availability of high bandwidth public wireless networks gives rise to new mobile healthcare services.</li> </ul>	<ul style="list-style-type: none"> <li>- The system has many applications in healthcare and will enable a variety of healthcare services to be delivered in the community.</li> <li>- Security and quality of service guarantees need to be clarified.</li> </ul>
Hun, J. et al., (2013)	International Journal Of Medical Informatics	<ul style="list-style-type: none"> <li>- Older adults’ wellness self-monitoring tools enhance patient and healthcare provider interaction, patient education, and improvement in overall wellness.</li> </ul>	<ul style="list-style-type: none"> <li>- Making sense of self-monitoring on perceived stakeholders by older adults, social workers, communities, family members, and healthcare providers</li> </ul>
Junglas, I. et al., (2009)	Decision Support Systems	<ul style="list-style-type: none"> <li>- Mobile computing offers the potential to improve the quality and safety of patient care by decreasing the errors and inefficiencies that caused by inadequate and inaccessible of patient document at the point and time of care.</li> </ul>	<ul style="list-style-type: none"> <li>- Technologies (particularly mobile technologies) can be major factors in improving decision making amongst healthcare personnel, cost cutting, and improved safety, but only if these applications are well designed and properly used.</li> </ul>
Lega, F. (2006)	Health Policy	<ul style="list-style-type: none"> <li>- An emphasis on marketing approaches which stress the organization's role in identifying, evaluating, prioritizing, and serving the health needs of target population/markets.</li> </ul>	<ul style="list-style-type: none"> <li>- The exponential growth of the internet laden information age, the interest of media in health issues and the performance measures publicized by authorities are increasing patient choice opportunities.</li> <li>- The development of a service culture in healthcare service</li> <li>- Collaboration in healthcare organizations: providers, purchasers, insurers(financers), and regulators.</li> </ul>

E-business in healthcare may expand to patient self-care through the internet on personal mobile phones and telemedicine facilities (Pagliari et al., 2005; Maass&Varshney, 2012; Chan, 2000; Halteren et al., 2004). Table 2.2 shows categorization of studies that minimize challenges in eHealth service model development. The main challenge of eHealth modeling is how to develop a service platform that provides the means of healthcare service in developing country (Oh et al., 2005; Detmer, 2003). In eHealth, it is also gaining particular popularity by implicating medical data sharing environment among organizations. In eHealth market, there are approaches that stress the organizations' roles in identifying, evaluating, prioritizing, and serving the needs related to healthcare of target population and markets.

Electronic Medical Record (EMR) is an integrated or interlinked (virtual) record of all health and medical related data independent of when, where, and by whom (Doupi et al., 2010). With the emergence of Cloud computing for eHealth service, EMR is transferred to be stored in Cloud servers, in which the data can be flexibly utilized resulting in reducing operation cost (Chen, 2012).The integration of big data and eHealth service will generate special value when being shared and collaboratively used among different parties in the healthcare area (e.g. healthcare centers, laboratories, pharmacies, patients, health insurance, quality assurance in healthcare service delivery, researchers, and national and regional health authorities).

Applications of eHealth with Cloud computing technology are totally challenging to big data, as it is possible to provide unlimited online storage resources. Applying eHealth concept to Cloud computing technology usually allows changes and improved quality through technological advancement effecting from the increased memory storage. In the field of big data for eHealth service, it involves many risks of security and privacy that lead to concerns among patients and medical workers (Fabian, 2015). The concerns are, for example, losing or failure in control over sensitive EMR while storing them on unsecure third-party servers.

Collaborative and secure sharing of healthcare data in eHealth is essential to the design of business process that ensures security and privacy in the service system. Designs of healthcare system are quickly changed due to the continuous development of ICT. This poses challenges when it comes to the process of selecting appropriate data and suitable levels of technology. Accordingly, it is inevitable for healthcare providers to deal with complicated and updated of Emerson the basis of changing technologies.

## 2.3 Healthcare Knowledge Management

Healthcare is a service that requires various management approaches related to material, workforce, information, and service activities. It needs accurate communication that ensures quality of service and confidence of consumer. Healthcare is also considered as an information rich industry that offers a unique opportunity to analyze extremely large and complex data sets (Wickramasinghe, 2010). Healthcare is globally facing many challenges including rising costs and more pressures to deliver high quality, effective, and efficient care.

Knowledge management is a key approach that solves current business problems such as intense competitiveness and the needs of innovate business practices. The goal of knowledge management is to provide decision makers appropriate tools, technologies, strategies and processes to turn data and information into valuable knowledge assets. Examples of healthcare knowledge are:

- Clinical experiences (both recorded and observed)
- Operational policies and Educational resources
  - Medical education content for practitioners
  - Health education content for patients.
- Social knowledge in terms of a community's practices and their communication patterns, and interests and expertise of individual community members.

In eHealth, knowledge management holds the key to develop better management practice techniques, whereas data and information are very necessary in disease management and evidence based medicine. Knowledge sharing in aging societies supports elderly people to share and exchange healthcare knowledge with families and other people who guide them on how to respond to emergency cases based on integrated technological service systems.

Electronic healthcare (eHealth) is an application of ICT in healthcare services that manages data, information, and knowledge in healthcare service system. To accomplish better quality of service, combinations of following factors are required:

- Reduction of costs or increase of revenues
- Streamline and operations
- Improved patients or member satisfaction
- Enhanced medical care services

Knowledge sharing is defined as the sharing of related information, ideas, suggestions and expertise by individuals in a community. The concept of knowledge sharing is based on the premise that knowledge is not an object that resides outside of context; instead, it is an individual's interpretation of an object, and therefore individuals possess knowledge that must be codified and shared (Nonaka and Takeuchi, 1995; Liebowitz, 1999; McInerney, 2002). Knowledge sharing is one of several processes of knowledge management, which includes knowledge creation, acquisition, codification, and sharing. Knowledge sharing is similar to knowledge transfer and knowledge use (Alavi&Leidner, 2001; Bock & Kim, 2002; Davenport, De Long, & Beers, 1998; Kankanhalli et al., 2005).

Knowledge sharing is a critical team process because if knowledge is not shared, the cognitive resources available within individuals remain underutilized (Argote, 1999). Consequently, knowledge sharing is a core component to enhance the performance (Mathieu et al., 2000; Smith-Jentsch et al., 2005; Srivastava et al., 2006). It is related to cost reductions, faster new product development projects, organization innovation capabilities, and growth of sales and revenues from new products and services (Wang & Noe, 2010). Knowledge sharing is especially critical for healthcare services because individuals in medical teams have different backgrounds, perspectives, and observations (Dougherty, 1992).

Healthcare knowledge sharing is a relatively new practice. For some cases, hospitals have motivated the used of this practice in medical universities; and healthcare knowledge sharing is defined as “team members sharing task-relevant ideas, information, and suggestions with each other” (Srivastava, 2006, p. 1243). Hence, the knowledge sharing in hospitals will enhance patient safety because the majority of medical errors are caused by a lack of learning combined with punitive behaviors (Kim, Bennett & Song, 2012). While many factors are involved in knowledge sharing, technology mediated environments are particularly important (Carlson & Davis, 1998; Yu, Lu & Liu, 2010). Knowledge sharing through innovative healthcare is an essential factor that can increase service quality based on the application of appropriate technology.



## 2.4 Emergency Medical Service System

An emergency medical service system (EMSS) can be defined as “a comprehensive system that provides the arrangements of personnel, facilities, and equipment for the effective, coordinated and timely delivery of health and safety services to victims of sudden illness or injury” (Moore, 1999, pp. 325-331). The main aim of EMSSs emphasizes providing timely care to victims of sudden and life-threatening injuries or emergencies to prevent needless mortality or long-term morbidity. The main function of EMSSs can be simplified into four main components: access to emergency care, care in the community, care along transportation routes, and care upon arrival at health care facilities (Razzak&Kellermann, 2002). EMSS provides services that support the needs of elderly people through integrated information and communication technologies. The availability of EMSS will increase life confidence in aging societies. Thus, actors in EMSS need to prepare for active supports for all possible cases on a 24-hour basis.

The impact of an aging society on the demand for EMSS must be addressed to handle the increased need for pre-hospital emergency training and proper technologies that are required to treat a larger number of elderly and presumably sicker patients (McConnell& Wilson, 1998; Shah, 2006; Wright &Sittig, 2008; Lee et al., 2012; Sheehan et al., 2013). Elderly people in aging societies need to find information and make decisions about providers of medical and social services to maintain their daily lives by taking into consideration of reasonable selections, costs, and time (Meinow et al., 2011). Physical and cognitive abilities decline as health problems increase. EMSS can build market mechanisms that increase the responsibility of individuals. In this case, some kinds of care coordinators who are available and be able to act as appropriate quality providers with respect to the interests of the elderly should be available. All in all, the integrated mobile technologies and EMSS applications create market mechanisms that increase healthcare self-service of people in the aging society.

Incoming trends in smart homes, pervasive healthcare (ubiquitous), and household devices may have a positive impact on daily life of the elderly by reducing burdens imposed by several tasks and enriching social interactions and emergency communications. There is a large variety of assistive devices such as alarms, sensors, detectors, and lifestyle monitoring devices that can help in the case of emergency (McKee et al., 2012). The values in future healthcare service are based on implications of technology that enhance quality of provided services and increase satisfaction of patients (Nieboer, 2014). In terms of applications the internet based service in EMSS, the following issues are worth focusing on:

- Determining the quantity, quality, and form of the information that is desirable and acceptable, both for the consumers and providers;
- Optimizing the consumer and provider experiences;
- Understanding the relationships between the information provided and subsequent consumer behavioral modification.

A report of WHO published in 2012 represents concerns of elderly people worldwide in a perspective of increasing emergency situations; and they are considered as one of the most seriously affected groups (WHO, 2012a). Until now, the needs of the elderly are generally overlooked by public organizations in terms of policies and practices. There are specific health and social factors that can separately affect elderly people and have impacts on them during emergency situations. These include physical health, mental health, functional status and disabilities, lifestyle habits, nutrition, family and social relations, economic situations, and gender considerations.

Awareness of the needs and contributions of elderly people should be taken into account to ensure that these people are identified and given care before, during, and after emergency situations happen. For example, impairments that in normal circumstances would not interfere with daily functioning can quickly become handicaps that overwhelm a person's capacity to cope in emergency situations. An elderly person with arthritic knees, diminished vision, and poor hearing can rapidly become incapable of obtaining food or receiving messages to flee from danger. WHO provides approaches to promote healthcare in the aging populations of developing countries. The approaches relate to strategies involving cultural and structural (government), intersectional (hospitals), community-based, family-based, and individual-based changes.

## 2.5 Service Dominant Logic (S-D Logic)

The dominant logic is often referred to an old manufacturing, industrial management practice known as good dominant logic (G-D Logic). The logic presents a pathway of continual human well-being that is to invent more tangible goods and interventions that are then diffused throughout society for massive application and problem solution. G-D logic emerged during the industrial revolution resulting as the high division of labor in society. It is the logic of separation where goods can be standardized and produced separately and away from the customers. Goods produced in this way are created at high efficiency and embedded with value and then stored and distributed through additional value-adding activities – selling and branding. The customer is someone who can be targeted and promoted to by the manufacturer in order to create sales and maximize firm profits. This logic needs to be transformed by focusing more on the interaction of providers and customers to be able to have a long-term sustainable provision.

Service is an act of doing something for someone else's benefit (Vargo&Lusch 2008b). The broad concept of service dominant logic(S-D Logic) is the logic of togetherness where actors use their applied knowledge and skills (competences) to provide benefit to another and to benefit themselves. In S-D logic, service is defined as

*“The application of specialized competences (operant resources – knowledge and skills), through deeds, processes, and performances for the benefit of another entity or the entity itself.”*  
(Vargo& Lusch, 2008b, p. 26)

S-D logic is based on relationships, mutual trust, and win–win exchange. When goods are involved, they are service distribution mechanisms or service appliances. Table 2.3 illustrates a conceptual transection of G-D logic to S-D logic (Lusch&Vargo, 2006). Ways of interaction and attitude of actors are transformed evaluating by the value through constant learning to find better solution with co-creators in a dynamic environment.

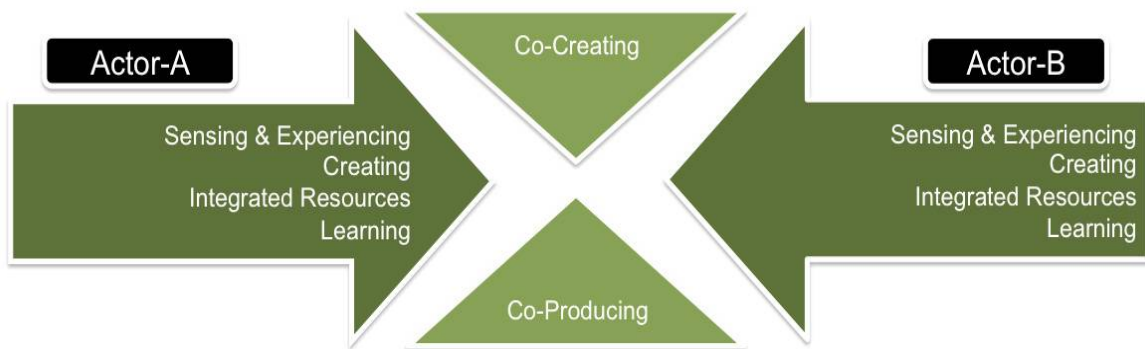
**Table 2.3**

Conceptual transection of G-D logic to S-D logic (Lusch&amp;Vargo, 2006)

Goods-dominant logic concepts	Transitional concepts	Service-dominant logic concepts
Goods	Services	Service
Products	Offerings	Experiences
Feature/attribute	Benefit	Solution
Value-added	Co-production	Co-creation of value
Profit maximization	Financial engineering	Financial feedback/learning
Price	Value delivery	Value proposition
Equilibrium systems	Dynamic systems	Complex adaptive systems
Supply chain	Value-chain	Value-creation network/constellation
Promotion	Integrated marketing communications	Dialogue
To market	Market to	Market with
Product orientation	Market orientation	Service orientation

S-D logic views customers as one of the most valuable resources of the firm – as an operant resource. The customers help in marketing program and work collaboratively to co-create value with providers and community. With the fast growth of an online network economy enabled by global telecommunication service platform, big data analysis, and ubiquitous computing, customers are part of an extended enterprise and co-producers of the firm. The trend of S-D logic in society is estimated to increase more, which providers and governments need to prepare a good structure of network market economy with a good framework and policies.

Co-produced marketing will be one of the most exciting opportunities for enterprises to enhance their marketing programs, improve their financial performance, and more efficiently and effectively serve customers, suppliers and other stakeholders. Value in S-D logic is uniquely determined by all customers, who are co-creators of value. The result of intense specialization is an increased interdependency among all involved stakeholders that leads to more collaboration, which in turn, stimulates innovation (Lusch, Vargo, & O'Brien, 2007). Rethinking on co-producing generates more possibilities of service provision through exchange of knowledge and skills that support increasing specialization and boost market growth.



**Figure 2.4** Collaborative economic system of S-D logic (Lusch&Vargo 2009, p. 9)

The context of the figure is that, it consists of actors that are part of the experience and other resources that are drawn upon the usage experience. The providers and the customers participate in an integrated economic system that supports their co-creation. An integrated economic system of actors who are firms and respective partners is not separated through the collaborative process, as illustrated in Figure 2.4. Both the customers and the providers are actors who co-create values by sensing, experiencing, and integrating resources for individual and collective benefit. In addition, they also learn how to better serve each other in the system (Lusch&Vargo, 2009). It is getting obvious that value creation in S-D logic is an interactive process between firms and customers.

Addressing S-D logic explicitly acknowledges that consumers co-create value by integrating many resources in a variety of ways. Foundational premises of S-D logic are explained in Table 2.4. S-D logic shifts the primary focus from operand resources to operant resources. The operand resources are tangible and static resources that require other more dynamic resources to act on them to be useful (Vargo&Lusch, 2009). The operant resources are dynamic resources that can act on other resources, both operand and operant, to create value through service provision.

**Table 2.4**

Foundational premises of S-D Logic (Vargo&amp;Lunch, 2008)

Premise number	Foundational premise	Explanation
FP1	Service is the fundamental basis of exchange.	<ul style="list-style-type: none"> <li>- The application of operant resources(knowledge and skills), “service,”as defined in S-D logic, is the basisfor all exchange.</li> <li>- Service isexchanged for service.</li> </ul>
FP2	Indirect exchange masks the fundamental basis of exchange.	<ul style="list-style-type: none"> <li>- Because service is provided throughcomplex combinations of goods,money, and institutions,the service basis of exchange isnot always apparent.</li> </ul>
FP3	Goods are a distribution mechanism for service provision.	<ul style="list-style-type: none"> <li>- Goods (both durable and non-durable)derive their value through use – theservice they provide.</li> </ul>
FP4	Operant resources are the fundamental source of competitive advantage.	<ul style="list-style-type: none"> <li>- The comparative ability to causedesired change drives competition.</li> </ul>
FP5	All economies are service economies.	<ul style="list-style-type: none"> <li>- Service (singular) is only nowbecoming more apparent withincreased specialization andoutsourcing.</li> </ul>
FP6	The customer is always a co-creator of value.	<ul style="list-style-type: none"> <li>- Implies value creation is interactional.</li> </ul>
FP7	The enterprise can not deliver value, but only offer value propositions.	<ul style="list-style-type: none"> <li>- Enterprises can offer their appliedresources for value creation andcollaboratively (interactively)create value following acceptanceof value propositions, but can notcreate and/or deliver value independently.</li> </ul>
FP8	A service-centered view is inherently customer oriented and relational.	<ul style="list-style-type: none"> <li>- Because service is defined in termsof customer-determined benefit andco-created it is inherently customer oriented.</li> </ul>
FP9	All social and economic actors are resource integrators.	<ul style="list-style-type: none"> <li>- It implies the context of value creation that is networks of networks(resource integrators)</li> </ul>
FP10	Value is always uniquely and phenomenologically determined by the beneficiary.	<ul style="list-style-type: none"> <li>- Value is idiosyncratic, experiential,contextual, and meaning laden.</li> </ul>

In terms of healthcare, G-D logic is manifested in the profusion of more specialized and sophisticated providers, delivery systems, pharmaceuticals, medical devices, facilities, procedures, sources of information, and technologies. Value from the customer's perspective of health enhancement may include such intertwined positive experiences that are now more enabled such as having lunch with a grandchild, attending a sporting event, joining a high school graduation, going to church, and participating in a book club. They may also include intertwined negative experiences that one is relieved of as a result of health care treatment.

A G-D logic frames of the relationship between the providers and the patients. The provider is viewed as experienced, knowledgeable, innovative, creative, and the source or creator of value (Frosch, 2012). The patient is viewed as inexperienced, unknowledgeable, passive or dull, and someone who consumes and uses up or destroys value. This represents the logic of separation between producer and consumer or in healthcare between healthcare providers and patients. Consumers assess values of health and a sense of well-being. The healthcare system cannot supply these values, but only products such as hospitalization, ambulatory care, medications, procedures, and preventative care. These components of healthcare represent the desired final output from system in G-D logic.

In S-D logic, both the health providers and the consumers are sensing, experiencing, learning, creating, and integrating resources. In the process, they co-create values using a definition of value, which far transcends that reflected by concepts, including patient engagement and patient activation, and measurements such as life expectancy, mortality in infancy or from treatable conditions, and vaccination rates (Jointer&Lusch, 2016). Value in healthcare has a different meaning, it is based on a perspective of value in healthcare of consumers. The value in S-D logic is not to be equated to a healthcare provider delivering medical treatments to patients; this is a highly centric perspective both to providers and patients that translates into the value recognition.



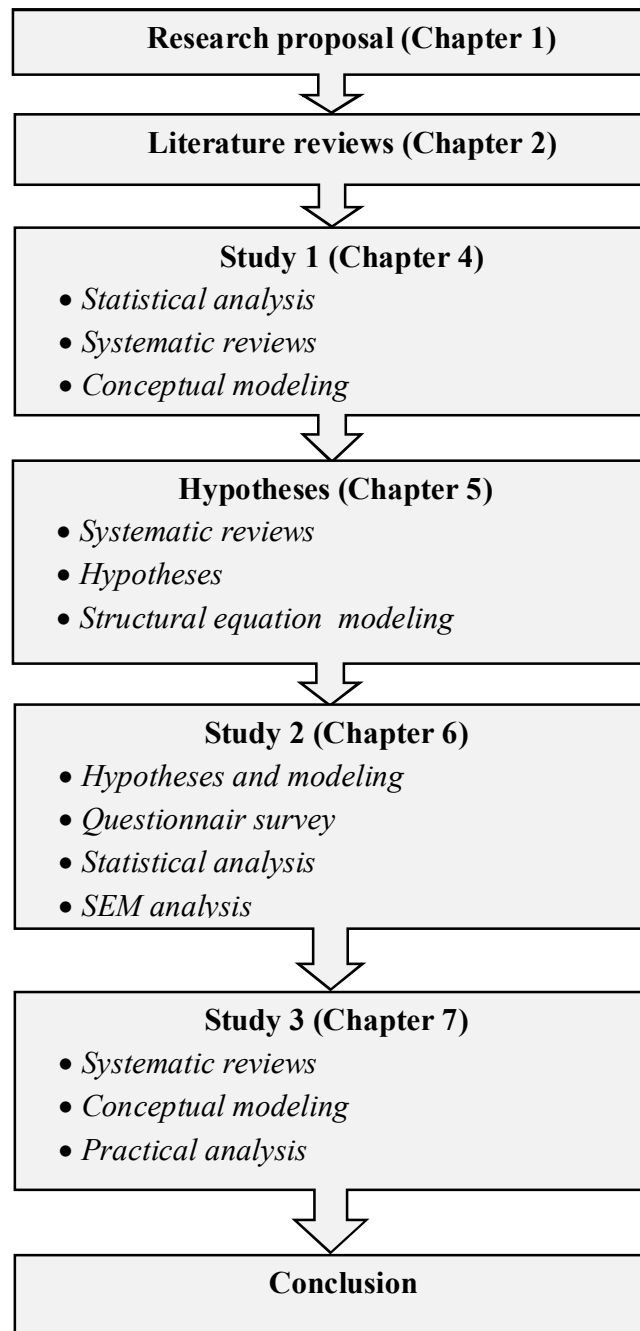
Online health information facilitates value co-creation between consumers and the health ecosystem that supports information to be fundamental for healthcare service management. The consistent in S-D logic is that it focuses more on community than on diagnosis or treatment. Consumers that include patients, family members, care givers, and others are organizing on their own to help each other. They are co-creating values by integrating their resources and experiences. Providers can help consumers co-create the pathway to value in ways that go well beyond patient activation measures and/or typical medical interventions or advice. S-D logic in healthcare service requires focus on service platform, service ecosystem, and value co-creation (Lusch&Nambisan, 2015). Implication of S-D Logic in healthcare service depends on the level of resource integration and resource density to enhance resource liquefaction in a service system.

# Chapter 3

## Research Methodology

### 3.1 Related Studies in Dissertation

The literature reviews and research problems discussed in Chapter 1-2 show the importance to improve EMS and eHealth for elderly care in developing countries to overcome the lack of workforce and technology to support healthcare knowledge management both for the elderly and health providers. To achieve the major research question that focuses on "How to design value co-creation eHealth service model for elderly care?". This dissertation is separated into three sub-studies that include topics of the technological challenges to elderly care, healthcare knowledge sharing, and a value co-creation eHealth service model. Figure 3.1 represents related research methods that are used in this dissertation. To achieve all research questions, the applied methods involve systematic reviews, hypotheses, questionnaire surveys, statistical analyses, conceptual service modeling, and practical analysis. These methods are used to support related objectives, emphasizing on the specific research scope and thorough consideration on limitation in research studies.



**Figure 3.1** Related studies and methods used in dissertation

## **3.2 Sub-studies Research Methods**

### **3.2.1 Sub-study 1: Technological Challenge to Aging Society**

The details of this sub-study is explained in “Chapter 4 Technological Challenge to Aging Society”, we separate research methodology into three steps to explore related details of technological challenge for EMSS in aging Asia. Healthcare policy and technology for elderly people needs to be classified by the readiness of countries that should prepare through socialization and healthcare innovation to support those who need them. A case study was executed to identify and verify challenges and solutions. In specific details, we conducted a questionnaire survey (Appendix A) with healthcare service providers who worked at hospitals in Thailand to identify current situation of EMSS and relative available technologies for system improvement. Related methods are as follows:

- First step: we conducted a statistical analysis by using the secondary data from WHO by focusing on the increase of the aging population and the healthcare system in Asia. The analyzed results show the situation of healthcare services in Asia in terms of workforce, infrastructure, and technology in the healthcare system.
- Second step: we used systematic reviews on technological research focusing on elderly people, which allowed us to identify the needs of technology aimed for aging people based on EMSS and findings in the statistical analysis. This step separates technological challenges facing EMSS based on income and level of healthcare systems and facilities.
- Last step: the conceptual modeling approach was adopted to represent the framework of actors in EMSS for elderly people on the basis of the value co-creation concept. It focused on the co-created values from the interaction between providers and receivers through the use of appropriate technology, in order to increase the service quality and well-being of elderly people.

### **3.2.2 Hypotheses of Knowledge Sharing Behavior**

Based on the proposed conceptual EMSS model presented in sub-study 1, the model requires a thorough study and supporting details in co-creation activities in EMSS based on perception of people. The activities relate to the processes of technology transfer and knowledge sharing. Hypotheses are created based on theory of reasoned action, technology adoption, systematic review, and SEM. The hypotheses are integrated to propose a structural model and identify key factors for healthcare knowledge sharing on the basis of statistical analysis, which will be explained in detail in Chapter 5. This research approach supports the use of mobile technology in the proposed EMSS conceptual model for healthcare service development. The hypotheses are created in three steps: systematic review, hypotheses, and structural modeling, which are explained as follows:

- First step: systematic review focused on healthcare knowledge behavior, theory of reasoned action, technology adoption, and the structural equation modeling.
- Second step: hypotheses formation was created based on findings and reviews on knowledge sharing behavior obtained from the first step. It related to attitude, intention, experience, and factors associated with the used of mobile technology.
- Last step, structural equation modeling was applied to represent relationship of related hypotheses and identify affected relation to healthcare knowledge sharing behavior.

### **3.2.3 Sub-study 2: Healthcare Knowledge Sharing for Elderly Care**

The sub-study 2 (explained in Chapter 6) is focused on healthcare knowledge sharing for elderly care based findings and hypotheses developed in Chapters 4 and 5. Methods in this sub-study include hypotheses, questionnaire survey, statistical analysis, and structural modeling. It focuses on attitudes on adopting mobile healthcare technology, knowledge sharing, and healthcare knowledge sharing behavior. The research methods used in this section can be divided into 4 steps:

- First step: hypotheses and a structural model developed in Chapter 4 were applied as basic foundation to study knowledge sharing behavior of people in target group. The questionnaire was developed on the basis of technology acceptance about mobile healthcare technologies to support older adults in developing countries (Appendix B). The topics were related to ease of use, enjoyment, and usefulness. Factors related to cost, motivation and security, and hypotheses in using mobile technology for healthcare activities were also taken into account.
- Second step: A questionnaire survey was administered to respondents who were service recipients or the consumers in EMSS model of Study 1 (Chapter 4: Technology Challenge to Aging Society). This process was to identify people's perspectives on knowledge sharing in healthcare service.
- Third step: in this sub-study, statistical analysis was applied to analyze the obtained questionnaire survey results. The analyses aimed to identify healthcare knowledge sharing perspective of respondents. Descriptive statistics function was used to explain the findings and results from the survey that classified groups of respondents by age and area of domicile.
- Last step: structural modeling or SEM was developed to represent relationships of related factors and identify affected relation to healthcare knowledge sharing behavior. The fit indexes were used to verify the developed model.

### **3.2.4 The sub-study 3: Value Co-creation in eHealth Service Model for Elderly Care**

The last sub-study (explained in Chapter 7) focuses on eHealth service modeling for the elderly based on value co-creation concept by focusing on frameworks and functions of mobile technologies. In the study, mobile technologies identified the needs of developing an eHealth service model for the elderly care. The conceptual model was designed to integrate EMR with mobile applications or Cloud database to provide simple and effective healthcare service to participants. Moreover, the study aims to enhance EMS systems by integrating the shared resources of providers and receivers through mobile technology. Research methods used in this section can be explained in three steps as follows:

- First step: we used systematic reviews to explore related components of EMS for the elderly in Asia. National health reports and WHO guidelines were used to identify EMS characteristics from selected developing countries in Asia.
- Second step: the conceptual service modeling approach was used to formulate a value co-creation eHealth model for elderly care to identify potential participants in EMS for the elderly people. Then, we identified the interactions among providers, elderly families, and patients through mobile technologies.
- Last step: practical analysis technique was adopted with selected healthcare service systems in Thailand which provided elderly care and other health services. This step intended to adjust the conceptual eHealth service model that used the co-creation concept to support and share benefits of actors in a practical service system.

# **Chapter 4**

## **Technological Challenge to Aging Society: EMSS**

### **4.1 Introduction:**

#### **Technological Challenge to Aging Society**

The trend of the aging populations in Asian countries is expected to increase at an average of 30% in 2050. Healthcare service management is an essential mechanism to support and increase well-being of the elderly. Factors need to be prepared in order to support aging populations including mobility, physical condition, and daily life (Peterson & Gray, 1999). The main factors are related to health policy, promotion, and service infrastructure (Stockdale, 2013; Wright, 2000; Richards, 2012). Asian countries are different in health system, health policy, and quality of services; the countries need to arrange those factors to support an increasing of the aging populations. Principle healthcare services for elderly involve, for example, health monitoring, emergency medical service (EMS), health management plan, and nursing at home. An essential mechanism for the well-being of the elderly is healthcare service from physical, mental and social well-being (Niehaves, 2011; Stockdale, 2013). Trends in aging populations have had an effect on Asian societies, especially on healthcare services and the well-being of people.



Primary healthcare service is a fundamental factor towards well-being; it depends on health policy and standard of each country that requires co-operation of providers in healthcare services and community. EMS is a primary health service that supports life-threatening of people in remote areas on a 24-hour basis. A lack of workforce in healthcare sectors and limited of funding are the main problems for having effective EMS in developing countries. Technologies for healthcare services need to be designed and selected to support the requirements of the aging population on the basis of respective countries (Patrick, 2008; Moor, 2013; Mercado, 2010; Peckham, 1999). Healthcare service developments for the elderly in Asia are challenged by healthcare technology investment and service management to support the increasing healthcare demand.

The Internet based devices stand to integrate and co-operate the ways in which respite care services for family and caregivers communicate with the elder members (Maass & Varshney, 2012; Chan, 2000; Halteren et al., 2004). Implications of communication technologies in healthcare service make efficient use of limited time and provide quality of life for both healthcare providers and recipients that will ultimately determine the “value” of technology in healthcare (Shine, 2004; Nieboer, 2014). Moreover, they can plan suitable time with appropriate technology to be used when providing healthcare to recipients in aspects of taking care, resting, monitoring and communicating. There is a need to identify specific technology and its possibility for the implementation in supporting the elderly. This chapter focuses on “Technological Challenge to Aging Society”, which is the first phase of study to identify related health service applications and technologies based on the needs and ability to participate of consumers. This chapter includes the study of Health system situation, aging society, healthcare technology for elderly, technological challenges to EMSS Thailand, and an EMSS model based on value co-creation concept.

## 4.2 Research Methodology

In this study, we separate research methodology into three steps to explore related details of technological challenges for EMSS in aging Asia. Healthcare policy and technology for elderly people needs to be classified by the readiness of countries that should prepare through socialization and healthcare innovation to support those who need them.

In the first step, we conducted a statistical analysis by using the secondary data from WHO that focused on the increase of the aging population and the healthcare system in Asia. The secondary data from WHO is statistic report about health resource and system of member country that include Asian countries. The analysis in this step showed the situation of healthcare services in Asia in perspectives of workforce, infrastructure, and technology in the health system.

After that, we used systematic reviews on technological research that focused on elderly people, which could identify the needs of technology aimed for supporting aging people based on EMSS. The findings obtained from statistical analyses represented technological challenges facing EMSS in aspects of levels of income, healthcare systems, and facilities.

In the final step, the conceptual modeling approach was applied to represent the framework of actors in EMSS for elderly people on the basis of the value co-creation concept. It was focused on the co-created values from the interactions between providers and receivers through the use of appropriate technologies, in order to increase the service quality and well-being of elderly people.

We conducted a questionnaire survey with healthcare service providers who worked in hospitals in Thailand to identify current situation of EMSS and relative available technologies for system improvement. Manipulating the practicality of statistical functions of Microsoft Excel 2013 and SPSS version 22 computer programs, descriptive statistics were used to explain findings and results from the survey.

## **Data collection and measurements**

Questionnaire items in this research were designed to find the current practices of EMSS that healthcare providers operated in developing countries. For data collection, we sent out questionnaire forms (Appendix A) that to the head-nurse of emergency department in hospitals. The questionnaire items were divided into two parts: hospital characteristics and technological applications in EMSS.

The first part focused on the hospital characteristics from type, level, number of beds, number of patients, and number of registered nurses in the emergency department.

The second part concerned on the technical applications for principle monitoring and communication that provide services both inside and outside the hospitals. In this part, the questions focused on technologies, applications, and communication devices for EMSS used with patients in the means of sharing healthcare databases between departments and hospitals.

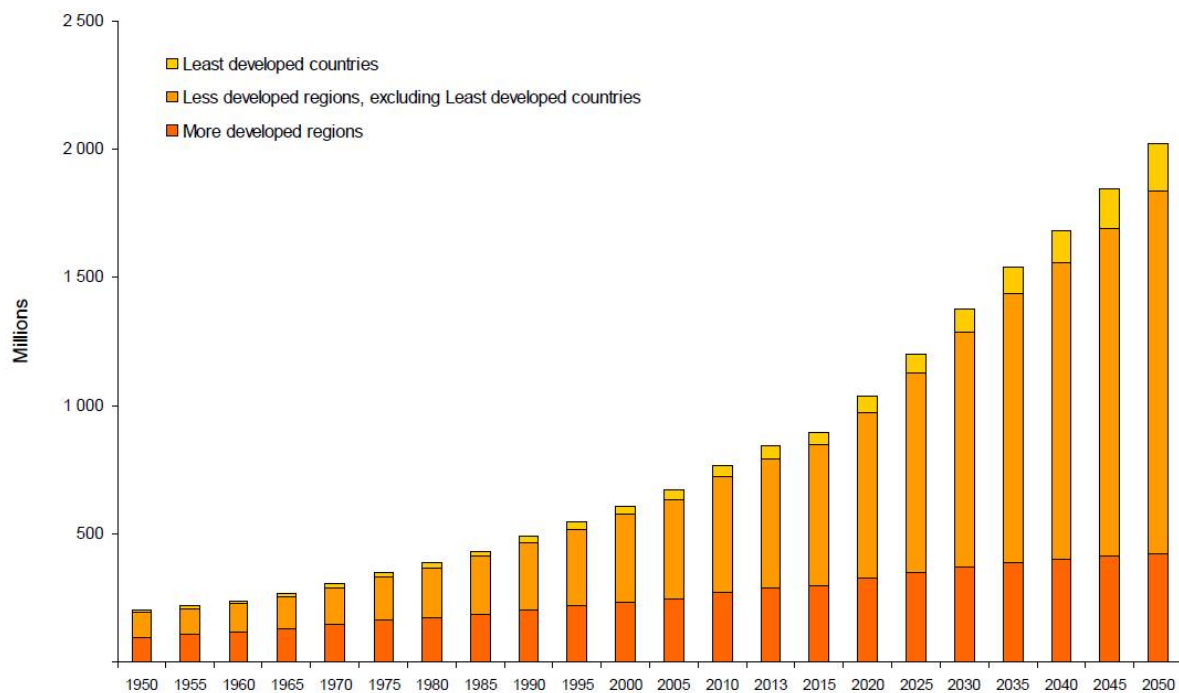
In this case study, Thailand is selected as a representative of developing country in Asia. According to that, there were selected 40 hospitals in total, which were located in urban and rural areas, of these hospitals there were 25 public hospitals and 15 private hospitals. Each question of questionnaire survey had at least two choices that respondents could choose based on their agreement and preference.

## **4.3. Findings**

### **4.3.1 Health System and Aging Society**

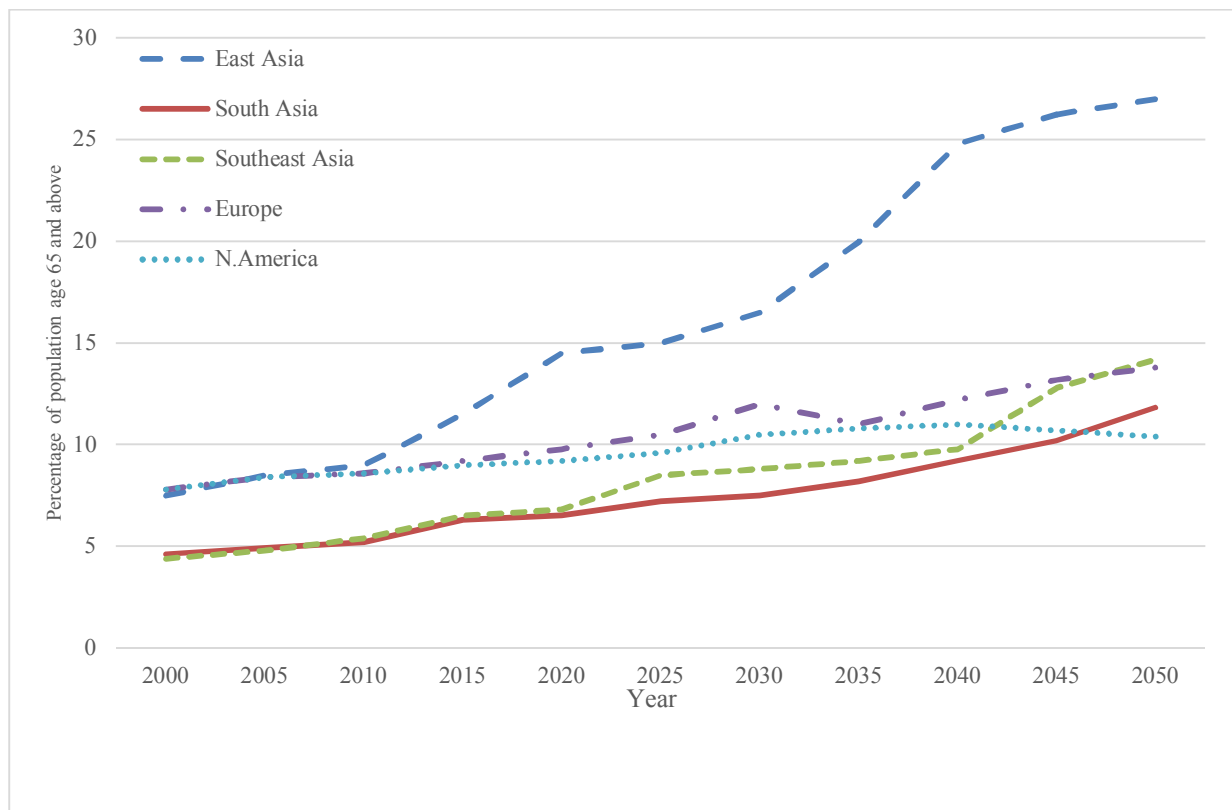
According to the published statistics of WHO in 2012, elderly people are the fastest growing age group in the world. By 2050, there will be over two billion people or nearly one out of every four people whose age is over 60 years old (WHO, 2012b,c). Figure 4.1 shows the trend of population aged 60 years or over by development region from projected population during 1950-2050 (United Nations, 2013). This aging population occurs highest in less developed countries, which consequently have less ability and knowledge comparing with the elderly in developed countries. This data send a sign that countries need to be ready and prepare for a social transition towards an effective healthcare system.

In 2050, most of elderly people will be living in developing countries that will have difficulties in facing these challenges. Therefore, WHO aims at increasing access of mobile medical devices and assistive devices for elderly people in low to middle income countries. The organization aims to find out what are the feasible technologies for these countries to implement in order to overcome the lack of resource problems, and also identify solutions to enhance the healthcare system. For this reason, WHO scheme focuses on research and development of appropriate devices designed for aging populations who live in rural areas or poor villages in low to middle income countries.



**Figure 4.1** Population aged 60 years or over by development region, 1950-2050  
(United Nations, 2013)

The Asian health system is a factor in sustaining the well-being of elderly people through physical and mental healthcare. The health system from WHO perspective focuses on the health workforce, infrastructure, and technology. It represents the ability and workload ratio with the number of resources and the population in each country. WHO health statistics reports in 2013 shows that the health systems of Asia have a lack of healthcare resource problem; especially for low to medium income countries, which account for 90% of Asia populations (WHO, 2013). These low to middle income groups include countries from Eastern Asia, South Asia, and Southeast Asia. Most of them are developing countries that have tried to improve service quality in healthcare services for their people.



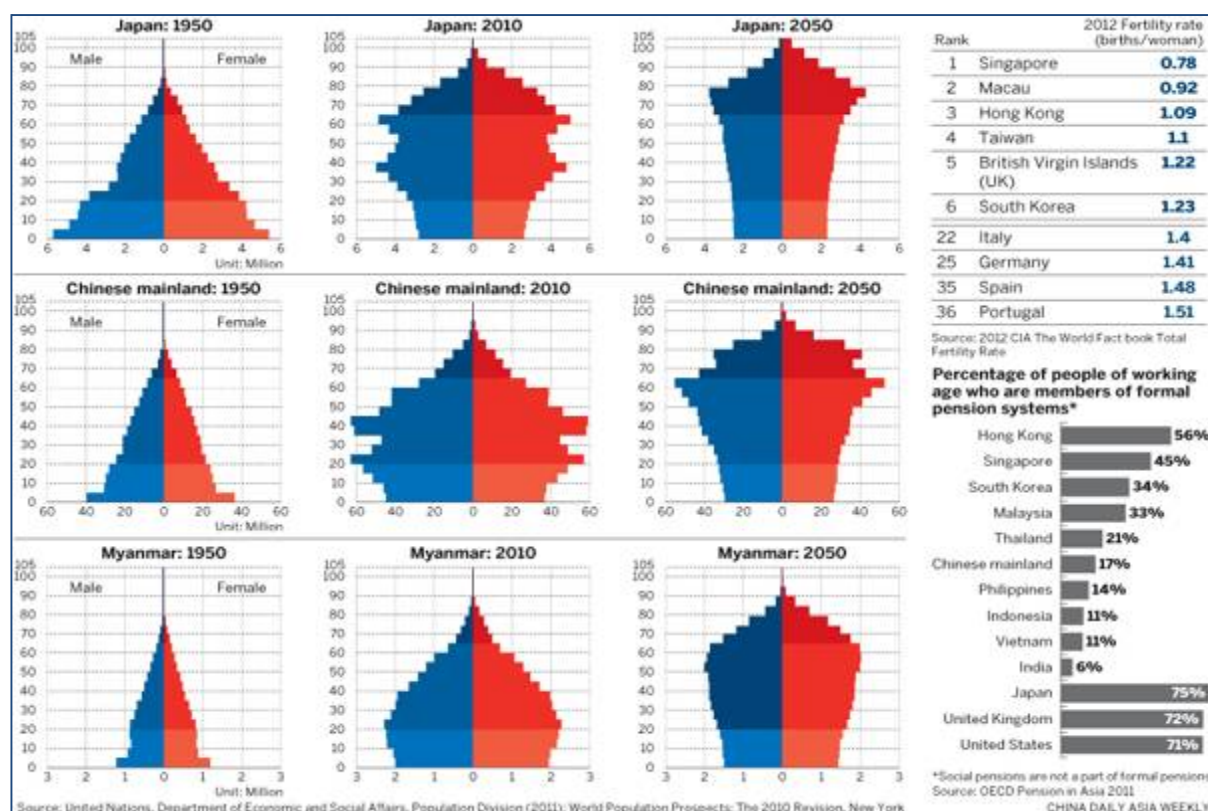
Notes: All data are based on the United Nations medium fertility variant. The analysis also includes Taiwan.

**Figure 4.2** Expected trends of population aging in the major regions of Asia, Europe, and North America in 2000–2050 United Nations (2001).

Today, population aging is much more advanced in Japan than in the other countries in Asia. The temptation might be to dismiss aging as an issue that needs not be considered until some point in the future. Figure 4.2 shows the projected trend that Asian countries have just begun experience population aging. However, in the case of Asia, the process is occurring much more rapidly than it was in Europe or North America (United Nations, 2001). These changes occurred over 50 years in the West are being compressed into 20 to 30 years in Asia. Moreover, Asian countries will have less time and resources to prepare for aging, but most countries will have to meet the challenges of aging at much lower levels of development than in Japan or the West. Anyway, the developing countries require to public systems prepared to deal with population aging which is occurring more rapidly than economic growth.

The workforce ratio by persons per population of 10,000 during 2005 – 2012 for physicians, nurses, and pharmacists are 5.5, 9.9, and 4.2 respectively, for developing countries; and 21.4, 41.4, and 21.5 for developed countries. These ratios affect the workload of the health workforce and service quality of healthcare systems. Therefore, Asian countries should prepare their healthcare systems to face with healthcare service demand from the aging population growth.

Statistics on healthcare expenditure of WHO is also a factor that relates to quality of life of people. WHO collects and measures these statistics on the basis of gross domestic product (GDP) of each country. They measure the statistics from 194 member states to find the status and policy of countries that provide budgets to sustain the healthcare system. Healthcare expenditure from their report focuses on the ratio of investment from government and private sectors, which in Asia has an average healthcare expenditure as percentage of GDP in 2010 at 3.6% for developing countries and 12.4% for developed countries. Healthcare expenditure ratios from governments in Asia are 34.7% and 55.5% for developing countries and developed countries, respectively. Both healthcare expenditure statistics implies the ineffective and poor ability of the developing countries compared with those of developed countries. Thus, developing countries need to find appropriate technologies to increase the quality of their healthcare service systems on the basis of the limit of capital expense, infrastructure, and workforce.



**Figure 4.3** Population pyramid of countries in Asia (WHO, 2013)

In Asian countries, the public sector provides low support to the elderly who need to assist themselves and supports from family. Although the elderly pay tax and supports in public utilities, what they receive back from the public, such as social welfare, is much less (Mason & Lee, 2011). Figure 4.3 shows population pyramid of developing and developed countries in Asia that are expected to be in aging population societies (WHO, 2013). The governments and people are necessary to prepare and accumulate their resources to get ready for the yet to be aging societies. In general, there is a wide range of assets which public-sector and community can support the elderly. To ensure that the elderly get suitable healthcare supports, good pension and healthcare systems are essential to be included in principle of public policy and social capital.



### **4.3.2 Technology and Health System for Elderly**

From the result of the health system situation of Asian countries, we classify Asian countries into three groups based on their ability to provide an effective healthcare system: low ability, medium ability, and high ability. In each group, the level of technology for EMSS is different in perspectives of effects on applications, complexity, and cost of technology. Regarding reviews on applications of technologies for elderly people, we cluster EMSS based on the ability to adopt the technologies in healthcare system and levels of income, as presented in table 4.1. Technological applications can be supported from basic requirements, communication, health plans and monitoring, online updates, and position tracking. However, the basic requirements of elderly people must be responded in order to communicate their needs with providers in EMSS. The main technological challenge of these countries is that prompt decision making to use appropriate technologies ranged from basic ICT to internet based ICT.

Some countries may separate elderly people into groups based on their ability in adopting technology and availability of technological infrastructure in each area. For example, in big cities and the countryside areas, the elderly may use different kinds of technology to support their daily lives and communicate with others in emergency cases. In big cities, they can use internet based devices to support social life and send out request to EMSS when need any help. In the countryside, they may have a limited technological telecommunication infrastructure. Thus, the elderly need supports that are compatible with landline phones or mobile phones for EMSS. However, with the concerns of cost of technology and availability of infrastructure, the elder people may opt to use advanced devices that meet their needs and match with their lifestyle.

**Table 4.1**

EMSS clustering based on ability in health system

Groups	Ability of technology adoption in healthcare system	
	Applications	Technologies
Low income	Support basic emergency requirements with basic technology	Public phone
	<ul style="list-style-type: none"> <li>• Contact hospital in emergency case</li> <li>• Family and Caregiver communication</li> </ul>	Landline phone Mobile phone
Medium income	Multi-purpose support in EMSS without auto active response	Public phone and landline phone
	<ul style="list-style-type: none"> <li>• Health plan, records, and communication with hospital</li> <li>• Self monitoring for basic health conditions</li> <li>• Family and caregiver communication</li> <li>• Position tracking</li> </ul>	Mobile phone and smart phone Tablet and computer Global positioning system (GPS) Internet and wireless technology
High income	Multi-purpose support in EMSS with automatic response	Mobile technology
	<ul style="list-style-type: none"> <li>• Auto update health plan, records and communication with hospital</li> <li>• Auto monitoring for basic health condition (alert, alarm, and request)</li> <li>• Online communication with auto detected sensor</li> <li>• Real-time position tracking</li> </ul>	Robot and Intelligence sensor Smart home system Pervasive healthcare (ubiquitous ) Internet based technology

From this study, we find that the cost of technology and application of communication devices are the key factors that refrain expanding effective healthcare services from elderly people who have limitations in technology adoption or residing in countryside areas. EMSS can be made available to the people through introducing appropriate technologies and suitable systems that are properly designed to support different segments of customers. The design and availability of devices are significant criteria that need to be focused; this is to assure that the devices match with the elderly needs. Moreover, technologies relating to privacy and security are remarkable issues to think about. This is because the technological based devices are developed to serve personal use and store personal information. In terms of EMSS investment, knowledge about limitations and cost of technology should be disseminated among related stakeholders including, governments, service providers, and service receivers. This will eventually influence the effectiveness of EMSS that provides service to all groups of elderly people at any locations.

### **4.3.3 EMSS Situation and Technological Challenges in Thailand**

Based on Asia health system situation that the low to middle income countries in the developing world have a lack of healthcare resource, the countries need to focus on technology, service quality, and health systems. Therefore, we select EMSS situation and technological challenges of Thailand as a case study. It is an example to focus on EMSS in developing country that needs to develop and prepare EMSS for the elderly. In the case study, we observe the current technologies in the EMSS that are used to support principle healthcare monitoring and communication activities for EMS in hospitals. We hypothesize that the use of EMS technology applications in public hospital and private hospital is not different. It includes applications for patients in linking data based and sharing information among hospitals.

In terms of the questionnaire survey results, the survey on the EMSS in Thailand focused on medium to large sized hospitals, which the collected primary data were from head-nurses working in emergency departments. Table 4.2 show, the total number of responses were 30 (75%), which 19 (63%) responses were from public hospitals and 11 (37%) were from private hospitals. The questionnaire consisted of two parts: provided services of hospitals and technological applications. In the first part, the provided services were for primary care (20%), secondary care (13%) and tertiary care (67%). From the survey results, 80% of hospitals had a number of beds higher than 150 and had a number of registered nurse higher than 10 nurses. The number of patients was more than 200 per day (70%), and the number of patients in emergency department was more than 50 patients per day (70%). Most of them (80%) have Nurse in emergency department more than 10 nurses.

Table 4.2 Hospital characteristic from the survey on the EMSS in Thailand

Demographics	Response (%)
1.1 Type of hospital	
• Public hospital	19(63)
• Private hospital	11(37)
1.2 Level of hospital	
• Primary care	6(20)
• Secondary care	4(13)
• Tertiary care	20(67)
1.3 Number of bed (for total)	
• Less than 150	6(20)
• 150-300	6(20)
• More than 300	18(60)
1.4 Number of patient per day	
• Less than 100	2(7)
• 100-200	7(23)
• More than 200	21(70)
1.5 Number of patient in Emergency department per day	
• Less than 50	9(30)
• 50-100	11(37)
• More than 100	10(33)
1.6 Number of Nurse in Emergency department	
• Less than 10	6(20)
• 10-20	10(33)
• More than 20	14(47)

The second part was related to the technological applications in the EMSS that included monitoring activities: blood pressure, heart rate, temperature, types of patient, patient record, and review health record. In table 4.3, Most of them use mobile medical devices in emergency cases to all patients groups, the operating activities are supported by mobile medical devices; however those devices did not link the results to the system (80%). Health records were done on paper based and were not shared with other hospitals (93%). From statistical analysis conducted by the proportion test, the Z values represent indifferent results between public hospitals and private hospitals in terms of adopting technological applications to support patients (1.762), link data (-1.796), and share information among hospitals (-1.063), respectively. All values are between the range of -1.96 and 1.96 with a confident interval value at 95%.

Table 4.3 Mobile technology application from the survey on the EMSS in Thailand

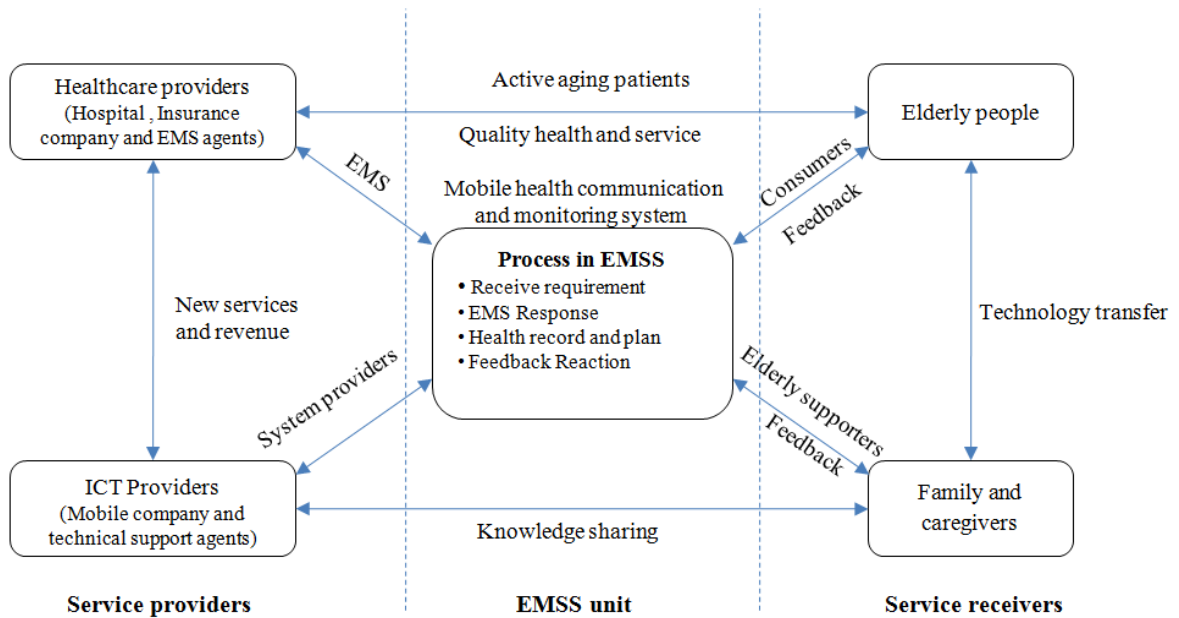
Mobile technology application in Healthcare and Emergency service system			
2.1 Internal hospital service		2.2 External hospital service	
2.1.1 Activities and technology application		2.2.1 Activities and technology application	
• Blood pressure	53%	• Blood pressure	100%
• Heart rate	50%	• Heart rate	100%
• Temperature	47%	• Temperature	100%
• Classify type of patient	37%	• Classify type of patient	-
• Record patient detail	47%	• Record patient detail	33%
• Review Health record	47%	• Review Health record	33%
• Real-time Monitoring	100%	• Real-time Monitoring	100%
2.1.2 Application to patients in service		2.2.2 Application to patients in service	
• All patients	60%	• All patients	90%
• Based on case	40%	• Based on case	10%
• Based on Age	0%	• Based on Age	0%
2.1.3 Patient database system (Patient health record)		2.2.3 Patient database system (Patient health record)	
• Link to system	20%	• Link to system	0%
• Not link to system	80%	• Not link to system	100%
2.1.4 Linkage of information technology with other hospital (Patient health record)		2.2.4 Linkage of information technology with other hospital (Patient health record)	
• Link	7%	• Link	7%
• Not link	93%	• Not link	93%

For mobile healthcare applications for smartphones, during 2013–2014 the applications were available on the most popular two operating systems: Google Play (Android) and the App Store (iOS). Although many an application is available to support EMSS, the applications are not widely used in general practices. They allow many useful functions such as position tracking, blood sugar monitoring, heart rate monitoring, and health alert and health plan notifying. These applications can support in the EMSS, but they will not be effectively implemented unless the users have skill and experience with those health related applications.

In Thailand, there was no service provider or hospital that linked their EMSS through real-time healthcare services. For this point, the government and private sector should focus on active aging people to develop an effective healthcare service system, through the employment of smartphone applications and mobile medical devices based on the current available infrastructure and technology. Additionally, technical support and skilled workforce in EMSS are the main factors that need to be set up for aging populations.

From the service viewpoint in a perspective of feasible technologies in Thailand and Asian societies, developing an internet based device is a critical challenge yet to overcome. The internet based device mainly aims to provide applications in healthcare services for the elderly people. Regarding the growth of the smartphone market, providers can provide various applications from a basic monitoring service to a complex online EMSS for hospitals. For the effective use, mobile medical devices should be available and easy to use for the elderly and their family by connecting those devices online with smartphones and personal medical devices. In addition, the electronic health record which is a great source of important information should be linked with these medical devices or available on online database for the purpose of continuous improvement in service quality.

#### 4.3.4 EMSS model Based on Value Co-creation Concept



**Figure.4.4** Value Co-creation in EMSS Model

The concept of EMSS as a healthcare service is needed to reconsider from pro-active to active service perspectives in order to maintain the growth of aging populations. From the current situation of the emergency healthcare services in developing countries, the services are provided to incoming patients with technological support system that is not effectively available in all regions. For an effective service provision, the governments of these countries should ensure that a set of policy, trained workforces, and involvement of private sectors are ready to be able to adopt appropriate technologies for communication in EMSS. As represented in Figure 4.4, this study presents an EMSS model based on the value co-creation concept by using mobile technology to support the elderly. We focus on the value that increases service quality and the well-being of elder people through information and knowledge sharing in EMSS. In the EMSS model, service receivers are elder people, family members, and caregivers. These groups of people are active customers that need to share information about health condition of patients, feedbacks of service activities, together with collaborating with service providers.



Values in the EMSS model are co-created by collaboration of participators in emergency case to support communication in the processes of nursing preparation, patient transportation management, and personal health monitoring. Elder patients are possible to communicate with hospitals or families to report their health condition emergency case or daily activities. Co-created values in the model include knowledge sharing, technology transfer, and quality of service that are the results of interaction between service providers and receivers. Knowledge sharing and technology transfer in EMSS are activities that support applications of mobile technology for the elderly.

This model separates service providers into healthcare service providers (hospital, insurance company, and EMS agent) and ICT service providers (mobile company and technical support agent). Service providers are essential for designing systems and providing technical support with health records that make the records available on EMSS. The process will increase their revenues by providing new services from integrated resources and the co-created service system. The EMSS model broadens applications of service concept by developing an improved healthcare service through medical preparation, prehospital decision making, and friendly communication to provide an accurate to patient's symptom. Moreover, EMS can alternatively be prepared with selected providers based on patient's preference, quality care, and service cost.

Telecommunication infrastructure is a technology that supports value co-creation between actors in a system through communication, suggestion, monitoring, reminders and alerts, health plans and record, and tele-healthcare. This model is developed to support elderly requirements that might concern with health monitoring, reminders and alerts, and emergency requests. It requires the use of communicating devices, such as medical service devices, that allow interactions between providers and patients on a timely basis. It operates like the information sharing concept in supply-chain management in which actors in a system co-create value together to support their needs and efficiency.

**Table 4.4**

Roles of participators in EMSS from service viewpoint

Actors	Requirements	Roles of Technology	Co-created value
<b>Service Receiver</b>			
• Elderly	• Emergency request	• Update health status	• Well-being
• Family and Caregivers	• Health monitoring	• Report errors to system	• Life confidence
	• Health reminder and alerts	• Communicate to provider	• Increase healthcare knowledge
<b>Service Provider</b>			
• Hospital and EMS agent	• Health records and plan	• Health database management	• Service quality and accessibility
• Insurance company	• Tele-health	• Activities suggestion	• Active service system
• Mobile company	• Monitoring results	• Communicate with patient	• Effective healthcare service and cost
• Technical support center	• Real-time information	• Integrated service	• Revenue

Table 4.4 shows details of roles of EMSS from a service viewpoint. The table presents related actors that co-create value in a practical EMSS. Participation of actors will increase healthcare service quality and revenue through the mobility and accessibility of customers. Regarding WHO policy on active aging population, elderly people in the EMSS model act as active patients who are ready to co-create value that have an effect to their well-being in modern society with health and mental confidence. Consequently, Asian countries should determine healthcare service innovations to be available for their people through technological investment based on existing capability and readiness of current infrastructure.

## **4.4 Summary: Technological Challenge to Aging Society (EMSS)**

Today, information and communication technology development depends on the ability of the internet and the infrastructure of each country. Technologies can support the demands of elderly people to communicate their needs to family members, caregivers, friends, or hospitals. They can store their essential information on mobile devices or Cloud memory that can be used to guide healthcare providers to secure quality care for them in case of emergency. The process can be easily done with a simple search from database system within a few minutes through the internet. The needs and expectations in using technology for elderly people are required to apply in their daily lives, for example, to contact caregivers, to help the elderly in health monitoring, to remind health plans, or to alert when there are any health problems. These applications should be taken into account in defining the current and future roles of healthcare technology for the elderly through applications of mobile phone and the internet.

In EMSS development, technology transferring from family and communities is a basic requirement to guide elderly people to adopt potential applications to their daily lives. It is necessary to classify levels of service through mobile phone applications including information security, related providers, personal issue, and cost of service. This chapter reveals the topics of Health system situation, aging society, healthcare technology for elderly care, technological challenges to EMSS in Thailand, and the EMSS model based on value co-creation concept. The study finds that healthcare communication trends of elderly people are shifting from face to face communication to online communications by the internet. These trends are useful to invest in policy and service platform development in eHealth to link consumers with communities and healthcare providers. Knowledge sharing and technology transfer in EMSS are activities that require support mobile technology adoption for the elderly through collaboration of participators. All in all, this chapter examines healthcare knowledge sharing for elderly care that involves people's attitudes on using mobile healthcare technologies and healthcare knowledge sharing.

# **Chapter 5**

## **Hypotheses in**

## **Knowledge Sharing Behavior**

### **5.1 Background of hypotheses**

Based on the conceptual EMSS model presented in chapter 4, there is a need to study about co-creation activities for EMSS, including technology transfer and knowledge sharing. It requires the use of communication device such as medical service devices, by allowing interactions between providers and patients on a timely basis. Healthcare knowledge sharing is studied through a structural modeling approach to explore relationships of related factors with people's attitudes in using mobile technology (Obi et al., 2013; Wiredu, 2007; Lin, 2004). A structural model is developed to focus on healthcare knowledge sharing behavior with mobile technology. It aims to represent the relationships and effects of factors in knowledge sharing behavior of people through hypothesis testing and statistical analysis (Jung et al., 2013; Selwyn, 2004).

Studies in healthcare knowledge sharing have focused on behaviors of people who participated in a service system based on the concepts of personal technology acceptance and theory of reasoned action (TRA) (Li, 2004; Beverly et al., 2014; Nina et al., 2009). TRA shows that a person's behavior is determined by his or her intention to perform the behavior (Ajzen, 1996). A predictable factor of behavior is intention, in which it represents the cognitive representation of a person's readiness to perform a given behavior. TRA relates with ease of use, enjoyment, and usefulness that supports the elderly and related caregivers in the process of selecting mobile technology in their healthcare activities (Nancy et al., 2011; Lin et al., 2014; Wu et al., 2007). There is a need to increase the quality of elderly care and primary care through mobile technology and knowledge sharing based on ability to use technology of people in healthcare system.

Attitudes are constructed based on an individual's perceptions that affect the use of technology. An individual's perceptions of a technology innovation are affected by the ultimate use of that technology (Davis, 1989). Perceived ease of use and perceived usefulness are identified to predict the perception characteristics of innovation. The perceived ease of use is the "level to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). It is linked to self-ability because ease of use is a principle personal judgment. The perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). It has been found to be a consistent influence of future individual use of a technology (Lippert & Forman, 2005).

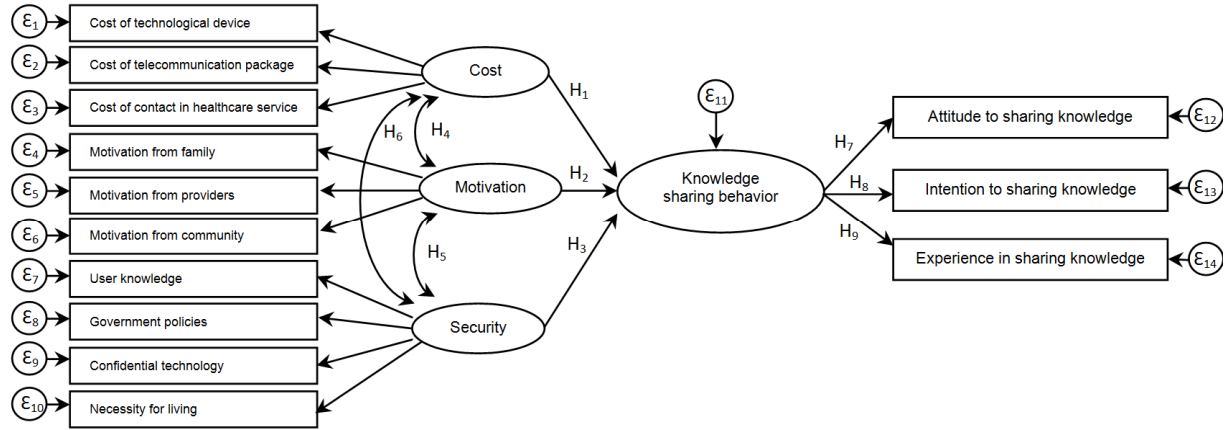
Technology transfer in the conceptual EMSS model is based on technology acceptance and technology readiness of actors in the service system. It is an issue that supports CT implication for healthcare service with mobile technology. Technology adoption is required to focus on external forces such as standards, cost, available funds, security, and technical support (Straub, 2009). It may limit not only the overall decision to deploy an innovation but also which specific technology will be adopted.

Knowledge sharing can be applied to solve health problems in the daily lives of elderly people, family, and caregiver through the internet that will guide them on how to respond to emergency cases based on prepared services systems. Trends in healthcare communication of elderly people are shifted from face to face communications to online communications by mobile technology. The adoption of mobile technology of the elderly requires a thorough consideration on related issues including cost of technology, motivation from participators with elderly, and security concerning. Accordingly, it is important to identify hypotheses on factors in adopting mobile technology with knowledge sharing behavior with its associated factors such as cost, motivation, and security.

The benefit of adopting mobile technology in EMSS is based on the ability to use technology and personal preference. It can use in communication and sharing healthcare knowledge between the elderly, caregivers, family members, and communities. Consequently, based on TRA and technology adoption, hypotheses aim to identify attitude, intention, and experience in sharing knowledge of people. The findings will support the promotion and the use of mobile technology in healthcare service development based on perception of people. List of hypotheses used in the structural model for healthcare knowledge sharing are as follows:

- H<sub>1</sub> Cost of technology will affect healthcare knowledge sharing behavior.
- H<sub>2</sub> Motivation will affect healthcare knowledge sharing behavior.
- H<sub>3</sub> Security will affect healthcare knowledge sharing behavior.
- H<sub>4</sub> Cost and motivation will be correlated factors in structural modeling.
- H<sub>5</sub> Motivation and security will be correlated factors in structural modeling.
- H<sub>6</sub> Cost and security will be correlated factors in structural modeling.
- H<sub>7</sub> Knowledge sharing attitude will affect healthcare knowledge sharing behavior.
- H<sub>8</sub> Knowledge sharing intention will affect healthcare knowledge sharing behavior.
- H<sub>9</sub> Knowledge sharing experience will affect healthcare knowledge sharing behavior.

## 5.2 Structural Modeling for Knowledge Sharing Behavior



**Figure 5.1** Structural modeling for knowledge sharing behavior.

In the process of creating hypotheses and model formation, knowledge sharing behavior is a latent variable that relates to attitude, intention, experience, and mobile technology related. The structural equation modeling is developed to represent relationships of related factors and identify possible impacts on healthcare knowledge sharing behavior. As presented in the proposed structural modeling for healthcare knowledge sharing in Figure 5.1, the proposed structured model includes nine hypotheses that are used to identify key factors based on statistical analysis.  $H_{1-3}$  represents groups of hypotheses that include cost, motivation, and security in using mobile technology for healthcare service that possibly affect knowledge sharing behavior.  $H_{4-6}$  shows groups of hypotheses that are conducted to represent correlation between factors in the structural modeling.  $H_{7-9}$  presents groups of hypotheses that focus on relationships among knowledge sharing behavior to attitude, intention, and experience.

The hypotheses and the structured model for knowledge sharing behavior in this chapter is a part of the value co-creation EMSS model presented in Study 1 (Chapter 4: Technological Challenge to Aging Society: EMSS). According to the proposed model, attitudes of people towards knowledge sharing and technology transfer in EMSS are needed to be identified. The attitudes are obtained through the processes of data collection and analysis which are explained in Study 2(Chapter 6: Healthcare Knowledge Sharing for Elderly Care). The results of these studies are incorporated and used as fundamental data for developing a value co-creation eHealth service model for EMSS, which will be discussed in Chapter 7. The proposed value co-creation eHealth service model is investigated to broaden service ecosystem research and promote elderly care in aging society based on the concepts of service design, service process, system adoption, and ability of actors.



# **Chapter 6**

## **Healthcare Knowledge Sharing for Elderly Care**

### **6.1. Introduction: Healthcare Knowledge Sharing for Elderly Care**

Implications of information and communications technology (ICT) to support healthcare service in developing countries are important issues for policy makers and governments, especially in mobile technology and applications through internet (Junhua et al., 2013). It effects to quality and cost of service in healthcare market by supporting basic health monitoring and communicating to caregivers. The advancement of mobile technology is a key factor of healthcare service management in many developed countries. As an alternative implication in developing country, mobile technology enables the provision of self-service on health monitoring, for example patients contact their medical physicians on a timely basis by online communication. Trends in healthcare market are expanded by the adoption of ICT to support consumer behavior and healthcare demand based on limited healthcare resources. It is essential to apply mobile technology in communication or interaction among healthcare providers, communities, families, and the elderly.

Technology acceptance and readiness to adopt the technology are issues that support implementation of ICT for healthcare service provision through mobile technology. Applications of mobile technology are available to support communication between people and social network. The applications can be applied in the process of communication and sharing healthcare knowledge between the elderly, caregivers, family members, and communities. Knowledge sharing through mobile healthcare applications is an essential factor that increases quality of service. Knowledge sharing concept can be applied to solve healthcare related problems in the daily lives of elderly people, family members, and caregivers through the internet that guides them on how to respond to emergency cases based on prepared service systems. Studies in healthcare knowledge sharing have focused on behavior of adults that participate in service systems based on the concepts of personal technology acceptance and theory of reasoning action (TRA) (Li, 2004; Beverly et al., 2014; Nina et al., 2009; Nancy et al., 2011; Lin et al., 2014; Wu et al., 2007). There is a need to increase the quality of elderly care and primary care through mobile technology and knowledge sharing based on ability and willingness to use mobile technology of people in healthcare systems.

In the 21<sup>st</sup> century, technology and service innovations drive the economy and society through a variety of applications involving education, communication, entertainment, and healthcare. Many technologies and innovations are aimed at supporting the well-being of the aging population for simple use with universal design, in which some examples can be found in smart homes, smart cities, and mobile applications (Obi, 2013; Wu, 2007; Davis, 2012; Wiredu, 2007). Peine (2013) focus on technology and aging population by using a new concept called an “innosumer”, for example, an innovative consumer for the aging market. Complementary perspectives on the relationship between technology and aging population have focused on the elderly as active consumers and co-creators of transformations in technological changes and consumption. Healthcare service and technology management are significant implications in elderly care service systems for the elderly, family, and caregiver by providing services based on their needs.

In terms of TRA, the implications of this theory relate to ease of use, enjoyment, and usefulness in supporting the elderly and related caregivers to select proper mobile technologies in their healthcare activities. The adoption of mobile technology of the elderly and related caregivers requires focusing on related issues including cost of technology, motivation from participators with the elderly, and security concerns. This chapter intends to focus on factors that influence healthcare knowledge sharing behavior of the people who in this case are consumers represented in the EMSS conceptual model (Chapter 4: Technological Challenge to Aging Society).

By using the structural equation modeling approach based on analyzed results of the questionnaire survey, this study aims to investigate the weight and relation of observed and latent variables in the constructed model. Healthcare knowledge sharing for elderly care is the second study in this dissertation that focuses on healthcare knowledge sharing perspective. The study aims to identify the people's attitudes on using mobile healthcare technology, knowledge sharing, and healthcare knowledge sharing behavior.

## **6.2 Research Methodology**

Research methodology in this study includes hypothesis testing, questionnaire survey, statistical analysis, and structural modeling. It focuses on identifying people's attitudes on using mobile healthcare technology, knowledge sharing, and healthcare knowledge sharing behavior.

Hypotheses and the structured model are developed and presented in Chapter 5, which the results relating to knowledge sharing behavior of people in target group are explained. A questionnaire survey was administered to respondents who are considered as consumers in the constructed EMSS model of Study 1 (Chapter 4: Technology challenge to Aging Society). The survey was conducted to identify perspectives in knowledge sharing in healthcare service.

The questionnaire was developed on the basis of technology acceptance, in which mobile healthcare technologies that support older adults in developing countries are assessed. The technologies aim to support ease of use, enjoyment, and usefulness of the older adults. In addition, the survey also included essential influencing factors related to cost, motivation, and security in using mobile technology for healthcare activities.

In this study, statistical analysis was adopted to analyze the obtained questionnaire survey data in order to identify healthcare knowledge sharing perspectives of respondents. Descriptive statistics function was used to analyze results from the survey in terms of classifying groups of respondents based on their age and area of domicile.

Structural modeling or SEM approach was developed to represent relationships of related factors and identify the connections to healthcare knowledge sharing behavior. Fit indexes were applied to verify the developed model.

### **6.2.1 Data Collection**

Field survey was conducted with the people who have experiences in healthcare knowledge sharing in Thailand. The questionnaire, details are available in Appendix B, was distributed to two groups of people. The first group of people was those that whose age was between 30 – 65 years old, whereas the second group was those who were older than 65 years old. The reason of having two groups of respondents is that, in the next 35 years (2050) the first group of people will have been older adults; whereas the second group of respondents will have been considered as elderly people. In current situation, respondents are considered as service receivers as shown in the EMSS model in Chapter 4. The service receivers are patient, family member, and caregiver who require supports and response in emergency cases.

By 2050, the respondents will have turned to be the elderly (65-100 years old) and live in the aging society. Accordingly, they will be the consumers in healthcare services, which are supported by the use of applications related to mobile technologies either by themselves (self-service technologies) or caregivers. By that time they are required to collaborate with healthcare service providers in preparing for emergency health response. According to that, the respondents of the survey were the ones who used mobile phones as a means of communication.

The questionnaire survey was launched to respondents who resided in both city and countryside areas. In this case, the respondents were considered as consumers in healthcare system. Attitudes on healthcare knowledge sharing expressed by the respondents served as a factor used in developing value co-creation EMSS service model. The attitudes are the respondents' perception related to technology transfer by learning and sharing between groups of consumers and providers in healthcare services. The survey focused on details of mobile technology in healthcare knowledge sharing and communication for personal care and elderly care. In details, the questionnaire was divided into five parts: (1) respondent demographic, (2) experience in using healthcare technologies, (3) attitudes of respondents on mobile healthcare technologies, (4) factors in selecting mobile technology for healthcare service, and (5) comments and suggestions.

The first part focused on respondent's characteristics ranging from sex, age, educational background, average income, and area of domicile. The second part focused on experience in using healthcare technologies to monitor and communicate health issues with others. It includes activities in using personal mobile healthcare technology to share health monitoring results to hospital or update personal health record with health provider, family member, and care giver. The third part focused on attitudes of respondents in adopting mobile technology to support elderly care. This part specially focused on mobile technologies, applications, and ways to share healthcare databases among patients, families, caregivers, and hospitals.

The forth part of the questionnaire aimed at influencing factors in selecting mobile technology for healthcare service. It was related to Cost of technology, Motivation from related people, Knowledge and confident to use mobile technology in healthcare service. In each factor had related parameter follow as;

Cost of technology to use mobile technology focuses on these criteria there are;

- Cost of technological device to support healthcare activities, it includes device that buy by personal interest and promote by related health provider.
- Cost of communication by mobile technology that includes SMS, Phone call, Internet package, and Online monitoring, and others
- Cost of contact for special healthcare service that includes insurance package, Online Monitoring, Care at home, and others

Motivation from related people focuses on these criteria there are;

- Motivation from family member to use and apply mobile technology for healthcare management and communication, it include health plan, interface, request, help, monitoring and other)
- Motivation from health provider to use and apply mobile technology for healthcare management and communication it include health plan, request EMS, reminding, suggesttion and other
- Motivation from communities (friends and group of people) to use and apply mobile technology for healthcare communication and sharing knowledge, it include social network, block, and other

Knowledge and confident to use mobile technology focuses on these criteria there are;

- Personal knowledge and skill of user in using mobile technology to communication with others in daily life, it include technology adoption, learning ability, ability to use technology, and others
- Health policy and promotion from government support in selecting and using mobile technology in healthcare service, It include acitvity in primary care, health communication, health monitoring, health record and management, and others)
- Confident and secure of technology in selecting and using mobile technology in healthcare service, It include security of personal issue, Trust in provider, Accurate in care, and others)
- Necessary on communication and monitoring, There are need to selecting and using mobile technology in healthcare service, It include personal health record, health management, EMS preparing, Self/ patient monitoring, and others

## 6.2.2 Measurements

The questionnaire design and measurements were developed for quantitative research to represent attitudes of respondents for a community health application and development (Neuman, 2006). It focused on mobile technology in healthcare knowledge sharing and communication for personal care and elderly care. It also involved related factors consisted in the proposed knowledge sharing model. The questionnaire question consisted of choices for respondents to choose based on their opinion and preference. For some questionnaire items, a five-point Likert scale was applied to obtain respondents' degree of agreement on given statements. Details of each level are explained as follows:

- Level 1 is "Strongly disagree",
- Level 2 is "Somewhat disagree",
- Level 3 is "Neither agree nor disagree,"
- Level 4 is "Somewhat agree,"
- Level 5 is "Strongly agree."

In order to understand whether the questions in the questionnaire are reliably measured on the perspective of knowledge sharing behavior, Cronbach's alpha was applied to measure the internal consistency or reliability. The technique is commonly applied with multiple Likert questions to determine the reliability of scale (Eisinga et al., 2013).

In quantitative results, we compared the primary results based on the age of respondents and their areas of domicile to represent their attitudes. In comparison, we aimed to understand the perspective of respondents who resided in the city and countryside areas, and between people who were younger than 65 years old and the elderly (respondents whose age were over 65 years). The results provided explanation in terms of characteristics of different groups of respondents. The survey results were used in SEM to identify correlation and coefficient values in healthcare knowledge sharing behavior. The coefficient value represented the level of correlation between factors and observed variables. It was applied to estimate results in SEM based on obtained characteristics of questionnaire results.



### **6.2.3 Data Analysis**

We used statistical analysis to classify and compare the primary results obtained from the survey. The analysis intended to find key factors in acceptance of mobile healthcare technologies and sharing personal healthcare. T-test, correlation analysis, structural equation modeling, and fit test were used to present characteristics of data and variable. For the part of comments and suggestions, perspectives of respondents in using mobile technology for elderly care were summarized based on factors in healthcare knowledge sharing.

T-test was the research technique used to identify different attitudes of respondents based on selected groups and identify effective factors from data collection. For all analyses, the tests were done with a confident interval at 95%. Correlation analysis was used to identify relationships between factors based on their characteristics and questionnaire results. SEM was used to analyze questionnaire results and propose a knowledge sharing structural model as presented in Chapter 5. The hypotheses of knowledge sharing behavior related with attitude, intention, experience, and factors in using mobile technology.

The Microsoft Excel 2013 computer program was used in summarizing primary data obtained from questionnaire survey. The SPSS version 22 computer program was used in statistical analyses to compare survey results. The SPSS AMOS version 22 computer program was used in statistical analyses with the aim of developing the structural equation modeling. The statistical analyses in this research also used a confidence interval at 95%. T-values in T-test (two tails) were in a range of -1.96 to 1.96, with a confidence interval at 95%. The GFI (Goodness of Fit Index) and AGFI (Adjusted Goodness of Fit Index) were used with maximum likelihood estimation for missing data, in which the values should be greater than 0.8. RMSEA (Root Mean Square Error of Approximation) is a corrected statistics value that gave a penalty for model complexity, calculated as root mean squared error of approximation. It should be less than 0.10 for acceptance the fits of model.

## **6.3 Findings**

### **6.3.1 Mobile Healthcare Technology and Knowledge Sharing**

Developing countries in Asia had experienced rapid growth in the smartphone market by 40% in 2011 to 70% in 2012 from the total mobile market in Southeast Asia (Rao, 2012). Many smartphone manufacturers and telecommunication system providers have tried to provide applications and functions that support the needs of people and increase the number of elderly users from the viewpoints of technologies, operating costs, and lifestyles. Thailand is a developing country in Asia that involves multi-cultural people on different levels.

In this research, we administered a questionnaire survey about mobile healthcare technology that supports elderly care. We obtained 114 responses from the respondents who resided in both city and countryside areas in Thailand. Cronbach's alpha value of this survey is 0.69, which indicates a high level of internal consistency of this survey. Demographic data are provided in Table 6.1, which are related to the number of responses and percentages of each issue, including sex, age, educational background, average income, and residence area.

The factors in selecting mobile technology to support healthcare services are listed in Table 6.2. The factors are related to cost of technologies, motivation from members, and user knowledge on technologies, government policies, confidential technologies, and the necessity for health monitoring. In comparison between groups of people by data analysis, we found significant factors as there were differences in selection of mobile technology. The results showed that people in city areas weighted the value of confident in the technologies and were willing to accept motivation from families more than people in the countryside areas. However, people in the countryside weighted the value on user knowledge more than people in city areas for selecting technologies to support their needs.

Comparing the respondents by different age groups, we only found the difference in motivation from the family for elderly people that they weighted it more than younger people who were 30 – 65 years old. Respondents in city areas had intention and experiences on knowledge sharing more than respondents in the countryside. It shows that people who live in city areas are easier to accept new services and technologies that consequently affect the willingness to support healthcare knowledge sharing in community.

The survey indicated that 74% of respondents were interested in knowledge sharing through mobile healthcare technologies to support elderly people and communication in emergency cases. We also found that 71% of respondents were interested in practicing and learning new technologies to monitor personal health by using mobile applications and medical devices.

We found that most of them (70%) were confident in using mobile healthcare technologies for elderly people to support their needs in healthcare services with their family and service providers. However, less than half (40%) of respondents had attitudes of sharing self-monitoring results obtained from mobile or smart phones with hospitals.

Sharing results with healthcare service providers for this group of people is important to the elderly because quick support and responses are needed in unexpected situations. However, the results indicated that the elderly (60%) preferred not to share the results. This might be caused by personal objections that require decision making before sharing the results with service providers. It can be concluded that people were interested in mobile technologies to support activities related to healthcare services for elderly people.

Introducing mobile healthcare technology to smartphone market in Thailand is an interesting approach, although political crises might affect healthcare schemes and plans with trends in technology that increasingly support elderly people. The attitudes of people regarding mobile healthcare technology are essential factors related to responses and interactions in healthcare service systems.

**Table 6.1**

Respondents' characteristics

Demographics	Level	Responses (%)
Sex	Male	48 (42)
	Female	66 (58)
Age	30–65	67 (59)
	>65	47 (41)
Educational background	None	14 (12)
	Primary school	21 (18)
	High school/College	50 (44)
	Bachelor's degree	26 (23)
	Postgraduate	3 (3)
Average income per month	< 10,000 THB (Thai baht)	41 (36)
	10,000-30,000 THB	64 (56)
	> 30,000 THB	9 (8)
Area of domicile	City	74 (65)
	Country	40 (35)

**Table 6.2**

Compared survey results by different age groups and living areas

Topics	City mean (SD) n= 74	Country mean (SD) n=40	T-value (P-value)	Age < 65 mean (SD) n=67	Age > 65 mean (SD) n=47	T-value (P-value)
1. Cost of technological devices	3.65(0.90)	3.90(0.71)	-2.10(0.038)	3.76(0.80)	3.70(0.91)	0.36(0.717)
2. Cost of telecommunication packages	3.93(0.78)	4.05(0.60)	-0.91(0.363)	3.94(0.69)	4.02(0.77)	-0.57(0.570)
3. Cost of healthcare services	4.16(0.62)	4.25(0.74)	-0.65(0.515)	4.21(0.66)	4.17(0.67)	0.31(0.757)
4. Motivation from family	<b>4.01(0.75)</b>	<b>3.63(0.59)</b>	<b>2.98(0.004)</b>	<b>3.70(0.67)</b>	<b>4.13(0.71)</b>	<b>-3.26(0.002)</b>
5. Motivation from provider (hospital)	4.15(0.72)	4.05(0.90)	0.61(0.547)	4.16(0.77)	4.04(0.81)	0.79(0.429)
6. Motivation from communities	3.65(0.90)	3.50(0.68)	1.00(0.320)	3.66(0.79)	3.51(0.88)	0.93(0.353)
7. User knowledge	<b>3.68(0.76)</b>	<b>4.08(0.66)</b>	<b>-24.87(0.00)</b>	3.81(0.70)	3.83(0.82)	-0.14(0.892)
8. Government policies	4.23(0.59)	4.15(0.98)	0.47(0.639)	4.22(0.76)	4.17(0.73)	0.35(0.724)
9. Confidential and secure technologies	<b>4.12(0.60)</b>	<b>3.60(0.74)</b>	<b>3.82(0.000)</b>	4.01(0.69)	3.83(0.70)	1.36(0.177)
10. Necessity for monitoring	4.21(0.56)	4.43(0.75)	-1.63(0.109)	4.37(0.60)	4.17(0.67)	1.64(0.105)
11. Attitude to health knowledge sharing	4.23(0.79)	3.90(1.06)	1.73(0.089)	4.01(0.93)	4.26(0.85)	-1.49(0.140)
12. Intention to health knowledge sharing	<b>3.09(1.05)</b>	<b>2.23(1.48)</b>	<b>3.26(0.002)</b>	2.79(1.31)	2.79(1.25)	0.00(1.00)
13. Experience in health knowledge sharing	<b>4.04(0.92)</b>	<b>3.65(0.82)</b>	<b>2.32(0.023)</b>	3.79(0.95)	4.06(0.89)	-1.55(0.124)

\*\*\* All bold values are significant

### **6.3.2 Determinant of Healthcare Knowledge Sharing**

Knowledge sharing through innovative healthcare is an essential factor that can increase service quality based on the application of appropriate technology. Healthcare knowledge sharing concerned with activities in the daily lives of older adults is related to discussions between people in the family, aging communities, and service providers. Their knowledge and experience are shared through many channels from face-to-face communication, taking notes, attending seminars, and engaging in public activities and social media. The internet stands to change and expand the ways in which respite care services can enable family and caregivers to communicate with elderly members. Table 6.3 shows the correlation matrix obtained from questionnaire survey, it represents relationships between factors in technology acceptance and communication in healthcare service. Significant factors that had high correlated were necessity for monitoring, cost of technology, and motivation from healthcare provider. The least correlated factor in knowledge sharing was motivation from communities.

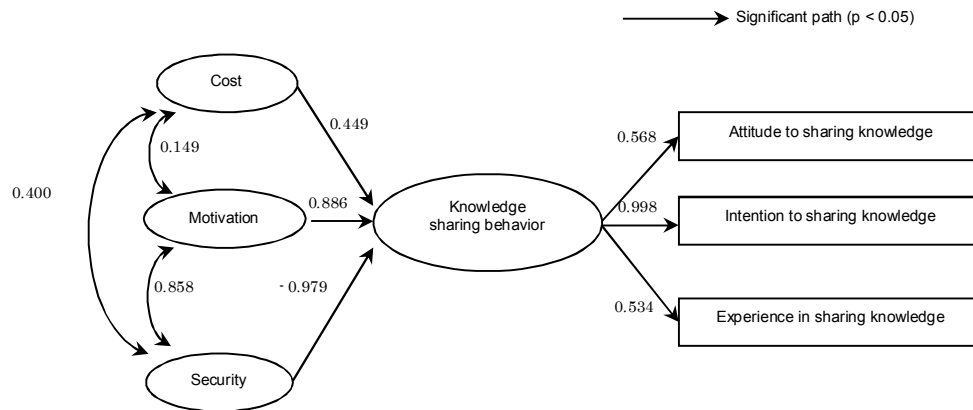
For respondents in the countryside, factors that related to user knowledge and the necessity for health monitoring were more significant than the results retrieved from respondents in the city areas. It refers that in countryside or rural areas people have high concern about knowledge and importance of healthcare technology to overcome the lack of service infrastructure and personal knowledge. By focusing on different age groups of respondents, we found that older adults were motivated from the family to use technology more than respondents who were 30 – 65 years old. It refers that families who support older adults are interested in promoting and supporting their seniors to use technology for personal health monitoring and management. Integrated healthcare service and technology have become a challenge to public sector and service providers in developing countries to enhance quality of life of residents and improve service efficiency. The effectiveness of healthcare knowledge sharing behavior of people in a community depends on level of service infrastructure, availability of technology, health policy, and personal knowledge.

**Table 6.3**

Correlation matrix of variables in technology acceptance for healthcare knowledge sharing

Factors	Factors Correlation (Sig.)									
	1	2	3	4	5	6	7	8	9	10
1. Cost of technological devices	1.00									
2. Cost of telecommunication packages	<b>0.373</b> (0.000)	1.00								
3. Cost of healthcare services	<b>0.186</b> (0.019)	<b>0.396</b> (0.000)	1.00							
4. Motivation from family	0.139 (0.062)	<b>0.344</b> (0.000)	-0.056 (0.268)	1.00						
5. Motivation from provider (hospital)	0.065 (0.234)	<b>0.211</b> (0.009)	0.106 (0.119)	<b>0.272</b> (0.001)	1.00					
6. Motivation from communities	-0.031 (0.366)	0.021 (0.407)	0.249 (0.003)	-0.019 (0.415)	<b>0.481</b> (0.000)	1.00				
7. User knowledge	<b>0.405</b> (0.000)	<b>0.252</b> (0.002)	<b>0.286</b> (0.001)	-0.032 (0.362)	0.012 (0.446)	0.106 (0.119)	1.00			
8. Government policies	0.104 (0.123)	<b>0.323</b> (0.003)	0.114 (0.102)	<b>0.292</b> (0.000)	<b>0.575</b> (0.000)	0.272 (0.001)	0.121 (0.090)	1.00		
9. Confidential in technologies	<b>0.163</b> (0.035)	-0.065 (0.236)	0.138 (0.063)	-0.032 (0.364)	<b>0.289</b> (0.001)	0.106 (0.120)	<b>-0.186</b> (0.019)	<b>0.232</b> (0.005)	1.00	
10. Necessity for monitoring	<b>0.164</b> (0.033)	<b>0.318</b> (0.000)	<b>0.224</b> (0.006)	-0.023 (0.400)	<b>0.466</b> (0.000)	<b>0.076</b> (0.000)	-0.033 (0.356)	<b>0.423</b> (0.000)	<b>0.327</b> (0.000)	1.00

\* All bold values are significant



**Figure 6.2 Results from structural model analysis.**

The results in figure 6.2 show that cost, motivation and security of technology had impact on knowledge sharing behavior of older adults, which the values were  $\beta = 0.499$ ,  $0.886$  and  $-0.973$ , respectively. In these result, cost and motivation are factors that have positive relation to knowledge sharing behaviors. But Security is a factor that has negative impact in using mobile technology to sharing healthcare knowledge. Technology adoption of respondent in this research is required to support through cost and motivation together with improving security concern and confident for using mobile technology in health service system. Security is a factor that had high correlation to cost and motivation at  $\beta = 0.400$  and  $0.858$  respectively, which support respondents in technology adoption and behavior in healthcare knowledge sharing.

In part of reasoned action, knowledge sharing behavior had a significant relation with attitude, intention, and experience in healthcare knowledge sharing represented by the values of  $\beta = 0.568$ ,  $0.998$ , and  $0.534$ , respectively. Knowledge sharing behavior in this model show that respondent have high positive intention to share knowledge based on positive relation with technology adoption including cost and motivation, although there have some security concern. Attitude and experience from this model also support behavior in sharing knowledge.



Table 6.4 showed the results for overall fits of the proposed model. The chi-square results were divided by the degrees of freedom; this means that the proposed model was acceptable (CMIN/DF = 2.969), as the acceptable value was less than 3. The GFI (Goodness of Fit Index) and AGFI (Adjusted Goodness of Fit Index) were used with maximum likelihood estimation for missing data, as the value should be greater than 0.8. The values were GFI=0.893 and AGFI=0.819, which both were acceptable for fits of models. RMSEA is a corrected statistics value that gave a penalty for model complexity, calculated as root mean squared error of approximation. RMSEA from the proposed model was 0.099 that was less than 0.10. Accordingly, all fit indexes were acceptable for the proposed model in healthcare knowledge sharing ( $P$ -value=0.000). Therefore, we accept all hypotheses relating to healthcare knowledge sharing behaviors of people. Cost, motivation, and security groups ( $H_{1-3}$ ) and the correlations of the three factors ( $H_{4-6}$ ) affected the healthcare knowledge sharing attitude of people. Healthcare knowledge sharing behavior ( $H_{7-9}$ ) affected the interest, intention, and experience in healthcare knowledge sharing.

Motivation was a key of knowledge sharing behavior of people in healthcare services that had a strong correlation with security of technology. Healthcare providers and community, including hospitals, insurance companies, community health and related parties should motivate and form collaboration among stakeholders in service system to enhance well-being of the elderly and increase effectiveness of their core business. The advancement of technology allows cost efficiency that provides cost reduction in mobile medical devices, communication packages, and healthcare insurance. Thus, applying applications of healthcare technologies will lessen disparity among people in urban and rural areas by providing the opportunity to receive effective services. In terms of security issue, governments should develop healthcare policies and promote feasible technologies that are affordable by the people in order to have sustainable national healthcare service. These factors will affect attitude, intention and behaviors of the people to share their personal healthcare knowledge and collaborate with caregivers in the service system.

**Table 6.4**

Overall fit index of structural model

Fit index	Criteria	Result
P-value	< 0.050	0.000
X <sup>2</sup> /d.f. (CMIN/d.f.)	< 3.000	2.969
GFI	> 0.800	0.893
AGIF	> 0.800	0.819
RMSEA	< 0.100	0.099

Although motivation from family and user knowledge were non-significant in this case study, but these two factors showed impacts on other factors. Above all, the results show factors that had impacts on people attitudes on healthcare knowledge sharing in the case of Thailand. Knowledge sharing behavior is influenced by different factors from country to country; therefore, the healthcare service of other countries may depend on different factors reflected by, for example, different cultures, economic norms, or impacts of social institution.

Increasing of elder consumers in smartphone market is a challenge in the view of enhancing quality of healthcare services by applications that link consumers to community and to healthcare providers. In case of older adults, they are willing to accept the technology that increases collaboration and embraces different information that is supported by appropriate and customized training features of hardware and software. Trends of knowledge sharing in healthcare service are expanding from activities in hospitals to society, especially through social media by using smartphones or tablets. An active use of social media through mobile technology is a means to communicate and exchange information for patients and healthcare professionals. Based on information and suggestions from members, interactions and knowledge sharing activities in community health support the older adults in selecting service providers, responding to emergency cases, and engaging in self-monitoring. The use of social media also increases the quality of services and level of healthcare in line with customer. For caregivers, technologies can help them prepare timetables in providing healthcare to recipients, taking care of them, or resting, monitoring, and communicating with them.

### **6.3.3 Promoting Healthcare Knowledge Sharing**

According to the survey result and statistical analyses, we found that people usually talked and shared knowledge with public healthcare providers, private healthcare providers, families, and societies. Most respondents participated and shared in healthcare knowledge with others less than ten times in a previous year. Their healthcare sharing interactions usually related to health results, health plans, and healthcare techniques. Knowledge sharing concerned with activities in the daily lives of elderly people was related to discussions between people in the family, aging communities, and service providers. Their knowledge and experience were shared through many channels such as face-to-face communication, taking notes, attending seminars, and engaging in public activities and social media. Effective healthcare knowledge sharing through mobile technology involved a number of factors, including motivation from health providers, personal awareness, and government policy.

- Motivation from health providers to consumers involves in using mobile technology for healthcare management and communication. It includes health plan, booking, request EMS, reminding, suggestion and other packages.
- Personal awareness relates to user knowledge and confidential technology that is based on the capabilities of elderly people and caregivers. Personal knowledge is the ability in using technology to communicate healthcare issue with others in daily life; it includes technology adoption, learning ability, and ability to use technology. Confidence in using mobile technology in healthcare service includes security of personal issue, trust in provider, and accurate in care.
- Health policy and promotion from government support that supports people to use mobile technology in healthcare service. It includes activity in primary care, health communication, health monitoring, health record and management, quality, and security.

The motivation of people in knowledge sharing for elderly care is affected by the family, hospital, and society that influence people to select mobile healthcare technologies. Hospital policy is required the incorporation of healthcare service knowledge sharing that enables the accuracy and security in healthcare communication through mobile technologies. It is an important factor to promote and expand the concept of healthcare knowledge sharing in developing countries in Asia. The knowledge sharing process in healthcare service systems between service providers and recipients needs to be applied to in healthcare services from daily healthcare activities to emergency cases. It is useful to prepare and practice healthcare communication.

Regarding the growth of the smartphone market, providers can provide various applications from basic monitoring to online care with hospitals. Smartphones for the elderly should be easy to use and linked with caregivers and attached to EMRs for health management. EMRs are important to be attached with smartphones or available on online database to improving service quality. The increasing number of internet users through smartphone is a factor that increases healthcare technology applications to people in healthcare service systems. Private providers who provide elderly care service try to promote online activities for the elderly and caregivers through a number of means, including webpage, social media, and mobile applications.

Table 6.5 presents comments of respondents regarding mobile technology in healthcare knowledge sharing. The comments were categorized into groups of cost, motivation, personal awareness (knowledge and security), and attitude in using mobile healthcare technology for elderly care. To be ready for the growth of aging population in developing countries, healthcare service policy should be designed on the basis of economics and mobile technology. Mobile healthcare applications are important technologies that make efficient use of limited time and provide quality of life to both healthcare providers and recipients. Implementation of internet based devices is a challenge in order to provide applications for healthcare knowledge sharing to the elderly, family members, and caregivers. Mobile technology for healthcare service provision will benefit both sides of providers and receivers.

**Table 6.5**

Comments of respondents on mobile technology in healthcare knowledge sharing

<b>Topic</b>	<b>Comment of respondents</b>
<b>Cost in using mobile health technology</b>	<ul style="list-style-type: none"> <li>- Healthcare services should be attached with mobile phone and internet with low price or free for primary care.</li> <li>- Alternative pricings will expand groups of consumer in mobile health applications (device and communication package).</li> <li>- Government should support cost of communication in EMS, EMR and ID for accurate and updated personal information.</li> </ul>
<b>Motivation to use mobile health technology</b>	<ul style="list-style-type: none"> <li>- There is high motivation from family members to use and communicate through social media.</li> <li>- Community care and volunteer are key players to support elderly care in rural areas by using mobile applications to communicate with hospitals.</li> <li>- Health technology should be available in all levels: family, school, community, city, and country.</li> </ul>
<b>Knowledge and confidence in using mobile healthcare technology</b>	<ul style="list-style-type: none"> <li>- Governments need to set and promote security of health service and communication through mobile technology from young to old people.</li> <li>- It takes time for people to accept and try using mobile phone for personal health management.</li> <li>- Learning technology is a key point to promote knowledge and confidence in using mobile healthcare technology.</li> <li>- Technical support center and training volunteers are needed for people in rural areas to co-operate with local hospitals.</li> </ul>

**Table 6.5**

Comments of respondents on mobile technology in healthcare knowledge sharing (Continue)

Topic	Comments of respondents
<b>Attitude on using mobile health technology</b>	<ul style="list-style-type: none"><li>- It is useful to elderly care management in family.</li><li>- It is based on confident in security of personal information and health record.</li><li>- It will make mobility and support personal health management in long-term care.</li><li>- For elderly care, it should link the elderly with community to reduce loneliness and easy to communicate with family and caregiver.</li><li>- Some medical and nursing practices are required to share for elderly care and preventive care. It will enhance the service quality.</li><li>- Governments should promote and apply mobile technology to manage EMR and healthcare service for people in both city and rural areas.</li></ul>

Governments and private sectors should focus on active aging in order to develop healthcare service with smartphone applications and mobile medical devices based on the current situation of available infrastructure and limitation of technology. Elderly people in Thailand have some activities with their community, which allow them to connect with social activities such as meditation, exercising, and sharing healthcare issues based on combinations of traditional and modern medical knowledge. The use of smartphone applications enables providers to support healthcare management and learning technology based on personal interest and nursing demand in community.

In addition, private sectors in developed country are trying to promote healthcare development and better quality of life to developing countries. For example, B&M foundation aims to harness advances in science and technology to save lives through building of strategic relationships and promoting healthcare policies (Bill & Melinda Gates Foundation, 2015). The foundation supports the development of integrated health solutions for family planning, nutrition, child and elder health, and community health through collaborations and innovation in proper settings in developing countries.

## **6.4 Summary: Healthcare Knowledge Sharing for Elderly Care**

Knowledge sharing in healthcare services for the elderly care involves co-creating values that enable interactions between members in service systems including elderly patients, families, and service providers. Knowledge sharing will increase the well-being of elderly people based on the value co-creation concept that involves life confident and participation among people in societies. Challenges that support growth of aging population have been prepared by applying integrated healthcare service systems for patients and providers on the basis of economics and technology.

In aging societies, healthcare knowledge sharing increases the confidence and convenience of communication to related members in service systems. Interactions and exchange in healthcare knowledge sharing support personal decision making by offering alternatives in selecting service providers, responding to emergency cases, and engaging self-monitoring based on information and suggestions from members. Sharing knowledge and experience is an essential activity that increases the quality of services and level of healthcare in line with customer perspectives. It enables implication of ICT to support healthcare management both onsite and online service systems. The next chapter will adopt knowledge sharing concept used in this chapter with the value co-creation concept to develop an eHealth service model for elderly care.



# **Chapter 7**

## **Value Co-creation eHealth Service Model for Elderly Care**

### **7.1 Introduction: Value Co-creation eHealth Service Model for Elderly Care**

Electronic healthcare (eHealth) is an application of information technology in healthcare services that communicates health information in a medical team or in healthcare service system. It is an interesting topic for policy makers in developing countries to overcome the lack of resource in healthcare system (Petrovic, 2013; Kishimoto et.al, 2013). eHealth expands from general healthcare practices to integrated healthcare communications between providers and patients. It relates to many applications from health records, radiography, picture archiving communication system (PACS) to tele-Health. eHealth requires incorporation of ICT, skill workforces, and technical support in health service systems; it is usually to gain applied effectiveness and efficiency of healthcare systems. Although applications of eHealth have been applied to healthcare system in developed countries for over 10 years; from basic information management to complex online health service, there has not been broadly adopted in healthcare systems in Asian developing countries. It is different when comparing with e-commerce and internet banking (Plaza et.al, 2011; Mendonca et.al, 2004; Liu et.al, 2011). Thus, there are challenges in preparation and implementation of eHealth in Asian countries with a crucial limitation that is a lack of resource and technology.

The applications of ICT in healthcare have exponentially developed over the last 15-20 years as the applications overcome concerns of a lack of communication and, instead, provide potential to improve effectiveness and efficiency of the healthcare service. eHealth applications used in many developed countries are different in terms of infrastructure and health policy. The World Health Organization (WHO) suggests that telemedicine and primary healthcare are required to propose for community health provider in rural areas. The applications are possible to be supported by main medical centers to improve quality of service through the use of ICT and EMR (Junhua et al., 2013). Internet based devices and mobile phones have become prospective pervasive technologies that change healthcare market in aspects of service cost, process, time, and place.

From the viewpoint of service-dominant logic (S-D Logic), the co-creation concept is intended to capture the essential nature of value creation between participators; it involves the participation of beneficiaries through use and integration of resources among partners (Vargo & Lusch, 2004 and 2008). The concept supports service exchange through the interaction of service providers co-operating together with consumers, who are active participants in the service system. The increasing aging population reflects the need of effective healthcare services and the well-being of the elderly, which is to receive flexible applications that enable the elderly to communicate their desires with others when they encounter with emergency cases. There is a need to improve the quality of EMS by being more service oriented and developing new technologies. Alternative of EMS applications for elderly should be provided with reasonable price to satisfy the needs of patient and caregivers.

For personal health management, the applications of eHealth have widely adopted as they are implemented with simple self-monitoring processes at home or complex processes in hospitals on mobile phone and computer support systems on the basis of practicality of the internet. Healthcare applications on mobile phones are an alternative medical device in healthcare service; it is possible to be supported by roles of eHealth in clinical data, healthcare service management, and co-operate in medical team (Etsenbach & Diepgen, 2001). Actors in healthcare service have to set health policies and strategies to develop health information infrastructures based on the successful best practices from developed countries.

Emergency medical service system (EMSS) is a critical healthcare service as it is a part of healthcare giving process ranges from simple cases like physical activity to severe cases relating to life-threatening illness on a 24-hour basis. These services need to provide a flexible application that enables the elderly to communicate their desires with others within a reasonable time. There is a need to identify and develop an eHealth model to support EMSS for the elderly. Therefore, this chapter, the 3<sup>rd</sup> study in this dissertation, integrates findings in the healthcare knowledge sharing and the co-creation concept in EMSS to develop an eHealth service model for elderly care.

This study aims to create an eHealth service model for middle income developing countries that have rapid growth in mobile phone market. Health service system in the model is designed to exchange data through the internet based devices and telecommunication systems both in city and rural areas. The eHealth service model is expected to support Thailand, a developing country that faces with the increasing demand of EMS and primary care for the elderly. Actors in eHealth service system are classified based on co-created activities and participants that are involved with elderly healthcare service through applications of ICT. A conceptual service modeling approach is adopted in the development and representation of relationships between groups of providers and receivers.

## 7.2 Research Methodology

In eHealth service modeling for the elderly, we used systematic reviews as the first step to explore related components of EMS for the elderly in Asia. Secondary data from national health reports and published data of WHO were used to identify EMS characteristics from selected developing countries in Asia (WHO, 2003). The EMS characteristics were used to broaden the focus of the EMS current situation in Asian developing countries in perspectives of service system, infrastructure, and technology (Sintonen & Immonen, 2013; Petrovic, 2013; Kishimoto et al., 2013). After that, we reviewed articles by focusing on frameworks and functions of mobile technologies in eHealth. As a result, the results showed that there is a need of an eHealth service model for the elderly care based on the applications of mobile technology.

The second step of this is about service modeling. It was the process of the eHealth service model formulation on the basis of applying the value co-creation concept to identify participators in EMS for the elderly people. Subsequently, we identified the interaction among providers, elderly family, and patients through mobile technologies (Lega, 2006). This was to increase the quality of service and well-being of elderly people. In addition, healthcare policies and technologies for the elderly were classified according to the readiness of each country and the prepared health system which have driven by socialization and healthcare innovation.

The conceptual value co-creation eHealth model for elderly care was designed to integrate EMR with mobile applications or Cloud database to increase the effectiveness of healthcare service and provide simple access to participators. Moreover, the constructed model was aimed to represent the enhanced EMS systems that resources of providers and receivers were integrated and shared through mobile technology. Therefore, the model shows that to increase the effectiveness of healthcare service; it is important to have communication activities based on preference of patients and family with health providers without concerns on privacy (Huh et al., 2013).

The last step is the part of practical analysis of the eHealth service model. We adopted the constructed model to selected healthcare service systems in Thailand that provide elderly care and health services. This step adjusted the conceptual eHealth service model that used co-creation concept to support and share benefits of actors in practical service systems. Each service system was analyzed by criteria presented on the proposed eHealth service model, for example, service activities, eco-service system, implication technology, collaboration, knowledge sharing, and well-being.

In addition, we outlined eHealth policy for developing countries in Asia to support the increasing demand of elderly care, which the policy will be very important for providing healthcare service in aging society. The eHealth policy is required to be linked and shared among service systems by specific settings on quality of service, system agreement, and support of stakeholders.

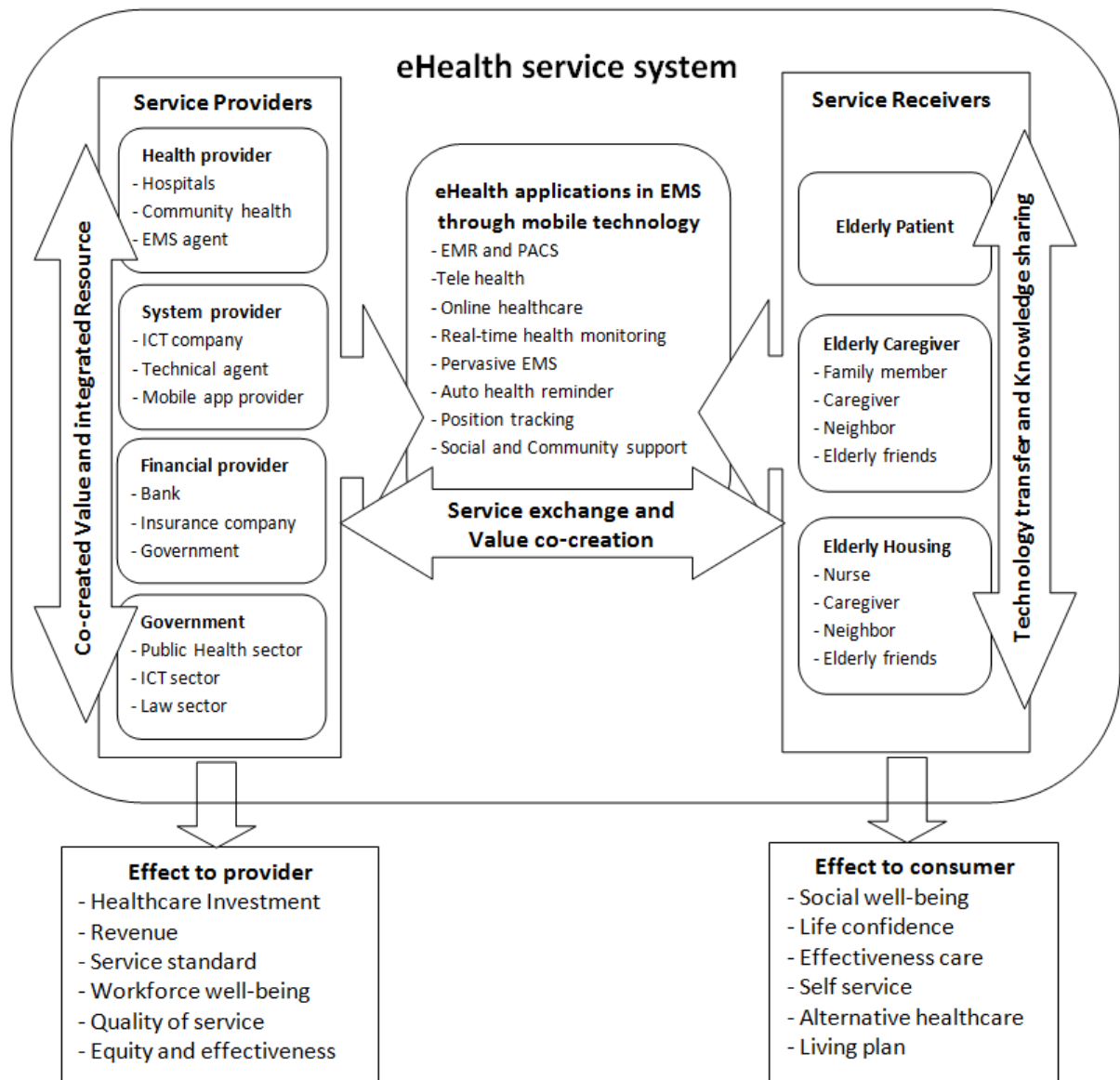
## 7.3 eHealth Service Model for Elderly Care

The increasing amount of elderly people in developing countries has called for a well prepared healthcare service despite the limitations of resources and investments. In eHealth and other E-business, ICT is a key factor that makes effective interaction and collaborations between providers and receivers. The EMSS eHealth service model for the elderly in this research presented the advantage of value co-creation between providers, between receivers, and among providers and receivers through mobile technology, as explained in findings of “Chapter 4: Technology Challenge to Aging Society” and “Chapter 6: Healthcare Knowledge Sharing for Elderly Care”. Although there is rapid growth in mobile phone market in many countries in Asia, there is lack of eHealth applications used in general practices of primary care through the internet in countries like Malaysia, Vietnam, Taiwan, India, China, Thailand, and the Philippines.

Consequently, these newly industrialized developing countries should focus on mobile technology and communication system to transform and develop eHealth service to be used as an alternative service in healthcare system. Studies show that EMR and personal healthcare management through mobile phone are important to enhance quality of service and confidence in medical treatment. Figure 7.1 shows the developed eHealth service model that includes service providers from related fields and service receivers in EMS service system. Providers in the eHealth service model are not only healthcare providers, but also system providers, financial providers, and governments. Service receivers are the elderly patients, elderly caregivers, and elderly housing companies, which are involved in eHealth service. However, healthcare providers in the model include hospitals, EMS agent, and community health providers, who support medical service, health management for elderly patients, and cooperate with other sectors.

The proposed eHealth service model was formulated on basis of value co-creation concept in healthcare service (McColl-Kennedy et al., 2012; Chakraborty & Dobrzykowski, 2013; Nordgren, 2008; Halsted & Lorig, 2000). Co-created values and integrated resources among providers on the basis of service ecosystem are significant factors to develop healthcare markets in Asia. Related healthcare markets include databases, ICT facilities, and mobile applications. The efficiency and quality of service depend on availability of service and confidence of participators in the eHealth system. Integrated resources and interactions of providers in the model represent many applications through mobile technology. They are used to manage EMR in medical practice, communicate in tele-Health, monitor patient location, monitor health status, and deal with required EMS. Besides, technology transfer and knowledge sharing are necessary for the elderly to use mobile phones in EMS communication. The elderly need to be supported and guided in learning technology from family members, caregivers, and healthcare service providers.

The quality of healthcare service depends on the ability to pay of consumers and collaboration with other providers in healthcare system. Consequently, related service providers and the governments who are involved in the eHealth system should clarify and arrange essential factors relating to security on ICT, healthcare policies, ICT laws, e-service processes, and technology infrastructure. The service values are exchanged between service providers and receivers through integrated ICT in healthcare processes. Thus, value in exchange in EMS eHealth is co-created through cooperation and interaction of members in the service system. Accordingly, health policy and investment on mobile technology are the more important factors that enhance healthcare service system.



**Figure 7.1.**Value co-creation eHealth service model for elderly care



Based on the previous value co-creation in EMSS model (Figure 4.4), the proposed eHealth service model for elderly care sheds some light on the importance of key actors in e-service business by integrating the essentials of having other related actors into the eHealth service system. The proposed model includes financial and government sectors as imperative service providers who support and provide healthcare services in terms of elderly care in various settings. By integrating these sectors into the model the traditional healthcare service provision will be altered from providing the services to just the elderly patients but also providing services to elderly caregivers and elderly housings. In other words, the proposed model focuses on providing services not only for personal care at the hospital but also community care as an extended level by integrating resources of service providers and recipients on the basis of a practical healthcare service system design and level of acceptance of related participators.

The model also focuses on a new viewpoint of providing eHealth service as the traditional providers (health and system providers) cooperate with financial providers and the government by integrating their resources to co-create value with the recipients, namely elderly patients, caregivers, and housings. The collaboration among healthcare service providers and recipients will eventually create mutual benefits for the elderly and also the community.

To support the aging society in emerging countries, the model proposes an alternative of healthcare service processes based on value proposition and service levels of related actors from the processes of pre-hospital service at household level, healthcare service at the hospital, to elderly care service at community level. The needed factors that are imperative in communication process along the healthcare service provision include mobile applications for elderly care and caregivers. The other vital factors that should be employed during the service provision are technology transfer and knowledge sharing, which is an important activity in eHealth model for both provider and receiver sides by using mobile phones and internet based devices.

In providing healthcare service to the elderly, the ICT providers (private system and government providers) are the key participators who support communication and database management in EMS. EMR and health plans are needed to manage and ensure the on time communication through mobile phones from remote locations, which significantly influence the performance of quality of healthcare service. Technical support and technology adoption in eHealth service system are an important part for support actors who have major roles in elderly care. Accordingly, caregivers and elderly housing are needed to know how to use mobile phone as a means to participate in the system and communicate with service providers and their patients.

In terms of the effect on service providers, for example, insurance and financial providers are actors who support activities and processes relating to billing, alternating service cost, managing insurance, and providing healthcare investment. They are key coordinators who ensure healthcare service quality enhancement for the elderly from primary care to special care. They also facilitate the service receivers and providers to link with the government support system in the integrated platform of the eHealth system. For the effect to consumer, personal plan and self-service of consumer in eHealth service system is useful for elderly care management and effect to healthcare resource investment.

All in all, the proposed value co-creation eHealth service model for elderly care integrates the importance of collaboration of the financial providers and the government with traditional healthcare service providers. By focusing on enhancing the people well-being at community level, the model involves necessity of having elderly caregivers and elderly housing as service recipients, in addition to the elderly patients. Based on the usefulness of mobile technology in eHealth service provision, integrating the resources, knowledge, and expertise of all service providers and recipients co-creates values that are beneficial for all sectors and eventually leads to a more sustainable healthcare service system that is ready to handle the upcoming aging society.

Constructed based on the value co-creation concept, Table 7.1 shows role of participators who are actors in Figure 7.1 (Vargo & Lusch, 2004, 2008). It supports value exchange in services through the interactions between service providers and consumers who cooperate together. Patients and caregivers are active participants in the eHealth model by interacting and communicating with healthcare service providers. The eHealth service model for EMSS proposes management system and communication methods and in healthcare service based on the advancement of mobile technology. Cloud technology is a kind of technology that supports EMR in EMS through a simple search on the internet. According to the study in a case of Thailand, Cloud technology increased quality of EMS and medical services across the country through online EMR. Mobile phones were used as the main medical internet based devices that included healthcare applications for elderly patients and caregivers to communicate with others within reasonable time. Primary care and medical service processes were expected to be more accurate in health treatment as the use of mobile technologies would allow effective collaborations of healthcare service members on a timely basis.

**Table 7.1**

Roles of participators in value co created eHealth model for elderly care

Actors in eHealth	Groups of actors	Participators	Role of participators
Providers	Health provider	Hospital	Medical service, share health knowledge, service management, online healthcare, and tele-Health
		Community health	Primary health, EMR
		EMS agent	Primary health and medical delivery
	System provider	Telecommunication company	Provide telecommunication service and internet
		Server provider	Support online Electronic Medical Records (EMR)
		Mobile Application provider	Support health knowledge, position tracking, and EMR management
	Financial provider	Bank	Internet banking, and billing
		Insurance company	Health insurance, co-operate with health provider
	Government	Health sector	Develop health policy and standard
		ICT sector	ICT infrastructure and security of data in eHealth
Receivers	Elderly	Active patient	Update health status, and self-monitoring,
	Caregiver	Patient family member, Neighbor	Patient health monitoring, and transfer technology
		Caregiver	Primary care and monitoring Cooperate elderly care schedule
	Elderly Housing	Nurse, Caregiver, Local community health	Support primary care, contact elderly family, technical support, and cooperate with health provider

## **7.4 Practical Analysis:**

### **Example Case of Elderly Care in Thailand**

#### **7.4.1 Overview of Health Service System for Elderly in Thailand**

In Thailand, The Ministry of Public Health (MPH) is the main health care provider. Other public organizations such as university, military, and state enterprises also provide healthcare services, particularly the secondary and tertiary healthcare levels. The MPH and the Bangkok Metropolitan Administration (BMA) are the main providers of most all of the public health services in Bangkok, particularly health promotion and disease prevention activities. However, there are a large number of private healthcare providers in a form of medical clinic that provide primary care service. These private healthcare providers account for over 50% of the total primary care service. For other provinces in Thailand, primary health services are provided through networks of Community Health Units (CHUs), the units are under MPH and responsible for providing curative and preventive healthcare services to people in community. Nevertheless, the CHUs do not provide rehabilitative services.

The CHUs are usually located in rural areas and are mainly staffed by one or two physicians, dentist, nurses and community health workers. The main functions of these units are promotional and preventive provisions. They provide some basic curative care to people living in their responsible areas. Community hospitals, which are the first referral center in rural areas, also provide primary health services for people living in their responsible areas. However, most health care personnel at primary health care level are not trained for elderly care. Only some have attended the short programs provided by the MPH and academic organizations.

The National Commission on the Elderly is prescribed to be established by the Act on Older Persons: 2003, to serve as the national mechanism on the elderly (Suwanrada, et al. 2014). In providing assistance to elderly people who face social problems, the government provides assistance in various forms either temporary assistance or long-term assistance such as pecuniary assistance, temporary or emergency housing, foods, clothing, medical treatments, rehabilitation, help in legal proceedings, counseling, as well as admission to staying in an elderly home for those who have no relatives or caregivers.

The Thai government is proactive in developing plans and programs to deal with needs related to the health and material welfare of elderly people. These efforts, however, are predicated on the assumption that the primary responsibility on long-term care will be handled by the family with supports from the government. There are also important issues that contribute to uncertainty about the future of family care for the elderly. The economic, social, political and technological environments in which Thais live out their lives are constantly changing, often in substantial ways. Future elderly people will be better educated and likely to have better health. Moreover, with this changing trend, parents and their adult children as well as those who will be childless in old age will get themselves ready to modify their current arrangements in attempts to adapt to new circumstances in ways that minimize negative impacts and maximize potential benefits.

All regional hospitals in Thailand open special clinics for the elderly. They provide special healthcare treatment for the elderly and support caregivers through training. According to the Universal Coverage Policy, all elderly people will receive free services. The hospitals at provincial level also create community networks for continuation of care and group therapy by multi-disciplinary teams. Not only are the elderly beneficial from these activities, but caregivers also gain advantage from the activities from improving their skills in terms of care giving for the elderly. Health promotion services for elderly people usually conduct at community level, both primary and secondary, including mental health promotion. In Thailand, village health volunteer system is very strong and effective. There are more than 200,000 volunteers working at the community level. Their work supports the activities such as, elderly club and home visit.

Community volunteering caregivers collaborate and provide primary care for the elderly with the public and private stakeholders from local government authority, EMS agency, and community hospitals in target areas (Prasartkul, et al. 2016). They propose proper alternatives of giving care to the elderly in communities especially those who have no caregivers but need assistance to perform their daily activities. This practice develop integrated community based health care and social welfare services resulting in sharing of resources and benefits

For a practical analysis for the proposed eHealth service model in this study (Figure 5.1), we adopt the model to three selected healthcare service systems in Thailand which provides health services to elderly. In this part, the conceptual eHealth service model is adjusted based on the selected practical service systems. Each service system is analyzed by related value co-creation factors presented in the proposed eHealth service model, for example, integrated resource, knowledge sharing, technology transfer, and required co-creation. To analyze the practicality of the proposed model, secondary data published by the Ministry of Commerce and Thai Elderly Promotion and Health Care association are incorporated into the analyses of the three selected healthcare service systems (Intachat, et al; 2016, Prasartkul, et al; 2016). Table 7.2 shows related value co-creation issues and expected results that influence stakeholders. The three selected cases in this study are homecare service, private hospital EMSS, and public community care with EMSS, which are listed follow as:

- Asia Nursing Home company (ANH) for homecare service,
- Bangkok Emergency Service (BES) by Bangkok Hospital for private hospital EMSS,
- Community care by Thai Health Promotion Foundation (ThaiHealth) and The National Institute for Emergency Medicine (NIEM) for public community care with EMSS.

**Table 7.2**

Value co-creation issues and expected results for stakeholders

Stakeholders	Value co-creation issues	Expected results
<b>Providers</b>		
• Hospital	• Collaboration in health system	• Service quality and accessibility
	• Sharing knowledge and technology	• Value proposition
• Mobile company	• Alternative service platform	• Sustainability
	• Mobile application (EHR, EMSS, SOS)	• Effective healthcare service
• Bank	• Linked service platform	• Service accessibility
	• Financial plan	• Effective system and application
• Government sector	• Elderly Service business model	• Increase service level
	• Quality of Elderly service	• Alternative service
<b>Recievers</b>		
	• Health enhancement	• Social well-being
	• Sharing knowledge, experience, and practice	• Effective investment fund
	• Quality of life enhancement	• Economic growth
	• Health management plan	
	• Self service response	



## **7.4.2 Case Study 1**

### **Asia Nursing Home (ANH): Homecare Service**

#### **ANH Background**

Homecare service is a healthcare service that requires nursing practitioners or nurses to support patients at home. Related homecare services are, for example, nursing delivery and nursing home. These services are necessary for patients who cannot take care of themselves and need caregivers to support daily activities. Asia Nursing Home (ANH) is a private healthcare provider that is under the supervision of Bangkok Healthcare Service Company which focuses on providing elderly care service through nursing home, nursing delivery, nursing aids school, and nursing products. ANH is a member in the working group of Thai Elderly Promotion and Health Care association and co-operates with contracted hospitals in preparing medical services for elderly care. (ANH, 2016)

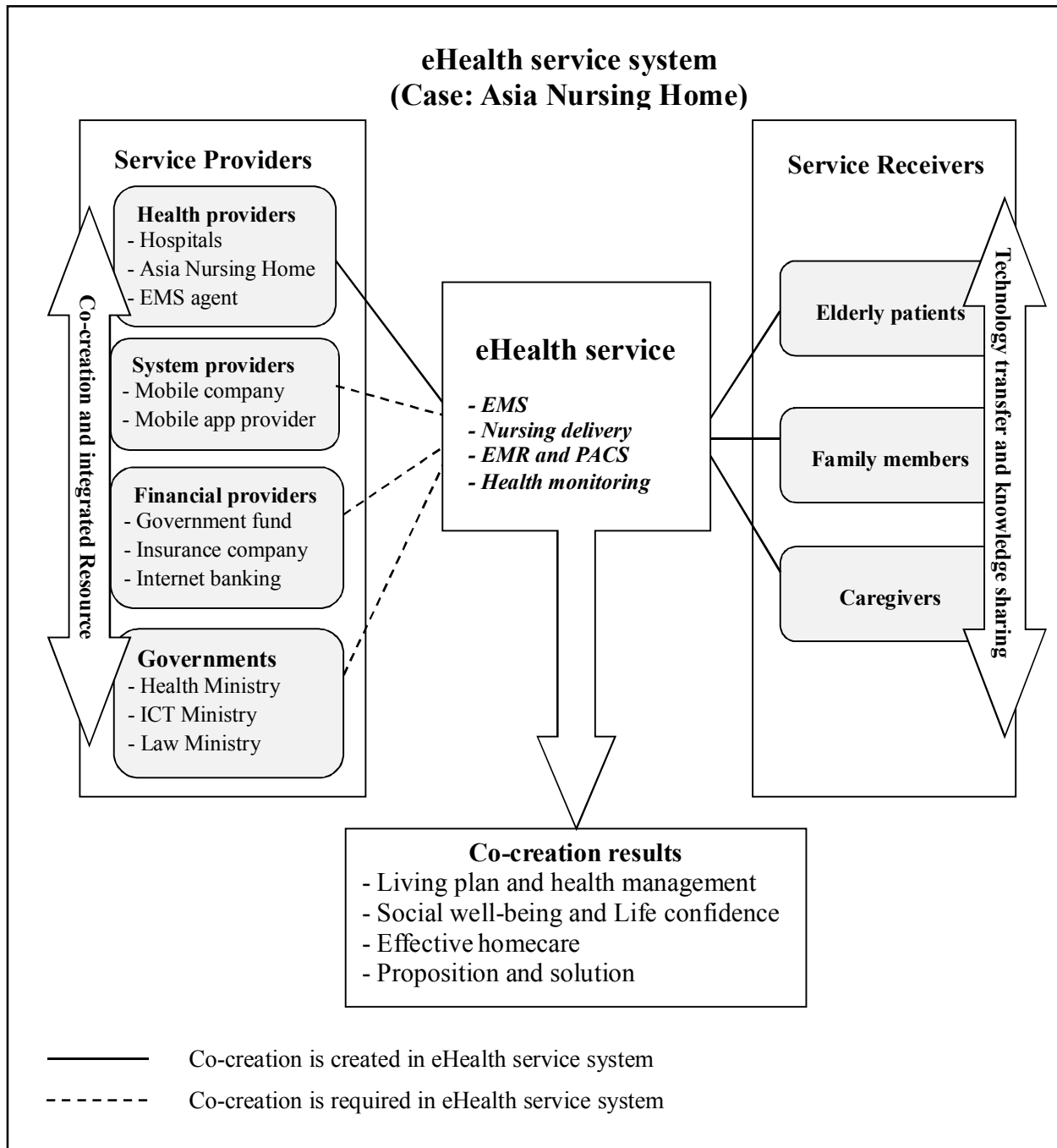
#### **ANH Services**

Nursing delivery service of ANH is provided at patient's home operated by professional nursing teams and nursing assistant teams with highly skills and experience in providing nursing delivery service at home. It includes, for example, consultation and planning home caring service, injection, wound dressing service, replacing feeding tube, replacing urinary catheter and sterile catheterization set, and phlegm suction. In part of nursing home, AHN provides rehabilitation and caring services for the elderly, rehabilitated patients whom either can rely on oneself or cannot take care of themselves or patients who have chronic disease. EMS and EHR are part of the services that ANH prepares for the processes of communication and delivering patients to the hospital.

## **Co-creation in eHealth Service Model for the Case of ANH**

In this study, the eHealth service model was developed by adopting the S-D Logic, value co-creation concept. In this case study, co-creation was a criterion that explained expected values or results from interactions between ANH and other related actors. Based on the conceptual eHealth service model, ANH is a healthcare provider who supports personal health management involving demand of elderly patients, family members, and caregivers. ANH supports services range from primary care to EMS transportation with prepared EHR of patients. Figure 7.2 shows co-creation paths in the ANH adopted eHealth service model. The model includes values that are co-created based on stakeholders' requirements. In this case, the possible implication of eHealth service for communication and support in elderly care of ANH can be done through social media, messaging applications, EMS applications, phone calls, personal SOS mobile devices, and other internet based devices. The success of the implementation of mobile technology depends on the ability in using technology of both providers and consumers.

As a service provider, ANH collaborates and shares technologies and practices to groups of elderly care business. It enhances quality and level of service in service system based on healthcare standards and related laws. To provide elderly care services, ANH promotes nursing delivery and homecare services to receivers through collaboration of family members and caregivers. ANH and receivers can mutually plan, manage nursing practices, select medical devices based on the scheduled treatment and cleaning activities. Mobile technologies are used in communicating for nursing delivery, sharing experience, monitoring the elderly, or providing EMS. Table 7.3 identifies value co-creation factors in eHealth service model for elderly care in the case of AHN healthcare service provision.



**Figure 7.2.**Co-creation path in eHealth service model for Elderly care: Asia Nursing Home

**Table 7.3**

Value co-creation in eHealth service model for elderly care: a case of Asia Nursing Home

Co-creators	Value co-creation in eHealth service system with ANH (Homecare)			
	Integrated resources	Knowledge sharing	Technology transfer	Required co-creation
<b>Provider groups</b>				
Health provider	○	○	○	- Online care - Mobile application
System provider	○	X	X	- Technical support
Financial provider	○	X	X	- Secure system
Government	X	○	X	- Cloud EMR - eGovernment
<b>Receiver groups</b>				
Elderly	○	X	X	- Share experience
Family member	○	○	○	- Online monitoring
Caregiver	○	○	○	- Caregiver app

○ Co-creation is created in eHealth service system

X Co-creation is required in eHealth service system

Based on the proposed eHealth model, co-creation is required in sharing EMR system, financial system, and technology support system. Integrated resources of related public sectors and the government are required by focusing the implementation of EMR system to support medical delivery service on a timely basis. It can be seen that, ANH is a private sector that supports co-creation in elderly care from daily activity to EMS. These services are considered as important healthcare services for handling the forthcoming aging society based on technology acceptance and confidence towards mobile technology of the elderly and caregivers.

### **7.4.3 Case Study 2**

#### **Bangkok Emergency Service (BES) Hospital: EMSS**

##### **BES Background**

Bangkok Emergency Service (BES) was established by the Bangkok Hospital Group with the aim of providing prompt treatment for accident victims or those in critical condition. BES provides medical delivery service to support EMSS and primary care in emergency cases for patients who need medical delivery and referral to hospitals that are in the Bangkok Hospital Group network. Emergency service center of Bangkok Hospital Group relates to emergency ambulance command and control centers providing convenient rescue services for patients within a reasonable time. The BES network consists of 14 hospitals located within Bangkok metropolitan region.

##### **BES Services**

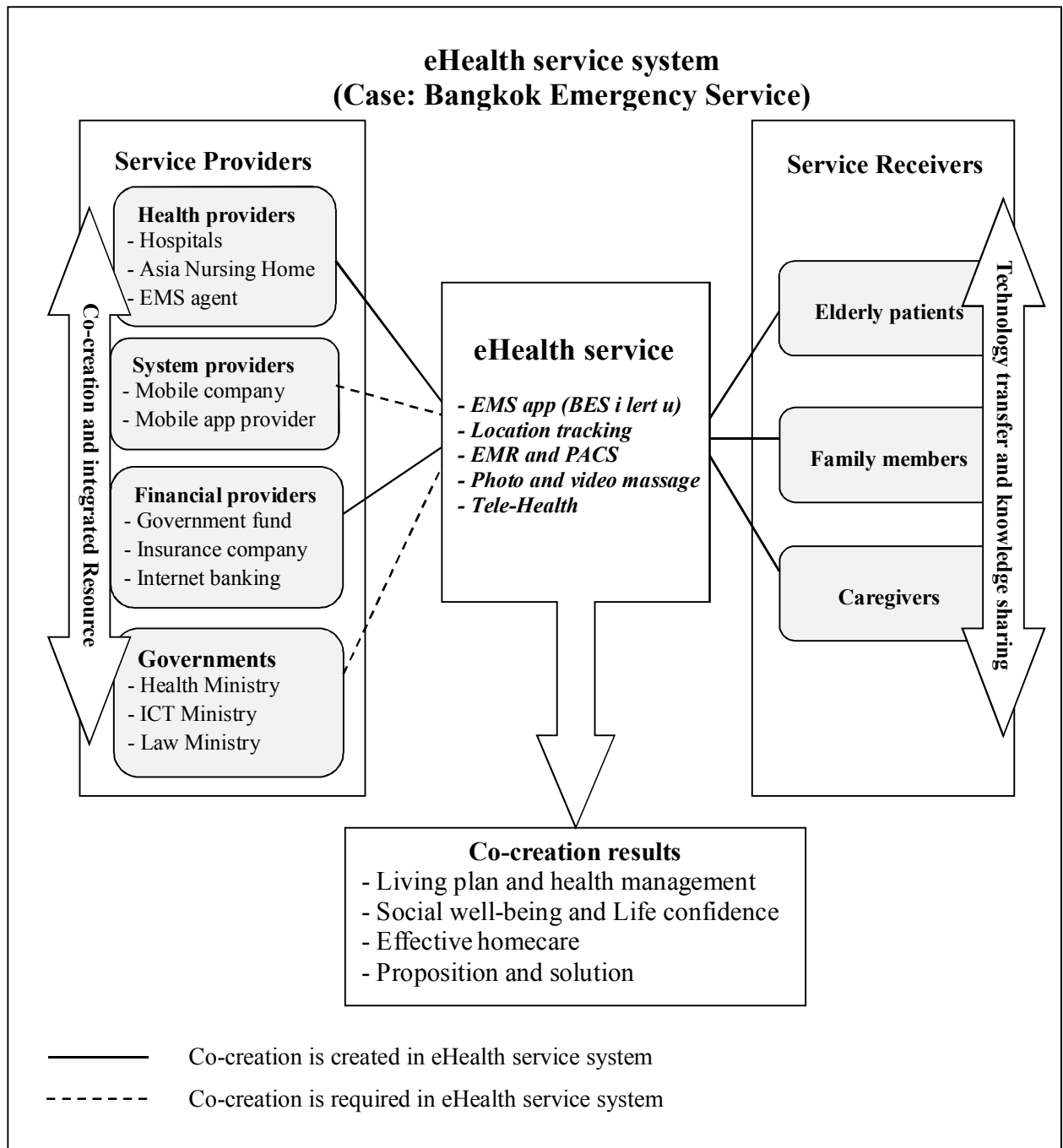
BES network is cooperation between qualified hospitals with the aim of providing the best possible and effective first aid to save lives in a crisis on a timely basis. In the emergency service provision process, the nearest hospital picks up the patient and provides basic life support including first aid before transferring the patient to the hospital (Bangkok Hospital, 2016). The patient will then receive secondary or tertiary care. To maximize the efficiency of service, the BES's "call center" keeps pertinent information on registered patients such as name, address, and contact number through an integrated GPS system. When an emergency call is received the coordinates as well as the optimal route will be displayed, the information will then be relayed to the nearest hospitals within the network. The "BES i lert u" application is available for download via smartphones; it allows emergency service providers to pinpoint an individual's coordinates and information in real-time.

### **BES in eHealth Service Model**

Based on the conceptual eHealth service model, BES is a healthcare service provider who supports medical delivery and health management services in response to the demands of elderly patients. BES supports from primary care to EMS transportation services with prepared EHR of patients with its network hospitals that are available to provide EMS. As a service provider, BES promotes EMSS by collaborating and sharing technologies and practices to groups of primary health providers. They collaboratively enhance quality and level of provided services in the service system based on healthcare standards and related laws. The implication of eHealth service for communication and support in elderly care of the BES can be done through the employment of mobile phones and online system.

### **Co-creation in eHealth Service Model for the Case of BES**

According to the presented conceptual eHealth service model, BES is a private healthcare service provider group that provides EMS in response to demands of elderly patients. BES provides EMS transportation service with registered EHR of patients to support work of network hospitals. Figure 7.3 shows co-creation paths in eHealth service model for the BES case, including co-creation processes that are created and required from the collaboration of stakeholders. Implication of the BES eHealth services relating to communication and support in elderly care can be executed through mobile applications.



**Figure 7.3** eHealth service model for Elderly care: BES by Bangkok hospital

**Table 7.4**

Value co-creation in eHealth service model for elderly care: a case of Bangkok Emergency Service

Co-creators	Value co-creation in eHealth service system with BES (Private hospital EMSS)			
	Integrated resources	Knowledge sharing	Technology transfer	Required co-creation
<b>Provider groups</b>				
Health provider	○	○	○	- Online care - Mobile application
System provider	○	X	X	- EMR network, - Technical support
Financial provider	○	X	X	- Financial plan - Secure system
Government	○	○	○	- EMR system
<b>Receiver groups</b>				
Elderly	○	○	X	- Share experience
Family member	○	○	X	- Online monitoring
Caregiver	○	○	X	- Caregiver app

○ Co-creation is created in eHealth service system

X Co-creation is required in eHealth service system

BES collaborates with public EMS providers to deliver rescue services and share service knowledge to the national EMS network. The collaboration with other related parties enhances quality and level of service in EMSS based on healthcare standard. BES promotes practicality of EMS applications to family members and caregivers who provide firsthand healthcare service to the elderly at home. Table 7.4 presents value co-creation in the eHealth service model for elderly care in the perspective of BES's healthcare service process. As presented in the adjusted eHealth model, BES is a private sector that provides healthcare service to the elderly by co-created EMSS. Based on levels of acceptance of the provided mobile technologies, the services provided by the BES are considered as important factors for healthcare service system to be ready for the aging society. In addition, factors that determine the effectiveness of mobile technologies and healthcare services in the case of BES are cost, service quality, and perception of consumer.



### **7.4.4 Case Study 3**

## **Community Care by ThaiHealth: Public Community Care EMSS**

### **ThaiHealth Community Care Background**

Thai Health Promotion Foundation (ThaiHealth) is an autonomous government agency established by the Health Promotion Foundation Act in 2001. ThaiHealth positions itself as a catalyst, which is mentioned to inspire, motivate, coordinate, and empower individuals and organizations in all sectors for the enhancement of health capability as well as healthy society and environment to support health promotion movement in Thailand (ThaiHealth, 2016). To implement community care projects, ThaiHealth has collaborated with the National Institute for Emergency Medicine (NIEM) and community hospitals. NIEM is the institution, established under the Emergency Medical Act B.E.2551 (2008). The institution is responsible for the administrative management and coordination between relevant agencies and hospitals that support emergency medical service.

ThaiHealth promotes health promotion and projects to community hospitals regarding providing care for the elderly to create a database of elderly people. In the project of ThaiHealth, the elderly are classified into three groups based on ability and health condition including active ageing Group, self-reliant group, and disabled group. The active ageing group refers to elderly people who can live by themselves and are available to support others. The self-dependent group includes the elderly who can help themselves but are not ready to help others. The disabled group refers to the elderly who need special care, as many of them are disabled or bedridden. Community volunteer caregivers are key providers to support community care based on level of collaboration and skills in elderly care. In this case, the volunteers are trained by public health providers.

Community volunteer caregivers have an important responsibility in home visits in order to assess the condition of the elderly home. They also arrange related services such as house cleaning, food delivery, and nursing delivery. The activities of community volunteer caregivers are not limited to health work, they also share information and help the elderly obtain healthcare services by requesting medical equipment wheelchairs, walkers, walking sticks, and beds, from the sub-district health promotion hospitals, community hospitals, or sub-district administration organizations.

### **ThaiHealth Community Care Services**

The community volunteer caregiver project started in 2003-2004 for the elderly homecare in eight provinces: Chiangmai, Phitsanulok, Phetchaburi, Suphanburi, Khon Kaen, Roi Et, Songkhla, and Surat Thani. This pilot project was initially set up with a community hospital in a sub-district of each province, with an initial target of 40 volunteers in each area. The implementation of this project has been carried out continuously since then. In 2013, the project was available in every district in the country, with 7,602 local administration units arranging elderly homecare volunteers in their areas. There were 51,854 volunteers to provide services to a total of 787,957 elderly people nationwide (Ministry of Social Development and Human Security 2014).

The roles and responsibilities of the community volunteer caregivers relate primarily to social welfare and elderly rights covering activities as making home visits, overseeing diets, taking care of medicines, helping with exercise, transporting to the doctor, taking the elderly to join events in the community, and assisting in adjustment of living conditions inside the home to be more suitable for the elderly. Moreover, they are required to form groups to conduct activities, provide information and knowledge to the elderly and their families. The volunteers also coordinate with authorities that provide help to the elderly. In terms of performance evaluation of the community volunteer caregivers, it is conducted by College of Population Studies of Chulalongkorn University. The results of performance evaluation reveal that the community volunteer caregivers have been able to provide social welfare benefits to the elderly at a satisfactory level (Suwanrada et al., 2014).

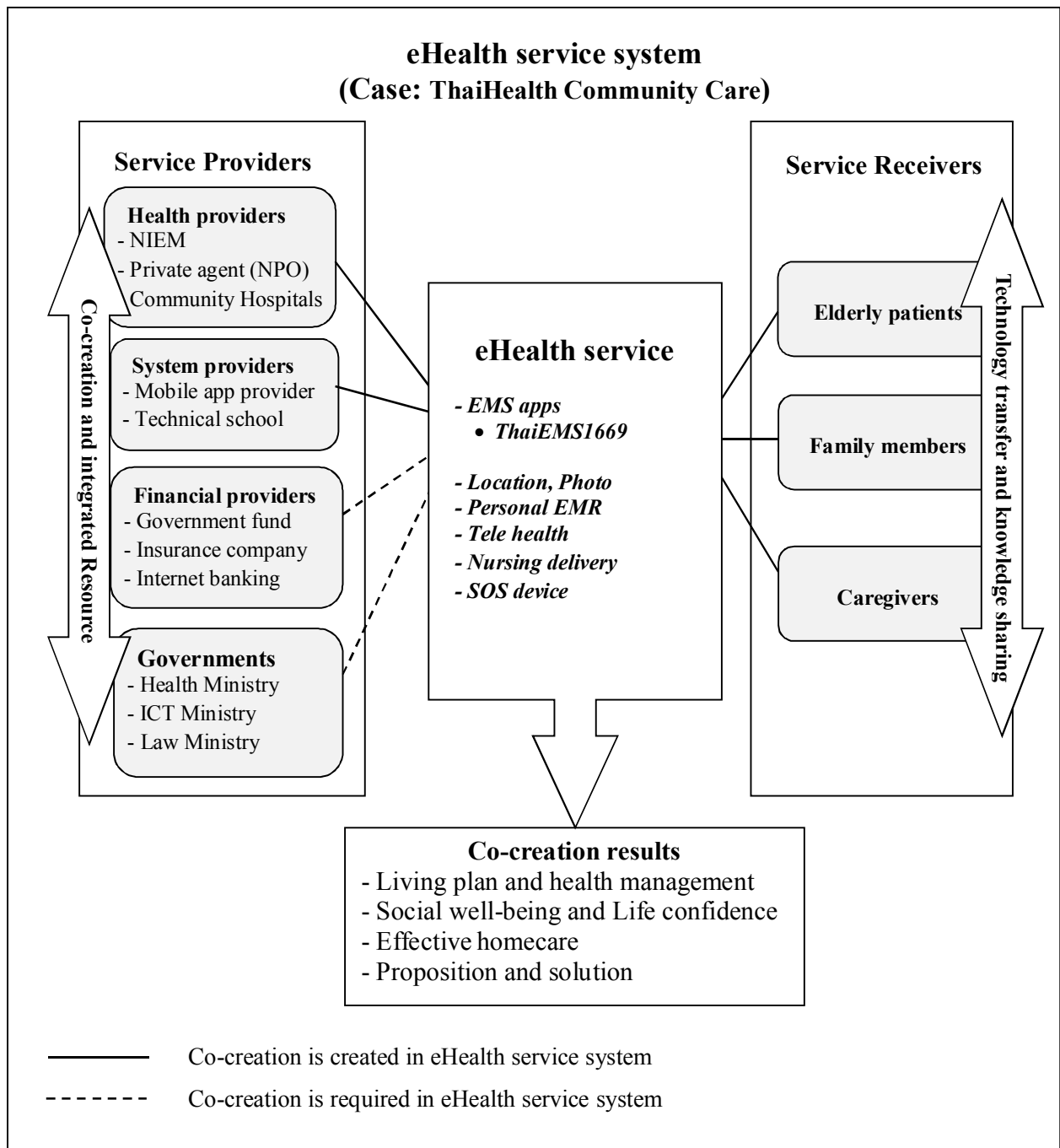
In 2015, NIEM launched an application called ThaiEMS1669 to support EMS. The application is available to download on smartphones or internet based devices in both iOS and Android operating systems. The application supports administrative EMS management and coordination among relevant agencies, both from public and private sectors. It includes location tracking, personal EHR, photo, and first aid guidance. This application can be used in community care in the means that supports work of the community volunteer caregivers. Its effective use in elderly care and EMS management depends on the level of collaboration among related sectors and the ability of community volunteer caregivers to provide healthcare service.

### **Co-creation in eHealth Service Model for the Case of ThaiHealth Community Care**

Co-creation was a criterion to explain expected values or results of interactions conducted by community volunteer caregivers and related actors in providing healthcare service. Based on the developed conceptual eHealth service model, community volunteer caregiver is considered as a caregiver who supports elderly care. The services that the caregivers provide are daily activity support and sharing knowledge to elderly patients and family members. Volunteer caregivers in community provide primary care to EMS transportation with registered health record of patients. Figure 7.4 demonstrates co-creation paths in the adjusted eHealth service model for case of ThaiHealth community care. The model includes co-creation issues that are created and required from the collaboration of related stakeholders.

Service providers in ThaiHealth community care mainly collaborate and share technology to community hospitals and volunteers based on designed community volunteer caregiver system. It enhances quality and level of elderly care at community level based on healthcare standards and supports of people in the community. For receivers, ThaiHealth community care project promotes the ThaiEMS1669 application and collaboration between volunteer caregivers and elderly. Mobile technology is promoted in community care system to the elderly through social communication, sharing experience, and having daily activities with the volunteers.

Implications of eHealth service for communication and support elderly care of ThaiHealth community care can be implemented through the use of social media, EMS applications, phone calls, and personal SOS devices. Those implications are selected and used based on the ability in using technology of community hospitals, volunteer caregivers, family members, and patients. Table 7.5 presents value co-creation in eHealth service model for elderly care in a perspective of providing healthcare service at community level in a case of ThaiHealth community care. Based on the adjusted eHealth model, co-creation is an essentially required factor in providing healthcare service at community level in perspectives of local government, EMR system, financial system, and technology support system. ThaiHealth is a community care project that enhances the overall public health system through, for example, assistance in daily activities or providing EMS. Based on level of technology acceptance and community need, ThaiHealth community care services are important for aging society as they have influence on the well-being of the elderly, family members, and society as a whole.



**Figure 7.4** eHealth service model for Elderly care: Community care by ThaiHealth

**Table 7.5**

Value co-creation in eHealth service model for elderly care: a case of ThaiHealth

Co-creators	Value co-creation in eHealth service system with ThaiHealth (Community Care EMSS)			
	Integrated resources	Knowledge sharing	Technology transfer	Required co-creation
<b>Provider groups</b>				
Community hospital	○	○	○	- Online care system - EMR network
System provider	○	○	○	- Technical support - Updated system
Financial provider	○	○	X	- Financial plan - Secure system
Government	X	○	○	- Cloud EMR - eGovernment
<b>Receiver groups</b>				
Elderly	○	X	X	- Share experience
Family member	○	○	○	- Online monitoring
Volunteer Caregiver	○	○	○	- Caregiver app

○ Co-creation is created in eHealth service system

X Co-creation is required in eHealth service system

## 7.5 eHealth Policy for Developing Countries in Asia

Applying eHealth as a national health standard is challenging to Asian countries. This is because most of those countries are lack of healthcare resources and policies. Standards of healthcare and practices are needed to be transferred and shared among countries in the region; as it will eventually affect the well-being of people through collaboration in healthcare service and research. For developing countries in Asia, especially the newly industrialized countries, limitations related to the lack of resources that support the use of applications of mobile technology are needed to overcome. Mobile technologies are the main factors that allow effective communication and expansion of healthcare service to all areas. Based on limited investment, it is necessary for the countries to prepare, develop, and suitable mobile technologies that support healthcare system.

Healthcare policy of Asian countries is required to be redesigned by incorporating the importance of mobile technology and quality of service. Subsequently health providers and related co-operators have to develop eHealth service systems to support the increasing healthcare demand. There are challenges for service providers and local governments to equally provide healthcare services to their people in all areas, especially for developing and less developed countries. World Health Organization (WHO) summarizes a guideline for eHealth by providing practicable investment and implications of eHealth, which is beneficial to healthcare service providers and policy makers.

Business plans for healthcare service in Asia should be developed to meet suggested standards through integrated ICT in national healthcare systems (International Telecommunication Union, 2008). It is highly to focus on the lack of collaboration among healthcare providers, communities and families in order to support the elderly. Collaborations between healthcare providers and patient families are the key to increase well-being of elderly patients. Developing EMR and tele-Health is a point of concern for developing countries to provide healthcare service to their people on a timely basis. Quality of eHealth should be clarified in the national health policy. Besides, healthcare system should be executed through the provision of primary care on the basis of effective communication and collaboration in the service system. Secondary care and special care may classify by levels of mobile technology, medical methods, and ability to pay of the patients.

As an implication of eHealth service, system thinking is needed to have an effective healthcare system. Factors that should be involved in the system are technical support, technology acceptance, investment funds, healthcare policies, and public insurance schemes. Clarification on healthcare policies can guide service providers to provide effective healthcare services. In terms of cost, it can be reflected by levels of complexity of healthcare services. In other words, cost of service can identify different groups of incoming patients (Agyepong et al., 2014).

Indicators that represent the quality of provided healthcare services are different from country to country. For example, in Bangkok, Thailand, “Gold Star” is an accredited indicator conferred by an accreditation program. The “Gold Star” rated service means that the healthcare service is good and provided at reasonable price. The accreditation program has attracted a large number of medical tourists who seek for good and affordable healthcare services. According to the success of the accreditation program, it is important to integrate eHealth service with rating system for hospitals and service providers in Asian countries to promote their effective healthcare for the elderly services (Smits et al., 2014; Kriza et al., 2014; McColl-Kennedy et al., 2012). Price and alternative healthcare services are important information that influences the decision of the elderly and family to select health providers. EMR is a key challenge to eHealth market that benefits both providers and patients by providing accurate communication in medical practices.

The eHealth service model shows that cost and quality of healthcare services are important factors that determine the effectiveness of communication processes between service providers and recipients in life-threatening cases. With the use of eHealth and other mobile technology applications, providers and patients are beneficial from collaboration processes. For example, eHealth is required to be well prepared through the integration of mobile technology and co-created service process between providers and patients. As a result, well-being of the patients is enhanced through the co-created values of provided EMS, an application of eHealth technology.



As an implication of eHealth on EMS for the elderly in Asia, we would like to propose the developed eHealth model for developing countries. The model can be applied with the emerging markets of mobile phone and other mobile technologies. The model is proposed in response to the lack of healthcare workforce and the needs of improved EMS across the countries. The effectiveness of eHealth implementation depends on levels of collaboration among providers and patients, together with levels of use of ICT in service provision. The primary role of mobile technologies in eHealth is that the technologies act as service exchanging tools for value co-creation in healthcare service system.

## **7.6 Summary: eHealth Service Model for Elderly Care**

Mobile technologies are used in eHealth service provision to support EMSS for the elderly care through the use of mobile health monitoring devices and personal EMS communication devices. The technologies are useful for the elderly to communicate their needs to health providers over mobile phones. Well-being of them is increased as they are confident to communicate with others through healthcare service functions attached on their mobile phones. Alternative emergency related services are increasingly provided for the elderly in remote areas to support different preferences of patient and caregivers. EMS is operated by different providers in Asian developing countries, as both public and private providers are required to cooperate and share knowledge of EMS practices and standards. Healthcare providers are pressed to overcome the lack of healthcare workforce in order to meet the increasing demands of elderly patients. Through the use of mobile technologies, benefits on revenue of providers are based on the growth of eHealth market from providing effective healthcare services with reliable quality on a timely basis.

This chapter proposes the EMS eHealth model to support an increasing of elderly people, in which effective healthcare service provision is needed across countries. For Thailand, eHealth is a new service management system, which the main problems needed to overcome are the lack of resources and limited healthcare services in rural areas. Three case studies are explained according to the proposed eHealth model. The three cases are homecare service, private hospital EMSS, and Public community care with EMSS. Based on the proposed eHealth model, providers in the model need to co-operate with others by employing the use of ICT infrastructure and service eco-system through integrating resources, sharing knowledge, and co-creating value in healthcare service system. There are challenges to apply eHealth in developing countries as limited funding for investment and resources are the main constraints. Collaboration and supports from developed countries are needed to formulate eHealth policy and plan to support the increasing of elder population in developing countries. Patient behaviors and trends of using mobile technology in daily life are key factors that transform healthcare market to eHealth through internet based devices.

# **Chapter 8**

## **Conclusions**

### **8.1 Answer for Research Questions**

#### **8.1.1 SRQ 1: What are the roles of stakeholders in eHealth service for elderly?**

The roles of stakeholders in eHealth service system are collaborating in co-creation and co-producing values in eHealth service system for EMSS that supports communication in the processes of nursing preparation, patient transportation management, and personal health monitoring. Elderly patients are possible to communicate with hospitals or family members in emergency cases to report their health or daily activities. Co-created values in eHealth service system include knowledge sharing, technology transfer, and increase quality of service that are the results of interactions between service providers and receivers. Knowledge sharing and technology transfer in EMSS are activities that support mobile technology applications for the elderly. Increasing quality of service is based on the collaboration between participators who accurately communicate and prepare for health service management.

### **8.1.2 SRQ 2: What are the key factors in healthcare knowledge sharing of the elderly?**

The growth of aging populations in Asian countries has directly affected the need for healthcare services and systems to support their well-being. Supporting the activities of elderly people in their daily lives can be achieved through the adoption of mobile technologies and internet based services that connect them to their functions. The study identifies effective factors in knowledge sharing by emergency medical service systems in developing countries in Asia. It represents the perspectives of people and the challenges in sharing healthcare knowledge to support elderly people. By conducting questionnaire surveys, we identify significant factors in selecting mobile healthcare technologies by comparing different groups of people. First, we analyze the attitudes of people who live in the city and countryside areas. Second, based on different age groups, we study attitudes' of people aged over 65 and less than 65 years old. The results show that attitudes of people in knowledge sharing are critical to increase collaboration in healthcare systems. The factors are motivation from the family, user knowledge, confidential technologies, and the necessity for monitoring. From the study, knowledge sharing involves positively significant factors that support communication by participators in emergency medical services; it is effectively based on the attitudes of people and the applications of mobile technologies.

Healthcare services in Asia need to be set up with practical policies and be linked with concepts of knowledge sharing to increase service values. The services will support the needs of people on the basis of technological changes through new applications, mobility, and technology costs. Healthcare promotions and policies are important factors for motivating people to share their knowledge through selected technologies. Mobile healthcare technologies and knowledge sharing should be integrated to effectively manage with the growth of elder population through the preparation of healthcare policies and the change in attitudes of people in society. Future research should focus on effective healthcare service systems and policies that support the needs of elderly people based on technological trends and lifestyles of people.

### **8.1.3 SRQ 3: How to co-create values in eHealth service model?**

This study presents technological challenges to support EMSS for elderly people in developing countries. It explains the decision making process for investment on alternative technologies on the basis of integrated resources in healthcare service ecosystem. Value co-creation concept is a tool for providers to collaborate with patients and other related healthcare agencies. The adoption of the concept is useful to improve healthcare system for developing countries that face with impacts of lack in healthcare resources and implication of technologies. This study develops an EMSS model in the means that prepares a healthcare system to support increasing elderly patients in the upcoming aging societies. The EMSS model proposed in this study supports principle healthcare monitoring and communication activities for elderly patients in EMSS of hospitals. It enhances quality of healthcare service through medical preparation and alternative EMSS on the basis of patients' preference and collaborative interaction.

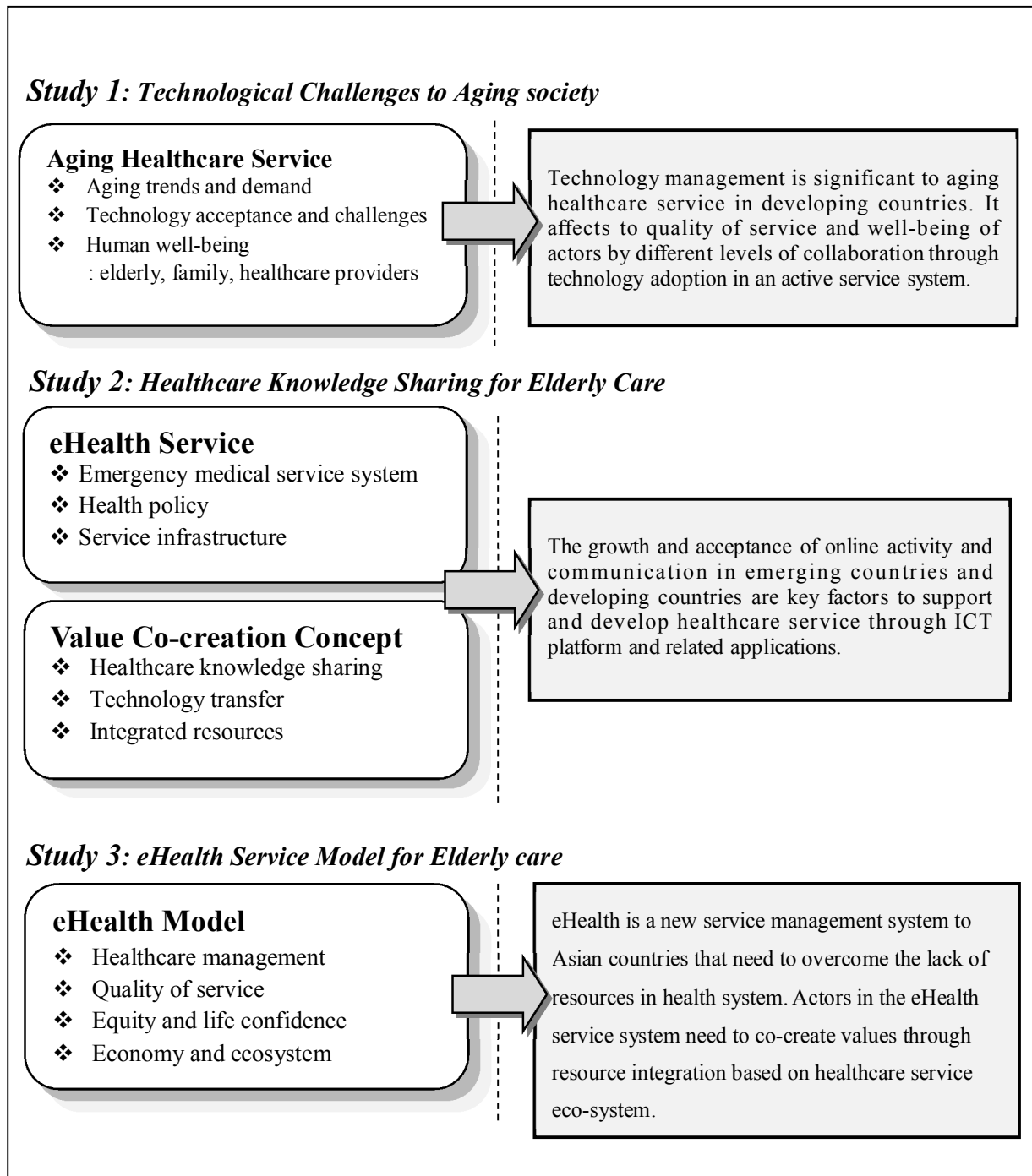
Applications of internet based devices are practical use of mobile technologies that are valuable for designing and developing functions for providing healthcare service for elderly people. Through smart phones and mobile medical devices, healthcare services are more accessible and available to people in all areas. The alternative technology clustering for EMSS will guide investors and related actors in the system to focus on communication channels between elderly people and their providers, including family members, caregivers, and hospitals. In addition to the fact that mobile technologies support the growth of aging population, the technologies also help the elderly live with confidence through the appropriate use of technologies. Future research should focus on technology acceptance and technology transfer of participators in EMSS to identify and promote related alternative technologies for people in different areas. Moreover, the healthcare service concept of developing countries is required to develop in response to the increasing demand of eHealth services and electronic health records through internet and Cloud database system.

#### **8.1.4 MRQ: How to design the value co-creation eHealth service model for elderly care?**

eHealth is an essential service concept that integrates communication system on limited resources and time. With the increasing number of elderly people, there is a need to rethink about collaboration of actors in healthcare service system through mobile technologies, which directly influences the healthcare market and quality of provided services. In this study, we adopt an eHealth service modeling approach based on value co-creation concept to support communications in EMS through the use of mobile technologies. Figure 8.1 represents a summary of all findings that answer all research problems.

In eHealth study, value co-creation concept is an alternative service concept for developing countries that are lack in application of ICT in healthcare service. The main idea of the proposed eHealth service model is that it introduces applications of mobile technology to support communication between providers and patients in primary healthcare service. Mobile applications are important tools to enhance quality of healthcare service on a timely basis by the collaboration of related actors that allows accurate communication and medical preparation. Actors in the eHealth model are required to cooperate with others to integrate resources and co-create values in health service system. Implementing eHealth technology and its applications will expand market of healthcare technology and promote other medical activities that support social well-being through technology transfer and knowledge sharing between participators.

In eHealth service system, it requires technical supports and a service platform as basic guidelines for other related actors. This study exemplifies eHealth development for policy makers, public sectors, and related service providers in developing countries to improve primary healthcare service system. There are challenges in applying eHealth in developing countries that are limited with investment funds and resources. The quality of eHealth services should be promoted as an important factor in the national healthcare policy and healthcare system to distribute primary care the on basis of available communication facilities and service system. The future research should focus on patient behaviors and trends of using mobile technology in healthcare market through e-service. Key success factors of case studies and best practices of eHealth in Asia based on different settings are needed to be identified. Technology acceptance and applications of eHealth in other healthcare services are needed of study in order to enhance eHealth service policy with appropriate use of technologies and investment funds.



**Figure 8.1.** Conclusion of research problems



## **8.2 Academic Implications**

### **8.2.1 Contribution to Domestic Research**

For mobile healthcare applications for smartphones, during 2013 – 2014 the applications were available on the most popular two operating systems: Google Play (Android) and the App Store (iOS). Although many an application is available to support EMSS, the applications are not widely used in general practices. They allow many useful functions such as position tracking, blood sugar monitoring, heart rate monitoring, and health alert and health plan notifying. These applications can support in the EMSS, but they will not be effectively implemented unless the users have skill and experience with those health related applications. In Thailand, there was no service provider or hospital that linked their EMSS through real-time healthcare services. For this point, the government and private sector should focus on active aging people to develop an effective healthcare service system, through the employment of smartphone applications and mobile medical devices based on the current available infrastructure and technology. Additionally, technical support and skilled workforce in EMSS are the main factors that need to be set up for aging populations.

In case of research on healthcare services and aging society in Thailand, most of the research in this field usually focuses more on medical practices that aim to enhance service quality with practical techniques and effective medicines. Accordingly, there is a need to prepare and develop an eHealth service concept through implementation of possible technologies and co-creation of related actors. This study aims to promote new ideas and possible action plans that support increasing elderly people through the integration of knowledge sharing and value co-creation concepts. In a different viewpoint of service perspective, rethinking and development of appropriate policies by providing effective healthcare services to patients are necessary. This study focuses more on the well-being of elderly people, therefore, an eHealth service model to satisfy demands of patients and providers with reasonable technologies is proposed.

### **8.2.2 Contribution to International Research**

The trend of the aging population in Asia is rising from 10% in 2009 to 30% in 2050. The increase in elderly people has caused by the unstable growth of population in many countries which is the consequence of developed healthcare quality and different lifestyles of people. The growth in the number of elderly people will have a huge effect on the society, economy, consumption, as well as healthcare services. Many factors need to be prepared in order to support aging populations, which include mobility, physical condition, and daily life. Healthcare service is essential for determining the well-being of elderly people in terms of personal care, nursing, life-threatening illness, health consulting, and contingency help. Lack of workforce in healthcare sectors and limited of funding are the main problems in developing countries. Appropriate technologies need to be properly used to support diverse requirements of the aging population that are different in aspects of policies, management structure, and cultures.

The aging population has an effect on societies, especially on healthcare services and the well-being of people. From the viewpoint of S-D Logic, this study applies the beneficiary's participation through the use of technologies for sharing resources and knowledge with other actors. It is an implication of service exchange through interactions of participators who are active actors in the healthcare service system. This study focuses on the quality of healthcare services by emphasizing on service perspective and applications of mobile technologies. This study identifies technological challenges facing healthcare service provision to support elderly patients' demands. By performing systematic reviews, the study classifies the needs for aging healthcare technologies that should be involved in the healthcare service system. A conceptual model is developed to represent a framework of eHealth for elderly people with the integration of value co-creation concept. Consequently, we expect that this study fulfills values in the body of knowledge in healthcare service to support the increasing of elderly people in Asian countries.

## 8.3 Practical Implications

The increasing of elderly patients and lack of resources in healthcare system in developing countries has influenced the well-being of people in the society. There is a need to prepare and develop an eHealth service concept through application of potential technologies and collaboration of related actors. It requisites to integrate the advancement of ICT and practicality service concepts in developing healthcare service system that is able to deal with changes of demographic of people and service value chain.

This study introduces new ideas and possible action plans to support increasing of elderly people by adopting knowledge sharing and value co-creation concepts. In this study, the eHealth concept for the elderly was designed to enhance service and knowledge management between providers and consumers through collaborative service system. It was developed to provide alternative EMS health services to elderly people in both city and remote areas.

The expected impacts of eHealth service development are better social well-being and alternative service systems that co-create values between healthcare providers and patients. Applicability of this research in developing countries, the governments, and private sectors should focus on trends of active aging in order to provide effective healthcare services over smartphone applications and mobile medical devices based on the existing available infrastructure and technology. The quality of eHealth services should be promoted in as an indispensable factor of the national health policy and health system to distribute active primary healthcare service to the elderly and those who need it.

Technology acceptance and consumer behavior are key factors to support healthcare service for elderly people in developing countries. To increase the level of technology acceptance and motivate people to use mobile technology for healthcare, promoting advantages of applications of ICT and co-created values in healthcare service system is a potential solution. In terms of healthcare knowledge sharing and knowledge management, technical support and skilled workforce in eHealth service provision are the main factors that need to be ready to handle the increasing number of aging populations across countries in Asia.

## 8.4 Limitations of the Study

This research focuses on eHealth service development for Thailand, which is considered a representative of Asian developing countries. Broadening service system study, value co-creation concept, theory of reasoning action (TRA), and levels of technology adoption are adopted as the fundamental research techniques. Based on the constitution of different healthcare service policies and standards, the developed conceptual models and related analyses aim to focus on service and technology as well as management practices that support communications and activities in healthcare service management and elderly care by related actors, including groups of providers and receivers. The developed models represent relationships of factors retrieved from people's perception regarding eHealth service development in a case of Thailand. Despite the analyzed results explained in this research, there are a few limitations to suggestions for further research.

Practical analyses in this research mainly focus on eHealth applications and related services that support EMS in Thailand by showing the cases of homecare, private EMSS, and community EMSS. These case examples are selected based on setting of situations in Thailand, relating to laws and regulations, health policies, development plans, and healthcare promotion. Some of the factors still need to be measured and studied in terms of technology adoption and feedback of consumers and providers about eHealth applications in practical situation.

Based on the readiness of technologies and facilities, collaboration among related actors and practical healthcare policies for eHealth are vital points for policy makers and business sector to give consideration on. Integrating resources in ICT, sharing EMR, and having trust on providers are important parts of value co-creation process, which are lack in general practice. In order to have a sustainable healthcare service system for the elderly people, every sector should work together to co-create values that are beneficial to all. Therefore, further studies on feasibility and how to have an effective collaboration among sectors are imperative. Moreover, as aforementioned that the proposed models are developed based on situations of healthcare service system in Thailand. Applying the proposed models and research techniques used in this study to enhance the effectiveness of eHealth service development for the elderly in other developing countries in Asia will be useful and provide a cross cultural research.

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# Appendix

## **Appendix A**

### **Mobile Technology on Healthcare and Emergency service system : A case in health monitoring and communication of hospital**

#### **Part 1 Hospital**

##### **1.1 Type of hospital**

- ☐ Public hospital
- ☐ Private hospital

##### **1.2 Level of hospital**

- ☐ Primary care
- ☐ Secondary care
- ☐ Tertiary care

##### **1.3 Number of bed (for total)**

- ☐ Less than 150
- ☐ 150-300
- ☐ More than 300

##### **1.4 Number of patient per day (.....patients)**

- ☐ Less than 100
- ☐ 100-200
- ☐ More than 200

##### **1.5 Number of patient in Emergency department per day (.....cases/day)**

- ☐ Less than 50
- ☐ 50-100
- ☐ More than 100

##### **1.6 Number of Nurse in Emergency department (.....nurses)**

- ☐ Less than 10
- ☐ 10-20
- ☐ More than 20



## Part 2 Technological application in Healthcare and Emergency service system

### 2.1 Internal hospital service

#### 2.1.1 Mobile technology application and Health application (Internal hospital)

Please select type of technology (✓) in the table

Application/ Service activities	Type of Technology				
	Barcode	RFID	Wireless	Mobile application	Other
Blood pressure					
Heart rate					
Temperature					
Classify type of patient					
Record patient detail					
Review Health record					
Real-time Monitoring					
Other					

#### 2.1.2 Application to patients in service

- ☐ All patients                      ☐ Based on case                      ☐ Based on Age

#### 2.1.3 Patient database system (Patient health record)

- ☐ Link to system                      ☐ Not link to system

#### 2.1.4 Linkage of information technology with other hospital (Patient health record)

- ☐ Link                      ☐ Not link

#### 2.1.5 Technological application in Emergency case

- ☐ Emergency device                      ☐ Phone                      ☐ Internet  
☐ Social network                      ☐ Mobile application                      ☐ GPS  
☐ Other.....

## 2.2 External hospital service

### 2.2.1 Mobile technology application and Health application (External hospital)

Please select type of technology (✓) in the table

Application/ Service activities	Type of Technology				
	Barcode	RFID	Wireless	Mobile application	Other
Blood pressure					
Heart rate					
Temperature					
Classify type of patient					
Record patient detail					
Review Health record					
Real-time Monitoring					
Other					

### 2.2.2 Application to patients in service

- ☐ All patients      ☐ Based on case      ☐ Based on Age

### 2.2.3 Patient database system (Patient health record)

- ☐ Link to system    ☐ Not link to system

### 2.2.4 Linkage of information technology with other hospital (Patient health record)

- ☐ Link      ☐ Not link

### 2.2.5 Technological application in Emergency case

- ☐ Emergency device      ☐ Phone      ☐ Internet  
☐ Social network      ☐ Mobile application      ☐ GPS  
☐ Other.....

## **Appendix B**

### **Mobile Technology in Healthcare Knowledge Sharing and Communication for Personal Care and Elderly Care**

#### **Part 1 Respondent characteristic**

##### **1.1 Sex**

- ☐ Male ☐ Female

##### **1.2 Age**

- ☐ <30 year olds ☐ 30-39 year olds ☐ 40-64 year olds ☐ >65 year olds

##### **1.3 Education background**

- ☐ Not have education background  
☐ Primary school  
☐ High school/ College  
☐ Undergraduate school (Bachelor degree)  
☐ Graduate school ( Master degree and higher)

##### **1.4 Average income per month (..... Bath)**

- ☐ Less than 10,000 ☐ 10,000 – 30,000 ☐ More than 30,000

##### **1.5 Living Area**

- ☐ City area ☐ Countryside

## Part 2 Experience in using technology for health monitoring and emergency case

Please select (✓) in front of preferred choice

### 2.1 Activities and technology application

- ☐ Review Health record
- ☐ Blood pressure
- ☐ Heart rate
- ☐ Temperature
- ☐ Real-time Monitoring (status on health service)
- ☐ Other

### 2.2 Sharing database or result to hospital (Patient health record)

- ☐ Yes
- ☐ No

### 2.3 Link health information to family member and care giver

- ☐ Link
- ☐ Not link

### 2.4 Technological application for communication in Emergency case

- ☐ Emergency device
- ☐ Phone
- ☐ Internet
- ☐ Social network
- ☐ Mobile application
- ☐ GPS
- ☐ Other.....

### 2.5 Type of technology and Health care application

Please select type of technology (✓) in the table

Application/ Service activities	Type of Technology				
	Public phone	RFID	Wireless	Mobile phone	Other
Review Health record					
Blood pressure					
Heart rate					
Temperature					
Real-time Monitoring					
Emergency communication					
Other					

### **Part 3 Attitude and Experience about Technology for Healthcare knowledge sharing**

#### **3.1 Interest to use Technology for Healthcare and Emergency service in family/home**

- ☐ No ☐ Yes

In case that answer "Yes", please specify weight level that you prefer for this issue

- ☐ Level 1 (Low)  
☐ Level 2 (Low-Medium)  
☐ Level 3 (Medium)  
☐ Level 4 (Medium-High)  
☐ Level 5 (High)

#### **3.2 Attitude for Learning technology for Healthcare management**

- ☐ No ☐ Yes

In case that answer "Yes", please specify weight level that you prefer for this issue

- ☐ Level 1 (Low)  
☐ Level 2 (Low-Medium)  
☐ Level 3 (Medium)  
☐ Level 4 (Medium-High)  
☐ Level 5 (High)

#### **3.3 Confident in using mobile technology for healthcare communication**

- ☐ No ☐ Yes

In case that answer "Yes", please specify weight level that you prefer for this issue

- ☐ Level 1 (Low)  
☐ Level 2 (Low-Medium)  
☐ Level 3 (Medium)  
☐ Level 4 (Medium-High)  
☐ Level 5 (High)

### 3.4 Should share health monitoring result to hospital? (For real time monitoring)

- ☐ No ☐ Yes

In case that answer "Yes", please specify weight level that you prefer for this issue

- ☐ Level 1 (Low)  
☐ Level 2 (Low-Medium)  
☐ Level 3 (Medium)  
☐ Level 4 (Medium-High)  
☐ Level 5 (High)

### 3.5 Experience in Healthcare knowledge sharing

3.5.1 During a previous year, who that you had received and shared healthcare knowledge?  
(It include personal health results, Health practice, Health quality, Health plan, Experience, and others)

- ☐ Public health providers  
☐ Private health providers  
☐ Friend and Family  
☐ Community/ Association/ Group of people  
☐ Others.....

3.5.2 Which topics that you received and shared during a previous year, and How it frequency?  
Please select frequency of each topic (✓) in the table

Topics	Frequency (Times)				
	Never	1-5	6-10	11-15	>15
Health plan and Management					
Health Monitoring practice					
Healthcare technique					
Online Health activity					
Healthcare results and Quality					
Other specific.....					

#### **Part 4 Factors on selecting mobile technology to support healthcare service for elderly people**

##### **4.1 Cost in selecting and using mobile technology in healthcare service**

Please select Influence level of each topic (✓) in the table (Level 1; Low, Level 2;Low-Medium, Level 3; Medium, Level 4; Medium-High, Level 5; High)

Topics	Influence level in selection				
	1	2	3	4	5
1. Cost of technological device (Cost in buying mobile technology device to support healthcare accivities, it includes device that buy by personal interest and promote by related health provider)					
2. Cost in operate mobile technology (Cost of communication by mobile technology that includes SMS, Phone call, Internet package, and Online monitoring, and others)					
3. Cost of contact with healthcare service provider (Cost in contact for special healthcare service that includes insurance package, Online Monitoring, Care at home, and others )					

##### **Comment on this topic**

(Cost in selecting and using mobile technology in healthcare service)

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#### 4.2 Motivation from related people in using mobile technology in healthcare service

Please select Influence level of each topic (✓) in the table (Level 1; Low, Level 2;Low-Medium, Level 3; Medium, Level 4; Medium-High, Level 5; High)

Topics	Influence level in selection				
	1	2	3	4	5
1. Motivation from family (Motivation from family member to use and apply mobile technology for healthcare management and communication, it include health plan, interface, request, help, monitoring and other)					
2. Motivation from provider (Hospital) (Motivation from health provider to use and apply mobile technology for healthcare management and communication it include health plan, request EMS, reminding, suggesttion and other)					
3. Motivation from communities (Motivation from friends and group of people to use and apply mobile technology for healthcare communication and sharing knowledge, it include social network, block,and other)					

#### Comment on this topic

(Motivation from related people in selecting and using mobile technology in healthcare service)

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#### 4.3 Knowledge and confident in using mobile technology in healthcare service

Please select Influence level of each topic (✓) in the table (Level 1; Low, Level 2;Low-Medium, Level 3; Medium, Level 4; Medium-High, Level 5; High)

Topics	Influence level in selection				
	1	2	3	4	5
1. Knowledge and skill of user (Personal knowledge in using mobile technology to communication with others in daily life, it include technology adoption, learning ability, ability to use technology, and others)					
2. Policy and promotion from government (Health policy and promotion from gorvernment support in your selecting and using mobile technology in healthcare service, It include acitvity in primary care, health communication, health monitoring, health record and management, and others)					
3. Confident and secure of technology (Confidence in selecting and using mobile technology in healthcare service, It include security of personal issue, Trust in provider, Accurate in care, and others)					
4. Necessary on communication and monitoring (There are need to selecting and using mobile technology in healthcare service, It include personal health record, health management, EMS preparing, Self/ patient monitoring, and others)					

**Comment on this topic**

(Knowledge and confident in selecting and using mobile technology in healthcare service)

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**Part 5 Comment and suggestion**

Topic: Mobile technology in healthcare knowledge sharing and communication for personal care and elderly care

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# List of Contribution

## **Journals**

Sukkird, V., & Shirahada, K., Technology challenges to healthcare service innovation in aging Asia: Case of value co-creation in emergency medical support system., Published, Technology in Society (TIS), 43, 122-128, 2015, doi:10.1016/j.techsoc.2015.08.002

Sukkird, V., & Shirahada, K., eHealth Service Modeling for Developing Country: A Case of Emergency Medical Service for Elderly in Asia. Published, International Journal of E-Services and Mobile Applications (IJESMA), 7(4), 30-43, 2015 doi:10.4018/IJESMA.2015100103

## **International conference proceeding**

Sukkird, V., & Shirahada, K., Technology challenges to healthcare service innovation in aging Asia: Case study of emergency medical service system. Proceedings of PICMET '14 Conference: Portland International Center for Management of Engineering and Technology; Infrastructure and Service Integration, Kanazawa, Japan , July 31st, 2014> 2791 - 2798

## **Poster presentation**

Sukkird, V., & Shirahada, K., Technology challenges to healthcare service innovation in aging Asia: Case study of emergency medical service system. Smart Home/Smart Grid/Smart Services Workshop 2015 (SHSGSS2015), 3 March 2015, Bangkok, Thailand