

Telecare projects in Taiwan

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C-S. Lin. Telecare projects in Taiwan. Gerontechnology 2010; 9(3):400-407; doi:10.4017/gt.2010.09.03.003.00 Telecare is believed to be one of the solutions to keep older people independent and reduce medical costs in an aging society. The government of Taiwan has initiated pilot telecare for homes, communities, and institutions, all based on Taiwan's excellent National Information Infrastructure (NII). The pilots also promote the development of the local telecare industry and implement Aging-in-Place. This paper introduces national ICT programs that provide the information infrastructure. Telecare projects are subsidized by the Ministries of Economic Affairs and of Health and developed by the private healthcare industry. Community and institutional telecare appear ready for profitable business models. Home telecare, however, should be combined with other home services to become affordable for the end-user.

Keywords: telecare, healthcare, older persons

There were 2.5 million 65+ persons in Taiwan in 2009 on a total population of 23 million, 66% of whom had acquired one or more chronic diseases¹. Most prevalent are hypertension, followed by arthritis, cardiac disease, and diabetes mellitus. This high prevalence of chronic diseases raised health care expenditure. The National Health Insurance (NHI) suffered financial difficulties in recent years and tried to find cheaper effective ways to care for older people, among which telecare. Telecare can be defined as the remote or enhanced delivery of health and social care services to people in their own home by means of telecommunications and computer-based systems².

Taiwan's Cabinet has been promoting Internet connectivity since 2001. The Ministry of Economic Affairs (MOEA) expects a growth of 340% of the business opportunities associated with the aging population, from US\$24.6 billion in 2001 to US\$108.9 billion in 2025³. To accommodate this expansion of the aging service industry, MOEA promotes Information Technology-enabled Services (ITeS) by encouraging healthcare companies to participate in the development of new and innovative healthcare services, and to expand busi-

ness around the world. In addition, Taiwan's Department of Health (DOH) initiated pilot telecare projects to develop an implementable care model.

This paper describes Taiwan's ICT infrastructure and reviews Taiwan's telecare programs, as to service delivery, process and evaluation results. Emergency telecare in Taiwan has been reported earlier in this journal⁵.

NATIONAL ICT PROGRAMS

All national ICT programs in Taiwan rely on the 1994 National Information Infrastructure (NII). The goal of NII is to expand the information superhighway to every household, office, factory, and school in an accessible and affordable way. In 1999, the number of Internet users reached 4 million, ranking 9th in the world; 96% of schools, 35% of homes and 53.5% of enterprises were connected with Internet⁴. Subsequently, Taiwan launched three major national ICT programs: e-Taiwan (2002-2007), M-Taiwan in 2005, and U-Taiwan in 2007.

The e-Taiwan program was directed at boosting industrial competitiveness and upgrading government performance⁶. It should establish Taiwan as one of Asia's leading e-nations.

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It contained five core initiatives: e-Infrastructure (to establish a comprehensive network of wired, wireless, mobile and fixed broadband Internet networks), e-Government (to implement innovative government services including integrated single-window government services, electronic transaction systems, and online public services), e-Industry (to promote industry digitization, facilitating Taiwan's transition into a high value-added manufacturing and service center), e-Life (to promote online education, entertainment, culture, health care, and transportation services), and e-Opportunity (to utilize limited resources to expand digital opportunities and improve access in different regions of Taiwan). In 2007, 83% of households in Taiwan owned a computer. 75% of these had Internet access with 87% of these 75% being broadband Internet. In its 2007-2008 report on overall networking and infrastructure e-readiness, The World Economic Forum ranked Taiwan 13th in the world, and 3rd in Asia⁷.

The 2005 NICI (National Information and Communication Initiative) of the Cabinet included the 'M-Taiwan' program⁷ investing NT\$ 37 billion (US\$ 1.2 billion) in 5 years to: (i) Implement wireless Internet access environment to improve Taiwan's penetration rate of mobile Internet from the 20th to 5th in world ranking; (ii) Become one of the top 10 countries with the lowest online access fee in the world (30-80% price discount as compared to existing charges); (iii) Support the development of the telecom industry to become the next industry with trillion dollar revenue with Taiwan as the first GSM-WLAN integrated nation in the world; (iv) Promote the construction of 6,000 km broadband network, (v) Encourage NT\$ 100 billion (US\$ 3.3 billion) investments from the cell-phone manufactures, content providers, and telecom operators; (vi) Improve the broadband infrastructures of remote areas, and (vii) Promote digital governmental services.

The M-Taiwan Program is expected to (i) bridge the digital divide, (ii) shift Taiwan from an 'e-nation' to an 'm-nation', and (iii)

reach the vision of "Mobile Taiwan, infinite application, in a brave new mobile world". By 2008 the number of broadband subscribers reached over 6.09 million of the 23 million inhabitants, and the mobile phone penetration rate reached 115% in that year⁸.

The 2007 'U-Taiwan Program' includes smart services that are available anytime, anywhere to offer everyone a safe, comfortable, and convenient living environment. The 2011 goals of this program⁹ include: (i) 80% connectivity to high speed (30Mbps+) networks; (ii) 50% of citizens to enjoy ITeS services with a satisfaction rate over 80%; (iii) 55% of citizens to enjoy e-Government services with a satisfaction rate over 60%; (iv) 3 billion different connections to the broadband convergence network; and (v) the production value of the ITeS industry to reach NT\$1 trillion (US\$ 33 billion).

The e-Taiwan, M-Taiwan, and U-Taiwan initiatives provide a clear direction for the growth of the ICT industry in Taiwan¹⁰ and make seamless telecare services possible.

The 2006-2008 'Seniors U-Care Flagship Program' of MOEA encouraged hospitals, long term care institutions, and information technology vendors to work together to develop home telecare, community telecare, institutional telecare and emergency care systems, and to create innovative business models and service processes. The 2007-2011 'Innovative Healthcare Service Program' supports these stakeholders to plan and develop business models for management platforms of diabetes, stroke, fitness, and providing leisure. In 2006-2008, MOEA funded 50% of the costs of planning and implementation of 7 telecare projects. Two of them are introduced below.

TELECARE PROGRAMS

Ucare: A deinstitutionalized telecare platform

In 2007-2008 the Ming-Sheng General Hospital and sensor and IT vendors collaborated in Ucare, an institutional telecare platform to deliver professional and comprehensive

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health care to older people, discharged patients and pregnant women. The system provides a 5 in 1 sensor for temperature, blood pressure, blood glucose level, SPO₂ (oxygen saturation of peripheral blood), and a phonocardiogram. Using Bluetooth technology and the Internet the vital signs are transmitted to the Mission Ucare platform for analysis. The platform monitors the health status of the users 24 hours a day and will send an alarm to on-duty staff in the call center if any abnormality happens (Figure 1). In addition, the staff makes home visits to comfort the older people, and to discover potential risks on a routine basis.

Mission Ucare platform served 50 residents in the Yi-De care center and 237 independently living older persons. During the two years' experimental operation, the average hospital stay decreased 21%, while both blood pressure and blood glucose levels of the users were controlled better. The total medical costs decreased 16% with a patient

satisfaction of 81%¹¹. Satisfaction levels of the staff were not reported.

Community health care network

Stroke patients that have just been discharged from hospital are addressed in the 2006 'Community Health Care Network' of Kaohsiung Medical University, Chung-Ho Memorial hospital, Hsiao-Kang hospital, Institute for Information Industry, and Dual-leaf Technology Company. Implementation started in 2007 with a pilot of 25 first-stroke patients in one year¹². Health status monitoring and tracking, emergency referrals and medical consultation, visit arrangement, assistance with taking drugs, mobile care visit, and social-security application assistance are covered in this project. In 2008 a Center of Community Health Care was erected to provide the needed care (Figure 2).

During one and half year of experimental operation, the 'Community Health Care Network' shortened the time to emergency

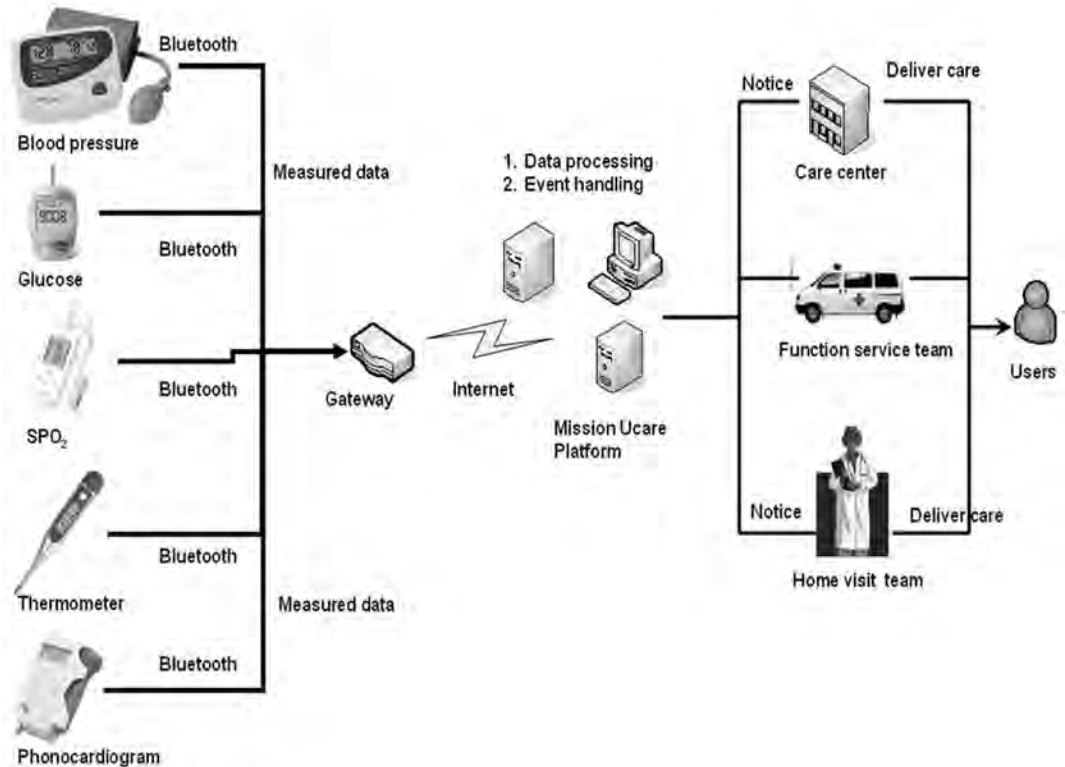


Figure 1. Ucare service flowchart

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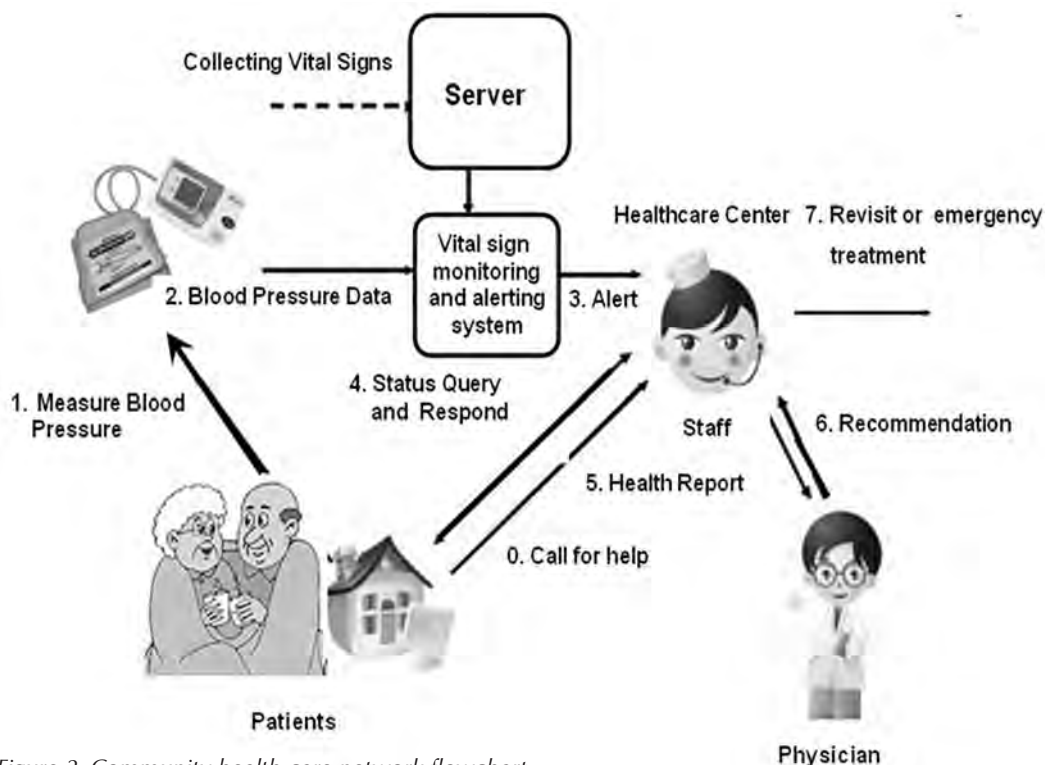


Figure 2. Community health care network flowchart

treatment and reduced the revisit rate 9.4% in the first 3 months after hospital discharge, 4.9% in the 4th to 9th month, and 4.7% 10-18 months after hospital discharge. The patient satisfaction was 92.3%¹³.

HOME, COMMUNITY AND INSTITUTIONS

In 2007, the Department of Health financed a 'Telecare Pilot Project' to resolve the strong demand for long-term care^{14,15}. The Municipal Wan Fang Hospital was responsible for executing the pilot project. The main goal was to verify the integration, accessibility, scalability and business model options. Three pilots were implemented: home telecare (200 clients), community telecare (157 clients), and institutional telecare (82 clients) with partly overlapping elements (Table 1). One district hospital and three nursing homes joined the project. The whole system is managed from one Telecare Service Center that employs a Telecare Information Platform (TIP). The three pilots have their own operating mechanisms, linking resources, and support systems, so they can operate

independently. In addition, they form an integrated care service network. The Telecare Service Center provides 24-hour customer consulting service, emergency reports, and handling of abnormalities to ensure service quality.

Table 1. Service elements in the three models of the telecare pilot of DOH, the Department of Health of Taiwan

Telecare elements	Telecare service model		
	Home	Community	Institutional
Vital signs monitoring	x	x	x
Emergency treatment	x		
Pharmaceutical management		x	x
Teleconsultation		x	x
Tele-education	x	x	x
Visit service	x		x
Location-based service		x	
Living-resource referrals	x	x	

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Table 2. Health indicators before and one year after the implementation of the telecare pilot of DOH, the Department of Health of Taiwan¹⁷; ER=Emergency Room; Test score for drug abuse according to questionnaire result; *=comparison of patients at the traditional home care center of Wan Fang Hospital ('Before') and the telecare pilot ('After')

Telecare model	Evaluation criterion	% of clients affected		Remarks
		Before	After	
Home*	Hospitalization rate	6.1	2.1	
	ER admission rate	4.3	2.8	
Community	Incorrect drug use	38.2	9.3	Test score ≤ 17
	Blood glucose level control	53.8	82.0	Weekly self-monitoring
Institutional	Infection rate	1.9	1.2	
	Re-hospitalization rate	0.4	0.3	

The project includes interoperable electronic care records exchange and certification mechanisms. Patients and staff access the services through building-bound or mobile Internet connectivity. If a change in health status requires a different care, continuity of care is guaranteed. In addition the project aims at demonstrations to enhance the diffusion of the telecare service model to other regions.

Results of this telecare program are promising^{16,17}. Infection rate and re-hospitalization rate of institutional patients decreased. Hospitalization rate and emergency admission rate of home clients decreased also. In addition incorrect use of medicines occurred less frequently, and self-monitoring of blood-glucose levels was more effective (Table 2).

CAMP: Care for Asthma via Mobile Phone

In Taiwan, asthma is the 11th cause of death, and prevalence among children amounted to 19% in 2002¹⁸. The cornerstone of modern asthma care is self-management, allowing the patients to monitor their disease severity continuously and to adjust the dose of inhaled drugs based on symptoms and lung function¹⁹. To achieve self-management of asthma a variety of approaches is needed such as daily peak expiratory flow rate (PEFR) measurements, appropriate medication, patient information and education, and sufficient adherence to the advice given. Adherence to treatment in asthma may be as low as 50%, leading to a deteriorated quality of life²⁰. Up to 30% of asthma patients

report forgetfulness to be one of the main reasons for their poor adherence²¹.

The National Center of High-Performance Computing (NCHC), Chang-Gang Memorial Hospital and Chung-Hwa Telecommunication Company developed a 'Care for Asthma via Mobile Phone (CAMP)' platform. CAMP's goal is to provide effective guidance using a cell phone. The patient enters his PEFR readings into his own cell phone and answers a simple questionnaire on a daily basis. The CAMP service professionals receive the assessments, and immediately send a care-suggestion message by email or SMS messaging²². The care-suggestion message is based on the patient's current asthma status as well as his physical location and any changes in his local weather that might adversely affect his asthma condition. The system also collects weather-related data from more than 40 weather stations across Taiwan. This data is updated to the CAMP server every 30~50 seconds. The CAMP system processes the local weather information data and the asthma patient's general condition to produce information that physicians use to determine the relevance of the specific local weather situation for the patient. Assessment of outdoor air pollution is not included in CAMP.

CAMP has been in service in Taiwan since 2003 and currently reaches more than 13,000 asthma patients and 400 physicians. DOH encouraged CAMP by transferring NT\$ 5,000 (US\$ 150) to the physician for

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each of his patients who take the CAMP service. The estimated reduction in medical costs in 2005-2006 was 60%. The number of Emergency Room visits of CAMP users decreased gradually from 0.41 in 2002 to 0.11 in 2005 (Figure 3)²².

In addition CAMP has a wired part that provides an educational website with an asthma medication introductory video, and an asthma symptoms survey questionnaire. Anyone interested in learning more about asthma can visit the website.

Minibond positioning and rescue service

In 2006, the population with dementia has been 20,896 in Taiwan, which is double the number of the demented population of 15 years ago. Prevalence among people aged 65 and older reaches 2-4%; at 80+ years this is 20%²³. No treatment is available and the survival time for diagnosed patients with Alzheimer's disease is up to 15-20 years²⁴. Persons affected by dementia may feel compelled to wander around, and experience problems with orientation²⁵. It is important to find solutions that preserve the person's independence and self-esteem. Support of self-esteem ranks high in the gerontechnology impact matrix²⁶.

In 2006, Chung-Hwa Telecommunication Company and Chung-Shing Security Company developed the Minibond phone (Figure 4) to provide location-based services for children, women and older people.

If an older person with dementia gets lost, s/he may push the SOS button to request for



Figure 4. The Minibond phone

help or directly talk to the Call Center or to family members by two default phone numbers. Family members can also call the Call Center or access a website to find the position of the Minibond holder by way of Assisted Global Positioning System (AGPS), a combination of GPS (Global Positioning System) and an auxiliary positioning system of cell phone bases. The location precision is less than 15m²⁷. Minibond was brought to the market in 2007. No user experiences are reported yet.

DISCUSSION

In their review on home telemonitoring, Paré et al.²⁸ surveyed the outcomes of 65 home telemonitoring programs mostly conducted in North-America and Europe, but only one in Asia. The results in Taiwan are comparable as far as data accuracy, patient-symptoms detection, improvement of physiological measurements, and the overall decrease in hospital admissions is concerned (Table 3). Nevertheless, in the future the clinical effectiveness needs to be evaluated over longer periods of time.

In contrast to Paré et al.²⁸, we found a considerable reduction in medical costs after telecare implementation. The reason for this discrepancy may be the different health insurance systems. NHI covers more than 99% of Taiwanese citizens, providing for most citizens protection from the financial risk of large medical expenses. It only costs the client US\$ 5 to obtain an (early)

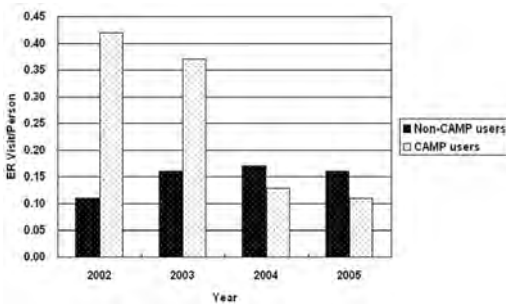


Figure 3. Emergency room (ER) visits for CAMP users and non-CAMP users²³

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Table 3. Comparison of telecare results in Taiwan with the combined results of North-America and Europe²⁸; *=*in case of free services*; **=*except for patients with diabetes*

Characteristics	Evaluation results	
	Taiwan n=8	North-America & Europe n=65
Study period	2007-2009	1990-2006
Duration of each single study	6-18 months	5-12 months
Data accuracy	Good	Good
Reliability of transmitted data	Needs improvement	Good
Patient symptom detection	Good	Good
Improved physiological values	Yes	Yes
Patient acceptance and satisfaction	High*	High
Decrease in hospital admissions	Yes	Yes**
Decrease in emergency room visits	Yes	Yes**
Improved medicine consumption	Yes	Unknown
Reduction of medical costs	Yes	Not clear

medical check-up in Taiwan, which is much less than people pay in most European and North-American countries.

Implementation costs of telecare equipment and systems are high. From the viewpoint of cost, community and institutional telecare is easier to make profitable than home telecare. The services in Taiwan's pilots were free of charge. As telecare is too new to be perceived as urgently needed, and since traditional care services are cheaper for the patient and easily accessible, clients have no strong intention to change. The commercial Minibound phone, for instance, has only few users.

Home telecare systems need Internet connectivity that is not available in rural areas and to older individuals in Taiwan. Those people have first to pay additional fees to install ADSL. One solution could be to com-

bine telecare with meal and grocery delivery, housekeeping services, security systems, insurance, and leisure, travel, and transportation services, and to provide one-stop shopping services.

CONCLUSION

Successful pilot telecare systems, based on the 1994 National Information Infrastructure program, have been developed under the sponsorship of the Taiwanese government. Initial positive results have been reported. However, most projects are still experimental and the effects on societal sustainability need to be evaluated over longer periods of time. Without enough incentives such as diversified services, the home telecare system is too expensive to be acceptable for the end-user. Instead, the community and institutional telecare services are worthy of being promoted in both urban and rural areas.

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