

# An Integrated Service Model for Community Care: Designing a Healthy Life for the Elderly in Taiwan

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**Abstract-** Objective of this study is to investigate the acceptance of proposed Integrated Service Model for community care. In this study, we implemented an actual community healthcare system, which integrates resources of district hospital and community development associations (CDAs), and applied this system with the integrated service model to the elderly in a community for almost a year. Results showed that community elderly were encouraged to attend regular activities at the Neighbourhood Activity Centre, which were hosted by two major units, i.e., the CDA and the district hospital. During these activities, volunteers for community service regularly checked the vital signs of the community residents, including blood pressure, oxygen saturation of blood, heartbeat, and body temperature. The system served as a mediated tool for storage of vital signs and help the elderly communicate with medical staff easily. The statistic results showed that the behavioural intention of the community elderly in using this integrated service model is extremely related with such critical dimensions as “system accessibility” and “perceived usefulness” ( $p < 0.01$ ). In addition, the novel concept of integrated service model integrating local CDA, the district hospital and volunteers for community healthcare service has a high degree of acceptance. Hence, constructing such an integrated service model can help the elderly in Taiwan achieve the ultimate targets of “aging in place” and “successful aging.”

**Keywords-** Health Services for the Aged; Information Management System; Service Mode; Community Care

## I. INTRODUCTION

Taiwan recorded a population of 23.16 million in 2010, with a low total growth rate of only 1.8%. The percentage of people above the age of 65 has been growing over the years, reaching 10.7% by the end of 1999. In addition, previous records have shown an aging index of 68.6%, experiencing an increase of 0.5% from 2007 to 2010 [1]. To be able to adapt to the aging trend and associated growing needs for support and long-term care of the elderly, the Executive Yuan endorsed the “Ten-Year Long-Term Care Service Project in Taiwan” in 2007, with the following service objects: (1) citizens above the age of 65, (2) mountain aborigines above the age of 55, (3) the physically and mentally disabled above the age of 50, and (4) the elderly who have only the instrumental functions for activities of daily living (IADL) and are living alone. The project focused on providing activities for daily living and included mainly home care, day care, family care, nutritional food, and transport service for the disabled elderly with low or medium-low income; and also on providing different

percentages of subsidies according to the degree of disabilities and family economical situation of the service objects [2].

However, Taiwan has a unique medical environment, i.e., it has a high density of medical institutions. For its total land area of 35,980 km<sup>2</sup>, Taiwan has 20,306 hospitals and 19,792 clinics [3]. Thus, the elderly in Taiwan have formed the habit of seeing a doctor even for the most minor reasons. Taking 2009 as an example, the elderly population above the age of 65 accounted for 10.63% of the total population in Taiwan. In addition, the elderly outpatients and hospitalized patients accounted for 29% of the total, while their expenses accounted for 34% of the total. Quite a large percentage were not very sick patients, but only those felt uncomfortable; however, their frequent visits to the hospitals have resulted in the abuse of medical resources in Taiwan, high expenses at healthcare clinics, and even serious financial losses for others [4].

The remote health monitoring and care system based on telecommunication technologies has been promoted by the Taiwan government in recent years. The Department of Health, through the decree of Executive Yuan, has been facilitating the “Remote Care Trial Program” since 1996 and the “Remote Care Service Quality Improvement Program” [5] since 1997, developing an integrated and continuum Remote Healthcare Network through the home, community, and institutional remote healthcare models. However, most sponsors are large-scale teaching hospitals that have placed emphasis on the development of remote healthcare apparatus and equipment, yet are unable to propose a sustainable business model once the program is completed.

Although Taiwan is a major producer of highly advanced electronic products, the promotion of a remote healthcare system still faces three unprecedented difficulties due to the extremely convenient hospital environment: (1) the remote healthcare apparatus are too complicated for the elderly to operate independently; and (2) except for special NII programs for remote areas [6], the remote medical service has not yet been legalized. Therefore, doctor in general medical institutions is unable to exercise medical functions or give instructions through the remote healthcare system as well as collect fees for such services. The cost of maintaining a remote healthcare system can be very expensive. From the statistical survey, we discovered that users are reluctant to use

the remote healthcare service if their monthly expenses exceed NTD1, 000 [5].

According to the statistics report of the Ministry of Health, Labour and Welfare [7], the ratio of the elderly who died in institutions to those who died in their homes has been increasing over the years, with the former group exceeding the latter by 1976. This implies that the elderly with traditional oriental concepts have lost the familiar lifestyle centred on their families. When they move into care institutions, their life quality is neglected and their health condition deteriorates rapidly despite the fact that a complete range of medical and care services are provided.

The same result is evidenced by the study of Åkesson et al. who state that a high quality life is partially obtained through interactions with other family members, friends, and care providers [8]. The study by Steele et al. [9] reveals that the elderly regard independence as the most important factor in having a high quality life. Friends often visit them, but this is not allowed at the Elderly Home or other care institutions. This is one of the reasons why the elderly hold negative opinions towards the Elderly Home and similar institutions. Moreover, the elderly also think that social activity is quite important and do not want to change their lifestyle, or worse, to lose their friends because they have to move into care institutions.

At present, the most important consideration of elderly care policies being implemented in major countries is the concept of “aging in place,” which means that the elderly should age naturally in communities where they live to maintain their independence, self-esteem, and privacy [10-11]. Taiwan scholars propose “aging in place” as the target for the development of Taiwan’s long-term care policy with reference to the experience of Organization for Economic Cooperation and Development (OECD) countries avoiding excessive institutionalization resulting from great efforts exerted toward this goal. Such efforts include the development of institutional service in major industrialized countries, reduction of related care costs, and allowing those who are in need of care to stay as much as they could in their own families and communities in order to maintain their dignified and independent lives. However, the number of disabled elderly and elderly with chronic diseases continues to grow, with the low birth rate resulting in an increasing lack of caregivers among family members. The health insurance system in Taiwan is indeed facing a serious loss due to the growing number of the elderly in need of medical care. If the elderly are sent to institutional care, they tend to die early and the objectives of the long-term care program become rather limited and regional. Thus, the problem of establishing a care service system that ensures a healthy life for the elderly in Taiwan and realizes the targets of “aging in place” and “successful aging” is a worthwhile research topic. In this study, an integrated service model combining the hospital (medical service provider) and Community Development Association (CDA, care services providers) is proposed. Furthermore, the acceptance of the elderly is discussed after a year of field tests.

## II. MATERIALS AND METHODS

### A. Healthcare Service System

Many researches have shown the application of IT in a remote care system after years of development, particularly

the application of mobile [12-14] and wireless sensor network technologies for transmission of vital signs [15-17]. Based on previous studies conducted by many scholars, applying Information Communication Technology (ICT) for the early detection of chronic diseases among the elderly and the disabled can help doctors understand and monitor the progress of the diseases, thereby improving the situation. Nevertheless, it shall avoid triggering the repulsion of the elderly towards the wearable sensors. Moreover, these contraptions must be affordable as well as effective [9-10] and must take into account the users’ need for an independent quality life that social interaction is not hindered. In addition, these must also maximize medical resources and realize the goal of total health promotion among the elderly.

For this study, we established a complete healthcare service system in one community as an experiment. For its main design direction, this study mainly considered the needs of the community users and the general measurable vital signs (as recommended by doctors), including blood pressure, oxygen saturation of blood, body temperature, and heart rate [18-20]. The blood sugar level is measured by a professional nurse through blood sampling and is carried out in hospitals or clinics; hence, it is not included in the services provided. The measuring devices that are used to check the vital signs used by the system are all available in the market, as shown in Table I. The sensors required wireless sensor network to provide a stable and efficient transmission of wireless signals, which has been developed by previous research [21]. Fig. 1 describes the measuring devices and wireless sensor network used. Moreover, a Health Service Management Platform has been created through LAMP (Linux +Apache+MySQL+PHP) as the server, in which information on vital signs of the elderly members of the community are stored.

TABLE I MEASURING DEVICES USED IN THIS STUDY AND THEIR FUNCTIONS

Name of Measuring Device	Maker/Model	Function
Sphygmomanometer	OSTAR Meditech Corp. Blood Pressure Monitor According to the Medical Class [19]	To Measure Blood Pressure
Pulse Oximeter	NONIN Medical, Inc., Ipod 3212 [20]	To Measure Oxygen Saturation of Blood and Heart Rate
Thermometer	Tidoc Technology, TICD-TD1261A [21]	To Measure the Forehead Temperature



Fig. 1 Devices and sensors for measuring vital signs: (1) Sphygmomanometer, (2) Pulse oximeter, (3) Thermometer, (4) ZigBee-based devices

Figure 2 shows a snapshot of the software used for measuring and capturing vital signs. The software was developed by Visual Basic. The measured values of vital signs are captured through an RS-232 communication port and displayed on the computer screen. After taking the measurements, the operator has the option to store the data on the computer or transmit it to the database in the remote healthcare service management platform [21]. All vital signs measured are documented at the same time to ensure the accuracy of data.



Fig. 2 Interface for vital sign measurement and capture software

We have provided an all-in-one touchpad computer with a 22-inch screen at the centre of each activity area, where the elderly could look for information regarding their vital signs by browsing through the application (Fig. 3). The computer adopts a web-based interface design using Flex [22], which could be operated via any browser. The interface could display all the measured vital signs and the user can view the changes in his/her vital signs over different periods by dragging and dropping slider bar at the right bottom corner. The entire system interface has been reengineered to make it user-friendly for the elders. By only three steps, one could log on and view a historical record of vital signs. Each user has his/her own account with a password for privacy; the user could only check his/her historical records. When they are home, the elderly could also check this history by logging on the remote Healthcare Service Management Platform through the Internet.

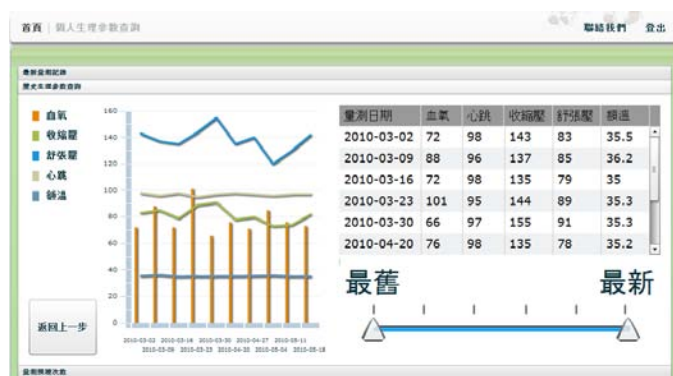


Fig. 3 Inquiry interface for individual historical records of vital signs

## B. Integrated Service Model

The integrated service model proposed here focuses on the community, led by the CDA. Fig. 4 illustrates the integrated service model and the service flow. Three main groups are included in the integrated service model: the family, CDA, and the district hospital, while the participants include cadres and volunteers from the CDA, along with doctors, nurses, and

caregivers from the hospital. Target group of services is at-home elderly in the community. There are three social interactions in these groups, that is, community elderly to community elderly, CDA volunteers to community elderly and hospital medical staff to community elderly. In this integrated service model, the CDA plays a leading role and CDA volunteers visit every family and encourage the middle-aged and older people to walk out of their houses attending community activities and to interact with other elderly. CDA volunteers lead the community elderly to engage in various activities, building mutual trust, and understanding the living condition of the elderly. The CDA acts as healthcare service provider. The medical personnel of the district hospital attend community activities to train CDA volunteers to measure vital signs, and provide community elderly with healthcare consultation. Therefore, it can build a healthy doctor/patient relationship, as well as strengthen the social interaction among the community elderly. The hospital acts as both medical service provider and healthcare service provider.

The CDA involved in this study was the Neighbourhood Care Association; the communities included Dongguangli and Sanguangli located at Beitun District, Taichung City, Taiwan; and the hospital involved was Li-An Hospital [23], a facility adjacent to the Dongguangli Activity Center, where the activities were held. The entire activity lasted from 21 January 2010 to 19 January 2011.

## C. Service Delivery

The CDA holds regular activities in the Community Activity Centre each week. All community residents are informed of the agenda of activities, and they attend the activity voluntarily. Activities include health education, shadow boxing, ballroom dancing, handicraft courses, and card-making. Prior to each activity, the CDA coordinates with the volunteers (some are local elderly) in preparing the venue, while two to three volunteers assist in measuring the vital signs of the participants at the centre. Vital signs are measured before the start of each activity.

Anytime an elderly feels uncomfortable, he could see the doctor in the adjacent Li-An Hospital. The doctor checks the hospital visitation records of the patient through the Hospital Information System (HIS) and logs on the database of the Healthcare Service Management Platform to check the vital signs of the patient. These historical records provide a good diagnosis reference for the doctor and opens up opportunities, through which the doctor can discuss the illness with the patient. The above information is provided voluntarily by the patient and this platform provides only an interface for data storage and inquiry; it can be checked by the patient or doctor at any time. The hospital provides health education needed by the community during community activities or paid home visits. A good doctor-patient relationship, which is built over time, can realize the function of real-time feedback and care of community residents (Fig. 4)

The integrated service model is different from the traditional practice, wherein the CDA holds regular activities in the community activity center, and invites the elderly to walk out of their houses and interact with other people in the community. The CDA serves as the healthcare service provider. Volunteers measure the vital signs of the elderly at regular intervals through the Community Healthcare System, and store the data at the Remote Healthcare Service Management Platform. When measuring vital signs,



through the help of their friends. Moreover, they encourage each other to attend community activities that do not only foster good health but good relationships as well.

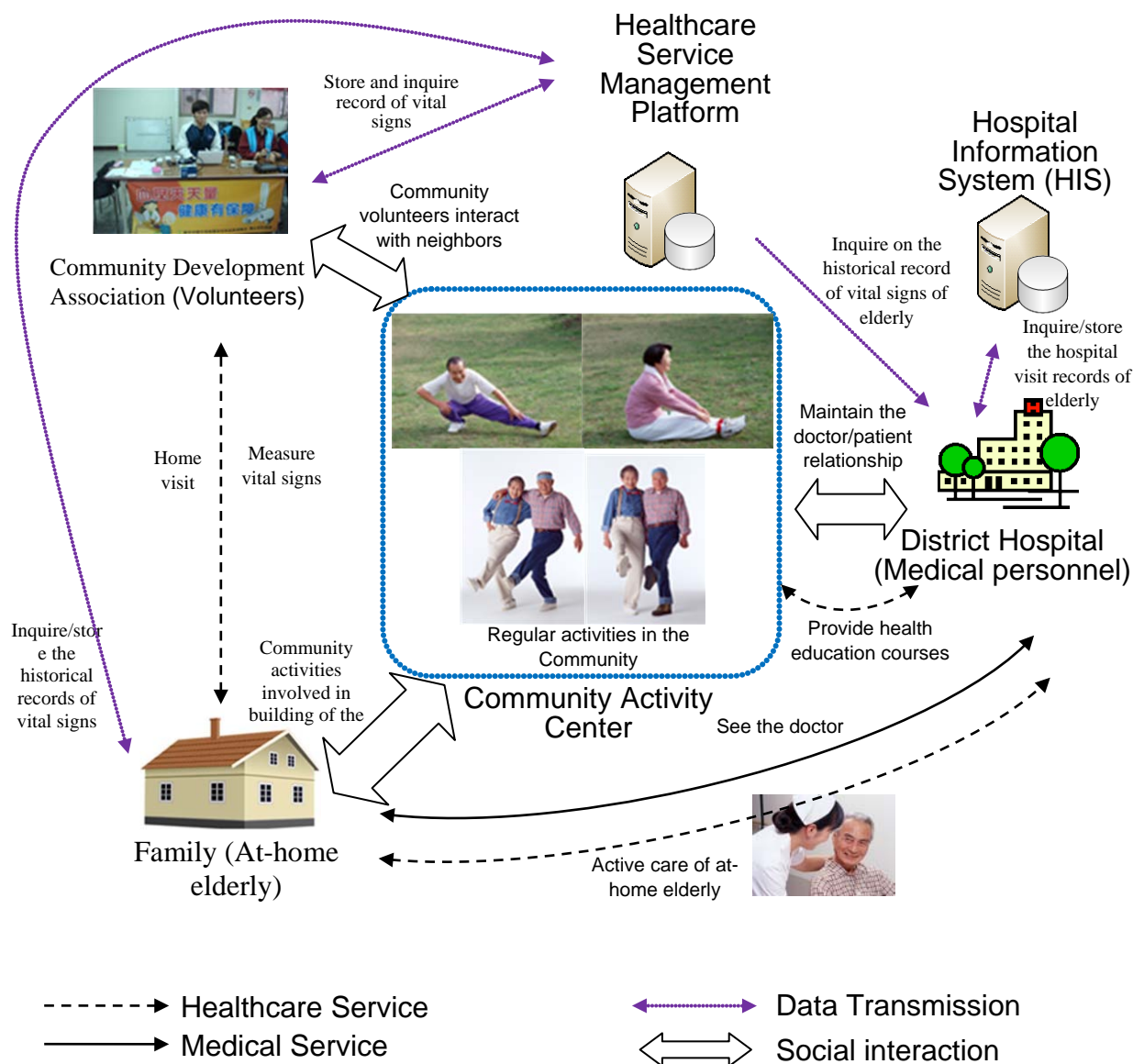


Fig. 4 Integrated service model flowchart

#### D. Technology Acceptance Model (TAM)

This study assessed the user acceptance of the integrated service model proposed in this study by the community elderly using the Technology Acceptance Model (TAM). We then examined the correlation between the variables in each dimension and other dimensions and then validated our own proposed integrated healthcare model.

TAM was developed by Davis [24] based on the Theory of Reasoned Action (TRA) by Fishbein and Ajzen [25] and the application scenario of the information system. It was developed for the study of technology used by examining the relationship between users and technology from the cognitive and emotional points of view of the former so as to explain the deciding factors for the consumers' acceptance of technologies. The theoretical structure is shown in Fig. 5 [26-27].

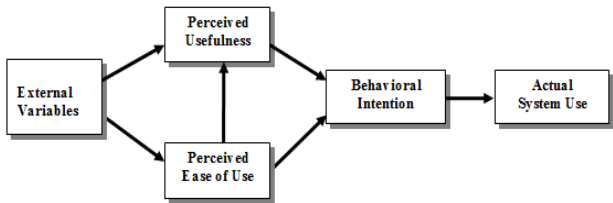


Fig. 5 Final version of TAM proposed by Fred Davis [25]

### E. Hypothesis and Questionnaire Structure

The integrated service model proposed in this study involves the operation of an information system's application scenario, which should be validated using TAM. Several important hypotheses about the integrated service model must also be validated. The hypotheses of this study are introduced here.

The elderly in Taiwan pay frequent visits to hospitals. We think that the elderly are very concerned about their health, especially those with poor health condition, and that they are more willing to use the system. The elderly often go directly to the hospital due to lack of caregivers in their households. However, if they directly use the healthcare system at home, it will not only aggravate the economic and operative burdens of the elderly, but also make the elderly more likely to stay at home and unable to interact with other peoples. In turn, this could lead to more serious health problems. Hence, if someone can help the elderly use the healthcare system to measure their vital signs, the system will be more beneficial to them. The Internet-based system enables the elderly to browse their records any time, thereby helping them understand their health conditions and reducing of the frequency of their hospital visits. Hence, “perceived ease of use” and its influence on “perceived usefulness” as well as “intention of system use” are major factors that shall be examined later.

Second, this system must convince the elderly that it can help improve their health conditions, so that they will develop the habit of using it and even encouragingly, recommend it to others [9-10]. Hence, perceived usefulness and the intention to use the healthcare system are major factors that must also be examined.

Another point that we believe very important to the elderly in Taiwan is trust in the doctors. If the system is also used by the doctors as their reference for diagnosis, the elderly will have higher intention of system use. This will improve the doctor’s understanding of the physical condition of the elderly, leading to more accurate diagnoses and prescriptions of medicine. Leading the elderly to perceive the usefulness of the system by discussing and interacting with the doctors in relation with the “intention of healthcare system use” is a major factor that we will also examine.

With this system, the hospital can monitor the health condition of the community elderly, provide them regular health education, and actively offer health recommendations and consultancy to the elderly, which could reduce hospital visits. In a good doctor-patient relationship, the elderly will be encouraged to see the doctor in the district hospital (even at times of serious health conditions); a good relationship can also increase the return rate of patients. Another major factor that shall be studied is the process of strengthening the interaction between doctors and elderly patients through this system in order to develop the latter’s perceived satisfaction towards the system and improve their intention to use it.

The hospital mainly provides the training on measurement of vital signs for volunteers in the CDA to improve the image of the district hospital. Volunteers walk into each family, interact with the elderly and other people, and establish good relationships with the elderly, thereby serving as links between the elderly and the district hospital. The hospital provides active healthcare services to the elderly in the community through volunteers, allowing it to gain the trust of community members. Apart from the distance between the venue where regular activities are held by the CDA and the homes of the elderly, the service attitude of the volunteers, also encourage the elderly to attend community activities; hence, the “system accessibility” influence on the intention of system use is also a key factor that must be examined.

This study developed a multi-dimensional structured questionnaire with reference to the TAM and relevant

literature, and conducted a questionnaire survey. Appendix 1 presents the questionnaire, while Fig. 6 presents the research structure and hypothesis (H1-H8), including the dimensions listed below.

1. “External variables” include four user characteristics, namely, gender, age, health status, and system accessibility. For example, proximity from the community activity center, regular provision of healthcare service at the center, professional and cordial service of volunteers, and the receipt of remote healthcare management must not aggravate the economic burden.

2. “Perceived ease of use” has five items: “It is easy to learn,” “It helps me to record health data,” “It helps me to communicate with the doctor,” “It is easy to use,” and “It is easy to understand.”

3. “Perceived usefulness” has five items: “It makes my health management more efficient,” “It enables me to know rapidly the change of my health data,” “It is easier to communicate with the medical staff,” “It enables me to discuss my disease with the medical staff more efficiently,” and “It enables my doctor to understand the change of my illness.”

4. “Intention of system use” has three items: “I could use this system to record my health data,” “I will introduce this system to my relatives,” and “I will continue to use this system in future.”

5. “Perceived satisfaction” has four items: “It allows me to have self-health management,” “It allows me to understand the change of health data,” “It allows me to discuss the disease with the medical staff and communicate with my family about the change of health data.”

6. “Times of service received” has just a single item: asking the user to indicate the times of services (measuring vital signs) received in the community.

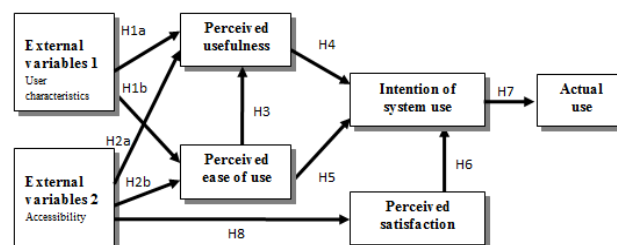


Fig. 6 TAM structure of the community elderly on the remote healthcare system

#### F. Questionnaire Reliability

We checked the credibility of each sub-item scale of the questionnaire with Cronbach’s  $\alpha$ , and the results are indicated in Table II. The value of Cronbach’s  $\alpha$  is ranged from 0.874–0.938, which is within the acceptable range, indicating that the scale has internal consistency reliability.

TABLE II RELIABILITY OF QUESTIONNAIRES ON THE ACCEPTANCE OF THE REMOTE HEALTHCARE SYSTEM BY THE COMMUNITY ELDERLY

Variables	Cronbach’s $\alpha$
Perceived Ease of Use	0.877
Perceived Usefulness	0.885
Intention of System Use	0.938
Perceived Satisfaction	0.874
System Accessibility	0.900

### G. Data Collection

This study took the elderly involved in community activities as the objects and conducted a questionnaire survey on those involved in community activities held by this study from January to December 2010 in the week from 15th to 22nd of December 2010. Of all the questionnaires distributed at Dongguangli Activity Center, 53 were collected.

### H. Data Analysis

An Excel spreadsheet was created using data from questionnaires, after which these were analyzed with SPSS17.0, including the description of general features of study objects, the acceptance of integrated service model by the community elderly, and the correlation analysis.

## III. RESULTS

### A. External Variables

#### 1) User Characteristics:

The basic characteristics of respondents are shown in Tables III and IV. Of the total number of participants, 30% were male and 70% were female; the average age was 70.6, and the standard deviation was 6.995 years (range: 57—84 years old). The result of test on gender and other dimensions

did not show a significant difference ( $p > 0.05$ ). This indicates that the conclusions are consistent for both male and female respondents. Concerning health, all study objects have one or more chronic diseases; 69.8% have high blood pressure, 39.6% have degenerative arthritis, and 20.8% have diabetes.

TABLE III FREQUENCY OF THE COMMUNITY ELDERLY'S RECEIPT OF COMMUNITY HEALTHCARE SERVICES BASED ON DIFFERENT CATEGORIES

Items	Frequency	Percentage (%)
<b>Gender</b>		
Male	16	30
Female	37	70
<b>Chronic disease</b> <sup>Note 1</sup>		
Hypertension	37	69.8
Diabetes	11	20.8
Osteoarthritis	21	39.6
Cataract	8	15.1
<sup>Note 1</sup> Calculated by the type of chronic diseases (multiple choices, calculated per capita) to estimate the general health condition of the community elderly		

TABLE IV DESCRIPTIVE STATISTICS OF AGE AND SYSTEM ACCESSIBILITY

Items	N	Minimum	Maximum	Mean	Std. Deviation
<b>Age</b>	53	57.000	84.000	70.623	6.995
<b>System accessibility</b>	53	3.500	5.000	4.491	.488
Short Distance away from the Community Activity Center	53	4.000	5.000	4.509	.505
Regular Provision of Health Service at the Community Activity Center	53	3.000	5.000	4.509	.541
Professional and Cordial Service of the Community Workers	53	3.000	5.000	4.566	.537
Receipt of Remote Healthcare Management Will Not Aggravate the Economic Burdens	53	2.00	5.00	4.3774	.62716

#### 2) System Accessibility:

As shown in Table IV, the community elderly have good comments on the accessibility of the community healthcare system (averaging 4.491), "short distance" (4.509), "regular provision of healthcare service" (4.509), and "professional and cordial attitude of volunteers" (4.566) which is the highest.

### B. Acceptance of the Community Healthcare System by the Study Objects

If we compare the score of each dimension with the score 4 (indicates "Agree" in the Questionnaire) (Table V), it denotes a significant difference where the average difference is greater than 0. This indicates that respondents have a high degree of acceptance and satisfaction towards the community healthcare system (Table VI). The details of these results are described below.

TABLE V SIGNIFICANCE TEST OF SCORES OF EACH DIMENSION WITH A SCORE OF 4 (ONE-SAMPLE TEST)

Variables	t	Degree of Freedom	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
(Perceived Ease Of Use)	8.093	52	.000	.491	.369	.612
(Perceived Usefulness)	8.476	52	.000	.506	.386	.625
(Attitude Towards Using System)	7.254	52	.000	.472	.341	.602
(Perceived Satisfaction)	7.515	52	.000	.458	.335	.580

TABLE VI ACCEPTANCE OF COMMUNITY HEALTHCARE SYSTEM BY THE COMMUNITY

Items	N	Min.	Max.	Mean	Std. Deviation
<b>Perceived Ease Of Use</b>	53	3.600	5.000	4.491	.441
It is easy to learn	53	3.000	5.000	4.566	.537
It helps me to record health data	53	4.000	5.000	4.642	.484
It helps me to communicate with the doctor	53	3.000	5.000	4.434	.572
It is easy to use	53	2.000	5.000	4.377	.627
It is easy to understand	53	3.000	5.000	4.434	.537
<b>Perceived Usefulness</b>	53	3.800	5.000	4.506	.434
It makes my health management more efficient	53	4.000	5.000	4.585	.498
It enables me to know rapidly the change of my health data	53	3.000	5.000	4.566	.537
It makes it easier to communicate with the medical staff	53	3.000	5.000	4.509	.541
It enables me to discuss my disease with the medical staff more efficiently	53	3.000	5.000	4.396	.531
It enables my doctor to understand the change of my illness	53	4.000	5.000	4.472	.504
<b>Intention of System Use</b>	53	4.000	5.000	4.472	.473
I could use this system to record my health data	53	4.000	5.000	4.491	.505
I will introduce this system to my relatives	53	4.000	5.000	4.472	.504
I will continue to use this system in future	53	4.000	5.000	4.453	.503
<b>Perceived Satisfaction</b>	53	3.750	5.000	4.458	.443
It allows me to have self-health management	53	4.000	5.000	4.434	.500
It allows me to understand the change of health data	53	4.000	5.000	4.509	.505
It allows me to discuss the disease with the medical staff	53	3.000	5.000	4.377	.563
It allows me to communicate with the family about the change of health data	53	4.000	5.000	4.509	.505
<b>Times of Services Received</b>	53	5.000	15.000	8.076	2.111
Valid N (listwise)	53				

The average score of perceived ease of use by the community elderly on the community healthcare system is 4.491. The highest average score is registered by “It enables me to record the health data” (4.6415), followed by “It is easy to learn” (4.566). This indicates that the community elderly accepts the ease of use of the Community Healthcare Service System.

The average score of perceived usefulness by the community elderly on the community healthcare system is 4.506. The highest average score of 4.585 is registered by “It makes my health management more efficient,” followed by “It enables me to track quickly the changes in my health data” (4.566) and “It enables me to communicate with the medical staff more easily” (4.509). This indicates that the community elderly recognizes the advantages of the healthcare system in managing their health data, making it easier for them to communicate with the doctor.

The total average score of the intention of using the community healthcare system by the elderly is 4.472. The average score of “I could use this system to record my health data” is 4.49064 and that for “I will recommend this system to my relatives” is 4.472, which is the highest.

The community elderly showed a high degree of perceived satisfaction towards the community healthcare system, with a total average score of 4.458. Particularly, the average score of “It makes me understand the changes in my health data” is

4.509, while that for “It allows me to communicate with my family about the change of health data” is 4.509, indicating that this system could meet the need for self-health management and help the elderly to communicate with their families about their illness.

#### C. Times of Service Received

The average times of actual use of the community healthcare system is 8.076, and the standard deviation is 2.111 times (range: 5-15 times). “More than five times” is the most (as indicated on the last row of Table VI). Based on the service frequency (twice a week), our elderly participants must have attended such activities continuously for at least one month, indicating that most of them have actually continued to use the system many times.

#### D. Factors Related with the Service Objects’ Use of the Community Healthcare System

We found out from the basic data in questionnaires that more than 80% of the community elderly use more than five times of the Remote Healthcare System. We wanted to know the reason why these people continue to use this system. Hence, we examined the correlation between “chronic disease”, “age”, “times of service received” and “perceived ease of use”, “perceived usefulness”, “intention of system use” and “perceived satisfaction” to examine factors that influence the use of the community healthcare system by the elderly, as resulted in Table VII.

TABLE VII CORRELATION ANALYSES

Items	1	2	3	4	5	6	7	8
Age	1							
Number Of Chronic Diseases	.628**	1						
System Accessibility	.226	.224	1					
Perceived Ease Of Use	.249	.356**	.880**	1				
Perceived Usefulness	.083	.163	.899**	.788**	1			
Intention Of System Use	.291*	.276*	.936**	.853**	.882**	1		
Perceived Satisfaction	.116	.149	.893**	.777**	.953**	.899**	1	
Times Of Service Received	.205	.078	.725**	.591**	.599**	.624**	.579**	1
**. Correlation is significant at the 0.01 level (2-tailed).								
*. Correlation is significant at the 0.05 level (2-tailed).								

TABLE VIII CORRELATION MATRIX BETWEEN ITEMS OF SYSTEM ACCESSIBILITY AND EACH DIMENSION

Items	Perceived Ease Of Use	Perceived Usefulness	Intention Of System Use	Perceived Satisfaction	Times Of Service Received
Short Distance away From the Community Activity Center	.721**	.908**	.907**	.915**	.613**
Regular Provision of Healthcare Services at the Community Activity Center	.705**	.895**	.845**	.893**	.656**
Professional and Cordial Attitude of The Community Workers	.785**	.744**	.770**	.668**	.640**
Receipt of Remote Health Management will Not Aggravate the Economic Burden	.875**	.656**	.792**	.699**	.646**
**. Correlation is significant at the 0.01 level (2-tailed).					

The result indicates a significant positive correlation between “chronic diseases” and “age”, indicating that the elderly tends to have of chronic diseases. From the health perspective, “chronic disease” has a significant positive correlation with “intention of system use”, indicating that those with diseases more chronic pay more attention to their health. Hence, higher intention to use the community healthcare system indicates that this system enables users to understand and monitor their health effectively and that older people have higher intention to use the system, thus those with diseases that are more chronic care more about their health. However, age has no significant correlation with other dimensions, indicating a consistent result about system use.

*1) The Correlation between “System Accessibility” and Use of Community Healthcare System by the Community Elderly:*

“System accessibility” has significant positive correlation with “times of service received,” “perceived ease of use,” “perceived usefulness,” “intention of system use,” and “perceived satisfaction,” indicating the relative importance of “system accessibility” for dimensions of TAM. When we conduct further Pearson correlation analyses on items under system accessibility and perceived ease of use, perceived usefulness, intention of system use and perceived satisfaction, the result indicates a significant positive correlation, as shown in the above Table VIII.

The correlation coefficient between the item “short distance away from the Community Activity Center” and each dimension is the highest ( $p < 0.01$ ), followed by “regular provision of healthcare service at the community activity center” ( $p < 0.01$ ), “professional and cordial attitude of community workers” ( $p < 0.01$ ), and “receipt of remote health

management doesn’t aggravate economic burdens” ( $p < 0.01$ ). All of these indicate that the short distance and regular provision of health service are the most important factors influencing the respondents’ perception and intention of system use. This means that such care services must be carried out in the community. If the center happens to be far from the community, the elderly will lose the intention to take advantage of the services. Moreover, the regular healthcare service gives new emphasis to the life of the elderly; for instance, attending the regular community activities has become a part of their life, which is an important factor in improving the perceived usefulness and satisfaction of the system. The professional and cordial service of community workers is another reason to improve the satisfaction of the elderly with the system use. Moreover, the system meets the criterion of not causing economic burden. The result conforms to the conclusion of the exploratory study by Steele et al. who stated that participants do care about the system’s cost. If the system is not helpful, the user will not want to pay the expense for the use of the system. In their work, the participants stated that they would use the system only if it would not cause their daily expense to exceed USD1.

*2) The Correlation between Perceived Usefulness and the Use of the Community Healthcare System by the Elderly:*

“Perceived usefulness” has a significant positive correlation with “times of services received,” “perceived ease of use,” “intention of system use,” and “perceived satisfaction” that has a relatively important influence on dimensions. We conducted further Pearson correlation analyses between items of perceived usefulness with times of services received, perceived ease of use, intention of system use and perceived satisfaction results, and the results are shown in Table IX.



TABLE IX CORRELATION MATRIX BETWEEN ITEMS OF PERCEIVED USEFULNESS AND EACH DIMENSION

Items	Perceived Ease of Use	Perceived Usefulness	Intention of System Use	Perceived Satisfaction	Times of Service Received
It makes my health management more efficient.	.595**	.794**	.630**	.747**	.360**
It allows me to monitor the changes in my health data.	.639**	.810**	.669**	.708**	.572**
It allows me to communicate with the medical staff more easily	.705**	.895**	.845**	.893**	.656**
It allows me to discuss my illness with the medical staff more efficiently	.746**	.798**	.721**	.726**	.419**
My doctor could monitor the changes in my illness	.582**	.857**	.796**	.888**	.472**
**. Correlation is significant at the 0.01 level (2-tailed).					

Items under perceived usefulness have a significant positive correlation with each dimension. The correlation coefficient between the item “It allows me to communicate with the medical staff more easily,” which is the highest ( $p < 0.01$ ), followed by “It allows me to discuss my illness with the medical staff more efficiently” ( $p < 0.01$ ), and “It enables my doctor to understand the change of my illness” ( $p < 0.01$ ), and then finally, “It makes my health management more efficient” ( $p < 0.01$ ) and “My doctor could monitor the changes in my illness” ( $p < 0.01$ ). These indicate that the participants regard the community healthcare system as helpful when discussing their health conditions with the doctor since the elderly tend to have difficulties in describing their health condition. In this sense, the system is helpful when they communicate their disease to their doctors. Hence, the system addresses another important factor influencing the participants’ perceptions and the intention of system use. Using this system to monitor the user’s own health status has a significant positive correlation with perceived satisfaction, indicating that this system helps the elderly to keep track of their health. The study result conforms to the conclusion of the exploratory study by Steele et al. who stated that participants are willing to use the system only when they deem it useful. With higher perceived usefulness, more services are also received. This study is different from what we think that Taiwan’s elderly hopes to discuss their disease or communicate with the doctor more easily through this system, which is also the difference between the elderly in Taiwan and other countries. Past studies on the remote healthcare policies in Taiwan have not been able to propose an effective business model because they have neglected this key factor. If we regard the healthcare system as the media (not the provider) through which the hospital can provide face-to-face healthcare service through other people (volunteers and medical staff), the remote healthcare service could work and expand across Taiwan. This study obtains the correlation between dimensions of TAM (Fig. 7). The result indicates that among external variables, age and chronic disease have a significant positive correlation with perceived usefulness and perceived ease of use (H1a, H1b,  $p < 0.05$ ); system accessibility has a significant positive correlation with perceived usefulness and perceived ease of use (H2a, H2b,  $p < 0.01$ ); perceived ease of use has a significant positive correlation with perceived usefulness (H3,  $p < 0.01$ ); perceived ease of use, perceived usefulness, and intention of system use all have a significant positive correlation (H4, H5,  $p < 0.01$ ); and intention of system use has a significant

positive correlation with times of service received (H7,  $p < 0.01$ ). It was found that system accessibility has a significant positive correlation with intention of system use (H6,  $p < 0.01$ ), which indicates that the system accessibility will influence the perceived satisfaction of users, and then influence the intention of system use, with the user continuing to use the system only when it meets indeed the need of the users [9].

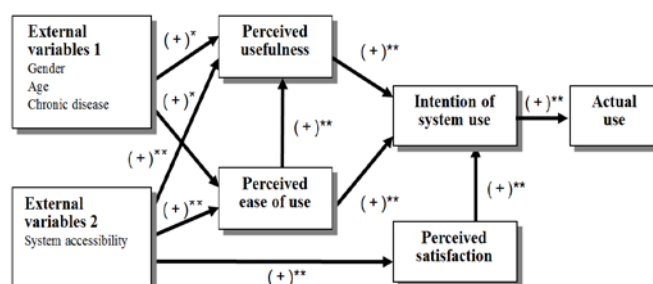


Fig. 7 Correlation in TAM of community residents on community healthcare system

#### E. Predictive Factor on the Intention of Using the Community Healthcare System by the Community Elderly

To examine the predicative factors on the intention of using the community healthcare system by the community elderly, we take “the intention of system use” as predicted variables ( $Y$ ), including gender ( $X_1$ ), age ( $X_2$ ), accumulative number of chronic disease ( $X_3$ ), perceived ease of use ( $X_4$ ), perceived usefulness ( $X_5$ ), perceived satisfaction ( $X_6$ ), and system accessibility ( $X_7$ ). Since gender is a category variable, we convert the gender into dummy variables (Male = 1, Female = 0) and adopt the stepwise regression (setup criteria: chosen when the probability  $\leq 0.05$ , deleted when the probability  $\geq 0.10$ ) to examine the predictive factors that influence “the intention of system use.”

According to the result of stepwise regression analysis, the best predicative factors for intention of system use are “system accessibility,” “perceived satisfaction,” and “gender,” while other variables such as age, accumulative number of chronic diseases, ease of use and usefulness are excluded. The standard regression formula is obtained, and the explanatory power is 90.6%

We can see from the regression coefficient that “system accessibility” has the greatest influence on the intention of system use, which is followed by “perceived satisfaction” and

that they both have a positive influence. Concerning the dummy variables of the gender, we set Male to 1 and its regression coefficient is positive, indicating that the male's intention of system use is slightly higher than the female. Although gender is one of the influential factors, its regression coefficient is low, and its influence is minimal. The regression results are shown in Tables X and XI. The regression model equation describing the relationship between the intention of system use and the three factors is as follows:

$$Y = 0.605X_7 + 0.365X_6 + 0.126X_1, \quad (1)$$

where

$Y$  = intention of system use;

$X_7$  = system accessibility;

$X_6$  = perceived satisfaction;

$X_1$  = gender.

TABLE X EXTRACT OF STEPWISE REGRESSION ANALYSIS ON THE INTENTION OF USING THE COMMUNITY HEALTHCARE SYSTEM

	Sum of Squares	df	Mean Square	F	Sig.
Regression	10.615	3	3.538	167.276	.000
Residual	1.037	49	.021		
Total	11.652	52			
Predictors: (Constant), system accessibility, perceived satisfaction, gender					
Dependent Variable: intention of system use					
$R^2 = 0.911$					
$R^2_{Adj} = 0.906$					

TABLE XI STANDARDIZED COEFFICIENTS OF STEPWISE REGRESSION ANALYSIS ON THE INTENTION OF USING THE COMMUNITY HEALTHCARE SYSTEM

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	.056	.205		.271	.787	-.357	.468
System Accessibility	.587	.094	.605	6.280	.000	.399	.775
Perceived Satisfaction	.390	.103	.365	3.790	.000	.183	.597
Gender	.129	.044	.126	2.909	.005	.040	.218
Dependent Variable: Intention of System Use							

#### IV. DISCUSSION

The proposed integrated service model is somewhat transformed from the traditional Chinese concept of a big family, in which members care for each other in an environment built through the interactions between small families (the existing family unit) within a big family (the community), thereby making up for the lack of care the elderly receive from their own small families. This study introduces the district hospital into the integrated service model, which functions as the provider of back end medical service. The elderly in Taiwan have high regard for the doctors that they rigorously follow their advice. We think that the community healthcare service must also be able to provide professional medical service; otherwise, it is very difficult to persuade the elderly that this system can effectively help improve their health. According to the statistic results, the district hospital is the best provider of professional medical service for three reasons: (1) the short distance from the community enables the hospital to provide in-place health and medical services; (2) since the medical staff are mostly local residents, they are already familiar with the environment and its residents, making it easier to build an interactive community network; and (3) it has a higher degree of medical professionalism than clinics and has more human and medical resources. Hence, the district hospital can provide health-related courses to the community elderly, thereby improving their health awareness and helping them learn to keep a healthy lifestyle. It also provides educational training to volunteers in the CDA, such as how to measure the vital signs and other basic medical knowledge that they may need to provide better healthcare

service. It also consolidates the collaborative relation between district hospital and community members.

Regarding the health insurance systems, Taiwan started to promote the "Healthcare Total Sum Payment System" in 2001 [28], which caused some hospitals to refuse patients due to their already large number of patients. The reason is that the Taiwanese generally believe that bigger hospitals have better services, and that large teaching hospitals are often crowded. In order to correct such unfair medical treatment and waste of medical resources, we should learn the "managed care spirit" of Health Maintenance Organization (HMO) by teaming up the District Hospital with the CDA, building a Community Health Management Structure, which assigns one district hospital to provide service to one or several communities [29]. In effect, this encourages the residents to choose their district hospital over teaching hospitals, thereby achieving ideal objective of national health insurance. The healthcare model proposed in this study, which integrates the CDA and the district hospital, serves as a good example to implementing a well-managed HMO.

According to the definition of WHO, [30-31] health is a dynamic state or condition of human organism that is multidimensional (i.e., physical, emotional, social, intellectual, spiritual, and occupational) in nature, a resource for living, and results from a person's interactions with and adaption to his or her environment. Therefore, it reveals an important "human-centric" concept emphasized by this healthcare model [32]. The healthcare system only serves as the media, and the key is to provide face-to-face service and people's interaction. The system only serves as a tool for storage of vital signs and

communication between the elderly and medical staff. Without the participation of volunteers and medical staff, the intention of using the healthcare system will drop significantly. This integrated healthcare service model also emphasizes the “social networking in the community,” and the result indicates that the service accessibility, i.e., short distance between a participant’s home and the venue of activities, as well as the regular provision of service, will encourage the elderly to attend community activities and improve their intention of system use.

## V. CONCLUSIONS

The integrated healthcare model proposed in this study is developed through a long-term experience in community healthcare. The results indicate that (1) system accessibility, (2) perceived usefulness, and (3) perceived ease of use of the integrated healthcare model are critical factors influencing the users of the community healthcare system. The integrated healthcare service model involves interaction between participants, i.e., between the community elderly and volunteers. In such a relationship, the higher satisfaction the community elderly and medical staff have the higher intention of system use they will manifest. The district hospital voluntarily provides healthcare activities and assists the CDA to interact with the elderly cordially. In addition to the short distance, the community elderly are accustomed to going to the district hospitals, which will help improve the business of district hospitals and facilitate its promotion in Taiwan.

Taiwan must learn more about the remote healthcare experiences of Europe, USA, and Australia, and apply these to Taiwan’s social environments while considering the habits of its elderly citizens in developing the healthcare model suitable to Taiwan. The integrated service model proposed in this study, together with the CDA and district hospital can provide a healthy life for the elderly in Taiwan. We are confident that this integrated service model can help to achieve the ultimate targets of “aging in place” and “successful aging”.

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