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Fifteen-year Experience with Telemedicine Services in Gangwon Province in Korea

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Objectives: This study attempted to identify the factors that contribute to successful telemedicine service. This was done by analyzing the operational state of successful telemedicine services offered in Gangwon Province of Korea and their outcome for the last fifteen years. **Methods:** A comparative analysis was made based on reports and a thesis on the satisfaction rate of patients and providers, patient compliance to treatment, and economic assessment of Gangwon telemedicine service, which were carried out in three periods: the years 2006, 2010, and 2012. **Results:** The satisfaction surveys in all three periods showed similar results for patients (4.46±0.70 point) and healthcare practitioners, including nurses (3.82±0.62 point) and physicians (3.60±0.56 point), in decreasing order from the year 2012. Through the survey of patients' compliance with treatment, it was confirmed that telemedicine services increased patients' compliance with drug administration, facilitated improvement of lifestyle habits, improved glycated hemoglobin for patients with diabetes mellitus, and enhanced the rate of blood pressure control. In the survey conducted on patients' willingness to pay for telemedicine services in 2007, it was found that those patients were willing to pay about $3.5 for services. **Conclusions:** The telemedicine services of Gangwon Province increased patients' compliance with drug administration, improved blood glucose control, enhanced blood pressure control for patients with hypertension, and provided economic advantage.

Keywords: Telemedicine, Rural Health Services, Patient Satisfaction, Patient Compliance, Cost Benefit Analysis

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I. Introduction

Gangwon Province of Korea represents an aging society spread out over a large area (16,873.5 km^2) with a relatively low population density (88.2 people/km^2). A large part (72.4%) of the provincial population resides in urban districts. In particular, Chuncheon, Wonju, and Gangneung (metropolitan cities) encompass 56% of the population of Gangwon Province [1]. The Greater Taebaek area (Taebaek city and Jeongseon county) has no general hospital, while 11 out of 18 municipalities have been categorized as regions that have inadequate medical services [1]. Five cities and counties are without a single obstetrics & gynecology clinic [1]. In

an effort to overcome the inadequate medical infrastructure and secure medical services for their residents, Gangwon Province has adopted and operated telemedicine services since the year 2000. The telemedicine services of Gangwon Province provide remote consultation between medical personnel. It is an approach to facilitate the conveyance of medical guidelines: 1) between a physician and a healthcare practitioner (HCP) as a nurse for patients with hypertension or diabetes mellitus and 2) between a neuropsychiatrist and a physician for patients with dementia [2].

II. Methods

1. History of Telemedicine Services

In 1995, when personal computer networking was popularly introduced through telephone lines in Korea, an X-ray reading service, utilizing network communication between the Hwacheon Medical Center (rural area) and Hallym University Chuncheon Sacred Heart Hospital was first introduced. However, it was unsuccessful due to the issue of slow transmission speed. Telemedicine services were attempted by way of transmitting direct consultations about all types of disorders between patients who visited public health subcenters and physicians through HCP mediation as Internet services took off in the year 2000. Nevertheless, there was much difficulty due to problems of the network environment, such as inconvenience of the web-cam method, unstable networks, and so on.

With the advent of high-speed Internet service in most of the rural area of Gangwon Province in 2004, 24 public healthcare centers (12 public health subcenters and 12 public health clinics) began providing regular healthcare services, but these services were limited to cases of hypertension and diabetes mellitus. The services were achieved through the transmission of medical instructions between physicians and HCPs. Thereafter, as the network environment changed, the ubiquitous health system was introduced in 2008. Several public health centers initiated a pilot program for home monitoring services by having public health clinics verify the result of 'muscle strengthening services for the frail elderly' by utilizing digital exercising equipment and check typical blood pressure and blood glucose levels.

Based on the positive results of the pilot program for physical activity improvement and home monitoring, the elderly-friendly digital exercising equipment, which allow aerobic and anaerobic exercises, and point-of-care testing equipment, which measure glycated hemoglobin (HbA1c) and cholesterol levels, was installed in public health centers, public health subcenters, and public health clinics in 2014. The e-learning system with utilization of a software codec was introduced to educate service providers and patients about lifestyle change. Furthermore, in an effort to have full-fledged home care, digital sphygmomanometers, blood glucometers, physical activity trackers, and digital meal diaries, all of which can be linked with smartphones, have been introduced. The scope of disorders was expanded to include hypertension, diabetes mellitus, dementia, age-related feebleness, and metabolic diseases, while the services were also extended to include pharmacologic management, as well as lifestyle counseling services, such as improvement of physical activity, and nutritional management [2] (Table 1).

2. Scope of Current Telemedicine Services

In Gangwon Province, there are 247 public health service centers (2 public health medical centers, 16 public health centers, 100 public health subcenters, and 129 public health clinics). Of these 247 public health service centers, 153 public healthcare centers (2 public health medical centers, 14 public health centers, 41 public health subcenters, and 90 public health clinics), 5 collaborating hospitals and 1 integrated remote control center, equipped with the telemedicine service system, are in operation.

This system comprises two applicable programs: an online video conference program and a telemedicine service program. The telemedicine service software consists of an information-sharing electronic medical record program and an order communication program. The digital equipment used to extract biophysical information includes electrocardiograms, digital stethoscopes, dermatoscopes, body composition analyzers, pulse oximeters, glucometers, sphygmomanometers, and point-of-care testing equipment, which are connected by cables. The digital equipment for aerobic and anaerobic exercise and physical strength measurement equipment were installed in 3 public health centers (public health medical centers) and a branch clinic. The digital equipment for aerobic exercise was installed in 1 public health subcenter and 14 public health clinics. Moreover, smartphone-linked digital sphygmomanometers, blood glucometers, physical activity trackers and digital meal diaries were made available in public health subcenters and public health clinics, and they are rented by patients who need them for home care [2].

3. Utilization of Telemedicine Services

When full-scale service was implemented at twelve public health clinics in 2004, the number of patients targeted for management was a mere 358. The number increased to 1,537 patients, for whom 8,852 prescriptions were written in 2006.

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Table 1. Operational processes and the outcome summaries of u-health service in Gangwon Province

Year	Method	Main contents
2000–2003	ADSL method Online video consultation with web-cam method	Target disorder: all types of diseases Could not be actuated due to inadequate transmission speed or legal glitches
2004–2008	e-Health system Online video consultation by hardware codec method Biometric signals (ECG, pulse oximetry, etc.) equipment application	Target disorder: hypertension, diabetes mellitus, dementia Expanded twice to 16 cities or counties, and 69 health service centers.
2008–2014	u-Health system POCT application	Target disorder: hypertension, diabetes mellitus, dementia, and age-related feebleness Commence non-pharmacological management such as home monitoring (blood pressure, blood glucose), lifestyle counseling service (strengthen body), etc.
2015–present	Introduction of smart health system Application of sphygmomanometer, glucometer, physical activity tracker, or digital meal diary, which can be linked with a smart phone. Application of digital exercising equipment, which allows aerobic and anaerobic exercises Online video consultation by software codec method	Target disorder: hypertension, diabetes mellitus, dementia, age-related feebleness, and metabolic disease. Home care expansion: introduction of life style counseling Introduction of e-Learning system for service providers and patients

ADSL: asymmetric digital subscriber line, ECG: electrocardiogram, POCT: point of care testing.

Thereafter, the number of participating health service centers steadily increased as well as the number of patients managed by each health service center. In 2015, 23,523 prescriptions have been written up for 1,365 patients, which account for 720,195 drug administration days. As quality control was initiated by excluding the list of patients under management, such as those patients receiving no drug management from 2009 through 2012 and patients who were not followed up for further management, the number of patients for each public health care center tended to decrease. The number of participating public health service centers has increased in 2014 and 2015, but the system was installed in late 2014. System building and patient registration were carried out simultaneously until the first two quarters of 2015; however, the number of patients has not increased as much as the number of health service centers. The total number of prescriptions issued from 2004 until the present is 214,882, and the number of drug administration days reached 6,195,105 [2] (Table 2). So far in 2015, 90 public health clinics have each managed about 76 patients, and each issuing 2,719 prescriptions per month on average. With respect to non-drug management, 14 public health clinics, 2 public health subcenters, 2 public health centers, and 2 public health medical centers have begun physical activity management and nutritional management service in 2015.

III. Results

1. Characteristics of Subjects (Patients) Targeted for Services

So far, the mean age of subjects targeted for telemedicine services has been 76.87 years in 2015. The proportion of the subjects aged 60 years or older has been 92.1%, showing an increasing trend, in comparison to 81.2% in 2006 and 81.5% in 2012. According to the 2012 survey, 42% of subjects lived alone, and 36% of subjects did not live with their children. The mean family income of these subjects earning less than $861 was 63% in 2012 [3]. With respect to health disorders, the number of patients under management for three or more diseases, such as dementia, hypertension, and diabetes mellitus, was 3,607 (32.8%), showing the largest number. Dementia was the disease with the largest number of patients, 3,458 (31.4%). This was followed by hypertension, for which there were 3,318 patients (30.2%); hypertension + diabetes mellitus, 416 patients (3.8%); and diabetes mellitus, 197 patients (1.8%). In 2015, regarding hypertension and dia-

Table 2. Current situation in terms of the number of patients, prescriptions, and drug administration days

Year	Number of remote centers[a]	Number of patients	Number of patients per center	Number of prescriptions	Drug administration days
2004	12	407	34	2,797	131,951
2005	12	522	44	4,074	237,512
2006	12	1,212	101	9,266	270,204
2007	24	1,507	63	13,033	377,969
2008	31	2,182	70	19,417	578,535
2009	40	2,395	60	22,242	671,321
2010	42	2,449	58	23,619	728,992
2011	42	2,266	54	23,085	720,195
2012	44	2,312	53	22,984	669,356
2013	44	3,323	76	38,634	731,600
2014	90	3,379	38	22,146	669,920
2015[b]	90	6,652	76	13,585	407,550
Total				214,882	6,195,105

[a]Number of remote centers: the number of public health clinics that perform telemedicine services. [b]Statistical data from January 2015 to May 2015.

betes mellitus, the mean number of patients for each public health clinic is currently 76. An average of 10 prescriptions and 308 drug administration days have been managed per patient each year. More patients in the counties or cities of Jeongseon, Cheorwon, Hoengseong, Samcheok, Goseong, Yangyang, Gangneung, in decreasing order, are managed, in comparison to the mean total number of patients (Table 3).

2. Characteristics of Service Providers

Telemedicine services are provided through bilateral communication between a HCP in the field and a physician in a distant location. In 2015, currently, there are a total of 57 physicians, of which all are males except one doctor. Except three doctors, they are all public health doctors with a mean age of 30.4 years old. Fifty-four physicians, except three, largely have 3-year experience or less, considering the fact that they carry out their duties in place of regular military service. These HCPs are in their 40's and 50's with 20-year experience or more. The investigation regarding service hours of face-to-face and telemedicine medical services provided by 12 physicians and 38 HCPs revealed that 71.4% of physicians replied that the service hours for both were about the same. On the contrary, 81.6% of HCPs responded that the service hours had increased due to increased time needed for biophysical information input and management (50.0%), increased preparation (18.4%), and increased duration of medical and telemedicine services (10.5%) in decreasing order.

3. Extent of Satisfaction [3-5]

The Korea Institute for Health and Social Affairs first conducted a satisfaction survey targeting patients with hypertension and diabetes mellitus who received telemedicine services from public health clinics in 24 regions in 2006. In 2010, the Korea Health Industry Development Institute investigated the extent of satisfaction targeting patients with hypertension and diabetes mellitus who received telemedicine services from public health clinics in six regions. In addition, Hallym University conducted a satisfaction study in 2012. The investigation focused on changes in satisfaction rates in comparison to those obtained in studies conducted in 2006 and 2010 (Table 4).

The 2006' inquiry on satisfaction rates and intention of utilization, conducted one year after the commencement of telemedicine services, showed high satisfaction rates for both patients and providers. In particular, the patients who received telemedicine services showed the highest satisfaction rates with 3.85 and 3.67 out of the full score of 5, respectively. The physicians who were telemedicine service providers showed relatively low satisfaction rates of 3.03 and 3.67, respectively. The satisfaction rates in the 2010 and 2012 surveys showed a similar tendency. The HCPs' scores for the necessity of telemedicine services were 4.07 and 3.88 in 2006 and 2012, respectively. However, the physicians showed a result of relatively lower scores of 3.33 and 3.22, respectively. The telemedicine services of Gangwon Province are provided by the transmission of patient care guidelines, provided by a

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Table 3. General characteristics of subjects (patients)

Characteristic	Value
Number of patients	10,996 (100)
Male	3,606 (32.8)
Female	7,390 (67.2)
Age (yr)	76.87±12.082
≤40	180 (1.6)
41–50	157 (1.4)
51–60	524 (4.8)
61–70	1,169 (10.6)
≥71	8,966 (81.5)
Target disease	
Hypertension	3,318 (30.2)
Diabetes mellitus	197 (1.8)
Hypertension + diabetes mellitus	416 (3.8)
Dementia	3,458 (31.4)
Complex diseases[a]	3,607 (32.8)
Region of residence	
Chuncheon city	43 (0.4)
Wonju city	157 (1.4)
Gangneung city	2,983 (27.1)
Taebaek city	44 (0.4)
Samcheok city	868 (7.9)
Hongcheon county	704 (6.4)
Hoengseong county	2,176 (19.8)
Yeongwol county	46 (0.4)
Pyeongchang county	317 (2.9)
Jeongseon county	446 (4.1)
Cheorwon county	360 (3.3)
Hwacheon county	394 (3.6)
Yanggu county	341 (3.1)
Inje county	729 (6.6)
Goseong county	270 (2.5)
Yangyang county	706 (6.4)
Sokcho city	412 (3.7)

Values are presented as number (%) or mean ± standard deviation.
[a]Complex disease: hypertension, diabetes mellitus, dementia, etc.

physician to an HCP, on the basis of shared information between these two parties. Accordingly, studies were conducted to inquire into satisfaction rates on quality of information and the application system. Investigations on the completeness, accuracy and timeliness of information were conducted in 2006 and 2012. HCPs showed a satisfaction rate of 3 points for both years, but physicians expressed a satisfaction rate of 3 points or more in accuracy but less than 3 points for both completeness and timeliness. A survey of satisfaction rates for the application system was conducted in 2010 and 2012. The results showed an overall satisfaction rate of 3.0 points or more for both HCPs and physicians. With respect to transmission of accurate information and network stability, the satisfaction rate of physicians was higher than that of HCPs. Both parties showed a similar satisfaction rate of 3.5 points regarding the program's convenience. However, the satisfaction rate of physicians was relatively rather low regarding quality of communication and convenience of equipment utilization.

4. Patient Compliance to Treatment

The most important goal of telemedicine services would be to increase the compliance of patients who have chronic diseases. In the 2006' study, changes in drug administration days, lifestyle, and behavior were measured on a five-point scale before and after the commencement of telemedicine services. It was confirmed that patients' compliance with treatment with respect to drug administration days, lifestyle, and level of adjustment (behavior), increased after the telemedicine services were introduced [3] (Table 5). In 2007, 111 telemedicine service patients and 71 face-to-face medical service patients, among those patients under drug management at the public health clinics for one year or longer, were examined for HbA1c measurement rates and funduscopic examination rates. The rates for the telemedicine service group were 64% and 35.1%, respectively, while the rates for the face-to-face medical service group in the corresponding regions were 1.6% and 3.2%, respectively. The rates for the former group were higher than the rates of the latter group. Also, the mean rates (30.4%, 6.1%) of HbA1c measurement and funduscopic examination of the telemedicine service group were higher than those of hospital patients nationwide [6]. A study on the drug compliance rates of face-to-face and telemedicine service patients conducted in 2012, revealed that patients who received telemedicine services with drug administration and lifestyle education once or twice a month for 3 years or improved more in compliance with drug administration than non-users of the telemedicine services did. Also, the levels of HbA1c at the time of registration for telemedicine and face-to-face services and the levels at the time of investigation were compared. Among 167 patients with diabetes mellitus who received telemedicine services, 106 patients regularly checked and managed their HbA1c levels.

Table 4. Satisfaction rate with telemedicine services

Item			2006	2010	2012
Satisfaction rate		Patient	4.31 ± 0.76	4.26 ± 0.58	4.46 ± 0.70
		HCP	3.85 ± 0.62	3.50 ± 0.76	3.82 ± 0.62
		Doctor	3.03 ± 0.74	3.25 ± 0.50	3.60 ± 0.56
Intention of utilization		Patient	4.38 ± 0.64	4.43 ± 0.66	4.56 ± 0.68
		HCP	3.67 ± 0.54	3.88 ± 0.99	3.73 ± 0.62
		Doctor	3.67 ± 0.54	3.25 ± 0.96	2.90 ± 0.77
Necessity		HCP	4.07 ± 0.48	-	3.88 ± 0.49
		Doctor	3.33 ± 0.91	-	3.22 ± 0.83
Quality of information	Completeness	HCP	3.15 ± 0.47	-	3.20 ± 0.55
		Doctor	2.51 ± 0.71	-	2.55 ± 0.64
	Accuracy	HCP	3.36 ± 0.47	-	3.53 ± 0.46
		Doctor	3.00 ± 0.89	-	3.34 ± 0.48
	Timeliness	HCP	3.22 ± 0.88	-	3.41 ± 0.57
		Doctor	2.74 ± 0.81	-	2.93 ± 0.67
Satisfaction rate of the application system	Quality of communication	HCP	-	3.38 ± 0.74	3.68 ± 0.66
		Doctor	-	3.20 ± 0.84	3.07 ± 1.07
	Convenience of equipment usage	HCP	-	3.75 ± 0.46	3.58 ± 0.76
		Doctor	-	3.20 ± 0.84	3.29 ± 1.14
	Convenience of the program	HCP	-	3.63 ± 0.52	3.71 ± 0.57
		Doctor	-	3.20 ± 0.45	3.71 ± 0.61
	Accurate information transmission	HCP	-	3.38 ± 0.74	3.87 ± 0.62
		Doctor	-	3.80 ± 0.45	4.07 ± 0.62
	Network stability	HCP	-	3.38 ± 0.74	3.66 ± 0.75
		Doctor	-	3.80 ± 0.84	3.71 ± 0.63

HCP: healthcare practitioner.

Table 5. Compliance scores before and after the telemedicine service

Sub-class of compliance		Score	SD	T-value	Significance level (degree of freedom)
Prescription[a]	Before the service	75.4	33.96	–12.861	0.000 (363)
	After the service	96.3	11.08		
Lifestyle[b]	Before the service	49.5	19.49	–20.066	0.000 (399)
	After the service	72.0	20.09		

[a]Drug prescription days score = total prescription days / required prescription days × 100. [b]Lifestyle score = (1/16) (compliance on smoking + compliance on alcohol drinking + dietary compliance + compliance on exercise) × 100.

The mean level of HbA1c at the time of registration was 7.1% but the level decreased to 6.87% at the time of investigation, showing a statistically significant decrease. Only 9 out of 59 diabetes mellitus patients who did not receive telemedicine services were regularly managing their HbA1c levels, and there was no significant difference [6]. In the comparative analysis of the levels of HbA1c changes between 148 telemedicine service users and 29 non-users in Hoengseong county in 2012, 44.6% of telemedicine service users and 24.1% non-users were managing their HbA1c levels below the level of 6.5%, showing a similar result [3] (Table 6).

A study investigated the drug administration compliance

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rates and blood pressure adjustment rates of 1,048 patients with hypertension who had been registered from 2004 through 2006. There were 941 patients (89.8%) in the treatment group among registered patients. Of these 941 subjects, 699 patients (74.3%) belonged to the drug compliance group—which required 80% or more drug administration days for patients to be included in this group. Of these 941 patients, 841 (89.4%) were managed with respect to blood pressure adjustment rate (at normal and pre-hypertensive levels) (Figure 1). The results showed that the treatment rate of hypertensive patients in Korea was 30% to 50% during the same period, while the adjustment rate was merely 20% to 30%. In comparison with these national data, it is clear that telemedicine services would improve a patient's drug compliance and facilitate adjustment of the patient's blood pressure [7]. Furthermore, the effects of telemedicine services were compared by comparative analysis of the state of blood pressure initially at the time of patient registration and that at the time of investigation. The proportion of patients whose blood pressure could be adjusted to a normal blood pressure level increased from 7.4% to 23.9% at the early registration stage. The ratio of patients who could achieve blood pressure levels of the pre-hypertensive stage also increased from 37.9% to 65.5%. The proportion of patients belonging to Stage 1 hypertension decreased from 29.9% to 8.8%; and that of patients belonging to Stage 2 hypertension decreased from 24.8% to 1.8%. Overall, the proportion of hypertension-adjusted patients increased from 45.3% to 89.4% at the initial registration, while the ratio of patients in Stage 1 to 2 hypertension decreased from 54.7% to 10.6% [7] (Table 7). A 2012' study involving 435 patients whose hypertension was managed through telemedicine services and 122 patients whose hypertension was managed through face-to-face clinical care reported that there was no significant difference between these two groups. The initial mean blood pressure of patients in the telemedicine service group was 148/88 at the time of patient registration. The mean blood pressure decreased to 121/74 three months after commencement of the investigation. The mean blood pressure of face-to-face clinical care patients changed from 158/93 at the registration time to 122/74 three months after initiation of the investigation. Statistically, no significant difference between telemedicine service group and face to face clinical care group was found. While this data might be statistically insignificant, the percentage of patients whose blood pressure was managed under 140/90 was 97.1% for the telemedicine service group.

Table 6. Comparative analysis of HbA1c levels based on the HbA1c level of 6.5% in patients with DM in the region of Hoengseong county in 2012

Classification	Telemedicine service group (n = 148)	Face-to-face service group (n = 29)	*p*-value
Final HbA1c less than 6.5%	66 (44.6)	7 (24.1)	0.041
Final HbA1c in excess of 6.5%	82 (55.4)	22 (75.9)	

Values are presented as number (%).
HbA1c: glycated hemoglobin, DM: diabetes mellitus.

Table 7. Control effect after telemedicine service in hypertension (n = 941)

Classification		Blood pressure	
		Initial stage	Average in the latest 3 months
Adjusted	Normal	70 (7.4)	225 (23.9)
	Prehypertension	357 (37.9)	616 (65.5)
Not adjusted	Hypertension (stage 1)	281 (29.9)	83 (8.8)
	Hypertension (stage 2)	233 (24.8)	17 (1.8)

Values are presented as number (%).

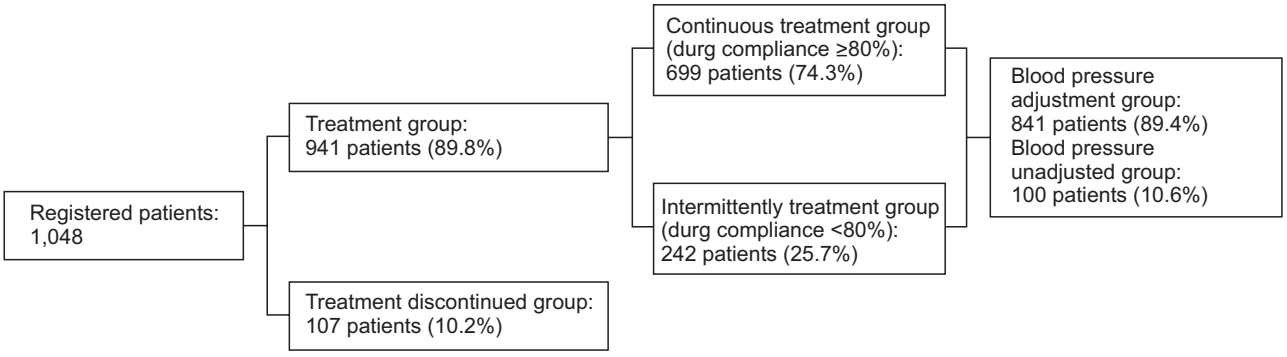

Figure 1. Drug administration compliance rate and blood pressure adjustment rate for hypertensive patients.

Table 8. Comparisons of blood pressure control for hypertensive patients with telemedicine service group and face-to-face service groups (unit: mmHg)

Blood pressure		Telemedicine service group (n = 435)	Face-to-face service group (n = 122)	*p*-value
At registration time	Systolic	148 ± 12.19	158.31 ± 13.28	-
	Diastolic	88.20 ± 12.68	92.65 ± 8.26	
For the last 3 months	Systolic	121.73 ± 8.05	120.85 ± 9.63	-
	Diastolic	74.22 ± 7.16	73.99 ± 8.54	
Adjustment for recent 3 months	Systolic <140 and diastolic <90	395 (97.1)	65 (92.9)	0.080
	Systolic ≥140 and diastolic ≥90	12 (2.9)	5 (7.1)	

Values are presented as mean ± standard deviation or number (%).

Table 9. Average expenses needed for telemedicine services in each public health clinic

Description	Expenses (USD)		Main contents
	2006	2015	
Additional wage	172.19	109.68	Wage paid to a physician (paid by local municipal government) Number of physicians per clinic: 1 (2006) & 1.57 (2015) have been applied.
Additional network expense	17.45	18.94	Network communication cost (paid by local municipal government)
Additional administrative expenses	5.74	-	Electric bill, vehicle operation cost, etc. (additional expenses incurred by telemedicine services)
Other additional expenses	11.51	-	Cost of drugs (additional cost incurred by telemedicine services)
Total amount	215.50	191.13	Public health clinic's charge: 20,036 Korean won Local municipal government's charge: 230,264 Korean won
Cost per patient	3.69	1.76	Average number of patients utilizing the service every month: 58.4 patients (2006); and 73.1 patients (2015) have been applied.

This is 4.8% higher than 92.9% of the face-to-face clinical care group [3] (Table 8).

5. Economic Assessment

An analysis of monthly expenses one year after the provision of telemedicine services revealed that the average monthly wage for a telemedicine physician was $172; the network usage fee, $26; the administrative expenses, $5.7; and other expenses, $11.5. It showed a total average expenditure of 250,300 Korean won. The estimated average monthly expenses for each public health clinic were $215.2. These expenses did not include the system development fee, maintenance and repair cost or the HCP wage [3]. The same study, recently conducted in 2015, showed the expense of $1.8 per patient. This is a reduction of expenses by half (Table 9). Telemedicine service duties have been established as duties of public health clinics. Hence, it has reduced the cost of additional drugs, and the numbers of public health clinics and their patients have increased.

In 2007, a presumptive survey was conducted to find out whether 451 patients who received telemedicine services through 20 public health clinics would have an intention to pay for telemedicine services. The survey found that these patients were willing to pay about $3.4 for the telemedicine services they received [8] (Table 10). When the results are applied to the entire user group of the telemedicine services in Gangwon Province, the benefits of time savings, transportation, and other expense reduction, in addition to the benefit arising from reduction of medical service costs, are estimated to be $835,127–$1,007,318.

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Table 10. Willingness to pay estimators (survival analysis)

Coefficient	Overall data		Truncated data	
	No covariance	With covariance	No covariance	With covariance
Alpha	1.6615	1.6459	1.6719	1.6508
Beta	0.000466	0.000452	0.000439	0.000432
$\bar{X}'\gamma$	-	0.190738	-	0.221446
Estimator ($)	3.07	3.50	3.28	3.73

In 2009, the Korea Health Industry Development Institute conducted an investigation on the benefits of time and clinic cost savings as well as transportation cost and other additional cost savings by the users of telemedicine services in Yongyang county, Gangneung, and Boryeong cities. The pilot project was carried out in preparation to build a ubiquitous sensor network (USN)-based remote health monitoring system for the regions in 2008. The full benefit of users in Gangneung city was estimated to be about $172 for 85 patients annually [9]. The reason for the rather low benefit is that Gangneung is an urban-agricultural complex region that includes patients (subjects) in the urban district, since the cost of transportation is lower than in other regions. The mean benefit for a patient in the entire Gangwon Province is estimated to be $387, which can be calculated with the number of patients (1,300) as above. The total estimate for all telemedicine patients in the Gangwon Province is about $542,402.

IV. Discussion

In an attempt to overcome deficiencies in medical service availability and to secure medical equity, Gangwon Province has introduced and successfully operated telemedicine services for the last fifteen years. First, in Gangwon Province, one factor that has enabled the successful operation of telemedicine services for fifteen years has been the adaptation of appropriate technologies that can be implemented, rather than preferentially applying appropriate technologies on the cutting edge. Second, the adoption of telemedicine systems has focused on patients with chronic diseases, such as hypertension, diabetes mellitus, or dementia, which require continuous management. Thus, a collaborative system between HCPs in the field and local physicians has been developed; and this is another important factor of successful operation. Furthermore, enthusiastic support from each municipal government was obtained by mediating the preferential order of public health policies of local municipal governments. The matter of harmonious tuning with regional public health planning in Gangwon Province is of paramount importance for the telemedicine services of Gangwon Province to progress and be maintained continuously in the days ahead. Furthermore, it is necessary to secure a basis for the assessment of scientific and medical-care-focused performance and to continuously develop and offer services that can appropriately assist residents.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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