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Original Article

Contemporary Practice in Telemedicine through Telecommunication Technology during COVID-19 Pandemic in Taiwan – A Single Center Experience

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SUMMARY

Background: To evaluate the feasibility, baseline characteristics, and satisfaction of patients receiving telemedicine care during the coronavirus 2019 (COVID-19) pandemic in Taiwan.
Methods: We retrospectively analyzed patients during the COVID-19 pandemic between May 2021 and December 2021 in a tertiary medical center in northern Taiwan. Information on the distribution of physician divisions, patients' clinical characteristics, and patterns of prescription use in telemedicine care was analyzed. Data were extracted from both the ordinary outpatient department (OPD) and nursing home systems.
Results: A total of 6587 patients (55.8% female, mean age: 57.3 ± 25.8 years) included in our telemedicine care conducted during the pandemic COVID-19 epidemic. Those who were older, female, and patients of Internal Medicine and Family Medicine utilized telemedicine more frequently than ordinary OPD, with a high refill prescription rate (82.6%) and low mail-back prescription use (35.9%). Patients of Family Medicine comprised the majority (40.3%) of nursing home telemedicine, with lower refill prescription use (37.3%). Overall satisfaction was high regarding telemedicine care, physicians professionalism, and medical problem solving (98.3% and 97.7%, respectively).
Conclusion: Older age, female sex, and potentially more health conditions were associated with higher willingness to access telemedicine. We identified medical divisional and disease-based differences in prescription patterns.

1. Introduction

Telemedicine enables provision of clinical services by transferring medical information from one location to another using electronic equipment, such as ordinary telephones, videos, computers, and the Internet. The National Information Infrastructure (NII) project initiated the development of telemedicine in Taiwan in 1994.[1] There have been three stages in the planning of telemedicine, namely the initiation research stage (1994–96), promotion research stage (1997–99), and implementation stage, which started in 2000.[1] Owing to the coronavirus 2019 (COVID-19) pandemic, the Taiwanese government pushed for the practice of telemedicine or health care that could be offered remotely via telecommunications technology as an alternative way of treating patients safely in an ordinary outpatient clinic setting.

Our hospital was involved in a telehealthcare program in 2009, providing medical services to people with chronic diseases living in rural areas. During the COVID-19 pandemic in 2020, telemedicine was implemented worldwide to avoid unnecessary in-person consultations. Our hospital started telecommunication by substituting the outpatient department (OPD) in May 2020, when the COVID-19 epidemic first emerged in Taiwan after the announcement of a nationwide Level-3 epidemic warning for disease control and prevention. We established video conferencing clinics of different sub-specialties under the government's instructions and gradually increased them until the epidemic decelerated. This study evaluated the use of telemedicine according to the age of patients and the types of different sub-specialties.

2. Materials and methods

We retrospectively analyzed patients from an academic medical center during the COVID-19 pandemic between May 2021 and December 2021. Our center is currently a tertiary medical center in northern Taiwan. Patients classified into the medical systems of OPD and nursing homes were analyzed. Five nursing homes were in-

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volved in the telemedicine service. The baseline characteristics of the patients, including age and sex, were defined. Our practice enrolled patients with chronic diseases under stable conditions and those who were restricted to staying at home for isolation. We collected data on the number of patients using telemedicine in separate months and the types of subspecialties. The degree of satisfaction was reported by the participants.

Owing to threat of COVID-19 in Taiwan, the National Health Insurance Administration has encouraged all hospitals (or medical institutes) and OPDs to launch telecare in their daily clinics to minimize the risk of COVID-19 infections. The details and resources of these policies can be found publicly on their website (https://www.nhi.gov.tw/Content_List.aspx?n=1482911120B73697&topn=787128DAD5F71B1A). Hospitals were constructed to partner with digital platform providers for telecare consultations. With just a phone or laptop, patients could obtain a private consultation with a doctor. The physicians and nurses prepared for the process of video conferencing to enter a one-to-one online consultation room with the aid of nursing staff trained in telecare specialties. After downloading the application (Supplemental Figure 1), the patients were given stepwise instructions on how to use it. Herein, patients were requested to show their health insurance cards and record them to confirm their identity through the video camera prior to the formal medical consultation process, with an upper time limit of 10–15 minutes. Hospital visits were scheduled for patients who required examination, including blood tests and radiological studies. Some cardiac examinations were carried out with different electrical apparatuses, such as a screening device for atrial fibrillation, wearable electrocardiogram, and a heart rate recorder. For prescription patterns, our institution allowed the use of both regular (single month prescription) and refill prescription (or so called "Chronic illness prescription refill slip" for continuous 2 or 3 months rather than one single month). After the end of each telemedicine session, patients received their medicines either by on-site prescription (on-site payment) or by mail-back (ATM payment). On-site payment refers to the payment behavior regarding prescriptions and medical services done at hospital site by patients, instead, mail-back payment (ATM payment) refers to payment via ATM remotely rather than in hospital. By setting prespecified satisfaction items, we were able to collect feedback from patients who underwent telemedicine care. This study was approved by local (MacKay Memorial Hospital) Institutional Review Board Committee (22MMHIS060e).

3. Results

3.1. Patterns and rates of telemedicine utilization

A total of 3258 participants from the ordinary OPD (both Taipei and Tamsui branches) and 3329 participants from five nursing homes were included in our study, which was conducted between May 2021 and December 2021. More than half of the patients were female (56% from the ordinary OPD and 55.6% from the nursing home group). The mean ages of ordinary OPD and nursing homes cohorts were 56.3 $\pm$ 22.4 years and 58.2 $\pm$ 28.7 years, respectively (Table 1).

Table 1
Data regarding the numbers of telemedicine practice stratified by both ordinary OPD and nursing home settings during COVID-19 pandemic in Taiwan.

		Ordinary OPD						Nursing home					
	Total	Male (n)	%	Female (n)	%	Overall (n)	%	Male (n)	%	Female (n)	%	Overall (n)	%
Age (yrs.) (mean, SD)	57.3	53.7	23.3	58.4	21.5	56.3	22.4	50.3	27.5	64.5	28.1	58.2	28.7
Month (n, %)													
From May-Dec	6587	1435	44.0%	1823	56.0%	3258	100.0%	1478	44.4%	1851	55.6%	3329	100.0%
May	734	134	45.9%	158	54.1%	292	9.0%	195	44.1%	247	55.9%	442	13.3%
June	2033	716	43.1%	944	56.9%	1660	51.0%	150	40.2%	223	59.8%	373	11.2%
July	1042	316	42.1%	435	57.9%	751	23.1%	118	40.5%	173	59.5%	291	8.7%
August	388	68	43.0%	90	57.0%	158	4.8%	104	45.2%	126	54.8%	230	6.9%
September	689	107	51.0%	103	49.0%	210	6.4%	208	43.4%	271	56.6%	479	14.4%
October	538	55	53.9%	47	46.1%	102	3.1%	200	45.9%	236	54.1%	436	13.1%
November	562	19	41.3%	27	58.7%	46	1.4%	232	45.0%	284	55.0%	516	15.5%
December	601	20	51.3%	19	48.7%	39	1.2%	271	48.2%	291	51.8%	562	16.9%
Division (n, %)													
Internal medicine	2226	1110	57.3%	826	42.7%	1936	59.4%	100	34.5%	190	14.2%	290	8.7%
Family medicine	1800	266	58.0%	193	42.0%	459	14.1%	601	44.8%	740	55.2%	1341	40.3%
Pediatrics	944	212	47.9%	231	52.1%	443	13.6%	268	53.5%	233	17.4%	501	15.0%
Neurology	539	45	58.4%	32	41.6%	77	2.4%	153	33.1%	309	23.0%	462	13.9%
Psychiatry	568	122	53.3%	107	46.7%	229	7.0%	138	40.7%	201	15.0%	339	10.2%
General surgery	72	39	54.2%	33	45.8%	72	2.2%						
Traditional Chinese Medicine	17	8	47.1%	9	52.9%	17	0.5%						
Rehabilitation	257							153	59.5%	104	7.8%	257	7.7%
Dermatology	139							65	4.8%	74	5.5%	139	4.2%
Gynecology	16	15	93.8%	1	6.3%	16	0.5%						
Orthopedics	8	6	75.0%	2	25.0%	8	0.2%						
Otorhinolaryngology	1		0.0%	1	100.0%	1	0.0%						
Prescription (n, %)													
Regular prescriptions	2654	292	51.6%	274	48.4%	566	17.4%	1007	48.2%	1081	51.8%	2088	62.7%
Refill prescriptions	3933	1143	42.5%	1549	57.5%	2692	82.6%	471	38.0%	770	62.0%	1241	37.3%
Receive medicine (n, %)													
On-site	5419	934	44.7%	1156	55.3%	2090	64.1%	1478	44.4%	1851	55.6%	3329	100.0%
Mail-back	1168	501	42.9%	667	57.1%	1168	35.9%						
Nursing home (n, %)													
Suang-Lien Elderly Center								475	31.7%	1023	68.3%	1498	45.0%
Bali Ai-Hsin Home								699	54.5%	584	45.5%	1283	38.5%
Taipei Happy Mount Home								166	59.5%	113	40.5%	279	8.4%
Psychiatric Center								94	42.2%	129	57.8%	223	6.7%
Eden Social Welfare Foundation								44	95.7%	2	4.3%	46	1.4%

OPD, outpatient department.

Figure 1 displays the distribution of telemedicine utilization by division from both ordinary OPDs and nursing homes. The division of internal medicine was most likely to use telemedicine from the ordinary OPD (n = 1936, 59.4%), followed by family medicine (n = 459, 14.1%), and pediatrics (n = 443, 13.6%). For nursing homes, the division of Family Medicine (n = 1341, 40.3%) had the highest telemedicine use, followed by pediatrics (n = 501, 15.0%) and neurology (n = 462, 13.9%) (Table 1). Overall, more than 80% of video telecommunication recordings were available for all telemedicine practices in the MacKay system during the COVID-19 pandemic in Taiwan.

In general, women had higher telemedicine utilization rates than men during the COVID-19 pandemic period (Figure 1A and 2A). Regarding telemedicine use from the ordinary OPD, the peak telemedicine use based on age categories occurred within 61–70 years (662 out of 3258, 20.3%) (Figure 1B). Female patients aged 61–70 years and higher also had the highest telemedicine utilization (in summation) across different age categories (Figure 1B). Regarding telemedicine use in nursing homes, the distribution of telemedicine appeared to be bimodal (M-shaped) across different age categories both in male and female patients (Figure 2B).

3.2. Patterns and rates of prescriptions after telemedicine

Table 2 presents the prescription patterns and ratios from the top five divisions stratified by both ordinary OPD and nursing home telemedicine use. Patients from the Internal Medicine Division had the highest rate of receiving refill prescriptions (1702 out of 1936, 87.9%) from the ordinary OPD, instead, the Neurology Division had the highest rate of receiving refill prescriptions (315 of 462, 68.2%) from nursing home practice (Table 2). In general, refill prescriptions were predominant in ordinary OPD, whereas regular prescriptions slightly outnumbered the use of refill prescriptions in nursing home practice. After the end of each telemedicine session from the ordinary OPD, nearly two-thirds (64.1%, n = 2090) of patients chose on-site payment (hence, to get prescriptions immediately), and one-third of patients received their prescriptions by the mail-back method (hence, to proceed with their payments via ATM) (Table 1). The comparisons of these payment differences by divisions showed that Psychiatry Division had highest on-site payment for prescriptions compared to mail-back approach (80.3% vs. 19.7%), followed by Pediatrics (70.8% vs. 29.2%) (Figure 3).

Table 3 further displays the prescription patterns and ratios from the top five disease classification systems using the International Classification of Diseases (ICD) stratified by both OPD and nursing home telemedicine use. Regarding telemedicine use from the ordinary OPD, Patients classified into The Circulatory System Diseases had highest refill prescription use (824 out of 884, 93.2%) (Table 3), followed by Endocrine, Nutritional, and Metabolic Diseases (599 out of 663, 90.3%), and diseases of the Musculoskeletal System and Connective Tissue (161 out of 190, 84.7%). Regarding telemedicine use in nursing homes, those individuals associated with Endocrine, Nutritional, and Metabolic Diseases had the highest rate of refill prescription use (105 out of 150, 70%), followed by Diseases of the Circulatory System (268 out of 427, 62.8%) and Mental, Behavioral, and Neurodevelopmental disorders (286 out of 615, 46.5%). Overall, the satisfaction of ordinary OPD telemedicine utilization during the pandemic was high in our

Figure 1. The distribution on percentage of telemedicine utilization from ordinary OPD stratified by age for both sexes across different age categories (A) and sex-specific distribution stratified by age categories (B).

Figure 2. The distribution on percentage of telemedicine utilization from nursing homes stratified by age for both sexes across different age categories (A) and sex-specific distribution stratified by age categories (B).

Table 2

Prescription patterns and ratios from top five divisions stratified by both ordinary OPD and nursing home telemedicine use.

Divisions	Ordinary OPD					Nursing home				
	Regular (n)	%	Refill (n)	%	p value	Regular (n)	%	Refill (n)	%	p value
Internal medicine	234	12.1%	1702	87.9%		167	57.6%	123	42.4%	
Pediatrics	46	22.4%	413	77.6%		738	55.0%	603	45.0%	
Family medicine	153	19.4%	290	80.6%	< 0.001	436	87.0%	65	13.0%	< 0.001
Psychiatry	80	34.9%	149	65.1%		249	73.5%	90	26.5%	
Neurology	10	13.0%	67	87.0%		147	31.8%	315	68.2%	
Others	43	37.7%	71	62.3%		351	88.6%	45	11.4%	

OPD, outpatient department.

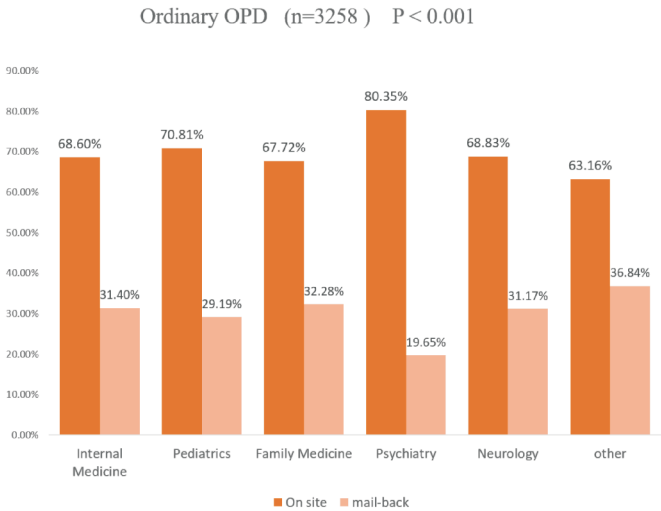

Figure 3. Distribution of differential payment (on site vs. mail-back) for prescription after each telemedicine session by division. OPD, outpatient department.

center (92.9%, 42.4% questionnaires available [n = 1382 out of 3258 from the ordinary OPD]), with both physicians' professionalism and medical problem solving reaching 98.3% and 97.7%, respectively, and video conference workflow and video fluency failing to reach satisfaction above 80% (77.9%) (Figure 4).

4. Discussion

We aimed to delineate the baseline features of patients (including age, sex, and medical subspecialty [or divisions]) in implementing telemedicine during COVID-19 in Taiwan. In the current analysis, we found that older age, female sex, and patients from the Internal Medicine Division were associated with a higher rate of telemedicine utilization in the ordinary OPD, whereas patients in the Family Medicine Division were predominantly telemedicine users from nursing care institutions. Patients from the ordinary OPD were more likely to adopt refilled prescriptions after telemedicine sessions from on-site payment. Overall, the satisfaction levels were high for the feasibility of telemedicine and physicians' professional use from ordinary OPD.

Table 3
Prescription patterns and ratios from top five categories of disorder stratified by both ordinary OPD and nursing home telemedicine use.

	ICD code	Overall (n)	Regular (n)	%	Refill (n)	%	p value
Ordinary OPD							
Diseases of the circulatory system	I10-I82	884	60	6.8%	824	93.2%	
Endocrine, nutritional, and metabolic diseases	E03-E89	663	64	9.7%	599	90.3%	
Mental, behavioral, and neurodevelopmental disorders	F01-F98	314	68	21.7%	246	78.3%	< 0.001
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	R00-R94	197	61	31.0%	136	69.0%	
Diseases of the musculoskeletal system and connective tissue	M02-M81	190	29	15.3%	161	84.7%	
Nursing home							
Diseases of the nervous system	G11-G98	1324	1042	78.7%	282	21.3%	
Mental, behavioral, and neurodevelopmental disorders	F01-F84	615	329	53.5%	286	46.5%	
Diseases of the circulatory system	I11-I95	427	159	37.2%	268	62.8%	< 0.001
Endocrine, nutritional, and metabolic diseases	E03-E88	150	45	30.0%	105	70.0%	
Diseases of the digestive system	K05-K92	109	63	57.8%	46	42.2%	

OPD, outpatient department.

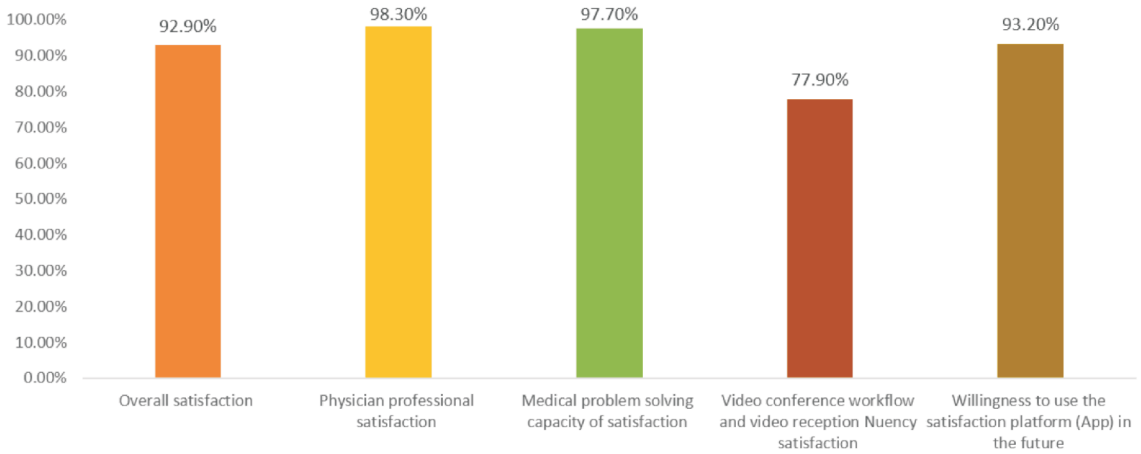

Figure 4. Ordinary OPD patients' satisfaction on several dimensions regarding telemedicine practice during COVID-19 in MacKay memorial hospital.

Distinct from the believes that older individuals may have a difficulty toward the access and use of internet technology,[2] the present study showed that middle-aged to elderly patients are more likely to use telemedicine than younger patients regarding the use of telemedicine from our OPD.[3] To date, a great body of literature showed that younger individuals are associated with higher utilization rate of telemedicine.[4–7] In one large-scale report about ambulatory telemedicine visits for primary care and medical specialty during the early phase of the COVID-19 pandemic, older age was associated with fewer completed telemedicine visits.[8,9] Some authors proposed that younger patients may utilize telemedicine more frequently owing to milder disease severity and less urgent healthcare conditions and needs, and thus, lessened necessity of blood tests and diagnostic imaging during medical seeking process.[10,11]

Furthermore, this population is probably more familiar with advances in information and communication technology (ICT) than the older population.[9] The explanation for higher rate of telemedicine use in older patients in our current study perhaps origin from racial differences on the concerns about potentially life-threatening comorbid conditions in the elderly population when simultaneously infected with COVID-19. In view of the fact that current care models could be inadequate to address the challenges of an aging population, we assume that telemedicine can be an attractive alternative option for the elderly seeking medical consultations. Additionally, the finding on the sex-based differences in accessing telemedicine (female patients more frequently than males) is compatible with previous reports.[8,12] Our current analysis also showed that patients from internal medicine and family medicine manifested higher rates of telemedicine use.

One analysis revealed that patients from psychiatry and endocrinology divisions were more likely to engage in the effective transition from ordinary OPD to telemedicine care during the COVID-19 pandemic.[12,13] Furthermore, subspecialty of geriatric and psychiatry showed economic benefits by providing telemedicine to long-term care facility residents compared to conventional medical services.[14] We further observed that patients with potentially higher burden of chronic diseases (e.g., patients from internal medicine/neurology divisions or classified into diseases of the circulatory system/endocrine, nutritional, and metabolic diseases) from ordinary OPD had a higher rate of requesting refill prescriptions. Despite the high rate of requesting refill prescriptions in patients with ordinary OPDs, surprisingly, we observed a relatively lower utilization of mail-back prescription services. The higher refill prescriptions (prescriptions for continuously 2 or 3 months rather than single 1 month) yet higher rate of on-site payment (64.1%) rather than payment remotely from ordinary OPD patients receiving telemedicine reflected the gap of practicing "real" telemedicine in daily practice. This finding indicated an unmet need in bridging the gap of implementing telemedicine services in actual health care settings, which may require a more convenient payment and prescription transfer from daily practice.

For patients from nursing homes or long-term care facilities, telemedicine should be encouraged to be implemented not only during COVID-19, but also for routine use as much as possible, owing to its convenience in practice. Some studies have shown that overcoming the barrier of internet access, mobiles, or devices leading to continuous improvement in technological skills in elderly residents

from nursing homes by trained paramedical staff will help enhance the use of telemedicine in such a population.[15] Some authors also found that the care delivery by telemedicine could be more cost-effective than the conventional care models (e.g., in-person services) in the care of elderly or acute and chronic disease patients.[16–19]

The future goals will be to expand the utilization of telemedicine or telecare to broader patient populations from diverse fields of subspecialty (e.g., disabilities or residents living in rural areas) by enabling patients' self-management, thereby relocating medical services more ideally and improving equity in access to high-quality care through telemedicine solutions. By taking advantage of advanced technologies (e.g., wearable medical devices or remote monitoring devices),[16,20,21] more physicians can be trained in relevant programs to achieve better professionalism in guiding the broader use of telemedicine in daily care.

5. Conclusion

Telemedicine, an alternative medical practice that adopts telecommunication technologies, was successfully implemented in a tertiary medical center in Taiwan during the COVID-19 pandemic. We observed that older age, female sex, and cardiology were associated with a higher rate of telemedicine utilization from ordinary outpatient clinics with high refill prescription use, albeit with relatively higher on-site payment solutions. Overall, satisfaction reached more than 90% regarding professionalism and the ability to solve medical conditions. Our data demonstrated the feasibility and potential of telemedicine care in future healthcare reforms.

6. Limitation

Our current work has several limitations. First, these data were extracted from single center experience, thereby limiting its generalizability. Second, owing to limited source (only available in the ordinary OPD cohort) and non-mandatory nature of survey feedback, our high satisfaction rate regarding telemedicine practice during COVID-19 pandemic may be susceptible to bias. Further larger scale studies may be helpful to validate our findings.

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Conflicts of interest

None.

Supplementary materials

Supplementary materials for this article can be found at http://www.sgecm.org.tw/ijge/journal/view.asp?id=22.

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