Targeted Antivirus Prophylaxis (TAP) Using ICT in a Gymnasium during a Pandemic

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Abstract— **Targeted antivirus prophylaxis (TAP) is a policy that involves the distribution of free antiviral drugs to citizens in advance of a pandemic outbreak. TAP also involves the use of gymnasiums and public halls as temporary accommodation facilities in the case of a shortage of medical institutions. Therefore, we conducted a questionnaire survey to investigate the actual situation of information and communications technology support for the coronavirus disease 2019 pandemic in Japan. The results suggest that a system capable of providing two-way online video consultations at a gymnasium could be effective for providing nationwide TAP to citizens unfamiliar with PCs and smartphone apps. This approach could help improve drug distribution to large segments of the population while minimizing exposure to infectious agents.**

Keywords— ***teleconsultation, cloud network, fax, oral tablet***

I. INTRODUCTION

1.1 Purpose

In the event of a pandemic outbreak, Japan has a policy of distributing antiviral drugs in advance to citizens free of charge so that they can take them at their own discretion. This policy also involves the use of gymnasiums and public halls as temporary accommodation facilities in the case of a shortage of medical institutions. The present paper investigated the actual situation of information and communications technology (ICT) support for the coronavirus disease 2019 (COVID-19) pandemic in Japan with the aim of using the results to suggest a social system that allows doctors and pharmacists to help people who cannot take medicine at their own discretion during a pandemic outbreak. Herein, we examine the pros and cons of such a system in terms of support for taking medications, technical aspects, the bandwidth of online video communications, and a system for collecting patient data.

1.2 Targeted antivirus prophylaxis

Targeted antivirus prophylaxis (TAP) refers to the provision of free antiviral drugs to the public just before an outbreak that can overwhelm the health-care system. Citizens have the advantage of being able to learn about the efficacy and side effects of the drugs in advance from online sources and audiovisual materials. However, the timing is still determined by each individual, which leads to the possibility of individuals forgetting to take the drugs. A field test was previously performed in the UK after the World Health Organization's declaration of the 2009 influenza pandemic. However, the ways in which older adults, individuals with disabilities, and citizens who remain hesitant to take drugs even after receiving the appropriate information make their own decisions remain unclear. This issue is a major challenge in Japan and requires further attention, as do the related extralegal administrative issues.

1.3 Distribution of iodine preparations after the Fukushima nuclear accident

An example of the distribution of drugs from the government to the general public during a disaster is the case of iodine preparations following the nuclear accident at Fukushima Daiichi Nuclear Power Plant.

Okuma town in Fukushima Prefecture has been stockpiling iodine preparations for some time with the aim of reducing thyroid exposure. It is located within the Urgent Protective Action Planning Zone (UPZ) established by the Japanese government as an area where emergency protective measures, such as sheltering indoors, were enacted. In the UPZ, which covers a radius of 5–30 km from the power plant, iodine preparations were to be urgently distributed to residents. However, in reality, the government issued no such directive; the mayor was cut off from communication with experts, so he made his own judgment and distributed the preparations to residents. It is difficult to distribute drugs on the street during evacuation from a disaster, and practically impossible to explain the side effects and timing of administration verbally. In Iwaki City, drugs were distributed, Instructions was not issued by the person in charge, so many residents did not take it. In Minamisoma City, preparations are being made, however

the distributors have given priority to evacuation and have not handed them out to residents (Table I). The author, Prof. Kurokawa, is the chairman of the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission, and Nakajima is an investigator under the committee, and fully understands the difficulty of communicating information in the event of a disaster. When distributing iodine preparations, we felt that it was essential to have time to explain indoors, such as gymnasiums and community centers, because information about side effects and dosing times could not be communicated at all if the drugs were handed over on the street [1, 2].

Worse yet, some residents who did not receive the preparation used "a mouthwash containing iodine" they had found on the Internet. In response, the National Institute of Radiological Sciences, an independent administrative agency, cautioned residents not to drink over-the-counter mouthwashes and disinfectants, citing baseless information. The distribution and dosing instructions for the iodine preparations are listed in the Table I.

Table I. Summary of stable iodine distribution and dosing
Municipalities that distributed and administered the drug

Municipality	Action	Population (n)
Tomioka town	Distributed mainly to townspeople under age 40 years on March 12	15,830
Futaba town	Distributed to children at evacuation centers on March 12	6932
Naraha town	Distributed to evacuees under age 40 years in Iwaki city on March 15	7700
Miharu town	Distributed to people under age 40 years, including evacuees from Hamadori who already had stable iodine pills, and called for them to take the pills on March 15	18,235

Municipalities that planned but gave up on the provision of the drug

Municipality	Action	Population
Minamisoma city	Decided to distribute a stable iodine solution to residents within a 10-km radius on March 12, but abandoned the idea as the evacuation zone expanded to a 20-km radius while packaging was underway	70,878
Iwaki city	Distributed to pregnant women and women aged under 40 years on March 18, but they were later instructed not to take the medication until further notice from the city; in the end, no medication instructions were issued	327,772

(Quoted from Ref [01] with permission,[2])

Even if preparations to distribute medicines are made in advance, when a disaster occurs, the government may lack the personnel or even forget to distribute them. According to our research, it is estimated that only about 5% of all residents in the target area were able to take medicine at the optimal time after the Fukushima nuclear accident. In other words, meticulous preparation in advance is essential for distributing drugs in the event of a disaster, but imparting knowledge of the side effects of such drugs to citizens during distribution on the street is difficult, and the risk of missing the timing for taking such drugs cannot be ignored. Therefore, the general public needs to be educated in advance using online audiovisual materials.

1.4 Online medical care in Japan

In the narrow sense of the term, so-called online medical care is telemedicine, which involves the provision of medical care by a doctor who is referring to videophone or medical device data for a remote patient. In Japan, online medical care has been provided for more than 30 years in limited areas such as remote islands and settings, which provides a spatial advantage in that patients in remote areas can receive the same medical services as those in urban areas through video calls on smartphones and online video chats. On August 10, 2015, the MHLW's health policy bureau issued an administrative notice stating that, "In effect, telemedicine (so-called online medical examinations and examinations) will be implemented not only for patients in remote areas and islands, but also for patients with specific diseases. The ban will be lifted in areas and uses (other than the first visit)."

In March 2018, guidelines emphasized the conditions for the proper implementation and spread of online medical consultations, such as that the first consultation be conducted face-to-face; however, this did not act as a deterrent. In April 2020, due to the rapid spread of COVID-19, the ban on initial online consultations was finally lifted. On October 9, 2020, Mr. Kohno, the Minister of Regulatory Reform, announced that in principle, even after COVID-19, the ban on online medical consultations, including initial consultations, would be lifted.

Work-style reforms will be implemented in April 2024 (after the 5-year probation period has passed), which will make it impossible to assign young doctors to support clinical medicine. Thus, as the capacity of emergency medical institutions is expected to decline substantially, medical support through ICT is needed as a compensatory measure.

1.5 Policy trend of online medical treatment at community centers

In December 2022, the MHLW's Social Security Council/Medical Subcommittee set the agenda for online medical examinations in familiar places such as regional public halls or community centers. From the viewpoint of securing medical care for older adults who are unfamiliar with digital devices, a regulatory reform implementation plan actively guided by the government agenda made it possible for such individuals to have "consultations at familiar places such as day care offices and community centers". Behind this is the idea that "online medical care will become important in areas where medical resources are scarce and the population is declining."

II. SURVEY

2.1 Survey

Since February 2020, the Japanese government has operated two major ICT support measures against the COVID-19 pandemic. The results of these investigations are summarized as follows.

A: COCOA

During the development process of a contact confirmation application (hereinafter referred to as COCOA), there was little

significance in calling attention to the actions of smartphone users because of the policy of responding to COVID-19 at the time[3-20]. Furthermore, COCOA was not designed to deal with the epidemiological data provided by public health centers. In addition, the collection of privacy-related data such as location information is prohibited by the Exposure Notification API's terms of use, that spatial resolution was relatively low, however it could be enough to provide administrative alarms from local governments with showing the local map with the amount of patients at each area. From a medical point of view, there is no basis for close contact (physical distance via Bluetooth) between mobile terminals and the establishment of an infection. The establishment of an infection is determined only by the power relationship between the host and the parasite that is a principle of infection. The cumulative amount of droplets in the air generated by conversation and the air flow characteristics in the room also play a factor. Furthermore, as a legal issue regarding COVID-19, there was a need to encourage people who had received a COCOA notice to take a polymerase chain reaction test and visit a medical institution. However, there was no official legal backup. The early COCOA program had a fatal bug and did not work on Android phones for the first 4 months after launch, and the number of COCOA users has not increased, and only about 10% of the corona-positive people have joined COCOA. Under these circumstances, the use of mobile phones for COCOA failed in Japan.

B: HER-SYS

"Japan's Coronavirus Infection Data Collection System", hereinafter abbreviated as HER-SYS, is an Internet-based patient information data collection system built by the MHLW. It was introduced at the end of May 2020 with the aim of reducing the workload of public health centers, etc., and speeding up information sharing and understanding among related parties, including public health centers, prefectures, and medical institutions. Physicians who have diagnosed patients with COVID-19 are obliged to provide reports in writing based on Article 12 of the Infectious Diseases Law. HER-SYS is an online version of this reporting process that was created based on the spirit of trustless communication lines and traffic access, which was considered to make it possible to speed up processing compared with paper media; however, various issues became apparent in its actual operation[21-23].

In particular, on July 26, 2022, just before the peak of the seventh wave of COVID-19, the number of infected patients and communication increased, and the system went down due to congestion on the line. Therefore, the government reduced the number of items to be reported by doctors from 120 to 5, and narrowed down the targets to only older adults and patients with comorbidities. This is what is referred to as the withdrawal of the "epidemiological grasp of all cases" adopted by the Japanese government as a coronavirus policy. HER-SYS is the flagship policy of the "digital transformation" being developed by the Japanese government, and despite its high cost (3.2 billion yen), infectious disease experts have criticized it as a "virtual failure". It was therefore considered a policy of unprecedented absurdity with no epidemiological merit that wasted countless hours of input from many doctors.
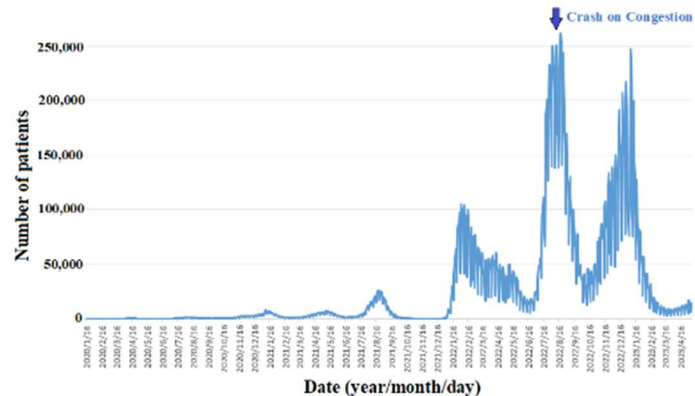

Fig. 1. Number of patients with coronavirus infections, ↓: On July 26, 2022, HER-SYS was down due to congestion.
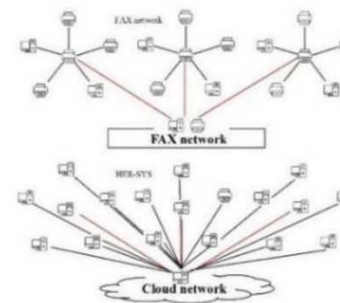

Fig. 2. HER-SYS is a system on the Cloud that forcibly migrated an autonomous decentralized fax network that used a public line.

2.2 Proposing a Model

The following equipment, medical terminals, and ICT support TAP in a gymnasium. One facility assumes 100 visitors every 30 minutes[26-28].

A: Facility Equipment

In the case of COVID-19, if the general public gathers, 5% will complain of symptoms, and 20% of those who become sick will be patients who need a bed. In general, if a gymnasium is transformed into an accommodation facility in the event of a disaster, it is divided into sections measuring 3 m² per person. However, in the case of COVID-19, the following area (Table II) was used to help individuals maintain an appropriate physical distance from their neighbors. In the case of 100 residents, 30 minutes in an 840m² gymnasium, the medicine distribution area is 25m², 4 examination rooms are (8x4) 32m², and remote examination room for infected patient with nurses is 12m².

Cardboard cots and air conditioning fans that were actually used in the Japanese COVID-19 operation were also provided (Figure 3).

Fig. 3. Cardboard cot and air conditioning fan used as additional equipment in the gymnasium.

Table II. Capacity per area

Contents	Persons	m²
Chairs (in front of an audiovisual monitor)	95	380
Examination room	1x4	32
Remote examination room	1	12
Medicine distribution area		25

B: Medical Terminal

Three vital signs (body temperature, blood oxygen saturation, and blood pressure) are used as discrete values, and the total size of the data transmitted is 22 bytes. Physicians can use these data as the basis for diagnosis in face-to-face practice[29-39].

1. Body temperature: Measured using a thermometer (total bytes: 4)

2. Blood oxygen saturation: Measured using a pulse oximeter for 60 seconds, along with heart rate and saturation concentration% (total bytes: 8).

3. Blood pressure (diastolic/systolic): Measures using a sphygmomanometer (total bytes: 10).

The Guidelines for Medical Treatment of New Coronavirus Infectious Disease (COVID-19) formulated by the study group of the MHLW of Japan describes the values of these three measuring instruments. If the fever is 38 degrees or higher, it is suspected to be infected with the novel coronavirus, and if the pulse oximeter value is 93% or less, respiratory failure will be admitted to a medical institution. If the blood pressure drops below 90mmHg, consider it as a state of shock caused by a cytokine storm, call the medical staff immediately, and call an ambulance at the same time.

C: Specifications of the ICT

Although many citizens can watch videos and increase their knowledge of antiviral drugs, some who are still worried can meet with pharmacists and doctors via video and ask questions. In the unlikely event of complaints of symptoms such as fever, citizens can receive a consultation in a private room equipped with a pulse oximeter and blood pressure monitor, as shown in Figure 4. Table III shows the number of lines required for an 840m² gymnasium with 100 people/30 minutes. Broadcast communication 20 Mbps 1 line for educational videos on drugs and infectious diseases, 2 Mbps 5 lines for teleconsultation or two-way video calls with specialists. The patient data collection system (HER-SYS) requires 1 cloud line and 1 of his fax lines as a backup.
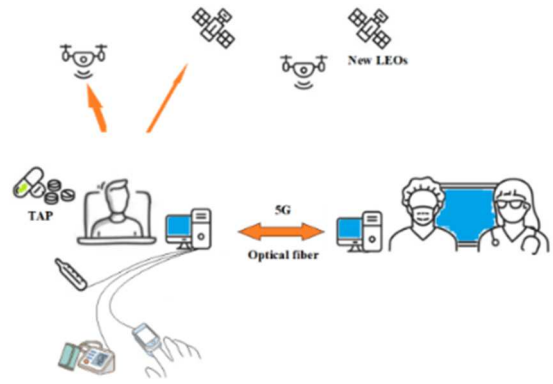

Fig. 4. Conceptual diagram of the TAP support system

Table III Necessary of lines for 100 citizens/30 minutes at each facility

Contents	Speed	Number of lines
Educational videos on drugs and infectious diseases	20-Mbps broadcast communication	1
Two-way videophone	Two-way 2 Mbps	5
Patient data collection system (HER-SYS)	Cloud	1, or a fax on a public line

III. CONSIDERATIONS

3.1 Expectations for Lines That Operate TAP Well

Public lines using optical fiber are common in high schools and universities to secure 20 Mbps broadband speeds for broadcast communication and 2 Mbps for both directions. However, connection points on campus separated by long distances are strong candidates for 5G lines. It is possible to make a video call using a mobile phone terminal, but it is desirable to attach an external display and microphone.

Although it is premised on the Internet, if personal information is made anonymous, it does not necessarily require strict security. If strict security is required, the flexibility of the network will be lost, and moreover, it will be necessary to secure a large number of communication lines. TAP was implemented before the peak of the COVID-19 pandemic, so it is possible that some of the factory workers maintaining the communication lines could have been infected. In other words, telecommunications business operators need to understand in advance that managing public networks may face additional challenges during a pandemic.

How should we respond in developing countries, remote islands, or mountainous areas where no 5G lines have been installed? As mentioned above, HER-SYS can send the minimum amount of information to the public health center as long as there is an operational line that can be connected several times per day.. In addition, educational drug videos for citizens stored on portable media can be transported by land or air and shown by local governments.

The communication lines needed to implement TAP for real-time, two-way video calls for about 15–30 minutes require a broadband capacity of about 2 Mbps (at least five lines per facility), thereby equaling a total of about 10 Mbps. According

to Erlang's formula, it is not adequate simply to divide by 5, but if 2 Mbps were the maximum capacity of an orbiting satellite, it would be necessary to reduce the number of users from about 100 to 20 and to reduce the overall configuration. This would allow the system to cover 20 people/30 minutes, 480 people/12 hours, and 2400 people/5 days. If more lines are needed, a line that raises the drone to near the stratosphere may be effective.

3.2 Bulletin Board System (BBS) Using a Fax Modem

In the latter half of the 1980s, when the Internet did not cover the entire world, enthusiasts built a digital network using a wireless radio bulletin board system (RBBS). At that time, a terminal node controller was used for the connection between PCs and radios, along with the communication protocol AX.25. The RBBS was capable of linking with the wired BBS of the public line network, and was capable of automatically exchanging files. Therefore, in this paper, BBS using a fax modem is evaluated as a potential bypass network in the event of a disaster.

Abolishing fax machines and shifting to digitalization have improved daily work efficiency in some respects. Compared with digital tools, fax machines require substantially more time to check, enter, and manage information. When transmitting patient data during a pandemic, a terminal equipped with digital tools such as voice recognition, optical character recognition, and a zip code address data link will show much higher efficiency. However, in HER-SYS, the medical side only sends patient data (a character string of a few kB at most) to the public health center unilaterally. However, during the peak of the COVID-19 pandemic, HER-SYS on cloud network crashed as a result of congestion. HER-SYS is simply a reporting of patient data from doctors to the central government, rather than a joint effort by the central government and end-user doctors, so choosing a cloud network is a mistake. is. In terms of network management, HER-SYS, which is used by many users at the same time and causes congestion, is very dangerous on the cloud. Due to system engineers and bureaucrats who can't even design circuits, Japan's HER-SYS missed the final goal of grasping the total number and ended in failure.

The communication network between medical institutions and public health centers in Japan has traditionally been managed by a fax network using a public line, and has operated without any major problems. An operational line that can be connected several times a day is sufficient. However, during the COVID-19 pandemic, under the name of the "digital transformation administration", the existing operating network was intentionally destroyed and everything was forced to migrate to a Cloud network. As a result, as the number of patients increased, the traffic increased, and the Cloud crashed daily owing to congestion. For this reason, the government gave up on grasping the total number of patients with COVID-19. The authors therefore ask, "Is it really right to use the Cloud in the event of a disaster?" In addition to the Internet protocol suite, PCs include the option of installing a fax modem connected to a telephone line. If there is a problem on the Cloud, a fax modem that can collect data using a public line at a local public health center and a BBS system linked to each public health center would be effective as a backup network for independent distributed processing.

Some media outlets are making a big deal about how outdated fax machines are, but these articles are technically superficial and short-sighted. In fact, even in the US, fax is the mainstream at medical institutions, county and state government agencies, banks, and financial institutions. The user's actual situation should be fully considered, rather than security governance, in regard to how to make doctors work efficiently, which is needed in a pandemic. The International Telecommunications Union makes recommendations to governments regarding the quality of public telephone networks. Also, the probability of tapping from the outside is extremely low.

In addition, Seisa University, to which one author (Nakajima) belongs, has under its umbrella a system called Escuela Inc. The source code for PAX88B is still the property of the Nakajima Laboratory.
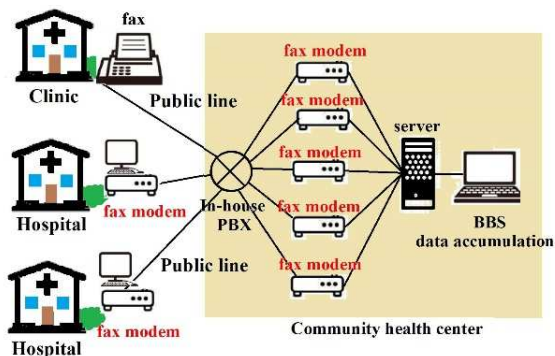

Fig. 5. BBS at a community health center using a fax modem

3.3 Medical Benefits

TAP is an extralegal policy that leaves the decision to take drugs with the individual. The medical benefits are enormous: antiviral drugs can be distributed to many citizens in a short period of time without the need for face-to-face consultations, thereby minimizing the number of infected people. Economically, compared with face-to-face medical care for each individual, medical expenses for society as a whole can be kept overwhelmingly low.

TAP is the last viable weapon governments have at their disposal on the eve of medical collapse.
In November 2008, Japan's Ministry of Health, Labor and Welfare issued guidelines for local communities to control community transmission by having residents take antiviral drugs en masse. This is an even stronger executive order than the TAP, which allows residents to make dosing decisions based on their own infectious disease outbreaks. In the midst of the chaos of a pandemic, handing drugs to residents on the street is dangerous because they cannot fully understand the reasons for taking them and the side effects. Giving the residents medicine in the gymnasium and using ICT to provide information will give many residents the opportunity to take medicine without accidents. To reduce the chance of the medical system collapsing due to a pandemic, the administrative and medical sides should consider TAP policies supported by ICT.

By the way, which oral drugs are actually effective and should be used with caution when performing TAP in COVID-

19? Among the therapeutic drugs for novel coronavirus infections, the following three are currently approved by the Japanese government as oral drugs for mild cases(Table IV).

1. Lagebrio capsules (active ingredient: molnupiravir)
2. Pakilobid pack (active ingredient: nirmatrelvir/ritonavir)
3. Zokova Tablets (active ingredient: nirmatrelbil fumarate)

Each oral medicine has the following characteristics, and not everyone can take it if infected with the new coronavirus. You can only take it if you are non-pregnant or within 5 days after the onset of symptoms (onset), and it is also dangerous to take multiple antiviral drugs at the same time. When implementing TAP, it is necessary to provide citizens with the risks of drugs, people who are prohibited from taking drugs, and the timing of taking drugs via ICT. ICT has an obligation to take care of it, and local governments need to post warnings on their websites in advance to widely inform society. Never hand over drugs on the street, and verbal instructions will not be understood by the public, so please gather in the gymnasium to explain, and conduct teleconsultation for patients who need it.

Table IV. Features of oral tablets for candidate of TAP

Lagebrio Capsules

Features	Patients subject to administration Elderly people, obese people, people with underlying diseases, etc. who are at risk of aggravation
Those who cannot administer	Women who are pregnant or may be pregnant
Precautions for use	Multiple drugs cannot be used together
Deadline for starting medication	Within 5 days from onset

Pak bid pack

Features	Patients subject to administration Elderly people, obese people, people with underlying diseases, etc.who are at risk of aggravation.
Those who cannot administer	Women who are pregnant or may be pregnant
	Precautions for use. Multiple drugs cannot be used together
Deadline for starting medication	Within 5 days from onset

Zokova Tablets

Features	Who are not at risk of aggravation and who have clinical symptoms such as high fever, strong cough, and strong sore throat
Those who cannot administer	Pregnant women or women who may be pregnant
Precautions for use	Multiple drugs cannot be used together
Deadline for starting medication	Within 3 days after onset

IV. CONCLUSION

In a pandemic outbreak, TAP allows for the distribution in advance of free antiviral drugs to citizens to take at their own discretion. Furthermore, the use of gymnasiums and public halls for temporary accommodation facilities is considered in the case of a shortage of medical institutions. This paper investigated the actual situation of ICT support for pandemic outbreaks in Japan. Based on the findings, we proposed a system that provides online support for citizens who cannot take drugs on their own and examined its technical backing. We believe that this approach could allow drug distribution to overwhelmingly large segments of the population while minimizing exposure to infection.

V. ACKNOWLEDGMENTS

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