



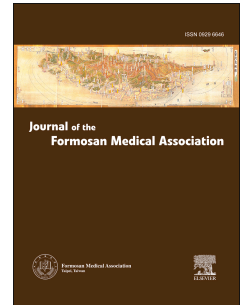
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Transformation from zero tolerance to living with COVID-19 in New Taipei City, Taiwan. Experience of the FEMH “Home-Hotel-Hospital” care model.

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Transformation from zero tolerance to living with COVID-19 in New Taipei City, Taiwan. Experience of the FEMH “Home-Hotel-Hospital” care model.

Abstract

In March 2022, local cases of COVID-19 infections of the Omicron variant were identified in Taiwan. In response to impending community transmission, the “Home-Hotel-Hospital” (3H) care model was implemented by the Far Eastern Memorial Hospital (FEMH). It established the first remote home care center in Taiwan and two quarantine centers in two hotels. The hospital focused on care for critical COVID-19 patients, community screening, and telehealth care.

The home care call center evaluated and triaged up to 104,244 cases and provided remote home care for 96,894 cases within the first three months; in 2022, it provided home care to 107,095 patients. The two quarantine hotels admitted a total of 1,834 individuals. A total of 3,796 COVID-19 patients were admitted to the hospital—367 in intensive care. The telehealth outpatient clinic—including the online video clinic—served 25,775 cases; 21.5% ($n=5,544$) of them were prescribed oral anti-viral medications. In 2022, the FEMH prescribed oral anti-viral therapies to a total of 12,571 cases.

The FEMH 3H care model not only enabled non-critical patients to recover at home, but also provided severely ill patients access to timely in-hospital care. In the future, this model will continue to play a significant role in COVID-19 management.

Keywords: COVID-19; remote home care; telemedicine; hospital response; surge capacity

Background

The total number of COVID-19 cases in Taiwan in late 2020—that is, when the pandemic began—was negligible. In 2021, a surge in cases owing to the Alpha variant was experienced in northern Taiwan; fortunately, it was controlled with a series of rapid responses and interventions.¹ The coverage of vaccination for COVID-19 increased markedly after the surge. In November 2021, the B.1.1.529 (Omicron) variant of the SARS-CoV-2 virus was first reported in South Africa; it was reported to the World Organization of Health (WHO) on November 24, 2021. The WHO recognized that the Omicron variant could potentially circumvent the protection afforded by vaccines and natural induction of neutralizing antibodies²; additionally, studies have shown that 40% of Omicron cases were asymptomatic,³ which facilitated widespread community transmission. As has been seen worldwide, a rapid surge of infections can collapse the healthcare system.⁴ However, Omicron cases reported less severity compared to previous variants, which signaled a favorable opportunity for the society to adapt to the virus.

Studies have revealed that efficient hospital-response strategies can successfully manage hospital capacity for COVID-19 and non-COVID-19 care.⁵⁻¹³ The strategies comprise early risk-stratification, triage of COVID-19 patients into homecare with adequate medications and remote monitoring, emergency room referral/hospitalization and intensive-care treatment, and early implementation of anti-viral therapies for high-risk patients. These initial steps are critical to preserve healthcare system resources, maintain the function of healthcare workforce, and reduce the mortality rates of both COVID-19 and non-COVID-19 patients. In March 2022, local cases infected with the Omicron variant emerged in New Taipei City¹⁴ after the government reduced the border-control quarantine duration from 14 to 10 days. Foreseeing the impending surge of cases, the New Taipei City government and Far

Eastern Memorial Hospital (FEMH) planned the FEMH “Home-Hotel-Hospital” (3H) care model to prevent unmanageable pressure on the healthcare system (Figure 1).

The Government’s Strategy

The Bureau of Health, New Taipei City Government initiated the “COVID-19 Home Care Program” in New Taipei City from April 11, 2022, pursuant to the guidelines for the “Home Care Management of Confirmed COVID-19 Cases” announced by the Central Epidemic Command Center (CECC), Taiwan on April 8, 2022.¹⁵ The New Taipei City COVID-19 Home Care Program mandated holistic case management with (1) confirmed-case isolation, (2) proactive contact and coordinated service by health, civil, police, social welfare, and hospital administrations, (3) health assessment, and (4) referral to remote video clinics or hospitalization.

As the ordinary public health facilities could not efficiently manage the overwhelming surge of cases, the New Taipei City government dedicated seven core hospitals to set up “Green Pathways” to handle the burgeoning confirmed COVID-19 cases. Once patients had a confirmed COVID-19 diagnosis, these hospitals provided the following services: (1) evaluated and triaged based on patients’ risk factors, (2) contacted patients to initiate isolation, (3) provided health education, (4) instructed patients to download New Taipei City Government’s iCare App, (5) instructed patients to complete the legally required epidemiology investigation questionnaire, (6) instructed patients to conduct self-monitoring of health, and (7) notified patients upon completion of isolation period. Health providers of the core hospitals could provide proactive care through phone calls and iCare digital technologies to continuously monitor the health condition of COVID-19 patients. If indicated, the patients could be referred to hospitals for further treatment through Green Pathways.

The Bureau of Health of New Taipei City Government collected the list of newly

diagnosed COVID-19 patients from the Taiwan Centers for Disease Control (TCDC), and designated the list of patients to responsible hospitals daily. There are four million people in New Taipei City, and seven core hospitals were proposed with affiliated small hospitals. The FEMH was responsible for the Ban-Chiao and Su-Lin Districts—that is, a total population of 0.75 million.

The Home-Hotel-Hospital Care Model

The concept of the FEMH Home-Hotel-Hospital care model is illustrated in Figure 1. First, to keep asymptomatic or mildly symptomatic patients at home, we established the first COVID-19 call center in Taiwan on April 11, 2022. It was operated by the nursing staff at the FEMH—based on phone interviews with COVID-19-positive patients, they directed the patients to either stay at home, transfer to quarantine centers (hotel), or referred them to hospitals for admission. Second, on April 6, 2022, two medical teams set up two designated quarantine hotels based on previous experience in setting up quarantine centers in two hotels.^{16,17} The designated quarantine hotels admitted patients with risk factors and those without adequate accommodation for quarantine, and telehealth care access was provided via smartphone apps for video diagnosis and treatment advice. Additionally, these designated quarantine hotels acted as a detention basin for hospitalized patients after improvement upon initial treatment. Finally, the hospital focused on care for severe COVID-19 patients and community screening, provided virtual clinic services, and telehealth care, and maintained medical capacity to care for regular and infected patients.

Call Center for Home Care

The FEMH pioneered the remote home care services, the call center, in Taiwan on

April 11, 2022. The nurse practitioners of the FEMH call center conducted triage by phone calls to COVID-19-PCR positive patients. Patients with high risk of developing severe illness (e.g., old age, dialysis, pregnancy, persistent fever, dyspnea, etc.) were triaged to medicalized quarantine hotels or hospitals; low-risk patients were triaged to receive remote home care. For the latter, the nurse practitioners monitored their self-reported symptoms and vital signs via the iCare App; they proactively made phone calls to the less technology savvy patients to provide home care. The FEMH call center offered 33 landlines of 24/7 accessibility to receive call-in inquiries, to provide health counseling, to refer to remote clinics, and to transfer indicated patients to emergent room (ER).

The FEMH developed its own cloud-based “intelligent case management system” (iCMS) to efficiently identify and triage high-risk patients. Furthermore, the iCMS proactively sent outbound text messages and arranged remote outpatient visits to qualified high-risk patients for anti-viral therapies. To ensure timely antiviral medication, since May 8, the iCMS incorporated COVID-19 diagnosed cases and proactively initiated triage and medical therapies, without waiting for the Bureau of Health’s dispatch processes, which significantly reduced the waiting period from diagnosis to antiviral medications.

Collaboration with Community Care-Providers and Clinics

To invite participation and collaboration from community clinics, the FEMH extended the home care experience outside to external community clinics starting from May 4, 2022. Within three weeks, a total of 91 community clinics received referral from FEMH to take care of an accumulated 16,890 COVID-19 patients. During the peak of the pandemic, the FEMH Home Care Center served as the coordinating center between the Bureau of Health of New Taipei City government and more than 200

community care-providers. The FEMH Home Care Center communicated critical information such as relaying top-down, rapidly modifying policies, as well as bottom-up community needs and realities back to the authorities.

Early Anti-viral Treatment in Long-term Care Facilities

Per contemporary rules, vulnerable long-term care facility residents would have to visit emergency rooms to undertake COVID-19 PCR tests and returned the facilities, waiting for results of PCR tests and then conduct video clinics for anti-viral treatment if qualified per CECC guidelines. To reduce COVID-19-related complications in these vulnerable facility residents, the FEMH Home Care Center arranged remote video clinics on the same day of positive rapid antigen tests (RAT) and dispatched early anti-viral therapies for qualified patients since May 11, 2022. In 2022, the FEMH established collaboration with 52 long-term care facilities, and operated 98 sessions of remote video clinics, which served 1,464 positive- rapid-antigen test (RAT) residents. Among them, 1,196 residents (81.6%) were prescribed anti-viral therapies following CECC guidelines.¹⁸ This approach facilitated early intervention and preserved hospital resources.

Transforming Hotels into COVID-19 Dedicated Care Hotels

Infection control was the initial critical step in transforming hotels into COVID-19 dedicated care hotels. To enforce infection control, we segregated hotel elevators into “red, yellow and green zones”. The “red zone” was used by patients and by transporting medical waste. The “yellow zone” was used by staff to enter and exit the patient isolation area. Lastly, the “green zone” was only used by staff to commute to and from get off work. By strict segregation of three pathways, we tried to eliminate the risk of cross contamination.

Staffing with healthcare providers into the hotels was the second key step in the transformation, which included four staff groups of physicians, nurses, and original hotel service, security, and logistics staff. On-site physicians provided medical consultation and interpretation of rapid antigen testing (RAT) results of COVID-19. Nurses checked in the quarantined patients daily and provided the front-line care. The remaining staff groups were supported by original hotel staff and ensured the continued operation of the hotels.

Through rapid deployment and close collaboration, FEMH worked with hotel staff groups in the transformed hotels for the unique “Hotel care” in the FEMH 3H care model.

Hospital Service

The Wan-Hua outbreak of May 2021 resulted in rapid expansion of service for hospitalized patients.¹⁹ The major concern of specialized COVID-19 service areas was whether negative pressure was necessary. Learning from previous experience, and confident because of significant vaccination coverage in the society, the staff provided care with proper personal protective equipment in designated wards without negative pressure rooms. The major concern in 2022 was that infected healthcare workers could not provide service. The peak of healthcare worker infection was approximately 1% daily, which significantly depleted the workforce. Fortunately, most healthcare workers suffered only mild symptoms, and soon returned to work. In 2021, during the Wan-Hua outbreak, the FEMH provided more than 50 beds in intensive care unit (ICU) and 138 beds in ward. In 2022, the FEMH provided 30 beds in ICU and more than 200 beds in ward at the peak of the surge in May 2022.

Evolution of Screening and Diagnosis Strategies

Since the onset of the pandemic, the polymerase chain reaction (PCR) test has remained the gold standard for COVID-19 diagnosis. However, the overwhelming rate of community transmission since April 2022 exceeded the existing PCR test capacity. Moreover, the turnaround time for PCR is long, and patients have to visit designated test centers for testing. Most importantly, awaiting PCR results often delays early antiviral treatment. Thus, starting May 12, the TCDC modified its policy, eliminating the necessity of PCR results as the diagnostic criteria for COVID-19 cases. People in home isolation or home quarantine were allowed to be legally diagnosed with COVID-19 after a physician's visual confirmation of positive rapid-antigen test (RAT) via the remote video clinic.

In response to such "Diagnosis by Positive RAT" policy (instead of "Diagnosis by Positive PCR" previously), the FEMH swiftly modified its administrative and information workflows and established remote video RAT confirmation clinics. These clinics utilized iCMS to confirm the patient's legality, which simplified the workflow processes of uploading relevant documents and reporting to the Bureau of Health. On a rolling basis, the TCDC expanded the "Diagnosis by Positive RAT" policy to elderly patients since May 18, and thereafter, to all patients since May 26. To address the exponential increase in the demand for remote video clinics, the FEMH opened new remote video clinics at daytime, night time, and on holidays.

PCR Testing for COVID-19 Pandemic in the FEMH

FEMH has meticulously established its 24/7-available, rapid PCR testing capacity since initially obtaining TCDC-approval in February 2020, and expanded its capacity from 10,109 in 2020, to 150,598 in 2021. And at the peak of outbreak and surged demands in May 2022, the PCR testing capacity rose to 70,031 per month. Such vast

capacity and rapid turnaround of PCR testing provided strong support of early diagnosis and early treatment for the FEMH 3H Care Model.

Results of the FEMH 3H Care Model

COVID-19 cases in Taiwan escalated after April 2022, especially among the high-density population of northern Taiwan. When the pandemic peaked in late May, the daily new COVID-19 positive count in Taiwan stood at approximately 100,000.¹⁴ The FEMH reported to the TCDC a total of 3,782 cases in April; 63,684 in May; 11,591 in June; and a total of 101,854 cases in 2022 (Figure 2).

At the beginning of the pandemic—from April to June 2022—our home care call center evaluated and triaged up to 104,244 COVID-19 cases, and provided remote home care for 96,894 cases, of which 127 patients (0.13%) were later referred for in-hospital admission. In 2022, we provided a total of 107,095 home care services (Figure 3).

Two quarantine hotels admitted a total of 1,834 persons from May 2022 to July 2022. Of these, 15 (0.8%) were referred to hospitals for admission; 255 (13.9%) were transferred from hospital ward after receiving treatment at the hospital; 597 (32.6%) were treated via online video clinics, and 98 (5.3%) patients were prescribed antiviral medications. A total of 4,069 COVID-19 patients were admitted to the hospital—371 in intensive care and 153 deaths—with an overall mortality rate of 3.8% in 2022 (Figure 4).

The telehealth outpatient clinic—including the online video clinic—served 25,775 cases; 21.5% (n=5,544) of them were prescribed antiviral medications (Figure 5). In 2022, the FEMH prescribed oral anti-viral therapies to 12,571 patients. At the peak of the pandemic in Taiwan, the FEMH dispatched up to 12.9% of all oral anti-viral prescriptions in Taiwan—this was on May 18, 2022—after the CECC permitted

outpatient prescriptions of oral anti-viral therapies for COVID-19 RAT-positive patients aged > 65 y/o (Figure 6).

Discussion

Back in 2021, at the peak of the initial COVID-19 outbreak, the service volume of hospitalization in FEMH dropped 50%, with 30% of hospitalizations due to COVID-19. In contrast, in 2022, the FEMH maintained 90% occupancy of hospitalization and less than 20% of hospitalizations were due to COVID-19—we believed that this was mostly attributed to the FEMH 3H care model, high vaccination coverage, and oral anti-viral agents. Collectively, the FEMH offered remote care to a total of 107,095 COVID-19 cases, admitted 1,834 persons in quarantine hotels, and hospitalized 4,069 cases in 2022.

Evolving Home Care Program Guidelines on a Rolling Basis

The first version of the Home Care Program Guideline by the CECC (April 8, 2022)¹⁵ applied only to COVID-19 PCR-confirmed patients aged less than 65 with only mild or no symptoms. Additional exclusion criteria included pregnancy, dialysis, co-habitants without confirmed infection being younger than 65 years, non-pregnant, and without dialysis; strict rules on single-room isolation were also applied.

With the surge of confirmed COVID-19 cases, the restrictions for the Home Care Program were relaxed. The modified CECC Home Care Program Guideline (May 17, 2022) eliminated dependence on the PCR test and relied on front-line physicians to diagnose and decide for home care—except for moderate to severe illness cases.

The initial CECC Home Care Guideline stated that COVID-19 patients could only take ambulance or quarantine taxi to hospitals—not their personal vehicles; the modified guideline removed this restriction after April 20, 2022. Initially, a patient could be released from isolation only after a negative RAT result after 10 days of isolation; gradually, this was reduced to five days, regardless of the RAT result.

The Guideline listed the following criteria to trigger referral to hospitals: dyspnea; respiratory distress; persistent chest pain; chest discomfort; disturbed consciousness; cyanosis of skin, lip, or nailbed; tachycardia without fever; inability to intake fluid, food, or medications; and reduced urine output for 24 hours. Compared to COVID-19 Home Care Programs elsewhere^{6,7,10,12,13,20-23}, pulse oximeters or monitoring equipment were not provided for home care patients.

Such extensive and rolling criteria implied significant workload of frontline healthcare providers who performed practice history taking, clinical examinations, and continuous monitoring. Therefore, the triage and caring process relied on the professionalism of the experienced medical personnel. As the pandemic subsided and accessibility to remote care improved, home-care for COVID-19 patients returned to the usual primary care system.

Diagnosis/treatment Criteria and Reporting System

Strict criteria for diagnosis and treatment and a comprehensive reporting system are crucial for effective management and evaluation of communicable diseases; however, healthcare systems possess limited capacity for this traditional structure. The reporting system was challenged in 2021, and the communicable disease reporting system was initially shut down, and thereafter, simplified. A similar situation was re-observed in 2022—at a much larger scale. When a communicable disease spreads as did the Omicron variant, its impact can be overwhelming. With the modification of diagnosis criteria from the PCR to RAT, and the establishment of remote video clinics, a real-time number of cases diagnosed with RAT could be obtained, and oral anti-viral treatment could be immediately started. Although the pandemic has peaked, repeated and frequent COVID-19 infections necessitate a revision of the current reporting system.

Conclusion

The FEMH “Home-Hotel-Hospital” care model based on medical triage principles not only enabled asymptomatic/non-critical patients to recover at home, but also provided moderately severe to critically severe patients access to early in-hospital care.

Additionally, transformation of hotels to designated quarantine centers helped divert the massive demand of in-hospital admissions, thus preserving medical capacity. In the future, this FEMH 3H care model will continue to play a significant role in COVID-19 management.

Figures

Figure 1 The FEMH “Home-Hotel-Hospital” 3H care model

Figure 2 COVID-19 monthly cases reported by Far Eastern Memorial Hospital in 2020-2022.

Figure 3. Monthly cases triaged and remote-cared by the FEMH Call Center in 2022.

Figure 4 Severe COVID-19 cases admitted to Far Eastern Memorial Hospital in 2022.

Figure 5 Monthly amounts of telehealth outpatient clinic and prescriptions of antiviral medications at Far Eastern Memorial Hospital via telehealth clinic in 2022

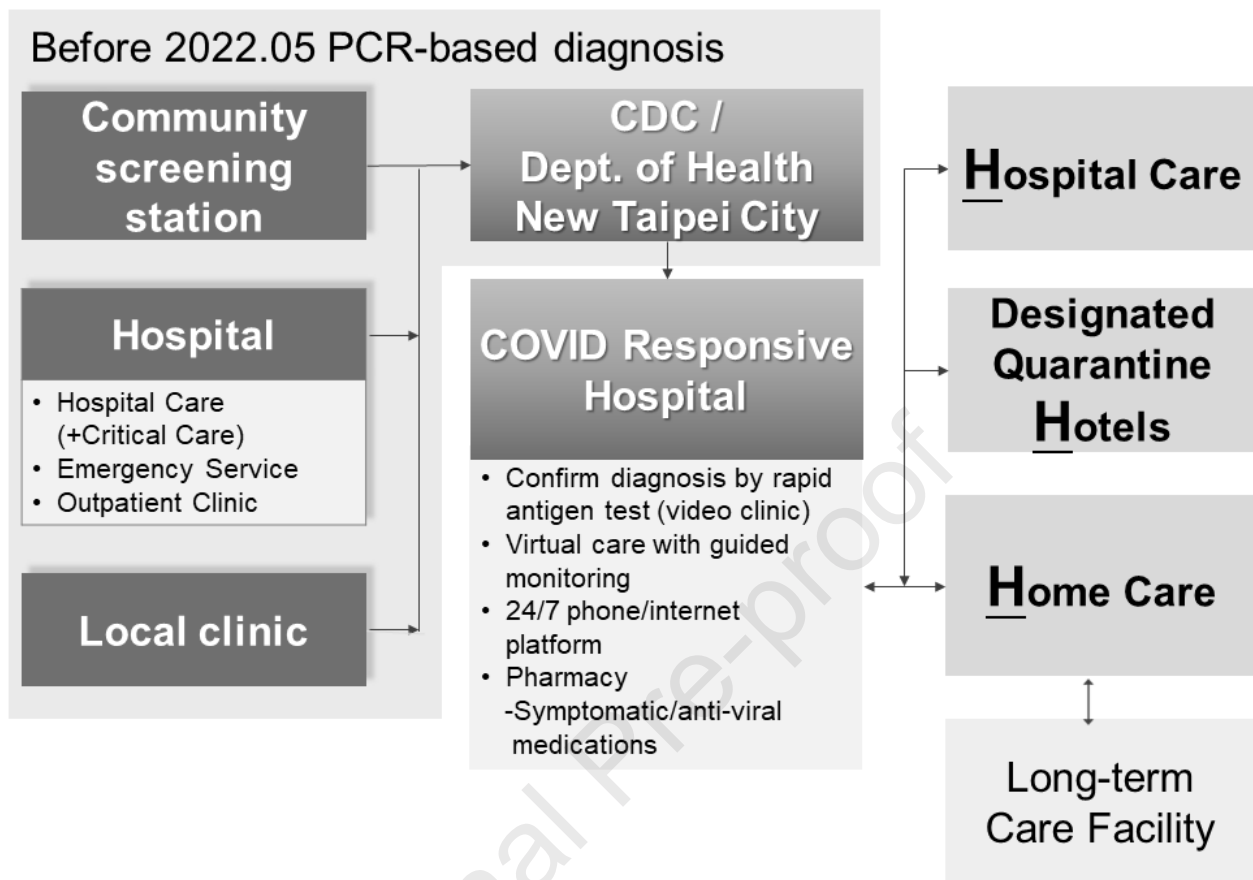
Figure 6 Daily prescriptions of oral anti-COVID-19 viral therapies at Far Eastern Memorial Hospital in May-Jun, 2022

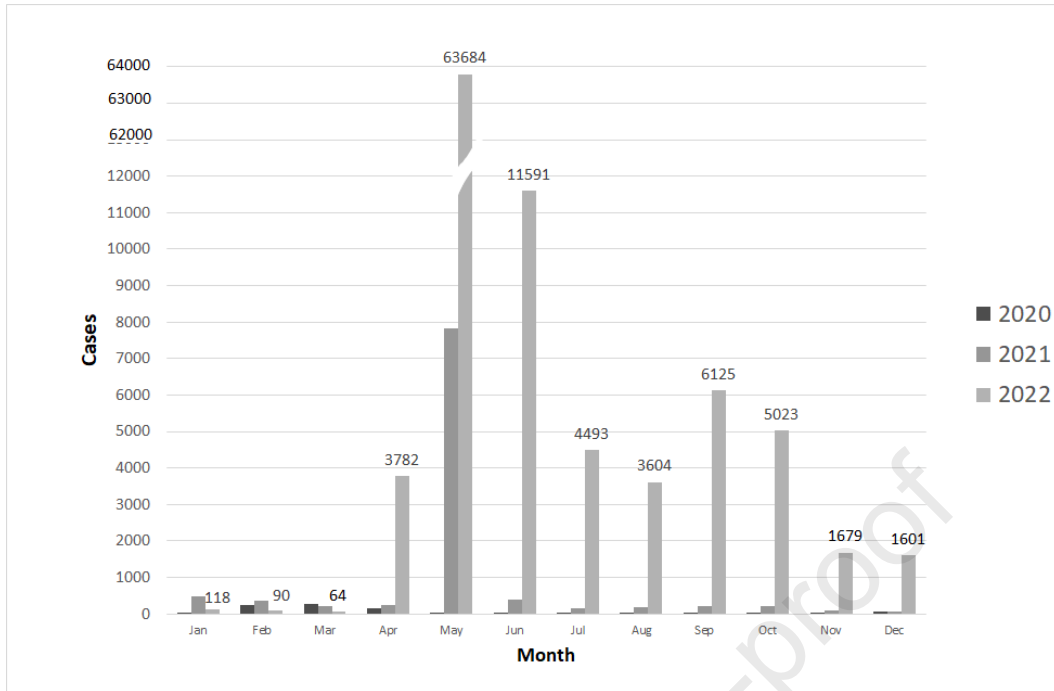
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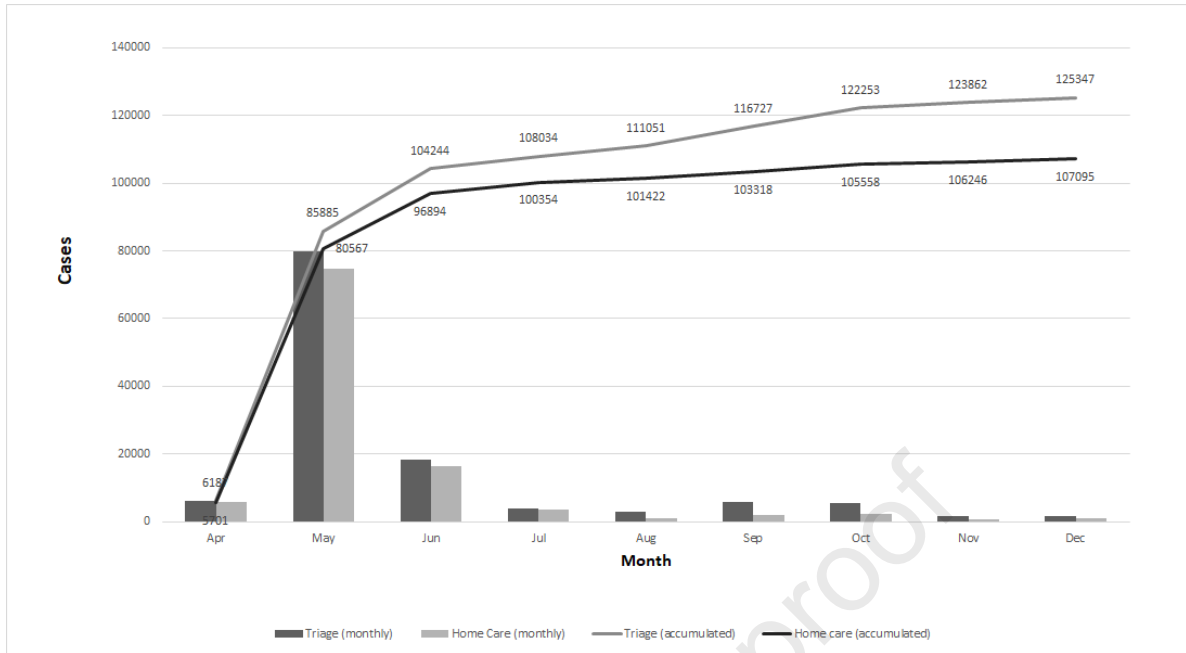
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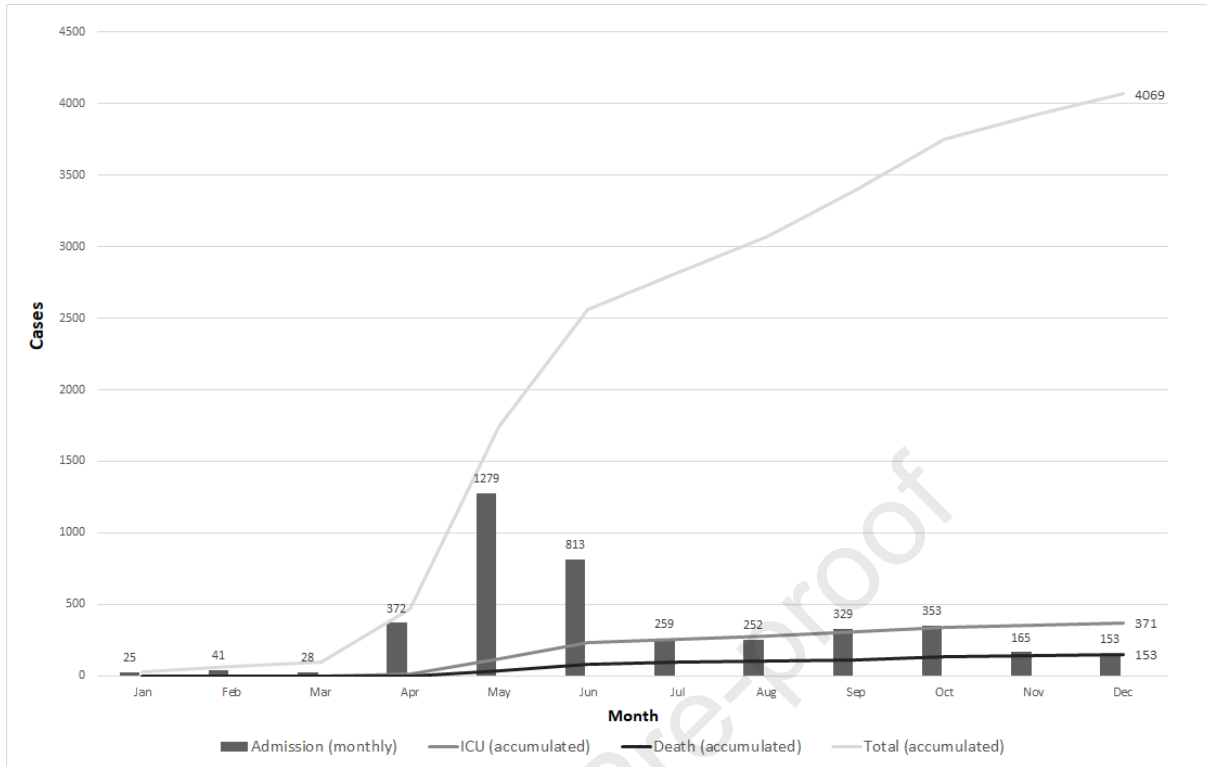
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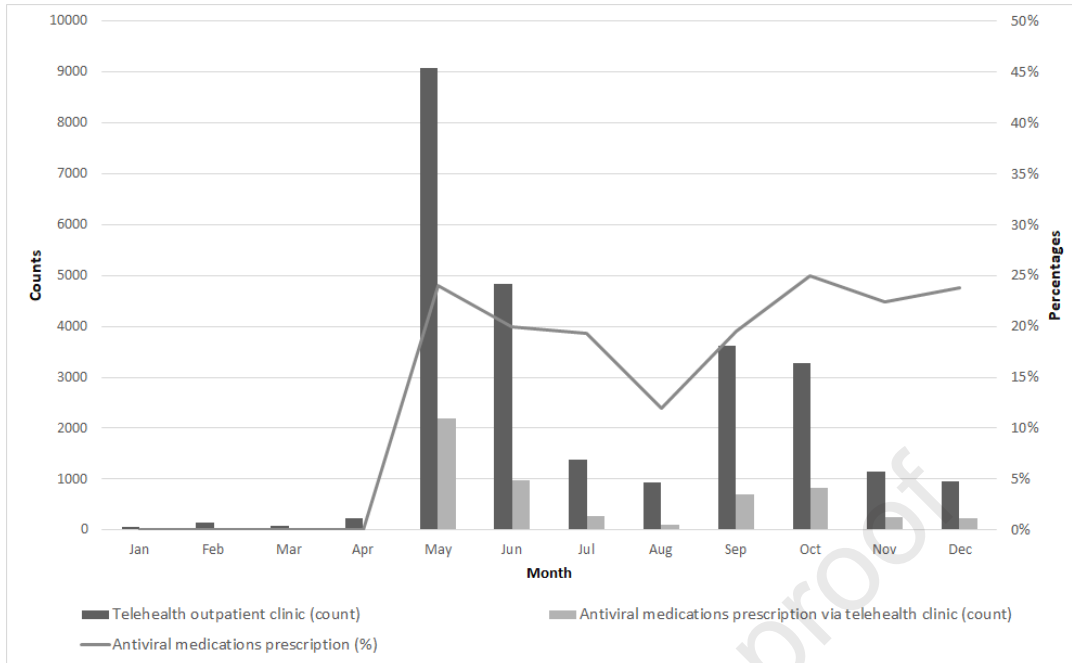
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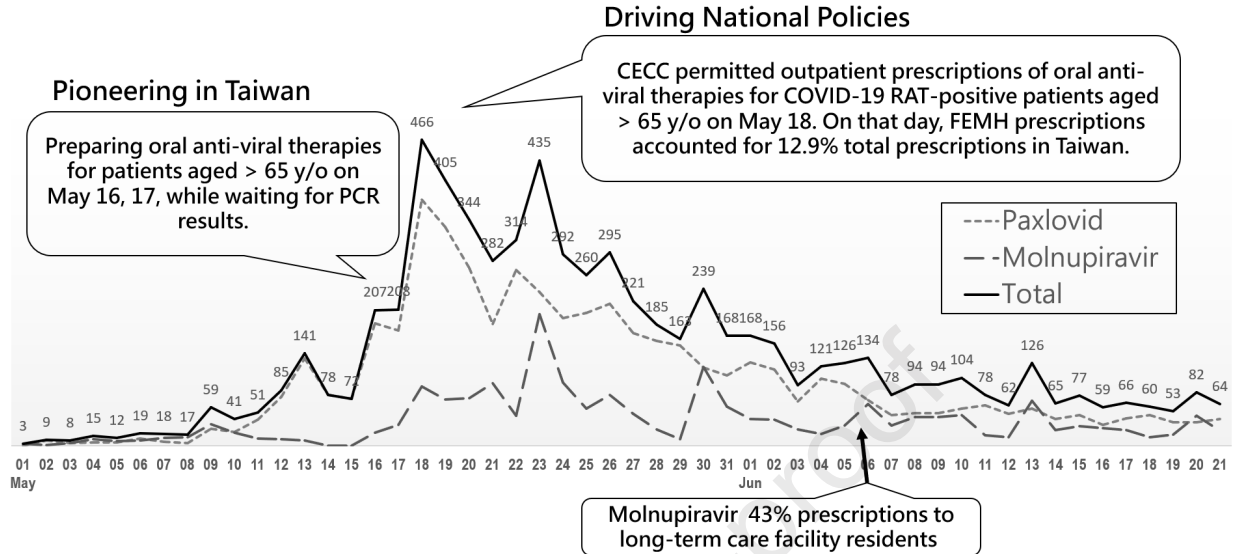












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