A Comparative Study of Pharmacy Services and Prescription Analysis in Internet-based Psychiatric Hospital During and After the COVID-19 Pandemic

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Abstract

Background: The COVID-19 pandemic has profoundly affected the mental health care system globally, and patients with mental disorders were more vulnerable to various challenges caused by pandemic-related quarantine measures. To ensure continuous and accessible pharmaceutical services for those patients, the Affiliated Brain Hospital, Guangzhou Medical University has implemented an internet-based hospital platform to offer remote pharmaceutical services.

Objective: This study aimed to analyze the characteristics and trends of internet-based psychiatric hospital prescriptions during and after the COVID-19 pandemic.

Methods: The electronic prescriptions from November 10th 2020 to December 31st 2023 were collected from the internet-based hospital. The characteristic analysis included factors such as gender, age, primary diagnosis, medications, audit time, approval rate, and the number of prescriptions per month.

Results: In this study, a total of 17,330 electronic prescriptions were collected from the internet-based hospital. During the pandemic phase, there were 11,812 prescriptions, with a male-to-female ratio of 1:1.62 and 47.46% of patients aged 18-40. Comparatively, in the post-pandemic phase, among 5,518 prescriptions, the gender ratio shifted to 1:1.76, the proportion of patients aged 18-40 increased marginally to 48.15%. Regarding primary diagnosis, during the pandemic phase, the top three diagnoses were depressive disorder (n=3,539, 29.96%), schizophrenia (n=2,095, 17.74%), and bipolar disorder (n=1,632, 13.82%). In the post-pandemic period, the top three diagnosis changed to depressive disorder (n=2,094, 37.95%), mood disorder (n=1,191, 21.58%), and schizophrenia (n=607, 11.00%). Quetiapine, lithium carbonate, and escitalopram remained the most prescribed medications throughout both periods. Prescription processing times showed notable variations. During the pandemic, 50.79% of prescriptions were audited within 5 minutes, compared to 18.09% post-pandemic. Conversely, prescriptions audited within 1-12 hours increased from 12.41% to 36.81% between periods. Rates of pharmacist approval and Physician double-check requirements demonstrated significant improvements. The proportion of prescriptions approved by pharmacists increased from 83.34% to 96.54%, while the proportion of prescriptions double-check by doctors decreased from 16.47% to 3.41%. Internet-based hospital utilization revealed dramatic growth. Initial operations yielded only 76 prescriptions (0.44%) in the first seven months, which surged to 3,427 (19.77%) during the month of suspended outpatient services. After the pandemic prescription volumes stabilized at approximately 460 per month.

Conclusions: The psychiatric hospital demonstrated the online medication services provided by internet-based hospitals were increasingly embraced by patients and evolved into routine healthcare solutions. This study revealed the characteristics and trends of electronic prescriptions in internet-based psychiatric hospitals during and after the COVID-19 pandemic, and may provide reference for public crisis in the future.

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Abstract

Background: The COVID-19 pandemic has profoundly affected the mental health care system globally, and patients with mental disorders were more vulnerable to various challenges caused by pandemic-related quarantine measures. To ensure continuous and accessible pharmaceutical services for those patients, the Affiliated Brain Hospital, Guangzhou Medical University has implemented an internet-based hospital platform to offer remote pharmaceutical services.

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Conclusions: The psychiatric hospital demonstrated the online medication services provided by internet-based hospitals were increasingly embraced by patients and evolved into routine healthcare

solutions. This study revealed the characteristics and trends of electronic prescriptions in internet-based psychiatric hospitals during and after the COVID-19 pandemic, and may provide reference for public crisis in the future.

Keywords: COVID-19; mental disorders; internet hospital; pharmacy services; prescriptions

Introduction

Since the outbreak of the COVID-19 pandemic at the end of 2019, global healthcare systems have been under immense pressure[1,2]. The pandemic has served as a critical stress test for conventional healthcare delivery systems, especially in managing the complex needs of psychiatric patients who require long-term medication[3]. To contain the virus's transmission, China implemented a comprehensive set of critical public health measure[4,5]. However, these measures inevitably disrupted conventional outpatient service operations. This resulted in periodic limitations on patients' access to in-person medical consultations, potentially compromising both the continuity and the maintenance of clinical care[6]. In response to these challenges, the accelerated expansion of internet-based hospital services emerged as a transformative solution, effectively addressing the limitations of conventional healthcare delivery systems while maintaining uninterrupted access to essential medical care for patients[7,8].

The COVID-19 pandemic highlighted several significant advantages of internet hospitals, particularly in transforming mental healthcare delivery. These digital platforms fundamentally improved healthcare accessibility by enabling patients to consult specialists and receive treatment remotely[9,10], a crucial development for individuals in geographically isolated areas or under quarantine restrictions[11]. Furthermore, internet hospitals demonstrated exceptional capacity in facilitating timely interventions and maintaining continuity of care, which proved essential for effective management of chronic mental health conditions[12]. Simultaneously, these platforms significantly alleviated pressure on overburdened healthcare systems by diverting non-emergency cases to online services, thereby optimizing resource allocation and reducing patient waiting times[13].

Beyond their role in resource optimization, internet hospitals provided comprehensive support systems specifically tailored for mental health patients. These platforms effectively addressed critical challenges in mental healthcare, particularly the societal stigma and misconceptions that often hinder treatment adherence[14]. By

offering discreet access to professional pharmaceutical services[15], including medication consultation[16], medication therapy management[17], and patient education[18], internet hospitals created a supportive environment that enhanced treatment continuity. The integration of online follow-up consultations and home medication delivery services not only reduced patients' financial burdens[19-21], but also significantly improved medication adherence rates[22]. Thus, these digital platforms provided a private, stigma-free treatment alternative, effectively mitigating the psychological distress often associated with societal misconceptions about mental illness[23]. Given the critical importance of ensuring safe and effective pharmacological treatment for psychiatric patients through internet hospitals, this study conducted a comprehensive retrospective analysis of electronic prescriptions from the internet pharmacy services at the Affiliated Brain Hospital, Guangzhou Medical University. By comparing prescription information during and after the COVID-19 pandemic, our research aims to better understand the evolving medication needs of psychiatric patients and offer valuable insights for developing effective responses to future public health emergencies.

Materials and Methods

Platform Development

During the COVID-19 pandemic, the Affiliated Brain Hospital, Guangzhou Medical University established an internet-based hospital, with all electronic prescription services provided through a website and app developed by Guangdong Yunhui Technology Co., Ltd.

Data Collection

In this study, a total of 17,330 electronic prescriptions were collected from November 2020 to December 2023, stratified into two distinct periods according to the time that Chinese government announced the end of all the COVID-19 prevention

and quarantine control measures. The pandemic phase (November 2020-December 2022) accounted for 11,812 prescriptions, while the post-pandemic phase (January 2023-December 2023) comprised 5,518 prescriptions.

Data Processing

Following rigorous data cleaning that excluded cancelled prescriptions, and pending prescriptions, a total of 17,330 valid prescriptions were included in the final analysis. The prescription information analyzed included gender, age, primary diagnosis, medicine, audit time, audit results, and prescription date. All statistical analyses and graphical representations were performed using GraphPad Prism version 10.1.2 (La Jolla, CA, USA). The prescription processing workflow for the internet hospital was as shown in the flowchart (**Figure 1)**.
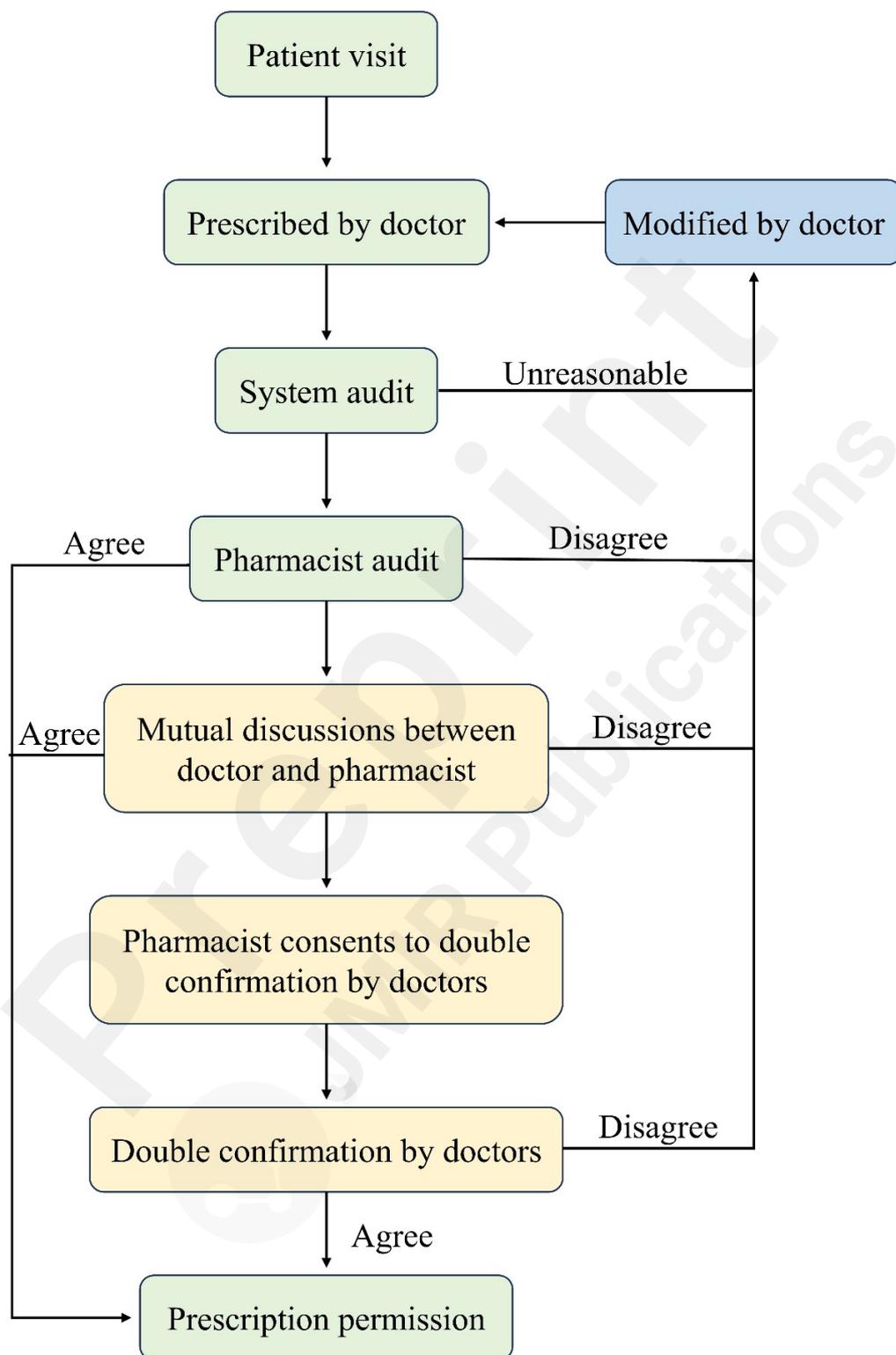
Figure 1. The workflow of the online prescriptions.

Results

Characteristics of prescriptions from internet-based hospital

For comparative analysis, all data were standardized using percentage distributions. The study population demonstrated a consistent gender distribution pattern, with male-to-female ratios of 1:1.62 during the pandemic phase and 1:1.76 in the post-pandemic phase (**Table 1**). Young adults aged 18-40 years constituted the predominant demographic cohort, accounting for 47.46% (n=5,606) of prescriptions during the pandemic and 48.15% (n=2,657) in the subsequent phase. Analysis of the number of prescribed drugs revealed that 88.09% (n=10,405) of pandemic-period prescriptions and 92.35% (n=5,096) of post-pandemic prescriptions contained one to three medications, consistent with standard prescription management regulations.

Table 1. Characteristics of prescriptions in internet-based hospital.

Characteristic	Number of patients (ratio)	
	During pandemic	**Post pandemic**
Total number of patients	11812	5518
Gender		
Male	4515	1998
Female	7297	3520
Age (years)		
≤17	2873 (24.32%)	1880 (34.07%)
18-40	5606 (47.46%)	2657 (48.15%)
41-65	2400 (20.32%)	703 (12.74%)
≥66	933 (7.90%)	278 (5.04%)
Number of drugs per prescription		
1	3896 (32.98%)	2231 (40.43%)
2	3947 (33.42%)	1897 (34.38%)
3	2562 (21.69%)	968 (17.54%)
4	1109 (9.39%)	353 (6.40%)
5	298 (2.52%)	69 (1.25%)

Distribution of primary diagnosed diseases in internet-based hospital

The analysis revealed that psychiatric disorders accounted for the predominant proportion of electronic prescriptions issued through the internet-based hospital platform (**Table 2**). The diagnostic distribution of the top five psychiatric conditions demonstrated variations between the pandemic and post-pandemic periods. During the pandemic period (November 2020-December 2022), the most commonly diagnoses were depressive disorder (n=3,539, 29.96%), schizophrenia (n=2,095, 17.74%), bipolar disorder (n=1,632, 13.82%), mood disorder (n=1,444, 12.22%), and anxiety disorder (n=1,208, 10.23%). In the subsequent post-pandemic phase (January 2023-December 2023), diagnostic patterns shifted significantly, with the following distribution: depressive disorder (n=2,094, 37.95%), mood disorder (n=1,191, 21.58%), schizophrenia (n=607, 11.00%), anxiety disorder (n=323, 5.85%), and bipolar disorder (n=301, 5.45%). This comparative analysis highlights substantial changes in diagnostic patterns and disease prevalence across the study periods, potentially reflecting evolving mental health needs and healthcare utilization patterns in the transition from pandemic to post-pandemic conditions.

Table 2. Distribution of primary diagnosed diseases in internet-based hospital.

During pandemic		Post pandemic	
Diseases	**Number of internet prescriptions**	**Diseases**	**Number of internet prescriptions**
Depressive disorder	3539 (29.96%)	Depressive disorder	2094 (37.95%)
Schizophrenia	2095 (17.74%)	Mood disorder	1191 (21.58%)
Bipolar disorder	1632 (13.82%)	Schizophrenia	607 (11.00%)
Mood disorder	1444 (12.22%)	Anxiety disorder	323 (5.85%)
Anxiety disorder	1208 (10.23%)	Bipolar disorder	301 (5.45%)
Obsessive-compulsive disorder	328 (2.78%)	Obsessive-compulsive disorder	162 (2.94%)
Attention deficit hyperactivity disorder	232 (1.96%)	Attention deficit hyperactivity disorder	127 (2.30%)
Alzheimer's disease	164 (1.39%)	Autistic disorder	117 (2.12%)

| Autistic disorder | 116 (0.98%) | Alzheimer's disease | 72 (1.30%) |
| Epilepsy | 108 (0.91%) | Epilepsy | 49 (0.89%) |

Distribution of drug prescriptions of internet-based hospital

A total of 109 distinct medications were analyzed pharmacologically in two study periods (**Table 3**). During the pandemic phase (November 2020-December 2022), the predominant pharmacological agents were quetiapine (n=2,653, 10.44%), lithium carbonate (n=1,439, 5.66%), and escitalopram (n=1,414, 5.57%). The post-pandemic phase (January 2023-December 2023) maintained similar therapeutic preferences, though with adjusted prescription frequencies. In the post-pandemic phase, the top-three most frequently prescribed medicine were quetiapine (n=1,276, 11.94%), lithium carbonate (n=733, 6.86%), and escitalopram (n=710, 6.64%). This consistent pharmacological profile across both periods suggests stable treatment protocols for managing psychiatric conditions through the internet-based hospital platform.

Table 3. Distribution of medication of internet-based hospital.

During pandemic		Post pandemic	
Medications	**Frequency**	**Medications**	**Frequency**
Quetiapine	2653 (10.44%)	Quetiapine	1276 (11.94%)
Lithium Carbonate	1439 (5.66%)	Lithium Carbonate	733 (6.86%)
Escitalopram	1414 (5.57%)	Escitalopram	710 (6.64%)
Olanzapine	1398 (5.50%)	Tandospirone	657 (6.15%)
Sodium Valproate	1356 (5.34%)	Sodium Valproate	612 (5.73%)
Sertraline	1356 (5.34%)	Sertraline	584 (5.47%)
Aripiprazole	1247 (4.91%)	Aripiprazole	570 (5.33%)
TrihexyPhenidyl	1185 (4.66%)	Lamotrigine	495 (4.63%)
Tandospirone	932 (3.67%)	Fluoxetine	460 (4.30%)
Agomelatine	870 (3.42%)	Olanzapine	458 (4.29%)

Time spent on prescription audit in internet-based hospital

Prescription audit efficiency demonstrated significant temporal variations

between study periods (**Table 4**). During the pandemic period (November 2020-December 2022), 5,999 prescriptions (50.74%) were audited within 5 minutes, 3,255 prescriptions (27.56%) within 30 minutes, and 1,466 prescriptions (12.41%) within 1-12 hours. In contrast, the post-pandemic phase (January 2023-December 2023) revealed substantial shifts in audit timelines, 998 prescriptions (18.09%) were audited within 5 minutes, 1,359 prescriptions (24.63%) were audited within 30 minutes, and 2,031 prescriptions (36.81%) were audited within 1-12 hours. Comparative analysis identified two notable trends. First, the proportion of prescriptions audited within 5 minutes decreased by 32.83% between periods. Second, the percentage of prescriptions requiring 1-12 hours for audit nearly tripled, increasing from 12.41% to 36.81%. These temporal shifts in audit efficiency likely reflect evolving operational priorities and resource allocation strategies across pandemic and post-pandemic healthcare delivery models.

Table 4. Time spent on prescription audit in internet-based hospital.

Time allocated on prescription audit	Number of prescriptions	
	During pandemic	**Post pandemic**
≤ 5min	5999(50.79%)	998(18.09%)
5min-30min	3255(27.56%)	1359(24.63%)
30min-1h	957(8.10%)	669(12.12%)
1h-12h	1466(12.41%)	2031(36.81%)
12h-24h	86(0.73%)	404(7.32%)
24h-48h	45(0.38%)	54(0.98%)
> 48h	4(0.03%)	3(0.05%)

Outcomes of prescription audit in internet-based hospital

The prescription audit outcomes from the internet-based hospital were classified into three distinct categories: pharmacist-approved, physician-verified, and non-approved (**Table 5**). Analysis of the 11,812 prescriptions processed during the pandemic phase (November 2020-December 2022) revealed the following distribution: pharmacist-approved (n=9,844, 83.34%), Physician-verified (n=1,946,

16.47%), and non-approved (n=22, 0.19%). In the subsequent post-pandemic phase (January 2023-December 2023), analysis of 5,518 prescriptions demonstrated significant improvements in verification efficiency. 5,327 prescriptions (96.54%) were pharmacist-approved, 182 prescriptions (3.41%) were physician-verified, and only 3 prescriptions (0.05%) were non-approved. These findings indicate a 13.20% increase in pharmacist approval rates and an 13.06% reduction in physician verification requirements between study periods. The substantial enhancement in prescription verification efficiency likely reflects optimized operational protocols and improved system integration in the post-pandemic phase.

Table 5. Outcomes of prescription audit in internet-based hospital.

Outcome of prescription audit	Number of prescriptions	
	During pandemic	After pandemic
Passed	9844 (83.34%)	5327 (96.54%)
Double-checked by doctors	1946 (16.47%)	188 (3.41%)
Failed to pass	22 (0.19%)	3 (0.05%)

Monthly trends of the internet-based prescriptions

From November 2020 to December 2023, monthly prescription volumes showed distinct utilization patterns between the pandemic and post-pandemic phases (**Figure 2**). The pandemic phase demonstrated three characteristic periods of internet-based hospital utilization. In the initial implementation period (November 2020-May 2021), there was limited adoption with only 76 prescriptions, reflecting typical early-stage implementation challenges. In the outpatient service suspension period (June 2021), there has been a significant surge in the number of electronic prescriptions (n= 3,427), which accounting for 19.77% of the total prescriptions. From July 2021 to October 2022, the number of prescriptions remained relatively stable at approximately 357 prescriptions per month. But in secondary major outbreak period in Guangzhou (November 2022-December 2022), there were secondary utilization peak, with 1,506 prescriptions (8.69%) in November 2022 and 1,092 prescriptions (6.30%) in

December 2022.

The post-pandemic phase (January 2023-December 2023) exhibited stabilized utilization patterns, consistent monthly average of 460 prescriptions, which demonstrated sustained integration into the healthcare delivery system. These trends reflect the internet-based hospital's evolving role in responding to both systemic healthcare disruptions and regional public health emergencies, while establishing a stable post-pandemic service baseline.
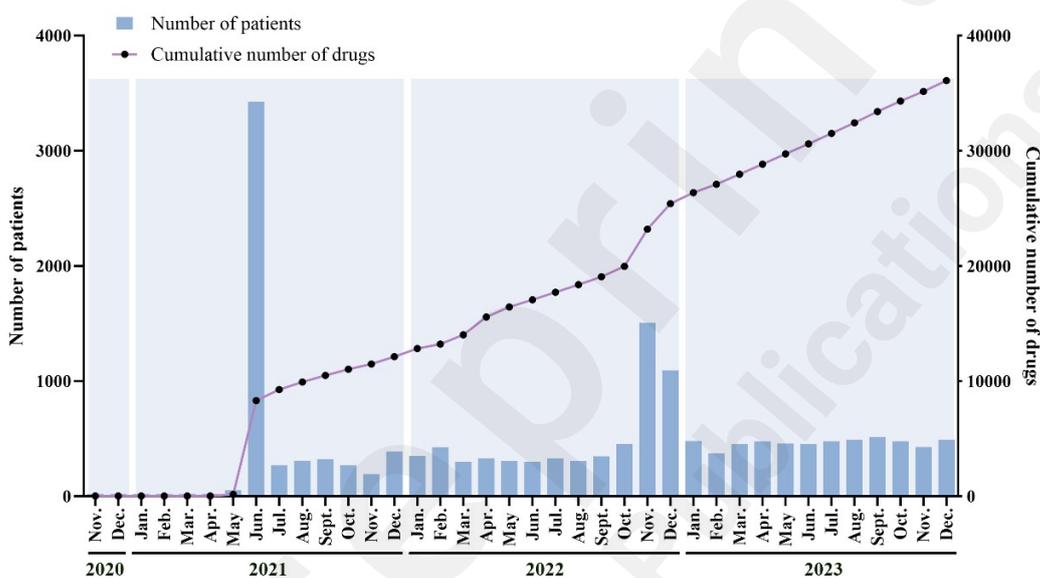

Figure 2. Monthly number of the online prescriptions from November 2020 to December 2023.

Discussion

This comprehensive study examined prescription patterns and utilization trends in an internet-based psychiatric hospital across pandemic and post-pandemic periods. The analysis revealed several key findings regarding patient demographics, pharmacological preferences, and service utilization. Young adults (18-40 years) consistently represented the predominant patient cohort and female patients outnumbered male patients in both study periods. Quetiapine, lithium carbonate, and escitalopram maintained their status as the most frequently prescribed medications. Prescription audit times were significantly shorter during the pandemic phase.

Pharmacist approval rates improved from 83.34% to 96.54% in the post-pandemic phase. In the initial implementation period showed minimal adoption (76 prescriptions over 7 months). But there was significant utilization surge during outpatient service suspension (peak: 3,427 prescriptions). After the pandemic, the number of prescriptions stabilized at 460 prescriptions per month. These findings collectively demonstrate the internet-based hospital's evolving role in psychiatric care delivery, highlighting its capacity to adapt to both emergency healthcare disruptions and long-term service integration.

This study's findings are supported by an extensive dataset of 17,330 electronic prescriptions, ensuring statistical reliability, methodological validity, and enhanced generalizability[24]. The substantial sample size not only strengthens the statistical power for detecting significant prescription trends and demographic patterns across pandemic phases but also minimizes potential margin of error and random variability[25]. Furthermore, the comprehensive dataset enables detection of subtle temporal variations, providing nuanced insights into the evolution of digital psychiatric care practices.

Our analysis of demographic trends revealed two significant patterns in internet-based service utilization. First, female patients consistently outnumbered male patients, corroborating existing literature demonstrating women's greater propensity to seek mental health services, particularly during public health crises[26,27]. Second, young adults (18-40 years) emerged as the predominant user group, potentially attributable to multiple intersecting factors. These include heightened vulnerability to pandemic-related stressors[28], such as career disruptions and financial instability, as well as increased digital literacy and a preference for online healthcare solutions. Additionally, virtual consultations align well with their lifestyle preferences and privacy needs, and they demonstrated greater adaptability to technological healthcare innovations compared to older demographics[29,30].

The comparative analysis of prescription processing metrics revealed distinct operational patterns between pandemic and post-pandemic phases. During the

pandemic, accelerated audit times were likely attributable to strategic reallocation of hospital resources to prioritize online services, the implementation of optimized audit workflows[31-33], and enhanced infection control measures necessitating rapid prescription processing[34]. The higher physician verification rates during this period may reflect initial physician unfamiliarity with digital platforms and increased clinical complexity of pandemic-era cases[35]. In contrast, the post-pandemic phase demonstrated improved operational efficiency, evidenced by higher pharmacist approval rates (96.54% vs. 83.34%), reduced physician verification requirements (3.41% vs. 16.47%), and sustained processing efficiency despite decreased audit speed. Service utilization patterns demonstrated three distinct evolutionary phases. The initial implementation (November 2020-May 2021) was characterized by limited adoption due to patient hesitancy and platform unfamiliarity, with cumulative total of 76 prescriptions. The outpatient service suspension (June 2021-October 2022) witnessed significant utilization surge, peaking at 3,427 prescriptions in June 2021, followed by stabilization at approximately 357 prescriptions per month. Local outbreak-related peaks occurred in November 2022, with 1,506 prescriptions. Post-pandemic stabilization (January 2023-December 2023) featured consistent monthly average of 460 prescriptions, demonstrating integration into standard care delivery and reflecting growing patient acceptance and trust. Collectively, these findings illustrate the internet-based hospital's transformation from an emergency response measure to an established component of comprehensive psychiatric care, highlighting its critical role in maintaining service continuity during healthcare disruptions and its potential for long-term integration into mental health service delivery models[36].

Future Prospects

While the global COVID-19 pandemic has transitioned to a sporadic phase, the persistent threat of emerging public health crises remains ever-present. Internet-based hospitals have demonstrated critical capacity in long-term medication need during healthcare disruptions, with pharmacy services constituting the cornerstone of

effective crisis response. To maximize operational resilience, we propose three evidence-based optimization strategies: strategic workforce optimization, implement tiered pharmacist deployment protocols during crisis surges, and establish real-time prescription surveillance through AI-augmented auditing systems. Additionally, we address geriatric-focused service adaptation by enhancing multimodal accessibility, which includes WeChat mini-programs, IVR telephone systems, smart TV interfaces, and family-mediated digital literacy programs with guided onboarding sessions. We also prioritize prescription routing for elderly patients with chronic conditions and implement iterative service quality improvement measures, including implement quarterly patient-reported outcome measures (PROMs), develop machine learning-driven sentiment analysis of service feedback, and establish rapid-cycle quality improvement protocols with < 72h implementation timelines. This multidimensional approach will reduce acute-phase workforce demands through predictive resource allocation while increasing elderly service utilization rates for sustainable digital healthcare systems in an era of recurrent public health challenges.

Limitations

This investigation has three principal limitations requiring consideration. First, the single-center design relying exclusively on data from a single internet-based hospital may limit the generalizability of findings across different healthcare systems and patient demographics. Second, the absence of longitudinal clinical outcome data, including treatment efficacy metrics, adverse event reporting, and patient-reported outcomes, which constrains our ability to assess prescription appropriateness comprehensively. Nevertheless, this research provides crucial empirical evidence regarding the operational dynamics of digital mental health pharmacovigilance systems during global health emergencies, offering a foundational framework for future multicenter studies.

Conclusions

This investigation conducted a retrospective analysis of internet-based psychiatry prescription patterns across pandemic and post-pandemic periods, identifying key operational characteristics including demographic distributions, prescription verification timelines, approval rates, and service utilization trends. The findings delineate critical evolutionary patterns in digital mental healthcare delivery and offer valuable insights for optimizing emergency response protocols in public health crises.

Authors' Contributions

JH and YT contributed to the study concept and design. DS contributed to the acquisition of data. GD and HX contributed to the statistical analysis and visualizing data. DG and HX drafted the manuscript. JH and YT contributed to the writing-review. YW contributed to the supervision. All authors contributed to the critical revision of the final manuscript and approved the final version of the manuscript.

Acknowledgments

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Umakanthan S, Sahu P, Ranade AV, et al. Origin, transmission, diagnosis and management of coronavirus disease 2019 (COVID-19). Postgrad Med J 2020 Dec;96(1142): 753-758. doi:10.1136/postgradmedj-2020-138234

2. Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, transmission, diagnosis, and treatment of coronavirus disease 2019 (COVID-19): a review. Jama 2020 Aug;324(8): 782-793. doi:10.1001/jama.2020.12839

3. Levitt G, Weller JA, Pandurangi A, Thippaiah SM. Impact of SARS-CoV-2 infection and implementation of infection prevention and control (IPC) measures on inpatient psychiatric units. Asian J Psychiatr 2021 Dec;66: 102868. doi:10.1016/j.ajp.2021.102868

4. Sunjaya AP, Jenkins C. Rationale for universal face masks in public against COVID-19. Respirology 2020 Jul;25(7): 678-679. doi:10.1111/resp.13834

5. Zhang J, Litvinova M, Wang W, et al. Evolving epidemiology and transmission dynamics of coronavirus disease 2019 outside Hubei province, China: a descriptive and modelling study. The Lancet Infectious diseases 2020 Jul;20(7): 793-802. doi:10.1016/s1473-3099(20)30230-9

6. Dehghani Tafti A, Fatehpanah A, Salmani I, et al. COVID-19 pandemic has disrupted the continuity of care for chronic patients: evidence from a cross-sectional retrospective study in a developing country. BMC primary care 2023 Jul;24(1): 137. doi:10.1186/s12875-023-02086-6

7. Mosadeghrad AM, Afshari M, Isfahani P, et al. Strategies to strengthen the resilience of primary health care in the COVID-19 pandemic: a scoping review. BMC Health Serv Res 2024 Jul;24(1): 841. doi:10.1186/s12913-024-11278-4

8. Wu J, Xie X, Yang L, et al. Mobile health technology combats COVID-19 in China. The Journal of infection 2021 Jan;82(1): 159-198. doi:10.1016/j.jinf.2020.07.024

9. Sun S, Yu K, Xie Z, Pan X. China empowers Internet hospital to fight against COVID-19. The Journal of infection 2020 Jul;81(1): e67-e68. doi:10.1016/j.jinf.2020.03.061

10. Wu X, Kuang Y, Guo Y, Wu J, Xiao L. Internet hospital response to the COVID-19 pandemic in a tertiary hospital in China: Perspectives based on a mixed-methods. Digital health 2024 Jan;10: 1–19. doi:10.1177/20552076241228418

11. Ye J, He L, Beestrum M. Implications for implementation and adoption of telehealth in developing countries: a systematic review of China's practices and experiences. NPJ digital medicine 2023 Sep;6(1): 174. doi:10.1038/s41746-023-00908-6

12. Sugarman DE, Busch AB. Telemental health for clinical assessment and treatment. BMJ (Clinical research ed) 2023 Jan;380: e072398. doi:10.1136/bmj-2022-072398

13. Cao Y, Li Q, Chen J, et al. Hospital emergency management plan during the COVID-19 epidemic. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine 2020 Apr;27(4): 309-311. doi:10.1111/acem.13951

14. Clement S, Schauman O, Graham T, et al. What is the impact of mental health-related stigma on help-seeking? A systematic review of quantitative and qualitative studies. Psychological medicine 2015 Jan;45(1): 11-27. doi:10.1017/s0033291714000129

15. Lapão LV, da Silva MM, Gregório J. Implementing an online pharmaceutical service using design science research. BMC medical informatics and decision making 2017 Mar;17(1): 31. doi:10.1186/s12911-017-0428-2

16. Liu Y, Jin H, Yu Z, Tong Y. Impact of internet hospital consultations on outpatient visits and expenses: quasi-experimental study. J Med Internet Res 2024 Nov;26: e57609. doi:10.2196/57609

17. Bates DW, Cheng HY, Cheung NT, et al. 'Improving smart medication management': an online

expert discussion. BMJ health & care informatics 2022 Apr;29(1)doi:10.1136/bmjhci-2021-100540

18. Timmers T, Janssen L, Kool RB, Kremer JA. Educating patients by providing timely information using smartphone and tablet apps: systematic review. J Med Internet Res 2020 Apr;22(4): e17342. doi:10.2196/17342

19. Han S, Li L. Consulting doctors online after offline treatment: investigating the effects of online information on patients' effective use of online follow-up services. Frontiers in public health 2024 Apr;12: 1375144. doi:10.3389/fpubh.2024.1375144

20. Ding L, She Q, Chen F, et al. The internet hospital plus drug delivery platform for health management during the COVID-19 pandemic: observational study. J Med Internet Res 2020 Aug;22(8): e19678. doi:10.2196/19678

21. Wang K, Zou W, Lai Y, et al. Accessibility, cost, and quality of an online regular follow-up visit service at an internet hospital in China: mixed methods study. J Med Internet Res 2024 Oct;26: e54902. doi:10.2196/54902

22. Hassan A, Davies N. Expert insight into the use of ehealth interventions to aid medication adherence during COVID-19. Patient preference and adherence 2024 Mar;18: 721-731. doi:10.2147/ppa.S437822

23. Zhang M, Fan C, Ma L, et al. Assessing the effectiveness of internet-based interventions for mental health outcomes: an umbrella review. General psychiatry 2024 Jul;37(4): e101355. doi:10.1136/gpsych-2023-101355

24. Leung L. Validity, reliability, and generalizability in qualitative research. J Family Med Prim Care 2015 Jul;4(3): 324-327. doi:10.4103/2249-4863.161306

25. Akobeng AK. Understanding type I and type II errors, statistical power and sample size. Acta paediatrica (Oslo, Norway : 1992) 2016 Jun;105(6): 605-9. doi:10.1111/apa.13384

26. Liu S, Yang L, Zhang C, et al. Gender differences in mental health problems of healthcare workers during the coronavirus disease 2019 outbreak. Journal of psychiatric research 2021 May;137: 393-400. doi:10.1016/j.jpsychires.2021.03.014

27. Lindert J, Jakubauskiene M, Bilsen J. The COVID-19 disaster and mental health-assessing, responding and recovering. Eur J Public Health 2021 Nov;31(Supplement_4): iv31-iv35. doi:10.1093/eurpub/ckab153

28. Cook JA, Jonikas JA, Burke-Miller JK, et al. Social determinants, mental well-being, and disrupted life transitions among young adults with disabling mental health conditions. The journal of behavioral health services & research 2025 Jan;doi:10.1007/s11414-024-09924-0

29. Schultz A, Honnens S, Bauer EH, et al. Patients' preferences for virtual outpatient consultations and health care professionals' assessment of suitability for their patients: a single-centre survey. Journal of telemedicine and telecare 2024 Nov:1357633x241294125. doi:10.1177/1357633x241294125

30. Hamilton JL, Nesi J, Choukas-Bradley S. Reexamining social media and socioemotional well-being among adolescents through the lens of the COVID-19 pandemic: A theoretical review and directions for future research. Perspectives on psychological science : a journal of the Association for Psychological Science 2022 May;17(3): 662-679. doi:10.1177/17456916211014189

31. Li Y, Hu H, Rozanova L, Fabre G. COVID-19 and internet hospital development in China. Epidemiologia (Basel, Switzerland) 2022 Jun;3(2): 269-284. doi:10.3390/epidemiologia3020021

32. Dettori M, Castiglia P. COVID-19 and digital health: evolution, perspectives and opportunities. Int

J Environ Res Public Health. 2022 Jul;19(14)doi:10.3390/ijerph19148519

33. Yang Y, Le KJ, Liang C, et al. Changes in inpatient admissions before and during COVID-19 outbreak in a large tertiary hospital in Shanghai. Ann Transl Med 2022 Apr;10(8): 469. doi:10.21037/atm-22-1594

34. He D, Gu Y, Shi Y, Wang M, Lou Z, Jin C. COVID-19 in China: the role and activities of Internet-based healthcare platforms. Glob Health Med 2020 Apr;2(2): 89-95. doi:10.35772/ghm.2020.01017

35. Zheng SQ, Yang L, Zhou PX, Li HB, Liu F, Zhao RS. Recommendations and guidance for providing pharmaceutical care services during COVID-19 pandemic: a China perspective. Research in social & administrative pharmacy : RSAP 2021 Jan;17(1): 1819-1824. doi:10.1016/j.sapharm.2020.03.012

36. Omboni S, Padwal RS, Alessa T, et al. The worldwide impact of telemedicine during COVID-19: current evidence and recommendations for the future. Connected health 2022 Jan;1: 7-35. doi:10.20517/ch.2021.03
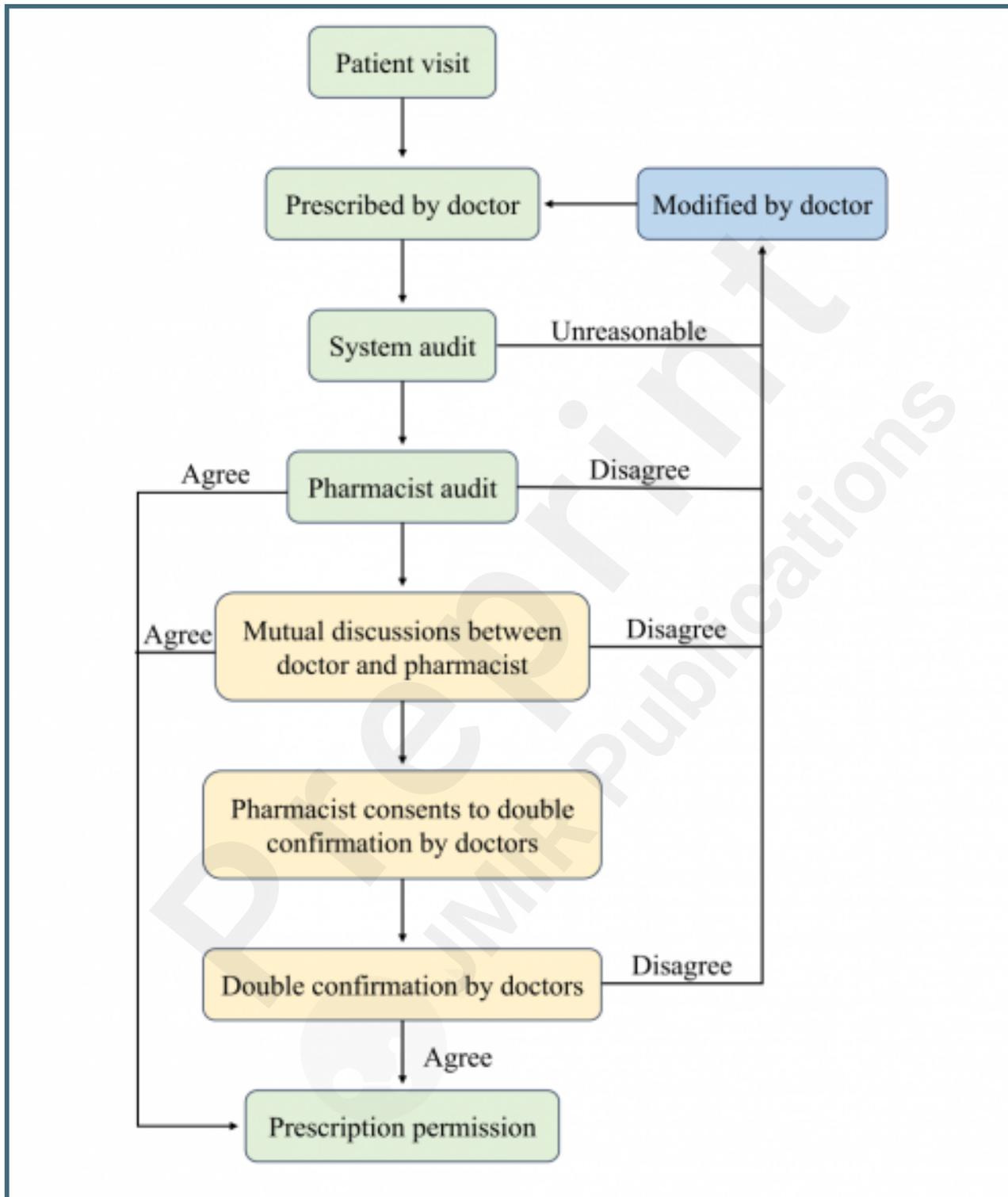
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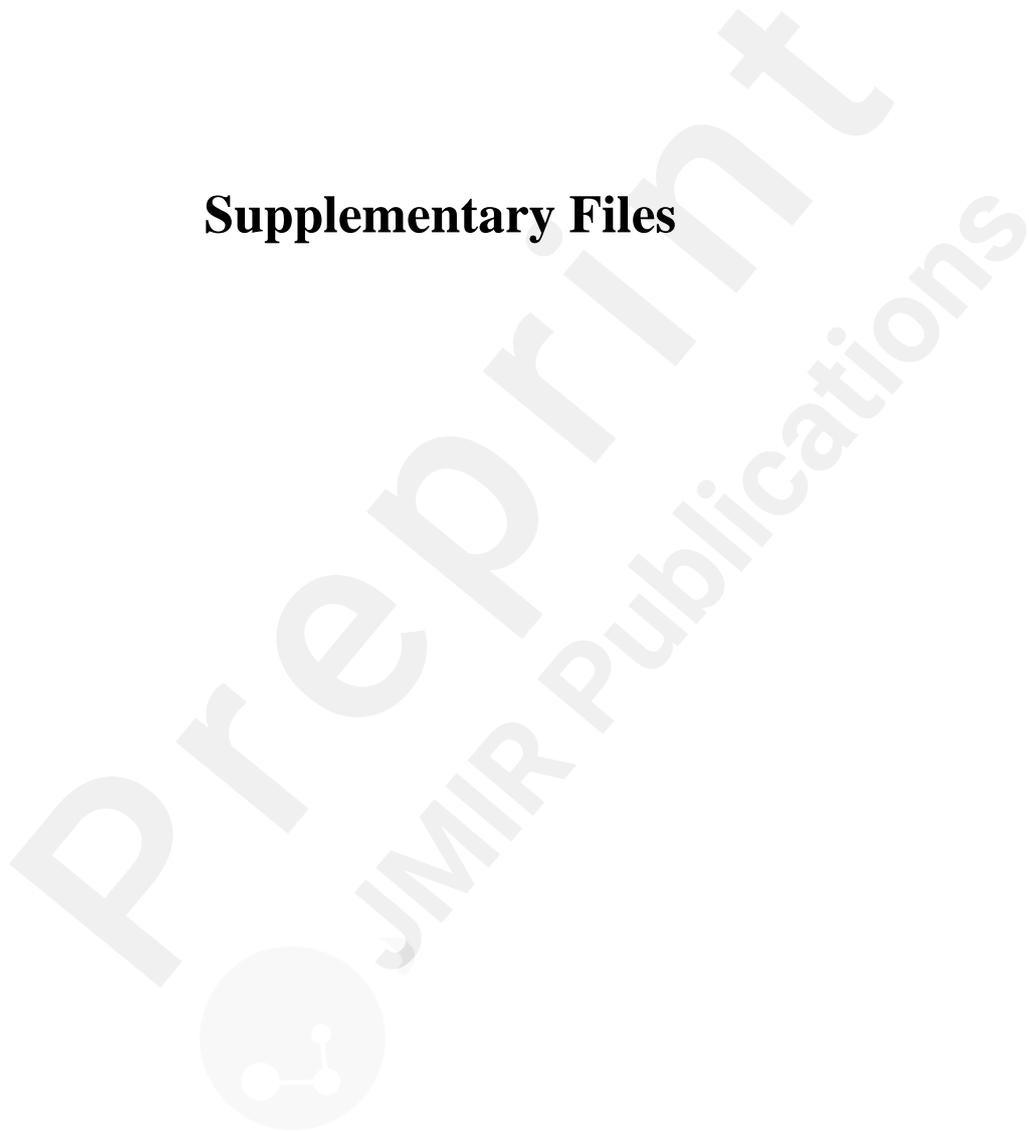
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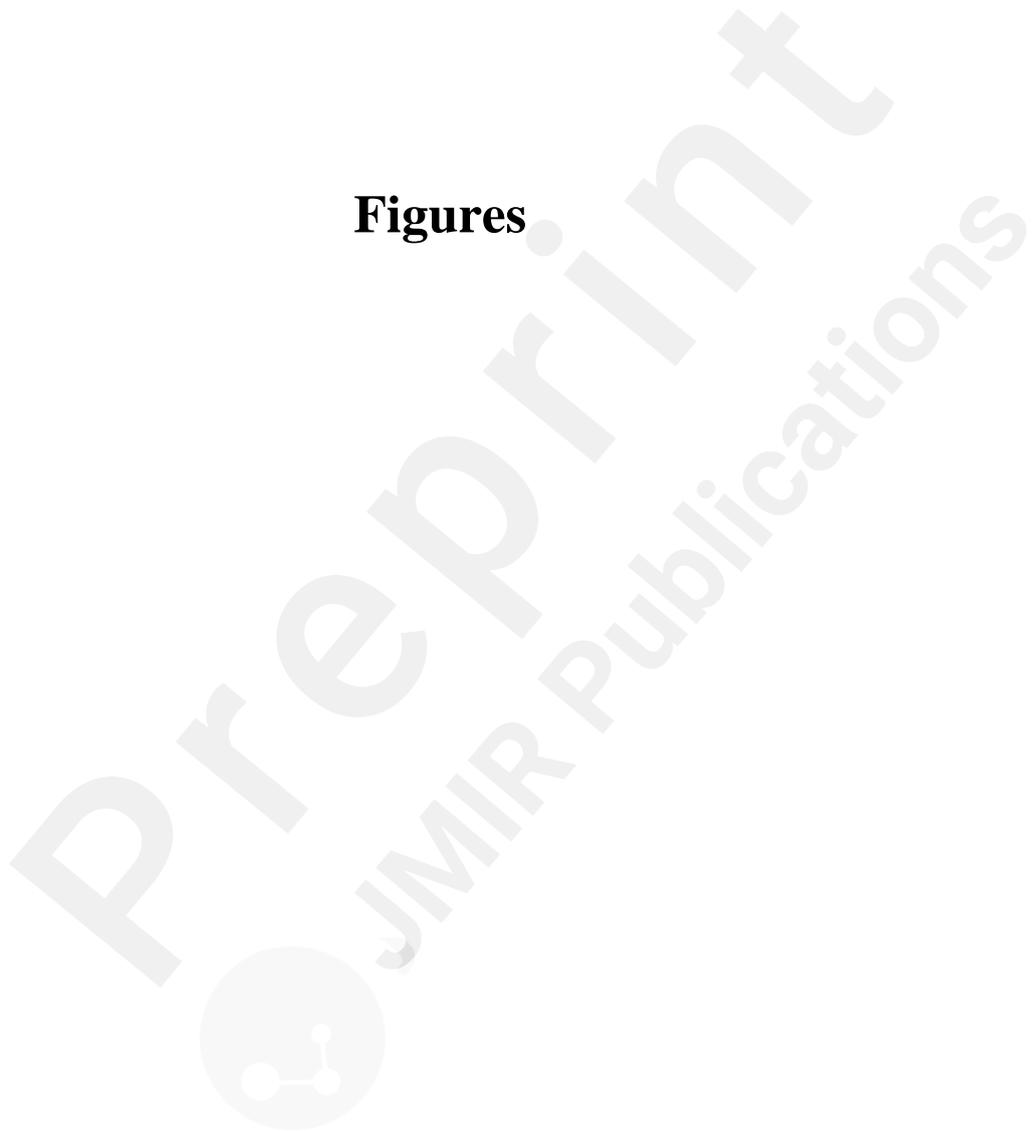
The workflow of the online prescriptions.

Monthly number of the online prescriptions from November 2020 to December 2023.