

The Perspectives of Community Pharmacists Toward the Name-Based Rationing System (NBRS) During the COVID-19 Pandemic in Taiwan: Cross-sectional Survey Study.

En-ling Chen, Chyi-Huey Bai, Paul T. Kocis, Wenke Hwang

Submitted to: JMIR Formative Research
on: April 29, 2024

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on its website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressly prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Original Manuscript..... 5

Supplementary Files..... 27

 Figures 28

 Figure 1..... 29

 Figure 2..... 30

 Figure 3..... 31

 Multimedia Appendixes 32

 Multimedia Appendix 1..... 33

 Multimedia Appendix 2..... 33

 Multimedia Appendix 3..... 33

 Multimedia Appendix 4..... 33

The Perspectives of Community Pharmacists Toward the Name-Based Rationing System (NBRS) During the COVID-19 Pandemic in Taiwan: Cross-sectional Survey Study.

En-ling Chen^{1, 2} MPH; Chyi-Huey Bai³ PhD; Paul T. Kocis⁴ PharmD, RPH, MPH, CACP; Wenke Hwang¹ MA, PhD

¹Department of Public Health Sciences Penn State College of Medicine Hershey US

²Department of Clinical Pharmacy Taipei Medical University Taipei TW

³Department of Public Health Taipei Medical University Taipei TW

⁴Department of Pharmacology Penn State College of Medicine Hershey US

Corresponding Author:

Wenke Hwang MA, PhD

Department of Public Health Sciences

Penn State College of Medicine

90 Hope Drive, Suite 2200

Hershey

US

Abstract

Background: In Taiwan's public health system, community-based pharmacists are often regarded as the first-line healthcare providers due to their high accessibility. During the COVID-19 pandemic, when there was an acute shortage of masks and testing kits, pharmacists played a central role in the distribution of these supplies through the Name-Based Rationing Systems (NBRS) that helped reduce the spread of the disease. The NBRS, an innovative government-guided strategy developed after the COVID-19 outbreak, allowed the public to access masks and COVID-19 test kits equitably and conveniently.

Objective: This study aims to investigate Taiwanese pharmacists' Knowledge, Attitude and Practices (KAP) for effectively responding to public health emergencies and the impact of the NBRS on community pharmacies.

Methods: A cross-sectional online survey was conducted in two major cities in Taiwan, from June 18th, 2022 to September 11th, 2022 during the peak of COVID-19 pandemic. To gauge community pharmacists' KAP, a 66-question instrument was developed using multiple guidelines from Taiwan's CDC, the International Pharmaceutical Federation, and the Taiwanese Pharmacist Association. The instrument was pilot-tested and externally validated by field experts.

Results: 343 Taiwanese community pharmacists were recruited in the study. Among them, 88% scored high in knowledge domain questions related to COVID-19, 50% in positive attitude toward NBRS, and 75% in practicing infectious disease prevention measures compliant with official guidelines. Results demonstrated a high level of competency in pharmacists in a public health crisis. It revealed factors including pharmacy ownership, age, and KAP of COVID-19 were associated with their perceptions and willingness to continuously participate in the NBRS. Responses also highlighted concerns about rapid government policy changes and supply dynamics, underscoring the importance of effective communication and considering supply availability in facilitating a successful NBRS.

Conclusions: The community pharmacy NBRS is an effective system to minimize the uneven distribution of preventive supplies during a public health crisis. Despite varied responses to the rationing system, the NBRS optimized the accessibility of community pharmacy networks and the clinical expertise of pharmacists to achieve an equitable outcome.

(JMIR Preprints 29/04/2024:60000)

DOI: <https://doi.org/10.2196/preprints.60000>

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**

Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.

Only make the preprint title and abstract visible.

No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain visible.

Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <http://www.jmir.org>, I will be able to make my manuscript PDF available to anyone at any time.



Original Manuscript

Original Paper

En-ling Chen, MPH^{1,2}, Chyi-Huey Bai, PhD³, Paul T. Kocis, PharmD, RPH, MPH, CACP⁴, Wenke Hwang, PhD, MA^{1*}

¹ Department of Public Health Sciences, Penn State College of Medicine, Hershey, PA, United States.

² Department of Clinical Pharmacy, Taipei Medical University College of Pharmacy, Taipei, Taiwan.

³ Department of Public Health, Taipei Medical University College of Medicine, Taipei, Taiwan.

⁴ Department of Pharmacology, Penn State College of Medicine, Hershey, PA, United States.

* Correspondence:

Wenke Hwang

whwang@psu.edu

Author Contributions

EC and CB initiated the study, with EC conducting data collection and analyses, and drafting the original manuscript. CB validated the questionnaire, oversaw data collection, and refined experimental procedures. PK meticulously reviewed the manuscript and assisted in editing and proofreading. Meanwhile, WH led the manuscript reorganization and conducted critical reviews. All authors contributed significantly to shaping the final paper.

The Perspectives of Community Pharmacists Toward the Name-Based Rationing System (NBRS) During the COVID-19 Pandemic in Taiwan: Cross-sectional Survey Study.

Abstract

Background

In Taiwan's public health system, community-based pharmacists are often regarded as the first-line healthcare providers due to their high accessibility. During the COVID-19 pandemic, when there was an acute shortage of masks and testing kits, pharmacists played a central role in the distribution of these supplies through the Name-Based Rationing Systems (NBRS) that helped reduce the spread of the disease. The NBRS, an innovative government-guided strategy developed after the COVID-19 outbreak, allowed the public to access masks and COVID-19 test kits equitably and conveniently.

Objective:

This study aims to investigate (1) Taiwanese pharmacists' Knowledge, Attitude and Practices (KAP) of COVID-19, with the intention to assess their preparedness for public health emergencies and their capabilities to implement COVID-19-related policies effectively, (2) their perspectives toward the NBRS, and (3) the association between individual's KAP and corresponding perspective toward the NBRS.

Methods:

A cross-sectional online survey was conducted in two major cities in Taiwan, from June 18th to September 11th of 2022, during the peak of COVID-19 pandemic. To gauge community pharmacists' KAP, a 66-question instrument was developed using multiple guidelines from Taiwan's CDC, the International Pharmaceutical Federation, and the Taiwanese Pharmacist Association. The instrument's internal consistency reliability was ascertained using Cronbach's alpha ($\alpha = 0.819$), and its content validity was established by field experts.

Results:

343 Taiwanese community pharmacists were recruited in the study. Among them, 88% scored high in knowledge domain questions related to SARS-CoV-2, 50%/44.9% in positive/neutral attitudes toward COVID-19-related policies, and 75% in practicing infectious disease prevention measures compliant with official guidelines. Results demonstrated a high level of competency in pharmacists in a public health crisis. It revealed factors including age, pharmacy characteristics and the number of customers were associated with their perceptions and willingness to continuously participate in the NBRS. Overall, the community pharmacists were more in favor of the COVID-19 testing NBRS (17.43 ± 4.68) than the mask NBRS (15.76 ± 4.44), due to the perceived more positive impacts on pharmacies' revenue and manpower, as well as pharmacists' well-being. Responses also highlighted concerns about rapid government policy changes and supply dynamics, underscoring the importance of effective communication and considering supply availability in facilitating a successful NBRS.

Conclusion:

The community pharmacists' good KAP justified the government leveraging their expertise in the fight against the COVID-19 pandemic in Taiwan. While community pharmacies have proven to be essential distribution centers through the NBRS, several adjustments, such as enhancing community connections, improving communication with the government, and considering supply dynamics, are suggested to enhance practitioners' perceptions of the system. These potential approaches aim to ensure successful NBRS implementation and better preparedness for future public health emergencies. Overall, pharmacists have demonstrated their integral

role in achieving equitable outcomes and their dedication to public health efforts in times of crisis.

Keywords: Name-Based Rationing System; NBRs; community pharmacy; community pharmacist; COVID-19; SARS-CoV-2; KAP; public health; health emergencies; government strategy.



Introduction

Background

COVID-19, a highly infectious respiratory disease caused by the novel coronavirus SARS-CoV-2, has significantly impacted global healthcare systems [1,2]. Despite Taiwan's geographic proximity to the initial epicenter of the COVID-19 outbreak, its swift response and containment policies during the early stages have allowed Taiwan to maintain a relatively controlled situation compared to other countries [3,4,5]. The first surge of COVID-19 cases in Taiwan occurred in late April 2021, with a total of 8,924 and 4,871 confirmed cases in May and June 2021, respectively [3]. This facilitated the government to implement stricter nationwide control measures such as a mask mandate, a ban on in-restaurant dining, work-from-home policies for nonessential businesses, and the cancellation of social and religious gatherings, resulting in Taiwan reporting zero daily cases by October 2021 [6,7]. Amidst the ongoing efforts to combat the COVID-19 pandemic, community pharmacists leveraged their existing network with the public and ensuring access to essential supplies and healthcare services to support communities, making them valuable assets in times of crisis.

In Taiwan, community-based pharmacists are often viewed as the frontline healthcare providers in the public health system [8]. During the COVID-19 pandemic, the high visibility and accessibility of community pharmacies made them key hubs for providing necessary health services, including medication, preventive supplies, and consultation [9]. In addition to the standard services provided by pharmacies, there were several expanded roles of community pharmacists introduced after the COVID-19 outbreak such as home delivery, telehealth consulting, and serving as the distribution center of the prevention supplies, bringing great convenience to the public [9,10].

Name-Based Rationing System (NBRS)

In response to the COVID-19 outbreak, the Taiwanese government initiated the "Name-based Rationing System" (NBRS) to ensure the public with adequate infection prevention supplies (e.g., masks and COVID-19 testing kits) [6,11]. This system called upon the Taiwanese community pharmacies to help distribute supplies while preventing chaotic purchasing behavior and public panic during the global crisis [3, 8,13,14]. Furthermore, this safeguarded the healthcare system by prioritizing healthcare providers' needs for masks during distribution [3,12]. An important feature of NBRS was its utilization of the National Health Insurance (NHI) system. The NHI, a government-managed health insurance program covering about 99% of the Taiwanese population [15,16], recognized individuals' ID numbers once they received healthcare services from NHI-contracted healthcare institutions, including community pharmacies. Consequently, the NHI data collection system received uploads of their electronic health records, encompassing diagnoses, procedures, and medications, and now equipped with records of supply purchases tied to the NBRS system [12].

Under the NBRS, individuals could purchase preventive supplies on designated days based on the last digit of their NHI card number. For instance, those with an odd-numbered NHI card could purchase masks or test kits on Mondays, Wednesdays, and Fridays, while those with even-numbered cards could do so on Tuesdays, Thursdays, and Saturdays. Sundays were open to all to prevent stockpiling [12]. Pharmacists could check customers' eligibility and whether the masks or testing kits were repeatedly purchased [12]. Therefore, the term "Name-Based" in the NBRS originates from its reliance on individuals' NHI cards for healthcare services and records, ensuring transparency and preventing exploitation of essential health supplies during a public health emergency.

Moreover, a survey of Taiwanese residents reported that 95.5% of participants believed mask-wearing was protective of COVID-19 infection [17]. The study also indicated a high level of satisfaction from the public as the system provided equitable distribution of supplies and pre-empted possible price gouging among distributors, effectively alleviating overall anxiety [17].

Challenges

Despite the benefits of the NBRS system to ensure fair distribution of medical supplies, pharmacists faced several challenges while implementing the system. One major challenge was managing the large numbers of the public requesting supplies, which created long queues of people waiting and at the same time increased the risk of COVID-19 transmission [13]. Another significant challenge faced by pharmacists was the time needed to individually package the masks that were initially provided in bulk into small units [8]. Unlike several other countries where the role of pharmacy technicians is well-established, Taiwan lacks this support system. As a result, the newly developed NBRS collaborating with the community pharmacy may result in burdensome time shifts for pharmacists, impacting their ability to carry out medication dispensing, patient education, and other essential services.

While several studies have discussed the advantages of the system [6,13,18,19], there is a lack of research on the perspectives of the NBRS practitioners, hindering a comprehensive understanding of the potential impacts of this system on community pharmacies. Despite the government's selection of community pharmacists to implement the NBRS, likely due to the high accessibility, existing community connections, and clinical expertise, a gap exists in assessing their preparedness for public health emergencies and their necessary capabilities to implement COVID-19-related policies effectively. This study seeks to address this by investigating Taiwanese community pharmacists' Knowledge, Attitudes, and Practices (KAP) toward COVID-19 since they play important roles in controlling the pandemic by disseminating accurate information, educating customers on preventive measures and serving as the distribution center of essential supplies, which reached a broader population within the communities.

Therefore, the study aims to fill the aforementioned gap in the literature by examining (1) pharmacists' KAP, (2) their perspectives toward the NBRS, and (3) the association between individual's KAP and corresponding perspective toward the NBRS. By exploring these research questions, we can gain a more comprehensive understanding of the factors influencing pharmacists' perspectives toward public health interventions during pandemics, and better support pharmacists in their important roles in the next global health crisis.

Methods

Study Design

A cross-sectional online questionnaire was distributed in Taiwan from June 18th to September 11th of 2022, during the COVID-19 pandemic, to analyze pharmacists' Knowledge, Attitudes, and Practices (KAPs) of COVID-19 and the impact of the NBRS on community pharmacies.

Questionnaire development and structure

The questionnaire was developed and referenced from multiple sources, including the International Pharmaceutical Federation (FIP), the official website of the Taiwan Centers for Disease Control (CDC), the pandemic preventive guidelines for community pharmacies issued by the Taiwanese Pharmacist Association, and prior KAPs or pandemic preparedness survey

research conducted among pharmacists in other countries [20-22; 23-30]. We assessed the internal consistency reliability of the questionnaire using Cronbach's alpha, which demonstrated strong internal consistency across different sections: KAP survey (Cronbach's alpha = 0.819), NBRS mask section (Cronbach's alpha = 0.774), and NBRS COVID-19 testing section (Cronbach's alpha = 0.838). The content validity was ascertained with a team of two pharmacists, two epidemiologists, and a survey research consultant. This team carefully reviewed the questionnaire and provided feedback on the appropriateness and relevance of the questions to the covered construct. Based on their feedback, necessary revisions were made to enhance the clarity of the questionnaire.

The final questionnaire comprised 66 questions divided into demographics, KAPs, and perceptions of the NBRS effectiveness. Demographics included age, sex, pharmacist ownership (pharmacy owner or employed pharmacist), year(s) of work experience, and daily working hours. Pharmacy characteristics included location, pharmacy type (chain or independent), and the number of customers.

The subsequent section focused on pharmacists' KAP. The Knowledge (K) measured community pharmacists' knowledge level of COVID-19, including SARS-CoV-2's transmission, symptoms, treatments and preventive measures according to evidence-based information. It was designed with multiple-choice questions with right, wrong, or uncertain options about the COVID-19-related statements to measure their extent of knowledge about the disease. The Attitude (A) investigated pharmacists' attitudes towards the effectiveness of controlled policies, vaccination, and the responsibility of healthcare professionals to possess and share accurate COVID-19-related information. It comprises six questions on a 5-point Likert scale, Strongly Disagree=1, Disagree=2, Neutral=3, Agree=4, and Strongly Agree=5. The Practices (P) was divided into self-oriented (Practice SO) and customer-oriented (Practice CO) practices to evaluate pharmacists' own disease-preventive behaviors and their implementation of advising customers to adhere to the guidelines. Practice SO involved actions such as hand-washing, wearing personal protective equipment (PPE), and maintaining social distancing; whereas, Practice CO investigated whether the pharmacists prompted customers to wear masks, measure temperature, sanitize before entering the pharmacy, and other preventive behaviors. Sixteen questions on a 5-point Likert scale according to the frequency of practicing preventive measures were included in the Practice section, with Never=1, Rarely=2, Sometimes=3, Often=4, and Always=5.

Lastly, the questionnaire queried pharmacists' perceptions of the NBRS for masks and COVID testings to evaluate the impact on revenue, manpower, and pharmacists' well-being. Furthermore, the questionnaire encompassed open-ended questions for both mask and COVID testing systems concerning additional consequential impacts of the NBRS on pharmacists or their affiliated pharmacies.

Data collection

A convenience sampling method was utilized for data collection in two major cities in Taiwan (Taipei City and New Taipei City), that were also the cities with the highest COVID-19-caused death [3,18] and the largest impact of the NBRS on the community [11]. The total number of the contracted pharmacy in these regions was 1923. We calculated the target sample size $N=321$ with the formula below to generalize pharmacies in Taipei City and New Taipei City with a 5% margin of error and 95% confidence interval.

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 \times N} \right)}$$

This online survey was distributed through social media platforms (e.g., Facebook, LINE). The cover page of the questionnaire included a short introduction of the study objectives, inclusion criteria, declarations of anonymity and confidentiality, and the voluntary nature of participation. The inclusion criteria for the subjects were determined as follows, with the accompanying flow chart visually representing the process (Figure 1). The criteria included:

1. Full/part-time community pharmacists with a valid pharmacist license
2. Pharmacists that work in NHI-contracted pharmacies located in Taipei City and New Taipei City
3. Pharmacists that were or are currently responsible for the Named-Based Rationing masks and/or testing.

Statistical analysis

The data from the online questionnaire was exported into Microsoft Office Excel and IBM SPSS Statistic v18. Descriptive analyses were measured as frequency and percentage for categorical variables and mean \pm standard deviations (SD) for continuous variables. Scores of questions on Knowledge (8 questions; range of score: 0-8), Attitudes (6 questions; range of score: 6-30), and Practices (15 questions; range of score: 15-75) were computed by adding the score of each item. The Knowledge section initially featured ten questions. Two were subsequently omitted: one due to the swift evolution of COVID-19 treatment and another following Taiwan's quarantine policy change. In this Knowledge section, 1 point was assigned to the correct answer and 0 to the wrong and uncertain answer. Questions for Attitude and Practices using a five-point Likert scale were added up for further analysis. We used Bloom's cut-off points to classify scores into categories of good, moderate, and poor, following established methodology in KAP studies [30,31,32]. Specifically, scores between 80% -100% were considered high, 60% -79% as moderate, and below 60% as low. For the practice sections, divided into self-oriented and customer-oriented practices, we employed modified cut-off points based on the distribution of scores within our sample to create meaningful groupings. The cut-off points for high, moderate, and low were as follows: Knowledge (≥ 7 , 5-6, ≤ 4), Attitudes (≥ 26 , 21-25, ≤ 20), Practice SO (≥ 36 , 26-35, ≤ 25), and Practice CO (≥ 21 , 11-20, ≤ 10). Pearson correlation coefficient and multilinear regression analysis were conducted to examine the relationship between Knowledge, Attitudes, and Practices concerning COVID-19 prevention among pharmacists.

Furthermore, the assessment of pharmacists' perceptions of NBRS effectiveness was calculated by combining the positive effect score and the reversed negative effect score, resulting in a total range of 10-60. The mean difference of the NBRS effect score among different sociodemographic characteristics was compared using the independent sample t-test and one-way analysis of variance (ANOVA). The online survey was anonymous per the study protocol; thus, we have no way to ascertain which region the survey participants were from. However, we inspected the data distribution for the responses from each question and ascertained that the data were relatively normally distributed. Pearson correlation coefficients were calculated and tested. Univariate and multivariate linear regression analyses were used to determine the significant variables within sociodemographic, pharmacy characteristics, and KAP that affect pharmacists' perspectives on the NBRS effectiveness. The related coefficient

and standard error (SE) / 95% confidence interval (CI) were shown. The two-sided *P*-value was shown as significant by $P < .05$.

Ethical considerations

This study was reviewed and approved by the expedited review process of the TMU-Joint Institutional Review Board (JIRB) (Approval No. N202205055). It was subsequently reviewed by the Human Subjects Protection Office of Penn State University, which determined that the proposed activity – secondary analysis of de-identified data, did not meet the definition of human subject research and the IRB review and approval were not required (Approval No. STUDY00021659). The informed consent descriptions were stated at the beginning of the questionnaire, including a declaration that the survey was solely for research purposes, along with the study objectives, inclusion criteria, and declarations of confidentiality. On the same declaration page, participants were informed about the voluntary nature of their participation, with a statement that proceeding to provide responses to the survey indicated their consent to participate. To protect privacy and confidentiality, all data were de-identified before analysis. Participants were compensated with a coupon amounting to NTD\$100 (or \$3 USD), as approved by the IRB. No images in this manuscript identify individual participants.

Results

Pharmacist's demographics

Among 343 Taiwanese community pharmacists, 53.6% (N=184) were male and 46.4% (N=159) were female. As for the pharmacist age distribution, the most common age groups were 31-40 years (29.4%) and 21-30 years (25.9%). Additionally, the majority (70.6%) were employed pharmacists, while 32.4% were pharmacy owners. In terms of the region of the pharmacy, 165 (48.1%) were located in New Taipei City, and 178 (51.9%) in Taipei City. The participants' socio-demographic information and pharmacy characteristics are shown in Table 1.

Table 1. Demographic and Professional Experience of Community Pharmacists (N=343)

Categories	Groups	Frequency (N)	Percentage (%)
Sex			
	Male	184	53.6
	Female	159	46.4
Age			
	≤ 30	89	25.9
	31-40	101	29.4
	41-50	75	21.9
	51-60	44	12.8
	Over 60	34	9.9
Pharmacy ownership			
	Pharmacy owner	111	32.4
	Employed	232	67.6
Work hours/day			
	Less than 5hrs	18	5.2
	5-8hrs	139	40.5
	More than 8hrs	186	54.2
Pharmacy location			
	Taipei City	178	51.9
	New Taipei City	165	48.1
Pharmacy characteristics			
	Independent pharmacy	242	70.6
	Chain pharmacy	101	29.4
Number of customers/day			
	<50 people	47	13.7
	51-100 people	136	39.7
	101-150 people	96	28.0
	151-200 people	33	9.6
	201-250 people	14	4.1
	>250 people	17	4.9

Knowledge, Attitudes, and Practices of Taiwanese Pharmacists Regarding COVID-19

Research findings indicated that among 343 pharmacists, the mean Knowledge score for COVID-19 was 7.22 ± 0.73 out of 8.00. Scores of ≥ 7 was categorized as high, 6 as moderate and scores of ≤ 5 as low, with 88.3% demonstrating good knowledge levels and 9.6% showing moderate levels. The mean score for Attitude questions was 25.33 ± 2.97 (range 10-30). The cut-off point for Attitude score was ≤ 20 as low, 21-25 as moderate and ≥ 26 as high. The majority of participants had a positive (58.6%) or neutral (39.7%) attitude towards the controlled policies, vaccination, and the responsibility of healthcare professionals. More than 75% of the participants demonstrated good compliance with the guidelines in Practice self-oriented (SO) behaviors (75.4%) and Practice customer-oriented (CO) behaviors (78.8%), with the cut-off points ≤ 25 (low), 26-35(moderate), and ≥ 36 (high) for Practice SO and ≤ 10 (low), 11-20(moderate), and ≥ 21 (high) for Practice CO (Table 2). The findings indicated that pharmacists exhibited high professional competency and individual responsibility in implementing COVID-19 preventive measures.

Table 2. Descriptive Analysis of Pharmacists' KAP of COVID-19: Number of Questions, Range of Score, Total Score (Mean \pm SD), and Percentage of Low, Moderate, and High Scores for Each Section. (N=343)

Variables	Number of Questions	Range of score	Total score (mean \pm SD)	% of respondents (cut-off points); N=343		
				Low	moderate	High
Knowledge	8	3-8	7.22 ± 0.73	0.3(≤ 4)	11.3(5-6)	88.3(≥ 7)
Attitudes	6	10-30	25.33 ± 2.97	1.7(≤ 18)	39.7(19-23)	58.6(≥ 24)
Practices	SO	9	1.8 (≤ 25)	1.8(≤ 25)	22.8(26-35)	75.4(≥ 36)
	CO	6	1.7 (≤ 10)	1.7(≤ 10)	19.6(11-20)	78.7(≥ 21)

^a Practice SO and Practice CO stand for self-oriented and customer-oriented practices, respectively.

^b The table presents the number of questions, range of scores, and total score (mean \pm SD) for each variable.

^c Level of knowledge, attitude, and practice is determined based on the cumulative score of items within each variable. The percentage distribution presented in the table reflects the proportion of pharmacists falling into categories of poor, moderate, and good levels for each KAP variable.

The results also noted some changes in services during the COVID-19 pandemic among community pharmacies. In the past, assistance with measuring blood pressure was one of the common services offered in Taiwan's community pharmacies; however, this practice was decreased due to the need for direct contact with patients that could increase the risk of spreading COVID-19. Conversely, home delivery and telehealth, two evidence-based strategies that were not widely provided before the outbreak, were increasingly utilized to reduce contact with potential or confirmed cases of COVID-19. Although there was no mandate from the Taiwanese Disease Control Center for these services, the community pharmacy has gone through various shifts in preventive strategies during the pandemic. Among 262 pharmacies that measured blood pressure for customers, we found a 39.3% decrease ($P < .001$) in providing this service, with 41.6% pausing it completely and 14.1% adjusting to letting customers measure by themselves after the pandemic outbreak. Furthermore, pharmacies that provided home-delivery services significantly increased from 18.4% to 38.4% ($P < .001$) and the percentage of online consulting services also increased by 9.9 % ($P = .008$), as shown in Figure

2.

Relationship between Knowledge, Attitudes, and Practices among pharmacists

Pearson correlation coefficient tests indicated there was a positive and statistically significant correlation between the Attitude and Practice scores: Attitude-Practice SO ($r = 0.279, P < .001$), Attitude-Practice CO ($r = 0.204, P < .001$), and Attitude-Combined Practice SO-CO ($r = 0.275, P < .001$) (Table 3). Despite measuring different behaviors, Practice SO and CO were both associated with pharmacists' Attitudes, a trend that persisted when combining Practice SO-CO. This suggests that engagement in one practice is likely to coincide with engagement in the other (Table 3).

The multivariate linear regression analysis, with Practice as the dependent variable and Knowledge and Attitude as independent variables, revealed that Attitudes significantly influenced Practices related to COVID-19 prevention among pharmacists ($b = 0.872, P < .001$). Specifically, the positive attitude toward preventive behaviors related to COVID-19 was strongly associated with a higher likelihood of practicing SO and CO preventive behaviors. In contrast, Knowledge was not found to have a significant effect on Attitudes or Practices.

Table 3. Correlation Analysis between Pharmacists' Attitudes (A) towards COVID-19 Preventive Measures and Their Implementation of Associated Practices (P)

Variables	Correlation Coefficient	P-value
Attitude- Practice SO	0.279	$P < .001$
Attitude- Practice CO	0.204	$P < .001$
Attitude- Combined Practice SO-CO	0.275	$P < .001$

^a Practice SO = Self-Oriented Practices; Practice CO = Customer-Oriented Practices

^b The Knowledge scores were not significantly correlated with Attitudes or Practices.

The Name-Based Rationing System (NBRs)

Overall impact of the NBRs on community pharmacies

To examine the overall impact of the NBRs, the survey instrument includes three areas of question: revenue, manpower, and pharmacists' well-being. Data were collected separately for masks and COVID testing. Overall, the community pharmacists were more in favor of the COVID-19 testing NBRs (17.43 ± 4.68) than the mask NBRs (15.76 ± 4.44). This greater favorability is reflected in the willingness of pharmacists to continue participation in the NBRs in the future. Specifically, 59.7% of responding pharmacists expressed a willingness to distribute COVID testing, compared to only 38.5% who were willing to distribute masks under the NBRs system (Figure 3). This difference in willingness can be attributed to the perceived higher negative impacts on revenue, manpower, and pharmacists' well-being for the NBRs masks system compared to the NBRs testing system ($P < .001$ for all comparisons).

Factors associated with various impacts of the NBRs on community pharmacies

The study revealed various pharmacists' perceptions of the NBRs across different demographic categories through ANOVA. Pharmacy owners exhibited higher satisfaction levels with the NBRs mask compared to employed pharmacists ($P < .014$). Age also emerged as a

significant factor, with pharmacists over 60 exhibiting more positive perceptions than younger age groups ($P<.001$). Specifically, the post-hoc analysis highlighted pharmacists aged over 60 rated the NBRs masks higher than those aged ≤ 30 ($P=.003$), 31-40 ($P<.001$), and 41-50 ($P=.006$), but not 51-60 ($P=0.459$). Similarly, significant factors were observed in responses to the NBRs testing system based on ownership, age, and the average number of customers.

Univariate and multivariate regression analyses were conducted while controlling for potential confounders. Table 4 shows that older pharmacists (>60 years of age) (coefficient of slope; $b=6.579$, $P<.001$) showed a significantly positive perception for both NBRs mask and testing. However, pharmacists who served more customers per day ($b= -8.211$, $P<.001$) showed significant negative effects on their perspective on the NBRs.

Furthermore, our study combined mask and testing scores as an indicator of pharmacists' overall satisfaction with the NBRs. The results revealed that among their KAP scores, their Attitude (A) toward preventive guidelines, disease control authorities, and pharmacist's added responsibilities during the pandemic significantly affected their perceptions on the NBRs, regardless of masks or COVID testing (Table 4). We assessed multicollinearity in the multivariable linear regression models, finding all Variance Inflation Factors (VIF) to be below 10, indicating an acceptable level of multicollinearity.

Table 4. Multivariate Regression Analyses Identifying Factors Influencing Pharmacists' perspectives toward NBRs Mask, NBRs COVID-19 Testing, and Overall NBRs Implementation

Variables	NBRs mask		NBRs testing		Overall NBRs (masks + testing)	
	coefficient \pm SE (95% CI)	P value	coefficient \pm SE (95% CI)	P value	coefficient \pm SE (95% CI)	P value
Sex (male)	-0.128 \pm 0.481 (-1.074, 0.817)	.79	0.352 \pm 0.542 (-0.716, 1.419)	.517	0.363 \pm 0.963 (-1.534, 2.259)	.707
Age groups (years; Ref.: <30)						
31-40	-0.745 \pm 0.625 (-1.975, 0.486)	.235	-0.017 \pm 0.71 (-1.414, 1.381)	.981	-0.712 \pm 1.253 (-3.177, 1.754)	.57
41-50	-0.077 \pm 0.674 (-1.403, 1.25)	.909	0.692 \pm 0.76 (-0.803, 2.187)	.363	0.963 \pm 1.34 (-1.674, 3.6)	.473
51-60	1.142 \pm 0.793 (-0.417, 2.702)	.151	2.077 \pm 0.95 (0.208, 3.947)	.03	3.952 \pm 1.676 (0.654, 7.25)	.019
61 and above	3.395 \pm 0.867 (1.679, 5.101)	<.001	3.026 \pm 0.983 (1.091, 4.96)	.002	6.579 \pm 1.734 (3.166, 9.992)	<.001
Ownership (pharmacy owner)	-0.701 \pm 0.618 (-1.916, 0.514)	0.257	-1.398 \pm 0.712 (-2.799, 0.003)	.051	-1.813 \pm 1.264 (-4.302, 0.676)	.153
Work hours/day (Ref.: ≤ 5 hrs)						
5-8 hrs	-0.073 \pm 1.102 (-2.241, 2.096)	.947	-0.534 \pm 1.222 (-2.939, 1.871)	.662	0.133 \pm 2.17 (-4.14, 4.405)	.951
> 8hrs	-0.529 \pm 1.129 (-2.751, 1.693)	.64	-0.74 \pm 1.251 (-3.202, 1.722)	.555	-0.721 \pm 2.222 (-5.094, 3.653)	.746
Location (Taipei City)	0.653 \pm 0.473 (-0.278, 1.583)	.168	0.378 \pm 0.53 (-0.665, 1.421)	.476	0.879 \pm 0.941 (-0.974, 2.732)	.351
Characteristics (independent pharmacy)	1.752 \pm 0.591 (0.589, 2.915)	.003	1.555 \pm 0.657 (0.262, 2.848)	.019	3.036 \pm 1.167 (0.739, 5.333)	.01
Number of customers/day (Ref.: ≤ 50)						
51-100	-1.022 \pm 0.752	.176	-2.459 \pm 0.879	.005	-4.638 \pm 1.561	.003

	(-2.502, 0.459)		(-4.189, -0.729)		(-7.711, -1.565)	
101-150	-1.126 ± 0.812 (-2.723, 0.471)	.166	-1.945 ± 0.939 (-3.794, -0.097)	.039	-4.383 ± 1.668 (-7.667, -1.099)	.009
151-200	-0.773 ± 1.037 (-2.814, 1.267)	.456	-2.751 ± 1.205 (-5.123, -0.379)	.023	-5.071 ± 2.141 (-9.285, -0.857)	.019
201-250	-1.993 ± 1.374 (-4.697, 0.711)	.148	-2.722 ± 1.525 (-5.724, 0.279)	.075	-5.854 ± 2.709 (-11.186, -0.522)	.032
> 250	-2.14 ± 1.282 (-4.662, 0.382)	.096	-4.809 ± 1.39 (-7.546, -2.072)	.001	-8.211 ± 2.47 (-13.074, -3.349)	.001
Knowledge, Attitudes and Practices (KAP) of COVID-19						
Knowledge (COVID-19 transmission, symptoms, treatment, etc.)	-0.26 ± 0.336 (-0.922, 0.402)	.44	-0.073 ± 0.37 (-0.801, 0.655)	.843	-0.325 ± 0.657 (-1.618, 0.968)	.621
Attitudes (COVID-19-related policies, vaccination, pharmacists' responsibilities etc.)	0.172 ± 0.085 (0.005, 0.338)	.043	0.27 ± 0.094 (0.086, 0.454)	.004	0.435 ± 0.166 (0.107, 0.762)	.009
Practices (Disease-preventive behaviors)	0.028 ± 0.031 (-0.032, 0.089)	.352	0.047 ± 0.035 (-0.022, 0.115)	.179	0.059 ± 0.062 (-0.063, 0.18)	.343

^a Variables showing statistical significance include age groups (51-60, and over 60), pharmacy characteristics, the number of customers/day (>250 people) and pharmacists' attitudes toward COVID-19-related policies, the vaccination mandate, and their responsibilities to share accurate information with the public.

Impact measured based on dimensions of revenue, manpower, and pharmacists' well-being

A similar percentage of pharmacists (76.7% for masks and 77.9% for COVID testing) reported that the NBRS has resulted in increased customer flow, positively impacting revenue. However, more than half (55.97%) of the pharmacists revealed that the busy NBRS mask-related operations had negatively affected the pharmacy's traditional business, subsequently impacting revenue. In comparison, only 40.6% felt the same for the NBRS COVID testing system. The impact on manpower was more significant, with 90.1% of pharmacists reporting increased workload due to NBRS operations for masks and 74.8% experiencing the same for COVID testing, resulting in a shortage of manpower.

In order to investigate the specific dimension the demographic variables were affecting, we removed the factors that showed no significant effects on the overall NBRS outcomes, including sex, work hours, and location of pharmacy (Taipei City or New Taipei City) as shown in Supplementary Table 1 and 2. Results found that the pharmacists' ownership had distinct effects on manpower. Compared to pharmacy owners, employed pharmacists were more likely to report that the system caused the increased workload, and that they experienced a more pronounced negative impact from manpower shortage. Furthermore, chain pharmacies reported a more positive impact of the NBRS on revenue compared to independent pharmacies.

We also conducted a stepwise linear regression to look into each question since there were nuances between them even within the three dimensions. One notable finding was that among the demographic variables, pharmacists' Knowledge, Attitude, and Practices measurement (KAP), their Practice score demonstrated as a significant predictor of their

willingness to provide the NBRS service without a government mandate ($P<.001$). This means pharmacists who practiced SO or CO preventive behaviors had more favorable perceptions of the NBRS.

Additional Impacts of the NBRS on Community Pharmacies

The inclusion of open-ended questions in the questionnaire was crucial to capture in-depth insights from pharmacists regarding their experiences with the NBRS (Supplementary Table 3 and 4). Two major themes emerged from their responses, centered around customer behaviors and government policy changes. Pharmacists highlighted behavior issues such as irritable and unruly customers waiting in queue to purchase masks and COVID-testing, which not only disrupt pharmacy operations but also necessitate additional staffing and time. They also described concerns regarding service challenges, including the public's misunderstanding of purchasing rules leading to disputes.

Communication issues regarding government policy changes were another prominent theme, with pharmacists feeling uninformed and lacking advance notices about the policy changes. Concerns about the supply and demand of inventory were also raised. Some pharmacists emphasized the importance of distinguishing the impact of the NBRS mask and COVID testing on pharmacies based on availability. They noted that while selling the NBRS supplies can be beneficial during times of severe shortage, it may be redundant when supplies become readily available. The decision to continue selling them was contingent on factors such as manufacturer pricing and the convenience of the public (Supplementary Table 3 and 4).

Discussion

Principal Results

The findings of this study revealed that the majority of pharmacists demonstrated sufficient Knowledge, positive/neutral Attitudes, and good Practices (KAP) towards COVID-19, indicating their competent roles in the fight of a deadly pandemic. This showed pharmacists were well-versed in COVID-19 transmission, symptoms, treatments, and preventive measures. They generally viewed the COVID-19-related policies and vaccination positively and recognized their responsibility to share accurate information. In terms of practices, pharmacists demonstrated strong personal preventive behaviors (Practice SO) and were proactive in advising customers on preventive measures (Practice CO). At this pivotal moment, this reaffirms the government leveraging the NBRS in cooperation with the community-based pharmacy due to its convenient locations, existing relationship with the community, and most importantly, pharmacists' competence in facing the challenges posed by the pandemic and contributing to the public. Furthermore, our results found that among KAP, Attitudes(A) rather than Knowledge(K) significantly influenced Practices(P) related to COVID-19 prevention among pharmacists.

Building on the KAP findings, the assessment of pharmacists' perceptions of NBRS reflected how they played a key role as the distribution center during the pandemic and the associated impacts of this government-guided strategy. Compared to the NBRS mask distribution (15.76 ± 4.44), a more favorable perception of NBRS testing distribution (17.43 ± 4.68) was found. Pharmacists in older age groups, pharmacy owners compared to employed pharmacists, and those who have more positive attitudes toward COVID-19-related policies reported more favorable perceptions and thus demonstrated a higher willingness to continue participating in the NBRS.

Lastly, responses from the open-ended questions gathered additional impacts of the NBRS reported by pharmacists. The major themes found in our qualitative analyses highlighted

concerns about rapid government policy changes and supply dynamics, underscoring the importance of effective communication between the government and pharmacists and considering evolving supply availability in implementing the NBRs.

Interpretation of Results/Comparison with Prior Work

Regarding the good KAP of pharmacists, the findings were consistent with studies conducted in other nations, such as Pakistan [23], Vietnam [24], Egypt [30]. Results revealed that Attitudes towards COVID-19 preventive measures had a significant impact on pharmacists' Practices; however, Knowledge did not show any significant relationship. This relationship was also found in the previous study conducted on the general public in Taiwan [32], showing that greater effort is needed to improve practitioners' Attitudes in order to improve their compliance with the guidelines (Practices) as the study showed that the increase in Knowledge was not associated with the level of compliance (Practices). Interestingly, the studies conducted on community pharmacists in other countries showed that Knowledge and Attitude both affected their Practices, which pointed out that the responses may vary based on the diverse cultures, COVID-19 situation, and policies [23,24,33].

As for pharmacists' perspectives on the NBRs, the results showed that pharmacists had a more gratifying experience with the NBRs COVID testing than the NBRs mask distribution. This perception was primarily influenced by the challenges associated with preparing supplies, along with heightened public anxiety. Pharmacists needed to repackage masks into smaller quantities due to rationing requirements, which imposed additional time and effort on them [8]. It is suggested to assign additional personnel to handle preparatory tasks. In contrast to certain countries where the employment of pharmacy technicians is common, such a practice remains unavailable in Taiwan. In our study, 26.8% of pharmacists reported experiencing time shifts when there is only one pharmacist responsible for all duties, which could be a great burden if they have to maintain all the original work such as medication dispensing and education while dealing with the NBRs-related services.

In contrast, testing kits were distributed to pharmacies in pre-packaged boxes, likely requiring less handling and preparation. Additionally, disparities in public anxiety levels were evident during the initial implementation of the mask system in 2020, when vaccinations were unavailable [34]. However, with the subsequent initiation of the testing system in 2022, coinciding with the increased prevalence of immunization, the anxiety levels among both the public and pharmacists were alleviated [3,34]. This anxiety reduction may indirectly influence the willingness of pharmacists to assume responsibility for the system (Figure 3). Responses from pharmacists also highlighted the significance of timing in delivering NBRs services. Specifically, they noted that the NBRs is deemed necessary during periods of severe shortage for masks or testing and when the price of NBRs masks and COVID testing is lower compared to supplies from other manufacturers. They emphasized that providing NBRs services is most opportune when it is convenient for the public to access supplies from pharmacies (Supplementary Tables 3 and 4). These factors are likely to influence pharmacists' decisions regarding the continuation of such services.

Furthermore, older pharmacists (>50 years of age) in this study held more positive perspectives than younger age groups ($P<.001$), primarily due to their long-standing connections with their communities. The analysis of the open-ended questions indicated that pharmacists in the older age groups exhibited a stronger sense of community contribution and a deep sense of belonging. In contrast, younger pharmacists, who may have started their pharmacies more recently, may have weaker bonds with the public and expressed a relatively lower level of community attachment. Another factor of pharmacist ownership showed that pharmacy owners had better perceptions compared to employed pharmacists. Respondents

reported that the subsidy from the government for serving the public under the NBRS was given in the unit of pharmacy; thus, some funds were used for the general improvement of the pharmacy but not for the staff pharmacists.

The findings of this study can inform future policy decisions by providing valuable insights and potential approaches, such as optimizing the preparation process, enhancing communication between officials and pharmacists, and building up the connections between newer pharmacies with the communities. Based on the responses received, it is recommended that policymakers consider implementing measures to improve communication regarding rapid policy changes. This could involve informing practitioners in advance or delivering information through designated mechanisms for pharmacists to follow, especially during periods of heightened pandemic severity or the emergence of new variants. Furthermore, policymakers may consider assigning designated groups to handle the preparatory tasks such as supply packaging. This would allow pharmacists to maximize their effectiveness by focusing their time and efforts on serving the public and ensuring optimal service delivery. Lastly, given the difference in perceptions based on employment, it is suggested that giving subsidies to individual pharmacists to improve their perceptions and compliance. By addressing the underlying concerns, policymakers can foster a more favorable working environment and ultimately enhance overall service quality.

Limitations

The limitations of this study include the relatively small sample size ($n=343$) limited to two cities, Taipei City and New Taipei City. These two cities were focused since they reported the highest number of COVID-19 caused death and were in need of strengthened epidemic prevention measures during the pandemic [3,7]. Additionally, the involvement of NHI pharmacies in these cities towards COVID-19 related policies was higher than in other cities [21]. While the findings may not be generalizable to other regions, this study provides crucial insights into the experiences of pharmacists who were directly involved in pandemic preparedness in relatively high-risk areas. Nonetheless, a broader geographic sampling is needed for future studies in Taiwan to enhance objectivity and representativeness.

Another limitation was the study's cross-sectional design, which led to the inability to determine the causal direction between variables. It is suggested that future studies collect data longitudinally to more thoroughly assess how the NBRS influences pharmacist perspectives and practices over time. Furthermore, data were self-reported by the pharmacists, which may be subject to recall bias or social desirability bias (a type of response bias). However, all participants were asked to focus on their recent experiences and were assured anonymity and confidentiality to minimize potential biases. Therefore, the results could still serve as a reference for future policies and interventions aim to improve public health outcomes.

Conclusions

The study highlights the crucial role of pharmacists in the fight against the COVID-19 pandemic, with a majority demonstrating sufficient knowledge, positive attitudes, and good practices towards COVID-19, justifying the government leveraging their expertise during such a pivotal moment. While community pharmacies have proven to be essential distribution centers through the NBRS, several adjustments are suggested to enhance practitioners' perceptions of the system and ensure its successful implementation. These include building stronger connections between pharmacies and their communities, assigning additional personnel to handle preparatory tasks, establishing effective communication channels between the government and pharmacists, and considering evolving supply dynamics. Overall, pharmacists

have proven to be integral to public health efforts during the pandemic, underscoring their vital role and dedication in times of crisis.

Acknowledgements

We extend our heartfelt thanks to Taiwanese pharmacists for their insightful contributions, both to our research and to the broader efforts in pandemic control.

Data Availability

The data sets generated during and/or analyzed during this study are not publicly available due to the restrictions imposed by our previous IRB approval. According to this approval, the data can only be accessed by the research team (PI and co-PI) to maintain confidentiality. However, the data are available from the corresponding author on reasonable requests for aggregated data.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Abbreviations

NBRS: Name-Based Rationing System

KAP: Knowledge, Attitudes, and Practices

Multimedia Appendix 1

Online questionnaire

[Excel file, 86 kB]

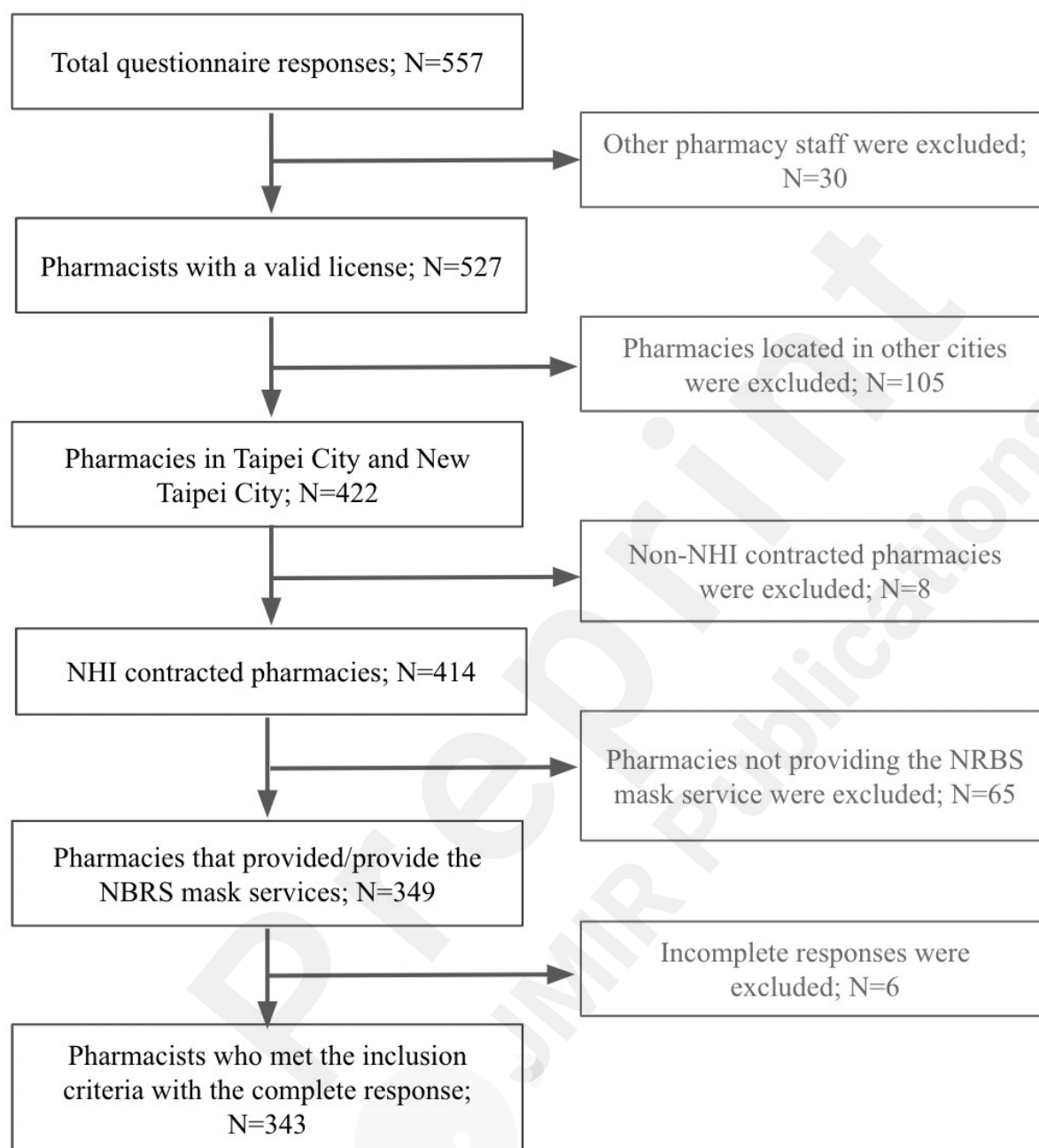
References

1. Chakraborty I, Maity P. COVID-19 outbreak: Migration, effects on society, global environment and prevention. *Sci Total Environ.* 2020;728:138882. doi:10.1016/j.scitotenv.2020.138882
2. Acter T, Uddin N, Das J, Akhter A, Choudhury TR, Kim S. Evolution of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as coronavirus disease 2019 (COVID-19) pandemic: A global health emergency. *Sci Total Environ.* 2020;730:138996. doi:10.1016/j.scitotenv.2020.138996
3. Lai CC, Lee PI, Hsueh PR. How Taiwan has responded to COVID-19 and how COVID-19 has affected Taiwan, 2020-2022. *J Microbiol Immunol Infect.* 2023;56(3):433-441. doi:10.1016/j.jmii.2023.04.001
4. Bliźniewska-Kowalska KM, Halaris A, Wang SC, et al. A Review of the Global Impact of the COVID-19 Pandemic on Public Mental Health, with a Comparison Between the USA, Australia, and Poland with Taiwan and Thailand. *Med Sci Monit.* 2021;27:e932220. Published 2021 May 11. doi:10.12659/MSM.932220
5. Kim J, Moon J, Jung TY, Kim W, Yoo HC. Why Have the Republic of Korea, Taiwan, and Singapore Coped Well with COVID-19 and What Are the Lessons Learned from Their Experiences?. *Yonsei Med J.* 2022;63(3):296-303. doi:10.3349/ymj.2022.63.3.296
6. Chen CC, Tseng CY, Choi WM, et al. Taiwan Government-Guided Strategies Contributed to

- Combating and Controlling COVID-19 Pandemic. *Front Public Health*. 2020;8:547423. Published 2020 Oct 21. doi:10.3389/fpubh.2020.547423
7. Akhmetzhanov AR, Cheng HY, Linton NM, Ponce L, Jian SW, Lin HH. Transmission Dynamics and Effectiveness of Control Measures during COVID-19 Surge, Taiwan, April-August 2021. *Emerg Infect Dis*. 2022;28(10):2051-2059. doi:10.3201/eid2810.220456
 8. Ou HT, Yang YK. Community Pharmacists in Taiwan at the Frontline Against the Novel Coronavirus Pandemic: Gatekeepers for the Rationing of Personal Protective Equipment. *Ann Intern Med*. 2020;173(2):149-150. doi:10.7326/M20-1404
 9. Strand MA, Bratberg J, Eukel H, Hardy M, Williams C. Community Pharmacists' Contributions to Disease Management During the COVID-19 Pandemic [published correction appears in *Prev Chronic Dis*. 2020 Sep 03;17:E98]. *Prev Chronic Dis*. 2020;17:E69. Published 2020 Jul 23. doi:10.5888/pcd17.200317
 10. Al-Quteimat OM MSc, BCOP, Amer AM R.Ph, MSc. SARS-CoV-2 outbreak: How can pharmacists help?. *Res Social Adm Pharm*. 2021;17(2):480-482. doi:10.1016/j.sapharm.2020.03.018
 11. Huang CK, Chen SH, Hu CC, Lee MC. Understanding the adoption of the mask-supply information platforms during the COVID-19. *Electronic Markets*. Published online November 12, 2022. doi: <https://doi.org/10.1007/s12525-022-00602-7>
 12. Lin CH, Lin YW, Wang JY, Lin MH. The pharmaceutical practice of mask distribution by pharmacists in Taiwan's community pharmacies under the Mask Real-Name System, in response to the COVID-19 outbreak. *Cost Eff Resour Alloc*. 2020;18:45. Published 2020 Oct 19. doi:10.1186/s12962-020-00239-3
 13. Huang IY. Fighting COVID-19 through Government Initiatives and Collaborative Governance: The Taiwan Experience. *Public Adm Rev*. 2020;80(4):665-670. doi:10.1111/puar.13239
 14. Lo WC, Wang FC, Lin LY, et al. Enhancing Data Linkage to Break the Chain of COVID-19 Spread: The Taiwan Experience. *J Med Internet Res*. 2021;23(5):e24294. Published 2021 May 7. doi:10.2196/24294
 15. Wu TY, Majeed A, Kuo KN. An overview of the healthcare system in Taiwan. *London J Prim Care (Abingdon)*. 2010;3(2):115-119. doi:10.1080/17571472.2010.11493315
 16. Lin LY, Warren-Gash C, Smeeth L, Chen PC. Data resource profile: the National Health Insurance Research Database (NHIRD). *Epidemiol Health*. 2018;40:e2018062. doi:10.4178/epih.e2018062
 17. Tai YL, Chi H, Chiu NC, Tseng CY, Huang YN, Lin CY. The Effect of a Name-Based Mask Rationing Plan in Taiwan on Public Anxiety Regarding a Mask Shortage During the COVID-19 Pandemic: Observational Study. *JMIR Form Res*. 2021;5(1):e21409. Published 2021 Jan 22. doi:10.2196/21409
 18. Liu CM, Lee CT, Chou SM, et al. Strategies for supplying face masks to the population of Taiwan during the COVID-19 pandemic. *BMC Public Health*. 2021;21(1):1854. Published 2021 Oct 14. doi:10.1186/s12889-021-11808-3
 19. Lai CC, Yen MY, Lee PI, Hsueh PR. How to Keep COVID-19 at Bay: A Taiwanese Perspective. *J Epidemiol Glob Health*. 2021;11(1):1-5. doi:10.2991/jegh.k.201028.001
 20. COVID-19: GUIDELINES for PHARMACISTS and the PHARMACY WORKFORCE INTERNATIONAL PHARMACEUTICAL FEDERATION. <https://www.fip.org/files/content/priority-areas/coronavirus/COVID-19-Guidelines-for-pharmacists-and-the-pharmacy-workforce.pdf>
 21. Taiwan Centers for Disease Control. Home. [Cdc.gov.tw](https://www.cdc.gov.tw). Published 2019. <https://www.cdc.gov.tw/En>
 22. Community Pharmacy Pandemic Preventive Guidelines (n.d.). https://dpm.taiwan-pharma.org.tw/media/uploads/j5333326/2020/04/01/0327_hLBMVvO.PDF

23. Muhammad K, Saqlain M, Muhammad G, et al. Knowledge, Attitude, and Practices (KAPs) of Community Pharmacists Regarding COVID-19: A Cross-Sectional Survey in 2 Provinces of Pakistan. *Disaster Med Public Health Prep.* 2022;16(5):1864-1872. doi:10.1017/dmp.2021.54
24. Nguyen HTT, Dinh DX, Nguyen VM. Knowledge, attitude and practices of community pharmacists regarding COVID-19: A paper-based survey in Vietnam. *PLoS One.* 2021;16(7):e0255420. Published 2021 Jul 29. doi:10.1371/journal.pone.0255420
25. Bahlol M, Dewey RS. Pandemic preparedness of community pharmacies for COVID-19. *Res Social Adm Pharm.* 2021;17(1):1888-1896. doi:10.1016/j.sapharm.2020.05.009
26. Novak H, Tadić I, Falamić S, Ortner Hadžiabdić M. Pharmacists' role, work practices, and safety measures against COVID-19: A comparative study. *J Am Pharm Assoc (2003).* 2021;61(4):398-407. doi:10.1016/j.japh.2021.03.006
27. Itani R, Karout S, Khojah HMJ, et al. Community pharmacists' preparedness and responses to COVID-19 pandemic: A multinational study. *Int J Clin Pract.* 2021;75(9):e14421. doi:10.1111/ijcp.14421
28. Sum ZZ, Ow CJW. Community pharmacy response to infection control during COVID-19. A cross-sectional survey. *Res Social Adm Pharm.* 2021;17(1):1845-1852. doi:10.1016/j.sapharm.2020.06.014
29. Luo YF, Chen LC, Yang SC, Hong S. Knowledge, Attitude, and Practice (KAP) toward COVID-19 Pandemic among the Public in Taiwan: A Cross-Sectional Study. *Int J Environ Res Public Health.* 2022;19(5):2784. Published 2022 Feb 27. doi:10.3390/ijerph19052784
30. NeJhaddadgar N, Pirani N, Heydarian N, et al. Knowledge, attitude, and practice toward the COVID-19 infection among adults Iran: A cross-sectional study. *J Public Health Res.* 2022;11(4):22799036221129370. Published 2022 Oct 24. doi:10.1177/22799036221129370
31. Juttla PK, Ndiritu M, Milliano F, Odongo AO, Mwanicha-Kwasa M. Knowledge, attitudes and practices towards COVID-19 among healthcare workers: A cross-sectional survey from Kiambu County, Kenya. *PLoS One.* 2024;19(3):e0297335. Published 2024 Mar 12. doi:10.1371/journal.pone.0297335
32. Mohammed Basheeruddin Asdaq S, A S A, Imran M, Sreeharsha N, Sultana R. Knowledge, attitude and practices of healthcare professionals of Riyadh, Saudi Arabia towards covid-19: A cross-sectional study. *Saudi J Biol Sci.* 2021;28(9):5275-5282. doi:10.1016/j.sjbs.2021.05.036
33. Wong LP, Hung CC, Alias H, Lee TS. Anxiety symptoms and preventive measures during the COVID-19 outbreak in Taiwan. *BMC Psychiatry.* 2020;20(1):376. Published 2020 Jul 16. doi:10.1186/s12888-020-02786-8

Figure 1. Inclusion Criteria Flow Chart of the Cross-sectional Online Questionnaire for Community Pharmacists and Their Affiliated Pharmacies in Two Major Cities (Taipei City and New Taipei City) in Taiwan (N=557)



^a Participants failing to meet the predetermined inclusion criteria were automatically excluded through the online questionnaire settings.

^b Upon application of the inclusion and exclusion criteria, incomplete responses were excluded (N=6), with only fully completed responses (N=343) being included in the final analysis."

Figure 2: Changes of Pharmacy Provided Services Before and After the COVID-19 Outbreak

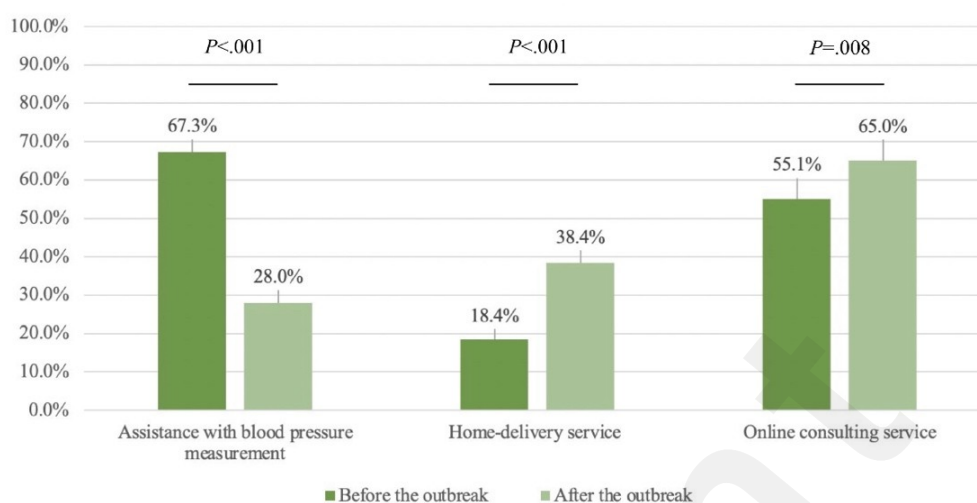
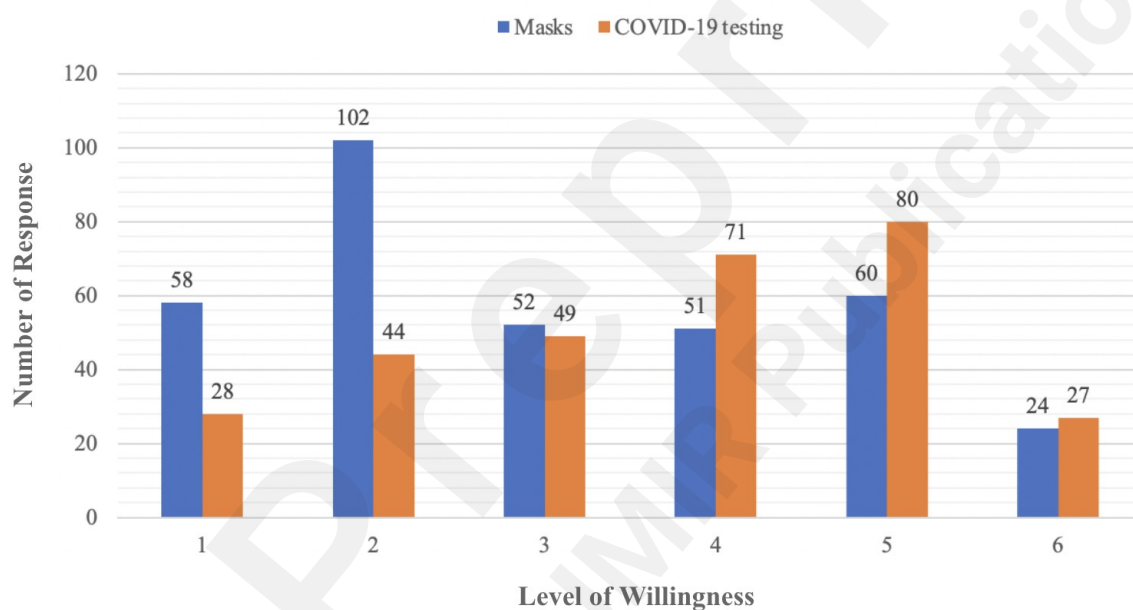


Figure 3. The Community Pharmacists' Willingness to Continue Implementing the (a) Mask (b) COVID-19 Testing NBRS.



^a The x-axis represents pharmacists' willingness to continue implementing the NBRS, graded on a scale from 1 to 6, where 6 denotes the strongest agreement with collaborating with the government to implement the system, and 1 indicates the least willingness.

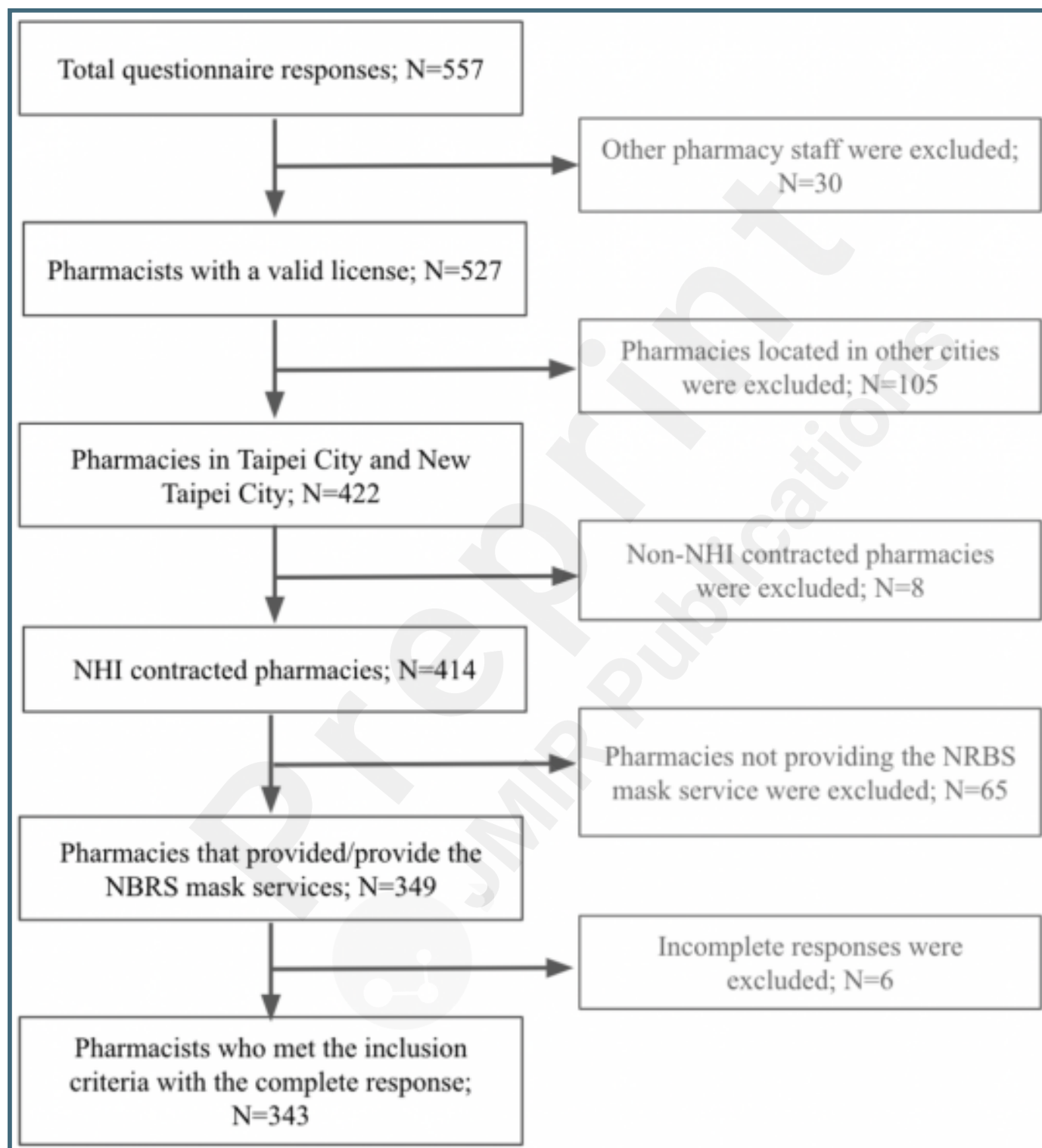
^b The y-axis corresponds to the number of responses received from pharmacists.

^c In the chart, the mask system responses are depicted in blue, while responses related to the COVID-19 testing system are represented in orange.

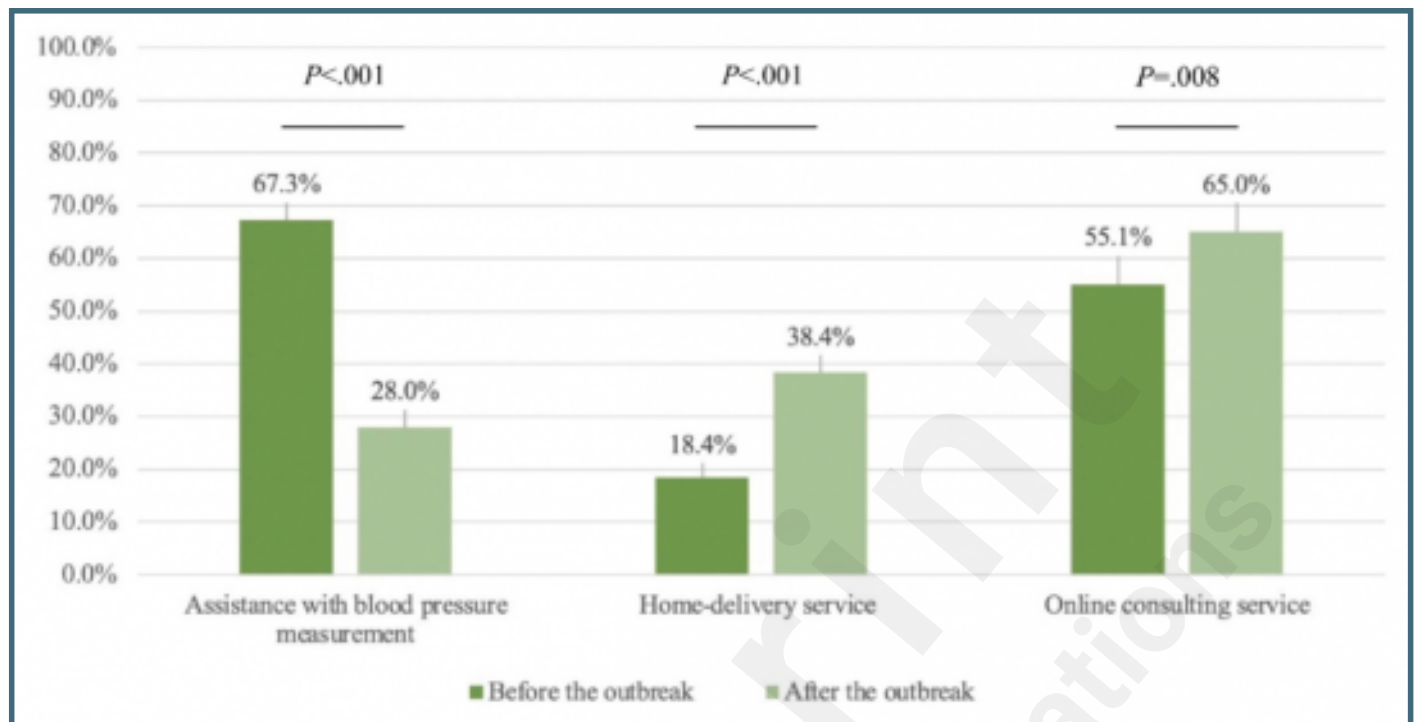
Supplementary Files

Figures

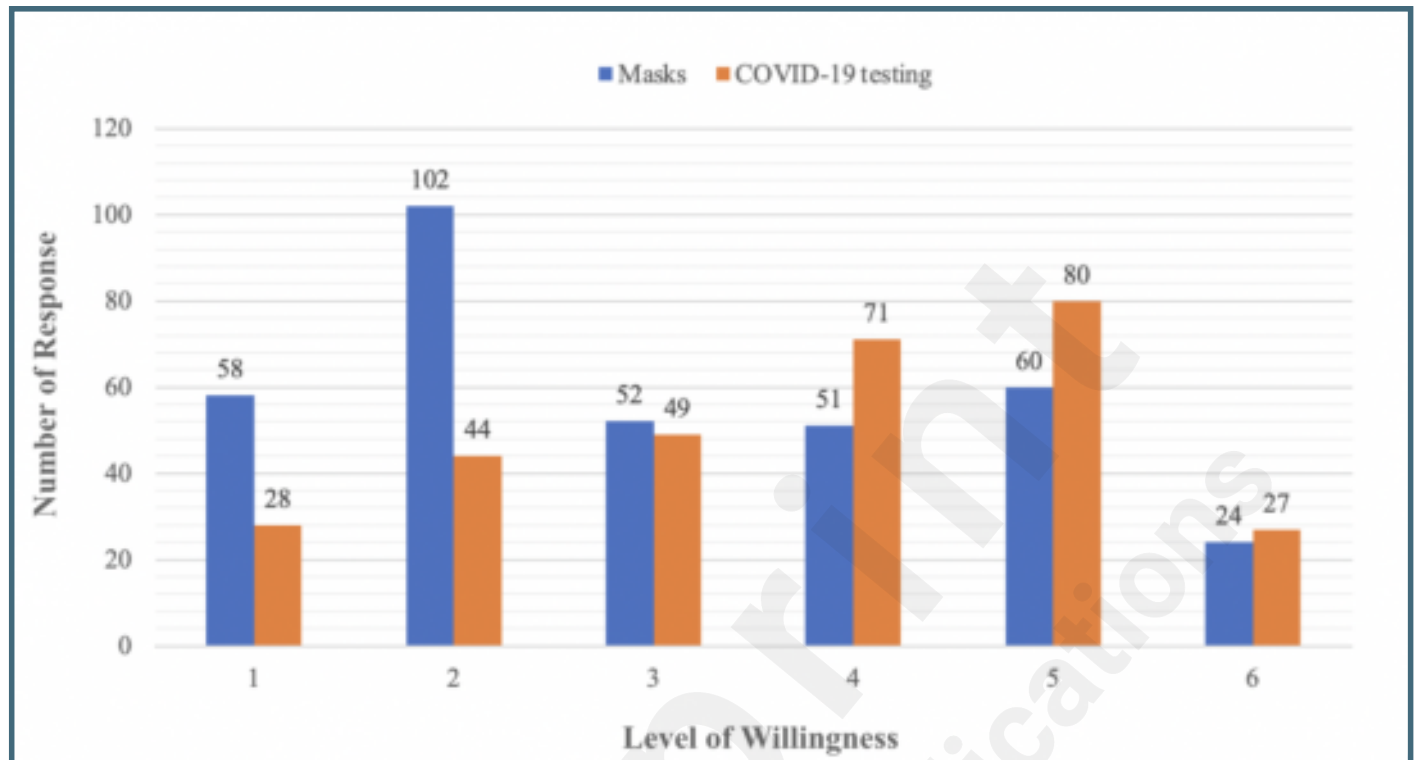
Inclusion Criteria Flow Chart of the Cross-sectional Online Questionnaire for Community Pharmacists and Their Affiliated Pharmacies in Two Major Cities (Taipei City and New Taipei City) in Taiwan (N=557).



Changes of Pharmacy Provided Services Before and After the COVID-19 Outbreak.



The Community Pharmacists' Willingness to Continue Implementing the (a) Mask (b) COVID-19 Testing NBRS.



Multimedia Appendixes

Impact of the NBRS mask on pharmacies' revenue and manpower, and pharmacists' well-being.

URL: <http://asset.jmir.pub/assets/9dd571f86485071a3876ab371724f384.docx>

Impact of the NBRS testing on pharmacies' revenue and manpower and pharmacists' well-being.

URL: <http://asset.jmir.pub/assets/626e5f711877ebe26d9b3cb2ef15739f.docx>

Supplementary Table 3. Codebook for additional impacts of the NBRS mask on community pharmacies as reported in open-ended .docx.

URL: <http://asset.jmir.pub/assets/89e2cb6ea309d5dfa3d621518070f8ce.docx>

Supplementary Table 4. Codebook for additional impacts of the NBRS testing on community pharmacies as reported in open-ended questions.

URL: <http://asset.jmir.pub/assets/0100ecde3317b5e8ce9fec25ff49b11f.docx>