# The Perspectives of Community Pharmacists Toward the Name-Based Rationing System (NBRS) During the COVID-19 pandemic in Taiwan: Lessons Learned

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

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En-ling Chen[1, 2] MPH; Chyi-Huey Bai[3] PhD; Paul T. Kocis[4] PharmD, RPH, MPH, CACP; Wenke Hwang[1] MA, PhD

[1]Department of Public Health Sciences Penn State College of Medicine Hershey US
[2]Department of Clinical Pharmacy Taipei Medical University Taipei TW
[3]Department of Public Health Taipei Medical University Taipei TW
[4]Department 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.

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## Original Paper

En-ling Chen, MPH[1,2], Chyi-Huey Bai, PhD[3], Paul T. Kocis, PharmD, RPH, MPH, CACP[4], 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.

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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.

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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.

**Conclusion:**

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.


**Keywords:** Name-Based Rationing System; NBRS; community pharmacy; community pharmacist; COVID-19; SARS-CoV-2; KAP; 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, played a vital role in supporting the community, and significantly contributed to disease control.

In Taiwan, community-based pharmacists are often viewed as the front-line healthcare providers in the public health system [8]. During the COVID-19 pandemic, the high visibility and accessibility of community pharmacies further ensured the public with adequate access to essential health services, including medication, 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 providing 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-emptied 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 practitioners of the NBRS system, their Knowledge, Attitudes, and Practices (KAP) toward NBRS, and whether they are equipped to respond effectively to public health emergencies. Therefore, the study aims to address this 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 investigating 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, during June 18th to September 11th of 2022, of the COVID-19 pandemic, to analyze pharmacists' Knowledge, Attitude, and Practices (KAPs) and the impact of the NBRS on pharmacies. Our study was approved by the Joint Institutional Review Board (JIRB) of Taipei Medical University (N202205055) and the Institutional Review Board (IRB) of Penn State University (STUDY00021659).

### 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 performed the expert validity carefully, and the questionnaire underwent a thorough review process involving two pharmacists, two epidemiologists, and a survey research consultant to exclude or revise questions. The final questionnaire comprised 66 questions divided into demographics, KAPs, and perceptions of the NBRS effectiveness. Demographics included age, gender, 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 Knowledge (K) section was designed with multiple choice questions for participants to choose right, wrong, or uncertain about the COVID-19-related statements to measure their knowledge level of the evidence-based information. The Attitude (A) section comprises six questions on a 5-point Likert scale, Strongly Disagree=1, Disagree=2, Neutral=3, Agree=4, and Strongly Agree=5, to investigate pharmacists' Attitudes toward COVID-19 related policies. The Practices (P) section was divided into self-oriented (Practice SO) and customer-oriented (Practice CO) control measures 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]. With a 5% margin of error and 95% confidence interval (CI), the target sample size (N=321) to generalize pharmacies in Taipei City and New Taipei City.

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 ± standard deviations (SD) for continuous variables. Scores of questions on Knowledge (8 questions), Attitudes (6 questions), and Practices (16 questions) 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. 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 scoring system for assessing pharmacists' perceptions of NBRS effectiveness included positive effect score (PES) and negative effect score (NES). The overall impact of NBRS on the pharmacy was calculated by adding PES to the reversed NES. 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). 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 $P<.05$.

## 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

| Categories | Groups | Frequency (N) | Percentage (%) |
|---|---|---|---|
| **Gender** | | | |
| | 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** | | | |
| | 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/days** | | | |
| | <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, with 88.3% demonstrating good knowledge levels and 9.6% showing moderate levels (Table 2). The mean score for Attitude questions was 25.33±2.97 (range 10-30). The majority of participants had a good (50.4%) or moderate (44.9%) scores in attitude towards the effectiveness of controlled policies, vaccination, and the responsibility of healthcare professionals to possess and share accurate COVID-19-related information (Table 2). More than 75% of the participants demonstrated good compliances with the guidelines in Practice self-oriented (SO) behaviors (75.4%) and Practice customer-oriented (CO) behaviors (78.8%) (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 KAP Study Variables among Pharmacists (N=343)

| Variables | Number of Questions | Range of score | Total score (mean ± SD) | Level (%), N=343 | | |
|---|---|---|---|---|---|---|
| | | | | Poor | moderate | good |
| **Knowledge** | 8 | 3-8 | 7.22±0.73 | 2.0 | 9.6 | 88.3 |
| **Attitude** | 6 | 10-30 | 25.33±2.97 | 4.7 | 44.9 | 50.4 |
| **Practice SO** | 9 | 23-45 | 38.69±5.24 | 1.8 | 22.8 | 75.4 |
| **Practice CO** | 6 | 6-30 | 23.87±5.00 | 1.7 | 19.6 | 78.7 |

[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 ± 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 service lines 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, more than half of the pharmacies adjusted their services, with 41.6% pausing the services after the pandemic outbreak and 14.1% adjusting to letting customers measure by themselves. Secondly, pharmacies that provided home-delivery services increased from 18.4% to 35.6%. Lastly, the percentage of pharmacies with online consulting services increased from 55.3% to 64.3%.

## 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 results of the multivariate linear regression analysis 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 between Pharmacists' Attitudes and Practices

| 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. The overall impact of the NBRS testing system (17.43±4.68) on pharmacies was more favorable than the NBRS masks system (15.76±4.44), which also reflected the willingness to continue participation in the NBRS in the future. Overall, if without a government mandate, 59.7% of responding pharmacists were willing to distribute COVID testing, while only 38.5% of them were willing to distribute masks under the NBRS system (Figure 2). Results also indicated that the negative impact of the NBRS masks on revenue (*P*<.001), manpower (*P*<.001), and pharmacists' well-being (*P*<.001), was significantly higher compared to NBRS COVID testing.

### *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 that pharmacist 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 (>50 years of age) (coefficient of slope; b=1.576, *P*<.001) showed a significantly positive perception for both NBRS mask and testing. However, employed pharmacists compared to pharmacy owners (b= -2.527, *P*=.014), and those who served more customers per day (b= -1.406, *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).

Table 4. Regression Analysis Results: Factors Influencing NBRS Mask, NBRS Testing, and Overall NBRS

| | NBRS mask | | NBRS testing | | Overall NBRS (masks + testing) | |
|---|---|---|---|---|---|---|
| **Model** | Unstandardized coefficient ± SE | *P* value | Unstandardized coefficient ± SE | *P* value | Unstandardized coefficient ± SE | *P* value |
| **Gender** | -0.087 ± 0.481 | .856 | 0.176 ± 0.545 | .747 | 0.13 ± 0.976 | .894 |
| **Age groups** | 0.715 ± 0.185 | <.001 | 0.743 ± 0.209 | <.001 | 1.576 ± 0.371 | <.001 |
| **Ownership** | -1.015 ± 0.51 | .047 | -1.539 ± .0.573 | .008 | -2.527 ± 1.027 | .014 |
| **Work hours** | -0.003 ± 0.403 | .995 | 0.003 ± 0.454 | .994 | -0.058 ± 0.813 | .944 |
| **Location** | 0.338 ± 0.48 | .482 | 0.028 ± 0.544 | .959 | 0.169 ± 0.973 | .862 |
| **Characteristic** | 0.419 ± 0.526 | .426 | 0.02 ± 0.58 | .986 | 0.143 ± 1.037 | .891 |
| **Number of customers/days** | -0.434 ± 0.193 | .025 | -0.744 ± 0.211 | <.001 | -1.406 ± 0.377 | <.001 |
| **Knowledge** | -0.503 ± 0.329 | .128 | -0.135 ± 0.369 | .714 | -0.619 ± 0.659 | .348 |
| **Attitudes** | 0.259 ± 0.08 | .001 | 0.385 ± 0.087 | <.001 | 0.654 ± 0.157 | <.001 |
| **Practices** | 0.049 ± 0.027 | .067 | 0.09 ± 0.029 | .002 | 0.145 ± 0.053 | .006 |

[a] Variables showing statistical significance include age groups (categorized as ≤ 30, 31-40, 41-50, 51-60, and over 60), ownership (pharmacy owner, employed pharmacist), and number of customers/days (<50 people, 51-100 people, 101-150 people, 151-200 people, 201-250 people, >250 people).

## *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 gender, 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 had good Knowledge, Attitudes, and Practices (KAP) towards COVID-19, indicating their competent roles in the fight of a deadly pandemic. At this pivotal moment in time, 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 the pharmacist’s clinical expertise. The impacts of the NBRS on community pharmacies include revenue, manpower, and pharmacists’ well-being. Factors such as age, pharmacy ownership and pharmacists' Attitudes toward COVID-19 were associated with their perceptions of the NBRS and willingness to continue participating in this system. Responses also 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 2). 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, 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.

Another limitation was the study's cross-sectional design. The primary limitation was the inability to determine the causal direction between variables. Furthermore, data were self-reported by the pharmacists, which may be subject to recall bias or social desirability bias (a type of response bias). Nonetheless, efforts were made to ensure the anonymity of the respondents to minimize potential biases. Therefore, the results could still serve as a reference for future policies and interventions aimed at improving public health outcomes.

## Strengths

To our knowledge, this is the first study to investigate and systematically collect data on pharmacists' responses regarding the NBRS for masks and COVID-19 testing. Previous studies discussed how the NRBS worked effectively and contributed to the control of the pandemic [6, 8 ,18,19]; however, our study explored how this system was received by pharmacy practitioners and factors that affected their perceptions.

Our study not only investigated the perceptions of the NBRS but also the Knowledge, Attitudes and Practices (KAP) of Taiwanese pharmacists to examine their relationships with the NBRS. Through the KAP survey, we discovered that Taiwanese pharmacists demonstrated strong competency in handling COVID-19. This comprehensive understanding of their KAP also allowed us to better comprehend how these factors influenced the implementation of public health initiatives and identify areas for future focus.

Lastly, although the COVID-19 pandemic is gradually coming under control, continued research on the impact of the pandemic on the community is needed. This allows policymakers, researchers, and healthcare professionals to prepare for and respond to future pandemics or similar global crises. By understanding the experiences and perspectives of community pharmacists during the COVID-19 pandemic, we can improve practitioners' experiences and identify strengths and weaknesses in our strategies and make improvements to public health.

## Conclusions

The Name-Based Rationing System (NBRS) of community pharmacies is an effective distribution system used to solve the uneven distribution of epidemic preventive supplies. Despite the varied responses to the rationing system, the NBRS optimized the expertise of pharmacists and available technology to achieve an equitable and reliable intervention. The contribution of the NBRS during the COVID-19 pandemic has proven the important role of community pharmacists in disease prevention, and it is essential to develop targeted interventions to further utilize pharmacists' expertise and their connection with the community to maximize the benefit to the public.

## 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.

## 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]

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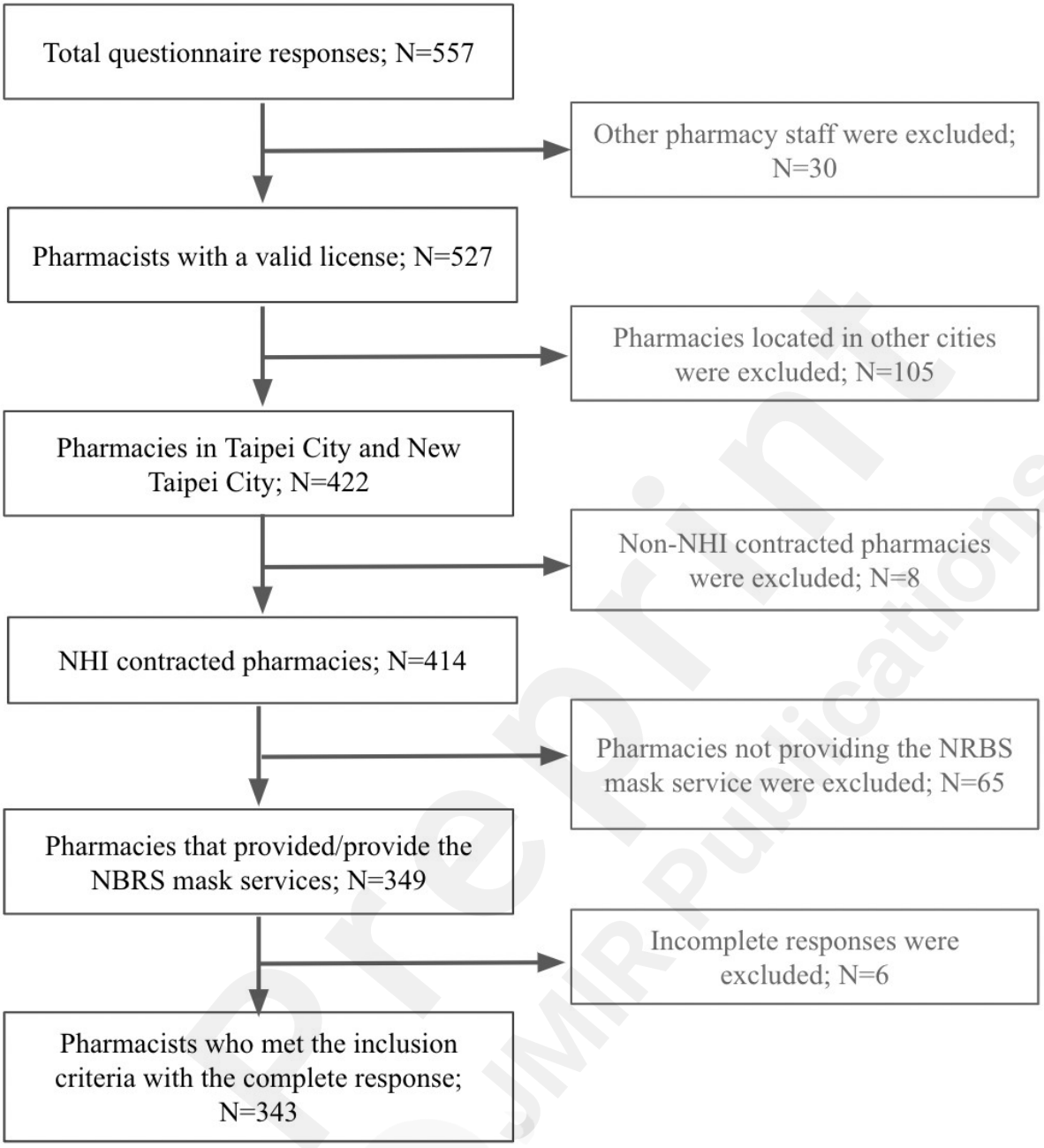
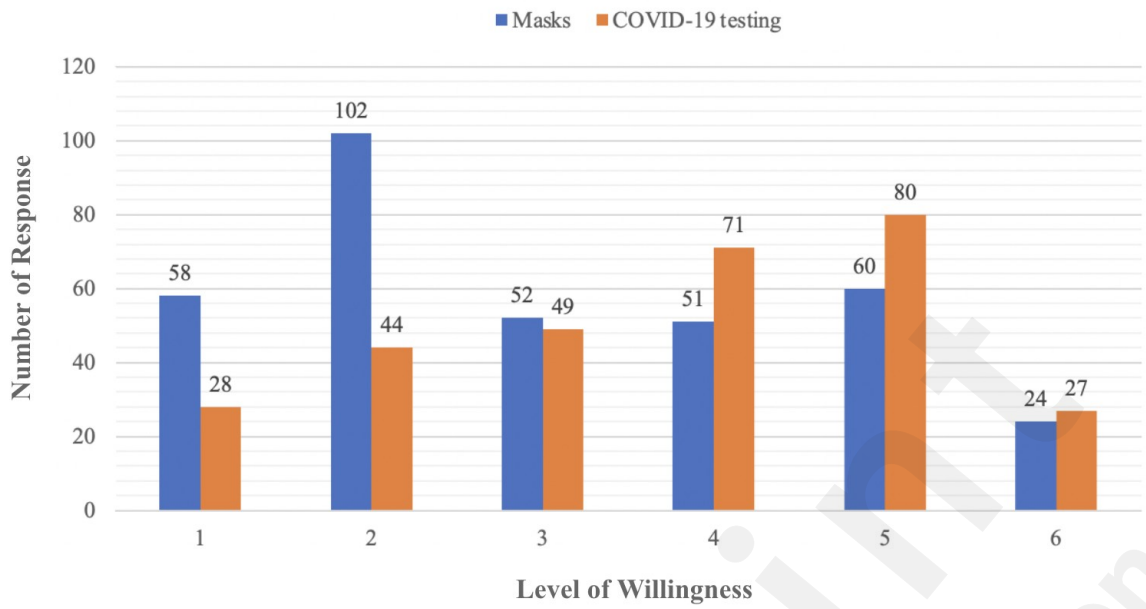
Figure 1. Inclusion Criteria Flow Chart for Pharmacists and Their Affiliated Pharmacies (N=557)




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




[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.

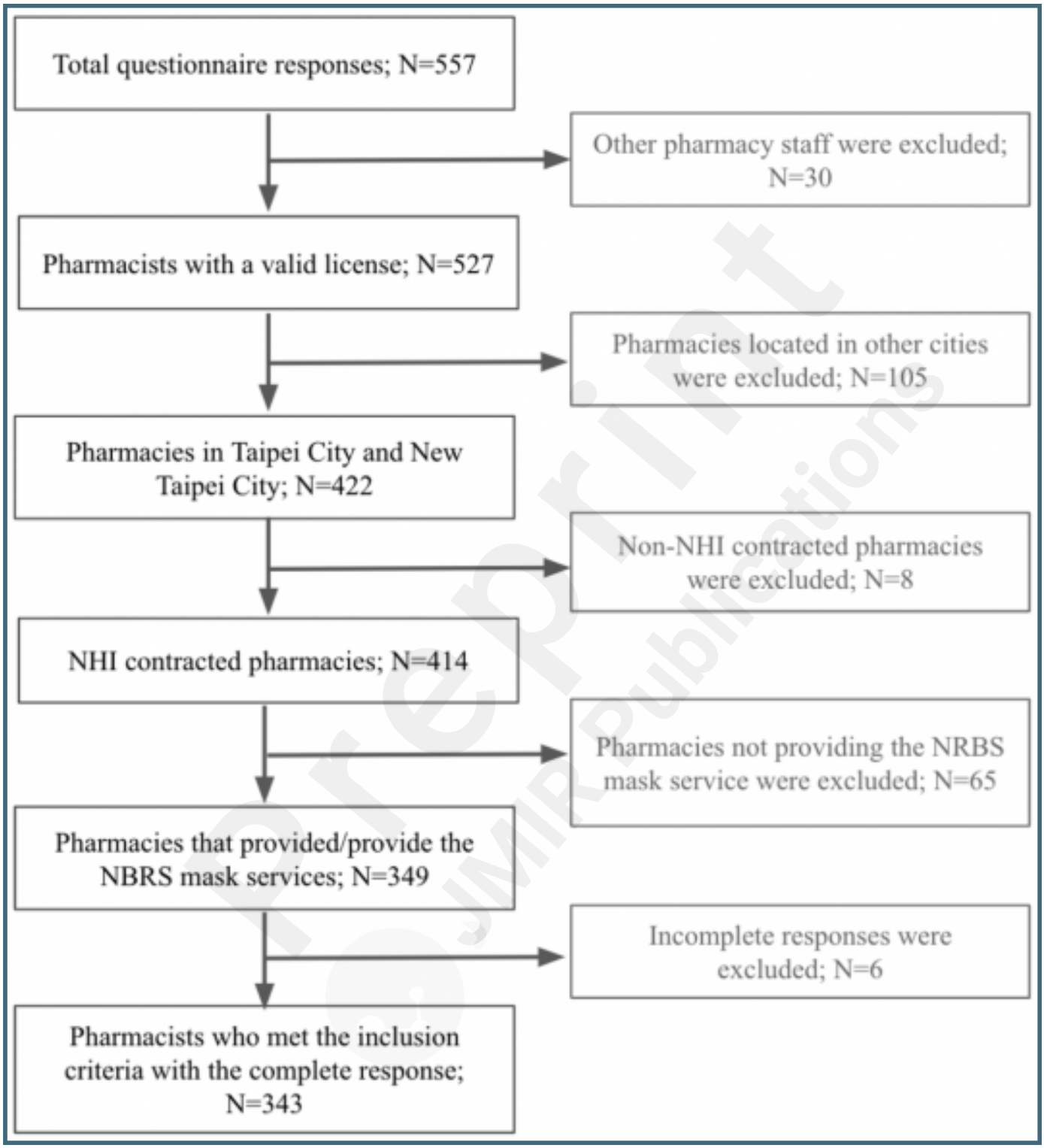
[b] The y-axis corresponds to the number of responses received from pharmacists.

[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.

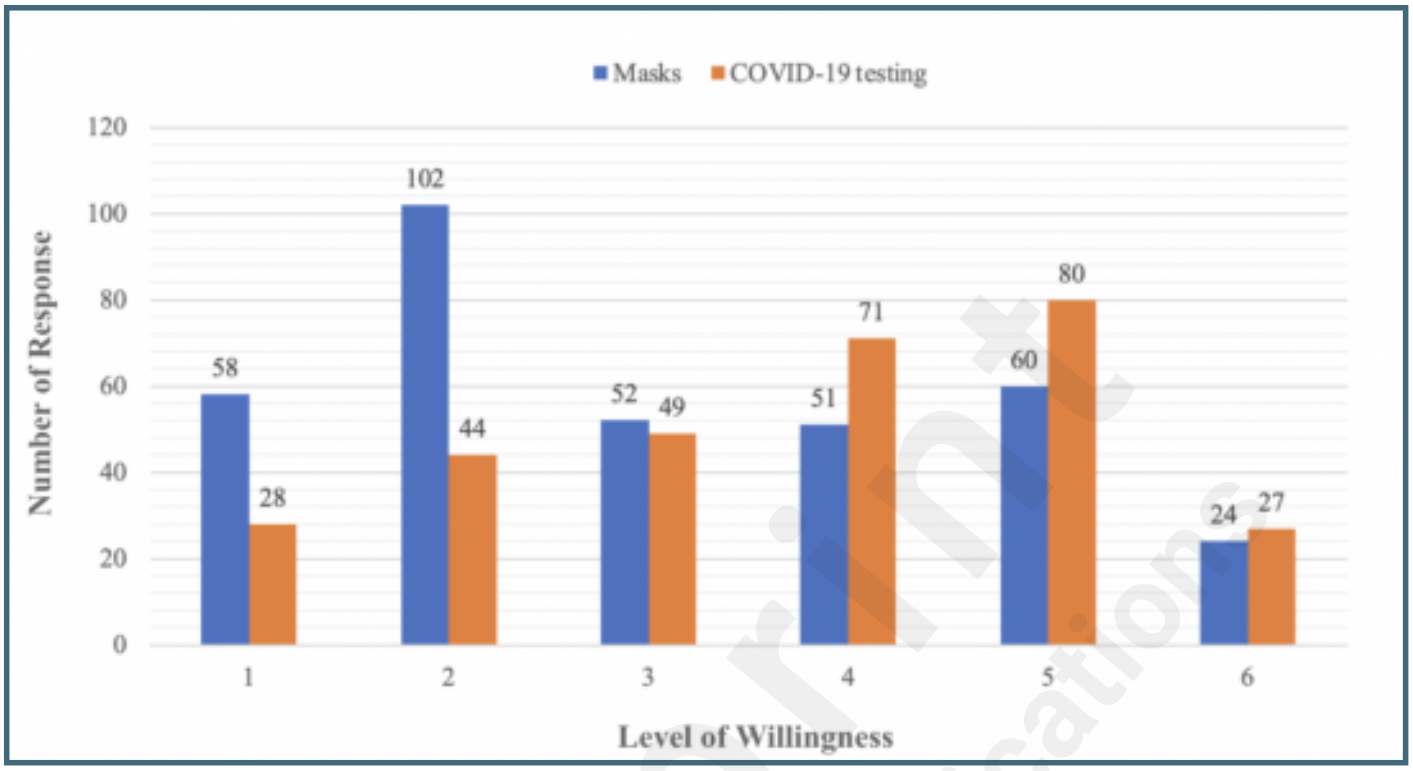
# Supplementary Files

# Figures

Inclusion criteria flow chart for pharmacists and their affiliated pharmacies (N=557).



The willingness to continue implementing the NBRS (a) Mask (b) COVID-19 testing.



# 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