Home medication management problems and associated factors among psychiatric patients under home care pharmacy services at government hospitals in west Malaysia

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Abstract

Background

Proper home medication management plays a role in improving medication adherence, preserving drug efficacy and ensuring safe medication practices, which is crucial to establish positive treatment outcomes. However, no published studies are available on home medication management among psychiatric patients. The study aimed to identify home medication management problems among psychiatric patients in Malaysia and to examine the association between inappropriate medication storage and lack of medication administration schedule with socio-demographic factors, disease insight, number of medication and type of Home Care Pharmacy Services (HCPS).

Methods

This multicentre cross-sectional study was conducted among psychiatric patients under HCPS in six government hospitals in west Malaysia. Data was extracted from the HCPS form used for each visit as per protocol published by the Pharmaceutical Services Division, Ministry of Health Malaysia. A minimum sample size of 169 was needed. Proportional random sampling was applied. Associations between inappropriate medication storage and lack of medication administration schedule with study parameters were analysed using multiple logistic regressions.

Results

A total of 205 home visits were conducted with 229 home medication management problems identified; inappropriate medication storage and lack of medication administration schedule topped the list. Inappropriate medication storage was significantly associated with low income [AOR=4.34 (95%CI 1.17:15.98), p=0.027], alcohol consumption [AOR=14.26 (95%CI 1.82:111.38), p=0.011], poor insight [AOR=2.34 (95%CI 1.08:5.06), p=0.030] and part-time HCPS [AOR=2.60 (95%CI 1.20:5.67), p=0.016]. Lack of administration schedule was significantly associated with low income [AOR=6.90 (95%CI 1.46:32.48), p=0.014], smoking [AOR=2.43 (95%CI 1.20:4.92), p=0.013], poor insight [AOR=5.32 (95%CI 2.45:11.56), p<0.05] and part-time HCPS [AOR=2.96 (95%CI 1.42:6.15), p=0.004].

Conclusions

Inappropriate medication storage and lack of medication administration schedule is common among psychiatric patients. The study also highlighted the potential of HCPS to improve disease insight and home medication management among psychiatric patients, provided if the service is utilised fully.

Introduction
The overall drug expenditure in 2018 and 2019 by the Malaysian government were at a staggering RM 2.32 and RM 2.80 billion respectively [1]. Despite the huge amount of money spent, many patients still failed to achieve their targeted treatment goal. A national survey on the use of medication by Malaysian consumers in 2015 reported that despite extensive use of pharmaceuticals, 18.6% of respondents did not fully understand the proper use of their medication and 17.0% had no knowledge on proper medication storage [2]. Underutilization and non-adherence coupled with poor knowledge of medication management could be the contributing factors towards treatment failure and wastage of resources.

The number of patients that have been seeking treatment at government facilities with regards to mental health problems have been increasing steadily over the years. Local statistics from the Malaysian Burden of Disease and Injury Study 2013 showed that besides diabetes mellitus and asthma, mental illness made up the top five leading causes of non-fatal disease and injury burden [3]. Furthermore, drug-related issues among mentally ill patients can be escalated further attributable to the chronicity of the illness itself due to the decline in cognitive and executive functioning. The rates of adherence are low at 50–60% and 35% for schizophrenia and bipolar affective disorders, respectively [4]. Additionally, patients with major psychiatric disorders with medication non-adherence can cause exacerbation of their illness and complications which lead to re-hospitalization, poor psychosocial outcomes, relapse of symptoms, reduce effectiveness of subsequent treatment, wastage of limited health care resources, increase substance abuse, poor quality of life and increased suicide [4]. Medication are most often neglected due to stigma, poor family support, inadequate knowledge as well as the impairment caused by the progression of the illness. Appropriate management of medication is crucial for positive treatment outcomes in this group of patients.

While non-adherence to medication, polypharmacy and inappropriate prescribing has always been a concern in regards to treatment outcomes, it is now recognised that there are broader range of drug-related problems that need to be addressed. These include poor home medication management. Good home medication management is important to ensure that drugs maintain their potency, avoid mix-ups, prevent overdosing and most importantly reduce wastage [5–6]. Poor management include overstocking of medication, inappropriate medication storage, lack of medication administration schedule, polypharmacy, use of discontinued medication, expired medication and the use of over-the-counter medication which are not suitable for their conditions [7].

Studies conducted on other groups of chronically ill patients have reported the rate of inappropriate home medication management to be as high as 57% [4, 6, 8]. Thompson et al. found that the majority of patients kept their medication in the kitchen. In addition, 4% and 8.3% of patients were found to store their medication in the bathroom and at multiple locations respectively. Many also stored their medication in containers other than the original dispensed packaging and these containers were not labelled accordingly. The most common reasons cited include portability of medication, the need to half the tablets which were originally blister packs, a dislike of the original packaging and difficulty in opening the original containers. An even more worrying finding was that about 9% of them mixed multiple prescription drugs in the same containers [9].
The factors associated to poor medication management may include low health literacy, confusion over the drug name, inability of the patients to read the storage and drug use instruction or unaffordability of patient to own refrigerators that are required for storage of certain drugs [10–11]. There is very limited data on the ability of mentally ill patients as well as their carers in managing their medications. Many of these problems are complex or even impossible to be identified over the counter during drug dispensing and the only probable way to be able shed light onto these problems is to access patients’ medication at their homes. Thus, as pharmacists conducting Home Care Pharmacy Services (HCPS) for the mentally ill, it is vital to understand the magnitude of the problem, to identify possible factors attributable to the problem as well as to help patients and their carers to better manage their medication at home to further improve treatment outcomes. The HPCS program, previously known as Home Medication Review, is a collaborative effort with the Community Mental Health Team (CMHT), a service program provided under the Mental Health Act 2001 and Mental Health Regulations 2010. The team comprises various disciplines and aims to provide comprehensive mental health care services to the community. The pharmacist’s role is to support the team by providing education on the importance of treatment of medication, regimens, dose as well as side effects of medication and their management. The pharmacist is also responsible for identifying any medication-related problems and doing the necessary interventions [12]. Home visits by pharmacists are conducted together with the CMHT case managers after obtaining consent from the patient and family, which is done by the case managers prior to patient’s recruitment into the CMHT program [13–14].

Earlier studies have concentrated on the adherence rate as well as other medication-related problems faced by psychiatric patients, but none have focused on home medication management among this group of patients. Education given to patients usually focuses on knowledge regarding their illness, medication and side effects as well as importance of adherence to their prescribed regimens. Limited information is disclosed to patients on proper home medication management, if at all. Nevertheless, this is an important factor which affects a patient’s treatment outcome as proper home medication management ensures drug efficacy is maintained, medication safety is ascertained and adherence to medication is improved. Therefore, this study aimed to identify home medication management issues and its associated factors among psychiatric patients under the HCPS program at government facilities in the state of Perak, Malaysia. This study also aimed to identify the association between inappropriate storage and lack of medication administration schedule with (i) socio-demographic factors, (ii) numbers of drugs prescribed, (iii) disease insight, and (iv) type of HCPS. By identifying these problems and studying the possible factors associated, we hope to draw a clearer view on managing medication related issues in this group of patients and further improve the quality of the HCPS program in Malaysia.

**Methodology**

This study was reported in accordance with the STROBE guidelines.

**Study design and sample**
This was a multicentre cross-sectional study conducted among patients under the HCPS program from October 2019 until June 2020 in six government hospitals in the state of Perak, Malaysia. The study was initially planned for duration of six months but had to be extended due to the Covid-19 pandemic transmission which hindered home visiting activities. These six hospitals were chosen as they have at least one pharmacist actively conducting the HCPS program in their respective settings.

All home care pharmacists involved had undergone and received certification for their specialization in Pharmacy Psychiatry in HCPS. Information from the HCPS-6 form, published in the HCPS Protocol 2nd edition 2019 by the Pharmaceutical Services Division Malaysia, which is routinely used by the HCPS pharmacists for each visit to document down findings such as medication reconciliation, medication storage and medication related problems was extracted into a data collection form developed by the investigators [12]. The data collection form was pre-tested to ensure all relevant data was collected.

Sampling was done in accordance to the 2018 statistics from the Pharmacy Management Report, whereby a total number of 712 psychiatric patients were under the HCPS program in Perak. The study took into consideration the study duration of six months, thus the estimated population was taken from half of the total number of patients from 2018, which was 356 patients. Using the sample size calculator for prevalence study developed by Naing et al. (2006), setting precision level at 5%, confidence level at 95%, the minimum sample size required was 169 [15]. This was based on the assumption that overall home medication management was inappropriate for 70% of patients with chronic diseases [16]. Proportional random sampling was used in the study whereby the number of samples required from each centre was divided proportionally depending on the total number of patients from each setting. A Microsoft Excel (Microsoft Corporation 2010, US) formula was then applied to generate unique random numbers which were then used to generate a randomised list based on the setting’s patient registry under HCPS.

The study protocol was approved by the National Medical Research Register, Ministry of Health Malaysia with the registration number of 19-2303-49656. The investigators applied for waivers of taking informed consent from the patients as only routine activities were carried out during visits and no new information were collected from the patient and carers. All data collected were kept confidential, and no unique identifiers were collected. Data presented did not identify individuals. Subjects were not given access to their personal information and study data. Data used for publication did not review any identity of the subjects.

**Definition of study term**

In the study, appropriate home medication management included appropriate storage of medications, having a drug administration schedule, absence of medication duplication, absence of drug hoarding or keeping expired medicines and not sharing medication with others. Appropriate storage was defined as storing medication in a cool, dry place (preferably not in bathrooms or near the kitchen stove) or refrigerator and out of direct sunlight. Medication must be stored so as to ensure that they could not be
taken by children if the household has children. Medication sensitive to humidity should be stored in their original containers or blisters. For patients using pill boxes, medication removed from blisters should not undergo any changes in physical appearance. Medication administration schedule was defined as taking medication with meals or putting pillbox or medicine bottles near the kitchen table (if applicable) or associating medication with a daily activity that will help patients to remember. Patients were considered to have no medication administration schedule if they did not have a fixed administration time for their medication or tend to forget their medication. The concept of disease insight was defined by three dimensions which were (i) the recognition that one has a mental illness (awareness), (ii) the ability to re-label unusual mental events (delusions and hallucinations) as pathological (attribution) and (iii) the recognition of the need for treatment (action) [17]. In the study, a person was deemed to have poor insight when he indicated unawareness, misattribution and inaction; either alone, or together. Monthly household income groups were categorized into three categories, which were the bottom 40% (B40), middle 40% (M40) and top 20% (T20), based on the income thresholds provided by the Department of Statistics Malaysia in 2014 [18]. Type of HCPS were categorized as full-time and part-time and were defined as HCPS as the primary job scope and essential duty, other tasks in other departments as secondary job scope and primary job scope and essential duties in other departments such as Outpatient and Inpatient, HCPS as secondary job scope respectively.

Data analysis

Descriptive statistics were used to describe patients’ socio-demographic characteristics. Normality of continuous data was determined using the Kolmogorov-Smirnov test. As data was not normally distributed, median with interquartile range was used. Categorical variables were presented as percentage. Inappropriate medication storage and lack of medication administration schedule were selected for multiple logistic regression analysis. An initial univariate analysis of the studied variables was performed against the patients’ demographic characteristics and the type of HCPS. Only factors that reported a p-value of 0.25 and below were selected for multivariate analysis. A p-value of less than 0.05 was considered statistically significant. All statistical analyses were conducted using IBM SPSS Version 20.0 (IBM Corp., Armonk, NY).

Results

During the study duration, home care pharmacists at participating hospitals conducted a total of 205 home visits. Out of the total number of patients, 54.6% (n=112) were under part-time HCPS and 45.4% (n=93) were under full-time HCPS. The number of male and female patients in the study was similar, with a median age of 45 years (IQR= 38-56). Majority of them were of Malay ethnicity (n=118; 57.6%); followed by Chinese (n=60; 29.3%), Indian (n=19; 9.3%) and others (n=8; 3.9%) which consisted of indigenous people and Sikhs. The median disease duration and number of medication was 14 years (IQR= 6-23) and 3 (IQR= 2-4) respectively. The academic degree of respondents varied widely; from no formal education to tertiary education, with more than half completed secondary schooling (n=120; 58.5%). Majority of patients were unemployed (n=155; 75.6%). Most of the patients were in the B40 group.
of income earners (n=181; 88.3%). None were classified under the T20 group of income earners. Majority of respondents were non-smokers (n=133; 64.9%), did not consume alcohol (n=195; 95.1%) and had no history of substance abuse (n=180; 87.8%). More than two third (n=157; 76.6%) of respondents had good insight regarding their mental illness (Table 1).
Table 1
Demographic characteristics of study patients (N=205)

| Characteristics (N=205)               | Median (IQR) | N   | %    |
|---------------------------------------|--------------|-----|------|
| Age                                   | 45 (38 – 56) | -   | -    |
| Disease duration                      | 14 (6 – 23)  | -   | -    |
| Number of medications                 | 3 (2 – 4)    | -   | -    |
| Gender                                |              |     |      |
| Male                                  | -            | 102 | 49.8 |
| Female                                | -            | 103 | 50.2 |
| Ethnicity                             |              |     |      |
| Malay                                 | -            | 118 | 57.5 |
| Chinese                               | -            | 60  | 29.3 |
| Indian                                | -            | 19  | 9.3  |
| Others                                | -            | 8   | 3.9  |
| Highest Level of Education            |              |     |      |
| No formal education                   | -            | 29  | 14.2 |
| Primary school                        | -            | 42  | 20.5 |
| Secondary school                      | -            | 120 | 58.5 |
| Tertiary education                    | -            | 14  | 6.8  |
| Marital status                        |              |     |      |
| Married                               | -            | 39  | 19.0 |
| Single                                | -            | 127 | 62.0 |
| Divorced                              | -            | 23  | 11.2 |
| Widowed                               | -            | 16  | 7.8  |
| Employment                            |              |     |      |
| Employed                              | -            | 50  | 24.4 |
| Unemployed                            | -            | 155 | 75.6 |
| Household Income                      |              |     |      |
| B40                                   | -            | 181 | 88.3 |
| M40                                   | -            | 24  | 11.7 |
| T20                                   | -            | 0   | 0.0  |
| Smoking                               |              |     |      |
| Yes                                   | -            | 72  | 35.1 |
| No                                    | -            | 133 | 64.9 |
| Alcohol intake                        |              |     |      |
| Yes                                   | -            | 10  | 4.9  |
| No                                    | -            | 195 | 95.1 |
| Substance abuse                       |              |     |      |
| Yes                                   | -            | 5   | 2.4  |
Home care pharmacists identified a total of 229 home medication management problems. Out of these, 31.9% (n=73) were classified as inappropriate storage; four major categories were found which were inappropriate location, medication not in original container, multiple storage area for medication and multiple medication in the same container. Other home medication management problems identified were drug hoarding (n=41, 17.9%), not having a medication administration schedule (n=71, 31.0%), sharing of medication (n=4, 1.7%) and presence of expired medication at home (n=8, 3.5%). Patients were found keeping medication that have already been discontinued by their doctors and were not taking their medication according to a standard repeated frequency and timing daily. There was no medication duplication found but the home care pharmacists identified the possibility of medication duplication (n=32, 14.0%) in the patients’ homes (Table 2).

### Table 2

| Category of home medication management problems identified by category, N=229 | Frequency, n (%) |
|---|---|
| Inappropriate storage of medication | 73 (31.9) |
| Drug hoarding | 41 (17.9) |
| No medication administration schedule | 71 (31.0) |
| Possible medication duplication | 32 (14.0) |
| Sharing of medication | 4 (1.7) |
| Presence of expired medication at home | 8 (3.5) |
Compared to the Malays, Indians were associated with an 84% reduction in the odds of having inappropriate storage of medication at home [AOR=0.16 (95%CI 0.03:0.84), p=0.031]. Patients under the B40 household income category have higher odds (four times more likely) to have inappropriate storage of medication at home versus patients under the M40 household income category [AOR=4.34 (95%CI 1.17:15.98), p=0.027]. Besides that, patients who consumed alcohol were fourteen times more likely to have inappropriate storage of medication at home as compared to patients who did not consume alcohol [AOR=14.26 (95%CI 1.82:111.38), p=0.011]. Patients who have poor insight towards their disease and treatment were two times more likely to have inappropriate storage of medication at home [AOR=2.34 (95%CI 1.08:5.06), p=0.030]. Furthermore, patients enrolled under part-time HCPS were twice more likely to have inappropriate storage of medication at home versus those who were under full-time HCPS [AOR=2.60 (95%CI 1.20:5.67), p=0.016] (Table 3).
Table 3
The logistic regression of factors associated with inappropriate storage of medications at home (N=205)

| Variables                  | Univariate Analysis |          |          |          |          | Multivariate Analysis |          |          |
|----------------------------|---------------------|----------|----------|----------|----------|-----------------------|----------|----------|
|                            | Crude OR            | 95% CI of OR | Wald's χ²(df) | p-value | Adjusted OR | 95% CI of OR | Wald's χ²(df) | p-value |
| Gender                     | Male                | 0.72 (0.29, 1.77) | 0.50 (1) | 0.478    | 1.03 (0.99, 1.06) | 3.32 (1) | 0.068    |
|                            | Female              | 1.00     |          |          |          | 1.00     |          |          |
| Age (year)                 |                     | 1.03 (0.99, 1.06) | 3.57 (1) | 0.059    | 1.03 (0.99, 1.06) | 3.32 (1) | 0.068    |
| Ethnicity                  |                     | 5.82 (3) | 0.120    |          | 6.27 (3) | 0.099    |
|                            | Chinese             | 1.33 (0.56, 3.14) | 0.44 (1) | 0.506    | 1.38 (0.62, 3.06) | 0.64 (1) | 0.423    |
|                            | Indian              | 0.16 (0.03, 0.86) | 4.54 (1) | 0.033    | 0.16 (0.03, 0.84) | 4.65 (1) | 0.031*   |
|                            | Others              | 1.34 (0.21, 8.56) | 0.09 (1) | 0.753    | 1.34 (0.23, 7.67) | 0.11 (1) | 0.738    |
| Malay                      |                     | 1.00     |          |          |          | 1.00     |          |          |
| Highest level of education |                     | 1.47 (3) | 0.689    |          |          | 1.47 (3) | 0.689    |
|                            | No formal education | 0.96 (0.20, 4.61) | 0.03 (1) | 0.959    |          |          |          |
|                            | Primary school      | 0.51 (0.11, 2.27) | 0.77 (1) | 0.380    |          |          |          |
|                            | Secondary school    | 0.78 (0.20, 2.94) | 0.13 (1) | 0.718    |          |          |          |
| Tertiary education         |                     | 1.00     |          |          |          | 1.00     |          |          |
| Marital status             |                     | 2.66 (3) | 0.446    |          | 2.51 (3) | 0.473    |
|                            | Single              | 1.47 (0.57, 3.79) | 0.65 (1) | 0.420    | 1.44 (0.58, 3.59) | 0.63 (1) | 0.427    |
|                            | Divorced            | 2.27 (0.63, 8.07) | 1.60 (1) | 0.205    | 2.37 (0.68, 8.28) | 1.85 (1) | 0.173    |
|                            | Widowed             | 0.67 (0.15, 3.03) | 0.25 (1) | 0.611    | 0.78 (0.19, 3.17) | 0.11 (1) | 0.735    |
| Variables                      | Univariate Analysis |                        |                      | Multivariate Analysis |                        |                      |
|-------------------------------|---------------------|------------------------|----------------------|-----------------------|------------------------|----------------------|
|                               | Crude OR | 95% CI of OR | Wald's \( \chi^2(df) \) | p-value | Adjusted OR | 95% CI of OR | Wald's \( \chi^2(df) \) | p-value |
| Married                       | 1.00     | 1.00          | 1.00                 |          | 1.00       | 1.00          | 1.00                 |          |
| Employment                    |          |              |                      |          |            |              |                      |          |
| Unemployed                    | 0.89     | (0.39, 2.05) | 0.06 (1)             | 0.793    |            |              |                      |          |
| Employed                      | 1.00     |              |                      |          |            |              |                      |          |
| Household Income              |          |              |                      |          |            |              |                      |          |
| B40                           | 4.20     | (1.12, 15.74)| 4.53 (1)             | 0.033    | 4.34       | (1.17, 15.98)| 4.87 (1)             | 0.027*   |
| M40                           | 1.00     |              |                      |          | 1.00       |              |                      |          |
| Smoking                       |          |              |                      |          |            |              |                      |          |
| Yes                           | 1.28     | (0.47, 3.48) | 0.24 (1)             | 0.624    |            |              |                      |          |
| No                            | 1.00     |              |                      |          |            |              |                      |          |
| Alcohol intake                |          |              |                      |          |            |              |                      |          |
| Yes                           | 16.55    | (1.90, 143.66)| 6.48 (1)             | 0.011    | 14.26      | (1.82, 111.38)| 6.42 (1)             | 0.011*   |
| No                            | 1.00     |              |                      |          | 1.00       |              |                      |          |
| Substance abuse               |          |              |                      |          | 0.04       | (2)          | 0.977                |          |
| Yes                           | 1.28     | (0.11, 14.72)| 0.04 (1)             | 0.838    |            |              |                      |          |
| Ex-abuser                     | 1.09     | (0.32, 3.67) | 0.02 (1)             | 0.887    |            |              |                      |          |
| No                            | 1.00     |              |                      |          |            |              |                      |          |
| Total number of medications   | 1.23     | (0.98, 1.55) | 3.30 (1)             | 0.069    | 1.23       | (0.98, 1.54) | 3.40 (1)             | 0.065    |
| Insight                       |          |              |                      |          |            |              |                      |          |
| Poor                          | 2.37     | (1.07, 5.22) | 4.61 (1)             | 0.032    | 2.34       | (1.08, 5.06) | 4.72 (1)             | 0.030*   |
| Good                          | 1.00     |              |                      |          | 1.00       |              |                      |          |
Patients under the B40 income category have higher odds (six times more likely) to not have a medication administration schedule [AOR=6.90 (95%CI 1.46:32.48), p=0.014] as compared to those under the M40 income category. The odds of not having a medication administration schedule at home were two times higher in smokers versus non-smokers [AOR=2.43 (95%CI 1.20:4.92), p=0.013]. Patients with poor insight have higher odds (5 times more likely) of not having a medication administration schedule when compared to patients with good insight [AOR= 5.32 (95%CI 2.45:11.56), p<0.05]. Furthermore, patients who were under part-time HCPS were two times more likely to not have a medication administration schedule at home versus those who were under full-time HCPS [AOR=2.96 (95%CI 1.42:6.15), p=0.004] (Table 4).
Table 4
The logistic regression of factors associated with lack of medication administration schedule at home (N=205)

| Variables                | Univariate Analysis |                  |                  | Multivariate Analysis |                  |                  |
|--------------------------|---------------------|------------------|------------------|-----------------------|------------------|------------------|
|                          | Crude OR            | 95% CI of OR     | Wald's χ²(df)    | p-value               | Adjusted OR      | 95% CI of OR     | Wald's χ²(df)    | p-value               |
| Gender                   |                     |                  |                  |                       |                  |                  |
| Male                     | 1.70                | (0.66, 4.36)     | 1.23 (1)         | 0.267                 |                  |                  |
| Female                   | 1.00                |                  |                  |                       |                  |                  |
| Age (year)               | 1.01                | (0.97, 1.04)     | 0.56 (1)         | 0.451                 |                  |                  |
| Ethnicity                | 0.35                | (3)              |                  | 0.949                 |                  |                  |
| Chinese                  | 1.28                | (0.50, 3.27)     | 0.27 (1)         | 0.597                 |                  |                  |
| Indian                   | 1.30                | (0.37, 4.60)     | 0.17 (1)         | 0.676                 |                  |                  |
| Others                   | 1.15                | (0.17, 7.69)     | 0.02 (1)         | 0.879                 |                  |                  |
| Malay                    | 1.00                |                  |                  |                       |                  |                  |
| Highest level of education | 4.34 (3)           |                  | 0.227            |                       | 4.71 (3)         | 0.194            |
| No formal education      | 0.34                | (0.06, 1.76)     | 1.62 (1)         | 0.202                 | 0.33             | (0.07, 1.55)     | 1.94 (1)         | 0.163                 |
| Primary school           | 0.85                | (0.19, 3.79)     | 0.04 (1)         | 0.836                 | 0.85             | (0.21, 3.42)     | 0.04 (1)         | 0.826                 |
| Secondary school         | 0.41                | (0.10, 1.59)     | 1.64 (1)         | 0.199                 | 0.42             | (0.11, 1.53)     | 1.71 (1)         | 0.190                 |
| Tertiary education       | 1.00                |                  |                  |                       | 1.00             |                  |
| Marital status           | 2.52                | (3)              | 0.472            |                       |                  |                  |
| Single                   | 0.85                | (0.31, 2.32)     | 0.09 (1)         | 0.765                 |                  |                  |
| Divorced                 | 2.01                | (0.53, 7.64)     | 1.07 (1)         | 0.301                 |                  |                  |
| Variables          | Univariate Analysis | Multivariate Analysis |
|-------------------|---------------------|-----------------------|
|                   | Crude OR | 95% CI of OR | Wald's χ²(df) | p-value | Adjusted OR | 95% CI of OR | Wald's χ²(df) | p-value |
| Widowed           | 0.67     | (0.13, 3.30) | 0.23         | 0.629   | 1.00       | 1.00        | 0.014*        | 0.013* |
| Married           | 1.00     |              |              |         |            |             |              |        |
| Employment        |          |              |              |         |            |             |              |        |
| Unemployed        | 1.07     | (0.45, 2.51) | 0.02         | 0.871   | 1.00       | 1.00        |              |        |
| Employed          | 1.00     |              |              |         |            |             |              |        |
| Household Income  |          |              |              |         |            |             |              |        |
| B40               | 6.45     | (1.29, 32.18)| 5.16         | 0.023   | 6.90       | (1.46, 32.48)| 0.014*        |        |
| M40               | 1.00     |              |              |         | 1.00       | 1.00        |              |        |
| Smoking           |          |              |              |         |            |             |              |        |
| Yes               | 1.97     | (0.73, 5.32) | 1.79         | 0.180   | 2.43       | (1.20, 4.92) | 0.013*        |        |
| No                | 1.00     |              |              |         | 1.00       | 1.00        |              |        |
| Alcohol intake    |          |              |              |         |            |             |              |        |
| Yes               | 0.77     | (0.14, 4.11) | 0.09         | 0.763   |            |             |              |        |
| No                | 1.00     |              |              |         |            |             |              |        |
| Substance abuse   |          |              |              |         | 0.68(2)    | 0.711       |              |        |
| Yes               | 0.41     | (0.03, 4.94) | 0.48         | 0.485   |            |             |              |        |
| Ex-abuser         | 0.65     | (0.19, 2.21) | 0.46         | 0.496   |            |             |              |        |
| No                | 1.00     |              |              |         |            |             |              |        |
| Total number of medications | 0.94 | (0.73, 1.21) | 0.17 | 0.676 |            |             |              |        |
| Insight           |          |              |              |         |            |             |              |        |
| Poor              | 5.61     | (2.50, 12.59)| 17.53        | p<0.05  | 5.32       | (2.45, 11.56) | 17.85        | p<0.05* |
### Variables

|               | **Univariate Analysis** | **Multivariate Analysis** |
|---------------|-------------------------|----------------------------|
|               | **Crude OR** | **95% CI of OR** | **Wald’s χ²(df)** | **p-value** | **Adjusted OR** | **95% CI of OR** | **Wald’s χ²(df)** | **p-value** |
| Good          | 1.00          | 1.00              |                      |             | 1.00            | 1.00              |                   |             |
| HCPS          |              |                   |                      |             |                |                   |                   |             |
| Part-time     | 2.88         | (1.21, 6.83)      | 5.79                 | 0.016       | 2.96           | (1.42, 6.15)      | 8.51              | 0.004*      |
| Full-time     | 1.00         | 1.00              |                      |             |                |                   |                   |             |

* p-value below 0.05 is considered statistically significant; CI, Confidence Interval; OR, Odd Ratio

### Discussion

To our knowledge, this study is the first study on home medication management problems in psychiatric patients. The study revealed that patients who consumed alcohol were highly associated with inappropriate storage of medications at home, consistent with the result of a secondary study of cohort data by Bryson *et al* [19]. This is most likely due to the effect of excessive alcohol consumption which can impede brain functions and result in cognitive as well as behavioural impairments [20]. The effect of alcoholism on cognitive function coupled with the nature of psychiatric disease itself could have caused direct detrimental consequences on patient’s drug management; namely drug storage condition and medication adherence.

The study also found that smokers were more likely to not have a medication administration schedule. Although there is currently no literature available to support any association between smoking and the presence of a medication schedule, many studies have demonstrated smoking to be highly associated with poorer adherence to medication [21–22]. As medication schedule serves as an aid for better adherence, a lack of it would most likely give rise to unsatisfactory adherence to medication. This could be due to the fact that smokers, who are already engaged in a chronic unhealthy lifestyle habit, may find it difficult to commit themselves to a fixed medication administration routine which requires certain degree of discipline. Moreover, there appears to be a general consensus that smokers portray significantly lower quality of life (QoL) in the physical, psychological, social and environmental dimensions of health. Problems of self-care and usual activities were found to be among the highest reported problems among smokers [23]. Self-care is defined as the ability of individuals, families and communities to promote health, prevent disease, maintain health, and to cope with illness and disability with or without the support of a healthcare provider while the usual activities dimension evaluates the severity of problems in their usual activities such as work, study, housework and family or leisure activities [24–25]. Therefore, smokers who are generally incapable of promoting and maintaining their health by themselves, along
with difficulty in conducting their daily activities, are expected to fail to adhere to timely medication consumption.

Kapplan et al. stated that ethnic minority patients were much more likely to record higher non-compliance, independent of other demographic factors [26]. Furthermore, South Asians in western countries were also found to more likely record non-adherent behaviour to oral medication as compared to white Caucasians [27]. To elaborate, studies have found that language barriers in healthcare led to miscommunication between healthcare workers and patients, leading to a compromise in the quality of healthcare delivery and a threat to patient safety [28–29]. Tideman et al. also found language barrier to be a long-term problem in Malaysia's healthcare system due to the population's different ethnicities [30]. Therefore, misinterpretation of information on medication storage condition during counselling sessions is plausible. Interestingly, while other studies showed that ethnic minorities to be practicing poorer quality of medication management, this study showed that the Indians as minority race were more likely to have better medication storage as compared to the Malays. Further studies are needed to identify other possible causes that could have led to this finding.

The study also showed that patients from lower household income were more likely to have poorer medication storage and lack of administration schedule at home. This finding is similar to the study finding by Martins et al. where they found that lower household income was close to reaching statistical significance as an independent factor in increasing the risk of inadequate medication storage, though no explanation was given [31]. In Malaysia, there are about 2.7 million households in the B40 category, of whom 44% are in the rural areas and 56% are in the urban areas [32]. Poor medication management among this group could be attributed to their living environment where only the bare necessities are available in their homes. Some homes do not have furnishing such as tables and refrigerator to store their medications and many do not possess a mobile phone which could serve as a reminder for their medication schedule. Sadly, some do not even have a working clock at home to tell them the time. Although Boron et al. claimed that compensatory strategies such as associating medication schedule with meal times is important to improve adherence, the reality is that some underprivileged households in Malaysia struggle to have three fixed main meals a day [33].

The study also found that poor insight was associated with inappropriate medication storage and lack of medication schedule at home. While there are no studies that have linked poor insight with inappropriate storage of medication as well as lack of medication schedule, previous studies have demonstrated significant relationship between poor insight and poor adherence as well as poor adherence and inappropriate storage of medication at home. Novick et al. and Misdrahi et al. claimed that patients with lack of insight in their diseases had higher risk of non-adherence to their medication [34–35]. Jimmy et al. also stated that having a medication administration schedule serves as an aid to improve medication adherence [36]. Thus, it is plausible to infer that those without a medication administration schedule are deemed to have poor adherence to their medication. Smaje et al. affirmed that poor medication storage was negatively associated with adherence to medication [37]. A possible explanation for this could be that patients with better insight towards their diseases will undeniably have a more positive attitude
towards their medication, thus resulting in better medication management such as proper storage of medication as well as having a medication schedule at home. Therefore, patients with better insight transpose to better medication management and subsequently, better medication adherence [38].

Part-time HCPS was found to be one of the factors associated with both inappropriate medication storage and lack of medication administration schedule among patients as compared to full-time HCPS. These two medication management problems are heavily affected by patient’s cooperation on daily basis. Leach MJ affirmed that good rapport with patients essentially leads to stronger therapeutic alliance with patients and can significantly improve the effectiveness of healthcare services [39]. Therefore, a good rapport between the HCPS pharmacists with the patient and family is important in order to secure their trust and cooperation to practice better medication storage and administration schedule. However, this requires continuous follow up visits and higher contact time between the pharmacists and the patient as well as their family. Unfortunately, the nature of part-time HCPS makes this rather difficult, which supports the findings of this study. Studies have shown that HCPS can enhance patient understanding, prevent medication accidents and lead to patient benefits, provided the service is well performed and utilized appropriately [40–41].

**Recommendation**

Overall, our findings indicate that full-time HCPS shows more benefits in regards to patients’ home medication management which could further attribute to their medication adherence as well. Thus, raising the question as to how the Ministry of Health Malaysia can further improve this service for the benefit of patients. As one of the key strategies to boost population health is through community-based services, it might be beneficial to give HCPS due attention as there is definitely room for improvement for the well-being of patients. The roles of pharmacists have shifted towards services-based and patient-centered, but emphasis is usually given for services within health facilities. By expanding these services to patients’ homes, HCPS can help fill the gap which may hinder the effectiveness and care provided at health facilities. A complete and updated protocol on HCPS is in place but it is not fully utilized as the service is usually considered secondary. One strategy is to allow appointed home care pharmacists to concentrate on their service rather than giving more emphasis on counter services. This can be done through better human resource management within the Ministry of Health as the main reason given deterring the pharmacist to conduct home visiting is lack of manpower. More studies on the benefits of full-time HCPS in countering the long-standing non-adherence and poor medication management issues would be helpful to systemically quantify its outcomes both clinically and economically.

**Study Limitation**

One limitation identified in this study was that the Movement Control Order (MCO) was issued during part of the study period in response to the Covid-19 pandemic transmission, leading to disruption in home visits especially to red zone areas. This might have disrupted the medication refill by the patients,
especially during the initial phase of MCO whereby patients were requested to stay indoors. Some patients were also afraid to come to the hospital for medication refills, causing them to run out of medication during HCPS home visits. Some patients might have adjusted their medication administration schedule, such as from once daily dosing to every alternate day dosing to prolong their medication supply. Though this may not have any effect on medication storage at home, it may have greatly impaired patients’ medication administration schedules during the Covid-19 pandemic.

**Conclusion**

This study highlights issues on home medication management among psychiatric patients and possible factors associated with it. Findings indicate certain socio-demography factors, disease insight and type of HCPS are significantly associated with medication management at home. However, the effect of socio-demographic factors (ethnicity, educational level and income) on patients’ home medication management is rather difficult to explain due to limited studies available and confounding variables as they may not be truly independent factors influencing medication management. Nevertheless, findings shed light on the benefits of full-time HCPS and good disease insight towards patients’ home medication management. Thus, with improved implementation of HCPS as well as thorough patient education by pharmacists, home medication management among psychiatric patients may perhaps be improved.

**Abbreviations**

HCPS: Home Care Pharmacy Services; CMHT: Community Mental Health Team; B40: Income thresholds below 40%; M40: Income thresholds middle 40%; T20: Income thresholds top 20%; MCO: Movement Control Order

**Declarations**

**Ethics approval and consent to participate**

The study protocol was approved by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia. Informed consent waiver from Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia was approved (KKM/NIHSEC/P19-1951 (5)). All methods were carried out in accordance with relevant guidelines and regulations.

**Consent for publication**

Not applicable

**Availability of data and material**

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request and with permission of the Director General of Health Malaysia.
Competing interests

The authors declare no competing interests.

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Authors’ contributions

SR proposed the study framework and analysis strategy. CLLL wrote the first draft of the manuscript. CLLL, CYH, STO, XYB, MFR and DP carried out all aspects of data collection. CLLL carried out the statistical analyses. CLLL and SR participated in interpretation of the results. CLLL, CYH and STO gave the revised suggestions and approved the final version. All authors read and approved the final manuscript.

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