

DISPOSAL BEHAVIOUR OF UNUSED MEDICINES WITH ENVIRONMENTAL AWARENESS AS MODERATOR: A CONCEPTUAL PAPER

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ABSTRACT

Rising economies and developing nations lead to expanded access to essential medications. Malaysia is not an exception to the trend of increased pharmaceutical product. They are referred to medications or drugs that are necessary for maintaining public health as well as for the prevention and treatment of illnesses. Pharmaceutical products increased by 24% from 2015 to over 4.5 trillion doses globally in 2020. Nonetheless, not all patients had consumed all the prescribed medicines they have. Unused medicines are defined as pharmaceuticals that are no longer consumed by the intended users or patients. These unused medicines could be improperly disposed. Improper disposal of unused medicines is defined as discarding unused medicine other than returning them to a Medicine Return Programme (MRP). It is shown that most people in Malaysia did not aware of the proper disposition of unused medications. For instance, the potential environmental harm caused by medicines when disposed of in household trash, leading to their presence in landfill and contamination of surface water. Consequently, one objective of this conceptual paper is to examine the factors influencing the disposition behaviour of unused medicines and the moderating effect of environmental awareness in the relationship between intention and disposition behaviour in Malaysia. Health Belief Model (HBM) theory will be used in this paper to explain the factors influencing the disposition behaviour of unused medicines. Quantitative Research Design is used in this study. A sample size of 2,256,108 of Malaysia's population will be taken for this study. This paper aims to provide a conceptual process for understanding how patients evolve in their disposal behaviour of unused medicines by putting forth a conceptual framework that incorporated these elements.

Keywords: Environmental Awareness, Disposal, MRP, Unused Medicine, HBM Theory

1.0 INTRODUCTION

Due to growing economies with good healthcare infrastructure, including hospitals, clinics, and pharmacies, the medications are more accessible to a larger population. With an ageing population and people with chronic illnesses, Malaysia is seeing a rise in the use of pharmaceutical products. This can be proved as the budget for healthcare industries has rosed every year since 2016 (Table 1). Recently, through The Star on 13 October 2023, Prime Minister, Anwar Ibrahim has announced for Budget 2024, Health Ministry will have the biggest allocation of RM41.2 billion for maintaining and upgrading the health services and facility, including to promote health information. It has risen 13.5% year over year (y-o-y) which is one of the biggest year-over-year growths in recent times.

Table 1: Budget Allocation for Healthcare Sector (RM) in billion 2016-2024

Year	Budget Allocation for Healthcare Sector (RM) in Billion
2016	22.87
2017	25
2018	26.58
2019	29
2020	30.6
2021	31.9
2022	32.4
2023	36.3
2024	41.2

Sources from Annual Report of Minister of Health from 2016 to 2023 and Announcement of Budget 2024 by Prime Minister from The Star on 13 October 2023

The increase in budget is important for the development of new hospitals, clinics, and healthcare facilities in both urban and rural locations, as well as the resolution of the overpopulation of ministry hospitals (Nurul, 2023). Ironically, while medications serve to prevent and treat diseases in humans and animals, they currently stand as one of the most prevalent environmental pollutants when they are disposed improperly (Ariffin & Zakili, 2019). Since not every patient had taken every prescription medication (Kristina, 2018), the unused medicine has increased over the time (Makki et al., 2019).

Patients could have unused medicines for a variety of reasons, such as non-compliance with their treatment plan, an improvement in their health, a change in their treatment plan, the occurrence of unfavourable effects, and an oversupply of medicines from various sources (Wang et al., 2021). According to a study done in Malaysia's government hospitals, patients preferred to keep obtaining as many prescriptions as they needed because they were provided free of charge or at a reduced cost by the government, even if they still had enough medication to last for a few months (Ong et al., 2019).

Dumping unused medicine instead of bringing them back to a Medicine Return Programme (MRP) constitutes improper disposal of unused medicines. Under the programme, the collected unused medicine will be disposed of as pharmaceutical waste through regulated incineration (Leong et al., 2021). Through the Medicine Return Programme (MRP) in 2010 introduced by the Ministry of Health (MOH) Malaysia, awareness programmes and programmes about sensible drug use have been promoted in Malaysia for the last 10 years (Yut, 2019). However, numerous studies found that improper drug disposal practices were related to a low level of knowledge and awareness among people in Malaysia (Yut, 2019). Several research have proven that, less than a quarter of the population in Malaysia returned unused or unwanted medicines to the collection points which are pharmacy departments at MOH hospitals and health clinics (Wang, 2021).

While in other countries, such as Dutch, showed a high degree of knowledge among them, when 80% of respondents in a poll have returned their unused medicines to pharmacies or to chemical waste facilities (Ong et al., 2019). The success of these nations is attributed to targeted information programmes conducted by their policymakers. These

programs have effectively raised public awareness regarding the disposal of unused medicines and promoted efficient disposal methods (Wang et al., 2021).

Guided by recommendations from poison-control centres, or only by convenience, health professionals and consumers alike have customarily disposed of unused medicines into the public water system by flushing them down the toilet or rinsing them down the drain (McCullagh et al., 2012; Ortner & McCullagh, 2010). This practice was standard until the discovery of measurable amounts of pharmaceutical chemicals in water triggered alarm about the consequences of pharmaceutical pollution in the environment, and its potential effects on human health (WHO, 2011), as it will contaminate the surface of water, endangering people who use the water sources for daily life, aquatic, and animals. To protect the environment from pharmaceutical products, it is essential to dispose of unused medicines correctly.

One of the most well-known theories that has been used in many studies related to healthy behaviour is the Health Belief Model or known as HBM (Umaki et al., 2012). Hence, HBM will be used in this study to explain the factors influencing the disposition behaviour of unused medicines.

2.0 LITERATURE REVIEW

2.1 Health Belief Model Theory (HBM)

Godfrey Hochbaum and Irwin Rosenstock, social psychologists, developed the Health Belief Model (HBM) in the early 1950s (Strecher & Rosenstock, 1997). According to Razmara et al. (2018), the model assesses the connection between preventive health behaviours and health-related attitudes. HBM is also one of the most functional theories for understanding preventive health behaviours (Rahnavard et al., 2011). Perceived vulnerability and perceived rewards of action are the two ideas that Hochbaum established as the foundation of the model based on thorough assessments of probability samples of adults living in places that provided tuberculosis screening. Although Hochbaum never conducted an empirical investigation into this aspect of the concept, he acknowledged the importance of both extrinsic and intrinsic cues or triggers in inspiring people to act (Strecher & Rosenstock, 1997).

The HBM has been improved and enlarged over decades, and it is well-supported by empirical research (Strecher & Rosenstock, 1997). It is predicated on the idea that preventive actions rely on an individual's beliefs. Based on the model, people will engage in preventive actions to avoid risk if they feel exposed and sensitive to a situation (perceived susceptibility); additionally, if someone believes that a situation is potentially dangerous and could have a significant impact (perceived severity); and finally, if they believe that they can reduce the risks and side effects of the situation through a series of actions and that the benefits of these actions (perceived benefits) outweigh the barriers to complying with the behaviour (such as time and money–perceived barriers), they will have a higher probability of exhibiting the necessary behaviour (Moghadam et al., 2020).

Therefore, HBM will be used in this study to explain the factors influencing the disposition behaviour of unused medicines. Perceived susceptibility, perceived severity, perceived benefits and perceived barriers are the independent variables that make up the HBM.

2.2 Disposal Behavior of Unused Medicines in Malaysia

Since the improper handling and disposal of unused medicines raises serious concerns globally, including in Malaysia, the Ministry of Health in Malaysia has designated this field of

research as one of the five study domains outlined in the Pharmacy Study Priorities of Malaysia. In order to dispose of leftover medications in government healthcare facilities securely, Malaysia has been implementing the Medicine Return Programme (MRP) since 2010. The country has also created national guidelines for managing returned medications. It is preferable to participate in the MRP in order to dispose of unused medicine. It would be inappropriate for users to dispose of unused medicine in other ways (Wang et al., 2021).

However, according to multiple surveys conducted in Malaysia, the majority of people (about 75%) dispose of their unused medicines in the trash, the sink, or the drainage system (Wang et al., 2021). According to different research, 93% of Malaysian university students had flushed unwanted drugs down the toilet or washbasin and were unaware of the "Return Your Medicines Programme" (Lai et al., 2021). However, this poor disposal behaviour is related to poor handling experience of unused medicines and health care facilities' and health professionals' behaviour on medication waste.

Compared to Malaysia, many nations have had official programmes in place for some years to gather leftover medications, including Australia, France, Sweden, Portugal, Spain, the United Kingdom, and New Zealand (Ruhoy & Daughton, 2008). Member states of the European Union are required by directives to establish appropriate mechanisms for the return of unused and expired medications (Health Canada, 2009). Australia's federal government provides funding for the Return Unwanted Medicines Project. Sweden has a unique retail pharmacy system that is consolidated under Apoteket B, a single government-owned chain. Targeted public awareness campaigns are used by Apoteket B to run an environmental programme that educates the public about the harmful consequences of disposing of or flushing pharmaceuticals down the toilet. The emphasis on raising public awareness appears to be effective, as over 70% of customers who have leftover medications return them to the drugstore. In addition, the Spain Integrated Waste Management System runs extensive public awareness efforts that are successful in generating a lot of medicine returns.

2.3 Perceived Susceptibility – Poor Handling Experience of Unused Medicines

Perceived susceptibility refers to an individual's subjective perception of experiencing a health or medical condition. This dimension encompasses susceptibility to illness in general in addition to vulnerability to a specific condition. In the study, poor handling experience of unused medicines is the perceived susceptibility.

Other than that, a study carried out in Malang and Yogyakarta, the majority of respondents did not process medications in a proper or safe manner. People's attitudes can be influenced by personal experience and cultural influences. Even if a person is knowledgeable about how to manage medication properly, due to the experience they have in their home contexts and their culture, this knowledge is often ignored (Pramestutie et al., 2021).

Besides, poor attitude towards unused medicines also may cause by many factors including the age of users, gender, and income of households (Ong et al., 2019). Elderly citizens tended to be more disciplined than young people, who typically take things for granted and look for simple ways to live. A study conducted in Ghana; women are recognised to be mainly accountable for all household duties including to properly dispose of medication waste compared to men. Proper disposal of waste was significantly and favourably impacted by household per capita expenditure, a measure of household wellbeing. Households with higher per capita expenditure were marginally more likely to collect their domestic waste (Adzawla et al., 2019).

2.4 Perceived Severity – Amount of Medication Waste Found in the Environment

Perceived severity is a related factor, denoting the seriousness of experiencing the condition or allowing it to remain untreated or unaddressed. This aspect includes medical consequences (pain, disability, and death) and social consequences (such as the impact of the condition on work and social relationships). In conjunction, perceived susceptibility and perceived severity produce perceived threat. In this study, the amount of medication waste found in the environment is the perceived severity.

As a result of increased drug use, these substances are more prevalent in the environment, which may have an impact on organisms' survival, reproduction, metabolism, and population as well as alter the ecosystem's community structure and ecological functions, which include biodiversity and biomass production (Shao et al., 2018). One of the main reasons medicines are present in the environment is improper disposal of unused medicine, particularly when it is done through solid waste disposal or into sinks and toilets (Vieno et al., 2017). According to a report released by the Baltic Marine Environment Protection Commission and UNESCO/HELCOM (United Nations Educational, Scientific, and Cultural Organisation), wastewater is the primary source of pharmaceutical contamination in the Baltic Sea (Vieno et al., 2017). Nevertheless, it will take time and money to modernise the wastewater treatment facilities that surround the Baltic Sea since they are not built to remove micro-pollutants. Thus, it is essential for residents of the Baltic Sea region to properly dispose of any unused medicines in order to lower the number of pharmaceuticals in the water (Rogowska & Zimmermann, 2022).

2.5 Perceived Barriers– Health Care Facilities' and Health Professionals' Poor Behaviour on Medication Waste

Despite awareness of the potential benefits of a given health behaviour or behaviours, perceived barriers serve as obstacles to the recommended course of action. In a comprehensive research review of the HBM, perceived barriers emerged as the single most important factor in health behaviours across all studies and behaviours (Strecher & Rosenstock, 1997). For preventive behaviours, perceived susceptibility and perceived barriers are the best predictors of behaviour, whereas for behaviour related to a current health problem (such as adhering to medication), perceived severity and perceived barriers are most significant (Nisbet & Gick, 2008). In this study, the potential perceived barrier is the health care facilities' and health professionals' poor behaviour on medication waste.

2.5.1 Poor Disposal Behaviour of healthcare facilities

The EPA (2008, 2010) started looking at how healthcare facilities dispose of their pharmaceutical waste after receiving strong evidence of detectable levels of different pharmaceutical chemicals in US waterways. The premise behind the study was that medical facilities are still disposing of enormous amounts of unneeded medications into sewers, which is bad for the environment and the general public's health. The primary factors influencing disposal procedures were, for the most part, federal, state, and municipal regulations controlling the disposal of medical waste. However, other factors that affected the disposal of unwanted pharmaceuticals were size, simplicity of use, and cost. Long-term care facilities were subject to stricter requirements for the return of unwanted pharmaceuticals than hospitals were because of the disparities in their respective regulatory frameworks.

2.5.2 Poor advice received from Health Care Worker

Other than that, advice from health care workers (HCWs) may not have had the desired effect for a number of reasons. Firstly, patients may not have followed the advice.

Secondly, the advice may not have been correct in the first place. Thirdly, the likelihood of correct disposal appears to be reduced when advice comes from multiple sources. Out of the 18 patients who reported receiving advice from sources other than HCWs, none were assessed to be consistently practicing a proper disposal method (Quiwa & Jimeno, 2014). It is crucial that pharmacy students, chemists, and medical personnel have the appropriate education in this area. Alhomond et al. (2021) found in the aforementioned survey that, of students who were given information on how to properly dispose of medications, 85% did not dispose of unused or expired medications in household garbage and 91% did dispose of medications in household garbage among those who had never received such information.

2.5.3 Suggestion for Health Care Worker to Encourage Proper Disposal of Unused Medicine

In order to comply with all applicable laws and maybe save expenses, the start of a waste-management programme involves a variety of waste segregation strategies (EPA, 2010). Staff training for chemists, nurses, and other people involved in managing unwanted medications is a crucial part of an effective waste-management programme. According to the EPA, employees should get training on when to discard or return unwanted prescriptions to the pharmacy, as well as how to do so. Staff members should receive regular training including refresher courses to keep them up to date, and their input should be sought for ongoing quality improvement.

2.6 Perceived Benefits - The Effect on the Environment with Efficient Disposal of Unused Medicines

Perceived Benefits are the good results that are achieved by healthy behaviour as it pertains to the efficiency of certain acts in minimising the risk of health problem (Moghadam et al., 2020). Bringing unused and expired drugs to a take-back event or MRP neutralises the potential hazard to people and pets and does not contribute to environmental pollution. Beyond the practical benefit, this action might produce the intrinsic reward of believing one has done the right thing. A drug take-back event can offer an opportunity for socialising with friends or neighbours or meeting others in the local community. For young people in particular, peer pressure to engage in environmentally friendly behaviour might influence unused medicines disposal practices.

It is beneficial to the government and environment if there is a smaller number of unused medicines and if efficient disposal of unused medicines is promoted. An upstream strategy for drugs already on the market entails reducing the over prescription of pharmaceuticals, restricting aggressive marketing that prompts patients to request medications that may not be necessary, and clearing out household medicine cabinets filled with samples of multiple drugs that are never used. Enhancing the diagnostic processes for these medications enables doctors to prescribe the best medications at the right doses to patients, which increases patient compliance with treatment regimens. Ineffective medication compliance is a primary cause of unused medications ending up in waterways (Daughton & Ruhoy, 2013).

Besides, the promotion of efficient disposal methods also aligned with the Sustainable Development Goals (SDG) of 13 – Climate Action. As stated by Thakur (2021), the environment and even ecosystem are suffering from water pollution which result in an increase in the heavy metals in the groundwater that is caused by leachate as an effect of improper disposal of unused medicine.

3.0 ENVIRONMENTAL AWARENESS AS MODERATOR

The main factor in the inappropriate disposal of unused and expired medicines was the lack of law, implementation, and education on the subject. Although Brazil's National Solid Waste Policy, issued in 2010, stated that waste products will be returned to their original makers (Brazil, 2010), a sizable proportion of respondents (71.9%) stated that they had never received any advice regarding proper medication disposal. The poor investment in environmental education to inform the populace and the lack of a reverse logistics system in Brazil are the main causes of these figures (Amoabeng et al., 2022).

A different study on the knowledge, attitude, and practice (KAP) of healthcare professionals in South India found that participants were very unclear about how to dispose of the medication waste because many nations lack standardised medication disposal protocols (Michael et al., 2019). According to research done in Indonesia, 64.91% of the respondents (209 respondents) had college-level education. A person with a high degree of education will be able to reason and think logically, which will enable them to address difficulties analytically, such as those in the medical or health fields (Pramestutie et al., 2021).

It should come as unsurprising that households headed by more educated individuals were more likely to separate their household waste specifically including the medication waste into trash cans instead of burying or burning it. It is generally anticipated that formal education will increase people's awareness of the importance of maintaining a clean and healthy environment. Education has made the detrimental impacts of burning trash widely acknowledged. Higher educated household heads can therefore make sure that their waste is appropriately covered and collected (Adzawla et al., 2019). The knowledge of inappropriate disposal methods and their present practices were found to be significantly correlated. Up to 85.7% of respondents who do not realise that it is improper to dispose of solid medications in the trash also dispose of unused or expired medicines in the trash, but only 67.9% of respondents who were aware of this fact did the same (Ong et al., 2019).

Educational initiatives and programmes run by local and national governments, environmental organisations, and commercial institutions are some sources of information which will run as environmental awareness. According to a study, the frequency of patients returning unused or expired medications to pharmacies increased significantly in just six months, from 1.1% to 87.3%, thanks to public education programmes on pharmaceutical waste management in the Bihor County (Romania) population (Tit et al., 2016).

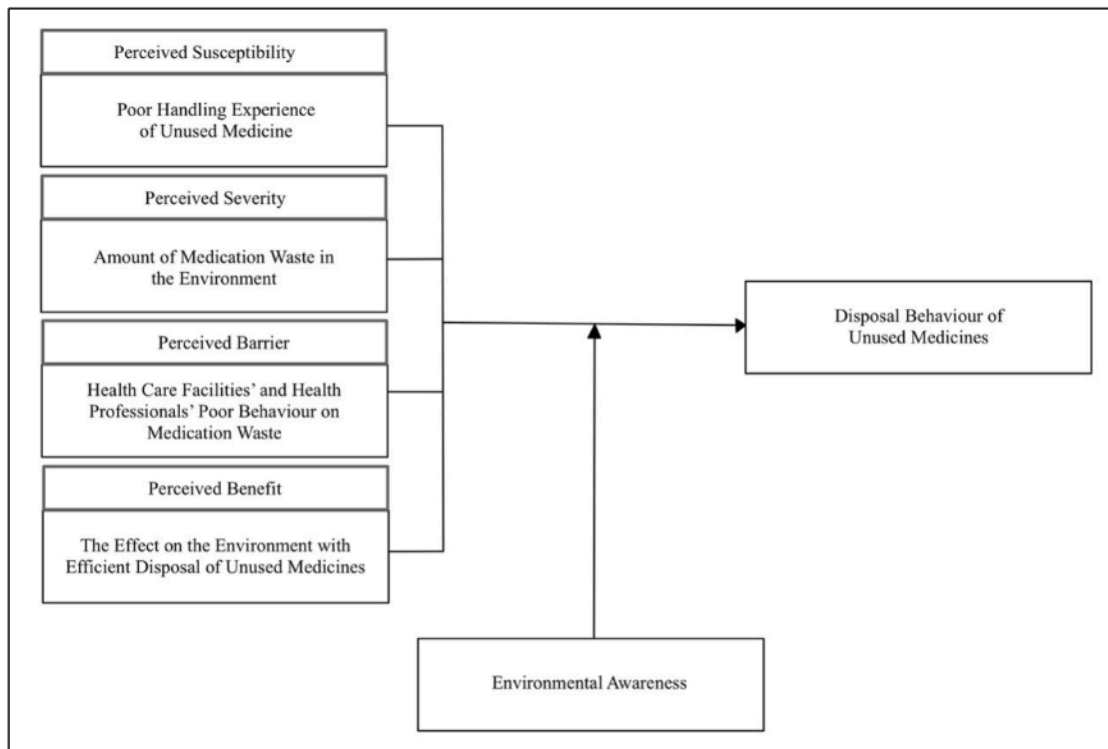


Fig. 1 Conceptual Framework Based on Health Belief Model
Adopted from Quiwa & Jimeno (2014)

4.0 IMPLICATION OF DISPOSITION BEHAVIOUR OF UNUSED MEDICINES

Participating community pharmacists discussed the potential risks of child poisoning from unused and expired medications, as well as the need for the drug returns program to be offered at their chemist's. According to prior research conducted in Malaysia, pharmaceuticals were the cause of 40.5% of purposeful poisoning cases and 30% of unintentional poisoning cases (Chong et al., 2022). Children between the ages of one and nine years old made up 46% of the victims of unintentional poisoning cases. According to a different research, pharmaceuticals were the main cause of paediatric poisoning, accounting for 39.2% of instances that were documented (Afni et al., 2012).

Other than that, Waste of medications is both an opportunity cost and a waste of financial resources from the perspective of health economics. Research at public hospitals in Malaysia has revealed that the average monthly waste of medicines was much greater than the amount that might have been used for each patient's care (Azas et al., 2016). According to the current findings, respondents were aware that improper prescription waste practices might have negative effects on the environment and public health. Nonetheless, there is a gap in their knowledge and actual medication disposal practices (Hassali & Shakeel, 2020).

5.0 METHODOLOGY

The research is using Saunders Onions as the methodology reference.

5.1 Research Philosophy

Positivist is chosen for the research philosophy since the Health Belief Model is an existing theory. Positivist researchers use existing theories to generate hypotheses. Howell (2013) claims that positivism has its roots in empiricist philosophy, which holds that hypotheses can only be proven true by empirical research. Ryan (2018) goes on to say that positivism upholds the idea of natural science, that things must have logical relationships

inside and between them, and that object study tries to identify these relationships and provide a rationale for them using scientific methods.

5.2 Research Approach

Deduction Approach is chosen in the research as data collection is used to evaluate hypothesis related to an existing theory. It is ideally for theory verification or falsification.

5.3 Methodological Choice

Quantitative research design will be used in this study. A quantitative approach is helpful when a researcher wants to look at relationships between concepts that can be quantified and are objectively measurable (Howell, 2010). This study's major goal was to test the hypothesis that there is a relationship between the factors (independent variables) that may have an impact on disposition behaviours of unused medicine—the outcome of interest or dependent variable—and those practices. A quantitative approach was appropriate because the factors under consideration are quantifiable and objectively measurable.

5.4 Research Strategies

Experimental and Survey will be used in the study. Experiment is a form of research that owes much to the natural sciences, although it features strongly in psychological and social science research. The purpose is to study the probability of a change in independent variable causing a change in another, dependent variable, as well as this study. While survey strategy is usually associated with a deductive approach. It is most frequently used to answer 'what', 'who', 'where', 'how much' questions. Hence, survey strategies are used to answer the questions in the study.

5.5 Time Horizon

The time horizon will be cross-sectional as the study is carried out and the data are gathered just once at a time.

5.6 Data Collection

Researchers use techniques like exams, questionnaires, and interviews to obtain information directly from primary sources, which is known as primary data. Primary data, which is usually obtained from the source where the data originally originates, is the most valuable kind of data for study. Hence, data will be collected through a structured online-survey questionnaire. All the questions were closed-ended, and some offered the option for the respondents to record their own opinion if the choices were not suitable (Amoabeng et al., 2022). The survey will include between 10 and 15 structured questionnaires for communities and pharmacies, and it will be divided into three parts. Part A will ask respondents about their sociodemographic characteristics and their background. Part B will be about the independent variables (Perceived Susceptibility, Perceived Severity, Perceived Barriers and Perceived Benefits), Part C will be about the moderating variables (Environmental Awareness) and Part D will be about the Disposal of Unused Medicines Behaviour, how they dispose of expired or unused medicines, and their knowledge of the environmental impact of improper medication disposal. An online questionnaire created specifically for this research will be distributed in Google Form with 5 scales of Strongly Disagreed, Disagree, Neutral, Agree, and Strongly Agreed except for the sociodemographic characteristics.

5.7 Data Analysis

The data collected will be analysed by the Smart Partial Least Square or known as Smart-PLS. The same function as Lisrel and AMOS, The Smart PLS examines the relationship between variables, both between latent and manifest indicator variables. When there are few samples available and the model being constructed is complicated, it is strongly advised to use Smart PLS compared to the other software. Hence, Smart PLS is a good choice to run the data especially when we are using quantitative measures (Purwanto, 2021).

5.8 Sampling Technique

The sampling technique chosen in the study is probability sampling. Based on annual report of Minister of Health in the year 2021, 2,256,108 of Malaysia's population are having morbidity patients. From this data, each member of the population has an equal chance of being selected. Hence, it is usually referred to as the probability sampling procedure.

Systematic Sampling Technique will be used as all information from the participants will be chosen after they are being filtered from the criteria needed. One easy way to draw scattered groupings of items is by systematic sampling. One element is chosen at random from the frame in a systematic probability sampling design, and all subsequent elements that are added to the sample are those that are separated from this initial selection by a predetermined sampling interval. While systematic sampling makes sure that every element has an equal chance of being included, it also makes only combinations of components that fall within the sample interval visible (Rahman et al., 2022).

6.0 CONCLUSION

Malaysia lags behind many other developed countries in establishing formal guidelines and policies for the safe disposal of pharmaceuticals. Countries such as Iran, Philippines, Australia, France, Sweden, Portugal, Spain, New Zealand, and the United Kingdom have had formal programs for collecting unused medications for quite some time (Moghadam et al., 2020, Helme et., al, 2020, Leslie Quiwa and Cecilia Jimeno, 2014). A study conducted by Health Canada (2009) compared the status of the recommended disposal practices across the European Union and member states to establish a benchmark against which to compare those established in Canada. For example, the report illustrated that Sweden has one of the most successful programs for the proper disposal of pharmaceuticals (Health Canada, 2009).

Taking unused or expired pharmaceuticals and bringing them to a designated location for proper disposal, or even mixing the drugs with unappetizing substances represents a radical shift in behaviour after years of disposing of pharmaceuticals down the drain or toilet, which may seem like the most convenient way to get rid of unused medicines. Medication disposal procedures have been the subject of investigations using frameworks like the TPB and the HBM to determine what encourages or impedes changes in health-related behaviour (Nisbet & Gick, 2008). Disposing of pharmaceuticals is different from altering one's behaviour in relation to health conditions that could endanger oneself right away, such as obesity or cardiovascular risk. Empirical studies on recycling habits, however, show that behaviour-change models are useful for protecting the environment. The environment and public health are at risk when medications are disposed of improperly (Fatta-Kassinos et al., 2011).

In conclusion, this conceptual paper has endeavoured to elucidate the intricate relationship between disposal behaviour of unused medicine and poor handling of unused medicine, health care facilities' and health professionals' behaviour on medication waste and

the effect on the environment with efficient disposal of unused medicines with environmental awareness as the moderator. Through an extensive review, this paper has underscored the paramount significance of these variables in shaping the behaviour intention.

REFERENCES

- (2020). A review on water pollution: causes, effects and treatment methods. *International Journal of Pharmaceutical Sciences Review and Research*.
<https://www.globalresearchonline.net> .
- (2023). *Malaysian Statistic on Medicine*. <https://pharmacy.moh.gov.my/en/documents/malaysian-statistics-medicines.html> on 15 March 2024.
- Adjovu, G. E., Stephen, H., James, D. E., & Ahmad, S. (2023). Measurement of total dissolved solids and total suspended solids in water systems: a review of the issues, conventional, and remote sensing techniques. *Remote Sensing*, 15(14), 3534.
<https://doi.org/10.3390/rs15143534> .
- Adzawla, W., Tahidu, A., Mustapha, S., & Azumah, S. B. (2019a). Do socioeconomic factors influence households' solid waste disposal systems? Evidence from Ghana. *Waste Management & Research*, 37(1_suppl), 51-57.
<https://doi.org/10.1177/0734242x18817717> .
- Alhamad, H., & Donyai, P. (2021). The validity of the Theory of Planned Behaviour for understanding people's beliefs and intentions toward reusing medicines. *Pharmacy*, 9(1), 58. <https://doi.org/10.3390/pharmacy9010058> .
- Alhomoud, F. K., Alsadiq, Y., Alghalawin, L., Alhifany, A., & Alhomoud, F. (2021). Pharmacy students' knowledge and practices concerning the storing and disposal of household medication in Saudi Arabia. *Currents in Pharmacy Teaching and Learning*, 13(1), 5–13. <https://doi.org/10.1016/j.cptl.2020.08.004>.
- Amoabeng, I. A., Otoo, B. A., Darko, G., & Borquaye, L. S. (2022a). Disposal of unused and expired medicines within the Sunyani Municipality of Ghana: A cross-sectional survey. *Journal of Environmental and Public Health*, 1–7. <https://doi.org/10.1155/2022/61113346> .
- Ariffin, M., & Zakili, T. S. T. (2019). Household pharmaceutical waste disposal in Selangor, Malaysia—Policy, public perception, and current practices. *Environmental Management*, 64(4), 509–519. <https://doi.org/10.1007/s00267-019-01199-y> .
- Aslam, A., Gajdács, M., Zin, C. S., Rahman, N. S. B. A., Ahmed, S. I., & Jamshed, S. Q. (2020). Public awareness and practices towards self-medication with antibiotics among the Malaysian population.: A development of questionnaire and pilot-testing. *Antibiotics*, 9(2), 97. <https://doi.org/10.3390/antibiotics9020097> .
- Azad AK, Muhammad K.R., Hossin M.M., Robiul I., Abdullahi M.M., Islam M.A.(2016). Medication wastage and its impact on environment: evidence from Malaysia. *Pharmacologyonline*.,3,14–21.
- Azzeri, A., Goh, H. C., Jaafar, H., Noor, M. I. M., Razi, N. A., Then, A. Y., Suhaimi, J., Kari, F., & Dahlui, M. (2020). A review of published literature regarding health issues of coastal communities in Sabah, Malaysia. *International Journal of Environmental Research and Public Health*, 17(5), 1533. <https://doi.org/10.3390/ijerph17051533> .
- Bashaar, M., Thawani, V., Hassali, M. A., & Saleem, F. (2017). Disposal practices of unused and expired pharmaceuticals among general public in Kabul. *BMC public health*, 17, 1-8.
- Bettington, E., Spinks, J., Kelly, F., Gallardo-Godoy, A., Nghiem, S., & Wheeler, A. J. (2018). When is a medicine unwanted, how is it disposed, and how might safe disposal be promoted? Insights from the Australian population. *Australian Health Review*, 42(6), 703-717.

- Busetto, L., Wick, W., & Gumbinger, C. (2020a). How to use and assess qualitative research methods. *Neurological Research and Practice*, 2(1). <https://doi.org/10.1186/s42466-020-00059-z> .
- Borhan, H., Ridzuan, A. R., Subramaniam, G., Amin, S. M., & Saad, R. M. (2021a). Modelling the environmental kuznets curve of water pollution impact on economic growth in developing country. *International Journal of Energy Economics and Policy*, 11(5), 545–552. <https://doi.org/10.32479/ijeeep.11571> .
- Chong, K. M., Rajiah, K., Chong, D., & Maharajan, M. K. (2022). Management of medicines wastage returned medicines and safe disposal in Malaysian community pharmacies: a Qualitative study. *Frontiers in Medicine*, 9. <https://doi.org/10.3389/fmed.2022.884482>.
(2022, December 8). *Collecting and disposing of unwanted medicines US EPA*. <https://www.epa.gov/hwgenerators/collecting-and-disposing-unwanted-medicines>
- De Oliveira Souza, H., Costa, R. D. S., Quadra, G. R., & Fernandez, M. A. (2019). How can we help to prevent medicines from polluting the environment? *Frontiers for Young Minds*, 7. <https://doi.org/10.3389/frym.2019.00081> .
(2022, July 6). *Drug pollution is threatening the water quality of the world's rivers*. Natural History Museum. <https://www.nhm.ac.uk/discover/news/2022/july/drug-pollutionthreatening-water-qualityworldsrivers.html#:~:text=Drug%20pollution%2C%20also%20known%20as,primarily%20affects%20water%20and%20soil>.
- Ehrhart, A., Granek, E. F., Nielsen-Pincus, M., & Horn, D. A. (2020). Leftover drug disposal: Customer behavior, pharmacist recommendations, and obstacles to drug take-back box implementation. *Waste Management*, 118, 416–425. <https://doi.org/10.1016/j.wasman.2020.08.038> .
- Gidey, M. T., Birhanu, A. H., Tsadik, A. G., Welie, A. G., & Assefa, B. T. (2020). knowledge, attitude, and practice of unused and expired medication disposal among patients visiting ayder comprehensive specialized hospital. *BioMed Research International*, 1–7. <https://doi.org/10.1155/2020/9538127> .
- Hamilton, A. B., & Finley, E. P. (2019). Qualitative methods in implementation research: An introduction. *Psychiatry Research*, 280. <https://doi.org/10.1016/j.psychres.2019.112516> .
- Hamzah, N. M., Perera, P. N., & Rannan-Eliya, R. P. (2020). How well does Malaysia achieve value for money in public sector purchasing of medicines? Evidence from medicines procurement prices from 2010 to 2014. *BMC Health Services Research*, 20(1). <https://doi.org/10.1186/s12913-020-05362-8> .
- Hassali, M. A., & Shakeel, S. (2020). Unused and expired medications disposal practices among the general public in Selangor, Malaysia. *pharmacy*, 8(4), 196. <https://doi.org/10.3390/pharmacy8040196> .
- Helme, D. W., Egan, K. L., Lukacena, K. M., Roberson, L., Zelaya, C. M., McLeary, M. S., & Wolfson, M. (2020). Encouraging disposal of unused opioid analgesics in Appalachia. *Drugs: Education, Prevention Policy/Drugs: Education, Prevention & Policy*, 27(5), 407–415. <https://doi.org/10.1080/09687637.2020.1711871>.
- Hew, T. Y. A., Yap, C. K., Azhar, M. T., Defiffaldi, M., Chew, J. M., Sapawi, D. K. A., Rahman, M. N. A., Ismail, M. S., Wakid, S. A., Syazwan, W. M., Okamura, H., Horie, Y., Ong, M. C., Setyawan, A. D., Krishnan, K., & Cheng, W. H. (2023). Perception of water pollution among Malaysian university students: A case study. *Sustainable Social Development*, 1(2). <https://doi.org/10.54517/ssd.v1i2.2199> .
- Hojjati-Najafabadi, A., Mansoorianfar, M., Liang, T., Shahin, K., & Karimi-Maleh, H. (2022). A review on magnetic sensors for monitoring of hazardous pollutants in water resources. *Science of the Total Environment*, 824,. <https://doi.org/10.1016/j.scitotenv.2022.153844> .
- Global Monitoring of Pharmaceuticals Project. (n.d.). Global Monitoring Of. <https://www.globalpharms.org/> .

- IOSR Journal of Humanities and Social Science. (2017). *IOSR Journal of Humanities and Social Science*. <https://doi.org/10.9790/0837> .
- Janmaimool, P. (2017b). Application of Protection Motivation Theory to investigate sustainable waste management behaviors. *Sustainability*, 9(7), 1079. <https://doi.org/10.3390/su9071079> .
- Jie, W., Liu-Lastres, B., Ritchie, B. W., & Mills, D. (2019). Travellers' self-protections against health risks: An application of the full Protection Motivation Theory. *Annals of Tourism Research*, 78. <https://doi.org/10.1016/j.annals.2019.102743> .
- Jumani, Z. A., & Sukhabot, S. (2020). Identifying the important attitude of Islamic brands and its effect on buying behavioural intentions among Malaysian Muslims. *Journal of Islamic Marketing*, 12(2), 408–426. <https://doi.org/10.1108/jima-09-2019-0196>.
- Islahudin, F., & Hasan, S. Z. (2019). Medication adherence and satisfaction among patients in Malaysia. *Research Journal of Pharmacy and Technology*, 12(3), 1051. <https://doi.org/10.5958/0974-360x.2019.00173.2> .
- Khasawneh, O. F. S., & Palaniandy, P. (2021). Occurrence and removal of pharmaceuticals in wastewater treatment plants. *Process Safety and Environmental Protection*, 150, 532–556. <https://doi.org/10.1016/j.psep.2021.04.045> .
- Kim, S., Jeong, S., & Hwang, Y. W. (2012). Predictors of pro-environmental behaviors of American and Korean students. *Science Communication*, 35(2), 168–188. <https://doi.org/10.1177/1075547012441692> .
- Kim, J., Yang, K., Min, J., & White, B. (2021). Hope, fear, and consumer behavioral change amid COVID-19: Application of protection motivation theory. *International Journal of Consumer Studies*, 46(2), 558–574. <https://doi.org/10.1111/ijcs.12700> .
- Kılıç, Z. (2021). Water pollution: causes, negative effects and prevention methods. *İzūfbed İstanbul Sabahattin Zaim Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 3(2), 129–132. <https://doi.org/10.47769/izufbed.862679> .
- Kristina, S. A. (2018). A survey on medicine disposal practice among households in Yogyakarta. *Asian Journal of Pharmaceutics (AJP)*, 12(3).
- Kothe, E., Ling, M., North, M., Klas, A., Mullan, B., & Novoradovskaya, E. (2019). Protection motivation theory and pro-environmental behaviour: A systematic mapping review. *Australian Journal of Psychology*, 71(4), 411–432. <https://doi.org/10.1111/ajpy.12271> .
- Kusturica, M. P., Sabo, A., Tomic, Z., Horvat, O., & Šolak, Z. (2012). Storage and disposal of unused medications: knowledge, behavior, and attitudes among Serbian people. *International Journal Of Clinical Pharmacy*, 34, 604-610.
- Lai, P. S. M., Tan, K. M., Lee, H. G., Wong, Y. Y., Wasi, N. a. A., & Sim, S. M. (2021). Effectiveness of an intervention to increase the knowledge, attitude, and practice regarding the return and disposal of unused medications. *Malaysian Family Physician: The Official Journal of the Academy of Family Physicians of Malaysia*, 16(1), 56–63. <https://doi.org/10.51866/oa1013> .
- Ling, M., Kothe, E., & Mullan, B. (2019a). Predicting intention to receive a seasonal influenza vaccination using Protection Motivation Theory. *Social Science & Medicine*, 233, 87–92. <https://doi.org/10.1016/j.socscimed.2019.06.002> .
- Liu, L., Yang, H., & Xu, X. (2022). Effects of water pollution on Human Health and Disease Heterogeneity: A review. *Frontiers in Environmental Science*, 10. <https://doi.org/10.3389/fenvs.2022.880246> .
- Loi, J. X., Chua, A. S. M., Rabuni, M. F., Tan, C. K., Lai, S. H., Takemura, Y., & Syutsubo, K. (2022). Water quality assessment and pollution threat to safe water supply for three river basins in Malaysia. *Science of the Total Environment*, 832, . <https://doi.org/10.1016/j.scitotenv.2022.155067> .
- Madhav, S., Ahamad, A., Singh, A. K., Kushawaha, J., Chauhan, J. S., Sharma, S., & Singh, P. (2019). *Water pollutants: sources and impact on the environment and human health*. In *Advanced functional materials and sensors* (pp. 43–62). https://doi.org/10.1007/978-981-15-0671-0_4 .

- Maeng, D. D., Snyder, R. C., Medico, C. J., Mold, W. M., & Maneval, J. E. (2016). Unused medications and disposal patterns at home: Findings from a Medicare patient survey and claims data. *Journal of the American Pharmacists Association*, 56(1), 41-46.
- Manocha, S., Suranagi, U. D., Sah, R. K., Chandane, R. D., Kulhare, S., Goyal, N., & Tanwar, K. (2020). Current disposal practices of unused and expired medicines among general public in Delhi and national capital region, India. *Current Drug Safety*, 15(1), 13–19. <https://doi.org/10.2174/1574886314666191008095344>
- Mehrad, A., & Tahriri Zangeneh, M. (2016). Comparison between Qualitative and Quantitative Research Approaches: Social Sciences. *International Journal for Research in Educational Studies*, 5(7).
- Michael, I., Ogbonna, B., Nduka, S. O., Anetoh, M. U., & Matthew, O. (2019a). Assessment of disposal practices of expired and unused medications among community pharmacies in Anambra State southeast Nigeria: a mixed study design. *Journal of Pharmaceutical Policy and Practice*, 12(1). <https://doi.org/10.1186/s40545-019-0174-1> .
- Milne, S., Sheeran, P., & Orbell, S. (2000). Prediction and intervention in health-related behavior: a meta-analytic review of Protection Motivation Theory. *Journal of Applied Social Psychology*, 30(1), 106–143. <https://doi.org/10.1111/j.15591816.2000.tb02308.x> .
- Moghadam, M. T., Raheli, H., Zarifian, S., & Yazdanpanah, M. (2020). The power of the health belief model (HBM) to predict water demand management: A case study of farmers' water conservation in Iran. *Journal of Environmental Management*, 263. <https://doi.org/10.1016/j.jenvman.2020.110388> .
- Nathanson, J. A. (2023, September 27). Water pollution : Definition, causes, effects, solutions, examples, & facts. *Encyclopedia Britannica*. <https://www.britannica.com/science/water-pollution> .
- Nur Afni, A., Rahmat, A., Sa'ed, Z., Sulastri, S., Haslina, H., & Sazaroni, M. R. (2012). Poisoning in children: a 4-year review (2006–2009) on cases reported to the National Poison Centre of Malaysia. *J Med Toxicol*, 8, 192-237.
- Ong, S. C., Ooi, G. S., Shafie, A. A., & Hassali, M. A. (2019a). Knowledge, attitude and disposing practice of unused and expired medicines among the general public in Malaysia. *Journal of Pharmaceutical Health Services Research*, 11(2), 141–148. <https://doi.org/10.1111/jphs.12333> .
- Ortúzar, M., Esterhuizen-Londt, M., Olicón-Hernández, D. R., González-López, J., & Aranda, E. (2022a). Pharmaceutical pollution in aquatic environments: A concise review of environmental impacts and bioremediation systems. *Frontiers in Microbiology*, 13. <https://doi.org/10.3389/fmicb.2022.869332> .
- Othman, A., & Ariffin, M. (2019). Source water protection from pharmaceutical contaminants: Assessment of environmental quality act 1974 and its regulations. *Planning Malaysia Journal*, 17. <https://doi.org/10.21837/pm.v17i10.638> .
- Papa, A., Mital, M., Pisano, P., & Del Giudice, M. (2020). E-health and wellbeing monitoring using smart healthcare devices: An empirical investigation. *Technological Forecasting and Social Change*, 153. <https://doi.org/10.1016/j.techfore.2018.02.018>
- Pennente, K., Lyle, J., & Gardocki, B. (2015). *Global medicines use in 2020: Outlook and implications*. IMS Institute for Healthcare Informatics.
- Purwanto, A. (2021, July 16). Education research quantitative analysis for little respondents: Comparing of LisRel, Tetrad, GSCA, AMos, SmartPLS, WarpPLS, and SPSS. <https://deliverypdf.ssrn.com/delivery.php?ID=39708309407002509009310008111402902503301906304900203701008701610911112106408200310512300002202010812>

- 11180660881050980310011210980420690490111802006609500912411401906
906401312609010709211411602508702503111406610802300706406610609307
0000028090104084109&EXT=pdf&INDEX=TRUE .
- Pramestutie, H. R., Hariadini, A. L., Gusti, E. T., Kurnia, I. R., & Nur, I. S. (2021a). Managing unused, damaged, and expired medications: Knowledge and attitudes among people of Malang, Indonesia. *Journal of Applied Pharmaceutical Science*. <https://doi.org/10.7324/japs.2021.110912> .
- Quesada, H. B., Baptista, A. T. A., Cusioli, L. F., Seibert, D., & De Oliveira Bezerra, C. (2019a). Surface water pollution by pharmaceuticals and an alternative of removal by low-cost adsorbents: A review. *Chemosphere*, 222, 766–780. <https://doi.org/10.1016/j.chemosphere.2019.02.009> .
- Rahman, M. M., Tabash, M. I., Salamzadeh, A., Abduli, S., & Rahaman, M. S. (2022). Sampling techniques (probability) for quantitative social science researchers: A conceptual guidelines with examples. *SEEU Review*, 17(1), 42–51. <https://doi.org/10.2478/seeur-2022-0023>.
- Rogowska, J., & Zimmermann, A. (2022). Household pharmaceutical waste disposal as a global problem: A review. *International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health*, 19(23). <https://doi.org/10.3390/ijerph192315798>.
- Rogowska, J., Zimmermann, A., Muszyńska, A., Ratajczyk, W., & Wolska, L. (2019). Pharmaceutical household waste practices: Preliminary findings from a case study in Poland. *Environmental Management*, 64(1), 97–106. <https://doi.org/10.1007/s00267-019-01174-7> .
- Shafiei, A., & Maleksaeidi, H. (2020). Pro-environmental behavior of university students: Application of protection motivation theory. *Global Ecology and Conservation*, 22.. <https://doi.org/10.1016/j.gecco.2020.e00908> .
- Shamsudin, M. S., Azha, S. F., & Ismail, S. (2022a). A review of diclofenac occurrences, toxicology, and potential adsorption of clay-based materials with surfactant modifier. *Journal of Environmental Chemical Engineering*, 10(3), 107541. <https://doi.org/10.1016/j.jece.2022.107541> .
- Shamsudin, M. S., Azha, S. F., & Ismail, S. (2022b). A review of diclofenac occurrences, toxicology, and potential adsorption of clay-based materials with surfactant modifier. *Journal of Environmental Chemical Engineering*, 10(3), . <https://doi.org/10.1016/j.jece.2022.107541> .
- Shao, S., Hu, Y., Cheng, J., & Chen, Y. (2018). Research progress on distribution, migration, transformation of antibiotics and antibiotic resistance genes (ARGs) in aquatic environment. *Critical Reviews in Biotechnology*, 38(8), 1195–1208. <https://doi.org/10.1080/07388551.2018.1471038>.
- Sim, S. M., Lai, P. S. M., Tan, K. M., Lee, H. G., & Sulaiman, C. Z. (2018). Development and validation of the Return and Disposal of Unused Medications Questionnaire (REDIUM) in Malaysia. *Asia-Pacific Journal of Public Health*, 30(8), 737–749. <https://doi.org/10.1177/1010539518811161> .
- Speight, J. G. (2020). *Sources of water pollution*. In Elsevier eBooks (pp. 165–198). <https://doi.org/10.1016/b978-0-12-803810-9.00005-x> .
- Seehusen, D. A., & Edwards, J. (2006). Patient practices and beliefs concerning disposal of medications. *The Journal of the American Board of Family Medicine*, 19(6), 542–547. .
- Szymczycha, B., Borecka, M., Białk-Bielińska, A., Siedlewicz, G., & Pazdro, K. (2020a). Submarine groundwater discharge as a source of pharmaceutical and caffeine residues in coastal ecosystem: Bay of Puck, southern Baltic Sea case study. *Science of the Total Environment*, 713, 136522. <https://doi.org/10.1016/j.scitotenv.2020.136522> .

- Thakur, V. (2021a). Framework for PESTEL dimensions of sustainable healthcare waste management: Learnings from COVID-19 outbreak. *Journal of Cleaner Production*, 287, 125562. <https://doi.org/10.1016/j.jclepro.2020.125562> .
- Terzić-Šupić, Z., Bukumirić, D., Santric-Milicevic, M. M., Ćorac, A., Kusturica, M. P., Mirković, M., Bukumirić, Z., Todorović, J., Ristić, B., & Trajković, G. (2019). Knowledge and practices related to unused medications in households in Serbia. *Indian Journal of Pharmaceutical Education and Research*. <https://doi.org/10.5530/ijper.53.2.43> .
- Tit, D. M., Bungau, S., Nistor Cseppento, C., Copolovici, D. M., & Buhas, C. (2016). Disposal of unused medicines resulting from home treatment in Romania. *J. Environ. Prot. Ecol*, 17(4), 1425-1433.
- Vieno, N., Hallgren, P., Wallberg, P., Pyhälä, M., Zandaryaa, S., & Baltic Marine Environment Protection Commission. (2017). *Pharmaceuticals in the aquatic environment of the Baltic Sea region: a status report*, 1. UNESCO Publishing.
- (n.d.). *View of disposal practices of pharmaceutical waste among medical facilities in Nakuru Town, Nakuru County Kenya*. <http://journals.laikipia.ac.ke/index.php/ojs/article/view/10/14>
- Wang, L. S. (2021a). *Disposal practice and factors associated with unused medicines in Malaysia: A cross-sectional study*. Monash. https://www.academia.edu/72929675/Disposal_practice_and_factors_associated_with_unused_medicines_in_Malaysia_a_cross_sectional_study .
- Wang, L. S., Aziz, Z., & Chik, Z. (2021a). Disposal practice and factors associated with unused medicines in Malaysia: a cross-sectional study. *BMC Public Health*, 21(1). <https://doi.org/10.1186/s12889-021-11676-x> .
- Wu, F., Yuan, Y., Deng, Z., Yin, D., Shen, Q., Zeng, J., Xie, Y., Xu, M., Yang, M., Jiang, S., Zhang, C., Hui-Xi, L., & Sun, C. (2022). Acceptance of COVID-19 booster vaccination based on the protection motivation theory: A cross-sectional study in China. *Journal of Medical Virology*, 94(9), 4115–4124. <https://doi.org/10.1002/jmv.27825> .
- Yang, S. L., Tan, S. L., Goh, Q. L., & Liau, S. Y. (2018). Utilization of Ministry of Health Medication return programme, knowledge and disposal practice of unused medication in Malaysia. *Journal of Pharmacy Practice and Community Medicine*, 4(1), 07–11. <https://doi.org/10.5530/jppcm.2018.1.3> .
- Yimenu, D. K., Teni, F. S., & Ebrahim, A. J. (2020a). Prevalence and predictors of storage of unused medicines among households in Northwestern Ethiopia. *Journal of Environmental and Public Health*, 1–10. <https://doi.org/10.1155/2020/8703208>.
- Yut, F. P. (2019a). *Malaysian behaviour towards proper disposal of unused medications*. The European Proceedings of Social and Behavioural Sciences. <https://doi.org/10.15405/epsbs.2019.08.27> .
- Zhang, X., Liu, S., Wang, L., Zhang, Y., & Wang, J. (2019). Mobile health service adoption in China. *Online Information Review*, 44(1), 1–23. <https://doi.org/10.1108/oir-112016-0339>