# Assessment of Knowledge and Attitude of Pharmacy Staffs towards Handling of Hazardous Drugs in Tuanku Fauziah Hospital (HTF), Malaysia: A Questionnaire Validation

Tan Xiu Quan[1], Siti Umairah Abu Hassan[1], Najihah Abdul Razak[2], Nur Hani Zainal Abidin[1], Hazirah Ishak[1]

[1] Hospital Tuanku Fauziah, Perlis, Ministry of Health Malaysia
[2] Hospital Kulim, Kedah, Ministry of Health Malaysia

**Abstract**

**Introduction:** Hazardous drugs are defined as agents that due to its inherent toxicity present danger to healthcare personnel. While the drugs were proven to have therapeutic benefits for its intended patients, they may cause adverse effects to healthy staffs who handle the hazardous drugs. Studies had shown that pharmacy staffs had low knowledge regarding proper handling of hazardous drugs.
**Objective:** This study aimed to develop a validated questionnaire to assess pharmacy staffs on their knowledge and attitude in hazardous drug handling.
**Methods:** The questionnaire was constructed based on published guidelines and studies. Content validation and face validation were carried out on three oncology pharmacists and three other pharmacists respectively. Data collection for construct validity and reliability test was carried out on a sample of 36 pharmacy staffs from selected health facilities in Perlis and Kedah. Construct validation was carried out using factor analysis, while internal consistency was tested through reliability analysis. For factor analysis, Principle Component Analysis was used as the extraction method.
**Results:** During the content validation, six questions were omitted while 23 questions were rephrased. After construct validation, six questions were removed due to zero variance, communality values of the correlation matrix below 0.5, and to improve the internal consistency. The final questionnaire comprised 61 questions in five domains: eight socio-demographic (Domain 1), 41 knowledge (Domain 2 to 4) and 12 attitude (Domain 5) questions. All questions and domains in the final questionnaire satisfied the requirement for anti-image correlation, Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin Measure of Sampling Adequacy. The Cronbach's alpha values for Domains 2 to 5 were 0.618, 0.610, 0.839 and 0.609 respectively, which demonstrated the reliability of the domains.
**Conclusion:** A validated questionnaire to evaluate the knowledge and attitude in handling hazardous drug among the pharmacy staffs was developed.
**Keywords:** knowledge, attitude, hazardous, drugs, handling, pharmacy staffs

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**Corresponding Author:** Tan Xiu Quan
Pharmacy Department, Hospital Tuanku Fauziah, Jalan Kolam, 01000 Kangar, Perlis.
Email: tanxiuquan@moh.gov.my

## Introduction

Hazardous drugs are drugs that are known or suspected to cause adverse health effects from their exposure in the workplace. Studies had shown that antineoplastic agents, antiviral agents, biological modifiers, hormones, and some other agents, despite providing therapeutic benefits to patients, may cause adverse effects to the health workers (1). Hazardous drugs could potentially manifest genotoxicity, carcinogenicity, teratogenicity, infertility, serious organ or other toxic manifestation at low doses as shown in animal or human experiments (2).

In 2006, American Society of Health-System Pharmacists (ASHP) published an update on the Guidelines on Handling Hazardous Drugs in order to provide better understanding of the risks associated with handling toxic agents and the advent of new technologies to minimize occupational exposure (2). There was also an alert by The Centers for Disease Control and Prevention through the National Institute for Occupational Safety and Health (NIOSH) to update the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) on establishing a comprehensive technical manual for employees who

were involved in the handling of hazardous drugs (3). Table 1 highlighted some important terminologies of hazardous drugs.

Table 1: Comparison of 2004 NIOSH and 1990 ASHP definitions of hazardous drugs

| NIOSH | ASHP |
|---|---|
| Carcinogenicity | Carcinogenicity in animal models, in the patient population, or both as reported by International Agency for Research on Cancer |
| Teratogenicity or developmental toxicity | Teratogenicity in animal studies or in treated patients |
| Reproductive toxicity | Fertility impairment in animal studies or in treated patients |
| Organ toxicity at low doses | Evidence of serious organ or other toxicity at low doses in animal models or treated patients |
| Genotoxicity | Genotoxicity (i.e. mutagenicity and clastogenicity in short-term test systems) |

Abbreviation: ASHP – American Society of Health-System Pharmacists; NIOSH – National Institute for Occupational Safety and Health
Source: ASHP Guidelines on Handling Hazardous Drugs (2, page 135)

Awareness on the effects resulting from long term occupational exposure to hazardous drugs among the pharmacy staffs should be emphasized as pharmacy staffs may be involved in the handling of hazardous drugs in their daily job. Improving the knowledge regarding safe handling of hazardous drug among the pharmacy staffs is crucial to minimise occupational exposure and the potential adverse effects. It is also important to provide a better working environment and proper guidelines for them. Based on previous study, pharmacists' knowledge on proper handling of hazardous drugs were unsatisfactory with an average score of only 25% (4). In the Malaysian public healthcare facilities setting, pharmacists and assistant pharmacists are usually the ones who store, prepare, distribute and dispose drugs (5). Therefore, it is necessary to ensure that their knowledge and attitude regarding hazardous drugs are satisfactory. As there was no study instrument to measure the knowledge and attitude for pharmacy staff towards the safe handling of hazardous drugs in Malaysia, this study aimed to develop a validated questionnaire to assess pharmacy staffs on their knowledge and attitude in hazardous drug handling.

**Methods**

This study involved both pharmacists and assistant pharmacists working in selected government hospitals and health clinics in the state of Perlis and Kedah from October 2017 to May 2018. The developed questionnaire underwent content validity, face validity, construct validity and reliability testing to ensure the consistency and homogeneity of the questions.

The questionnaire was constructed by the investigators based on literature review. The guidelines by ASHP (2) and NIOSH (3) were the main references used for the development of questionnaire. This is a self-administered questionnaire. The initial questionnaire comprised 73 questions and was divided into six domains: socio-demographics, hazardous drug handling, management of disposal and spillage, route of exposure, effects of exposure and attitude on handling hazardous drugs. Domains 2 to 5 were to evaluate the knowledge while domain 6 was to evaluate the attitude of the respondents (Table 2).

Table 2: Overview of the questionnaire before validation

| Information | | Domain | Number of questions |
|---|---|---|---|
| Socio-demographic | 1 | Socio-demographic | 8 |
| Knowledge | 2 | Hazardous drug handling | 17 |
| | 3 | Management of disposal and spillage | 10 |
| | 4 | Route of exposure | 8 |
| | 5 | Effects of exposure | 17 |
| Attitude | 6 | Attitude on handling hazardous drugs | 13 |

For the purpose of questionnaire validation process, only questions from Domain 2 to Domain 6 will be analysed. Three stages of validity assessments including content validity, face validity and construct validity were carried out. Content validity was carried out by three experts who were oncology pharmacists. The comments from the experts were considered and the questionnaire was restructured following their constructive advices. In the next stage, face validity was carried out on three pharmacists from the Perlis Pharmaceutical Services Division and Kangar District Health Office to test the consistency of the meaning and comprehensibility of the questionnaire. In total, two rounds of content and face validity were conducted. Then, construct validation was carried out using factor analysis. The questionnaire was also tested for internal consistency or homogeneity through reliability analysis.

Data for construct validity and reliability analysis was collected by distributing the questionnaire to the pharmacists and assistant pharmacists from Sultanah Bahiyah Hospital, Sultan Abdul Halim Hospital, Kuala Nerang Hospital and Kangar Health Clinic. As this was a pilot study to test for the questionnaire's construct validity, the required sample size was ten percent of the projected study population (6). Based on the total number of pharmacy staffs in Tuanku Fauziah Hospital (HTF) in Perlis, which was 59, the targeted sample size was six respondents. The respondents were recruited using convenience sampling method. The respondents' involvement in this study was voluntary and their confidentiality as well as anonymity was ensured. Each participant was assigned and identified by a unique code known only to the investigators.

Data analysis was carried out using the Statistical Package for Social Science (SPSS) version 20.0. Continuous data were expressed as means and standard deviations (SD) while categorical data were expressed as frequencies and percentages. Factor analysis was done to determine the strength of the variables. For factor analysis, the data undergone several tests. Principle Component Analysis was used as the method of extraction. Anti-image correlation was a measure of the sampling adequacy for individual variables, in which the value should be more than 0.5 for each variable. Communality values were used to determine how the answers from each question correlated among each other in the anti-image correlation matrix. High value of communalities means that these questions explained most of the variables in the questionnaire. Only those questions with communalities above 0.5 with acceptable correlation will be considered to be analysed further in factor analysis. Bartlett's Test of Sphericity with significance level (p) less than 0.001 indicated the strength of the relationship among variables in the factor analysis while Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy value of 0.5 and above for overall variable showed the sample adequacy for the factor analysis. Internal consistency reliability of the questionnaire was assessed using Cronbach's Alpha value. Cronbach's alpha value of 0.6 and above showed the reliability of the domain.

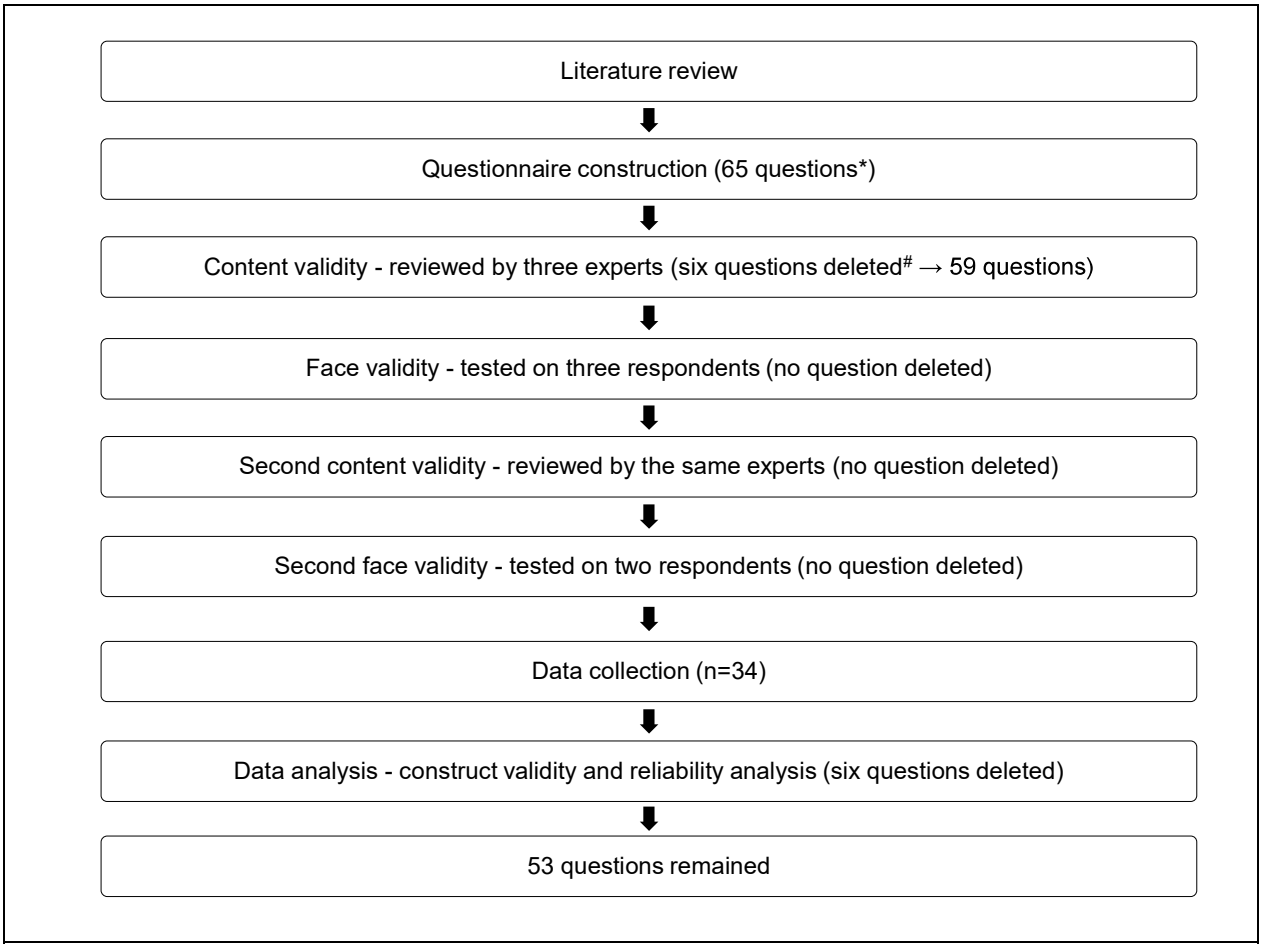
**Results**

During content validation, five questions were omitted in the Knowledge Domains (Domain 2 to 5) of the instrument in view of the questions being too general, repetitive of similar concept and not suitable to be presented to the respondents. Twenty-three questions were rephrased to make them more specific and easier to understand based on the experts' opinion. Meanwhile in the Attitude Domain, one question was omitted because the item was found to be controversial in the institutional practice. After the process of content validity, 47 knowledge questions and 12 attitude questions were retained.

During face validation, most of the items in the knowledge and attitude domains were fully understood by the respondents. The time spent to complete the questionnaire was approximately 20 to 30 minutes. No question was deleted during face validation.

After the content and face validation, the questionnaires were distributed to the targeted respondents. A total of 36 subjects were approached. Out of that, 34 subjects responded and thus the response rate was 94.4%. The process of data collection took around two weeks. The process of the questionnaire construction and validations was summarised in Figure 1.

Figure 1: Overview of the process of questionnaire construction and validations




* There were 65 questions in Domain 2 to 6 initially, excluding the eight questions in the socio-demographic domain.
# One question from Domain 2, one question from Domain 3, two questions from Domain 4, one question from Domain 5, and one question from Domain 6 were deleted.

Construct validation was carried out using factor analysis. Following factor analysis, all questions in Domain 2 (Hazardous drug handling) were retained resulting in a total of 16 questions (Table 3). There were 16 communalities values recorded to be more than 0.5 which satisfied the requirements for the questionnaire to be valid. Inspection of the anti-image correlation matrix also revealed that majority measures of sampling adequacy were well above the acceptable level of 0.5. Bartlett's test of sphericity showed significant values ($p<0.001$) while the Kaiser-Meyer-Olkin (KMO) test value was 0.418. The value of Cronbach's Alpha for Domain 2 was 0.618 (n=16, mean=26.85, SD=3.076) which had proven the reliability of the domain.

Two questions from Domain 3 were deleted due to the variables of zero variance, and another one was omitted due to communalities value less than 0.5 and thus only six questions remained in the domain (Table 4). Inspection of the anti-image correlation matrix revealed that majority measures of sampling adequacy were well above the acceptable level of 0.5. The Bartlett's test of sphericity showed significance ($p<0.001$) and KMO test results was 0.545 which indicated that there was a good correlation among the variables. However, the Cronbach's Alpha was only 0.297 (n=6, mean=8.91, SD=1.311) which showed that the domain was unreliable.

One question in Domain 4 (Route of exposure) were deleted due to communality value less than 0.5, and only five questions remained in this domain (Table 5). Inspection of the anti-image correlation matrix revealed that majority measures of sampling adequacy were well above the acceptable level of 0.5. The results of Bartlett's test of sphericity was not significant ($p=0.078$) and KMO value was 0.495. The value of Cronbach's Alpha was 0.421 (n=5, mean=8.35, SD=1.790) showing that the domain was unreliable.

Table 3: Communality values of the correlation matrix for Domain 2 (Hazardous drug handling)

| | Item | Initial | Extraction |
|---|---|---|---|
| 1 | A surgical mask provides protection from inhalation of hazardous aerosols | 1.000 | 0.706 |
| 2 | Wearing one pair of surgical gloves is enough to protect personnel from hazardous drug exposure | 1.000 | 0.739 |
| 3 | Polyethylene-coated gown is more appropriate than cloth gown during extemporaneous drug preparation of hazardous drug | 1.000 | 0.682 |
| 4 | Disposable gowns during hazardous drug preparation can be reused | 1.000 | 0.886 |
| 5 | Eye protection are recommended during hazardous drug preparation | 1.000 | 0.707 |
| 6 | Hazardous drugs should be stored in well-ventilated area | 1.000 | 0.767 |
| 7 | Some of the hazardous drug can be stored together with other drugs, example: hydroxyurea stored together with paracetamol | 1.000 | 0.560 |
| 8 | Containers of hazardous drug should clearly display warning labels stating the contents are 'Hazardous' in nature | 1.000 | 0.810 |
| 9 | In storage of hazardous drug, it should be kept below eye level | 1.000 | 0.742 |
| 10 | Any equipment can be used for counting and pouring of oral hazardous drugs | 1.000 | 0.839 |
| 11 | Hazardous drugs in the unbroken blister form can be held without gloves as protection is sufficient | 1.000 | 0.855 |
| 12 | Cutting hazardous drugs in tablet form can be done without wearing rubber gloves if it is needed in a smaller dose | 1.000 | 0.907 |
| 13 | It is not advisable to prepare hazardous extemporaneous preparation wearing only latex glove | 1.000 | 0.841 |
| 14 | All hazardous drugs have same handling measure * | 1.000 | 0.446 * |
| 15 | Hand wash should be practice only before handling hazardous drugs | 1.000 | 0.704 |
| 16 | It is safe to use the same apparatus to prepare all extemporaneous preparation including hazardous | 1.000 | 0.923 |

Note: Extraction method: Principle component analysis.
* Question was retained despite communality less than 0.5 and rephrased to "The same handling measures apply to all hazardous drug".

Table 4: Communality values of the correlation matrix for Domain 3 (Management of disposal and spillage)

| | Item | Initial | Extraction 1 | Extraction 2 |
|---|---|---|---|---|
| 1 | The first step of spillage management is to wear PPE | 1.000 | 0.718 | 0.723 |
| 2 | Spillage kit should be made available at storage area of hazardous drug * | 1.000 | 0.327 * | - |
| 3 | Pharmacist in charge of hazardous drugs is responsible for all spillage | 1.000 | 0.549 | 0.576 |
| 4 | It is not necessary to clean up spills immediately | 1.000 | 0.825 | 0.841 |
| 5 | Workers who handle hazardous drugs should receive proper training in spill management and the use of PPE | 1.000 | 0.828 | 0.868 |
| 6 | Spillage management for all dosage forms of hazardous drugs are the same | 1.000 | 0.685 | 0.741 |
| 7 | Hazardous drug-contaminated sharp or sharp items should be place in the designated sharp container | 1.000 | 0.884 | 0.929 |

Note: Extraction method: Principle component analysis; Extraction 1: Communality values before deletion of question; Extraction 2: Communality values after deletion of question.
* Question was deleted due to communality value less than 0.5.

Table 5: Communality values of the correlation matrix for Domain 4 (Route of exposure)

| | Item | Initial | Extraction 1 | Extraction 2 |
|---|---|---|---|---|
| 1 | Breathing in powder form of hazardous drug can cause organ damage in long term | 1.000 | 0.771 | 0.770 |
| 2 | Proper hand washing should be practiced before handling food to prevent ingestion of hazardous drug * | 1.000 | 0.465 * | - |
| 3 | Hazardous drugs can only enter the body through open wound | 1.000 | 0.503 | 0.655 |
| 4 | Hazardous gas can enter the body through skin and mucous membranes | 1.000 | 0.528 | 0.526 |
| 5 | Effect to organ can only occur if hazardous drugs are inhaled or ingested | 1.000 | 0.527 | 0.542 |
| 6 | Hazardous drug can enter the body during removal of personnel protective equipment | 1.000 | 0.620 | 0.616 |

Note: Extraction method: Principle component analysis; Extraction (1): Communality values before deletion of question; Extraction (2): Communality values after deletion of question.
* Question was deleted due to communality value less than 0.5.

No question was deleted from Domain 5 (Effects of exposure) and total of 16 questions remained in this domain. Anti-image correlation matrix showed that the communality values were more than 0.5 which reflected a strong correlation between the variables and therefore the data set was suitable for factoring (Table 6). Inspection of the anti-image correlation matrix revealed that all measures of sampling adequacy were well above the acceptable level of 0.5. Bartlett's test of Sphericity was significant ($p<0.001$) and KMO value was 0.530. The value of Cronbach's Alpha was 0.839 (n=16, mean=25.54, SD=7.085) and this confirmed that the domain was reliable.

For Domain 6 (Attitude of hazardous drug handling) under the Attitude Domain, the communality values were more than 0.5 which showed that there was a strong association between the items and the set of questions was accepted and suitable for factoring (Table 7). Inspection of the anti-image correlation matrix revealed that all measures of sampling adequacy were well above the acceptable level of 0.5. The Bartlett's test was significant ($p<0.001$) and KMO test value was 0.550. The value of Cronbach's Alpha was 0.609 (n=16, mean=25.54, SD=7.085) which demonstrated that the domain was reliable.

Table 6: Communality values of the correlation matrix for Domain 5 (Effects of exposure)

| | Item | Initial | Extraction |
|---|---|---|---|
| 1 | Hypertension | 1.00 | 0.798 |
| 2 | Dryness of mouth | 1.00 | 0.572 |
| 3 | Erectile dysfunction | 1.00 | 0.708 |
| 4 | Temporary infertility | 1.00 | 0.820 |
| 5 | Permanent infertility | 1.00 | 0.826 |
| 6 | Constipation | 1.00 | 0.767 |
| 7 | Blood count change | 1.00 | 0.856 |
| 8 | Neuropathy | 1.00 | 0.764 |
| 9 | Nephropathy | 1.00 | 0.666 |
| 10 | Diabetes | 1.00 | 0.801 |
| 11 | Skin infection | 1.00 | 0.729 |
| 12 | Weight loss | 1.00 | 0.777 |
| 13 | Hearing impairment | 1.00 | 0.711 |
| 14 | Bone marrow damage | 1.00 | 0.722 |
| 15 | Lung/Heart damage | 1.00 | 0.675 |
| 16 | Loss of sight | 1.00 | 0.739 |

Note: Extraction method: Principle component analysis.

Table 7: Communality values of the correlation matrix for Domain 6 (Attitude of hazardous drug handling)

| | Item | Initial | Extraction |
|---|---|---|---|
| 1 | I am confident that I can handle hazardous drugs safely | 1.00 | 0.786 |
| 2 | The safe-handling measures make my job harder | 1.00 | 0.753 |
| 3 | I am not worried about the side effects of occupational exposure to hazardous drugs | 1.00 | 0.526 |
| 4 | Non-adherence to safe-handling measures is acceptable if I am too busy | 1.00 | 0.912 |
| 5 | Non-adherence to safe-handling measures among my colleagues is acceptable as long as I practice as recommended myself | 1.00 | 0.866 |
| 6 | My training on safe-handling of hazardous drug is sufficient | 1.00 | 0.748 |
| 7 | I agree that the standard procedure for safe handling of hazardous drug should be applied in the pharmacy department | 1.00 | 0.825 |
| 8 | I think it is my responsibility to clean up and report spillage of hazardous drugs | 1.00 | 0.633 |
| 9 | I agree that alternative duty should be offered to individual who are pregnant, breast feeding or attempting to conceive or father a child | 1.00 | 0.686 |
| 10 | I agree that all personnel who handle hazardous drugs should be routinely monitored in medical surveillance program | 1.00 | 0.735 |
| 11 | I think that the awareness in hazardous drug handling is the responsibility of both workers and institution | 1.00 | 0.860 |
| 12 | I would like to keep myself updated with the latest recommendations for safe-handling of hazardous drugs | 1.00 | 0.628 |

Note: Extraction method: Principle component analysis

Table 8: Communality values of the correlation matrix for the revised Domain 3 (Disposal, spillage and route of exposure)

| | Item | Initial | Extraction |
|---|---|---|---|
| 1 | The first step of spillage management is to wear PPE | 1.000 | 0.615 |
| 2 | Pharmacist in charge of hazardous drugs is responsible for all spillage | 1.000 | 0.695 |
| 3 | It is not necessary to clean up spills immediately * | 1.000 | 0.804 |
| 4 | Workers who handle hazardous drugs should receive proper training in spill management and the use of PPE | 1.000 | 0.877 |
| 5 | Spillage management for all dosage forms of hazardous drugs are the same | 1.000 | 0.752 |
| 6 | Hazardous drug-contaminated sharp or sharp items should be place in the designated sharp container | 1.000 | 0.902 |
| 7 | Breathing in powder form of hazardous drug can cause organ damage in long term | 1.000 | 0.871 |
| 8 | Hazardous drugs can only enter the body through open wound | 1.000 | 0.704 |
| 9 | Hazardous gas can enter the body through skin and mucous membranes * | 1.000 | 0.640 |
| 10 | Effect to organ can only occur if hazardous drugs are inhaled or ingested | 1.000 | 0.587 |
| 11 | Hazardous drug can enter the body during removal of personnel protective equipment | 1.000 | 0.699 |

Note: Extraction method: Principle component analysis.

As the Cronbach's Alpha values of both Domain 3 and Domain 4 showed that the domains were unreliable, the questions from these two domains were combined into a single domain and renamed as Domain 3: Disposal, spillage and route of exposure. All eleven questions in the revised Domain 3 were retained as their communality values were more than 0.5 (Table 8). The communalities in the correlation matrix satisfied the requirements for validity. Inspection of the anti-image correlation matrix revealed that majority measures of sampling adequacy were well above the acceptable level of 0.5. Bartlett's test of sphericity was p=0.003 and KMO value was 0.476. The value of Cronbach's Alpha was 0.547 (n=11, mean=17.26, SD=2.609) which showed that the domain was near to the acceptable value. Then, two out of

eleven questions from the new Domain 3 were omitted to improve the internal consistency of the questions. The new value of Cronbach's Alpha was found to be 0.610 (n=9, mean=13.91, SD=2.479), which demonstrated reliability of the domain. The original Domain 5 and Domain 6 were then renamed as Domain 4 and Domain 5 accordingly.

**Discussion**

The initial questionnaire contained 73 questions regarding knowledge and attitude on the handling of hazardous drug. The number of questions was reduced to 63 questions following the content validation through experts' opinion. After the construct validation and reliability testing, 61 questions remained in the final version of questionnaire.

The construct validity of the questionnaire was examined through principal component analysis. Communality values less than 0.5 may indicate that the variables had considerable variance unexplained by the extracted factors which render the question not to be valid. In this study, however, we decided to retain a question with Communality value 0.446 in Domain 2 ("All hazardous drugs have same handling measure") because the question was deemed crucial to assess the knowledge of hazardous drug handling. In addition, all three experts had also recommended to retain and rephrase the question. This was also supported by further analysis that showed that retaining the question resulted in a higher value of Cronbach's alpha. Thus, the question was rephrased to "The same handling measures apply to all hazardous drug."

In terms of internal consistency, the threshold for Cronbach's Alpha value was set at 0.6 in this study. The domain with Cronbach's Alpha value above 0.6 was considered to be reliable. According to Nunnaly *et al*., the reliability testing of newly developed measures can be accepted when the alpha value is at least 0.60. Otherwise, 0.70 should be used as the threshold (7). The Cronbach's Alpha value for Domain 2, revised Domain 3 and Domain 6 were just slightly above 0.6 while only Domain 5 had a Cronbach's Alpha value above 0.7. Using 0.6 as a threshold, all domains in the questionnaire were considered to have acceptable internal consistency.

During the reliability analysis, the Cronbach's Alpha values of the initial Domain 3 and Domain 4 were less than 0.6. Studies reported that low Cronbach's Alpha values could be due to inadequate number of questions, poor inter-relatedness between the variables or heterogenous constructs (8). Also, the values from Bartlett's test was found to be significant for Domain 3 ($p<0.001$) but not Domain ($p=0.078$). Therefore, we decided to combine the questions from Domain 3 and Domain 4 and the new domain was renamed as Domain 3: Disposal, spillage and route of exposure. This revised domain initially comprised 11 questions that aimed to assess the knowledge about management of disposal and spillage of hazardous drug and the possible routes of exposure to hazardous drugs. Nevertheless, the reliability test showed that the revised domain was unreliable, resulting in the deletion of two questions to improve the internal consistency.

Domain 5 (Effects of exposure to the hazardous drugs) underwent some deliberations during the content validation process, as there was limited direct evidence that demonstrated that the hazardous effect of chemotherapy seen in the patients are the same as the effects of chronic long-term low dose exposure to all kinds of hazardous drugs among the healthcare workers. The domain was retained, however, in reference to the NIOSH guidelines which quoted that workplace exposure to hazardous drugs can cause either or both acute or chronic effects. Some examples were skin rashes, adverse reproductive outcomes which include infertility, spontaneous abortion and congenital malformations, and possibly leukaemia. The risk of exposure depends on the toxicity of the drugs as well as the amount of exposure of a worker to these hazardous drugs (9). The results of factor analysis and reliability testing for Domain 5 were satisfactory.

Our literature review failed to discover comparable studies that focus on the aspects of knowledge, attitude and practices (KAP) of pharmacy staffs towards the handling of a broad selection of hazardous drugs. Most published literature aimed to explore the KAP among healthcare workers on the handling of harmful drugs particularly anticancer agents. Most of these studies utilised validated questionnaires conducted either through cross-sectional design or pre-post interventional design with the aim to further improve the practice among the staffs in the institutional towards a safer operating procedures of handling antineoplastic agents. When these studies were used as our reference to derive the questions in the beginning stage of questionnaire development, it was found that most of the items contained in the final validated questionnaire were of similar dictions as those used in previous studies evaluating the KAP towards the handling of cytotoxic drugs among healthcare staffs. The main difference between our newly

validated questionnaire and the previous instruments was that our questionnaire aimed to measure the KAP of pharmacy staffs towards a broader range of hazardous drugs, not only limited to anticancer agents (10-14).

The main limitation of this study was the small sample size if compared to previous studies. Although the number of the recruited respondents in this study was well above the targeted sample size, it was recommended that pilot studies should include a larger sample size especially when there is no prior information available to the researchers (15). Moreover, a small sample size could also affect the values of Cronbach's alpha. According to Javali *et al*., the results from internal consistency reliability testing will be more consistent and comparable when the sample size is at least 50 (16).

## Conclusion

A validated questionnaire to assess the safety-related knowledge and attitude in hazardous drug handling among the pharmacy staffs was developed. The final questionnaire with 61 questions was demonstrated to be valid and reliable. There were 16 questions in Domain 2 (Hazardous drug handling), nine questions in Domain 3 (Management of disposal and spillage and route of exposure) and 16 questions in Domain 4 (Effect of exposure) to evaluate the knowledge, and 12 questions in Domain 5 (Attitude on handling hazardous drugs) to assess the attitude towards hazardous drug handling. This survey instrument can serve as an important tool to evaluate knowledge and attitude in handling hazardous drugs among the pharmacy staffs.

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## Conflict of Interest Statement

No external funding was received and the authors declared no conflict of interest.

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