# ORIGINAL ARTICLE

# Development and Validation of a Questionnaire to Evaluate the Knowledge and Perception among Caregivers on the Handling of Liquid Medication among Children

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## ABSTRACT

**Introduction:** Liquid medications are common dosage forms used among children. However, their use is linked with a high risk of medication errors due to their weight-based dosing. Thus, caregivers are always prone to make errors which may lead to reduced safety and efficacy of the medications. The aim of this study was to develop a validated and reliable tool to evaluate knowledge and perception among caregivers on the handling of liquid medications among children. **Methods:** A draft of the questionnaire was developed through a literature review. The questionnaire consisted of three sections including Section A: sociodemographic (9 items), Section B: knowledge (21 items), and Section C: perception (10 items). Content validation was performed twice by the panel of experts (pediatrician, pharmacist, nurse, and caregiver) to discuss the ambiguity, simplicity, relevance, and clarity of each developed item. The test-retest reliability was conducted to evaluate the reproducibility and consistency scores of the questionnaire by re-evaluating the same respondents at intervals of two weeks. **Results:** About 80% (18/21) of items in domain knowledge had a Content Validity Index for Individual Item (I-CVI) of more than 0.71. In addition to that, 80% (8/10) of the items in domain perception had achieved an acceptable I-CVI value (>0.71). Domains' knowledge and perception had shown Scale of content validity index/Average (S-CVI/Ave) 0.77 and 0.87, which indicates excellent content validity of the questionnaire. **Conclusion:** Items in knowledge and perception domains were appropriate and acceptable and can be explored further by future studies for validity testing.

**Keywords:** Questionnaire; Knowledge; Perception; Liquid medication handling; Caregivers

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## INTRODUCTION

Liquid medications are often considered the first choice for children when compared to other dosage forms (1). Inappropriate handling of liquid medication possibly exhibits several complications and hence,  increases the risk of unnecessary adverse events among children (2). Many concerns have been addressed as a result of rising awareness about medication safety among children, including the unstandardized use of dosing measurements for liquid medications such as dosing cups, oral syringes, tablespoons, or teaspoons (3). However, the inconsistent usage of dosing instruments and instructions for each of the liquid medications confuses the caregivers (4). Thus, caregivers need to be equipped with adequate knowledge of liquid medication handling before administering it to their children. Adverse drug reactions can have a variety of origins, and one of those is the failure to properly administer medications at home. Incorrect dosage calculations based on a child's weight, hurried administration with inappropriate equipment, and a disregard for drug powder weight are just a few examples (5). When administering medication to children, it's important to be aware of the potential dangers of non-prescription or over-the-counter medications as well. The overuse of non-prescription and over-the-counter medications by children has risen to the level of a major public health concern in recent years (6). Overdosing, poisoning, and increased risk of growth retardation are the major side effects reported in prior studies due to caregivers' inadequate medication knowledge (7). Drug label reading difficulties, poor comprehension of medication instructions and confusion about the brand names of drugs, as well as a lack of communication among caregivers, are all well-known contributors to medication errors in young children (8). Thus, emphasis must be provided by health care practitioners  on identifying, encouraging, and reinforcing best practices among caregivers to reduce medication errors.  Despite a high need of awareness to reduce medication errors, limited number of studies have been carried out in Malaysia to examine

knowledge and perceptions of liquid medication handling among caregivers (9–11). No study till date have developed validated tool for the accurate assessment of knowledge and perception of liquid medication among Malaysian caregivers. Evaluation of parents' perceptions and knowledge is crucial in educating the caregivers on the importance of appropriate handling of liquid medication to ensure its effectiveness and safety thus, improving the children's quality of life (12). In this context, this study aims to develop and validate a functional tool to assess caregivers on their knowledge and perception towards handling of liquid medication among children.

## MATERIALS AND METHODS

### Study population
The reference population for this study was Malaysian parents and caregivers who are currently taking care of a child of 10 years old or below that have met the inclusion and exclusion criteria. A purposive sampling method among respondents that meet the inclusion and exclusion criteria was utilized in this study. The questionnaire was administered by the respondents voluntarily. The minimum expected sample size required for this study was 100 participants and it was calculated by using the sample-to-item ratio as suggested by Hair et. Al (13), this ratio should not be less than 5-to-1 and the total sample size should be more than 100 respondents. As a result, using the rule of thumb, the total number of items in the questionnaire, excluding the demographic data, is multiplied by 5, yielding a total of 155 participants. This study was conducted online through social media platforms such as Facebook and Twitter in Malaysia through Google Forms. The forms were distributed to respondents through email, with each respondent restricted to providing only one response.

### Development of Questionnaire
The items and subdomains of the questionnaire were developed based on a review of the literature and previously published studies on the handling of liquid medication among caregivers in the general public(14–16). The questions were derived from various English sources, capturing the fundamental concepts from previously published studies and were then subsequently translated into Malay language. Information was also gleaned from the supervisory team and clinicians with extensive experience in the research area. The results of the literature review were used to develop operational definitions for subdomains, and items within the subdomains were then selected and formatted as questions in google forms which were then distributed to the study population (Fig. 1 illustrates methodological flow of study). An initial set of 40 items was identified on the information gathered from

the available sources. The 40 items were divided into four sections comprising Section A: sociodemographic (9 items), Section B: knowledge (21 items), and Section C: perception (10 items).

### Content Validity
Content validity is achieved when an instrument can accurately measure a target variable (relevance & representativeness). The first draft of the questionnaire was reviewed and approved by seven content experts from a variety of academic fields. They consisted of one pediatrician, two nurses, three pharmacists, and one caregiver who has experience in administering liquid medication to children. The inclusion criteria for selecting the panel for content validity were 1) For pediatricians and nurses (licensed practitioners working in the clinical setting and working experience of greater than 5 years), 2) Pharmacists (licensed and have experience in preparing and administration of liquid medications for children), 3) Caregivers having experience in administering liquid medications to children. The expert panel was tasked with grading each item on a scale of 1 or 2 for factors such as relevance, clarity, simplicity, and ambiguity. The details of scale grading are as follows:

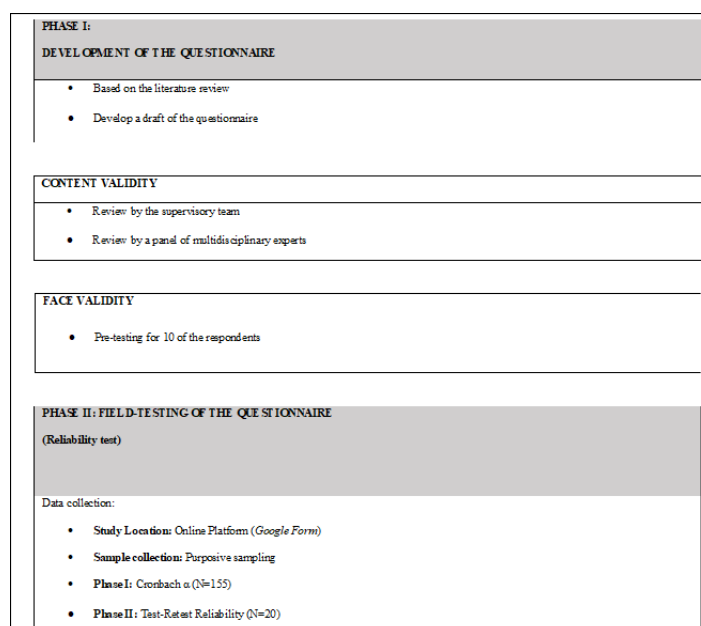| Relevance | Clarity |
|---|---|
| 1 = Item does not relevant to the item | 1 = Item is not understandable to the domain |
| 2 = Item is relevant to the item | 2 = Item is understandable to the domain |
| **Simplicity** | **Ambiguity** |
| 1 = Item is not simple | 1 = Doubtful |
| 2 = Item is simple | **2 = Meaning is clear** |



**Fig. 1 :** Methodological flow of study.

## Face Validity

As recommended by the published study, a minimum sample of 10 raters should be involved in the face validation of the questionnaire(17). Accordingly, a pre-testing of the questionnaire was conducted with 10 respondents in this study. A total of 15 minutes were given to the respondents to evaluate the questionnaire based on the criteria given. Additionally, participants in the pre-test were asked to provide feedback on the structure and format of questions to see if they are relevant and understandable to the reader (sentences or wording). The questionnaire's final draft was constructed after some minor changes were made in response to feedback from the pre-test.

## Pilot testing of the questionnaire

The field testing of the questionnaire was divided into two parts. To ensure construct validity, a total of 155 people participated in Phase I and had a total of 15 minutes to complete the questionnaire. In phase II, as suggested by published study 20 respondents (which is the minimum requirement of raters that should be included for estimation of ICC values) were selected using purposive sampling for test re-test reliability testing of questionnaire in this study (18). After two weeks interval respondents were given the same questionnaire, and they had 15 minutes to complete it. The results of the questionnaire were analyzed, and feedback from the participants was gathered.

## Ethical Consideration

This study was approved by research ethics comitte Jawatankuasa Etika Penyelidikan Manusia, Universiti Sains Malaysia [Reference no USM/JEPeM/21100684]. The informed consent was taken from the respondents before the questionnaire administration. All questionnaires are anonymous, and data will be presented as grouped data and will not identify the responders individually. All the written research documents, including study data (demographic and clinical data), were protected by the researcher. The data was only allowed to be reviewed by the principal investigator and research supervisors. All the data information was archived by the researcher for 10 years for any inquiries. The study data will be destroyed after the period of storage.

## Statistical Analysis

The data was analyzed using SPSS version 26.0 (IBM Corporation, New York, USA). Continuous variables were expressed as mean and standard deviation while frequency and percentages were reported for categorical variables. Cronbach's alpha was used to measure the questionnaire's internal consistency, and a value of greater than 0.60 was an indicator of a high degree of reliability of the questionnaire. Individual items were also tested for statistical reliability. Some items that were selected had a corrected item-total correlation value of more than 0.2 and were deleted from the study

questionnaire. Cronbach's α following the deletion of an item was used to determine which item had the greatest impact on the questionnaire's reliability. Deleted items that had a lower Cronbach's α value indicate that they had a significant impact on the α value and therefore have biological significance for the domains. In contrast, if Cronbach's α value for those items that were deleted increased, it would indicate that the items had a negative impact on the alpha. Test-retest results were then used to calculate the intraclass correlation coefficient (ICC). ICC >0.80 were considered to have excellent reliability(19).

## RESULTS

## Content Validity

A group of 7 expert panels reviewed the 40 items of the first draft questionnaire including Section A: sociodemographic (9 items), Section B: knowledge (21 items), and Section C: perception (10 items). The results were reported in I-CVI for each item and S-CVI/Ave for each domain i.e, knowledge and perception (Table I). Majorly (85%, (18/21)) of items in domain knowledge had I-CVI of more than 0.71, and the items were appropriate for the domain knowledge. A discussion with the expert panel had been conducted to discuss the relevance, clarity, and simplicity of each item in each domain. For clarity of the items, the expert panel suggested specifying the usage of the term "kesilapan dos" to either "kekurangan dos" or "kelebihan dos" as it is more understandable for caregivers. In addition to that, the experts also suggested the use of "memudaratkan" instead of "tindak balas" in explaining the item's "adverse effects associated with the inappropriate dosing". In the aspect of ambiguity, most of the experts had agreed to re-arrange the items "adverse effects associated with the inappropriate dosing", "inappropriate dosing", and "reduced therapeutic efficacy" as the flow of the questions would be more understandable. Other than that, the panels also suggested adding items by differentiating them with the term "enggan" with "tidak mampu" for pediatric patients with chronic and acute diseases. The majority of the experts also suggested adding several new items to further specify the knowledge of the caregivers for the items in the appropriate measures on children's reluctance. The new items regarding the administration of the liquid medication such as by giving only a portion of the medication left in the measuring devices and discontinuing the dose indefinitely. For domain knowledge (Table I), the items "Provided tools", "Easy-to-reach devices", and "Stopping the administration of liquid administration" achieved I-CVI of 0.43, 0.43, and 0.57 respectively. The expert panel concluded that these three items would remain in the questionnaire. However, expert panels had suggested considering simplifying and combining the items "Using a syringe, dropper or measuring cup" and "provided tools, and "Any measuring devices available at home" and "Easy-to-reach devices" because it was equivocal

**Table I : Calculation of I-CVI and SCVI/Ave of knowledge item (First review)**

| Items | No. of experts rated as relevant | No. of experts rated as not relevant | I-CVI | Interpretation | |
|---|---|---|---|---|---|
| Adverse effects associated with inappropriate dosing | 7 | 0 | 1.00 | Appropriate | |
| Inappropriate dosing | 6 | 1 | 0.86 | Appropriate | |
| Reduced therapeutic efficacy | 6 | 1 | 0.86 | Appropriate | |
| **Children's reaction management (Vomiting)** | | | | | |
| Immediate action | 5 | 2 | 0.71 | Appropriate | |
| Missed the dose | 5 | 2 | 0.71 | Appropriate | |
| Withhold the dose | 6 | 1 | 0.86 | Appropriate | |
| **Appropriate measures on children's reluctancy** | | | | | |
| Mixed with milk | 5 | 2 | 0.71 | Appropriate | |
| Diluting with other liquids | 5 | 2 | 0.71 | Appropriate | |
| Given forcibly | 6 | 1 | 0.86 | Appropriate | |
| Willingness of the child | 6 | 1 | 0.86 | Appropriate | |
| Missed the dose | 5 | 2 | 0.71 | Appropriate | |
| **Measuring Devices** | | | | | |
| Syringe, dropper or measuring cup | 7 | 0 | 1.00 | Appropriate | S-CVI/Ave= 0.77 |
| Any measuring devices available at home | 5 | 2 | 0.71 | Appropriate | |
| Provided tools | 3 | 4 | 0.43 | Not Appropriate | |
| Easy-to-reach devices | 3 | 4 | 0.43 | Not Appropriate | |
| Stopping the administration of liquid medication | 4 | 3 | 0.57 | Not appropriate | |
| **Appropriate actions for missed dose** | | | | | |
| Skipped the dose if the time for next dose is closer | 5 | 2 | 0.71 | Appropriate | |
| Double the dose | 5 | 2 | 0.71 | Appropriate | |
| Instructions on the used of medication | 5 | 2 | 0.71 | Appropriate | |
| Information needed in handling the liquid medication | 7 | 0 | 1.00 | Appropriate | |
| Sources of information received | 7 | 0 | 1.00 | Appropriate | |
| **Perception of Caregivers** | | | | | |
| Read the instructions | 5 | 2 | 0.71 | Appropriate | |
| Knowing on the appropriate practice | 6 | 1 | 0.86 | Appropriate | |
| **Importance of medication's dosing accuracy** | | | | | |
| Children's relief of symptom | 7 | 0 | 1.00 | Appropriate | |
| Prevention on the therapeutic effects | 6 | 2 | 0.86 | Appropriate | S-CVI/Ave= 0.87 |
| Prevention on the adverse effects | 5 | 2 | 0.71 | Not appropriate | |
| Prolonged of child's health problem | 5 | 2 | 0.71 | Not Appropriate | |
| **Appropriate attitude** | | | | | |
| Only given when needed | 7 | 0 | 1.00 | Appropriate | |
| Measuring devices provided | 7 | 0 | 1.00 | Appropriate | |
| Medication's storage | 7 | 0 | 1.00 | Appropriate | |
| Read on the leaflet provided | 6 | 1 | 0.86 | Appropriate | |

Abbreviations: I-CVI; Content Validity Index for Individual Item, S-CVI/Ave; Scale of content validity index/Average

**Table II : Calculation of I-CVI and SCVI/Ave of knowledge item (Second review)**

| Items | No. of experts rated as relevant | No. of experts rated as not relevant | I-CVI | Interpretation | |
|---|---|---|---|---|---|
| Adverse effects associated with inappropriate dosing | 6 | 1 | 0.86 | Appropriate | |
| Inappropriate dosing | 7 | 0 | 1.00 | Appropriate | |
| Dosing of the liquid medication | 7 | 0 | 1.00 | Appropriate | |
| **Children's reaction management (Vomiting)** | | | | | |
| Immediate action | 6 | 1 | 0.86 | Appropriate | |
| Missed the dose | 5 | 2 | 0.71 | Appropriate | |
| Given only a part of the medication | 6 | 1 | 0.86 | Appropriate | |
| Withhold the dose | 6 | 1 | 0.86 | Appropriate | |
| **Appropriate measures on children's reluctancy** | | | | | |
| Mixed with milk | 7 | 0 | 1.00 | Appropriate | |
| Diluting with other liquids | 7 | 0 | 1.00 | Appropriate | |
| Given forcibly | 7 | 0 | 1.00 | Appropriate | |
| Willingness of the child | 6 | 1 | 0.86 | Appropriate | S-CVI/Ave= 0.87 |
| Skipped the dose | 6 | 1 | 0.86 | Appropriate | |
| Withhold the dose | 7 | 0 | 1.00 | Appropriate | |
| **Measuring Devices** | | | | | |
| Syringe, dropper or measuring cup provided | 7 | 0 | 1.00 | Appropriate | |
| Any measuring devices available at home | 6 | 1 | 0.86 | Appropriate | |
| **Stopping the administration of medication** | | | | | |
| Acute patients become active | 6 | 1 | 0.86 | Appropriate | |
| Chronic patients look healthy | 5 | 2 | 0.71 | Appropriate | |
| **Appropriate actions for missed dose** | | | | | |
| Skipped the dose if the time for the next dose is closer | 5 | 2 | 0.71 | Appropriate | |
| Double the dose | 5 | 2 | 0.71 | Appropriate | |
| Immediate action | 5 | 2 | 0.71 | Appropriate | |
| Dose is taken immediately when the time for the next dose is still distant. | 6 | 1 | 0.86 | Appropriate | |
| **Perception of Caregivers** | | | | | |
| Read the instructions | 6 | 1 | 0.86 | Appropriate | |
| Knowing the appropriate practice | 5 | 2 | 0.71 | Appropriate | |
| **Importance of medication's dosing accuracy** | | | | | |
| Children's relief of symptom | 6 | 1 | 0.86 | Appropriate | |
| Prevention of the therapeutic effects | 7 | 0 | 1.00 | Appropriate | S-CVI/Ave= 0.87 |
| Prevention of the adverse effects | 7 | 0 | 1.00 | Appropriate | |
| Prolonged child health problem | 6 | 1 | 0.86 | Appropriate | |
| **Appropriate attitude** | | | | | |
| Only given when needed | 6 | 1 | 0.86 | Appropriate | |
| Measuring devices provided | 5 | 2 | 0.71 | Appropriate | |
| Medication's storage | 7 | 0 | 1.00 | Appropriate | |
| Read on the leaflet provided | 6 | 1 | 0.86 | Appropriate | |

Abbreviations: I-CVI; Content Validity Index for Individual Item, S-CVI/Ave; Scale of content validity index/Average

and constitutes the same idea. Additionally, for the item "Stopping the administration of liquid medication", the majority of the experts had suggested to differentiate it for the acute and chronic pediatric patient since it was an area that needs more attention among caregivers. Besides, the item in regard "appropriate actions for missed dose" that had higher risk in medication errors had been agreed by the expert panels to include several items which focused on the duration of the administration of the liquid medication for better assessment of the caregiver's knowledge. While the items related to "information needed in handling the liquid medication" and "sources of medication's information" had been removed, as the items had been repeated in the domain perception.

For domain perception (Table I), 80% (8/10) of items were appropriate, with I-CVI > 0.71. Discussion among the expert panels had agreed to modify several items which are the use of the terms "selalu membaca" changed to "perlu membaca", the use of "saya sudah mengetahui" changed to "saya percaya pada pengalaman saya", and the item for measuring an appropriate dose from the usage of the term "pengukuran" to "pemberian" for a better understanding. Additionally, the majority of the experts also suggested specifying and giving some examples for the item "Memberikan ubat cecair hanya jika perlu" which include "ubat tahan sakit", "alahan" and "batuk". However, one of the expert panels also suggested modifying the item of "menyimpan ubat cecair di tempat yang selamat dan sukar untuk dicapai oleh kanak-kanak" into "Menggunakan alat pengukur yang mudah didapati di rumah" to prevent caregivers from answering the items blindly by not being attentive to the question as well as ensuring its integrity.

After the first discussion and review, a set of second draft questionnaire with a total of 40 items: Section A: sociodemographic (9 items), Section B: knowledge (21 items), Section C: perception (10 items) were sent for the second review by the same group of the expert panel. All 40 items were appropriate with I-CVI > 0.71. Domain knowledge resulted in an S-CVI/Ave of 0.87 while domain attitude and perception yielded the same S-CVI/Ave of 0.87. This indicated that the content of all the items in these domains was appropriate and acceptable. The details of scoring and calculation were summarized in Table II.

**Face Validity**
A short interview section was conducted among 10 respondents. Respondents gave feedback that all items in the questionnaire were relevant and understandable to the reader (sentences or wording). However, most of the respondents (50%, n=5) gave feedback that the total number of 40 items were too much and made them feel bored during filling up the questionnaire. Most of the respondents gave feedback that they do not understand the duration of the administration of liquid medication.

**Table III : Demographic and socio-professional characteristics of participants (n=155)**

| Variables | Characteristics | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 38 | 24.5 |
| | Female | 117 | 75.5 |
| Age | 21–25 years | 4 | 2.6 |
| | 26–30 years | 31 | 20.0 |
| | 31–35 years | 33 | 21.3 |
| | 36–40 years | 43 | 27.7 |
| | 41–45 years | 32 | 20.7 |
| | 46–50 years | 6 | 3.9 |
| | 51–55 years | 1 | 0.6 |
| | 56-60 years | 4 | 2.6 |
| | 61-65 years | 1 | 0.6 |
| Race | Malay | 102 | 65.8 |
| | Indian | 19 | 12.3 |
| | Chinese | 34 | 21.9 |
| | *'Bumiputra Sarawak'* | 0 | 0.0 |
| Marital status | Single/Unmarried | 13 | 8.4 |
| | Married | 135 | 87.1 |
| | Divorced | 7 | 4.5 |
| | Widow | 0 | 0.0 |
| Education level | Primary school | 0 | 0.0 |
| | Secondary school | 11 | 7.1 |
| | Diploma/Skill certificate | 43 | 27.7 |
| | Degree/Master/PhD | 101 | 65.2 |
| Occupational status | Unoccupied | 4 | 2.6 |
| | Freelance | 26 | 16.8 |
| | Private worker | 70 | 45.2 |
| | Government worker | 53 | 34.2 |
| | Retired | 2 | 1.3 |
| Occupational field | Medical | 30 | 19.4 |
| | Not medical | 125 | 80.6 |
| Average monthly income (RM) | <10000 | 1 | 0.6 |
| | 1001 - 4500 | 39 | 25.2 |
| | 4501 - 7000 | 56 | 36.1 |
| | 7000 - 10 000 | 40 | 25.8 |
| | >10000 | 19 | 12.3 |

Thus, the item for "Tindakan yang harus dilakukan apabila terlupa memberikan dos ubat menurut arahan yang telah ditetapkan jika dos yang seterusnya dalam masa yang terdekat" has been changed as well as

**Table IV : Descriptive data on domain knowledge and Perception among the caregivers (n=155)**

| | Item | Yes | No | Not sure |
|---|---|---|---|---|
| | | n (%) | n (%) | n (%) |
| Q1. | Underdosing of the medication may leads to the detrimental of health | 101 (65.2) | 37 (23.9) | 17 (11) |
| Q2. | Underdosing of the medication affected the therapeutic efficacy | 121 (78.1) | 13 (8.4) | 21 (13.5) |
| Q3. | Overdosing of the medication increases the risk of adverse effects | 131 (84.5) | 11 (7.1) | 13 (8.4) |
| **Children's reaction management (Vomiting)** | | | | |
| Q4. | The dose of the medication is being given immediately | 115 (74.2) | 21 (13.5) | 19 (12.3) |
| Q5. | Missed the dose when the time of the administration is still distant | 53 (23.3) | 73 (45.2) | 29 (31.4) |
| Q6 | Given only a part of the medication | 44 (28.4) | 81 (52.3) | 30 (19.4) |
| Q7. | Discontinue the dose indefinitely | 33 (21.3) | 107 (67.7) | 17 (11.0) |
| **Appropriate measures on children's reluctancy** | | | | |
| Q8. | Mixed with milk | 100 (64.5) | 42 (27.1) | 13 (8.4) |
| Q9. | Diluting with other liquids | 56 (36.1) | 78 (50.3) | 21 (13.5) |
| Q10. | Given forcibly | 77 (49.7) | 72 (46.5) | 6 (3.9) |
| Q11. | Willingness of the child | 127 (81.9) | 26 (16.8) | 2 (1.3) |
| Q12. | Skipped the dose | 54 (34.8) | 89 (57.4) | 12 (7.7) |
| Q13. | Withhold the dose | 9 (5.8) | 125 (80.6) | 21 (13.5) |
| **Measuring devices** | | | | |
| Q14. | Syringe, dropper, or measuring cup provided | 155 (100) | 0 (0) | 0 (0) |
| Q15. | Any measuring devices available at home | 25 (16.1) | 114 (73.5) | 16 (10.3) |
| **Stopping the administration of medication** | | | | |
| Q16. | Acute patients become active | 139 (89.7) | 15 (9.7) | 1 (0.6) |
| Q17. | Chronic patients look healthy | 28 (18.1) | 104 (67.1) | 23 (14.8) |
| **Appropriate actions for missed dose** | | | | |
| Q18. | Skipped the dose if the time for the next dose is closer | 110 (71) | 33 (21.3) | 12 (7.7) |
| Q19. | Double the dose | 15 (9.7) | 123 (79.4) | 17 (11) |
| Q20. | Immediate action | 33 (21.3) | 101 (65.2) | 21 (13.5) |
| **Perception of Caregivers** | | | | |
| Q21. | Trusting on one's experiences | 88 (56.8) | 28 (18.1) | 39 (25.2) |
| Q22. | Read the instructions | 123 (79.4) | 13 (8.4) | 19 (12.3) |
| **Importance of medication's dosing accuracy** | | | | |
| Q23. | Children's relief of symptom | 142 (91.6) | 7 (4.5) | 6 (3.9) |
| Q24. | Prevention of the therapeutic effects | 137 (88.4) | 11 (7.1) | 7 (4.5) |
| Q25. | Prevention of the adverse effects | 145 (93.5) | 4 (2.6) | 6 (3.9) |
| Q26. | Prolonged child's health problem | 124 (80) | 12 (7.7) | 19 (12.3) |
| **Appropriate attitude** | | | | |
| Q27. | Only given when needed | 141 (91.0) | 8 (5.2) | 6 (3.9) |
| Q28. | Measuring devices provided | 9 (31.0) | 28 (57.4) | 4 (1.9) |
| Q29. | Medication's storage | 145 (93.5) | 8 (5.2) | 2 (1.3) |
| Q30. | Read on the leaflet provided | 153 (98.7) | 1 (0.6) | 1 (0.6) |

**Table V : Reliability analysis for knowledge among caregivers (n=155)**

| Item & Domain | | Corrected Item Total Correlation | Total Cronbach's Alpha if item Deleted | Cronbach's Alpha |
|---|---|---|---|---|
| **Children's reaction management (Vomiting)** | | | | |
| Q5. | Missed the dose when the time of the administration is still distant | 0.241 | 0.590 | |
| Q6. | Given only a part of the medication | 0.245 | 0.589 | |
| Q7. | Fasten the infusion rate do not cause harm | 0.380 | 0.561 | |
| **Appropriate measures on children's reluctancy** | | | | |
| Q8. | Mixed with milk | 0.212 | 0.596 | |
| Q9. | Diluting with other liquids | 0.315 | 0.573 | |
| Q12. | Skipped the dose | 0.303 | 0.576 | |
| Q13. | Withhold the dose | 0.129 | 0.606 | **0.604** |
| **Measuring devices** | | | | |
| Q15. | Any measuring devices available at home | 0.317 | 0.575 | |
| **Stopping the administration of medication** | | | | |
| Q17. | Chronic patients look healthy | 0.398 | 0.558 | |
| **Appropriate actions for missed dose** | | | | |
| Q18. | Skipped the dose if the time for the next dose is closer | 0.204 | 0.597 | |
| Q19. | Double the dose | 0.213 | 0.594 | |
| Q20. | Immediate action | 0.146 | 0.608 | |
| **Perception among Caregivers** | | | | |
| Q21. | Trusting on one's experiences | 0.210 | 0.505 | |
| Q22. | Read the instructions | 0.177 | 0.503 | |
| **Importance of medication's dosing accuracy** | | | | |
| Q23. | Children's relief of symptom | 0.401 | 0.417 | **0.508** |
| Q24. | Increases the therapeutic effects | 0.296 | 0.448 | |
| Q25. | Overdosing may lead to undesirable adverse effects | 0.204 | 0.489 | |
| Q26. | Prolonged of child's health problem | 0.256 | 0.465 | |
| **Appropriate Attitude** | | | | |
| Q29. | Medication's storage | 0.274 | 0.462 | |

modifying its choices of answers to "Dos yang terlupa itu dilangkau", "Dos yang tertinggal itu digandakan dengan dos yang seterusnya", and "Dos yang terlupa itu diambil serta merta apabila teringat" for better understanding. The final draft of the questionnaire was constructed and used in field testing for construct validity and reliability.

**Fields-testing of Questionnaire (construct Validity and reliability)**
A total of one hundred and fifty-six questionnaires were received throughout the study period of 1 month. However, one of the questionnaires was excluded due to the missing data for several items. For test-retest, twenty (N=20) questionnaires were distributed again to similar participants who had filled out the questionnaire priorly. The demographic and socio-professional characteristics of respondents are described in Table III. The majority of the respondents were female (n= 117, 75.5%) with an age range from 36 to 40 years old (n=43, 27.7%), were Malay (n=102, 65.8%), married (n=135, 87.1%), and holding higher education (n=101, 65.2%) in Degree/Master/Ph.D. Almost half of the respondents (n=70, 45.2%) were working in the private sector followed by (n=53, 34.2%) one third of the respondents working in the public sector, and rest (n=26,16.8%) were freelancers. Most of the respondents (n= 125, 80.6%) were non-medical workers and have an average monthly income in the range of RM 4501 to RM 7000.

**Table VI : Intraclass correlation coefficient (ICC) for test-retest of each domain (n=20)**

| Domain | Items | Intraclass correlation coefficient (ICC) | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower bound | Upper bound |
| Knowledge | 20 | 0.513 | 0.140 | 0.176 |
| Perception | 10 | 0.393 | 0.014 | 0.280 |

### Items in domain knowledge

The frequency of each item in the domain knowledge was described in detail in Table IV. The majority of respondents (>60%) hold good knowledge regarding the questions related to the under and over-dosing of liquid medications among children. The majority of the respondents (n=127, 81.9%) agreed that the liquid medication needs to be given according to the willingness of the children to avoid any incorrect doses being administered. Almost half of the respondents (n=89, 57.4%) prefer to "Skipped the dose" and (n=125, 80.6%) think of "Withhold the dose" as an appropriate measure to avoid children's reluctancy while administering liquid medication. Besides, (n=114, 73.5%) of the respondents reported inappropriate practices for the administration of liquid medication by using any measuring device available at home. The majority (n=110, 71%) of respondents answered correctly by taking appropriate actions for the missed dose by skipping the dose if the time the of next dose is closer.

### Items in domain perception

The frequency of each item in domain perception is described in detail in Table IV. The majority of the respondents had a good perception in regard to blood transfusion management, including responsibility in "Children's relief of symptom" (n=142, 91.6%), "Increased the therapeutic effects" (n= 137, 88.4%), "Overdosing may lead to undesirable adverse effects" (n=145, 93.5%) "Prolonged of child's health problem (n=124, 80%), "Only given when needed" (n=141, 91%), "Medication storage" (n=145, 93.5%) and "Read on the leaflet provided" (n=153, 98.7%). On the other hand, (n=88, 56.5%) of the respondents trusted their own's experiences when administering the liquid medication and only (n=123, 79.4%) read the instructions before administering. Nevertheless, only (n=9, 31%) of the respondents had the right perception in regard to Q28 "Measuring devices available at home".

### Construct Validity: Internal consistency

The internal consistency of all items in each domain was evaluated by using Cronbach's alpha. A value of Cronbach's alpha between 0.70-0.90 demonstrates good reliability without redundancy and an item-total correlation between 0.2 and 0.39 indicates good discrimination. Cronbach's alpha value in the domain knowledge (20 items) was 0.441 (Table V). Some items had corrected item-total correlation <0.2, Q1 (0.057), Q2 (0.163), Q4 (0.005), Q5 (0.161), Q6 (0.179), Q10 (0.135), Q13 (0.078), Q14 (0.083), Q16 (0.179) and Q18 (0.150). Several items (Q1, Q2, Q3, Q4 Q10, Q14, and Q16) were deleted, and increased the Cronbach alpha from 0.441 to 0.607 (Table V). It was generally considered to represent a measure of high internal consistency of the questionnaire regarding domain knowledge. On another hand, Cronbach's alpha value for all the items in domain perception (10 items) was 0.574. A total of 2 items (Q28 and Q27) were eliminated to increase Cronbach's alpha from 0.467 to 0.508 (Table V).

### Test-retest reliability

The test-retest reliability was conducted to evaluate the reproducibility and consistency of scores of the questionnaire by re-evaluating the same respondents at intervals of two weeks. Based on 20 responses, test-retest for each domain of the questionnaire at Time 1 and Time 2 was evaluated using intraclass correlation coefficients (ICC). ICC can estimate correlations of items in each domain between Time 1 and Time 2. ICC estimations and their 95% confidence intervals were computed with SPSS statistical package version 26 (SPSS Inc, Chicago, IL) using a mean-rating (k=3), absolute-agreement, 2-way mixed-effects model. Based on the analysis, ICC for each domain of the questionnaire was 0.5 and 0.39, which indicated moderate test-retest reliability (Table VI).

### DISCUSSION

Evaluation of parents' perceptions and knowledge is crucial in educating caregivers on the importance of appropriate handling of liquid medication to ensure its effectiveness and safety, thereby improving the children's quality of life. In this context, this study will provide a functional tool to assess caregivers on their knowledge and perception of handling liquid medication among children. To the best of our knowledge, this is the first comprehensive study designing and validating a questionnaire for the knowledge and perception assessment among caregivers regarding oral liquid medication handling among children. The questionnaire was shown to be well understood and accepted by caregivers. The internal consistency of the knowledge and perception domains were 0.513 and 0.393 respectively. Both results had shown unsatisfactory findings which indicate the questionnaire might lack relevant items resulting in the poor interrelatedness between the test questions. Thus, some of the questions shall be revised or removed if needed to avoid the diversity of the items. In this case, items (Q1, Q2, Q3,

Q4 Q10, Q14, and Q16) were deleted to increase the Cronbach alpha from 0.441 to 0.607. However, for the perception domain, a total of 2 items (Q28 and Q27) were eliminated to increase Cronbach's alpha from 0.467 to 0.508. These items need to be restructured to increase the inter-correlation by more than 0.6 and are considered simple questions which would be rephrased and would have easy answers by future research.

ICC estimates and their 95% confidence intervals were calculated by using SPSS statistical package version 26 (SPSS Inc, Chicago, IL) based on a mean-rating (k=3), absolute agreement, and 2-way mixed-effects model (20). ICC values less than 0.5 indicate low reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability (20). However, according to the results obtained in this study, the ICC for the knowledge and perception domains were 0.513 and 0.393 respectively which is of moderate reliability. A low ICC may not only represent a low degree of rater or measurement agreement, but also a lack of subject variability, a limited number of participants, and the small number of raters being assessed. The reliability of the questionnaire mainly affected by three main factors as reported in published studies including length of the questionnaire, quality of the questions and the fit to the group being measured. The fairly reliable questionnaire length should be greater 30 questions and is well written but if the questionnaire length is short and are not effective reliability of the questionnaire affected (21). Length of our study questionnaire is more than 30 items and has been filled by caregivers for whom it has been developed and intended to collect responses. In our study the low reliability of the questionnaire may mainly be associated with the structure of the questionnaire that may require more clarity. Small number of participants could also be the factor that may result in low ICC of study questionnaire, however responses from the 20 respondents that would be considered as minimum sample required for estimating the value of ICC has been recruited in this study (18). Some authors suggest that sample size as small as thirty should be required to sufficiently measure the precise estimates of intra class correlation coefficient. However, as a rule of thumb it can be said that the larger the sample size smaller would be the standard error of the statistics (22). For correlation statistics in generally along with the other statistical indices have standard errors indicating how trustworthy results are. Thus, it is essential that the larger number of subjects should be recruited to reduce the expected standard error of the statistics. This study includes several other limitations that should also be considered by future research. First, this study is limited to caregivers who are only exposed to the usage of social media therefore, caution should be taken when interpreting the study result, as they may differ if data were collected uniformly across Malaysia. The second limitation is that study subjects were chosen using a form of purposive sampling, which may introduce sampling error into the presented results. Therefore, future studies should employ a random sampling method to reduce sampling bias. Considering these restrictions, any interpretation or attempt to generalize the result should be approached with caution. The third limitation is the use of a single language (Malay) questionnaire that might have biased towards Malay language users only. Despite limitations that stated above the validated tool design in this study can be used to gather baseline information and in-depth knowledge about appropriate dose administration of liquid medication among children. The baseline data can be compared with subsequent post-intervention surveys. Furthermore, it can be utilized to design interventions and test the acceptability of educational intervention programs. This, in turn, provides insights into the level of knowledge and perception of the caregivers which will direct healthcare professionals on the counseling needed for parents and caregivers to administer medications accurately.

## CONCLUSION

All of the items in these knowledge and perception domains were appropriate and acceptable and can be explored for validity testing further by future studies.

## ACKNOWLEDGEMENT

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