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Original Article

Analysis of Pharmacists' Knowledge Level on Good Compounding Practice (GCP) in Pharmacies of Tenggarong and Tenggarong Seberang Subdistricts

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Abstract

Introduction: The compounding of medications is gaining significant attention due to increasing reports of pharmaceutical errors, contamination, and adverse drug interactions. These risks highlight the importance of adhering to Good Compounding Practice (GCP), a set of standards that pharmacists must understand and implement to ensure the safety, effectiveness, and quality of compounded medications. GCP also supports access to customised medications for patients with specific health needs. This study was conducted to assess the level of knowledge regarding GCP among pharmacists in the Tenggarong and Tenggarong Seberang districts. **Methods:** This study employed a non-experimental, descriptive qualitative research design. The sampling technique used was total sampling, targeting all 56 pharmacists practicing within the specified districts. Data were collected using a structured questionnaire designed to assess knowledge of GCP. The data were then analysed through univariate analysis using Microsoft Excel to determine overall knowledge levels. **Results:** The findings revealed that pharmacists in both districts demonstrated a generally high level of knowledge regarding GCP. The average score among respondents was 85.98%, classifying their knowledge level as "good." This suggests a satisfactory understanding of the core principles of compounding, including hygiene, documentation, labelling, storage, and quality assurance. **Conclusion:** The study concluded that pharmacists in Tenggarong and Tenggarong Seberang possess a good level of knowledge about Good Compounding Practice. Nevertheless, continued training, evaluation, and adherence to standard guidelines are recommended to maintain and enhance compounding quality, thus ensuring the delivery of safe, effective, and legally compliant pharmaceutical care.

Keywords: *Compounded Medications; Good Compounding Practice; Knowledge Level; Pharmacists*

Introduction

Pharmaceutical services refer to direct, patient-centered services aimed at improving the quality of life through the responsible provision of pharmaceutical preparations. Pharmacists hold a vital responsibility to the public, and delivering such care effectively requires a scientific approach. Pharmacy practice research, a form of health services research, plays a crucial role in identifying optimal methods for delivering pharmaceutical care (Garcia-Cardenas *et al.*, 2020).

The drug management process in pharmacies encompasses four key phases: selection, procurement and purchase, distribution, and use. These phases are interdependent and require careful coordination

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to ensure optimal performance at each stage. A well-structured supply system is essential to maintain the seamless operation of this cycle, enabling each phase to support the others effectively and ensuring the continuous availability of medications to meet healthcare service needs (Maulina *et al.,* 2020; Athiyah *et al.,* 2019). The process of preparing compounded medications, known as compounding, aims to meet the specific needs of patients based on prescriptions from healthcare providers (Janusziewicz *et al*. 2021). To support its implementation, guidelines are in place to regulate this practice, referred to as Good Compounding Practice (GCP). These guidelines provide detailed instructions on the standards and procedures required for preparing compounded medication formulations, whether for humans or animals (USP, 2020). With the implementation of GCP, pharmacists can prepare compounded medications that are both safe and effective. The practice of compounding has garnered attention due to the occurrence of undesirable incidents, such as pharmaceutical issues and drug interactions (Rochjana *et al*. 2019). Compounded medications are an essential part of prescription services that must ensure the safety and quality of compounded preparations. A pharmacist in Indonesia must meet the competency standards set by the Indonesian Pharmacists Association. Pharmacists must master the core competencies required for dispensing (Wijianto *et al.,* 2023). The study by Rochjana *et al*. (2019) revealed the presence of pharmaceutical issues (incompatibilities) in 3.4% of prescriptions (17 prescriptions), drug interaction problems in 45.1% of prescriptions (228 prescriptions), and a total of 329 drug interactions. Pharmacists play a crucial role in compounding; therefore, it is essential to explore their level of knowledge about GCP to identify factors that hinder its application in Pharmacists. This study aims to assess the level of Pharmacists knowledge regarding Good Compounding Practice (GCP) in Pharmacist located in the districts of Tenggarong and Tenggarong Seberang.

Methodology

The MAPE (Mean Absolute Percentage Error) test is one of the evaluation methods used to measure the accuracy of the calculation model, specifically the calculation, including in the context of calculations with existing algorithms, an application that will be made with the function of calculating pharmacokinetic parameters by entering 2 TDM (Therapeutic Drug Monitoring) data. MAPE gives an idea of how much the average error of the calculation is compared to the actual value of the calculation result with the same algorithm in MS Excel, expressed in percentages. How to calculate the modified Absolute Percentage Error (APE) can be seen in equation (1) below (Makridakis, 1993).

$$\text{APE} = \left|\frac{\text{Calculation Value in the KFI Application} - \text{Calculation Values in MS Excel}}{\text{Calculation Values in MS Excel}}\right| \times 100\% \quad (1)$$

Results and Discussion

Demographic Data

In the context of research articles, demographic data serves to provide a general overview of the characteristics of the participants who are the subjects of the study. In this study, the data collected to describe the sociodemographic characteristics of the respondents included the year of graduation, length of employment, and training in Good Compounding Practice (GCP). The results of the respondent's characteristics in this study are presented as follows:

Table 1: Percentage of Respondents Based on Year of Graduation

Year of Graduation of Pharmacists	Number of Respondents (Persons)	Percentage (%)
1998-2002	1	2
2003-2007	1	2
2008-2012	1	2
2013-2017	15	27
2018-2022	35	62
>2023	3	5
Total number	56	100%

As shown in Table 1, respondents are grouped into 5-year intervals, as pharmacists' competencies tend to change every five years. The majority of respondents graduated between 2018 and 2022, with a total of 62 individuals. The number of respondents for the years 1998-2002, 2003-2007, 2008-2012, 2013-2017, and post-2023 are 2, 2, 2, 27, and 5 individuals, respectively.

Table 2: Percentage of Respondents Based on Length of Service

Length of Service (years)	Number of Respondents	Percentage (%)
<1	3	5
1 - 3	36	64
4 - 7	10	18
8 - 11	5	9
> 12	2	4
Total number	56	100%

According to Table 2 a total of 36 respondents have been working in pharmacies for 1-3 years. Wahyudi's research (2018) demonstrates that work experience significantly enhances performance, evidenced by a regression coefficient of 0.451, indicating that performance is intrinsically linked to work experience.

GCP training is designed to enhance the competence of Pharmacists in consistently applying principles across all stages of the compounding process, from selecting raw materials to distributing the final product. Below is an overview of respondents who have participated in GCP training:

Table 3: Percentage of Respondents Based on GCP Training

Training GCP	Number of Respondents	Percentage (%)
Yes	30	54
No	26	46
Total number	56	100

Based on Table 3, it is shown that 26 respondents have never received training on Good Compounding Practice (GCP) after graduating from college. Meanwhile, 30 respondents attended Good Compounding Practice training after graduation. Patient-centered care should be the main emphasis of pharmacy education, preparing aspiring pharmacists to spearhead patient-centered pharmaceutical care services and quality use of medication programs (Sakeena, Bennett & McLachlan, 2019).

Assessment of Pharmacists Knowledge Level on Good Compounding Practice (GCP) in Pharmacies

Accurate knowledge is essential for Pharmacists to carry out the compounding process. The measurement of a pharmacists' knowledge level encompasses definitions, personnel, compounding process, equipment, stability, and facilities in the pharmacy. Based on research conducted on 56 respondents, the knowledge level of Pharmacists regarding Good Compounding Practice (GCP) in pharmacies in Tennggarong District and Tenggarong Seberang District can be determined. The following are the results of the recap of Pharmacists knowledge levels about Good Compounding Practice (GCP) in pharmacies:

Table 4: Recapitulation of Pharmacists Levels on Good Compounding Practice (GCP)

Respondents	Knowledge Level			
	Good		Enough	
	N	%	N	%
Pharmacists	54	96	2	4

Based on the measurement results in Table 4, Pharmacists' knowledge levels of GCP are categorized into good and sufficient. The percentage of Pharmacists with a good knowledge level of GCP is 96%, equivalent to 54 individuals, while 4% or 2 individuals fall into the sufficient category. The average score of Pharmacists' knowledge level on GCP is 85.98, which falls under the "Good" category. The following are the questions and corresponding answers provided to Pharmacists to assess their knowledge level regarding GCP:

Table 5: Proportion of Pharmacists Knowledge Levels on Good Compounding Practice (GCP)

Number	Questions	Correct		Wrong	
		N	%	N	%
1	Compounding Is one of the pharmaceutical services that falls under the responsibility of Pharmacists in pharmacies and other pharmaceutical service facilities	53	94.64	3	5.336
2	The Beyond Use Date (BUD) refers to the expiration date of the compounded product after it is prepared, or its primary packaging is opened	56	100	0	0
3	Personal protective equipment used during the compounding process includes masks	13	23.21	43	76.78
4	Non-sterile preparations must be compounded using purified water	47	83.93	9	16.07
5	Equipment calibration must be conducted every two years if there are no calibration instructions provided by the manufacturer	19	33.93	37	66.07
6	The Beyond Use Date (BUD) for oral preparations containing water is no more than 14 days	47	83.93	9	16.07
7	Furniture surfaces for compounding must be made of stainless steel	41	73.23	15	26.79
8	In the GCP process, compounding tables must be smooth, waterproof, free of cracks and crevices, and non-peeling	51	91.07	5	8.93
9	The labeling should only include the usage instructions	51	91.07	5	8.93
10	Labels for oral preparations use white labels, while topical preparations use blue labels	56	100	0	0
11	Medications should be placed in appropriate and separate containers for different medications to maintain their quality and prevent misuse	51	91.07	5	8.93
12	Equipment must be rinsed with clean water after being washed thoroughly with soap	54	96.43	2	3.57
13	The compounding area must be isolated from chemical contaminants, dust sources, and particles	53	94.64	3	5.36
14	Its location should be sufficiently distant from routine dispensing and counseling functions	54	96.43	2	3.57
15	The compounding room must be designed, arranged, and used to prevent cross-contamination	56	100	0	0
16	Proper compounding involves preparing one prescription at a time. Before handing the medication to the patient, the Pharmacists must recheck the patient's name on the label, usage instructions, as well as the type and quantity of the medication	55	98.21	1	1.79
17	One of the Pharmacists roles as the person responsible for compounding medications is to create Standard Operating Procedures (SOP) for compounding.	54	96.43	2	3.57
18	Upon dispensing, Pharmacists are not required to provide information about drug-food interactions	51	91.07	5	8.93
19	GCP encompasses the preparation, dispensing, and provision of drug information	50	89.29	6	10.71
20	The Beyond Use Date (BUD) for topical preparations containing water is no more than 30 days	51	91.07	5	8.93

Based on Table 5, the knowledge assessment results on Good Compounding Practice (GCP) were largely influenced by questions that received the highest number of correct and incorrect responses. Questions 2, 10, and 15 recorded a 100% correct response rate, with all 56 respondents answering correctly. In contrast, the highest percentages of incorrect answers were observed in question 3 (76.78% or 43 respondents), question 5 (66.07% or 37 respondents), and question 7 (26.79% or 15 respondents).

Specifically, question 2 addressed the concept of the Beyond Use Date (BUD), which refers to the period within which a drug should be used after it has been compounded or after the original packaging has been opened. All 56 respondents (100%) answered this question correctly. It is important to distinguish BUD from the expiration date. The expiration date is determined by the manufacturer and indicates the period during which the drug is expected to remain stable, provided it is stored in its original, unopened packaging. In contrast, the BUD is assigned to compounded or repackaged medications and

marks the time after which the drug should not be used once the preparation process is complete or the original container is opened.

However, despite the high rate of correct responses in this specific study, broader research indicates a lack of public understanding regarding the BUD. According to a recent study by Cokro *et al*. (2021), only 3% of the North Jakarta community in Indonesia demonstrated adequate knowledge about BUD, and notably, none of the respondents' cited pharmacists as a source of information on the topic.

Question 10 addressed the topic of labels for oral preparations using white labels and topical preparations using blue labels, with 56 respondents (100%) answering correctly. A drug label is a piece of paper attached to medication containing essential information. According to the standards for pharmaceutical services in pharmacies, label colors are used as a safety measure: white for internal/oral medications, blue for external and injectable medications, and additional labels like shake well for suspensions (Ministry of Health of the Republic of Indonesia, 2016). Proper label preparation is crucial before medication distribution, as poorly presented labels may lead to assumptions about inadequate drug quality and result in a loss of trust in Pharmacists. Labels must fit the packaging, be neatly attached, and include required components, such as the drug name, dosage form, strength, usage instructions, patient's name, preparation date, and pharmacy identity. The Indonesian National Drug Information (IONI) also mandates that drug names on packaging must remain visible and not be covered by the label (Art Workflow HQ, 2024; Waworundeng & Sandag, 2022; Wijaya & Octavia, 2024).

In the process of non-sterile compounding, the percentage of correct answers among respondents was 100%. Question 15 asked whether good compounding practice involves preparing one prescription at a time, a criterion understood by all 56 respondents. Preparing prescriptions one at a time is essential to prevent cross-contamination (USP, 2022). Cross-contamination occurs when raw materials or products are contaminated by other substances or products, leading to unintended mixing. This can compromise the quality and safety of pharmaceutical products. Morbidity and mortality are often caused by a compounded medication that was tainted during production by bacteria, fungi, or another medication, or by an error where the drug's dispensed concentration was not as intended, which can result in an unintentional overdose or underdose. Patient harm caused by compounded medications has been the focus of media, medical, and legislative attention in recent years, especially following a multistate, multi-fatality outbreak of fungal meningitis caused by contaminated steroid injections compounded at a pharmacy in Framingham, MA (Watson *et al*. 2021; Khraim, Alabbadi & Alnahar, 2025).

On the topic of question 3, regarding Personal Protective Equipment (PPE) used during drug compounding, 13 respondents, representing 23.21%, correctly identified that the PPE used during drug compounding includes wearing a mask. Meanwhile, 43 respondents, accounting for 76.79%, answered incorrectly. Wearing a mask during drug compounding serves an important purpose in maintaining drug safety and quality. Wearing a mask during drug compounding is a crucial step, but it is usually not sufficient to ensure optimal safety and cleanliness. The drug compounding process requires compliance with a broad range of hygiene and safety standards, such as wearing a mask to protect against the inhalation of harmful drug particles, gloves to prevent direct contact with potentially toxic or irritating substances, a gown to reduce the risk of cross-contamination, and a head cover to prevent hair or other particles from falling into the compounded drug. The safety of patients receiving compounded sterile pharmaceuticals will depend on enhancing the competency of compounding professionals, fortifying environmental quality controls, and strictly enforcing quality assurance procedures, particularly during non-patient-specific compounding (Shehab *et al*. 2018; Ridwan, Sukri & Badarussyamsi, 2021).

On the topic of question number 5, regarding the calibration of equipment, which should be conducted every two years if there are no calibration guidelines from the manufacturer, 19 respondents, representing 33.93%, answered correctly, while 37 respondents, accounting for 66.07%, answered incorrectly. Calibration is the process of verifying that the accuracy of a measuring instrument aligns with its design specifications. The ability to use, calibrate, clean, and update current systems is a prerequisite for compounding staff. To reduce the possibility of unfavourable outcomes, all

compounding staff members need to be aware of the checks and balances incorporated into the company's sterile compounding procedure as well as the reasoning behind it (Billstein-Leber *et al*., 2018). According to the USP, equipment used for drug compounding must be calibrated at least once a year if there are no recommendations from the manufacturer (USP, 2020).

Question number 7, regarding the requirement that furniture surfaces for drug compounding must be made of stainless steel, 41 respondents, representing 73.23%, answered correctly, while 15 respondents, accounting for 26.79%, answered incorrectly. The work surface must be smooth, waterproof, crack and crevice-free (preferably seamless), and non-peeling to prevent contamination. According to the Ministry of Health of the Republic of Indonesia (2016), stainless steel tables are preferred because they are easy to clean, resistant to acids, non-corrosive, non-moldy, and odor-resistant, making them safer. According to the National Institutes of Health (2016), materials such as wood and marble are porous, which increases the likelihood of residual contamination even after cleaning.

In Indonesia, Pharmacists working in pharmacies play a crucial role in drug compounding, especially in areas where access to drugs with specific formulations remains limited. Below is a summary of Pharmacists knowledge levels regarding GCP in pharmacies, specifically in the Tenggarong and Tenggarong Seberang regions:

Table 6: Recapitulation of Pharmacists' Knowledge Level Regarding GCP

Respondents	Knowledge Level			
	Good		Enough	
	N	%	N	%
Pharmacists	54	96	2	4

Based on the measurement results presented in Table 6, the Pharmacist's knowledge level regarding GCP is categorized into two groups: good and insufficient. The level of knowledge categorized as good accounted for 96%, or 54 respondents, out of the total number of participants. This indicates that Pharmacists in pharmacies within Tenggarong District and Tenggarong Seberang District have a good understanding of Good Compounding Practice (GCP). Meanwhile, 4% of 2 respondents had sufficient knowledge of GCP, indicating that some Pharmacists possess an adequate basic understanding of GCP. The average score for Pharmacists' knowledge of GCP was 85.98%, which falls into the “Good” category. Improving Pharmacists' knowledge of Good Compounding Practice (GCP) can be achieved through regular training and certification programs emphasizing the application of GCP, especially in the preparation of compounded medications. Accessible information can be provided via online modules and practical guides, while collaboration with regulators, professional organizations, hospitals, and the pharmaceutical industry enhances support for training initiatives. Structured oversight, such as audits and mentoring, ensures compliance in the field. Furthermore, offering incentives and career advancement opportunities motivates Pharmacists to excel in GCP, supported by regulatory measures that establish this training as a mandatory standard of practice. These efforts collectively enhance Pharmacists' competence in maintaining the quality and safety of compounded medications.

Conclusion

This study's accuracy assessment, using MAPE, confirms the reliability of the developed Android-based pharmacokinetic application for amikacin. The application offers a user-friendly and portable means for clinical pharmacists to calculate individual pharmacokinetic parameters, ultimately facilitating timely and accurate dosing adjustments to improve therapeutic outcomes and minimise toxicity risks associated with narrow therapeutic index drug. Future developments could explore the integration of real-time patient data and artificial intelligence to further enhance the precision of dosing recommendations. Additionally, expanding the application's capabilities to other drugs with narrow therapeutic indices could broaden its clinical utility and improve patient safety across diverse therapeutic areas.

Conflict of Interest

The authors affirm that there are no conflicting objectives.

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