



Pharmacists' Knowledge of Non-Sterile Good Compounding Practice (GCP) and Its Implementation in Balikpapan Community Health Centers: A Cross-Sectional Study

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Abstract

Introduction: Good Compounding Practice (GCP) is a guide to compounding drugs that contains more in-depth instruction on implementing good compounding practices to prepare compounded drug formulations that will be given to patients. Poorly conducted compounding can reduce quality, including uniformity of content/levels and weights, impaired stability in both physical, chemical and biological, and the risk of drug interactions and side effects. This study aims to determine the level of pharmacist knowledge about GCP, and GCP implementation. **Methods:** This type of research is the descriptive correlation with a cross-sectional research design. The object of this research is to the level of knowledge of pharmacists in all Health Centers of Balikpapan City about GCP, and its implementation. The sampling technique used in this research is total sampling technique, then data analysis to determine the correlation between knowledge level and implementation using chi-square analysis. **Results:** The results showed that the level of pharmacist knowledge about GCP was classified as good, with an average of 87.78. Implementation of GCP by pharmacists is also good with an average value of 83.10. No significant relationship was found between the level of knowledge and the implementation of Good Compounding Practice (GCP) with a *P* value of 0.484. **Conclusion:** There is no significant relationship between pharmacists' knowledge of Good Compounding Practice (GCP) and its implementation in Balikpapan City Health Centers.

Keywords: *Compounded Drugs; Good Compounding Practice; Level of Pharmacist Knowledge; Health Center*

Introduction

The health of all Indonesian citizens is protected by the constitution, as stated in Article 27, paragraph 2 of the 1945 Constitution, which guarantees every citizen the right to employment, health, and a decent livelihood in accordance with human dignity. To achieve optimal public health status, various efforts must be undertaken, one of which is providing healthcare services (1945 Constitution, article 27, paragraph 2). One of the most crucial primary healthcare facilities in Indonesia is the Community Health Center. The goal of pharmaceutical care (PC) and good pharmacy practices (GPP) is to provide patients with the best possible treatment and an enhanced quality of life. The GPP and PC quality standards

are very important in the healthcare system since the quality assessment is related to patient satisfaction (Alotaibi et al. 2021; Hidayati, Nuraini & Nasution, 2024).

Extemporaneous compounding is the process by which a pharmacist or other health care provider makes medications on-site (in a pharmacy or other health facility) based on the patient's needs or in specific circumstances when a medication that meets the patient's needs is not commercially available. Mixing, measuring, and producing drugs in dose forms in accordance with a physician's prescription can all be part of impromptu compounding. These medications are manufactured in response to patient's request or a doctor's prescription, which calls for dosages or formulas not found in commercially available versions. Nonetheless, many pharmacies continue to provide extemporaneous compounding as a relevant pharmaceutical service. Compounding is still emphasised in the modern pharmaceutical landscape, which includes both industrial and clinical aspects motivated by patient care, in order to meet the individualised therapeutic needs of patients with rare diseases, children, and those requiring particular dosage forms (Kurniawan et al. 2024; Setyoningsih et al., 2023).

Subsequent behavioural patterns may be influenced by the patient's satisfaction with the treatments received. The patient will return to the health service if reality surpasses expectations. Specifically, pharmaceutical services, which are the last medical services provided at Community Health Centers services. The degree of patient satisfaction that results from the skills of pharmaceutical staff after obtaining services is known as patient satisfaction (Fadhilah et al. 2024).

Good Compounding Practice (GCP) is general guidance that outlines the standards and criteria for proper compounding, which must be understood and adhered to by pharmacists. This ensures that they can prepare compounded medications with acceptable strength, quality, and purification (USP, 2020). GCP is an integral part of pharmaceutical care standards, aimed at ensuring that every compounded medication dispensed to patients meets therapeutic needs and is safe and of high quality. In Indonesia, compounded prescriptions are commonly found in healthcare services, including hospitals, community health centers, and pharmacies (drugstores), as many doctors continue to prescribe compounded medications, particularly to address the limited availability of paediatric formulations. The compounding and mixing process of existing medications can affect the stability and compatibility of pharmaceutical preparations. The quality of compounded medications in Indonesia heavily relies on pharmacists' expertise in compounding. Therefore, pharmacists must master the skill of medication compounding.

In our research, both undergraduate pharmacy students and practicing pharmacists regarded pharmaceutical compounding as an engaging practice that effectively meets patients' needs, aligning with the traditional role of pharmacists in compounding. These motivations were largely consistent with findings from studies conducted in Australia and the United States, which also highlighted the role of compounding in fostering stronger professional relationships with patients and enhancing pharmacists' professional satisfaction (Choo et al., 2018; van der Schors et al., 2021).

Previous research has shown that knowledge of Good Compounding Practices remains low. Therefore, further study is needed to assess the extent of pharmacists understanding of GCP and its implementation across all community health centers in Balikpapan City. This will help identify issues in the compounding process at these facilities. The continued relevance of GCP highlights its importance in supporting individualised therapy, while keeping pace with advancements in science, regulations, and technology. Community Health Centers serve as public healthcare facilities that handle prescription services, including both compounded and non-compounded medications. A compounded prescription requires the medication to be prepared by pharmaceutical personnel, while a non-compounded prescription refers to ready-to-use medications, such as tablets. In Balikpapan, there are 27 Health Care, each with a pharmacist responsible for the operation of the pharmacy within the facility.

Based on the background above, the researcher conducted a study to analyse the level of pharmacists' knowledge regarding Good Compounding Practice (GCP) for non-sterile preparations and its implementation in Community Health Centers (Puskesmas) in Balikpapan City.

Methodology

This study employs a descriptive correlational design with a cross-sectional approach. Data collection involves the use of questionnaires administered to pharmacists. The data collected include demographic information, knowledge levels regarding GCP, GCP implementation (Good Compounding Practices), and challenges in applying good compounding practices. The analysis is conducted using Microsoft Excel. Primary data, obtained from respondents through questionnaires, form the basis of this research. The sampling process involves distributing questionnaires to 27 Apothecaries in charge at Community Health Centers (Puskesmas) in Balikpapan City. Two types of questionnaires are designed to measure Apothecaries knowledge of GCP and its implementation in the Community Health Centers. A validity test is conducted to ensure the feasibility of the questionnaires used.

To measure pharmacists' knowledge levels, a multiple-choice questionnaire is used, with options a, b, and c, where respondents select one answer. Correct answers are scored as 1, while incorrect answers are scored as 0. The researcher adopts a modified categorisation of response results based on (Mahmudi, 2019). The responses are divided into two categories "good" (>88%-100%) and "poor" (<88%). The data interpretation is presented in percentages using the following formula:

$$\text{Score percentage} = \frac{\text{Number of Correct Answer}}{\text{Total Questions}} \times 100\%$$

The questionnaire used to assess the implementation of GCP utilises a Guttman scale, with "yes" or "no" response options. The evaluation of the questionnaire aligns respondents answer with the GCP guidelines. The responses are then categorised into two groups: "good" for correct answers ranging from 83%-100% and "poor" for correct answers below 83%.

Bivariate analysis (Statistical analysis) is employed to determine whether there is a relationship or difference within the study sample. This analysis aims to explore correlations between demographic characteristics and both knowledge levels and GCP implementation. The chi-square test is applied to nominal data to determine the appropriate analysis. If the p -value is less than 0.05, it indicates a significant relationship between the two variables tested (McCrum-Gardner, 2008). The odds ratio (OR) is applicable if the two variables are significantly related, with a p -value < 0.05 (Szumilas, 2010). For the chi-square test to be valid, the expected frequency must exceed 5. If any expected frequency falls below 5, Fisher's exact test is used instead (McCrum-Gardner, 2008).

Ethical Consideration

The study received Ethical Approval from the Ethical Committee Medical Research, Universitas Muhammadiyah Lamongan, Indonesia with reference number 109/EC/KEPK-S1/05/2024 on 21 May, 2024.

Results and Discussion

Validity Test

Face validity was conducted to evaluate the questions/statements measuring Apothecaries knowledge of Good Compounding Practice (GCP) for non-sterile preparations and its implementation. This involved reviewing respondents answers to ensure the appropriateness of the questions/statements provided. A total of 30 respondents were included in the sample for this test. The purpose of the face validity test was to assess the clarity of language, layout, and flow of the questionnaire. The questionnaire was deemed valid once the language used was understood, and the layout and structure were considered acceptable by respondents (Puspasari & Puspita, 2022). The results of the face validity test conducted in this study are presented in Table 1.

Table 1: Validity Test Results

Question Number	Answer "Yes"	Answer "No"	Significance Level	Description
1	29	1	0.97	Valid
2	30	0	1	Valid
3	30	0	1	Valid

Based on table 1, the results of the face validity test in this study showed that 29 respondents achieved a significance level of 1, while respondents had a significance level of 0.97, resulting in an overall average of 0.99. This indicates that the results were satisfactory, and no revisions to the questionnaire were necessary. These findings align with the standard for assessing face validity, which states that if the validity score is less than 0.7-0.9, the questionnaire requires revision. However, if the score exceeds 0.7, the questionnaire is considered appropriate for measuring the intended data.

Assessment of Apothecaries Knowledge Level on Good Compounding Practice (GCP) for Non-Sterile Preparations and Its Implementation in Health Care (Puskesmas)

According to the theory of correspondence, knowledge is considered true if it corresponds to a reality that is indeed true (Maine, 2008). Over the years, with a switch in the approach in pharmacy education and practice from product-focused to patient centred care, clinical knowledge appeared to have a more important position in education. Based on the study conducted with 27 respondents, the level of Apothecaries knowledge regarding Good Compounding Practice (GCP) in Community Health Care in Balikpapan City was evaluated. Below are the results of the Apothecaries knowledge levels about Good Compounding Practice (GCP):

Table 2: Proportion of Responses on Apothecaries Knowledge Level About GCP

Number	Question	Correct Response		Incorrect Response	
		N	%	N	%
1.	The preparation of syrup formulations falls under the category of compounding	26	96%	1	4%
2.	One of the Apothecaries roles as a supervisor is to oversee the compounding process	27	100%	0	0%
3.	Which of the following is considered a critical step during the compounding process	24	89%	3	11%
4.	Good compounding involves preparing prescriptions in quantities of	27	100%	0	0%
5.	When should equipment calibration be performed if there are no calibration instructions from the manufacturer	26	96%	1	4%
6.	The Beyond Use Date (BUD) for oral preparations containing water is	23	85%	4	15%
7.	Personal protective equipment used during the compounding process includes	15	56%	12	44%
8.	The surface of furniture used for compounding must be made of stainless steel	12	44%	15	56%
9.	The water used for compounding must meet standards	17	63%	10	37%
10.	How should labeling be carried out	27	100%	0	0%
11.	The Beyond Use Date (BUD) for semi-solid topical/dermal and mucosal preparations containing water is	25	93%	2	7%
12.	In the GCP process, the compounding table must meet the following requirements	26	96%	1	4%
13.	Compounding is one of the pharmaceutical services that falls under the Apothecaries responsibility	16	59%	11	41%
14.	The components of Good Compounding Practice (GCP) include	24	89%	3	11%
15.	The Beyond Use Date (BUD) of a drug is typically calculated from	26	96%	1	4%
16.	How should Apothecaries provide medication information to patients in accordance with Good Compounding Practice (GCP)	27	100%	0	0%
17.	Why is the design of the compounding area crucial in preventing cross-contamination	27	100%	0	0%
18.	Why is generally recommended to use white labels for oral preparations and blue labels for topical preparations	27	100%	0	0%
19.	Why is it important to verify the patients name, instructions for use, and the type of quantity of the medication on the label before dispensing it to the patient	27	100%	0	0%
20.	Why is it essential to place medications in appropriate and separate containers to maintain their quality	25	93%	2	7%

Based on Table 2, the respondents answer regarding their knowledge of Good Compounding Practice (GCP) show a pattern dominated by both the most frequently correct and incorrect responses. The average percentage of correct answers for questions 2, 10, 16, 17, 18, and 19 was 100%, with all 27 respondents answering correctly. Meanwhile, the average percentage of incorrect answers for question 7 was 44%, involving 12 respondents, and for question 13, it was 41%, with 11 respondents answering incorrectly.

In question 7 about Personal Protective Equipment (PPE) used during compounding on the topic of PPE in compounding, 15 respondents (56%) correctly identified that PPE includes wearing masks, gloves, head covers, and lab coats. However, 12 respondents (44%) answered incorrectly. Apothecaries engaged in compounding must maintain hand and clothing hygiene by wearing head covers, gloves, masks, and lab coats to protect themselves from chemical exposure and prevent contamination (GCP 1st Edition, 2018). 4 respondents (15%) selected only masks and gloves, and 8 respondents (30%) selected masks, gloves, and head covers. Among the 12 respondents (44%) who answered incorrectly, the majority 8 respondents, had 2-5 years of work experience. Additionally, 11 respondents who had never participated in Good Compounding Practice (GCP) training answered this question incorrectly. This indicates a possible gap in knowledge among Apothecaries with limited experience or those lacking formal training, highlighting the need for further education on GCP standards.

On the topic of question 8, regarding the surface material of furniture used for compounding medication, 12 respondents (44%) correctly answered that furniture for compounding must be made of stainless steel, while 15 respondents (56%) answered incorrectly. Only 1 respondent (4%) answered with other materials. To prevent contamination, the work surface should be smooth, waterproof, free from cracks and crevices (preferably seamless), and non-porous. 14 respondents (52%) incorrectly identified materials such as marble, tiles, or ceramics as suitable. According to Good Compounding Practice (2018), surfaces should be cleaned at the beginning and end of each compounding session and free from any drugs or chemicals used during previous compounding activities.

Based on research conducted by Boky *et al.* (2021) on the implementation of pharmaceutical service standards, it was found that pharmacists who participated in the training were able to improve their ability to perform their tasks in patient-oriented pharmaceutical services and increase their awareness of fulfilling their professional responsibilities effectively.

Apothecaries must understand and be aware of the potential for medication errors in the service process and be capable of identifying, preventing, and addressing issues related to medications, pharmaco-economic, and social pharmacy (Ministry of Health of the Republic of Indonesia, 2016). A total of 27 respondents (100%) answered correctly, with no respondents (0%) providing incorrect answers. The following is the summary of Apothecaries knowledge levels regarding Good Compounding Practice (GCP) in Community Health Centers:

Table 3: Summary of Apothecaries Knowledge Levels Regarding GCP

Number	Respondents	Level of Knowledge			
		Good		Not Enough	
		N	%	N	%
1.	Male	3	12%	0	0
2.	Female	12	44%	12	44%

Based on Table 3, the "Good" category accounted for 12% (N = 3) of male respondents and 44% (N = 12) of female respondents. Meanwhile, 44% (N = 12) of respondents fell into the "Poor" category. The responses were categorised into two groups: "Good" (88%-100%) and "Poor" (<88%). The average knowledge level of Apothecaries regarding Good Compounding Practice (GCP) was 87.78%, placing it in the "Good" category. Detailed results of Apothecaries knowledge levels in Community Health Centers in Balikpapan can be found in the appendix.

The enhancement of Apothecaries knowledge of Good Compounding Practice can be achieved through regular training and certification programs focusing on applying GCP, particularly for compounded

medications. Providing online modules and practical guides facilitates access to information, while collaboration with regulators, professional organisations, hospitals, and the pharmaceutical industry strengthens training support. Structured supervision, such as audits and mentoring, helps ensure compliance in the field. Additionally, offering incentives and career opportunities can motivate pharmacists to master GCP, supported by regulatory reinforcement mandating this training as a practice standard. These steps will enhance Apothecaries competence in ensuring the quality and safety of compounded medications.

Implementation of Good Compounding Practice (GCP) at Community Health Centers

Compounding is an integral part of pharmacy practice and is crucial for the provision of healthcare services. Compounding is defined in USP 795 as follows: "The preparation, mixing, assembling, altering, packaging, and labeling of a drug, drug delivery device, or device in accordance with a prescription, medication order, or initiative based on the practitioner-patient-pharmacy-compounder relationship in the course of Apothecaries" (Bou-Saba, Kassak & Salameh, 2022; Lam & Feng, 2021). Therefore, Apothecaries are responsible for compounding preparations with acceptable strength, quality, and purity, as well as proper packaging and labeling in accordance with good pharmacy practice, official standards, and the latest scientific principles. To ensure the safety, quality, and effectiveness of compounded medications, Apothecaries must continuously enhance their knowledge through seminars, current literature, and discussions with other medical professionals.

Apothecaries at Community Health Centers who receive prescriptions for compounded medications must implement or adhere to guidelines for good compounding practices. One such guideline is USP, as well as the Indonesian Ministry of Health Regulation Number 74 of 2016 concerning Standards for Pharmaceutical Services at Community Health Centers. Below are the results of the implementation of Good Compounding Practice (GCP) at Community Health Centers in Balikpapan City:

Table 4: Proportion of Questionnaire Responses on the Implementation of GCP at Community Health Centers

Number	Question	Yes		No	
		N	%	N	%
1.	There is a Standard Operating Procedure (SOP) in place at the Apothecaries for compounding	27	100%	0	0%
2.	There is an SOP for cleaning compounding equipment	22	81%	5	19%
3.	The compounding room is separate from the medication storage area	13	48%	14	52%
4.	The compounding room is used exclusively for preparing medications	9	33%	18	67%
5.	The Material Safety Data Sheet (MSDS) used is easily accessible	20	74%	7	26%
6.	The scales used for compounding are calibrated regularly	14	52%	13	48%
7.	The measuring tools used for compounding are calibrated regularly	18	67%	9	33%
8.	The medicinal ingredients used have been approved by the Food and Drug Administration (BPOM)	27	100%	0	0%
9.	The storage of both active and inactive ingredients complies with the recommendations of the manufacturer or pharmacopeia	27	100%	0	0%
10.	I am allowed to bring food into the compounding room	25	93%	2	7%
11.	I always use cleaned equipment for compounding medications	27	100%	0	0%
12.	After compounding, I always wash the equipment I have used	27	100%	0	0%
13.	I always refer to the MSDS to handle medicinal ingredients safely	24	89%	3	11%
14.	I always compound one prescription at a time	22	81%	5	19%
15.	I wear a watch or bracelet while compounding	21	78%	6	22%
16.	The furniture material I work with (eg: table) is made of	5	19%	22	81%
17.	The compound medications containing water, the type of water I use is	4	15%	23	85%
18.	The Personal Protective Equipment (PPE) I use includes	27	100%	0	0%

Based on Table 4, the respondents answer regarding the implementation of Good Compounding Practice (GCP) at Community Health Centers in Balikpapan City were dominated by questions with the

most correct and incorrect responses. The average percentage of correct answers for questions number 1, 8, 9, 11, 12, and 18 was 100%, with 27 respondents answering correctly. On the other hand, the average percentage of incorrect answers for question number 4 was 67%, with 18 respondents answering incorrectly. Only 9 respondents (33%) reported using the compounding room exclusively for medication preparation. This does not align with the Indonesian Ministry of Health Regulation number 74 of 2016, which stipulates that facilities supporting healthcare services in Community Health Centers must include a prescription receiving area, a compounding room, a dispensing room, and a medication storage room. For example, the storage room must have refrigeration facilities, while the compounding room does not necessarily require one but may need it depending on specific circumstances. Regardless, the compounding room should provide sufficient space and at the very least, be free from any obstructive items. The absence of inadequacy of these facilities can hinder the optimisation of pharmaceutical services, particularly in ensuring the safety, accuracy, and convenience of patients receiving medications and other pharmaceutical services. Therefore, efforts to improve and adjust the facilities to meet established standards are urgently needed.

Similarly, the average percentage of incorrect answers for question number 16 was 81%, with 22 respondents answering incorrectly. For this question, 19% of respondents reported using stainless steel furniture, 81% reported using wooden furniture, and 0% used marble furniture. According to Good Compounding Practices (GCP), the furniture used should be made from materials that are resistant to chemicals, easy to clean, and do not absorb liquids, such as stainless steel or high-quality plastic. The surface of the furniture must be smooth, without gaps or cracks that could accumulate dirt or microbial contamination. In Good Compounding Practices, the furniture and equipment in the compounding room should be designed to prevent cross-contamination, facilitate cleaning, and comply with hygienic work procedures.

Regarding question number 17, about the implementation of Good Compounding Practices (GCP) related to the use of water in the compounding process for medications containing water, the results indicate that the practice is still not optimal. Only 4 respondents reported using purified water in the compounding process, with the results showing that 15% of respondents chose purified water, while 85% used mineral water. The availability of water in the compounding area must be considered. The piping system should be flawless and preferably made of stainless steel to avoid contaminating the compounded preparation. This is in line with research by Yuliani *et al.* (2021), which states that if a compounded preparation requires water, it should be purified water or at least potable water. According to the Indonesian Ministry of Health Regulation No. 492/Menkes/PER/IV/2010 on drinking water requirements, drinking water that is safe and suitable for consumption must meet physical, chemical, and microbiological standards. According to the Indonesian National Standard 01-3553-2006 (BSN, 2006), bottled drinking water (AMDK) is raw water that has been processed, packaged and is safe for consumption, including both mineral water and demineralised water. Here is a summary of the implementation of GCP at the Community Health Centers:

Table 5: Summary of the Implementation of GCP

Number	Respondents	Implementation of GCP			
		Good		Not Enough	
		N	%	N	%
1.	Male	2	7	1	4
2.	Female	14	52	10	37

Based on Table 5, male respondents in the “good” category reached 7% (N = 2), while female respondents reached 52% (N = 14). There were 4% of male respondents (N = 1) in the “poor” category, and 37% of female respondents (N = 10) in the “poor” category. The assessment categories are divided into two: “Good” (83%-100%) and “poor” (<83%). The average score for implementing Good Compounding Practice (GCP) at the Community Health Center is 83.10, which falls into the “Good” category. The results of the GCP implementation at the Balikpapan City Community Health Center can be seen in the appendix.

According to Schors *et al.* (2020) research on the important of compounding for addressing patient needs is compounding, preparation, and manufacturing are distinctive activities within the pharmacy profession. In all European countries, national regulations have been established to address the specific characteristics of pharmacy compounding. The regulations ensure the implementation of appropriate procedures as well as the quality and safety of pharmaceutical preparations by pharmacists. In addition, Good Compounding Practice emphasises the responsibility of pharmacists to ensure that compounded medications meet the highest standards of quality, safety, and efficacy.

The Relationship Between the Knowledge Level and The Implementation of Good Compounding Practice (GCP) by Apothecaries

The knowledge level of Apothecaries highly influences the implementation of Good Compounding Practice (GCP). A higher level of knowledge about GCP tends to correlate with better adherence to the standards and guidelines set for pharmaceutical compounding. Apothecaries who are well-versed in the principles of GCP are more likely to implement practices that ensure compounded medications' safety, quality, and efficacy. The following table presents the relationship between the level of Apothecaries knowledge and the implementation of Good Compounding Practice in Community Health Centers:

Table 6: The Relationship Between Knowledge Level and Apothecaries Implementation of GCP

Variable	GCP Implementation		P (Value)	Confidence Interval		OR	Description
	Good	Not Enough		Lower	Upper		
Knowledge Level							
Good	8	7	0.484	0.119	2.751	0.571	No Connection
Not Enough	8	4					

Based on Table 6, the P-value obtained for the variable of knowledge level about the implementation of GCP is greater than 0.05, indicating that the null hypothesis (H0) is accepted. This suggests that knowledge level does not have a significant influence on the implementation of GCP. These results indicate that increasing Apothecaries knowledge alone is insufficient to improve GCP implementation. This may be due to other factors such as the lack of facilities, resources, or adequate practical training. This study highlights the need to consider other external factors that may affect GCP implementation, such as management support, facilities, infrastructure, availability of tools and materials, and Apothecaries workload. To enhance GCP implementation, a more comprehensive approach is required, focusing not only on improving knowledge but also on providing adequate facilities and continuous practical training.

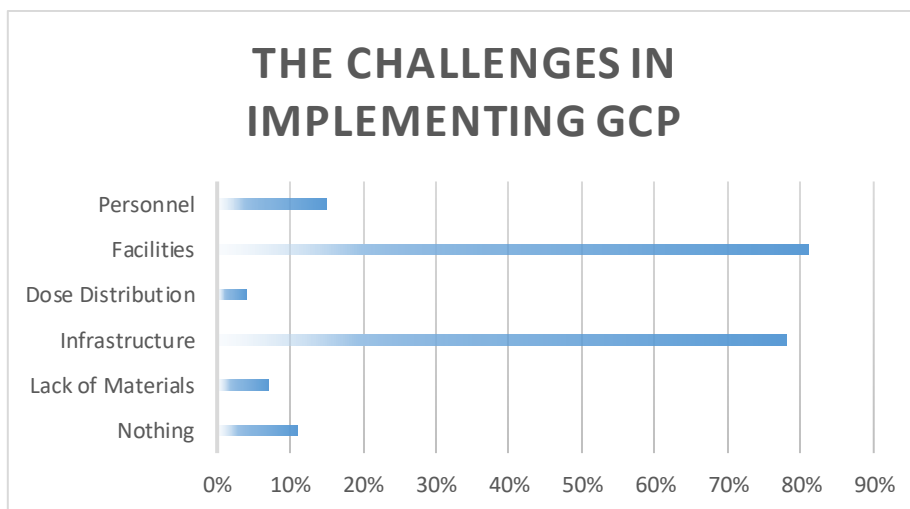


Figure 1: The Challenges in Implementing GCP

Based on Figure 1, the main challenges faced by Apothecaries in implementing Good Compounding Practice (GCP) are facilities and infrastructure, with 81% of respondents (22 respondents). The common problems related to facilities and infrastructure include the lack of separation between medication storage areas and other rooms, as well as the insufficient compounding equipment needed during the compounding process. This is consistent with the research article written by Kurniawan, Safrina & Yusmaniar (2024) on the implementation of GCP in healthcare facilities, which highlights that the most common issue with facilities is the lack of separation between the compounding area, the medication storage area, and other spaces due to limited and inadequate room size. In the compounding area, at a minimum, there should be compounding equipment, drug scales, mineral water for dilution, medicine spoons, drug packaging materials, a refrigerator, a room thermometer, prescription copy forms, drug labels, and stickers. This is in line with Tarigan (2023) research, which found that the facilities and infrastructure of several Community Health Centers in Indonesia are still inadequate. As Indonesia's first-level healthcare institution, it is still limited in terms of full equipment and service types, making it difficult to guarantee the quality of Community Health Services. In addition, the community believes that the community health center's employees continue to operate below professional standards.

Extemporaneous preparations are associated with quality concerns related to the drug product and the compounding process. Challenges in extemporaneous compounding practices have been reported in some countries, including limited competence among staff, unqualified facilities, lack of quality control, absence of national formula guidelines for extemporaneous preparations in many countries, assurance of stability and insufficient information on the age-appropriateness of dosage forms (Vugigi, 2023).

Management strategies to address pharmaceutical issues include evaluating the layout to ensure the separation of medication storage areas from other rooms, procuring the minimum facilities by regulations, developing clear Standard Operating Procedures (SOPs), training staff, and regularly monitoring compliance and facility conditions. Additionally, budget management should be optimized by prioritising the procurement of essential equipment and coordinating with the health department for technical assistance or funding. Through these measures, pharmaceutical facilities can meet regulatory standards, improve operational efficiency, and ensure the safety and quality of pharmaceutical services for patients.

Conclusion

This study concludes that pharmacists in Balikpapan City Community Health Centers generally demonstrate a "Good" level of knowledge about Good Compounding Practice (GCP), with an average score of 87.78%. Similarly, the implementation of GCP is also categorised as "Good," with an average score of 83.10%. However, the study found no significant relationship between pharmacists' knowledge and their practical application of GCP, suggesting that factors beyond knowledge—such as infrastructure, resource availability, and institutional policies—may play a critical role in effective GCP adherence. While the findings highlight a strong foundation in pharmacists' understanding and practice of GCP, gaps remain in areas such as facility readiness, adherence to strict compounding protocols, and real-world application of knowledge. Addressing these challenges requires a multi-faceted approach, including infrastructure improvements, continuous professional training, regulatory reinforcements, and enhanced monitoring systems. Future research should explore additional variables influencing GCP implementation, such as the impact of structured training programs, facility adequacy, and policy interventions. Longitudinal studies assessing the long-term benefits of targeted educational initiatives, patient safety outcomes, and regional comparative analyses could provide deeper insights into optimising pharmaceutical compounding practices. By addressing these areas, healthcare institutions and policymakers can work toward strengthening the quality and safety of compounded medications, ultimately enhancing patient care in community health settings.

Conflict of Interest

The authors declare that they have no competing interests.

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