Evaluasi Keterampilan Mahasiswa dalam Meracik Pulveres

Evaluation of Students’ Skills in Compounding of Divided Powders

M. Rifqi Rokhman1, Hardika Aditama1, Angi Nadya Bestari2
1. Pharmaceutical Management and Social Pharmacy Laboratory, Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta
2. Pharmaceutical Technology Laboratory, Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta

Submitted: 1-18-2019 Revised: 3-26-2019 Accepted: 3-27-2019
Korespondensi : M. Rifqi Rokhman : Email : m_rifqi_rokhman@ugm.ac.id

ABSTRAK
Beberapa obat yang diperlukan pasien anak tidak tersedia secara komersial dalam bentuk sediaan yang sesuai. Bentuk sediaan pulveres yang dihasilkan melalui proses compounding dapat menjadi alternatif untuk mengatasi permasalahan tersebut, meski permasalahan akurasi dosis masih menjadi isu utama. Tujuan penelitian adalah membandingkan kemampuan mahasiswa sebelum dan setelah mengambil praktikum compounding sekaligus melihat akurasi bobot pulveres yang diracik oleh mahasiswa. Desain penelitian merupakan pre-post study. Mahasiswa yang mengambil praktikum compounding (selama 12 minggu) pada tahun 2017 diminta untuk meracik sebuah resep yang berisi racikan pulveres pada awal dan akhir semester, diberikan penambahan materi dengan video peracikan dan juga feedback terhadap hasil pre-test mereka sebagai bahan evaluasi. Data ditampilkan dalam bentuk persentase dan perbedaan antara pre-test dengan post-test diuji dengan uji Wilcoxon. Hasil penelitian menunjukkan bahwa terdapat peningkatan secara signifikan kemampuan mahasiswa dalam perhitungan kebutuhan bahan obat, pemilihan warna etiket, perhitungan beyond-use date, melipat pulveres, dan pembuatan salinan resep. Namun demikian, hanya sebagian kecil mahasiswa (15,3%) yang semua pulveres hasil racikannya masuk dalam rentang bobot yang diperbolehkan. Studi ini mendokumentasikan kebutuhan penilaian kualitas produk hasil racikan mahasiswa secara kuantitatif dan menjadikan penilaian tersebut sebagai salah satu parameter penilaian kinerja mahasiswa. Kata kunci: compounding, penilaian mahasiswa, pulveres, keseragaman bobot

ABSTRACT
Several types of medicines for pediatric patients are not commercially available in appropriate dosage forms. While divided powder resulted from compounding process is an alternative to address this problem, the dosage accuracy is still profoundly a major issue. This research was aimed at comparing student’s ability to and after taking compounding practical work and analyzing weight accuracy of divided powders compounded by students. This research was designed as a pre-post study. Students who were taking compounding practical work (for 12 weeks) in 2017 were asked to fill a prescription contained divided powders in the beginning and the end of the semester, given enriched learning material of compounding technique videos and feedback as evaluation of their pretest results. The data is presented in the form of a percentage, while differences between pretest and post-test are compared utilizing Wilcoxon test. This study suggests that there was a significant increase of students’ ability in calculating the amount of each ingredient required to fill the prescription, choice of label color, approximating the beyond-use date, folding the divided powders, and making a copy of the prescription. However, there was a small number of students (15.3%) whose divided powders they have dispensed were in the allowed weight range. This study documents the need for quality assessment of medications prepared by students quantitatively and this assessment serves as a parameter of student performance.
Keywords: compounding, student assessment, divided powders, weight uniformity

INTRODUCTION
Compounding is one of the important elements in pharmaceutical practices and is defined as both art and science in tailoring medicines for specific needs of the patients. This is one of ten competencies that need to be mastered by Indonesian pharmacist candidates. Therefore, many universities include it as part of their curriculum.
Compounding is addressed more for pediatric patients and is used to adjust to the availability of medications which are not supplied commercially. There are many commercial medications, which are not available for pediatric patients due to its relatively small market. Thus, it gives quite little return on investment for pharmaceutical industry. Moreover, there will be more requirements for doing researches on children than on adults, so it leads to the potential delay in the marketing of certain products. Therefore, compounding is needed to solve the availability of medications, especially for pediatric groups.

The patient-care paradigm requires pharmacists to be responsible for developing the outcome of the patients. According to this paradigm, even the modest compounding needs to have a quality assurance. Considerable attention is given to the medication error that can influence the patients’ outcome, and that compounding is one of the potential sources of these problems. One of the most important problems in compounding is an issue of dosage accuracy.

Several types of research have attempted to observe the dosage accuracy problem from compounded medications such as dosage accuracy in the compounding of potassium permanganate solution and caffeine citrated solution, diphenhydramine hydrochloride solution, and calcium carbonate capsule. The quality assurance for calculating the amount of active substance in the compounded products is conducted by using several methods, ranging from a simple method such as scaling the weight of capsules, the use vapor pressure osmometer to the use of a spectrophotometer or expensive method such as using high-performance liquid chromatography (HPLC). Aside from the type of instrument used in quality assurance, a simple, less expensive, and fast analysis method is needed in the educational field. Thus, teachers can evaluate the students' compounding ability during their training.

Dosage forms, mostly made through compounding in several countries, are a dermatological product, oral solution, and oral suspension. In Indonesia, dosage forms that are mostly prepared by compounding are divided powders. There are some advantages of divided powders, some of which are that it can contain several ingredients in a single dosage form; it can be done to adjust the dosage; dosage adjustment can be made easily; it is more stable than the liquid availability; it has been packed for one time-giving; and it is easier to give. On the other hand, the drawback is that it is difficult to eliminate the unpleasant taste.

There has not been any research conducted on the quality of the compounded medications in the form of divided powders that are produced by pharmacy students. Therefore, this research attempts to compare the students’ ability prior to and after they have taken the compounding practical work as well as to observe the accuracy of the weight of the divided powder dispensed by them.

**METHODS**

The design of the research was a pre-post study where in the beginning and the end of the semester students were asked to compound the same prescription, which was then compared. Before the pre-test, the students were given information about the study (fully informed) and written informed consent was taken from those students. This informed consent included the information that students can freely to participate or not and information about their decision to participate or not would not affect on their final grade. This study was approved by the Dean and Head of Pharmacist Professional Program.

**Student and Course Description**

The population was 172 students of Pharmacist Professional Program at one of a state university in Indonesia, especially those in the first semester of 2017/2018 who were...
doing their compounding practical work. According to Raosoft online sample size calculator(https://www.raosoft.com/samplesize.html) the sample estimate was at least 120 by using 5% margin of error and 95% confidence interval.

The compounding practical work is the last practical course before students undergo their internship in pharmacies or hospitals and then attend the national examination to get a license as a pharmacist. These practical work course included 12 sessions with 4 hours duration in each session. The first session was to provide an explanation about the whole training activity as well as the rules of it, followed by 9 sessions of dispensing pharmaceutical products based on a prescription and 2 others with service simulation in a pharmacy setting. It contained the use of safety equipment, operating a prescription balance, scaling the substances (fluid, solid, semi-solid), compounding method, and packaging. Students were also given feedback on their pretest result as an evaluation object in the 9th week.

**Prescription**

The prescription given to students during pre-test and post-test was a prescription for 5-year-old children just like what (Figure 1). Students were asked to compound that prescription, starting from prescription screening (administrative, pharmaceutical, and clinical evaluations) including the calculation of each ingredient required to fill the prescription, compounding of 5 divided powders based on the prescription, and copying the prescription for patients’ reimbursement process. As for during pre-test and post-test, the source of ingredients was obtained by crushing commercial generic tablets. This was used to lessen the mistakes due to the scaling factor so it could also be used to see the students’ ability to divide the divided powders based on the permitted weight range. Students’ skill evaluation can be done by measuring the physical attribute from the compounded product they have made as an example of the parameter is the uniformity of divided powders’ weight².

**Data Analysis**

The data observed from the students included skills in calculating each ingredient needed for the prescription, choosing the right label colors, deciding the beyond-use date (BUD), folding the divided powders, and making a copy of the prescription. The researchers evaluated and assessed the working paper and divided powders of each student using a specific list of assessment criteria.

The problems in the prescription that include the mark of dtd (da tales doses or give such doses) so the medicine’s ingredients written in the prescription should be multiplied by the number of the divided powders supposed to be made (5 divided powders). Since the source of ingredients was obtained from commercial generic tablets, the calculation of the medicine’s ingredients needed has to be converted into how many paracetamols and chlorpheniramine maleate tablets needed. This is determined by dividing the medicine’s ingredients with the active substance on each tablet. The label color used

---

**Figure 1. Prescription for Pre-Test and Post-Test (Written in Branded Names)**

<table>
<thead>
<tr>
<th>R/ Paracetamol</th>
<th>300 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorpheniramine maleate</td>
<td>1,6 mg</td>
</tr>
<tr>
<td>mf pulv dtd No V</td>
<td></td>
</tr>
<tr>
<td>s t d d pulv I</td>
<td></td>
</tr>
</tbody>
</table>

![Figure 1](https://www.raosoft.com/samplesize.html)
was white because the divided powders should be given orally\textsuperscript{11}. Since there was not enough information about the stability of the compounded product, BUD of divided powders was decided 6 months at most\textsuperscript{12}. This BUD needs to be included in the label. The copy of prescription needs to be written according to the original prescription due to the statement of the pro copie conform (written based on the original prescription), and a marking det (detur or already given to the patient). Besides, medicine in its branded name was written in the prescription, while the ingredients of the medicine were available in generic. Therefore, the da generic marking should be provided inside the copy of the prescription. In Indonesia, pharmacists are allowed to make a change from branded medicines approved by physician permission and or the patients\textsuperscript{13}.

Divided powders made by the student would be weighted by laboratory technician using a digital scale to know whether its weight was already in accordance with the allowed weight range or 90-110\% of the theoretically calculated weight for each unit\textsuperscript{12}. The data analysis was shown in the form of a percentage while the analysis of the comparison between the pre-test and post-test was done by using the Wilcoxon test. The p-values of 0.05 or less were considered to be statistically significant.

**RESULT AND DISCUSSION**

The result indicates that there was an increase in students’ skill in calculating each medicine’s ingredient needed to fill the prescription, choosing the right label color, deciding the beyond-use date (BUD), folding the divided powders, and making a copy of prescription (Table I). All of the increase was significant when compared to the pre-test result (p<0.05), except in one point namely the calculation of chlorpheniramine maleate

<table>
<thead>
<tr>
<th>Calculation of the quantity of each ingredient for the prescription</th>
<th>Pre-test (n=165)</th>
<th>Post-test (n=164)</th>
<th>Significance Value of Wilcoxon Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation of paracetamol</td>
<td>Correct: 148 (89.7%) 157 (95.7)</td>
<td>False: 17 (10.3) 7 (4.3)</td>
<td>0.018*</td>
</tr>
<tr>
<td>Calculation of chlorpheniramine maleate</td>
<td>Correct: 152 (92.1%) 156 (95.1)</td>
<td>False: 13 (7.9) 8 (4.9)</td>
<td>0.225</td>
</tr>
<tr>
<td>Choice of label color</td>
<td>Correct: 160 (97.0%) 164 (100.0)</td>
<td>False: 5 (3.0) 0 (0.0)</td>
<td>0.025*</td>
</tr>
<tr>
<td>Determining BUD</td>
<td>Correct: 39 (23.6%) 153 (93.3)</td>
<td>False: 126 (76.4) 11 (6.7)</td>
<td>0.000*</td>
</tr>
<tr>
<td>Folding the divided powders</td>
<td>Correct: 76 (46.1%) 161 (98.2)</td>
<td>False: 89 (53.9) 3 (1.8)</td>
<td>0.000*</td>
</tr>
<tr>
<td>Making a copy of the prescription</td>
<td>Correct: 77 (46.7%) 158 (96.3)</td>
<td>False: 88 (53.3) 6 (3.7)</td>
<td>0.000*</td>
</tr>
<tr>
<td>Written based on original prescription</td>
<td>Correct: 105 (63.6%) 161 (98.2)</td>
<td>False: 60 (36.4) 3 (1.8)</td>
<td>0.000*</td>
</tr>
<tr>
<td>Da generic marking</td>
<td>Correct: 9 (5.5%) 56 (34.1)</td>
<td>False: 156 (94.5) 108 (65.9)</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*Significant differences
needed to be dispensed. When the pre-test and post-test were compared, there was a slight increase in the number of students calculating the right amount of chlorpheniramine maleate. However, the increase was still not significant because the baseline in the pre-test was already quite high reaching 95.1%.

There were 825 divided powders during pre-test and 820 divided powders during post-test dispensed by 165 and 164 students respectively. The desired weight of each divided powder that was dispensed by students should be 0.418 g or 418 mg. The comparison of divided powders' weight between pre-test and post-test (Table II). The average weight of the divided powders during the pre-test (426 mg) was higher than the desired weight. This is because during the pre-test several students made mistakes in counting, so they took the tablet more than it should be. The average of divided powders during the post-test (415 mg) was closer to the expected divided powders' weight. The standard deviation of divided powders' weight during the post-test (2 mg) was less than the deviation standard during the pre-test (8 mg).

The weight variation allowed is 10% of the desired concentration which was in the range of 90-110%. In the prescription, the weight of the divided powder included in the range was between 376 mg to 560 mg. From the whole divided powders made by the students, there was an increase of the number of divided powders which are in the permitted weight, rising from 47.6% during the pre-test to 55.7% during the post-test. In the weight of the divided powder less than 90%, there was a slight increase during the post-test compared to the pre-test. While the number of divided powders that weight more than 110%, there was a decrease from 27.4% to 18.2% (Figure 2).

In this research, even though the divided powders' weight did not guarantee the uniformity of dosage, the probability of the uniformity of active substance was higher in the divided powders with a more homogenous weight. The research from the divided powders weight and active substance from the pharmacies’ compounding shows that all of the divided powders which do not reach the weight uniformity is actually also do not reach the uniformity of medicine’s dosage. Therefore, weight uniformity can be an alternative to be an objective evaluation parameter of students’ compounding skill. Coloring substance in the compounding process can be used as another parameter to reveal the homogeneity of the compounded product.

The analysis was also conducted to the number of students who succeeded in making divided powders within the allowed weight range. Figure 3 shows a decrease in the number of students in which all the five divided powders were not met in the range of allowed weight, falling from 11.6% to 9.8%. In addition, the number of students who were only able to make 1 or 2 divided powders in the allowed weight range was also decreasing. On the contrary, there was an increase in students who are able to make 3 or more divided powders in the allowed weight range. The number of students who were able to make all the five divided powders increased from 5.5% to 15.3%.

This research was carried out on pharmacy students or pharmacist’ candidates, not to those of licensed pharmacists.
Even though students are a lack in experience compared to licensed pharmacists, they are working in a more controlled environment and repeatedly warned and observed for always using the right technique and procedure where it is always overlooked by licensed pharmacists in real practice. Continuous observation and attention have made students, during the training, view as a representative of pharmacists. In this research, there was only 15.3% of students whose divided powders were categorized in the allowed weight range. A study in Yogyakarta indicates that there was only 40% of pharmacies that made divided powders based on the allowed weight range. However, the number of pharmacies in this study was still limited to only 10 pharmacies.

Objective evaluation of the students’ skills in compounding needs to be used for calculating competencies. This kind of evaluation takes a long period of time, needs
experienced personnel in product analysis, and high amount of expense as well\(^2\). A simple, less expensive, and quick analytical method should be developed to evaluate students’ compounding skills during the compounding practical work\(^3\). As an example of cytotoxic drug admixtures scaling, even though the analytical measurement by weighing the IV solution did not verify medication dosage inside an IV solution. This quantitative method, however, could be used to document whether the right technique was used during the compounding process\(^3\). Scaling the weight is needed because even pharmacists that have already completed their education are still feeling worried due to little evaluation to medicines they made, especially about the dosage and the weight\(^1\).

Pharmacists should have knowledge and accurate skills in compounding. The result suggests that there was an increase in all aspects of evaluation after students undergo practical work. However, students’ skills in dividing the divided powders with allowed weight were still lower compared to their skills in other aspects. However, students’ skill in these other aspects such as calculating each medicine’s ingredient, choosing the right label color, calculating the BUD, folding the divided powders, and making the copy of prescription got higher portion in the students’ working evaluation. There were only a few evaluations related to the product quality of the compounded product. This could result in mistakes in the evaluation process because there were more than 90\% students who appropriately calculated the medicine’s ingredients to be dispensed, chose the label color, calculated the BUD, folded the divided powders, or made the prescription’s copy. However, there was only 15.3\% of them who were able to make divided powders in the allowed weight range. Integrating the quality decision during the compounding practical work can increase students’ comprehension of products’ quality from the compounded products. It can also give students a chance to think about the cause of their mistakes and correct their compounding technique in the future\(^16\).

In this research, the feedback on the products’ quality was only carried out for once, and the quality measurement of the divided powders was conducted by the laboratory technician. The feedback related to the products’ accuracy from the compound product needs to be given to students in order to provide a view about the quality and how well the target had been reached\(^17\). It is suggested that the analysis of the compounded medication is carried out by the students themselves. Thus, they can get the estimation of active substance dosage while at the same time they would also get feedback for their compounded medication\(^4\). Evaluation of the products’ quality should be done repeatedly, and the feedback given directly will increase the students’ learning and make them more competent\(^18\). Students also need to be pushed and to be directed to do a review for the feedback obtained, namely the mistakes they did during the training (reflection) so that they will understand what they need to do to decrease those mistakes\(^19\). Therefore, the evaluation of the students’ compound products should be carried out from time to time, and that quality assessment also includes students. Thus, the feedback can be obtained from them soon.

This study has some limitations. First, there is a possibility that some divided powders which reach the weight uniformity are actually do not reach the uniformity of medicine’s dosage. Second, weight uniformity is not the only one of quality control of divided powders, there are other parameters such as uniformity of color or particle size that did not measure in this study.

**CONCLUSION**

This research indicates that there was a significant increase of students’ ability in calculating the quantity of each ingredient to be dispensed, choices of label color, approximating the beyond-use date, folding divided powders, and making a copy of the
prescription. However, there was a small number of students (15.3%) whose divided powders they dispensed are in the allowed weight range. Therefore, it is necessary to make changes in the assessment of student ability, especially in practical work. Current assessment without assessing the uniformity of divided powders weight will lead to bias in assessing the students’ competency. This study documents and highlights the need for quality assessment of products prepared by students quantitatively and this assessment serves as a parameter of student performance.

ACKNOWLEDGMENT
This research was funded by grants of Pharmacist Professional Program of the Faculty of Pharmacy, Universitas Gadjah Mada in 2017.

DAFTAR PUSTAKA
