Rubric Assessment for Pharmacotherapy in Spiral Curriculum: Development and Usefulness Evaluation

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A requirement, which students must satisfy, for a diploma at the Showa University School of Pharmacy is the ability to “plan, practice, and assess pharmacotherapy”. To continuously assess the ability of students to meet this requirement and to provide patients with proper pharmacotherapy during student clinical rotations, we formulated the “Rubric assessment for pharmacotherapy” and evaluated its usefulness in tutorial learning classes. Clinical pharmacy faculty members created the rubric based on the Subjective, Objective, Assessment, and Plan (SOAP) note guidelines of the university. Third- (2016) and fourth-year students (2017) were required to self-assess their SOAP notes to analyze six clinical cases using the rubric. The rubric consists of three domains: (1) Evaluation of patient condition, (2) Proposal of pharmacotherapy, and (3) Plan for an assessment of pharmacotherapy. The rubric comprises 31 subdomains and is evaluated according to four levels of performance. In this study, 978 rubric sheets that were used by students to evaluate their own SOAP notes were analyzed. We found that the students were able to continuously self-assess their performance using the rubric while continuously improving their achievement level \((p < 0.05)\). The results of this study suggest that rubric assessments may be used as a tool for supporting students to plan, practice, and assess pharmacotherapy.

Key words—rubric; pharmacotherapy; usefulness; Subjective, Objective, Assessment, Plan (SOAP) note; student self-assessment; spiral curriculum

BACKGROUND AND OBJECTIVE

The Model Core Curriculum for Pharmacy Education (2015)1–3 emphasizes outcome-based education focused on the “fundamental qualities required as a pharmacist”, which students should acquire when they graduate. Universities that follow this model ensure that their students meet this expectation before awarding diplomas. Harden4,5 stated that a spiral curriculum involves an iterative revisiting of topics, subjects, or themes throughout the course, and this is particularly relevant in outcome-based education. Outcome-based curriculums are taught following a bottom-up approach to meet the desired goals. Thus, there is a need for a common tool for continuous assessment.

The 2012 Central Council for Education issued a report titled, “Towards a Qualitative Transformation of University Education for Building a New Future”.6 In this report, the council stated that undergraduate education is required to produce human resources with the ability to continue learning and think independently throughout their lifetime, during which the structure of society is expected to change significantly. The authors stated that repeated learning experiences enhance the ability of graduates to continue learning throughout their lifetime. Thus, there is a need for tools that allow students to continuously self-assess their progress to achieve the aforementioned ability to plan, practice, and evaluate pharmacotherapy, both in class and during clinical rotations, in the Showa University School of Pharmacy.

Stevens and Levi defined a rubric as “a tool that lays out the specific expectations for an assignment”.7 In essence, a rubric is an evaluation sheet that presents criteria for a goal-oriented evaluation in a matrix format. This tool can be used by students to evaluate subjects that they have learned, assess their performance in these subjects with regard to a predetermined level, and determine clear goals to advance to the next level. The rubric system has the benefit of shared awareness between the assessor (teacher) and the student being assessed as well as the ability to standardize evaluations by multiple assessors.8

Therefore, we developed a “Rubric assessment for...
pharmacotherapy”, which enabled students to independently assess their progress. We considered that the rubric format was best suited for the continuous evaluation of progress made by the third- and fourth-year students with regard to planning, practicing, and evaluating pharmacotherapy before their clinical rotations. We introduced the rubric in tutorial classes and had students evaluate themselves using this rubric. The aim of this study was to develop a rubric assessment for pharmacotherapy, and determine whether continuous evaluation using the rubric was possible and whether this self-assessment improved student performance in pharmacotherapy.

**METHODS**

**Development of a Rubric Assessment Sheet**

In January 2015, we formed a working team comprising Clinical Pharmacy faculty members from Showa University. One of the requirements for a diploma at the Showa University School of Pharmacy (https://www.showa-u.ac.jp/education/pharm/overview/) is the ability of students to plan, practice, and evaluate pharmacotherapy. To evaluate this requirement, we determined elements and observations that were required to assess student performance in pharmacotherapy. There were five subcategories of practical ability. Two of these subcategories were related to the ability to communicate; thus, we decided that the remaining subcategories (i.e., Understanding patient condition, Proposal of pharmacotherapy, and Evaluation for pharmacotherapy) should be included as the first domains in the rubric because they were more related to the process of thinking in pharmacotherapy.

Next, we prepared a draft of the rubric based on both relevant items from the original hospital training rubric of Showa University and literature, including the Subjective, Objective, Assessment, and Plan (SOAP) note Preparation Guide and Checklist as well as the Content guide for Problem-oriented System (POS) and SOAP (using the SOAP-note format) for case analysis, which were created and improved repeatedly by the university.

We set the rubric assessment to five levels (A-E). Level A was the highest and most advanced and indicated the completion of residency, level B was achieved by the top 10 fourth-year students before the clinical rotations, level C was achieved by approximately 80% of the fourth-year students before the clinical rotations, level D was achieved by all fourth-year students, and level E indicated a failure to achieve level D (Table 1). Level A was set as the target performance level; thus, students would be goal oriented.

Next, we set up the levels of each subdomain. Some subdomains related to Assessment and Plan in SOAP note were ranked by the resources providing the data; package inserts, school textbooks, and handouts were assessed by level D and guidelines, and the primary literature was assessed by level C or higher. The resources were ranked either level B or A based on priorities, such as treatment, care, and patient’s thoughts, or based on a thorough evaluation of the data, including negative data.

Thereafter, the rubric assessment draft, which was determined via a consensus of the team faculty members, was presented to the clinical rotations teaching staff and the pharmacotherapy teaching staff. Subsequently, we made adjustments to the original hospital learning rubric assessment of the university, considering the opinions of those who reviewed the rubric assessment draft, and prepared the first version of the new rubric (Table 2 and Supplementary Table S1 Japanese Version).

As a result of discussions between faculty and staff, we decided to prepare a self-assessment sheet for stu-
| Subdomains                                      | A                                                                 | B                                                                 | C                                                                 | D                                                                 |
|------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|
| Symptoms and physical findings (vitals, etc.)  | All the symptoms and physical findings were evaluated, the assessment was performed in combination with other findings, and the necessary information was mentioned. | Assessment was performed including negative findings.             | The student evaluates the patient’s condition (severity, urgency) based on multiple symptoms reported and physical findings. | The student evaluates individual symptoms and physical findings (abnormal findings). |
| Test findings (Blood count, biochemistry laboratory test, culture test, serum drug concentration, etc.) | All the test findings were evaluated, the assessment was performed in combination with other findings, and the necessary information was mentioned. | Assessment was performed including negative findings.             | The student evaluates the patient’s condition (severity, urgency) based on the information obtained from multiple test findings. | The student evaluates individual test findings (abnormal findings). |
| Imaging findings (X-R, CT, MRI, UCG, ECG, etc.) | All the imaging findings were evaluated, the assessment was performed in combination with other findings, and the necessary information was mentioned. | Assessment was performed including negative findings.             | The student evaluates the patient’s condition (severity, urgency) based on information obtained from multiple imaging findings. | The student evaluates individual imaging findings (abnormal findings). |
| Disease assessment                               |                                                                  |                                                                  |                                                                  |                                                                  |
| 1                                               | ☐ Evaluates the severity of the disease and discusses its progression, prognosis, and risk of complications. | ☐ Evaluates the severity of the disease based on symptoms, test and imaging findings, or prescription drugs, and considers the association with complications and medical history. | ☐ Evaluates the severity of the disease based on symptoms, test and imaging findings, or prescription drugs. | ☐ Evaluates symptoms, test and imaging findings, or prescription drugs in association with the disease. |
| 2                                               | ☐ The student is able to list treatment strategies for the highest priority risk factors and causes. | ☐ The student is able to raise multiple risk factors and causes, and present treatment strategies. | ☐ The student raises multiple risk factors and causes. |                                                                  |
| Assessment of side effects (Discussion about the possibility of side effects) | The student takes measures after considering the causal relationship between symptoms and drugs, and proposes plans after considering the possibility of side effects. | The student discusses evidence from individual case reports, multiple cases and adverse events, and the known knowledge about drugs (drug comparative charts). | The student discusses the timing of the onset of side effects, body constitution, dosage, administration etc. in relation to past reports and possible side effects. | The student discusses the possibility of side effects in association with side effect information from package inserts, etc. |
| Patient background (History of side effects and allergy, smoking, alcohol consumption, occupation, family history, and PGx) | In addition to B, the student considers multiple possibilities for the assessment. | The student makes assessments to reflect pharmacotherapy proposals. | The student collects information on the patient’s background and lists the characteristics. | The student collects data on the main aspects of the patient’s background and lists the characteristics in his/her own way. |
Table 2. (Continued)

| Medication history (including supplements and OTC medications) | In addition to B, the student makes comparisons with other drugs (drug comparative charts). | The pharmacological effects, purpose of use, relevance to the condition/symptoms, necessity (addition, continuation, discontinuation, review), and dosage and administration are evaluated for all drugs being used. | The purpose of use and relevance to conditions/symptoms are assessed for all drugs being used. | The student explains the pharmacological effects and typical indications of all drugs being used. |
|---|---|---|---|---|
| Thoughts of the patient and family members | In addition to B, the student considers multiple possibilities for the assessment. | The student analyzes the feelings and statements of the patients and their families, and evaluates them so that they can be reflected in pharmacotherapy proposals. | The student collects and analyzes data on the statements and behaviors of patients and their families. | The student has collected information on the statements and behaviors of patients/their families (acceptance of disease, treatments, and medication), but they are in fragments. |
| Patient's level of understanding | In addition to B, the student considers multiple possibilities for the assessment. | The student analyzes the statements and behaviors of the patient regarding their understanding of drugs, diseases, and their situation, and evaluates them so that they can be reflected in pharmacotherapy proposals. | The student raises statements and behaviors of the patient (such as taking medication) regarding the understanding of drugs, diseases, and their own situations, and analyzes them. | The student raises statements and behaviors of the patient (such as taking medication) regarding the understanding of drugs, diseases, and their own situations. |

2. Proposal of pharmacotherapy (Self-assessment form)

| Therapeutic plan | Short-term/long-term goals | 1 | □ The students judge the necessity of pharmacotherapy and non-pharmacotherapy beyond the standard treatment. | □ In addition to C, the student determines the necessity of pharmacotherapy/non-pharmacotherapy within the scope of standard treatment, based on the wishes of the patient. | □ The student judges the necessity of pharmacotherapy based on the patient’s condition (severity, urgency) and the effects of current pharmacotherapy. | □ The student discusses the need for pharmacotherapy by taking into consideration the effect of current pharmacotherapy. |
|---|---|---|---|---|---|---|
|  | | 2 | □ In addition to B, the student formulates a long-term strategy (new, addition, continuation, discontinuation, changes) based on the viewpoints of patients and medical teams. | □ The student formulates specific short-term strategies (new, addition, continuation, discontinuation, changes) based on evidence, taking into consideration the viewpoints of patients and medical teams. | □ The student formulates multiple strategies and assigns priority to each of them. | □ The student formulates strategies within the scope of standard treatment. |
|  | | 3 | □ The long-term goals of treatment are items for which the pharmacological effect can be properly assessed (true endpoints), and the rationale is clear. | □ The short-term goals of treatment are items for which the pharmacological effect can be properly assessed (surrogate endpoints), and the rationale is clear. | □ The student formulates specific short-term and long-term goals of treatment. | □ The student formulates short-term and long-term goals of treatment. |
| Choice of drugs | 1 | □ In addition to B, the student examines medicines comprehensively. | □ In addition to C, the student lists multiple drugs in the order of priority. | □ The student lists multiple typical drugs that can be used for the patient’s current condition, chief complaint, and disease. | □ The student suggests a typical drug that can be used for the patient’s current condition, chief complaint, and disease. |
|-----------------|---|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
|                 | 2 | □ In selecting drugs, the student makes a selection suitable for the physiological function and disease condition of the patient. | □ Legal restrictions and evidence are being considered in the selection of drugs. | □ In selecting drugs, the student considers whether the drugs chosen are suitable in terms of ADME, drug interactions, and the physiological function and condition of the patient. | □ In selecting drugs, the student considers the mechanism of action, side effects, and contraindications. |
|                 | 3 | □ Comparison of candidate drugs are made based on factors such as evidence, potency, duration of action, side effects, cost, and medical environment. | □ The student compares the evidence of candidate drugs. | □ The student suggests multiple candidate drugs. | |
| Dosage form/route of administration | 1 | □ The student thoroughly examines the available routes of administration and dosage forms of pharmaceuticals. | □ The student lists multiple routes of administration and dosage forms that are available for a given drug, in the order of priority. | □ The student lists multiple routes of administration and dosage forms available for a drug. | □ The student lists the route of administration and dosage form available for a drug. |
|                 | 2 | □ In selecting the route of administration and dosage form, the student considers, in addition to 3, the viewpoints of convenience and storage. | □ In selecting the route of administration and dosage form, the student considers the pharmacological effect (potency, timing of onset of effect, duration of effect, etc.). | □ In selecting the route of administration and dosage form, the student considers the physical function of the patient (ability to take oral medications, cognitive function). | |
| Mid-term and long-term dosage and administration | 1 | □ The student sets the dosage and administration by also considering concomitant drugs. | □ The student recommends the dosage and administration by considering the properties of the drug (PK-PD) in addition to C. | □ The student recommends the dosage and administration based on patient age, physiological/physical functions (liver and kidney function, height, body weight, body surface area). | □ The student recommends the general dosage and administration based on drug information (package insert, textbook, etc.). |
|                 | 2 | □ The student plans dose adjustments by taking into consideration the pharmacological effect and incidence of side effects in patients. | □ The student considers dose adjustments in response to pharmacological effects and side effects by making use of information other than what is provided in the package insert and textbook. | □ The student checks drug information (package insert, textbook, etc.) to adjust doses in response to pharmacological effect and side effects. | |
### Table 2. (Continued)

| 3 |  |  |
|---|---|---|
| 3 | The medium-to-long-term treatment plan (continuation, discontinuation, changes) has been set specifically based on evidence of patient condition, pharmacological effects, and purpose of use (treatment, prevention etc.) | The student formulates a medium-to-long-term treatment plan (continuation, discontinuation, changes). |

3. Plan for assessment of pharmacotherapy (Self-assessment form)

| Monitoring item | The student comprehensively lists the monitoring items that are in line with the patient’s treatment goals, and assigns priority to them. | The student suggests multiple monitoring items in line with the patient’s treatment goals. | The student suggests multiple general monitoring items for the target disease and drug and indicates the need for them from the perspective of the pharmacological effect and condition. | The student suggests general monitoring items for the target disease and drug. |
|---|---|---|---|---|
| Timing of judgment | The student proposes appropriate timing and frequency for the judgment of effect for each patient according to the patient’s condition. | The student proposes appropriate timing for the judgment of effect for each patient according to the patient’s condition. | The student is able to provide a typical timing of onset of effect of a drug, and provides a pharmacological and pharmacokinetic reasoning. | The student specifies a typical timing of onset of effect for a drug. |
| Effects | | | | |
| Response (Sufficient, somewhat, inadequate, none) | The student sets stepwise assessment criteria in light of mid- and long-term treatment. | The student sets assessment criteria for each individual patient in light of the patient’s treatment goals, and by considering the risks and benefits. | The student is able to set general criteria for the monitoring items he/she raised, and indicates the rationale for the setting. | The student sets general criteria for the monitoring items raised. |
| Side effects item | The student lists, in the order of priority, side effects that should be noted for each patient in consideration of the patient’s treatment goals and risks and benefits. | The student lists side effects to be prioritized in accordance with the patient’s condition, bodily constitution, concomitant drugs, etc. | The student raises the major side effects by taking into account the severity and frequency. | The student lists the major side effects. |
| Side effects | | | | |
| Monitoring item | The student lists test items and symptoms that should be monitored preferentially for each patient and indicates the method of monitoring for those that need to be. | The student lists the main test items and symptoms that should be monitored and indicates the method of monitoring for those that need to be. | The student lists the monitoring items needed to assess the side effects he/she has specified. | The student lists some of the monitoring items. |
| Timing of judgment | The student plans appropriate timing and frequency of monitoring for each individual patient according to the patient condition, for those side effects that need to be prioritized for each patient. | The student plans the timing of monitoring for side effects that need to be prioritized for each patient by considering the timing of onset from the condition and physiological viewpoint. | In addition to D, the student considers the monitoring timing and frequency for the side effects of drugs used, based on the manual for handling disorders due to adverse drug reactions. | The student considers the monitoring timing and frequency for side effects of drugs used based on the package insert information. |
| Side effects | Assessment criteria for severity | Risk factors | Mechanism of action underlying side effects | Countermeasures (including the decision on discontinuation/continuation) |
|--------------|---------------------------------|--------------|--------------------------------------------|---------------------------------------------------------------------|
| The student plans to assess the side effects in light of the patient's treatment goals and considering the risks and benefits. | The student proposes a plan to assess the side effects by taking the patient's condition, history of side effects, body constitution, concomitant drugs, etc. into consideration | The student estimates risk factors based on patient background, and where possible, formulates plans for improvement. | The student is able to estimate the mechanism of action underlying a side effect. |
| The student proposes a plan to assess the side effects by taking the patient's condition, history of side effects, body constitution, concomitant drugs, etc. into consideration | The student shows the criteria to assess the severity of all side effects he/she has listed. | The student estimates risk factors based on patient background. | The student provides a general summary of antidotes, supportive care, and countermeasures. |
| The student shows criteria to assess the severity for some of the side effects. | The student shows criteria to assess the severity for some of the side effects. | The student lists general risk factors for side effects. | The student presents several countermeasures based on evidence. |
| The student shows criteria to assess the severity for some of the side effects. | The student shows criteria to assess the severity for some of the side effects. | The student lists general risk factors for side effects. | The student considers countermeasures. |
udents that allowed not only continuous assessments during tutorials and clinical rotations but also students to establish their own simple and specific learning goals to accumulate independent learning experience. For this reason, we mostly used affirmative sentences in the individual assessments. Furthermore, we supplied keywords in some parts of the assessment criteria to provide self-learning hints. For example, some of the keywords that were included in the assessment criteria were vitals, symptoms, physical findings, blood count, biochemistry laboratory tests, bacterial tests, and serum drug concentrations.

Rubric Introduction: Subjects and Students

We introduced the rubric to third-year students in the Showa University School of Pharmacy in 2016 and again in 2017, when they were in the fourth year. The subjects in which the rubric was introduced included the third- and fourth-year tutorials on drugs and diseases and in-hospital ward pre-pharmacy practical experience. A tutorial is a mandatory small group discussion-based course incorporated into the curriculum at Showa University. The practical experience is conducted following three tutorials. Approximately 170 students are enrolled per class, and the classes are delivered over four consecutive semesters in a spiral curriculum. Informed consent was obtained from the students. The 3rd and 4th cases in a drug and disease tutorial on respiratory disease were conducted 4 d apart. The 5th and 6th cases in the practical experience were conducted 5 d apart. During each tutorial or pre-pharmacy practice experience, all students were randomly assigned to groups of approximately eight members. The students discussed each case, such as patient condition and thoughts, what resources were available, and what issues were important. By repeating these classes for six different paper patient cases, the fundamental ability for performing pharmacotherapy as a student pharmacist is induced. The six cases in the tutorials and practical experiences were produced and arranged by clinical teaching staff. The first case was that of Parkinson’s disease in a drug and disease tutorial on neurological diseases in the first term of the third year. The second was an angina case in a drug and disease tutorial on cardiovascular diseases in the second term of the third year. The third and fourth cases were that of lung cancer in a drug and disease tutorial on respiratory disease in the first term of the fourth year. The fifth and sixth cases were that of cancer pain in the hospital ward in pre-pharmacy practical experience in the second term of the fourth year. During the tutorials in the first semester of the fourth year, the students freely described their reflections and goals for the next lesson in the reflection sheet, and the teaching staff provided feedback, when needed.

Data Collection and Analysis

All students carried out self-assessments in the following manner. During each tutorial or pre-pharmacy practical experience, the students created their own SOAP notes. At the end of a tutorial or practical experience class, the students made copies of their SOAP notes. The original was submitted and the copy was used for self-evaluation. The teaching staff provided expectations for clinical content and evaluation keys in each level of the rubric at the end of the classes. After receiving expectations and evaluation keys, the students used the rubric to assess their SOAP notes, and then submitted their assessment. In addition, at the end of the drug and disease tutorial on respiratory diseases that was conducted during the first semester of the fourth year, the students were asked to fill in their reflections and goals for the next session, and the forms were collected. The data that the students consented for use in the study were analyzed. During 2016, the teaching staff that had used the rubric was also asked to complete a questionnaire regarding the introduction of the rubric assessment. The questionnaire was created by modifying a meta-rubric from Portland State University. It consisted of 15 yes-no questions, such as whether the evaluation point of view in the subdomains includes the main points that a student required, whether all evaluation points of view in the subdomains are clear, and whether it is useful as feedback for students’ performance. Questions with “No” responses also required open-ended explanations.

A Cochran-Armitage trend test was conducted using JMP Pro v. 12 (SAS Institute, Cary) to analyze the continuous rubric assessment by the proportion of levels A, B, and C compared with that of levels D and E for the third-year students in 2016 and the fourth-year students in 2017. Results with a $p$-value of less than 0.05 were considered statistically significant.

We used descriptive statistics to analyze the student rubric-based self-assessment and the teaching staff questionnaire. We performed text analysis of the content of the open-ended entries made by students on their reflections and goals using Text Mining Studio v.
We conducted a word frequency analysis of student reflections but excluded the word “rubric” because it appeared too frequently. This study was conducted with the approval of the Ethics Committee on Research with Human Subjects of the Showa University School of Pharmacy (No. 250, June 21, 2016).

RESULTS

Development of the “Rubric Assessment for Pharmacotherapy” Table 2 shows the first version of the “Rubric assessment for pharmacotherapy”. There were four levels on the assessment scale (A–D). Level A was set as the ideal performance level, and the remaining levels contained specific predetermined achievement goals, with level D being reserved for the worst level of achievement.

The three major domains of the rubric, “Evaluation of patient condition”, “Proposal of pharmacotherapy”, and “Plan for assessment of pharmacotherapy”, consisted of 10, 11, and 10 items, respectively, for a total of 31 subdomains. The “Evaluation of patient condition” domain included the Subjective, Objective, and Assessment content of the SOAP notes, the “Proposal of pharmacotherapy” domain corresponded to the Assessment and Plan content of the SOAP notes (i.e., the patient care plan), and the “Plan for assessment of pharmacotherapy” domain corresponded to the Plan content of the SOAP notes (i.e., the patient observation plan).

The rubric was designed to be three pages long, such that each domain would fit on one page. As there were assessment subdomains that may not apply depending on the case being examined, the case providers presented the rubric assessment forms to the students after excluding any irrelevant subdomains in advance. Given that appropriate settings could not be determined, level D was left blank in four subdomains (i.e., 2D in Table 2.1. Disease assessment), whereas levels C and D were left blank in one subdomain (i.e., 3C and 3D in Table 2.2. Midterm and long-term dosage and administration).

“Rubric Assessment for Pharmacotherapy” Student Assessment Form Evaluation Written consent was obtained from the students in 2016 before beginning each course in this study. A total of 156 students (88% response rate) participated in the first term of the third year and 162 students (92% response rate) participated in the second term of the third year. In 2017, 158 students (90% response rate) participated in the first term of the fourth year and 172 students (98% response rate) participated in the second term of the fourth year.

The rubric assessment form was introduced for six different cases through the third- to fourth-year, and 978 rubric sheets that the students had evaluated based on their own SOAP notes were analyzed. We summed the number of students for each level by individual rubric evaluation score for each subdomain. We then set the value to 100 percent with the total number and calculated the ratio at each level.

The students achieved a higher level for the domain “Evaluation of patient condition”, and the subdomains “Thoughts of patient and family members” and “Patient’s level of understanding”. Figure 1 shows the student level distribution for each domain. With regard to the “Evaluation of patient condition” domain, the six rubric assessments showed that the proportion of students that attained a level higher than level C gradually increased over time ($p < 0.05$); moreover, 91.3% of students attained at least level C in the last assessment. With regard to “Proposal of pharmacotherapy”, the six rubric assessments showed that the proportion of students that attained a level higher than level C gradually increased over time ($p < 0.05$); moreover, 90.4% of students reached level C in the last assessment point. With regard to the “Plan for assessment of pharmacotherapy” domain, although the six rubric assessments generally showed a gradual increase in the level attained ($p < 0.05$), only 75.5% of students reached level C in the last assessment. With regard to the six subdomains, 80% or more students were unable to achieve level C. For 21 out of the 31 subdomains, several students remained at level E, but most students were able to reach a level higher than level D.

“Rubric Assessment for Pharmacotherapy” Teaching Staff Questionnaire Evaluation An evaluation of the teaching staff questionnaire was conducted on the responses of 12 teachers who were not involved in the preparation of the rubric. Generally, the teachers responded “Yes” with regard to various assessment items, such as “Evaluation viewpoints (items in column) include the essential points required by students”. There were many “No” responses for the following two items: “Are the de-
Fig. 1. Changes in the Achievement Level with the Six Pharmacotherapy Rubric Assessments

The rubric assessment form was introduced in the following classes: 1st: Parkinson’s disease case in a drug and disease tutorial on neurological diseases in the first term of the third year. 2nd: Angina case in a drug and disease tutorial on cardiovascular diseases in the second term of the third year. 3rd and 4th: two cases of lung cancer in a drug and disease tutorial on respiratory disease in the first term of the fourth year. 5th and 6th: two cases of cancer pain in the hospital ward pre-pharmacy practical experience in the second term of the fourth year. We summed the number of people for each level by individual rubric evaluation score for each subdomain. We then set the value to 100% with the total number and calculated the ratio at each level. *The Cochran-Armitage trend test was used to examine the proportion of students attaining higher than level C versus those who were unable to attain level D, according to the rubric assessment form (1st through 6th assessments).

Student Reflections

During the drug and disease tutorial on respiratory diseases in the first term of the fourth year, the students were asked to reflect after completing the rubric assessment form and provide an open-ended feedback regarding their reflections. The results of the text analysis, particularly the word frequency analysis, showed that the most frequently used words were (in the following order): patient, original articles, side effects, treatment, and SOAP (Fig. 2).
DISCUSSION

In this study, we developed the “Rubric assessment for pharmacotherapy” to continuously assess student performance with regard to planning, practicing, and assessing pharmacotherapy in their third and fourth years of study, including their practical pharmacotherapy rotations. We introduced this assessment with case studies to allow the students to carry out self-assessments. In general, the students demonstrated a continual improvement in their level of achievement.

Led by the Clinical Pharmacy faculty staff, we generated a pharmacotherapy rubric through discussions with pharmacists and with the teaching staff of the clinical rotations to determine the rubric criteria. The rubric was created as a pre-training tool for pharmacotherapy using the SOAP format before clinical rotations and clinical clerkships (practical training with clinical participation) and was proposed by Showa University as a part of the clinical rotations. This rubric was implemented to provide students with the ability to start their clinical rotations. Key elements leading to practical pharmacotherapy have been identified using the SOAP Preparation Guide and Checklist as well as the Content guide for POS and SOAP (using the SOAP-note format) for case analysis in the university. In Assessment and Plan, a student can identify the items and their corresponding depth of learning required to achieve a certain level, as provided by the rubric evaluation sheet. A SOAP note, using information from a package insert, textbook, and handout, was assessed in a low level and that using information from guidelines and the primary literature was assessed in a high level. The results showed that anyone can write extensive SOAP notes, and we presume that this led to continuous improvements in many students. For the 3rd and 4th cases, the number of students scoring level E increased in “Plan for assessment of pharmacotherapy” (Fig. 1). The 3rd and 4th case scenarios were the initial and recurrent treatments for a patient with lung cancer. The level E scores observed in the “Plan for assessment of pharmacotherapy” were in the following subdomains: timing of judgment of therapeutic effect, response of therapeutic effect, monitoring item of side effects, timing of judgment of side effects, assessment criteria for the severity of side effects, risk factors of side effects, and mechanism of action underlying side effects and countermeasures for side effects. These items required the use of a variety of resources; that is, Response Evaluation Criteria in Solid Tumors, Common Terminology Criteria for Adverse Events, and palliative care and lung cancer guidelines. We
Table 3. Subdomains with Low Achievement Level in the Sixth Pharmacotherapy Rubric Assessment

| Subdomain                                      | Achievement Level |
|------------------------------------------------|-------------------|
| Plan for assessment of pharmacotherapy         |                   |
| Effects-Timing of judgment                     |                   |
| Effects-Response                               |                   |
| Side effects-Timing of judgment                |                   |
| Side effects-Assessment criteria for severity  |                   |
| Side effects-Mechanism of action underlying side effects |                   |
| Side effects-Countermeasures                   |                   |

List of subdomains for which more than 80% of students failed to achieve Level C.

presumed that students might not be familiar with integrating these resources to describe proper assessments and plans.

At the end of the drug and disease tutorials in the first term of the fourth year, the students were asked to reflect on their performance in pharmacotherapy and include open-ended answers after filling out the rubric assessment form. Through text analysis of these open-ended answers (Fig. 2), we determined that when “Patient” was the most frequent word, students were able to focus on the patient’s thoughts. The second most frequent word, “Original articles”, may have been associated with the instruction of using an original article to support assessments during the drug and disease tutorial on respiratory disease. Some students experienced difficulty in the application of a key article as evidence in the SOAP note. Additionally, we were able to identify the high-frequency words related to the subdomains in which less than 80% of students scored level C in the rubric assessment form, such as “Timing of assessment of therapeutic effect” and “Timing for judgment of side effects” (Table 3). Thus, we concluded that the students understood points that they needed to improve on by the next performance in pharmacotherapy. Therefore, it would be useful for students to conduct self-assessments and reflect using the rubric assessment form and to set goals for themselves for the next performance in pharmacotherapy to engage in continuous learning.

Although one of the goals that we set was at least 80% of the students to achieve level C at the time of the last evaluation, it was not attained in this study. However, this led to the identification of important issues for improving pharmacotherapy education and that of related subjects. These subdomains were in the “Proposal of pharmacotherapy” domain. The content needed to achieve level C may not have been emphasized in the pharmacotherapy lectures, for example, monitoring parameters and timing. Therefore, faculties related to pharmacotherapy should understand these concepts and adapt accordingly. The students did not reach level D in multiple subdomains of the “Proposal of pharmacotherapy” domain. This may have been the result of a lack of information required for constructing proposals; “The manual for handling disorders due to adverse drug reactions” was recommended as the resource for “Timing of judgment” for side effects. However, this manual did not contain some of the information about monitoring the appropriate time and frequency of side effects. Some students may need to experience more cases to achieve level C; thus, we must consider suitable chances using SOAP notes for pharmacotherapy. In addition, we surmised that because several subdomains in the first version of the rubric did not provide all the levels of the rubric content, there may have been some confusion during the self-assessment process. For example, some students made mistakes while evaluating subdomains that did not have level C or D. These mistakes were assessed in level E. We decided that in the next version of the rubric, the contents of levels A to D will be added and modified for the subdomains that did not have level C or D settings.

There are some issues to overcome to enhance the use of this pharmacotherapy rubric assessment. Firstly, the rubric as an evaluation tool for diploma policy is expected. Thus, we must estimate the student’s achievements in pharmacotherapy during and after clinical rotations. Further discussions and investigations are necessary for the development of a diploma policy, such as the association between evaluation by a preceptor in clinical rotations and self-evaluation by students. Secondly, we will consider the use of the rubric system for performance assessments by teaching staff based on the student self-assessments. However, although the explanation and evaluation key for each case was provided to students for SOAP note evaluation, they were not supplied to the teaching staff. The questionnaire evaluation, which was conducted with the help of the teaching staff, mostly resulted in a good evaluation of the rubric assessment. However, for the question that had many “No” responses (“Are the details of assessment
criteria clear?’)’, there was not enough explanation of the assessment criteria. Thus, the content must be clarified and more explanation should be provided to the teaching staff, which will allow staff to understand the rubric and help in better assessment of the students. In the future, we will provide briefing sessions of the rubric assessment for teachers and, to use this rubric to grade students, we will integrate subdomains to reduce the assessor’s workload. Thirdly, an environment to enable continuous assessment that utilizes the rubric effectively should be prepared. We plan to post pharmacotherapy rubric forms in an electronic portfolio system; thus, students can always check their own evaluations and be aware of items that need improvements. Moreover, the rubric development team will regularly review changes in the medical environment to implement further improvements, such as selecting drugs based on pharmacogenomic updates. Some studies have reported that SOAP notes can be used to evaluate the clinical writing skills required by pharmacists. In these studies, the SOAP structure and pharmacotherapy content were evaluated. We have already assessed the SOAP structure in the Guide, but addressing structure issues in the rubric can be useful to improve the students’ SOAP note skills. Some evaluation content in the rubric employed a check-box style to amplify important points. We may need to revise the content in the rubric carefully because using the check-box style might lead to questions being ignored, which will affect the quality of performance. Thus, it could be helpful to emphasize the importance regarding the quality of performance.

In conclusion, we developed a pharmacotherapy rubric assessment that can be used during the 3rd and 4th year of pharmacy school. We were able to confirm a continuous improvement in student achievement levels by introducing the rubric assessment system with the intention of students performing self-assessments and setting goals.

Conflict of Interest The authors declare no conflict of interest.

Supplementary Materials The online version of this article contains supplementary materials.

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