Assessing medical students' pharmacological therapy ability through a mobile application

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Abstract. This aim of study is to explore the ability to make an appropriate diagnosis and treatment in clerkship students on their final examination as medical doctor. We used analytic method to 609 sheets of prescription from 180 clerkship students in their last try out Objective Structured Clinical Examination at Medical Faculty UNISBA, March 2018. There were 20 diagnoses from 10 groups of body systems. Based on different cases, clerkship students must write their own diagnosis and gave an appropriate pharmacological therapy for each diseases. The result showed there were more than 80% made an appropriate diagnosis and less than 50% made inappropriate pharmacological therapy. As conclusion, the ability to make proper therapy for clerkship medical student is lower than the ability to make an appropriate diagnosis.

1. Introduction

Making an appropriate diagnosis and treatment is a very important competency every medical student must has. Medical students must acquire adequate prescribing competencies before they graduate. For safe, effective and rational drug prescribing, they should have adequate knowledge and skill. Rational drug prescribing means prescribing appropriate drug in adequate dose for sufficient duration at a reasonable cost to obtain the best possible effect. Medical students should be regularly trained and assessed on their prescribing knowledge and skills in order to promote rational drug prescribing. Awareness regarding prescribing errors today can improve the health care delivery system in future [1].

Prescribing is a complex and challenging task for every medical graduate. Poor prescribing may result in medication errors and adverse drug reactions with potential consequences for patient safety and healthcare costs. In order to prescribe safely and effectively at the start of their professional careers, medical graduates should have acquired appropriate prescribing competencies (knowledge, skills, and attitudes) [2].

With rapid advances in science and technology, correct prescribing is becoming more difficult and complex. Nevertheless, medical students are known to be poor at writing prescriptions, partly due to a lack of learning opportunities and assessment related to the safe and effective use of drugs. This is a serious concern because medical students are the future prescribers [3].

Clerkship student after underwent 5,5 years of study in college and hospital, should have a proficiency in making an appropriate diagnosis and treatment to various kinds of diseases. Standardized examinations are ubiquitous throughout medical education and are designed to objectively measure
performance. Performance on a given standardized test tends to predict performance on subsequent tests. The tryout of Objective Structured Clinical Examination (OSCE) is widely used to prepare the clerkship students and predicts their performance on the national board exam [4].

On the national board exam for clerkship students, they tested with the application of medical knowledge, skills, and understanding of clinical science that are essential for providing patient care under supervision. It includes questions regarding the dermatomusculoskeletal, cardiovascular, neurosensory, tropical medicine, respiratory, neurobehaviour, endocrine, reproduction, genitourinary, and gastrointestinal systems, as well as interpretation of the medical literature. Medical schools strive to produce inquisitive physicians with a basic foundation of knowledge, technical skills, reasoning ability, and empathy; this provides a sufficient framework for graduate medical education and helps develop skills for self-directed lifelong learning [4,5].

Prescription writing is a complex and challenging skill which depends on the physician’s diagnostic skills, comprehensive pharmacological knowledge, communication skills, understanding of the principles of clinical pharmacology, the ability to make decisions regarding the potential risks versus benefits, and clinical experiences. Good prescription will bring a good recovery or healing process for the patient. Drug-related problems are one of the most common reasons for hospitalization, and most of these problems are considered to be avoidable. Frequent mistakes relate to over-medication, under-medication, the prescription of non-indicated drugs, wrong doses, or ambiguous dosage ordering [6-8].

Clerkship students must have a good competency to make appropriate diagnosis, choose the right medication and prescribe an appropriate drugs or therapy. Medical students are generally expected to acquire their prescribing skills during clerkships. In the present paper, we explore the ability to make an appropriate diagnosis and treatment in clerkship students on their final examination as medical doctor [9]. This aim of study is to explore the ability to make an appropriate diagnosis and treatment in clerkship students on their final examination as medical doctor.

2. Methods

2.1. Participants and study design

Every medical student requires to complete of clerkships during their education time before national final board examination. Students are completed the clerkship periode in the teaching hospitals. We used analytic method to 609 sheets of prescription from 180 clerkship students in their last try out Objective Structured Clinical Examination at Medical Faculty UNISBA at March 2018.

During the test, students were required to complete patient’s management based on case include writing the prescription within a timeframe of 10 minutes per case. Study participation was voluntary and the study protocol was approved by the local ethics committee. There were 20 diagnoses from 10 groups of body systems. Based on different cases, clerkship students must write their own diagnosis and gave an appropriate pharmacological therapy for each diseases.

Participants in this research are asked to respond clinical cases about how much they know about a particular subject after they have some basic knowledge of the subject itself and how they give accurate diagnosis and appropriate therapy based on their knowledge during the clerkship’s period.

2.2. Statistical analysis

The statistical package of social sciences (SPSS/PC) version 17 was used for data entry and analysis. Calculations were based on table of proportrons evaluation. We compared the averages of each group using this statistical analysis. A P value of <0.05 was considered statistically significant.

3. Results

We identified 180 students who completed the tryout of Objective Structured Clinical Examination. There were 20 diagnoses from 10 groups of body systems. Based on different cases, clerkship students must write their own diagnosis and gave an appropriate pharmacological therapy for each diseases.
We first reported the proportion statistics of all the systems. From the table 1 there were 10 groups of questions with the proportion of respiratory systems representing the highest proportion, followed by neurobehavior, dermatomusculoskeletal, and reproductive groups. The genitourinary group is a group of questions with the smallest proportion (2.79%) and followed by endocrine system (3.94%).

| Groups                  | n   | %    |
|-------------------------|-----|------|
| Dermatomusculoskeletal  | 84  | 13.79|
| Cardiovascular          | 51  | 8.37 |
| Neurosensory            | 46  | 7.55 |
| Tropical medicine      | 63  | 10.34|
| Respiratory             | 108 | 17.73|
| Neurobehaviour          | 91  | 14.94|
| Endocrine               | 24  | 3.94 |
| Reproduction            | 74  | 12.15|
| Genitourinary           | 14  | 2.79 |
| Gastrointestine         | 51  | 8.37 |
| **Total**               | 609 | 100  |

From the table 2, 3 and 4 we got the accuracy of diagnosis is 88.83%, but the accuracy of the therapy is still below that of 51.89%. The proportion of the accuracy of therapy based on the actual diagnosis is even smaller to 42.2%.

| Accuracy of diagnosis | n   | %    |
|-----------------------|-----|------|
| Not accurate          | 68  | 11.17|
| Accurate              | 541 | 88.83|
| **Total**             | 609 | 100  |

| Accuracy of Therapy Based on Diagnosis | n   | %    |
|----------------------------------------|-----|------|
| Not accurate                           | 293 | 48.11|
| Accurate                               | 316 | 51.89|
| **Total**                              | 609 | 100  |

| Accuracy of Therapy Based on the Actual Diagnosis | n   | %    |
|---------------------------------------------------|-----|------|
| Accurate                                           | 352 | 57.8 |
| Not accurate                                       | 257 | 42.2 |
| **Total**                                          | 609 | 100  |

Based on the table 5 it can be concluded that the accuracy of diagnosis above 90% is in the medicine, neurosensory, endocrine, gastrointestinal and genitourinary tropical systems. The problem group with
the largest proportion of inaccurate diagnoses was in the dermatomusculoskeletal group (28.57%),
followed by cardiovascular (17.65%), neurobehavior (15.38%) and reproduction (13.51%).

Table 5. Group cross table and diagnosis.

| Groups               | Diagnosis                  | Not accurate | Accurate | total | P   |
|----------------------|----------------------------|--------------|----------|-------|-----|
| Dermatomusculoskeletal | 24                         | 28.57       | 60       | 84    | 100 |
| Cardiovascular       | 9                          | 17.65       | 42       | 51    | 100 |
| Neurosensory         | 2                          | 4.35        | 44       | 46    | 100 |
| Tropical medicine    | 1                          | 1.59        | 62       | 63    | 100 |
| Respiratory          | 4                          | 3.7         | 104      | 96.3  | 8    | 100 |
| Neurobehavior        | 14                         | 15.38       | 77       | 84.62 | 91   | 100 |
| Endocrine            | 1                          | 4.17        | 23       | 95.83 | 24   | 100 |
| Reproduction         | 10                         | 13.51       | 64       | 86.49 | 74   | 100 |
| Gastrointestinal     | 2                          | 3.92        | 49       | 96.08 | 51   | 100 |
| Total                | 68                         | 11.17       | 541      | 88.83 | 609  | 100 |

There is a significant relationship between the accuracy of diagnosis and therapy that the candidate
determines. In groups that are not right to diagnose 66.18% of candidates are not right to give therapy,
while in the right group diagnose 54.16% right to give therapy (table 6). In table 7 the inaccuracy of
therapy in the group that was misdiagnosed was greater (76.47%), but in the right group diagnosed the
proportion of accuracy in giving therapy decreased to 44.55% compared to the previous cross-table.

Table 6. Cross table diagnosis and accuracy of therapy based on candidate diagnosis.

| Diagnosis | Accuracy of Therapy Based on Candidate Diagnosis | total | P   |
|-----------|-----------------------------------------------|-------|-----|
|           | Not accurate | Accurate | n  | % | n  | % | n  | % |
| Not accurate | 45           | 66.18       | 23  | 33.82 | 68  | 100 |
| Accurate   | 248          | 45.84       | 293 | 54.16 | 541 | 100 |
| total      | 293          | 48.11       | 316 | 51.89 | 609 | 100 |

Table 7. Cross table diagnosis and accuracy of therapy based on the actual diagnosis.

| Diagnosis | Accuracy of Therapy Based on the Actual Diagnosis | total | P   |
|-----------|-----------------------------------------------|-------|-----|
|           | Not accurate | Accurate | n  | % | n  | % | n  | % |
| Not accurate | 52           | 76.47       | 16  | 23.53 | 68  | 100 |
| Accurate   | 300          | 55.45       | 241 | 44.55 | 541 | 100 |
| Total      | 352          | 57.8        | 257 | 42.2  | 609 | 100 |
The key strengths of this study may allow us to identify clerkship students with need of assistance in improving performance the ability to make the right diagnosis and therapy before the national board of exam. This finding is educationally meaningful.

4. Discussion
Therapeutic decision-making or therapeutic reasoning is an important part of the process of clinical reasoning. Therapeutic reasoning can be defined as the step in clinical reasoning that pertains to the choice of therapy. Much research has been done on diagnostic reasoning. When an experienced doctor is confronted with a patient with certain symptoms and signs, so-called illness scripts are called up from memory. Illness scripts contain clinically relevant information on diseases, their consequences, the context in which diseases develop, including the personal circumstances, and the experience of the doctor with previous patients. These scripts are generated by the frequent solving of diagnostic clinical problems. Based on recognition, experienced doctors are able to choose the right script for solving a specific diagnostic problem efficiently, particularly in routine cases [10].

In order to verify whether this is the right script for the individual patient, two types of diagnostic reasoning may be used – analytical and non-analytical. Analytical reasoning is characterised as a slow and relatively time-consuming process that is carried out consciously and systematically and, if possible, evidence-based. Less or inexperienced doctors, such as medical students, mostly use this type of reasoning, mainly because they do not possess the ability to call up so-called ‘illness scripts’. In contrast to analytical reasoning, non-analytical reasoning is carried out rapidly and subconsciously and is based on experience and pattern recognition. This type of reasoning is used especially by experienced doctors. However, when an experienced doctor is confronted with a complex patient case, he or she will also use analytical reasoning [10].

Gaining knowledge and at the same time applying this knowledge in practice is essential for learning in general and, presumably, also for the development of treatment scripts by medical students. Storing pharmacotherapeutic knowledge in combination with the situation in which this knowledge will be applied benefits the speed and quality with which the information is recalled [10].

Medicines are products capable of preventing, diagnosing, curing illnesses or relieving symptoms, but countless errors occur in the medication treatment process the patients receive. National Coordinating Council for Medication Error Reporting and Prevention defines medication error as an avoidable event, which can lead to the bad use of medication or to patient damage while the patient is under the professional’s control. Based on an analysis of the contribution of medical errors to deaths in the United States of America, it was estimated through research that medical errors can represent approximately 251 thousand deaths per year in the country, ranking third. Error is considered as an unintentional act, which did not produce the desired outcome, as well as execution or planning errors or failures in the care process. Among the different medication errors, prescription errors stand out due to their potential to cause harmful consequences to the patients and because they represent a considerable proportion of avoidable drug-related problems [11].

How students learn and perform depends on at least 3 variables: the learner, the teacher, and the method employed. The learner is the main variable because ultimately all learning is self-learning; this is of even greater significance in schools that follow a Problem Based Learning (PBL), self-directed program. The learner should be motivated enough to learn and actively participate in teaching-learning activities because those who participate are known to perform better, especially in the skills component. It has been argued that standard recognized competencies for safe prescribing can be accommodated within the existing medical curriculum. The competencies required for medication prescribing by general practitioners include 4 domains: pharmacology, regulatory standards, therapeutics, and communication [12].

The Objective Structured Clinical Examination (OSCE) and structured clinical examinations in general are well-known and approved methods for assessing competence and performance. The Objective Structured Clinical Examination not only can predict overall performance, but specific deficits across a variety of domains (communication skills, professionalism, physical exam skills, or clinical
reasoning) may be identified to provide remediation efforts tailored to a student’s individual needs in a controlled setting before the clerkship students moving on to the internship period [5,10].

Clinical reasoning skills may help students to better focus on the efficient history taking and physical examinations that are required for making a correct diagnosis and therapy. There were 541 sheets of prescription (88,83%) made an appropriate diagnosis. From 541 correct diagnoses, there were 300 sheets (55.45%) made inappropriate pharmacological therapy. This further suggests that some students have a higher ability to make a diagnosis, but they still have lack of ability to make an appropriate medication for the patients.

The step of clinical reasoning pertaining to the choice of therapy is defined as therapeutic reasoning (therapeutic decision making). Good prescribing competency is defined as a situation when students demonstrate therapeutic reasoning skill and ability to write complete prescriptions without errors [13].

Many efforts have been made to develop a valid and reliable measure of clinical reasoning ability for the clerkship students. The clinical knowledge test was originally designed to assess problem solving and clinical decision-making abilities. The exam situation presented in try out Objective Structured Clinical Examination at Medical Faculty is closer to real-world clinical reasoning than the paper examination, as physicians can only get clinical information when they properly ask. Clinical information obtained from the patient may not be the only factor that raises the probability of correct diagnosis and that clinical reasoning may be more vital for correct diagnosis than the amount of clinical information [14].

Medical students sometimes find that they don't have a very clear idea of how to prescribe a drug for their patients or what information they need to provide. This is usually because their earlier pharmacology learning had concentrated more on theory than on practice. Medical students must have memorized numerous detailed facts about drugs and pharmacologically active substances without a direct clinical context. The pharmacology textbooks are often too drug-centered and clinical guidelines more disease-oriented and thus the reason why particular therapies are chosen remains unclear [2].

This study has several limitations. This study was performed in a single institution and only included 180 clerkship students. Therefore, these results may not be generalizable to other institutions, which might have different clinical clerkship programs and student evaluation systems.

5. Conclusion
Therapeutic decision making is defined as an important part of clinical reasoning process that pertains to the choice of therapy of a clinical problem in a specific diagnosis og the patient. The fundamental cognitive principle that underpins prescribing skill is a pre-requisite for the interpretation (knows how) and knowledge interpretation are essential for solving the problem (shows how). These principles should be considered as a continuum, and prescribing skill incorporates these dimensions at different stages of the medical training until mastery is achieved.13 This study assessed the ability to make an appropriate diagnosis and therapy for clerkship medical students. From the study we can conclude that ability to make proper therapy is lower than the ability to make an appropriate diagnosis for clerkship medical student. Results will be added to other evidence to serve as part of a needs assessment for future improvement of medical education for clerkship students. However, further research is needed to determine the most appropriate teaching methods to increase diagnostic and how to choose the right medication ability. Future studies not only will serve to enhance professional education, but also to optimize patient medication safety. It is important to critically examine the level of diagnostic and prescribing the right medication competence expected from students at different stages of the medical education program.

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There is no conflict of interest

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Ethical approval
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