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Virtual patient case studies in pharmacy education – how to make it work and worth

Metoda wirtualnych pacjentów w nauczaniu farmacji – jak wdrożyć i dlaczego warto

STRESZCZENIE

Metody dydaktyczne wykorzystujące wirtualnych pacjentów wydają się być idealne do nauki praktycznych umiejętności niezbędnych do świadczenia usług z zakresu opieki farmaceutycznej. Mimo to liczba opublikowanych studiów przypadków szczegółowo opisujących zastosowanie wirtualnych pacjentów w kształceniu studentów farmacji czy podczas kursów w ramach szkolenia ciągłego farmaceutów jest zaskakująco niska. W niniejszej publikacji został opisany proces tworzenia wirtualnego pacjenta jako strategii nauczania. W celu skonstruowania wirtualnego pacjenta wykorzystano platformę Decision Simulation, która służy do zgodnego ze standardami projektowania i udostępniania rozgałęzionych, narracyjnych scenariuszy przypadków. Przygotowany scenariusz przypadku pacjentki z cukrzycą typu 1 został zaprojektowany, aby umożliwić studentom rozwinięcie umiejętności logicznego rozumowania, wyciągania wniosków, uzasadniania i podejmowania decyzji dotyczących pacjentów w bezpiecznym, wirtualnym środowisku. Większość studentów zaangażowanych w testowanie i walidację tej metody uznała ją za bardziej użyteczną i skuteczną niż kurs opieki dostarczany za pomocą tradycyjnej metody nauczania. Bazując na doświadczeniach z przeprowadzonego eksperymentu podjęto decyzję o wdrożeniu wirtualnych pacjentów jako oficjalnego elementu programu studiów studentów farmacji Collegium Medicum Uniwersytetu Jagiellońskiego.

Słowa kluczowe: studium przypadku, cukrzyca typu 1, opieka farmaceutyczna, edukacja farmaceutyczna, wirtualny pacjent

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ABSTRACT

Virtual patients (VPs) based methods seem to be perfect to teach the skills of pharmaceutical care practice, yet there is a surprisingly small number of the published case studies with a detailed description of their use in the undergraduate pharmacy curricula or continuing pharmacy education courses. In this paper, we describe the development of VP as teaching strategy. The Decision Simulation platform, which is a standard-based VP platform for authoring and delivering the branched narrative case scenarios was used to construct a VP scenario. The virtual case was designed to develop decision-making and reasoning skills. Most of the students, involved in this approach testing and validation, found it useful and beneficial as compared with the traditional course. Consequently the VP methodology was introduced as an official part of the pharmacy curriculum.

Key words: case study, diabetes type 1, pharmaceutical care, pharmacy education, virtual patient

Introduction

Pharmaceutical care and VPs are the two key phrases which make a lot of buzz in the world of pharmacy education. A simple search with the use of the most popular internet search engines points to a plethora of sites and documents touching upon these topics. There is although a surprisingly small number of the published case studies with a detailed description of their use in the undergraduate pharmacy curricula or continuing pharmacy education courses. In one of the recent review publications, Jabbur-Lopes and colleagues conducted a literature review aiming in the evaluation of the VPs technology utilization in pharmacy education. They concluded that there were few published papers in the field and few patient case scenarios available. Authors suggest that there is a paucity of examples where VPs were effectively used, which indicates underuse of such methods in pharmacy education (Jabbur-Lopes et al., 2012). It was further noticed by Cavaco and colleagues (Cavaco&Madeira, 2012). There are multiple potential reasons for such situation, yet probably most obvious is hidden behind the word 'resources' used in the Jabbur-Lopes conclusions section. Despite of indisputable benefits coming from using VPs technology, including effective teaching of clinical and communications skills, the scale of necessary investments in the launch of VPs technology and development of virtual cases is significant (Marriott, 2007; Noori et al., 2015; Smith&Benedict 2015; Villaume, Berger, Barker, 2006).

There are various approaches to develop virtual cases, from standardized patients to high-fidelity human patient simulation (Benedict, 2010; Marken et al., 2010; Mieure et al., 2010; Noori et al., 2015; Rickles et al., 2009; Smithburger et al., 2010; Vyas et al., 2010). An example of implemented virtual environment covering various clinical scenarios and 3D characters allowing for flexible interaction is a Keele University project (University Keele, 2016).

Aim of the project

The aim of this project was to develop interactive, adaptive, competency-based tool for the course delivery. The created VP provides students with the opportunity to face and manage complex clinical situations which demand integration and proper use of gained knowledge and skills to deliver evidence-based patient-centered care. In this paper, we describe the development and a case of use of the VP as teaching strategy during Pharmaceutical Care course in the pharmacy curriculum at Jagiellonian University Medical College in Krakow, Poland.

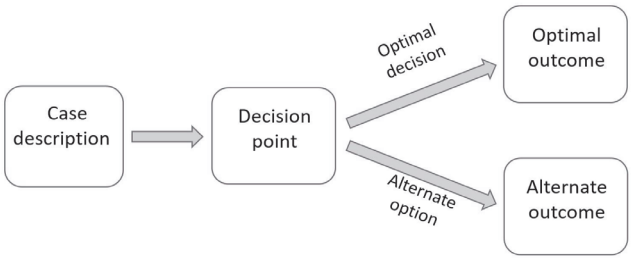

Fig. 1. The scheme of a simple case (source: authors' own work).

Virtual patient case study development

Software

The Decision Simulation, LLC, (2012, University of Pittsburgh) platform was used to construct a VP scenario. The DecisionSim is a standards-based VP platform for authoring and delivering the branched narrative case scenarios. The simplest case scheme contains following elements (Fig. 1): descriptive introduction, decision node, and outcome nodes.

VP case scenario can be composed of unlimited nodes and branching rules. Five types of nodes may be utilized to structure a case: (1) narrative, which provides information and directs learner to the next, single node; (2) branching, which directs learner to the different paths according to the decision made; (3) multiple choice, where learner may select one, more than one or no answer; each choice may be used to determine the further course of a case; (4) inquiry, where learner may select multiple answers; instant feedback before continuing is an option (e.g., history-taking questions); (5) text responses, which test learner's knowledge. DecisionSim also allows the creation of rules directing learner to defined paths depending on previously made decisions. Optionally, every decision or answer can be scored, and counters may be used to track user's performance. Author panel allows groups creation and advanced management of both learners and cases; permission levels can be assigned to users, learning objectives can be defined as well as counters and rules. An automatic case validation tool helps identify and fix potential problems. Reports upon specific learners sessions are available to case authors and managers. Reports include the path taken by the user (sequential list of nodes that had been visited with answers chosen by the learner), counter values (scores, number of steps, or amount of real time spent to reach a case end-point, total time based on time assigned to each node by the author of case) so that individual learner performance or progress can be monitored and assessed.

Case structure assumptions

Our case for a patient with diabetes type 1 is composed of over 500 nodes. Its fragments are presented in Fig. 2 and Fig. 3. Students were allowed to access the virtual case during the classes, which lasted 3 hours and 45 minutes. This time should have been spent on making decisions in DecisionSim software. However, the documentation of the pharmaceutical care process could have been delivered to the

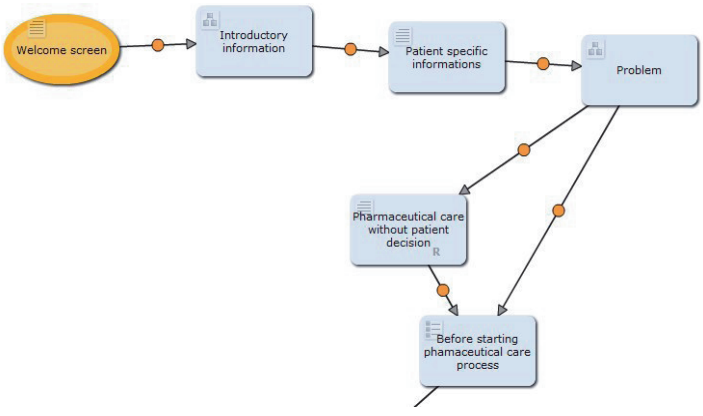

Fig. 2. Introductory elements of the case map (source: authors' own work).

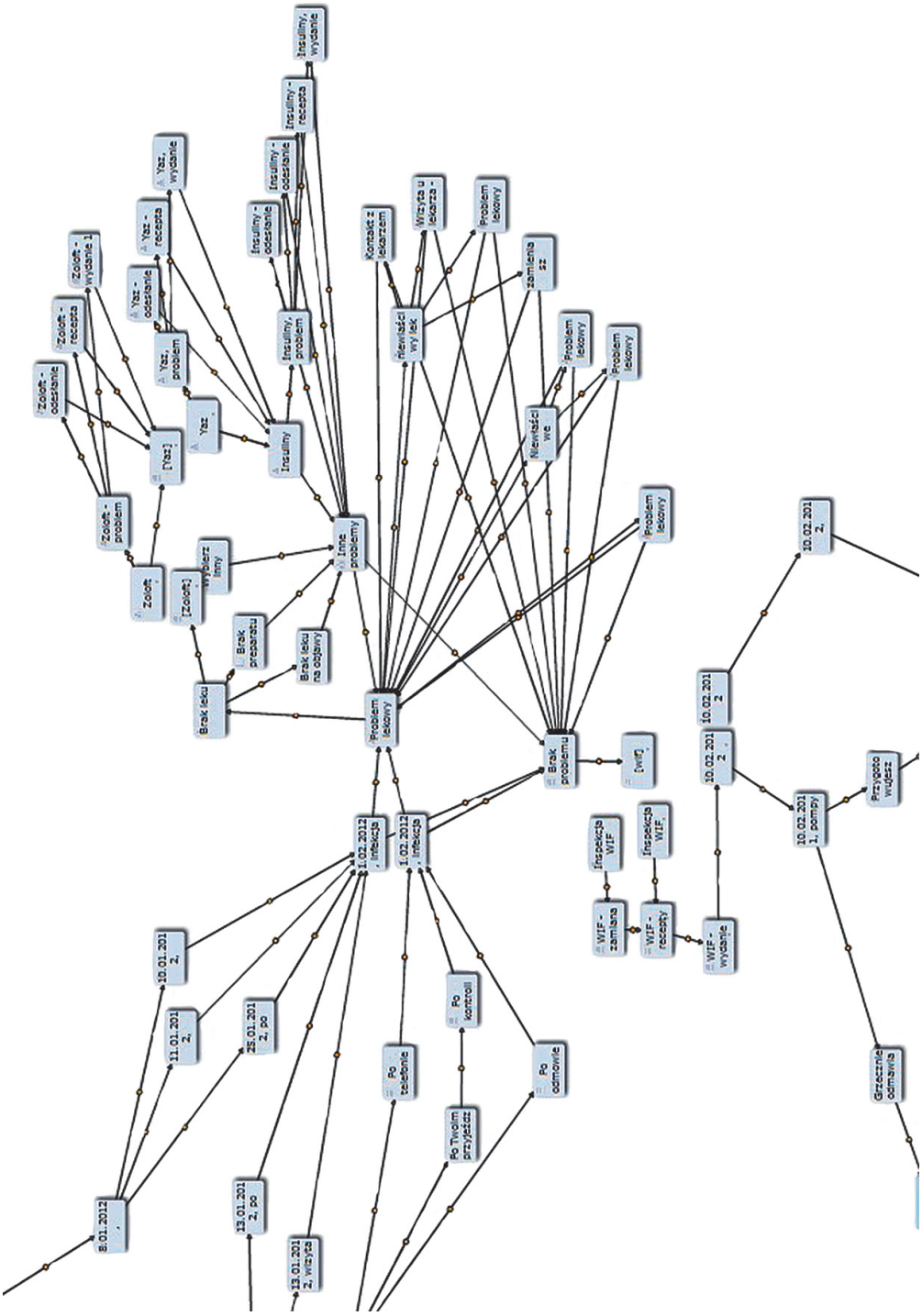

Fig. 3. A section of the case map (source: authors' own work).

tutors within 10 days. The case can be only played forward. Thus the learner cannot go back while solving the case nor change previously made choices. However, solving the case can be stopped at any time and resumed later on beginning from the last visited node. Thereby, students can come through therapeutic guidelines and recommendations of scientific societies, read relevant publications or discuss possible alternatives with colleagues before making final decisions. They were, however, encouraged to work individually.

Case construction

Clinical problem

Diabetes type 1 was chosen as a pharmaceutical care - eligible disease. In the course of this chronic disease, the patient's behavior is directly linked to a health outcome. Any wrong decision or negligence may shortly lead to serious negative health consequences. Patient knowledge about the pathophysiology of the disease, role of insulin and the lifestyle is crucial to maintaining proper blood glucose level and diminish the risk of complications associated with hyper- and hypoglycemia. Trained and cautious pharmacists can detect problems as well as gaps in patient knowledge. However, the time required for this kind of activity usually exceeds the time of the routine visit of the patient in the pharmacy. Providing pharmaceutical care in concordance with Hepler and Strand definition offers the opportunity to identify and prevent (potential) or resolve (real) drug-related problems (DRP).

Target audience

Since the proper patient care planning, implementing and evaluation require comprehensive background knowledge, pharmacy students attending mandatory Pharmaceutical Care course in their fifth study year were selected as the target audience for the VP case. Completion of prerequisite courses, i.e., physiology, pathophysiology, pharmacokinetics, pharmacology, toxicology, pharmacognosy, and epidemiology was required before admission to this course. The case was designed as an optional module of the Pharmaceutical Care course. Students were assured that their performance during virtual case would not influence their general course learning assessment nor grading. However, achieving good patient's outcome would be gratified by some extra points in the final course grade.

Tab. 1. Virtual patient case learning objectives (source: authors' own work).

Students will be able to	describe insulin-therapy rules in diabetes type 1
	define possible complications of diabetes
	demonstrate the technique of the insulin administration
	demonstrate blood glucose meter use
	assess and alter therapeutic regimen to control hyper-/hypoglycaemia or co-morbidities
	define therapeutic goals for a diabetic patient with the use of guidelines
	identify and manage drug-related problems
	prepare and execute diabetes monitoring plan for the patient
	evaluate the effectiveness of insulin therapy
	develop a patient education plan
	discuss the role of exercise, diet and foot care
	monitor patient compliance
	describe insulin-therapy rules in diabetes type 1

Learning objectives

Self-directed learning, when learners work individually with limited interaction with the tutors, was chosen as a learning model for our VP case. The case scenario building started from defining learning objectives. Completed case should result in knowledge and skills gain. The learning outcomes for the VP case are outlined in Tab. 1.

The realization of learning objectives was evaluated by scoring students' decisions made in a particular situation related to one of the learning goals emerged during the course of the case. Additionally, students were to document whole pharmaceutical care process in the in-house documenting paper system.

Patient description

Proposed VP is 17-years old woman, known by the pharmacist-student for several years, who was recently referred to the community pharmacist (student) to the general practitioner with the symptoms of diabetes. After diabetes mellitus type 1 diagnosis and short hospital treatment for glycaemia stabilization, an insulin therapy has been prescribed. Patient's parents and herself feel confused and uncertain about the disease and its treatment; they ask the pharmacist for help. Soon after, the patient is diagnosed with depression.

Case scenario

The first decision to take is whether to provide pharmaceutical care to the patient or not. Students are given the opportunity to refuse pharmaceutical care service to the patient. However, they are still obliged to deliver standard pharmaceutical service including making decisions, providing information about dispensed drugs and addressing patient's concerns. Regardless the choice, each student's decision entails different consequences which should be tackled. The patient generally does not consult the pharmacist's decisions with any other health care specialist so that the learner can observe possible effects of his/her counseling. For example, if the student advises discontinuation of the drug, the patient will usually follow the instructions. Moreover, to enhance the collaboration between the pharmacist and physicians some problems are addressed by the medical practitioner, who requests additional information from the pharmacist about the scientific grounds of pharmacist's decision or counsel.

Path without pharmaceutical care

A decision on giving up the full pharmaceutical care pathway does not exempt pharmacist from liability for his/her patients. Therefore, even that it was decided to allow learners not to follow the full pharmaceutical care process, some of the commonly met issues, which should be addressed by the pharmacist, were encoded in a parallel path. With or without pharmaceutical care, wrong decisions could have been made or wrong advice could have been given by the learner, resulting in serious

Tab. 2. Pharmacotherapy issues included into the path without pharmaceutical care (source: authors' own work).

Diabetes specific issues	Non disease-specific issues
General information about the newly diagnosed disease, prescribed therapy and diet (patient-specific leaflet expected)	Acne and its complex therapy including OTC drugs and diet
Insomnia (lack of the proper glycaemia control)	Analgesics choice (aspirin and acetaminophen)
Damaged insulin pen and expected pharmacist reaction	Cracked heel skin (the pharmacist should consider fungal infection)
Hypoglycaemia ca. 2h after the morning meal (lack of the proper glycaemia control)	OTC/herbal immunostimulant

health consequences including hospitalization.

The medical and pharmaceutical problems covered in the current path can be divided into two separate groups: the first one touching mainly upon the diabetes-specific issues and the second one, which was more general and non-disease-specific (Tab. 2). The pharmacist is neither expected to track back the pharmacotherapy history nor to plan specifically further services. The problems faced require good general pharmaceutical knowledge yet do not exceed the capability of a properly prepared and well-trained pharmacist.

Path with pharmaceutical care

If the full pharmaceutical care path is chosen, the student is supposed to collect patient-specific information, assess drug-related problems, establish therapeutic goals and specify monitoring plan. During the consecutive visits, the student is faced with therapeutic complications, emerging DRPs, and patient inquiries. The case covers almost 4 months of continuous pharmaceutical care process (from October 28th until 10th of February next year) with at least 6 visits to the pharmacy. However, the total number of visits depends on the decisions made by the student. Antidiabetic therapy consists of NPH insulin once daily in the evening (8 IU) and regular insulin three times daily before meals (10 IU before breakfast, 6 IU before dinner and 8 IU before supper). Other drugs used by the patient occasionally are acetaminophen and drotaverine for menstrual pain. The patient monitors her blood glucose levels regularly and keeps a log of the readings. Case scenario includes following elements:

1. Initial interview

Medical history is an important initial step of the pharmaceutical care process. The learner decides which questions should be asked at the very beginning, during the first meeting. If student omits any essential questions (e.g., about pharmacotherapy), he/she is not capable of informed decision making.

2. Blood glucose monitoring and special issues management

The student is supposed to analyze blood glucose results according to current guidelines. The student should also assess the appropriateness of blood glucose monitoring technique and insulin injection technique with the preparation of injection site, based on the description obtained from the patient.

Coordination of the insulin injections with meals is crucial to ensure the safety and effectiveness of antidiabetic therapy. The patient reports morning symptoms suggesting hypoglycaemia. Learner should ask additional questions, which let him/her find the most probable reason - omitting or delaying breakfast after insulin injection. Learner should remind the patient that insulin must be injected 15 minutes before meal and food must be taken if insulin is administered to avoid hypoglycaemia.

3. Patient counseling for minor ailments

The case covers also issues not specifically related to diabetes, putting emphasis on various aspects of pharmacotherapy and drug-related problems. Patient presents with symptoms of upper respiratory tract infection, including a productive cough, high fever, headache, sore throat and trouble breathing due to rhinitis. Apart from dispensing a prescription for antibiotic, pharmacist should also suggest medical products relieving these symptoms, taking into consideration that:

- some drugs contain sugar, and patients with diabetes should not use them (e.g., some lozenges, syrups),
- some ingredients may alter blood glucose control, like acetylsalicylic derivatives,
- the patient suffers from a productive cough though antitussives and combined drugs with antitussive ingredients are contraindicated unless a cough disturbs night sleep,
- there is no indication for dispensing an antiallergic drug (e.g., nasal dimetindene),
- pharmacist should rely on evidence-based medicine and should not counsel

drugs containing ingredients effectiveness of which was not scientifically proven in a particular indication (for the treatment of upper respiratory tract infection, e.g., low doses of vitamin C, codein, herbal drugs (Sexton&McClain, 2016),
- some substances interact with sertraline used by the patient for depression (naproxen, acetylsalicylic acid - increased toxicity and risk of upper gastrointestinal bleeding; dextromethorphan increases the serotonin level and should not be used concomitantly).

The learner should also deal with a prescription for antibiotics. A probiotic product may be suggested together with information about its proper use. Learner should also clarify the prescription for inhaled formoterol for upper respiratory tract infection with breathing difficulties due to rhinitis because there is no evidence that inhaled beta2-agonists improve symptoms in patients without any obstructive respiratory disease (Becker et al., 2015).

4. Compliance monitoring

Non-adherence is a vital problem among patients, often undiscovered in standard medical care procedures. Pharmaceutical care requires that every supply of the patient's medications is documented. Therefore pharmacist should identify and resolve this kind of pharmacotherapy issue. Presented case includes non-adherence problems regarding insulin, test strips and antidepressants. Learner should remind the patient that current drugs supply is running out. Otherwise, the patient has to arrange an emergency visit.

5. Referral

Several times, the learner may decide to refer the patient to a physician without the specific need (for example referral for the prescription while current drugs supply is not going to run out or referral for switching or discontinuing of medicine while another action e.g., cautious blood glucose monitoring would be sufficient). These decisions lead to unnecessary medical resources involvement and a waste of patient time, so the learner receives negative feedback either from the physician or the patient. Negative feedback from the physician is also given when learner makes a decision which is not within his/her professional competence, e.g., changing insulin dosage without prior physician consultation.

Depending on the path taken by the student the several problems can arise

Pharmaceutical care should result in the improvement or, at least, maintenance of a current level of quality of life. The learner may ask the patient to fill in SF36v.2 quality of life questionnaire, which is a valid instrument to assess the physical, mental and social performance of the respondent (Ware, Kosinski, Dewey, 2002). This may be particularly useful in patients with diabetes as depression is a common comorbidity which influences patient's life quality and health outcomes (Johnson et al., 2013). Based on the knowledge from previous year courses, the learner should interpret the results and incorporate them into the pharmaceutical care plan. The questionnaires combined with information from anamnesis show that the patient may be depressed. Therefore she should be referred to the specialist. Otherwise, to improve the mood the patient begins using marijuana. Besides its addictive potential, the major concern of pharmacist should be its possible hypoglycemic effect (Penner, Buettner, Mittleman, 2013). Learner should encourage the patient to discontinue the drug and refer the patient to the specialist. Postponing referral results in hospitalization due to hypoglycaemia.

A woman with diabetes should be informed that it is better to plan the pregnancy to avoid complications from high blood glucose levels. It is recommended that a woman, who does not wish to conceive and is sexually active, use effective contraception. The patient is at reproductive age and has a boyfriend so the pharmacist should raise this problem. In Poland hormonal contraception is available only with a prescription.

Therefore, the patient should be referred by the learner to the gynaecologist, otherwise, at the end of the case, the patient becomes pregnant.

After referral to the gynaecologist the patient presents with a prescription for combined oral contraceptive pills. During the consecutive visits, a learner has several occasions to modify unreasonably the gynaecologist orders (e.g., discontinuation of a drug, introducing 7-day long break while the patient has medication with four placebo pills) which may result in pregnancy. Learner should also advise additional contraception during and the seven days after amoxicillin is administered for upper respiratory tract infection. Otherwise, the patient gets pregnant.

Learner is supposed to prepare the patient for the winter holidays away from home, including advice on storage of the insulin preparations, additional supply before leave to secure continuity of pharmacotherapy, as well as advice on dealing with regular insulin ampule, which becomes cloudy probably due to low temperature.

Many compounds used for medical and recreational purposes may affect blood glucose control. However, some of them may be used by diabetic patients. When dispensing fluoxetine, ciprofloxacin and oral contraceptives learner should advise additional glycaemia monitoring and reporting any blood glucose levels irregularities; additional monitoring should also be advised when the patient presents with signs of infection and with prescription for antibiotics (for urinary tract infection, for upper respiratory tract infection) because the infection, especially with fever, may affect blood glucose control. Otherwise, the patient experiences symptoms of hypo- or hyperglycaemia. In the case of urinary tract infection treated with ciprofloxacin, unless the learner points out the potential additive hyperglycemic effect and advises additional monitoring of blood glucose level, the patient presents with symptoms of hyperglycaemia. Disregarding symptoms result in hospitalization due to diabetic ketoacidosis.

Presented case also emphasizes economic aspects of pharmacotherapy. Test strips, which are going to run out within few days, may be dispensed legally without prescription, however, their cost is almost 15-fold higher as compared to test strips dispensed with a valid prescription. Learner should refer the patient to the physician rather than dispense test strips at full cost to the patient.

Conclusions

Virtual laboratory for pharmaceutical care practicing was created allowing students to test their professional skills in the simulation of real situations. The virtual case was designed to develop decision-making and reasoning skills, which was accomplished through including numerous decision points affecting patient's care outcomes. Learners receive immediate feedback on the impact of their decisions. However, some symptoms or complications may occur in the longer period as a result of wrong decision or omission. Simulation of pharmaceutical care process for diabetic patient lasting four months can be realized in about 4 hours. However, this time did not cover the time needed to document the whole process.

General student's perception of the teaching/learning method according to our experience is positive. However, their opinions were expressed only orally, and neither satisfaction nor the method or case scenario itself wasn't evaluated with written questionnaires. The students claimed the VP to be challenging and demanding, but they enjoyed the learning method and suggested it should be embedded into the traditional teaching scheme of the Pharmaceutical Care course.

As anatomy, physiology, pathophysiology, medicinal chemistry, pharmacokinetics, pharmacognosy, toxicology, epidemiology, and pharmacology courses were Pharmaceutical Care course prerequisites defined in the syllabus, we assumed that students had essential knowledge and skills, but they found it difficult to integrate the previously gained

information and use them in real life situations. The traditional, subject-based teaching might be the reason; virtual patient case studies in pharmacy education was probably the first time during their undergraduate education when students had to focus on a specific, individual patient and not just on a drug. During the case, many students made decisions which did not belong to the professional competence of pharmacists. These problems indicate the need to pay more attention to the drug-related problems as well as to the legal aspects of being a pharmacist in the pharmaceutical care teaching process.

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