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Example of a Simulation Design in Nursing Education: Safe Chemotherapy Administration

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ABSTRACT

Chemotherapy is one of the treatment methods increasingly used in cancer. In this article, we aimed to share our simulation experiences within the scope of the elective course of Cancer Nursing in the Nursing Internship (4th year) program in the process of teaching safe chemotherapy administration methods. Simulation-based experience should be designed to attain specified educational goals and expected results as best as possible. Scenario implementation is based on the criteria of the International Nursing Association for Clinical Simulation and Learning standards. A biologically safe drug preparation cabin in the drug preparation room of a simulation center was used, and a medium-fidelity mannequin-based simulator evaluating the vital signs was utilized as the simulator during the simulation implementation. In the patient history prepared within the scope of the scenario, the students were expected to achieve goals. An analysis was performed by a trainer who followed attentively the implementation during the scenario. In the analysis stage, sessions including 8–10 students were held using the Promoting Excellence and Reflective Learning in Simulation. A checklist was used to evaluate the skill steps of the students objectively. It is thought that this simulation scenario maintained in accordance with the standards of best practice of the International Nursing Association for Clinical Simulation and Learning would guide the readers. The simulation is considered to be an effective method for safe medications, and it is recommended to plan different scenarios according to the levels of students.

Keywords: Nursing education, safe medication, simulation, simulation-based experience, simulation design

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INTRODUCTION

According to GLOBOCAN (The Global Cancer Observatory) data, the increasing number of cancer cases increases further the importance of oncology nurses providing care service to this patient group. Chemotherapeutic (CT) drugs administered to patients have negative effects on cancerous cells, as well as normal cells. When considering the side effects of CT drugs, they negatively affect the health of the nurses preparing and administering the treatment, as well as their patients (Tuna, 2014). It is stated that a long-term exposure to CT drugs may have negative effects such as nausea, vomiting, diarrhea, irritant and allergic contact dermatitis, hair loss, and corneal ulcers if they come into contact with the eye (Olgun, & Şimşek, 2010).

For reducing the exposure to CT drugs, it is recommended to use biological safety cabinets, disposable gloves made of protective materials, an apron, mask to prevent inhalation, and goggles to prevent eye splashing (Connor, & McDiarmid, 2006; Ministry of Health Safe Working Guide with Antineoplastic Drugs, 2004; Oncology Nursing Association, 2014; Power, & Coyne, 2018). The studies conducted on CT drug administrations of the nurses reported that the preventive measures taken by nurses in preparing and administering CT drug were insufficient and recommended that training be given for the safe use of CT drugs (Olgun, & Şimşek, 2010; Önal, & İntepeler-Seren, 2017). It has been stated that health care professionals do not take adequate precautions to protect themselves from CT drugs since they have not adopted protective behaviors enough (McGovern, Vesley, Kochevar, Gershon, Rhame, & Anderson, 2000).

Along with the problems the nurses encounter with the CT drug exposure, the lack of possible knowledge and skills regarding safe CT drug administration poses significant risks for patients. The most common drug errors encountered by nurses about CT drugs are related to the wrong physician requests, improper administration of the drug, correct dose, and time (Büyük, Güdek, Güney, Yıldırım, & Akkoca, 2014). Therefore, integrating the administration of CT drugs into the undergraduate education curriculum is important for patient safety. However, the training of CT drug administration in the real patient is a difficult situation. Therefore, mistakes that may be made during the drug administration can be prevented by conducting simulation implementations in an environment that is the closest to the real one.

Simulation is a method that allows participants to develop cognitive, affective, and psychomotor skills by imitating real-life situations in a realistic and reliable environment (Committee, 2016f).

In simulation-based experience, the best practice standards developed by the International Nursing Association for Clinical Simulation and Learning (INACSL) are recommended to be used INACSL Standards of Best Practice (Barbara et al., 2015). These eight standards that define the whole process include the simulation design, results and objectives, facilitation, analysis, evaluation of the participants, professional behavior (professional integrity), extended inter-professional training, and operation.

The aim of this study is to share the simulation method that was prepared based on the INACSL standards for nursing students (n=16), who took and applied the elective course of cancer nursing in the intern program (4th year) of a university, during safe CT administrations. According to the simulation design standard, it is thought that this simulation scenario applied using the design template would guide the readers.

SIMULATION DESIGN

Simulation-based experience should be designed to ensure that the specified learning objectives and expected outcomes are reached at the most appropriate level. The criteria examined within the scope of the design standard are as follows and form the parts of a design template:

- Perform a needs assessment to provide the foundational evidence of the need for simulation ,
- Determine the measurable objectives,
- Decide the simulator type and modality,
- Design a clinical scenario or situation in accordance with the training content,
- Use fidelity methods to create the required perception of realism,
- Provide a facilitative approach that is participant centered,
- Begin simulation-based experiences with a prebriefing,
- Debrief and/or have a feedback session by using appropriate techniques after the implementation,
- Evaluate the participant(s), facilitator(s), and the simulation-based experience,
- Ensure the preparation of the participants,
- Pilot test simulation-based experiences before full implementation (Committee, 2016e).

It is recommended to use a design template to achieve standardization in the simulation process. This ensures the consistency of the simulation and also guides the development, implementation and evaluation of the simulation (Bartlett, 2015; Lamontagne, McColgan, Fugiel, Woshinsky, & Hanrahan, 2008). The use of template during the scenario design provides the trainers with a roadmap for monitoring the desired steps. The details of a "safe chemotherapy administration" scenario in accordance with design standard criteria are as follows:

Perform the Needs Assessment

To determine the needs, comprehensive targets or objectives specific to the participants should be determined. Different methods can be used in determining the needs. These can be listed as the analysis of underlying causes (root cause analysis), SWOT (strengths, weaknesses, opportunities, and threats) analysis, evaluation of the participants (clinicians, trainers, participants), and outputs (pilot studies, health needs of the country, previous simulation experiences) (Committee, 2016e). The reasons for the implementation of this scenario are the following:

- Wide use of CT today due to an increased incidence of cancer,
- A risky CT administration during clinical practices cannot be experienced by every student in a safe learning environment, and they are expected to do such practices in case of graduation.

Measurable Objectives

In simulation-based experience, the specified objectives must be accessible, realistic, and appropriate to the knowledge level and experiences of the participants. The results expected from the training should be determined (Committee, 2016c). In this context, the implementation objectives of the scenario are given in Table 1.

Table 1. Objectives of the scenario

Before chemotherapy drug preparation
• The student/user can take protective measures for safe chemotherapeutic drug administration
• Safe drug administration
• Evaluation of drug responses

While the main purpose of the simulation scenario is to make the students perform CT practices in oncology clinics in line with patient safety principles, the main purpose of the program/curriculum is to have students perform drug administration in line with the patient safety principles.

The main question of the scenario: Can the student administer the drug properly in oncology clinics in accordance with the patient safety principles?

Main question of the program/curriculum: Can the student administer the drug in accordance with the patient and employee safety using the acquired knowledge and skills?

Modality

While deciding on the simulator type, the main objective and existing sources should be taken into account (Committee, 2016e). In this simulation implementation, a biologically safe drug preparation cabinet found in a drug preparation room of the simulation center was used, and a medium-fidelity mannequin-based simulator in which vital signs could be evaluated was used as a simulator.

Design a Clinical Scenario or Situation

Scenario is a planned situation developed by the trainer to help participants in achieving their learning goals (Alinier, 2011). It is defined as models based on real-life situations involving problem solving, critical thinking, clinical decision making, and other complex mental skills (Nadolski et al., 2008).

Table 2 shows demographic characteristics of the patient in the scenario. In the patient history prepared within the scope of the scenario, the student was expected to achieve the objectives. The scenario flow prepared by the trainer toward the goals was used in this scenario implementation (Table 3). The scenario started with the nurse's encounter with the patient and evaluation of the patient's blood tests, ending with the initiation of drug administration.

Table 2. Patient demographic information

Simulation date: 10/27/2017	**Patient name and surname:** K. Ş.
Gender: Male	**Age:** 58
Body mass index: 25.7	**Race/Religion:** Turk, Islam
Caregiver: Wife	**Allergies:** Pollen, strawberries
Primary medical diagnosis: Colon (Rectum) Cancer	
Surgical procedures/interventions & date: Mitral valve replacement 2012	
Medical history: The patient who had hypertension for 10 years underwent the cardiac surgery 5 years before due to a mitral valve failure. He regularly uses Norvasc 5 mg 1x1 tablet, Aldactone 1x1 tablet, and Coumadin 5 mg 1x1 tablet.	
Current disease history: The patient who presented with indigestion and constipation symptoms for 4 months had lost 10 kg in the past 1 year. He was diagnosed with stage III rectum cancer. The patient's treatment plan included eight cycles of neoadjuvant chemotherapy. Surgery is planned for the patient.	
Social history: The patient who is married and retired meets his own self-care needs.	
Information given to the student before simulation: You work as a nurse in the oncology inpatient service, and your shift started at 08:00 o'clock. There are six patients in the service, and you are responsible for their care. One of the patients will receive a chemotherapy drug today. The patient diagnosed with stage III rectum cancer will receive the third cure of neoadjuvant. A performance assessment and toxicity assessment of the patients were made by the physician before. After evaluating the laboratory findings, consent will be obtained, and the drugs will be prepared and started. The facilitator (instructor) will take part in the scenario when necessary.	

Table 3. Scenario flow

Scenario flow				
Time	**Mannequin actions**	**Environmental factors**	**Expected interventions**	**Clues**
1–3 minutes	The patient's condition remains stable.	Making necessary arrangements in the drug preparation unit (setting up lights and sound system of the device)	Interpreting laboratory results and informing the patient	**Doctor (Facilitator):** If the laboratory findings are not evaluated, he or she makes a phone call and requests the student's interpretation by asking, "How are the laboratory findings?" and "When will chemotherapy approval be obtained?"
	Pulse: 88/min	- Preparing the cabinet	Obtaining the chemotherapy protocol approval by informing the physician	**Patient:** If the patient is not informed, he or she asks, "Will drug be given to us today? Nobody gave us any information!"
	Breath: 14/min	- Preparation of medicines		
	SpO_2: 97%	- Placement of necessary materials		
	Blood Pressure: 118/72 mmHg			
	The patient is in a semi-sitting position on the bed.			
3–12 minutes	The patient's condition remains stable. The patient lies in the bed	Making necessary arrangements in a drug preparation unit	To be dressed according to chemotherapy drug preparation standards,	**Doctor (Facilitator):** Requests to repeat the dose calculation.
			Complying with the principles of chemotherapy drug withdrawal from ampoules and vials	
			Preparing the drugs specified in the chemotherapy protocol in appropriate doses	
12–15 minutes	The patient's condition remains stable. The patient lies in the bed	There is an infusion pump in the patient room	Informing the patient	**Patient:** If the patient is not informed, he or she asks, "What are you going to put on me now?" and wants to get information.
			Initiating premedication by following the patient safety principles	

Testing the Design

Once the design is completed, it should be tested with a pilot study. The parts that are forgotten, missing, or are not understood should be determined in the pilot study, and the design should be edited (Committee, 2016e). In this implementation, the environment and checklists were tested with other nursing students (a different group similar to the target group) who were not involved in this simulation implementation.

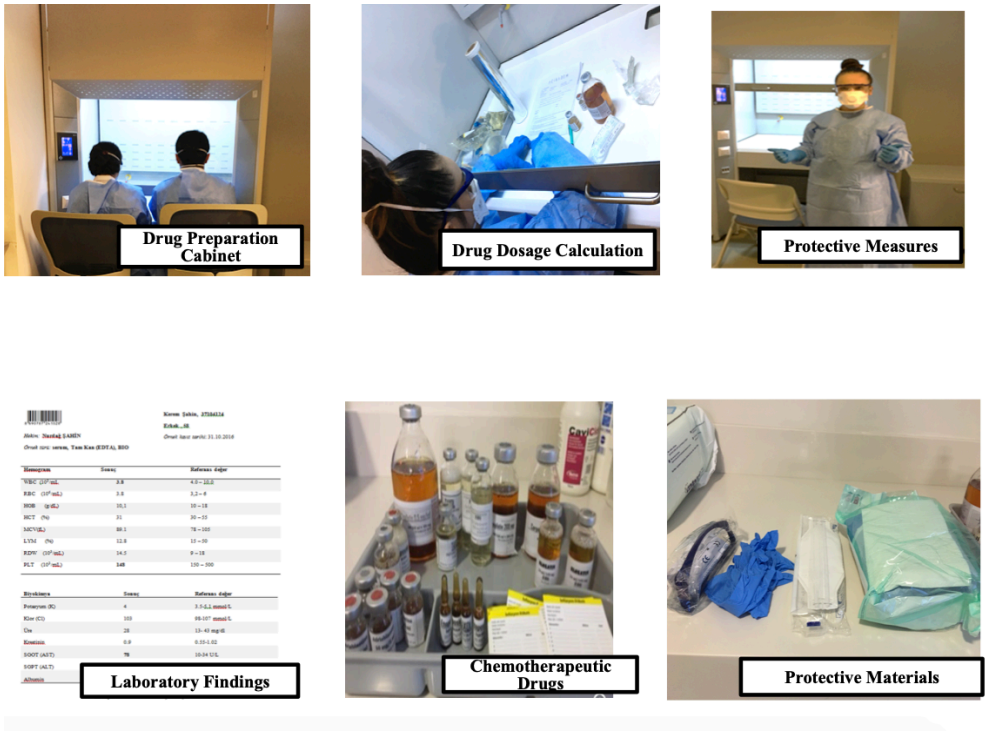

Figure 1. Physical, psychological, and conceptual fidelity implementation*
**The images are from the authors' archive. Consent was obtained from the students for their use*

Fidelity

Fidelity can be defined as the possibility of the case to be seen in real life, its reasoning, and the simulation ability of the cases in the simulation environment (Committee, 2016f). Physical fidelity is associated with the patient, simulator, standardized patient, environment, equipment, embedded participants, and support systems. It reflects the case of the implementation or situation to be seen in real life. Conceptual fidelity is the logic and reality of each case in the scenario or situation (e.g., diagnosis and vital signs compliance). Psychological fidelity is defined as the simulation ability of the cases in the simulation environment (e.g., active voice of the patient, noise, family members, other team members, time pressure, competition) (Committee, 2016e).

In practice, preparations were made for physical, psychological, and conceptual fidelities to increase the fidelity level of the scenario (Figure 1).

Within the context of physical fidelity, necessary materials for security measures were obtained according to the number of students, and the drug preparation cabinet was used.

Within the scope of psychological fidelity, the medium-fidelity simulator was dressed in a patient outfit and laid in a semi-sitting position. Moulage was applied to the simulator according to its age, and glasses and a wristband were put on it. The model was made speak by the moderator with the help of a walkie-talkie. By providing lighting and sound effect in the drug preparation cabinet, the cabinet became operational. Labels were prepared in a word file suitable for the visual images of the requested drugs and adhered onto the empty drug bottles, and the water put into the empty drug bottles according to the drug properties was colored with moulage paints. Within the context of conceptual fidelity, the breast, lung, and colon cancer cases having the highest possibility to be encountered by the students during clinical practice

were prepared. Chemotherapeutic drug protocols similar to the ones used in the hospital were adapted to the patient, and a physician request form was prepared. By obtaining hospital laboratory results, laboratory results were prepared in the same image. The patient file was prepared, and attachments were placed in it. To prevent information transmission during the scenario implementation, different case histories and drug protocols were given to each group.

Facilitator Approach

There are many facilitator methods, and the method to be used for the determined goals should be decided. The facilitator is the person who takes responsibility for managing the entire simulation-based experience. Facilitation enables the simulation to progress. Facilitation actually begins by reconciling participants' goals with the course or learning goals before orienting the participants to the simulators and simulation environment. It also continues during the simulation implementation. Facilitators in the simulation implementation can manage this process with various clues (Committee, 2016b).

The trainers in this simulation implementation took a different professional role to ensure the progress of the scenario and the facilitator role as the analysis session moderator. The students experienced the scenario in groups of two. A total of three people including one facilitator participated in the scenario. Each scenario took about 15 minutes. One of the trainers played a doctor role as a facilitator and ensured to give clues facilitating the scenario flow in case that the scenario does not continue/block (Table 3). The roles expected from the students were as follows:

Nurse 1: Meets the patient and interprets the laboratory findings, obtains approval from the physician about its suitability, and requests support from a teammate (Nurse 2) for the preparation of drugs; ensures the preparation of drugs.

Nurse 2: Prepares the drugs in line with safe drug administration steps after approval his/her teammate obtains the approval; starts premedication treatment.

Doctor (facilitator): Receives information from the nurse interpreting laboratory findings and approves drug administration.

Prebriefing

Prebriefing includes informing the participants and adaptation activities to build trust about the environment prior to the scenario implementation. It contains the activities such as meeting the participants, sharing information about the simulator, and introducing the environment, understanding the expectations/goals, defining the roles of the participants, obtaining ethical approvals, and setting a time schedule (Chmil, 2016; Committee, 2016f).

In this implementation, the prebriefing stage was applied to all students who would participate in the implementation prior to the scenario, and it took about 20 minutes. Table 4 shows the information given to the students within the scope of prebriefing.

Table 4. Prebriefing

- Sharing information about the simulator
- Expectations about the scenario/understanding the goals
- Fulfillment of requirements before the simulation
- Obtaining video/photo shooting permissions
- Ensuring privacy and a safe learning environment
- Reminding of safety issues
- Understanding the defined role by all participants
- Giving the expected timetable
- Giving information about the debriefing

Participant Preparation

The preparation stage is important for the participants to achieve simulation goals successfully. During the preparation stage, the preparation for the implementation (reading assignments, courses, didactic sessions, questions/answers specific to the simulation, video, pretest, etc.) and for administrative (confidentiality/privacy and informing about expectations) processes must be completed (Committee, 2016e).

The theoretical course content prepared for course objectives within the scope of the Cancer Nursing course was transferred to students using the classical learning method. One week before the simulation scenario implementation, lecture notes, books, and guidelines about the preparation of CT drugs were given to the students as printed materials. Prior to the implementation, the students were reminded about the rules to be followed in the simulation center (no cell phones, course notes, books or any course materials, food and drink in the implementation area, removing the jewelry, wearing a lab coat, etc.).

Ethical Issues: It was informed that all education practices were for learning purposes and that the privacy of the training should be considered. Images of the students were recorded during the implementation. The students were informed that the personal information would be kept confidential, and their consent was obtained. In addition, consent was obtained from the students for the use of their photos.

Debriefing and/or Feedback

After the implementation of all simulations, a debriefing session should be held to help participants gain permanent skills (Committee, 2016a). The planned session consisting of collaborative and reflective process led by a competent person after simulation-based experience and in which the participants' experiences are discussed is defined as analysis (Committee, 2016f). In this study, debriefing was performed by a trainer who carefully observed the implementation during the scenario implementation. The debriefing environment was planned in a way that supported learning, was safe, protected privacy, maintained open communication, and enabled the self-assessment of the individual. Attention was paid to ensure that the debriefing is compatible with the expected results. During the debriefing phase, sessions involving 8–10 students were held and the Promoting Excellence and Reflective Learning in Simulation (PEARLS) method was used (Eppich & Cheng, 2015). The PEARLS method consists of four stages: reaction, identification, analysis, and summarizing. Sample questions by stages are listed in Table 5.

Evaluation

In nursing education, an evaluation of the simulation technique is as important as its use. The evaluation of the implementation is multidimensional, and many parameters such as participants, facilitators, team members, training results, and simulation process can be evaluated. In all simulation implementation, the assessment methods of scenario participants should

Table 5. Steps of the debriefing by using the PEARLS method

Reaction	Definition	Analysis	Summarizing
How did you feel?	What did you do for your patient?	What do you think you're doing well?	In summary, what are your inferences?
How do you feel now?	What were the objectives of the scenario?	What would you like to change if you had a second chance?	What are the key points we learned from this scenario?

be determined and clearly indicated to the participants. Valid and reliable tools should be used to evaluate the results (Committee, 2016d).

To objectively assess the skill steps of the students during the simulation implementation, a checklist consisting of 26 items, including the steps of preparing CT drugs and being developed by the trainers in line with the literature, was used. The method of assessing the skill defined as a competence-based assessment strategy through direct observation was used (Boztepe, & Terzioğlu, 2013). While the students fulfilled the skills expected in the simulation environment, the clinical trainer monitored how those skills were performed and evaluated through a pre-structured and staged checklists. The clinical trainer observed whether the students followed the determined drug preparation steps and chose the appropriate material during drug preparation, and the students used the material correctly during drug preparation steps. For each skill step, "sufficient," "partially sufficient," and "insufficient" options were marked. The checklists were shared with the students in the analysis session, and the reflective questions were discussed over the implementation steps.

CONCLUSION AND RECOMMENDATIONS

In this study, the steps followed during the use of a simulation method in teaching safe CT drug administration were shared. During the realization of the method, simulation design stages and a design template from the best practice standards of INACSL were used. A well-designed scenario implementation is important in terms of minimizing the problems that may arise during the flow and ensuring the quality of education. Therefore, a scenario design should be systematically addressed and planned according to the INACSL best practice standards. The use of a simulation method in teaching the drug administrations is an effective method enabling students to work in a comfortable and safe learning environment without being exposed to risky CT drugs. It is thought that the students indirectly meet the patient and employee safety measures with the simulation method. Planning of different scenarios according to student's levels and using them in education are recommended.

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