



Influence of undergraduate nursing student teaching methods on learning standard precautions and transmission-based precautions: Experimental research



Maria Soledad Kappes Ramirez

Nursing School, San Sebastian University, Lago Panguipulli 1390, Puerto Montt 5501842, Chile

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ABSTRACT

Objectives: An experimental study was performed with undergraduate nursing students in order to determine, between two methodologies, which is the best for learning standard precautions and precautions based on disease transmission mechanisms.

Methods: Students in the sample are stratified by performance, with the experimental group (49 students) being exposed to self-instruction and clinical simulation on the topic of standard precautions and special precautions according to disease transmission mechanisms. Conventional classes on the same topics were provided to the control group (49 students).

Results: The experimental group showed the best performance in the multiple-choice post-test of knowledge ($p = 0.002$) and in the assessment of essay questions ($p = 0.043$), as well as in the evaluation of a simulated scenario, in relation to the control group.

Conclusions: This study demonstrates that it is possible to transfer some teaching subjects on the prevention of Healthcare Associated Infections (HAIs) to self-learning by means of virtual teaching strategies with good results. This allows greater efficiency in the allocation of teachers to clinical simulation or learning situations in the laboratory, where students can apply what they have learned in the self-instruction module.

1. Introduction

Healthcare Associated Infections (HAIs) are the most prevalent adverse events in the world according to the World Health Organization (WHO) (Barríos Araya et al., 2011).

Millions of dollars are spent on direct costs (Abdraboh et al., 2016) that have a great impact on public health, not counting indirect HAI costs and associated morbimortality for patients, families, and communities. For this reason, prevention is a central issue for nursing (Chalmers and Straub, 2006).

Within HAI, the key concepts in terms of prevention are the correct management of standard precautions and precautions based on disease transmission mechanisms (CDC, 2007; Tavolecci et al., 2008). Standard precautions and precautions based on disease transmission mechanisms were strategies developed by the World Health Organization in order to reduce the risk of transmission from pathogens by blood or other sources (CDC, 2004).

There is no consensus about the best way to teach these concepts to nursing students or other health care students (Lam, 2014; Barikani and Afaghi, 2012; D'Alessandro et al., 2014; Hinkin and Cutter, 2014).

Nursing education has traditionally been based on behavioral models and conventional learning methodologies (Acevedo-Gamboa, 2009); nonetheless, the importance of developing critical thinking in students is also considered key, which is not achieved by this type of learning (Stanley and Dougherty, 2010).

Constructivism has been indicated as one of the learning theories that contributes to teaching through knowledge transformation, which occurs due to the learner's active thinking. Furthermore, this learning is best in circumstances that are of interest to the student, stimulating his or her autonomy (Kahn and Friedman, 1993).

Due to the relevance of HAI and its complexity, it is necessary to have a transversally instilled teaching method in nursing which stimulates reading and critical thinking (De Oliveira Giroti and Garanhani, 2016; Sax et al., 2005) and the correct application of standard precautions, especially hand hygiene and aseptic techniques (Megeus et al., 2015; Seibert et al., 2014; Van de Mortel et al., 2010).

Thus, the development of interactive support for nursing education seems to be a natural scenario (Ainsley, 2009). Moreover, it is well evaluated by students, who see it as a fast and easily accessible tool for learning (Ryan and Davies, 2016). Interactive computer modules allow

E-mail address: maria.kappes@uss.cl.

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the use of all available technology, including videos, to be incorporated as teaching tools (Blazeck et al., 2016; Bloomfield et al., 2010; Gerdrasert et al., 2010). Based on this background, an experimental study was conducted with nursing students to determine which method is best to teach standard precautions and precautions based on disease transmission mechanisms. The methodologies of lectures vs. computational modules and clinical simulations were analyzed.

This study contributes to nursing and its undergraduate education due to the lack of agreement about the best methodologies to teach key HAI concepts, which lead to a better understanding and subsequent management and prevention of this important adverse event.

2. Method

An experimental study was performed with second-year nursing students at San Sebastián University, Puerto Montt, Chile. Students did not receive theoretical content of standard precautions or precautions based on disease transmission mechanisms prior to the study.

As a student's prior academic performance may influence his or her acquisition of knowledge that will be evaluated later, second-year students were previously stratified according to academic performance and then randomized to be assigned to two groups (intervention and Control) in a way that both groups were homogeneous in prior academic performance.

Inclusion criteria:

- Students who regularly attend the second year of the nursing degree.
- Students who signed informed consent agreeing to participate.

Exclusion criteria:

- Transfer students from other venues or universities.
- Non-regular students (repeat students)
- Students declining to participate in the study

Inclusion criteria were applied to the sample population (125 students), which was required to consent to the research, resulting in 98 students. A survey numbered from 1 to 98 was given to the 98 students. This survey contained socio-demographic data (age, sex, who they lived with while studying) and also questions about study habits (teaching methodology preference, frequency of university library visits, electronic resources used, hours devoted to study) and teaching preferences for better learning. On a separate document, a faculty administrative officer associates the correlative survey numbers with the identification numbers of student ID cards and, according to prior academic performance, classifies the students into Group 1, group 2, group 3 and group 4. Group 1 corresponds to students with a previous academic average of 4.0–4.4, group 2, 4.5–4.9, group 3, 5.0 to 5.4 and group 4, over 5.5. Thus, researchers received surveys with only a correlative number and the group to which the student belonged according to prior academic performance. Subsequently, the 98 students were randomized, leaving 49 students in the control group and 49 in the intervention group.

The sample size was calculated based on a universe of 125 students, with an error of 5% for 95% confidence and 50% variability, resulting in a minimum of 95 students.

A knowledge pre-test was performed at the beginning, which was the same for both groups (control and intervention). The pre-test consisted of two parts: the first item with multiple choice questions (15 questions) and the second item with essay questions (5 questions). The multiple choice and essay questions were based on knowledge of standard precautions and precautions based on disease transmission mechanisms. This pre-test provides a basis to evaluate knowledge acquired by students after exposing them to the teaching methodology.

The alternative questions corresponded to multiple-choice questions, where students attempted to choose the right alternative, for example:

One of the following diseases requires precautions based on airborne transmission:

- a) Varicella Zoster Virus (Chickenpox)
- b) Meningococcal meningitis
- c) Syncytial ARI (Acute Respiratory Infection)
- d) ARI caused by adenoviruses
- e) Pneumonia by *A. baumannii*

Students were asked to apply their knowledge to clinical situations in the essay questions. For example:

“List the elements necessary to establish precautions based on transmission mechanisms in a patient diagnosed with acute diarrheal syndrome with dehydration. *C. difficile* has been identified as a causative agent.”

This instrument was validated locally through the judgment of 3 experts and subsequently submitted to a pilot test that determined a reliability of 0.85 measured with Cronbach's alpha. It is available for any researcher who requests it.

The control group (Group 1) was exposed to theoretical lectures on standard precautions, additional precautions according to disease transmission mechanisms, Ministry of Health of Chile (MINSAL) regulations and at the end of the class, questions were asked based on a clinical case. In this clinical case, students were confronted with a clinical service with a high rate of surgical site infection (SSI) by *E. aureus*. Students should have been able to recognize the problem and identify relevant SSI prevention measures.

The intervention group (Group 2) was given access to a self-instructional computer module, accessed through a password, containing the same contents and self-assessment questions as the control group (Group 1). This module was carried out by the student, without a teacher. At the end, a clinical simulation was carried out for a clinical case (the same one used in group 1) in a nursing laboratory, using dummy patients in a simulated clinical environment to identify relevant SSI prevention measures.

Finally, a posttest was performed for both groups, which was similar to the test at the beginning. They were also evaluated in a simulated clinical setting to assess knowledge application. These two assessment strategies were done for the two groups (control and intervention), after two weeks of intervention.

In the simulated scenario evaluations, students were confronted with a patient presenting an infected wound with a history of previous infections by Multi-resistant MOs. Therefore, for three scenarios, student abilities were assessed with their patients, considering the multi-resistant MO infection, wound healing and culture taking. This assessment was performed blindly by a tutor in another level of career instruction that was different from the researchers. Students who were evaluated were only identified by the number they were assigned associated with their I.D. card (RUT in Chile) after agreeing to participate in the study. The evaluation was performed by a rubric that assigned scores to each behavior, cataloging results as: unacceptable, insufficient, good and very good.

The researcher adhered to ethical principles of E. Emanuel, which were analyzed in this study and accepted by the nursing faculty scientific ethics committee.

3. Results

Both groups were compared statistically to verify sample normality in terms of previous academic performance. Normality was tested with the Kolmogorov-Smirnov & Lilliefors test (95% confidence level). Data presented was normal ($p > 0.05$); therefore, a parametric analysis was performed. A student analysis test with a reliability level of 95% ($p > 0.05$) was carried out for dependent samples. Results showed that the two groups were homogeneous in relation to their grades

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