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Educational Interventions for Infection Prevention and Control Among Nursing Students: An Integrative Review

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Abstract

Objectives: The research results indicated that nursing students were injured by needles or sharp objects and exposed to blood or body fluids. The study aims to critically review the literature on educational interventions for infection prevention and control among nursing students. *Methods:* The database of Google Scholar, EBSCO MEDLINE, PubMed, CINAHL and ScienceDirect was used to search for related literature, using the keywords "educational program", "nursing students" and "infection control and prevention". Three researchers independently screened and reviewed literature based on certain criteria for differences in variables such as study characteristics, population characteristics, intervention characteristics, outcomes and intervention effectiveness. *Results:* 11 articles were finally determined to fully meet the inclusion criteria for reviewing, including four simulation-based educational intervention studies, four technology-based educational intervention studies and three traditional education intervention studies. The results indicated that most of studies found a statistically significant improvement in students' knowledge and performance of infection prevention and control in the intervention groups, however, the retention of the variables occurred in the intervention program with simulation or technology components. *Conclusion:* The results of the study were evidence for further intervention studies that develop the intervention program in enhancing the nursing students' competency in infection prevention and control.

Keywords: infection prevention and control, education, nursing students, integrative review.

Introduction

Nurses play an important role in patient care. Therefore, training of clinical practice skills for nursing students accounts for a large proportion (50%) in the nursing curriculum [1]. During the entire clinical practice period, nursing students participate in patient care under the supervision of clinical instructors. However, the clinical environment always has potential risk factors such as toxic environment, chemotherapy drugs, violence, needle/sharp injury, latex allergy, blood-borne infectious diseases, mental health problems [2]. The research results indicated that nursing students were injured by needles or sharp objects and exposed to blood or body fluids [3],[4]. Consequences of exposure to blood and body fluids increased the risk of anxiety and stress among students, more seriously, the risk of infection with blood-borne pathogens such as HBV, HCV, HIV and life threatening [2], [5]. The research results showed 17.8% of students experienced occupational exposure during their clinical internship [2].

Study results indicated that the effectiveness of education and training for students effectively limited

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the risks of occupational exposure for nursing students [6]. There were various educational interventions to improve infection prevention control (IPC) practice among nursing students. IPC educational programs depended on the level of competence of the nursing student, the characteristics of the nursing education system, and the ability of the faculty providing the education [7]. Research mentioned that simulation-based educational intervention was associated with increased knowledge, compliance, and practical quality and outcomes in patients [8]. The simulation based - education intervention about IPC presented their effectiveness for nursing students, these programs should be offered repeatedly during clinical practice to reinforce students' knowledge and adherence to IPC practice [9]. In addition, the technology-based educational interventions with poster and short video clips can help strengthen the practice of IPC in safe clinical practice. Traditional educational methods using video presentations, demonstrations, and structured observations proved that nursing students will receive adequate support in solving IPC issues encountered during clinical practice.

Although these interventions were developed, implemented and researched, most faculty were unable to implement them because some interventions were controversial about the effectiveness of the intervention program on student outcomes and practice outcomes [10],[11]. In addition, some interventions were not guaranteed to effectively implement these interventions, because the intervention process were complex and unclear, some interventions were without follow-up period to evaluate sustainability of the intervention on the outcomes of nursing students' IPC practice and practice outcomes [10-12]. Therefore, the aim of this study was to critically review the literature on educational intervention aimed at promoting and enhancing the IPC practice in nursing students. The results were the integrated review as evidence of the effectiveness of educational interventions on IPC practice among nursing students. The interventions and their effectiveness discussed in this integrated review may assist higher education institutions with appropriate educational interventions in effectively motivating nursing students during clinical practice. It may also enable nursing students to act as responsible future nurses, understanding the importance of IPCs in providing safe and quality care.

Methods

Search Procedure and Database

An integrated assessment approach was implemented and PRISMA was used to improve rigor. The researchers conducted an extensive database search using Google Scholar, EBSCO MEDLINE, PubMed, CINAHL and ScienceDirect to search for related literature, using the keywords "educational program", "nursing students" and "infection control and prevention". The review included all studies of educational intervention conducted using experimental designs that compared a group of students receiving an infection prevention and control educational intervention by a certain method with a group of students receiving traditional educational program. The results indicated that there were some integrative reviews, however, no similar systematic reviews existed. A screening process would then examine titles and abstracts in order to assess suitability.

Inclusion Criteria

Journal articles were identified according to the following criteria: (1) nursing student population; (2) the intervention was an educational intervention on IPC for nursing students, elements of an intervention were examined; (3) Outcomes were the goals of educational interventions (e.g., IPC knowledge, attitude, practice, confidence, satisfaction, performance; (4) Most appropriate study designs were randomized controlled trials.

Purpose: To critically review the literature on educational intervention aimed at promoting and enhancing the IPC practice in nursing students.

Research Questions

1. How have educational interventions for nursing students that promoted and enhanced the IPC knowledge and practice?
2. In what way(s) has/have effective teaching approaches enhanced IPC knowledge and practice in nursing students?

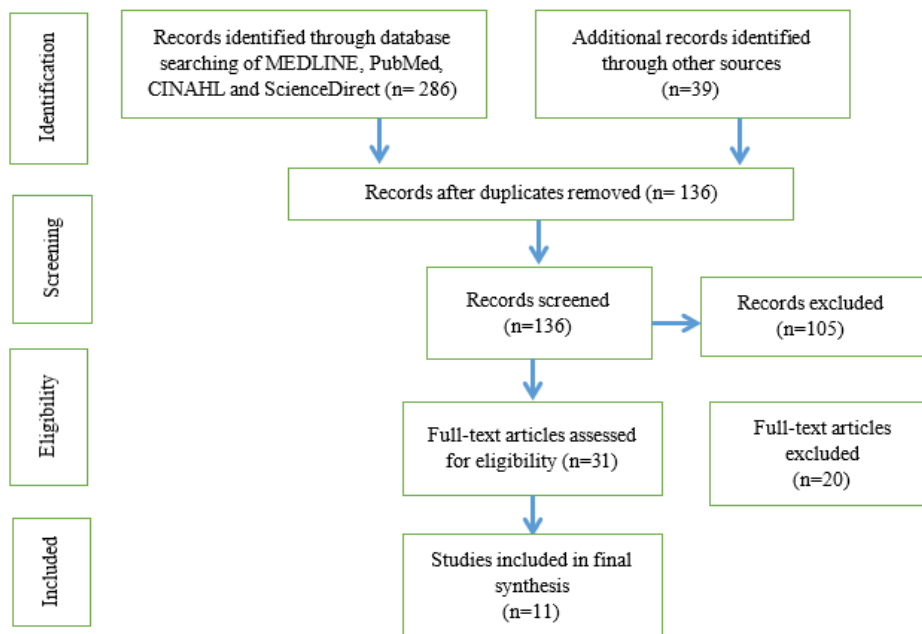
Screening Process

Three authors reviewed articles that used educational intervention as a focus, concentrated on articles among nursing student populations. Reviewed journal articles published after 2010 were included in the study. The researchers then looked for citations in these collected studies. In addition, the researchers continued to check the list of references from the primary reviews to identify additional studies that were not identified in the previous electronic search.

Data Extraction and Analysis

The three researchers performed the data extraction independently, based on certain criteria for differences in variables such as study characteristics, population characteristics, intervention characteristics, outcomes and intervention effectiveness. From the articles included, we perform content analysis to uncover topics relevant to IPC educational interventions for nursing students.

Figure 1: PRISMA flow diagram of study selection



Results

During a database search, there were 286 potentially related articles and then there were 39 more likely related articles from the reference list of the original articles. By removing duplicates, 136 potentially related articles were identified for inclusion in the review. The titles and abstracts of the articles were carefully read, 31 articles were selected to be read in their entirety. Finally, 11 articles were determined to fully meet the inclusion criteria. These articles were summarized in Table 1.

The major findings of this study are presented as follow: (1) Characteristic of included studies; (2) interventions details; (3) impact of interventions; (4) quality of studies, and (5) translation to practice and replication of study.

Characteristic of Included Studies

Eleven studies were included in the review (Table 1). Three of the included studies were RCTs [1], [2], [3] and four were non-RCTs [4], [5], [6], [7]. Two studies used pretest and posttest designs without a control group [8], [9], and two studies utilized mixed method [10], [11]. Most articles were published in English except one published in Korea but including abstract in English [6]. These studies were from various regions of the world including Canada (n=2), Korea (n=2), USA (n=1), Spain (n=1), Indonesia (n=1); Jordan (n=2), China (n=1), and Taiwan (n=1). Sample size ranged from 24 to 287.

Interventions Details

The content and format of educational interventions varied considerably across studies. Eight studies provided the educational intervention through school or university setting [2], [3], [4], [6], [7], [9], [10], [11] two at clinical setting [1], [5] and one through online [8]. These educational interventions ranged in duration from a hour [2] to a few hours [10], [11], [7], [9] to several days [6], [3] to multiple weeks [1], [8], [5] or across a school or university semester [4]. Regarding to teaching methods, seven studies consisted of a multiple teaching method [4], [1], [10], [11], [7], [5], [9] and included lectures, small group work, group discussions, simulation, scenarios, role play, video clips, online group. Two studies relied on independent learning either by using an online education module [8] or poster [2]. One used only a lecture format [3] and one reported unclear teaching method that was approached [6]. Of nine studies which used multiple teaching method, three focused on simulation [10], [11], [7], two utilized peer assistance learning [5], [9].

The timing of the measurement of outcomes varied across studies. Most of included studies completed the pretest before giving the intervention and posttest immediately or shortly following the educational intervention except only one study of Luctkar –Flude et al (2014) was without pretest survey [11]. Two studies measured long term effect of the intervention [4], [9].

Types of Interventions

The simulation-based educational interventions. The programm consisted of modules, formal lectures, simulation scenarios [10],[11],[7]. Wu and colleagues (2009) provided various strategies of five modules and prereading, triggers (presenting relevant problems), formal lectures, hands-on demonstrations, simulation scenarios, role play, brainstorming and group discussion [10]. Another research was conducted on 24 students participated in a pilot IPC simulation intervention. This pilot project demonstrated the feasibility of using high-fidelity patient simulation to reinforce infection control skills and promote interprofessional communication and teamwork [11]. The simulation based educational program was conducted on 237 students in an interactive lecture and four standardized patient scenarios by Kim and colleagues (2020). The simulation using standardized patients. It was found to be more effective in improving nursing students' infection control performance from these studies [7],[10],[11].

The technology-based educational interventions. There were four articles using the technology supports. The programmes consisted of media education sessions with audio tapes, videos and online sessions. A pre-post experimental intervention study was conducted with a total of 293 nursing students randomly assigned to two groups. The use of posters as a teaching method indicated indications of efficacy for the intervention group. Further evaluation of teaching methods is needed to ensure good technical performance of hand hygiene to prevent the spread of infectious diseases during the

COVID-19 pandemic [12]. The study of Xiong was conducted on 84 nursing students participated in a media education intervention program at a teaching hospital in China. The intervention group attended 3 biweekly mixed media education sessions, consisting of lectures, videos, role-play, and feedback via online and face-to-face sessions. The results indicated that the knowledge attitude and compliance with standard precautions were significantly improved in the intervention group [13]. The study of Hassan (2018) revealed a significant improvement in undergraduate nurses' knowledge and compliance through online sessions [14]. However, the research results indicated that large numbers of students were satisfied with the intervention program, although, the intervention was without effectiveness [15].

The traditional educational interventions. Kim and colleagues conducted for four-day sessions, seven hours in each session. The program was conducted by the specialists in infectious diseases and the nurses specializing in infection and the third year students at University. The results revealed that the experimental group showed statistically significant improvements in knowledge, attitude, and performance confidence in infection control and prevention [8]. Another research was conducted at the hospital environment with 45 nursing students. The program consisted the peer assisted learning method involving senior students. The strategy increased the knowledge and skills of nursing students in applying standard precautions [16]. Hussami and colleagues conducted research on 104 final year students using the educational program with 6 modules related to IPC. The program was developed based on the King's theory. The results indicated that there was a significant difference in the knowledge and attitude scores of participants in the intervention group [17].

Impact of Interventions

Of the eleven studies, nine examined the impact of education interventions on knowledge of infection control [1], [3], [4], [5], [6], [7], [10], [8], [9]. All these nine studies found a statistically significant improvement in knowledge of ICP. However, two studies measured long term effects after 3 months in study of Wu (2009) and after 2-5 months of the author Wagner (2010) revealed conversed result. In particular, Wu (2009) showed the long-term effect of education intervention whereas Wagner (2010) reported that retention of knowledge was disappointing low in 2 of 3 participant groups [9], [4], [15]. However, there was no control group for objective comparison of effectiveness of the educational intervention in Wagner (2010) study might present a risk of bias.

Four studies examined the confidence of participants in resolving infection-related issues [4], [10], [11], [6]. Three of them reported increased significantly after the intervention [4], [10], [6], the other one study without pretest survey to compare the results with before intervention reported confidence with all skills except enhanced precautions [11].

Four studies examined participants' ability to apply their knowledge correctly in a clinical situation and performance ICP [2], [4], [7], [9]. Two studies illustrated the effects of poster [2] and simulation scenarios [7] in improving the performance with infection control. The study of Wu (2009) which used multiple teaching method did not significantly improve participants' ability to apply infection control precautions when compared with the control group [4] as well as Wagner (2010) which used ICE PACK with interdisciplinary approach showed the disappointment when the skill dropped from 100% at the initial training to 59% at the follow up session [9].

Four studies examined participants' attitude to implement standard precautions procedures [1], [3], [9], [6]. All these four studies demonstrated the effect of education interventions in increasing the attitudes of participants with ICP. Five studies examined participants' compliance with standard precautions [1], [3], [5], [8]. Of these studies, three reported a statistically significant improvement

in compliance with standard precautions [1], [5], [8]. One study of Hussami and Dawarad, 2013 did not show the difference between 2 groups, however, the statistic reported the significance within intervention group before and after the education [3]. However, this study only used a lecture format and limited sample size presented risk of bias. These results demonstrated the effect of mixed media education, online education and peer-assistance learning in enhancing the compliance with standard precautions.

Other impacts of interventions were self-developed, communication and team work, satisfaction with the educational module [18], [10]; awareness of ICP, infection-related anxiety [7]. These outcomes measurements came from simulation-based intervention studies. The results found that simulation scenarios increase the awareness of ICP, self-developed, infection-related anxiety, the communication and teamwork of participants as well as the satisfaction with the educational module. Specially, study of Kim (2020) reported infection-related anxiety and infection control performance were significantly higher in the simulation using a standardized patient group compared to peer role-play [7].

Discussion

Our initial database searches identified 11 studies that met the inclusion criteria for this review. Of these, results found evidence regarding to the effects of education intervention on knowledge, attitude, confidence, performance, and compliance with ICP. The majority of studies found statistically significant differences in educational intervention group compared to control group or pretest result compared to posttest result on knowledge, attitude, confidence, performance, and compliance with ICP. Moreover, simulation-based education studies reported the impact of simulation patient on self-developed, communication and teamwork, satisfaction with module, awareness, and anxiety of participants. However, due to some inherent methodological limitations including an absence of randomization [4], [5], [6], [7], lack of a control group [8], [9], small sample size [11] hence may threaten the reliability of our review findings. Only three out of eleven studies were randomized controlled trial designs, it is, therefore in high demand to conduct further studies which have randomized controlled trial designs and larger sample size to confirm the effectiveness of education interventions to inform policymakers, nursing administrators, and hospital administrators.

There was substantial variation in types of intervention, the intensity and duration of the educational interventions, the educational format, and the teaching methods across studies. The current review suggested multiple teaching methods should be applied in approaching and delivering the education intervention. This finding is consistent with other literature review which concluded participant's preferred educational method used for teaching infection control cited small group discussion with integration of practical sessions, frequent follow-up, and interactive lecturing [12]. However, the question raises what types of intervention are more effective, how long it should be conducted to yield positive impact on participants' learning outcomes still unanswered.

Across the studies, most outcomes were measured immediately after the intervention, with only two studies measuring outcomes a long time (typically 2 to 5 months) later that showed mixed results on knowledge of ICP. Therefore, the effect of education can only improve short term effect whether the effects are sustained in the long term is unclear. Further studies that evaluate the long-term effect of education intervention should be performed.

In term of effectiveness of the studies, the simulation based educational intervention program indicated that there were statistically significant increases students' learning outcomes. However,

absenteeism from classes was a factor that might have caused the failure of the programme to improve students' performance and confidence [10], [11]. Some research studies have established that students' academic performance is affected by their attendance records [19]. A further indicator of the degree of success of the SnAP programme is the increased confidence of students in resolving infection-related issues. This success can be attributed to the strength of the learning theory applied in delivering the programme. A study demonstrated the feasibility of using high-fidelity patient simulation to reinforce infection control skills and promote interprofessional communication and teamwork [11]. Moreover, the simulation using standardized patients was found to be more effective in improving nursing students' infection control performance. These results were congruent with the previous studies; therefore, it is recommended that simulation-based education be included in curricula focused on performance [20], [21], [16].

The technology-based educational interventions presented somehow effectiveness. The studies indicated that there was a significant improvement in nurses' knowledge and compliance after the educational intervention with technology support such as online sessions, mixed media [14],[13],[12]. Although the education component was entirely online and no mentors were involved, the short-term implications were good for the instructional methodology [14]. The study demonstrated the significant effect of a mixed media intervention for nursing students at the beginning of clinical training was effective in improving knowledge, attitude, and compliance with SPs as well as hand hygiene among nursing students [13], [12]. These findings were consistent with a recent study among Jordanian nursing students [22].

The health and education system are increasingly developed, the purely traditional teaching methods seem to be no longer relevant in practice. The educational program was effective in promoting only participants' knowledge of infection prevention and control [17]. Kim and colleagues (2016) showed that our intensive education program on hospital infection control was effective for the nursing students. The results congruent with the previous studies [16], [23].

Studies synthesized in our literature review were carried out in different countries over the world. This can be explained by the critical important of this topic along with the recent emergence of a number infectious disease and consequences to health care professional as well patient safety. However, there were without discussions regarding to each country's cultural backgrounds, which may inhibit the applicability of the findings in a diverse population.

Previous studies were conducted in different countries with some low-resource countries, where healthcare and education systems are inadequate. Therefore, the future studies need to conduct in low-resource areas to develop the effective interventions for improving nursing students's competency in IPC. In addition, longitudinal studies with simulation and technology intergration in the education are needed to evaluate the long-term effects of effective interventions.

Conclusion

The current integrative review included 11 articles that provided evidence on the interventions for improving nursing students' competency on IPC. The simulation-based educational intervention, the technology-based educational intervention and the traditional education intervention were types of the interventions, in which the simulation and technology -based educational interventions presented the better learning outcomes of the nursing students. Further intervention studies should be developed with

integrating of simulation or technology components for enhancing the nursing students' competency in infection prevention and control.

Table 1: The IPC educational interventions for nursing students

Study quality/Recommendations/Limitations	<ul style="list-style-type: none">This is a good quality studyThe duration of classes of 18 weeks may be too long to be feasible in nursing	<ul style="list-style-type: none">The study was high bias because of small sample size and no control groupthe interprofessional infection control	<ul style="list-style-type: none">The low response rates presented risk of biasThe combination of IP exposure, infection control skills practice, and the SP simulation mode were	<ul style="list-style-type: none">The mixed media education intervention implemented at the beginning of clinical training was
Findings	<p>Research results showed that an educational program with a simulation component improve significantly</p> <ul style="list-style-type: none">The SnAP intervention program included 1 hour weekly of classes for 18 weeks.The programThe 15-item Knowledge ScaleThe 13-item An Application Scale	<ul style="list-style-type: none">Participants reported confidence with all skillsThe interprofessional simulation-based training was valuable.A simulation involving three high-fidelity patients in a complex health care context was offered to senior prelicensureThe Communication and Teamwork ScaleA 7-item, 6-point Likert scale of Confidence	<ul style="list-style-type: none">Participants improved in their knowledge quiz scores following the scenarios.The student' s confidence (p<0.05) performing infection control skills <p>The IPC education intervention included:</p> <ul style="list-style-type: none">50 mins interactive sessionstudents worked in IP groups of six to seven studentsA knowledge quiz of infection control practicesThe 8-item confidence performing infection control skills scale	<ul style="list-style-type: none">At 6-week follow-up, Knowledge with Standard Precautions, Attitude with Standard
Intervention program	<ul style="list-style-type: none">The SnAP intervention program included 1 hour weekly of classes for 18 weeks.The programThe 15-item Knowledge ScaleThe 13-item An Application Scale	<ul style="list-style-type: none">Participants reported confidence with all skillsThe interprofessional simulation-based training was valuable.A simulation involving three high-fidelity patients in a complex health care context was offered to senior prelicensureThe Communication and Teamwork ScaleA 7-item, 6-point Likert scale of Confidence	<ul style="list-style-type: none">Participants improved in their knowledge quiz scores following the scenarios.The student' s confidence (p<0.05) performing infection control skills <p>The IPC education intervention included:</p> <ul style="list-style-type: none">50 mins interactive sessionstudents worked in IP groups of six to seven studentsA knowledge quiz of infection control practicesThe 8-item confidence performing infection control skills scale	<ul style="list-style-type: none">The intervention group (n=42) attended 3 biweekly mixed media education sessions, consisting of lectures,The Knowledge with Standard PrecautionsQuestionnaire, The Attitude with
Measurements	<ul style="list-style-type: none">The 15-item Knowledge ScaleThe 13-item An Application Scale	<ul style="list-style-type: none">The Communication and Teamwork ScaleA 7-item, 6-point Likert scale of Confidence	<ul style="list-style-type: none">A knowledge quiz of infection control practicesThe 8-item confidence performing infection control skills scale	<ul style="list-style-type: none">The Knowledge with Standard PrecautionsQuestionnaire, The Attitude with
Participants, sample size, sampling methods	<p>175 4th year students in the 5-year programmes were assigned to an intervention (n=80) or control group (n=95)</p>	<p>24 students participated in a pilot IPC simulation intervention</p>	<p>237 students participated in an interactive lecture and four standardized patient scenarios</p>	<ul style="list-style-type: none">80 nursing students participated in a media education intervention program at a teaching hospital in Hubei, China (40
Study design	<p>Quasi experimental design</p>	<p>Mixed method study</p>	<p>Mixed method study</p>	<p>RCT</p>
Author, year and settings	<p>Wu et al., 2009 Taiwan</p>	<p>Luckar -Flude et al, 2014</p>	<p>3. Luckar -Flude et al, 2016, Canada</p>	<p>4. Xiong, 2016, China</p>

<ul style="list-style-type: none"> • This was a feasibility study with small sample size and without • The students reported a low level of understanding and adherence to Standard • The intervention program included - learning contract contained the questions 	<ul style="list-style-type: none"> • Nursing instructors should consider to combine the application of PAL methods in 	<ul style="list-style-type: none"> • The intervention was not clear described • The measurement • In the experimental group, a significant difference was observed in • The intervention program included 2-group intervention • The number of CFU/cm2 before and after hand hygiene 	<ul style="list-style-type: none"> • There was only one scenario used in the study • The study • The students in the intervention group statistically • The program was developed based on the • Knowledge of Standard Precaution • Awareness of Standard 	<ul style="list-style-type: none"> • Limitation: quasi-experimental design • There was no follow-up period • The intervention program had only 4 IPC • There was a significant difference in the knowledge and attitude scores of participants in the intervention group • There was no difference • The program included 4 IPC sessions. Each session last 4 hours at the school of nursing. The sessions were guided by King's • The knowledge of infection prevention • The attitude 	<ul style="list-style-type: none"> • This was a multicenter study to evaluate the effectiveness of an IPC education program, there was no control group for comparison. • Research results showed that students experiencing the program demonstrated solid knowledge and skills. • ICE teaching and assessment module • The multiple educational modalities were developed using PP, tests, live and video • The knowledge and attitude questionnaire of IPC • The hand hygiene and aseptic technique
<p>Measurements of the study were:</p> <ul style="list-style-type: none"> • Questionnaires for 256 undergraduate nursing students participated in an online education module in <p>Pretest and posttest without control group</p>	<p>Quasi experimental design</p>	<p>RCT</p>	<p>Quasi experimental design</p>	<p>RCT</p>	<p>Thirty-four students participated in the aseptic technique training module.</p> <p>Pretest and posttest without control group</p>
<p>5. Hassan, 2018, Jordan</p>	<p>6. Desnita, et al, 2020, Indonesia</p>	<p>7. Gázquez - López, et al., 2021, Spain</p>	<p>8. Kim et al., 2020, Korea</p>	<p>9. Al-Hussami, et al., 2013, Jordan</p>	<p>10. Wagner, 2010, USA</p>

11. Kim 2016, Korea	Quasi experimental design	<p>61 nursing students assigned to an intervention group (33) and a control group (28)</p> <p>The measurement were assessed at</p> <ul style="list-style-type: none"> • There was no follow-up period to examine the sustainability of the intervention program on nursing student improvement • The intervention program had only 4 IPC sessions of 7 hours. • The study results showed that the intervention program significantly improved knowledge, attitude and confidence about the ability to perform IPC skills when compared with the control group. • The intervention program was developed by the specialists in infectious diseases and the nurses specializing in infection. • The program was provided to nursing students in the • The IPC knowledge and attitude questionnaire. • The confidence questionnaire of IPC skill
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