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## Knowledge Level of Nursing Students on Nosocomial Infection

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### ABSTRACT

**Objective:** This study was carried out to evaluate the knowledge level of student nurses on nosocomial infection.

**Materials and Methods:** The sample of this descriptive study consisted of a total of 208 nursing students in the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> year of a foundation university between February and March 2019. Study data were collected through “Student Information Form” and “Nosocomial Infection Information Form of Nursing Students” prepared in accordance with the literature.

**Results:** The mean age of the student nurses was 21.78±2.21 years. Moreover, 27.4% of the students graduated from a vocational school of health services and 20.7% of them were already employed while continuing their education. Further, 72.1% of the student nurses stated that they received training on nosocomial infections, 90.4% needed training on nosocomial infections, and 76.9% required training, most importantly, on the measures related to the route of transmission. The item in which most of the student nurses provided an incorrect answer (92.3%) was “The intravenous catheters attached to the patient should be changed every 48–72 h at the latest.”

**Conclusion:** The total mean score of student nurses’ knowledge level of nosocomial infection was above the moderate level. To meet the educational needs of the student nurses about nosocomial infections, provisions of more comprehensive trainings on this issue and of updated information in line with the recently published guidelines through continuing education programs after graduation are necessary.

**Keywords:** Nosocomial infection, infection control, education, nursing student

### INTRODUCTION

Nosocomial infections (NIs), also known as healthcare-associated infections, are one of the most common adverse events in care delivery and emerge as a public health problem that have a significant effect on morbidity, mortality, and quality of life (1). Over a million healthcare-associated infections occur in the United States healthcare system every year, leading to the loss of tens of thousands of lives (2). Prolonged lifespan, patients’ access to modern medical and treatment facilities, and widespread use of surgical and invasive interventions have greatly changed the source, transmission route, and susceptible NI population. In addition, the emergence of multidrug-resistant bacteria increased the rate of refractory infections and difficulty of infection control (3).

The development of NIs causes extra use of antibiotics, increases treatment cost, and prolongs hospitalization (4). In the United States, NIs cause at least 30,000 deaths per year, prolong hospital stay by 7–10 days, and incur an additional cost of \$ 5–10 billion per year (5). According to the Centers for Disease Control and Prevention, on any given day, approximately 1 in 31 in-hospital patients has at least one health care-associated infection (6). In addition, with surveillance and/or effective infection control measures, a large percentage of NI can be prevented (7). Effective infection prevention and control reduces NI by at least 30%. Many infection prevention and control measures, including hand hygiene practices, are simple, low-cost, and effective; however, staff training requires accountability and behavioral change (8). However, even when it comes to the well-being or survival of the patients, it has been very difficult to change human behavior, including the behavior of medical staff. Therefore, an organizational culture that focuses on infection control practices will reduce the incidence of NI (9). To achieve sustainable success in this area, leaders are encouraged to support and improve their infection prevention activities (10).

NI is an important threat to patient safety, and nurses play an important role in the development and prevention of NI (11). Compliance of nurses responsible for patient care and treatment with infection control measures are extremely important for a safe and quality health care. Nurses should know when isolation is applied and what is included in isolation types and must comply with isolation measures during care and treatment practices (12). Since they are healthcare professionals with most contact with the patients, nurses should know the importance of NIs more than others. Therefore, nurses need to have accurate and sufficient knowledge in the prevention of NI (13). Student nurses are also more often at risk for transmission of infectious agents when providing services

#### Cite this article as:

Davran E, Karaca A.

Knowledge Level of Nursing Students on Nosocomial Infection. Erciyes Med J 2021; 43(2): 135-41.

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Submitted  
05.04.2020

Accepted  
11.09.2020

Available Online Date  
09.02.2021

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in health institutions (14). For this reason, they should be provided with information on the causes of NI, transmission routes, isolation measures, hand hygiene, and use of protective equipment. In line with this purpose, the knowledge level of student nurses on NI should be evaluated and necessary training programs organized. In this way, NI development can be prevented or incidence rate can be decreased by providing student nurses with information on prevention of NIs before, during, and after patient care. This study was carried out to evaluate the knowledge level of student nurses on NI.

## MATERIALS and METHODS

### Study Design

This study follows a descriptive design.

### Population and Sample of the Study

The study was carried out at the school of nursing of a foundation university. The study population included 300 student nurses in their 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> year. The minimum sample size was calculated to be at least 169 people with an alpha 0.05 margin of error and a 95% confidence interval. The study sample consisted of 208 student nurses (69%) who agreed to participate in the study and provided data appropriate for analyses. Since first-year student nurses lacked clinical experience and did not take a course on infectious diseases and nursing practices, they were not included in the study.

### Ethical Considerations

The study was carried out with permission from the University Clinical Research Ethics Committee (Decision No: 15.01.2019/2019–02–01) and institutional permission from the school of nursing. The participants were explained that obtained data would be kept confidential and would not be shared with anyone, and their consent was obtained using the “Voluntary Informed Consent Form.”

### Data Collection

Prior to data collection, the class, day, and time of questionnaire collection were planned. Relevant teachers were contacted and informed about the subject, and their permission was obtained. At the determined dates and times, data were collected by attending the classes before the related lesson started. To increase the number of samples, the same classes were re-attended on different days and lessons to reach student nurses who were absent or did not attend the course that day. Before the questionnaire forms were distributed to the student nurses, the purpose of the study was explained and they were told not to write any identifying information. The filled forms were collected by the researchers after 10–15 min. The “Student Information Form” and “Nosocomial Infection Information Form of Nursing Students” were used as data collection tools.

**Student Information Form:** This form, prepared in light of the literature (12–16), contained a total of 15 questions related to the sociodemographic characteristics of the student nurses.

**Nosocomial Infection Information Form of Nursing Students:** This form was developed by the researchers based on the literature. It consists of eight sub-dimensions and a total of 36 questions. These sub-dimensions were as follows: nosocomial infection, catheter-associated urinary tract infections, surgical site infections,

bloodstream infection, ventilator-associated pneumonia, hand hygiene, glove use, and isolation measures. Statements were based on the information about the most common NIs and the practices that nurses should know and pay attention in preventing NI. Each statement was answerable by “true” or “false.” Correct answers are scored as 1 point and wrong answers as 0 with 0 as the lowest score and 36 as the highest score. An increase in the knowledge score indicates that the knowledge level of the student nurses on NIs have increased. Accordingly, the highest score that student nurses can receive from the Nosocomial Infection Information Form is divided into three equal parts and breakpoints were determined. For the information form score, 0–12 points were classified as low level, 12–24 as moderate level, and 24–36 as high level.

Although the tool was not valid and reliable, as it was developed by the authors, to ensure its reliability, the internal consistency coefficient of the information form was calculated with Kuder-Richardson Formula 20 (KR-20). The calculated coefficient was 0.85, which showed that the findings were reliable for the study sample.

### Data Analysis

Descriptive statistics such as frequency, arithmetic mean, standard deviation, and percentage were used in regard to sociodemographic characteristics of the student nurses.

## RESULTS

The mean age of student nurses was  $21.78 \pm 2.21$  years, and 80.3% were female. Moreover, 40.4% of the student nurses were in the 3<sup>rd</sup> year, and 40.9% were general high school graduates. In addition, 20.7% of the student nurses who graduated from the health vocational high school nursing department were already employed while continuing their education. The average working time in the profession was  $22.28 \pm 27.56$  months and that of the unit was  $15.98 \pm 23.79$  months. In this study, 8.2% of the working students also worked in other units (oncology, hematology, plastic surgery, kidney–liver–bone marrow transplantation, neonatal intensive care unit, etc.). In addition, 72.1% of the student nurses stated that they received training on NIs, of which 60.1% claimed that they received formal training, while 16.8% received in-service training. In addition, 90.4% of the student nurses stated that they needed training on NIs. Accordingly, 76.9% needed training on measures related to the route of transmission (Table 1).

The distribution of the NI total knowledge scores of student nurses is presented in Table 2. The total mean score of the students’ NI knowledge was  $26.62 \pm 2.73$  (range, 12–33) and the median value was 27. The distribution of the responses to the Nosocomial Infection Information Form items are presented in (correct answers are indicated in bold). In the analysis of the responses to the information form, 97.1% of the student nurses provided the correct answer on the item “NIs are one of the most important indicators of the quality of care in hospitals,” while 92.3% provided incorrect answer on the item “The intravenous catheters attached to the patient should be changed every 48–72 hours at the latest.”

## DISCUSSION

NIs are an important health problem both in the world and in our country and are one of the most important indicators of the quality

**Table 1.** Distribution of student nurses by sociodemographic characteristics (n=208)

Characteristics	Category	n	%
Age	Mean: 21.78±2.21 (Range: 19–35)		
Sex	Female	67	80.3
	Male	41	19.7
Year	2. year	62	29.8
	3. year	84	40.4
	4. year	62	29.8
High school education	General high school	85	40.9
	Anatolian/science high school	66	31.7
	Vocational school of health services	57	27.4
Working status	Yes	43	20.7
	No	165	79.3
Working time in the profession	Mean: 22.28±27.56 ay (Range: 1–108)		
Working time in the unit	Mean: 15.98±23.79 ay (Range: 1–108)		
Unit	Intensive care	9	4.3
	Surgical service	7	3.4
	Internal medicine	4	1.9
	Operating room	2	1.0
	Emergency	3	1.4
	Outpatient clinic	1	0.5
	Others	17	8.2
	Education received about nosocomial infections	Yes	150
	No	58	27.9
Education type received about nosocomial infections*	Formal education	125	60.1
	In-service training	35	16.8
	Symposium/congress	17	8.2
	Social media/internet	10	4.8
	Others	7	3.4
Whether there is a need for training on nosocomial infection	Yes	188	90.4
	No	20	9.6
Training needed about nosocomial infection*	Causative factors		
	Urinary tract infection	132	63.5
	Surgical site infection	154	74.0
	Bloodstream infection	135	64.9
	Ventilator-associated pneumonia	138	66.3
	Prevention activities		
	Standard measures	147	70.7
	Measures related to the route of transmission	160	76.9
Protective equipment	153	73.6	

\*Multiple answers

of care in hospitals. Personnel working in NI prevention, especially nurses, have important responsibilities. For this reason, issues related to isolation measures should be given importance and related trainings provided not only to the healthcare personnel but also to all hospital workers, including student nurses and their awareness should be augmented. Although NI is not completely eradicated, its contribution to patient health and national economy is certainly

reduced. This section explores the study findings in the light of the literature, in accordance with the sub-dimensions of the Nosocomial Infection Information Form.”

### Catheter-Associated Urinary Tract Infections

According to the National Healthcare Safety Network, urinary tract infection is the most common type of healthcare-associated infec-

**Table 2.** Descriptive statistics of nosocomial infection total knowledge scores (n=208)

	Range	Median	Mean±SD	Min.	Max.
Total score	0–36	27.00	26.62±2.73	12	33

**Table 3.** Distribution of student nurses' responses to nosocomial infection knowledge scores (n=208)

Items	True		False	
	n	%	n	%
Nosocomial infection				
1. These are infections that do not exist at the time of admission to the hospital and are acquired in the hospital.	201	96.6	7	3.4
2. It develops after 48–72 h of hospitalization.	186	89.4	22	10.6
3. It can appear after discharge from the hospital.	179	86.1	29	13.9
4. Hospital infections are one of the most important indicators of the quality of care in hospitals.	202	97.1	6	2.9
Cathete-associated urinary tract infections				
5. Urine catheters made of silicone should be replaced within 15 days.	132	63.5	76	36.5
6. It is important to keep the drainage bag at the bladder level	114	54.8	94	45.2
7. Sterile gloves do not need to be worn while the Foley catheter is attached.	35	16.8	173	83.2
8. It is very important to monitor the urine color in a patient with a Foley catheter.	199	95.7	9	4.3
Surgical site infections				
9. Surgical site infections are infections that occur within a maximum of 30 days after surgical intervention.	157	75.5	51	24.5
10. Electric shaver should be used for cleaning the area to be operated.	179	86.1	29	13.9
11. Antiseptic skin preparation should be carried out circularly from the incision line to the outside.	198	95.2	10	4.8
12. The temperature of the operating room changes according to the type of surgery.	109	52.4	99	47.6
Bloodstream infection				
13. The intravenous catheters attached to the patient should be changed every 48–72 h at the latest.	192	92.3	16	7.7
14. The infusion sets should be changed within 24 h after the start of the infusion.	175	84.1	33	15.9
15. Before the catheter is inserted, the antiseptic solution applied to the entrance site should be allowed to dry.	175	84.1	33	15.9
16. The catheter area should be wiped out with antiseptic solution from center outside.	196	94.2	12	5.8
Ventilator-associated pneumonia				
17. Sterile water must be used in oxygen flow meter containers.	197	94.7	11	5.3
18. When the amount of water in the oxygen flow meter containers is reduced, it can be added.	113	54.3	95	45.7
19. The tracheostomy tube should be changed only when necessary	103	49.5	105	50.5
20. It is important to adjust the head of the patient's bed to 30–45°.	201	96.6	7	3.4
Hand hygiene				
21. Hand hygiene is among the most important factors in preventing nosocomial infections.	164	78.8	44	21.2
22. Washing hands before and after touching the patient is among the five indications of hand washing.	201	96.6	7	3.4
23. Hygienic hand washing is washing hands and wrists for at least 1 min with water, soap and antiseptic solution.	188	90.4	20	9.6
24. Social hand washing is washing hands and wrists with soap and water for 30–60 s.	193	92.8	15	7.2
25. Surgical hand washing is the washing of hands by brushing them with antibacterial soap or detergent, usually by friction for 2–6 min.	195	93.8	13	6.2

**Table 3 (cont.).** Distribution of student nurses' responses to nosocomial infection knowledge scores (n=208)

Items	True		False	
	n	%	n	%
26. It is not enough to use only alcohol-based hand sanitizer in cases where there is visible contamination in the hands	<b>174</b>	<b>83.7</b>	34	16.3
Glove use				
27. Sterile gloves should be worn in contact with blood and all kinds of body fluids.	184	88.5	<b>24</b>	<b>11.5</b>
28. There is no need to wash hands with soap and water after removing the gloves.	26	12.5	<b>182</b>	<b>87.5</b>
29. After removing the gloves, rubbing hands with an alcohol-based hand sanitizer is sufficient	<b>91</b>	<b>43.8</b>	117	56.2
30. It is not necessary to change gloves for different procedures on the same patient.	31	14.9	<b>177</b>	<b>85.1</b>
31. Gloves must be removed first while removing the personal protective equipment.	<b>115</b>	<b>55.3</b>	93	44.7
Isolation measures				
32. Standard measures should be applied to all patients regardless of the patient's diagnosis and whether there is an infection.	<b>182</b>	<b>87.5</b>	26	12.5
33. Standard measures include measures for factors that can be transmitted with blood and body fluids.	<b>187</b>	<b>89.9</b>	21	10.1
34. Respiratory isolation is applied in addition to standard measures.	<b>174</b>	<b>83.7</b>	34	16.3
35. N95 mask should be used in patients with tuberculosis, measles and chickenpox.	<b>196</b>	<b>94.2</b>	12	5.8
36. In the presence of contact isolation, the "yellow star" identifier should be used on the entrance door of the room.	119	57.2	<b>89</b>	<b>42.8</b>

Correct answers are indicated in bold

tion. Urinary catheters are placed in 15%–25% of the patients in a health facility, at least once during their stay. Approximately 75% of hospital-acquired urinary tract infections are associated with urethral catheterization (6). To prevent the development of the urinary tract infection, the drainage bag should be lower than the bladder level and should not touch the ground. Silicone or Teflon catheters, which reduce urethritis formation and better tolerated by the body, are preferred for catheterization for as long as 2–3 months (17).

When the items of urinary tract infection sub-dimension were examined, 54.8% of the student nurses stated that the drainage bag should be kept at the bladder level and 63.5% of them claimed that urine catheters made of silicone should be replaced within 15 days. More than half of the student nurses had incorrect conception on these issues. Thus, necessary explanations should be made to the student nurses regarding these issues. In this study, 37.2% of the student nurses stated that the drainage bag and the whole collecting system should be at the level of the bladder, and this finding is similar to obtained by Yıldız (16).

### Surgical Site Infections

Infections that occur within 30–90 days after surgical intervention and within 1 year after implant placement are defined as surgical site infections (18). Only 24.5% of the student nurses responded correctly to the item "Surgical site infections are infections that occur within 30–90 days after surgical intervention." However, 86.1% of the student nurses gave correct answer to the item "Electric shaver should be used for cleaning the area to be operated." Yıldız (16) determined that 67.6% of the student nurses responded correctly by saying "The hairs are cut 24 hours before the surgery," and this rate was lower than that in our study. Within the scope of

this dimension, 52.4% of the student nurses gave correct answer to the item "The temperature of the operating room changes according to the type of surgery." On literature review, the temperature of the operating room should be 20°–23° and adjusted to 18°–26° according to the type of the surgery (19).

### Bloodstream Infection

Intravenous catheter is an indispensable tool of medicine. Many interventions are performed for the diagnosis and treatment of patients, and every attempt increases the risk of infection. Although catheters are used for many interventions, they are also used for fluid therapy, parenteral nutrition, infusion of blood and blood products, and infusion of medications. Peripheral catheters do not need to be replaced more frequently than every 72–96 h to reduce the risk of thrombophlebitis and infection in adult patients (20). In our study, 92.3% of the student nurses responded incorrectly to the item indicating that indwelling intravenous catheters should be changed every 48–72 h at the latest. Yıldız (16) reported that 81.4% of their respondents stated that catheters inserted for intravenous treatment should be changed every 48–72 h at the latest. In this regard, information provided for the student nurses should be presented in accordance with the current guidelines. In other items, 84% of the student nurses gave correct answer to the item "The infusion sets should be changed within 24 hours after the start of the infusion." On literature review, the infusion sets should be changed every 24 h in primary intermittent infusions. Multiple replacements of intermittent infusion sets increase the risk of contamination at all connection points and consequently catheter-related bloodstream infection. In parenteral nutrition, solutions and sets should be changed every 24 h at the latest (20).

### Ventilator-Associated Pneumonia

Mechanical ventilation increases the risk of pneumonia, and ventilator-associated pneumonia is the leading cause of death among hospital-acquired infections. Reducing mortality due to ventilator-associated pneumonia requires consistent application of the best evidence-based practices (2). To prevent aspiration, the head of the patient's bed should be maintained between 30° and 45°, and ventilator circuits should not be changed unless necessary (21). When the amount of water in the oxygen therapy humidifier decreases, it should not be added on top, and containers that are cleaned and disinfected should be filled with sterile water after drying. Moreover, the tracheostomy tube should be changed only when necessary, and aseptic technique should be followed during replacement (22)."

In this study, less than half of the student nurses (45.7% and 49.5%, respectively) responded correctly to the items "When the amount of water in the oxygen flow meter containers is reduced" and "Tracheostomy tube should be changed only when necessary." Moreover, 96.6% of the student nurses stated that the head of the patient's bed should be adjusted to 30°–45°.

### Hand Hygiene

The simplest and most effective method of preventing NIs is hand washing. The source of the transport and spread of microorganisms with high virulence and multiple drug resistance among patients is the dirty hands of healthcare professionals in 20%–40% of cases (23). Five situations that required hand hygiene are as follows: before touching the patient, before clean/aseptic procedure, after body fluid exposure/risk, after touching the patient, and after touching the patient surroundings (9). For this sub-dimension, 96.6% of the student nurses gave correct answer to the item "Washing hands before and after touching the patient is among the five indications of hand washing." Within the scope of this sub-dimension, the item "It is not enough to use only alcohol-based hand sanitizer in cases where there is visible contamination in the hands" was answered largely (83.7%) correctly. Unlike our study, in the study by Yıldız, 62.1% of the student nurses responded incorrectly to the item "It is sufficient to use only alcohol-based hand sanitizer in cases where there is visible contamination in the hands." (16) Student nurses were found to have low-to-moderate level of knowledge and compliance with hand hygiene. A study revealed the importance of the role of nurse educators in improving hand hygiene competence in student nurses (24). Tem et al. (25) reported that the level of knowledge, attitude, and hand hygiene practice among nursing and midwifery students was moderate; thus, they recommended conducting training programs to improve students' attitudes about hand hygiene. Similarly, student nurses have insufficient knowledge about the significance of hand hygiene, so the importance of education, specifically on this subject, should be emphasized (15). In another study (26), the lowest moment-specific compliance of the student nurses was recorded before contacting patients or patient surroundings and before the application of clean/aseptic procedures, so student nurses should be trained to comply with the guidelines during clinical procedures.

### Glove Use

Using gloves to prevent NI is an important barrier method for both staff and patients. The main purpose of using gloves is to prevent

hand contamination, to prevent transmission of microorganisms through blood, body fluids, secretions, or skin contact, and to prevent the transmission of microorganisms from healthcare staff to patient, from patient to healthcare staff, or from one patient to another (27). Gloves with tear or puncture should be changed immediately, and a used glove should not be reused. While removing the glove, the clean side should be pulled inside out, and after taking off the gloves, hands should be washed again or rubbed with alcohol-based hand sanitizer (28). In our study, 11.5% of the student nurses gave correct answer to the item "Sterile gloves should be worn in contact with blood and all kinds of body fluids" (glove use sub-dimension). In addition, 87.5% of the student nurses stated that after removing the gloves, hands should be washed with soap and water, and 43.8% stated that after removing the gloves, rubbing hands with an alcohol-based hand sanitizer is sufficient. To prevent the spread of infection, the order of removing protective equipment is as follows: gloves, protective eye-wear-face shield, apron, and then mask (29). In this study, 55.3% of the student nurses responded correctly to the item "Gloves must be removed first while removing the personal protective equipment."

### Isolation Measures

One of the main strategies to successfully control NIs is to employ isolation measures. Implementing isolation measures is important to protect healthcare professionals, patients, and families (11). Standard precautionary measures that should be applied to each patient regardless of the illness should include measures to eradicate microorganisms that can be transmitted through blood and body fluids. In addition to standard measures, respiratory measures should be applied to people known or suspected to be infected with respiratory and epidemiologically important pathogens. In infections requiring respiratory isolation, an N95 type mask should be worn, and a yellow leaf symbolizing the respiratory tract should be hung on the door of the room (29). In this sub-dimension, 94.2% of the student nurses gave correct answer to the item "N95 mask should be used in patients with tuberculosis, measles, and chickenpox." In addition, 87.5% of the student nurses stated that standard measures should be applied to all patients regardless of the patient's diagnosis and whether there is an infection. In addition, 57.2% of the student nurses incorrectly answered that the identifier should be used in cases indicated for contact isolation. Cruz (30) revealed that student nurses had moderate compliance with standard precautions, so clinical nurses should supervise the student nurses on practicing infection prevention standards and techniques and monitor hospital's adherence to policies (30). In the present study, as a measure to assure student compliance during clinical placements, mentors should be aware of their influence on students' performance, help them comply with established guidelines, and give regular feedback.

### Limitations

This study is limited to students studying nursing in the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> year of a foundation university. In addition, students' level of knowledge about NI is limited to the information form prepared by the researchers.

### CONCLUSION

In our study, the total mean score of the NI level of knowledge among student nurses was above the moderate level. Most of the

student nurses stated that they received training on NIs during formal education. Moreover, most of the student nurses needed education even though they received training on hospital infections. Thus, it is necessary to provide trainings to student nurses in line with the current guidelines, to support and update them at certain intervals, especially after graduation through continuing education programs, and to include them in the orientation program of new nurses. Evaluating the students' level of knowledge determines the needed training related to NI. By this way, data on which issues should be prioritized or on which misinformation needs to be corrected will be obtained.

Infection prevention and control are universally relevant components of all health systems that affect the health and safety of both recipients and providers of health services. There is a need to increase the awareness of nurses, whose primary role is patient care and who have a great role in preventing infections, starting from formal education, so that they can internalize this issue.

**Ethics Committee Approval:** The İstanbul Bilim University Clinical Research Ethics Committee granted approval for this study (date: 15.01.2019, number: 2019–02–01).

**Informed Consent:** Written informed consent was obtained from student nurses who participated in this study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – ED, AK; Design – ED, AK; Supervision – ED, AK; Resource – ED, AK; Materials – ED, AK; Data Collection and/or Processing – ED, AK; Analysis and/or Interpretation – ED, AK; Literature Search – ED, AK; Writing – ED, AK; Critical Reviews – ED, AK.

**Conflict of Interest:** The authors have no conflict of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

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