

Practical Strategies for Decreasing and Controlling Permi-Cath Infection in Patients on Hemodialysis

Shahrzad Khojandi,¹ Safoura Dorri,² Meisam Rahimipour-Anaraki,¹ and Alireza Irajpour^{1,*}

¹Nursing and Midwifery Care Research Center, Critical Care Nursing Department, Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, IR Iran

²Department of Medical Surgical Nursing, Iran University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Alireza Irajpour, Nursing and Midwifery Care Research Center, Critical Care Nursing Department, Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, IR Iran. E-mail: irajpour@nm.mui.ac.ir

Received 2015 December 21; Accepted 2015 December 23.

Abstract

Background: One of the methods for achieving vascular access in hemodialysis patients is using cuffed hemodialysis catheters (permi-cath), which has some risks such as infection. *Staphylococcus* is the most common microorganism that causes permi-cath infection, and has contaminated 90% of clinical staff.

Objectives: This study aimed to determine some strategies to reduce the level of permi-cath infection in hemodialysis patients.

Patients and Methods: This was an action research, conducted on 32 patients with permi-cath, 21 of whom had acquired this infection in the past six months. The subjects were selected through convenient sampling. The required data were collected by observations, interviews and using the data documented in the patients' medical files as well as a questionnaire. The etiological factors of permi-cath infection were investigated; the strategies were determined through staffs' participation and using a standard guideline. Economical strategies were administrated based on their priority and applicability.

Results: Twenty-five (65%) patients received antibiotics (vancomycin); this number decreased to one (4.6%) after the intervention. Fourteen (44%) were hospitalized before the intervention; this also decreased to zero after the intervention. Therefore, there was a statistically significant difference between the number of patients taking antibiotics before and after the intervention.

Conclusions: Action research is an appropriate method for changing and improving nurses' practice. Since staffs' viewpoints are considered in this method, it makes them accept the required changes more rapidly. In addition, the decisions that are made will be more stable.

Keywords: Hemodialysis Patients, Permi-Cath, Infection Control

1. Background

The most remarkable medical concern among health staff and communities in the early 21st century was the increasing prevalence of chronic diseases (1). One of these diseases, which caused significant stress for the patients, was end stage renal disease (ESRD). More than two million people have ESRD throughout the world; this number is increasing by 5% every year (2). Among alternative treatments, hemodialysis is the most commonly used treatment method in ESRD patients (3). Hemodialysis does not change the natural course of renal disease and does not replace the kidneys completely and the patient still experiences various problems and complications (4). There were about 3670 hemodialysis patients in Iran in 1992; this number was 8500 in 2002, 11250 in 2003 and 18000 in 2007 (5). According to the statistics of the special diseases treatment deputy of Isfahan, the number of hemodialysis patients reached 1400 patients in 2011.

Vascular access methods include temporary and permanent methods. One of the permanent vascular access methods is using cuffed hemodialysis catheters (permi-

cath). Using permi-cath has some risks such as infection, vein stenosis and inadequate blood flow (3); among the mentioned risks, infection is the leading cause of losing catheters, hospitalization and death.

Staphylococcus aureus is one of the most common cultured bacteria in permi-cath infections; it is present in the nose and intestine natural flora of 30% - 50% of the population, and 90% of the hospitals clinical staff are contaminated by this organism. Such bacteria, especially those that are transferred to patients from the hospital environment, are among methicillin-resistant bacteria and vancomycin is usually used for treating them (6).

Nurses can provide the background for more appropriate care for themselves and the patients (7). According to previous studies, considering the issue that most of the nursing management of the hemodialysis ward is being done in the absence of physicians, hemodialysis nurses' role during treatment stages has been estimated as 80% (8). Nurses should be able to identify problems associated with renal replacement therapies (7), and thus have

a significant role in preventing or treating hemodialysis patients' infections.

2. Objectives

In this regard, there has been an action research study with the aim of providing possible strategies for decreasing permi-cath infections in hemodialysis patients of Ali Shariati hospital of Isfahan.

3. Patients and Methods

This study was done through the action research method. Participants of the study included all the hemodialysis patients (who had active and constant files at the hemodialysis ward of Ali Shariati hospital in 2012 and were being treated by hemodialysis through permi-cath), infection control and hospital health authorities and the staff of the hospital hemodialysis ward, one nephrology specialist physician and the patients' relatives in Isfahan. The present study was done with the participation of the hospital management and the medical sciences research team of Isfahan.

Action research began in the 1960s by a social psychologist named Kort Louin in America (9, 10). This type of research has some stages in the experts' viewpoints. In Louin's viewpoint, action research has four stages including: planning, implementation, observation and publication (11).

In Speziale et al. viewpoint, action research has five stages including: defining the problem, planning, data interpretation, implementation and evaluation of the research procedure during the work or at the end (12). Since Streubert Speziel and Carpenter's action research stages have been used more than other nursing research methods, this study was done according to their viewpoint.

In the first stage of the study, the problem was defined, which was increasing prevalence of permi-cath infection compared with global standards among hemodialysis patients of the hospital. In the second stage, planning was done to solve the problem; all the possible strategies were considered and planning was done for their implementation. In the third stage, the collected data were analyzed and scored according to the suitability, feasibility and flexibility (SFF) model. In this model, every item (suitability, feasibility and flexibility) was scored from one to three; a score of three was the highest and one was the lowest score. Then the sum of the three items was calculated; so that, every strategy could have a score of nine at most and three at least. In the fourth stage, the strategies with the highest score were implemented and finally in the fifth stage, an evaluation was done quantitatively and qualitatively.

3.1. Defining the Problem

The first observations of the researchers indicated a high level of permi-cath infection in chronic renal failure

patients that were being treated by hemodialysis at Ali Shariati hospital; in total, 100 hemodialysis patients were at Ali Shariati hospital, among which 32 patients were using vascular permi-cath for implementing the hemodialysis procedure. According to the conducted investigation on these patients' records, 21 of them had taken antibiotics during the recent eight months due to diagnosis of permi-cath infection. Sixty-five percent of all the patients had permi-cath. Fourteen patients (44% of patients with permi-cath), in addition to taking antibiotics were also hospitalized and had positive blood culture; this is while a study in Australia conducted during year 2012 reported an infection prevalence rate of 11%; 25% of this amount was related to blood infection due to permi-cath infection (13). Comparison of these statistics shows that the level of permi-cath infection in Iran is much higher than the international statistics.

Dancer (2008) emphasized on the importance of hospital environment health; he stated that the hospital environment is an important factor in transferring hospital infections such as methicillin-resistant *Staphylococcus*, *Clostridium difficile*, vancomycin-resistant enterococci and noro viruses (14). Martinez et al. (2003) stated that the prevalence of vancomycin-resistant enterococci was high at intensive units even with using available severe environmental hygiene disinfectants, which indicates that there is a need for new disinfectants (15).

3.2. Data Collection

Data collection was done through observations, interviews and records on permi-cath infection cases, positive blood culture, use of antibiotics and hospitalization rate due to permi-cath infection, as well as questionnaires.

After presenting an introduction letter, we visited Ali Shariati hospital and obtained informed written consents regarding participation in the study from all the participants.

All the probable causes such as, symptoms like fever, frequent shivering during hemodialysis, increasing amount of permi-cath change, infectious secretions of permi-cath entrance, positive blood culture, increasing amount of antibiotics in hemodialysis ward and patients' hospitalization due to permi-cath infection were assessed and listed. After implementing strategies, their effectiveness was determined by a final evaluation during a seven-week period. The causes of permi-cath infection were assessed by the nursing staff, the head nurse and the infection control and hospital health authorities, during seven sessions, which were about 405 minutes in duration. Some strategies for decreasing permi-cath infection were presented in these sessions. The suggested strategies were in accordance to the infection decrease guideline for hemodialysis patients (16) and the study of Charmaine and Lok (2011) regarding prevention and management of permi-cath infection (17).

After collecting strategies in different categories, all the presented strategies were scored according to suitability, feasibility and flexibility. All the strategies with higher scores and feasibility were chosen and planning was done for their implementation.

Finally, the strategies according to their priorities were as follows:

- Training the patients regarding personal hygiene (shaving around the permi-cath area)
- Disinfecting patients' permi-cath by the patient themselves before entering the ward
- Hand-washing education for the nurses
- Emphasizing on nurses' hand-washing before coming in contact with any patient
- Emphasizing on using individual gloves for every patient
- Having a hand dryer or napkin available for drying hands after washing
- Disinfecting floor mats, sinks etc. using appropriate antiseptic solutions (according to the standards)
- Training nurses regarding permi-cath infection complications and how to work with them
- Placing disinfecting solutions beside the dialyzer for disinfecting nurses' hands before and after contact with the patient
- Emphasizing on complete disinfection of the dialyzer with appropriate disinfecting solution after every usage
- Applying permi-cath bandage if required
- Emphasize on completing dialyzer washing time
- Wearing shoes or slipper covers by the patient before entering the ward
- Wearing shoes or slipper covers and gowns by the patient's relatives before entering the ward
- Observation of the sterilization points by the nurses for setting machines
- Training the patients regarding wearing appropriate clothes in at home and at the time of rest (cotton, clean and loose clothes)
- Training the patients about the way of taking care of permi-cath
- Providing and presenting educational pamphlets for the patients
- Screenings of educational films for the patients about sterilization of the permi-cath area before entering the ward

All the above strategies were implemented by the approval of the infection ward and hospital health authorities. There was some resistance and problems during implementation of the strategies. For educating patients, a change in their attitude was required for improving their knowledge, which was very difficult as they had been carrying out their activities with a routine procedure for a long time and they didn't feel any need for change. Changing patients' attitudes and promoting their knowledge was done by inviting their families and asking their cooperation and also holding several educational classes and using motivational methods. The

ways of taking care of the permi-cath and preventing permi-cath infection were taught to all the patients during dialysis. The importance of using shoe covers and personal hygiene (shaving around the permi-cath area, using appropriate and clean cotton clothing at home) was taught to the patients.

Seyedin septicemia disinfectants were used for disinfecting the permi-cath area; this was done when the patient was lying on the hemodialysis bed waiting for the dialysis session. The adequate time required for drying of antiseptic solutions in the permi-cath area has not been specified by previous reports; therefore the solution does not have the appropriate efficacy. Finally it was decided to place the solution in the patients' waiting room and to train the patients to spray it on the permi-cath area and around it before entering the ward. The time interval between a patient's entrance to the waiting room and his/her contact with the dialyzer was about 10 to 20 minutes; this interval is appropriate for drying of disinfectant solutions and having necessary efficacy.

After consulting with representatives of pharmaceutical companies and hygiene and infection control authorities, a suitable disinfectant solution for the hands that contained vitamin E and Aloe Vera was provided for all the nurses in the form of a pocket solution. A film regarding correct hand washing was screened for all the nurses and monitoring of the head nurse was used to solve this problem.

Educational classes regarding correct floor disinfection by using appropriate solutions were held for all the service staff. Then a test was taken and it was emphasized at the end of every shift that the service staffs were responsible for disinfecting the ward floor; this was controlled and recorded by the shift authorities.

A meeting was held with the presence of the infection control authority, hospital chief and surgeons about placement of a permi-cath; this responsibility was transferred to a limited number of surgeons and the procedure was emphasized to be done in the surgery room and in a completely sterilized situation. In order to prevent infection transmission from the dialyzer to the staff, the staffs were asked to perform a 15-minute wash for all the machines before beginning the hemodialysis.

One strategy that was not feasible was changing patients' clothing before entering the ward and placing a cupboard for the patients' additional equipment; this was not possible due to a lack of adequate physical space.

4. Results

There were 21 patients who were taking vancomycin and antibiotics during the first six months of 2012. Seven of them were female and the others were male. The age range of the patients was between 49 to 79 years old. Table 1 shows the relative and absolute frequencies of these patients.

14 patients were hospitalized for treatment of infection due to permi-cath, during the first six months of 2012. A blood culture test was taken from the hospitalized patients and the result of most of the cultures (except one case of *Enterococcus* and one case of *Pseudomonas*) showed infection with *Staphylococcus aureus*. Table 2 shows the relative and absolute frequency of the infection according to months of the study.

The results showed that the nurses of the ward did not care about standard principles of washing hands. During oral interviews with the nurses, 5% stated that this was because of not knowing the standard hand washing procedures and 95% stated that this was because of their dry skin due to frequent washings and using alcohol-based antiseptic solutions; they stated that despite their knowledge of the standard hand-washing procedures and its importance, they did not accept to wash and disinfect their hands before and after taking care of the patients.

An evaluation was done after implementation of the study. Stage and final evaluation methods were used for the evaluation process (18).

Table 1. Frequency Distribution of Hemodialysis Patients That Were Taking Antibiotic and Vancomycin

Age Range, y	Gender, %		Values ^a
	Male	Female	
45 - 55	60	40	5 (24)
56 - 65	80	20	10 (48)
66 - 75	75	25	4 (19)
76 - 85	NA	100	2 (9.5)
Total	NA	NA	21 (100)

Abbreviation: NA, not available.

^aValues are expressed as No. (%).

Table 2. Frequency Distribution of Permi-Cath Infection and the Results of the Chronic Renal Failure Patients' Cultures at Ali Shariati Hospital in the First Six Months of 2012

Month	Culture Result	Values ^a
April	<i>Staphylococcus aureus</i>	1 (7)
May	<i>Staphylococcus aureus</i>	1 (7)
June	<i>Staphylococcus aureus</i>	1 (7)
July	NA	0
August	NA	0
September	<i>Staphylococcus aureus</i> 4 cases, <i>Enterococci</i> 1 case	5 (36)
November	<i>Staphylococcus aureus</i> 2 cases, <i>Pseudomonas</i> 1 case	3 (21)
December	<i>Staphylococcus aureus</i>	3 (21)
Total	NA	14

Abbreviation: NA, not available.

^aValues are expressed as No. (%).

4.1. Stage Evaluation

This was done by asking questions and conducting oral interviews with the staff.

4.2. Final Evaluation

This was done by determining the amount of permi-cath infection and the number of hospitalizations due to permi-cath infection at the infection ward.

4.3. Stage Evaluation

This evaluation was done with two tangible and intangible methods. In the first method, one of the researchers, who was working in the ward assessed the nursing staff regarding the way of washing and disinfecting hands and patients' permi-cath area during all the shifts that he/she was present in the ward. In case of any problem in the procedure, the staff was notified in a friendly manner and the number of the notifications was confidentially recorded in a notebook. The number of the notifications in terms of the way of washing and disinfecting hands and patients' permi-cath area decreased from 70% in October to 57.14% in the first half of November, 47% in the second half of November and 28.57% in December; this amount is statistically significant according to the paired t-test (from October to December) and confidence level of 95%.

For the second method, this evaluation was done intangibly by the researchers for seven consecutive weeks. The evaluation date was determined after staff educational classes. For example in the first evaluation, among five nursing staff, three of them did not wash their hands correctly and four did not disinfect their hands correctly; or in the second evaluation, which was one week after the first evaluation, among four nursing staff, two did not wash their hands correctly and three did not disinfect their hands. Evaluations and recording the observed cases continued in this regard. In the last week of evaluation, among four nursing staff, only one did not wash her hands correctly.

All the checklists of the evaluation stage were researcher-made checklists and their face and content validity were approved by the midwifery and nursing college faculty members of Isfahan and one of the nephrology specialists who was a faculty member of the medical college of Isfahan University of Medical Sciences.

4.4. Final Evaluation

Considering the studies of the research team based on the high level of infection in hemodialysis patients of Ali Shariati hospital of Isfahan, symptoms, causes and strategies of solving this problem were considered. There were several identified signs and symptoms such as: fever, frequent shivering of the patients during dialysis, increasing amount of permi-cath change, infectious secretions at the permi-cath entrance, positive blood culture, increasing use of antibiotics at hemodialysis ward and patients' hospitalization due to permi-cath infection.

The probable factors leading to infection in the observed cases included patients and nurses' contaminated hands, contaminated environment and patients' lack of personal hygiene. This problem threatens patients' life and increases hospital and treatment costs. After the implementation of the strategies, there was only one case of permi-cath infection at the hemodialysis ward of Ali Shariati hospital from October to December 2012. This case was a 45-year old female and was administered antibiotic and vancomycin; the type of microorganism was *Staphylococcus aureus*, and even in this case there was a significant decrease of antibiotic consumption compared with before the intervention.

After implementation of the interventions, there was no case of hospitalization due to permi-cath infection.

Table 3 compares the results of the amount of infection and hospitalization before and after the intervention.

Another tool for evaluation was qualitative evaluation. Qualitative evaluation was done by conducting interviews during the study. Three categories were achieved at this stage through content analysis, only by interviewing 10 nurses, who were working at the ward (three nurses with less than five years of experience, two nurses with five to ten years of experience and five nurses with ten years experience). Every one of the interviews was done during the nurses' shifts and at the hemodialysis nursing pavilion environment during 30 minutes of their tea break. The achieved categories of this stage included; environment security, procedure security and patient's interaction. The extracted categories are presented in Table 4.

Table 3. Comparing the Amount of Infection and Hospitalization Before and After the Research Action^a

Results	Receiving Antibiotics	Hospitalization
Before action	21 (-65)	14 (-44)
After action	1 (-4.6)	NA
The amount of P value with the independent t-test	< 0.001	< 0.001

Abbreviation: NA, not available.

^aValues are expressed as No. (%).

Table 4. Extracted Categories and Subcategories

Properties	Confirming Sentences
Security of the Environment: Cleaning the Ward and Staff's Self-Control of Their Duties	
Disinfecting the ward	Correct disinfecting of the ward (educating services staff were very effective)
Separating personal belongings	Relatives' reduced traffic at the ward decreased the occurrence of infection
Reduced traffic	It seems that the services staff of the ward were more involved, they were working very well and efficiently monitored the relatives
Educating services' staff	
Services staff's increased knowledge and awareness	
Services staff's self-control	
Security of the Procedure: Security of the Machines and Actions	
Completing washing time	Completing washing time of the machines, nursing educations and controlling vital signs accurately have been an effective step in solving this problem
Physicians' better care when placing the permi-cath	The level of infection decreased in these months; prevention of infection to this extent only by simple actions like washing hands and using sprays is remarkable
Washing hands	Permi-cath infection problems are not always due to nursing problems or the patients themselves, vascular surgeons should be more involved for solving this problem.
Putting away crockery	
Patient's Interaction: Patients' Personal Hygiene and Self-Responsibility	
Observing general health	Patients' education made them enter the ward with better hygiene
Observing permi-cath area	Mrs. B (a patient) was teaching the way of holding and wearing permi-cath with sterile gauze to Mrs. L (a patient). These relationships lead to a decrease of infection and it could be suggested that patients learning is better when they are taught by somebody at the same position
Patients' learning from each other	Mr. J called one of the researchers and said: "I have another strategy, put a special cupboard for the patients to change their clothes before entering the ward, tell your head nurse to prepare a space for that", it is interesting that patients are really involved in this regard and feel responsible.
Patients' monitoring each other	
Willingness to have a better relationship with the staff, other patients and authorities	
Willingness for more learning	

In addition, there was a significant change in patients and their relatives attitudes after seven weeks; by placing high emphasis on observing hygiene and the importance of permi-cath infection, relatives felt obliged to control the other relatives in terms of wearing gowns and shoe cover.

5. Discussion

One of the important complications of patients that are being treated by hemodialysis through permi-cath is infection, which can have significant effects on patients' quality of life. Patient and nurse's role are simultaneously important for increasing quality of life; group participation, considering the standards and designing care protocols for nurses and patients and having appropriate facilities and equipment are also essential for achieving better results.

Considering the results achieved from this study, which indicated a significant decrease of permi-cath infection and nursing staff's viewpoints in this regard, the causes of quality promotion can be considered in various categories including; patients' interaction and education, security of the environment and security of the procedure.

Education plays a very important role in controlling infection. Education is part of the main strategy of controlling infection at the national and international level (19) and provides nurses with correct and adequate scientific information regarding different kinds of hospital infections and their prevention methods to protect patients from these infections (20). The nurses' role as a trainer and the patients' role as a trainee are very important in decreasing infections. In the viewpoint of Dubbert et al. (1990), education can increase quality of washing hands, which will lead to a decrease of infection level (21), also Rosenthal et al. (2004) suggested that education and feedback can cause significant effects in decreasing urinary catheter infection (22).

The effect of education on the level of positive central venous catheters was also studied by Warren et al. (2004). Sampling of this study took three years (2000 - 2003) and included patients hospitalized at the intensive care unit. It was indicated from this study that the intervention, which emphasized on educating health care providers regarding prevention of blood stream infections in relation with catheterization could prevent primary bloodstream infections. Also the above study concluded that education programs decrease medical expenses and patients' death related to central venous catheterization (23). Another study by Coopersmith et al. (2002) was done with 4238 patients hospitalized at the intensive care unit. This study stated that education has a positive effect on blood infections due to central venous catheterization, death rate and medical expenses (24).

Another important factor in decreasing infection is educating hand hygiene and washing hands before and after taking care of the patients (25). Researchers have shown

that hands are very important factors in transferring hospital infections (26). Health care providers hands are one of the most important sources of transferring infection, thus washing hands are recommended as the first step for prevention and control of hospital infections (27). It has also been emphasized that hands should be washed with soap and water and other allowed disinfectants before and after every contact with the patients and the equipment (28, 29). Nurses stated different causes for less washing of their hands such as not being used to it, inadequate knowledge, carelessness, usual work, lack of washing and drying equipment, crowded wards, inappropriate washing materials and finally due to defects in the management system (30, 31).

In the study of Zandiyeh and Borzo nurses and physicians hand washing indication was respectively 15% to 0% in all the cases (32). Also in the study of Samadi-pour et al. in 2008, hand hygiene before contact was 4.3% and after contact was 32.3%, the best hand hygiene was after contact in situations with high risk of infection and the average of hand hygiene was 22.6% at the medical, surgical, intensive and emergency ward (33). In the study of Lankford et al. (2003) in Chicago, hand hygiene after having contact with the patients was significantly better than before having contact; it was being done 58% of the time at the hematology, oncology, medical and surgical and transplant ward of a hospital and 48% of the time at another hospital (34). Another study done by Zandiyeh and Borzo (2012) at one of the hospitals of Hamedan regarding assessment of hand hygiene level by the operating room staff, the level of hand hygiene was more than 50%, yet the matter was the lack of washing hands with soap and water before and after care; most of the staff considered it adequate to use gloves for taking care of the patients and washing hands before and after care was less observed (32). In another study by Lam et al. (2004) at the infants' intensive care unit of a hospital in Hong Kong, hand hygiene was reported 43% of the time (35).

Having complete information about the disease and treatment procedure is an essential need of the patients and several factors such as health promotion, the primacy of prevention over treatment etc. indicate the importance of educating patients (36). Having complete information of the disease and treatment procedure is one of the most important rights of the patients and this information should be designed and implemented according to the individual requirements and the disease for appropriate behavioral changes (37, 38). Educating a patient is a heavy responsibility that should be considered by the medical team members specially nurses. Nowadays, educating patients is one of the most important roles of nurses, which is essential in promoting and reviving health (39). Educating patients is an independent nursing action and it is one of the main and inevitable duties of this profession. Educating patients promotes health behavior and changes unhealthy and harmful behaviors and leads to better public health (40) and increases pa-

tients' participation in taking care of themselves (41).

Moezzi states that shortage of educational resources, shortage of time and lack of patient's cooperation are the main obstacles of the procedure of educating patients (42). Marcum states that three important factors such as nurses' inadequate time, inadequate human force and lack of patient's guidance by the health staff are the main obstacles (43). In the study of Dehghani, it was pointed out that lack of official attention to the issue of patients' education, adequate funding and appropriate location, medical team members' cooperation with each other and shortage of training space at the hospitals are the main obstacles (44), which can significantly influence the level of infection among patients.

Some efforts have been made for providing some strategies that solve health problems. The first stage is increasing access to antiseptic solutions, which cause less dryness and irritation (45). Dancer (2009) pointed out to the importance of equipment and facilities in transferring hospital infections. This study also stated that disinfecting the environment that the nurses' hands are in contact with is very important in controlling infection. This matter is not considered by people and they believe that prevalence of hospital infections due to this matter is related to disease natural prevalence (46). Limited number of samples and working at only one hemodialysis ward are among the limitations of the present study, it is recommended to conduct similar studies with larger sample size. Another limitation was monitoring samples within a limited time. Since research action studies are cyclic, longer monitoring time and consequently reform, reprogramming and assessing interventions can be more useful and more effective.

It seems that research action is an appropriate way for changing and improving nurses' practice at the hemodialysis ward for controlling permi-cath infection. Since the present study was done through research action, staff viewpoints were considered; this makes them accept changes faster, in addition it causes more stability in the adopted decisions.

Acknowledgments

We thank and appreciate the management of social security services, all the staff of the hemodialysis ward, health and infection control authorities of Ali Shariati hospital medical center and also the nursing and midwifery college of Medical Sciences University of Isfahan.

References

1. Longo D, Fauci A, Kasper D, Hauser S. *Harrison's Principles of Internal Medicine 18th edition*. McGraw-Hill Professional; 2011.
2. Schophuizen CM, De Napoli IE, Jansen J, Teixeira S, Wilmer MJ, Hoenderop JG, et al. Development of a living membrane comprising a functional human renal proximal tubule cell monolayer on polyethersulfone polymeric membrane. *Acta Biomater*. 2015;**14**:22-32. doi: 10.1016/j.actbio.2014.12.002. [PubMed: 25527093]
3. Brunner LS, Smeltzer SC, Bare BG, Hinkle JL, Cheever KH. *Brunner*

- & Suddarth's textbook of medical-surgical nursing. Lippincott Williams & Wilkins; 2010.
4. Braunwald E. *Harrison's principles of internal medicine*. McGraw-hill; 2001.
 5. Shahdadi H, Badakhsh M, Masinaei N, Heydari M, Rahnama M. The effect of increasing blood flow rate on complications and dialysis adequacy in hemodialysis patients with low Kt/v. *IJNR*. 2010;**5**(17):62-7.
 6. Walker TS. *Microbiology*. Michigan: W.B. Saunders Company; 1998.
 7. Muringai T, Noble H, McGowan A, Channey M. Dialysis access and the impact on body image: role of the nephrology nurse. *Br J Nurs*. 2008;**17**(6):362-6. doi: 10.12968/bjon.2008.17.6.28900. [PubMed: 18414304]
 8. Morey JH. Integrative reflexivity: a therapy within a naturopathic nursing practice. *Explore (NY)*. 2005;**1**(5):400-1. doi: 10.1016/j.explore.2005.06.020. [PubMed: 16781575]
 9. Hall JE. Professionalizing action research—a meaningful strategy for modernizing services? *J Nurs Manag*. 2006;**14**(3):195-200. doi: 10.1111/j.1365-2934.2006.00584.x. [PubMed: 16600007]
 10. Williamson GR, Prosser S. Action research: politics, ethics and participation. *J Adv Nurs*. 2002;**40**(5):587-93. [PubMed: 12437608]
 11. Hampshire AJ. What is action research and can it promote change in primary care? *J Eval Clin Pract*. 2000;**6**(4):337-43. [PubMed: 11133117]
 12. Speziale HS, Streubert HJ, Carpenter DR. *Qualitative research in nursing: Advancing the humanistic imperative*. Lippincott Williams & Wilkins; 2011.
 13. Chín CH, Tsai FC, Chen SP, Wang KC, Chang CC, Pai MH, et al. YC-1, a potent antithrombotic agent, induces lipolysis through the PKA pathway in rat visceral fat cells. *Eur J Pharmacol*. 2012;**689**(1-3):1-7. doi: 10.1016/j.ejphar.2012.05.013. [PubMed: 22659114]
 14. Dancer S. Importance of the environment in meticillin-resistant *Staphylococcus aureus* acquisition: the case for hospital cleaning. *Lancet Infect Dis*. 2008;**8**(2):101-13. doi: 10.1016/S1473-3099(07)70241-4. [PubMed: 17974481]
 15. Martinez JA, Ruthazer R, Hansjosten K, Barefoot L, Snyderman DR. Role of environmental contamination as a risk factor for acquisition of vancomycin-resistant enterococci in patients treated in a medical intensive care unit. *Arch Intern Med*. 2003;**163**(16):1905-12. doi: 10.1001/archinte.163.16.1905. [PubMed: 12963563]
 16. *Advanced Programmable Interrupt Controller Guide to the Elimination of Infections in Hemodialysis*. 2010. Available from: www.apic.org.
 17. Charmaine E, Lok HM. *Prevention and management of catheter-related infection in hemodialysis patients*. International Society of Nephrology; 2011. Available from: http://www.kidney-international.org.
 18. Seif AA. *Educational assessment, measurement and evaluation*. Tehran: Doran; 2003.
 19. Ward DJ. The infection control education needs of nursing students: an interview study with students and mentors. *Nurs Educ Today*. 2011;**31**(8):819-24.
 20. Allah-Bakhshian A, Moghaddasian S, Zamanzadeh V, Parvan K, Allah-Bakhshian M. Knowledge, attitude, and practice of ICU nurses about nosocomial infections control in teaching hospitals of Tabriz. *Iran J Nurs*. 2010;**23**(64):17-28.
 21. Dubbert PM, Dolce J, Richter W, Miller M, Chapman SW. Increasing ICU staff handwashing: effects of education and group feedback. *Infect Control Hosp Epidemiol*. 1990;**11**(4):191-3. [PubMed: 2332602]
 22. Rosenthal VD, Guzman S, Safdar N. Effect of education and performance feedback on rates of catheter-associated urinary tract infection in intensive care units in Argentina. *Infect Control Hosp Epidemiol*. 2004;**25**(1):47-50. doi: 10.1086/502291. [PubMed: 14756219]
 23. Warren DK, Zack JE, Mayfield JL, Chen A, Prentice D, Fraser VJ, et al. The effect of an education program on the incidence of central venous catheter-associated bloodstream infection in a medical ICU. *Chest*. 2004;**126**(5):1612-8. doi: 10.1378/chest.126.5.1612. [PubMed: 15539735]
 24. Coopersmith CM, Rebmann TL, Zack JE, Ward MR, Corcoran RM, Schallom ME, et al. Effect of an education program on decreasing

- catheter-related bloodstream infections in the surgical intensive care unit. *Crit Care Med*. 2002;**30**(1):59-64. [PubMed: 11902288]
25. Association of periOperative Registered Nurses Recommended Practices C. Recommended practices for surgical hand antisepsis/hand scrubs. *AORN J*. 2004;**79**(2):421-6. [PubMed: 15002838]
 26. Parsi D, Mirrezaee SM. *Infection control Basic concepts and training*. Shiraz: Motargem; 2006.
 27. Fuller C, Besser S, Cookson BD, Fragaszy E, Gardiner J, McAteer J, et al. Technical note: Assessment of blinding of hand hygiene observers in randomized controlled trials of hand hygiene interventions. *Am J Infect Control*. 2010;**38**(4):332-4. doi: 10.1016/j.ajic.2009.10.005. [PubMed: 20189686]
 28. Jenner EA, Fletcher BC, Watson P, Jones FA, Miller L, Scott GM. Discrepancy between self-reported and observed hand hygiene behaviour in healthcare professionals. *J Hosp Infect*. 2006;**63**(4):418-22. doi: 10.1016/j.jhin.2006.03.012. [PubMed: 16772101]
 29. Gaonkar TA, Geraldo I, Shintre M, Modak SM. In vivo efficacy of an alcohol-based surgical hand disinfectant containing a synergistic combination of ethylhexylglycerin and preservatives. *J Hosp Infect*. 2006;**63**(4):412-7. doi: 10.1016/j.jhin.2006.03.005. [PubMed: 16759740]
 30. Akyol A, Ulusoy H, Ozen I. Handwashing: a simple, economical and effective method for preventing nosocomial infections in intensive care units. *J Hosp Infect*. 2006;**62**(4):395-405. doi: 10.1016/j.jhin.2005.10.007. [PubMed: 16478645]
 31. Bilski B, Kosinski B. [An analysis of selected hands hygiene habits in selected population of nursing staff]. *Med Pr*. 2007;**58**(4):291-7. [PubMed: 18041198]
 32. Zandiyeh M, Borzo SR. The level of hand hygiene compliance by operating room personnel of Educational Hospitals in Hamadan University of Medical Science. *Holistic Nurs Midwifery J*. 2012;**22**(1):23-9.
 33. Samadi-pour E, Daneshmandi M, Mehdisalari M. Hand hygiene behavior in Sabzavar hospital. *Sci J Sabzavar Med Univ*. 2010;**15**(1):59-64.
 34. Lankford MG, Zembower TR, Trick WE, Hacek DM, Noskin GA, Peterson LR. Influence of role models and hospital design on hand hygiene of healthcare workers. *Emerg Infect Dis*. 2003;**9**(2):217-23. doi: 10.3201/eid0902.020249. [PubMed: 12603993]
 35. Lam BCC, Lee J, Lau YL. Hand hygiene practices in a neonatal intensive care unit: a multimodal intervention and impact on nosocomial infection. *Pediatrics*. 2004;**114**(5):e565-71.
 36. Mohajer T. *Fundamental of patient education*. Tehran : Salemi; 2001.
 37. Douglas B. *Fundamental of patient care, Comprehensive approach in nursing*. Tehran : Ministry of health, treatment and medical education; 1992.
 38. Rankin SH, Stallings K, London F. *Patient education in health and illness*. Lippincott Williams & Wilkins; 2005.
 39. Behnam Vashani HR, Heidari E. Effect of education on Hemodialysis' patients about decreasing complication. 1997;**4**(2):45-52.
 40. Margaret K, Barbara Leen N. *Basic of patient education*. Tehran: Kankash; 1998.
 41. Morgan AK. A phenomenological perspective. *J Adv Nurs*. 1994;**19**(3):192-201.
 42. Moezzi D, Rizabi N. *Fundamentals and methods of patient education*. Tehran: Sokhan Gostar; 1995. pp. 69-75.
 43. Marcum J, Ridenour M, Shaff G, Hammons M, Taylor M. A study of professional nurses' perceptions of patient education. *J Contin Educ Nurs*. 2002;**33**(3):112-8. [PubMed: 12046712]
 44. Dehghani H. Survey of nurses and physician's viewpoint about patient education barriers. *J Shahid Sadoghi Yazd Med Sci Univ*. 1998;**5**.
 45. Larson E, Killien M. Factors influencing handwashing behavior of patient care personnel. *Am J Infect Control*. 1982;**10**(3):93-9. [PubMed: 6922685]
 46. Dancer SJ. The role of environmental cleaning in the control of hospital-acquired infection. *J Hosp Infect*. 2009;**73**(4):378-85. doi: 10.1016/j.jhin.2009.03.030. [PubMed: 19726106]