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ORIGINAL RESEARCH

A preliminary study of ecosmart intra venous system on patients' comfort

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Abstract
Intravenous fluid therapy may cause discomfort to patients most of the time. More research and innovation are needed to develop infusion devices to provide a more comfortable feeling for patients receiving the therapy. This preliminary study analyzed the effect of economical and smart (ecosmart) infusion systems on comfort in healthy adults. The one-group post-test-only design was used in this pre-experimental investigation. A range of ages, gender, body weight, body temperature, and normal blood pressure selected participants. An independently created, valid, and reliable tool was used to measure comfort. Data analysis employed a t-test on a single sample. Fifteen nursing students are participating as sampling objects. The average comfort score for the study's participants was 11.2 (SD = 2.5967; $p < 0.05$). The result indicates that the participants are at ease using the ecosmart system. The respondents' sense of comfort related to the instrument showed comfort or relaxation.

Keywords: Nursing care; ecosmart; comfort; patient-centered care; hospital; fluid therapy

Introduction

The development of science requires researchers to collaborate their knowledge, especially in the field of electronics and biomedical. The need for intra venous (IV) therapy in hospitals is still relatively high. Fluid therapy using infusion is the majority of therapy carried out in hospitals. More than 80% of patients receive intravascular therapy (Chang & Peng, 2018; Manrique-Rodríguez et al., 2021; Marsh et al., 2020). The most effective and efficient method of providing fluid therapy via intravascular is to use intravenous therapy (infusion). Danger can arise if, in the process of giving intravenous therapy, there is an error in giving either too little or too much dosage. This can be detrimental to the patient as a recipient of intravenous therapy (Di Simone et al., 2018). In addition, the infusion can cause infection, and one of the signs is pain (Gorski, 2016), which is correlated with comfort (Nosch et al., 2020). It is necessary to innovate intravenous therapy devices that pay attention to quality and patient safety (Moreira et al., 2017).

Conventional infusion therapy is still doubtful about the accuracy of the liquid drops (Maiguy-Foinard et al., 2017). Therefore, a modified device for infusion therapy was made. The current infusion fluid control tool is using an infusion pump. This tool is commonly used in emergency rooms, inpatients, and intensive care units. The infusion pump works automatically to enter fluids or drugs through the intravenous route. This device is used to ensure the correct dose of intravenous therapy (Arimbawa & Nugraha, 2018). However, when using this device, the patient feels uncomfortable. The discomfort felt by the patient is due to the noise and circulation factors of the device or related to movement (Arimbawa & Nugraha, 2018). The infusion pump becomes problematic when the patient moves from place to place or physical transportation (del Carmen Arcentales Herrera et al., 2022). In addition, when using an infusion pump, one must also pay attention to the infusion set used. To get effective results, the recommended infusion set is the same as the brand of infusion pump used (Iskandar et al., 2017). This will have an impact on the costs required. Therefore, innovations are needed that pay attention to patient safety and comfort while using intravenous therapy (Giuliano, 2018).

The study's findings will complete previous research on infusion fluid control and monitoring devices (Ecosmart Intra Venous System) for hospital patients with information technology from 2018 to 2020. However, the system developed has not been equipped with a feature to program the number of droplets infusion fluids. In this system, the nurse manually adjusts the tension of the roller that clamps the hose on the infusion set so that there are

many drops of fluid per time, according to the doctor's program (Pranjoto et al., 2021). Likewise, the device is not equipped with a battery, so it can still be carried out when the patient changes therapy with this device. Innovation is being developed by adjusting the infusion drip through an automatic clamp device and evaluating the patient's comfort during the use of the device. This pilot study aimed to analyze the effect of the ecosmart intravenous system on comfort in healthy adults.

Method

The study used pre-experimental research that utilized the one-group post-test-only design. The sample criteria were individuals who did not have a history of hypertension, diabetes mellitus, or blood clotting disorders. Respondents have average temperatures and are not coughing or cold. The sampling technique used is purposive sampling with a sample size of 15 people. Sample recruitment was carried out through a physical examination process by measuring vital signs and interviews regarding the health history of prospective respondents. Respondents who are willing and meet the criteria are then asked for approval to become respondents after getting information about the objectives, benefits of research, risks, and guarantees received by respondents. Respondents who were willing then placed an intravenous catheter (infusion), taking into account the standard of infusion used by the researcher. After installation of the infusion, then the infusion hose is connected to the ecosmart to regulate the frequency and rate of drip. The infusion fluid used was Normal saline 100 cc and IV catheter number 22. The fluid was given in approximately 3 hours, according to the program on the device. After that, respondents were asked to fill out a questionnaire about the comfort of the tool when used.

In this study, the intervention given was the installation of an infusion using an ecosmart device in only one group. Then, the respondents' comfort was assessed while the device was installed. Data collection is done by giving a comfort questionnaire to subjects who have installed the innovation tool. The researcher created this questionnaire by considering the physical and environmental comfort domain of Kolcaba's theory. This questionnaire consists of 6 statements with a Likert scale with options: Strongly agree, Agree, Disagree, Strongly Disagree. This questionnaire has been tested for validity and four valid (r = 0.527-0.782). The four statements were followed by a reliability test with Cronbach's Alpha test, which had a value of 0.659, which means reliable. The questionnaire results were assessed and tested with a one-sample t-test (normally distributed data). The research ethics was applied to ensure the confidentiality of patient data. In this study, researchers provide a minimum guarantee of risk and a guarantee if a risk arises from the research. The ethical clearance was obtained before the study outset (No.0225/WM12/KEPK/DOSEN/T/2022).

Results

The study involved 15 respondents with various characteristics. The following is a table of data on respondent characteristics. The table shows that the majority of respondents are female (60%), with body weight between 51kg - 60kg (40%), temperature 36°C - 36.5°C (100), systolic pressure ≤120 mmHg (60%) and diastolic ≤80 mmHg (73%). The differences in characteristics of body weight and temperatures were significant among categories ($p < 0.05$). Gender and blood pressure (systolic and diastolic) did not affect comfort. The research results on the comfort of the ecosmart are presented in the following table **(Table 1)**. Another table shows that the highest comfort value is 14, and the lowest is 6. The average comfort value is 11.2 (SD = ± 2.5967; $p < 0.05$), meaning that respondents feel comfortable with the ecosmart device **(Table 2)**.

Discussion

The study was conducted by considering and implementing Kolcaba's theory of comfort; as this theory is essential to provide the patient comfort during nursing care (Kolcaba & DiMarco, 2005). According to Kolcabas' theory, comfort consists of physical, psychospiritual, sociocultural, and environmental (Bergström et al., 2018). Environmental factors can be noisy visitors, medical equipment, night-time noises, and ambient light (Ho et al., 2022), temperature (Sawyer et al., 2020). In this study, the characteristics of respondents that affect comfort are body weight and body temperature. Measurement of body weight and controlling body weight is one of the things that can cause discomfort (Altman et al., 2022). Being overweight correlates with pain (Moreira-Silva et al., 2013; Tas, 2022), and pain is one indicator of discomfort (Van Der Steen et al., 2015). Another factor is body temperature. Changing the temperature to warm can increase comfort (Panda & Sharawat, 2022). The average temperature makes the body comfortable. Increased body temperature (fever) can cause discomfort (Huang et al., 2016).

Table 1. Participants characteristics

Characteristics	*n*	%	*p*
Gender			
Male	6	40	0.955
Female	9	60	
Body weight			
40-50 kg	2	13	0.039
51-60 kg	6	40	
61-70 kg	3	20	
> 70 kg	4	27	
Temperature			
36.00-36.50	15	100	0.025
Systole			
≤ 120 mmHg	9	60	0.721
> 120 mmHg	6	40	
Diastole			
≤ 80 mmHg	11	73	0.464
> 80 mmHg	4	27	

Table 2. Respondents' comfort

No	P1 (Noise)	P2 (Pain)	P3 (Movement)	P4 (Rest)	Total
1	3	3	3	3	12
2	2	2	3	2	9
3	2	2	1	1	6
4	4	3	3	4	14
5	2	4	4	3	13
6	4	3	3	3	13
7	1	4	4	4	13
8	3	3	3	3	12
9	3	3	3	2	11
10	2	2	2	2	8
11	1	2	2	2	7
12	4	3	3	4	14
13	3	1	3	3	10
14	3	3	3	4	13
15	3	3	4	3	13
Mean	2.66	2.73	2.93	2.86	*Mean* = 11.2 ± 2.59 ($p < 0.05$)

In this study, 100% of the respondents felt comfortable using the tool. Comfort assessment is obtained from the questionnaire given to the respondents: One indicator of comfort is the sound that can cause noise. Sound sources that cause noise in hospitals can come from the sound of alarms, medical devices, health workers, hospital support equipment, and so on (Bergström et al., 2018). The sound generated by the ecosmart comes from the sound of an automatic hose clamp set to open and close in milliseconds. This sound does not cause discomfort to the respondent because the sound can be ignored and does not interfere with rest. The recommended sound for comfort is around 30 dB – 60 dB, which does not interfere with sleep in the hospital (Sawyer et al., 2020). The noise from clinical sources (e.g., monitors, infusion pumps, and other equipment) influences patients' well-being (Cunha & Silva, 2015). The sound produced by the ecosmart is relatively small, and the sound can almost be disguised by the sound generated by the air conditioner.

The drip control system that occurs in the ecosmart innovation is clamping (opening and closing) automatically on the infusion set hose connected to the client, so it is estimated that it can cause pain at the location of the intravenous catheter insertion. Discomfort may arise due to pain (Ho et al., 2022). Pain is one indicator of the discomfort felt by the patient (Chen & Chen, 2015; Harvey & Kovalesky, 2018). Respondents in this study stated that the level of comfort on this indicator is comfortable, so it can be concluded that this tool does not cause pain or interfere

with it. As many as 84% of respondents who received continuous insulin therapy felt pain at the infusion site (Taleb et al., 2018). Incorrect location of the infusion order can also cause pain, a phlebitis symptom (Sijabat et al., 2021). In this study, respondents did not feel pain because of the relatively short order time, normal saline infusion fluids, small intravenous catheters, and the selection of the correct location. Recommendations from the Infusion Nursing Society (INS) to prevent line-related phlebitis, namely, everything that passes through peripheral venous catheter access is the application of catheter irrigation with 0.9% sodium chloride (normal saline), which aims to maintain catheter permeability (Gorski, 2016; Mali et al., 2022). Comfort in the use of intravenous therapy is related to the movement that the patient can do. Patients can still move without having to worry about stopping treatment. This ecosmart innovation tool should not interfere with the respondent's movements during the intervention. In this study, respondents who felt comfortable said they could rest during the intervention. Respondents do not feel disturbed by the sound of the tool and do not feel pain when using the tool so that the respondent can rest. A comfortable room can affect the sleep rest of the patient, and pain correlates with the patient's rest and sleep (Masry et al., 2017; Samsir & Yunus, 2020).

According to Basak et al. (2020), the comfort of inserting an IV line can be increased by a modified visual distraction method which can decrease the patients' pain. Pain or discomfort during IV-line installation can occur due to an inappropriate location, such as the hand, wrist, or antecubital vein. More than 10% of patients feel pain (Alexandrou et al., 2018). Therefore, choose the right location for installing the intravenous catheter to increase comfort. According to the study findings, the comfort felt by the subjects came from the explanation that had been given previously and routine monitoring carried out by the researcher. This provides comfort and a sense of security for the subjects in the research. The presence of nurses is significant in every intervention given to patients. The presence of a nurse shows attention to the patient so that the patient feels safe. Nurses provide safety guarantees for every action given to patients and can also increase comfort while providing therapy. Safety assurance can begin with an explanation for each action, including the benefits, risks, and procedures that the patient will undergo. The role of nurses is significant in every action given to patients.

Conclusion

The ecosmart device benefits to patients which can be observed during study process such as increase the comfortable. This device can be recommended for use in hospitalized patients while still assessing the patient's comfort while using the device for a long time without changing the intravenous therapy the patient receives. This research is fundamental because it can contribute to creating innovative medical devices that provide accurate intravenous fluid therapy administration. The tool being developed is cheaper and is expected to be used by all patients so that the quality of nursing services increases, patient satisfaction increases, and patient safety increases.

Author's declaration

Made Indra Ayu Astarini: Conceptualization, Methodology, Writing- Original draft preparation. Maria Manungkalit: Writing- Reviewing and Editing Validation. Lanny Agustine: Software, Data curation, Visualization. Hartono Pranjoto: Supervision, Investigation.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

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