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Hospital Bed for Diabetes Care: An Invention to Support Professional and Hygienic Nursing Practice

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This article contributes to:

Highlights:

- Diabetes mellitus (DM) wounds require special care and treatment
- Hospital Bed for Diabetic Foot Ulcer Care (HBDFUC) has been successfully developed in this research
- The use of HBDFUC can reduce the risk of occupational disorders for nurses

Abstract

Appropriate diabetes mellitus (DM) wound care requires safe and comfortable space and facilities for patients and nurses. However, the existing hospital bed for DM has not supported the safety and comfort for nurses to serve patients, including the problem of liquid waste and some DM wounds emit a foul smell. Therefore, a hospital bed for DM wound care was designed in this research to support professional, efficient, ergonomic, and safe nursing practice. Multidisciplinary collaboration by engineers, wound nursing practitioners, and industry is carried out in this project. The level of risk of work disturbances was evaluated using a rapid entire body assessment (REBA), the level of risk of contamination was evaluated by a qualitative exposure assessment, and the level of comfort was measured using the visual analog method. Trials on 30 respondents consisting of 28 nurses and 2 doctors indicated that they were comfortable working with the new design of this prototype with lower risk.

Keywords: Wound care bed, Diabetes mellitus, Diabetic foot ulcer, Professional nursing

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1. Introduction

Wound care is one form of nursing care to support cell growth, so that wounds heal and avoid infection. The wound care process begins with assessment, washing the wound, preparing the wound bed, dressing [1][2]. Based on the observations of researchers at the wound care clinic, the time required to perform wound care is in the range of 30-120 minutes. Wound bed preparation takes the longest time compared to other wound care processes. The length of time for wound care poses a work risk for nurses [3][4]. A nurse on duty requires a dynamic and comfortable work position. Based on the observations of researchers at the wound care clinic, there are 2 nurse working positions in performing wound care, namely sitting and standing. Referring to the clinical observations made, the nurse's ability to perform treatment in a standing position for 5 minutes,

while the sitting position is 60 minutes. If the work position is forced into an uncomfortable position, a nurse will experience muscle problems [4].

From the results of observations in several hospitals and wound care clinics, the existing wound care facilities are still minimal and have not met the expectations of nurses and doctors. A hospital or wound care clinic implements wound care which includes wound washing, debridement, and dressings, which are still carried out with minimal facilities. Wound washing is carried out using a liquid reservoir in the form of a basin, bent and sometimes even using crackle plastic which is far from aesthetic, safety and efficiency aspects. When a basin is used to collect biological liquid waste, there is a risk of spillage, thus disrupting work safety for nurses and the risk of nosocomial infection for clinic visitors. In addition, when washing the wound using a basin, it requires a minimum of 2 people, as exemplified in Figure 1. One is in the charge of caring for and the second is in the charge of holding the basin, so it doesn't spill. Even worse is when the patient's family is asked to hold the basin. This condition describes the current wound care process with existing equipment and is inefficient.

Meanwhile, the need and practice of wound care has a huge opportunity to be developed. Chronic wound cases every year increase along with the increase in the number of people with diabetes mellitus (DM). DM wounds are wounds that are difficult to heal and sometimes cause a foul smell [5]. DM wounds require good care to create a microenvironment in the wound that accelerates wound healing. Good DM wound care takes a long time compared to just changing the wound dressing. Therefore, this requires good supporting facilities, especially wound care beds that meet work safety and comfort aspects.

Wound care in health care facilities that currently exist is not in accordance with the principles of safety and work comfort. The wound care bed is still an ordinary examination bed and has not been devoted to wound care with liquid medical waste, such as patent number US20070174965A1 [6]. To wash the wound, you must place a basin above the bed so that it is at risk of contaminating linen, the room and even the clothes of patients and nurses. The smell that arises from the wound has also not been managed properly, resulting in an unpleasant working atmosphere and an impact on the low quality of work.

Figure 1. Treatment of diabetic foot wounds using a regular bed (source: link)

DM wound care begins with washing the wound. Figure 1. It shows that the position of the nurse who is working is not in accordance with ergonomic principles. Liquid medical waste is at risk of spilling and polluting the treatment environment. The static and undirected air circulation allows unpleasant odors to interfere with the wound care process. Based on the survey, nurses who practice independent wound care have not used special wound care beds. Meanwhile, the availability of this bed is very important to support a more professional nursing practice. Work efficiency and effectiveness are the main parameters in evaluating the performance of a nurse. The existing treatment beds are not in accordance with the work needs of wound care. Therefore, this research was conducted to develop a special bed that can improve work efficiency, ergonomics and ensure work safety, so that it is possible to be used by various characteristics of the body of the nurse who uses it.

2. Method

2.1. Prototype development

The development of this wound care bed prototype was carried out through academic collaboration with industry, with the following series of activities:

a. Conducting discussions with practicing nurses and PT Paramount Bed Indonesia;
b. Designing Hospital Bed using CAD (Autocad 2014 64 bits and Mechanical desktop 2002 32 bits);

c. Reconstruction of the Bed platform which is already owned by PT Paramount Bed Indonesia into a Hospital Bed for Diabetic Foot Ulcer Care (HBDFUC); and
d. Conduct design reviews for clinical applications.

2.2. Prototype test preparation and procedure

To know the response of nurses and doctors who are prospective Hospital Bed users, a public test of the prototype is carried out. The Public Test was carried out in the wound care unit of the Primary Clinic of the University of Muhammadiyah Magelang and the Mungkid Health Center as a representation of the primary clinic and Aisyiah Muntilan Hospital as a representative of the hospital. This stage is carried out to explore related information and data:

a. The level of risk of work disorders is evaluated using the REBA (Rapid Entire Body Assessment) instrument. The data obtained are grouped into the categories of Negligible (REBA 1), Low (REBA 2-3), Medium (REBA 4-7), Hight (REBA 8-10), Very High (11-15) [7].
b. The level of risk of contamination is evaluated using a qualitative exposure assessment of several parts of the treatment area such as patient clothes, nurse clothes, nursing beds, clinic floors, clinic walls. The data obtained are grouped into categories: LR (Low Risk), MR (Moderate Risk), HR (High Risk) [8].
c. Comfort Level - comfort level is measured using the Visual Analog system method. This instrument is an instrument designed by the implementing team with reference to the description of comfort, namely physical comfort with respect to body sensations felt by the individual himself [9]. The comfort range instrument was made by the implementing team with a range between 1-10. The categories of high comfort (8-10), moderate comfort (4-7) and low comfort (1-3).

3. Results and Discussion

3.1. Proof of concept

Figure 2a represents a side view of HBDFUC and Figure 2b shows the functional elements of the liquid waste container before the waste plastic is installed. This bed design is designed to refer to Indonesian government regulations or regulations regarding the handling of infectious liquid waste. Infectious liquid waste should be handled by placing it in an incinerator, as regulated by Government Regulation Number 101 of 2014 concerning Hazardous and Toxic Waste Management and Minister of Health Regulation No. 7 of 2019 concerning Hospital Environmental Health. The design encourages nurses to comply with government regulations and regulations from the Ministry of Health of the Republic of Indonesia. According to regulations, some liquid waste can be treated with the principle of water treatment, but not all health facilities in Indonesia have water treatment. The most feasible step for health facilities that do not have water treatment is to cooperate with third parties who have incinerator facilities.

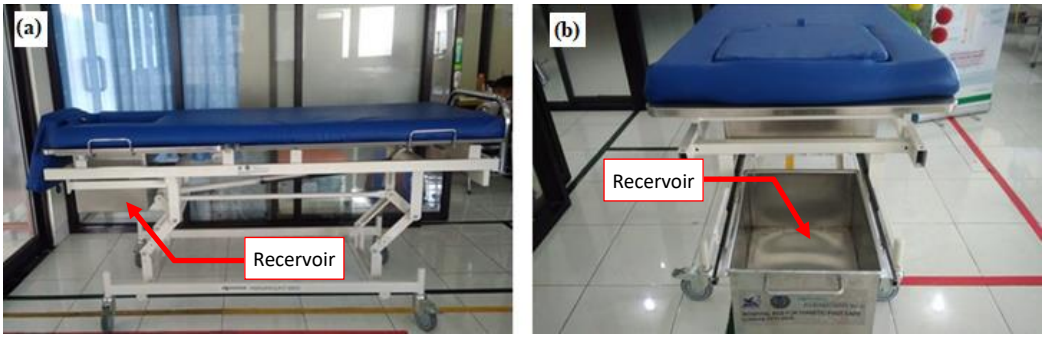

Figure 2. Prototype of HBDFUC developed by this research

3.2. Public test

The public test was conducted on 30 respondents consisting of 28 nurses and 2 doctors, with the characteristics of the respondents as presented in Table 1. Most of the respondents' gender is male (53%). Most professions are nurses (93%). The highest body mass index (BMI) is in the range of 18.5-22.9 (43%). A review of health workers by gender, found that the majority of nurses worldwide are dominated by women [10]. However, the emergency unit of the Aisyah Muntilan Hospital (RSAM) which is the public testing site in this research employs more men than women.

The explanation for this is the heavy workload both physically and psychologically for nurses. Working in the emergency department is required to be able to have speed, accuracy and strength in acting.

Based on the Body Mass Index, there are respondents who have a BMI > 30 (overweight). This condition needs attention, considering that workers' BMI is related to work-related injuries. Increased BMI values are associated with muscle disorders in the back area [11]. Obesity increases the risk of musculoskeletal disorders [12]. Losing weight can reduce symptoms of musculoskeletal disorders [13].

Table 1. Characteristics of respondents

Characteristics of respondents	Frequency	Percentage
Sex		
Male	16	53
Female	14	47
Profession		
Nurse	28	93
Doctor	2	7
Body Weight Index (BWI)		
<18,5	5	17
18,5-22,9	13	43
23-24,9	4	13
25-29,9	6	20
>30	2	7

3.2.1. Environmental contamination risk

Based on Table 2, it appears that the use of HBDFUC can reduce the risk of contamination in the treatment environment. The highest risk of contamination that has the potential to occur in the use of HBDFUC is in the patient's bed. When rinsing with water is not careful it will contaminate the treatment bed, it is also very easy to clean. The reduction in the risk of contamination occurs in all components of the care environment, namely patient clothes, nurse clothes, patient beds, clinic floors and clinic walls. However, the HBDFUC design still lacks in the aspect of risk of contamination in patient beds.

Infection prevention in health care settings or Hospital Acquired Infections (HAIs) is one indicator of the quality of health care settings and has become a global issue [14]. The smaller the possibility of infection becomes a benchmark that a health institution can anticipate infection. Prevention of contamination is the first step towards preventing infection in health care settings.

The use of HBDFUC can reduce the risk of Hospital Aquaired Infections (HAIs). Washing infected wounds and diabetes mellitus wounds can be a route of transmission to other patients if not done properly. Facilities for carrying out these procedures must be able to prevent contamination of the treatment environment. HBDFUC can provide closed facilities and minimal contamination in carrying out DM and infected wound care procedures. One of the procedures for preventing infection in hospitals is to provide facilities and minimum contamination [14].

Table 2. Risk of contamination using HBDFUC (LR: Low Risk, MR: Moderate Risk, and HR: High Risk)

Treatment Environment	Qualitative Exposure Assesment	
	Existing Bed Design	HBDFUC Design
Patient clothes	HR	LR
Nurse clothes	HR	LR
Patient's bed	HR	MR
Clinic floor	HR	LR
Clinic wall	MR	LR

3.2.2. The risk of ergonomical disorders

Nurse is a profession with the highest percentage in a health service agency. Nurses play a very important role in meeting patient care needs. Nurses are even the profession that has the longest interaction with patients. The work starts from examinations, patient transfers, meeting the basic needs of patients and includes wound care for injured patients.

Treatment of diabetes mellitus wounds takes a long time. This happens because diabetic wounds usually contain a lot of dead tissue and pus. The cleaning time ranges from 30 to 120 minutes. Some nurses stated that they had a history of muscle pain due to standing too long in an uncomfortable position. Standing for too long is a factor that causes muscle disorders in nurses [15].

Based on a comparative study of measuring the risk of disorders using the REBA instrument, the HBDFUC design has a negligible risk when used in a standing or sitting position. Meanwhile,

when using an old bed, a medium risk occurs when the nurse is in a sitting position. When using the old bed, nurses are required to work in a static standing position for too long. This shows that HBDFUC provides answers to the problems faced by nurses when using old beds (see Table 3). When using HBDFUC nurses are free to choose a standing position and when they are tired of standing, they can choose a sitting position by adjusting the height of the bed according to the nurse's comfortable position. This causes the work position to be dynamic. This can avoid one of the factors of musculoskeletal disorders due to work, namely a static position for a long time [15].

Table 3. The risk of ergonimical disorder in using HBDFUC

Working Position	REBA Score	
	Existing Design	HBDFUC Design
Sitting	HR	LR
Standing	HR	LR

Note: Negligible (REBA 1), Low Risk (REBA 2-3), Medium Risk (REBA 4-7), High Risk (REBA 8-10), Very High Risk (11-15)

3.2.3. HBDFUC comfort level

Respondents feel comfortable at medium and high levels when a public test of HBDFUC is carried out, with test results presented at Table 4. Photographic views during the public test is presented on Figure 3. Some respondents stated that they had a history of muscle disorders when treating wounds with static beds or old beds. HBDFUC has a feature to adjust the height of the bed, being one of the reasons for respondents to give an assessment that HBDFUC provides high comfort. This is in accordance with the principle of preventing muscle disorders due to work in a static position [15]. The length of time the treatment process carried out by the highest respondent was 75 minutes. Most of the respondents recommended the use of HBDFUC in carrying out services in hospitals and clinics.

Table 4. Comfort level of HBDFUC

Comfort Level	Frequency	Percentage
High	13	43
Moderate	17	47
Low	0	0
Sum	30	100

Figure 3. Photographic view in public test

4. Conclusion

The use of HBDFUC can reduce the risk of occupational disorders, reduce the risk of contamination, and increase comfort when carrying out wound care in the long term. This HBDFUC can be set to adjust the nurse's working position, when sitting, the HBDFUC can be lowered, when the standing position can be raised. This makes the nurse's work position dynamic and minimizes the risk of muscle disorders. The integrated HBDFUC design minimizes the risk of cross-infection at the wound care site. The transfer of infectious wastewater from HBDFUC can be done with closed plastic to minimize contamination of the treatment room. Diabetic wound care, takes a long time, compared to ordinary wound care, using HBDFUC, will increase the comfort and safety of nurses at work.

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Authors' Declaration

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as human, for human PARAMOUNT BED PT. PARAMOUNT BED INDONESIA

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