

# Design and Development an Ergonomic Transfer Lifter Assistor from Wheelchair to Bed Transfer for Patients Under 50kg

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## Abstract

Moving a patient from their bed to some other places for daily routine is such hard work. Caregiver usually using a wheelchair to move a patient from place to place. Nevertheless, they are facing a problem in lifting the patient from bed to wheelchair. The caregiver needs to use lots of energy to lift the patient into a wheelchair, and it may take a long time. This study focuses on design and develop a transfer lifter assistor to assist the caregiver move the patient from bed to another place. It was flexible and easy to conduct. This innovation's advantages are that the height could be adjusted, making the patient more comfortable to sit on from a bed. The size could be adjusted up to 3 and a half feet. The structure mostly from steel and can be disassembled for storage purposes. The result shows that Transfer Lifter Assistor can perform effectively to lift patients with a maximum weight of 50 kilograms. It can support one patient at a time. This innovation has been successfully produced with cost-effective and can be owned by everyone.

**Keywords:** wheelchair, back pain, transfer lifter, assistive devices, low-cost design.

## I. INTRODUCTION

THE wheelchair is an excellent mobility assistive device, although transferring from a wheelchair proves difficult to lifting patients because of the high burden to caregiver and risk of falls. The studies conducted by Al-Samawi and Awad [1] found that carrying heavy medical equipment and patients are the major causes of low back pain for nurses.

Likewise, Ovayolu et al [2] observed that conducting certain nursing practices without help/getting support from an equipment increases the frequency and intensity of low back pain. Moreover, nurses who position patients in beds and lifts them without getting help experience low back pain [3].

Previous study shows, the manual transfer of disabled patients from the bed to an ordinary wheelchair is demanding and involves complex movements [4]. Caregivers need to lift of the patient, repositioning or turning from the bed towards the direction of the wheelchair, and seating the patient safely in the chair.

Therefore, improving the designs of wheelchairs is highly essential in order to resolve various difficulties transfer patient from bed to wheelchair. The goal of this project was to develop a user-friendly device which is designed to eliminate the manual lifting of patients from bed to wheelchair. This simple transfer equipment will be beneficial to the health of caregivers.

## II. LITERATURE REVIEW

Table 1 shows several recent transfer lift wheelchair options that can be owned by wheelchair users. The majority of transfer lift wheelchair that have been developed to date expensive and difficult to own by low-income families. The information regarding the type and price is also presented.

**Table 1:** Current price market for various transfer lift chair

|   |   |
|---|---|
|  |  |
| Rover Manual Transfer Lift wheelchair chair                                       | Nursing Moving Commode Transfer Chair   |
| RM 2,250.00   | RM 2,238.40   |
|  |  |
| RITZ Rehab Mover Transfer Lift Chair  | RITZ rehab salvo electric lifting chair   |
| RM 2,800.00   | RM6,120.00  |

The design concept and their development are presented below.


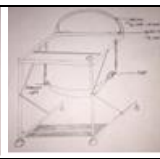
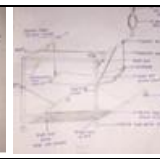
### A. Design and Development

The concept design of the transfer lifter assistor is based on specification requirement from customer. Manufacturing costs are also taken into account so that the products produced can be owned by the low-income group.

### B. Idea Selection

The idea selection of the transfer lifter assistor is based on specification requirement from customer. The developed prototype is developed as a test for research purposes. Three idea alternatives as shown in table 2 have been proposed, idea selection is made based on design, cost, safety ergonomic and disassemble impacts. All designs are proposed in a way to let the patient the patient does not need to be lifted from bed to chair or from chair to bed.

**Table 2:** Idea selection

| Criteria               | 1st Idea  | 2nd Idea  | 3rd Idea   |
|------------------------|---|---|--|
| Sketch                 |  |  |                                   |
| Safety                 | Using wheel without lock. Not placed barriers that can support the head             | Using wheel with lock. Place barriers that can support the head                     | Using wheel with lock. Place barriers that can support the head  |
| Ergonomic Dis-assembly | Height can be adjusted All connections are welded and cannot be disassemble         | Height can be adjusted Only the rear barrier can be disassembled.                   | Height can be adjusted. The rear barrier easy to put in & disassembled. Legs can be disassembled for storage purpose |

### C. Concept Development

The transfer lifter assistor shown on figure 1 was design for safe assistance when transferring a patient, which is a heavy burden for caregivers. The transfer lifter assistor consists of three components: a seats front assist bar and back barrier.

The characteristics of the transfer lifter assistor include U-shape frame, allowing attachment to a bed or toilet, and detachable back barrier. With these features, patient can transfer from one place to another in sitting position.

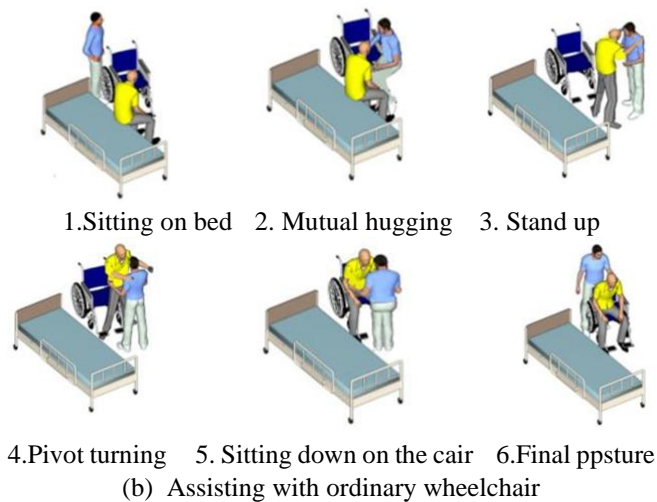
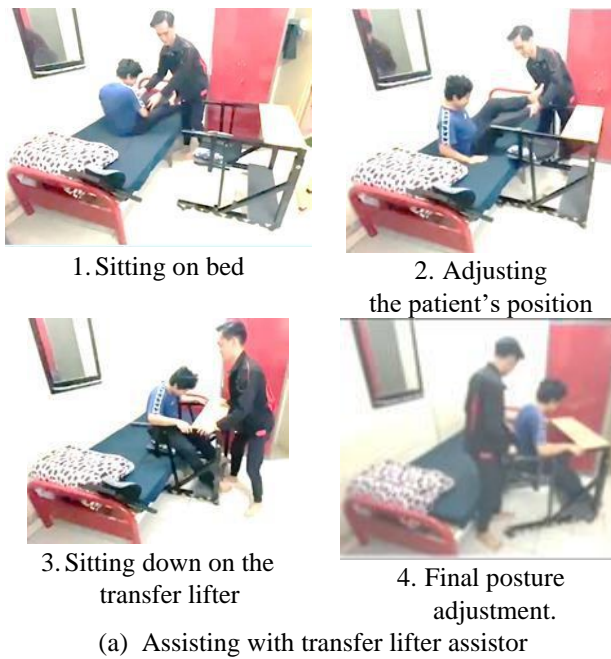
**Figure 1.** Transfer Lifter Assistor

As shown in Figure 2 (a), the patient does not have to stand for moves from a bed or toilet seat to the transfer lifter assistor. The caregiver can assist patient move to the transfer lifter assistor simply by bending up and down from his/her waist. Therefore, caregivers do not need to lift the patient.

This innovation is more helpful to caregivers than ordinary wheelchair. As shown in Figure 2(b), when caregiver using ordinary wheelchair to assist patient to transfer from a bed or toilet seat, the caregiver often has back pain from lifting patient and assist patient to do pivot turning. Therefore, caregivers need to be more careful when helping patients stand up for avoid injury when transferring patients

### D. Function and Operation Method

Single caregiver was assuming will handle transfer lifter assistor to lift patient. The target for this product is a wheelchair user who is able to take a seated position. It helps the caregiver transfer a disabled person between a wheelchair and a bed or other places easily and safely without lifting. Instruction for using the transfer lifting assistor is shown in Figure 2(a). First, let the patient sit on bed. Then, adjusting the patient's position toward transfer lifter assistor. After that, let the patient's buttocks on the chair. Lastly, do the final posture adjustment. This completes the transfer form bed to the transfer lifter assistor. Transfer lifter assistor very easy to conduct and does not require high skills to handle it.



**Figure 2.** Assisting transfer from bed to transfer lifter assistant or ordinary wheelchair [5].

Refers to Figure 2, ordinary wheelchair is demanding and involves complex movement to transfer patient. Patient handling task involved with an ordinary wheelchair can be classified into six steps: sitting on bed, mutual hugging, stand up, pivot turning, sitting down on the wheelchair and final posture adjustment.

While, handling task involved with a transfer lifter assistant can be classified four steps: Sitting on the bed, adjusting patient's position, sitting down on the transfer lifter assistant and final posture adjustment. Therefore, handling task may decrease time, complexity of transfer and decrease physical load during transfer.

#### E. Time for Assistance

Person that playing role of caregiver who had no medical history that could affect the assisting actions and had no experience with nursing care. While, person that playing role patient were assisted while relaxing his lower limbs. He was fully informed about the objective

of the experiment.

### III. RESULTS

#### A. Patient transfer skill

Burdorf et al [6] estimated the impact of lifting device use on prevention of low back pain and musculoskeletal disorder injury claims observed that complete elimination of manually lifting patients would reduce the low back pain prevalence to 31.4% and musculoskeletal disorder injury claims from 4.3 per 100 work-years.

Lifting patient using transfer lifter assistant, completely eliminate the mutual hugging stands up and pivot turning which is which requires the caregiver to lift the patient. Therefore, it can be concluded here that this device would reduce back pain and musculoskeletal disorder injury claims.

#### B. Time for assistance

The average time necessary to assist transfer from bed to wheelchair was  $32 \pm 54$  second, and the average time to transfer from wheelchair to bed was  $26 \pm 37$  second. Others have studied that mean task times for transfer from a bed to a wheelchair were  $140.7 \pm 61.3$  seconds and mean task time for transfer from a wheelchair to a bed were  $129.8 \pm 52.0$  seconds using ordinary wheelchair [7]. Thus, the time was decreased by 77% while transferring patient from bed to wheelchair and 80% while transferring patient from wheelchair to bed transfer lifter assistant was used, compared to the case where the ordinary wheelchair use.

#### C. Cost

Manufacturing cost and market price for this product very reasonable and affordable price. It can be it can be marketed at a price RM 600 which is 70% to 90 % compare to the current lifter. Therefore, this lifter can be owned by all wheelchair users regardless of cost.

### IV. CONCLUSION

Therefore, it can have concluded that the objective of this project has been achieved successfully. Transfer lifter assistant enables patients to be transferred from the sitting position directly to the frontal position. Indirectly, it is possible that the transfer lifter assistant method decreases workplace injuries and lower back pain which is benefits in healthcare workers. Besides that, it would encourage wide- range deployment to assist wheelchair users, especially in developing countries. To improve this transfer lifter assistant for better practical use, mechanical strength, stability, and design. The product is more practical if it can be used

indoor and outdoor. While mechanical strength needs to be improved so that it can be used by all groups. In addition of height adjustment point and more interesting shapes need to be done in an effort to improve the design.

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