Patient Transfer System

By

Team:
Hatem Alabdali
Abdelrahman Hassane

Advisor:
Dr. Mansoor Nasir

Technical Advisor:
Professor Ken Cook

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ABSTRACT

The goals of this project are to reconstruct and improve the comfort of a patient transfer assist device. The patient transfer assist device should efficiently transfer patient from bed to bed, bed to stretcher, and stretcher to stretcher as well as keeping the same strain that the current system provide, or reducing the strain on the caregiver. There are many patient transfer assist devices available on the market today, including transfer board, slide sheets, roller sheets, transfer belt, and roller boards. However, most of these devices cause pain to patients who have pressure sores. To target this issue, we will redesign the roller board with fluidic cylindrical tubes, instead of metal roller. This system will replace the current roller board, as well as fully satisfy the patient and the caregiver by efficiently and comfortably transferring the patients.
Background/Introduction

Patient transfer assist device's main function is to assist independence, provide a safe means of transferring patients from one surface to another such as bed to bed, bed to stretcher, or stretcher to stretcher, and to reduce the risk factors that may cause or lead to caregiver or patient injury. The procedure that is used for transferring patients is very simple and unique. First, the surface that the patient will be transferred to is placed next to the patient surface. Secondly, a log-roll is done by placing the patient on their side than placing the patient back to their original position once the transferring device is placed under the patients. Than the caregiver applies force, such as pulling or pushing, to transfer the patient, which is dependent on the device used to transfer the patient. Finally, another log roll is performed to remove the transferring device from beneath the patient.

Caregiver assistance is only required when patient are partially or totally dependent. Various factors such as the patient weight reflect what devices and

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**Figure 1:** Lateral Transfer to and from
caregiver’s number is acquired (fig.1). The transferring devices reduce the amount of force required by the caregiver.

There are many types of patients assist devices such as transfer board, slide sheets, roller sheets, transfer belts, roller boards. All these assist devices perform the same function in different way.

**Transfer board:**

Is made out of wooden or plastic smooth surface with round edges(fig.2). The device is placed under the patient and than the patient is being lifted with device by caregiver to the different surface. Some advantages of the device are; it allows the transferring of patient from surfaces far away from each other, and it can be used more than one time for more than one person. Some disadvantages of the device are requires lifting of the patient, and it has a hard surface, which makes it uncomfortable for the patients.

**Slide sheets:**

The device is made out of low friction fabrics that allow the patient to slide over a surface(fig.3). Two sheets are placed beneath the patient, then the top sheet is pulled with the patient on it. The device is placed under the patient by performing a log roll. Some advantages of the slide sheets are; that it does not require lifting the patient, it is simple to use, it is more comfortable for the patient than transfer boards, and it reduce the force required by the caregiver. Some
disadvantages of slide sheets are that it causes pain to patients with pressure sores, heavy patients may still require a lot of force to be moved, you can’t bridge gaps between surfaces, and cannot be used on more then one person.

**Roller sheets:**

The device is made out of tubular sheets with low friction in the inner surfaces (fig.4). Also the device is placed under the patient using the logroll technique. Some advantages of the device are that it is simple to use, it does not require manual lifting, it reduces awkward posture for the caregiver, and can move patients in sitting position. Some disadvantages are that it can cause pain to patients with pressure sores, it cannot be used for more than one person, and not suitable for transferring patient when there is a gap between two surfaces.

**Transfer belts:**

It’s a belt that is worn by the patients to assist caregivers with a safe and secure grip of the patient while assisting the patient with walking, transferring, or sliding transfer. The belt handles can be positioned diagonally, vertically, or horizontally (fig.5). Also the belt is padded to create more comfort for the patients. Some advantages of the transfer belts are it can provide a secure grip, there is no need to use patient clothing as a grip, it can allow caregiver to guide falling patients, and it allows the caregiver to work in a upright posture. Some disadvantages of the transfer belt are its too wide,
which doesn’t allow the patient to lean forward, and it cannot be used to lift all the patient body weight

**Roller boards:**

This device have five metal rollers on a metal frame surrounded a convye belt (fig.6). The patient is placed on top of the device by performing a logroll and then the patient is pushed to the other surface. Some advantages of the device are there is no manual lifting required, the patient has the option to transfer themselves, and there is less horizontal forces required by the caregiver. Some disadvantages of the device are it does not sufficiently reduce friction, there are no handles to carry the board, it has a hard bumpy surface which makes it uncomfortable for the patients, and sometime caregiver will still apply forces in awkward postures.

![Figure 6: 25” Roller Board](image)
Research Plan

With taking into the consideration the above mentioned factors, we brainstormed in order to come up with a specific idea to advance the world of patient transfer assist devices. As mentioned before, lots of transfer applications were developed for different types of patient transfer. The one we are focusing on is the Roller board transfer system. This system transfer patients from bed to bed or from stretcher to bed in a nice smooth way. However, it has a much ridged surface which could cause pain or sourness to the patients.

The main goal of our project is to increase the comfort, while transferring the patient using the roller board system by changing and developing more comfortable parts. The current device has metal rollers which created a hard uncomfortable hard surface. By replacing those metal rollers with cylindrical fluid filled tube/rollers it provides the comfort desired while keeping the ease of movement. Also, we are going to apply cushioning to the current design and compare the results of the two types of rollers we are using to give us the maximum comfort. We will determine this by looking at the body weight distribution of the system on a flat surface, while the load is being applied with the use of pressure-stat paper, or the body weight pressure measurement system. We should see less pressure along the center of the tubes and more weight/pressure distribution all over the contact surface.

We are going to determine a certain distance between each rollers to ensure that the rollers role, and do not come in contact with each other. The distance is going to be created by attaching the rollers to a solid frame. The distance will be defined by the
elasticity of the material and the cylindrical tube pressure. The fabrication of the fluid cylindrical tubes will be done by Strobel, once the dimensions are decided. This company will provide us with the materials, such as Vinyl material which used in making high quality waterbeds, and manufacturing/sealing the tubes. Fluids will be selected based on their viscosity. In order to determine the maximum weight the device can handle we will need to estimate the stress each tube can handle and multiply that by the number of tubes to be used.

The body frame or our design going to be assembled using the Lawrence Technological University (LTU) fabrication lab. Tests will be done at LTU campus. The estimated total cost of the project would be around one thousand US dollars and LESA organization will be targeted early in the spring semester of 2013 to assist with grants for the project
Methods

- Two roller designs:
  1. Fluid cylindrical tubes
  2. Cushioned cylindrical tubes

- Metal rods or rollers inside the fluid cylindrical tubes to secure it in place on the body frame.

- By calculating the bursting pressure we will be able to know max load on each one of the fluid cylindrical tubes using the following equation:

  \[ P = \frac{(2st)}{(d_0SF)} \]

  Where, \( P \) = max working pressure (psi)
  \( s \) = Material strength (psi)
\[ t = \text{material wall thickness (in)} \]
\[ d_0 = \text{outside diameter (in)} \]

- The volume \((v)\) of the cylindrical tubes = \(\pi r^2 h\)

- The distance between each tubes/rollers will be determined based on how much stiffness needed VS comfort; this would be done in the testing process. We are going to test the materials that don’t expand too much, to touch each other, but enough to provide the comfort (fig.7).

**Figure 7:** Distance distribution between the rollers on the roller
Project Expected Outcome

This system provides excellent comfort while transferring the patient. The light weight and the friction free material used make it very easy to use by the caregiver. The goal to have a device that leaves the patients satisfied while helping the caregiver attain the best possible results and usability. This can change the dynamic of typical patient transfer assist devices. The device will be able to accommodate to fit all body sizes. Furthermore it will be light weight will being able to carry a maxim weight of 300 lb. It will require only two caregivers to transfer the patients, and if the patient is able then they can transfer themselves while using the device.

Anticipated Challenges

When patient lay on it, some parts might have slightly different weight distribution. So, the question is perhaps use different kind of rollers among the edges than the middle because center ones might need to be a little more firm than the one on the sides.

1- Leakage that may occurs when using fluid tubes

2- The device to maintain a low weight and be able to hold heavy weight.
Implication/Impact

In the United States, when a patient is choosing a hospital they want the best service with high comfort accommodations. Targeting this concept the new patient transfer assist devices will allow most patients to experience a comfortable transition. In the same token, most hospitals want to create an efficient and satisfactory experience for the patients, while having devices that assist their employees in doing difficult tasks. This will create a quicker system that utilizes fewer hands, which allows the hospital employees to be used in other areas. These types of designs are what can make the most impact in the health system and how it is provided.

Future Direction

This research can be continued in the future by looking into newer materials that weigh less in order to have a even lighter system while being to hold more weight. This can be done by not having monetary limitations on the quality of material that can be tested. Also, by understanding the fluid properties we can use it to enhance other devices that utilize similar technology. It will be able to generate interest from industry because it will be a device that can be mass produced for hospitals all around the world. Industry will play a major role in how quickly the device is produced and placed into the market. This device will create a direct customer, which are the healthcare systems that will be using it.
Cost Analysis

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<th>Material</th>
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<td>Stretcher</td>
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<td>Tubing Fabrication</td>
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<td>Metal Rollers</td>
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<td>Outer Frame</td>
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Time Line

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<th>March</th>
<th>April</th>
<th>May</th>
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<td>Selecting fluid roller material/contact vendors</td>
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<td>Testing/Selecting different fluids</td>
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Team Members/ Responsibilities

Work will be divided between the two team members Abdelrahman Hassane and Hatem Alabdali.

- Hatem
  - Frame dimensions
  - Identify different metal properties for the frame design
  - Testing design for the frame

- Abdelrahman
  - Fluid tubing dimensions
  - Determine filling material/tubing mater
  - Testing method for different filling material/tubing material

Both team member will work together to assemble the full design and insuring the devices is working. Also work together on testing the design. The team member will meet at least 3 to 4 times a week to insure the correct work flow is being followed.
Bibliography/References


