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Design and Development of Multifunctional Stretcher

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Abstract

Hospital stretchers and wheelchairs are integrated in this piece. Instead of using the chair and stretcher individually, the suggested stretcher can be utilized for multiple purposes. Patients' mobility issues can be greatly reduced by this arrangement. There is a challenge in the ICU moving seriously damaged or fractured patients from stretcher to wheelchair. This product is capable of addressing such situations. One more advantage of the proposed design to conduct the tests like ECG & SCAN, without shifting the patient from stretcher to wheelchair. The current design also accommodates the provision of carrying accessories like oxygen cylinder and electronic blood pressure measuring machines. In addition to improving patient comfort, the integrated stretcher-wheelchair system significantly enhances safety during intra-hospital transport. By eliminating repeated patient transfers, the risk of secondary injuries, discomfort, and musculoskeletal strain to healthcare staff is substantially reduced. The transformation mechanism is designed to be smooth and controlled, allowing caregivers to convert the stretcher into a seated wheelchair configuration with minimal physical effort and without disturbing the patient's posture. The ergonomic design includes adjustable backrest inclination, leg support elevation, and secure locking mechanisms to ensure stability during both stationary and mobile conditions. High-quality caster wheels with braking systems provide controlled movement across different hospital surfaces, including ramps and narrow corridors. Safety features such as side rails, patient restraint belts, and shock-absorbing frames further enhance reliability, particularly in critical care environments like the ICU and emergency wards. From a clinical perspective, the ability to perform diagnostic procedures such as ECG, scanning, and routine monitoring directly on the integrated unit improves workflow efficiency and reduces waiting time. The built-in mounting brackets for oxygen cylinders, infusion stands, and monitoring devices ensure uninterrupted care during transport. This continuity is especially beneficial for critically ill or trauma patients who require constant observation and life-support equipment.

Keywords: Stretcher, wheel chair, multi-purpose, mobility, design features, mechanism

INTRODUCTION

In emergency situations such as accidents, natural disasters, or serious health conditions, the quick and safe movement of patients is very important. However, many stretchers used today are basic and lack features that support both patient comfort and medical staff convenience. They often have fixed heights, no space for carrying medical equipment like oxygen cylinders, and are difficult to use on uneven surfaces.

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Existing research highlights the challenges in hospital patient mobility, focusing on separate stretcher and wheelchair systems. Studies emphasize the inefficiencies in transferring critically ill or injured patients between mobility aids. In order to improve patient management, particularly in hospitals with limited capacity for completely automated beds or wheelchairs, researchers have looked at the creation of wheelchair-cum-stretcher systems [1].

Figure 1. (a–d) Step to transfer patient bed to chair [3].

In hospitals, patients must be transferred from wheelchair to stretcher, stretcher to beds, bed to wheelchair, or vice versa, resulting in risky conditions for patients, as illustrated in Figure 1 [2]. This project aims to design and develop a Multifunctional Stretcher that solves these problems by including features such as adjustable height using a linear hydraulic bottle jack, foldable structure, strong wheels, and medical tools. This type of stretcher will reduce the physical effort needed by rescuers, improves patient safety and comfort, and is useful in ambulances, hospitals, military camps, and rescue operations.

As a result, we created a multifunctional wheelchair that can be used both as a wheelchair and a stretcher. To accomplish the necessary motion and transform the wheelchair into a stretcher, we have used basic mechanical linkages together with a few additional devices [3, 4]. With the help of a developed stretcher/wheelchair, a nurse or attendant may effortlessly move a patient from their bed to the stretcher and back again. It is quite easy to move around in both configurations, even on a stretcher and in a wheelchair [3].

LITERATURE SURVEY

The increasing number of emergency cases and the need for safer, faster, and more comfortable transport choices in hospitals and healthcare facilities have led to a rise in demand for effective, multipurpose patient transfer systems. Although conventional wheelchairs and stretchers have their uses, they frequently have drawbacks such poor ergonomics, a lack of adjustability, and physical strain

on patients and caregivers. As a result, a lot of research and design effort has gone into creating multipurpose stretcher systems that enhance patient support and mobility [5, 6].

Many researchers have proposed various wheelchair/stretcher designs to reduce manual handling requirements and improve patient safety during transfers. A multipurpose device that combines the functions of a wheelchair and stretcher was introduced by Katkar et al. in an attempt to simplify patient mobility and give medical facilities a cost-effective choice [7].

Similarly, Vishwakarma et al. developed a multifaceted, reasonably priced wheelchair that can also be used as a stretcher when needed. Reducing patient handling injuries and making the device more affordable for more people were their goals [2].

Mohanavel et al. developed a lightweight design and constructed an effective yet adjustable stretcher out of stainless steel. Hospitals, ambulances, schools, and even factories were all the critical situations for which their model was designed. The main goal was to combine the use of a wheelchair and a stretcher into one design in order to save time and labor [4].

Borkar et al. constructed a mechanically operated wheelchair that could be transformed into a stretcher using a reclining mechanism held up by hinges and linkages. Their objective was to develop a low-maintenance, user-friendly design that will work reliably for both patients and attendants in a range of situations [8].

By adding a hydraulic bottle jack to modify the stretcher's height in accordance with the bed, Sushir et al. went one step further. This reduced the amount of work required for nurses or attendants to move patients. In order to support the structure during conversion and mobility, their concept additionally makes use of a linking mechanism. Additionally, it has six wheels for increased stability, and it is reasonably priced and manual to operate [9].

A stretcher/wheelchair with an adjustable backrest and leg rest was constructed by Vaghela et al. using screw jacks. Depending on the medical requirements, the user can sit up or lie down because of this design. Considering that patients regularly need to be moved between beds and chairs in hospital settings, their model proves helpful [3].

Despite their effectiveness in enhancing mobility and use, these designs frequently lack necessary medical equipment that would enable more continuous and effective patient care while in transit. Our present work is notable in this regard.

The objective of our project is not to only combine the capabilities of a wheelchair and stretcher, but also, to equip the stretcher with essential medical equipment and accessories, such as:

- A bottle hydraulic jack for smooth and adjustable height control
- A Blood Pressure machine for real-time monitoring
- An oxygen cylinder for respiratory emergencies,
- A saline stand to support IV fluids,
- And safety belts to keep the patient safe while being moved.

These modifications turn the stretcher from a straightforward transport tool into a mobile care unit that may offer prompt medical assistance in emergency situations. This is especially helpful in emergency transport, hospital hallways, or disaster assistance situations where every single piece of equipment counts.

Our design combines mechanical innovation with functional integration, drawing on prior research to offer better safety, faster response times, and more mobility. In the end, it promotes patient-centered care by decreasing reliance on several technologies and improving medical staff productivity.

METHOD AND MATERIALS

Blood Pressure Machine

Measuring blood pressure is critical when a patient is being transferred on a stretcher, especially in an emergency (Figure 2). Traditional machines that use a cuff on the arm are not necessarily user-friendly during transportation. To address this issue, new type of blood pressure machines are being incorporated to stretchers [5].

Hydraulic Jack

A hydraulic jack is a device that raises heavy objects by applying force through a hydraulic cylinder [6]. Hydraulic jacks use the force generated by the pressure inside the cylinder chamber to raise items. Fluid pressure in a hydraulic jack doubles the force in a cylinder when lifting a heavy load.

These jacks are utilized in a variety of industries, including machine shops, automotive manufacture, material handling equipment, lifting platforms, railroad construction, and hydropower plants. This article examines the many types of hydraulic jacks, their functions, proper usage, and factors to consider when selecting one, as seen in Figure 3 [6].

Figure 2. Blood Pressure Measuring Machine.

Figure 3. Hydraulic jack

Figure 4. Conceptual design

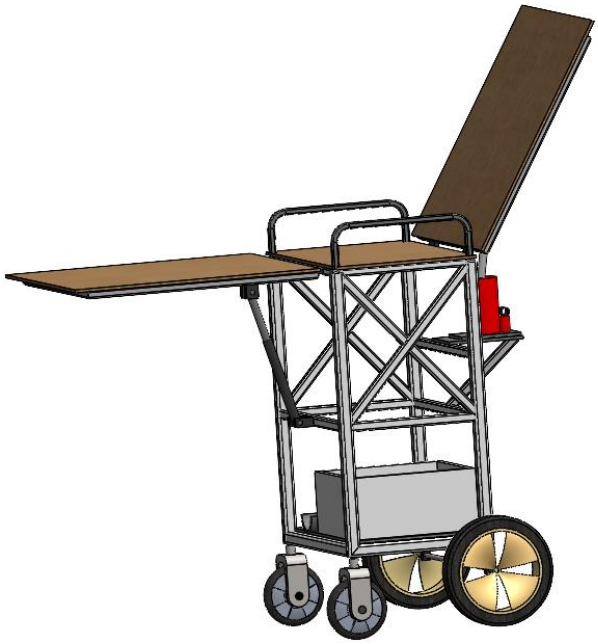

Figure 5. Partially Foldable view

Figure 6. Fully Foldable view.

DESIGN OF STRETCHER

In our stretcher, we used a hydraulic jack mechanism to adjust the height of the back stretcher to your desired height, as well as a simple mechanism to alter the leg support height (Figure 4–6).

Here is the Back support of stretcher is lifted upward direction with the help of Hydraulic pump by applying the force on pump. This takes the back support to required height as per patient needs.

CONCLUSIONS

The purpose of this study was to synthesize design features for the conceptualization of multifunctional stretcher. This was achieved by reviewing a variety of stretchers, and extracting their useful key features for the formation of different concepts. The finest idea was chosen, and it includes a stretcher that can be folded up and transformed into a wheelchair with a seat that can be adjusted. The

advantages of this multifunctional stretcher are ease of maintenance, customizable usability, quick adjustment, durability, and cost effectiveness. The general objective of improving the patient experience while reducing dependency on manual assistance is in line with these developments, which together seek to increase patient comfort, enhance facility logistics, and strengthen overall safety standards. By assuming different research processes which helped us to recognize the different points of the matter, priority of security along with hygiene, and understanding of materials and manufacturing process involved in the development of whole product. Therefore, this project mainly focuses on cost-effectiveness and easy acceptance.

In addition to conceptual development, the study incorporated ergonomic analysis and user-centered design principles to ensure that the stretcher meets the practical needs of both patients and healthcare providers. Anthropometric data were considered to optimize seat height, backrest angle, and handle positioning, thereby enhancing comfort and reducing physical strain during operation. The folding and transformation mechanism was engineered to function smoothly with minimal force, allowing healthcare staff to perform adjustments quickly and safely in emergency scenarios.

Material selection played a crucial role in achieving durability and hygiene compliance. Lightweight yet high-strength materials such as aluminum alloys and medical-grade polymers were evaluated to ensure corrosion resistance, ease of cleaning, and long service life. Surface finishes were designed to withstand frequent sterilization without degradation, supporting infection control protocols within hospital environments.

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