Design And Development of Patient Transfer Aid for Hospitals

SAJEESH N[1], SADANANDAN R[2], ATHUL ANAND A S[3], AKHIL BOBAN[4], ANAND M B[5], KRISHNENDHU S[6], RAGESH P R[7], KRISHNAPRASAD C N[8]

[1, 2, 7, 8] *Assistant Professor, Jawaharlal College of Engineering and Technology, Palakkad, Kerala, India*

[3, 4, 5, 6] *Final year me students, Jawaharlal College of Engineering and Technology, Palakkad, Kerala, India*

***Abstract*— Nurses and nursing aids continue to be one of the top professionals that suffer from Muscular skeletal disorders (MSDs) specifically lower back and shoulder injuries. This is due to the fact that, in hospitals patients are to be lifted and transferred with the help of 3 or 4 people. Hence the project aims at reducing the human involvement and the patient can be transferred with the help of single person assistance. the horizontal movement of the transfer aid is carried out by a conveyor belt system.**

***Index Terms*— Stretcher, Conveyor Belt System**

I. INTRODUCTION

Patient transfers in hospitals are crucial but pose challenges for both patients and staff. Specialized transfer aids are on the cutting edge of improving healthcare, making transfers safer and smoother. These tools prioritize patient comfort and safety while reducing physical strain on caregivers. The design of these aids combines ergonomics, engineering, and an understanding of user needs. As hospitals push for better efficiency and patient-centered care, innovative transfer aids become even more important. This development requires collaboration between healthcare professionals, engineers, designers, and patients to create user-friendly equipment that optimizes mobility and minimizes transfer-related injuries.

A. Reduce work load

Current transfer methods, often relying solely on manual lifting, can lead to a multitude of health problems for both patients and staff. Musculoskeletal disorders, a common consequence of improper lifting techniques, plague healthcare workers. This innovative transfer aid seeks to revolutionize this process, minimizing the physical strain placed on caregivers. By reducing reliance on manual lifting, the workload is significantly lessened, creating a safer environment for both patients and medical professionals.

B .Safe transfer

This transfer aid offers a significant improvement for patient transfers, particularly for those with limited mobility like paralyzed individuals and elderly populations. The traditional lifting methods can be arduous and risky for both patients and caregivers. This innovative device facilitates a smoother and less strenuous transfer process, promoting patient comfort and safety. By reducing the physical demands on healthcare staff, this aid fosters a more efficient and positive care environment for everyone involved.

C.Cost efficent

Recognizing the budgetary constraints of government hospitals and smaller private facilities, this stretcher prioritizes cost-effectiveness. Luxury features have been strategically omitted to ensure affordability without compromising on functionality. This approach makes the stretcher a viable option for a wider range of healthcare institutions, ultimately increasing access to improved patient transfer methods for a larger population.

II. BACKGROUND STUDY

A .Survey

The background study for the project includes survey through online platform and interview with medical staff of different hospitals in Kerala. The problem was identified by the interaction with nurses and other medical staff. Along with this, a survey using google forms was also conducted. The question asked and the responses received are as given below:

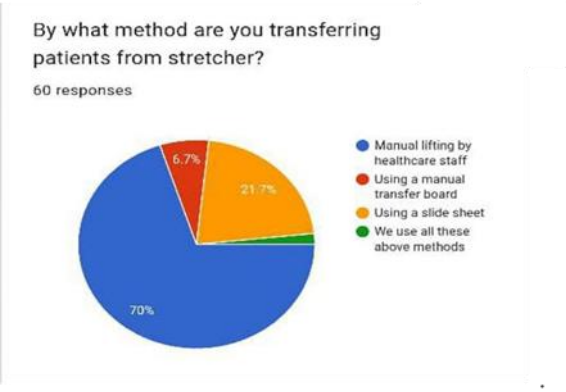

Fig.1 survey response from google forms

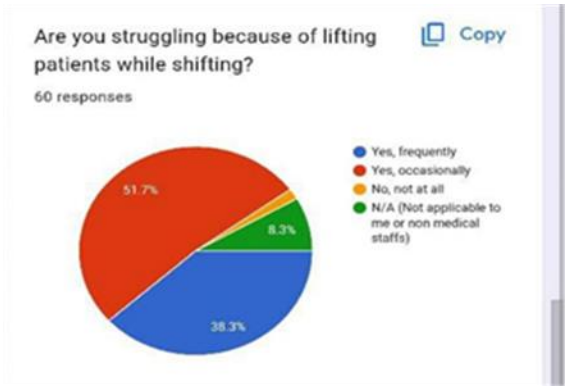

Fig. 2 survey response from google forms

From the responses we could conclude that around 50% of the people struggle because of lifting the patients and 70% of people still using the lifting method for the transfer of patients. So from these survey conducted we reached a conclusion that an easy method of patient transfer is a need

B. Interview

As a part of the background work, we interviewed some medical staff. The important questions asked are as follow:

- Are you struggling because of lifting patients while shifting?
- By what method are you transferring patients from stretcher?
- Will it help if we introduce an automated patient transferring aid ?

The responses to the query regarding the struggle encountered while lifting patients during shifts painted a vivid picture of the formidable difficulties these professionals contend with on a regular basis. The unanimous sentiment conveyed was one of significant hardship, highlighting the toll manual patient lifting takes on the well-being of medical staff. This not only emphasizes the physical strain but also underscores the potential long-term health implications and the need for innovative solutions to address these challenges. In addition to the struggle of lifting, our interview delved into the methods employed by medical personnel when transferring patients from a stretcher. This line of questioning aimed to gain a nuanced understanding of the current practices and identify potential areas for improvement in patient transfer protocols. By scrutinizing these established methods, we aimed to pinpoint specific pain points in the workflow, seeking opportunities to streamline and enhance efficiency in patient transfer procedures.

A particularly intriguing proposal was introduced during the survey, the prospect of integrating automated patient transferring aids into the healthcare environment. The significance of this proposition lies in its potential to revolutionize the way patient transfers are conducted, mitigating the difficulties expressed by medical staff. The survey participants were encouraged to contemplate the impact of such technological interventions on their daily routines and overall job satisfaction. Their insights and perspectives on the feasibility, acceptance, and potential benefits of automated aids serve as invaluable data for shaping future innovations in healthcare practices. By considering the collective feedback from these professionals, we hope to pave the way for advancements that not only alleviate the physical strain on medical staff but also enhance the overall quality of patient care in healthcare settings.

III. METHODOLOGY

A. Problem Statement

Despite medical advancements, safely transferring patients in budget-constrained environments remains a hurdle. Traditional methods, reliant on manual lifting, cause caregiver injuries and patient discomfort. Existing aids often require patient strength or cater to specific transfers, limiting their use. Cost and availability further restrict access, especially in low-resource settings like government hospitals. To revolutionize patient care, an ideal transfer aid should

prioritize safety and comfort, with features to prevent falls and injuries.

It should be user-friendly for caregivers with minimal training and integrate seamlessly with existing equipment. Sustainability is also important, with durable and potentially recyclable materials being a plus. By addressing these challenges, such an aid can improve patient experiences, caregiver well-being, and empower those with limited mobility.

B. Background Study

To inform the design, extensive research was conducted. Medical staff across various hospitals were interviewed and surveyed to understand their needs. Existing stretcher models were also analyzed and evaluated. This combined approach - user experience and market research - provided the foundation for the new stretcher's development.

C. Design considerations

The needs assessment paves the way for the creation of a comprehensive design criteria list. This list prioritizes safety for both patients and caregivers, ensuring features that prevent falls and injuries. Ease of use is key, catering to a range of physical abilities. Durability is essential for a hospital environment with frequent use. Portability allows for effortless movement between locations. To be accessible, the aid should be cost-effective to purchase and maintain. Patient comfort and proper support are crucial elements. Finally, ergonomic design promotes safe body mechanics for caregivers and reduces the risk of musculoskeletal injuries, complying with all relevant regulations.

D. Fabrication and testing

The design transforms from concept to a tangible prototype through various methods. Initial ideas take shape with sketches and physical models, allowing for early visualization and refinement. 3D printing brings the design to life as a functional prototype for basic testing and evaluation. Finally, Computer-Aided Design (CAD) software creates a precise digital model with exact specifications. This digital model allows for virtual testing, simulating real-world use and interaction with patients, caregivers, and surroundings. It also facilitates the creation of technical drawings and documents crucial for future manufacturing. Once a prototype is built, rigorous testing begins. This testing ensures the transfer aid meets safety, effectiveness, and usability standards. Laboratory testing assesses its mechanical properties and performance in a controlled environment. Clinical trials then evaluate its real-world functionality and user experience in a hospital setting with patients and healthcare workers. Throughout this process, feedback is actively collected to identify any areas for improvement. This may involve design tweaks to address safety or usability concerns, or even adding new features to enhance performance. Based on these findings, the design is refined and further testing ensures the success of these modifications.

IV. DESIGN

The current stretcher design, while functional, presents challenges during patient transport, especially on uneven terrain or stairs. To address these limitations and improve patient care, this proposal introduces a stretcher concept that has horizontal movement to transfer patients stretcher to bed and vice versa without lifting them . it utilizes conveyor belt mechanism for the transfer , ensuring a safer and more comfortable experience for both patients and medical personnel. The design was developed using CATIA V5 software.

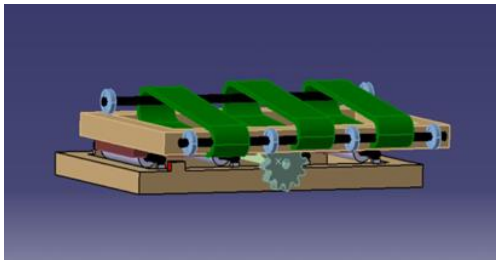

Fig 3 front view

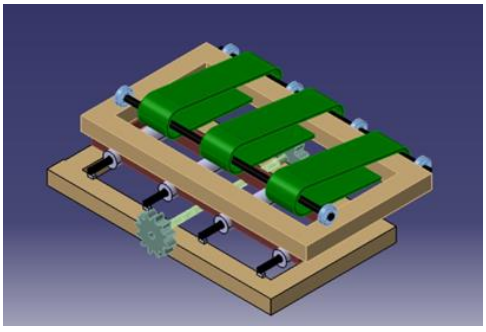

Fig .4 top view

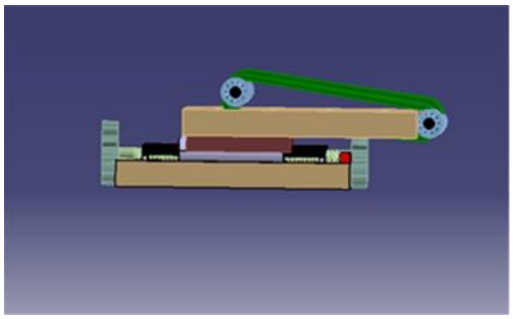

Fig .5 Side view

V. RESULT AND FUTURE SCOPE

A . Result

Fig .6 Actual model

The product has been fully constructed and is now operational. It is designed to handle a weight capacity of up to 100 kilograms. To assess its functionality, a practical test was conducted utilizing a human subject. The test results were highly positive. The participant experienced a smooth, efficient, and effortless transfer process. They reported no discomfort or pain throughout the operation and did not raise any concerns regarding the product's performance. This positive user experience indicates the project's overall success in achieving its intended goals.

B Future Scope

While the current prototype demonstrates a strong foundation, our team is committed to continuous improvement. We see exciting possibilities for optimization in three key areas: size, speed control and overall weight.

Firstly, size reduction is a major focus. A more compact design would make the product easier to maneuver and store. This would be particularly beneficial in situations with limited space or when portability is crucial. Imagine being able to easily transport this device for on-site applications or seamlessly integrate it into existing workflows without requiring dedicated areas.

Secondly, introducing variable speed control would unlock a new level of versatility. This would allow users to fine-tune the transfer process based on specific needs. Delicate objects could be handled with a gentle, slow movement, while heavier loads could be moved more quickly. This level of control would enhance user experience and expand the product's potential applications.

Finally, weight reduction remains a top priority. Utilizing lighter materials and refining the design can significantly improve portability. Imagine a lighter version that can be easily carried by a single person, streamlining deployment and operation. This focus on weight reduction will not only enhance user comfort but also contribute to a smaller environmental footprint during transportation.

CONCLUSION

An effective patient transfer aids goes beyond just equipment; it's a strategic decision impacting patient safety, staff well-being, and overall workflow. The right aids, combined with proper training, create a positive experience for everyone. The development of these aids transcends technological advancements, becoming a cornerstone of improved patient care and a safer work environment. As hospitals strive for patient-centered care and streamlined operations, innovative transfer aids stand as a critical pillar in building a better healthcare future for all.

Patient transfer aids are essential for hospitals, promoting patient safety and comfort by minimizing manual lifting and anxiety. They also improve staff efficiency and comply with safety regulations. Choosing the right aid depends on the patient's needs, environment, and staff expertise. Options include sliding sheets for transfers, belts and slings for assisted movement, hoists for non-ambulatory patients, and sit-to-stand devices. Investing in these aids is wise as they benefit everyone. Ultimately, patient transfer aids are not just technology, but a crucial investment in well-being and safety. They are a vital part of medical equipment, facilitating safe transfers and reducing staff strain. As hospitals prioritize patient-centered care, the evolution of transfer aids becomes key for a better healthcare experience. This ongoing development requires collaboration between various stakeholders to create innovative, reliable, and user-friendly tools that minimize risks and optimize mobility, shaping a safer and more patient-centric future for healthcare

Patient transfer aids are much more than just convenient tools in a hospital setting; they play a vital role in ensuring the well-being of both patients and staff. By minimizing the need for manual lifting, these aids significantly reduce the risk of musculoskeletal injuries for caregivers, a common consequence of improper lifting techniques. This translates to a safer work environment and a healthier staff. For patients, transfer aids promote smoother transitions between locations, minimizing pain and anxiety during the process. These aids can also foster a sense of dignity and independence by allowing patients to participate in their transfers as much as possible. Furthermore, efficient patient transfers free up valuable staff time, allowing them to focus on other crucial patient care tasks. The importance of patient transfer aids is further underscored by hospital regulations, many of which mandate the use of safe patient handling equipment

REFERENCES

[1] Kin Cheung et al.[2020] The biomechanical evaluation of patient transfer tasks by female nursing students: With and without a transfer belt, Applied Ergonomics, Volume 82,2020,102940,ISSN 0003-6870

[2] Arunkumar K N et al. [2019] ‘Design Experiment and Fabrication of Multipurpose Stretcher for Patient’, International Journal of Innovative Technology and Exploring Engineering, ISSN: 2278-3075, Volume-8, Issue-6S4, April 2019

[3] Bortnowski, Piotr, et al.[2022] "Types and causes of damage to the conveyor belt–Review, classification and mutual relations." *Engineering Failure Analysis* 140 (2022): 106520.

[4] Wang, Hongbo, and Fumio Kasagami. "Careful-patient mover used for patient transfer in hospital." 2007 IEEE/ICME International Conference on Complex Medical Engineering. IEEE, 2007.

[5] Salmani Nodooshan, Hamid, et al. "Designing, prototype making and evaluating a mechanical aid device for patient transfer between bed and stretcher." International Journal of Occupational Safety and Ergonomics 23.4 (2017): 491-500.