

Caregiver Perceptions of the AgileLife Patient Transfer System

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INTRODUCTION

In the United States, approximately 39.8 million caregivers provide essential support to adults with a disability or illness [1]. Caregivers often provide assistance with activities of daily living (ADLs), including tasks that involve assisting with transfers, like bathing, getting in and out of a bed, and transferring to a toilet. Approximately 43% of caregivers assist with transfer-related tasks in a home setting [1]. However, caregivers who assist with transfers are at a high risk for developing musculoskeletal pain and injury. Prior research has shown that 43.4% of all developed musculoskeletal injuries in caregivers occur due to transfer-related activities, such as lifting and transferring a care recipient [2]. In addition to the physical burden experienced during transfers, 45% of individuals providing care to an individual with a long-term physical disability also experience high levels of emotional strain [3]. High levels of physical and emotional burden impact a care provider's ability to perform transfer tasks safely and effectively.

Clinical settings are equipped with assistive technology to reduce burden during transfers. However, lift devices are not always immediately available, convenient, or intuitive to use. Mechanical lifts, such as ceiling lifts and floor lifts are a common solution in hospital settings for patient transfer but are difficult to install and implement in home care settings [4]. Operation of some lift devices can be difficult to use and maneuver in confined or tight spaces and requires awkward manipulations of the care recipient [5]. As a result, transfer technology presence does not necessarily help reduce the burden experienced by informal caregivers [6]. Although mechanical transfer devices are more biomechanically favorable than manual lifting, they still do not completely solve the issues involved with patient transfer [7]. As the population ages, the need for alternative patient transfer methods that reduce burden on caregivers increases.

The AgileLife Patient Transfer System (PTS) is a new transfer device designed to lower effort required by caregivers while providing a simple and streamlined transfer for patients. The system uses a series of actuators and a conveyor to seamlessly transfer the user from bed to chair and vice versa at the push of a button and involves no manual lifting or repositioning. Although commercially available, the effects of the AgileLife PTS on caregiver burden during use in a home setting has yet to be examined. The purpose of this study is to examine caregiver perceptions of the AgileLife PTS after a nine-week in-home intervention. Findings from the study will determine if use of the AgileLife PTS reduces physical and mental burden while increasing feelings of safety and performance in caregivers during transfers.

METHODS

This study was approved by the University of Pittsburgh Institutional Review Board. Participants were recruited for this study along with their care recipients and all signed informed consent forms. Caregivers who provided care to device users were enrolled in the study if they 1) were 18 years of age or older, 2) provided transfer assistance to the individual at least 3 days a week and 3) had no reported lower back pain that may be exacerbated by performing transfers.

The AgileLife Patient Transfer System: The AgileLife Patient Transfer System (PTS) is composed of a hospital bed with a wheelchair docking station and a wheelchair, as shown in **Figure 1**. To prepare for a transfer, the caregiver brings the wheelchair to the docking station at the foot of the bed and latches it into the docking station. The caregiver holds down the "Transfer to bed" button on the primary user interface (PUI) to initiate the transfer. The docking station pulls the wheelchair closer to the bed while the mattress rises to meet the back of the chair. The system prompts the caregiver to manually lower the back of the chair and the mattress acts as the chair back. Once the care recipient is in the correct position, the seat of the wheelchair rotates backward as the bed begins to lower and the conveyor starts to gently pull the patient onto the bed. The system stops when

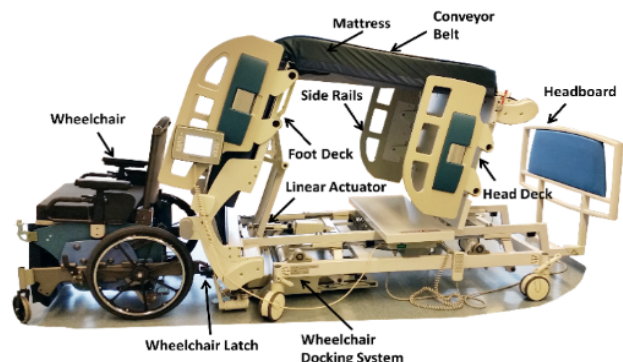


Figure 1: The AgileLife Patient Transfer System

The system stops when

it senses that the feet are past the foot of the bed. The process proceeds in reverse when the caregiver holds the “Transfer to chair” button on the PUI. The system can be paused at any time by releasing hold of the button on the PUI. Transfers require no lifting and can be completed in 90 seconds. In addition to transfers to bed and to wheelchair, the bed also gives the caregiver the ability to adjust bed height, head and foot position, and sheet position.

Protocol: A single subject research study with a three-week baseline period and a six-week intervention period was conducted. The baseline period involved the caregivers using only the bed component with their care recipient to ensure that all reported differences were due to the new transfer functions and not the introduction of a new bed. After three weeks the transfer components were enabled and participants were trained on the transfer functions of the PTS. When the bed was installed participants were given a series of questionnaires consisting of a demographics survey and a transfer assessment survey that asked about burden associated with performing transfers. Participants were asked to evaluate their current method of transfer based on mental demand, physical demand, level of success, levels of frustration, and safety when preparing for a transfer and performing a transfer. The transfer evaluation questionnaire was re-administered at the end of the six-week intervention period with the addition of a Patient Transfer System Evaluation, which asked about the PTS in terms of overall safety, comfort, ease of operation, timeliness, functionality, and likelihood to recommend.

Data Analysis: Both the transfer and PTS evaluation surveys used a 10 cm visual analog scale and the subject was asked to mark on the line to indicate their response. The transfer evaluation used 0 as an indicator of “very low” and 10 as an indicator of “very high” levels of the metric being described. When comparing previously used transfer methods during the PTS Evaluation survey, 0 indicated “much worse”, 5 indicated “no difference” and 10 indicated “much better” than previously used methods. Caregivers were also asked how likely they were to recommend the PTS to others, with 0 being “not at all likely” and 10 being “very likely”. Average pre and post intervention scores were calculated. A Wilcoxon matched pairs test was performed to examine differences in caregiver responses pre and post intervention with the level of significance set to $p < 0.05$. All statistical analysis was performed using SPSS Version 25 (SPSS Inc, Chicago).

RESULTS

Five caregivers were enrolled in the study along with four care recipients whom the caregivers provided assistance with transfers. Three caregivers provided care to family members and two were paid care attendants providing care to a client. Details about each caregiver and their care recipient can be found below.

Subjects

Caregiver A: Caregiver A is an 18-year-old African American male who weighs 99 kg and is 175 cm tall. He provides 16-24 hours of care per week to his 39-year-old mother, who underwent thoracic-lumbar surgery due to chronic low back pain. While his mother is capable of ambulating over short distances, she requires assistance from her son to get in and out of bed. Prior to the intervention, Caregiver A manually lifted his mother in and out of bed without the use of assistive technology.

Caregiver B: Caregiver B is a 76-year-old African American female weighing 68 kg and is 145 cm tall. She provides over 40 hours of care per week to her husband, who has had multiple strokes and has a visual impairment. During bed to wheelchair transfers, Caregiver B provides physical assistance during stand-and-pivot transfers assisted with a walker.

Caregiver C-1 and C-2: Caregiver C-1 and Caregiver C-2 are care attendants who provide 8-16 hours of care per week to their client, a 50-year-old Caucasian female who underwent cervical spinal fusion surgery and has osteoarthritis in both knees. Caregiver C-1 is a 45-year-old female who weighs 68 kg and is 175 cm tall. Caregiver C-2 is a 41-year-old female who weighs 45 kg and is 162 cm tall. Both caregivers provide physical assistance during bed to wheelchair transfers.

Caregiver D: Caregiver D is a 53-year-old Caucasian female who provides over 40 hours of care per week to her husband, who has multiple sclerosis. She reports being 170 cm tall and weighing 90 kg. Caregiver D assists with all transfers her husband performs via manual lift.

Perceptions of the AgileLife PTS

Table 1 shows individual and average (\pm standard deviation) perceptions of preparing for a transfer and performing a transfer before and after PTS implementation. Because similar results were seen when asking about transferring from a wheelchair to a bed and from the bed to the wheelchair, only the results from transferring from the bed to the wheelchair are shown. Caregivers reported significantly higher levels of perceived success when preparing for a transfer post-intervention ($p=0.043$).

Table 1. Caregiver perceptions of preparing for and performing transfers pre and post intervention.

	Preparing for a transfer									
	Mental Demand		Physical Demand		Level of success		Insecurity, stress, annoyance		Safety	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Caregiver A	0	4.1	9.7	5.8	8.5	8.8	1.0	3.0	8.8	9.6
Caregiver B	9.5	1.3	9.2	3.6	5.4	9.5	9.3	0.3	5.3	0.3
Caregiver C-1	0.3	1.8	7.4	0.7	3.4	10	2.2	0.5	1.8	10
Caregiver C-2	0.3	0.5	0.3	0.6	8.8	8.4	0.3	6.8	9.5	8.5
Caregiver D	0.5	0.0	4.9	0.0	8.0	9.9	0.8	0.0	8.7	10
Average	2.1 (4.1)	1.5 (1.6)	6.3 (3.9)	2.2 (2.5)	6.8 (2.3)*	9.3 (0.7)*	2.7 (3.8)	2.1 (2.9)	6.8 (3.2)	7.7 (4.2)
Performing a bed to wheelchair transfer										
Caregiver A	1.3	7.6	9.1	5.4	9.7	9.0	0.6	0.0	9.1	10
Caregiver B	5.1	0.7	9.3	1.6	5.3	1.6	8.8	1.6	8.7	9.1
Caregiver C-1	0.2	1.6	7.2	0.5	5.8	9.2	5.1	3.6	4.7	7.7
Caregiver C-2	0.3	0.6	0.3	0.5	9.3	7.9	0.4	7.8	9.6	7.9
Caregiver D	5.0	0.0	9.0	0.1	9.3	10	0.7	0.0	8.6	10
Average	2.4 (2.5)	2.1 (3.1)	6.9 (3.8)	1.6 (2.2)	7.9 (2.1)	7.7 (3.5)	3.1 (3.7)	2.6 (3.3)	8.1 (1.9)	8.9 (1.1)

Table 2 shows the ratings of overall safety, comfort, ease of operation, timeliness, and functionality compared to their previous transfer method. The subject’s likelihood of recommending the PTS is also shown in Table 2.

Table 2. Caregiver Device Evaluation Summary

	Safety	Comfort	Ease of Operation	Timeliness	Overall Functionality	Likelihood to recommend
Caregiver A	10	10	10	1.2	8.6	9.0
Caregiver B	5.0	5.0	3.2	5.0	2.9	10
Caregiver C-1	7.6	8.0	8.4	8.3	8.2	10
Caregiver C-2	4.8	9.0	4.8	1.9	8.9	8.6
Caregiver D	10	10	10	10	10	10
Average	7.5 (2.5)	8.4 (2.1)	7.3 (3.1)	5.3 (3.9)	7.7 (2.8)	9.5 (0.7)

DISCUSSION

The majority of caregivers reported improvements in physical demand, mental demand, level of success, stress levels, and safety when preparing for and performing transfers after regular use of the PTS. As caregivers are at a high risk for injury during transfer-related activities, reducing physical burden is a priority during transfers. Four out of five caregivers reported decreases in physical burden during both transfer preparation and transfer performance, with the fifth caregiver reporting similar low levels of burden before and after routine PTS use. As high levels of physical burden may indicate an increased risk for musculoskeletal pain and injury, the reduction in perceived physical burden after routine PTS use may indicate its potential to reduce pain and injury in caregivers assisting with transfers.

A significant difference was seen in caregiver perceived success when preparing for transfers with and without the use of the PTS. When using other forms of assistive technology, transfer set up can be cumbersome and involve awkward positioning [5], which may affect how caregivers perceive their level of success. Because the AgileLife PTS utilizes automated repositioning of the care recipient when preparing for a transfer, caregivers may perceive themselves as more successful during transfer preparation when using the PTS. Emotional burden is also a huge problem in caregivers who provide long term care to those with physical disabilities. By improving how an individual perceives their success with transfers, we may be able to alleviate some of the emotional burden experienced by caregivers who assist with transfer-related tasks.

Most caregivers reported increased or similar levels of safety when preparing for and performing a transfer with the PTS when compared to their previous transfer method. However, Caregiver B reported a large decrease in safety when preparing for the transfer. It is worth noting that Caregiver B also reported the PTS as lower on other metrics, including ease of operation, overall device functionality and perceived success when performing a transfer. Caregiver B reported that her care recipient had a difficult time adjusting to the new transfer technology. This is one potential explanation for

why Caregiver B felt less safe using the PTS than her previous transfer method, but still reported decreases in physical demand, mental demand, and stress.

The majority of caregivers scored the PTS as better than or equal to their current method of transfer in terms of safety, comfort, and overall functionality. Caregivers had mixed opinions on PTS ease of operation and timeliness. One potential explanation for this difference is the introduction of new assistive technology. When using new technology for the first time, there is often apprehension or uncertainty associated with its use. Transfers in and out of bed are performed regularly by caregivers, and therein become habitual, as they are a part of an everyday routine. The PTS is a new technology that caregivers would not have been trained to operate outside of the study; therefore, caregivers may feel uneasy due to being unfamiliar with the device operation. Additionally, the system takes 90 seconds to complete a transfer, which may be significantly longer than manually lifting but safer, as the caregiver is not having to physically assist. Although subjects participated in a nine-week intervention, certain caregivers may need more time to adjust to the use of a new piece of assistive technology. Despite differing perceptions of the PTS, all caregivers who participated in the study rated that they were likely to recommend the device to others, with scores ranging from 8.6 to 10 out of 10.

Limitations and Future Work

The small number of subjects in the study may have prevented the ability to detect statistically significant differences in pre and post intervention perceptions. Additional investigation into caregiver perceptions of the AgileLife PTS may reveal further insights into potential benefits to alleviate burden. Future work should also investigate how perceptions of new transfer technology differ between paid and unpaid caregivers, as their role in assisting with transfers may differ greatly. Finally, education of caregivers in regard to safety issues associated with manual lifting may encourage more use of assistive technology during transfers.

CONCLUSION

Overall, caregivers had favorable opinions of the AgileLife PTS and indicated that it alleviated the burden experienced during bed to wheelchair transfers. Additionally, caregivers reported significantly higher ratings for perceived success after nine-weeks of in-home use of the PTS when preparing for a transfer. Improvements in transfer technology may reduce caregiver burden during wheelchair to bed transfers.

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