

How Smart is the Carevo[®]? Results of a Study on a New Shower Trolley Generation

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Abstract: The purpose of this study was to compare the traditional height-adjustable shower trolley with the Carevo, a shower trolley with a new design. Compared to the traditional height-adjustable shower trolley, the Carevo has higher side supports, indented curves on the long sides, handles, arrow-shaped ends, and a mattress with a flexible mid-section. In this study four nurses carried out five shower cycles using the traditional height-adjustable shower trolley and five shower cycles using the Carevo. These activities were filmed and analysed by multi-moment sampling at a fixed 3-second interval. Each observation consists of a back score, arm score, leg score and neck score. Results show that working with the Carevo leads to less postural stress on the musculoskeletal system of the caregiver, compared to the traditional height-adjustable shower trolley. There is a 10.2% improvement in time spent in a neutral back position and a 9.4% improvement in the time spent in a neutral neck position. However, the improvements depend on the cut off point: if the cut off point is a flexed back posture of 20°, a 3.0% improvement is found. Although quality of care and comfort was not the subject of this research, we would like to state there is room for improvement, as the patient spends only a small part of the total time on the trolley being showered, which can easily lead to an uncomfortable experience. This quality of care issue seems to be addressed more effectively by new features of the Carevo compared to the traditional height-adjustable shower trolley.

Keywords: Shower trolley, nursing, physical load, ergonomics, Carevo, back pain, static load.

INTRODUCTION

Occupational back pain among nurses still leads to high costs for healthcare facilities and personal suffering for nurses. Ergonomic solutions remain necessary [1-4]. According to scientific studies, the primary causes of back injuries are patient handling tasks, such as lifting, transferring and repositioning patients [5], and static postural stress [6-7]. In order to reduce these injuries, healthcare facilities worldwide are paying greater attention to ergonomics. Actions include the use of lifting aids to reduce dynamic loads during lifting and repositioning patients, lifting specialists¹ and training. Research continues to prove that an ergonomic approach focusing on a combination of interventions can be beneficial [8, 21]. Evidence exists that multi-element ergonomic interventions, - particularly those that include risk assessments, observation of workers in their working environment, tailoring of training to suit individual needs, and the redesign of equipment and handling tasks - can be effective in reducing the risk of manual handling injuries [9]. However, although there is evidence that the caregiver's back is in a bent, twisted, or bent and twisted position during a substantial percentage of the total work

time [10], little attention is being paid to this kind of load, known as static, postural or covert load. 'Covert load' is used as opposed to overt load, as this load is not visible (nothing is being lifted, pushed, pulled etc), but there is still an actual load on the musculoskeletal system, caused by the posture of the caregiver's body. Static loads can be heavy for two reasons. Firstly, the weight of the lifter's own trunk, arms and head places a strain on the back, neck and shoulder area; parts of the body that make up about two-thirds of total body weight. The more the caregiver bends forward, the greater these loads become. Secondly, muscles must hold the position assumed by stabilizing the weight of the trunk, head and arms. This requires a great deal of muscle power, which rapidly increases the more the caregiver bends forward. If the position must be maintained for any length of time, muscle fatigue can occur quickly. This causes a nagging pain in the back or neck [11].

Regarding static load, bathing and showering patients is one of the most stressful tasks a nurse must perform [12]. Height-adjustable devices enable caregivers to work at their individually optimised ergonomic height and, when used properly, should reduce the static load on the musculoskeletal system. Studies have shown that the type of device used when bathing and showering patients has a major effect on the resulting static load on the caregiver's musculoskeletal system. The height-adjustable shower chair was shown to cause the least physical overload compared to a height-adjustable shower stretcher, bath or bed [13]. The

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¹Lifting specialists are key workers, ErgoCoaches, ergo rangers, link nurses, etc..

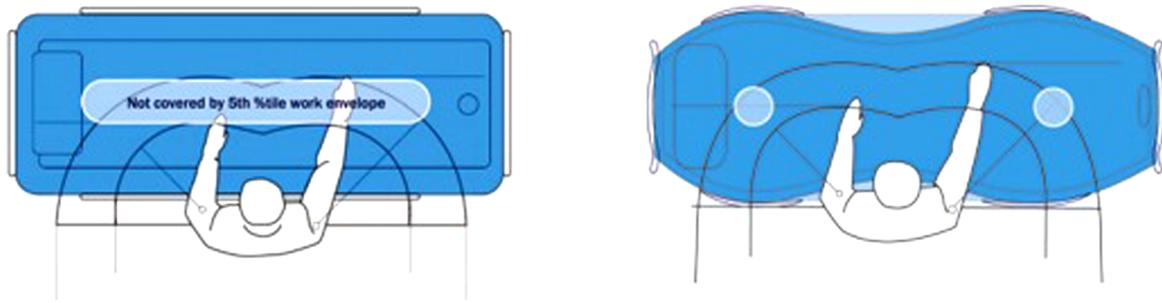


Fig. (1). The traditional height-adjustable shower trolley (on the left) versus the Carevo (on the right) from a bird's-eye view.

latter can be explained by the width of the bed, which is broader than the shower trolley.

RESEARCH QUESTION

A shower trolley with a new design has been developed. Its aim is to reduce static load when showering patients. Compared to the traditional shower trolley, this trolley has higher side supports, indented curves on the long sides, handles, arrow-shaped ends and a mattress with a flexible mid-section (Fig. 1). Because of the curved shape, this new shower trolley is referred to as 'the Carevo'. In this study, we compared the Carevo to the traditional height-adjustable shower trolley, leading to the following research question: is there a difference in the resulting static load on the musculoskeletal system of the caregiver when working with the Carevo compared to the traditional height-adjustable shower trolley?

METHOD

A pre-study in actual nursing practice revealed that a great number of diverse factors influence static load, therefore a laboratory study was performed. This study compared four nurses showering four patients with mobility levels D or E (2 Ds and 2 Es). These mobility levels are taken from the Mobility Gallery [14-16]. The Mobility Gallery is a classification system of five typical patients ranging from A (active) to E (passive), which focuses on functional mobility rather than the underlying specific diseases and their medical diagnoses. This means that the consequences of diseases, their impact on functioning in daily activities, are central to the classification system. After all, it is the consequences of the disease (the resulting functional mobility), not the disease itself, that determines dependency on care, and, to a large extent, quality of life. Therefore this Mobility Gallery is a useful tool for a study like this, as it clearly identifies typical patients based on their mobility and also links the mobility levels with devices used in patient handling and bathing, washing and showering. These links are based on international ergonomic standards. Regarding this study, a shower trolley is used for patients with mobility level D or E.

The four nurses were all female, ranging from 34 to 45 years of age and had normal body postures, weight (average 68 kg) and height (average 171 cm). Of the four patients, two were female, and two male. The females were 165 and 170 cm, weighing 62 and 63 kg. The males were 184 and 181 cm, and weighed 90 and 82 kg.

The measurements were taken over a four-day period. On each day one caregiver and two patients were present. Each caregiver performed five shower cycles using the traditional shower trolley and five cycles using the Carevo. At first, washing the patient's private parts was not done, for obvious reasons, but it was soon realized that as the indented curves on the long sides of the trolley had potential benefits for reducing static load, it was necessary to do additional measurements in this area. As changing incontinence pads is performed in the same body zone, it was decided to score the working postures of the caregiver while carrying out this activity.

All shower cycles were filmed and subsequently analysed. Data concerning the load on the caregiver's musculoskeletal system was gathered by multi-moment sampling at a fixed 3-second interval using four trained observers. Each observation consists of a back score, arm score, leg score and neck score. Joint cut off points were based on the Ovako Working Posture Analyzing System [17] and updated according to ISO/TR 12296 [18]. Earlier studies with the same method revealed an interobserver reliability of > 90% [19]. In addition, the actual activity of the carer (showering, washing, drying, etc) and the position of the carer in relation to the trolley (head end, middle part or foot end) were scored. The data was processed using SPSS. A Chi-square test was used to determine differences between the traditional shower trolley and the Carevo. The test was chosen because two sets of nominal data that have been arranged into categories by frequency counts are compared. Differences were regarded as significant when a P value of $\leq .05$ was obtained.

RESULTS

A total of 10,135 valid observations were scored. As Fig. (2) shows, the percentage of time the caregivers spent in a neutral back posture ($\pm 0^\circ$) is 37.7% when working with the Carevo and 34.2% when working with the traditional height-adjustable shower trolley. This is a 10.2% improvement, which is significant (Chi-Square $p < .000$). The percentage of time spent in a limited flexed, limited twisted back posture $< 20^\circ$ for the Carevo and traditional height-adjustable shower trolley was 68.2% and 66.2% respectively (Fig. 3).

This 3.0% difference is quite small, but still significant (Chi-Square $p < .000$). As Fig. (4) shows, the percentage of time spent in a neutral neck posture ($\pm 0^\circ$) is 41.7% when working with the Carevo and 38.1% when working with the traditional height-adjustable shower trolley. Again, this 9.4%

improvement is significant (Chi-Square $p < .000$). No differences were found for the arm and leg scores.

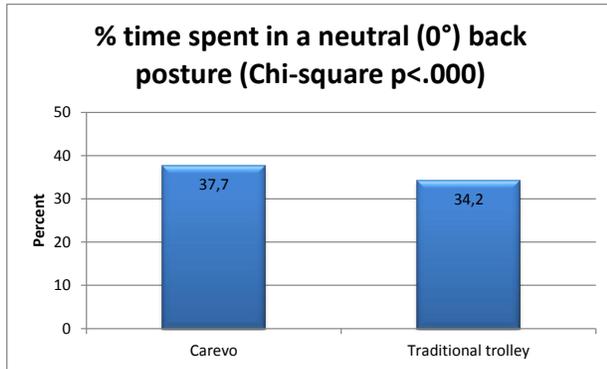


Fig. (2). Percentage of time spent in a neutral (0°) back posture (Chi-Square $p < .000$).

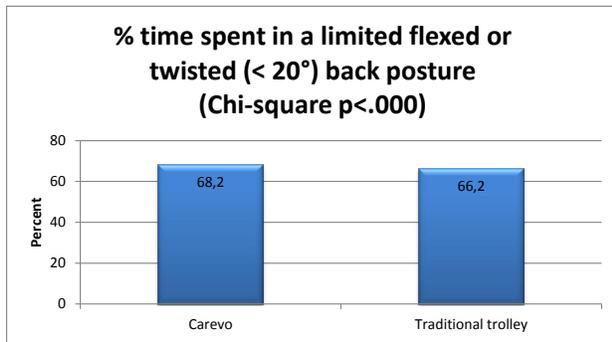


Fig. (3). The percentage of time spent in a limited flexed or limited twisted (<20°) back posture (Chi-Square $p < .000$).

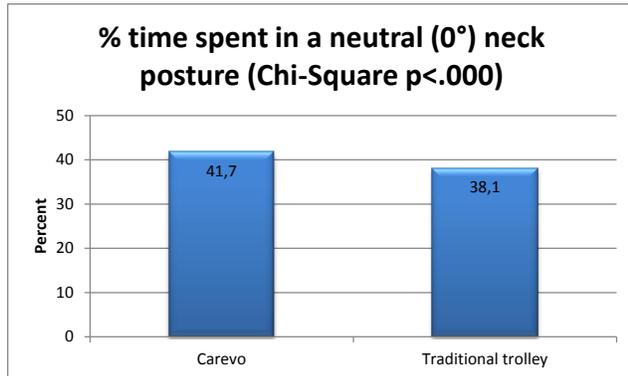


Fig. (4). Percentage of time spent in a neutral (0°) neck posture (Chi-Square $p < .000$).

Furthermore, the data shows (Fig. 5) that the caregivers work a significantly (Chi-Square $p < .000$) higher percentage of time at the middle part of the trolley when working with the Carevo (60.8%) compared to working with the traditional height-adjustable shower trolley (57.2%). When working at the middle part of the trolley, the percentage of time spent in a neutral back posture is 40.6% for the Carevo and 35.8% for the traditional height-adjustable shower trolley (Fig. 6), so there is a significant 13.4% improvement (Chi-Square $p < .000$). A closer look at the actual activities the caregivers perform during the shower cycles reveals that 19.0% of the total time is spent drying the patient's body, 18.9% dressing

the patient and 17.1% sprinkling the patient. More details can be found in Fig. (7).

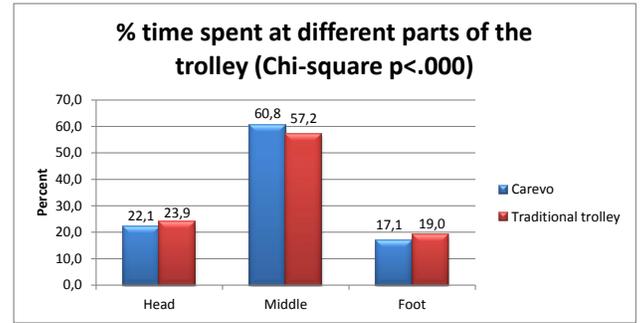


Fig. (5). Percentage of time spent at different parts of the trolley (Chi-Square $p < .000$).

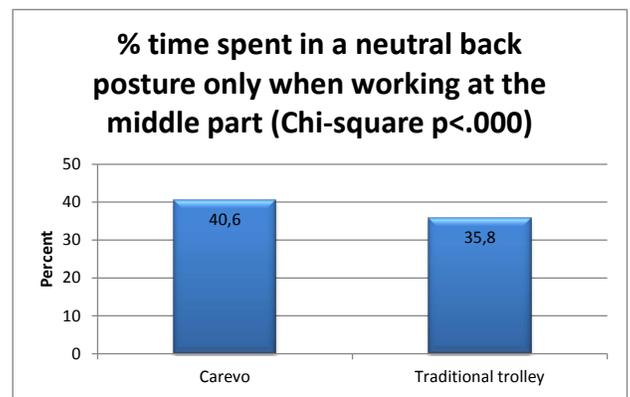


Fig. (6). Percentage of time spent in a neutral back posture only when working at the middle part of the trolley (Chi-Square $p < .000$).

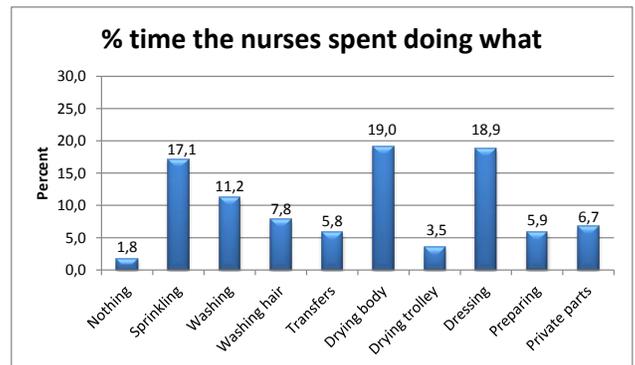


Fig. (7). Percentage of time the nurses spent doing what.

DISCUSSION AND CONCLUSION

First we have to realize that since the observational method used in this study is labor-intensive, a relatively small number of four caregivers were observed. Consequently, the results could be more dependent on coincidental factors than would be true had more caregivers been included. As a result, generalization to other situations and persons remains open to debate. However, using this method means that a large amount of data was collected, making possible relevant statistical analysis.

There is also a generalization question regarding the type of trolley used. The traditional shower trolley used in this

study is just one type in a range of traditional height adjustable shower trolleys. Having said that, this ‘family’ of traditional height-adjustable shower trolleys are all quite similar and have no clear differentiating unique features regarding ergonomics.

The study shows that working with the Carevo leads to a reduction of static load on the musculoskeletal system of the caregiver compared to working with the traditional height-adjustable shower trolley. There is a 10.2% increase in time spent in a neutral back posture ($\pm 0^\circ$) and a 9.4% increase in a neutral neck posture. When the non-twisted back posture $<20^\circ$ is used as the cut off point (ISO 11226), the increase is smaller (3%). Therefore, it must be emphasized that the level of the above-mentioned improvements depends on the cut off point.

Furthermore, the study shows that when the caregiver is working at the middle part of the trolley there is a 13.4% reduction of static load when using the Carevo. This indicates that the middle part of the Carevo, the curved section, enables a reduction of the static load. This effect is magnified by the finding that caregivers spend more time working at the middle part of the Carevo (40.6%) compared to the middle part of the traditional height-adjustable shower trolley (35.8%).

In 1996 Knibbe & Knibbe [13] studied the effects of several bath and shower devices on the working posture of the caregivers. The results are presented in terms of the percentage of OWAS [17] scores in Action Category 1 (normal posture). The higher the score, the less harmful it is. As the height-adjustable shower trolley in the 1996 study is identical to the shower trolley in this present study, there is reason to use the 10.2% reduction of static load when working with the Carevo (Fig. 8). Doing this indicates that the Carevo leads to less static load than the height-adjustable bath. However, for methodological reasons, we must be careful when comparing these two studies, as the research conditions are not identical.

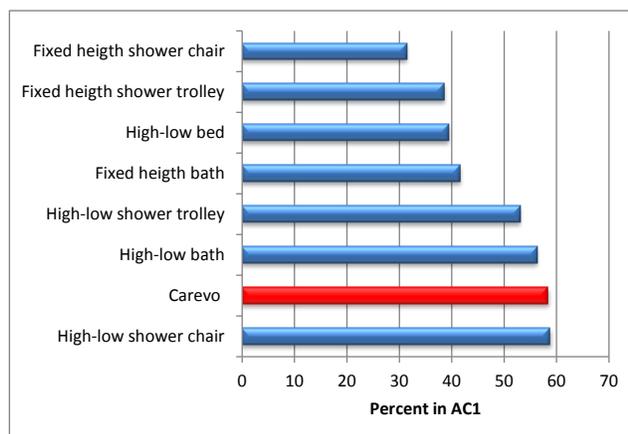


Fig. (8). Top eight in terms of harmfulness measured by the percentage of OWAS scores in AC1 (normal posture). The higher the score, the less harmful it is. The blue bars are derived from Knibbe & Knibbe [13]. The red bar is from this present study.

There are several possible explanations as to why the Carevo leads to better working postures compared to the traditional height-adjustable shower trolley. Firstly, the curve

in the middle part of the trolley increases the area where caregivers can work in acceptable postures. A disadvantage of the curve design was that some caregivers found themselves more or less stuck in the curve. These caregivers needed to flex and twist their backs to reach the patient's head and feet. Based on the preliminary results of this study, the manufacturer adapted the Carevo by smoothing the curve, which should reduce the disadvantage and lead to further reduction of the static load.

A second explanation is the presence of handles integrated in the sidebars of the Carevo. These handles can make log roll transfers easier, because the patient can, depending on the mobility level, participate in the rolling action. This feature not only reduces the load on the caregiver's musculoskeletal system, it also stimulates patient cooperation.

Thirdly, as the head end of the Carevo can be lifted, hair washing, or other activities that should be done in this area, can be performed in a more ergonomic posture. Again, this not only reduces static load, but also improves quality of care, as the patient is in a more comfortable and dignified position. When working with a lifted head end, extra attention should be paid to the trolley height, as the study shows that some caregivers tend to work with elevated shoulders when the head end is up.

Finally, the Carevo reduces static load because of the soft section in the middle of the trolley mattress, also known as the comfort zone. The comfort zone is positioned where the patient is the most voluminous. The patient sinks slightly into the mattress due to the softer material used. This prevents the patient from sliding down (for example, when the head end is up) and makes turning easier. A disadvantage is that water tends to flow to the comfort zone, as it is the lowest part of the mattress, while trolley drainage is at the foot end. Based on this preliminary finding, the manufacturer has already modified the product to reduce this disadvantage.

Although quality of care during showering in a supine position was not the subject of this research, there seems to be room for improvement. And although the patients were not asked in structured, scientific way, all four patients in the study were struck by deficiencies in terms of dignity, mattress comfort, warmth and comfort in general when being showered on a stretcher. Further research is required to pinpoint whether or not the Carevo addresses this issue more effectively than the traditional shower trolley.

Regarding this comfort issue it is calculated that showering the patient's body (the actual sprinkling) takes up only 28.1% of the total cycle time². The rest of the time the patient is wet and might be cold. Although research on this point is lacking, it can be expected that this percentage is much higher when showering in a standing or a sitting position. In addition, research shows that the cooling down rate is dependent on the ratio of surface area to body mass. A

²This is an estimated percentage, based on Fig. (7). All possible moments in which the patient is wet are counted: 0.5*nothing + showering + washing + hair washing + 0.5*transfers + 0.5*drying body + 0.5*drying trolley + 0.5*preparing + private parts. Some percentages of time spent in an activity are halved, because the patient is not wet for the entire duration of this activity. We calculated which part of the total sum was attributable to sprinkling.

higher ratio refers to a higher rate of cooling down, requires more energy to stay warm and leads to a less comfortable feeling [20]. Emaciated or small patients have a higher ratio and therefore cool down faster, need more energy to keep themselves warm, start shivering at an earlier stage and tend to regard showering on a shower trolley as an unpleasant experience. This comfort issue might be addressed more effectively by the Carevo, because a higher water level is possible, a softer mattress is used and the Carevo seems cosier (as knees and shoulders do not go over the side and the patient can see the side support), but further research is required on this subject.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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Declared none.

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