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Healthcare and Society: new challenges, new opportunities

Does the use of friction reducing devices actually reduce the exposure to high force lateral transfers?

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Abstract

The activity of transferring a person from lying to lying frequently occurs in healthcare, e.g. bed to trolley, treatment tables, theatre departments and ambulance services. These positional changes can include lateral transfers (bed to bed), moving up a bed (boosting), or supine to side lying (turning). Transferring patients has long been identified as a contributory cause of MSD in healthcare processes. This study explored routes to error in a UK national healthcare provider for the range of transfers indicated and investigated the level of knowledge within the workforce to complete these transfers.

A survey (n=170) showed that a high percentage of staff reported that transfers that using slide sheet devices were being performed in a way which did not following the evidence based guidance. 31.6% of the descriptions of how to set up a transfer were incorrect and a further 13.0% were less than optimal. Only 31/170 respondents showed no errors in their survey responses.

A secondary laboratory study quantified the force differences between a best practice transfer and the various erroneous methods. The additional forces were compared to show that there could be more than 100% increase in the amount of effort that healthcare workers have to use of the preparation of the transfer is not performed correctly.

Processes and design considerations that enforce the compliance with best practice guidelines can assist in the reduction of the overall musculoskeletal effort that healthcare workers endure.

Keywords: patient handling, biomechanics, healthcare workers, load movement, assistive devices

1. Introduction

The activity of transferring a person from lying to lying frequently occurs in healthcare, e.g. bed to trolley, treatment tables, theatre departments and ambulance services. Transferring patients has long been identified as a contributory cause of MSD in healthcare processes (Smith, 2011). Early studies reported that methods of transfer include staff reaching over one flat surface to hold a draw sheet and pulling the patient across the surface to the destination point (Zelenka et al, 1996; Bohannon, 1999; Lloyd et al, 1998). As patient handling methods have developed, interventions and equipment options have become increasingly available to improve lateral transfer methods (Derbyshire Interagency Group, 2011, Hall, 2005).

Several studies have identified the benefits of using friction reducing equipment to reduce the manual handling risks of a laterals transfer (Zelenka et al, 1996, Bohannon, 1999; McGill and Kavcic, 2005; Lloyd and Baptiste, 2006, Fragala and Fragala, 2014) and suggest that forces

will be reduced with the use of equipment. Other mechanical or assistive technologies have been evaluated to improve the methods for lateral transfers, for example: long handled transfer sheets to improve operator's posture (Derbyshire Interagency Group, 2011, Baptiste et al, 2006, Fray and Hignett, 2009); inflatable devices (Hall, 2005, Baptiste et al, 2006). Some mechanical solutions have been evaluated, including: hoisting solutions (Silvia et al, 2002; Dolan et al, 1998) and mechanically assisted rolling (Silvia et al, 2002). All of the studies and best practice guides indicate that the benefits are most effective when there are two layers of friction reduction material under the load being moved. Unfortunately more recent studies appear to show that the compliance with safer handling methods may not be developing as organisations and care delivery services would like (Koppelaar et al ., 2013, D'Arcy, Sasai, and Stearns, 2012). Safe patient handling practitioners see one of their roles as the improvement of both competence and compliance within their staff groups (Smith 2011).

2. State of the art

This project explored the knowledge and applied skills of the workforce within the participating health-care provider. The data from this first survey then informed a laboratory investigation that utilised previously defined research methods (Fray and LARF, 2012) to measure the forces to move a patient in a variety of ways. The study included a novel product which aimed to improve the relative number of errors in the transfer set up. It adds to the current knowledge by quantifying the level of force that can be apportioned to erroneous use of this standard piece of patient handling equipment.

3. Objectives and Methods

Objectives

This study explored two items:

- To identify the level of understanding of healthcare workers regarding the multiple sizes and positions used in various horizontal transfers
- To measure the difference in force required to complete horizontal transfers with different combinations of slide sheet, transfer type and surface

Questionnaire Survey

A simple questionnaire survey evaluated the knowledge and practical selection of methods for the use of friction reduction devices for the staff in a UK healthcare provider. A convenience sample was used as participants were invited as they attended their various patient handling updates or when the team were required to visit an area. The questionnaire required the individual to select the position and format of the friction reducing device for a number of activities e.g. horizontal lateral transfer, moving up a bed, turning from supine to side lying. Various options were provided and the participants selected the ones they used. The options varied for number of sheets, type of sheets, and the position of sheets under the patient and the direction of movement. The responses were categorized as correct or incorrect depending upon the response and the best practice guidance given in the local protocols. These patterns of movement and alignment defined the correct and incorrect conditions for the laboratory study.

Laboratory Trials

A repeated measures design was used with three different sized patient loads (58-98kgs) for different combinations of sliding devices (n=12). The range of devices included:

1. Tube slide sheets of differing sizes
2. Pairs of single flat slide sheets
3. A novel design of tube design that allowed movement in 90 degree opposing directions
4. Transfers were aided by one solid slide board and one flexible slide board

Data was collected by the same experimental team for all the physical trials. The patients completed a series of lateral transfers starting a) on the bed, b) half on a transfer board and c) fully on a transfer board. Additionally a series of movements up the bad were also recorded with the patients only lying on the bad (as in a) above). The combinations were created to replicate both the evidence based best practice, and incorrect positions of the slide sheets for different transfers. Due to the similarity of the initial movements between supine to supine lateral transfers and supine to side lying transfers only the lateral transfer was reported in this study.

Experimental Scenario.

Patient actors were formally introduced to the trial and consent in line with Loughborough University ethical approval system. During the transfers the patient was completely passive and adopted a fixed position, hands across chest, legs straight and not crossed. The range of conditions was defined by the experimental group based on the results from the survey. The correct/incorrect classification, the positioning of patient, sheet and slide sheet was based on current best practice and supported by the training and protocols agreed in the healthcare organization. The 'patient' started on a hospital bed with the chosen equipment in place. The forces to move the patient were measured as the minimum repeatable force to initiate movement (Fray and Hignett, 2015). To record the force at the start of horizontal movement, markers were placed on the patient and bed. The patient and observer had to agree that horizontal movement had occurred. The forces for the physical tasks were recorded using a Mecmesin AFG2500N force gauge for all pulling actions. The activity was repeated until a sample of 5 values within 5% variation around the median was achieved. The quality of the movement was noted as there were different interactions between boards, sheets, positon and loads. The adhesion between some board and sheet combinations caused a build-up of force and excessive movement to occur and measures had to be excluded.

4. Results & Discussion

4.1 Questionnaire Results

The questionnaire response (n=170) showed that there were numerous routes to error for the use of friction reducing devices in the organisation. Figure 1 shows that 78.2% of the respondents gave an incorrect description of the position and use of the slide sheets.

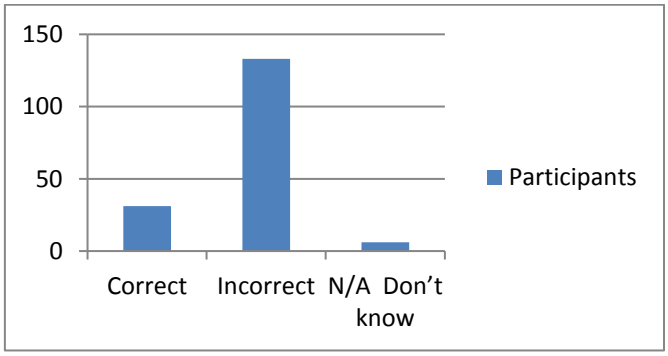

Figure 1. Correct/Incorrect responses

The errors were shown to include incorrect selection of device including wrong number of layers, wrong type, wrong shape and wrong positioning of sheets during the transfer e.g. vertical to horizontal alignment. The survey investigated if the lack of suitable slide sheets may have contribute to the poor understanding and develop poor practice. Figure 2 shows the frequency that there was insufficient choice or equipment in the various areas.

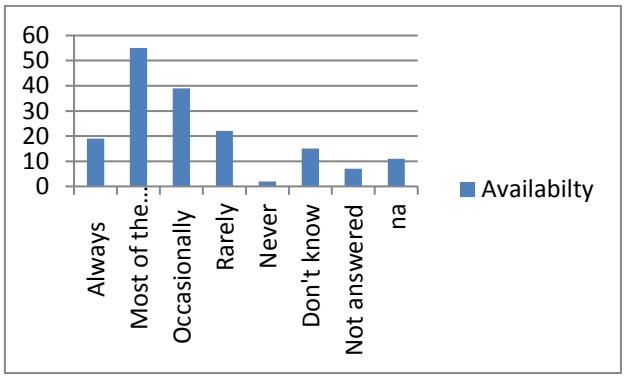

Figure 2. Are correct size of slide sheets available?

The level of confidence that staff were able to make the correct choice of size, shape and position for the three transfers was also questionable. Figure 3reports that the 21.2% of staff were confused most of the time and a further 57.6% reported most if the time

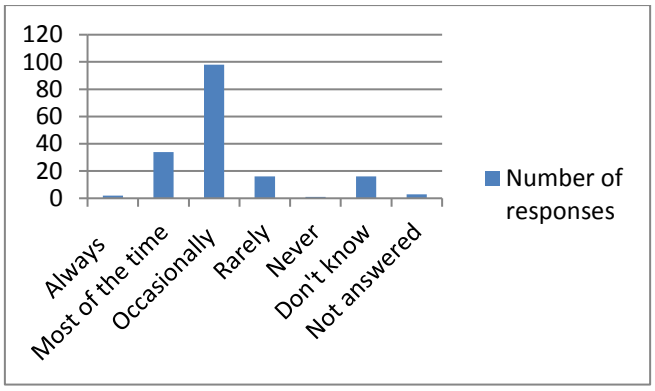

Figure 3. Do staff get confused with the variability of size and shape of slide sheets

Further investigation explored the relationship between the different transfer types and the descriptions of safe practice. Moving a person up in bed showed the highest knowledge of the set up at 64.1%, Lateral transfers next with 55.9% and turning to side-lying showed the worst understanding with only 44.7% being correct.

Transfer	Correct	Possible solution	Incorrect
Move up Bed	209		117
Turn in Bed	113	92	48
Lateral Transfer	138	16	97
Total	460	108	262

Table 1. Quality of knowledge across transfer types

The indications suggested in the evidence from this survey shows that the staff would regularly complete transfers for these three movements with the slide sheet combinations in either incorrect or less than optimum positions. This inaccuracy will inevitably lead to some

increased effort for the healthcare worker. The patterns described were used to define the force measures and the analysis for the laboratory study.

4.2 Laboratory Study

	Equipment	Size(cm)
1	Single layer Theatre Sheet A	70x190
2	Single layer Theatre Sheet B	70x190
3	Pair of Flat Sheets (Coated Polyester, no handles)	70x200
4	Pair of Flat Sheets (Green Plastic)	70x200
5	Pair of Flat Sheets (Coated paper)	70x200
6	Tubular Double bed size (Coated Polyester)	140x200
7	Tubular Slide Sheets (Coated Polyester, 3 of, full body length)	70x145
8	Pair of Flat Sheets (Coated Polyester Handles)	70x200
9	Redi Slide (Coated Polyester, Novel design)	90x220
10	Tubular Slide Sheets (Coated Polyester 2 of, Shoulder to hips and calf)	70x145
11	Tubular Slide Sheets (Coated Polyester 1 of, Shoulder to hips)	70x145
12	Pair of Flat Sheets Double bed size (Coated Polyester Handles)	140x200

Table 2. Equipment and positon combinations

The force data was collected for 12 slide sheet combinations, correctly and incorrectly used with two different slide board combinations for the 3 patient loads recruited. Table 2 lists the different slide sheet combinations each combination was measured under 5 positional variations (directly on bed, ½ on solid transfer board, fully on solid transfer board, ½ on flexible transfer board and fully on flexible transfer board) with three different sizes of patient (58, 72 and98kgs). The agreed reliability for the consistency of force was achieved across the range of activities (n=180 slide sheet and patient combinations and n=1123 force measures).

The forces to laterally move the patient were proportional to the body weight of the patient being moved. Some transfer board and sheet combinations showed different qualities of movement. The flexible board showed an element of adhesion so there was a higher force and staggered jerky movement. One of the problems identified with the incorrect methods was where two layers become one during the transfer. The forces Table 3, showed a significant increases for large and medium sized patients

	Single Layer	Double Layer
Heavy	214.7	104.7
Med	172.6	98.3
Small	71.5	65.2

Table 3. One layer to two layers for lateral transfer on bed

The second error identified was the lack of coverage between the patient and the bed. This can occur when narrow sheets are used under full body, trunk and legs or just trunk. Table 4 shows the force to move the patients when on a solid transfer board similarly to the previous example more than double the force was required between best and worst scenarios.

	Heavy	Med
Full length	62.5	44.3
Shoulders and legs	91.6	72.2
Trunk Only	132.8	71.2

Table 4. Force for 1, 2 and 3 sheets under a heavy and medium patient.

The trials explored the differences between solid and flexible transfer boards. The evidence was not clear as different boards interacted with different slide sheets to confuse the effects. It was however clear in most transfers that the solid boards reduced the force required for horizontal movement. Comparisons between like styles of slide sheet were also made Table 5 shows sheets of different material for the different lateral movements. The innovative product (9) compared favourably with the selection and the disposable products (4,5) were less effective.

Lateral Transfer	9	8	5	4	3
On Bed top	63	105	167	154	109
1/2 On Solid Board	101	102	149	182	140
Fully on Solid Board	79	107	97	134	80
1/2 on Flexible Board	93	118	151	195	102
Fully on Flexible Board	65	100	101	184	101

Table 5. Force (n) for different materials of slide sheets

5. Discussion & Conclusion

The survey clearly showed that the use of varying sizes and shapes confused the workers. It was possible to measure the differences between the efficient and non-optimum use patterns. Further analysis is required to estimate how much extra work could be being required for shift patterns based on the workload in different healthcare areas. This trial included a slightly over-sized tubular sheet of novel shape and format (9). The aim of this slide sheet is to simplify the process and learning and be the only size shape in the hospital. This study would show that a device that improves compliance with best practice could make significant reductions in the work required across the care setting. The additional forces recorded when not using the optimum operating procedures show that providers of assistive devices and safe procedures still have improvements to make. Equipment solutions need to be intuitive so as to make the correct use the only use. In addition these raised forces will add to the physical demand in an area that has reduced the demand but high load tasks are still prevalent e.g. fitting hoist slings, high risk mobility situations and plus-size care delivery.

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References

Baptiste A, Boda SV, Nelson AL, Lloyd JD, Lee WE. (2006). Friction-reducing devices for lateral transfers. A clinical evaluation. *AAOHN Journal*, 54, 4, 173-180.

Bohannon RW. (1999). Horizontal transfers between adjacent surfaces: Forces required using different methods.' *Arch Phys Med Rehabil*, 80, 851-853.

D'Arcy, J., Y. Sasai, and S. Stearns. (2012). "Do Assistive Devices, Training and Workload Affect Injury Incidence? Prevention Efforts by Nursing Homes and Back Injuries Among Nursing Assistants." Journal of Advanced Nursing 68: 836–845.

Derbyshire Interagency Group. (2011). Care *handling for people in hospital, community and educational settings. A code of practice.* Southern Derbyshire NHS Trust (Community Health), North Derbyshire NHS Trust (Community Health),, Derbyshire County Council Social Services, Derbyshire Local Educational Authority, Derbyshire Royal Hospital NHS Trust, Southern Derbyshire Acute Hospitals NHS Trust.

Dolan P, et al. (1998). Spinal loading during manual handling procedures in nursing. *Proceedings of the International Society for the Study of the Lumbar Spine*. Brussels, Belgium. June 9-13. 80.

Fragala G and Fragala M, (2014). Improving the safety of patient turning and repositioning tasks for caregivers. *Workplace Health and Safety* 2014; 62(7): 268-273.

Fray M., Hignett S. (2009) The Evaluation of a Prototype Handling Device to assist with Horizontal Lateral Transfers. *Proceedings of the 17th Triennial Congress of the International Ergonomics Association* Beijing, China, 9-14 August 2009

Fray M. and Hignett S. (2015). Using patient handling equipment to manage mobility in and around a bed. *British Journal of Nursing*, Vol 24, Issue 6, 10-14, 6th April 2015.

Fray M., and L.A.R.F. (2012). A mixed ergonomics method for the evaluation of a prototype handling device to facilitate horizontal transfers. *Column* 24.2. P16-22. NBE UK.

Hall J, (2005). Chapter 16 'Lying to lying transfers and associated manoeuvres.' In Smith J. (Ed) *The Guide to the Handling of Patients* (5th Ed.). Teddington, Middlesex: BackCare/Royal College of Nursing

Koppelaar, E., J. Knibbe, H. Miedema, and A. Burdorf. 2013. The Influence of Individual and Organisational Factors on Nurses' Behaviour to Use Lifting Devices in Healthcare. *Applied Ergonomics* 44 (2012): 532–537.

Lloyd JD, Baptiste A. (2006). Friction-reducing devices for lateral transfers. A biomechanical evaluation.' *AAOHN Journal*, 54, 3, 113-119.

McGill SM, Kavcic NS. (2005). Transfer of the horizontal patient: The effect of a friction reducing assistive device on low back mechanics. *Ergonomics*, 48, 8, 915-929.

Silvia CE, Bloswick DS, Lillquist D, Wallace D, Perkins MS. (2002). An ergonomic comparison between mechanical and manual patient techniques. *Work* 19, 19-34.

Smith J. (Ed) (2011). *The Guide to the Handling of People A systems approach* (6th Ed.). Teddington, Middlesex: BackCare/Royal College of Nursing.

Zelenka JP, Floren AE, Jordan JJ. (1996). Minimal Forces to move patients. *American Journal of Occupational Therapy*, 50, 5, 354-361.