Participatory organizational intervention for improved use of assistive devices in patient transfer: a single-blinded cluster randomized controlled trial[1]

by Markus D Jakobsen, PhD,[2] Birgit Aust, PhD, Pete Kines, PhD, Pascal Madeleine, PhD, Lars L Andersen, PhD

1. *Supplementary material*
2. *Correspondence to: Markus Due Jakobsen, National Research Centre for the Working Environment, Lersø Parkalle 105, Copenhagen, Denmark.[E-mail: markusdue@gmail.com]*

Primary outcome measure – Validation of the use of the necessary assistive devices (Push buttons)

Because the use of the necessary assistive devices was calculated as the ratio between the number of push button counts (Button 1/ Button 1+ Button 2), the validity of the measurement will depend on whether there is a relative difference between how often the healthcare worker remembered to press the "green" (Button 1) versus the "red" button (button 2). Accordingly, the following two questions were asked in the 6 and 12-month follow-up questionnaire to validate the use of push buttons as a method to assess the use of assistive devices: 1) *"In situations where you used the necessary assistive device to perform a patient transfer, how often did you remember to press the green button?",* and 2)*"In situations where you did not use the necessary assistive device to perform a patient transfer, how often did you remember to press the red button?"*. The participants in both groups reported that they remembered to push the "green" and the "red" button in approximately 3 out of 4 situations (see Table A). This did not differ between the groups, nor between how often the participants remembered to push either of the buttons. The present method, therefore, seems to be a valid and unbiased method for measuring the relative use of the necessary assistive devices.

Table A. Mean (95% CI) values of how often (n out of 4) the participants remembered to push the "Green" and "Red" push buttons at 6 and 12 month follow-up.

	Control		**Intervention**	
	Mean (95% CI)		Mean (95% CI)	
	6 months	12 months	6 months	12 months
Red button (n out of 4)	2.8 (2.6 - 3,0)	2.8 (2.7 - 3.0)	3.0 (2.8 - 3.1)	3.0 (2.9 - 3.2)
Green button (n out of 4)	2.8 (2.6 - 2.9)	2.7 (2.5 - 2.9)	2.8 (2.6 - 2.9)	2.9 (2.8 - 3.1)

Secondary outcome – Validation of general use of assistive devices (accelerometer-based)

Outcome selection

During trial design, we intitially aimed at using this outcome as the primary outcome. However, not all departments used lifts or transporters for patient transfer. Two of the departments used only disposable assistive devices such as gliding sheets, which could not be mounted with

accelerometers. Therefore, we decided to use the push buttons as the primary outcome, and the accelerometer-based method as the secondary outcome.

Data validation and data analysis:

We conducted the following steps and data analyses in order to distinguish random movements of the assistive devices from actual episodes of patient transfer:

Visual inspection of pilot data:

Eight nurse students performed a total of 64 patient transfers (20 using patient transporters and 44 using lifts), which were measured with accelerometers. A visual inspection of the accelerometer signal from all patient transfers was made. We found that a typical patient transfer could be divided into three movement phases (phase 1 = getting/placing the devices, phase 2 = transferring the patient, and phase 3 = putting the devices back in place). In all patient transfers, the total duration of the three phases was between one and four minutes. However, it may occur that the device was not always put back in place immediately after the actual patient transfer, and thus only two phases would be detected for this specific patient transfer. When only using the first two phases, the duration of the fastest patient transfer was approximately 30 seconds. Based on visual inspection, we decided that the following two criteria should be present for accepting the movement as an actual patient transfer: criteria 1) The patient transfer has to include at least two movement phases, and criteria 2) the duration of the entire patient transfer (phase 2) has to be at least 30 seconds.

Visual inspection of intervention data:

Accelerometer data were sampled at 30 Hz.While visually inspecting the accelerometer signal from 80 devices (40 from baseline and 40 from follow-up) obtained over approximately 30-40 days at baseline and at 12-month follow-up, the data did not look quite as consistent as in the pilot study. However, based on the criteria found in the pilot tests, it was still possible to distinguish an actual patient transfer from a random movement of the assistive devices, i.e. when the device was being moved by cleaning personnel. In addition, we observed that a period of at least a three-minute break with no movement was present after every patient transfer (criteria 3).

Datanalysis

After the visual inspection and identification of the afforementioned three criteria, the following algorithm was used to identify the number of patient transfers for each device/accelerometer:

Step 1: In order to locate the movement phases the resultant acceleration of the x,y,z-direction was calculated, rectified and subsequently smoothed using a 4^{th} order Butterworth lowpass filter with a cut-off frequency of 1/30 Hz. Each movement phase could then be identified whenever the smoothed signal had a local peak/top that was above one standard deviation of the entire smoothed signal. Step 2: Locate periods including at least two phases, which is followed by an episode of no activity for at least three minutes. Based on this algorithm a proper patient transfer, and the total number of patient transfers for each device, was then calculated.