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Research article

The impact of an End-PJ-Paralysis quality improvement intervention in post-acute care: an interrupted time series analysis

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Abstract: The “End-PJ-Paralysis” social movement has promoted global recognition of the problem of low activity levels for hospitalised older adults, but whether aligned quality improvement programmes impact length of stay or adverse events is unknown. To determine the impact of a multicomponent intervention, which included data displays, exercise groups, a clothing repository, widespread promotion, and targeted education for staff and patients to promote dressing and activity, we conducted an interrupted time series analysis. Although there was no clear impact upon length of stay or fall or pressure rates after 12 months, this is an important finding for other centres implementing their own “End-PJ-Paralysis” interventions as it highlights that such programmes are not associated with increased falls, as commonly feared.

Keywords: falls; hospital; interrupted time series; length of stay; pressure injuries

1. Introduction

Internationally, awareness of the “epidemic of immobility” amongst hospitalised older adults is increasing [1,2]. In acute settings, older adults have been shown to spend 97% of their day sitting or lying down [3]. In rehabilitation settings, where patients are presumed to be more active, older adults spend as much as 95% of the day in sedentary behaviours [4]. Older adults are particularly vulnerable to the detrimental effects of immobility. After only ten days of bed rest, older adults can lose 1kg of muscle mass and 16% of their strength [5,6]. Low physical activity and bed rest during hospitalisation are associated with serious adverse outcomes, such as functional decline, hospital-acquired disability and complications including thrombosis or pressure injuries, hospital readmission, new institutionalisation, and death [7–10].

In 2017, the global social movement "End-PJ-Paralysis" was launched in the United Kingdom to raise awareness of the need to get patients out of their pyjamas and out of bed [11]. It is perceived that the movement has been successful in motivating hospitals around the world to increase patient activity levels. Despite the popularity of End-PJ-Paralysis, evidenced by millions of twitter impressions (#EndPJParalysis), global summits in 2019 and 2020 attracting over 1000 participants, and implementation across hospitals worldwide, there is still a lack of empirical evidence on the effectiveness of "End-PJ-Paralysis" interventions [12,13]. The literature regarding "End-PJ-Paralysis" in peer-reviewed journals is currently limited to editorials, opinion pieces and small exploratory studies [11,12,14]. There are also few studies investigating whether interventions promoting patient activity have unintended consequences such as increased falls or length of stay or pressure injuries [15–18].

Low physical activity in hospitals has been described as a "Wicked Problem", seemingly simple to fix but, in reality, complex and difficult to change [11]. Wicked problems are characterised by the influence of multiple interacting factors. Some of the barriers to physical activity in hospitals include factors such as pain, fatigue, "tethers" (e.g. lines and catheters), inadequate staffing, lack of ambulatory equipment and environmental barriers, and cultural factors, such as patient, family and staff beliefs and fears [11,19]. These barriers create a wicked problem as they are often present concurrently.

Such complex barriers indicate that a unimodal approach is unlikely to be effective in increasing the physical activity of hospitalised adults over the age of 65 [11,20]. The reasons for this are two-fold: (i) individual locations are likely to have unique barriers to solving the problem; and (ii) barriers are multifactorial. As such, any effective efforts to address this problem must commit to involving hospital patients, families, clinicians, managers and administrators in the development and implementation of local solutions. Furthermore, interventions should be multi-modal in order to address identified barriers [21].

Another barrier to independent patient ambulation in hospitals is staff fear of increased falls. This fear reduces prompting of mobility, resulting in further patient deconditioning, and ultimately prolonged hospital stays and increased healthcare utilisation [20]. In order to justify continued efforts by hospitals to reduce the problem of immobility, there is a need to determine whether hospital-based interventions such as "End-PJ-Paralysis", have an impact on falls, other adverse events and length of stay. Therefore, the aims of this study were to examine the impact of a 12-month quality improvement intervention to improve dressing and mobility at a post-acute hospital in Australia.

2. Methods

2.1. Study design

This study used an interrupted time series (ITS), quasi-experimental design [22,23] to determine the impact of a quality improvement intervention on length of stay, falls and pressure injuries. The ITS design used time series data from before and after the intervention to determine whether post-event trends differed significantly from the counterfactual predicted by pre-event trends.

2.2. Setting

The hospital has 129 Health of Older People (HoP) beds across four wards, where older adults recovering from acute illness and surgery, often complicated by functional decline, are assessed and managed by multidisciplinary teams. Three out of four wards were included in the study. The fourth ward was excluded owing to a differing case mix.

2.3. Interventions

A quality improvement programme of work was carried out between 1 November 2018 and 31 October 2019 to improve the number of patients getting dressed, sitting out of bed and walking daily. The programme was guided by a working party comprising representatives from each ward, nursing executives, harm reduction consultants and research. The group met monthly to set the implementation agenda and review current interventions. The local programme of work was conducted in the setting of a state-wide "End-PJ-Paralysis" collaborative, run by Safer Care Victoria's Care of Older People's Clinical Network. This initiative supported hospital-based teams throughout Victoria (an Australian state) to implement "End-PJ-paralysis" using improvement science methods and sharing learning.

Acknowledging staff and patients' low recognition of immobility as a problem, initial interventions focussed on increasing education and awareness. The first intervention displayed locally-collected data (see Figure 1), presenting the number of patients dressed, sitting out of bed and walking daily on each ward. These data were collected daily by ward-based staff and displayed on wards alongside educational posters regarding the potential complications of bed rest and low mobility levels.

Alongside commencement of data displays, members of the working party provided multiple five-minute education sessions about the problem to all available ward staff. They also asked staff to contribute to solution finding. Verbal solutions were collected and presented with the data display, inviting staff, patients and their families to contribute. Additional interventions included a staff education video [24]. Launched at the hospital's annual research presentation meeting, the video highlighted the importance of mobility for patients in hospital whilst promoting the programme of work. Further education and awareness focused on patients and families, but were also visible to staff. A booklet (see Supplementary Figure 1 for an example page) was written and illustrated in the style of Dr Seuss to describe the problems associated with low mobility levels in hospital. Posters and bookmarks were provided to patients with the same branding and messages. Patients on ward three provided an assessment of whether the books, posters and bookmarks were acceptable and understandable, and, at the time of programme completion, the materials were due for roll-out across the other wards.

In addition to the education and awareness components, additional interventions were patient-focussed. A trial of patient pedometers was undertaken over five week-long cycles. Volunteer patients were recruited from wards, provided with information regarding the pedometers and asked to provide feedback regarding use. Further patient-focussed interventions included volunteer-led, therapist-supported walking groups and exercise sessions supplemental to regular therapy programmes. Due to resource limitations, these sessions were only conducted on ward one.

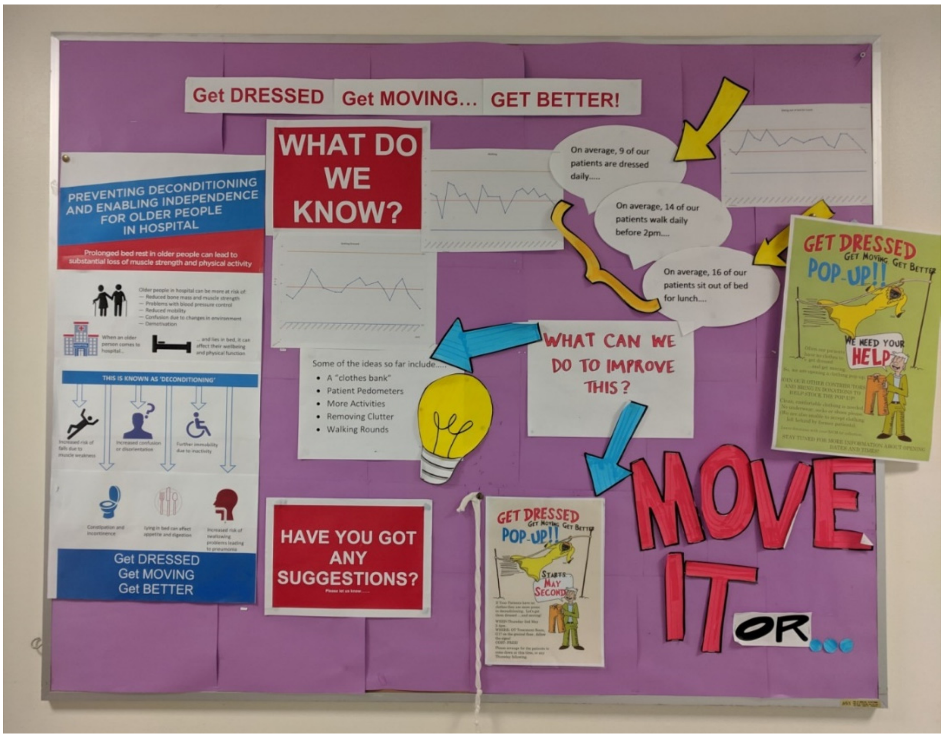

Figure 1. Example of data display board on one of the wards (ward 2).

An additional patient-focussed intervention to increase patient dressing was the opening of a "pop-up" clothing repository, where patients received clothing at no cost. This initiative resulted from suggestions gathered early in the programme, highlighting that many patients had no access to clothing. Staffed by volunteers and stocked with donations, the "pop-up" opened on a weekly basis. Patients who could not attend due to mobility limitations or on the day the pop-up was open, could have staff retrieve clothing for them.

2.4. Measures

Adverse event outcomes included length of stay, fall rate, and pressure injury rate. Length of stay data are collected routinely as part of health service monitoring and were reported as the mean number of days between admission and discharge. The mean was preferred over median to better capture overall changes among patients, rather than just change in the "average" patient. Falls and new pressure injuries were routinely captured using the Riskman Incident Reporting System. Both of these outcomes were converted into the monthly number per 100 occupied beds.

Patient activity outcomes included the proportion of patients wearing day clothes (i.e., not pyjamas or hospital gowns), sitting up out of bed and walking (anything more than a step-transfer from bed to chair or vice-versa, assisted by any member of staff or independently if the patient was able), before 2pm. Each patient activity outcome was converted to the monthly rate per 100 occupied beds. Dressing, sitting out bed and walking rates were recorded from the start of the intervention. These measures were collected by staff on each of the wards during the 12-month program and recorded on a standardised data collection sheet. Once completed, the sheet was stored in a designated collection point and then collated weekly.

2.5. Analysis

Generalised least square regression models were used to conduct ITS analyses for the adverse event outcomes. Outcomes were log-transformed. Results were reported as acute (change to the intercept) and gradual effects (change to the slope) [22]. To account for seasonality, six pairs of sine and cosine terms were included in each model, and only retained if significant at $p \leq 0.05$ [25,26]. Autocorrelation and partial autocorrelation plots were inspected to lag 12 to identify residual autocorrelation and determine Auto Regressive-Moving Average (ARMA) adjustments [27]. Final models for each outcome were selected from all possible models (both unadjusted and ARMA-adjusted) based on fit using the Akaike Information Criterion [26,27]. For each outcome, effects and standard errors across wards were combined using meta-analyses to provide pooled effects. This can reveal small effects where individual sites are underpowered. Sensitivity "leave one out" analyses [28] were conducted, excluding one ward from the meta-analysis, if any ward appeared to follow a different pattern to the others.

Patient activity outcomes lacked pre-intervention data and were only collected during the 12-month intervention, making them unsuitable for ITS analysis. A qualitative approach was therefore applied for these outcomes. The monthly time series for each outcome was plotted by ward and inspected for obvious step-shifts that could be associated with any component of the intervention. Patient activity outcomes were recorded daily but missing data increased significantly over time (4.2 percentage points/quarter; 95% Confidence Interval (CI): 2.8 to 5.6), as would be expected, because enthusiasm for data collection waned. However, the increase in proportion of missing data was not significantly associated with patient activity outcomes ($p = 0.748$). The analytical code is available via an open access repository [29].

2.6. Ethical approval

Ethics approval was granted by the Institution's Human Research Ethics Committee (Approval No: 259/19). The need for individual informed consent was waived because the intervention was a quality improvement initiative, and the study used a non-identifiable administrative data to evaluate its effectiveness.

3. Results

During the 12-month period 4528 patients were admitted to the three wards (1476 on ward one, 1491 on ward two, and 1561 on ward three).

3.1. Adverse event outcomes

The pooled effect of the intervention on length of stay was non-significant (acute: −6%, 95% CI: −20% to 9%; gradual: −2%/month, −5% to 0%) (As shown in Figure 2). There was some indication ward two followed a different post-intervention pattern to the other two wards, as illustrated in Figure 2. The pattern on ward two may have masked significant gradual effects, with sensitivity analysis "leave one out" analysis (Supplementary Figure 2) showing that when ward two was excluded there was a significant gradual reduction in length of stay of 3% per month.

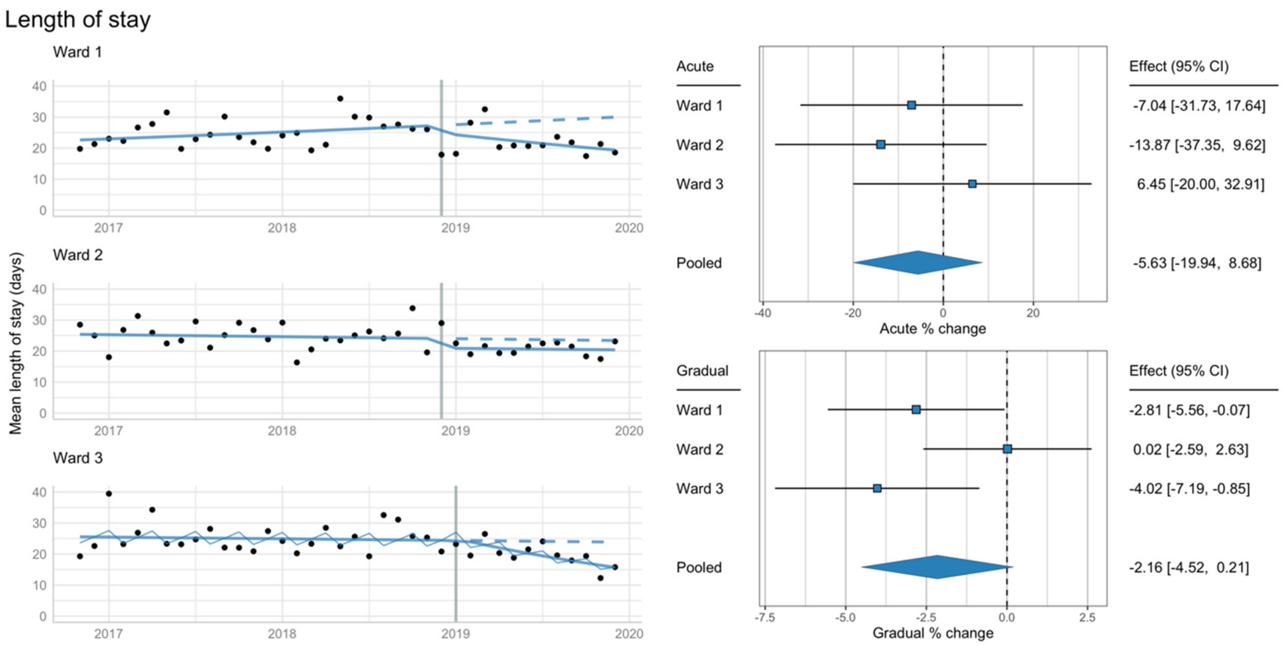

Figure 2. Impact of End-PJ-Paralysis intervention on length of stay; interrupted time series plots on left, where black dots correspond to monthly mean length of stay in days, thick solid blue lines correspond to de-seasoned trends, thin jagged blue lines correspond to seasonal trends where present, thick dashed blue lines correspond to the counterfactual, and solid vertical grey lines indicate intervention implementation; meta-analyses on right report percent change with 95% confidence intervals and pooled effects for both acute and gradual effects.

The pooled effect of the intervention on the rate of falls was also non-significant (As shown in Figure 3). On ward two, there was a significant, acute reduction in the rate of falls (35%, 95% CI: −58% to −12%), but otherwise, no obvious pattern based on data points was detected. There appeared to be an acute effect on wards two and three that was not reflected on ward one. Sensitivity “leave one out” analysis (As shown in Supplementary Figure 3) when ward one was excluded indicated a 35% acute reduction in falls (95% CI: −56% to −14%), but no gradual effects (change in slope).

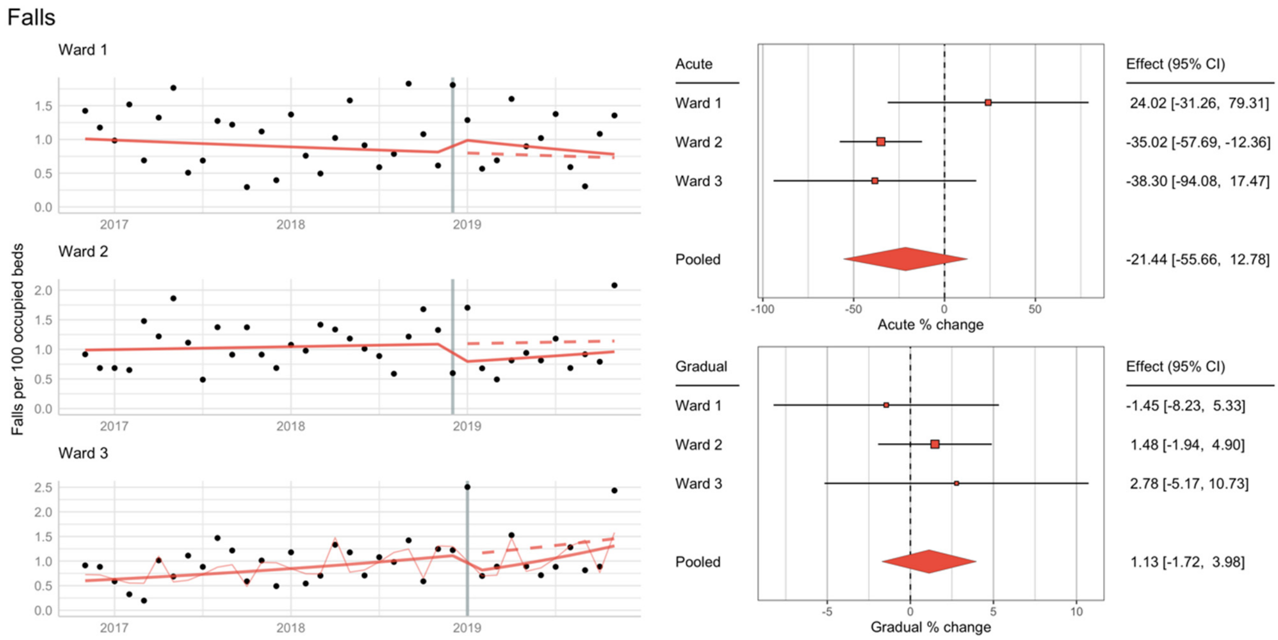

Figure 3. Impact of End-PJ-Paralysis intervention on rate of falls; interrupted time series plots on left, where black dots correspond to monthly mean length of stay in days, thick solid red lines correspond to de-seasoned trends, thin jagged red lines correspond to seasonal trends where present, thick dashed red lines correspond to the counterfactual, and solid vertical grey lines indicate intervention implementation; meta-analyses on right report percent change with 95% confidence intervals and pooled effects for both acute and gradual effects.

There was a significant gradual decrease in pressure injuries over time (−10%/quarter, 95% CI: −20% to 0%) (As shown in Figure 4). However, this may be a statistical artefact, as the gradual reductions were largely driven by a significant acute increase on ward one (136%, 95% CI: 108% to 163%) and a non-significant acute increase on ward two (56%, 95% CI: −24% to 137%). On both of these wards, it appeared the reduction was a regression to the mean rather than a genuine reduction in pressure injuries, especially considering how closely the data points clustered around the counterfactual line on both wards.

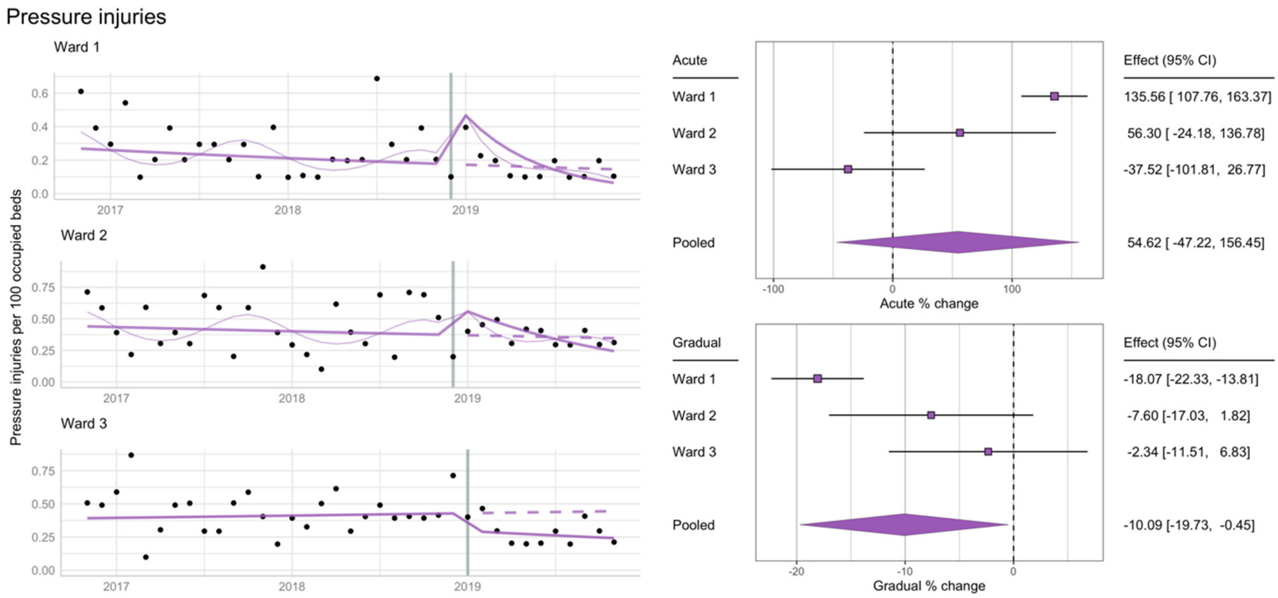

Figure 4. Impact of End-PJ-Paralysis intervention on rate of pressure injuries; interrupted time series plots on left, where black dots correspond to monthly mean length of stay in days, thick solid purple lines correspond to de-seasoned trends, thin jagged purple lines correspond to seasonal trends where present, thick dashed purple lines correspond to the counterfactual, and solid vertical grey lines indicate intervention implementation; meta-analyses on right report percent change with 95% confidence intervals and pooled effects for both acute and gradual effects.

3.2. Patient activity outcomes

For patient activity outcomes (as shown in Figure 5) there were relatively consistent patterns across all three wards, with steady increases in the rates of dressing, sitting out of bed, and walking. However, there was no obvious step-shift that was associated with any component of the intervention. While there appeared to be slight increases in the rates of dressing and sitting out of bed, without secular trend data, we cannot say whether this was related to the intervention.

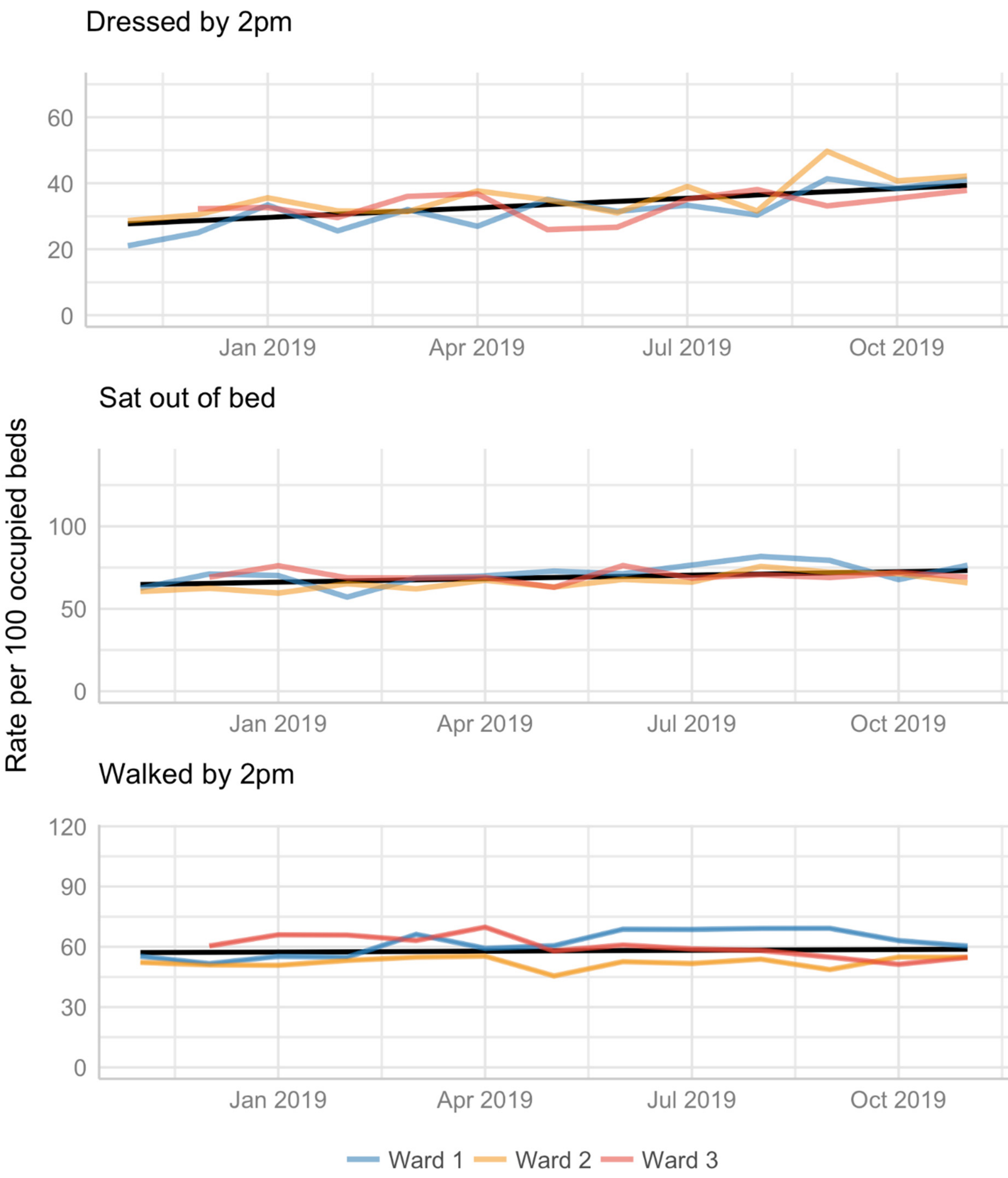

Figure 5. Trends in dressing, sitting out of bed and walking during 12-month intervention. Coloured lines denote wards, black line denotes the regressed "average."

4. Discussion

This is one of the first studies reporting a robust statistical analysis of a complex pragmatic intervention inspired by the social movement "End-PJ-Paralysis". Although there was no clear impact upon length of stay or adverse event rates, our findings highlight that such programmes are not associated with increased falls, as commonly feared [2,15,16].

Our results showed that although there was no associated change in length of stay or adverse events, there was a slight trend regarding increased rates of dressing, sitting out of bed and walking. This indicates that the programme may have been successful for certain outcomes. More robust data may have allowed further explanation as to why these improvements did not translate into positive changes in length of stay and adverse events. We used length of stay and adverse event rates as indirect measures of patient function and acknowledge that these measures can be influenced by many factors, including patient case-mix and staffing levels. Previous trials using more direct measures of patient function, such as step count, accelerometry and muscle strength, have also shown conflicting results in their associations with length of stay [18,30].

With regards to adverse events, hospital-based mobility programmes reporting falls have shown improved falls rates [19] or no impact [18,20], similar to our own results. Where improved falls rates have been demonstrated with mobility programmes, the primary outcome of interest has been delirium reduction rather than deconditioning, making it difficult to compare results. Inclusion of a delirium assessment, although not feasible for our work, would have allowed us to determine if the failure to produce a falls rate benefit was due to persistent delirium.

Pressure injuries have not been previously investigated in relation to hospital mobility programmes. We expected that pressure injury rates would decrease with increased mobility, as has been shown in other environments [31], but interpretation of why there was no observed improvement may be related to other patient characteristics, such as weight-bearing or nutritional status. Additionally, a higher baseline rate of sitting out of bed may have made any significant change more difficult to achieve. However, given the fact that there was no increase in falls or pressure injuries, and subsequent length of stay, supports the implementation of programmes of this nature as previously recommended [2].

Our approach to localised implementation based upon available resources and needs may have explained the differing results across wards. For example, the "leave one out" analysis revealed an acute decrease in falls for wards two and three, but not one. This may have reflected varying levels of engagement on each of the wards, case-mix differences not visible without further analysis, or other unknown factors. Throughout the intervention, mandatory falls prevention strategies remained unchanged and in use across all three wards, suggesting that there was no significant change to falls prevention strategies for any of the wards.

4.1. Strengths and limitations

Our pragmatic methodology was tailored to a real-world approach to change, where multi-modal interventions are required to impact complex problems such as hospital-related immobility. By tailoring the intervention to meet local wards' needs, we were able to involve staff in design, implementation, and data collection. Our adverse event outcome measures were based on routinely collected data for most inpatient care settings and thus were widely interpretable and free from bias.

Limitations of the study included the single centre context, which may limit generalisability. However, the complexity of the problem warranted a feasible intervention, sustainable at a local level. A further limitation was lack of detailed patient data and outcomes. This may have allowed explanation of the differences between wards. Whilst it has strengths, the ITS design is vulnerable to co-occurring events, undermining the case for causal interpretation [22,23]. However, its strength is demonstrated here in providing an overall assessment of the intervention.

4.2. Implications for future research

Future work should focus on impacts for patient function and other outcomes important to patients. Measurement of staff, patient and carer experiences would also be of benefit.

5. Conclusions

The "End-PJ-Paralysis" movement is a patient-centred approach that aims to increase patient dignity, improve patient care and prevent functional decline due to low patient activity levels in hospital. We found no evidence of increased falls, pressure injuries, or length of stay associated with a multicomponent "End-PJ-paralysis" intervention. Our findings are reassuring for organisations and clinicians wanting to implement localised solutions aligned to the "End-PJ-Paralysis" movement, but who encounter resistance due to fear of falls and increased length of stay.

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Conflict of interest

All authors declare that there is no conflict of interest.

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