

## Effectiveness of Built-in Bathroom Facilities in Reducing Inpatient Falls from an Acute Care Setting

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### Abstract

**Background:** Built-in bathroom facilities located within patients' room were identified as a strategy to reduce inpatient falls. However, the relationship between having built-in bathrooms and falls incidence has not been examined.

**Purpose:** To explore whether built-in bathrooms within an acute multi-bedded hospital room setting will reduce falls incidence among adult patients as compared to those sharing a separate bathroom situated outside their rooms.

**Method:** A pre-and-post study involving a single group comparison of three-time phases was conducted.

**Results:** Presence of built-in bathrooms in multi-bedded hospital room settings was not statistically significant in reducing falls,  $p > 0.05$ .

**Conclusions:** Built-in bathrooms had shortened the distance from the bathroom to patients' bed, but it did not reduce falls incidence significantly. Other fall preventive measures such as reminding patients to seek assistance before ambulating and installation of handrails linking from the bed to the built-in bathrooms may be required in order to reduce fall incidence.

**Keywords:** Bathroom Facilities, Inpatient Falls, Acute Care

### Introduction

Falls during hospitalization are identified by healthcare facilities across the world as an adverse event [1]. In the United States, data on inpatients' fall collected from a large acute care adult hospitals reported a fall rate of 3.53 per 1000 patient days [2]. In comparison to our local statistics in Singapore, the reported fall rates among the acute hospitals' medical, surgical and geriatric wards were between 0.68 to 1.44 per 1000 patient days [3]. Patients who had a fall experience, not only suffered physical injuries but could also be affected emotionally and subsequent fear of falling [4]. Fall-related adverse events are also associated with poorer quality of life, increased use of healthcare resources and higher hospitalization costs [5]. In Australia, a fall incident was associated with a mean increase of eight days in the length of stay (LOS) and additional AUD 6669 in their total hospitalization cost. Patients who sustained an injury after a fall had a higher LOS (4 days) and a higher mean hospitalization cost (AUD 4727) compared to fallers without injury [6].

A study on inpatient falls found that many falls were unassisted (79%) and occurred in the patient's room (85%), during the evening/overnight (59%), and during ambulation (19%). Half of the falls (50%)

were elimination related, which was more common in patients over 65 years old [7]. In recent years, hospital's rooms were remodelled towards having single rooms or cohort rooms with built-in bathroom within the patient's room based on the notion that it increases privacy and safety by reducing the spread of nosocomial infections [8-10]. Nevertheless, the concept of built-in bathrooms within the patient's room seems to agree with the conventional wisdom that it might reduce the chance of patient's falling as they do not need to walk a long distance to get to the bathroom. However, there is limited evidence on the effectiveness of built-in bathrooms in reducing falls among hospitalized patients. The lack of evidence in this area could be due to the inability to practically and ethically evaluate such studies in the real clinical setting.

Nevertheless, renovations work at our hospital had created an opportunity for this natural experiment to evaluate the effectiveness of built-in bathrooms in reducing falls among hospitalized patients. To our knowledge, this is the first study that examines the association of built-in bathrooms in reducing falls within a multi-bedded room of an acute-care setting. More specifically, we aimed to ascertain whether built-in bathrooms within an acute multi-bedded hospital room reduces falls

incidence among hospitalized adults compared to the bathroom that is located outside of the patient's room.

The authors hypothesized that having a built-in bathroom located within the patient's room will shorten the distance for patients to ambulate for their toileting needs, thus reducing falls incidence.

## Methodology

A pre-and-post study involving the comparison of the three phases was conducted. The study was granted exemption from ethics approval as it was based on service evaluation. The study spanned over 27 months (November 2015 to January 2018), and it follows the relocation journey of a 100-bedded medical ward. The process of relocation was divided into three phases: (P1) Pre-relocation (no built-in bathrooms) from November 2015 to July 2016; (P2) New ward with built-in bathrooms from August 2016 to April 2017 and; (P3) Post-relocation (no built-in bathrooms) from May 2017 to January 2018.

Patients and nursing staffs were relocated from ward A in P1 to a new ward B in P2 which had built-in bathroom facilities and back to ward A in P3. During this relocation period, fall incidences were identified from the hospital's Risk Managing System (RMS), a database where healthcare professionals document falls incidence. Segmented Poisson Regression was used for analysis. To account for potential confounders, we adjusted for the number of inpatient days, the average number of female patients in the ward, average nurse-per-patient-days (NPPD)/Manpower, average workload (number of admission and discharge) for each month. These potential confounders were taken into consideration for adjustment in the model; as literature has shown that patient days, females, lower manpower (staffing) and high workload affected fall rates [11-14]. There were no new policies introduced during the study period (e.g. change in visitor hours, nursing practice) that could otherwise affect the fall rates.

## Details of the three phases

In P1, about 7 to 8 patients were nursed in a room and share a common bathroom that was located along the corridor, outside the patient's room. Handrails were available along the corridors and within bathrooms. The approximate distance between the bathroom and the patients' room was about 15 to 30 meters. In P2, the new ward B, five patients were nursed in a room and share a common bathroom that was built within the patient's room. Handrails were also available within the bathroom. The approximate distance between the patient's bed and the bathroom is now only 4 to 8 meters. In P3, the physical layout of the room was similar to P1, i.e. the bathroom is outside of the patient's room.

We compared the fall rate incidence of the three phases during the relocation period. Using the segmented Poisson regression model, we considered a full model to include the 3 phases (P1, P2, P3) in our regression. Two parameters defined each phase of the time series; level change and trend. The level change is known as the value of the series at the start of a given time interval (i.e. the y-intercept seen in the first segment and for subsequent segments, it is the level

change corresponding to the start of the intervention concerned). The trend is defined as the change of a measure during a segment. We adjusted for the number of inpatient-days within each month as the exposure variable. Additionally, we included the average percentage of female patients in the ward, NPPD and average workload (number of admissions and discharges) for each month of the phases. Thereafter, we looked for a parsimonious model by carrying a stepwise backward selection of variables that were in the full model.

## Results

In P1, female patients made up an average of 46% of participants, and the average age group was 65 years old. In P2 and P3, there were 55% and 59% of females and the average age group was 63 and 65 years old, respectively. The median number of falls seen per phase was 3.0, 2.0 and 2.0, in P1, P2, and P3, respectively.

Overall, after adjusting for confounders, there was a trend of decreasing fall rates over time (Incidence Rate Ratio, IRR=0.892,  $p=0.007$ ). The cohort of patients may not have been the same in each phase; however, there were no additional fall preventive measures implemented that could contribute to the decreasing trend. Refer to Figure 1 for observed and predicted falls per month across the 3 phases.

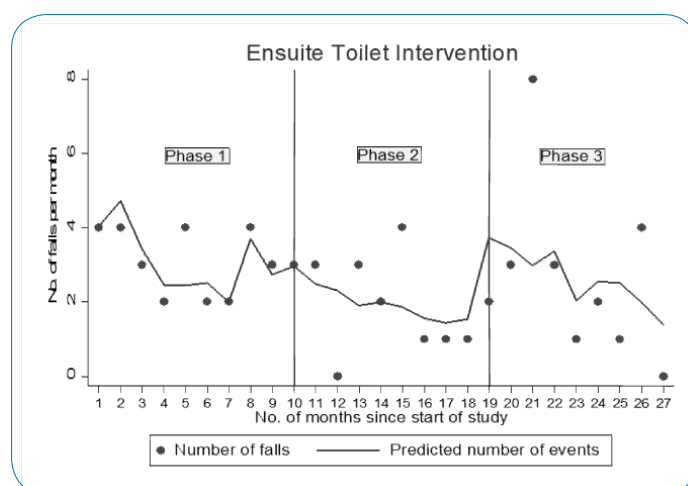


Figure 1: Observed and predicted falls per month across the 3 phases.

Table 1: Parameter estimates with 95%CI for the full segmented regression model.

Number of Falls	IRR (95%CI)	p-value
Baseline trend	0.948 (0.875, 1.028)	0.197
Level change after P2	1.514 (0.872, 2.627)	0.141
Trend change after P2	0.923 (0.821, 1.037)	0.176
Level change after P3	3.157 (0.821, 12.265)	0.097
Trend change after P3	1.028 (0.833, 1.268)	0.799
Percentage of Females	1.035 (1.007, 1.065)	<b>0.015</b>
NPPD	1.000 (1.000, 1.000)	0.954
Admissions	1.002 (0.995, 1.008)	0.579
Discharges	1.001 (0.995, 1.006)	0.836

**Table 2:** Parsimonious segmented regression model.

Number of Falls	IRR (95%CI)	P>z
Baseline trend	0.892 (0.821, 0.970)	<b>0.007</b>
Level change after P2	1.374 (0.638, 2.960)	0.417
Level change after P3	2.960 (1.199, 7.308)	<b>0.019</b>
Percentage of Females	1.038 (1.007, 1.069)	<b>0.015</b>

Refer to Table 1 for the full segmented regression model and Table 2 for the most parsimonious model. Results from this study showed that the introduction of built-in bathrooms was not statistically significant in reducing inpatient falls, ( $p > 0.05$ , Table 2). There was an increase in the incidence of falls by 37.4% (IRR=1.374) right after P2 when the built-in bathrooms were introduced, but this was not statistically significant. The monthly falls rate increased to 2.96 times (IRR=2.96,  $p = 0.019$ , Table 2) right after P3 compared to P2, inferring that the withdrawal of built-in bathrooms may lead to an increase in falls rate.

Our study also found that having a higher percentage of female patients in the ward was associated with a higher incidence of falls. There was an increase in falls incidence by 3.8% for every 1% increase in the number of female patients in the ward (IRR=1.038,  $p = 0.015$ , Table 2).

## Discussion

This short paper has examined the effect of having a built-in bathroom versus a bathroom that is located outside of the patient's room in the incidence of inpatient falls during the relocation period in an acute-care setting. In general, hospitalized patients are usually subjected to prolonged bed rest which poses a threat to muscle tissue and functional capacity [15]. The loss of muscle mass and strength during hospitalization, in addition to the disease trajectory, can lead to poor activity tolerance. Therefore, having built-in bathrooms may provide patients with poor activity tolerance a shorter distance to meet their toileting needs while preventing the chance for patients to trip and fall [16].

Increases in fall incidences were seen in each relocation period, followed by a downward trend. Unfortunately, we are unable to compare or confirm with the published literature as this phenomenon has never been evaluated before. One plausible reason could be due to the change in the environment for the patients [17]. Although the cohort of patients is different between each phase but the change from home to a hospitalized environment may be a possible reason for the increase in fall rate. Another plausible reason but need future research to confirm; would be the change in the working environment for the nurses, whereby the nurses would have to get used to the new physical layout. In this study, the cohort of nurses was the same throughout the three phases. Therefore, future studies could examine the impact of the nurses working environment on fall incidence.

In this paper, there seems to be a trend of reducing fall rates, but the result was not statistically significant. On the contrary, a study

in the United Kingdom reported an increase in fall rates when patients were lodged in single room facilities as compared to multi-bedded wards. The authors attributed the increase in fall rates due to several factors; the single room had built-in bathrooms which allowed easy access for patients to go toilet without a nurse's supervision and delay in nurses responding to call bells due to a further walking distance along corridors [18]. Although the setting of their study may differ from ours, it was the closest comparison available in the literature to explain the contrasting results in our study. In P2, our multi-bedded room has a nursing station that allowed for a direct view of the patients, and being in a multi-bedded room also meant that other patients in the room could also help to alert the nurse if a frail patient gets out of bed.

Nevertheless, Tzeng and Yin [19] argued that the distance between the bed to the bathroom across the room may still seem short to healthy people but can still be dangerous and difficult for patients who are acutely ill. Therefore, provision of walking aids or handrails should be made available throughout the patient's room (not just within bathrooms and corridors) so that patient can hold on during ambulation and give them the confidence and freedom to ambulate. Thus hospital administrator and system engineers will need to consider deploying a continuous handrail leading patients from their bed to bathrooms as a measure to reduce falls in the hospital [20].

Besides modifying the physical aspects of the room, understanding patients' behaviour and their actions could help further reduce falls too. A study in Singapore explored the perceptions of patients who had suffered a fall during hospitalized and found that patients did not perceive that falls are preventable. The patients often did not want to call the nurse for assistance because they did not want to 'bother' the nurses. Patients also often overestimated their own capabilities; thus, they took the risk of ambulating themselves [21]. Therefore, it is equally important to reinforce patient education, constantly reminding patients to call nurses for assistance and delivering a clear message that calling nurses for assistance will not be bothersome, and nurses are there to ensure patient's safety.

## Limitations

This study has several limitations. We had a small sample size with small data points in each phase ( $n = 9$ ) due to the time frame of the renovation work, which was lesser than the recommended 12 points for a time series study, before and after the intervention [22]. Additionally, due to the small number of fall incidences seen in each month, a single fall incidence can cause significant fluctuations within the trend line seen in the study.

## Conclusion

This study did not find any significant effect of built-in bathroom facilities in reducing inpatient fall rates as solely reducing the distance between bathrooms and patients may not be sufficient in reducing falls. Additional preventive measures such as the inclusion of handrails leading patients to bathrooms and providing walking aids to patients could further enhance patient safety while ambulating across the room to the bathroom; and

besides modifying the physical environment, it is also imperative to reinforce fall preventive education to patients, remind patients to call for assistance and to answer every patient's call for assistance promptly.

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