Health. Innovation. Community: It Starts With Us
J. Bichel-Findlay (Ed.)
© 2024 The Authors.
This article is published online with Open Access by IOS Press and distributed under the terms of the Creative Commons Attribution Non-Commercial License 4.0 (CC BY-NC 4.0).
doi:10.3233/SHTI240902

Improving Residential Aged Care Placement from Hospital Through the Implementation of a Digital Matching Solution – A Before-After Evaluation

Ibrahima DIOUF [a,1], Wen K LIM [b], Rajiv JAYASENA [a] and Sankalp KHANNA [a]
[a] *Australian e-Health Research Centre, Commonwealth Scientific and Industrial Research Organisation, Australia*
[b] *Department of Geriatrics, Royal Melbourne Hospital, Melbourne, Victoria, Australia*

ORCID ID: Ibrahima Diouf https://orcid.org/0000-0002-9672-303X, Wen Kwang Lim https://orcid.org/0000-0003-4559-2276 , Rajiv Jayasena https://orcid.org/0000-0003-4943-8524, Sankalp Khanna https://orcid.org/0000-0002-9672-303X

Abstract. Patient discharges from hospital to residential aged care facilities (RACFs) are often delayed due to inefficiencies in matching them to suitable available beds. To investigate the improvements that digital solutions can offer here, case-mix adjusted Length of Stay (LOS) of patients discharged to RACFs from a major metropolitan Victorian hospital were compared before and after the introduction of a digital solution for matching patient needs and preferences to available RACFs places. The study found that after the digital solution was implemented, the period where a patient would wait in the hospital for a RACF placement post the Aged Care Assessment Services (ACAS) assessment, the LOS reduced by 26.0% [95% confidence interval (95%CI):8.5%-40.5%]. The corresponding decrease in complete LOS for the After period was 16.5% (95%CI=1.5%-29.4%). This equates to a significant reduction in time spent by vulnerable patients in hospital while potentially freeing up 88,805 (95%CI:28,934-137,864) patient bed days and delivering a cost saving of $105,993,947 (95%CI:$34,651,867-$165,105,956) if applied to the reported number of hospital patient days used by those eligible and waiting for residential age care nationally across the country in 2021-22.

Keywords. residential aged care, delayed discharge, aged care placement.

1. Introduction

The movement of people between acute hospital care and Residential Aged Care Facilities (RACFs) has long been recognised as a major issue in Australia [1]. Older people are more likely to stay in hospital than medically needed. It has been reported that older patients who have multiple chronic conditions and are on multiple medications are

[1] Corresponding Author: Aibrahima Diouf, Ibrahima.Diouf@csiro,au.

more likely to experience delayed discharge [2]. In Australia, difficulties with access to aged care, together with access to disability care, have been highlighted as major reasons for delayed transfer of care (DTOC) that have negative impacts on the healthcare system [3]. An Australian 2024 report for government services in 2021-22 revealed that 340,405 hospital patient bed days were used by those eligible and waiting for residential aged care [4,3]. The impacts of faster discharge to RACFs in terms of Length of Stay (LOS) reduction and cost reduction are still poorly understood in Australia.

Finding an acceptable RACF for older patients with care needs that prevent them from being discharged to their regular home is often a slow process, delaying their discharge from the hospital. There is potentially a role for digital tools to assist here, but the benefit they could deliver is not sufficiently understood. This study was designed to understand this potential impact better.

In June 2018, a major metropolitan Victorian hospital transitioned to a digital solution to improve the efficiency of matching patients who were ready for discharge to RACFs that had availability and matched the patient's medical, social, and community needs. DailyCare is a digital software tool that, in real-time, matches the patient's information needed to select a RACF: geographical proximity, availability of specific services, vacancy and capability for clinical and personal requirements. It is hypothesised that the use of this approach reduces the "Exit Block" problem and reduces patients' wait time in hospitals for care placement. "Exit Block" refers to the situation where patients in a hospital are ready to be discharged, but no safe destination is available for them. This study compares case mix-adjusted LOS between patients who have been discharged to a RACF before and after the introduction of the digital solution. This study aims to estimate the potential impact on LOS and cost in hospital bed days from the implementation of the DailyCare digital solution.

2. Methods

2.1. Data and Study Design

Data on 912 patients were obtained from a major metropolitan public hospital in Victoria, Australia, following ethics exemption from the hospital ethics committee. This study included all patients admitted to a hospital and subsequently discharged to a RACF between 1 July 2017 and 30 June 2021, with an even amount of time before and after the implementation of the Daily Care software. Patients' demographic data included age at admission, gender and primary language. A large number of primary languages were spoken by a small number of patients, therefore, the variable primary language was re-coded as English vs Other. Patients' Diagnosis Related Groups (DRGs) were used to group them into broader clinical categories defined by Major Diagnostic Category (MDC) codes.

The data sample was restricted to 278 patients, representing those patients who had their ACAS assessment after hospital admission but before discharge. This was chosen to ensure they went through the hospital processes for selection and placement into RACFs. The use of the digital solution began at the hospital on 15 June 2018. Patients who had an ACAS assessment before this date were classified in the "Before" the digital solution group, while those who had an assessment after were classified in the "After" the digital solution group. The "After" group corresponds to patients for whom the digital solution was used to complete the aged care placement process.

It was hypothesised that this digital solution would speed up the aged care placement process after ACAS assessment and reduce LOS by reducing the time spent in hospital since ACAS assessment (Figure 1). If this is the case, then the use of this digital tool will be associated with a reduction of LOS after assessment (the number of days after ACAS assessment) and of complete LOS (the total number of days between admission and discharge).

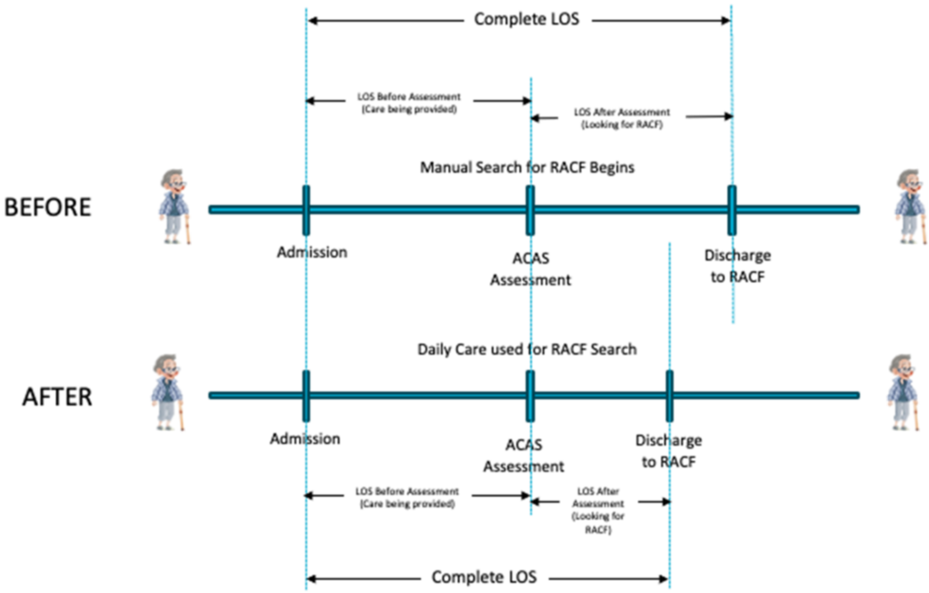

Figure 1. This figure depicts the different LOS of interest in this study. **Complete LOS** represents the number of days between admission and discharge; **LOS before assessment** is the number of days between admission and ACAS assessment; and **LOS after assessment** represents the number of days between ACAS assessment and discharge.

The three LOS defined above were assessed as outcome variables of interest in the statistical modelling.

2.2. Statistical Analysis

Patients' demographics and clinical data were described between the two groups (Before and After) with Median[Min, Max] for LOS (as it is skewed), Mean(SD) for age at admission and n(%) for categorical variables.

LOS (in number of days) is often over-dispersed. A negative binomial was used, a special case of Poisson distribution for over-dispersed count data, to assess the associations between the use of the digital solution (Before and After) with the three LOS outcomes while taking into account patients' demographics (age, gender, primary language) and MDC. First, an unadjusted model with only the digital solution (Before vs After) was fitted; then, patients' demographics were added to the model. After that, non-significant covariates were removed from the model, and MDC was added. Only the unadjusted model and the final model were presented in this report.

The proportion of reduction in LOS after ACAS assessment associated with the use of the digital tool computed from the final model (adjusted for age and MDC) was applied to the 340,405 hospital patient days used by those eligible and waiting for residential age care to calculate the potential saving in terms of hospital patient days. The average cost of one patient day in a hospital was multiplied by the number of patient days to calculate the economic impact of the digital solution [5].

3. Results

This study included 278 patients who had an ACAS assessment while in hospital. A total of 76 patients were classified in the Before group, while 202 were classified in the After group (Table 1). The median LOS before ACAS assessment was 18.0 days in the Before group and 18.5 days in the After group. The median LOS after ACAS assessment was 14.5 days in the Before group and 12.0 days in the After group, while the median complete LOS was 37 days in the Before group and 31 in the After group. The mean age at admission was similar in the two groups (80 years). The proportions of females (48.7% and 46.5 for Before and After) were similar, while the Before group was four percentage points higher in the proportion of patients with English as a primary language. Patients in the After group were more likely to be diagnosed with neurological and cranial conditions (46.5% vs 36.8% in the Before group).

Table 1. Descriptive data were computed for each group separately and for all selected patients (overall).

	Before (N=76)	**After (N=202)**	**Overall (N=278)**
LOS before assessment, Median [Min, Max]	18.0 [0, 203]	18.5 [0, 116]	18.0 [0, 203]
LOS after assessment, Median [Min, Max]	14.5 [2.00, 117]	12.0 [1.00, 91.0]	13.0 [1.00, 117]
Complete LOS, Median [Min, Max])	37.0 [4.00, 232]	31.0 [3.00, 149]	33.5 [3.00, 232]
Age at admission, Mean (SD)	80.3 (10.4)	80.4 (10.7)	80.4 (10.6)
Female, %(n)	37 (48.7%)	94 (46.5%)	131 (47.1%)
Primary language English, n(%)	60 (78.9%)	151 (74.8%)	211 (75.9%)
Major Diagnosis categories, n(%)			
B†	28 (36.8%)	94 (46.5%)	122 (43.9%)
I*	15 (19.7%)	26 (12.9%)	41 (14.7%)
Z‡	16 (21.1%)	30 (14.9%)	46 (16.5%)
Other	17 (22.4%)	52 (25.7%)	69 (24.8%)

† neurological and cranial
* orthopaedic incl. spinal surgery, soft tissue and hand injuries
‡ Rehabilitation, diagnoses of other contacts, signs and symptoms only, post-op review

For the unadjusted analysis in Table 2, the digital solution was not significantly associated with LOS before ACAS assessment. However, it was associated with a 26% reduction in LOS after ACAS assessment and a 16% reduction in complete LOS.

When added to the models, gender and primary language were not significantly associated with any of the LOS variables and were therefore removed. Even after adjustment for age and MDC, the observed results were similar to those in the unadjusted model (Table 3). No association between the use of the digital solution and LOS before ACAS assessment was evident, while the use of the digital solution (After) was associated with a 26% reduction in LOS after ACAS assessment and a 16.5% reduction in complete LOS.

Table 2. Unadjusted statistical model. Results from a negative binomial model with LOS as the dependent variable and the digital solution (Before vs. After) as the independent variable. The effects of the digital solution are measured as Rate Ratios(SE) for the After group relative to Before (reference category).

	LOS before assessment	LOS after Assessment	Complete LOS
Intercept	23.961 (0.114), p <0.001	22.263 (0.093), p <0.001	46.224 (0.072), p <0.001
Digital solution			
Before	reference	reference	reference
After	**0.936(0.133), p = 0.619**	**0.743 (0.109), p = 0.006**	**0.843 (0.085), p = 0.044**

Table 3. Statistical model adjusted for age and MDC. Results from a negative binomial model with LOS as dependent variable and the digital solution (Before vs. After) as the independent variable adjusted for age at admission, and MDC. Gender and primary language were not significantly associated with any LOS variables and were therefore removed from the models. For age at admission rate ratios (SE) are calculated for a 1-year increase. Categorical variables (digital solution and MDC) rate ratios (SE) are calculated relative to the reference category.

	LOS before assessment	LOS after Assessment	Complete LOS
Intercept	150.102 (0.452), p <0.001	34.348 (0.378), p <0.001	the
Age at admission	0.978 (0.005), p <0.001	0.995 (0.005), p = 0.231	0.987 (0.004), p <0.001
MDC			
B†	reference	reference	reference
I*	1.292 (0.173), p 0.138	0.811 (0.146), p = 0.151	1.059 (0.113), p = 0.615
Z‡	0.595 (0.167), p = 0.002	1.448 (0.136), p = 0.006	0.997 (0.108), p = 0.974
Other	1.052 (0.143), p = 0.723	0.833 (0.120), p = 0.129	0.955 (0.094), p = 0.621
Digital solution			
Before	reference	reference	reference
After	**0.913 (0.129), p = 0.477**	**0.740 (0.107), p = 0.005**	**0.835 (0.084), p = 0.032**

† neurological and cranial
* orthopaedic incl. spinal surgery, soft tissue and hand injuries
‡ Rehabilitation, diagnoses of other contacts, signs and symptoms only, post-op review

For the analysis of the economic impact of this digital solution, in the final model for LOS after ACAS assessment, the coefficient for the After period is -0.301 (95% CI: -0.519,-0.088). After transformation from the log-linear to the original scale, this means that episodes LOS after assessment in the After period are 74.0%(95%CI: 59.5%-91.5%) of those in the Before period. Therefore, the reduction in the After period was 26.0%(95%CI=8.5%%-40.5%). When this reduction was applied to the 340,405 hospital patient days used by those eligible and waiting for aged care placement in 2021-22, the potential patient days savings were estimated at 88,505(28,934-137,864). The cost of one bed-day ($1,197.6) was derived from the National Hospital Cost Data Collection report for 2020-21 [6]. When this cost per day is multiplied by the bed-days savings, the potential cost savings were estimated at $105,993,947($34,651,867 - $165,105,956).

4. Discussion

As expected, introducing this digital solution in the aged care placement process was not associated with a reduction in LOS before ACAS assessment but was associated with reductions in LOS after ACAS assessment. This is not surprising as the process for aged care placement starts after ACAS assessment. Through the reduction of LOS, this digital tool has a significant economic impact (reduction of hospitalisation-related costs).

Delayed discharges are issues for both patients, especially frail old patients, and the healthcare system. Delayed discharges in older patients are often associated with functional decline and health complications such as infections and mental health [7]. At a health system level, delayed discharges are associated with a reduction in patient flow, emergency department overcrowding and cancellation of outpatient surgeries, and they also impact resources across the healthcare system [7]. Therefore, the benefits of tools that reduce LOS, such as the digital solution presented in this study, go beyond a reduction in LOS and its corresponding economic evaluation.

This study has some limitations. Although the magnitude of the effect of this digital tool on LOS is substantial, the study sample is small. Future studies on a larger patient population with more clinical covariates will provide more robust evidence for the benefits associated with the adoption of this digital solution. Future studies will also benefit from the enrolment of multiple hospitals.

5. Conclusions

This study provides evidence that the digital matching solution presented reduces hospital LOS in older patients, thereby reducing healthcare costs. Such a digital tool, if used at a large scale, can potentially reduce hospital crowding and a cascade of related issues such as medical complications for patients, delayed healthcare delivery and increased costs for the healthcare system.

Acknowledgements
The authors would like to acknowledge Tull Roseby, Sean St. Quentin and Alex Lynch from DailyCare for their assistance in this project.

References

[1] AIHW: Karmel R and Anderson P. Movement from hospital to residential aged care. Data linkage series no. 6. Canberra [released 2008 Nov; cited 2024 Apr]. Available from: https://www.aihw.gov.au/reports/aged-care/movement-from-hospital-to-residential-aged-care/contents/summary.

[2] McCloskey R, Jarrett P, Stewart C, and Nicholson P. Alternate level of care patients in hospitals: what does dementia have to do with this? Can Geriatr J. 2014 Jul;17(3):88–94, doi: 10.5770/cgj.17.106.

[3] Rogers B, Legaspi JP, and Bastiampillai T. Hospital congestion: a market solution to address delayed transfers of care from hospital beds. Med J Aust. 2023 Apr;218(7):298–300, doi: 10.5694/mja2.51876.

[4] Australian Government Productivity Commission. Report on Government Services 2024: aged care services. Accessed: 2024 Apr [released 2024 Jan; cited 2024 Apr]. Available from: https://www.pc.gov.au/ongoing/report-on-government-services/2024.

[5] Rolls D, Khanna S, Lloyd N, Reeson A, Jayasena R, McCormick C, Hakkennes S. Before-after evaluation of patient length of stay in a rehabilitation context following implementation of an electronic patient journey board. *Int J Med Inform. 2023 Feb*; 34:104042, doi: 10.1016/j.ijmedinf.2019.104042.

[6] IHACPA. National Hospital Cost Data Collection (NHCDC) Public Sector Report 2020-2 [updated 2023 Jun; cited 2024 Apr]. Available from: https://www.ihacpa.gov.au/resources/national-hospital-cost-data-collection-nhcdc-public-sector-report-2020-21.

[7] McGilton KS, Vellani S, Krassikova A, Robertson S, Irwin C, Cumal A, Bethell J, Burr E, Keatings M, McKay S, Nichol K, Puts M, Singh A, Sidani S. Understanding transitional care programs for older adults who experience delayed discharge: a scoping review BMC Geriatr, 2021 Mar;21(1):210, doi: 10.1186/s12877-021-02099-9.