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Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Title page

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility – a before and after cohort study

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Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Abstract

Introduction

Hospital readmission is a burden to patients, relatives, and society. Older patients with frailty are at highest risk of readmission and its negative outcomes.

Objective

We aimed at examining whether follow-up visits by an outgoing multidisciplinary geriatric team (OGT) reduces unplanned hospital readmission in older patients discharged to a skilled nursing facility (SNF).

Design

A retrospective single-centre before and after cohort study.

Setting and participants

Study population included all hospitalised patients discharged from a geriatric department to a SNF during 1 January 2016 – 25 February 2020. To address potential changes in discharge and readmission patterns during the study period, patients discharged from the same geriatric department to own home were also assessed.

Intervention

OGT visits at SNF within seven days following discharge. Patients discharged to SNF before 12 March 2018 did not receive OGT (-OGT). Patients discharged to SNF on or after 12 March 2018 received the intervention (+OGT).

Main outcome measures

Unplanned hospital readmission between 4 hours and 30 days following initial discharge.

Results

A total of 847 patients were included (440 -OGT; 407 +OGT). No difference was seen between the two groups regarding age, sex, activities of daily living (ADL), Charlson Comorbidity Index (CCI), or 30-day mortality. The cumulative incidence of readmission was 39.8% (95% CI 35.2-44.8, n=162) in -OGT and 30.2% (95% CI 25.8-35.2, n=113) in +OGT. The unadjusted risk (HR (95% CI)) of readmission was 0.68 (0.54-0.87, p=0.002) in +OGT compared to –OGT, and remained significantly lower (0.72 (0.57-0.93, p=0.011)) adjusting for age, length of stay, sex, ADL, and CCI. For patients discharged to own home the risk of readmission remained unchanged during study period.

Conclusion

Follow-up visits by OGT to patients discharged to temporary care at a SNF significantly reduced 30-day readmission in older patients.

Trail registration

Danish Data Protection Agency (rec.nr. 20/1681).

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Strengths and limitations of this study

- This was a hospital-based before and after cohort study with no patients lost to follow-up
- We accounted for the competing risk of death and adjusted for potential confounders in our analysis (age, sex, activities of daily living, comorbidity, and length of stay)
- We explored general changes in readmission pattern not related to the intervention
- This was a before and after cohort study, which has a risk of overestimating the effect
- This was a single centre study, which may limit the generalisability of study results

Keywords

Readmission, Follow-up visit, Outgoing team, Geriatrics, Older people, Integrated care

Word count

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Introduction

Acute hospitalisation can be lifesaving but may also lead to adverse health outcomes in older adults, such as hospital-acquired infections and poorer functional health, as well as anxiety and distress [1-7].

Some acute hospitalisations are preventable, and readmissions in particular are therefore in focus for preventive initiatives. The risk of readmission increases with age, especially in patients characterised by high age, multimorbidity, polypharmacy, longer in-hospital stay, lower functional status, male sex, and prior hospitalisation [8-10]. After an acute treatment, such vulnerable patients may be transferred to a post-acute care facility for further stabilisation of medical and functional health, either in a hospital or in a skilled nursing facility (SNF). SNF is an in-patient rehabilitation centre staffed with trained medical professionals and affiliated primary care physicians, SNF offers a temporary residence for patients undergoing medically necessary rehabilitation and treatment.

Interventions to prevent readmission among older adults are widely studied. Several models have been investigated, involving various staff groups (i.e. pharmacist, nurse, primary care physician, geriatrician) and different point of actions (i.e. nutrition, medication, exercise, care) [11-14], but no single or a bundle of interventions appears to reduce hospital readmission reliably [15-17]. For patients discharged to a SNF, only few intervention studies exist [4-6 18 19], mainly from countries with a mixture of public and private health care providers.

Our aim was to examine whether early follow-up visits by an outgoing multidisciplinary (nurse and doctor) geriatric team (OGT) reduce acute hospital readmission in older vulnerable patients discharged to a temporary stay in a SNF.

Methods

Design

We conducted a retrospective single-centre, before and after cohort study, following the implementation of an OGT at a SNF in the municipality of Odense, Denmark.

Settings

In Denmark, all citizens have free access to their primary care physician, hospital treatment, and health care services including home care due to a tax-funded public health care system [20]. Odense University Hospital is a highly specialised hospital, which serves citizens in the Region of Southern Denmark. It is the main hospital for the citizens of Odense municipality with approximately 200,000 inhabitants, of which 17% are above 65 years of age [21]. The Department of Geriatric Medicine at Odense University Hospital consists of a medical ward with 38 beds. All patients are admitted as acute patients from the emergency department or transferred from other departments. They are characterised by having a high age and suffering from multimorbidity, polypharmacy, and functional decline in addition to their acute medical illness. The department has a close collaboration with Odense Municipality, which is responsible for providing home- and nursing care services for patients

after hospital discharge [20]. Most patients (87%) are discharged to the same residence they had before admission. However, patients admitted to hospital from their own home, but at the time of discharge unable to return to their own home due to social, physical, or medical reasons, are discharged to a municipal SNF for temporary care and rehabilitation.

The SNF of Odense municipality hosts 64 temporary beds and has a turnover of approximately 1,000 patients a year with an average length of stay of 24 days (unpublished administrative data). The SNF staff includes nurses, social and healthcare assistants, physiotherapists, and occupational therapist, but there is no staff physician. If a patient needs medical attention, the SNF staff contacts the patient's personal primary care physician.

Intervention

The OGT was initiated 12 March 2018. It consisted of a geriatric nurse and a specialist geriatrician, who in close collaboration with the patient and the SNF-staff dealt with any health issues related to the recent hospital admission and discharge i.e. effect and side-effects of initiated treatment, nutritional, and rehabilitation issues. The OGT consulted patients at the SNF within seven days following hospital discharge. The OGT had access to the patients' electronic hospital records, including records from physicians, nurses, occupational- and physiotherapists, and an updated list of medications. Moreover, the team could carry out collection of venous blood samples, urine, and stool-tests, when needed. The SNF-staff measured blood pressure, pulse, temperature, and blood oxygen saturation ahead of OGT visits. The OGT visited the SNF three times a week, a total of six hours per week. Patients received at least one visit from the OGT during the follow-up.

Participants

We included all patients discharged from the Department of Geriatric Medicine at Odense University Hospital from 1 January 2016 to 25 February 2020. Eligible patients were identified from Odense University Hospital's patient administrative system and the Odense municipality's electronic care journal. Patients discharged to SNF (SNF patients) prior to initiation of OGT 12 March 2018 were categorized as –OGT and as +OGT if discharged on or after. Further, in order to explore time trends and potential variations in discharge, readmission patterns, and patient characteristics during the study period, we categorized patients discharged to own home (non-SNF patients) prior to 12 March 2018 as pre-OGT and those discharged on or after 12 March 2018 as post-OGT.

Variables and Data Sources

The primary outcome was 30-days readmission rate. Readmission was defined as any acute/unplanned hospital admission within 4 hours and 30 days after discharge from the Department of Geriatric Medicine [22]. Index-admission was defined as any unplanned admission to the Department of Geriatric Medicine during the study period. Patients with several hospital admissions could have several index admissions but only one readmission per index admission. Thereby each unplanned admission to the geriatric department counted as an index admission.

We used the patient's unique civil registration code to extract data from Odense University Hospitals patient administrative system for each index admission. Data included information of unplanned hospital admissions, date and time of the admission and discharge, location, type, and hospital department. Length of index admissions and readmissions were derived from medical records. Participants' characteristics e.g. age, sex, and information on mortality was obtained from the Civil Registration System. Information of comorbidity and Barthel index (BI) were obtained from Odense University Hospitals patient administrative system or directly from medical records when missing in the register (n=59). BI is a measure of function in activity of daily living (ADL), with a sum score across ten domains of ADL. BI is the official ADL tool used in Danish hospitals and assessed routinely upon hospital admission [23]. The total score ranges from 0 (completely dependent) to 100 (completely independent). In Denmark BI is categorized in four standard diagnostic categories BI=80-100 (independent ADL), BI=50-79 (moderate reduced ADL), BI=25-49 (low ADL), and BI=0-24 (very low ADL). The burden of comorbidity was assessed using Charlson Comorbidity Index (CCI), which was computed based on all primary and secondary discharge diagnoses registered in the hospital's electronic patient journal the past four years. The CCI score was divided into three levels: low (score of 0), moderate (score of 1-2), and high (score of ≥3) [24].

The health-interventions by the OGT were registered in an administrative database without any personally identifiable data. This database provided summary data of the interventions made by the OGT (i.e. adjustments of medication, blood samples, nutritional advice, information of tests/examinations, and intervention from a specialised acute nursing function). Data of number of OGT-visits per patient were extracted from the patient administrative system.

Statistical Analysis

The study sample size was calculated from expected change in readmission rate 'before and after'. The inclusion of 367 patients in each group would give the study 80% power to detect a 30% reduction in readmission rate assuming a baseline readmission rate of 30% [19], with a level of significance of 5%. This power calculation was used to define the length of the study period in order to ensure an adequate sample size. Patient characteristics were reported using numbers/percentages, means (SD), and medians [IQR]. Differences between groups were calculated using chi^2 tests, Student's *t*-test, or Kruskal-Wallis test, as appropriate. The primary outcome, readmission rate, was calculated as the total number of 30 days readmissions divided by total number of index admissions. A Cox proportional hazard model for readmission within 30 days was used to investigate the effect of the OGT. Patients who died or moved to another municipality within 30 days after discharge were censored from analysis and the model was adjusted for age, length of stay (LOS), sex, CCI, and BI. The incidence of readmission was plotted as a function of time in a Kaplan-Meier plot of cumulative incidence. The analysis did not include patients with a follow-up of less that 12 hours. The proportional-hazard assumption was tested using Schoenfeld residuals. The statistical significance threshold for all tests was set to $P < 0.05$. STATA software version 16 (StataCorp LLC, Texas, USA) was used for statistical analysis.

Ethics

The study was approved by the Danish Data Protection Agency (rec. nr. 20/1681) and reported according to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines [25]. Approval by ethical committee and informed consent was not necessary according to Danish legislation on medical ethics due to the register-based study design [26].

Results

A total of 6,624 patients (54.1% women) were discharged from the Department of Geriatric Medicine during the study period with a mean (SD) age of 83.0 (8.8) years. Of these, 847 patients (women 56.1%) with a mean (SD) age 84.2 (8.3) years were discharged to the SNF (-OGT: n=440 and +OGT: n=407) (Table 1) whereas 5,777 patients (women 53.8%) with a mean (SD) age of 82.9 (8.8) (pre-OGT=3,343 and post-OGT=2,434) were discharged to their own home (non-SNF) (figure1).

Characteristics and outcome data for SNF patients (-OGT and +OGT) (n=847)

No difference was found between –OGT (n=440) and +OGT (n=407) regarding age, sex, BI, CCI, and 30-days mortality. Median [IQR] LOS of index-admission was 7.8 [5.0-12.8] days and 6.0 [3.9-10.0] days in -OGT and +OGT, respectively (p≤0.0001) (Table 1). The median number of OGT visits pr. patient was 1 ([IQR 1-2] range 1-10). The proportion of patients visited more than once was 38%. In 32% of the visits the patients had adjustments to their medication, 14% had blood samples taken, 12% were given nutritional advice, 5% were informed of tests-results (i.e. x-ray, endoscopy), and 6% received intervention from a specialised municipal acute nursing function.

The 30-days readmission rate was 36.8% (n=162) and 27.8% (n=113) in -OGT and +OGT group, respectively (p=0.005). The cumulative incidence of readmission (95% CI) was 39.8% (35.2-44.8) in the –OGT group and 30.2% (25.8-35.2) in +OGT group (figure 2). Unadjusted risk (HR (95% CI)) of readmission was 0.68 (0.54-0.87, p=0.002) in the +OGT group compared to the –OGT group. Risk of readmission remained lower in the +OGT group in the fully adjusted model (0.72 (0.57-0.93), p=0.011). Subgroup analysis defining readmission as an unplanned hospital contact with a duration of 12+ hours, occurring between 4 hours and 30 days after discharge from the Department of Geriatric Medicine did not change the results (data not shown).

Patients had a wide spectrum of primary diagnoses at index admission and readmission with no difference between the two groups in regards of proportions within each ICD-10 groups (Chi2). The three most common ICD-10 groups were diseases of the respiratory organs (ICD10: J00-J99) (-OGT: 27% and +OGT: 22%, p=0.127); endocrine, nutritional, and metabolic diseases (ICD10: E00-E90) (-OGT: 10% and +OGT: 12%, p=0.271); and certain infectious and parasitic diseases (ICD10: A00-B99) (-OGT: 9% and +OGT: 9%, p=0.996). The three most common ICD-10 groups at readmission were diseases of the respiratory organs (ICD10: J00-J99) (-OGT: 29% and +OGT: 17%, p=0.069); injury, poisoning, and certain other consequences of external causes (ICD10: S00-T98) (-OGT: 11% and +OGT: 12%, p=0.834); and diseases of the circulatory system (ICD10: I00-I99) (-OGT: 10% and +OGT: 11%, p=0.692).

Characteristics and outcome data for non-SNF patients (pre-OGT and post-OGT) (n=5,777)

No difference in age, sex, CCI, and 30-days mortality was found between the pre-OGT (n=3,343) and post-OGT (n=2,434) groups. The distribution of BI in the four subcategories differed significantly between groups (p=0.012). BI 80-100: pre-OGT = 13.8% and post-OGT = 12.5%; BI 50-79: pre-OGT = 27.6% and post-OGT = 27.0%; BI 25-49: pre-OGT = 21.4% and post-OGT = 24.7%; BI 0-24: pre-OGT = 32.4% and post-OGT = 5.6%. Median [IQR] LOS of index-admission was 5.1 [3.1-7.9] days and 4.8 [2.9-6.9] days in pre-OGT and post-OGT groups, respectively (p<0.0001) (table 2).
Among the pre-OGT and post-OGT groups the 30 days readmission rate was 26.5% (n=887) and 27.8% (n=676) (p=0.295), respectively. The cumulative incidence of readmission (95% CI) was 29.1% (27.5-30.7) in pre-OGT and 28.8% (27.0-30.7) in post-OGT (figure 3). No difference was found in the risk of readmission between the pre-OGT and post-OGT group, neither for unadjusted nor adjusted risk (HR (95%CI)) of 1.00 (0.90-1.10, p=0.922) and 1.01 (0.91-1.11, p=0.920), respectively.

Discussion

This study shows that follow-up visits by an outgoing multidisciplinary geriatric team reduces hospital readmissions among patients discharged from a geriatric department to a skilled nursing facility. The results remained significant even after adjusting for sex, age, in hospital length of stay, comorbidity, and functional status.

To our knowledge, only few other studies have assessed interventions to prevent readmission among patients discharged to SNF [4-6 19]. A retrospective study from Cleveland (US) demonstrated a significant reduction in readmission rates from 28% to 22% (p< 0.001) after implementation of a connected care model [6]. The applied model was very extensive with patients receiving visits from an outgoing team including doctors and nurses 4-5 times a week after discharge from hospital to SNF and telephone coverage at nights, weekends, and monthly meetings with multidisciplinary teams. This extensive model may be difficult to apply in other settings. Another US-study explored whether readmission could be reduced by implementing video conference to improve transition between hospital and a SNF [5]. Videoconference reduced the 30-day readmission rate from 24% to 15% (OR 0.57 95% CI 0.34-0.96, p=0.04). However, this was a prospective cohort study comparing pre- and post-intervention rates in two different SNF's. The effect was mainly due to an increase of readmission in the control-cohort rather than a reduction of readmissions in the intervention-group [5]. Interpretation and application of these studies' results to a different health care system, as the Danish, should be done with care, as large organizational variations exist across countries. A Danish randomized controlled trial studied the effect of comprehensive geriatric care offered to patients 65 years and older, referred from any hospital department to a rehabilitation unit [19]. The study did not show any reduction in 90 days hospital readmission rates in the intervention group compared to usual care. However, the study did not explore 30-days readmission rates specifically and the negative result may be due to a spill over effect, i.e. the intervention may have affected the control group, and a non-real-life setting since the intervention was performed by a single geriatrician only [19].

Among the SNF-patients in our study, the pre-intervention 30-days readmission rate was 36%, which is high compared to an overall readmission rate of 18% among older hospitalised patients in Denmark [27]. However, it is well known that patients discharged to SNF or other post-acute care facilities have a higher risk of readmission. A study of patients discharged to post-acute care facility demonstrated a readmission rate of 22% and most readmissions (80%) occurred within 30 days of discharge [28]. Other studies on patients discharged to temporary care have shown 30-days readmission rates between 24-28% [4-6]. This variation in readmission rates between studies, may be explained by differences in patient characteristics, since other studies have included all patients resident at a SNF including patients referred to the SNF from home or a surgical department. Our study solely included the most vulnerable patients discharged from a geriatric department, characterised by high age, low functional status, and multi-morbidity and therefore at highest risk of readmission [8-10]. Moreover, there may be differences in the definition of readmission [29]. Our definition included any unplanned hospital contact within 30 days of discharge, thereby including brief contacts to the emergency department.

In-hospital LOS declined significantly during the study period. However, this decline was not reflected by a change in disease-burden since CCI or primary diagnoses of hospital admission remained unchanged. The trend towards shorter hospital stay seen in our study is also reported on a national and European basis [30]. In our study, LOS did not affect the readmission rate.

We found no difference in the proportion of men and women, which is surprising, since other studies of similar geriatric cohorts have shown a higher proportion of women compared to men [31]. However, our sex-ratio corresponds to the sex-ratio shown in the Danish national database of geriatrics 2019 [32].

Strengths and limitations of this study

Our study has limitations. Firstly, this was a before and after study, which has a risk of overestimating the effect [33] due to residual confounding. The participants in the intervention group (+OGT) may have been exposed to other non-identified factors compared to the control group. However, readmission rates among non-SNF patients remained unchanged in the pre-OGT and post-OGT groups highlighting that no general change in the pattern of admissions occurred during the study period. Secondly, this was a single centre study, which limits the generalizability of study results. Furthermore, as no consensus-definition of SNF exists, other studies may represent differently organized SNF's, dissimilar patient populations, and other discharge procedures from geriatric departments worldwide, also limiting the generalizability. Thirdly, the study only included data on hospital readmissions at Odense University Hospital, which may underestimate the risk of readmissions. However, only patients, who would have travelled or moved to other municipalities outside Odense, would be at risk of readmission to other hospitals than Odense University Hospital. In our dataset, we were able to track all patients, and none had residence outside the municipality of Odense within 30 days after discharge.

The study also has several strengths. We used data from registers with no patients lost to follow-up. In addition, we performed power- and sample size calculation when planning the study to ensure appropriate length of study period. The adjusted analysis involved patient characteristics including measures of activities of daily living (Barthel-Index), comorbidity (Charlson Comorbidity Index), and

LOS, which are important risk factors for readmission [8-10]. Furthermore, our results are strengthened by accounting for the competing risk of death in our analysis, censoring those who died with-in 30 days of discharge. Finally, the study was carried out in a real-life setting and therefore implementable in similar settings.

Several elements of our OGT-intervention may have been crucial in the prevention of readmissions. The OGT facilitated a close co-operation between hospital, patient, and SNF, which potentially prevented miscommunication and loss of information in the transition from secondary to primary care sector. Furthermore, early detection and correction of ambiguities and inadequate hospital care plans may have led to improved and shared goals of care for the benefit of the patient. A shared responsibility of the patient in the early days after discharge may have ensured confidence among patients, relatives, and caregivers and prevented unnecessary contacts to doctors on call or emergency doctors. Lastly, reassessment of the patient's medical condition may have led to early detection and treatment of recurrence of disease, thereby preventing readmission.

Despite the obvious potential benefit of outgoing hospital teams, the intervention is costly and hospital resources are redistributed outside the hospital. In our set-up, limiting the post-discharge follow-up visit to patients discharged to SNF reduced the time-expenditure since all patients were discharged to the same SNF and therefore the intervention may have been economical rentable. Cost-effective analysis of the intervention remains to be assessed, before dissemination of this model. Our study does not give insight to sub-elements of the intervention, but further studies with an explorative or qualitative design may provide further insight important to elements to address in the prevention of readmission. Such insight may be valuable in the development of less costly interventions, such as telemedicine. Telemedicine and videoconference are likely to be less costly and perhaps as effective tools for post-discharge follow-up, which calls for further exploration.

Conclusion

Follow-up visits by an outgoing multidisciplinary geriatric team significantly reduced 30-days readmission rates by 28% in older vulnerable patients recently discharged from hospital to a skilled nursing facility.

Author Contributions

KT is the guarantor of the study. KT and AF directed and contributed equally to all aspects of this manuscript. KAR, JR, and LM contributed to study design, data interpretation, and writing. All authors have commented, read, and approved the final manuscript.

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interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Conflicts of Interest statement

The authors declare that no conflicts of interest are associated with this publication.

Patient and public involvement:

Neither patients nor the public were involved in the design, conduct, reporting, or dissemination of the study.

Patient consent for publication:

Not required

Provenance and peer review

Not commissioned; externally peer review

Data availability

Data are available upon reasonable request

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Legends

Figure 1: Timeline of patients discharged from the Department of Geriatric Medicine according to discharge destination and initiation of outgoing geriatric team. Abbreviations: OGT: outgoing geriatric team, pre-OGT; before implementation of OGT, post-OGT; after implementation of OGT, SNF; skilled nursing facility

Figure 2: Kaplan-Meier curves of cumulative incidence of 30-days readmissions for any unplanned readmission for patients discharged to skilled nursing facility and outgoing geriatric team compared to patients discharged to skilled nursing facility only. Abbreviations: OGT: outgoing geriatric team

Figure 3: Kaplan-Meier curves of cumulative incidence of 30-days readmissions for any unplanned readmission for patients discharged to own home. Before and after implementation of outgoing geriatric team (pre-OGT and post-OGT). Abbreviations: OGT: outgoing geriatric team

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Table 1: Characteristics of patients discharged from Department of Geriatric Medicine to a skilled nursing facility without follow-up (-OGT) or with follow-up (+OGT) by an outgoing geriatric team

	-OGT (n=440)	**+OGT (n=407)**	**p**
Age, y, mean (SD)	84.2 (8.0)	84.2 (8.5)	0.980
Female, n (%)	240 (54.6)	235 (57.9)	0.329
Barthel Index, n (%) 80-100 50-79 25-49 0-24 missing	 12 (2.8) 80 (18.7) 121 (28.3) 215 (50.2) 12 (2.7)	 9 (2.2) 71 (17.4) 117 (28.8) 191 (46.9) 19 (4.7)	0.600
CCI, median [IQR]	2 [1-3]	2 [1-3]	0.182
CCI, n (%) 0 1-2 ≥3	 93 (21.1) 165 (37.5) 182 (41.4)	 99 (24.3) 157 (38.6) 151 (37.1)	0.370
LOS, days (index admission) median [IQR]	7.8 [5.0-12.8]	6.0 [3.9-10.0]	0.0001
Died within 30 days after discharge, n (%)	75 (17.1)	68 (16.7)	0.896

Abbreviations: SD standard deviation, CCI: Charlson Comorbidity Index, LOS: length of stay (in hospital), IQR: inter quartile range, OGT: outgoing geriatric team

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Table 2: Characteristics for patients not discharged to skilled nursing facility from Department of Geriatric Medicine before (pre-OGT) and after (post-OGT) implementation of outgoing geriatric team.

	pre-OGT n=3,343	**post-OGT n=2,434**	**p**
Age, y, mean (SD)	82.7 (8.8)	83.1 (8.9)	0.144
Female, n (%)	1,805 (54.0)	1,307 (53.7)	0.817
Barthel Index, n (%) 80-100 50-79 25-49 0-24 missing	 462 (13.8) 924 (27.6) 716 (21.4) 1,083 (32.4) 158 (4.7)	 303 (12.5) 655 (27.0) 600 (24.7) 738 (30.3) 129 (5.6)	0.012
CCI, median [IQR]	2 [1-4]	2 [1-3]	0.146
CCI, n (%) 0 1-2 ≥3	 682 (20.4) 1,233 (36.9) 1,428 (42.7)	 521 (21.4) 911 (37.4) 1,002 (41.2)	0.450
LOS, days (index admission) median [IQR]	5.1 [3.1-7.9]	4.8 [2.9-6.9]	0.0001
Died within 30 days after discharge n (%)	360 (10.8)	233 (9.6)	0.139

Abbreviations: SD standard deviation, CCI: Charlson Comorbidity Index, LOS: length of stay (in hospital), IQR: inter quartile range, OGT: outgoing geriatric team

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

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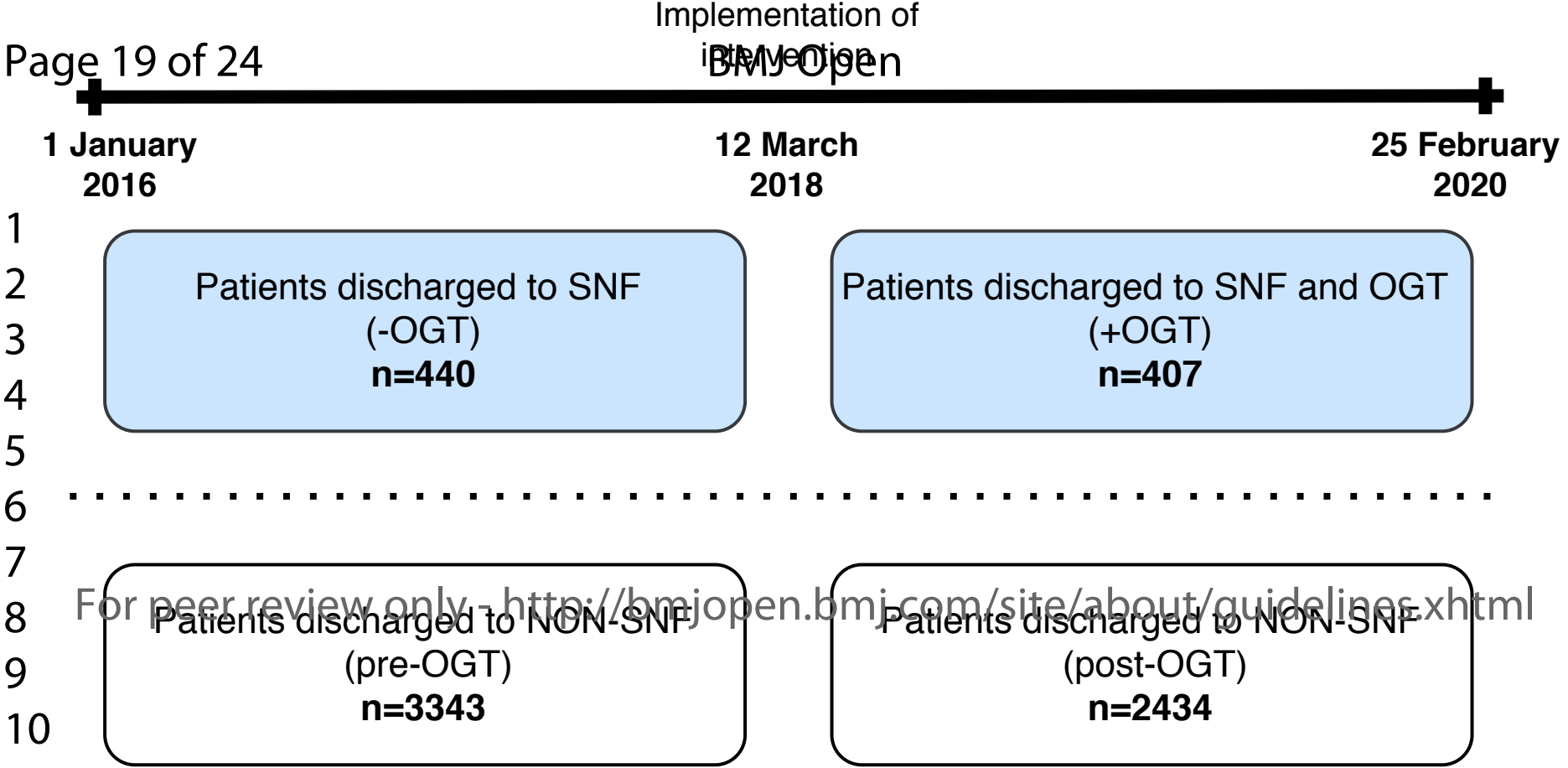

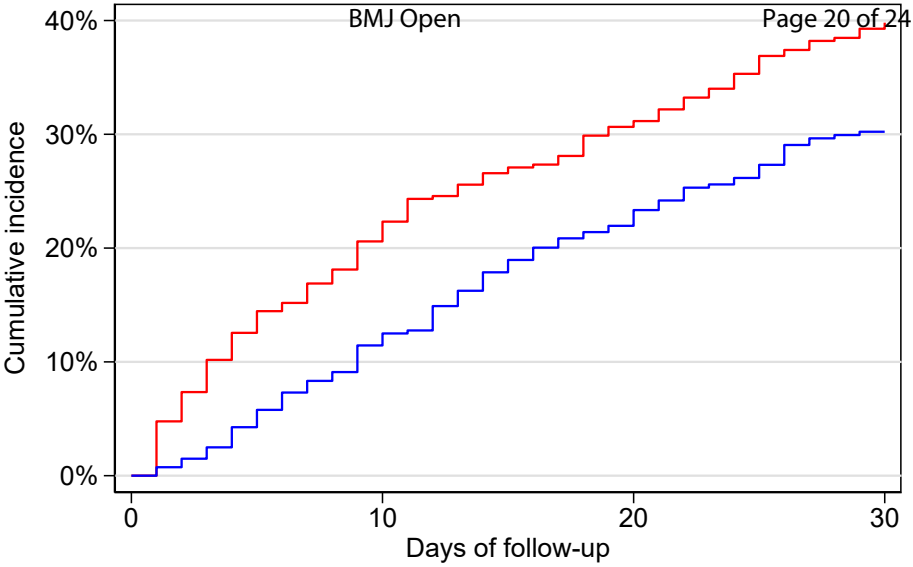

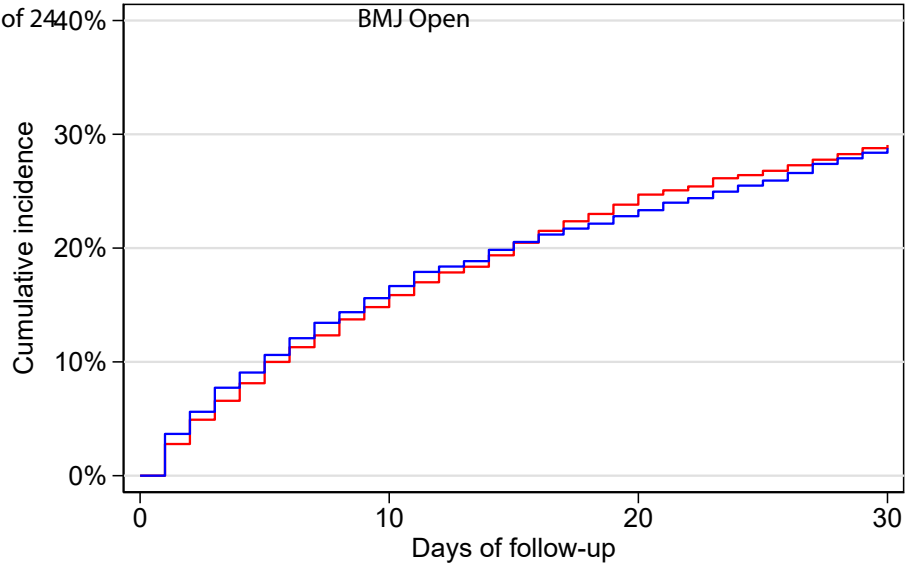

Number at risk

pre-OGT	3341	2584	2238	2030
post-OGT	2425	1980	1761	1600

Reporting checklist for quality improvement in health care.

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		Reporting Item	Page Number
Title			
	#1	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patientcenteredness, timeliness, cost, efficiency, and equity of healthcare)	1
Abstract			
	#02a	Provide adequate information to aid in searching and indexing	3
	#02b	Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions	2
Introduction			
Problem	#3	Nature and significance of the local problem	4

description			
Available knowledge	#4	Summary of what is currently known about the problem, including relevant previous studies	4
Rationale	#5	Informal or formal frameworks, models, concepts, and / or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work	4
Specific aims	#6	Purpose of the project and of this report	4
Methods			
Context	#7	Contextual elements considered important at the outset of introducing the intervention(s)	4
Intervention(s)	#08a	Description of the intervention(s) in sufficient detail that others could reproduce it	5
Intervention(s)	#08b	Specifics of the team involved in the work	5
Study of the Intervention(s)	#09a	Approach chosen for assessing the impact of the intervention(s)	6
Study of the Intervention(s)	#09b	Approach used to establish whether the observed outcomes were due to the intervention(s)	6
Measures	#10a	Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability	5-6
Measures	#10b	Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost	5-6
Measures	#10c	Methods employed for assessing completeness and accuracy of data	5-6
Analysis	#11a	Qualitative and quantitative methods used to draw inferences from the data	6
Analysis	#11b	Methods for understanding variation within the data, including the effects of time as a variable	6
Ethical considerations	#12	Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential conflict(s) of interest	7

Results			
	#13a	Initial steps of the intervention(s) and their evolution over time (e.g., time-line diagram, flow chart, or table), including modifications made to the intervention during the project	7-8
	#13b	Details of the process measures and outcome	7-8
	#13c	Contextual elements that interacted with the intervention(s)	7-8
	#13d	Observed associations between outcomes, interventions, and relevant contextual elements	7-8
	#13e	Unintended consequences such as unexpected benefits, problems, failures, or costs associated with the intervention(s).	7-8
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Discussion			
Summary	#14a	Key findings, including relevance to the rationale and specific aims	8-10
Summary	#14b	Particular strengths of the project	9
Interpretation	#15a	Nature of the association between the intervention(s) and the outcomes	8-10
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Conclusion	#17e	Suggested next steps	10
Other information			
Funding	#18	Sources of funding that supported this work. Role, if any, of the funding organization in the design, implementation, interpretation, and reporting	10

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Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility – a before and after cohort study

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Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Title page

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility – a before and after cohort study

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Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Abstract

Introduction

Hospital readmission is a burden to patients, relatives, and society. Older patients with frailty are at highest risk of readmission and its negative outcomes.

Objective

We aimed at examining whether follow-up visits by an outgoing multidisciplinary geriatric team (OGT) reduces unplanned hospital readmission in patients discharged to a skilled nursing facility (SNF).

Design

A retrospective single-centre before and after cohort study.

Setting and participants

Study population included all hospitalised patients discharged from a Danish geriatric department to a SNF during 1 January 2016 – 25 February 2020. To address potential changes in discharge and readmission patterns during the study period, patients discharged from the same geriatric department to own home were also assessed.

Intervention

OGT visits at SNF within seven days following discharge. Patients discharged to SNF before 12 March 2018 did not receive OGT (-OGT). Patients discharged to SNF on or after 12 March 2018 received the intervention (+OGT).

Main outcome measures

Unplanned hospital readmission between 4 hours and 30 days following initial discharge.

Results

Totally 847 patients were included (440 -OGT; 407 +OGT). No differences were seen between the two groups regarding age, sex, activities of daily living (ADL), Charlson Comorbidity Index (CCI), or 30-day mortality. The cumulative incidence of readmission was 39.8% (95% CI 35.2-44.8, n=162) in -OGT and 30.2% (95% CI 25.8-35.2, n=113) in +OGT. The unadjusted risk (HR (95% CI)) of readmission was 0.68 (0.54-0.87, p=0.002) in +OGT compared to –OGT, and remained significantly lower (0.72 (0.57-0.93, p=0.011)) adjusting for age, length of stay, sex, ADL, and CCI. For patients discharged to own home the risk of readmission remained unchanged during the study period.

Conclusion

Follow-up visits by OGT to patients discharged to temporary care at a SNF significantly reduced 30-day readmission in older patients.

Trail registration

Danish Data Protection Agency (rec.no. 20/1681).

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Strengths and limitations of this study

- This was a hospital-based before and after cohort study with no patients lost to follow-up
- We accounted for the competing risk of death and adjusted for potential confounders in our analysis (age, sex, activities of daily living, comorbidity, and length of stay)
- We explored general changes in readmission pattern not related to the intervention
- This was a before and after cohort study, which has a risk of overestimating the effect
- This was a single centre study, which may limit the generalisability of study results

Keywords

Readmission, Follow-up visit, Outgoing team, Geriatrics, Older people, Integrated care

Word count

3930 words

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Introduction

Acute hospitalisation can be lifesaving but may also lead to adverse health outcomes in older adults, such as hospital-acquired infections and poorer functional health, as well as anxiety and distress [1-7].

Some acute hospitalisations are preventable, and particularly readmissions are therefore in focus for preventive initiatives. Readmission risk increases with age, especially in patients characterised by multimorbidity, polypharmacy, longer in-hospital stay, lower functional status, male sex, and prior hospitalisation [8-10]. After an acute treatment, such vulnerable patients may be transferred to a post-acute care facility for further stabilisation of medical and functional health, either in a hospital or in a skilled nursing facility (SNF), which offers temporary stays. SNF is an in-patient rehabilitation centre staffed with nurses and allied health professionals, while medical attention is carried out by a primary care physician.

Interventions to prevent readmission among older adults are widely studied. Several models have been investigated; involving various staff groups (i.e. pharmacist, nurse, primary care physician, and geriatrician) and different point of actions (i.e. nutrition, medication, exercise, care) [11-14], but no single or a bundle of interventions appear to reduce hospital readmission reliably [15-17]. For patients discharged to a SNF, only few intervention studies exist [4-6 18-20], mainly from countries with a mixture of public and private health care providers.

Our aim was to examine whether early follow-up visits by an outgoing multidisciplinary (nurse and doctor) geriatric team (OGT) reduce acute hospital readmission in older vulnerable patients discharged to a temporary stay in a SNF.

Methods

Design

We conducted a retrospective single-centre, before and after cohort study, following the implementation of an OGT at a SNF in the municipality of Odense, Denmark.

Settings

In Denmark, all citizens have free access to their primary care physician, hospital treatment, and health care services including home care due to a tax-funded public health care system. Hospital treatment is provided by five regions, who also are responsible for financing primary care physicians and specialist physicians, while 98 municipalities are responsible for providing home care, social care, rehabilitation, and health promotion as well as permanent and temporary care at SNF [21].

Odense University Hospital is a highly specialised hospital serving citizens in the Region of Southern Denmark. It is the main hospital for the citizens of Odense municipality with approximately 200,000 inhabitants, of which 17% are above 65 years of age [22]. The Department of Geriatric Medicine at Odense University Hospital consists of a medical ward with 38 beds. All patients are admitted as

acute patients from the emergency department or transferred from other departments, and are characterised by acute medical illness, high age, multimorbidity, polypharmacy, and functional decline. Occasionally, the department treats patients with planned admissions e.g. preparation for colposcopy. All other planned treatments are conducted as ambulant care in the department's outpatient clinical, only 0.5% were planned admissions during study period. The department has a close collaboration with Odense Municipality, which is responsible for providing home- and nursing care services for patients after hospital discharge [21]. Most patients (87%) are discharged to the same residence they had before admission. Patients admitted to hospital from their own home, who at the time of discharge are in need of substantial care and rehabilitation can be recommended by the hospital to be discharged to a municipal SNF for temporary care and rehabilitation. However, the municipality decides whether the recommendation should be complied with or the patients should be cared for in their own home.

Odense municipality has organized their SNF in one facility hosting 64 temporary beds located seven kilometres from Odense University Hospital. The SNF has a turnover of approximately 1,000 patients a year with an average length of stay of 24 days (unpublished administrative data). The SNF staff includes nurses, social and healthcare assistants, physiotherapists, and occupational therapist, but there is no staff physician. If a patient needs medical attention, the SNF staff contacts the patient's personal primary care physician.

Intervention

The OGT was developed as part of a quality assurance project at Odense University Hospital aiming at reducing unnecessary readmissions among older citizens. The personnel did not follow a prespecified protocol. However, medical staff at the Department of Geriatric Medicine and the personnel at the SNF developed a co-operation agreement specifying the scope of the OGT-visit, mutual responsibilities in the cooperation, and which medical issues to handle during the OGT-visit.

The OGT was initiated 12 March 2018. It consisted of a geriatric nurse and a specialist geriatrician, who in close collaboration with the patient, and the SNF-staff dealt with any health issues related to the recent hospital admission and discharge i.e. effect and adverse effects of initiated treatment, nutritional and rehabilitation issues, and any uncertainties of the discharge summary. The OGT consulted patients at the SNF within seven days following hospital discharge. The OGT had access to the patients' electronic hospital records, including records from physicians, nurses, occupational- and physiotherapists, and an updated list of medications. Moreover, venous blood samples, urine, and stool samples could be collected by the OGT for analyses at the hospital. The SNF-staff was instructed to closely read the hospital discharge summary, to pay a special attention to effect and potential adverse effect of initiated treatment, and to nutritional and to rehabilitation issues. Moreover, it was required that blood pressure, pulse, temperature, and blood oxygen saturation were measured

ahead of OGT visits. The OGT visited the SNF three times a week, totally six hours per week. Patients received at least one OGT visit from the OGT during the follow-up.

Participants

We included all patients discharged from the Department of Geriatric Medicine at Odense University Hospital from 1 January 2016 to 25 February 2020. Eligible patients were identified from Odense University Hospital's patient administrative system and the Odense municipality's electronic care journal. Patients discharged to SNF (SNF patients) before and after initiation of OGT 12 March 2018 were categorized as –OGT and as +OGT, respectively. To explore time trends and potential variations in discharge, readmission patterns, and patient characteristics during the study period, we categorized patients discharged to own home (non-SNF patients) before and after 12 March 2018 as pre-OGT and post-OGT, respectively.

Variables and Data Sources

The primary outcome was 30-days readmission rate. Readmission was defined as any acute/unplanned hospital admission within 4 hours and 30 days after discharge from the Department of Geriatric Medicine [23]. Index-admission was defined as any unplanned admission to the Department of Geriatric Medicine during the study period. Patients with several hospital admissions could have several index admissions but only one readmission per index admission. Thus, each unplanned admission to the geriatric department counted as an index admission.

We used the patient's unique civil registration code to extract data from Odense University Hospitals patient administrative system for each index admission. Data included information of unplanned hospital admissions, date and time of the admission and discharge, location, type, and hospital department. Length of index admissions and readmissions were derived from medical records. Participants' characteristics e.g. age, sex, and information on mortality were obtained from the Civil Registration System. Information of comorbidity and Barthel index (BI) were obtained from Odense University Hospitals patient administrative system or directly from medical records when missing in the register (n=59). BI is a measure of function in activity of daily living (ADL), with a sum score across ten domains of ADL. BI is the official ADL tool used in Danish hospitals and assessed routinely upon hospital admission [24]. The total score ranges from 0 (completely dependent) to 100 (completely independent). In Denmark BI is categorized in four standard ICD-10 diagnostic categories BI=80-100 (independent ADL), BI=50-79 (moderate reduced ADL), BI=25-49 (low ADL), and BI=0-24 (very low ADL). The burden of comorbidity was assessed using Charlson Comorbidity Index (CCI), which was computed based on all primary and secondary discharge diagnoses registered in the hospital's electronic patient journal the past four years. The CCI score was divided into three levels: low (score of 0), moderate (score of 1-2), and high (score of ≥3) [25].

The health-interventions by the OGT were registered in an administrative database without any personally identifiable data. This database provided summary data of the interventions made by the OGT (i.e. adjustments of medication, blood samples, nutritional advice, information of

tests/examinations, and intervention from a specialised acute nursing function). Data of number of OGT-visits per patient were extracted from the patient administrative system.

Statistical Analysis

The study sample size was calculated from expected change in readmission rate 'before and after'. The inclusion of 367 patients in each group would give the study 80% power to detect a 30% reduction in readmission rate assuming a baseline readmission rate of 30% [19], with a level of significance of 5%. This power calculation was used to define the length of the study period in order to ensure an adequate sample size. Patient characteristics were reported using numbers/percentages, means (SD), and medians [IQR]. Differences between groups were calculated using chi^2 tests, Student's *t*-test, or Kruskal-Wallis test, as appropriate. The primary outcome, readmission rate, was calculated as the total number of 30 days readmissions divided by total number of index admissions. A statistical process control chart plot was created plotting monthly readmission rates over the entire study period. A Cox proportional hazard model for readmission within 30 days was used to investigate the effect of the OGT. Patients who died or moved to another municipality within 30 days after discharge were censored from analysis and the model was adjusted for age, length of stay (LOS), sex, CCI, and BI. The incidence of readmission was plotted as a function of time in a Kaplan-Meier plot of cumulative incidence. The analysis did not include patients with a follow-up of less than 12 hours. The proportional-hazard assumption was tested using Schoenfeld residuals. The statistical significance threshold for all tests was set to $P < 0.05$. STATA software version 16 (StataCorp LLC, Texas, USA) was used for statistical analysis.

Ethics

The study was approved by the Danish Data Protection Agency (rec. no. 20/1681) and reported according to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines [26]. Approval by ethical committee and informed consent was not necessary according to Danish legislation on medical ethics due to the register-based study design [27].

Results

Totally, 6,624 patients (54.1% women) were discharged from the Department of Geriatric Medicine during the study period with a mean (SD) age of 83.0 (8.8) years. Of these, 847 patients (women 56.1%) with a mean (SD) age 84.2 (8.3) years were discharged to the SNF (-OGT: n=440 and +OGT: n=407) (Table 1), whereas 5,777 patients (women 53.8%) with a mean (SD) age of 82.9 (8.8) (pre-OGT=3,343 and post-OGT=2,434) were discharged to their own home (non-SNF) (figure1). Proportion of patients with >1 index-admission was 58% (range 1-13).

Characteristics and outcome data for SNF patients (-OGT and +OGT) (n=847)

No difference was found between –OGT (n=440) and +OGT (n=407) regarding age, sex, BI, CCI, and 30-days mortality. Median [IQR] LOS of index-admission was 7.8 [5.0-12.8] days and 6.0 [3.9-10.0] days in -OGT and +OGT, respectively (p≤0.0001) (Table 1). The median number of OGT visits pr. patient was 1 ([IQR 1-2] range 1-10). The proportion of patients visited more than once was 38%. In 32% of the visits the patients had adjustments to their medication, 14% had blood samples taken, 12% were given nutritional advice, 5% were informed of tests-results (i.e. x-ray, endoscopy), and 6% received intervention from a specialised municipal acute nursing function.

The 30-days readmission rate declined from start of intervention from 36.8% (n=162) in –OGT to 27.8% (n=113) in +OGT group (p=0.005) (figure 2). The cumulative incidence of readmission (95% CI) was 39.8% (35.2-44.8) in the –OGT group and 30.2% (25.8-35.2) in +OGT group (figure 3). Unadjusted risk (HR (95% CI)) of readmission was 0.68 (0.54-0.87, p=0.002) in the +OGT group compared to the –OGT group. Risk of readmission remained lower in the +OGT group in the fully adjusted model (0.72 (0.57-0.93), p=0.011). Subgroup analysis defining readmission as an unplanned hospital contact with a duration of 12+ hours, occurring between 4 hours and 30 days after discharge from the Department of Geriatric Medicine did not change the results (data not shown).
Patients had a wide spectrum of primary diagnoses at index admission and readmission with no difference between the two groups in regards of proportions within each ICD-10 groups (Chi^2). The three most common ICD-10 groups were diseases of the respiratory organs (ICD10: J00-J99) (-OGT: 27% and +OGT: 22%, p=0.127); endocrine, nutritional, and metabolic diseases (ICD10: E00-E90) (-OGT: 10% and +OGT: 12%, p=0.271); and certain infectious and parasitic diseases (ICD10: A00-B99) (-OGT: 9% and +OGT: 9%, p=0.996). The three most common ICD-10 groups at readmission were diseases of the respiratory organs (ICD10: J00-J99) (-OGT: 29% and +OGT: 17%, p=0.069); injury, poisoning, and certain other consequences of external causes (ICD10: S00-T98) (-OGT: 11%

and +OGT: 12%, p=0.834); and diseases of the circulatory system (ICD10: I00-I99) (-OGT: 10% and +OGT: 11%, p=0.692).

Characteristics and outcome data for non-SNF patients (pre-OGT and post-OGT) (n=5,777)

No difference in age, sex, CCI, and 30-days mortality was found between the pre-OGT (n=3,343) and post-OGT (n=2,434) groups, while the distribution of BI in the four subcategories differed significantly between groups (p=0.012). BI 80-100: pre-OGT = 13.8% and post-OGT = 12.5%; BI 50-79: pre-OGT = 27.6% and post-OGT = 27.0%; BI 25-49: pre-OGT = 21.4% and post-OGT = 24.7%; BI 0-24: pre-OGT = 32.4% and post-OGT = 5.6%. Median [IQR] LOS of index-admission was 5.1 [3.1-7.9] days and 4.8 [2.9-6.9] days in pre-OGT and post-OGT groups, respectively (p<0.0001) (table 1).

Among the pre-OGT and post-OGT groups the 30 days readmission rate was 26.5% (n=887) and 27.8% (n=676) (p=0.295), respectively. The cumulative incidence of readmission (95% CI) was 29.1% (27.5-30.7) in pre-OGT and 28.8% (27.0-30.7) in post-OGT (figure 4). No difference was found in the risk of readmission between the pre-OGT and post-OGT group, neither for unadjusted nor adjusted risk (HR (95%CI)) of 1.00 (0.90-1.10, p=0.922) and 1.01 (0.91-1.11, p=0.920), respectively.

Discussion

This study shows that follow-up visits by an outgoing multidisciplinary geriatric team reduces hospital readmissions among patients discharged from a geriatric department to a skilled nursing facility. The results remained significant even after adjusting for sex, age, in hospital length of stay, comorbidity, and functional status. Further, the effect of the intervention was immediate and persistent throughout the study period.

To our knowledge, only few other studies have assessed interventions to prevent readmission among patients discharged to SNF [4-6 19]. A retrospective study from Cleveland (US) demonstrated a significant reduction in readmission rates from 28% to 22% (p< 0.001) after implementation of a connected care model [6]. The applied model was very extensive with patients receiving visits from an outgoing team including doctors and nurses 4-5 times a week after discharge from hospital to SNF and telephone coverage at nights, weekends, and monthly meetings with multidisciplinary teams. This extensive model may be difficult to apply in other settings. Another US-study explored whether readmission could be reduced by implementing video conference to improve transition between hospital and a SNF [5]. Videoconference reduced the 30-day readmission rate from 24% to 15% (OR 0.57 95% CI 0.34-0.96, p=0.04). However, the prospective cohort study compared pre- and post-intervention rates in two different SNF's, and the effect was mainly due to an increase of readmission in the control-cohort rather than a reduction of readmissions in the intervention-group [5]. Interpretation and application of these studies' results to a different health care system, as the Danish, should be done with care, as large organizational variations exist across countries. A Danish randomized controlled trial studied the effect of comprehensive geriatric care offered to patients 65 years and older, referred from any hospital department to a rehabilitation unit [19]. The study did not show any reduction in 90 days hospital readmission rates in the intervention group compared to usual care.

However, the study did not explore 30-days readmission rates specifically and the negative result may be due to a spill over effect, i.e. the intervention may have affected the control group, and a non-real-life setting since the intervention was performed by a single geriatrician only [19].

Among the SNF-patients in our study, the pre-intervention 30-days readmission rate was 36%, which is high compared to an overall readmission rate of 18% among older hospitalised patients in Denmark [28]. However, it is well known that patients discharged to SNF or other post-acute care facilities have a higher risk of readmission. A study of patients discharged to post-acute care facility demonstrated a readmission rate of 22% and most readmissions (80%) occurred within 30 days of discharge [28]. Other studies on patients discharged to temporary care have shown 30-days readmission rates between 24-28% [4-6]. This variation in readmission rates between studies may be explained by differences in patient characteristics, since other studies have included all residents at a SNF including residents referred to the SNF from home or a surgical department. Our study solely included the most vulnerable patients discharged from a geriatric department, characterised by high age, low functional status, and multi-morbidity and therefore at highest risk of readmission [8-10]. Moreover, there may be differences in the definition of readmission [29]. Our definition included any unplanned hospital contact within 30 days of discharge, thereby including brief contacts to the emergency department.

In-hospital LOS declined significantly during the study period. However, this decline was not reflected by a change in disease-burden since CCI or primary diagnoses of hospital admission remained unchanged. The trend towards shorter hospital stay over time seen in our study is also reported on a national and European basis [30]. In our study, LOS did not affect the readmission rate. The decrease in LOS was higher among patients discharged to SNF compared to patients not discharged to SNF. This indicates that the intervention may have affected LOS. The decision of when to discharge is based on the geriatrician's clinical judgement, but may have been affected by a knowledge of an OGT follow-up shortly after discharge, enabling patients to earlier discharge. However, the municipality decides, based on availability whether care and rehabilitation is provided at the SNF or at home. The geriatricians are seldom aware of this decision when discharge is planned. We therefore consider it less likely, that the intervention has affected LOS. However, other non-identified factors may have had an impact on the ability of SNF-patients to be discharged sooner. This must be addressed in future studies.

We found no difference in the proportion of men and women, which is surprising, since other studies of similar geriatric cohorts have shown a higher proportion of women compared to men [31]. However, our sex-ratio corresponds to the sex-ratio shown in the Danish national database of geriatrics 2019 [32].

Strengths and limitations of this study

Our study has limitations. Firstly, this was a before and after study, which has a risk of overestimating the effect [33] due to residual confounding. The participants in the intervention group (+OGT) may have been exposed to other non-identified factors compared to the control group. However, readmission rates among non-SNF patients remained unchanged in the pre-OGT and post-OGT groups highlighting that no general change in the pattern of admissions occurred during the study period.

Secondly, this was a single centre study, which limits the generalizability of study results. In addition, as no consensus-definition of SNF exists, other studies may represent differently organized SNF's, dissimilar patient populations, and other discharge procedures from geriatric departments worldwide, also limiting the generalizability. Thirdly, the study only included data on hospital readmissions at Odense University Hospital, which may underestimate the risk of readmissions. However, only patients, who would have travelled or moved to other municipalities outside Odense, would be at risk of readmission to other hospitals than Odense University Hospital. In our dataset, we were able to track all patients, and none had residence outside the municipality of Odense within 30 days after discharge.

The study also has several strengths. We used data from registers with no patients lost to follow-up. In addition, we performed power- and sample size calculation when planning the study to ensure appropriate length of study period. The adjusted analysis involved patient characteristics including measures of activities of daily living (Barthel-Index), comorbidity (Charlson Comorbidity Index), and LOS, which are important risk factors for readmission [8-10]. Furthermore, our results are strengthened by accounting for the competing risk of death in our analysis, censoring those who died with-in 30 days of discharge. Finally, the study was carried out in a real-life setting and therefore implementable in similar settings.

Several elements of our OGT-intervention may have been crucial in the prevention of readmissions. The OGT facilitated a close co-operation between hospital, patient, and SNF, which potentially prevented miscommunication and loss of information in the transition from secondary to primary care sector. Furthermore, early detection and correction of ambiguities and inadequate hospital care plans may have led to improved and shared goals of care for the benefit of the patient. A shared responsibility of the patient in the early days after discharge may have ensured confidence among patients, relatives, and caregivers and prevented unnecessary contacts to doctors on call or emergency doctors. Lastly, reassessment of the patient's medical condition may have led to early detection and treatment of recurrence of disease, thereby preventing readmission.

Despite the potential benefit of outgoing hospital teams, the intervention is costly and hospital resources are redistributed outside the hospital. In our set-up, limiting the post-discharge follow-up visit to patients discharged to SNF reduced the time-expenditure since all patients were discharged to the same SNF and therefore the intervention may have been economical rentable. Cost-effective analysis of the intervention remains to be assessed before dissemination of this model. Our study does not give insight to sub-elements of the intervention, but further studies with an explorative or qualitative design should address this. Such insight may be valuable in the development of less costly interventions, such as telemedicine. Telemedicine and videoconference are likely to be less costly and perhaps as effective tools for post-discharge follow-up, which calls for further exploration.

Conclusion

Does geriatric follow-up visits reduce hospital readmission among older patients discharged to temporary care at a skilled nursing facility - a before and after cohort study

Follow-up visits by an outgoing multidisciplinary geriatric team significantly reduced 30-days readmission rates by 28% in older vulnerable patients recently discharged from hospital to a skilled nursing facility.

Author Contributions

KT is the guarantor of the study. KT and AF directed and contributed equally to all aspects of this manuscript. KAR, JR, and LM contributed to study design, data interpretation, and writing. All authors have commented, read, and approved the final manuscript.

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Conflicts of Interest statement

The authors declare that no conflicts of interest are associated with this publication.

Patient and public involvement:

Neither patients nor the public were involved in the design, conduct, reporting, or dissemination of the study.

Patient consent for publication:

Not required

Provenance and peer review

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Data availability

Data are available upon reasonable request

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Legends

Figure 1: Timeline of patients discharged from the Department of Geriatric Medicine according to discharge destination and initiation of outgoing geriatric team. Abbreviations: OGT: outgoing geriatric team, pre-OGT; before implementation of OGT, post-OGT; after implementation of OGT, SNF; skilled nursing facility

Figure 2: A statistical process control chart of monthly readmission rates during the study period among patients discharged to skilled nursing facility and outgoing geriatric team compared to patients discharged to skilled nursing facility only. Abbreviations: OGT: outgoing geriatric team; SNF: Skilled Nursing Facility; CI: Confidence Interval

Figure 3: Kaplan-Meier curves of cumulative incidence of 30-days readmissions for any unplanned readmission for patients discharged to skilled nursing facility and outgoing geriatric team compared to patients discharged to skilled nursing facility only. Abbreviations: OGT: outgoing geriatric team

Figure 4: Kaplan-Meier curves of cumulative incidence of 30-days readmissions for any unplanned readmission for patients discharged to own home. Before and after implementation of outgoing geriatric team (pre-OGT and post-OGT). Abbreviations: OGT: outgoing geriatric team

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Table 1: Characteristics of patients discharged from Department of Geriatric Medicine to a skilled nursing facility without follow-up (-OGT) or with follow-up (+OGT) by an outgoing geriatric team and patients not discharged to a skilled nursing facility from Department of Geriatric Medicine before (pre-OGT) and after (post-OGT) implementation of outgoing geriatric team

	-OGT (n=440)	**+OGT (n=407)**	**p**		**pre-OGT (n=3,343)**	**post-OGT (n=2,434)**	**p**
Age, y, mean (SD)	84.2 (8.0)	84.2 (8.5)	0.980		82.7 (8.8)	83.1 (8.9)	0.144
Female, n (%)	240 (54.6)	235 (57.9)	0.329		1,805 (54.0)	1,307 (53.7)	0.817
Barthel Index, n (%) 80-100 50-79 25-49 0-24 missing	 12 (2.8) 80 (18.7) 121 (28.3) 215 (50.2) 12 (2.7)	 9 (2.2) 71 (17.4) 117 (28.8) 191 (46.9) 19 (4.7)	0.600		 462 (13.8) 924 (27.6) 716 (21.4) 1,083 (32.4) 158 (4.7)	 303 (12.5) 655 (27.0) 600 (24.7) 738 (30.3) 129 (5.6)	0.012
CCI, median [IQR]	2 [1-3]	2 [1-3]	0.182		2 [1-4]	2 [1-3]	0.146
CCI, n (%) 0 1-2 ≥3	 93 (21.1) 165 (37.5) 182 (41.4)	 99 (24.3) 157 (38.6) 151 (37.1)	0.370		 682 (20.4) 1,233 (36.9) 1,428 (42.7)	 521 (21.4) 911 (37.4) 1,002 (41.2)	0.450
LOS, days (index admission) median [IQR]	7.8 [5.0-12.8]	6.0 [3.9-10.0]	0.0001		5.1 [3.1-7.9]	4.8 [2.9-6.9]	0.0001
Died within 30 days after discharge, n (%)	75 (17.1)	68 (16.7)	0.896		360 (10.8)	233 (9.6)	0.139

Abbreviations: SD standard deviation, CCI: Charlson Comorbidity Index, LOS: length of stay (in hospital), IQR: inter quartile range, OGT: outgoing geriatric team

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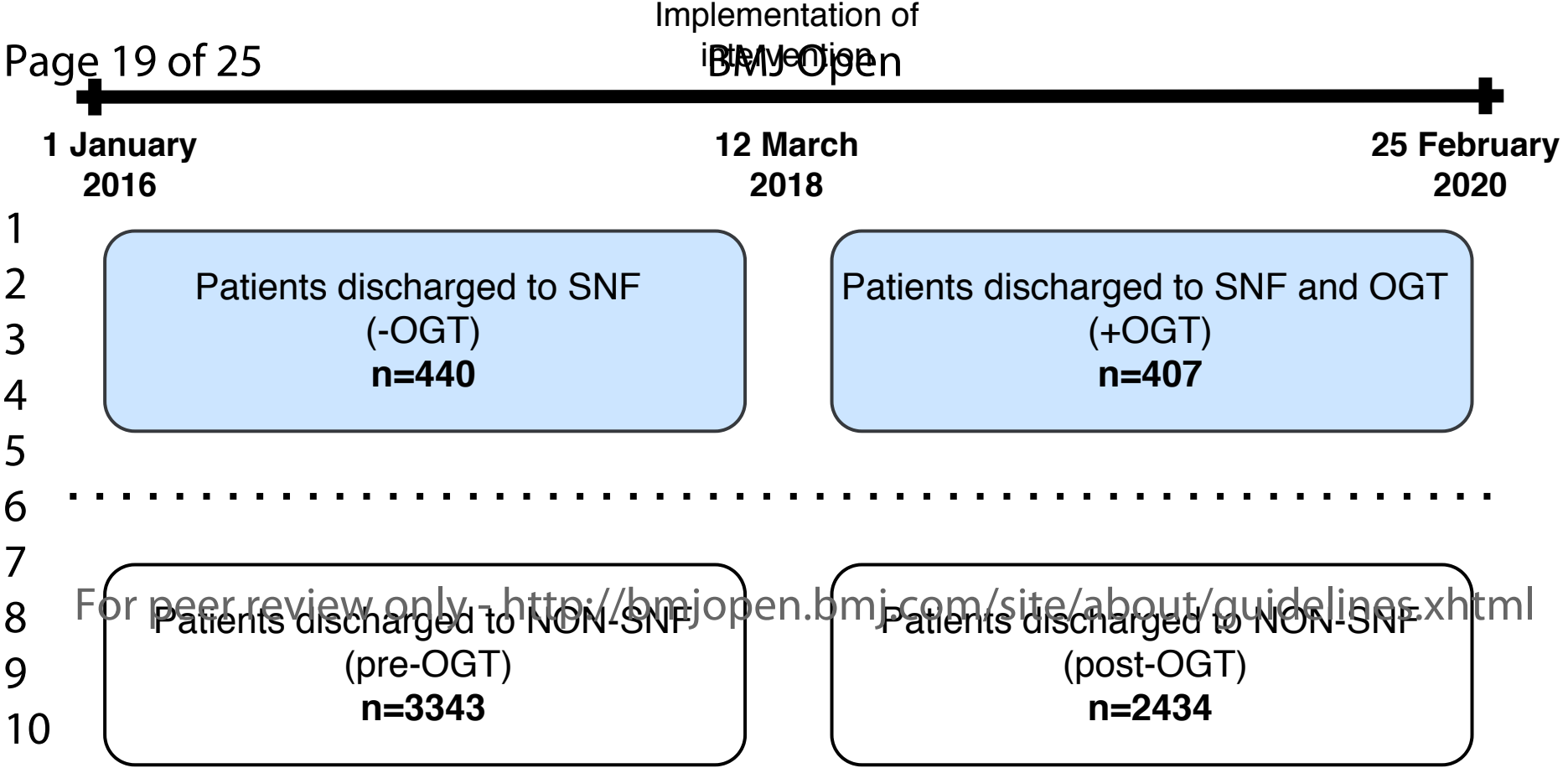
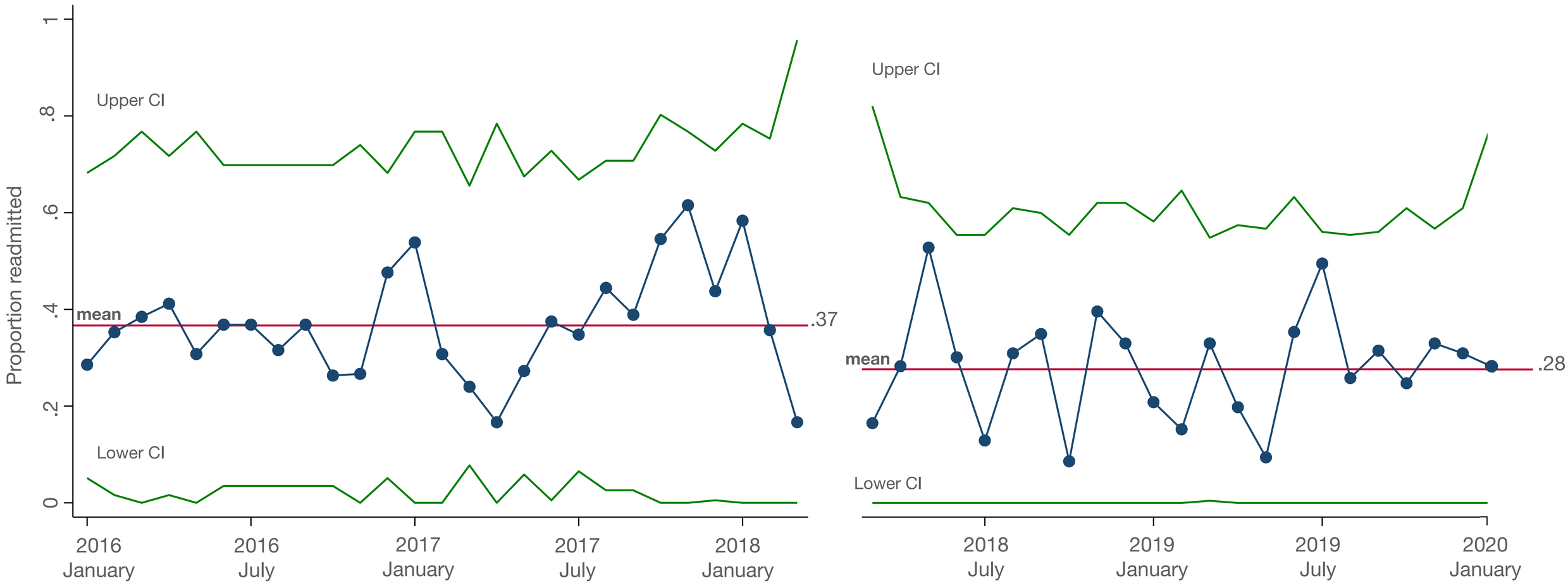
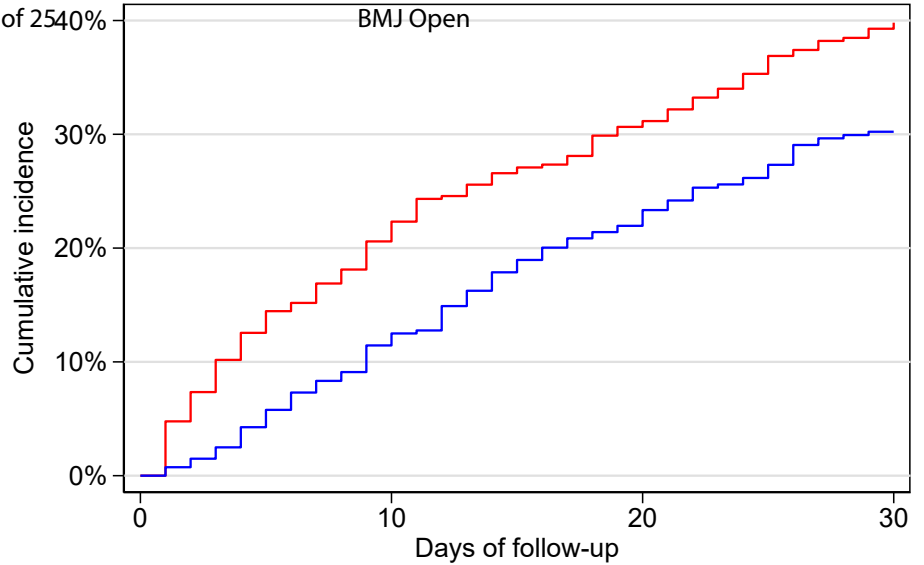
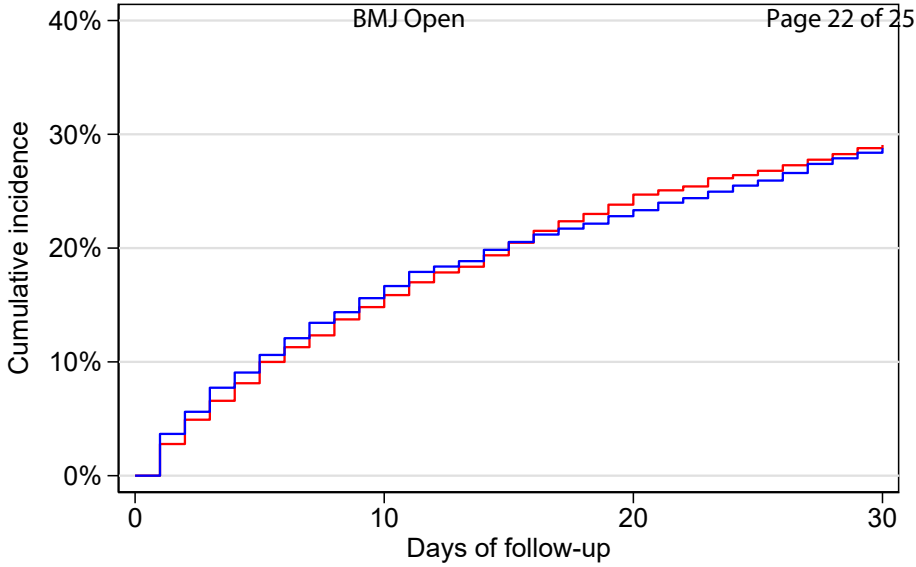



Patients discharged to SNF (-OGT)
Proportion readmitted
0
.2
.4
.6
.8
1
Upper CI
mean
.37
Lower CI
2016 January
2016 July
2017 January
2017 July
2018 January
Patients discharged to SNF and OGT (+OGT)
Upper CI
mean
.28
Lower CI
2018 July
2019 January
2019 July
2020 January





Reporting checklist for quality improvement in health care.

Based on the SQUIRE guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the SQUIREreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title			
	#1	Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patientcenteredness, timeliness, cost, efficiency, and equity of healthcare)	1
Abstract			
	#02a	Provide adequate information to aid in searching and indexing	3
	#02b	Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions	2
Introduction			
Problem	#3	Nature and significance of the local problem	4

description			
Available knowledge	#4	Summary of what is currently known about the problem, including relevant previous studies	4
Rationale	#5	Informal or formal frameworks, models, concepts, and / or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work	4
Specific aims	#6	Purpose of the project and of this report	4
Methods			
Context	#7	Contextual elements considered important at the outset of introducing the intervention(s)	4
Intervention(s)	#08a	Description of the intervention(s) in sufficient detail that others could reproduce it	5
Intervention(s)	#08b	Specifics of the team involved in the work	5
Study of the Intervention(s)	#09a	Approach chosen for assessing the impact of the intervention(s)	6
Study of the Intervention(s)	#09b	Approach used to establish whether the observed outcomes were due to the intervention(s)	6
Measures	#10a	Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability	5-6
Measures	#10b	Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost	5-6
Measures	#10c	Methods employed for assessing completeness and accuracy of data	5-6
Analysis	#11a	Qualitative and quantitative methods used to draw inferences from the data	6
Analysis	#11b	Methods for understanding variation within the data, including the effects of time as a variable	6
Ethical considerations	#12	Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential conflict(s) of interest	7

Results			
	#13a	Initial steps of the intervention(s) and their evolution over time (e.g., time-line diagram, flow chart, or table), including modifications made to the intervention during the project	7-8
	#13b	Details of the process measures and outcome	7-8
	#13c	Contextual elements that interacted with the intervention(s)	7-8
	#13d	Observed associations between outcomes, interventions, and relevant contextual elements	7-8
	#13e	Unintended consequences such as unexpected benefits, problems, failures, or costs associated with the intervention(s).	7-8
	#13f	Details about missing data	7-8
Discussion			
Summary	#14a	Key findings, including relevance to the rationale and specific aims	8-10
Summary	#14b	Particular strengths of the project	9
Interpretation	#15a	Nature of the association between the intervention(s) and the outcomes	8-10
Interpretation	#15b	Comparison of results with findings from other publications	8-10
Interpretation	#15c	Impact of the project on people and systems	10
Interpretation	#15d	Reasons for any differences between observed and anticipated outcomes, including the influence of context	9
Interpretation	#15e	Costs and strategic trade-offs, including opportunity costs	10
Limitations	#16a	Limits to the generalizability of the work	9-10
Limitations	#16b	Factors that might have limited internal validity such as confounding, bias, or imprecision in the design, methods, measurement, or analysis	9-10
Limitations	#16c	Efforts made to minimize and adjust for limitations	9-10
Conclusion	#17a	Usefulness of the work	10
Conclusion	#17b	Sustainability	10
Conclusion	#17c	Potential for spread to other contexts	10

Conclusion	#17d	Implications for practice and for further study in the field	10
Conclusion	#17e	Suggested next steps	10
Other information			
Funding	#18	Sources of funding that supported this work. Role, if any, of the funding organization in the design, implementation, interpretation, and reporting	10