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Original Study

A Nurse-Led Bridging Program to Reduce 30-Day Readmissions of Older Patients Discharged From Acute Care Units

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A B S T R A C T

Objectives: Older hospitalized patients are at high risk of early readmissions, requiring the implementation of enhanced coordinated transition programs on discharge. The objective of this study was to evaluate the impact of a nurse-led transition bridging program on the rate of unscheduled readmissions of older patients within 30 days from discharge from geriatric acute care units.
Design: A stepped-wedge cluster randomized trial.
Setting and Participants: Seven hundred five patients aged ≥75 years hospitalized in one of 10 acute geriatric units, with at least 2 readmission risk-screening criteria (derived from the Triage Risk Screening Tool), were included from July 2015 to August 2016.
Methods: The intervention condition consisted in a nurse-led hospital-to-home bridging program with 4 weeks postdischarge follow-up (2 home visits and 2 telephone calls). Unscheduled hospital readmission or emergency department (ED) visits were compared in intervention and control condition within 30 days from discharge.
Results: The rate of 30-day readmission or ED visit was 15.5% in the intervention condition vs 17.6% in the control condition [hazard ratio stratified on clusters: 0.61 (upper limit unilateral 95% confidence interval = 1.11), $P = .09$]. Rate of presence of professional caregivers was increased in the intervention condition ($P < .001$).
Conclusions and Implications: Although the intervention resulted in an increase in the rate of implementation of a package of care at the 4-week of follow-up, we could not demonstrate a reduction in the rate of 30-day readmissions or ED visits of older patients at risk of readmission. These findings support the evaluation of this type of program on the longer term.

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Growing numbers of patients admitted in acute care are aged 75 years or older, of whom many are at high risk of unplanned repeated hospitalizations.[1] Constraints in bed capacity and resources lead to a trend toward rapid discharges to support efficient patient flow, but this does not always serve the needs of frail older people with competing comorbidities and disabilities, who may take longer to recover from illness.[2] In these patients, sudden disruptions in continuity of care in the posthospital period contribute to high rates of unnecessary readmissions potentially amenable to targeted prevention.[3,4]

Unscheduled readmissions can affect around 20% of patients in the adult population.[5–7] Given demographic projections, reducing hospital readmissions of older adults has become a priority for hospitals and national health plans. Repeated admissions have multiple causes (eg, issues with discharge planning, coordination, social support, self-managing of symptoms, medication safety, or financial issues).[8–10] This makes improving hospital-to-home transition a complex task, requiring interventions starting during hospitalization and continuing after discharge.[11,12] The numerous transition programs that have been developed on this basis[13–21] were shown to be effective in reducing unscheduled readmissions in the adult population.[11,12,22,23] Such discharge interventions appear particularly adapted to meet the needs of frail older people,[2] but the level of evidence is less consistent in this age group[24–26] and older adults at highest risk of readmission are often excluded from transitional care interventions.[27]

Dedicated "transition coaches"[11,13] may assist patients during this critical period by bridging hospital-to-home transition, improving handover and coordination of care, and reducing the rate of unplanned readmissions.[28–31]

The objective of this study was to evaluate the impact of a nurse-run bridging program on the rate of unplanned readmissions or emergency department (ED) visits of patients aged ≥75 years within 30 days from discharge of a geriatric acute care ward.

Methods

Type of Study

We conducted a multicenter stepped-wedge cluster-randomized trial. Ten geriatric care units constituted the clusters. The study included 7 periods of 2 months each. All units started simultaneously to recruit patients as a control condition, and 1 to 3 clusters joined the intervention at each step. No implementation phase was planned. The detailed protocol has been published previously.[32]

Setting

The study took place in 10 geriatric acute care units, of which 3 were university hospitals and 7 were general hospitals.

Participants

All patients aged 75 years or older hospitalized in a participating acute care geriatric unit for at least 48 hours and returning home after hospitalization (ie, without transfer to step-down community hospital or rehabilitation unit) were screened prospectively from July 2015 to August 2016. Patients were included if they were deemed at risk of hospital readmission after returning home based on the presence of at least 2 of the following criteria derived from the Triage Risk Screening Tool[33] and French guidelines[34]:

- Dependencies in daily living as assessed by the basic and instrumental scales for activities of daily living (ADL and IADL);
- Previous admissions: 1 unscheduled hospital admission during the 3 previous months, or 2 or more unscheduled hospital admissions during the previous year;
- Presence of a "geriatric syndrome": 2 or more falls during the previous year, undernutrition, diagnosed major cognitive disorder, or depression;
- One or more chronic diseases with high risk of acute decompensation or hospital readmission (eg, chronic heart failure, chronic respiratory failure);
- Polypharmacy (defined as daily intake of 5 or more drugs);
- Unfavorable social situation (social isolation, unreliable helper).

Patients living in a retirement home (nursing or residential home) or benefiting from a hospital-at-home scheme and patients living further than 30 km (18 miles) from the inclusion cluster were excluded. Finally, patients could not be included in the study more than once in the event of readmission.

Investigators were advised to offer participation to each consecutive patient eligible for inclusion.

Intervention Condition

The intervention was supported by a trained transition nurse (TN) at a patient level. The aim was to bridge the patients' pathways at 3 steps: (1) during hospitalization (support with discharge planning, communication with community services, and anticipation of needs after discharge); (2) on the day of discharge (making sure all elements of the care plan are made operational with regard to prescriptions or package of care (POC; ie, the combination of professional helpers and services put together to meet the person's assessed needs), providing a handover sheet with summary of hospitalization and care plan and providing a contact phone number in case of need); (3) and follow-up after discharge. This follow-up was of 1 month comprising 2 home visits (at 48-72 hours after discharge and during third week) and a minimum of 2 telephone calls during second and fourth week from discharge (see Occelli et al[32] for further detail on the intervention). The TNs were external to the care team. All had work experience in a geriatric hospital department (short stay, rehabilitation, or out-of-hospital liaison service).

Control Condition

Patients were managed and discharged according to the usual care plan of each participating hospital. Communication of information to the primary care providers was left to the discretion of the medical teams, with no additional follow-up after discharge.

Primary Outcome

The primary outcome was a composite of at least 1 unscheduled hospital readmission or ED visit within 30 days from discharge. It was collected by a research assistant in both groups through systematic telephone calls to the patient and/or caregiver as well as systematic screening of the information system of the hospital in which the index admission took place.

Secondary Outcomes

The 2 elements of the main composite outcome were considered separately. Thirty-day mortality was recorded. Length of stay during index admission and delay for sending the discharge letter to general practitioners (GPs) were retrieved from medical records. After discharge, other secondary outcomes included an evaluation of the POC made available to patients in each group (access to different types of caregivers and professionals at home, namely, nurses,

physiotherapists, health care assistants, housekeepers, and home care services; meals on wheels; and tele-survey systems) as well as the delay for initiation of the first actions of the POC after discharge. Patients' quality of life was assessed using the French version of EuroQoL-5D questionnaire,[35] and patients' satisfaction with transition at 30 days after discharge was assessed with the Care Transition Measure−15 (CTM-15) questionnaire,[36] at 30 days after discharge. Time from decision about discharge until discharge and number of contacts between TN and primary care and other providers could not be collected as initially planned.[32]

Sample Size

The sample size was determined using the method developed by Hussey and Hughes.[37] The expected percentage of events (unscheduled hospital readmission or emergency visit) in the control condition was 20%. For a 1-tailed test, a type I error of 5%, a coefficient of variation between clusters of 10%, and an expected percentage of events of 10% in the intervention condition, the power was 70% for the inclusion of 84 patients per period. This represented a total of 588 patients. Taking into account around 7% of missing data on the outcome, the number of patients to be included was 630.

Randomization

For feasibility reasons, the randomization had to be rationalized to anticipate the recruitment of TNs given the wide area covered by the project and the recruitment capacity of each units: 3 separate geographical areas were decided pragmatically by grouping 3 or 4 close-by units. A computerized randomization generating random numbers was used to place each geographical area on the timeline of the study and randomize groups of units within each geographical area.

Units were informed of the intervention date 2 months prior.

Data Collection and Blinding

In all patients, patient characteristics were retrieved by a research assistant from the inclusion document (filled in by study investigators) and medical files. TNs had no role in data collection for neither patient characteristics nor outcome measures. The study was open-labeled for patients, health professionals, and clinical research assistants, whereas statisticians were blinded for randomization and data analysis.

Statistical Methods

Patient characteristics are described using the absolute and relative frequencies for categorical variables and the mean and standard deviation (SD) for continuous ones. They were compared between the 2 conditions using the chi-square test and the Student t test for categorical and continuous characteristics, respectively.

We estimated the probability for the patients to present the main outcome at 30 days after hospital discharge in both conditions using the Kaplan-Meier method, which allowed taking into account patients with a follow-up lower than 30 days. The probabilities of the main outcome were compared between the 2 conditions using the log-rank test.

We used a Cox model stratified on the clusters to quantify the effect of the intervention on the main outcome. The intervention effect was quantified by the estimate of a hazard ratio (HR) with its unilateral 95% confidence interval (CI). The analysis was adjusted on the time period and successively on age, the presence of a geriatric syndrome, CIRS-G score, social deprivation, the number of severe comorbidities, polymedication, and cognitive impairment in 3 categories (mild, moderate, severe), as the distribution of these criteria were unbalanced at baseline. The adjusted analyses were carried out on complete data. A 1-tailed P value $< .05$ was retained to conclude on statistical significance as no negative impact of the intervention was anticipated.

We carried out the same type of analysis for each component of the main outcome.

For analysis of secondary outcomes, we used the Mann-Whitney test to compare delays and scores between the 2 conditions, the chi-square test for categorical outcomes, and the log-rank for comparing survival curves.

All the analyses were carried out using the statistical software SAS, version 9.4.

Ethics

Approval for the study was obtained from the hospital ethics committee, the Institutional Review Board, and the French Data Protection Authority (ID RCB 2014-A00898 39: 10 September 2014). As stipulated by French law, patients were informed of the study and nonrefusal was notified in the medical file.

Results

Study Population

In total, 705 patients were included over 7 time periods of 2 months. Figure 1 shows the study flowchart. The recruitment diagram per time scale for the intention-to-treat population is pictured in Table 1. Baseline characteristics of patients are presented at the individual level in Table 2 and at the cluster level in Supplementary Table 1.

Implementation

The intervention was implemented as planned on its main components (see Supplementary Table 2). In terms of postdischarge follow-up, 78% (262 of 336) participants in the intervention condition received 2 home visits and 2 telephone calls, and 326 participants (97%) received at least 2 follow-up contacts (home visit and/or telephone call).

Main Outcome

Sixty-five patients (17.6%) had at least 1 unscheduled hospital readmission or emergency visit in the control condition vs 52 patients (15.5%) in the intervention condition. At the cluster level, the number of events in each cluster is available in Supplementary Table 3. For the 117 patients who had at least 1 event of the main outcome, the median time of event occurrence was 14 days, ranging from 7 to 21 days.

The probability of unscheduled hospital readmission or emergency visit at 30 days of follow-up was estimated at 17.7% (95% CI: 13.8%-21.6%) in the control condition and 16.2% (95% CI: 12.1%-20.3%) in the intervention condition (log-rank test P value $= .75$) (Figure 2). When considering the 2 elements of the composite main outcome separately, the probability of unscheduled readmission at 30 days was estimated at 15.3% (95% CI: 11.6%-18.9%) in the control condition and 14.1% (95% CI: 10.3%-18.0%) in the intervention condition ($P = .81$). The probability of emergency visit at 30 days was estimated at 12.5% (95% CI: 9.1%-15.9%) in the control condition and 10.3% (95% CI: 7.0%-13.6%) in the intervention condition ($P = .48$).

After adjustment for time period, the HR quantifying the effect of the intervention on the main outcome was estimated at 0.61 (upper limit of the unilateral 95% CI $= 1.11$; $P = .09$) (Supplementary Table 4).

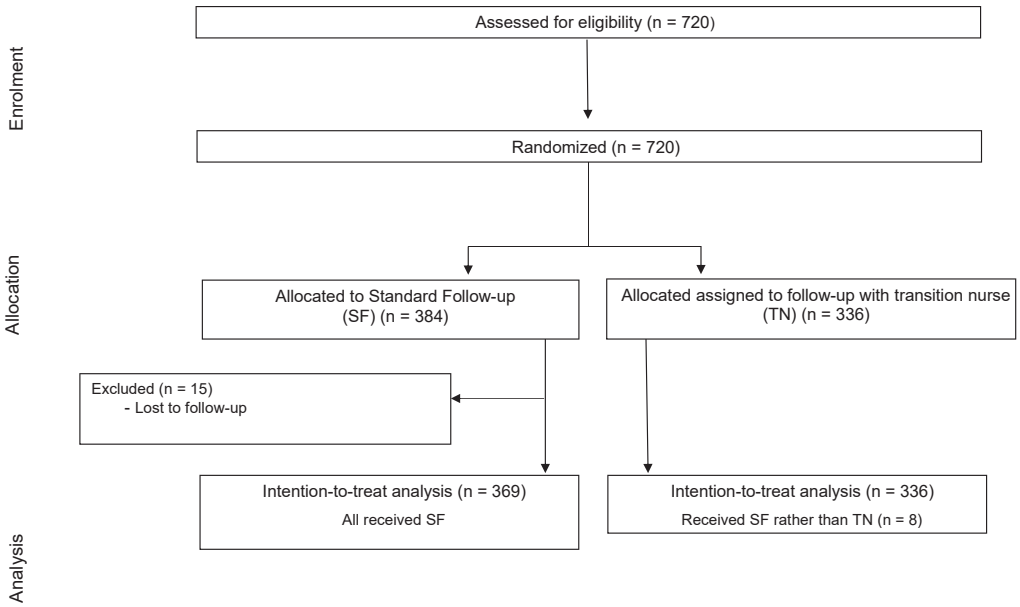

Fig. 1. Study diagram.

Table 1
Inclusions per Cluster and Time Period (Intention-to-Treat Population)

Geographic Area	Sequence	Cluster (Center)	Time Period							Total
			1	2	3	4	5	6	7	
			July 2015	Sept 2015	Nov 2015	Jan 2016	Mar 2016	May 2016	July 2016	
TN 1	1	A*	18	**22**	**18**	**18**	**16**	**17**	**5**	114
	2	B	7	6	**7**	**8**	**7**	**11**	**7**	53
		C	4	4	**6**	**11**	**9**	**4**	**5**	43
TN 2	3	D	12	6	9	**15**	**14**	**12**	**15**	83
	4	E	16	8	8	5	**15**	**16**	**15**	83
TN 3	5	F*	12	20	18	19	15	**13**	**2**	99
		G*	30	34	16	13	6	**12**	**4**	115
		H†	-	-	-	6	9	**5**	**12**	32
	6	I	5	2	3	12	10	2	**8**	42
		J	9	6	6	5	7	1	**7**	41
Total			113	108	91	112	108	93	80	705

Each time period was of 2 months. Periods in intervention are presented in bold.
*University teaching hospitals.
†Centre H joined the study at period 4 (+TN 4).

Cox models adjusted for age, CIRS-G score, presence of a geriatric syndrome, number of severe comorbidities, polymedication, or social deprivation showed similar results. When adjusting for cognitive impairment, the estimate of the effect of the intervention increased and became statistically significant (HR = 0.45; upper limit of the unilateral 95% CI = 0.88; *P* value = .03). Finally, in the multivariate Cox model adjusted on the time period and all the characteristics that appeared to be unbalanced between the 2 groups, the effect of the intervention was not statistically significant (HR = 0.58; *P* value = .12) (Supplementary Table 4).

The results of the model highlighted a heterogeneity of the main outcome rate according to the time period (*P* = .02), but there was no linear trend toward increased rates of readmission over time (*P* = .15). The rate of unscheduled hospital readmission or emergency visits during the seventh period was 2.6 times greater than the rate during the first time-period (*P* = .05) (Supplementary Table 5).

Secondary Outcomes

Seven deaths (1.9%) were recorded within 30 days from discharge during the study in the control condition and 4 (1.2%) in the intervention condition. Survival curves were not significantly different (log-rank test *P* value = .52).

The mean length of stay of index admission was of 10.6 days (SD = 6.2) in the control condition and was significantly increased by about 1 day (11.8 days; SD = 6.5) in the intervention condition (*P* = .01).

Concerning the effective implementation of a POC, there was a significant increase in the rate of presence of community health care professionals in the intervention condition at the end of follow-up (Table 3). The intervention did not reduce the delay for setting up the first aid or caregiver, which was of 13.2 days in the control condition (SD = 9.0) vs 13.5 days (SD = 6.6) in the intervention condition (*P* = .29).

The mean delay for sending a discharge letter to GPs was significantly longer in the intervention condition (mean 13.5 days, SD = 7.9) compared with control (mean 11.1 days, SD = 6.6; *P* < .001).

We observed no significant difference between conditions in terms of quality of life measured by EuroQol-5D [mean score in the control condition = 0.29 (95% CI: 0.20-0.38); mean in intervention = 0.36 (95% CI: 0.31-0.41); *P* = .19], nor patient satisfaction [mean CTM-15

Table 2
Patient Characteristics at Baseline (N = 705)

	Control (SF) (n = 369)	Intervention (TN) (n = 336)	*P* Value*
Demographics			
Age, y, mean (SD)	87.0 (5.5)	86.8 (5.4)	.69
% female	63.7	63.4	.94
Social environment			
% living alone (n = 702)	50.9	49.2	.65
% with no professional helper or POC (n = 698)	29.4	25.4	.24
% with social deprivation†	11.9	21.4	<**.001**
% with nonelective hospitalization in last 3 mo	28.5	29.8	.70
Medications			
Medications on admission			
% with ≥5 medications	79.7	66.7	<**.001**
Number of medications, mean (SD)	7.47 (3.26)	6.49 (3.17)	<**.001**
% with at least 1 psychotropic drug (n = 704)	59.1	59.7	.87
Medications on discharge			
Number of medications, mean (SD)	7.49 (3.21)	7.28 (2.88)	.37
% with at least 1 psychotropic drug (n = 704)	61.5	65.4	.29
Comorbidities			
% with at least 1 condition with high risk of readmission†	51.8	56.5	.20
No. of comorbidities, mean (SD) (n = 658)	6.64 (2.45)	6.94 (3.37)	.20
No. of severe comorbidities§, mean (SD)	1.35 (1.12)	1.14 (1.19)	**.022**
CIRS-G score, mean (SD) (n = 658)	12.8 (5.0)	12.1 (6.0)	.11
% with presence of a geriatric syndrome†	60.2	71.7	.001
Functional assessment			
ADL score (of 6), mean (SD)	4.2 (1.8)	4.3 (1.7)	.75
IADL score (of 4), mean (SD)	1.8 (1.5)	1.8 (1.4)	.95
GIR score (of 6), mean (SD) (n = 455)	3.8 (1.3)	3.9 (1.3)	.57
Nutritional assessment			
BMI, mean (SD) (n = 612)	24.91 (5.42)	25.19 (5.39)	.52
Albumin level, g/L,‖ mean (SD) (n = 610)	35.4 (5.0)	35.3 (4.6)	.77
% with swallowing problems (n = 698)	11.2	7.6	.10
Falls risk			
% using walking aid device (n = 689)	64	58.8	.17
Walking speed, m/s, mean (SD) (n = 98)	0.46 (0.32)	0.49 (0.39)	.73
Falls risk‡ (n = 527), %			
Low	23.8	28.1	.55
Moderate	47.1	44.5	
High	29.0	27.4	
% stop walking when talking (n = 403)	55.6	39.0	.94
% able to stand on one foot >5 s (n = 442)	12.4	18.7	.08
% able to rise from floor (n = 643)	57.6	50.5	.07
Mental health			
% with delirium on admission (n = 704)	27.9	24.8	.35
Cognitive impairment‡ (n= 541), %			
No	47.2	36.4	**.029**
Moderate	40.7	45.9	
Severe	12.1	17.7	
MMSE score, mean (SD) (n= 413)	20.7 (6.4)	20.6 (5.7)	.90
% with confirmed depression** (n= 451)	11.8	12.5	.82
Mini-GDS score (n = 419), %			
0	67.0	55.1	.15
1	12.5	18.1	
2	9.7	14.4	
3	6.8	7.0	
4	4.0	5.3	

ADL, Activities of Daily Living (Katz); CIRS-G, Cumulative Illness Rating Scale–Geriatric; mini-GDS, short version of Geriatric Depression Scale; GIR, "Groupe iso-Ressource" French overall assessment of physical and mental autonomy ranging from 1 (complete dependency) to 6 (independent); IADL, instrumental activities of daily living (Lawton); MMSE, Mini-Mental State Evaluation; POC, package of care.
N = 705 unless otherwise specified.

*P values correspond to the results of Student *t* test for continuous variables and chi-square test for categorical variables and distribution. Significant values are presented in bold.

†According to inclusion criteria.

‡Subjective assessment from clinician on inclusion.

§Three- and 4-weighted comorbidities on CIRS-G scale.

‖Adjusted to C-reactive protein level.

**According to *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-V*), criteria.

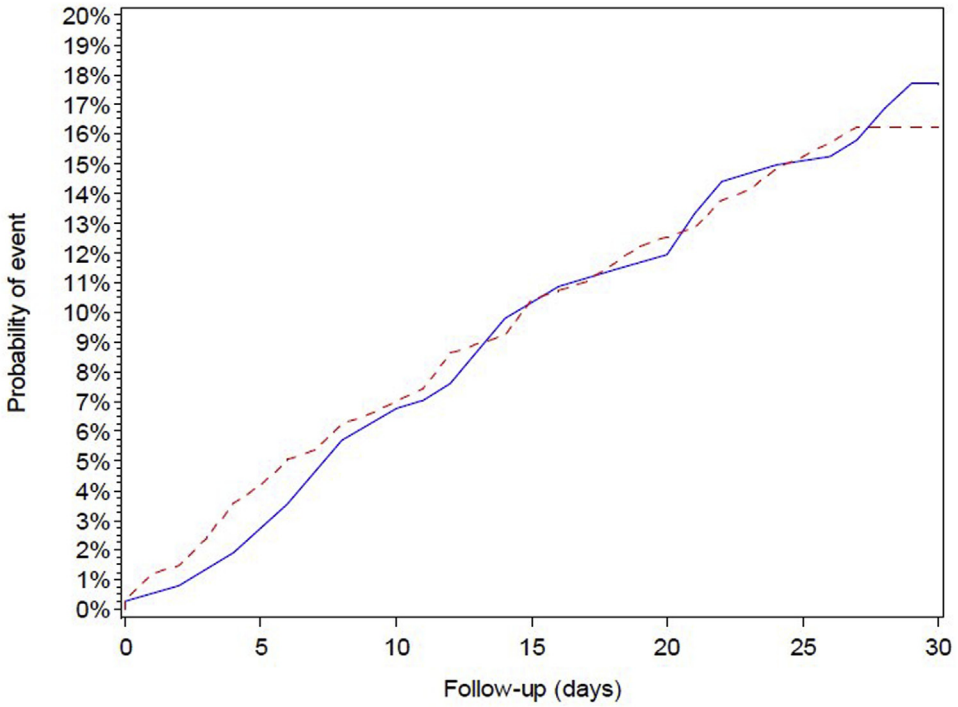

Fig. 2. Probability of readmission or ED visit within 30 days after discharge in both groups (blue line: control group, red dashed line: intervention group).

score in control condition = 42.55 (95% CI: 37.3-47.8); mean in intervention = 39.79 (95% CI: 34.2-45.4); $P = .48$]. The return rate of the questionnaires was low (respectively 37% in intervention and 24% in control condition).

Discussion

In this study aimed at bridging hospital-to-home transition of older patients through the intervention of a transition nurse, we were unable to show a statistically significant reduction in the rate of unscheduled readmissions or ED visits. Nevertheless, the intervention resulted in an increased rate of presence of health care professionals at 4 weeks of follow-up. Length of stay of index hospitalization and delay for sending a discharge letter to GPs were significantly longer in the intervention condition. We observed no differences in mortality rates, quality of life and satisfaction measures between study phases.

In the adult population in general, recent meta-analyses and reviews found a reduction of the rate of hospital readmissions associated with discharge interventions.[12,22,23] Patients with at least 2 home visits and 2 telephone calls postdischarge had the lowest likelihood of readmission.[23] The overall relative risk reduction for hospital readmissions was about 20% within 30 days and within 3 months of discharge.[12,22] This indicates that it should be possible to show a benefit of transition programs for patients, perhaps by combining them with other actions.

Previous studies conducted in older people showed low or no impact of transition programs on hospital readmissions.[22,24–26,38] A recent retrospective cohort study conducted in the United States among Medicare beneficiaries suggests that care transition care programs may be effective in reducing mortality and health costs within 30 to 60 days from discharge.[39] In this study, authors noted that the rate of patients benefiting from such program remained relatively low (around 5% in 2015), highlighting implementation complexities outside the context of clinical trials.[39]

Recent reviews conclude that most effective interventions were oriented toward patient empowerment and support patient capacity for self-care,[12,22] a better integration of caregivers into the discharge process,[40,41] and a more formalized medication review process.[41,42] In the context of frail older patients, a comprehensive medication review and a more active role of caregivers are needed (eg, with a discharge letter intelligible to the patient and caregiver, useful contacts and instructions on what to do in case of warning signs of decompensation, and education programs on self-management).[43] Nurse-led transition programs should support and combine with such interventions.

Table 3
Presence of Community Health Care Professionals at End of Follow-Up in the Control and Intervention Conditions

Presence at end of follow-up	Control, n (%) (n = 369)	Intervention, n (%) (n = 336)	*P* Value
Health care assistant	10 (2.7)	20 (6.0)	.03
Housekeeper	48 (13.0)	109 (32.4)	<.001
Home care services	32 (8.7)	78 (23.2)	<.001
Physiotherapist	35 (9.5)	105 (31.3)	<.001
Nurse	60 (16.3)	196 (58.3)	<.001
Meals on wheels	23 (6.2)	64 (19.1)	<.001
Tele-survey system	13 (3.5)	58 (17.3)	<.001

In our study, we observed a higher rate of community professionals at 30 days from discharge in the intervention group, showing that the TN was effective for facilitating the implementation of the POC. However, we were surprised to find that the mean delay for implementing the first professional support exceeded 12 days. There were also important delays for communication of discharge summaries to GPs in both conditions. This corroborates the hypothesis that setting up a POC in older people may be impaired by issues in care coordination. Further studies seeking to understand the factors that impact care coordination after discharge are needed.[8]

Our study has several strengths. First, this study was based on an elaborate stepped-wedge design, which allowed the intervention to be tested in 10 different hospital care settings, in different population basins, and with 4 different TNs, therefore taking into account possible heterogeneity in the delivery of the intervention. In the review by Leppin et al, the vast majority of the studies (19/24 studies) were conducted in a single academic hospital and 15/24 studies had a single individual meaningfully involved in the delivery of the intervention.[22] Second, our intervention was designed in order to be applicable in different settings in a context of current practice. Medical teams were left responsible for discharge planning and decided on elements such as medication review.[44] TNs were also given flexibility within the framework of the intervention to plan patients' follow-up according to the patients' and/or caregiver's availability, adapt the time required to each patient. Finally, the inclusion period covered 14 months, which made it possible to take into account seasonal variations in the readmission rate.

Our study has some limitations. First, our study may have been underpowered. Indeed, the readmission rate in the control condition (17.6%) was lower than the expected 20%. In other studies, mostly conducted in USA, the rates were similar, ranging from 11% to 19%.[2,45–48] Furthermore, we had set ourselves an ambitious relative risk reduction target of 50%, and the observed reduction (around 40%) in relative readmission risk was lower than expected. Second, we observed that more socially deprived patients were included in the intervention condition. To limit the risk of selection bias, investigators were advised to include all consecutive eligible patients, irrespective of the control or intervention condition. However, in the case of an open-cluster trial, investigators might have included some patients in a targeted way rather than consecutively during intervention, based on the knowledge that a TN would assist with discharge. Although the analyses were adjusted on patients' characteristics, this may also explain the longer hospitalization stay observed in the intervention condition. Third, patient characteristics with an element of subjectivity such as geriatric syndromes or cognitive impairment may be prone to error of measurement. Therefore, the results of the secondary analyses with adjustment on the unbalanced characteristics at baseline need to be interpreted with caution, in particular the significant effect of the intervention after adjustment on cognitive impairment that was missing for 164 patients (23%). Fourth, an assessment of preventability of readmissions would have been required to better evaluate the effectiveness of the intervention. A previous meta-analysis suggests that almost 1 in 4 readmissions within 30 days can be avoidable.[49] Readmission at 30 days and over may be linked more to coordination issues between primary care providers and hospitals than quality of hospital care.[50] It would seem warranted to assess the impact of the intervention on a longer term (eg, 90 days), especially given the observed delay of implementation of POCs, close to 12 days in both groups. Finally, the low response rate on the Quality of Life and transition satisfaction questionnaires prevented us from drawing conclusions on potentially relevant judgment criteria from the patients' point of view.

Conclusions and Implications

We could not confirm nor exclude that nurse-led bridging programs are effective in preventing 30-day unplanned readmissions in older patients and in reducing the time required to set up a POC. This type of program could be improved by better integrating patients and their caregivers into the management plan, and by including a more formalized medication review process. Given the difficulty of evaluating this type of complex program, future studies should also include mixed methods to evaluate the implementation of the intervention.

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Appendix

Supplementary Table 1
Baseline Characteristics at Cluster Level: Intention-to-Treat Analysis

	Control	Intervention
Number of individuals in cluster, median (min-max)	30.5 (8-99)	26 (7-96)
Median age in cluster, median (min-max)	85.23 (82.75-88.27)	86.58 (84.86-88.5)
% women in cluster, median (min-max)	66.07 (44.44-76.47)	64.48 (33.33-76.47)
Number of women in cluster, median (min-max)	19.5 (4-58)	18.5 (4-59)
% living in flat (vs house), median (min-max)	54.73 (26.67-75)	53.57 (29.63-86.67)
% living alone, median (min-max)	52.23 (12.5-55.88)	46.88 (25-62.5)
GIR at inclusion in cluster, median (min-max)	3.77 (3-4.44)	3.82 (3.14-5.33)
CIRS-G at inclusion in cluster, median (min-max)	12.45 (6.73-18.38)	12.4 (7.62-21.47)
Number of individuals in cluster, mean (SD)	36.9 (30.6)	33.6 (27.7)
Mean age in cluster, mean (SD)	85.37 (1.7)	86.56 (1.28)
%women in cluster	63.03 (9.98)	61.39 (12.6)
Number of women in cluster, mean (SD)	23.5 (19)	21.3 (17.6)
% living in flat (vs house), mean (SD)	53.67 (16.4)	57.09 (16.7)
% living alone, mean (SD)	46.26 (13.6)	46.35 (12.1)
GIR at inclusion in cluster, mean (SD)	3.82 (0.47)	4.03 (0.63)
CIRS-G at inclusion in cluster, mean (SD)	12.27 (3.39)	13.27 (5.1)

CIRS-G, Geriatric Cumulative Illness Rating Scale.
GIR ("Groupe iso-resource") corresponds to a French classification of the level of dependency of patients, ranging from 1 (completely dependent for activities of daily living) to 6 (completely independent).

Supplementary Table 2
Implementation of the Intervention

Time	Control Condition	Intervention *as Planned* (32)	Intervention *as Delivered*	
During Hospitalization				
During the patient's stay in hospital				
	The medical team delivered a medical and geriatric assessment of the patients according to existing recommendations. Apart from prescriptions and discharge summary, there was no transitional care file, except for 1 center (no. 5).	Data about the patient, his caregiver, his primary care physician, and current primary care providers was to be collected (adaptable to the patient's context). TNs were to check that the admission geriatric assessment has been carried out. A transitional care file was created to assist the TNs (adaptable by the TN).	The transitional care file contained information about hospitalization: - hospital stay - context of life - primary care providers before hospitalization - autonomy at discharge - medical history - geriatric assessment at discharge - discharge plan TN customized the file.	A transitional care file was always (n = 3 TNs) or often (n = 1 TNs) done, as declared by TN.* Tools were always (n = 3) or often (n = 1) available to complete the transitional care file, as declared by TN.*
	The discharge was planned by the medical team through contact with the families. The support of a social worker was proposed.	TNs should take part in discharging planning in collaboration with the medical team.	No dedicated meeting. Direct communication with speakers according to availability of the TN. The TN regularly visited the department or following a call from the medical team.	A discharge plan was enough detailed: often (n = 2) or not often (n = 2), as declared by TN.* Integration within hospital teams was often easy (n = 3) or not often easy (n = 1), as declared by TN.*
When the day of hospital discharge is set				
	Patient and family informed by the physician or chief nurse of the expected day of discharge. No communication of information to the primary care providers. Transport was planned by chief nurse.	TNs should check that the date of returning home is known by the patient, his caregiver, and the primary care physician. TNs should check the organization of transport if needed.	TNs met the patient during hospitalization. TNs met the families or contacted them by phone.	Patient visit was always (n = 3) or often (n = 1) achievable, as declared by TN.*
	Recommendations were to send the discharge letter to GPs within the following days after discharge.	TNs should check that the discharge summary and plan have been transmitted to the primary care physician.	The TN recalled the doctors from the services in case of absence of discharge summary.	No influence on the mean delay for sending a discharge letter to GPs (intervention: mean 13.5 days, SD = 7.9 compared to control: mean 11.1 days, SD = 6.6; $P < .001$).
	Specialized follow-up consultations planned by the medical team if necessary.	TNs should check that a primary care physician visit is planned during the month following discharge.	The TNs called GPs prior to discharge.	Contact with GPs was often easy (n = 4), as declared by TN.*
	No handover sheet or other tools for transition.	TNs were to prepare the handover sheet, which includes the meetings scheduled, the contacts scheduled with the TN, the telephone number of the TN, and the contact information of the primary care providers. A handover sheet was intended for patient and primary care providers	No handover sheet was used. TN had calling cards.	
The day of hospital discharge				
	Delivery of prescriptions, not always done on the day of discharge. Explanations to patients/caregivers about prescriptions and care plan were left to the discretion of the medical teams.	TNs should check that the prescriptions for the discharge care plan have been written. TNs were to explain the discharge plan to the patient and/or his caregiver.	If done, not always done the day of discharge	Verification of the prescriptions in accordance with the discharge plan was always (n = 2), often (n = 1), or not often (n = 1) achievable, as declared by TN.* Explain the prescriptions to patients/caregivers always (n = 1), often (n = 1), or not often (n = 2) achievable, as declared by TN.*
	Provision of a discharge summary to the patient at the discretion of the team and delay of provision variable.	The completed handover sheet should be given to the patient or caregiver. TNs should check that the inpatient nursing care plan, along with the medical discharge summary, is in the handover sheet; check that the visits scheduled are planned in accordance with the patient or caregiver's availability.	No handover sheet	

(*continued on next page*)

Supplementary Table 2 (*continued*)

Time	Control Condition	Intervention *as Planned* (32)	Intervention *as Delivered*	
		TNs should check that the social worker has been associated to the discharge plan and informed.	TN ensured that workers were contacted either directly or through the families.	Care plan was often (n = 2) or not often (n = 2) detailed enough, as declared by TN.*
Follow-up by home visit and telephone				
	None	TNs were commissioned to verify the effective implementation of human and material aids. TNs should ask about difficulties and seek to resolve problems, help to prevent the risk of falls by having a look at the environment at home, ensure good medication compliance, verify the autonomy and clinical status of the patient, and contact stakeholders if necessary, retrieve the results of biological monitoring and of medical visits. The transitional care file is intended for the TN: home part (adaptable by the TN)	Transitional care file contained information about home follow-up: - effective implementation of human and material aid - difficulties concerning the autonomy and clinical status of the patients - risk of falls TN customized the file.	Verification of the effective implementation of human and material aid was always (n = 1) or often (n = 3) achievable, as declared by TN.* Verification of medication compliance was often (n = 4) achievable, as declared by TN.* 262 patients received 2 visits and 2 phone calls.
		Answer questions from the patient and his caregiver.	TN gave a call number to patients/caregivers/ primary care providers (phone permanence).	There was never, often (n = 1), or not often (n = 3) calls by patients during phone permanence, as declared by TN.* There was never (n = 1), often (n = 1), or not often (n = 2) calls by primary caregivers during phone permanence, as declared by TN.*
		Provide regular reports to the primary care providers (by completing the handover sheet) and to the geriatrician.	No handover sheet; TN gave regular updates on patients to the medical team	

GP, general practitioner; TN, transition nurse.

*Feedback questionnaire administered to each TN at the end of the study.

Supplementary Table 3
Number of Events (Table A) and Event-Free Survival Probability (Table B) in Each Cluster

A

Cluster	Total	Event	Censored	Percent Censored
1	114	17	97	85.09
2	99	16	83	83.84
3	115	20	95	82.61
4	43	6	37	86.05
5	53	8	45	84.91
6	41	8	33	80.49
7	42	5	37	88.10
8	83	19	64	77.11
9	83	12	71	85.54
10	32	6	26	81.25
	705	117	588	83.40

B

Cluster	Survival (Control), %	Survival (Intervention), %	Maximal Follow-up Time (Control)	Maximal Follow-up Time (Intervention)
1	83.75	84.91	27	27
2	83.74	84.90	29	29
3	82.13	83.40	29	29
4	85.38	86.44	21	21
5	83.60	84.77	27	27
6	80.41	81.78	22	22
7	88.12	89.00	14	14
8	74.72	76.44	28	28
9	84.79	85.89	23	23
10	80.83	82.18	16	16

Supplementary Table 4
Estimates of the Hazard Ratio Quantifying the Effect of the Intervention on the Rate of the Main Outcome (Unscheduled Hospital Readmission or Emergency Visit) and on the Rate of Each of Its 2 Components: Results of the Cox Models Stratified on the Clusters

Models	HR Intervention vs Control (Unilateral 95% CI)	*P* Value
Main outcome		
Nonadjusted	0.92 (—, 1.34)	.36
Adjusted on period	0.61 (—, 1.11)	.09
Adjusted on period and age	0.64 (—, 1.16)	.11
Adjusted on period and GS	0.60 (—, 1.09)	.08
Adjusted on period and CIRS-G	0.78 (—, 1.49)	.26
Unscheduled hospital readmission		
Nonadjusted	1.05 (—, 1.56)	.57
Adjusted on period	0.63 (—, 1.21)	.12
Emergency visits		
Nonadjusted	0.88 (—, 1.37)	.31
Adjusted on period	0.70 (—, 1.46)	.21

CI, confidence interval; CIRS-G, Cumulative Illness Rating Scale–Geriatric comorbidity score; HR, hazard ratio. GS: geriatric syndrome.
Period corresponding to the 7 time periods of 2 months of the study.

Supplementary Table 5
Estimate of the Hazard Ratios Quantifying the Effect of the Intervention and Periods (Reference Period: Period 1) on the Main Outcome (Unscheduled Hospital Readmission or Emergency Visit): Results of the Cox Model Stratified on Clusters

	Hazard Ratio (95% Confidence Interval)	*P* Value
Intervention vs control	0.61 (—, 1.11)	.09
Period 1	1	
Period 2	0.75 (0.38, 1.51)	.42
Period 3	0.96 (0.47, 1.95)	.91
Period 4	0.96 (0.46, 1.99)	.91
Period 5	1.78 (0.87, 3.62)	.11
Period 6	0.82 (0.29, 2.56)	.69
Period 7	2.61 (1.01, 6.65)	.05