

Supplementary Material

Predicting hospital trajectories in older adults with the Hospital Frailty Risk Score: a nationwide study of complex readmission sequences

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Table S1: Characteristics of initial stays according to the secondary outcome of in-hospital death within 6 months

	In-hospital death within 6 months	Absence of in-hospital death for at least 6 months	P value
n	366,465	2,334,759	<.001
Age – mean (SD)	86.0 (6.1)	83.3 (6.0)	<.001
Gender: men	183,524 (50.1)	1,016,205 (43.5)	<.001
Admission from home (vs inter-hospital transfers)	336,902 (91.9)	2,233,603 (95.7)	<.001
Surgical stay	34,577 (9.4)	601,589 (25.8)	<.001
HFRS – median (Q1 - Q3)	9.2 (3.8–16.6)	2.8 (0–9.5)	<.001
Change in HFRS ^a – median (Q1 - Q3)	5.7 (1.0–12.0)	1.3 (0–6.1)	<.001
Number of stays in previous year - median (Q1 - Q3)	1 (0–2)	0 (0–1)	<.001
Local Potential Accessibility to primary care (LPA)	3.67 (1.2)	3.71 (1.2)	<.001
Socioeconomic deprivation index – mean (SD)	–0.10 (1.1)	–0.18 (1.2)	<.001
Season			<.001
Summer	73,929 (20.2)	475,157 (20.4)	
Autumn	52,220 (14.3)	334,323 (14.3)	
Winter	111,637 (30.5)	656,165 (28.1)	
Spring	128,679 (35.1)	869,114 (37.2)	

Data are reported as N (%) unless otherwise indicated. ^a Change in HFRS: change in the HFRS from two years before index stay to one year before index stay. HFRS: Hospital Frailty Risk Score.

Table S2: Multivariable analysis by logistic regression modelling the probability of in-hospital death within 6 months

	Odds Ratio (95% Confidence Interval)	P value
Age (continuous variable)	1.051 (1.050 to 1.052)	<.001
Gender: men (Ref.: women)	1.506 (1.495 to 1.518)	<.001
HFRS (continuous variable)	1.030 (1.029 to 1.030)	<.001
Change in HFRS from two years before index stay to one year before index stay (continuous variable)	1.014 (1.014 to 1.015)	<.001
Number of stays in previous year (continuous variable)	1.031 (1.029 to 1.033)	<.001
Local Potential Accessibility to primary care (LPA, continuous variable)	0.993 (0.989 to 0.997)	<.001
Socioeconomic deprivation index (continuous variable)	1.025 (1.021 to 1.030)	<.001
Season		<.001
Summer	1 (Ref.)	
Autumn	1.049 (1.035 to 1.062)	
Winter	1.131 (1.119 to 1.143)	
Spring	1.054 (1.042 to 1.065)	

Adjusted for: individual hospital, age, gender, year of the stay, season, mode of entry (from home or inter-hospital transfer), activity domain of the stay, surgical character of the stay, the HFRS (calculated from all diagnoses present in the last 2 years for each patient), change in the HFRS from year –2 to year –1, the number of stays in the previous year, the socioeconomic deprivation score of the residence of the patient FDEP, an indicator of access to primary care for the place of residence of the patient (LPA). To allow for varying effects of surgery according to the type of condition, an interaction effect between surgical stay and activity domain was included in the model. Odds ratios for terms included in the interaction are not presented in this table as their interpretation differs from the interpretation of single terms. HFRS: Hospital Frailty Risk Score.

Technical Appendix

List of medical activity domains used for risk adjustment

The medical domain of the stay was used for risk-adjustment in addition to the Hospital Frailty Risk Score. All medical activity domains were included unless mentioned otherwise (D13, D25, D27, D90, and the subset of D11 pertaining to the surgical treatment of cataract were excluded and D14 is out of scope). The complete list of activity domains is translated here. The original list is edited by the French Technical Agency for Information on Hospitalization.

D01	Digestive system
D02	Orthopedics, trauma
D03	Multiple trauma or complex/severe trauma
D04	Diseases of bone and joints
D05	Nervous system (except invasive vascular diagnosis and treatment; see D06)
D06	Diagnostic and therapeutic vascular catheterization
D07	Cardio-vascular system (except diagnostic or therapeutic catheterization; see D06)
D09	Pulmonology
D10	Ear Nose Throat (ENT), stomatology
D11	Ophthalmology (cataract treatment were excluded in current study)
D12	Gynecology and diseases of the breast
D13	Obstetrics (excluded in current study)
D14	Newborns and diseases of the perinatal period (out of scope for current study)
D15	Nephrology, urology, genital system
D16	Hematology
D17	Chemotherapy and radiotherapy, except iterative treatments
D18	Infectious diseases (including Human Immunodeficiency Virus HIV)
D19	Endocrine system
D20	Skin and subcutaneous tissue
D21	Burns
D22	Psychiatry
D23	Toxicology, Intoxications, Alcohol
D24	Chronic pain, palliative care
D25	Organ transplantation (excluded in current study)
D26	Inter-specialty activity, disease follow-up
D27	Iterative treatments (excluded in current study)
D90	Misclassified stay (excluded in current study)

Calculation of the predicted probability of outcome

We will consider the example of a patient with a probability of the composite outcome of 26.0%, corresponding to the average probability observed in our data. We can then calculate the probability of a similar patient who was hospitalized one extra time in the previous year.

The logit function is defined as $f(p) = \log\left(\frac{p}{1-p}\right)$ where log refers the natural logarithm of base e . Therefore:

- The logit of 0.26 (26.0%) is approximately -1.046 .
- The coefficient for each additional stay was 0.187 on the log odds scale ($\log 1.206 = 0.187$; Odds Ratios are exponentiated coefficients, so this is simply going back to the initial scale).

We will estimate the predicted value on the probability scale by adding an additional stay in the previous year to the patient characteristics while keeping all other characteristics constant. We can do this by adding the value of the number of previous stays coefficient to the baseline probability on the log odds scale, then finding the corresponding probability using the inverse logit function (which has the equation: $\text{InvLogit}(x) = \frac{e^x}{1+e^x}$)

$$\text{InvLogit}(-1.046 + 0.187) = 29.8\%$$

Therefore, according to our model, if all other stays, patient, and hospital-level characteristics are held constant, the same patient would have a corresponding predicted probability of the composite outcome of 29.8% with an additional previous hospitalization during the year, corresponding to an absolute change of 3.8 percentage points.