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Original Study

Factors Associated With Discharge Destination in Older Patients: Finnish Community Hospital Cohort Study

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A B S T R A C T

Objectives: Primary care physician-led community hospitals provide basic hospital care for older people in Finland. Yet little is known of the outcomes of the care. We investigated factors associated with discharge destination after hospitalization in a community hospital and the role of active rehabilitation during the stay.
Design: Prospective observational study.
Setting and Participants: Short-term community hospital stays of older adults (≥65 years) living in the Kuopio University Hospital district in central and eastern Finland.
Methods: Data on short-term (1-31 days) hospital stays from 51 community hospitals were collected with an electronic survey between January and June 2016. Physicians, secretaries, and rehabilitation staff from each community hospital completed the data collection form. Discharge destination was defined as home, residential care or death, and active rehabilitation as frequency of rehabilitation at least once a day. Analyses were conducted using the Bayesian approach and the BayesiaLab 9.1 tool.
Results: Data of 11,628 community hospital stays were analyzed. The patients' mean age was 81.6 years (SD 7.9), and 57.5% were women. A younger age (65-74 years), a high number of rehabilitation staff (>2 per 10 patients), and receiving rehabilitation at least once a day were associated with discharging patients to their own homes. Daily rehabilitation was associated with returning to home in all patient groups.
Conclusions and Implications: Older patients admitted to a community hospital for any reason may benefit from active rehabilitation. The role of community hospitals in the acute care and rehabilitation of older patients is important in aging societies.

The current population of Finland is 5.55 million. There are 5 university hospital districts, 22 specialized care hospital districts, and about 200 general practitioner–run local community hospitals. Local hospitals are part of the primary health care system and use shared premises with health centers. In 2016, half of inpatient days in Finnish somatic hospitals were provided by community hospitals.[1] The Finnish hospital system is publicly financed.[2]

Community hospitals are designated to care for older people who usually have multiple illnesses and needs. Acute diseases are the main reason for care, but there are also other tasks such as treatment of chronic conditions, treatment after hospitalization in specialized health care, rehabilitation, and end-of-life care.[2,3] Local hospitals serve as consultation units for home care and play an important role in supporting older people living at home.

Regardless of the reason for admission, hospitalization represents a risk for functional decline in older people.[4–6] Early rehabilitation for hospitalized older people may improve functioning without additional costs.[7,8] In Finland, there are national guidelines and recommendations for the management of specific health conditions such as stroke or hip fracture, but rehabilitation recommendations for several other conditions of older people are incomplete or missing.[9]

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Community hospitals seek to provide basic hospital care for older people and enhance their functional recovery and return to their own homes. However, as far as we know, there is little research on factors associated with discharge destination or outcome of rehabilitation in local community hospitals or comparable primary care physician–led wards.[10,11]

The aim of this study was to analyze which factors were associated with discharge destinations after short-term (up to 1 month) inpatient care in local community hospitals. In addition, we estimated the specific impact of rehabilitation on the discharge of the patients. The study was conducted in real-life settings in central and eastern Finland and using the Bayesian approach.

Methods

Setting

This study was conducted in the catchment area of Kuopio University Hospital (KUH) in central and eastern Finland. The population of the KUH area was 813,000 and represented 15% of the total population of Finland. There were 55 community hospitals in the KUH area in 2016, and all of them were invited to participate. The principal investigator contacted the chief physicians of the community hospitals, and written information about the study was sent to the community hospitals. A total of 51 community hospitals run by 65 municipalities participated in the study. The data collection was carried out between January and June 2016, the collection time was 2-4 months (mean 3.2 SD 1.0) per hospital unit. The study was approved by the Ethics Committee of the Hospital District of the Northern Savo (approval number 340/2015).

Patient Selection

Community hospital stays of patients aged $\geq$65 years were included in the study. Patient selection was restricted to short-term care. Patients with community hospital stays lasting 1-31 days were included.

Data Collection

We developed a structured and standardized electronic survey for the data collection. Most of the items in the survey were similar to the records routinely collected for the Finnish Care Register (HILMO).[12,13] Furthermore, the primary reason for hospital stay, content of the care, and whether a patient received rehabilitation were inquired. Physicians responsible for treatment, ward secretaries, and rehabilitation professionals were responsible for data collection. Most respondents were visited, and all received written instructions for how to complete the survey. The survey was completed at the end of each patient's hospital stay and included no personal identifiers.

The survey consisted of 25 questions on the following items: demographics (age, sex, home municipality), community hospital identifier, where the patient came from to the community hospital (secondary or tertiary hospital, residential care, home with or without home care), the primary reason for the hospital stay (acute diseases, chronic diseases, assessment of symptoms, diagnostic investigations), underlying diagnoses, content or goal of the care (management of multimorbidity, continuing care, care of medical complication, starting a new treatment, diabetes management, treatment of pain, wound care, psychiatric care, substance abuse treatment, treatment of poisoning, terminal care, scheduled interval care) and discharge. Home care refers to the status of being a long-term recipient of services at home as defined by legislation. Finnish home care services include support and assistance in activities of daily living, home nursing, physician and hospital-at-home services, rehabilitation, and end-of-life care.[14]

Outcome and Intervention Variables

Discharge destination was used as an outcome variable and it was defined as follows: discharged home, discharged to a residential care, or died during the hospital stay. Residential care included public and private nursing and care homes providing accommodation and round-the-clock care services for older adults.

Rehabilitation served as an intervention variable in Bayesian analyses. We asked whether patients received rehabilitation according to a specific plan during their community hospital stay and how frequent the rehabilitation sessions were. Rehabilitation performed at least once a day was defined as active rehabilitation.

Statistical Analysis

We utilized the Bayesian approach to analyze the data. The advantages of Bayesian analysis (BA), especially in complicated data, have been widely discussed.[15–17] An important feature of BA is the possibility to make assumptions in causal inference from observational data.[18,19]

The visual form of a Bayesian network (BN) uses a Directed Acyclic Graph (DAG), which consists of nodes representing random variables, and arcs between the nodes representing the existence of a statistical dependency between 2 nodes. A conditional probability table (CPT) is attached for each node to describe the size of this statistical dependency (a local conditional dependency) between 2 nodes. Arcs between nodes are directed from a starting node (called a parent) and an ending node (called a child). Arc direction can represent both noncausal (predictive or explanative) or causal modeling. A DAG allows testing and identifying causal and noncausal relationships among the variables involved in the study.[18]

The analyst can control for a certain variable or a combination of variables when testing the causal effect of a variable of interest on the target variable.[20] A DAG is constructed either manually or with machine learning based on observational data. The analyst can set restrictions for the structural learning algorithm to avoid illogical connections or to add theoretically justified connections. In this study, we used the expert-assisted machine learning by adding an arc we considered to be hypothetically relevant.[16,21]

We analyzed the data using the BayesiaLab 9.1 tool (Bayesialab). The analysis was done with a data set of 11,628 individuals. In total, 2436 (0.4% of the data set) numerical values of the data set were missing, being the type missing at random. We performed missing value imputations by predicting missing values using a structural equation model (EM) algorithm.[22] The variable *Age* indicating the patient's age, was discreted into 3 groups with 10-year intervals. The variable *Rehabilitation staff/10 pts* was discreted as follows: (1) number of staff per 10 patients $\leq$ 0.7, (2) number of staff per 10 patients 0.8-2.0, (3) number of staff per 10 patients over 2.0, (4) number of staff per 10 patients not defined (indicating that rehabilitation staff was only partially available in hospital units). All other variables in the final data set were discrete.

The outcome variable *Outcome discharge* was set as a target node (a dependent variable). We used the variable *Active rehabilitation* as an intervention variable. The original data set consisted of 45 independent variables.

We used the TabooEQ (Equivalence Classes) unsupervised learning algorithm to construct a noncausal Bayesian network to find the relevant dependences between all the 48 variables (46 independent variables, the intervention variable, and the outcome). The TabooEQ algorithm did not recognize an arc *Active rehabilitation* → *Outcome discharge*. Because, according to our hypothesis, we wanted to

Table 1
Explanations and Distributions of the Variables of Short-Term Community Hospital Stays Analyzed in BayesLab

Variable	Variable Distribution, n (%)
Age, y (BN)	65-104 (min-max) 81.6 ± 7.9 (mean ± SD) 65-74 = 2360 (20.4%) 75-84 = 4578 (39.5%) ≥85 = 4657 (40.2%)
Sex	Female = 6578 (57.5%) Male = 4869 (42.5%)
Where coming from (BN)	Referral hospital (secondary or tertiary care) = 3348 (28.9%) Another health center = 243 (2.1%) Home, with home care = 3684 (31.8%) Home, no home care = 3210 (27.7%) Residential facility = 1100 (9.5%)
Length of stay, d	≤5 = 6613 (56.9%) 6-10 = 2819 (24.2%) 11-15 = 1168 (10.0%) 16-31 = 1017 (8.7%)
Community with referral hospital (BN)	No = 8475 (72.9%)
Secondary or tertiary care hospital which is in same locality as the community hospital	Yes = 3153 (27.1%)
Type of community	Rural = 3457 (29.7%) Urban = 8171 (70.3%)
Rehabilitation resources/10 patients (BN)	≤0.7 = 7048 (60.6%) >0.7-2 = 2183 (18.9%) >2 = 309 (2.7%) Not defined 2087 (18.0%)
Did the patient receive rehabilitation?	No = 9452 (81.3%) Yes = 2160 (18.6%)
Primary reason for care	
New diagnosis (BN)	No = 6721 (57.8%)
Confirmed during the hospital stay	Yes = 4907 (42.2%)
New diagnosis not confirmed	No = 10,892 (93.9%)
New symptoms/nonspecified condition	Yes = 703 (6.1%)
Chronic disease (BN)	No = 9196 (79.1%) Yes = 2432 (20.9%)
Chronic disease and need for rehabilitation	No = 11,419 (98.5%) Yes = 176 (1.5%)
Assessment and investigations of long-lasting symptoms	No = 10,664 (91.7%) Yes = 964 (8.3%)
Due to investigation	No = 11,353 (97.9%) Yes = 242 (2.1%)
Continuing care after stay in secondary or tertiary care hospital; treatment in progress	No = 9496 (20.0%) Yes = 4063 (18.0%)
Continuing care after stay in secondary or tertiary care hospital; need for rehabilitation	No = 10,783 (93.0%) Yes = 812 (7.0%)

Diagnostic Variables	*ICD-10* Diagnoses	
Other infection (BN)	A00-B99 Certain infectious and parasitic diseases	No = 10,928 (94.0%) Yes = 700 (6.0%)
Neoplasm (BN)	C00-D48 Neoplasms	No 0 = 11,037 (94.9%) Yes 1 = 591 (5.1%)
Dementia (BN)	F00-F09 Organic, including symptomatic, mental disorders G30-G32 Other degenerative diseases of the nervous system	No = 10,956 (94.2%) Yes = 672 (5.8%)
Alcohol abuse (BN)	F 10 Mental and behavioral disorders due to use of alcohol	No = 11,490 (98.8%) Yes = 138 (1.2%)
Heart failure (BN)	I 50 Heart failure	No = 10,958 (94.2%) Yes = 670 (5.8%)
Other circulatory system disease (BN)	I00-I99 Diseases of the circulatory system, excluding I 50 Heart failure	No = 10,155 (87.3%) Yes = 1473 (12.7%)
Pneumonia (BN)	J10.0; J11.0; J12-J18; J20-J22 Pneumonia and other acute lower respiratory infections	No = 10,308 (88.6%) Yes = 1320 (11.4%)
Digestive system disease (BN)	K00-K93 Diseases of the digestive system	No = 11,094 (95.4%) Yes = 534 (4.6%)
Musculoskeletal system disease (BN)	M00-M99 Diseases of musculoskeletal system or connective tissue	No = 10,909 (93.8%) Yes = 719 (6.2%)
Urinary tract infection (BN)	N10-N12; N30; N34; N39 Infectious renal tubulo-interstitial disease or other infectious urinary system disease	No = 10,981 (94.4%) Yes = 647 (5.6%)
Symptomatic (BN)	R00-R99 Symptoms, signs or abnormal clinical or laboratory findings, not elsewhere classified	No = 10,597 (91.1%) Yes = 1031 (8.9%)

(*continued on next page*)

Table 1 (*continued*)

Diagnostic Variables	*ICD-10* Diagnoses	
Injury (BN)	S00-T98 Injury, poisoning and certain other consequences of external causes	No = 10,635 (91.5%) Yes = 993 (8.5%)
Other (BN)	A disease not classified elsewhere	No = 9488 (81.6%) Yes = 2140 (18.4%)
Primary Content of the Care		
Treatment of acute infection or trauma		No = 7017 (70.5%) Yes = 4578 (39.5%)
Treatment after stay in secondary or tertiary care hospital		No = 10,352 (89.0%) Yes = 1276 (11.0%)
Terminal care (BN)		No = 11,310 (97.3%) Yes = 318 (2.7%)
Scheduled interval care		No = 11,530 (96.8%) Yes = 374 (3.2%)
Treatment of pain		No = 11,254 (96.2%) Yes = 446 (3.8%)
Treatment of mental confusion		No = 11,336 (97.8%) Yes = 259 (2.2%)
Treatment of psychiatric problems		No = 11,535 (99.2%) Yes = 93 (0.2%)
Preplanned treatment		No = 11,449 (98.5%) Yes = 179 (1.5%)
Management of multimorbidity		No = 11,025 (94.8%) Yes = 603 (5.2%)
Treatment of poisoning		No = 11,614 (99.9%) Yes = 14 (0.1%)
Detoxification and substance abuse treatment		No = 11,535 (99.2%) Yes = 93 (0.8%)
Management and care of diabetes		No = 11,595 (99.7%) Yes = 33 (3.8%)
Starting a new treatment		No = 11,449 (98.5%) Yes = 179 (1.5%)
Treatment or care complications		No = 11,576 (99.6%) Yes 0 52 (0.4%)
Rehabilitation		No = 11,122 (95.6%) Yes = 506 (4.4%)
Wound care		No = 11,542 (99.3%) Yes = 86 (0.7%)

Variables in Bayes Network Model are marked with the abbreviation BN.

measure the causal effect of the intervention (*Active rehabilitation*) on the outcome (*Outcome discharge*), we manually added an arc between those variables.[21] We dropped out all variables not connected with the outcome or the intervention variable, as well as other variables with only a marginal connection with the outcome or the intervention variable.

The result was a BN consisting of 10 variables, including the intervention variable and the outcome. Arcs between variables were noncausal, except the manually added arc *Active rehabilitation* → *Outcome discharge*. We analyzed the robustness of the arcs by using the Jackknife resampling method in BayesiaLab. We only used arcs that were present in all networks obtained from the Jackknife resampling.

We calculated the mutual information (MI) between each variable and the outcome variable, as well as maximum and minimum Bayes factors (BF) in order to clarify the strength of the dependency and its confidence level for each variable state. The MI between 2 variables (X and Y) shows how much the knowing of variable Y reduces the uncertainty about variable X. MI is a measure that is not dependent on the variables' linearity.[23,24] BF is a Bayesian approach for hypothesis testing. A high BF value indicates a stronger association, and a lower BF indicates uncertainty. Kass and Raftery (1995) give the following interpretation for BF: $\log_{10}K = 0$ to 0.5 not worth more than a bare mention, 0.5 to 1 substantial, 1 to 2 strong, and >2 decisive.[25]

BayesiaLab enables controlling for (ie, to fix the distribution) any variable and their combinations, for example, fixing the variable *Terminal care* of the state to "yes" = 100% and state "no" = 0%. This means that the model changes; accordingly, the state distribution of the outcome variable in the previous hypothetical case that all patients were in the state of *Terminal care* is true.

To identify a causal connection between the intervention variable and the outcome, technically 2 alternatives exist. First, the intervention variable can be isolated from unwanted associational backdoor paths between the intervention variable and the outcome. This method requires full knowledge about causal associations of the BN.[18,26] In this study, the true causal network between the variables and the outcome variable remains unknown. Therefore, we applied VanderWeele's and Shiptser's modified disjunctive confounder criteria (DCC) for estimating a direct causal effect of an intervention variable on the outcome variable from an otherwise noncausal Bayesian network.[27] VanderWeele and Shiptser defined the original DCC as controlling for each variable that is a cause of the treatment, or of the target, or both.[27] The variables to be controlled must have been present before intervention. No unmeasured confounder is allowed to have a direct effect on the intervention or on the outcome. VanderWeele added 2 additional qualifications to DCC for practical use for confounder controlling and renamed it as "modified DCC."[28] Additional definitions are (1) excluding from this set any variable known to be an instrumental variable and (2) including variables that do not satisfy the criterion but are good proxies for unidentified common reasons for treatment.[18,26–28]

Results

A total of 11,628 community hospital stays were analyzed. The patient characteristics and variables used in Bayesian analyses are

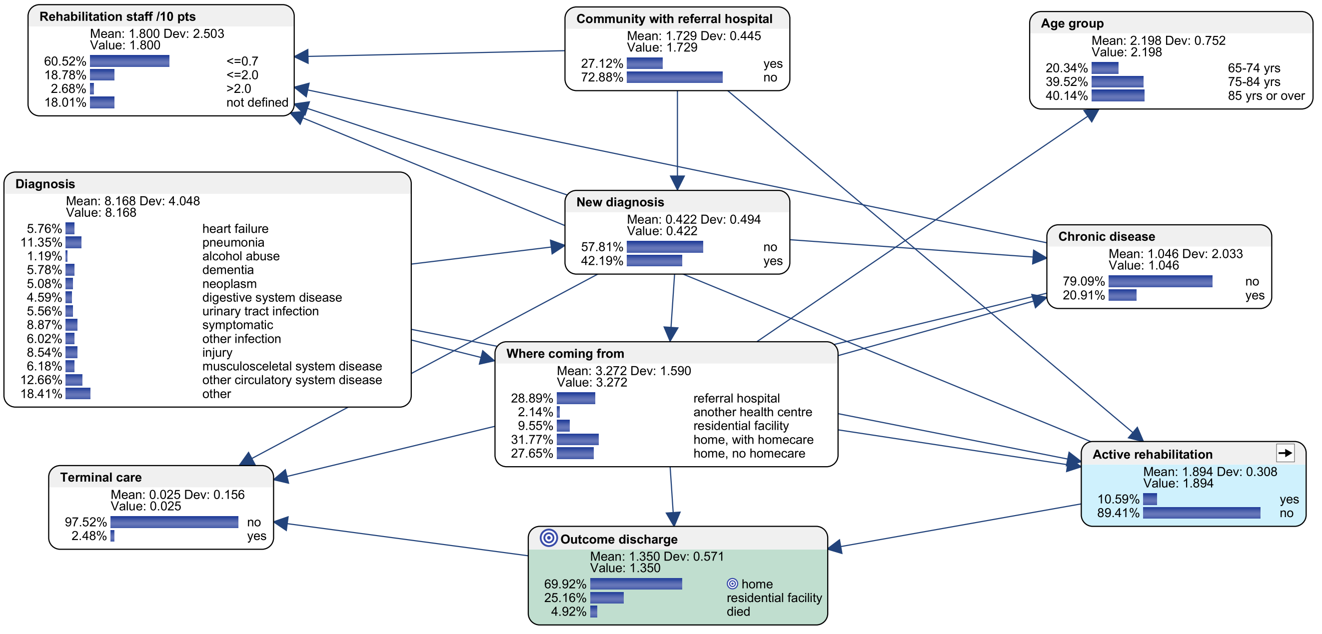

Fig. 1. Bayesian Network Model. Variables associated with the outcome variable *Outcome discharge* or intervention variable *Active rehabilitation.* Variables are presented with a conditional probability table (CPT).

shown in Table 1. The mean age of the patients was 81.6 (SD 7.9) years and 57.5% were women. The majority of patients came to a community hospital from home (n = 6894; 59.5%); nearly a third came from a secondary or tertiary care hospital (n = 3348, 28.9%), and 9.5% (n = 1100) from a residential care facility. The median of length of community hospital stay was 5 days (interquartile range 2-8). Regarding the first underlying diagnoses, the 4 most common categories were cardiovascular diseases, 18.4% (n = 2143); respiratory system diseases, 15.7% (n = 1830); symptoms, 8.9% (n = 1031); and injuries, 8.5% (n = 993).

Table 2
Local Analyses of Mutual Information Between Target Variable and Independent Variables

Node	Mutual Information	Max Bayes Factor		Min Bayes Factor	
Outcome discharge = Home (69.9%)					
Where coming from	0.1959	home, no home care	1.2459	residential facility	0.0283
Terminal care	0.0306	no	1.0236	yes	0.1619
Age group	0.0018	65-74 y	1.0364	85 y or older	0.9599
Active rehabilitation	0.0010	yes	1.0713	no	0.9916
Chronic disease	0.0003	yes	1.0278	no	0.9926
New diagnosis	0.0003	no	1.0111	yes	0.9848
Diagnosis	0.0002	dementia	1.0171	pneumonia	0.9885
Rehabilitation staff/10 patients	0.0000	>2 (3/4)	1.0238	not defined (4/4)	0.9970
Community with referral hospital	0.0000	yes	1.0019	no	0.9993
Outcome discharge = Residential facility (25.2%)					
Where coming from	0.1673	residential facility	3.5919	home, no home care	0.4351
Terminal care	0.0037	no	1.0186	yes	0.3375
Age group	0.0019	85 y or older	1.1073	65-74 y	0.9008
Chronic disease	0.0015	no	1.0394	yes	0.8511
New diagnosis	0.0014	yes	1.0880	no	0.9357
Diagnosis	0.0005	urinary tract infection	1.0658	dementia	0.9158
Active rehabilitation	0.0000	no	1.0026	yes	0.9776
Rehabilitation staff/10 patients	0.0000	≤2 (2/4)	1.0019	>2 (3/4)	0.9645
Community with referral hospital	0.0000	yes	1.0073	yes	0.9973
Outcome discharge = Died (4.9 %)					
Terminal care	0.0840	yes	16.3284	no	0.5690
Where coming from	0.0106	another health center	1.6355	home, no home care	0.3926
Active rehabilitation	0.0055	no	1.1063	yes	0.0995
New diagnosis	0.0015	no	1.1709	yes	0.7659
Chronic disease	0.0012	yes	1.3672	no	0.9028
Diagnosis	0.0007	dementia	1.1872	urinary tract infection	0.8262
Rehabilitation staff/10 patients	0.0001	not defined	1.0416	>2 (3/4)	0.8434
Community with referral hospital	0.0001	no	1.0242	yes	0.9350
Age group	0.0000	85 y or older	1.0210	75-84 y	0.9835

The results are presented separately for all 3 states of the target. The column Max Bayes Factor presents the states with the highest Bayes Factor (BF) values. Correspondingly, the column Min Bayes Factor presents states with the lowest BF values. Only factors having Bayes factor >1 are presented.

Table 3
States of the Outcome Variable (Outcome Discharge) When the Variable *Active Rehabilitation* Is Unfixed and Independent Variable States Are Fixed to the Alternative Yes = 100%

	No Fixation of *Active rehabilitation*			Fixation of Intervention Variable *Active Rehabilitation* yes = 100%		
	Home	Residential Care	Died	Home	Residential Care	Died
No fixation of independent variables	69.9	25.2	4.9	75.0	24.5	0.5
Fixations of independent variables						
Terminal care = yes	12.7	9.6	77.7	none	none	none
Where coming from: referral hospital	66.1	25.9	8.0	73.9	25.5	0.6
Where coming from: other health center	58.6	33.3	8.1	66.7	33.3	0.0
Where coming from: residential facility	11.6	82.0	6.4	14.7	85.3	0.0
Where coming from: home, with home care	79.6	16.8	3.6	81.5	17.9	0.6
Where coming from: home, no home care	87.1	11.0	1.9	87.9	12.1	0.0
Dg heart failure	70.8	22.6	6.6	77.2	21.4	1.4
Dg pneumonia	60.3	34.2	5.5	63.5	36.1	0.4
Dg alcohol abuse	76.5	19.5	4.0	none	none	none
Dg dementia	70.2	25.7	4.1	78.9	20.6	0.5
Dg neoplasm	71.4	22.6	6.0	74.9	24.4	0.7
Dg digestive system disease	69.4	24.7	5.9	76.0	23.5	0.5
Dg urinary tract infection	63.9	31.2	4.9	73.9	25.6	0.5
Dg symptomatic	73.3	22.4	4.3	76.9	22.7	0.4
Dg other infection	70.5	24.7	4.8	72.5	27.0	0.5
Dg injury	70.2	25.2	4.6	74.3	25.2	0.5
Dg musculoskeletal system disease	74.6	21.7	3.7	75.2	24.3	0.5
Dg other circulatory system disease	70.0	24.4	5.6	74.7	24.7	0.6
Dg other	73.0	22.3	4.7	77.5	22.0	0.5
Rehabilitation staff/10 patients ≤0.7	69.7	25.2	5.1	76.3	24.2	0.5
Rehabilitation staff/10 patients ≤2.0	70.3	25.2	4.5	74.5	25.0	0.5
Rehabilitation staff/10 patients >2.0	72.1	24.3	3.6	75.6	23.9	0.5
Rehabilitation staff not defined	69.9	25.2	4.9	74.9	24.6	0.5
Community with referral hospital: yes	70.2	25.2	4.6	74.4	25.2	0.4
Community with referral hospital: no	69.8	25.1	5.1	75.5	25.0	0.5
Age group: 65-74 y	72.5	22.7	4.8	76.0	23.5	0.5
Age group: 75-84 y	71.5	23.7	4.8	75.7	23.8	0.5
Age group: 85 y or older	67.1	27.9	5.0	73.9	25.6	0.5
Chronic disease: yes	73.9	22.2	3.9	77.7	21.9	0.4

Dg, Diagnosis.
Three columns in the right show the same independent variables' fixations when the Active rehabilitation is fixed to value yes = 100%.

In the final model, there were 8 independent variables with an association relevant to the outcome *Discharge destination* or intervention variable *Active rehabilitation* (Figure 1). The overall prediction performance of the BN was 80.1%, ROC index = 76.9%, and $R^2 = 0.34$.

The MI between the states of the variables and the outcome are presented in Table 2. The strongest associations were seen between variables *Diagnosis* → *Where coming from* (overall contribution 19.1%) and *Where coming from* → *Outcome discharge* (overall contribution 9.1%). *Outcome discharge* = *Home* was most common among patients who came to a community hospital from their homes and did not receive regular home care services (MI = 0.196). Having no terminal care (MI = 0.03), being younger (65-74 years) (MI = 0.002), and receiving active rehabilitation (MI = 0.001) showed a strong association with discharge to home. The BF was >1 in all associations indicating strong association.

As expected, coming from a residential facility was most strongly associated with *Outcome discharge* = *Residential facility* (MI = 0.167, BF = 3.59). In addition, discharging to a residential facility was associated with no terminal care (MI = 0.004), age ≥85 years (MI = 0.002), urinary tract infection (MI = 0.0005), and not receiving active rehabilitation (MI = 0.000). The BF was >1 in all these variables.

Outcome discharge = *Died* was self-evidently associated with terminal care (MI = 0.84, BF = 16.3). Other variable values associated with *Outcome discharge* = *Died* were the following: transfer from another primary care hospital (MI = 0.01), not receiving active rehabilitation (MI = 0.001), and presence of chronic disease (MI = 0.001).

The number of rehabilitation staff was associated with discharge destination (Table 2). A high number of rehabilitation staff (>2 per 10 patients) was associated with *Outcome discharge* = *Home*. Conversely, a lower or unspecified number of rehabilitation staff were associated

Table 4
States of the Outcome Variable (Outcome Discharge) in Selective Combinations

Fixations of Selected Patient Group Combinations	No Fixation of *Active Rehabilitation*			Fixation of Intervention Variable *Active Rehabilitation* yes = 100%		
	Home	Residential Care	Died	Home	Residential Care	Died
Dg* pneumonia + Age group 85 y or older	54.7	39.6	5.7	59.0	40.6	0.4
Dg urinary tract infection + Age group 85 y or older	60.2	34.8	5.0	73.0	26.5	0.5
Dg dementia + Age group 85 y or older	67.5	28.3	4.2	78.3	21.2	0.5
Dg pneumonia + Age group 75-84 y	63.4	31.3	5.3	65.9	37.7	0.4
Where coming from = referral hospital + Dg injury	64.4	25.9	9.7	73.9	25.5	0.6
Age group 65-74 y + Dg injury	70.5	23.2	6.3	75.4	24.1	0.5

Dg, Diagnosis.

with *Outcome discharge* = *Residential facility or Death*. The number of rehabilitation staff showed MI less than 0.001 with all the outcome variable values. However, the BF >1 indicated a strong association.

Receiving active rehabilitation increased the rate of patients being discharged to their own homes and reduced the rate of deaths in all patient groups (Table 3). Patients whose hospital stay was caused by urinary tract infection, heart failure, or dementia benefited the most from active rehabilitation.

To test the role of active rehabilitation in patient groups assumed to be high risk, certain characteristics of the patients were combined (Table 4). The favorable effect (*Discharge destination* = *Home*) of active rehabilitation was seen in all these patient groups.

Finally, to estimate the effect of active rehabilitation, we fixed all variables to their original distributions according to vanderWeele.[28] Among the patients who did not receive active rehabilitation, discharge destinations were broken down as follows: home 69.4%, residential facility 25.3%, and died 5.4%. The corresponding figures for active rehabilitation were 73.9%, 25.3%, and 0.8%, respectively.

Discussion

Our study identified the factors associated with the discharge of older patients after short-term hospital stays in community hospitals. Moreover, associations between rehabilitation and discharge were analyzed using Bayesian network models. This method enabled us to investigate the impact of rehabilitation in unselected patient samples and a real-life context.

In the present study, a vast majority of the patients were discharged to their own homes, a quarter to residential care facilities and 5% of patients died during their hospitalization. There were few other studies with comparable settings and reporting on discharge destinations.[29–31] Furthermore, previous community hospital research has mainly focused on nonacute care,[32–34] whereas our study assessed older patients needing short-term care and for acute reasons in most cases. Thus, discharge to home was more common in the present study than in most previous studies.

A younger age, a higher number of rehabilitation staff per patient, and daily rehabilitation were associated with discharging patients to their own homes. Consequently, a lower number of rehabilitation staff and less frequent rehabilitation were associated with discharging to a nursing home or death during the hospital stay. The favorable effect of active rehabilitation was identified in all patient groups, including patients with urinary tract infections, heart failure, and dementia, both in unadjusted and adjusted analyses.

Patients coming to a community hospital from a secondary or tertiary hospital showed a poorer outcome than patients coming directly from their own homes or from other care or residential facilities. This can reflect differences in the disease severity. The variable "Where coming from" can be seen as a proxy of disease severity. Patients coming from a secondary or tertiary care hospital were presumably more seriously ill than patients coming from health centers or from their homes. Some of our findings were rather self-evident, such as high mortality among terminal care patients. Patients who came to a hospital from a nursing home or other residential settings are presumably discharged back to the same settings. However, this was a real-life study on short-term community hospital care, and based on this, it was important to include all the patients in the analyses. Despite the substantial heterogeneity of the patients, favorable effects of active rehabilitation were notable.

Unlike the majority of research that investigated rehabilitation from the perspective of certain diseases or rehabilitation intervention,[35–42] our study was carried out in a usual care context, in real-life clinical settings and without patient selection. The content of rehabilitation varied and was determined individually according to the patients' needs and local rehabilitation resources. Consequently, our findings are not fully comparable with the previous research.

To our knowledge, this was the first study using BA to investigate factors associated with the discharge destination and outcome of rehabilitation in community hospital settings. We considered BA to be useful for this complicated data set. A beneficial feature of BA was the possibility to estimate causal effects.

A strength of our study was the high participation rate of community hospitals and good compliance in the data collection. Thus, our study provided comprehensive data on the reasons for treatment and contents of short-term primary care hospital stays. There were few interruptions in data collection and, similarly, hospitals were operating normally at the time of the data collection.

We identified several limitations in our study as well. Some unmeasured variables may have had an effect on the discharge, or on whether the patient received active rehabilitation. Use of the disjunctive confounder criterion requires, in addition to the use of pretreatment variables only, that no unmeasured confounder have a direct effect on treatment selection, outcome, or both. We believe that the patient's disease severity, physical and cognitive functioning, frailty status, and assumed prognosis were potential and partially overlapping confounders. Diagnoses and coming from a secondary or tertiary hospital are proxies for disease severity. In addition, the patient's assumed rehabilitation capacity probably influenced the choice and activity of rehabilitation.

Conclusion and Implications

Our study showed the real-life outcome of rehabilitation among unselected older patients in community hospital settings. Active rehabilitation in community hospitals enhances the patients' likelihood of returning home. Community hospitals know the local service system and have the possibility to tailor care and rehabilitation for older patients according to their individual needs. The role of community hospitals in the acute care and rehabilitation of older adults as well as support for health services given at home is valuable and increasingly important in rapidly aging societies.

Older patients hospitalized for any reason, for example, acute infection or dementia, may benefit from active rehabilitation. Our findings indicate that the availability and intensity of rehabilitation should be increased. Local community hospitals can serve this purpose.

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