Reasons for Home Care Clients' Unplanned Hospital Admissions and Their Associations with Patient Characteristics

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Abbreviated title: Hospitalizations among New Home Care Clients

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BACKGROUND: Unplanned hospitalizations and emergency room visits occur frequently among home care clients The aim of this study was to identify typical discharge diagnoses and their associations with patient characteristics among a total of 6,812 Finnish home care clients aged ≥63 years who were hospitalized within one year of their first home care assessment.

METHODS: A register-based study based on Resident Assessment Instrument-Home Care (RAI-HC) assessments and nationwide hospital discharge records. The RAI-HC assessments were linked to the hospital discharge records of the participants' first unplanned hospitalization. Univariate and multivariable regression analyses were used to evaluate the association of RAI-HC determinants with discharge diagnoses.

RESULTS: The most common reason for the first hospitalization was an infectious disease (21%; n=1,446). When hospitalizations were classified according to the main diagnosis, chronic skin ulcers, functional impairment and daily urinary incontinence were associated with hospitalization due to infectious diseases; impaired cognitive capacity, Alzheimer's disease or other dementia and polypharmacy (protective effect) were associated with hospitalizations due to dementia; age of ≥90 years, congestive heart failure, coronary artery disease and using ≥10 drugs with hospitalizations due to heart diseases; and moderate or strong pain with hospitalization due to musculoskeletal disorders. Previous falls, female sex and an earlier hip fracture were associated with injury-related hospitalizations. Feelings of loneliness increased the odds of hospitalization due to geriatric symptoms without a specific diagnosis.

CONCLUSION: Patient characteristics and geriatric syndromes identified using RAI-HC predict the reasons for future hospitalizations among new home care clients.

Key words: hospitalization, RAI assessment, home care, diagnosis

1. INTRODUCTION

The aim of home care services is to help people with functional limitations to live in their own homes. Home care is considered a possible strategy for reducing hospital use among older people (1), and in fact, there are studies showing that home care prevents hospitalizations among selected older people (2, 3). Nevertheless, unplanned hospitalizations and emergency room visits occur frequently among home care clients, and they are often associated with adverse outcomes (4-6).

Although hospitalizations are often due to acute exacerbations of chronic diseases (7), an earlier study among new home care clients indicated that many of the risk factors predicting unplanned hospitalization represent major geriatric challenges (6). Targeting the identified risk factors for hospitalization (6-12) could provide a means to prevent future hospitalizations. A better understanding of how patient characteristics are linked to different reasons for hospitalization would help to identify potentially modifiable conditions and thereby to reduce hospital admissions.

The aim of the present study, which is based on nationwide register data and Resident Assessment Instrument for Home Care (RAI-HC) assessments, is therefore to identify conditions that could be targeted in the care planning of home care clients to prevent hospital admissions. This study extends an earlier analysis (6), describes the most common discharge diagnoses, and analyzes how patient characteristics are associated with the reasons for hospitalization.

2. METHODS

The Resident Assessment Instrument for Home Care (RAI-HC) is a comprehensive assessment system developed by InterRAI, a multinational research network dedicated to cross-national comparisons of health and health care for elderly people and people with disabilities. The collected data contains core assessment items necessary for a comprehensive assessment, such as function, health, social support, and service use (13), and its reliability and validity have been tested in international studies (2, 13, 14).

This study was based on the first RAI-HC assessments made for new home care clients (i.e. persons with no previous use of home care), aged ≥63 years, in Finland in 2009–2011 (n=15,700) and hospital discharge records of those clients who were hospitalized at least once within one year of the first RAI-HC assessment (n=6,812). The nurses responsible for each client perform the assessments, and they have been trained in the use of RAI-HC. According to national guidelines, home care clients are assessed upon initiation of services and thereafter at least twice a year. The RAI data were collected from the national database maintained by the National Institute for Health and Welfare (THL), which includes assessments from both rural (30%) and urban (70%) settings. Of the RAI-HC scales, those measuring activities of daily living performance (ADLh) (15), cognitive performance (CPS) (16), depression (DRS) (17), pain, and health stability (CHESS) (18) were used in this study. The variables used in the analyses are listed in Table 1.

The information about hospitalizations and discharge diagnoses (according to International Classification of Diagnoses, 10th revision) were collected from the Finnish Hospital Discharge Register (FHDR) and were linked to the RAI-HC data using each citizen's unique identification number. The FHDR contains the data of all discharged patients from inpatient care in health centers and hospitals, including both public and private institutions. The coverage of the register exceeds 95%, and the completeness and accuracy of the registered items varies from satisfactory to very good (19).

For this study, only the first hospitalizations occurring within one year of the first RAI-HC assessment were included. Scheduled hospitalizations (e.g. elective surgery) were excluded, because the aim was to analyze unplanned hospitalizations. The hospitalizations were divided into nine diagnosis groups according to their primary discharge diagnoses (the first registered diagnosis representing the main cause of hospitalization according to the treating physician): infectious diseases; dementia; cardiovascular, cerebrovascular, and musculoskeletal diseases; other specific diseases; geriatric symptoms (e.g. malaise, dizziness, syncope, malnutrition); injuries; and other reasons (Appendix Table A1). The diagnosis groups were determined according to the previous studies concerning hospital care among old people (20, 21) and to the authors' clinical experience. Final classification was reached by consensus between three experienced geriatricians. Finally, in order to clarify how often geriatric syndromes are identified and registered in discharge records, we searched both primary and secondary diagnoses for records about malnutrition and delirium.

2.1. Ethics

The use of the RAI database for this study, including linkage to the FHDR, was approved by the THL ethics committee (THL/134/6.02.00/2012; Feb 16, 2012).

2.2. Statistical analyses

A two-stage analysis was used to identify associations between the status of new home care clients and the reasons for their later hospitalization. First, a univariate analysis was used to explore associations between RAI-HC determinants and diagnosis groups. In the second stage, multivariable models were constructed in order to identify factors with independent association with the causes of hospitalizations. All variables with $p \leq 0.01$ in the univariate analysis were included in these multivariable models. This level of significance was selected because of the high number of separate comparisons. Although the analyses were performed separately for all nine diagnosis groups, all variables found to have statistically significant

association with hospitalization in the univariate analyses (independent of the reason for hospitalization) were included in all multivariable models, because these all were considered clinically important and potentially confounding factors in all diagnosis groups, despite some not being significant for each of the diagnosis groups individually. The results are presented as odds ratios (OR) with 95% confidence intervals (CI). The odds ratios indicate how much higher (or lower) the possibility of the analyzed diagnosis group being the reason for hospitalization (e.g. infectious disease or injury) is in patients with a specific characteristic (e.g. age, diagnosis of dementia, ADL performance) than in patients without that characteristic. All the statistical analyses were performed using SAS 9.3 (SAS Institute INC., Cary, NC, USA).

3. RESULTS

Of the 15,700 new home care clients, 6,812 (43%) were hospitalized. Some 48 patients (0.7%) were excluded because of missing discharge diagnoses. The characteristics of the remaining 6,764 patients are described in Table 1. The most common reasons for hospitalization were infectious diseases (21.2%; n=1,446). In 34% of hospitalizations due to infectious diseases, the specific diagnosis was urinary tract infection, and it was the most common individual diagnosis (7.2%; n=490) (Table 2). Dementia disorders were the reason for hospitalization in 449 patients (6.6%). Other geriatric syndromes were recorded very infrequently: delirium was recorded as the main diagnosis in 11 patients and as the secondary diagnosis in 8 patients. Malnutrition as a main or secondary diagnosis was recorded not even once.

3.1. Univariate analysis

Most of the analyzed variables were associated with some of the diagnosis groups in the univariate analysis (Table 3). Only living alone, housing defects, vision, dementia associated with Parkinson's disease, a psychiatric diagnosis, and psychotropic medication had no significant association ($p \leq 0.01$) with any diagnosis group, and they were therefore excluded from the multivariable models.

3.2. Multivariable analysis

The results of the multivariable analysis are shown in Table 4. When hospitalizations were classified according to the main diagnosis, chronic skin ulcers (OR 1.35, 95% CI 1.11–1.65), functional impairment (ADLh 1–2 1.23, 1.04–1.47; ADLh 3–4 1.40, 1.12–1.75; ADLh 5–6 1.65, 1.11–2.50), and daily urinary incontinence (1.24, 1.05–1.45) were associated with hospitalizations due to infectious diseases. Impaired cognitive capacity (CPS 1–2: 4.10, 2.72–6.18; CPS 3–4: 4.70, 2.84–7.78; CPS 5–6: 5.66, 3.27–9.8), Alzheimer's disease (1.77, 1.31–2.38), and other dementia disorders (2.63, 1.91–3.64) increased the likelihood that the reason

for hospitalization was dementia, while polypharmacy was associated with a decreased probability of dementia-related hospitalization (5–9 drugs: 0.69, 0.52–0.91; ≥10 drugs: 0.47, 0.33–0.66). A history of heart diseases (congestive heart failure (2.40, 2.05–2.82) and coronary artery disease (1.71, 1.46–2.00)) was associated with hospitalizations due to heart diseases. A similar effect was found for an age of ≥90 years (2.03, 1.53–2.70) and using ≥10 drugs (1.37, 1.01–1.86). Moderate or strong pain (1.76, 1.35–2.29) was more common among patients with hospitalization due musculoskeletal disorders. Previous falls (1.43, 1.21–1.68), female sex (1.33, 1.11–1.60), and an earlier hip fracture (1.61, 1.11–2.32) were associated with injury-related hospitalizations. Feeling lonely increased the odds of being hospitalized due to geriatric symptoms without a specific diagnosis (1.35, 1.08–1.69).

Despite statistically significant analyses in the multivariate models, only a minority of hospitalizations among patients with a certain characteristic were due to the cause of hospitalization that the characteristic was associated with. One third of hospitalizations among patients with ADL score of 5-6 and approximately one-fourth (24-29%) of hospitalizations among patients with ADL 1-4, with wounds or urinary incontinence, were due to infections.. Dementia accounted for one-fifth (17-27%) of hospitalizations among patients with cognitive decline, Alzheimer's disease or other dementia. The proportion was similar for associations related to hospitalizations due to heart diseases, whereas moderate pain explained only 6% of hospitalizations for musculoskeletal disorders, and female sex, previous falls and history of hip fracture about 14-19% of hospitalizations due to injuries.

4. DISCUSSION

This study indicates that already at the beginning of home care services, certain patient characteristics are related to specific discharge diagnoses if the new home care client becomes hospitalized within one year of the first RAI-HC assessment. These associations differ partly from the risk factors for hospitalization identified in early studies (6-12), because only patients who were hospitalized were included in this study. Infectious diseases were the most common reason for hospitalization, and urinary tract infections the most common individual diagnosis. As expected, some common symptoms and geriatric syndromes, for example delirium and malnutrition, were rarely documented probably because of inadequate identification and registration of these conditions in clinical practice (22). Despite the observed significant associations, it however turned out that among all patient subgroups the reasons for hospitalizations varied markedly, and at maximum one-third of hospitalizations were due to a certain disease-group (i.e. two-thirds were due to conditions in the other eight diagnosis groups).

In an earlier study, previous hospitalizations represented the strongest independent risk factor for unplanned hospitalization after the initiation of home care services (6). Interestingly, previous hospitalizations were not associated with dementia-related hospitalizations or injuries. Instead, they were associated with an increased probability of being hospitalized due to cardiovascular diseases or other chronic conditions. In the univariate analysis, CHESS ≥1 as a marker of unstable health status also increased the likelihood of hospitalization for specific diagnoses, including malignant neoplasms and diseases of the nervous, circulatory, metabolic, respiratory, or digestive system. In new home care clients with previous hospitalizations, special attention should be paid to good care and the monitoring of underlying chronic conditions. Furthermore, not only diseases but also their symptoms require

attention. This is highlighted by the observation that moderate to severe pain was associated with hospitalizations due to musculoskeletal disorders.

In previous studies, adverse drug events have been associated with hospital admissions (23), and the association has been observed among home care clients too (24). The strongest factor associated with adverse drug events is the number of drugs taken (23, 25). In our study, polypharmacy was associated with a decreased probability of dementia-related hospitalizations but an increased probability of hospitalization due to cardiovascular reasons. Interestingly, polypharmacy was not associated with injuries, unlike in previous studies (26). The reasons for these findings are unclear. Perhaps the particular drugs used are more important than the number of drugs alone. In patients with cardiovascular diseases, the number of drugs could be an indicator of the severity of the disease.

Unsurprisingly, infectious diseases emerged as the most common reason for the first hospitalization of new home care clients. Daily urinary incontinence, chronic skin ulcers, and both functional and cognitive impairment increased the likelihood that the unplanned hospitalization was for that reason. Incontinence and skin ulcers are easily identifiable conditions, and their effective prevention and care could reduce the need for hospitalizations. Functional impairment could be an indicator of frailty (27, 28), thus increasing susceptibility to infections. Furthermore, in patients with poor physical capacity even minor infections may lead to the need for hospital care. Another explanation is that according to clinical experience, various unspecific symptoms are often thought to be caused by urinary tract infections, and the actual causes for weakened physical condition—like geriatric syndromes—may remain undetected. Urinary tract infection was the most common individual diagnosis in this study, but due to a lack of clinical data, the possibility of over-diagnostics could not be investigated. According to previous reports, overdiagnostics related to common asymptomatic bacteriuria is very common and even around half of the cases of suspected urinary tract infection do not

fulfill diagnostic criteria (29, 30). So patients with vague symptoms must be assessed carefully to identify other, more likely underlying conditions, and urinary tract infections should be diagnosed only in presence of positive urine culture accompanied by lower urinary tract symptoms or signs of systemic inflammation and when other, more likely causes of acute illness are ruled out (31).

Dementia as the primary discharge diagnosis was more common in this study than has been reported previously (21). In the earlier study, the hospitalized dementia patients had no home care services and hence were probably in better condition. The large share of hospitalizations due to dementia raises the question of how well the somatic diseases and symptoms underlying neuropsychiatric conditions were recognized during hospital care. This question also concerns the underdiagnostics of delirium. Delirium affects approximately 10–60% of all hospitalized older patients (32-34), but in the present materials it was recorded only in 11 patients. Caregiver stress was strongly associated with dementia as a discharge diagnosis in the univariate analysis, and this should be recognized, even though the association was lost after adjustments.

Previous falls were common in every diagnosis group and especially among patients hospitalized due to injuries and geriatric symptoms. Patients with previous falls and an earlier hip fracture were more likely to be hospitalized because of injuries. The finding is supported by an earlier study where previous injurious falls in patients with dementia increased the risk of recurrent injurious falls resulting in hospitalization (35). The strong association is worrying; previous falls and fractures in the client's history should lead to the multidisciplinary assessment of the risk factors for falls and interventions to prevent new falls occurring (36, 37). Based on the present data, it is unclear if such assessments had been done.

Finally, an important observation was that feelings of loneliness increased the probability of being hospitalized because of geriatric symptoms without specific diagnosis. When a patient

has vague symptoms, such as malaise and fatigue, the possibility of loneliness should be considered. Recognizing loneliness is important, because interventions like psychosocial group rehabilitation may reduce the use of health services and even mortality (38). It is nevertheless important to distinguish between loneliness and living alone, which was not associated with any reason for hospitalization.

4.1. Study Strengths and Limitations

The strength of this study lies in the data, which were collected from a wide geographical area. Furthermore, the follow-up was practically complete thanks to the nationwide registers. In addition, the large number of patients and hospitalizations allowed the analysis of independent relationships using multivariable models. Although only about 20% of Finnish home care clients are assessed using RAI-HC, in the areas where RAI-HC is used, it covers about 80% of the clients, and those assessed reflect typical new home care clients. In Finland, all citizens are covered by public health insurance free of charge, so their economic or social status does not affect access to public health care that unplanned hospitalizations represent. The types and availability of services differ in different regions, however, which may affect hospital utilization rates. But unfortunately, due to a lack of clinical data we couldn't take these local differences into account in the analyses.

Conversely, the register-based data is the cause for the main limitations of this study. Due to the lack of clinical data, the accuracy of individual diagnoses cannot be confirmed; indeed, they would be impossible to confirm because of the sheer quantity of diagnoses. In addition, the diagnosis distribution does not only describe diseases causing hospitalization; it also reflects the physicians' decisions in documenting the main diagnosis. In clinically unclear situations, it may be easier to use an existing long-term diagnosis or easily identifiable conditions like an infection. Besides the main diagnosis, there are usually other reasons for hospital treatment that are listed as secondary diagnoses. These were not taken into account in

this study, however, because recording practices may vary, and the number of different combinations of main and secondary diagnosis would have been extremely high.

Some of the protective associations between patient characteristics and the reasons for hospitalization may be explained by the fact that only the first hospitalization was recorded. Though the same characteristic would have been related to several reasons for admission, in this study it was linked to the one occurring first. If later hospital periods had also been taken into account, it would have been difficult to distinguish the effects of patient characteristics and the consequences of the previous hospitalizations on the occurrence and reasons for the new episode.

Finally, when dealing with big data, clinically irrelevant differences may become statistically significant, and the high number of separate comparisons may add to the risk of false positive associations in the analyses. To avoid this problem, only variables with a $p \leq 0.01$ in the univariate analyses were selected for the multivariable analysis. Despite this, the number of variables in the models is relatively high especially in relation to the number of events (hospitalizations for a specific cause) in some cases. When the number of events is low relative to the number of predictors, standard regression analysis may produce overfitted models that tend to underestimate the probability of an event in low risk patients and overestimate it in high risk patients (39). In our study, this has to be taken into account in the analyses concerning dementia, cerebrovascular and musculoskeletal diseases, where there are less events per variable (EPV) than the 10-15 EPV that has been recommended (40). However, also these results appear clinically relevant and reasonable.

5. CONCLUSIONS

Upon the initiation of home care services, there are identifiable patient characteristics related to certain discharge diagnoses if the new home care client is hospitalized later. These characteristics help in creating care plans aiming to reduce unplanned hospital admissions. The results also raise the concern that geriatric syndromes, especially delirium and malnutrition, are inadequately identified and reported during hospital care and poorly captured in the health register data.

HIGHLIGHTS

- Among new home care clients who were later hospitalized, specific patient characteristics identified upon initiation of the service were found to be associated with certain discharge diagnoses.

- Identification of these characteristics can aid the creation of care plans aiming to reduce unplanned hospital admissions.

- Infectious diseases emerged as the most common reason for the first hospitalization of new home care clients.

- Patients with previous falls and an earlier hip fracture were more likely to be hospitalized because of injuries.

- Feelings of loneliness increased the probability of being hospitalized because of geriatric symptoms without specific diagnosis.

- Geriatric syndromes, especially delirium and malnutrition, are inadequately identified and reported during hospital care and poorly captured in the health register data.

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Conflict of interest statement

Financial/Personal Conflicts	Rönneikkö		Jämsen		Mäkelä		Finne-Soveri		Valvanne	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		X		X		X		X		X
Grants/Funds		X		X		X		X		X
Honoraria		X	X			X		X		X
Speaker Forum		X		X		X		X		X
Consultant		X		X		X		X		X
Stocks		X		X		X		X		X
Royalties		X		X		X		X		X
Expert Testimony		X		X		X		X		X
Board Member		X		X		X		X		X
Patents		X		X		X		X		X
Personal Relationship		X		X		X		X		X

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References

1. Landi F, Onder G, Russo A et al. A new model of integrated home care for the elderly: impact on hospital use. J Clin Epidemiol 2001;54:968-970.

2. Bernabei R, Landi F, Gambassi G et al. Randomised trial of impact of model of integrated care and case management for older people living in the community. BMJ 1998;316:1348-1351.

3. Vasquez MS. Preventing rehospitalization through effective home health nursing care. Home Healthc Nurse 2008;26:75-81.

4. Doran DM, Hirdes J, Poss J et al. Identification of safety outcomes for Canadian home care clients: evidence from the resident assessment instrument--home care reporting system concerning emergency room visits. Healthc Q 2009;12:40-48.

5. Dorr DA, Jones SS, Burns L et al. Use of health-related, quality-of-life metrics to predict mortality and hospitalizations in community-dwelling seniors. J Am Geriatr Soc 2006;54:667-673.

6. Ronneikko JK, Makela M, Jamsen ER et al. Predictors for Unplanned Hospitalization of New Home Care Clients. J Am Geriatr Soc 2017;65:407-414.

7. Landi F, Onder G, Cesari M et al. Comorbidity and social factors predicted hospitalization in frail elderly patients. J Clin Epidemiol 2004;57:832-836.

8. Rosati RJ, Huang L, Navaie-Waliser M et al. Risk factors for repeated hospitalizations among home healthcare recipients. Journal for Healthcare Quality 2003;25:4-10.

9. Shugarman LR, Buttar A, Fries BE et al. Caregiver attitudes and hospitalization risk in michigan residents receiving home- and community-based care. J Am Geriatr Soc 2002;50:1079-1085.

10. Paddock K, Hirdes JP. Acute health care service use among elderly home care clients. Home Health Care Serv Q 2003;22:75-85.

11. Fortinsky RH, Madigan EA, Sheehan TJ et al. Risk factors for hospitalization among Medicare home care patients. West J Nurs Res 2006;28:902-917.

12. Morris JN, Howard EP, Steel K et al. Predicting risk of hospital and emergency department use for home care elderly persons through a secondary analysis of cross-national data. BMC Health Services Research 2014;14:519.

13. Morris JN, Fries BE, Steel K et al. Comprehensive clinical assessment in community setting: applicability of the MDS-HC. J Am Geriatr Soc 1997;45:1017-1024.

14. Landi F, Tua E, Onder G et al. Minimum data set for home care: a valid instrument to assess frail older people living in the community. Med Care 2000;38:1184-1190.

15. Morris JN, Fries BE, Morris SA. Scaling ADLs within the MDS. Journals of Gerontology Series A-Biological Sciences & Medical Sciences 1999;54:M546-53.

16. Morris JN, Fries BE, Mehr DR et al. MDS Cognitive Performance Scale. J Gerontol 1994;49:M174-82.

17. Burrows AB, Morris JN, Simon SE et al. Development of a minimum data set-based depression rating scale for use in nursing homes. Age & Ageing 2000;29:165-172.

18. Hirdes J, Frijters D, Teare G. The MDS-CHESS scale: A new measure to predict mortality in institutionalized older people. J Am Geriatr Soc 2003;51:96-100.

19. Sund R. Quality of the Finnish Hospital Discharge Register: a systematic review. Scand J Public Health 2012;40:505-515.

20. Walsh B, Roberts H, Hopkinson J. Emergency hospital admissions for ill-defined conditions amongst older people: a review of the literature.. International Journal of Older People Nursing 2007;2:270-277.

21. Natalwala A, Potluri R, Uppal H et al. Reasons for hospital admissions in dementia patients in Birmingham, UK, during 2002-2007. Dementia & Geriatric Cognitive Disorders 2008;26:499-505.

22. Buurman BM, Hoogerduijn JG, de Haan RJ et al. Geriatric conditions in acutely hospitalized older patients: prevalence and one-year survival and functional decline. PLoS ONE [Electronic Resource] 2011;6:e26951.

23. Colt HG, Shapiro AP. Drug-induced illness as a cause for admission to a community hospital. J Am Geriatr Soc 1989;37:323-326.

24. Flaherty JH, Perry HM3, Lynchard GS et al. Polypharmacy and hospitalization among older home care patients. Journals of Gerontology Series A-Biological Sciences & Medical Sciences 2000;55:M554-9.

25. Col N, Fanale JE, Kronholm P. The role of medication noncompliance and adverse drug reactions in hospitalizations of the elderly. Arch Intern Med 1990;150:841-845.

26. Helgadottir B, Laflamme L, Monarrez-Espino J et al. Medication and fall injury in the elderly population; do individual demographics, health status and lifestyle matter?. BMC Geriatrics 2014;14:92.

27. Fried LP, Tangen CM, Walston J et al. Frailty in older adults: evidence for a phenotype. Journals of Gerontology Series A-Biological Sciences & Medical Sciences 2001;56:M146-56.

28. Boyd CM, Xue Q, Simpson CF et al. Frailty, hospitalization, and progression of disability in a cohort of disabled older women. Am J Med 2005;118:1225-1231.

29. Woodford HJ, George J. Diagnosis and management of urinary tract infection in hospitalized older people. J Am Geriatr Soc 2009;57:107-114.

30. Ojanen R, Huttunen R, Syrjanen J et al. Urinary tract infections in acutely hospitalized geriatric patients. Finnish Medical Journal 2016;71:2635-2643.

31. Schulz L, Hoffman RJ, Pothof J et al. Top Ten Myths Regarding the Diagnosis and Treatment of Urinary Tract Infections. J Emerg Med 2016;51:25-30.

32. Inouye SK. Delirium in hospitalized older patients: recognition and risk factors. Journal of Geriatric Psychiatry & Neurology 1998;11:118-125.

33. Miu DKY, Chan CW, Kok C. Delirium among elderly patients admitted to a post-acute care facility and 3-months outcome. Geriatrics & Gerontology International 2016;16:586-592.

34. Siddiqi N, House AO, Holmes JD. Occurrence and outcome of delirium in medical in-patients: a systematic literature review. Age & Ageing 2006;35:350-364.

35. Meuleners LB, Fraser ML, Bulsara MK et al. Risk factors for recurrent injurious falls that require hospitalization for older adults with dementia: a population based study. BMC Neurology 2016;16:188.

36. Close J, Ellis M, Hooper R et al. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. Lancet 1999;353:93-97.

37. Davison J, Bond J, Dawson P et al. Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention--a randomised controlled trial. Age Ageing 2005;34:162-168.

38. Pitkala KH, Routasalo P, Kautiainen H et al. Effects of psychosocial group rehabilitation on health, use of health care services, and mortality of older persons suffering from loneliness: a randomized,

controlled trial. Journals of Gerontology Series A-Biological Sciences & Medical Sciences 2009;64:792-800.

39. Pavlou M, Ambler G, Seaman S et al. Review and evaluation of penalised regression methods for risk prediction in low-dimensional data with few events. Stat Med 2016;35:1159-1177.

40. Peduzzi P, Concato J, Kemper E et al. A simulation study of the number of events per variable in logistic regression analysis. J Clin Epidemiol 1996;49:1373-1379.

Table 1. Characteristics of those hospitalized

	ALL N	%
	6812	
Demographic		
Age		
63-74v	1160	17,0
75-79v	1137	16,7
80-84v	1935	28,4
85-89v	1675	24,6
90+v	905	13,3
Gender		
Female	4610	67,7
Male	2202	32,3
Social situation		
Living alone	4624	67,9
Caregiver stressed	611	9,0
Housing defects	1723	25,3
Use of services		
Reason for home care: client has been discharged from hospital	2384	35,0
Hospitalization during one year before assessment	5135	75,4
Acute outpatient care in 90 days before assessment	2537	37,2
Function		
ADLH (0 - 6)		
0	4920	72,2
1-2	1079	15,8
3-4	669	9,8
5-6	144	2,1
Client believes he/she is capable of improving performance in physical function	1117	16,4
CPS		
0	2599	38,2
1-2	3317	48,7
3-4	514	7,5
5-6	382	5,6
Clinical symptoms		
Urinary incontinence daily	1319	19,4
Fecal incontinency	537	7,9
Chronic skin ulcers	586	8,6

Mouth problems	**5637**	82,8
Vision		
good enough	**5076**	74,5
moderately impaired	**1557**	22,9
severely impaired	**179**	2,6
Falls during 90 days before assessment	**2171**	31,9
DRS		
0-2	**5669**	83,2
3-14	**1143**	16,8
Feeling lonely	**1554**	22,8
Poor self-rated health	**2307**	33,9
BMI		
<18.5	**404**	5,9
18.5-23.9	**2251**	33,0
24-29.9	**2279**	33,5
≥ 30	**1076**	15,8
PAIN		
0-1	**4378**	64,3
2-3	**2434**	35,7
Diagnoses		
Congestive heart failure	**1502**	22,0
Coronary artery disease	**1808**	26,5
Alzheimer's disease	**1299**	19,1
Other dementia	**1932**	28,4
Old stroke	**1932**	28,4
Parkinson's disease	**261**	3,8
Parkinson's disease and dementia	**66**	1,0
Musculoskeletal disorders	**1711**	25,1
Old hip fracture	242	3,6
Old other fracture	262	3,8
Cancer	**644**	9,5
Renal insufficiency	**409**	6,0
Psychiatric diagnosis	**852**	12,5
Chronic obstructive pulmonary disease	**832**	12,2
Diabetes	**1632**	24,0
Medication		
Number of drugs *		
0-4	**734**	10,8
5-9	**2864**	42,0
10 or more	**3214**	47,2
Psychotropic medication	**3638**	53,4
Influenza vaccination	**3687**	54,1
Health stability		

CHESS

0	**3026**	44,4
1	**1857**	27,3
2-5	**1929**	28,3

* including prescription and non-prescription medications

ADLh =The Activities of Daily Living Hierarchy

CPS=The Cognitive Performance Scale

DRS= The Depression Rating Scale

PAIN=The Pain Scale

CHESS= The Changes in Health, End-Stage Disease, Signs, and Symptoms Scale

Table 2. The diagnosis groups and ten most common discharge diagnoses of those hospitalized

	N	%
The diagnosis groups		
Infectious diseases	1446	21.2
Dementia diseases	449	6.6
Cardiovascular diseases	905	13.3
Cerebrovascular diseases	311	4.6
Musculoskeletal diseases	280	4.1
Injuries	778	11.4
Other specific diseases	964	14.1
Geriatric symptoms	487	7.1
Other diseases and symptoms	1144	16.9
Ten most common discharge diagnoses and their ICD10 codes		
Urinary tract infection (N10, N30, N39.0)	490	7,2
Pneumonia (J12-J18)	435	6,4
Congestive heart failure (I50)	368	5,4
Alzheimer's disease (G30)	343	5,0
Hip fracture (S72)	242	3,6
Malignant neoplasms (C00-C26, C30-C41, C43-C58, C60-C97)	237	3,5
Malaise and fatigue (R53)	195	2,9
Atrial fibrillation and flutter (I48)	180	2,6
Cerebral infarction (I63)	171	2,5
Acute myocardial infarction (I21)	158	2,3

Table 3. The univariate analysis showing the associations between the RAI-Hc determinants and the diagnosis groups

	Infectious diseases			Dementia diseases			Cardiovascular diseases			Cerebrovascular diseases			Musculoskeletal diseases			Injuries			Other specific diseases			Geriatric symptoms			Other diseases and symptoms		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Demographic																											
Age			0.247			0.006			<.001			0.04			0.103			<.001			<.001			0.034			<.001
63-74v	1			1			1			1			1			1			1	1		1			1		
75-79v	1.18	0.96-1.45		1.69	1.19-2.40		1.05	0.80-1.39		1.40	0.93-2.09		1.19	0.76-1.85		1.08	0.81-1.42		0.60	0.49-0.74		1.52	1.09-2.10		0.79	0.64-0.97	
80-84v	1.22	1.02-1.46		1.72	1.24-2.37		1.49	1.17-1.89		1.37	0.95-1.98		1.32	0.90-1.96		1.25	0.98-1.60		0.47	0.39-0.57		1.23	0.91-1.68		0.72	0.60-0.87	
85-89v	1.11	0.92-1.34		1.54	1.10-2.15		1.83	1.44-2.33		1.41	0.97-2.04		1.58	1.07-2.33		1.50	1.18-1.92		0.41	0.33-0.50		1.7	0.85-1.61		0.66	0.55-0.80	
90+v	1.20	0.97-1.49		1.20	0.80-1.78		2.29	1.77-2.97		0.80	0.49-1.30		1.01	0.62-1.65		1.59	1.21-2.10		0.36	0.28-0.47		1.79	1.28-2.50		0.54	0.43-0.69	
Gender			0.356			0.245			0.159			0.855			0.002			<.001			0.001			0.177			0.063
Male	1			1			1			1			1			1			1			1			1		
Female	0.94	0.34-1.07		1.13	0.92-1.40		0.90	0.78-1.04		0.98	0.77-1.25		1.54	1.17-2.04		1.53	1.28-1.81		0.79	0.68-0.91		1.15	0.94-1.41		0.88	0.77-1.01	
Social situation																											
Living alone	0.87	0.77-0.99	0.033	0.89	0.85-1.07	0,9	0.99	0.85-1.15	0.920	0.90	0.70-1.14	0.377	1.15	0.88-1.49	0.300	1.12	0.95-1.32	0.168	0.87	0.75-1.00	0.056	1.25	1.02-1.53	0.03	1.15	1.00-1.32	0.040
Caregiver stressed	1.16	0.95-1.41	0.138	1.63	1.22-2.17	<.001	0.86	0.67-1.11	0.252	1.17	0.81-1.71	0.405	0.65	0.39-1.06	0.806	0.88	0.67-1.16	0.366	1.17	0.93-1.48	0.174	0.93	0.67-1.29	0.659	0.75	0.59-0.95	0.02
Housing defects	1.09	0.95-1.23		0.88	0.70-1.11	0.283	0.99	0.85-1.16	0.941	0.90	0.69-1.18	0.450	0.93	0.70-1.22	0.592	1.14	0.96-1.35	0.132	0.88	0.75-1.04	0.129	1.09	0.88-1.33	0.461	0.99	0.85-1.15	0.912
Use of services																											
Reason for home care: client has been discharged from hospital	1.19	0.96-1.22	0.193	0.68	0.55-0.85	<.001	1.16	1.01-1.35	0.034	0.94	0.74-1.20	0.640	0.79	0.61-1.02	0.074	0.92	0.78-1.08	0.289	0.92	0.80-1.06	0.260	0.93	0.76-1.12	0.463	1.06	0.93-1.20	0.388
Hospitalization during one year before assessment	0.96	0.84-1.10	0.533	0.64	0.52-0.79	<.001	1.09	0.93-1.29	0.289	0.92	0.71-1.20	0.550	0.94	0.72-1.24	0.664	0.77	0.66-0.91	0.002	1.31	1.11-1.55	0.002	1.02	0.83-1.27	0.837	1.23	1.06-1.44	0.007
Acute outpatient care in 90 days before assessment	1.06	0.94-1.19	0.343	0.70	0.57-0.86	<.001	0.98	0.85-1.14	0.822	0.84	0.66-1.07	0.156	1.00	0.78-1.28	0.972	0.75	0.64-0.88	<.001	1.25	1.09-1.44	0.002	1.02	0.84-1.23	0.874	1.16	1.02-1.32	0.026
Function																											
ADLH (0 - 6)			<.001			<.001			<.001			0.651			0.05			0.032			0.40			0.243			0.007
0	1			1			1			1			1			1			1			1			1		
1-2	1.32	1.13-1.54		1.82	1.44-2.31		0.71	0.58-0.88		0.93	0.68-1.29		0.82	0.58-1.16		0.97	0.79-1.19		0.91	0.75-1.11		1.24	0.98-1.58		0.75	0.62-0.90	
3-4	1.67	1.40-2.01		1.71	1.28-2.29		0.72	0.56-0.93		1.19	0.83-1.71		0.59	0.36-0.96		0.79	0.60-1.03		0.82	0.64-1.06		0.94	0.68-1.30		0.81	0.64-1.01	
5-6	2.16	1.52-3.07		1.55	0.85-2.84		0.54	0.30-0.99		0.76	0.31-1.86		0.30	0.07-1.22		0.38	0.18-0.817		0.92	0.57-1.51		0.79	0.38-1.62		1.09	0.72-1.66	
Client believes he/she is capable of improving	0.81	0.69-0.96	0.013	0.58	0.43-0.79	<.001	1.05	0.87-1.27	0.589	1.23	0.92-1.64	0.159	1.00	0.73-1.38	0.989	0.95	0.78-1.17	0.638	1.23	1.03-1.46	0.03	1.00	0.78-1.29	0.985	1.19	1.01-1.40	0.039

	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
performance in physical function																											
CPS			*<.001*			*<.001*			*<.001*			*0.359*			*0.002*			*0.284*			*<.001*			*0.186*			*<.001*
0	1			1			1			1			1			1			1			1			1	0.76-1.00	
1-2	1.02	0.90-1.16		8.27	5.62-12.16		0.76	0.65-0.88		1.22	0.95-1.58		0.77	0.60-0.99		1.12	0.95-1.31		0.75	0.65-0.86		1.10	0.90-1.35		0.87	0.76-1.00	
3-4	1.52	1.22-1.89		14.67	9.43-22.82		0.59	0.43-0.80		1.33	0.86-2.05		0.37	0.20-0.72		0.93	0.68-1.27		0.55	0.40-0.75		1.03	0.70-1.49		0.69	0.53-0.91	
5-6	1.49	1.17-1.90		17.84	11.33-28.08		0.49	0.34-0.71		1.26	0.76-2.07		0.46	0.23-0.90		0.87	0.61-1.24		0.55	0.38-0.78		1.50	1.04-2.18		0.51	0.36-0.72	
Clinical symptoms																											
Urinary incontinence daily	1.52	1.32-1.74	*<.001*	1.11	0.88-1.41	*0.383*	0.81	0.68-0.98	*0.029*	0.81	0.60-1.10	*0.177*	0.95	0.70-1.29	*0.732*	0.93	0.77-1.13	*0.461*	0.78	0.65-0.94	*0.009*	0.95	0.75-1.21		0.93	0.79-1.09	*0.375*
Fecal incontinency	1.57	1.29-1.91	*<.001*	1.59	1.17-2.15	*0.003*	0.58	0.42-0.79	*<.001*	0.89	0.57-1.38	*0.588*	0.652	0.38-1.11	*0.112*	0.76	0.56-1.04	*0.082*	0.94	0.72-1.22	*0.621*	0.93	0.65-1.32	*0.677*	1.01	0.80-1.27	*0.942*
Chronic skin ulcers	1.43	1.18-1.73	*<.001*	0.35	0.21-0.59	*<.001*	0.99	0.77-1.27	*0.914*	0.72	0.46-1.14	*0.165*	0.90	0.58-1.41	*0.650*	0.55	0.39-0.76	*<.001*	1.19	0.94-1.50	*0.150*	0.87	0.61-1.22	*0.412*	1.24	1.00-1.53	*0.05*
Mouth problems	0.90	0.77-1.05	*0.168*	1.08	0.83-1.40	*0.566*	1.35	1.10-1.65	*0.003*	1.15	0.84-1.57	*0.386*	0.96	0.70-1.31	*0.783*	1.01	0.83-1.23	*0.904*	0.96	0.80-1.15	*0.669*	0.85	0.67-1.07	*0.171*	0.95	0.80-1.12	*0.505*
Vision			*0.173*			*0.188*			*0.920*			*0.922*			*0.389*			*0.414*			*0.114*			*0.9*			*0.087*
good enough	1			1			1			1			1			1			1			1			1		
moderately impaired	1.10	0.96-1.26		1.22	0.98-1.51		0.97	0.82-1.15		1.06	0.81-1.38		0.92	0.69-1.23		0.99	0.83-1.18		1.00	0.85-1.18		0.96	0.77-1.20		0.84	0.72-0.98	
severely impaired	1.28	0.91-1.81		0.88	0.46-1.68		1.06	0.69-1.62		0.99	0.48-2.04		0.52	0.19-1.41		1.22	0.87-2.03		0.57	0.33-0.97		0.92	0.51-1.67		0.97	0.65-1.44	
Falls during 90 days before assessment	1.03	0.91-1.17	*0.603*	0.79	0.63-0.97	*0.027*	0.92	0.79-1.07	*0.269*	0.97	0.76-1.24	*0.793*	0.93	0.72-1.21	*0.579*	1.37	1.17-1.60	*<.001*	0.87	0.75-1.02	*0.079*	1.29	1.06-1.56	*0.01*	0.91	0.79-1.04	*0.179*
DRS			*0.280*			*<.001*			*0.005*			*0.735*			*0.141*			*0.059*			*0.015*			*0.771*			*0.976*
0-2	1			1			1			1			1			1			1			1			1		
3-14	0.92	0.78-1.07		1.57	1.25-1.97		0.75	0.61-0.91		0.95	0.70-1.29		1.25	0.93-1.69		0.82	0.66-1.01		1.25	1.04-1.48		1.04	0.81-1.32		1.00	0.85-1.19	
Feeling lonely	0.86	0.75-0.99	*0.036*	1.29	1.04-1.60	*0.023*	0.89	0.75-1.06	*0.189*	0.94	0.72-1.24	*0.684*	1.07	0.81-1.41	*0.650*	1.01	0.85-1.21	*0.890*	0.89	0.75-1.05	*0.166*	1.37	1.12-1.68	*0.003*	1.11	0.96-1.28	*0.177*
Poor self-rated health	1.05	0.93-1.18	*0.478*	0.62	0.49-0.77	*<.001*	0.94	0.81-1.09	*0.386*	0.89	0.69-1.13	*0.308*	1.49	1.17-1.90	*0.001*	0.87	0.74-1.03	*0.099*	1.12	1.03-1.37	*0.017*	0.96	0.79-1.17	*0.698*	1.09	0.96-1.25	*0.196*
BMI			*0.661*			*0.003*			*0.003*			*0.518*			*0.331*			*<.001*			*<.001*			*0.439*			*0.245*
<18.5	0.96	0.74-1.25		0.85	0.55-1.33		0.75	0.52-1.07		0.59	0.32-1.08		0.87	0.48-1.57		1.07	0.78-1.47		1.60	1.22-2.08		1.30	0.90-1.89		0.85	0.63-1.14	
18.5-23.9	1			1	1		1			1			1			1			1			1			1		
24-29.9	1.09	0.95-1.26		0.96	0.76-1.21		1.18	1.00-1.41		0.89	0.67-1.17		1.14	0.84-1.53		0.92	0.77-1.10		0.96	0.76-1.21		0.99	0.79-1.24		1.02	0.87-1.19	
≥ 30				0.62	0.44-0.86		1.37	1.11-1.68		0.96	0.68-1.35		1.41	0.99-2.00		0.59	0.46-0.77		0.92	0.74-1.14		0.99	0.75-1.32		1.16	0.96-1.40	
PAIN			*0.741*			*<.001*			*0.285*			*0.039*			*<.001*			*0.095*			*0.173*			*0.695*			*0.031*
0-1	1			1			1			1			1			1			1			1			1		
2-3	1.02	0.90-1.15		0.62	0.50-0.77		0.92	0.80-1.07		0.77	0.60-0.99		1.99	1.57-2.53		0.87	0.75-1.02		1.10	0.96-1.27		0.96	0.79-1.17		1.15	1.01-1.31	
Diagnoses																											
Congestive heart failure	1.11	0.95-1.26	*0.248*	0.45	0.34-0.61	*<.001*	3.07	2.65-3.56	*<.001*	0.55	0.40-0.77	*<.001*	0.74	0.54-1.02	*0.062*	0.74	0.61-0.90	*0.002*	0.83	0.70-0.98	*0.031*	0.79	0.62-1.00	*0.049*	0.79	0.67-0.92	*0.003*
Coronary artery disease	1.02	0.89-1.16	*0.777*	0.64	0.50-0.81	*<.001*	2.20	1.90-2.54	*<.001*	0.89	0.68-1.16	*0.390*	1.15	0.89-1.50	*0.289*	0.73	0.61-0.87	*<.001*	0.77	0.65-0.91	*0.002*	0.95	0.77-1.18	*0.650*	0.90	0.78-1.04	*0.166*

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	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Alzheimer's disease	0.95	0.82-1.10	.510	6.56	5.38-8.00	<.001	0.55	0.45-0.68	<.001	1.02	0.76-1.36	.918			.056	1.17	0.98-1.41	.087	0.50	0.41-0.62	<.001	1.11	0.88-1.39	.393	0.79	0.66-0.93	.005
Other dementia	0.94	0.83-1.07	.354	7.67	6.19-9.50	<.001	0.56	0.47-0.67	<.001	1.21	0.95-1.54	.129	0.68	0.51-0.91	.009	1.20	1.02-1.41	.026	0.573	0.48-0.68	<.001	1.08	0.89-1.32	.473	0.82	0.71-0.95	.006
Old stroke	1.44	1.13-1.83	.003	0.23	0.10-0.53	<.001	0.68	0.47-0.97	.034	2.27	1.56-3.31	<.001			.207	0.81	0.57-1.16	.255	0.90	0.66-1.25	.536	1.16	0.79-1.72	.454	1.04	0.78-1.37	.80
Parkinson' disease	0.90	0.66-1.23	.497	0.80	0.46-1.38	.417	0.47	0.29-0.77	.002	0.48	0.21-1.09	.08	0.63	0.30-1.36	.240	1.25	0.87-1.80	.220	2.26	1.70-3.01	<.001	1.08	0.68-1.72	.743	0.89	0.64-1.26	.514
Parkinson's disease and dementia	0.58	0.29-1.18	.134	2.26	1.11-4.60	.024	0.31	0.10-0.99	.047	1.00	0.31-3.12	.993	0.36	0.05-2.58	.307	2.11	1.16-3.82	.014	1.6	0.84-2.85	.160	0.84	0.70-2.31	.731	0.86	0.44-1.69	.567
Musculoskeletal disorders	1.05	0.92-1.20	.461	0.67	0.53-0.86	.001	0.95	0.81-1.12	.547	0.91	0.70-1.19	.493	1.62	1.23-2.08	<.001	1.34	1.14-1.58	<.001	0.80	0.67-0.94	.007	1.04	0.85-1.29	.690	0.98	0.84-1.13	.747
Old hip fracture	0.71	0.50-1.00	.05	0.87	0.50-1.50	.607	0.55	0.34-0.88	.013	1.30	0.75-2.25	.355	1.01	0.53-1.92	.986	1.87	1.35-2.60	<.001	1.06	0.74-1.53	.740	1.25	0.79-1.97	.348	0.98	0.70-1.38	.913
Old other fracture	0.96	0.71-1.31	.805	0.67	0.37-1.21	.184	1.11	0.78-1.58	.554	0.74	0.38-1.45	.374	1.33	0.77-2.32	.306	1.65	1.18-2.29	.003	0.93	0.65-1.35	.714	0.96	0.59-1.56	.861	0.79	0.55-1.12	.179
Cancer	0.88	0.72-1.08	.236	0.50	0.33-0.77	.002	0.70	0.54-0.91	.009	0.65	0.41-1.03	.064	0.65	0.40-1.05	.08	0.54	0.40-0.74	<.001	3.30	2.74-3.96	<.001	0.87	0.63-1.21	.418	0.94	0.76-1.17	.599
Renal insufficiency	0.93	0.72-1.19	.548	0.52	0.31-0.89	.016	1.67	1.30-2.16	<.001	0.62	0.34-1.11	.106	0.69	0.39-1.25	.219	0.64	0.45-0.93	.019	1.35	1.03-1.76	.029	0.95	0.64-1.41	.806	0.99	0.76-1.30	.960
Psychiatric diagnosis	0.92	0.77-1.10	.923	1.15	0.87-1.52	.313	0.80	0.64-1.00	.05	0.85	0.59-1.23	.391	0.65	0.42-0.99	.044	0.78	0.61-1.00	.047	1.28	1.05-1.55	.015	1.19	0.91-1.55	.197	1.23	1.03-1.49	.023
Chronic obstructive pulmonary disease	1.22	1.03-1.45	.022	0.42	0.28-0.63	<.001	1.01	0.81-1.25	.960	0.48	0.30-0.76	.002	1.06	0.74-1.52	.737	0.81	0.63-1.03	.081	1.47	1.21-1.78	<.001	0.79	0.58-1.07	.133	1.08	0.89-1.30	.441
Diabetes	1.00	0.88-1.15	.968	0.66	0.52-0.85	.001	1.39	1.19-1.63	<.001	0.69	0.51-0.92	.012	0.98	0.74-1.30	.878	0.70	0.58-0.85	<.001	1.30	1.12-1.52	<.001	0.93	0.75-1.16	.532	1.00	0.86-1.16	.987
Medication																											
Number of drugs *			.018			<.001			<.001			<.001			.369			.003			.683			.016			.441
0-4	1			1			1			1			1			1			1			1			1		
5-9	1.20	0.99-1.47		0.57	0.44-0.74		1.27	0.99-1.69		0.91	0.65-1.28		1.24	0.79-1.94		0.97	0.76-1.24		1.01	0.79-1.28		1.30	0.95-1.81		1.04	0.84-1.30	
10 or more	1.02	0.83-1.25		0.28	0.21-0.37		2.07	1.58-2.72		0.52	0.36-0.74		1.36	0.87-2.11		0.75	0.59-0.96		1.07	0.84-1.35		1.0	0.72-1.38		1.12	0.90-1.39	
Psychotropic medication	0.96	0.85-1.08	.467	1.08	0.89-1.31	.422	0.95	0.83-1.10	.50	0.81	0.64-1.01	.062	0.91	0.71-1.15	.424	1.02	0.87-1.18	.849	1.08	0.94-1.25	.255	1.08	0.90-1.30	.401	1.05	0.92-1.19	.476
Influenza vaccination	1.18	1.05-1.33	.005	0.86	0.71-1.04	.117	1.23	1.07-1.42	.004	0.96	0.76-1.20	.698	0.98	0.77-1.24	.849	0.95	0.82-1.11	.536	0.89	0.77-1.02	.100	0.80	0.66-0.96	.016	0.96	0.84-1.09	.505
Health stability																											
CHESS			.466			.058			.377			.367			.176			<.001			.006			.543			.009
0	1			1			1			1			1			1			1			1			1		
1	1.02	0.89-1.17		0.87	0.69-1.12		1.06	0.89-1.26		0.83	0.63-1.10		0.93	0.70-1.24		0.81	0.68-0.97		1.20	1.01-1.42		0.96	0.77-1.21		1.09	0.94-1.27	
2-5	1.09	0.95-1.25		1.19	0.95-1.49		1.13	0.95-1.33		0.87	0.66-1.15		0.75	0.56-1.02		0.67	0.56-0.81		1.30	1.10-1.53		1.10	0.88-1.37		0.84	0.72-0.98	

* including prescription and non-prescription medications

OR= odds ratio

ADLh =The Activities of Daily Living Hierarchy

CPS=The Cognitive Performance Scale

DRS= The Depression Rating Scale

PAIN=The Pain Scale

CHESS= The Changes in Health, End-Stage Disease, Signs, and Symptoms Scale

Table 4. The multivariable analysis showing the associations between the RAI-HC determinants and diagnosis groups

	Infectious diseases			Dementia diseases			Cardiovascular diseases			Cerebrovascular diseases			Musculoskeletal diseases			Injuries			Other specific diseases			Geriatric symptoms			Other diseases and symptoms		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Demographic																											
Age			0.118			0.223			<.001			0.026			0.156			0.177			<.001			0.003			0.001
63-74v																											
75-79v	1.23	1.00-1.51		1.48	1.01-2.16		1.03	0.77-1.37		1.44	0.96-2.18		1.15	0.77-1.80		1.04	0.78-1.38		0.64	0.51-0.80		1.55	1.11-2.16		0.80	0.65-0.99	
80-84v	1.29	1.07-1.56		1.26	0.88-1.79		1.36	1.05-1.74		1.47	1.01-2.16		1.32	0.88-1.98		1.15	0.89-1.48		0.55	0.45-0.67		1.25	0.91-1.71		0.77	0.64-0.94	
85-89v	1.20	0.98-1.46		1.13	0.78-1.63		1.69	1.31-2.19		1.49	1.00-2.21		1.52	1.00-2.29		1.29	1.00-1.67		0.50	0.40-0.63		1.17	0.84-1.63		0.72	0.59-0.89	
90+v	1.26	1.00-1.58		1.05	0.68-1.62		2.03	1.53-2.70		0.83	0.50-1.38		0.98	0.59-1.64		1.33	0.99-1.78		0.46	0.35-0.61		1.81	1.27-2.58		0.60	0.47-0.77	
Gender			0.736			0.536			0.007			0.892			0.289			0.002			0.951			0.300			0.058
Male																											
Female	0.98	0.85-1.12		1.07	0.85-1.36		0.80	0.68-0.94		0.98	0.76-1.28		1.18	0.87-1.59		1.33	1.11-1.6		1.00	0.85-1.17		1.12	0.90-1.40		0.87	0.75-1.01	
Social situation																											
Caregiver stressed	1.03	0.83-1.26	0.818	1.12	0.82-1.54	0.483	1.09	0.82-1.43	0.564	1.18	0.79-1.75	0.419	0.76	0.45-1.27	0.297	1.02	0.77-1.36	0.880	1.22	0.95-1.58	0.116	0.87	0.61-1.22	0.415	0.890	0.63-1.03	0.086
Use of services																											
Reason for home care: client has been discharged from hospital	1.13	0.99-1.28	0.063	1.04	0.82-1.33	0.720	1.17	1.00-1.37	0.050	0.93	0.72-1.20	0.558	0.78	0.59-1.02	0.072	0.95	0.89-1.13	0.564	0.94	0.80-1.10	0.424	0.90	0.73-1.10	0.292	0.98	0.86-1.13	0.806
Hospitalization during one year before assessment	0.89	0.77-1.03	0.112	0.99	0.79-1.25	0.948	0.96	0.80-1.15	0.645	1.07	0.81-1.42	0.619	1.00	0.74-1.34	0.984	0.87	0.72-1.04	0.115	1.08	0.90-1.30	0.407	1.08	0.86-1.36	0.509	1.19	1.02-1.40	0.032
Acute outpatient care in 90 days before assessment	1.06	0.93-1.20	0.387	0.83	0.66-1.04	0.110	0.95	0.81-1.11	0.524	0.91	0.71-1.17	0.457	0.97	0.75-1.26	0.812	0.81	0.68-0.95	0.012	1.13	0.97-1.31	0.120	1.01	0.83-1.23	0.898	1.13	0.99-1.29	0.081
Function																											
ADLH (0 - 6)			0.004			0.976			0.496			0.533			0.529			0.228			0.638			0.335			0.138
0																											
1-2	1.23	1.04-1.47		1.04	0.79-1.37		0.83	0.66-1.05		0.94	0.66-1.34		1.03	0.71-1.49		0.99	0.79-1.24		0.99	0.80-1.24		1.18	0.91-1.54		0.82	0.67-1.00	
3-4	1.40	1.12-1.75		1.08	0.74-1.59		0.97	0.71-1.32		1.30	0.83-2.02		0.77	0.44-1.34		0.85	0.62-1.17		0.83	0.62-1.12		0.90	0.61-1.32		0.90	0.69-1.17	
5-6	1.65	1.11-2.50		1.00	0.48-2.08		0.93	0.48-1.80		0.83	0.31-2.24		0.41	0.09-1.78		0.45	0.20-1.00		0.83	0.47-1.45		0.70	0.32-1.56		1.23	0.77-1.99	
Client believes he/she is capable of improving performance in physical function	0.87	0.74-1.04	0.118	0.96	0.68-1.34	0.794	1.02	0.84-1.25	0.842	1.24	0.92-1.69	0.164	0.99	0.70-1.38	0.933	0.97	0.78-1.20	0.764	1.05	0.87-1.27	0.610	1.02	0.79-1.33	0.868	1.06	0.90-1.26	0.486
CPS			0.036			<.001			0.881			0.933			0.323			0.803			0.054			0.164			0.020
0																											
1-2	1.06	0.92-1.22		4.10	2.72-6.18		0.94	0.79-1.11		1.10	0.83-1.45		0.86	0.65-1.14		1.02	0.85-1.22		0.85	0.72-1.00		1.04	0.83-1.30		0.92	0.79-1.07	
3-4	1.45	1.13-1.88		4.70	2.84-7.78		0.97	0.68-1.39		1.10	0.67-1.83		0.52	0.23-1.06		0.87	0.61-1.24		0.63	0.44-0.91		0.97	0.63-1.50		0.79	0.58-1.07	
5-6	1.17	0.86-1.59		5.66	3.27-9.8		0.91	0.58-1.43		1.072	0.58-1.98		0.79	0.36-1.74		0.92	0.60-1.43		0.72	0.47-1.10		1.62	1.01-2.60		0.53	0.36-0.79	
Clinical symptoms																											
Urinary incontinence daily	1.24	1.05-1.45	0.009	0.89	0.66-1.19	0.415	0.93	0.76-1.15	0.518	0.79	0.56-1.12	0.182	1.12	0.80-1.56	0.525	1.04	0.84-1.30	0.693	0.88	0.71-1.09	0.231	0.92	0.70-1.19	0.519	1.01	0.84-1.21	0.918
Fecal incontinency	1.14	0.91-1.44	0.256	1.25	0.85-1.83	0.262	0.73	0.52-1.04	0.084	0.92	0.55-1.52	0.734	0.84	0.47-1.50	0.562	0.93	0.66-1.30	0.658	0.99	0.73-1.34	0.952	0.91	0.61-1.35	0.629	1.16	0.89-1.52	0.266

	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Chronic skin ulcers	1.35	1.11-1.65	0.003	0.59	0.34-1.02	0.057	0.81	0.62-1.06	0.129	0.84	0.53-1.35	0.478	0.88	0.56-1.39	0.582	0.64	0.46-0.90	0.009	1.20	0.85-1.40	0.475	0.90	0.63-1.28	0.547	1.20	0.96-1.49	0.114
Mouth problems	1.03	0.88-1.22	0.687	1.18	0.89-1.57	0.271	1.28	1.03-1.59	0.026	1.12	0.81-1.57	0.495	0.90	0.65-1.25	0.527	0.89	0.72-1.10	0.284	0.98	0.81-1.20	0.852	0.86	0.67-1.10	0.218	0.89	0.75-1.06	0.200
Falls during 90 days before assessment	1.01	0.89-1.15	0.878	0.82	0.65-1.04	0.100	0.99	0.84-1.17	0.891	1.01	0.78-1.30	0.973	0.91	0.69-1.20	0.506	1.43	1.21-1.68	<.001	0.81	0.69-0.96	0.013	1.24	1.01-1.51	0.039	0.91	0.79-1.05	0.180
DRS			0.100			0.008			0.442			0.853			0.313			0.198			0.058			0.542			0.976
0-2		(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)	
3-14	0.86	0.72-1.03		1.46	1.11-1.93		0.91	0.72-1.15		1.03	0.73-1.47		1.19	0.85-1.68		0.86	0.68-1.08		1.22	0.99-1.50		0.92	0.70-1.21		1.00	0.83-1.21	
Feeling lonely	0.9	0.77-1.04	0.153	1.15	0.90-1.48	0.261	0.93	0.77-1.12	0.425	0.95	0.71-1.28	0.756	0.89	0.66-1.20	0.430	1.01	0.83-1.22	0.949	0.90	0.75-1.08	0.257	1.35	1.08-1.69	0.007	1.13	0.97-1.32	0.130
Poor self-rated health	1.05	0.92-1.20	0.500	0.80	0.62-1.03	0.083	0.90	0.76-1.06	0.214	1.05	0.80-1.38	0.727	1.28	0.98-1.68	0.074	0.98	0.82-1.18	0.859	1.03	0.87-1.21	0.726	0.92	0.74-1.14	0.439	1.04	0.89-1.20	0.647
BMI			0.693			0.241			0.810			0.260			0.632			0.118			0.001			0.519			0.436
<18.5	0.99	0.76-1.30		0.83	0.51-1.33		0.92	0.64-1.34		0.62	0.34-1.15		0.82	0.45-1.51		1.06	0.77-1.47		1.43	1.08-1.91		1.24	0.85-1.82		0.81	0.6-1.10	
18.5-23.9		(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)	
24-29.9	1.09	0.944-1.26		1.03	0.80-1.33		1.04	0.87-1.25		0.94	0.71-1.25		1.12	0.82-1.52		0.97	0.81-1.17		0.82	0.69-0.99		1.03	0.82-1.30		1.00	0.85-1.17	
≥ 30	1.02	0.84-1.24		0.92	0.64-1.33		1.12	0.89-1.41		1.26	0.88-1.82		1.27	0.87-1.85		0.72	0.55-0.95		0.77	0.61-0.98		1.14	0.84-1.53		1.09	0.90-1.34	
PAIN			0.872			0.972			0.017			0.392			<.001			0.492			0.938			0.829			0.231
0-1		(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)	
2-3	0.99	0.87-1.13		1.00	0.78-1.29		0.82	0.69-0.97		0.89	0.68-1.17		1.76	1.35-2.29		0.94	0.79-1.12		0.99	0.85-1.17		0.98	0.79-1.21		1.09	0.94-1.26	
Diagnoses																											
Congestive heart failure	1.02	0.88-1.19	0.757	0.75	0.54-1.03	0.072	2.40	2.05-2.82	<.001	0.64	0.45-0.90	0.011	0.64	0.46-0.89	0.008	0.86	0.70-1.05	0.138	0.86	0.71-1.04	0.112	0.80	0.62-1.03	0.082	0.76	0.64-0.90	0.001
Coronary artery disease	0.96	0.83-1.10	0.542	0.88	0.67-1.15	0.349	1.71	1.46-2.00	<.001	1.08	0.82-1.43	0.596	1.15	0.87-1.52	0.335	0.79	0.66-0.96	0.018	0.80	0.67-0.96	0.014	1.02	0.82-1.23	0.844	0.91	0.78-1.06	0.216
Alzheimer's disease	1.02	0.80-1.30	0.889	1.77	1.31-2.38	<.001	0.84	0.60-1.18	0.324	0.68	0.45-1.04	0.073	0.96	0.55-1.67	0.871	0.94	0.70-1.25	0.659	0.71	0.52-0.98	0.039	1.07	0.74-1.55	0.728	0.89	0.68-1.16	0.380
Other dementia	0.82	0.66-1.02	0.077	2.63	1.91-3.64	<.001	0.67	0.50-0.90	0.007	1.30	0.89-1.89	0.172	0.80	0.49-1.33	0.393	1.18	0.91-1.55	0.219	0.91	0.69-1.19	0.488	0.92	0.66-1.30	0.648	1.08	0.85-1.36	0.536
Old stroke	1.23	0.96-1.59	0.102	0.32	0.14-0.73	0.007	0.66	0.45-0.96	0.032	2.27	1.52-3.39	<.001	0.80	0.42-1.54	0.501	1.00	0.69-1.46	0.992	0.85	0.61-1.20	0.361	1.30	0.87-1.95	0.208	0.96	0.72-1.28	0.774
Parkinson's disease	0.85	0.61-1.17	0.304	0.89	0.50-1.59	0.689	0.57	0.35-0.94	0.029	0.47	0.21-1.08	0.074	0.66	0.31-1.44	0.298	1.27	0.88-1.85	0.205	2.26	1.66-3.06	<.001	1.12	0.70-1.81	0.630	0.82	0.58-1.17	0.272
Musculoskeletal disorders	1.10	0.94-1.29	0.229	0.85	0.63-1.16	0.304	0.92	0.76-1.12	0.408	1.02	0.74-1.41	0.901	1.44	1.08-1.93	0.014	1.14	0.93-1.40	0.200	0.76	0.62-0.93	0.008	1.04	0.81-1.34	0.738	1.00	0.84-1.18	0.965
Old hip fracture	0.64	0.44-0.92	0.017	1.15	0.61-2.16	0.661	0.58	0.35-0.97	0.036	1.43	0.77-2.63	0.256	0.80	0.41-1.58	0.521	1.61	1.11-2.32	0.011	1.31	0.87-1.98	0.197	1.17	0.71-1.92	0.550	0.99	0.68-1.43	0.950
Old other fracture	0.91	0.65-1.26	0.568	0.85	0.44-1.64	0.620	1.33	0.90-1.98	0.159	0.73	0.35-1.50	0.386	0.98	0.54-1.78	0.949	1.40	0.97-2.02	0.074	1.16	0.77-1.75	0.484	0.92	0.54-1.55	0.741	0.74	0.51-1.08	0.118
Cancer	0.91	0.73-1.12	0.353	0.71	0.45-1.12	0.136	0.67	0.51-0.89	0.005	0.63	0.40-1.02	0.058	0.65	0.39-1.06	0.0862	0.63	0.46-0.87	0.005	2.84	2.34-3.45	<.001	0.91	0.65-1.28	0.587	0.85	0.68-1.06	0.142
Renal insufficiency	0.87	0.67-1.12	0.281	0.87	0.50-1.52	0.630	1.19	0.90-1.56	0.222	0.80	0.44-1.46	0.470	0.72	0.39-1.31	0.275	0.82	0.56-1.20	0.303	1.25	0.94-1.66	0.120	1.03	0.69-1.54	0.896	0.96	0.73-1.27	0.794
Chronic obstructive pulmonary disease	1.20	1.00-1.43	0.049	0.73	0.48-1.22	0.153	0.71	0.56-0.90	0.004	0.58	0.36-0.93	0.025	1.02	0.70-1.48	0.938	1.02	0.79-1.32	0.873	1.32	1.07-1.63	0.009	0.90	0.66-1.24	0.533	1.01	0.83-1.23	0.920
Diabetes	0.93	0.80-1.08	0.343	0.93	0.71-1.23	0.614	1.15	0.97-1.37	0.107	0.72	0.53-0.99	0.042	1.01	0.75-1.37	0.935	0.87	0.71-1.07	0.190	1.32	1.11-1.56	0.002	1.04	0.82-1.31	0.756	0.92	0.78-1.07	0.278
Medication																											
Number of drugs *			0.123			<.001			<.001			0.004			0.807			0.509			0.998			0.052			0.601
0-4		(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)			(ref)	
5-9	1.02	0.83-1.26		0.69	0.52-0.91		0.97	0.73-1.31		0.96	0.68-1.37		1.11	0.70-1.75		1.06	0.82-1.36		21.00	0.78-1.28		1.36	0.97-1.90		1.07	0.85-1.34	
10 or more	1.17	0.93-1.46		0.47	0.33-0.66		1.37	1.01-1.86		0.62	0.41-0.92		1.02	0.63-1.65		0.95	0.73-1.26		1.00	0.77-1.31		1.10	0.77-1.58		1.12	0.88-1.43	
Influenza vaccination	1.12	0.99-1.27	0.065	0.95	0.77-1.17	0.609	1.09	0.94-1.27	0.278	1.06	0.84-1.35	0.616	0.92	0.71-1.17	0.483	1.00	0.86-1.17	0.967	0.94	0.81-1.09	0.417	0.79	0.65-0.95	0.015	0.98	0.86-1.11	0.707
Health stability																											
CHESS																											
0			0.811			0.854			0.117			0.753			0.381			0.023			0.041			0.738			0.048

	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
1	0.96	0.83-1.11	0.93	0.72-1.21	1.03	0.86-1.23	0.91	0.69-1.22	0.89	0.66-1.19	0.86	0.71-1.03	1.14	0.96-1.36	0.96	0.76-1.21	1.10	0.94-1.28
2-5	0.96	0.82-1.12	0.96	0.74-1.24	1.21	1.00-1.47	1.03	0.76-1.39	0.80	0.57-1.11	0.76	0.62-0.93	1.27	1.05-1.53	1.06	0.84-1.35	0.88	0.74-1.04

* including prescription and non-prescription medications
OR= odds ratio
ADLh =The Activities of Daily Living Hierarchy
CPS=The Cognitive Performance Scale
DRS= The Depression Rating Scale
PAIN=The Pain Scale
CHESS= The Changes in Health, End-Stage Disease, Signs, and Symptoms Scale

Additional Supporting Information may be found in the online version of this article: https://doi.org/10.1016/j.archger.2018.06.008