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Assessment of the "Post-Acute Care Discharge Scores" (PACD) [Translated from the Original Article in German Published in Pflegewissenschaft 2015; 11: 582-95]

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Abstract

A systematic and early biopsychosocial assessment of older patients in acute care hospitals is necessary for a proactive and effective discharge plan in order to identify patients at risk for a care deficit after hospitalization. Our study aim was to adapt the, "Post Acute Care Discharge" (PACD) Scores developed in Geneva for use in the Cantonal Hospital of Aarau and evaluate as screening instruments in selected medical patients in a medical university clinic. Among 308 patients admitted from home with urinary tract infections, falls, syncope or heart failure day 1 PACD ≥ 8 had a sensitivity of 90% and a specificity of 62% and day 3 PACD ≥ 8 a sensitivity of 80% and a specificity of 60% to identify a nursing care deficit. The PACD is used as a screening instrument to identify patients at risk and therefore facilitate a structured, interdisciplinary and patient-centered analysis of the situation and discharge plan.

Keywords: Screening method; Post-acute care needs; Hospitalized medical patients

Introduction

In Switzerland, 17.2% of the total population comprises adults older than 65 years of age with an increasing tendency [1]. Living with one or more chronic diseases is common in older adults. Consequently, there is an increase in nursing care needs in this group of patients [2]. Patients with treatable medical conditions are usually admitted to acute hospitals if they have no family members to provide them with nursing care. Later during hospital stay, nursing problems often arise [3,4]. Simonet et al. [5] reported that the most frequent cause for delayed hospital discharge was the non-availability of a bed in a post-acute care institution. According to Boutin-Foster et al. [6], 30% of delayed hospital discharges were due to non-medical reasons. For example, when discharge to home is not possible, no free bed in a nursing home is available or delivery of nursing or medical aids is delayed. For inpatients with respiratory tract infections, nursing care reasons such as waiting for a free bed in a post-acute institution have become significantly more important [7]. Even in medically stable respiratory tract infection patients with a structured triage and discharge plan, organizational reasons were responsible in 50% of the cases for delayed discharge [8]. A prolonged hospital stay due to nursing and organizational reasons was evident in 42.7% of medically stable patients with decompensated heart failure [9]. In contrast to this, regarding discharge decision, physicians, nurses, patients and relatives give priority to medical reasons [10,11].

Older patients who are hospitalized due to acute conditions often lose functional abilities and independency of Activities of Daily Living (ADL) [3,12-14]. Maintaining self-care abilities is therefore essential for the discharge plan and for preparing patients to get back to their former living situation. Moreover, half of the patients who were older than 70 years and were hospitalized with an acute medical condition were not able to recover to their baseline function one year after discharge [15]. They suffered from serious consequences such as admission to a nursing home or death. For this reason, patients with biopsychosocial risks should be early identified–preferably at hospital admission, in order to determine discharge and follow-up care needs.

The German Experts Standard on "discharge management in nursing" emphasized that early systematic assessment is required to estimate post-discharge care deficit of patients in order to suit their needs [16]. Moreover, the Austrian "Quality Standard for admission and discharge management"[17] concluded that the discharge planning should begin with the nursing anamnesis. Patients' and relatives' feeling of insecurity is usually due to the lack of professional post care. Furthermore, rehospitalization could be caused by the interruption of care. Bowles et al. [18] suggest an automatized decision-making assessment to identify patients with post-discharge care needs. A standardized assessment to identify patients with post-discharge care needs is also considered to be needed by Holland et al. [19]. To be successful, nurse-guided discharge planning requires multidisciplinary collaboration and communication with patients and their families [16,20]. A comprehensive arrangement of discharge and post care for older patients leads to better patient outcomes, decreases the rate of rehospitalization and shortens the length of hospital stay [21-23].

Background

Predictors of post-acute care needs

Campbell et al. [24] identify physical functioning, age, presence of geriatric problems, male gender and living alone as predictors of a discharge to a post-acute care institution. Rudberg et al. [25] investigated characteristics of patients admitted to a nursing home after hospital discharge. The authors found following determinants:

older age, living alone and preexisting limitations in the ADL before hospitalization. Cornette et al. [26] outlined age, limited Instrumental Activities of Daily Living (IADL), cognitive deficiency, rate of fall in the last years and poor self-evaluation as the five risk factors which could be assessed at admission. A systematic review recognized older age, cognitive deficiency, difficulties with ADL and IADL before admission, and depression as the strongest predictors of functional decline [27].

The following factors remained constantly important in the various studies: older age, living alone, functional disability and preexisting limitations in the ADL respectively IADL prior the hospital admission [24-26].

Assessment tools/Measurements

Grosse Schlarmann et al. [28] reviewed the Self-Care Index (SPI), which was created based on the result-oriented nursing assessment, acute care (ePA-ac), as a screening tool to identify post-discharge nursing care deficit.

In a data analysis of 620 cases, the SPI showed with a cut-off < 32 a sensitivity of 81% and a specificity of 94%. However, the activities of the social workers as part of the nursing case management initiated with SPI<32 were used as external validation criterion.

The BRASS (Blaylock Risk Assessment Screening Score)-Index is a further discharge planning instrument which is applied shortly after admission. It predicts the necessity of discharge planning and can therefore prevent problems and undetected post-discharge care needs. The original English BRASS Instrument was translated and tested for validity in the Netherlands by Mistiaen et al. [29]. The Index composes information about age, living situation/emotional support, functional and cognitive status, behavioral pattern, mobility, perceptional deficit, previous hospital stays and emergency consultations, medically active problems and medication use. The authors found that with a cut-off of 9 points, the BRASS-Index has a sensitivity of 76% and a specificity of 75% in detecting a discharge to a location other than home. When applied in rehabilitation (n=104), the BRASS-Index was modified using Rasch analysis. In regard to reliability (0.78) and construct validity (correlation with FIM, r=-0.853; p<0.001; a higher risk of discharge to a nursing home at a Score of 12 RR=2.1, 95% CI=1.7-2.5), it shows a potential for further examination [30]. In a publication of an article 2010, Hoogerduijn et al. [31] compared the instruments Identification of Seniors at Risk (ISAR), Hospital Admission Risk Profile (HARP) and Care Complexity Prediction Instrument (COMPRI). The aim was to show the instrument which most precise identifies patients with a risk of functional disability. None of the instruments was satisfactorily able to provide a valid estimation of the addressed risk.

Boutin-Foster et al. [6] used a preexisting instrument of the social services and a literature research to generate the SWAAT (Shock Waves therapy and Arginine for Achilles Tendinopathy)-Score. It is supposed to identify patients with complicated social needs who require social services within 24 hours. The SWAAT reached a test-retest reliability of 0.7, the determination coefficient was r^2=0.40 (p=0.05), the AUC (Area Under the Curve): 0.75 and the relationship between SWAAT and both the need for social services (p<0.001) and the duration of hospital stay was significant (p<0.001). Items of the SWAAT Scores are limited ability to walk, patient cannot be discharged to the former place of residence, has home health care services, needs additional help at home, needs help to leave the hospital and/or with medical visits, is confused at admission and lives alone.

The Post-Acute Care Discharge scores (PACD) were developed in Geneva to identify patients with post-acute care needs, to enable the discharge plan to be discussed during ward rounds [5]. Two models with significant predictors (PACD version day-1 and day-3) were calculated to predict a discharge to a post-acute care institution. Both versions (day-1 and day-3) showed good predictive ability in medicinal patients (AUC: 0.81 and 0.82 respectively). Scores of ≥ 8 PACD day 3 reached a sensitivity of 87% and a specificity of 63% [5]. The PACD includes information about medically active problems, the support situation at home and the age. Furthermore are questions integrated related to ADL/IADL which is very much in line with the Swiss nursing culture. The PACD is best applicable for a risk estimation of a post-acute care need after hospital discharge and an early assessment at Interdisciplinary Emergency Center (INZ), because the questions are related to the situation prior the admission [32].

Aim of the Study

The aim of phase two of the OPTIMA Project (Optimized Patient Transfer through Innovative Multidisciplinary Assessment) [33] was to locally test the applicability of the PACD and to analyse the PACD as screening instruments in order to identify potential improvements or modifications. In addition, we intended to clarify whether the ideal point of time for the application of PACD was within 24 hours on day-1 or on day-3. The sensitivity and specificity of the Swiss-German modified PACD's should be validated to evaluate its applicability on all medicinal patients of the Cantonal Hospital of Aarau AG (KSA; a teaching hospital in the German-speaking Switzerland)

Methods

Design

For the purposes, a prospective observational design has been selected.

Sample

Patients' recruitment and data collection was carried out in the interdisciplinary emergency center and on the wards of the medical university clinic of the KSA. Around 6000 patients are admitted yearly to the department of internal medicine which has around 400 employees from various disciplines. Four prevalent diagnoses were selected and a sample of around 400 patients was aimed for (1 winter season).

Patients were consecutively included if they were more than 18 years old, diagnosed with heart failure, fall, syncope or urinary tract infection and were admitted to the emergency department. Patients with limited cognitive ability or inability to communicate in German were excluded from the study.

Ethical considerations

Within the framework of the OPTIMA project, the quality management project was approved by the ethics commission of the canton Aargau (EK AG 2010/029). The responsible physician informed the patients orally and in a written form about the quality management project. The ethical commission waived an informed consent because

of the observational nature of the study and to avoid selection bias. An oral consent was obtained from the patients for the telephone interview one month after the first data collection.

Instruments

To estimate the risk of post-acute care needs, patients' living situation was assessed using the PACD (Version day-1 and day-3). The PACD Version day-1 includes 15 items (Figure 1):

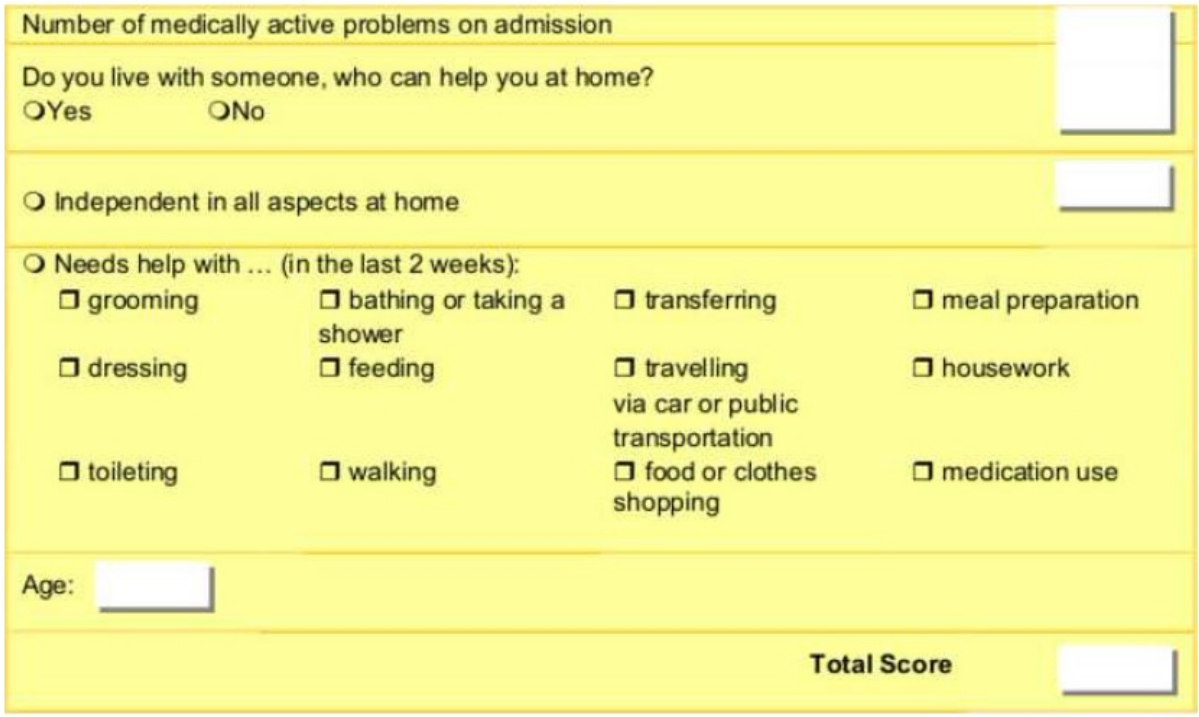

Figure 1: PACD day.

- The number of medically active problems on admission (1 point for each affected organ system). A medically active problem is one with therapeutic or diagnostic consequences for the actual treatment. One point is given for each organ system (based on the ICD 10 categories), whereas in some cases two points are given for diagnoses like respiratory tract infections with one point for the organ system and one point for the infectious disease. Are there more than one problem in the same organ system (for example, anemia, thrombopenia, leukopenia as a hematological problem) only one point is given (personal communication with Louis Simonet 17.05.2010; unpublished clinical documents 2010)
- Unavailability of a person in the same household who can provide help (4 points).
- Number of limitations in 12 ADLs or IADLs (grooming, dressing/undressing, toileting, bathing or taking a shower, feeding, moving, transferring, travelling *via* car or public transportation, food or clothes shopping, meal preparation, housework, medication use (1 point per limitation).
- Age (1 point for each decade starting at the age of 60; for example, 2 points for someone between 70-79 years old).

"Internal hospital transfer", an item of the original score [5], occured rarely in the pilot study conducted in 2009/2010 in patients with respiratory tract infections [33] where it could not significantly predict the risk for post-acute care needs. Therefore, it was omitted in the KSA version.

In the original Geneva PACD day-1, no scoring was defined for the admission day model, because only the day-3 version score was implemented. The principle for point definition used by the authors for the scoring version day-3 [5] was adopted and applied on day-1 model. To define the point allocation, the standardized regression coefficients of day-1 model were compared with each other. Based on their value in relation to each other, proportional points per answer were defined (see explanation of day-3 scoring). Based on clinical considerations, the point definition for the age group was set to start from the age of 60, where one risk point was given for each 10 years with a maximum of 5 points for patients older than 99 years.

- The cut-off for risk determination was set to ≥ 8 points.
- The PACD version day-3 contained 5 items (Figure 2):
- The medically active problems at admission (1 point for each affected organ system)
- If the patient did not live with someone at home who could help (4 points)
- If the patient needed help with medication management before hospital admission (4 points)
- Dependency for bathing/taking a shower on day-3 (4 points)
- Dependency in transfers bed/chair on day-3 (4 points)

The scoring was adopted from Simonet et al. [5]. The justification of the point definition in the original PACD was as follows. The number of medically active problems, which is a continuous predictor in the

logical regression model, showed a regression coefficient of 0.24. This value was 4 times smaller than the standard regression coefficient of the other 4 predictors. Therefore, the 4 predictors were assigned 4 points and the medical problems 1 point pro problem [5].

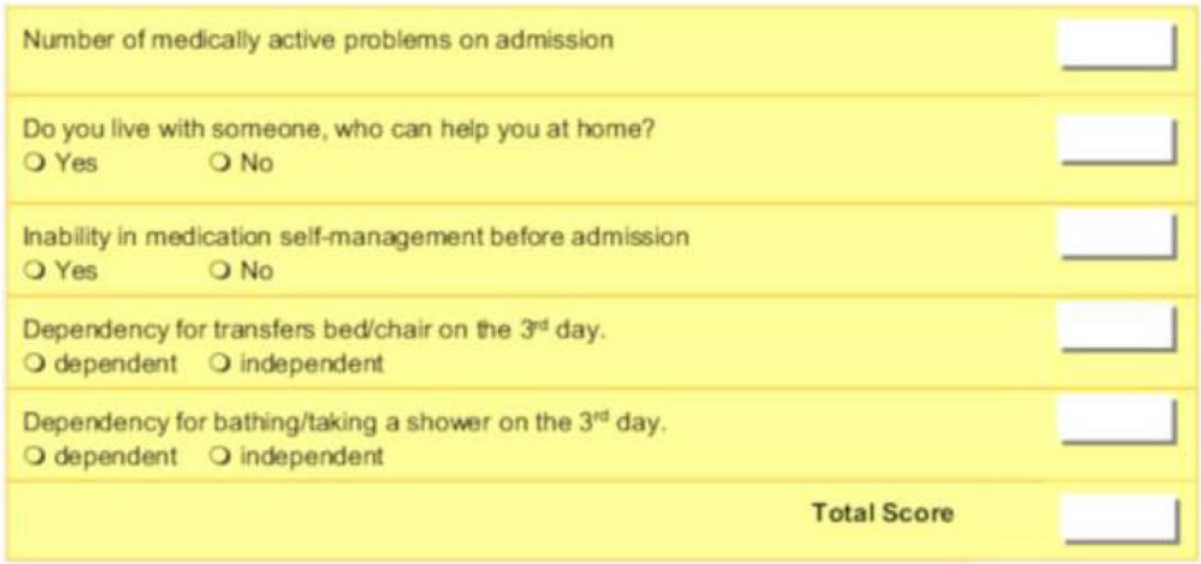

Figure 2: PACD day 3

The cut-off of risk determination for post-acute care need with PACD day-3 was adopted from the Geneva Version with ≥ 8 points [5]. The scoring of both the PACD version day-1 and day-3 was verified on patients with respiratory tract infections as part of the pilot study OPTIMA I (n=180) in the KSA. Both versions showed the best cut-off with 8 points showing an acceptable sensitivity and specificity (day-1: sensitivity 82%, specificity 55%, AUC: 0.80; day-3 was primarily tested on the fourth day: sensitivity 69%, specificity 76%, AUC: 0.79) [7,33]. Consequently, the cut-off of PACD day-1 was set to ≥ 8 points. Based on the PACDs, patients were then divided in two or three categories. For the allocation of patients in two categories, low risk was assigned to scores<8 and a risk for post-acute care needs was assigned to scores ≥ 8. On the other hand, for the allocation of patients to three categories, a low risk for post-acute care needs was assigned to<8, a raised risk to 8-15 and a very high risk to scores >15 points. A risk for post-acute care need was defined as discharge to a post-acute care facility (for example, temporary care, transient nursing care, health resort treatment, rehabilitation or nursing home).

Data collection

Data collection was carried out from September 2010 to September 2011. Data were collected from patients with the above-mentioned health problems. Physicians at the INZ collected clinical characteristics like confusion and the number of comorbidities. The health care team at the INZ (nurses/physicians) collected and evaluated the PACD day-1 (admission day). If this was not possible, the PACD scores were collected retrospectively by the study team members on the ward using the same questions. In this case, data were collected from interviewing the patient and from the clinical patient record. On the third day after admission, the nursing staff of the ward evaluated in addition to the information from the PACD day-1 the patients' abilities for grooming and mobility. The SPI was measured as part of the standard nursing assessment within the first three days after admission. Patients' residence prior to admission (for example, home, transfer from another hospital, nursing or elderly home, etc.), discharge destination, nursing care complications or death of patients were collected from the electronic clinical patient records by the study team. Patient discharge home/to a geriatric apartment (with or without formal or informal ambulatory support) was differentiated from discharge to a post-acute care facility (temporarily or permanently).

Data cleaning

The consistency of the answers based on the same situation (point of admission or before) of day-1 and day-3 scores was verified. Whereas the questioning on day-1 and day-3 was conducted by different persons and on two different locations (emergency room/ward), 94 pieces of information (10% of the cases) which should have been identical (as they were related to the situation before admission) were differently documented. All inconsistency was revised from the electronic clinical patients' records and verifiably modified. Any missing data were not replaced.

Analysis of the diagnostic quality

Knottnerus et al. [34] recommend the evaluation of the diagnostic estimations. They point out that the development and evaluation of the research-based diagnostic methods are less common than the evaluation of interventions in the evidence-based health care. To evaluate the diagnostic quality, a test objective should be defined. In this study, the test objective was to identify the risk of post-discharge transfer to a post-acute care facility.

The analysis aimed to illustrate the reliability of using the PACD on admission day and on the third hospitalization day to estimate the post-acute care needs.

The key figures are sensitivity, specificity and "Receiver Operating Characteristics" (ROC) with "Area Under the Curve" (AUC). An AUC

test of 0.5 was considered useless, while an AUC test of 1.0 was the maximal score [34].

The primary endpoint of the study was the discharge to post-acute care facility. The calculations of the AUC ("Area Under the Curve", resulting from the ROC "Receiver Operating Curve" analysis) and the sensitivity and specificity of the PACD on day-1 and day-3 were based on this target value.

Description measurement of the diagnostic tests PACD day-1 and 3

The PACD should be implemented as a screening tool in the patient triage to identify every potential patient at risk of post-acute care needs who needs further assessment. Therefore, the requirement of high sensitivity and adequate specificity is justified. Scores of >70% sensitivity and if possible >70% specificity are recommended [35]. For the interpretation of the test question, the sensitivity is the most important measure followed by the AUC and the specificity. A very low specificity is considered unfavourable as it would lead to unnecessary extra assessment of the patients (additional effort), who do not need post-acute care transfer [34].

ROC analysis and AUC

ROC analysis was used to analyse the PACD score from day-1 and day-3 with the target variable "transfer to an institution" and to determine the AUC (SPSS, 2007) [36]. The AUC evaluated the PACD day-1 and day-3 and the cut-offs were determined using the ROC analysis.

Patient characteristics were analysed descriptively using frequencies, percentages, median, mean and standard deviation based on the data types and variable distributions. Statistical analysis was performed using SPSS Version 20.0.

Results

Sample characteristics

A total of 371 patients with urinary tract infection, congestive heart failure, fall or syncope who were admitted to the INZ of the KSA and were then transferred to a medical university clinic ward were included in the study.

The average age of patients was 68.9 years; 43.9% were males. The majority lived at home with a partner/family (62.5%). The number of patients who lived in a nursing home before admission varied depending on the diagnosis (1.3%-16.5%). The sociodemographic data like age, gender and living situation are shown in Table 1. The medical characteristics of patients with congestive heart failure [9] and patients with urinary tract infections [37] were published previously.

	Patients total (n=371)	Syncope (n=132)	Urinary tract infection (n=127)	Congestive heart failure (n=75)	Fall (n=37)
Sociodemographic characteristics					
Gender					
Male, number (%)	163 (43.9%)	71 (53.8%)	34 (26.8%)	43 (57.3%)	15 (40.5%)
Age mean; median	68.9;74.6	65.8; 72.2	61.8; 67.9	79.8; 81.5	82.1; 84.0
(SD)	(± 19.7)	(± 20.6)	(± 20.8)	(± 8.75)	(± 10.9)
Living Situation, number (%)					
Living alone	103 (28.2%)	40 (30.3%)	19 (15.7%)	28 (37.3%)	16 (43.2%)
Living with partner/family	228 (62.5%)	90 (68.2%)	79 (65.3%)	44 (58.7%)	15 (40.5%)
Geriatric and nursing home	27 (7.4%)	2 (1.5%)	20 (16.5%)	1 (1.3%)	4 (10.8%)
Another location, eg. geriatric apartment	7 (1.9%)	-	3 (2.5%)	2 (2.7%)	2 (5.4%)

Table 1: Sociodemographic characteristics.

71.1% of patients reported the availability of someone who could help within the household (Table 2). The results showed the extent to which patients required help with the IADL within two weeks before admission. Patients showed an average of 2.8 (SD ± 4.0) restrictions in the ADL/IADL and the majority of patients showed no restrictions before admission (median 0).

Patients with congestive heart failure and falls were older, lived more alone at home and required more help before hospital admission. Moreover, patients with urinary tract infections were mostly females and lived in nursing or elderly homes before admission.

The number of medically active problems at admission to the INZ was a median of 2. Nursing complications were observed in 18.4% of the patients and 4.9% of patients died during hospitalization (Table 3). The collected data on day-3 showed that 55.3% of the patients were dependent with bathing or taking a shower and 31.8% needed help with transferring. Consequently, fall patients were the most restricted in this regard. This was supported by the first estimation of the SPI results.

	Patients total (n=371)	**Syncope (n=132)**	**Urinary tract infection (n=127)**	**Congestive heart failure (n=75)**	**Fall (n=37)**
Living with a person who can provide help, number (%)	256 (71.1%)	90 (69.8%)	107 (87.0%)	47 (64.4%)	12 (34.3%)
Formal help in the last two weeks before admission, number (%)					
Nursing care at home, housework with nursing care	77 (21.2%)	11 (8.3%)	29 (24.0%)	23 (31.1%)	14 (37.8%)
Informal help in the last two weeks before admission, number (%)					
Help from family, neighbors, friends	80 (22.0%)	21 (15.9%)	25 (20.7%)	25 (33.8%)	9 (24.3%)
Needed help before admission to the hospital with: number (%)					
Grooming	90 (25.0%)	15 (11.6%)	39 (31.7%)	21 (28.8%)	15 (42.9%)
Dressing	73 (20.3%)	13 (10.1%)	28 (22.8%)	19 (26.0%)	13 (37.1%)
Toileting	51 (14.2%)	7 (5.4%)	25 (20.3%)	12 (16.4%)	7 (20.0%)
Bathing or taking a shower	94 (26.1%)	16 (12.4%)	40 (32.5%)	23 (31.5%)	15 (42.9%)
Feeding	32 (8.9%)	5 (3.9%)	17 (13.8%)	5 (6.8%)	5 (14.3%)
Walking	54 (15.0%)	6 (4.7%)	28 (22.8%)	13 (17.8%)	7 (20.0%)
Transferring	46 (12.8%)	6 (4.7%)	25 (20.3%)	10 (13.7%)	5 (14.3%)
Travelling *via* car or public transportation	99 (27.5%)	18 (14.0%)	40 (32.5%)	27 (37.0%)	14 (40.0%)
Food or clothes shopping	116 (32.2%)	20 (15.5%)	44 (35.8%)	33 (45.2%)	19 (54.3%)
Meal preparation	107 (29.7%)	20 (15.5%)	41 (33.3%)	27 (37.0%)	19 (54.3%)
Housework	132 (36.7%)	25 (19.4%)	48 (39.0%)	36 (49.3%)	23 (65.7%)
Medication use	100 (27.8%)	17 (13.2%)	43 (35.0%)	24 (32.9%)	16 (45.7%)
Number of limited	2.8; 0.0	1.3; 0.0	3.4; 0.0	3.4; 2.0	4.5; 4.0
ADL /IADL; mean; median (SD)	(±4.0)	(±2.9)	(±4.5)	(±3.9)	(±4.2)

Table 2: Availability and need for help prior to hospital admission; total patients.

	Patients total (n=371)	Syncope (n=132)	Urinary tract infection (n=127)	Congestive heart failure (n=75)	Fall (n=37)
Clinical Characteristics					
Hospital Status, number (%)					
Ambulatory	90 (24.3%)	56 (42.4%)	29 (22.8%)	2 (2.7%)	3 (8.1%)
Inpatient	281 (75.7%)	76 (57.6%)	98 (77.2%)	73 (97.3%)	34 (91.9%)
Number of medically active problems at admission; Mean; Median (SD)	2.6; 2.0 (± 1.4)	2.1; 2.0 (± 1.4)	2.9; 3.0 (± 1.2)	2.6; 2.0 (± 1.3)	3.5; 3.0 (± 1.6)
Self-Care Index (SPI) Day 1-3; Mean; Median (SD)	34.2; 38.0 (± 7.6)	37.9; 40.0 (± 3.7)	32.1; 37.0 (± 9.2)	32.8; 35.0 (± 7.7)	30.2; 30.5 (± 6.5)
Charlson Comorbidity Index; Mean; Median (SD)	4.6; 5.0 (± 3.3)	3.9; 4.0 (± 3.2)	3.9; 4.0 (± 3.4)	6.6; 6.0 (± 2.7)	5.5; 6.0 (± 2.5)

Nursing complications, number (%)	68 (18.4%)	14 (10.6%)	25 (20.0%)	19 (25.3%)	10 (27.0%)
Death during hospital stay, number (%)	18 (4.9%)	2 (1.5%)	5 (3.9%)	7 (9.3%)	4 (10.8%)
Confusion, number (%)	33 (8.9%)	4 (3.0%)	21 (16.7%)	3 (4.0%)	5 (13.5%)
Independent with bathing or taking a shower day 3, number (%)	146 (55.3%)	30 (44.8%)	51 (54.3%)	39 (54.9%)	26 (81.3%)
Independent transferring day 3, number (%)	84 (31.8%)	13 (19.4%)	34 (36.2%)	21 (29.6%)	16 (50.0%)
* SPI: the higher the score, the more independent. Minimum 10, maximum 40.					

Table 3: Clinical characteristics; total patients.

The average PACD-Score on day-1 was considerably higher in fall patients than in patients with one of the other evaluated diseases (Table 4).

The majority of patients (77.7%) were discharged home, 11.3% were discharged to a nursing home, 3.4% to temporary care, 2.8% to other places, 2.3% to rehabilitation, 2.0% to another hospital and 0.6% to health resort treatment. Most of the patients discharged home had syncopes and most of the patients discharged to a post-discharge care institution (rehabilitation, health resort, temporary care or nursing homes) experienced falls (Table 5).

Diagnostic key figures

With a sensitivity of 90%, the PACD day-1 Score ≥ 8 points was more sensitive (62% specificity) than the score ≥ 8 day-3 with 80% (60% specificity) (Table 6). In all cases, the PACD showed the best sensitivity with a cut-off ≥ 8. With cut-offs >8 or >9 the specificity was higher which consequently caused a decrease in the sensitivity.

The accuracy related to transfer in a post-acute institution was good on day-1 and day-3 (AUC: 0.82-0.87 and AUC: 0.79-0.81 respectively). The PACD version day-1 reached the maximum accuracy (AUC 0.87) in the whole group of patients (Figure 3).

	Patients total (n=371)	**Syncope (n=132)**	**Urinary tract infection (n=127)**	**Congestive heart failure (n=75)**	**Fall (n=37)**
PACD–Score* day 1; Mean; Median (SD)	8.4; 7.0 (± 5.8)	6.2; 5.0 (± 4.9)	8.2; 6.0 (± 6.0)	9.9; 9.0 (± 5.2)	13.5; 13.0 (± 5.1)
PACD–Score* day 3 Mean; Median (SD)	9.0; 8.0 (± 5.5)	7.8;6.0 (± 5.1)	8.9; 7.0 (± 5.8)	8.5; 7.0 (± 5.2)	13.3; 14.5 (± 4.5)
*PACD: the higher the score the higher the risk					

Table 4: PACD Scores.

	Patients total (n=371)	**Syncope (n=132)**	**Urinary tract infection (n=127)**	**Congestive heart failure (n=75)**	**Fall (n=37)**
Discharge locations, number (%)					
At home	275 (77.7%)	117 (90.0%)	92 (75.4%)	50 (72.5%)	16 (48.5%)
Rehabilitation	8 (2.3%)	2 (1.5%)	1 (0.8%)	3 (4.3%)	2 (6.1%)
Health resort treatment	2 (0.6%)	1 (0.8%)	-	-	1 (3.0%)
Temporary care	12 (3.4%)	3 (2.3%)	2 (1.6%)	3 (4.3%)	4 (12.1%)
Nursing home	40 (11.3%)	3 (2.3%)	19 (15.6%)	8 (11.6%)	10 (30.3%)
Other hospital	7 (2.0%)	3 (2.3%)	1 (0.8%)	3 (4.3%)	-
Other location, e.g. geriatric apartment	10 (2.8%)	1 (0.8%)	7 (5.7%)	2 (2.9%)	-

Table 5: Discharge locations.

Discussion

The aim of the study was to illustrate the ability of the PACD to identify post-acute care needs. The diagnostic value of the PACDs for risk identification showed the following three main points. The screening quality of the PACD on day-1 is high with a sensitivity of 90%. The main criterion to evaluate the screening ability of PACD is the high sensitivity, as the instrument is intended to be used for screening purposes. As expected, the instrument showed lower specificity, however it is considered high enough for the instrument intended purpose. The specificity reached almost 70% and therefore lies near the recommended range for screening tests. As a global measurement, the AUC confirmed the benefits of systematic estimation.

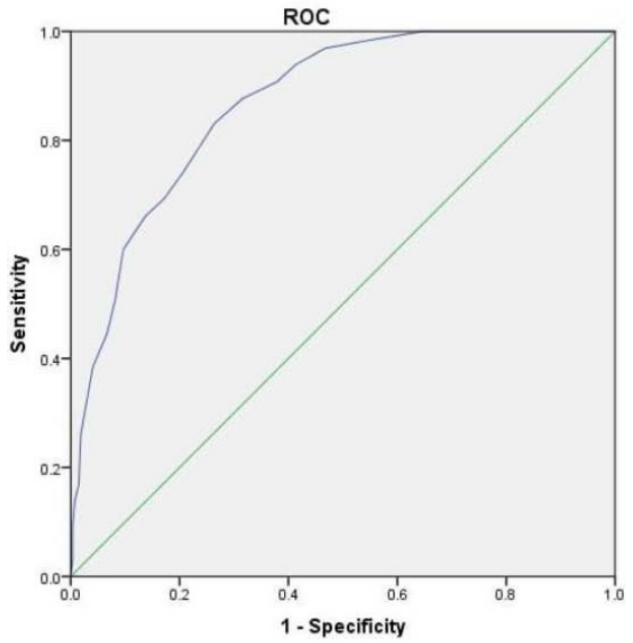

Figure 3: ROC curve PACD day 1; total patients.

The current study showed slightly lower sensitivity and specificity (80% and 60% respectively) on day-3 compared to the values of the Geneva PACD scores: sensitivity 87% and specificity 63% [5]. Moreover, the AUC-values of day-1 (AUC: 0.82 *vs.* AUC Geneva: 0.81) and the values of day-3 (AUC: 0.79 *vs.* AUC Geneva: 0.82) were similar [5]. The overall relatively small differences in day-1 could be attributed to the age factor – weighted 60 years and above – and to the exclusion of the item "transfer within the hospital".

The results of the first project phase OPTIMA I [33] confirmed a significant relationship between the risk of post-acute care needs of patients with respiratory tract infections and transfer destination, which could also be shown in the Geneva version [5]. In the more extended diagnosis groups of OPTIMA II, the estimation of biopsychosocial risks showed sensitivity and specificity similar to that of the respiratory tract infection patients, hence a potential additional benefit to the discharge organization.

Strengths and limitations

As recommended in the expert standard [16], in Bowles et al. [18] and in Holland et al. [19], the PACD–with its good sensitivity and specificity values–can be used as a standardized assessment instrument to early identify patients with post-acute care needs. The PACD data can be collected mainly by nurses, which is in accordance with the expert standards [16]. The physicians' role with the PACD is limited to the assessment of the medically active problems. Data collection is tested in the clinical context and has been proven feasible.

Some limitations of the study need to be addressed. Data were not collected from 11 (3%) of the potential patients at admission or during their hospital stay due to the poor general condition of the patients, the need for intensive medical treatment or patients' refusal to participate in the study. Furthermore, the lack of distinct documentation resulted in missing data. Whether a patient was transferred from a nursing or elderly home to the hospital was not differentiated. Most of the elderly homes in Switzerland have an integrated nursing ward and are therefore similar to nursing homes. A possible bias is therefore improbable.

Cut-off	≥ 8	> 8	> 9
PACD day 1			
Patients total (n=3341)			
Sensitivity	91%	88%	
Specificity	62%	68%	
AUC: 0.87			
Hospital admission from home (n=308)			
Sensitivity	90%	86%	
Specificity	62%	68%	
AUC: 0.85			

Without ambulatory Patients and Patients without admitted from institution (n=233)			
Sensitivity			
Specificity	93%	88%	80%
AUC: 0.82	51%	59%	65%
PACD day 3			
Patients total (n=246)			
Sensitivity	82%	79%	
Specificity	61%	64%	
AUC: 0.81			
Hospital admission from home (n=220)			
Sensitivity	80%	76%	
Specificity	60%	64%	
AUC: 0.79			
The deviations n are evident, because not all complete records of the 371 included patients could be collected.			

Table 6: Diagnostic key figures.

Furthermore, data were collected by nurses at the INZ and on the ward. Although it probably was less standardized than that carried out by the study team, it was integrated in the clinical routine. Overall, this did not seem to be a significant problem, as only 10% of the data on day-1 and day-3 which should have been identical were documented differently. It is therefore to be assumed that the application of the instrument in the daily routine without monitoring by the study team gets less precise and causes more variable data. However, an enhanced precision is expected with progressively gained skills. The collected PACD scores were not blinded. They were accessible in the electronic patient system (day-3) and the paper documentation of the INZ (day-1) was stored in the medical history. It is therefore possible, that the decision of nurses and physicians to transfer patients to post-acute care institutions was based on the scores of the collected data.

The wide spectrum of the medical diagnosis (urinary tract infection, congestive heart failure, fall and syncope) which bears differences in the need for support, independence and social situation could have caused slight distorted positive diagnostic values (sensitivity/specificity). A misclassification in the direction of false positive rate (lower specificity) was taken into account because the aim was to reach high sensitivity. Another limitation related to the transfer to a post-acute care institution was the inability to check whether such an institution was the most suitable discharge destination. The collected data showed merely the discharge destination.

Conclusion

Although the studied patient group did not represent the whole spectrum of medical patients, it is recommended to use the PACD version of day-1 in order to start the discharge plan early. PACD day-1 might be more effective than day-3 because it allows for more time to plan the discharge and to involve the social worker at an early stage if needed. The sensitivity of day-1 was slightly higher than that of day-3. To have the emergency team, as pioneers in Switzerland, identifying extraordinarily early and systematically patients at risk seems at the first glance unfamiliar. Therefore, the health care team, especially nurses is required to understand the importance of the collected information and be able to interpret it and put it into action. In such a way, it would be possible to early identify post-acute nursing and care deficits, to set early and structured priorities, to allow nurses and physicians to analyse the situation together and to be able to react appropriately. On the one hand, a targeted assessment of the situation is important for an early discharge plan. On the other hand, it is important to involve the social workers and the physiotherapists, plan and reevaluate the required interventions for the discharge as recommended by Simonet et al. [5].

Future studies should:

- Evaluate the screening qualities of the PACD in a non-selective and larger sample of medical patients.
- Evaluate the prediction power of the PACD on the longtime course to include re-hospitalization and development of individual nursing care needs.
- Test the combination of PACD with other social, clinical information and/or laboratory biomarkers regarding prediction improvement.
- Directly compare the PACD with other screening instruments, for example, SWAAT, BRASS-Index or SPI.
- Verify the potential for process optimization by application of the screening to allow automatic referral to the social worker in a discharge-oriented case management as part of an intervention study.
- Verify whether the discharge destination was retrospectively the most suitable for the patient.

In the OPTIMA Phase 3, a multi-professional communication platform would be developed. The so-called "ward round tool" [38]

integrates the PACD systematically in patient evaluation and discussion of discharge plan during physician-nurse rounding. This would foster close collaboration between physicians, nurses and social workers. The information in the PACD about the availability and need of care or assistance at home gives the social services a prompt picture of the possible care needs. This study provided the prerequisites to develop general standards to optimize the patient process in the medical university clinic and in the whole hospital. This, in accord with the recommendation of Ackerly et al. [39] supports the development of new models of coordination between acute and post-acute care that are team-based and patient-oriented through the exchange of clinical and social information in a shared information technology.

The application of post-acute nursing care needs estimation will be further studied and evaluated. Furthermore, data of a bigger sample of medical inpatients at our university clinic will be collected 2012-2013 to re-evaluate the diagnostic characteristics of the PACD. The analysis of these data would show whether the PACD can be applied to all medical patients and which point of time is the most significant to collect the score.

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