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Extension and Validation of the Self-care Index to Predict Transfer to a Post-acute Care Institution in Internal Medicine Patients

Erweiterung und Validierung des Selbstpflegeindexes bei internistischen Patienten mit dem Ziel eine Verlegung in eine post-akute Nachsorgeinstitution vorauszusagen

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Abstract

A systematic screening of patients with a need for post-acute care is a helpful support for interprofessional discharge planning teams. We aimed to test self-care abilities, measured by the self-care index (SPI) as predictors of post-acute care transfer and to update the existing SPI prediction model.

We analysed data from a prospective, observational cohort study conducted at the Kantonsspital Aarau between February and October 2013. We updated the SPI model, adding age and gender using a training and validation data set. Logistic regression models were run on the outcome "transfer to a post-acute care facility" and judged based on their AUC (area under curve), AIC (Akaike information criterion), and BIC (Bayesian information criteria) values. ROC curves (receiver operating characteristic) were derived from the models; and cut-points for the linear predictors of the models were defined (thus defining the new scores). Sensitivities and specificities were calculated.

This study included 1372 adult internal medicine in-patients admitted from home, who either returned home or were transferred to a post-acute care institution. The total SPI score was a significant predictor for post-acute care referral ($p < 0.001$). Including age and gender in the SPI model increased the AUC to 0.85 (training) and 0.84 (validation). An improvement in the AUC by 3% (0.81 [95% CI: 0.77–0.85] to 0.84 [95% CI: 0.80–0.87]), compared to the original SPI was achieved ($p = 0.004$). The new score reached a sensitivity of 81% and specificity of 74% compared to a sensitivity of 64% and specificity of 84% for the original score.

The extended SPI can be used as a tool for individualised discharge organisation of internal medicine patients with higher accuracy.

Abstract

Ein systematisches Screening von Patienten mit einem potentiellen postakuten Pflegebedarf ist hilfreich für interprofessionelle Teams, welche die Entlassung planen. Unsere Ziele waren zu prüfen, inwieweit der Selbstpflege-Index (SPI) zur Vorhersage einer postakuten Pflegeüberweisung geeignet ist und den bestehenden Score zu verbessern.

Wir analysierten Daten einer zwischen Februar und Oktober 2013 am Kantonsspital Aarau durchgeführten prospektiven, beobachtenden Kohortenstudie. Wir aktualisierten das SPI-Modell und fügten Alter und Geschlecht hinzu. Dieses Modell überprüften wir durch Trainings- und Validierungsdatensatz. Einflüsse der Prädiktorvariablen auf die binäre Zielvariable "Überweisung in eine post-akute Pflegeeinrichtung" wurden anhand logistischer Regressionsmodelle untersucht, welche anhand ihrer AIC- und BIC-Werte sowie der AUC verglichen wurden. Es wurden Sensitivität und Spezifität berechnet.

Die Studie umfasste 1372 erwachsene stationäre Patienten der Inneren Medizin, die nach Hause zurückkehrten oder in eine postakute Pflegeeinrichtung verlegt wurden. Der Gesamtscore des SPI war ein signifikanter Prädiktor für die Überweisung in eine postakute Einrichtung ($p < 0.001$). Der Einbezug von Alter und Geschlecht erhöhte die AUC auf 0.85 (Training) und 0.84 (Validierung). Im Vergleich zum ursprünglichen SPI wurde eine Verbesserung der AUC um 3% (0.81 [95% KI: 0.77–0.85] auf 0.84 [95% KI: 0.80–0.87]) erreicht ($p = 0.004$). Der neue Score erreichte eine Sensitivität von 81% und eine Spezifität von 74% im Vergleich zu einer Sensitivität von 64% und einer Spezifität von 84% des ursprünglichen Scores.

Der erweiterte SPI bietet somit eine höhere Genauigkeit als Hilfsinstrument in der Planung der Entlassung internistischer Patienten.

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Keywords
Self-care index – social worker referral – predictive model – post-acute care transfer – screening tool – discharge destination – model update – discharge planning

Keywords
Selbstpflegeindex – Sozialdienstanmeldung – Prädiktionsmodell – post-akute Institutionsverlegung – Screeninginstrument – Austrittsort – Modellaktualisierung – Austrittsplanung

INTRODUCTION

The interprofessional team together with patients and their relatives must make a decision during the hospital stay regarding a discharge destination: home versus post-acute care (PAC) institution. The majority of internal medicine patients are discharged directly to their homes, but some need a PAC referral (Conca, Gabele, et al., 2018; Koch et al., 2019; Louis Simonet et al., 2008). In organising discharge of post-acute care patients, social workers, a case manager, or a discharge planner are involved (Conca, Ebrahim, et al., 2018; Louis Simonet et al., 2008). In a German hospital setting, 17.7% of the patients needed a case management service (Grosse Schlarmann, 2007). Louis Simonet (2008) in Geneva, Switzerland, reported a discharge rate of 30% to PAC facilities. Ward nurses may have difficulties anticipating PAC service needs (Holland et al., 2013) or consider only the obvious reasons for referral (Bowles et al., 2008). Clinicians sometimes lack relevant information (Bowles et al., 2008). Algorithms could help to involve social workers or discharge planners and are therefore their use is recommended (Bowles et al., 2019). Using a decision support tool could differentiate patients who need post-acute discharge services from those who do not need these services (Holland et al., 2017). Computerised patient records allow professionals to use algorithms to support clinical care decisions (Potthoff et al., 1997). In the United States, hospitals use systematic approaches in screening patients for enhanced discharge planning with a licensed instrument: D2S2 (Bowles et al., 2015; Bowles et al., 2012). Clinicians are under more and more pressure in discharge planning because the length of stay in hospitals is generally decreasing (Bowles et al., 2008). Changes in the environment, for example, as from fee-for-service to DRG (diagnosis-related group) financing, additionally increases the time pressure for decisions during a hospital stay (Potthoff et al., 1997). Predictive scores could assist earlier planning decisions (Fiebig et al., 2016; Warter, 2020), for instance, regarding a customised discharge destination. A more proactive approach in discharge planning is needed in order to support clinicians in their decisions, and there is a need for better-performing tools (Holland et al., 2017; Warter, 2020). Starting early can help to gain time (Holland et al., 2017; Warter, 2020). Social workers are often informed too late about organisation needs (Conca, Ebrahim, et al., 2018). In order to accelerate the process of interprofessional discharge planning, a systematic screening of the needs for a transfer to a PAC facility after hospital stay appears to be key.

The predictors of the need for support services after hospital discharge in internal medicine patients include age, absence of an informal caregiver, frailty, and deficits in physical function or performance of activities of daily living (Kobewka et al., 2020). The extended Barthel index, as measure of functional status, has also been used as a tool for discharge planning and has shown similarity to the self-care index (SPI) in a comparison study (Suter-Riederer et al., 2014). The SPI developed by Hunstein and team in the year 2005 in a German hospital aimed to predict after-care deficits after hospital discharge (Hunstein, 2016). It measures patient's capabilities and impairments in 10 activities. Hunstein initially called the index the "case-management score" (CMS), but later changed the name to self-care index ("Selbstpflege-Index" in German). It is part of a result-oriented nursing assessment "ergebnisorientiertes PflegeAssessment© (ePA©)" and is used to decide whether to involve nursing case-management or social services in hospitals for discharge organisation. This instrument considers the predictive factor deficits in physical function (Kobewka et al., 2020). The assessment of the current status of a patient's self-care skills could help the treatment teams to set an accurate starting point for discharge planning at an early stage of the hospital stay. Patients in need of a transition to a follow-up institution can also be identified by the SPI (Koch et al., 2019). For an efficient assessment, it is recommended that the SPI be integrated into routine documentation (Potthoff et al., 1997).

After his validation study, Warter (2020) doubted the usefulness of the SPI as a screening tool, because in his study the assessment after admission had only 30% sensitivity. He explained the low predictive ability of this early nursing assessment by factors that can develop during hospital stay like treatments or complications that make PAC transfer necessary (Warter, 2020). Warter also indicated gender as an influencing factor as elderly women are more often living alone (Warter, 2020).

The aim of this study was to replicate the SPI all-item model, to update the model by evaluating whether an expanded SPI model involving gender and age could better predict transfer to post-acute care, and to refine the scoring accordingly.

Table 1: Items and scoring of the self-care index (SPI).

	Dimension	Additional information
Point value: 1–4 (no ability / severely impaired ability / low impaired ability / full ability)	Movement	Self-care ability activity/movement (e.g., from bed to chair)
	Personal hygiene, upper body	Self-care ability in personal hygiene, upper body
	Personal hygiene, lower body	Self-care ability in personal hygiene, lower body
	Dressing, upper body	Self-care ability in dressing and undressing upper body
	Dressing, lower body	Self-care ability in dressing and undressing lower body
	Feeding, food	Self-care ability ingestion: food
	Feeding, drink	Self-care ability ingestion: drink
	Excretion, urine	Self-care ability urine excretion
	Excretion, stool	Self-care ability stool excretion
	Cognition/consciousness	Ability to acquire knowledge
Scoring (sum of points):	10 (full dependency)	40 (full independency)

Source: Koch et al. 2019, used with permission.

Research questions

1. Can the item-based SPI model be replicated?
2. Is a modified SPI better able to identify medical in-patients requiring transfer to post-acute care facilities?
3. How should the scoring be adapted to identify patients with an increased probability for transfer to an SPI after a hospital stay?

METHODS

Population and sample

All consecutive adult internal medicine patients admitted through the emergency department to the medical University Clinic of the Cantonal Hospital of Aarau (KSA), Switzerland – a 600-bed tertiary care hospital – were included. Excluded were patients transferred from or to another hospital, admitted from post-acute care facilities (e.g., nursing homes), or patients who died in hospital.

Data collection

Within a prospective, observational cohort study (TRIAGE) at the Kantonsspital Aarau in Switzerland, data was collected between February and October 2013 (Schuetz et al., 2013). The self-care index was part of routine clinical nursing care documentation on the ward (Hunstein, 2009). It was assessed by the nurse in charge as part of the standard nursing assessment (ePA-AC) within the first two days in the hospital. Physicians in the emergency room judged the acuity of the patient's condition by the number of active medical problems. Data was exported out of the clinical information system.

The medical coding department provided data on age, gender, pre-admission and post-discharge residence, length of stay, and international classification of disease diagnosis. The coding team extracting the endpoint discharge destination was blinded to the SPI.

Instrument

The SPI includes one cognitive item, the ability to acquire knowledge, and nine self-care abilities in activities of daily living like dressing, eating, body care, and bodily secretions (see Table 1). Each self-care activity is rated according to four levels regarding the ability to perform the tasks: from completely dependent (=1) to completely independent (=4). The items are summed to a total score of 10–40 points; the lower the values, the more abilities of self-care are impaired.
In a previous validation study, the interrater reliability of the items reached Cohen's kappa > 0.6 (Hunstein, 2007) in all items. The evaluation took place with intermediate care, traumatological, cardiological, and cardio-gastro-pneumological patients (Grosse Schlarmann, 2007) in the same hospital in which Hunstein developed the score. In another hospital, Warter (2020) found low sensitivities, particularly in internal medicine patients, in his replication study.

Endpoint

The binary endpoint for the predictive model was defined as transfer to PAC facilities (i.e., temporary care, transient nursing care, health resort treatment, rehabilitation, or nursing home).

Table 2: Patient characteristics discharged to PAC facility versus home.

	Overall	Discharged to PAC facility	Discharged to home	P-value
	n = 1372	n = 154	n = 1218	
Gender[a]: female (%) male (%)	571 (41.6%) 801 (58.4%)	93 (60.4%) 61 (39.6%)	478 (39.2%) 740 (60.8%)	<0.001
Age[b]: mean (SD); median [IQR]	66.4 (15.9) 69 [57–78]	75.3 (12.3) 77.5 [69–83]	65.3 (16.0) 68 [56–77]	<0.001
SPI first assessment on ward[b]: mean (SD); median [IQR]	35.6 (6.0); 38 [34–40]	29.0 (7.5); 30 [25–35]	36.4 (5.2); 38 [35–40]	<0.001
Length of hospital stay[b]: mean (SD); median [IQR]	7.7 (7.8); 6 [4–9]	16.8 (12.2); 14 [10–21]	6.6 (6.2); 5 [3–8]	<0.001

[a] *Chi-square tests*

[b] *Mann-Whitney U-tests*

Statistical methods

We conducted descriptive analyses calculating frequencies, percentages, means, standard deviations, medians, and interquartile ranges. Only patients with complete data were included in the analyses. To test differences according to discharge destinations (home vs. PAC facility), Chi-square tests were used for nominal variables and Mann-Whitney U tests for ordered categorical and numerical variables. Differences between the odds ratios of the individual SPI items of the two samples (Conca, Gabele, et al., 2018; Grosse Schlarmann, 2007) were tested by Chi-square. At the beginning, we randomly divided the data into two parts: a training dataset (60%) to develop the models and a validation dataset (40%) to test the models. The random split was stratified by gender, age group (tercile categories), and number of active medical problems (1, 2, 3, ≥4), providing 24 strata in order to obtain a high comparability of the two data sets. The endpoint post-acute care transfer was similar in both groups (training: 11.6%; validation: 10.8%). Logistic regression analyses were conducted for the original SPI total score and the expanded predictor models in the training data set. In order to refine the scoring, we included all individual SPI items in the model simultaneously, which provided a separate coefficient for each of the items. Then we expanded the SPI models (total score or all individual items) including age and gender. The predictors in the multivariable models were entered as one step into the analysis. We applied the prediction model derived from the training data set to the validation data set. We used the intercept value, the coefficients of each SPI individual item, and the additional variables to build the new score. To judge discrimination properties ROC (receiver operating characteristic) curves were plotted, and AUC (area under curve) were calculated with 95% confidence intervals and compared by the "roccomp" procedure (stata.com). Sensitivity and specificity for the optimal threshold in favour of sensitivity based on the index of Youden (i.e., the sum of sensitivity and specificity–1) were provided. The criteria AUC, AIC (Akaike information criterion), and BIC (Bayesian information criteria) were used to compare the performance of the original total SPI score and the updated SPI models. A weighted score based on the best model was proposed using the coefficients of the regression model as weights. Statistical significance was defined at the 5%-level. Statistical analyses were conducted using SPSS Version 24.0 (IBM Corporation) and Stata Version 15.1. (StataCorp).

RESULTS

Of 1472 eligible in-patients, 100 (7%) had to be excluded from the analysis because of missing values in the SPI.
There were 801 (58.4%) male and 571 (41.6%) female patients with a median age of 69 years (IQR: 57–78). The patients were diagnosed with diseases of the circulatory system (377, 27.5%), infectious and parasitic diseases (185, 13.5%), diseases of the respiratory system (165, 12%), diseases of the digestive system (155, 11.3%), neoplasms (143, 10.4%), and other diseases (347, 25.3%). The median duration of hospital stays was 6 days (IQR: 4–9), and 154 (11.2%) patients were admitted to a PAC facility.
The group of medical in-patients transferred to a PAC facility was older (mean age 75 years) compared to those discharged directly to home (mean age of 65 years). Women were more likely to be transferred to PAC (6.8% vs. 4.4%). The abilities of self-care at admission in hospital (SPI total score) also differed significantly ($p < 0.001$) between patients discharged to a PAC facility (median = 30) indicating lower self-care abilities than in patients discharged to home (median = 38). There were also differences in length of hospital stay between the two discharge destinations (twice as long for a PAC facility vs. home) (see Table 2).

Table 3: Odds ratios of discharge to a post-acute care institution by individual SPI-items compared to the original evaluation; both models include all individual items.

10 SPI all individual items	Medical inpatients Conca, this study		Mixed population Grosse Schlarmann, 2007	
	Odds ratio	Sig.	Odds ratio	Sig.
Activity*	0.73	0.03	0.40	<0.001
Food intake	0.70	0.17	0.51	0.38
Drink	2.67	0.001	4.32	0.07
Urine*	0.92	0.53	0.39	0.001
Stool	1.07	0.66	1.38	0.45
Body care, upper body	1.02	0.93	0.78	0.64
Body care, lower body	0.44	0.002	0.23	0.005
Dress/undress upper body	0.88	0.61	0.68	0.48
Dress/undress lower body	0.96	0.89	2.92	0.06
Acquire knowledge	0.57	<0.001	0.95	0.86

** p < 0.05 differences (Chi-square test).*
Note: Lower item values mean higher dependence in the respective dimension. Odds ratios < 1 (> 1) stand for a positive (negative) association between discharge to a post-acute care institution and the degree of dependence in the respective item's dimension.
Endpoints; timing and criteria of SPI selection:
Discharge destination post-acute care institution after hospital; first assessment SPI (Conca, this study).
Activities of the case-management by nurses; lowest assessment SPI during hospital stay (Grosse Schlarmann, 2007)

The SPI total score significantly predicted PAC transfer ($p < 0.001$) with an overall AUC of 0.81 (n = 1372). With the proposed threshold of ≤ 32 SPI points, we found a sensitivity of 64.3% and a specificity of 83.7%. The threshold for which the sum of sensitivity and specificity (index of Youden) was maximal turned out to be 35. With SPI ≤ 35, the sensitivity and specificity were 79.9% and 73.7%, respectively. In favour of higher sensitivity, the threshold was increased to ≤36, resulting in a sensitivity of 81.8% and a specificity of 68.4%. When estimating the independent effects of individual SPI items, following the work of Grosse Schlarmann (2007), not all individual items were significantly associated with PAC transfer in our internal medicine population (see Table 3). The odds ratios (OR) differed in size and direction (OR: 0.44 – 2.67). Independent significant predictors of discharge destination were: activity (OR = 0.73, $p = 0.03$), drinking (OR = 2.67, $p = 0.001$), lower body care (OR = 0.44, $p = 0.002$), and the ability to acquire knowledge (OR = 0.57, $p < 0.001$), all odds ratios relating to a one-point increase in SPI. Significant differences between SPI items between our data and the first validation (Grosse Schlarmann, 2007) were found regarding activity and urine excretion ($p < 0.05$) (see Table 3).

Table 4: Comparison of training and validation measures; Age: centered (65 years).

Model training (t), validation (v)[a] n = 814 (t), n = 558 (v)	AUC	AIC	BIC
Total SPI, t	0.824	477.0	486.4
Total SPI, v	0.808	338.9	347.6
Total SPI + age + gender, t	0.836	456.5	475.3
Total SPI + age + gender, v	0.829	321.1	329.8
SPI all individual items, t	0.828	461.6	513.3
SPI all individual items, v	0.814	328.2	336.8
SPI all individual items + age + gender, t	0.848	451.2	512.3
SPI all individual items + age + gender, v	**0.837**	**317.9**	**326.5**

[a] The analysis in the validation data set involved the score having been derived in the training data set, and thus it only used one degree of freedom.
Abbreviations: AUC, area under curve; AIC, Akaike information criterion; BIC, Bayesian information criterion.

In the validation set, the SPI total score alone yielded an AUC = 0.808 [95% CI: 0.77–0.85]. The addition of age and gender improved the AUC by 0.02. The SPI model with all individual items was better than the SPI total, with an AUC of 0.814. The best AUC and lowest AIC and BIC was reached with the inclusion of age and gender in the all-item model AUC = 0.847 (training data set) and 0.837 (validation data set). This indicates a gain in AUC of 0.03 between the original score and the extended model (see Table 4 and Figure 1) ($p = 0.004$).
The extended model, including all SPI items, age, and gender, gained in discrimination as indicated by an AUC of up to 0.842 (training) and 0.837 [95% CI: 0.80-0.87] (validation) (see Table 5).
A new scoring is proposed based on the regression coefficients of the best prediction model (Table 5):

> -0.577 + (-0.011 x activity) + (0.046 x body care upper body) + (-0.304 x body care lower body) + (-0.099 x dress/undress upper body) + (-0.661 x dress/undress lower body) + (-0.496 x food intake) + (0.972 x drink) + (-0.229 x urine) + (0.044 x stool) + (-0.537 x acquire knowledge) + (0.024 x age (centred around 65 years)) + (0.666 x gender)

From the ROC curve of this score in the whole data set, we found that a threshold of -2.4 for this score maximised the sum of sensitivity and specificity. With the threshold ≥-2.40, we calculated sensitivity at 80.5% and specificity at 73.5%.

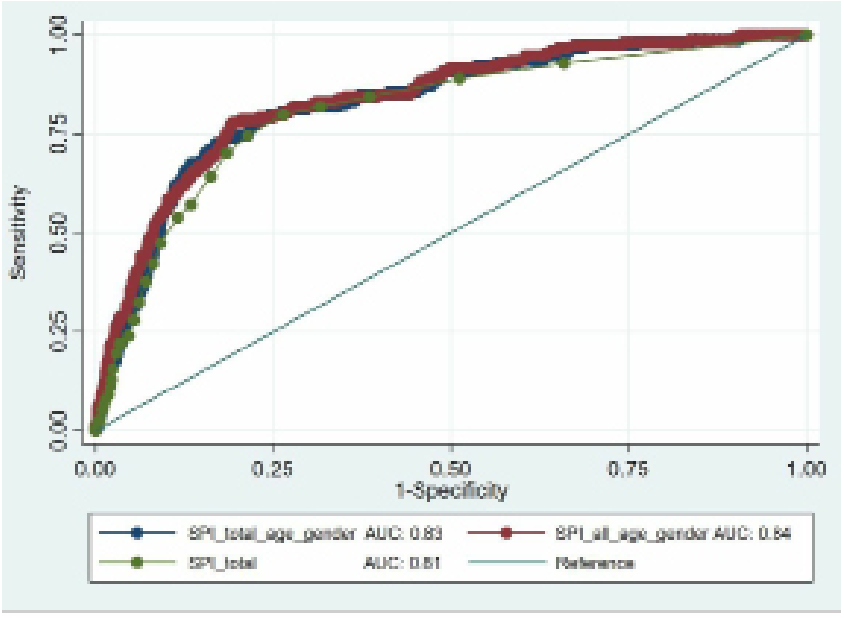


Figure 1: Validation dataset: Score involving all SPI items, age, and gender. Score involving SPI total, age and gender, and original SPI total score.

Table 5: Extended model training data set.

Extended model: SPI all individual items, age, and gender AUC = 0.842	Medical in-patients training dataset (n = 814)	
	Coefficients	Sig.
Activity	-0.011	0.957
Body care, upper body	0.046	0.895
Body care, lower body	-0.304	0.429
Dress/undress upper body	-0.099	0.781
Dress/undress lower body	-0.661	0.105
Food intake	-0.496	0.093
Drink intake	0.972	0.005
Urine excretion	-0.229	0.248
Stool excretion	0.044	0.849
Acquire knowledge	-0.537	0.005
Age (centered around 65 years)	0.024	0.013
Gender	0.666	0.010
Constant	-0.577	0.606

Limitations

The SPI data were gathered in routine care, which caused missing data, and in only one institution, which may limit generalisability of our results. The clinicians were aware of the SPI, which could have influenced their decision to refer a patient to a social worker. This may have introduced an upward bias into our probability estimates.

DISCUSSION

Our modified and extended SPI score was better able to identify medical in-patients requiring transfer to post-acute care facilities than the original SPI. Adding age and gender into the all-item SPI model improved the AUC by 3%. The original SPI total score (original endpoint: after-care deficits) was able to predict PAC transfer in medical in-patients (Koch et al., 2019). Using a threshold of ≤32 for the original SPI score to predict transfer to a PAC facility resulted in a sensitivity of 64% and specificity of 84% (Koch et al., 2019) compared to our sensitivity of 64.3% and specificity of 83.7%. Sensitivity was much lower than in the validation study of Grosse Schlarmann (2007). Warter (2020) validated the SPI on data of a mixed population in a general hospital setting and found even lower sensitivities for the endpoint "involvement of social care" (sensitivity: 30.8%). He determined in internal medicine patients widely varying key figures: gastroenterologic (sensitivity 50.0%, n = 320), hematologic (sensitivity 0%, n = 69), dermatologic (sensitivity 15.4%, n = 170), cardiologic (sensitivity 18.6%, n = 290), immunologic/rheumatologic (sensitivity 33.3%, n = 74), and nephrologic (sensitivity 68.4%, n = 80) (Warter, 2020). In all internal medicine patients, he found a sensitivity of 32.5% (n = 1003) (Warter, 2020).

This could be due to several possible reasons: overfitting of the development sample, the external setting with another population, and different discharge management procedures. According to Warter (2020), the challenge of properly predicting after-care is due to the fact that decisions are also influenced by medical and/or care needs. Sensitivity was higher in surgical than in internal medicine patients (Warter, 2020). The complexity of patient`s profiles and the inclusion of patients that were not living at home before admission may also have had an influence on sensitivity (Warter, 2020). In conclusion, Warter (2020) did not recommend the use of the SPI (total score) as screening tool for after-care needs. However, he recommended the combination of SPI with age, which we also found to improve predictions (Warter, 2020). It remains difficult to compare instruments across healthcare systems because of different levels of acuity and care in PAC services depending on the other actors as one part of the care continuum. As the goals of discharge planning vary, the importance of predictor variables will also vary (Potthoff et al., 1997). We found similar results in the replication of the item-based SPI model compared to the original SPI all-item analysis by Grosse Schlarmann (2007) with a few significant differences. In our sample the cognitive item related strongly and significantly to PAC transfer. The problem stated by Grosse Schlarmann (2007) of a positive OR for the ability to drink was replicated. Given the bigger sample size of our study, we doubt that this is a chance result or an artefact due to potential over-fitting of the data. The explanation why dependency in drinking could be a strong predictor for discharge to home remains hypothetical. The positive effect of independence on drinking might be explained by sub-additivity of the individual item effect on the logit scale. As all items are positively correlated with each other, one of them might then act in the opposite direction to adjust for such sub-additivity. If items are considered in univariable models, all of them show significant positive associations with discharge to a post-acute institution. To model sub-additivity properly, complex interaction terms between items would be needed.

After external validation, the extended SPI may contribute to the discharge decision on ward rounds in internal medicine patients. Even if the score does not identify all patients, the assessment may help to judge the situation early and ease the professional judgment and referral recommendation (Warter, 2020). The interprofessional coordination and discussion could be supported for clinical decision making in discharge planning and organisation. We see the potential clinical use as follows: The adapted scoring with the addition of age and gender can be used to screen patients shortly after their admission into a hospital. This allows quick identification of patients with a raised probability for transfer to a PAC facility after the hospital stay. Further validations with a bigger sample size in another cohort of patients and the combination of the SPI with additional predictors, like frailty, abilities in activities of daily living, and absence of an informal caregiver, are needed. As Koch (2019) found, there is potential that the SPI may provide a timely assessment in combination with other scores like the post-acute care discharge score (PACD) to enable staff to engage social service more quickly.

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ETHICAL APPROVAL, REGISTRATION

Because of the observational study design (quality control study), the institutional Review Board of the Canton Aargau ("Ethikkommission Nordwest- und

Zentralschweiz EKNZ") waived the need for individual informed consent and approved the study accordingly: EK 2012/059. The study was registered on 9 January 2013 on ClinicalTrials.gov; Identifier, NCT01768494.

CONFLICT OF INTEREST

None.

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