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The Use of the Dutch Self-Sufficiency Matrix (SSM-D) to Inform Allocation Decisions to Public Mental Health Care for Homeless People

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Abstract The current study set out to develop a decision support tool based on the Self-Sufficiency Matrix (Dutch version; SSM-D) for the clinical decision to allocate homeless people to the public mental health care system at the central access point of public mental health care in Amsterdam, The Netherlands. Logistic regression and receiver operating characteristic-curve analyses were used to model professional decisions and establish four decision categories based on SSM-D scores from half of the research population (Total $n = 612$). The model and decision categories were found to be accurate and reliable in predicting professional decisions in the second half of the population. Results indicate that the decision support tool based on the SSM-D is useful and feasible. The method to develop the SSM-D as a decision support tool could be applied to decision-making processes in other systems and services where the SSM-D has been implemented, to further increase the utility of the instrument.

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Introduction

Clinical decision support systems have the potential to assist clinicians to provide better care, improve treatment-related outcomes, and to enhance healthcare. Decision support systems can be defined as any system that contains a knowledge base, a program for integrating patient-specific information with the knowledge base, and a user-interface to allow the clinician to get the information that the clinician needs to make the right decision (Berner 2009; Eberhardt et al. 2012). Such systems have been developed for a myriad of clinical issues, ranging from reminder systems for prevention, diagnostic systems, systems for disease management, and systems for drug dosing and prescribing (Garg et al. 2005). In contrast, to our knowledge no decision support tools (DSTs) have been developed for clinical decisions in the complex and multidisciplinary field of public mental health care (PMHC), and clinical decisions at various stages in the PMHC process are still relatively opaque. To improve transparency in PMHC and reduce the gap between evidence-based knowledge and PMHC practice, the current study set out to develop a DST for the clinical decision at the first stage of the PMHC process, i.e. to allocate a person to PMHC, or refer him to regular health care services.

People that do not have a registered residential address, i.e. cope with homelessness, and claim social security income support from the municipality of Amsterdam, The Netherlands, need to apply for a postal address at a central access point (CAP). In addition to the verification of a persons' residency which is required to be eligible for a postal address, public health care professionals at the CAP

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screen whether provision of integrated, multi-disciplinary PMHC would be appropriate to the persons' needs.

The CAP is manned daily by highly experienced care professionals of local community shelter providers (HVO Querido and the Salvation Army) and social psychiatric nurses of the Public Health Service (GGD Amsterdam) in addition to a professional of the Municipal Work and Welfare Service (DWI). Screening consists of two phases. First, a professional of the DWI assesses the client's situation with regard to income, debts, employment and whether the client held residency in the municipality of Amsterdam in at least the preceding 2 years. This information is passed on to a care professional who conducts the second phase of the screening procedure, a short interview to assess the clients' social, physical and psychological functioning, including addiction behaviour, family situation, and housing status. Homelessness often co-occurs with a myriad of problems, such as drug-addiction, psychiatric disorders, debts, and problems in social relations (Fisher et al. 1986). A study of pathways into homelessness in Amsterdam showed that a majority (81 %) of homeless people cope with social problems (financial debts and/or domestic conflicts), almost half (48 %) of the population deals with addiction (alcohol, drugs, and/or gambling), and more than half (56 %) presents with (symptoms of) mental problems (Van Laere et al. 2009). The presence and severity of these co-occurring problems are assessed during screening at the CAP. The professional weighs the available information on the clients' situation against an implicit reference framework of the PMHC target group, current municipal policy, and personal experience to come to a decision to allocate the client to PMHC, or refer the client to a different (private) social or health care provider.

In June 2010 the Dutch version of the Self-Sufficiency Matrix (SSM-D; Lauriks et al. 2012), was implemented in the screening process at the CAP. The SSM-D is an observational screening tool that provides a reliable assessment of the degree of self-sufficiency on eleven life domains (Fassaert et al. 2013a, b). The SSM-D expresses the clients' functioning and status in levels of self-sufficiency. Self-sufficiency is defined as the realization of an acceptable level of functioning either by oneself or by adequately organizing the help of informal or formal care providers. The introduction of the SSM-D served two major objectives. The first objective was to increase transparency in the decision making process. Since 2011, clients who disagree with the decision made at the CAP have the legal option to challenge the decision in a court of law. The second objective was to enable the Public Health Service to monitor the allocation of clients to PMHC and ensure equanimity of admission to PMHC services in Amsterdam. This monitoring function became of paramount importance as the Public Health Service started collaboration with the community shelter providers to staff the CAP and conduct the screening in January 2010.

Screeners had been trained in the use of the SSM-D in the months before introduction and were instructed to score the SSM-D as part of the screening procedure. However, the screeners did not use the SSM-D, or at least not the specific domain and overall scores, to inform their allocation decisions. It was therefore possible to use the professional decision as an external criterion to develop a decision support tool (DST) based on the SSM-D. This report describes the development of the SSM-D as a DST in the allocation of clients to PMHC at the CAP in Amsterdam. The study aims to provide an answer to the following research questions: (1) How are the scores on (domains of) the SSM-D associated with the decision of professionals to grant/deny admission to PMHC? (2) Which criteria or cut-off points could be used to establish sensitive and specific decision categories? (3) Are the decision categories based on SSM-D scores reliable in supporting the decision made by CAP screeners?

Methods

Clients were included in the research group when they met the following criteria: (1) the client was screened between June 2010 and May 2011 at the CAP; (2) the client held residency in the municipality of Amsterdam in the preceding 2 year or more (i.e. eligible for a postal address in the municipality); (3) a complete SSM-D from the screening at the CAP was available for the client; and (4) an allocation decision was registered with the Public Health Service.

The SSM-D comprises 11 domains (e.g. income, housing, physical health, mental health, social network) and categorizes the level of self sufficiency on each domain on a 5-point scale with a score of 1 = 'acute problem'; 2 = 'not self-sufficient'; 3 = 'barely self-sufficient', 4 = 'adequately self-sufficient'; and 5 = 'completely self-sufficient'. Indicators that specify each level of self sufficiency for every domain are defined forming a matrix of domains and levels of self sufficiency. Inter-rater reliability and internal consistency of the SSM-D were found to be satisfactory: inter-rater agreement (*Cohen's kappa*) in screening of 'live' cases ranged from .35 (fair agreement) to .72 (substantial agreement). All domains of the SSM-D were found to be necessary and non-redundant for the assessment of the construct of 'self sufficiency', with all SSM-D domain factor loadings >.40 in a factor analyses with a one-dimensional solution Fassaert et al. (2013a, b).

The SSM-D was scored by the care professional immediately after the interview on a scoring sheet specially

designed for the CAP. Background characteristics (date of birth, sex, marital status, responsibility for children, and cultural background) were collected from the CAP screening registration form and from the Public Health Service client registration system.

Differences between the group that was allocated to PMHC (PMHC group, i.e. the group that is likely to benefit most from an integrated, multi-disciplinary treatment), and the group that was referred to other services (referral group, i.e. that group that is expected to solve their issues utilizing care and support services provided by private, regular organizations) were analyzed with *t* tests for continuous variables and Pearson's Chi square tests for categorical variables. One half of the clients in the research population was randomly selected to develop a SSM-D summary measure and decision categories based on the predicted probability of the professional decision that could be used as a DST. The fit of the SSM-D domains as predictors of the allocation decision made by the professionals for the clients in this group was analyzed with logistic regression modeling. For the development of a model that could be used as a DST, both the predictive value of the (domains of) the SSM-D, as well as the proportion of variance in the professional decision explained by the overall model [expressed as coefficient of determination, or effect size (*Pseudo-*)R^2] were of interest. Every SSM-D domain could be a deciding factor in the decision to allocate a client to PMHC. Both univariate logistic regression modeling of the individual domains as well as and a forced entry multivariate logistic regression modeling method with all domains of the SSM-D were used to develop a summary measure that explained the maximum proportion of variance in the professional allocation decision.

The predicted probability of allocation ['*P*(allocation)'], produced with the regression equation, was calculated for every client and plotted against the professional decision in a receiver operating characteristic (ROC) curve. The coordinates of the ROC curve were examined to select three cut-off criteria that were specified a priori: a 95 %-sensitivity criterion; a 95 %-specificity criterion; and a 'probable-criterion' set at predicted probability = .50. Specification of the cut-off criteria was informed by policy and judicial requirements that (only) a 5 % error in allocating or referring clients would be acceptable. In addition, to support decisions with less pronounced outcomes of the model, the logical criterion of the higher chance of allocation to PMHC than the chance of referral, i.e. *P*(allocation) $\geq$.50, was specified. With these three criteria, four decision categories were established: referral (R) category (the score on the SSM-D supports the decision to refer the client with more than 95 % certainty); PMHC (*P*) category (the score on the SSM-D supports the decision to allocate the client to PMHC with more than 95 % certainty); probable referral (PR) category (the score on the SSM-D supports the decision to refer the client as referral is more likely than allocation to PMHC) and Probable PMHC (PP) category (the score on the SSM-D supports the decision to allocate the client to PMHC as allocation is more likely than referral).

The second half of the research population was used in a round of cross-validation, to asses (1) the accuracy of the 'SSM-D predicted probability' summary measure in relation to two other measures that could be plausible methods of utilizing the SSM-D as a DST, and (2) the reliability of the decision categories. The other summary measures included a 'SSM-D Total' measure, based on the total SSM-D score which ranges from 11 to 55 and is a measure of the overall level of self-sufficiency, and an 'SSM-D problematic domains' measure, based on the number of domains with scores <3, which is considered to be a problematic level of self-sufficiency. This measure provides an indication of the level and severity of co-occurring problems, i.e. multi-problem situations, and ranges from 0 to 11.

The area under the curve (AUC) of the ROC curves of the three summary measures were compared using a statistical approach proposed by Hanley and McNeil (1983) to assess their differences in accuracy in allocating clients to PMHC in accordance with the professional taking into account the correlation between the ROC curve as they are derived from the same cases. Pearson's coefficients of determination (R^2) were calculated as measures of the proportion of variance in the professional decision explained by the summary measures.

Reliability of the decision categories of the *SSM-D predicted probability* measure was expressed by the proportion of agreement with the professional decision and *Cohen's kappa*. Proportions of agreement of .4–.6, .6–.8, and .8–1.0 were classified as 'moderate', 'sufficient', and 'excellent' agreement respectively. *Cohen's kappa* was classified as 'fair agreement' (.21–.40), 'moderate agreement' (.41–.60), 'substantial agreement' (.61–.80) and 'almost perfect agreement' (.81–1.00) (Landis and Koch 1977).

SPSS statistics software was used for all analyses (IBM 2011). All client identification variables were encoded in the database and only aggregated data is reported to ensure anonymity. Only data collected during the usual care process were used for this study and clients were not treated according to an additional study protocol. The Medical Ethics Committee of the Academic Medical Centre in Amsterdam confirmed the waiver of signed informed consent stipulated for this type of study design in the Dutch law of medical research.

Results

Characteristics of the Research Population

A total number of 1,060 persons were screened between June 2010 and May 2011 at the CAP. For 242 persons no complete SSM-D was available, and for an additional 186 persons no allocation decision was registered with the Public Health Service. Another 20 persons were excluded from the research sample based on unclear residential status and/or (erroneous) double screening. The research sample consisted of 612 unique persons that met the inclusion criteria of the study. 251 clients (41 %) were allocated to PMHC by the professional. Characteristics and differences between the PMHC group and referral group in background characteristics and in levels of self-sufficiency are presented in Table 1.

The research population had a mean age of 39 years. The majority was single (81 %), and male (85 %). The PMHC group did not differ significantly from the referral group with regard to age, marital status, and sex. With regard to the number of people that was responsible for children, and cultural background no significant differences between the PMHC- and referral groups were found either.

The problems, as assessed with the SSM-D, experienced by people in the PMHC group as well as in the referral group played mostly on the domains of income, day-time activities, and housing. In the total research population, 85 % of people had no income and/or increasing debts; 83 % was without any form of paid occupation and not enrolled in any educational institution; and 78 % was homeless, in housing unsuited for permanent habitation, and/or at risk of eviction in the immediate future. On every domain of the SSM-D at least 5 % of the research population presented with problematic levels of self-sufficiency, defined as an SSM-D score less than 3.

On all SSM-D domains except the income domain, significantly more people in the PMHC group scored problematic levels of self-sufficiency in comparison to the referral group. These differences were most pronounced on the domains of housing (93 % in the PMHC group vs. 68 % in the referral group), mental health (24 vs. 3 %), addiction (36 vs. 2 %), social network (52 vs. 14 %), and community participation (42 vs. 14 %). Furthermore, the mean number of SSM-D domains with scores <3 were significantly higher in the PMHC group, indicating more severe multi-problem situations in this group. Finally, the mean total SSM-D score of the PMHC group was significantly lower than the mean total SSM-D score of the referral group, suggesting that the overall self sufficiency (or 'general' self sufficiency) of people that were allocated to PMHC was less than those who were referred.

Table 1 Characteristics of the research population ($n = 612$) by professional allocation decision

Characteristic	Allocation decision	
	PMHC ($n = 251$)	Referral ($n = 361$)
Age		
Mean (SD) (years)	39.5 (10.2)	38.7 (10.7)
Sex		
Male [*n* (%)]	220 (87 %)	301 (84 %)
Marital status[a]		
Single/divorced [*n* (valid %)]	102 (84 %)	106 (79 %)
Living with partner/married [*n* (valid %)]	20 (16 %)	29 (21 %)
Parent/guardian		
Yes [*n* (%)]	35 (14 %)	41 (11 %)
Cultural background[b]		
Dutch [*n* (valid %)]	50 (34 %)	45 (28 %)
Surinam [*n* (valid %)]	31 (21 %)	32 (20 %)
Moroccan [*n* (valid %)]	30 (21 %)	28 (17 %)
Antillean [*n* (valid %)]	10 (7 %)	12 (7 %)
Turkish [*n* (valid %)]	8 (6 %)	7 (4 %)
Other, not-industrialized [*n* (valid %)]	15 (10 %)	27 (17 %)
Other, industrialized [*n* (valid %)]	2 (1 %)	12 (7 %)
SSM-D score		
Income <3 [*n* (%)]	215 (86 %)	305 (85 %)
Day-time activities <3 [*n* (%)]*	221 (88 %)	284 (79 %)
Housing <3 [*n* (%)]*	234 (93 %)	244 (68 %)
Domestic relations <3 [*n* (%)]*	60 (24 %)	34 (9 %)
Mental health <3 [*n* (%)]*	59 (24 %)	9 (3 %)
Physical health <3 [*n* (%)]*	26 (10 %)	12 (3 %)
Addiction <3 [*n* (%)]*	89 (36 %)	8 (2 %)
Daily life skills <3 [*n* (%)]*	25 (10 %)	4 (1 %)
Social network <3 [*n* (%)]*	131 (52 %)	52 (14 %)
Community participation <3 [*n* (%)]*	106 (42 %)	52 (14 %)
Judicial <3 [*n* (%)]*	65 (26 %)	24 (7 %)
Problematic SSM-D domains[c]		
Mean number of domains (SD)*	4.90 (1.67)	2.85 (1.23)
Total SSM-D score		
Mean score (SD)*	30.64 (4.71)	38.68 (4.54)

* Significant difference between groups ($p < .05$)

[a] *Valid* $n = 257$ (42 %; *valid n PMHC* $= 122$, *valid n referral* $= 135$); [b] *valid* $n = 309$ (51 %; *valid n PMHC* $= 146$, *valid n referral* $= 163$); [c] SSM-D domain score <3 is considered a problematic level of self-sufficiency

Half of the research population ($n = 306$) was randomly selected to develop the predicted probability summary measure and to select cut-off criteria decision categories. Similar to the total research population, 44 % ($n = 133$) of the selected population was allocated to PMHC and no

Table 2 Univariate logistic regression model SSM-D predictors of allocation decision

SSM-D domain included in model	*B* (SE)	OR (95 % CI)	Model χ^2	Effect size (R^2_N)
Income	−.06 (.13)	.94 (.74–1.20)	.24	.00
Day-time activities	−.93 (.20)	.40 (.27–.58)*	30.64*	.13
Housing	−1.13 (.18)	.32 (.29–.45)*	51.69*	.21
Domestic relations	−.34 (.11)	.72 (.58–.88)*	10.32	.04
Mental health	−1.11 (.14)	.33 (.25–.44)*	80.48*	.31
Physical health	−.51 (.12)	.60 (.47–.76)*	19.15*	.08
Addiction	−1.23 (.14)	.29 (.22–.39)*	111.69*	.41
Daily life skills	−1.22 (.17)	.29 (.22–.41)*	68.29*	.27
Social network	−1.04 (.14)	.35 (.27–.46)*	75.80*	.29
Community participation	−.96 (.17)	.38 (.28–.53)*	43.26*	.18
Judiciary	−.67 (.11)	.51 (.41–.64)*	43.37*	.18

* $p < .05$ (with Bonferroni correction)

Table 3 Multivariate logistic regression model SSM-D predictors of allocation decision

Included	*B* (SE)	OR (95 % CI)
Constant	14.45 (1.89)	
Income	−.13 (.20)	.87 (.59–1.29)
Day-time activities	−.50 (.27)	.60 (.36–1.03)
Housing	−.65 (.30)	.52 (.29–.94)*
Domestic relations	−.06 (.18)	.94 (.67–1.33)
Mental health	−1.02 (.21)	.36 (.24–.54)*
Physical health	−.06 (.19)	.94 (.65–1.36)
Addiction	−.99 (.18)	.37 (.26–.53)*
Daily life skills	−.14 (.25)	.87 (.54–1.41)
Social network	−.37 (.21)	.69 (.46–1.04)
Community participation	−.31 (.26)	.73 (.44–1.21)
Judiciary	−.43 (.17)	.65 (.47–.90)*

Effect size *Pseudo-*$R^2 = .49$ (Hosmer and Lemeshow), .50 (Cox and Snell), .68 (Nagelkerke)

Model $\chi^2(11, n = 306) = 214.64$, $p < .01$

* $p < .05$

significant differences were found in background characteristics between the PMHC group and the referral group within the selected population.

In the second half of the research population, which was used for cross-validation of the predicted probability summary measure, 118 clients (39 %) were allocated to PMHC, the mean total SSM-D score was 35.77 (SD = 6.13) and the mean number of problematic SSM-D domains was 3.62 (SD = 1.73). These values were not significantly different from the values found for these variables in the first half of the research population used to develop the *SSM-D predicted probability* measure.

Development of the SSM-D Predicted Probability Measure

Table 2 shows the odds ratios and model effect sizes of the eleven SSM-D domains in univariate logistic regression modeling with the professional decision as an outcome variable (referral = 0; PMHC = 1).

All SSM-D domains except *SSM-D income* are significant predictors of the allocation decision made by professionals. Lower levels of self-sufficiency on single domains of the SSM-D increase the probability of allocation to PMHC. In addition, nine models (all models except *SSM-D income* and *SSM-D domestic relations*), account for a significant amount of the variance in the professional decision. However none of the models accounts for more than 41 % (*SSM-D addiction*) of the variance in the professional decision. To be useful and meaningful as a DST, the model should account for as much of the variance as possible. Therefore, the next step was to assess the predictive value of the SSM-D in a multivariate logistic model.

Table 3 shows the odds ratios of the eleven SSM-D domains that were entered in a multivariate logistic regression model with the professional decision as an outcome variable (referral = 0; PMHC = 1).

The significant model Chi square ($p < .01$) and high effect size ($.49 < R^2 < .68$; dependent on the method of calculation) indicate the overall model of SSM-D domains is a good predictor of the professional decision to allocate a client to PMHC.

The negative regression coefficients found for all SSM-D domains confirmed the logical assumption that lower scoring clients, i.e. clients presenting with lower levels of self-sufficiency, had a higher probability of allocation to PMHC. The SSM-D domains housing (OR = .52), mental health (OR = .36), addiction (OR = .37), and judiciary (OR = .65) showed a significant association with the professional decision in this research group. However, a model with only these four domains as predictors had significantly lower model Chi square ($\Delta\chi^2$ (4, $n = 306$) = 16.33) and effect sizes ($R^2_N = .64$). Although the SSM-D domain income was not a significantly associated with the professional decision, it was included in the model as is has been found to be necessary to asses the construct of self-sufficiency in a previous study as reported earlier, and because inclusion of the income domain had a not significant, but positive effect on the amount of variance in the professional decision explained by the overall model. As the overall predictive value of the model was of primary importance for a DST, all domains and their regression coefficients

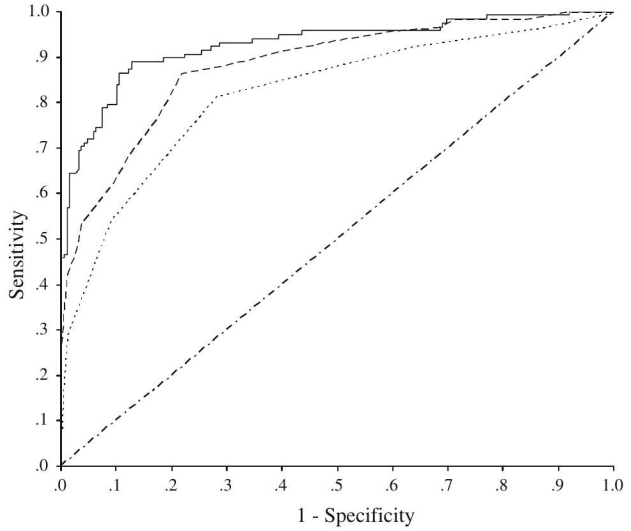

Fig. 1 Receiver operating characteristic curves for three SSM-D summary measures. *Solid line* SSM-D predicted probability; *dashed line* SSM-D total; *dotted line* SSM-D problematic domains; *dashed with dot line* reference

(weights) were included in the equation of the *SSM-D predicted probability* summary measure[1]

The AUC of the ROC curve of predicted probability against professional decision (no graph) was .93 (SE = .013; $p < .05$). Cut-off criteria were based on examination of the coordinates of this ROC curve and set at *P*(allocation) = .21 (the bottom cut-off criterion with 95 % sensitivity); *P*(allocation) = .50 (the 'probable' cut-off criterion with 83 % sensitivity and 85 % specificity); and at *P*(allocation) = .80 (the top cut-off criterion with 95 % specificity). With these cut off criteria, four decision categories were established: category *P* (PMHC, *P*(allocation) $\geq$ .80); category PP (probable PMHC, .50 $\leq$ *P*(allocation) $<$ .80); category PR (probable referral, .21 $<$ *P*(allocation) $<$ .50); and category R (referral, *P*(allocation $\leq$ .21).

Accuracy and Reliability of the SSM-D Predicted Probability Measure

The *SSM-D predicted probability* measure was then calculated for the clients in the second half of the research population ($n = 306$) to assess the accuracy of the method, and compared to the two other SSM-D summary measures that are plausible methods of utilizing the SSM-D as a DST (i.e. 'SSM-D total' and 'SSM-D problematic domains').

Figure 1 shows three ROC curves based on (1) the *SSM-D predicted probability* measure, (2) the *SSM-D total* measure, and (3) the *SSM-D problematic domains* measure against the professional decision for the clients in this group.

The AUC of *SSM-D predicted probability* was .93 (SE = .017). The AUC of *SSM-D total* was smaller at .88 (SE = .020) and the AUC *SSM-D problematic domains* was the smallest of the three measures with .82 (SE = .026). AUCs of all summary measures based on the SSM-D were significantly better (at $p < .05$) compared to the reference (AUC = .50). The difference between the AUC of *SSM-D predicted probability* and the AUC of *SSM-D total* was significant ($p < .05$), as was the difference between the AUC of *SSM-D total* and the AUC of *SSM-D problematic domains*. Total variance in the professional decision explained by the summary measures showed a similar trend with Pearson's R^2 for SSM-D predicated probability, *SSM-D total*, and *SSM-D problematic domains* of .60, .40, and .30 respectively. Thus, the *SSM-D predicted probability* measure is significantly more accurate in allocating clients to PMHC than the other two SSM-D summary measures, and the *SSM-D total* measure is significantly more accurate than the *SSM-D problematic domains* measure.

Next, the reliability of the decision categories based on the *SSM-D predicted probability* measure was assessed. The results of application of the decision categories to clients in the second half of the research population are presented in Table 4.

Calculated for the main, dichotomized, categories, i.e. predicted PMHC category (*P* and PP combined), and referral category (R and PR combined) with $n = 306$, the percentage of agreement was 86.6 % and *Cohen's*

Table 4 Agreement of allocation decision between professional versus *SSM-D predicted probability*

	Professional		Total
	PMHC	Referral	
SSM-D[a]			
PMHC categories			
P	66	2	68
PP	28	15	43
Referral categories			
PR	13	30	43
R	11	141	152
Total	118	188	306

[a] SSM-D decision categories: *P* PMHC, *PP* probable PMHC, *PR* probable referral, *R* referral

[1] The predicted probability, given the scores on the SSM-D domains is calculated as $P(\text{allocation}) = \frac{1}{1+e^{-[14.45-.13(I)-.50(E)-.65(H)-.06(F)-1.02(M)-.06(Ph)-.99(A)-.14(D)-.37(S)-.31(C)-.43(J)]}}$ where *I* = Income score; *E* = Employment/Education score; *H* = Housing score; *M* = Mental health score; *Ph* = Physical health score; *A* = Addiction score; *D* = Daily life skills score; *S* = Social network score; *C* = Civil Participation score; *J* = Judicial score.

kappa = .71. 220 clients (72 %) were categorized in the *P*- or R-category. The percentage of agreement between the SSM-D and the professional in these decision categories was 94.1 %, and *Cohen's kappa* = .87. In the two 'probable' categories, i.e. PP and PR, the percentage of agreement for the 86 clients that fell in these categories was 67.4 % and *Cohen's kappa* was .35.

Discussion

The current study set out to develop a decision support tool (DST) based on the Self-Sufficiency Matrix (Dutch version; SSM-D) for the central access point (CAP) for public mental health care (PMHC) for homeless people in Amsterdam, The Netherlands.

The model based on the SSM-D domains was a good predictor of the professional decision to allocate a client to PMHC and a SSM-D summary measure was derived from the regression equation (*SSM-D predicted probability*). Compared to the summed total score on the SSM-D (a measure of overall self-sufficiency) and the number of SSM-D domains with a low score (a measure of multi-problem situations) the *SSM-D predicted probability* measure was found to be a more accurate measure of allocation of homeless to PMHC. This indicates that some domains have more impact on the allocation decision than others, and that five response categories show a relevant subdivision compared to a dichotomous outcome (i.e. severe problem or not) per domain. However all three SSM-D summary measures distinguish well between the PMHC group and referral group.

Four decision categories on the *SSM-D predicted probability* measure were established: PMHC (*P*); probable PMHC (PP); probable referral (PR); and referral (R). Almost three-quarters of the research group was categorized in the PMHC or referral category (*P* or R) which were based on 95 % sensitivity and specificity cut-off criteria. The agreement between the professionals and the SSM-D was substantial for the dichotomized categories PMHC (*P* and PP combined) and referral (R and PR combined), and almost perfect in the separate *P* and R decision categories. Even in the two 'probable' categories PP and PR, the SSM-D decisions were in fair agreement with the professional. The findings suggest that the SSM-D can accurately identify persons in need of PMHC in a population of homeless people that claim social security income support with the municipality of Amsterdam. Severely limited levels of self-sufficiency with regard to housing, mental health, addiction and judiciary were found to be the strongest predictors of the decision to allocate a client to PMHC. Problems or functioning on these domains (in one combination or other) have been associated with the duration of homelessness (Canton et al. 2005), incarceration risk and criminal justice system involvement (Hawthorne et al. 2012; Greenberg et al. 2011), psychological distress (Wong 2002) and family violence (Yegedis 1992). The finding that the professional focuses on the domains that are associated with these important outcomes of PMHC (primary goals of PMHC include the provision of access to health services to reduce homelessness, criminal and nuisance offenses, and suffering for people with co-occurring psychosocial disorders) to inform their decision to allocate a client to PMHC or refer them to other services, provides insight into a decision making process that, until now, has been somewhat of a 'black box'. Although finding these particular domains (housing, mental health, addiction, and judiciary) is not surprising and in line with current municipal policy, these results do contribute to transparency in PMHC.

This project had a number of limitations that should be considered when interpreting the results. First, the SSM-D was scored by the same professional that made the allocation decision. It is therefore possible that the SSM-D scoring was influenced by the decision (expectancy effects) which would cause an overestimation of the accuracy and reliability of the DST. Possible expectancy effects could have been reduced by the fact that professionals were blind to the research questions postulated in this study. Furthermore, no explicit association between scoring the SSM-D and the allocation decision was advocated, especially in the first year of implementation of the SSM-D at the CAP. The SSM-D was (only) used to ensure that all relevant domains were covered in the screening procedure (i.e. as a topic list), and to record the information that was gathered by the professional during the interview, no summary measures were calculated, and the SSM-D scores were not utilized in the subsequent care process (i.e. referral or PMHC service). However, as the study design did not control for expectancy effects, they can not be dismissed completely. In addition, when the DST based on the SSM-D is implemented in the regular care and allocation process, it is likely that the SSM-D will be assessed by the same persons that takes the allocation decision. Possible expectancy effects and moral hazard could influence the reliability and accuracy of the DST based on the SSM-d assessment. Focusing on the support-aspect of the DST during implementation could reduce the possible influence of these effects, by ensuring that the SSM-D score is to be used only to support the professional and to promote transparency in the allocation decision, not to replace the professional in the clinical decision making process. The four decision categories of the DST constitute an advice that the professional is free to accept or reject. However, the accuracy and reliability of SSM-D scores should be monitored closely after implementation of the DST.

Second, the DST is specific to the population reporting at the CAP, and the PMHC-system in Amsterdam, The Netherlands. Although the DST is highly accurate and useful for professionals currently performing assessments at the CAP in Amsterdam, application of the SSM-D as a DST in other populations and/or other care systems and decision making moments requires 'recalibration' of the model. This specific DST can not be applied to other populations, in other care systems, or even to other decision making moments in the Amsterdam PMHC-system. Allocation decisions are dependent on specific factors such as care system capacity, municipal and federal policy, in- and exclusion criteria of services, and trends in the population. For example, as there is a waiting list for admission to PMHC in Amsterdam, i.e. the capacity of the PMHC-system is limited, municipal policy decrees that individuals coping with addiction and/or psychiatric disorders should be granted priority access to PMHC. This (probably) has influence on the allocation decisions made by the professionals and therefore on the weights in the model of the DST. In addition being specific to the CAP in Amsterdam, the DST may be time-specific as well. Both the population and the PMHC-system change over time; drug-trends, innovation in treatment, and changing social norms could have an affect on what is considered appropriate care and the care needs of clients. Thus, although this specific DST can only be used for this specific time and setting, the method of using the SSM-D for decision support and developing the model can be applied in other settings.

Assigning weights to the domains of the SSM-D by modeling allocation decisions retrospectively, was found to be a feasible and valid method to develop the SSM-D as a DST. This method could be applied in several other public care settings and at other decision making moments in clinical practice. Similar efforts that used information collected during routine clinical practice to support quality improvement in service provision have been described in literature (e.g. Donahue et al. 2012; De Vries and Spreen 2012; Prowse and Coombs 2009).

Several local and municipal payers and providers involved in PMHC and related care systems are considering the SSM-D for screening, monitoring or evaluation purposes. Others have already implemented the SSM-D as one of the instruments in their regular care processes. In addition to ensuring standardized, comprehensive and reliable assessment of clients, which is already a huge step forward in PMHC and related care systems with great potential benefits for professionals, policy makers and researchers, the current study showed that the SSM-D can be used to increase transparency in the clinical decision making processes in these health care systems. Within PMHC in particular, but in many other public care systems as well, how professionals decide to, for instance, assign a client to a particular treatment intervention, transfer a client to a different treatment team, or discharge a client from a treatment service is still mostly unknown. Integration of the SSM-D in the clinical decision making of providers, as is proposed here, could not only help to make the collection of information a real part of clinical practice, but could also contribute to a structural change in public health care delivery to a more transparent, accessible, and client-oriented system, and may ultimately alter client-provider interaction and improve client outcomes. Another benefit of implementation of the SSM-D in the clinical decision making process is that the provider responsible for allocation decisions can show it has made the appropriate decision when it is challenged by the client or a third party. The provider is able to support and complement the arguments of the professional with information on the self-sufficiency of the client, and whether or not the client would benefit from PMHC intervention based on sensitive and specific criteria provided by the DST.

The SSM-D model developed in the current study is a reliable and useful DST to inform allocation decisions at the CAP for PMHC in Amsterdam. Prior to the DST being fully implemented in the client management system (CMS) software developed by the Public Health Service of Amsterdam, the SSM-D model was programmed in a spreadsheet so that professionals could simply enter the SSM-D domain scores of the client and were not required to do any calculations on the SSM-D scores. When entering SSM-D scores, the spreadsheet immediately presented the chance of allocation to PMHC and allocation advice (decision category) to the professional. Implementation in the CMS software also provides several possibilities to analyze decisions on a group level and over time. The method that was used in the current study to develop the SSM-D as a DST could be applied in other (PMHC) systems, services, and decision making moments where the SSM-D is already implemented to further increase the utility of the instrument for all those involved in PMHC.

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