A predictive model to allocate frequent service users of community-based Mental Health Services to different packages of care

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SUMMARY. **Aim** – To develop predictive models to allocate patients into frequent and low service users groups within the Italian Community-based Mental Health Services (CMHSs). To allocate frequent users to different packages of care, identifing the costs of these packages. **Methods** – Socio-demographic and clinical data and GAF scores at baseline were collected for 1250 users attending five CMHSs. All psychiatric contacts made by these patients during six months were recorded. A logistic regression identified frequent service users predictive variables. Multinomial logistic regression identified variables able to predict the most appropriate package of care. A cost function was utilised to estimate costs. **Results** – Frequent service users were 49%, using nearly 90% of all contacts. The model classified correctly 80% of users in the frequent and low users groups. Three packages of care were identified: Basic Community Treatment (4,133 Euro per six months); Intensive Community Treatment (6,180 Euro) and Rehabilitative Community Treatment (11,984 Euro) for 83%, 6% and 11% of frequent service users respectively. The model was found to be accurate for 85% of users. **Conclusion** – It is possible to develop predictive models to identify frequent service users and to assign them to pre-defined packages of care, and to use these models to inform the funding of psychiatric care.

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INTRODUCTION

Since the Italian Mental Health Plan (1998-2000) and the Progetto Obiettivo for the Mental Health, Italy has adopted an organisational model for community psychiatric care focused on large multi-disciplinary teams. These

teams include psychiatrists, psychologists, nurses, social workers, rehabilitation therapists and are led by consultant psychiatrists. Each Community Psychiatric Service (CPS) consists of various mental health centres, including one Psychiatric Ward in a General Hospital (PWGH), one or more Community Mental Health Centres (CMHC), one Psychiatric Residential Rehabilitative Centre (PRRC) and one or more other residential facilities.

Community-based Mental Health Services (CMHSs) provide a spectrum of comprehensive care, including: in-patient care, out-patient care, domiciliary visits, and psychosocial rehabilitation. Because of this heterogeneity and complexity of care provided, there is a growing interest in the factors that may have an influence on patterns of service utilisation (pathways of care) among service users. The use of Diagnosis Related Groups (DRGs), Diagnostic Categories (DCs) or Healthcare Resources Groups (HRGs) has been proved to be difficult to implement in psychiatry, because these methods predict a low percentage of variation in hospital stay and of resources needed for treatment. Several factors have been associated with a greater utilisation of mental health services, such as personality factors (Goodwin *et al.*, 2002), sex (Albizu-Garcia *et al.*, 2001; Lindamer *et al.*, 2003), an individuals' recovery style (Tait *et al.*, 2003; Slade *et al.*, 2008), diagnosis (Keown *et al.*, 2005; Mojtabai *et al.*, 2005), socio-economic status (Tansella, 2007) and socio-demographic and clinical characteristics in schizophrenic patients (Carr *et al.*, 2003; Percudani *et al.*, 2003). Furthermore, psychiatric service use by ethnic minorities (Commander *et al.*, 2003) and accessibility and pathways to psychiatric care have also been studied (Amaddeo *et al.*, 2001; Bhui *et al.*, 2003). An Italian study has confirmed the effects of patients' psychopathology and users' characteristics in the clinicians' dispositional process (Rossi *et al.*, 2006).

It would be useful to allocate resources in a more effective way and to develop a funding system that can support the pathways of care of frequent users of services. There are two paths that researchers could follow: first, to predict an individual patient's pattern of utilisation; and, secondly, to predict the probability that a patient will use a certain package of care.

A package of care focuses on the complexity of the mental health system, since it can be seen as a cluster of services provided to an individual based on carefully constructed components. A package includes the characteristics of the patient, the type of treatment and the intensity of the care provided. Packages of care can be described as 'the mix of treatments provided to an individual patient within a specific timeframe involving different

settings' e.g., CMHCs, day-care facilities, general hospital wards, community residential facilities (Lora *et al.*, 2002; 2007; Patel *et al.*, 2007). The aims of this study (I-psycost) is to analyse, in five Italian CMHSs, located in five different regions, three in the northern, one in the central and one in southern Italy, the possibility to predict, after very few contacts with a service, on the basis of their clinical and socio-demographic characteristics, whether a patient will be a frequent user of the services and, for the frequent service users only, to identify different possible packages of care. Finally, to estimate the costs of each package.

MATERIALS AND METHODS

Catchments areas

Five Italian CMHSs were included in the study: Avellino (Campania Region) is situated in the south of Italy, Rome (Lazio Region) in the centre and Verona (Veneto Region), Bologna (Emilia-Romagna Region) and Legnano (Lombardia Region), in different parts of the north.

The areas' characteristics are very different.

Population density is of 174 inhabitants per Km^2 in Avellino, 1,073 in Verona, 3,790 in Rome, 4,500 in Bologna and 7,447.6 in Legnano.

One-year *treated* prevalence of psychiatric disorders in 2002 was 102.5 per 10,000 in Avellino, 154.8 in Legnano, 170.5 in Verona and 219.5 in Bologna.

One-year *treated* incidence of psychiatric disorders in 2002 was 25.2 per 10,000 in Avellino, 32.2 in Legnano, 55.7 in Verona and 61.2 in Bologna.

Data on annual prevalence and incidence were not available for Rome.

Study sample

In each of the five CMHSs, all users that had at least a contact, starting from the day of the 1st of October 2002, with each different service facility, were included in the sample consecutively during the following days, till the number of 250 patients was reached for each centre. This procedure allowed to select new cases and cases already in contact with the services. The index contact was not necessarily the first contact with the Service. In the five centre the time period necessary to reach the number of 250 patients was different.

According to the most common system of care that is available in Italy after the psychiatric reform each CMHS

runs several facilities, including acute psychiatric ward in general hospitals, out-patient department, a mental health centre and sheltered apartments. Those patients referred from other specialists, or from GPs, or only for a single consultation-liaison, were excluded, because they usually follow care pathways that are different from those of psychiatric patients.

Information about the user's socio-demographic and clinical characteristics were collected during the index contact and included the following information: sex, age, marital status, accommodation, education, employment status, professional status, diagnosis (according to ICD-10), Global Assessment of Functioning (GAF) score (Moos *et al.*, 2000), previous psychiatric contacts, previous admissions in a State Mental Hospital, previous compulsory admissions and total number of admissions. Each user was then followed up for a six months period from the index contact. Each contact with all facilities within the CMHSs during the follow-up period was registered using the local Mental Health Information Systems (MHIS). A list of 24 different types of contact (Unit Services List) was used to register user contacts, in the same way across the five services. Definitions for each of the 24 type of contacts were discussed by the research group to reach a consensus on the inclusion/exclusion criteria.

Users were divided into two groups on the basis of the intensity of their service utilisation:

Low service users: those who, during the six month follow-up, had a maximum of 26 out-patient contacts (one contact per week) or 52 out-patient contacts with a psychotherapist (two contacts per week) or seven or less days in hospital;

Frequent service users: all other users.

These criteria, applied collecting data on the effective service utilization during the follow up, were selected on the basis of:

i) a focus-group held in the study's preparatory phase to agree on a quantitative definition of low user patients composed by psychiatrists, psychologists, psychiatric nurses, statisticians and economists,

ii) the I-Psycost group members' previous clinical experiences and

iii) statistical simulations targeted to obtain two groups that were different between them and homogenous within themselves. As explained ahead, in order to define a criterion helpful to predict if the patients has to be assigned to one or to the other group, we used a logistic model that relates the probability of being a high user with socio-demographical characteristics, previous psychiatric history and clinical and anamnestic information.

The frequent service users group was then subjected to a cluster analysis to identify packages of care, each package being homogeneous in terms of service utilisation, and different from the others in terms of costs, taking into account administrative needs, medical knowledge and statistical analysis. More details on these procedures are given in Grigoletti *et al.* (2006).

Statistical analyses

Chi-square test and bivariate analysis of variance were performed, testing for differences by frequent and low service users.

A logistic model was estimated to assess the probability of being in the *frequent service users* group. In the model, the dependent variable was user status ($1 = frequent\ service\ users$, $0 = low\ service\ users$) and the explanatory variables were selected on the basis of stepwise (backward) selection procedure, excluding all variables with a $p > 0.05$. Explanatory variables were past psychiatric history, socio-demographic and clinical characteristics of users such as: sex; marital status; living condition; educational level; if the first contact was scheduled; if the patient had previous psychiatric contacts; previous compulsory admissions; previous psychiatric admissions and how many; and if the patient had been previously admitted to a State Mental Hospital. Other variables that were used included: GAF score, diagnosis and the previous year's use of Services (admissions, periods spent in residential or semi-residential services, day-care treatments and/or out-patient visits and/or home visits).

The performance of the regression model was evaluated using a multiple additive regression trees (MART) approach with 20-fold cross-validation, as recommended specifically for classification trees (Efron & Tibshirani, 1993). Twenty percent samples were drawn from the data set, the model was fitted to the remaining 80% (Training dataset) and then used as a predictive tool on the removed 20% (Test dataset). Although somewhat conservative in the estimation of success rates (because the model is based on only 80% of the sample), this measure incorporates the minimum degree of "shrinkage" that typically occurs when applying models to new samples, even of a similar type.

In many situation where there are a large number of predictors variables, only a few of them are actually relevant to prediction. MART also allow to assess the relative importance of predictor variables based on the number of times that variable was selected for splitting in the tree weighted by the squared improvement to the model as a result of each of those splits (Friedman & Meulman, 2003).

The k-means clustering method was used for grouping frequent service users into three categories, corresponding to three packages of care. This grouping was achieved by minimizing the sum of squares of distances between data and the corresponding cluster centroid, thus the purpose of K-mean clustering was to classify the data. As it is necessary to forejudge the number of cluster, after a series of trials, based on medical and statistical criteria it was decided to use three packages.

A multinomial logistic regression model was used to establish how a user is assigned to a particular package of care, on the basis of his/her socio-demographic and clinical characteristics and previous psychiatric service utilisation. This model is an extension of binary logistic regression, it allows the simultaneous comparison of more than one contrast, and the log odds of three or more contrasts are estimated simultaneously. Variables were entered in three steps: first socioeconomic variables, then clinical characteristics and, finally, all together. A 20-fold cross-validation was also applied to evaluate the performances of the three multinomial logistic regressions.

During a week preceding the study, the number of professionals involved in providing the service and time duration were collected by each CMHS. These data were used to estimate the different costs of care in each centre, applying a cost function generated in a previous study in South-Verona (De Agostini *et al*., 2001) in which we assume a linear relationship between the cost of each contact, its duration in minutes and the staff's cost per hour.

Statistical analyses were conducted using STATA 8.0 (STATA Corporation, 2003).

RESULTS

Socio-demographic and clinical characteristics of the two groups

Out of 1,250 users included in the study, 611 (48.9%) were frequent service users and 639 (51.1%) were low service users; the frequent service users group had 38,233 contacts with the services versus 5,026 contacts for the low service users (88% vs. 12% of all contacts). Socio-demographic and clinical characteristics of the 1,250 users are shown in Table I. Although in general there were more women than men (54% and 46%), there was a difference in the two groups, women were more numerous in the *low service users* group (p < 0.001). Regarding marital status the majority of the users were not married and, regarding living situation,

83% in the *low service users* group and 67% in the *frequent service users* group lived with family or partner. Regarding patients in employment there were 38% in the *low service users* group and 20% in the *frequent service users* group.

The diagnosis of schizophrenia and related disorders was much more represented in the *frequent service users* group (55.7% vs. 15.7% respectively), and affective disorders was the most common diagnosis in the *low service users* group (34.1%). All the differences in the distribution of the socio-demographic characteristics in the two groups were statistically significant.

Services utilisation

The pattern of services utilisation by *frequent* and *low service users* is summarised in Table II. Users are almost equally divided into the two groups, *frequent* and *low services users*. The *low service users* were 639 (51%) and the *frequent service users* 611 (49%). Nearly 90% of contacts are provided to the frequent service users patients. Differences between low and frequent service users in services' utilisation were significant for each type of service, when the analyses were performed across the whole sample. If the means are calculated only on those patients that actually used that particular service, the differences between low and frequent service users in the mean number of admissions and days in hospital were not significant.

Predicting frequent services users

A forward stepwise logistic model was applied to predict the probability that a patient will be a frequent user (Table III).

Patients most likely to be frequent service users are those who live alone (OR 2.15) compared to those living with partner or family, have a diagnosis of schizophrenia, a lower educational level, a lower GAF score, a higher number of previous psychiatric admission and of day care contacts and out patients visits, have had previous psychiatric contacts and those for whom the first contact was unplanned (OR 1.46).

Table III displays also the relative importance of the predictors variables. Severity of illness (GAF score) and variable that describe previous psychiatric history are the most important, diagnosis of neurosis and somatoform disorders ranks 11 with a relative contribution of 2.09%.

Table I – *Socio-demographic characteristics of frequent and low service users.*

	All users (N = 1250)		Low service users (N = 639)		Frequent service users (N = 611)		
	N	%	N	%	N	%	P
Sex							
Men	571	45.68	237	37.09	334	54.66	<0.001
Women	679	54.32	402	62.91	277	45.34	
Marital Status							
Single	703	56.24	305	47.73	398	65.14	<0.001
Married/live-in partner	363	29.04	247	38.65	116	18.99	
Separated/divorced	116	9.28	47	7.36	69	11.29	
Widowed	68	5.44	40	6.26	28	4.58	
Living situation							
NC	1	0.08	0	0	1	0.16	<0.001
Alone	224	17.99	81	12.76	143	23.44	
With partner or family	937	75.26	527	82.99	410	67.21	
Other	83	6.67	27	4.25	56	9.18	
Educational status							
NC	8	0.64	6	0.94	2	0.33	0.002
Primary or Secondary School	824	66.13	393	61.89	431	70.54	
Diploma	353	28.33	208	32.76	145	23.73	
Degree	61	4.9	28	4.41	33	5.4	
Occupational status							
NC	2	0.16	1	0.16	1	0.16	<0.001
Employed	364	29.17	242	37.93	122	20	
Unemployed	279	22.36	110	17.24	169	27.7	
Other	603	48.32	285	44.67	318	52.13	
Diagnostic group							
Schizophrenia	440	35.2	100	15.65	340	55.65	<0.001
Affective disorders	332	26.56	218	34.12	114	18.66	
Neurotic and Somatoform disorders	185	14.8	153	23.94	32	5.24	
Personality Disorders	151	12.08	74	11.58	77	12.6	
Other diagnosis	142	11.36	94	14.71	48	7.86	
	Mean	St dev.	Mean	St dev.	Mean	St dev.	
GAF	58.32	16.29	63.78	15.14	52.59	15.48	<0.001

Table II – *Differences in services utilisation by frequent and low service users, standard deviation in brackets.*

	All Users			Users of each service				
	Low service users (639 pts)	Frequent service users (611 pts)			Low service users		Frequent service users	
	Mean (sd)	Mean (sd)	P	n	Mean (sd)	n	Mean (sd)	P
Admission (number)	0.00 (0.04)	0.33 (0.95)	<0.001	1	1.00 (0.00)	124	1.62 (1.53)	0.687
Days in hospital	0.00 (0.12)	11.47 (30.62)	<0.001	1	3.00 (0.00)	124	36.99 (34.74)	0.332
Day care contacts	0.77 (2.35)	31.87 (49.10)	<0.001	150	3.27 (3.93)	537	36.26 (50.84)	<0.001
Rehabilitation contacts	–	14.20 (37.50)	–	–		365	23.77 (46.13)	–
Outpatient care contacts	3.71 (3.96)	10.03 (12.83)	<0.001	537	4.42 (3.94)	551	11.12 (13.05)	<0.001
Psychotherapy contacts	2.98 (6.00)	0.46 (2.64)	<0.001	187	10.19 (7.05)	47	6.02 (5.81)	<0.001
Community care contacts	0.40 (2.04)	5.58 (16.95)	<0.001	52	4.90 (5.46)	222	15.36 (25.34)	0.003

The performance of the logistic model are showed in Table IV. Direct comparison of the predictive accuracy of the full and stepwise standard logistic regression and the MART 20-fold cross-validation showed a good performance of the model with a slightly reduction in almost all indices after cross-validation. The percentage of correctly classified users has a very small reduction from 83.9% in the training dataset to 80.8% in the test dataset.

Costs for the low service users group were calculated for each type of contact. The most expensive contacts were the admissions in psychiatric ward (230 Euros) and in private clinic (138 Euros), and these, with the employment/rehabilitation workshop and the day in residential

Table III – *Logistic regression model identifying frequent service users characteristics and ranking of predictive variables by overall discriminatory power in the logistic regression.*

Demographical characteristics	Odds Ratio	Std. Err.	z	P	Power (%)
Sex					
Women vs men	0.65	0.10	-2.75	0.006	2.14
Living situation					
Alone vs with partner or family	2.15	0.45	3.70	<0.001	2.31
Alone vs other situations	1.24	0.46	0.58	0.559	0.58
Educational status					
Diploma vs up to secondary school	0.62	0.11	-2.58	0.010	1.66
Degree vs up to secondary school	1.28	0.44	0.72	0.469	0.69
Diagnosis groups vs Schizophrenia					
Affective disorders	0.35	0.73	-5.04	<0.001	2.87
Neurosis and somatoform disorders	0.24	0.07	-5.12	<0.001	2.09
Personality disorders	0.47	0.12	-2.87	0.004	1.51
Other diagnoses	0.30	0.08	-4.51	<0.001	1.51
Previous lifetime psychiatric history					
Previous psychiatric contact (Yes/No)	0.61	0.11	-2.84	0.005	1.17
From 1 to 5 admission vs no admission	1.98	0.37	3.60	<0.001	11.76
More than 5 admission vs no admission	4.83	1.65	4.63	<0.001	12.28
Previous admission in psychiatric hospital (Yes/No)	1.52	0.40	1.60	0.109	1.32
Previous compulsory admission (Yes/No)	0.73	0.18	-1.28	0.202	5.02
Previous year psychiatric history					
Number of admission	1.60	0.23	3.30	0.001	4.42
Number of outpatient contacts	1.04	0.01	6.87	<0.001	18.73
Number of day-care contacts	1.01	0.00	3.54	<0.001	10.27
GAF score	0.98	0.00	-4.48	<0.001	18.99
First contact unplanned vs planned	1.46	0.41	1.34	0.180	0.63

Table IV – *Performance of the logistic regression model identifying frequent service users characteristics and 20-fold cross-validation.*

	Full logistic regression	Forward stepwise logistic regression	20-fold cross validation	
			Training dataset	**Test dataset**
	13 variables§ (n = 1250)	10 variables§§ (n = 1250)	(n = 1000)	(n = 250)
Sensitivity	76.9%	75.7%	81.4%	81.2%
Specificity	81.2%	81.5%	86.1%	80.2%
Positive preictive value	79.8%	79.9%	83.7%	84.8%
Negative predictive value	78.4%	77.7%	84.1%	75.9%
Percent correctly classified	79.1%	78.7%	83.9%	80.8%
Pseudo R²	0.38	0.37	0.51	0.44

§sex, living situation, educational status, diagnosis, first contact planned/unplanned, previous lifetime psychiatric history (presence of psychiatric contact), admission in psychiatric hospital, compulsory admission, number of admission, previous year psychiatric history (number of admission, outpatient contacts, day-care contacts), GAF score.

§§sex, living situation, educational status, diagnosis, previous lifetime psychiatric history (presence of psychiatric contact, number of admission), previous year psychiatric history (number of admission, outpatient contacts, day-care contacts), GAF score.

care, were the only services to cost more than 100 Euros. The less expensive services resulted the individual rehabilitation contact, the rehabilitation group, the pharmacotherapy contact, the advocacy service and the nurse's support contact, with costs in a range from 13 and 23 Euros. Contacts as the out-patient psychiatric and psychological contact, the individual or group psychotherapy and the home visits have costs going from 35 to 59 Euros.

Packages of care

Looking just at the frequent service users patients data about their utilisation of services during the six months follow-up, three packages of care were identified, consisting of different outpatient and in-patient based treatment described afterwards, differing in number and type of contacts.

The first package was characterized mostly from out-patient psychiatric contacts, rehabilitation groups and home visits, the second package was the most heterogeneous, with the higher number of different types of contacts, whereas the third package was composed particularly by days spent in residential facilities, group rehabilitation contact and home visits.

The packages have been named according to the prevalence of the type of contacts, and are described as follows: *Basic Community Treatment* (BCT), in this group is 83% of the frequent service users. During six months follow-up, these patients make, on the average, five out-patient psychiatric contacts, four nurse's support contacts, three rehabilitation groups, four pharmacotherapy contacts, one psychoeducational intervention, five days in residential contacts and three or four home visits;

Intensive Community Treatment (ICT), this group (6% of frequent service users) includes patients that use mostly drug delivery contacts (i.e. contact for depot pharmacotherapy and/or to be given any type of medication) (100), nurse's support contacts (20), and days in residential facilities (19 days on average in six months), nine employment/rehabilitation workshops, ten out-patient psychiatric contacts, eight rehabilitation groups, nine home visits, six multi-professional meetings and two individual rehabilitation contacts and psychoeducational interventions.

Within the *Rehabilitative Community Treatment* (RCT) package falls the remaining 11% of the frequent service user group. Patients within this package mostly spend days in rehabilitative residential programmes (94 days on average in six months), rehabilitation groups (57), home visits (12-18), nurse's support contacts (about every 15 days), ten out-patient psychiatric contacts and drug delivery contacts. There were no differences among the three packages, in the number of admissions to an acute psychiatric ward.

Multinomial logistic analysis allows us to identify the characteristics affection of being in a particular package of care instead of another. The three steps procedure identified a model that correctly classified 83% of the users, taking into account the socio demographic characteristics and diagnosis only, 88% of the users, using previous history information, and 89% of users considering both socio demographic and clinical characteristics (Table V).

For example, a married person is most likely to be in the RCT package, regarding the age of a patient, as patients' become older there is a 3% probability for each year in age of being in the ICT package instead of the BCT.

When a user's clinical history is examined, users previously not admitted to a State Mental Hospital, or without compulsory admission, have a higher probability of being in the RCT or in an ICT package of care. In particular, for users without admission in a State Mental Hospital, the likelihood of being allocated to the RCT package is about two times larger than the probability of being allocated to the BCT package. The same patient is over two times more likely of being in the ICT package compare to the BCT package.

As day care contacts, out-patients visits and the number of admission become more numerous, the chances of being in the BCT package decrease.

Users with a diagnosis of schizophrenia are more likely to be in the RCT package than in the ICT or BCT package compared to patients with a diagnosis of affective disorders or neurosis and somatoform disorders or personality disorders.

As noticed above, *post hoc* checks enabled us to confirm that the final model obtained with the multinomial logistic regression was able to correctly assign 89% of users to the three different packages of care. After the 20-fold cross-validation the performance of the model decreased, the percentage of users correctly assigned fall down to 69.4%.

Costs of care

Low service users costs are associated with costs of single services provided. This suggests that the funding system for those patients may be based on the principle of fee-for-service. For example, one day in an acute psychiatric ward costs 229.25 Euros, an out-patient visit costs 59.53 Euros and an initial out-patient psychiatric assessment costs 60.77 Euros.

For *frequent service users*, the cost of each package was also estimated. The BCT package is the least expensive (4,133 Euros per six months), and this is not surprising as the type of contacts in this group are the less expensive; furthermore, costs are distributed over a greater number of different types of contacts. The ICT package costs 6,180 Euros per six months. Its cost is mostly due to days in residential facilities (25% of the total cost), drug delivery contacts (23%) and employment/rehabilitation workshops (19%). The RCT package is the most expensive, costing 11,984 Euros per six months. This package includes the most expensive types of contacts, both in terms of the unit cost and frequency. For instance the number of days spent in residential facilities covers 63% of the total costs and home visits cover a further 9%; in other words patients in the RCT package use most often most costly services.

Table V – *Multinominal logistic regression to assign users to three packages of care.**

| | Socio-demographic and diagnosis model | | | | Previous history model | | | | Complete model | | | |
| | RCT** | | ICT** | | RCT** | | ICT** | | RCT** | | ICT** | |
	RRR	se	RRR	se	RRR	se	RRR	se	RRR	se	RRR	se
Women vs men	1.06	0.30	0.52	0.22					0.76	0.28	0.25	0.17
Age	1.03	0.01	1.01	0.02					1.02	0.02	1.03	0.03
Marital Status vs. Single												
Married/live-in partner	8.47	5.43	1.11	0.73					24.39	23.31	3.27	3.74
Separated/divorced	8.44	5.89	0.68	0.60					22.30	21.86	2.62	3.27
Widowed	5.16	4.25	0.00	0.00					16.71	18.95	0.00	0.00
Diagnosis vs. Schizophrenia												
Affective disorders	0.95	0.36	0.80	0.43					1.08	0.52	0.90	0.70
Neurotic and Somatoform disorders	0.87	0.56	0.00	0.00					1.25	0.89	0.00	0.00
Personality Disorders	1.24	0.49	0.57	0.37					1.39	0.66	0.26	0.26
Other diagnosis	0.95	0.49	1.33	0.79					1.30	0.82	0.62	0.69
Educational status vs. up to secondary school												
Diploma	0.90	0.29	1.37	0.57					0.95	0.36	1.96	1.21
Degree	0.90	0.58	1.24	0.98					1.36	0.98	4.09	3.95
Living situation vs With partner or family												
Alone	0.52	0.19	2.52	1.29					0.66	0.28	1.42	1.07
Other	1.59	0.62	5.10	2.59					1.33	0.67	1.88	1.46
Previous lifetime psychiatric history												
Previous psychiatric contact (No vs. Yes)					0.60	0.24	1.01	0.59	0.56	0.23	1.05	0.69
From 1 to 5 admissions vs. no admissions					1.26	0.49	1.49	0.99	1.24	0.50	1.22	0.90
More than 5 admissions vs. no admissions					1.65	0.74	0.95	0.72	1.42	0.67	0.80	0.66
No previous admission in State Mental Hosp.					1.86	0.94	2.09	1.89	1.79	0.92	2.27	2.06
No previous compulsory admission					2.27	0.94	1.63	1.02	2.67	1.17	1.97	1.34
Previous year psychiatric history												
Number of admissions					0.91	0.12	1.05	0.12	1.05	0.14	1.24	0.19
Number of outpatient contacts					1.01	0.00	1.03	0.00	1.02	0.00	1.03	0.00
Number of day-care contacts					1.01	0.00	1.00	0.00	1.01	0.00	1.00	0.00
GAF score					1.00	0.01	1.01	0.02	1.01	0.01	1.02	0.02
First contact unplanned vs. planned					0.09	0.17	7.21	6.92	0.25	0.34	6.09	6.20
Performance and 20-fold cross validation of multinomial regression models												
Full logistic regression (n = 611)												
% of correctly classified cases (Pseudo R2)	83.14 (0.07)				88.38 (0.37)				89.04 (0.42)			
Training dataset (n = 467)												
% of correctly classified cases (Pseudo R2)	88.87 (0.11)				91.65 (0.39)				92.50 (0.47)			
Test dataset (n = 144)												
% of correctly classified cases	64.58				72.22				69.44			

*Basic Community Treatment (BCT) is the package utilized for the comparison. RRR is the Relative Risk Ratio.
**RCT = Rehabilitative Community Treatment; ICT = Intensive Community Treatment

DISCUSSION

The main purpose of this study was to identify predictors of users' pathways of care and to estimate the subsequent costs. Criteria were developed for classifying frequent and low service users, defined on the basis of clinical experience and knowledge. The analyses demonstrated that in our Services it was possible, using easily accessible socio-demographic and clinical data, to correctly classify prospectively, i.e. after a few contacts with the service, about 80% of the users. A second classification was then obtained using a statistical approach. Three different pathways of care were identified for those patients who were previously described as frequent service users of the CMHSs. From this analysis, the model classified correctly about 85% of the users.

Differences between frequent and low service users

Low service users usually do not consume excessive resources and to support their care the funding of services could be effectively realised with a fee-for-service system. In the *frequent service users* group, there are the great majority of those patients who have severe mental disorders associated with complex needs and are receiving intensive treatment, usually requiring expensive interventions, supplied by a multidisciplinary team. For these reasons, a CMHS could act more efficiently if the resources were already available in a prospective "package of care" payment system. Of course, the number of packages should be limited; there should be enough homogeneity within them and to justify the supply of different pathways of care the cost of each package should be different from the others.

The model to allocate frequent service users in different packages of care

In our model, frequent service users were divided into three packages of care, according to type of contacts, frequency in the use of the services and costs. *Basic Community Treatment; Intensive Community Treatment and Rehabilitative Community Treatment* are the three possible pathways of care, with a well-defined cost and a predictive model that correctly assigned about 85% of the patients' sample.

Such a system can be useful for allocating the approximate amount of money that will be dedicated to each patient. Furthermore this system would enable a service to decide if a patient should be funded with a fee-for-service system or with a package of care. In other terms, this system could help in providing a more effective system of care. Moreover, when a patient is reassessed after six months, if his/her situation has changed, he/she could be reassigned to a different system of care/funding.

The proposed funding system

A critical point to support community psychiatric care is what type of funding system is chosen. Under a fee-for-service system it is likely that certain activities will not receive enough funding; for instance, funding a community mental health centre according to the number of visits disregards the fact that the unit offers an "assurance" service to the community and not just interventions *per se*, even if a well designed, fee-for-service system makes some services more financially attractive than others. Consequently, the choice of the service mix may be driven by financial considerations rather than clinical appropriateness criteria. For example, it would be more rewarding, from a financial point of view, to provide intensive out-patient care to not-too-difficult patients, than to provide the necessary comprehensive out-patient, community and in-patient care to severe cases. Since the Italian approach to community psychiatry focuses on the overall management of the patients with mental disorders, the suggested funding system may be helpful for sustaining and promoting the latter approach. It is considered to be more appropriate to adopt a funding system focused on the patient and his/her needs rather than on the specific service contact to be provided (Fattore *et al.*, 1997).

As the purpose of this study was to find a way to guide the allocation of resources at various levels, not only at a regional level, these analyses were conducted in five different community-based psychiatric services with different clinical organisation, quantity of resources and numbers of patients in charge. The five services were also situated in areas where the socio-economic conditions are quite different. For these reasons, our results could be considered enough strong to be experimentally piloted in other settings, where CMHSs provide care for mentally ill.

Having found clinical and socio-demographic characteristics as predictor of the Service's utilization intensity, and as the packages of care are few and comprehensive of performances normally lavished by CMHSs, it could be possible to pilot this funding approach in other services and in different areas.

We shall underline that the five centers recruited the same number of patients in different span of time and that

the numbers of contacts provided by each CMHS were different. Another potential limitation of our study arises from the fact that to implement the suggested funding system it is necessary to have a good mental health information system that should include patients' characteristics and details on contacts.

The cross-validation showed that the performance of the prediction model to divide patients into two groups (*low service users* and *frequent service users*) have a good accuracy; on the contrary, when cross-validation was applied to the multinomial logistic regression model a reduction in the accuracy was demonstrated. This suggest that this method requires large dataset to produce robust results.

In spite of these possible difficulties, knowledge of the factors that influence services utilisation could usefully inform the planning of mental health services and the allocation of resources. The purpose of the approach proposed in this paper is to identify the combination of characteristics/factors able to make the best prediction of the care provision that a patient is likely to receive within the CMHS and to use this information to prospectively finance his/her care after the first few contacts with the services.

REFERENCES

Albizu-Garcia C.E., Alegria M., Freeman D. & Vera M. (2001). Gender and health services use for a mental health problem. *Social Science and Medicine* 53, 865-878.

Amaddeo F., Zambello F., Tansella M. & Thornicroft G. (2001). Accessibility and pathways to psychiatric care in a community-based mental health system. *Social Psychiatry and Psychiatric Epidemiology* 36, 500-507.

Bhui K., Stansfeld S., Hull S., Priebe S., Mole F. & Feder G. (2003). Ethnic variations in pathways to and use of specialist mental health services in the UK. Systematic review. *British Journal of Psychiatry* 182, 105-116.

Carr V.J., Johnston P.J., Lewin T.J., Rajkumar S., Carter G.L. & Issakidis C. (2003). Patterns of service use among persons with schizophrenia and other psychotic disorders. *Psychiatric Services* 54, 226-235.

Commander M.J., O'Dell S.M., Surtees P.G. & Sashidharan S.P. (2003). Characteristics of patients and patterns of psychiatric service use in ethnic minorities. *International Journal of Social Psychiatry* 49, 216-224.

De Agostini P., Bonizzato P., Amaddeo F., Bisoffi G., Perali F. & Tansella M. (2001). For a more rational funding system of mental health services. Analyses of costs for services supplied by community mental health services during a 7-year period. *Epidemiologia e Psichiatria Sociale*. 10(3),163-79.

Efron,B. & Tibshirani,R. (1993). *An Introduction to the Bootstarp*, Chapman and Hall: Washington.

Fattore G., Percudani M., Pugnoli C. & Contini A. (1997). Costs of psychiatric services: a study performed at a public mental center in the Lombardy Region, Italy. *Epidemiologia e Psichiatria Sociale* 6, 139-147.

Friedman J.H. & Meulman J.J. (2003). Multiple additive regression trees with application in epidemiology. *Statistics in Medicine* 22, 1365-1381.

Goodwin R.D., Hoven C.W., Lyons J.S. & Stein M.B. (2002). Mental health service utilization in the United States. The role of personality factors. *Social Psychiatry and Psychiatric Epidemiology* 37, 561-566.

Grigoletti L., Amaddeo F., Grassi A., Boldrini M., Chiappelli M., Percudani M., Catapano F., Fiorillo A., Bartoli L., Bacigalupi M., Albanese P., Simonetti S., Perali F., De A.P. & Tansella M. (2006). Proposal for a new funding system for mental health departments. Results from an evaluative multicentre Italian study (I-psycost). *Epidemiologia e Psichiatria Sociale* 15, 295-306.

Keown P., Holloway F. & Kuipers E. (2005). The impact of severe mental illness, co-morbid personality disorders and demographic factors on psychiatric bed use. *Social Psychiatry and Psychiatric Epidemiology* 40, 42-49.

Lindamer L.A., Bailey A., Hawthorne W., Folsom D.P., Gilmer T.P., Garcia P., Hough R.L. & Jeste D.V. (2003). Gender differences in characteristics and service use of public mental health patients with schizophrenia. *Psychiatric Services* 54, 1407-1409.

Lora A., Bezzi R., Di Vietri R., Gandini A., Spinogatti F. & Zocchetti C. (2002). Packages of care in the departments of mental health in Lombardy. *Epidemiologia e Psichiatria Sociale* 11, 100-115.

Lora A., Cosentino U., Gandini A. & Zocchetti C. (2007). Which community care for patients with schizophrenic disorders? Packages of care provided by Departments of Mental Health in Lombardy (Italy). *Epidemiologia e Psichiatria Sociale* 16, 330-338.

Mojtabai R., Herman D., Susser E.S., Sohler N., Craig T.J., Lavelle J. & Bromet E.J. (2005). Service use and outcomes of first-admission patients with psychotic disorders in the Suffolk County Mental Health Project. *American Journal of Psychiatry* 162, 1291-1298.

Moos R.H., McCoy L. & Moos B.S. (2000). Global assessment of functioning (GAF) ratings: determinants and role as predictors of one-year treatment outcomes. *Journal of Clinical Psychology* 56, 449-461.

Patel V., Araya R., Chatterjee S., Chisholm D., Cohen A., De Silva M., Hosman C., McGuire H., Rojas G. & van Ommeren M. (2007). Treatment and prevention of mental disorders in low-income and middle-income countries. *Lancet* 370, 991-1005.

Percudani M., Gerzeli S., Massagrandi R., Jommi C., Fattore G., Cerati G. & Contini A. (2003). Costs and outcome of care in subjects with severe mental disorders. *Epidemiologia e Psichiatria Sociale* 12, 175-186.

Rossi A., Sandri M., Bianco M., Marsilio A., Tansella M. & Amaddeo F. (2006). Factors associated with clinicians' dispositions in an out-patient psychiatric department. *Social Psychiatry and Psychiatric Epidemiology* 41, 832-840.

Slade M., Amering M. & Oades L. (2008). Recovery: an international perspective. *Epidemiologia e Psichiatria Sociale* 17, 128-137.

STATA Corporation (2003). STATA Statistical Software. Release 8.0. Texas.

Tait L., Birchwood M. & Trower P. (2003). Predicting engagement with services for psychosis: insight, symptoms and recovery style. *British Journal of Psychiatry* 182, 123-128.

Tansella M. (2007). Does socio-economic status influence the use of mental health services? *Epidemiologia e Psichiatria Sociale* 16, 1-2.