

Cost Effects of Diagnose, Indicate, and Treat Severe Mental Illness (DITSMI) in Residential Psychiatry

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Abstract

Background: In a previous study the DITSMI (Diagnose, Indicate, and Treat Severe Mental Illness) protocol, implemented in 2015, was shown to have a beneficial effect on long-term residential patients. Applying the protocol led to a change of diagnoses in half the patients, different treatment proposals and a significant reduction of bed utilization. To accurately estimate the potential economic impact of the DITSMI protocol, including potential savings related to deinstitutionalization, more precise knowledge of the costs of institutionalization is essential. The current observational study examined whether the DITSMI protocol affected changes in health care costs and revenues.

Methods: We studied costs and revenues of care in a consecutive sample of 94 long-term residential patients between 2012 and 2018 in the eastern Netherlands. Health care costs were operationalized using bed utilisation and time spent by professionals on inpatient or outpatient contacts and their direct costs to the health care provider. The costs for each type of professional were identified separately, including psychiatrists, psychologists, physicians, nurses and social workers. As revenues we considered payments from patients' health insurers to the provider for an inpatient admission (inpatient stay revenue) or for other costs such as outpatient treatment contacts (insurance revenue). The revenues were derived from the invoices sent to the health insurers. As the data sources were different, the costs and revenues were not related. These costs and revenues were aggregated to one record a year. Differences in proportions of costs and revenues before and after implementation of the treatment program were tested by Chi-square. The association of changed diagnosis, treatment proposal and medication to admission days and overall

revenues was tested by a repeated measures analysis of variance (ANOVA). These revenues included the total revenues from all possible aspects of patient care that may apply to a specific patient.

Results: The repeated measures ANOVA of admission costs and revenues between 2012 and 2018 showed a significant decrease in the number of admission days in the studied sample after applying the DITSMI protocol (slope=-3.23; p=0.002; effect size=0.062). In line with this, the inpatient stay revenues (slope -0.546; p=0.001; effect size=0.217) and the insurance revenues (slope=-0.403; p=0.001; effect size=0.109) decreased. These decreases were associated with change in diagnosis, different treatment, and changes to medication. Adversely, the analysis also showed an increase in costs of psychiatrists, psychologists, and physicians. Overall staff costs decreased, especially in patients with a change of diagnosis from 'schizophrenia' to 'neurodevelopmental disorders'.

Implications for Health Care Provision, Policy, and Future Research: Implementing the DITSMI protocol reduced the overall cost of long-term inpatients in our limited sample, primarily through discharge. However, despite an overall reduction of staff costs, implementation of the DITSMI protocol may require an investment in specific staffing groups to facilitate neuro-divergence appropriate treatments. Confirmation of the results of the current study should be investigated using designs such as a cluster randomized trial in which patients are allocated to care as usual or treatment. Future research is also necessary to investigate generalizability of the DITSMI protocol to other patients groups.

Received 9 October 2024; accepted 11 July 2025

Introduction

In the Netherlands, about 160,000 people aged between 18 and 65 suffer from severe mental illness (SMI).¹ According to recent national data, a stable number of approximately 24,000 patients have been hospitalized for more than two years.² In the catchment area of the Mental Health Institute where this study has been conducted (GGNET), the number of patients with SMI is estimated to be between 12,000³ and 14,000.⁴ The number of long-term residential patients with an accumulated hospital stay of 2 years or more is approximately 120.⁵ The

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**Supplementary Material: Data for sharing findings may be requested by contacting Eric O. Noorthoorn, MD, PhD, at e.noorthoorn@ggnet.nl

Source of Funding: This study was supported by ZonMw program 'Goed Gebruik Geneesmiddelen' [Appropriate medication use] grant number 848022006. And by ZonMW program "actieprogramma lokale initiatieven voor mensen met verward gedrag" [action program for local initiatives for people with confused behaviour]: grant number 6380210212. According to the guidelines ZonMW the funding authority had no influence on the content of the publication.

number of patients in long-term sheltered housing is about 150². However, some patients with SMI are considered too vulnerable to be discharged and remained hospitalized as long-term residential patients. These specific patients constitute only 3% of patients within the mental health system, but represent an important proportion of the numbers of inpatients in the Netherlands. The cost for each long-term residential patient averages at about €101,600 (US\$110,000) a year. The estimated number of these patients in the Netherlands is approximately 3000, leading to an estimated cost of €281 million (US\$355 million) per year.⁶

Health insurance and health care costs in the Netherlands are regulated in four healthcare-related Acts in the ways described in the following examples from day-to-day practice. If someone needs to see their general practitioner, or psychiatrist, or is hospitalized, this will be paid for by the mandatory basic health insurance under the Health Insurance Act. People who require permanent supervision or 24-hour home care can benefit from the provisions of the Long-Term Care Act. The Social Support Act and the Youth Act provide for other forms of support, assistance and care, based on a municipal approach, which is tailored to the needs of the patient and focused on community care provision. For example, those who require home assistance, sheltered housing or a wheelchair due to a disability can apply for this support to the local authority. The local authority can then arrange for support under the Social Support Act. If there are families that require parenting support, or if an autistic child requires support with everyday living, the local authority can provide this under the Youth Act. For patients in long-term care, the first 3 Care Acts are relevant.

Veereschild *et al.*⁷ developed the “Diagnose, Indicate, and Treat Severe Mental Illness” (DITSMI) protocol, a treatment protocol in keeping with the current Dutch guidelines for re-assessing patients with SMI. The protocol was based on several concepts and interventions, of which the most important ones were holistic diagnoses, multidisciplinary treatment planning, and shared decision making. Holistic diagnoses were made by re-evaluating patients with regards to various aspects of their life, including psychiatric, somatic, and social functioning, without relying solely on a DSM or ICD diagnoses. Subsequently, a redirected multidisciplinary treatment proposal in accordance with the current Dutch treatment guidelines⁸ was developed. This included shared decision-making throughout the treatment process with patients, relatives, and a multidisciplinary team. Veereschild *et al.*⁷ showed that over the 3 years in which the DITSMI protocol was provided to long-term residential patients, 49% obtained a new diagnosis, 67% a new treatment proposal, and 67% different medication. Bed utilization decreased by 40%. Extra time investment by professionals in the first year led to a total therapeutic time reduction of 22% in the third year (**Table 1**).

To accurately estimate the potential economic impact of implementing the DITSMI protocol, including potential savings related to deinstitutionalization, knowledge about the costs of institutionalization is essential. In the Netherlands, Mental Health Trusts need to send specified invoices to every patient’s health insurer every month. These invoices need to be backed by detailed information on staff engaged in the treat-

ment of individual patients, both inpatients and outpatients. We can measure costs to the health care provider by looking at the revenues as declared by means of hospital invoices to health insurers, local and national government. Accurate analyses of the possible costs and revenues associated with the DITSMI protocol can help decision-makers at a hospital level to identify where these budgetary resources can be found.

In the current study, we investigate the economic impact of the DITSMI protocol on the costs and yields of a mental health care provider. Our main question is: What is the effect of implementing the DITSMI protocol on trends of costs associated to admission days, care contacts, staff costs and yields from stay and insurance revenues?

Methods

The DITSMI protocol was implemented in a consecutive patient sample of 94 long-term residential psychiatric patients (mean length of stay at onset 20.2 years) in a longitudinal cohort study without a control group, in the eastern Netherlands. The DITSMI protocol, designed in advance, was implemented from the 1.1.2015 onward and ended on 31.12.2017. Data were gathered between 1.1.2012 and 31.12.2018⁷, and included all necessary source information from the Mental Health Trusts database.

For the current study, we used the same predictors to identify the direction of change. The first predictor was the change in diagnosis. The second predictor was the change from a diagnosis of ‘schizophrenia’ to ‘neurodevelopmental disorder’. This proved to be the most frequently occurring (22%) diagnosis change in the sample and was included as predictor post hoc. Treatment change was the third, and medication change the fourth predictor. In all analyses, age and gender were included as co-variables, to identify any confounding of the predictors by these patient characteristics.

The admission days, care contacts, inpatient stay revenues, staff costs and insurance revenues were included as outcome variables in the analyses (**Appendix, Table A1**). All revenues were payments from patients’ health insurers to the mental health care provider (hospital) for an inpatient admission (inpatient stay revenue) or other costs such as medication (insurance revenue). They were derived from the invoices sent to the health insurers. Admission days concerned the number of days of stay at a ward in the Mental Health Trust calculated by subtracting day of discharge from day of admission. The total revenue to the provider was collected from the financial administration of the Mental Health Trust.

These are made up of: (i) The health care revenues, i.e. the total of invoices to the health insurers, covering treatment per patient per month. (ii) The inpatient stay costs on the wards per patient per month. (iii) Revenue in case of long stay patients when the government covers invoices within the legislation of the Long-term Mental Health Care Act. (iv) Revenue from patients who stay in community or sheltered housing, financed by the Municipality within the Social Support Act. (v) Treatment revenues invoiced in accordance with regulations of the Health Insurance Act, where each combination of diagnosis and treatment could be invoiced separately.

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Table 1. Descriptives.

Variables	Predictors		Costs		Revenues	
	Before*	After**	Before	After	Before	After
Patent characteristics						
Mean age (Standard Deviation)	49 (11.8)	52 (12.7)				
Men	69%	69%				
Women	31%	31%				
Partner	18%	18%				
Developmental disorder	6%	16%				
Psychosis not otherwise specified	8%	19%				
Schizophrenia	53%	36%				
Schizoaffective disorder	8%	10%				
Bipolar disorder	8%	2%				
Depressive disorder	5%	4%				
Post Traumatic Stress Disorder	1%	5%				
Personality disorder	4%	2%				
Paedophilia	-	1%				
Mild or borderline intellectual functioning	4%	18%				
Substance abuse	21%	16%				
Resident patients	100%	54%				
Mean length of stay (Standard Deviation) in years	20.2 (8.7)	22.6 (9.0)				
Medication						
First-generation antipsychotic medication	44%	25%				
Second-generation antipsychotic medication	56%	75%				
Clozapine	25%	39%				
Anti-cholinergic use	35%	19%				
Outcome						
Admission days			31487	17264		
Costs staff wards			€ 35961	€ 39764		
Costs staff overall			€ 895863	€ 715970		
Costs psychiatrist			€ 143950	€ 132852		
Cost physician			€ 51311	€ 98820		
Cost Social worker			€ 86134	€ 94976		
Cost ward nursing team			€ 270718	€ 206160		
Health insurers invoice					€ 7696584	€ 4863690
Stay invoice total					€ 8289740	€ 4559830
Funded by Long-Term Care Act					€ 6975166	€ 4064594
Funded by Social Support Act					€ 151841	€ 813742
Funded by Health Insurance Act					€ 892106	€ 349955
Predictors						
Diagnosis changed		68%				
Change Schizophrenia in Neurodevelopmental Disorders		22%				
Treatment proposal changed		66%				
Medication changed		47%				
Total therapeutic time reduction ⁷		22%				

* Before was defined as in the baseline figures of 2012

** After as the final figures in 2018

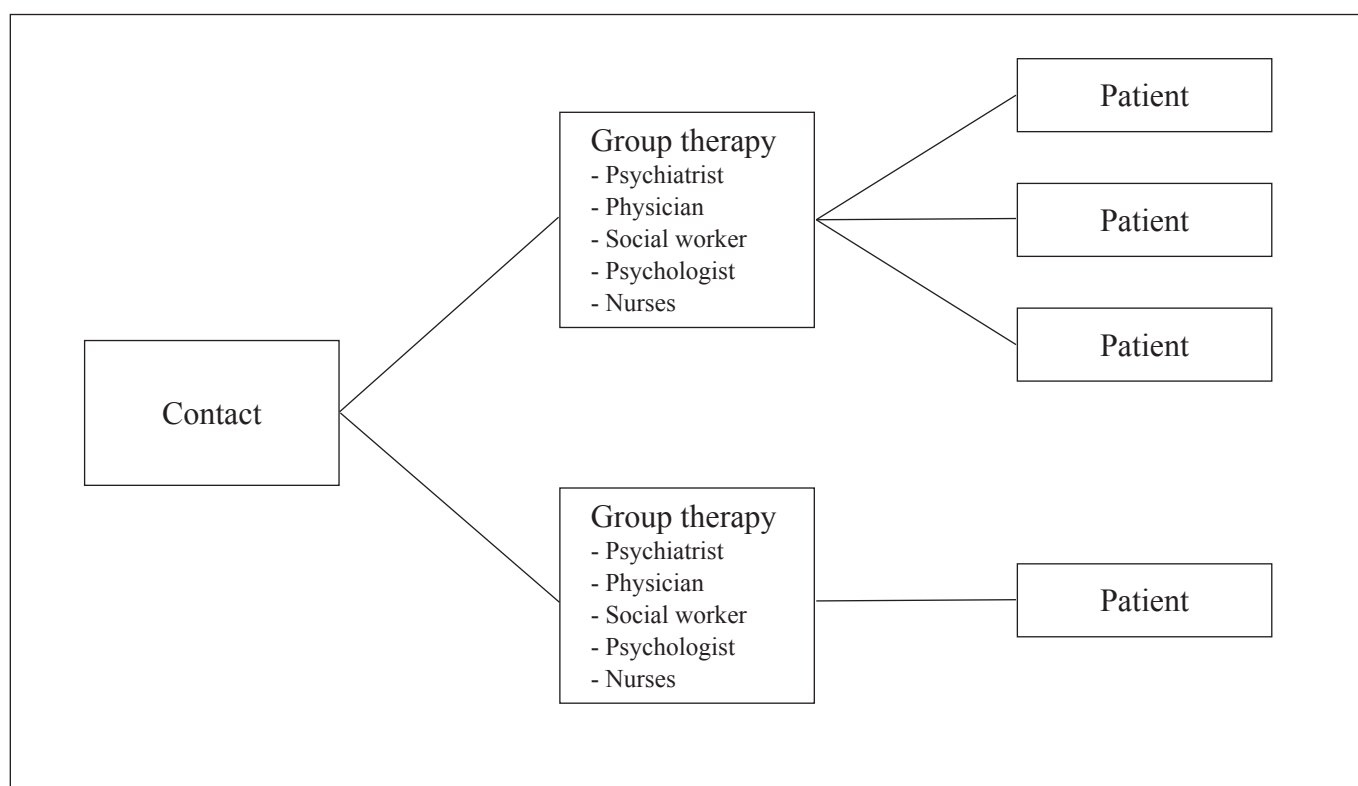


Figure 1. Nested Design.

The institutes' staffing costs were specified by profession. The time spent by professionals in individual or group therapy was registered by individual contacts involved. We calculated the precise costs of each professional, based on their salary and their day-to-day input into the treatment. This allowed a day-to-day calculation of all costs and revenues of the Mental Health Trust.

Six databases were constructed for the current study by extracting data at several levels from the hospitals registration systems. The first concerns individual patient contact time. This database provided day to day data. The data source was the electronic medical chart of each patient. Each single contact with a mental health care professional was included in this database. If a patient participated in a group therapy meeting, the costs of the attending therapists was divided through the number of patients attending. By means of a date and time algorithm, the data were aggregated to each patient per day, per month or per year. In such a way, precise costs could be related to each patient each day and aggregated to a month and a year. For the analysis, we developed a nested construction of the data. This is clarified in **Figure 1**. In the database, each care contact (single or within a group) was allocated for each patient and each hour at each day to each staff member. To organize the data in such a way allowed us to calculate the contribution of specific professionals to the total care cost. Thus, nurses could be identified separately from psychologists, clinical psychologists, social workers, physicians or psychiatrists in their precise contribution to care, either in group therapy meetings or in single patient contacts.

The second database is an aggregation of these data at a

departmental level. With respect to the costs of care contacts, we calculated the general time spent by professionals in direct face-to-face contact and indirect patient contact time. Indirect time is time spent in reporting the content of the contact or the time spent in contacting family members and other professionals engaged in care. This database provides monthly data. Here, the source did not concern single patient contacts, but summaries made by the financial department aimed to monitor and manage care costs. This data base is less precise than the first database, because it concerned individual contacts aggregated per month and added up to a year total per patient. For the hospital financial department, it is the main cost monitoring database.

Next, a medication database was constructed describing each prescription per patient. In this database we counted the medication changes in each patient sampled, recording each change as one record per change. Prescriptions for medication were categorized in the following overall groups: first- and second-generation antipsychotics, anticholinergics, benzodiazepines, anticonvulsants, tricyclic antidepressants, and selective serotonin reuptake inhibitors (SSRI). More specifically, we also counted the numbers of prescriptions for clozapine, olanzapine, lorazepam, and oxazepam, as these are the core of the Dutch National Treatment guidelines⁸.

Inpatient stay was calculated in two ways. First, we calculated the number of inpatient days. This compiled the fourth database. In the fifth database we calculated the costs per day, dependent on the ward where the patient stayed. Admission wards had different day prices compared to treatment wards, forensic wards, or long stay wards. These costs for inpatient

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Table 2. Included Variables.

Variables	Predictors	Costs	Revenues
Patient characteristics			
Age and gender	X		
Treatment effect variables			
Diagnosis	X		
Change Schizophrenia into developmental disorder	X		
Changed treatment	X		
Changed medication use	X		
Outcome variables			
Admission days		X	
Costs Staff		X	
Overall		X	
Psychiatrist		X	
Social worker		X	
Psychologist		X	
Ward nursing team		X	
Health insurers invoice			X
Total stay invoice			X
Funded by Long-Term Care Act			X
Funded by Social Support Act			X
Funded by Health Insurance Act			X

stay per ward were aggregated to a total per month and per year. Finally, the invoices sent each month to the health insurers for reimbursement were included in the sixth database by adding up all invoices sent as an expression of total cost. This simple database consists of patient identification, date of invoice and amount. **Appendix, Table A1** defines all economic terms included. **Table 2** presents an overview of all variables included, organized by costs and revenues. We identified patient background characteristics, the predictors, the costs, and respective revenues.

The association between changed diagnosis, changed treatment proposal, or changed medication and the several outcome variables was tested by a repeated measures analysis of variance (ANOVA⁹⁻¹¹). We calculated the slope over time as predicted by these variables and identified whether the repeated measures analysis of variance showed significance within and between subject differences over time. In the ANOVA, the slope represents the decrease or increase rate over all measurement moments. A negative slope implies a decrease and a positive slope represents an increase. A positive slope of 0.5 implies an increase of 50% over the observed time and a negative slope of -0.5 implies a 50% decrease over the same observed time. The within subjects *f* and *p* values show significant change over time for all patients. A between subjects *f* and *p* value represents the significantly different changes between the two groups compared by predictor. More importantly, the strength of the association in a repeated measures ANOVA is judged by effect size, expressed in the partial eta-squared. An effect size of above 0.01 is small, above 0.06 medium and above 0.14 large.¹⁰

Results

Sample

The sample has been described earlier.⁷ The final sample contained 83 patients for whom there were full data over the three-year study period between 2015 and 2018 and the three years before, between 2012 and 2014. **Table 1** provides an overview of the descriptive statistics. The six databases constructed for the purpose of the study covered a major part of care provided. The individual contact database contained 331,584 records. The aggregation of this database to monthly information contained 5,528 records, with a coverage of 71% of all possible months between start and end of the study. The inpatient stay database contained 220,868 records, a coverage of 92% of all possible stay days between start and end of the study. The medication database contained 43,913 records of prescribed medications. In this database, 417 main medication group changes were observed⁷. The invoice database contained 9,231 invoices.

Trend Analyses

Figure 2a presents the findings of the repeated measures analysis of variance. Figure 2a shows the general trend of the admission days in the complete sample observed between 2012 and 2018. The *r*-square of the slope represents the goodness of fit and the consistency of the rise. An *r*-square of between 0.7 and 0.85 can be seen as large and above 0.85 as excellent.^{11,12} The slope (**Table 3**) of -0.53 (**Table 3**) showed a change of -53%

Table 3. Association of Predictors to Outcome.*

Predictor	Outcome	slope		Effect size	Between Subjects		Within Subjects	
		predictor	else		F	P=	F	P=
Diagnosis changed	Admission days	-0.536	-0.457	0.035	4.226	0.043	2.747	0.012
	Costs staff overall	-0.258	-0.311	0.008	0.003	0.958	0.615	0.719
	Costs psychiatrist	-0.148	0.112	0.012	0.244	0.623	0.878	0.511
	Costs physician	0.935	1.363	0.041	2.745	0.102	3.181	0.005
	Costs social worker	0.126	-0.627	0.019	0.045	0.833	1.433	0.200
	Costs psychologist	0.221	0.534	0.058	0.461	0.499	4.650	<0.001
	Costs ward nursing team	-0.497	-0.521	0.005	0.008	0.928	0.400	0.879
	Total Health Insurance Act	-0.342	-0.443	0.060	1.925	0.169	4.283	<0.001
	Total stay revenues	-0.563	-0.552	0.050	5.989	0.019	3.940	<0.001
	Long-Term Care Act stay revenues	-0.553	-0.544	0.065	3.837	0.054	5.239	<0.001
	Social Support Act stay revenues	7.592	5.606	0.021	1.164	0.284	1.595	0.147
	Health insurance Care stay revenues	-1.350	-0.707	0.029	0.362	0.549	2.235	0.039
Schizophrenia changed in developmental disorders	Admission days	-0.333	-0.591	0.087	5.098	0.027	7.131	0.001
	Costs staff overall	-0.376	-0.208	0.015	8.018	0.006	1.112	0.345
	Costs psychiatrist	1.426	-0.179	0.001	10.018	0.006	0.105	0.966
	Costs physician	0.821	0.682	0.008	4.359	0.040	0.727	0.628
	Costs social worker	-0.150	-0.111	0.026	10.907	0.001	1.967	0.069
	Costs psychologist	1.597	0.324	0.036	5.140	0.026	2.531	0.020
	Costs ward nursing team	-0.721	-0.248	0.012	3.208	0.077	0.946	0.462
	Total Health Insurance Act	-0.370	-0.375	0.092	0.249	0.589	7.585	<0.001
	Total stay revenues	-0.292	-0.632	0.121	2.250	0.132	13.907	<0.001
	Long-Term Care Act stay revenues	-0.203	-0.574	0.078	3.011	0.087	6.364	<0.001
	Social Support Act stay revenues	2.466	6.887	0.023	4.926	0.029	1.742	0.110
	Health insurance Care stay revenues	-0.701	-0.644	0.008	5.534	0.021	0.583	0.744
Treatment proposal	Admission days	-0.323	-0.553	0.062	4.680	0.034	4.963	0.002
	Costs staff overall	-0.342	0.190	0.009	0.108	0.743	0.683	0.663
	Costs psychiatrist	-0.136	0.495	0.020	0.128	0.722	1.508	0.174
	Costs physician	1.168	1.681	0.040	3.771	0.056	3.116	0.005
	Costs social worker	0.038	0.050	0.049	0.370	0.545	3.893	0.005
	Costs psychologist	0.117	0.762	0.033	0.351	0.555	4.159	0.045
	Costs ward nursing team	-0.485	0.081	0.004	0.160	0.691	0.204	0.976
	Total Health Insurance Act	-0.403	-0.177	0.109	2.840	0.096	5.028	0.002
	Total stay revenues	-0.546	-0.451	0.217	6.458	0.013	7.804	<0.001
	Long-Term Care Act stay revenues	-0.530	-0.472	0.199	0.628	0.430	10.785	<0.001
	Social Support Act stay revenues	5.522	4.952	0.096	1.057	0.307	2.872	0.010
	Health insurance Care stay revenues	-1.350	2.306	0.013	0.001	0.977	1.476	0.184

* Age and gender were included as predictors in all models.



(continued)

Predictor	Outcome	slope		Effect size	Between Subjects		Within Subjects	
		predictor	else		F	P=	F	P=
Medication change	Admission days	-0.583	-0.465	0.232	0.143	0.767	8.779	<0.001
	Costs staff overall	-0.305	-0.189	0.013	0.020	0.887	0.931	0.416
	Costs psychiatrist	-0.342	0.225	0.002	0.746	0.390	0.416	0.896
	Costs physician	0.093	1.391	0.018	0.118	0.733	1.334	0.241
	Costs social worker	-0.263	0.093	0.046	2.369	0.128	3.690	0.002
	Costs psychologist	-0.038	0.751	0.033	1.143	0.288	2.934	0.008
	Costs ward nursing team	-0.186	-0.627	0.009	0.457	0.501	0.556	0.762
	Total Health Insurance Act	-0.459	-0.296	0.156	0.041	0.841	8.955	<0.001
	Total stay revenues	-0.661	-0.516	0.267	0.168	0.683	15.087	<0.001
	Long-Term Care Act stay revenues	-0.624	-0.421	0.234	0.629	0.430	10.785	<0.001
	Social Support Act stay revenues	11.696	2.063	0.084	0.053	0.819	3.769	0.002
	Health insurance Care stay revenues	-0.941	-4.878	0.030	0.900	0.346	1.971	0.068

* Age and gender were included as predictors in all models.

over the full timeframe.¹³ When looking at the between subjects effect, we observed a slight difference in favor of a changed diagnosis (**Figure 2b**, ES=0.035), a reasonable difference in favor of diagnosis ‘schizophrenia’ changed into ‘developmental disorder’ (**Figure 2c**, ES=0.087), and for changed treatment (**Figure 2d**, ES=0.062). For changed medication a significant (**Figure 2e**; ES=0.232) reduction in admission days over time (within subjects $f=8.779$; $p<0.001$) was observed, but not predicted by this variable (between subjects $f=0.143$; $p=0.767$).

When we look at **Figure 3** concerning staff costs, we see that the cost of the ward nursing team were clearly more than costs for psychiatrists, social workers, and psychologists. Whilst the ward nursing team showed a cost decrease after an initial rise, the psychiatrists showed a fluctuating line, with as much as five changes in direction but no clear trend. This can be observed by the exponent as presented in the formula below the figure. The trend line of the social workers showed a general decrease with five changes in direction. The trend line of the psychologists showed a general increase with three changes in direction, and a slight decrease at the end of the observation timeframe. In summary, nursing staff costs went down, while social worker and psychologist costs went up. The costs of psychiatrists remained the same.

Table 3 presents the association of the predictors to outcome. These predictors were also shown in **Figure 2**, the change in diagnosis in general and from ‘schizophrenia’ to ‘neurodevelopmental disorder’, the change in treatment, and a change in medication prescriptions. Admission days decreased significantly by changed diagnosis (slope=-0.536; ES=0.035; $p=0.043$), by diagnosis change from ‘schizophrenia’ into ‘developmental disorder’ (-0.333; ES=0.087; $p=0.027$), and by change in treatment (slope=-0.323; ES=0.62; 0.034). Total stay revenues decreased by changed diagnosis (slope=-0.563, ES=0.050, $p=0.019$) and by changed treatment proposal (slope=-0.546; ES=0.217, $p=0.013$). In short, the slope of the inpatient stay revenues showed a mean decrease of - 0.515

(SD=0.157), whereas the overall health insurers revenues went down by a mean of -0.393 (SD=0.050), albeit not associated with the predictors.

The cost of psychiatrists (slope=-1.426; ES=0.001; $p=0.006$) and psychologists increased (slope=1.597, ES=0.036; $p=0.026$) alongside the cost of physicians (slope=0.821; ES=0.008; $p=0.040$) in the patient group with a changed diagnosis from ‘schizophrenia’ to ‘neurodevelopmental disorder’. Cost of social workers (slope=-0.150; ES=0.26; $p=0.001$) and staff overall (slope=0.376; ES=0.015, $p=0.006$) decreased in the same patient group.

Figure 4 shows the three main types of revenue used in the Netherlands. The largest concerned government funding and covered long term inpatient costs such as total staff costs, the ward nursing team, food and buildings. The second was municipal and covers, for example, costs of outpatient housing or other outpatient services. The third was health care funding, which covered outpatient treatment costs such as psychiatrists, physicians, social workers and medication costs. These results showed that the largest share, government funding made a steep decline. Municipal funding showed an important but much smaller increase. Finally, health care funding declined during the first few years to rise at the end.

With respect to confounding of findings by patient characteristics, adding age and gender to the calculations did not show any important adjustments of the slopes of admission days and inpatient stay costs.

Discussion

In 2021, we showed a significant decrease of 41% in the number of admission days in our study sample after applying the DITSMI protocol.⁷ The current study looked at the exact costs and revenues in detail and found that revenues from inpatient stay and health insurance decreased for the health provider,

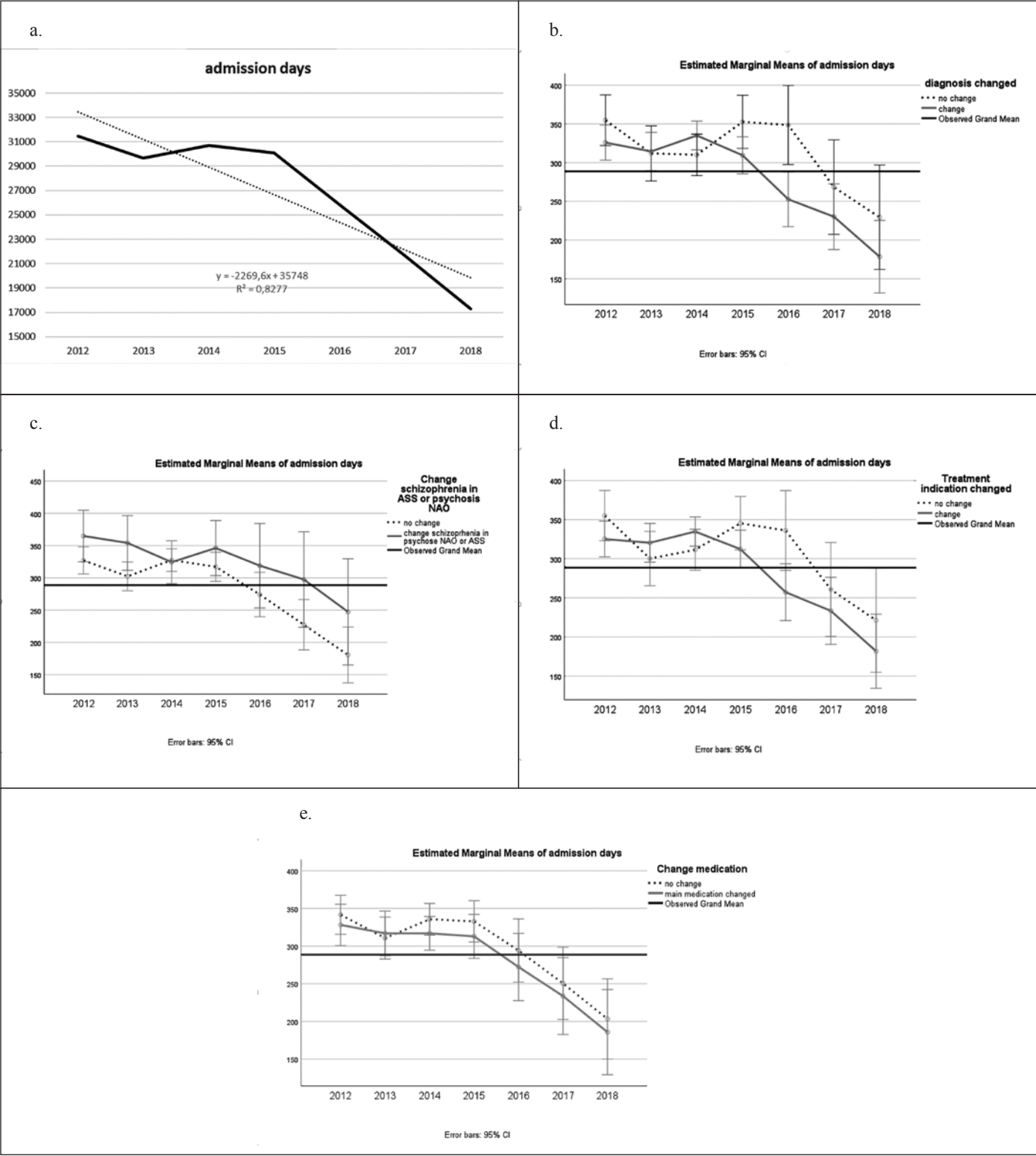


Figure 2. Change Trends in Admission Days by Diagnosis, Proposed Change in Treatment and Change in Medication

Note: a. Trend in admission days based on source data. b. Trends in admission days by diagnosis changed. c. Trends in admission days by change diagnosis from schizophrenia into developmental disorder. d. Trends in admission days by treatment indication changed. e. Trends in admission days by change in medication.

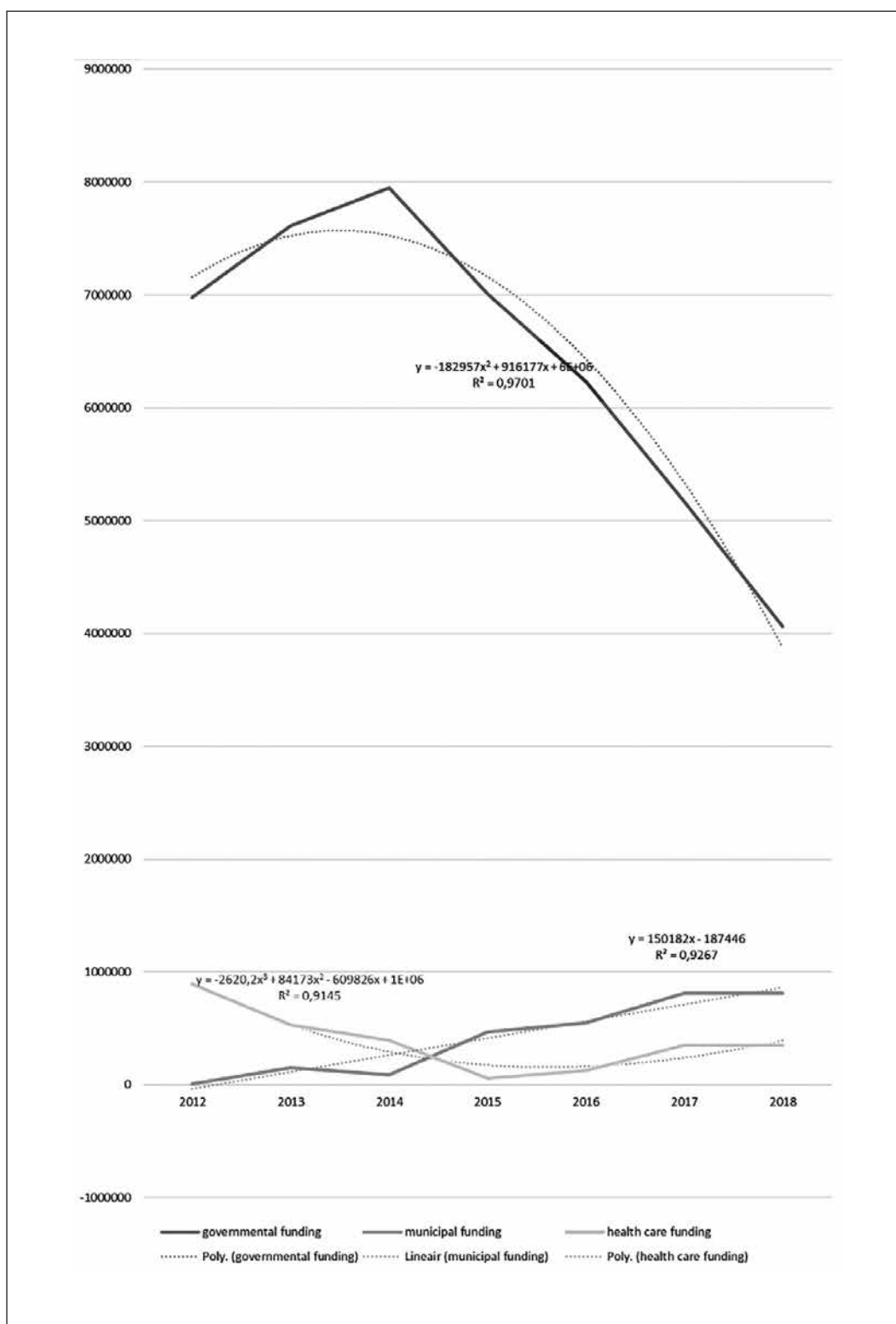


Figure 3. Trends Staff Costs Per Main Category.

Note: Regression equations x = costs and y = professional's category per year Team: $y = -1769,2x^4 + 30778x^3 - 183950x^2 + 414229x + 10168$
 $R^2 = 0,9116$ Psychiatrist: $y = -505,98x^5 + 10472x^4 - 80587x^3 + 281025x^2 - 428050x + 361728$ $R^2 = 0,9628$
 Social worker: $y = 1342,6x^5 - 26335x^4 + 192054x^3 - 644783x^2 + 986164x - 422347$ $R^2 = 0,9996$
 Psychologist: $y = -2221,4x^3 + 24812x^2 - 73353x + 97067$ $R^2 = 0,79$

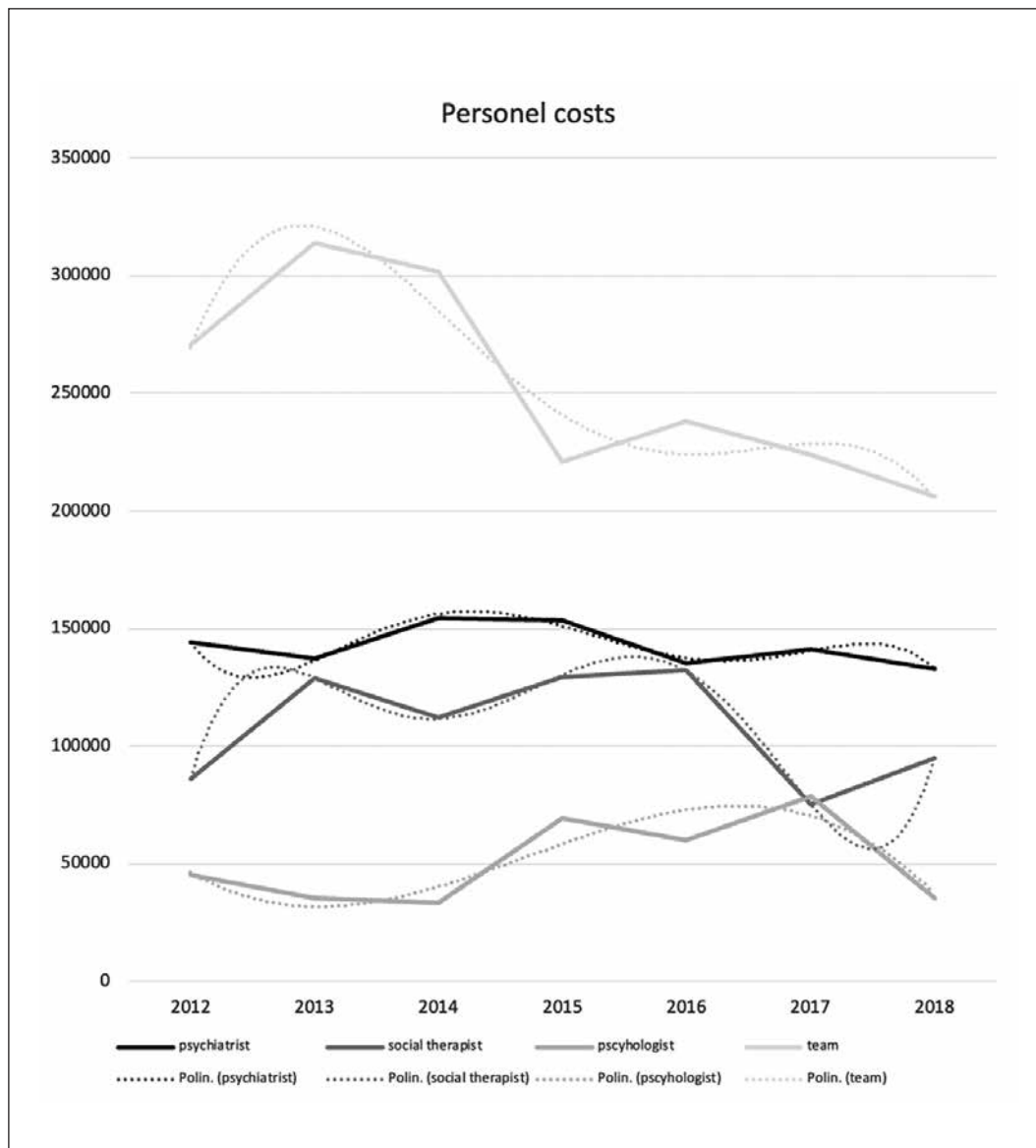


Figure 4. Trends in Revenues for Inpatient Stay Per Main Category

Note: Y = funding type; X = inpatient stay revenues per year

equivalent to a cost reduction for the funding authorities. This decrease was specifically associated with changes in diagnosis, especially with respect to 'schizophrenia' to 'neurodevelopmental disorders'. Costs of psychiatrists, psychologists and physicians increased, but overall staff costs decreased, especially in patients with the above mentioned diagnostic change.

We also have shown downwards slopes for admission days and health care costs of between approximately 30% and 40% in this sample, equating to significant overall savings to the health care economy. **Table 1** shows a reduction of €2,8 million (US\$3.1 – exchange rate of 1, 11 dollars per Euro) in health insurance invoices (and therefore costs to the provider) and a reduction of €3,7 million (US\$4.1) in inpatient stay invoices at the level of the examined Mental Health

Care Centre. When these figures are extrapolated to the entire mental health care economy, with an assumed capacity of 3,000 comparable beds, it reflects a potential saving of €196 (US\$211.7) million at a nationwide level.

Concerning diagnosis as a predictor of outcome, we have observed only small between-subjects effects. This is different in the schizophrenia subsample where we observe a clear association. Despite the clear general finding of a reduction in admission days and most revenues (i.e. reduced cost to the provider) but some increase in staff costs, the main difference in cost could be observed in the subpopulation of patients whose diagnosis has changed from 'schizophrenia' to a 'neurodevelopmental disorder'. Redirection of treatment also has a beneficial effect on care costs and revenues. It is unclear whether such diagnosis changes

are part of an increased awareness of neuro-developmental disorders, or whether neuro-developmental diagnoses are missed at initial assessment stages. Notwithstanding any such deliberations, these findings show that the effect of treatment amendments requires investment in specific staff, such as psychiatrists, physicians, and psychologists to facilitate successful outcomes for patients. Patients sometimes have received psychological treatment for the first time after a change of diagnosis with a new focus on neuro-developmental difficulties. This fits with a more general increase of employment of psychologists for such treatment on the wards, as well as social workers for practical support and resocialization outside and inside the ward.

Our findings are important when we look at health care costs of schizophrenia and severe mental illness. Kovacs *et al.*¹⁴ published an overview of the direct health care costs of schizophrenia in Europe and concluded that the annual costs per patient ranged from €533 (US\$592) in Ukraine¹⁵, €4,157 (US\$4,614) in Italy,¹⁶ €5,805 (US\$6,443) in Norway,¹⁷ €9,507 (US\$10,553) in Switzerland,¹⁸ €9,728 (US\$10,809) in Sweden,¹⁹ €12,251 (US\$13,599) in Germany,²⁰ to €13,704 (US\$15,211)²¹ in the Netherlands. Inpatients costs (and more specifically staff costs) were the largest component of the health service costs in the majority of countries. Similar differences in cost were observed outside Europe as well.²²⁻³⁰ According to Oleson *et al.*,¹⁷ the total cost of schizophrenia services in Europe were €94 (\$101) billion in 2010. In comparison, the estimated excess economic burden of schizophrenia in the US in 2019 was €317.7 (US\$343.2) billion.³⁰

Delamater *et al.*³¹ published evidence for the effects of Romer's Law, thus suggesting that variations in hospitalization rates have origins in the availability of hospital beds. In this context, it is important to balance funding, deinstitutionalization and appropriate care for people with severe mental illness. Patient outcomes should be prioritized before budget considerations, but substantial cost savings are possible where the DITSMI protocol is implemented, albeit with a shift of staff costs from nursing to other specialist staff.

Strengths and Limitations

A strength of the current study is the detailed analysis of Dutch financial and health care data. This allowed investigation of trends which may be difficult to replicate where these data cannot be accessed. However, the findings may be important to consider in many similar health economies.

The investigated sample was small. The finding of reduced care cost may not only be explained by patient improvements, but to some extent by reallocation of patients. A subsequent limitation was that the DITSMI protocol was carried out in a regular clinical setting where one of the researchers was himself one of the two psychiatrists working in the multidisciplinary team. An important limitation was that the patients' opinions were not assessed.

The study was an observational study with no control group and no randomization. A control group could not be established for two reasons. First, it was not possible to identify a comparable sample within our organization. Second, the DITSMI protocol concerns implementation of care along

Dutch care protocols; denying patients appropriate treatment was therefore not ethically justifiable.

Another limitation was that our findings only show the association between predictors and resource use. The findings do not allow any conclusions on causal relationships between these. For such an analysis, a larger sample over more hospitals and more follow up time is necessary.

Also, several contextual changes occurred at the start of the protocol such as engaging psychologists for treatment on the ward and social workers for resocializing outside the ward. Such changes are difficult to unravel within the gathered data.

Conclusion

Our observational study shows a clear general finding of a decrease in admission days and overall costs with an associated reduction of staffing costs. Where the financial impact of patients improves (especially expressed in the decrease of institutionalization), it requires investment in specific staff, such as psychiatrists, physicians, and psychologists, especially in the patient group suffering from schizophrenia.

Acknowledgments

This study was conducted and reported in line with the STROBE Guidelines for reporting observational studies. Medical-ethical approval was provided by the ethical board at the University of Twente, Enschede, the Netherlands.

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Appendix

Table A1. Dutch Health Economical Terms.

Admission days	Number of days stay at a ward of the Mental health Trust as defined by day of discharge minus day of admission.
Costs Staff overall	The gross costs of all personnel working for the ward.
Costs Psychiatrist	The gross costs of the psychiatrist working for the ward.
Costs MD	The gross costs of the MD working for the ward.
Costs Social Worker	The gross costs of the social worker working for the ward
Costs Psychologists	The gross costs of the MD working for the ward.
Costs Ward Nursing Team	The gross costs of the nurses working for the ward.
Health Insurance Revenues	The total of invoices as sent per patient per month to the health insurers
Total Stay Revenues	Invoice concerning the stay (hotel costs) at the ward as sent to health insurance
Government Funded Stay Revenues	Invoices concerning the stay as sent to the Dutch government in patient having been admitted for above 2 years, within the Dutch long-term care act
Municipal Funded Stay Revenues	Invoices concerning the stay at community or protected housing settings as sent to the Municipality of the residential address of the patient
Health Insurance Stay Revenues	Invoices concerning the stay as sent to the health insurers in patients having been admitted for treatment for less than 2 years