Disruption of patient-doctor relationships adversely affects mental health outpatient follow-up care– Evidence from a natural experiment

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Abstract

Background: Disruptions in long term doctor-patient relationship (relational and longitudinal continuity of care) in mental health care could, according to literature, adversely affect health outcomes, but those effects are hard to reliably measure. The abrupt closure of the National Institute of Psychiatry and Neurology, a major institution providing inpatient as well as outpatient psychiatric care in Budapest, Hungary in 2007 made it possible to test whether such disruptions are indeed detrimental to patients.

Methods: Using a nationwide panel patient case database for 2004-2015 for our natural experiment, we honed in on a study population with mental health conditions that warrant continual follow-up care (e.g. schizophrenia or recurring depression) and whose patient histories in the pre-closure years were sufficiently homogeneous. Carefully proxying case severity using population and care characteristics, we matched the subsample of patients whose continuity of care was disrupted by the

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closure with another, unaffected subsample. To test if the risk of death for the group whose continuity of care was disrupted was higher, we used a Cox proportional hazards model, whereas to test whether the disruption affected ex-post frequency of inpatient episodes or outpatient visits, we used a random effects logit model applying a difference-in-differences method.

Results: Our matching proved sufficiently balanced. While the direction of the effects was always what theory suggested: disruption should worsen follow-up care frequency and health outcomes, the effect on the likelihood of death and the frequency of after-disruption inpatient episodes did not prove significant. The sudden closure of their care giving institution and the subsequent change of doctor and location, however, decreased the odds of necessary outpatient visits taking place later on by 66.8% (significant at the 1% level).

Conclusions: Our analysis shows that disruptions of long-term patient-doctor relationships in mental health care adversely affect care quality, at least as measured by the actual frequency of ex post outpatient visits to physicians as prescribed in the medical guidelines. Should institutional change make such disruptions absolutely necessary, policy makers should pay special attention to the careful planning of patient handovers.

Keywords

mental health, continuity of care, quality of care, treatment effects, outcome assessment, Hungary, natural experiment

Background

Continuity of care (CoC) in mental health is a multidimensional construct [1–4]. For instance, Weaver et. al talk about experienced continuity, cross-boundary and longitudinal continuity, relational continuity, informational continuity, contextual continuity, and finally, flexible and responsive continuity [1]. According to a systematic literature review by Puntis et al. [5], effects of disruptions in care continuity are variable, but there is firm ground to say that it decreases social functioning.

Moreover, individual good quality studies identified by the authors of the review point towards associations with lower health care costs, higher mortality risk, worse therapeutic relations and lower number of needs met. Our current interest is in the elements of CoC dealing with consistent and permanent patient-doctor relationships, that is, relational and longitudinal continuity. Relational continuity is defined by Weaver et al. "as the establishment of a therapeutic relationship between one or more professionals and the service user", while longitudinal continuity as "having care delivered by as few professionals as possible with minimal gaps in treatment" [1]. Studies on this relationship were conducted both from professional [6] and user perspectives [7–10], thus we can say that long-term patient-doctor relationships are seen as essential for good quality and effective care both by professionals and mental health patients.

The National Institute of Psychiatry and Neurology in Hungary (OPNI) was completely closed down in the course of 2007. According to the law [11–13], during that year, 516 (out of which 268 acute care beds) of OPNI's originally 849 beds were gradually - literarily ward-by-ward - reallocated to 10 successor hospitals [14]. It is important to note, however, that many of those extra beds just made up for a parallel reduction of beds at the same successor hospitals. These institutions also received subsidies to finance the infrastructural costs of the reallocation. The cessation of OPNI's care provision was embedded in a large-scale restructuring of the Hungarian hospital system, where acute care beds were reduced from 60 thousand to 44 thousand, while chronic, rehabilitative and long-term care beds increased from 20 thousand to 27 thousand [15]. The number of beds that were provided for acute mental health care patients were lowered from 4 thousand to 3 thousand, but there was no parallel capacity increase in the outpatient or community financed mental health care services.

The Hungarian mental health care system is primarily based on acute and rehabilitative hospital provision and a network of outpatient follow-up care centers, called dispensaries. The majority of outpatient facilities are integrated with inpatient providers. Financing of acute inpatient care is DRG based, while chronic and rehabilitative inpatient care receives a fee based on the length of stay. Outpatient care is financed by a fee-for-services system. Community care capacity is limited, and the cooperation between health service providers and social providers is reported to be problematic. For more details on the Hungarian mental health care system see Dlouhy, 2014, Bitter and Kurimay, 2012 and Füredi et al., 2006 [16–18].

Before its closure, OPNI served as the clinical, methodological and research center for Hungarian mental health care. Its catchment area comprised of the whole country as a tertiary care institution, and roughly 1 million people in the Central-Hungary region for lower levels of care [19]. OPNI, like most health care institutions provided both inpatient and outpatient care. Only a minority of OPNI's doctors went on to work for another public provider, and even if they did, the original teams dispersed, causing a disruption of care continuity. According to two independent sources, out of 119 doctors, approximately 40 took up work in successor hospitals [14, 20].

The closure of OPNI can be considered as a natural experiment that allows us to quantify the effect of the loss of patient-doctor relationship in mental health care on selected process and outcome measures. Both the press, researchers [16, 19, 21] and "official" sources like the ombudsman [14] or the State Audit Office of Hungary [22] reported serious problems with the 2007 restructuring of psychiatric care, and in particular with the closure of OPNI. They reported loss of patients for follow-up, and disbanding clinical and research expertise. According to the then-operating ombudsman of citizen rights, even the legality of the process was questionable [14]. Considering the effects, we chose to concentrate on 3 measures: 1) the number of patients showing up in outpatient follow-up care before and after the closure, 2) the number of patients showing up in acute inpatient care before and after the closure and 3) the time/number of patient deaths after the closure.

Our aim is to use the closure of OPNI as a natural experiment to quantify the possible causal effects of loss of long-term patient-doctor relationships on mental health care patients. In accordance with the chosen measures, we formulated three hypotheses: 1) Patients of OPNI (the treatment group) will have a higher risk of being „lost" for outpatient follow-up, i.e. not appearing in outpatient care as regularly as the control group; 2) Patients in the treatment group will have a higher risk of death due to undertreatment and 3) Patients in the treatment group will have a higher risk of inpatient admissions due to undertreatment.

We only know of one paper by Lehman et al. [23], published in 1994, that used a quasi-experimental design to quantify the effects of the loss of patient-doctor relationships on patient outcomes or quality of mental health care. We have no knowledge of randomized experiments on the topic. The Hungarian natural experiment – however misguided in terms of good policy making - allowed us to draw conclusions on causality in this important issue. Moreover, because of the nature of our data source, we could ensure an extensive, 8-year-long follow-up period for the measurement of effects, uncommon in the literature [5].

Methods

All data manipulations, imputation and analyses were performed in the R statistical software [24] using libraries MatchIt [25], mice [26], data.table [27], dplyr [28], tidyr [29] and lme4 [30].

Data preparation, cleansing

Our data source was the case-based administrative financing database of the National Health Insurance Fund Administration (NHIFA). Certain parts of this dataset are maintained and made available for research purposes by the National Healthcare Service Center (NHSC). We received inpatient and outpatient financing case records for the period between 2004—2015, where the code for clinical profession equaled any code from the list of mental health profession codes. Individual patients were identified with the same masked code of their social security number in both databases. We also received the incidental date of death for each masked social security number.

As these databases primarily serve a financing goal, certain modifications were necessary to make them appropriate for analysis. From the inpatient database we deleted cases with zero length of stay

(LOS), as these are mainly artifacts of admission, transfer and discharge policies of individual providers. We also excluded cases where the admission and discharge dates of a hospital stay fell in between another hospital episode. We excluded cases with a LOS greater than 182 days, cases where the date of death preceded the discharge date and records with an unknown provider. We unified cases where either an admission to a second hospital happened on the day of discharge from the first, or admission to the second hospital happened one day later, and the first hospital coded the transfer of the patient to another hospital in the appropriate field. On this resulting inpatient dataset we performed an imputation to get missing values of the average taxed income and the distance in minutes between the place of residence and the care institution. Imputed values were generated using predictive mean matching based on the county of residence, sex and age.

In the outpatient database we excluded cases where the date of the visit fell between the admission and discharge dates of an inpatient stay. Also, we considered outpatient visits to be identical, if the same person on the same date went to the same institution. Institutions were identified with a permanent institution code given by the NHIFA.

Study population

We examined patients whose mental health condition warrants – at least theoretically – continual follow-up care. Consequently, people with main diagnosis of schizophrenia (ICD-10 F20.x), persistent delusional disorders (ICD-10 F22.x), schizoaffective disorders (ICD-10 F25.x) and those who got their depression main diagnosis at least the second-time (recurring depression) (ICD-10 F32.0, F32.1, F32.2, F32.3 and F33.0, F33.1, F33.2, F33.3), given at an inpatient provider, were selected. An episode was regarded as recurring depression, where the diagnosis was moderate or severe depression, and the (mild, moderate or severe) prior diagnosis was made at least 30-days back. To ensure that patients in OPNI and the control hospitals, at the time of their selection, were not affected by the hospital restructuring itself, and on the other hand, were not too far in time from it, the diagnoses had to be given in 2005—2006, i.e. one or two years before OPNI's closure.

Several restrictions were applied to define populations with homogenous patient histories. The inclusion criteria were the following:

- Patients received “appropriate follow-up care” (see definition below).
- There was an inpatient episode within 90-days before the start of the first follow-up visit. This is the index admission.
- The above two had to take place in the same institution, to ensure attributability of the care given.

Patients were excluded if…

- they were younger than 18 years old,
- they left the hospital during the index episode at their own risk, before the time set by clinicians,
- they were admitted to at least two other hospitals before the index admission, because we considered these patients as potentially having more complicated, severe conditions.

A series of outpatient visits were accepted as „appropriate follow-up care” if…

- The patient had at least four outpatient visits in years 2005—2006, the index period. These visits had to be consecutive, i.e. a maximum of a four-month gap could be put between them. Although these criteria are somewhat arbitrary, it is not rare that patients seek follow up care every four months due to regulations of drug prescription that allow drugs to be prescribed in three-month packs. The one month “extra” gap is to provide some slack. For purposes of clarity, examples of eligible configurations can be found in Additional file 1.
- All visits had to be made to the same institution, to make sure the patient is not just “wandering around” in the system.

- If there is more than one institution providing „appropriate follow-up care" to the same patient within the index period, the patient is excluded. This is to ensure the exclusivity of the institution, thus the attributability of the care given.

Matching

Since our setting is quasi-experimental, i.e. there was no true randomization of subjects, we used matching to select an appropriate control group to the treatment population in order to reduce modelling bias [31]. The treatment group is comprised of patients who were diagnosed with the selected mental problems and got appropriate follow-up care in OPNI in the index period. The control group involves patients receiving care in any of 12 care providers, which were either officially designated as successor hospitals, or where patients of OPNI actually went to after the closure.[6]

We matched on available socio-economic characteristics of individuals, to balance basic patient traits. We applied nearest neighbor matching based on propensity scores to age-categories in years (18 - 30, 31 - 40, 41 - 50, 51 – 60, 61 – 70, 71 and above) and to categorized distance in minutes between the provider and the place of residence (0, 1 - 15, 16 - 30, 31 – 40, 41 and above), while forcing exact matching on sex, 3-digit diagnoses, year of discharge and categorized mean taxed income in the city of residence measured in HUF (0-250 000, 250 001 – 500 000, 500 001 and above). Definitions and detailed description of this matching method can be found in Stuart, 2010 [28]. Categories were set by looking at the empirical distribution of the variables. This particular matching configuration – i.e. the combination of the nearest neighbor and exact matching - resulted from a process of selecting the "best" matching configuration based on a measure of multivariate imbalance. This measure, defined in Iacus et al., 2011[32], computes the distance between the multivariate empirical distributions of matching variables in the treatment and control groups:

[6] These hospitals were the following: Semmelweis University, Nyírő Gyula Hospital, Hospital of Péterfy Sándor utca, Szent János Hospital, Jahn Ferenc Hospital, Bajcsy Zsilinszky Hospital, Flór Ferenc Hospital, Szent István Hospital, National Institute of Clinical Neurosciences, Szent Imre Hospital, Gálfy Béla Hospital in Pomáz, and the Health Center of the Hungarian Military.

$$\mathcal{L}_1(f,g,H) = \frac{1}{2}\sum_{l_1 \dots l_k \in H(\boldsymbol{X})} |f_{l_1 \dots l_k} - g_{l_1 \dots l_k}|, \quad (1)$$

where $H = H(\boldsymbol{X}) = H(X_1) \times \dots \times H(X_k)$ is the multidimensional histogram; f and g are the relative empirical frequency distributions for the treatment and control groups; $f_{l_1 \dots l_k}$ and $g_{l_1 \dots l_k}$ are the relative frequency for the treatment and control group observation in cell $(l_1, \dots, l_k)$ of the multivariate cross tabulation, respectively. $\mathcal{L}_1$ can take any number from 0 to 1, where 0 corresponds to complete overlap of treatment and control distributions and 1 to complete separation. If, for example, $\mathcal{L}_1 = 0.3$, then 70 percent of the distributions overlap. The final matching method, i.e. the variables for exact and nearest neighbor matching, thus were chosen by considering which configuration resulted in the lowest value of $\mathcal{L}_1$ after matching, while not letting the number of observations drop substantially.

To make sure that pre-treatment care characteristics are also similar in the treatment and control populations, we conducted hypothesis tests on the difference of means of the following care related variables: length of stay of the index episode, whether the index admission was an emergency admission, whether the index admission was an involuntary admission, whether there were any readmissions within the index period, whether there was a 30-day readmission after the index episode, and whether the patient died within 30, 90 or 180 days following the index episode. Readmission rate is widely recognized as one of the most important quality-of-care indicator in mental health [33–35], just like length-of-stay [36–38]. According to a 2008 literature review by Kallert et al., there are diverging outcomes for patients with voluntary or involuntary admissions, hence the inclusion [39]. Short-term death rates were considered as an indication of an interaction between case severity and care quality. When defining rehospitalization, cases that happened within the same hospital episode were not counted as such. These in-hospital transfers typically happen on the day of admission, or after a transfer to and from a rehabilitation or long term care ward.

Principally, both sets of variables (population and care characteristics) served as proxies of case severity, arguably the most important non-observable confounding factor for the analyzed outcomes. Generally, it would be advisable to include all variables in the matching, as, in principle, they can be associated with treatment assignment. Stuart suggests however, that in cases of small sample size, variables that are linked to the treatment, but thought to be independent from the outcome should not be included in the matching as they increase variance [31]. Among care characteristic variables, only emergency admissions and involuntary treatment showed significant differences in the treatment and control groups after matching. We had two considerations regarding these potentially important covariates. First, since coding of emergency admissions in the administrative financing database is believed to be more-or-less arbitrary, while official decisions on involuntary treatment are highly dependent on local judges, usually permanently handling cases of a given hospital, differences in these variables seem to be more associated with external factors than with case severity. Second, when including emergency admissions and involuntary treatment in logit and Cox models, they turned out to be insignificant, another indication that omitting them from matching is not modifying our results.

Data analysis

Figure 1. shows how we approached pre- and post-treatment periods. As we previously laid down, the index period was 2005—2006. We chose to start the post-treatment period on 01.01.2008, so that we do not capture any partial effects of the uneven, gradual closure in 2007.

Figure 1. Structure of index and follow-up periods

To test if the risk of death for the treatment group is higher than for the control group, we used a Cox proportional hazards model [40]:

$$h(t) = h_0(t)\exp(\beta^T x), \tag{2}$$

where $h(t)$ is the expected hazard at time t; $h_0$is the baseline hazard function; *x* is the vector of covariates and $\exp(\beta)$ are the hazard ratios. If a hazard ratio is greater than 1, the event hazard, in our case the hazard of death, increases, thus the corresponding covariate is negatively associated with survival. Time is measured in days elapsed from index discharge to death, or – in case of survivors – to 31.12.2015, the date of our last data points. Data is thus right censored, which was taken into account in the model specification. Explanatory variables are: a dummy for being in the treatment group, a dummy of whether the index admission was an emergency admission and a dummy for involuntary admission.

For modelling the effects of covariates on inpatient stays or outpatient visits, we applied a random effects logit model. Let y_{ij} denote the dummy for having an inpatient or outpatient episode for individual *i* in calendar year *j*. In this formulation

$$\Pr\left(y_{ij} = 1 | x_{ij}\right) = logit\left(\beta^T x_{ij} + u_i\right), \tag{3}$$

where x_{ij} is the vector of explanatory variables, u_i is a normally distributed random intercept and logit is the logistic function.

We applied a difference-in-differences framework by interacting the dummy for being in the treatment group with the dummy of the time of the treatment, i.e. a variable that is 0 before 2008 and 1 afterwards, in the explanatory variable vector *x*. Furthermore, we controlled for emergency index admissions and involuntary index admissions among the explanatory variables. The random

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intercept was based on individual patients. It was tested for significance against a model without random effects using a likelihood ratio test.

Results

Constructing the study population

The administrative financing database we received had 1 342 050 acute and chronic inpatient mental health records and 872 649 acute inpatient records. The outpatient databases consisted of 6 708 528 records between 2004—2015. After excluding cases listed in the Methods section, we were left with 849 427 acute inpatient and 6 467 059 outpatient cases. As for the imputation, average income was missing in 7657 cases (0.9%), while distance in 16 439 cases (1.9%). These were substituted with corresponding predicted values.

Table 1. shows an overview of how the potential number of treatment and control populations are reduced step-by-step by applying the preset filters. We ended up with 81 patients in the treatment group and 196 patients in the control group.

Table 1. Outline of steps leading to populations ready to be matched in both the treatment and control groups

Filters applied consecutively	**# of patients in treatment group**	**# of patients in control group**
Step 1. # of patients who appeared in the treatment hospital or the control hospitals before the end of the index period	12 016	43 310
Step 2. # of patients with selected main diagnoses (schizophrenia, persistent delusional disorders, schizoaffective disorders and depression) in a hospital	3 663	10 090
Step 3. # of patients with at least one outpatient visit anytime in the index period	2 817	7 711
Step 4. # of patients who had „appropriate follow-up care” in own institution(s)	1 024	2 882
Step 5. # of patients who had NO „appropriate follow-up care” elsewhere (patients exclusively taken care of in either the treatment institution or the control institutions)	536	1 855

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Step 6. # of patients who had a preceding inpatient episode within 90 days (the diagnosis is presumably connected to the follow-up care)	181	612
Step 7. # of patients with the full implementation of the selected diagnosis criteria (depression given at least the second time)	119	360
Step 8. # of patients who are above 17, discharge was not on own risk, had no inpatient episode after the index episode or main diagnosis was the same, had no multiple consecutive prior admissions	112	319
Step 9. # of patients who had no preceding „appropriate follow-up care"(to ensure connection with given diagnosis)	81	196

Matching

The performed nearest neighbor matching resulted in 66 matched patients both in the treated and control groups. This means that 15 patients from the treated population and 130 patients from the control population were not matched. Basic properties of the whole and matched populations can be found in Table 2. The multivariate imbalance measure before matching was 0.770 and the percentage of local common support is 15.5%. After matching the numbers were 0.561 and 26.8%, indicating an improvement in balance.

Table 2. Balance of variables used in matching in pre- and post-matching populations

	Before matching			After matching		
	Mean treatment (n=81)	Mean control (n=196)	Standardized mean difference	Mean treatment (n=66)	Mean control (n=66)	Standardized mean difference
Age group (17-30]	0.173	0.225	-0.136	0.182	0.288	-0.279
Age group (30-40]	0.185	0.158	0.069	0.197	0.121	0.194
Age group (40-50]	0.210	0.276	-0.160	0.242	0.242	0.000
Age group (50-60]	0.198	0.219	-0.055	0.121	0.212	-0.227
Age group (60-70]	0.136	0.087	0.142	0.167	0.091	0.220
Age group (70-]	0.099	0.036	0.210	0.091	0.046	0.151
Minutes (0-15]	0.296	0.643	-0.754	0.303	0.530	-0.495
Minutes (15-30]	0.457	0.158	0.596	0.500	0.288	0.423
Minutes (30-45]	0.111	0.036	0.238	0.121	0.046	0.240

Minutes (45-]	0.099	0.122	-0.079	0.046	0.091	-0.151
Discharged in 2004*	0.222	0.225	-0.005	0.182	0.182	0.000
Discharged in 2005*	0.543	0.628	-0.168	0.606	0.606	0.000
Discharged in 2006*	0.235	0.148	0.203	0.212	0.212	0.000
Male*	0.346	0.372	-0.056	0.379	0.379	0.000
Female*	0.654	0.628	0.056	0.621	0.621	0.000
Avg tax [0-250 000)*	0.062	0.082	-0.082	0.030	0.030	0.000
Avg tax [250 000-500 000)*	0.198	0.163	0.086	0.152	0.152	0.000
Avg tax [500 000-)*	0.741	0.755	-0.033	0.818	0.818	0.000
Diagnosis group – F20*	0.543	0.612	-0.138	0.636	0.636	0.000
Diagnosis group – F22*	0.062	0.066	-0.019	0.030	0.030	0.000
Diagnosis group – F25*	0.296	0.204	0.201	0.242	0.242	0.000
Diagnosis group – Depression*	0.099	0.117	-0.062	0.091	0.091	0.000

*: exact matching

Table 3. contains information on how the matching process affected similarity of care variables not included in matching. Emergency admission rate and involuntary admission rate differences for the index episode stayed highly significant even after matching. 180-days death rate became insignificant, but only because of an increase in variance, since the absolute difference of values increased.

Table 3. Balance of care-related variables for pre-and post-matching populations

	Means for treatment and control groups	
	Before matching: treatment; control (significance)	**After matching: treatment; control (significance)**
Emergency admission rate	0.370; 0.755 (***)	0.348; 0.818 (***)
Involuntary treatment rate	0.531; 0.173 (***)	0.561; 0.258 (***)
Readmission rate	0.704; 0.806 (+)	0.682; 0.818 (Ns)
30-day readmission	0.000; 0.015 (Ns)	0.000; 0.000 (Ns)
90-day death rate	0.012; 0.000 (Ns)	0.015; 0.000 (Ns)
180-day death rate	0.037; 0.000 (*)	0.045; 0.000 (Ns)
Length-of-stay (days)	17.42; 19.04 (+)	17.20; 18.00 (Ns)

Significance levels: ***: < 0.001, **: < 0.01, *: < 0.05, +: < 0.1, Ns: Not significant

Tested with Fisher's exact test for proportions and two sample t test for length-of-stay

Modelling

Raw rates of inpatient stays in the treatment and control populations before and after the treatment show that appearance in hospitals declined in a similar manner in both populations (Table 4). Contrarily, the decrease of outpatient visits in the post-treatment period is more pronounced for the treatment group. In this case, while the pre-treatment raw rates are very similar, post-treatment rate for the treatment group is 53% lower than for the control group. Raw death rates are higher for the treatment group both before and after the treatment, actually corresponding to a relatively small (and statistically not significant) absolute difference due to the low number of base cases.

Tables 5 through 7 show the modelled effect of treatment on the hazard of death, inpatient stays and outpatient (follow-up care) visits.[7] In line with the non-significance of the pre-treatment differences of the treatment and control values in the raw data, the parameter of belonging to the treatment group itself is not significant in either models. At the same time, there is a clear trend in the data: the baseline odds decrease by 82.5% for inpatient episodes and 89.4% for outpatient visits in the follow-up period (from 2008). Most importantly, as measured by the interaction term, the closure of OPNI adds a further 66.8% decrease in odds of outpatient care, resulting in a 0.4 to 1 odds for ex-OPNI patients to appear in follow-up care after 2008, compared to the trends in the control group. Meanwhile, neither the interaction term in the model of inpatient care, nor the treatment effect term in the model of deaths are statistically significant. Modelled effects thus reinforce our observations for the raw effects. To sum up, this means that the closure of OPNI and the

[7] According to the likelihood ratio test, random intercepts in both (outpatient and inpatient) models are significant ($p<0.001$).

consequential disruption of patient-doctor relationships unfavorably affected follow-up care, but had no statistically significant effect on death or inpatient appearances.

Table 4. Raw outcomes for treatment and control groups before and after the treatment

		Raw inpatient appearance rate	Raw outpatient appearance rate	Raw death rate
Treatment group	Before follow-up period	0.515 (n=198)	0.823 (n=198)	0.121 (n=66)
	During follow-up period	0.178 (n=528)	0.337 (n=528)	0.242 (n=66)
Control group	Before follow-up period	0.520 (n=198)	0.899 (n=198)	0.030 (n=66)
	During follow-up period	0.205 (n=528)	0.631 (n=528)	0.152 (n=66)

Table 5. Results from the individual random effects, difference-in-differences logit model of **inpatient** stays (n=1452, random effect groups=132)

Covariate	**B**	**exp(β)**	**se**	**p-value**
Intercept	0.087	1.091	0.293	0.770
Member of the treatment group	-0.162	0.851	0.341	0.635
Observation is in the follow-up period	-1.743	0.175	0.204	<2e-16 (***)
OPNI closure effect (treatment x follow-up interaction term)	-0.241	0.786	0.290	0.406
Index admission was an emergency admission	-0.090	0.914	0.286	0.753
Index admission was an involuntary admission	0.374	1.453	0.265	0.158

Significance levels: ***: < 0.001, **: < 0.01, *: < 0.05, +: < 0.1

Table 6. Results from the individual random effects, difference-in-differences logit model of **outpatient** visits (n=1452, random effect groups=132)

Covariate	**B**	**exp(β)**	**se**	**p-value**
Intercept	3.207	24.706	0.487	4.48e-11 (***)
Member of the treatment group	-0.737	0.479	0.544	0.176

Observation is in the follow-up period	-2.244	0.106	0.297	3.86e-14 (***)
OPNI closure effect (treatment x follow-up interaction term)	-1.103	0.332	0.404	0.006(**)
Index admission was an emergency admission	0.036	0.965	0.427	0.934
Index admission was an involuntary admission	-0.226	0.798	0.394	0.566

Significance levels: ***: < 0.001, **: < 0.01, *: < 0.05, +: < 0.1

Table 7. Results from the Cox model of **deaths** in the follow-up period (n=122, number of deaths=26)

Covariate	**B**	**exp(β)**	**se**	**p-value**
Member of the treatment group	0.273	1.315	0.512	0.593
Index admission was an emergency admission	-0.626	0.535	0.493	0.205
Index admission was an involuntary admission	0.132	1.141	0.441	0.765

Significance levels: ***: < 0.001, **: < 0.01, *: < 0.05, +: < 0.1

Discussion

One element of quality of health care in general is appropriateness, i.e. how care given is in line with professional rules of conduct. Guidelines on schizophrenia, persistent delusional disorders, schizoaffective disorders and depression all state that patients suffering from these conditions need continuous monitoring for several years after being diagnosed [41–44]. Our approach was to restrict our analysis to these diagnoses to capture a true effect of loss of patients, if such effect exists. We can be sure that if these patients do not show up in follow-up care, then something has gone awry. This method was made possible by building our analysis on a full-scale national database. It provided the opportunity to concentrate on rather narrow disease categories that really need follow-up care, without losing considerable statistical power.

During the study period several health policy measures affected the provision of mental health care (e.g. cessation of the elevated financing of mental health rehabilitation, reduced financing of follow-up centers) [22]. Our study design, nevertheless, allows us to ignore these generic, country-wide changes, as they affected treatment and control groups alike. Apart from the treatment itself, i.e. the closure of OPNI, we have no knowledge of any specific policy actions that could have distorted our findings.

Study population and matching

It is noticeable that less than 30% of mental health patients with the selected diagnoses received appropriate follow-up care (step 4). This low rate of appropriate care is in line with international experience. Studies show that 29 to 74 percent of mental health patients are not eventually present in regular check-ups [45–47]. During the population screening, we also lost roughly two-thirds of patients in both treatment and control groups when we required that an inpatient episode precede the follow-up care within 90 days (step 6). This is a surprisingly high proportion of patients and we have no viable explanation for this phenomenon.

For most characteristics of care provision, our expectation that matching on population characteristics should bring balance to these variables too, was well-founded. Differences in emergency admissions and involuntary treatment were so great ab ovo, however, that no balance could have been achieved here.

Treatment effects

The closure of OPNI was, on the one hand, abrupt and arguably badly planned, and on the other hand, capacities were mostly transferred to other inpatient institutions. Logistics and communication were of no importance, providers and patients were mostly left on their own by the then-policy-makers. New hospitals were appointed by the lawmakers for every patient, so, at least in theory, everyone had the opportunity to make contact with their new provider, but there was no coordinated way to assist them in doing so. These personal connections for the majority of OPNI's acute care patients simply ceased to exist sometime in the course of 2007, and it was patients' sole responsibility to reestablish them with another provider. According to our findings many of them failed to do so. In our natural experiment, we discovered that a loss of patient-doctor relationships reduced the odds for the necessary outpatient follow-up care by 66.8%. Nonetheless, we found no such associations for cases of inpatient appearance or death.

In their literature review of effects, Puntis et al. report several continuity of care studies where at least one of the outcome measures were the risk of hospitalization [5]. Out of four studies, two report no association between hospitalization and CoC measures, and one reports mixed results. A study of schizophrenics in the Netherlands found higher costs due to more inpatient treatment among those whose care continuity suffered [48]. The aforementioned review of Puntis et al. found only one study examining death as an outcome. That single study, namely Hoertel et. al, found a significantly lower likelihood of death where CoC was better [49]. Laugharne et al. published a descriptive study [50] of a UK based mental hospital, where 30 acute care beds out of 54 had to be closed down within a week due to fire-safety concerns. They found that the event did not affect the number of serious incidents like violence and suicide within 3 months of the closure. These results are not at odds with our findings, though their mixed nature does not allow for a definite conclusion. It is interesting, however, that there were no publications assessing the effect of continuity problems on follow-up care, they rather used the concept and measures of suboptimal follow-up as a CoC measure causing whatever effects they wanted to quantify. In this respect our approach is novel, in that we used one CoC measure (the cessation of patient-doctor relationships) to assess its effect on another CoC measure (continuous follow-up care).

There are several publications that assess the effects of continuity of mental health care in the context of deinstitutionalization [51–53]. At first, these might sound entirely relevant to the Hungarian case, but the actual stories were rather different. Those papers look at situations where the reduction of inpatient beds, or even the closure of a hospital was accompanied by a planned buildup of community services and a subsequent transfer of patients. This was clearly different in OPNI's case, where restructuring happened strictly within the inpatient setting.

Strengths and limitations

We applied strict inclusion criteria to ensure homogeneity of treatment and control groups and reduce bias. This methodology, however, resulted in a relatively low number of observations, giving rise to high variance.

Our design did not account for the multidimensional nature of continuity of care, we rather concentrated on just two interrelated aspects: relational and longitudinal continuity of care. This way we might have missed factors affecting analyzed outcomes. There is great variability in how authors suggest to measure relational and longitudinal continuity. All the proposed operationalizations use, and at times combine, however, the number of total visits and the number of visits to a particular practitioner. Hoertel et. al [49], for example, define longitudinal CoC as "consulting the same physician in subsequent consultations". Our procedure is in line with these methods, as we explicitly looked at the definite cessation of relationship with the usual provider, defined on the level of institutions. Since we did not have data on the actual physicians who provided care for patients, we used established contact with institutions as proxies for patient-doctor relationships. While it is fairly safe to assume that there was one single doctor who primarily took care of patients in institutions, we actually do not know that. This opens up a possibility for a confounder. Also, it is possible that at least some of OPNI's patients were cured by the same doctor at a successor hospital then before, so treatment effect could be heterogeneous. We believe this not to be a very likely event, so we could ignore its consequences.

We did not have data on community care in Hungary. As a consequence we might have labeled a patient inappropriately treated in the follow-up period, while, in reality, they attended community care regularly. According to our clinician sources, nevertheless, this effect is most likely minuscule, owing to the limited community care capacity in Hungary, and the non-complimentary nature of follow-up care in the selected conditions and community care.

Conclusions

Our analysis, based on a natural experiment, shows that problems with long-term patient-doctor relationships in mental health care adversely affect care quality. Thus, policy makers should pay attention to careful planning of patient handovers if a restructuring is necessary. Despite the somewhat low number of observations, our study design allowed us to present reliable evidence on causal links between disruptions in the continuity of care and a lower probability of appearing in follow-up care.

Factors correlating with the considerable churn of patients for appropriate follow-up care are definitely worth further inquiry. Deeper analysis of the approximately 70% of patients, who did not show up regularly for checkups might reveal causal links that will imply policy measures to solve this serious issue.

List of abbreviations

CoC: Continuity of care

ICD: International Classification of Diseases

HUF: Hungarian forint

LOS: length of stay

NHIFA: National Health Insurance Fund Administration

NHSC: National Healthcare Service Center

OPNI: National Institute of Psychiatry and Neurology in Hungary

Declarations

Ethics approval and consent to participate

Our research obtained ethical approval from the Research Ethics Committee of the Medical Research Council under registration number 18842-2/2017/EKU.

Consent for publication

Not applicable.

Availability of data and material

Datasets used during the current study are available from the corresponding author on reasonable request, conditional upon the approval of such further use by the original institutions providing the data.

Competing interests

The authors declare that they have no competing interests.

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions which they are affiliated with.

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Authors' contributions

PM, PE, BG, BV participated in the design and execution of the study, including the analysis and interpretation of the results. ZM critically reviewed the manuscript and provided clinical insights together with a hands-on account of OPNI's closure. The final manuscript was read and approved by all of the authors.

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